decreased movement; and ultimately, coma or death. Neurological disorders can result from genetic predisposition for developing the neurological disorder, one or more environmental factors that induce a the disorder to enhance the individual's genetic predisposition, or exposure of an individual to infectious agents such as a virus, a bacteria, a fungus, or a prion that induces the disorder or enhances the individual's genetic predisposition.

[144] Exemplary neurological disorders include, but are not limited to, autism spectrum disorders (ASD), Angelman Syndrome, bipolar disorder, attention-deficit disorder (ADD), central auditory processing disorder (CAPD), cerebral palsy, Down Sydrome, expressive language disorder, IsoDendric 15 (abbreviated idic(15)), Lanau-Kleffner Syndrome, neural tube defects, seizure disorders, epilepsy, Tourette Syndrome, traumatic brain injury (TBI), childhood disintegrative disorder, agnosias (visual, auditory, and somatosensory), anorexia nervosa disorder, acute stress disorder, adjustment disorder, bipolar disorder, body dysmorphic disorder, breathing-related sleep disorders, brief psychotic episode, bulimia nervosa, schizophrenia, Huntington's Disease (HD), multiple sclerosis (MS), amyotrophic lateral sclerosis (ALS), Capgras (delusion) Syndrome, chronic motor or vocal tic disorder, circadian rhythm sleep disorder, cluttering (speech disfluency), conduct disorder, communication/language disorders, Creutzfeldt-Jakob Disease (CJD), kuru, Gerstmann–Sträussler–Scheinker syndrome (GSS), fatal familial insomnia (FFI), depression, addiction, Fahr's Syndrome (or idiopathic basal ganglia calcification), migraine, neoplasm (benign and malignant), aphasia, paralysis, Bell's Palsy, cerebrovascular disease, encephalitis, hydrocephalis, microcephaly, Parkinson's Disease, trigeminal neuralgia, narcolepsy, muscular distrophy, Guillain-Barre Syndrome, neurofibromatosis, dyslexia, Rett Syndrome, Fragile X syndrome, adrenoleukodystrophy, ataxia telangiectasia, Cockayne syndrome, deafness, Duchenne muscular dystrophy, Gaucher disease, Lesch-Nyhan syndrome, maple syrup urine disease, Menkes syndrome, phenylketonuria, Prader-Willi syndrome, spinal muscular atrophy, spinocerebellar ataxia, tuberous sclerosis, Neimann-Pick syndrome, Refsum disease, Tay-Sachs disease, Charcot-Marie-Tooth syndrome, fibrodysplasia ossificans progressive, myotonic dystrophy, and Meniere's Disease.

Stem Cell Disorders

[145] Compositions and methods of the invention are used to identify cells and subjects at risk of developing a "stem cell" disorder or those cells and subjects who may have a predisposition for developing a stem cell disorder. Moreover, the compositions and methods of the invention

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1326

are used to differentiate stem cell disorders for the purpose of diagnosing or prognosing a subject at risk of presenting or a subject who has been diagnosed with a stem cell disorder. The compositions and methods of the invention are further used to monitor to progression of a stem cell disorder or a treatment regime. Additionally, the compositions and methods of the invention are used to screen individuals for any genetic predisposition for presenting a stem cell disorder himself/herself, or for producing a child having a stem cell disorder.

[146] The term "stem cell disorder" includes any disorder that initially presents within a totipotent (or omnipotent), pluripotent, multipotent, oligopotent, or unipotent stem cell of an individual. Alternatively, or in addition, a stem cell disorder includes any disorder which can be treated or prevented by administering a composition including a stem cell to the individual. Stem cells are characterized by their ability to produce daughter cells, one of which will differentiate and the other of which will remain an undifferentiated stem cell. The potency of a stem cell relates to differentiation potential of the daughter cell that becomes committed to a particular cell fate. Specifically, the terms totipotent stem cell or omnipotent stem cell describe stem cells that can give rise to both embryonic stem cells or, alternatively, the stem cell can generate every type of cell in the human body. Pluripotent stem cells have a more restricted potential than totipotent stem cells, however, these stem cells can generate cells derived from any of the three germ layers (ectoderm, mesoderm, or endoderm). Multipotent stem cells have a more restricted potential than pluripotent stem cells, however, these stem cells can generate cells within a related lineage. Multipotent stem cells are often considered adult stem cells because they are found in, for instance, the adult brain (neural stem cells that give rise to neurons and all types of glia) and bones (bone marrow stem cells that give rise to all types of blood cells). Oligopotent stem cells have a more restricted potential than multipotent stem cells, however, these stem cells can generate a few related types of cells. For example, the corneal epithelium contains oliopotent stem cells that produce only corneal and conjunctival cells. Unipotent cells are the most restricted cell type because they can only reproduce their own cell type, however, they do maintain the ability to self-renew. Muscle stem cells are nonlimiting examples of unipotent stem cells.

[147] Exemplary stem cell disorders include, but are not limited to, autism spectrum disorders (ASD), neural tube defects, seizure disorders, epilepsy, hearing loss, deafness, blindness, vision impairment, jaundice / kernicterus, cluttering (speech disfluency), agnosias (visual, auditory, and

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1327

somatosensory), Huntington's Disease (HD), multiple sclerosis (MS), amyotrophic lateral sclerosis (ALS), chronic motor or vocal tic disorder, circadian rhythm sleep disorder, Alzheimer's Disease, dementia, senility, diabetes, Parkinson's Disease, muscular distrophy, Guillain-Barre Syndrome, sickle cell anemia or sickle cell disease, ataxia telagiectasia, Cockayne syndrome, DiGeorge syndrome, severe combined immunodeficiency, porphyria, paroxysmal nocturnal hemoglobinuria, thalassemia, familial Mediterranean fever, immunodeficiency with hyper- IgM, Charcot-Marie-Tooth syndrome, fibrodysplasia ossificans progressive, myotonic dystrophy, spinal muscular atrophy, spinocerebellar ataxia, and Gauchers Disease.

Kits

[148] Kits include a composition containing at least one tag (as shown, for example, in Table 2), at least one bridge (as shown, for example, in Table 3), and a substance that is a either a volume excluder or a nuclease. Alternatively, kits include a composition containing one or more tags (as shown, for example, in Table 2), one or more bridges (as shown, for example, in Table 3), and a substance that is either a volume excluder or a nuclease. Tags are provided separately from the bridges. Alternatively, tags are provided in a mixture containing bridges because the degree of cross-hybridization between tag and bridge molecules is negligible. In certain embodiments, kits also include ligase. In certain embodiments, kits can include at least one tag, at least one bridge and a ligase. In these embodimens, kits can also include a volume excluder or a nuclease.

[149] A nonlimiting example of a preferred ligase is the T4 DNA ligase, however, all ligases are encompassed by the invention. Ligases are often divided into classes referred to as EC 6.1 (form carbon-oxygen bonds), EC 6.2 (form carbon-oxygen bonds), EC 6.3 (form carbon-nitrogen bonds), EC 6.4 (form carbon-carbon bonds), EC 6.5 (form phosphoric ester bonds), and EC 6.6 (form nitrogen-metal bonds). Alternatively, or in addition, ligases are classified by the types of molecules they they unite. RNA ligase and DNA ligase (types I-IV) are contemplated. Although the T4 DNA ligase is shown herein, other natural, recombinant, synthetic, or engineered ligases are encompassed by the invention.

[150] A nonlimiting example of a preferred volume excluder is polyethylene glycol (PEG). Although PEG is shown herein, other polyether molecules are encompassed by the invention, including, but not limited to, poly(ethylene oxide) (PEO) and polyoxyethylene (POE), which vary by the size of the ethylene oxide polymer. Other natural, recombinant, synthetic, or

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1328

engineered polymers with similar size, charge, and solubility to PEG are encompassed by the invention. Specifically, PEG is soluble in water, methanol, benzene, dichloromethane and is insoluble in diethyl ether and hexane.

[151] A nonlimiting example of a nuclease is a DNA-specific exonuclease. Although the lambda exonuclease is shown herein, other natural, recombinant, synthetic, or engineered exonucleases are encompassed by the invention.

[152] Kits further optionally contain a control RNA molecule. Control RNA molecules are preferably isolated and purified miRNA molcules to which a control bridge specifically hybridizes, and to which a specific tag is ligated. The corresponding control bridge and tag molecules are provided and labeled accordingly.

[153] Kits also include instructions for handling the enclosed compositions and substances and protocols for performing singular or multiplexed denaturing, annealing, ligation, and/or purification reactions using the enclosed compositions and substances. Furthermore, the instructions provide guidance for preparing the resultant tagged RNA molecule(s) for detection using the nCounter® Analysis System.

EXAMPLES

[154] Example 1: MiRNA Detection Kit Protocol

[155] The nCounter® miRNA Sample Preparation Kit provides reagents for ligating unique oligonuceotide tags onto miRNAs, allowing these short RNAs to be detected with great specificity and sensitivity in the standard nCounter® gene expression assay. The miRNA tag ligation reaction can be performed in a background of total RNA.

[156] Sample preparation involved a multiplexed annealing of the specific tags to their target miRNA, a ligation reaction, and an enzymatic purification to remove the unligated tags. Sequence specificity between each miRNA and its appropriate tag was ensured by careful, stepwise control of annealing and ligation temperatures. Control RNA included in the nCounter® Human miRNA Sample Preparation Kit allowed the user to monitor the ligation efficiency and specificity through each step of the reaction. The total hands-on time for the sample preparation reaction was approximately 30 minutes, with an elapsed time of approximately 3 hours.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1329

[157] The nCounter® miRNA expression assay was run on the nCounter® Analysis system. The system was comprised of two instruments, the Prep Station used for post-hybridization processing, and the Digital Analyzer used for data collection.

[158] After hybridization, excess probes were washed away using a two step magnetic beadbased purification on the nCounter® Prep Station. Magnetic beads derivatized with short nucleic acid sequences that were complementary to the Capture Probe and the Reporter Probes were used sequentially. First, the hybridization mixture containing target/probe complexes was allowed to bind to magnetic beads complementary to sequences on the Capture Probe. Wash steps were performed to remove excess Reporter Probes and non-target cellular transcripts. After washing, the Capture Probes and target/probe complexes were eluted off the beads and are hybridized to magnetic beads complementary to sequences on the Reporter Probe. An additional wash was performed to remove excess Capture Probes. Finally, the purified target/probe complexes were eluted off the beads and immobilized on the cartridge for data collection.

[159] Data Collection was carried out in the nCounter® Digital Analyzer. Digital images were processed and the barcode counts were tabulated in a comma separated value (CSV) format.

[160] *Materials*

Table 1.1 Materials and Reagents Required for miRNA Sample Preparation and miRNA Expression Assay

Material	Manufacturer	Part Number
nCounter® Human miRNA Expression Assay Kit	NanoString Technologies	GXA-MIR1-xx
nCounter® Master Kit	NanoString Technologies	NAA-AKIT-xxx
QIAGEN miRNeasy® Kit	QIAGEN (or equivalent total RNA purification kit)	
Disposable gloves	Various	
DEPC-treated (or RNAse-free) water		
100ng total RNA per sample normalized to 33ng/µL		

[161] *Thermocycler*

[162] The thermocycler used for the miRNA Sample Preparation Protocol had a heated lid, such as the MJ Research / BioRad models listed in Table 1.2. Other thermocyclers with heated lids are also expected to perform well, and the assay kit includes controls to verify proper performance. The thermocycler should be calibrated before using this assay.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1330

Table 1.2 Instruments Required for miRNA Sample Preparation and miRNA Gene Expression Assay

Material	Manufacturer	Part Number
NanoDrop ND-1000 (or equivalent spectrophotometer)	NanoDrop Technologies	N/A
Bioanalyzer 2100	Agilent	G2940CA
Pipette for 0.5 - 10 µL	Rainin (or equivalent)	L-10
Pipette for 2.0 -20 µL	Rainin (or equivalent)	L-20
Pipette for 20 - 200 µL	Rainin (or equivalent)	L-200
Picofuge with strip-tube adaptor	Stratagene (or equivalent)	400540
DNA Engine Thermocycler or hybridization oven*	MJ Research / BioRad (or equivalent)	PTC-200G PTC-1148 PTC-0220G PTC-0221G PTC-0240G
nCounter Prep Station	NanoString Technologies	NCT-PREP-120
nCounter Digital Analyzer	NanoString Technologies	NCT-DIGA-120
USB Drive	NanoString Technologies	N/A

Hybridization oven can be used for the miRNA Hybridization Protocol only. A thermocycler with a heated lid is required for the miRNA Sample Preparation Protocol.

[163] The nCounter® miRNA Preparation protocol used careful temperature control of all reaction steps. A thermocycler with a heated lid was used for this procedure. Before beginning, the thermocycler protocols were programmed as follows:

Table 1.3 Annealing Protocol

Temperature	Time
94°C	1 min
65°C	2 min
45°C	10 min
48°C	hold
Total Time	**13 min**

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1331

Table 1.4 Ligation Protocol

Temperature	Time
48°C	3 min
47°C	3 min
46°C	3 min
45°C	5 min
65°C	10 min
4°C	hold
Total Time	**24 min**

Table 1.5 Purification Protocol

Temperature	Time
37°C	2 hours
70°C	10 min
4°C	hold
Total Time	**2 hours 10 min**

[164] *MiRNA Sample Preparation Protocol*

[165] All experiments were designed in sets of twelve assays. The protocol below is for one set of 12 assays. All reagents are supplied in 12 reaction aliquots.

[166] 1. RNA samples were normalized to 33 ng/μL using DEPC (or RNAse-free) H20.

[167] 2. A 1:500 dilution of the miRNA Assay Controls was prepared. 499 μL DEPC H_2O was added to 1 μL of the miRNA Assay Controls in a sterile microcetrifuge tube. The tube was mixed by vortexing, briefly spun down and stored on ice.

[168] 3. An annealing master mix was prepared by combining 13 μL of Annealing Buffer, 26 μL of nCounter® miRNA Tag Reagent and 6.5 μL of the 1:500 miRNA Assay Controls dilution prepared in Step 2. This was mixed well by pipetting up and down.

[169] 4. 3.5 μL of the annealing master mix was aliquotted into each tube.

[170] 5. 3 μL (100 ng) of RNA sample was added to each tube. Tubes were capped, flicked gently to mix and spun down.

[171] 6. The strip was placed in the thermocycler and the Annealing Protocol was initiated.

[172] 7. 19.5 μL PEG was combined with 13 μL Ligation Buffer to prepare a ligation master mix.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1332

[173] 8. Following completion of the Annealing Protocol, when the thermocycler reached 48°C, 2.5 μL of the ligation master mix was added to each tube. (The thermocycler was left on so that it was maintained at 48°C for Step 9 and Step 10). The tubes were flicked gently to mix and spun down.

[174] 9. The tubes were returned to the 48°C thermocycler, the lid was closed, and the tubes were incubated at 48°C for 5 min.

[175] 10. The thermocycler was opened, the caps were carefully removed from tubes, leaving the tubes in place in the heat block, and 1.0 μL of Ligase was added directly to each tube while they were incubated at 48°C. The pipette tip was checked to make certain all of the ligase was added to the reaction. There was no need to mix.

[176] NOTE: PEG is viscous was pipetted slowly to ensure accurate transfer of volume into the mix. It was mixed well by pipetting up and down.

[177] NOTE: For Step 10, the tubes were not removed from the thermocycler, maintaining the temperature of the tubes at 48°C.

[178] 11. Immediately after addition of Ligase to the final tube, the tubes were recapped and left in heat block. The thermocycler was closed and the Ligation Protocol was initiated.

[179] 12. After completion of Ligation Protocol, 1 μL Ligation Clean-Up Enzyme was added to each reaction. The tubes were removed from the heat block for this step. The tubes were flicked gently to mix and spun down.

[180] 13. The tubes were returned to the thermocycler and the Purification Protocol was initiated.

[181] 14. After completion of Purification Protocol, 40 μL DEPC was added (or RNAse-free) H_2O to each sample. This was mixed well and spun down. (If necessary, at this stage the purified sample preparation reactions were stored at –20°C for up to several weeks.) Samples were denatured (Step 5 of miRNA Hybridization Protocol) before proceeding to the hybridization protocol.)

[182] *Hybridization protocol*

[183] The final hybridization reaction contained the following components: 10 μL Reporter CodeSet, 10 μL hybridization buffer, a 5 μL aliquot from the miRNA Sample Preparation Protocol, and 5 μL Capture ProbeSet.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1333

[184] 1. Aliquots of both the Reporter CodeSet and Capture ProbeSet reagent were removed from the freezer and thawed on ice. The aliquots were inverted several times to mix well. The reagent was briefly spun down at <1000 rpm.

[185] 2. A master mix was created containing 130 µL of the Reporter CodeSet and 130 µL of hybridization buffer by adding the hybridization buffer to the tube containing the Reporter CodeSet. The master mix was inverted to mix and spun down.

[186] 3. Tubes were labeled.

[187] 4. 20 µL of master mix was added to each of the 12 tubes.

[188] 5. Samples were denatured from the miRNA sample prep protocol at 85°C for 5 minutes and quick-cooled on ice. A 5 µL aliquot from the miRNA Sample Preparation Protocol was added to each tube. During the setup of the assay, mixing was done by flicking or inverting the tubes.

[189] 6. The thermocycler was pre-heated to 65°C and then programmed using 30 µL volume, calculated temperature, heated lid and "forever" time setting.

[190] 7. 5 µL of Capture ProbeSet was added to each tube immediately before placing at 65°C. Tubes were capped and the reagents mixed by inverting the strip tubes several times and flicking to ensure complete mixing. The tubes were briefly spun down at <1000 rpm and immediately the tubes were placed in the 65°C thermocycler.

[191] 8. Hybridization assays were incubated for at least 12 hours. Hybridizations were left at 65°C until ready for processing. Maximum hybridization time did not exceed 30 hours.

[192] 9. Once removed from the thermocycler, we proceeded immediately to post-hybridization processing with the nCounter® Prep Station.

Example 2: Multiplexed nCounter® miRNA Expression Assay Kits Distinguish Individual Species of miRNAs with High Specificity.

[193] A multiplexed set of assays for 55 different miRNAs was run on individual synthetic miRNA targets present at 3pM in the ligation, and 300 fM in the final hybridization reaction (Table 5). Representative data for 10 targets and the corresponding 10 assays (a subset of the 55 multiplexed assays) are shown. The data is in counts per 600 fields-of-view. Each assay within the multiplexed set shows a strong specificity for the miRNA target it is designed to detect.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1334

Table 5: Data for Example 2.

miRNA target	miR-15a	miR-15b	miR-25	miR-92a	miR-92b	miR-122	miR-133a	miR-143	miR-195	miR-206
miRNA assay										
miR-15a	16143	1	2	1	1	1	2	2	2	3
miR-15b	1	14659	2	0	1	3	2	3	3	5
miR-25	0	0	8066	1	0	1	1	2	3	41
miR-92a	1	2	4	15558	2	2	2	2	3	3
miR-92b	0	6	0	20	20145	0	1	1	0	2
miR-122	0	2	1	13	10	12324	2	1	1	1
miR-133a	0	0	1	2	4	12	16217	2	3	1
miR-143	0	0	1	1	9	3	5	13519	3	2
miR-195	0	0	2	0	1	1	2	1	20814	2
miR-206	0	0	1	1	1	3	2	2	25	20754

Example 3: Multiplexed nCounter® Assays Kits Reveal MiRNA Expression Levels in Different Tissue Types.

[194] MiRNAs can be expressed at similar levels in a range of tissues, but many also exhibit differential expression in different tissue types. In these experiments, multiplexed nCounter® miRNA Expression Assays for 619 human miRNAs were run on total RNA purified from various human tissues (Ambion), including lung, skeletal muscle, colon and heart, and the data were compared in pairwise sets. Hundreds of microRNAs were specifically detected in each sample. In Figures 5A-D, the data points that fall on the diagonal are those miRNAs which were expressed at similar levels in both tissues. Those that fall outside of the diagonal represent miRNAs which were differentially regulated in the two tissue types. These results show the ability of the nCounter® miRNA Expression Assay Kit in a highly multiplexed context to measure the differential expression of hundreds of small RNAs.

[195] Figures 6A-B, taken from the same data sets, highlight the differential expression of several specific miRNAs in the four tissue types. In Figure 6A, the different expression levels of six human miRNAs, miR-133a, -143, -16, -21, -29a and -30b, can be seen to range from approximately 0 to 25,000 counts, while Figure 6B shows the muscle-specific expression of

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1335

human miR-1, which is essentially undetected in lung and colon tissue, but gives over 200,000 counts in skeletal muscle and 75,000 counts in heart tissue. These data demonstrate the ability of the nCounter® miRNA Expression Assay Kit in a highly multiplexed context to measure differences in the specific expression of a given miRNA over a large range of expression levels.

Example 4: The nCounter® miRNA Expression Assay Kit Identifies RNAs in Clinical Samples

[196] The ability to detect RNAs in a variety of sample types is an important feature in gene expression assays. Of particular interest in the field of small RNAs is the ability to measure their expression levels in clinical samples, where they may provide prognostic, diagnostic or therapeutic information. Clinical tissue samples are frequently preserved as formalin-fixed, paraffin-embedded (FFPE) samples, leading to modifications of the target RNA structure. Not all gene expression assays are compatible with RNA isolated from FFPE samples. Total RNA was isolated from FFPE samples using a miREasy FFPEKit (Qiagen, Gaithersburg, MD) following the manufacturer's instructions, and data obtained in the nCounter® miRNA Expression Assay Kit using these samples was compared to the data obtained using total RNA isolated from the same tissue stored as a frozen sample. The results of these experiments demonstrate that the nCounter® miRNA Expression Assay Kit is able to detect small RNAs in FFPE samples with the same specificity and sensitivity as in total RNA. A representative data set shown in Figure 7 demonstrates an extremely high correlation between the data from the two sample types, with an R^2 value of greater than 0.99.

Example 5: The nCounter® miRNA Expression Assay Kit Provides a Multiplexed Format

[197] nCounter® miRNA Expression Assay Kits generate reproducible data in a multiplexed format. Figure 8 shows the correlation of the data from two technical replicates in which multiplexed assays for 676 human miRNAs were run on 100 ng of Human Brain Reference total RNA (Stratagene, LaJolla, CA). The data from the two replicate experiments demonstrate an extremely high correlation, with an R^2 value of greater than 0.999.

Example 6: The nCounter miRNA Expresion Assay Kit Enables Profiling of 3' sequence variants of miRNAs.

[198] In order to study 3' sequence variants of miRNAs, nCounter® miRNA Expression Assay bridges may be created that direct the tagging of the variant miRNAs. Here we measured the two most common 3' variants (arbitrarily designated variant 1 and variant 2) for each miRNA of interest. Each sample was split into three and assayed separately with a canonical bridge pool,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1336

the variant 1 bridge pool, and the variant 2 bridge pool. In this experiment, the bridges directed the variants to the same tag as the canonical sequence, and thus had to be detected in separate assays. It is also possible to design bridges which direct each variant to a unique tag, allowing for the detection of all variants in the same assay. Specificity of the platform was demonstrated by assaying mixtures of five canonical, variant 1, or variant 2 synthetic miRNAs with each of the three bridge pools. We found that each bridge pool reliably distinguished the miRNA species of interest (Figure 9A), with minimal background detection of the other variants. We also assayed mixtures of synthetic miRNAs containing 60% canonical miRNA, 30% variant 1, and 10% variant 2 and found that, in general, the correct ratio of canonical to variant miRNAs could be distinguished (Figure 9B). These results demonstrate that the nCounter® miRNA Expression Assay provides a robust platform by which to investigate the expression of 3' sequence variants of miRNAs.

OTHER EMBODIMENTS

[199] While the invention has been described in conjunction with the detailed description thereof, the foregoing description is intended to illustrate and not limit the scope of the invention, which is defined by the scope of the appended claims. Other aspects, advantages, and modifications are within the scope of the following claims.

[200] The patent and scientific literature referred to herein establishes the knowledge that is available to those with skill in the art. All United States patents and published or unpublished United States patent applications cited herein are incorporated by reference. All published foreign patents and patent applications cited herein are hereby incorporated by reference. Genbank and NCBI submissions indicated by accession number cited herein are hereby incorporated by reference. All other published references, documents, manuscripts and scientific literature cited herein are hereby incorporated by reference.

[201] While this invention has been particularly shown and described with references to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the invention encompassed by the appended claims.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1337

CLAIMS

What is claimed is:

1. A composition comprising:

(a) a tag, wherein the tag comprises a first DNA sequence and a reporter attachment region to which are attached one or more reporter molecules that produce a signal and wherein the first DNA sequence comprises an alien DNA sequence; and

(b) a bridge, wherein the bridge comprises a second DNA sequence that is complementary to a RNA molecule and a third DNA sequence that is complementary to the first DNA sequence of the tag.

2. The composition of claim 1, wherein the second and third DNA sequences of the bridge are contiguous.

3. The composition of claim 1, wherein the RNA comprises a non-coding RNA.

4. The composition of claim 3, wherein the non-coding RNA is a transfer RNA (tRNA), a small nucleolar RNA (snoRNA), a microRNA (miRNA), a short interfering RNA (siRNA), a short hairpin RNA (shRNA), a repeat associated small interfering RNA (rasiRNA), or a piwi-interacting RNA (piRNA).

5. The composition of claim 1, wherein the non-coding RNA is a miRNA.

6. The composition of claim 1, wherein the second DNA sequence of the bridge and the RNA molecule form a DNA/RNA heteroduplex having a melting temperature of between 37-95°C.

7. The composition of claim 1, wherein the second DNA sequence of the bridge and the RNA molecule form a DNA/RNA heteroduplex having a melting temperature of between 43-52°C.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1338

8. The composition of claim 1, wherein the third DNA sequence of the bridge and the first sequence of the tag form a DNA/DNA duplex having a melting temperature of between 37-95°C.

9. The composition of claim 1, wherein the third DNA sequence of the bridge and the first sequence of the tag form a DNA/DNA duplex having a melting temperature of between 43-52°C.

10. The composition of claim 1, wherein the second and third DNA sequences of the bridge form nucleic acid duplexes having substantially the same melting temperature.

11. The composition of claim 1, wherein the third DNA sequence comprises an alien DNA sequence.

12. The composition of claim 1, wherein the RNA molecule and/or the tag contain sequences that specifically hybridize to the bridge with complete complementarity.

13. The composition of claim 1, wherein the RNA molecule and/or the tag contain sequences that specifically hybridize to the bridge with partial complementarity.

14. A kit comprising:

(a) a composition comprising:

(1) a tag, wherein the tag comprises a first DNA sequence and a reporter attachment region to which are attached one or more reporter molecules that produce a signal; and

(2) a bridge, wherein the bridge comprises a second DNA sequence that is complementary to a RNA molecule and a third DNA sequence that is complementary to the first DNA sequence of the tag; and

(b) a substance selected from the group consisting of a volume excluder and a nuclease.

15. A method of detecting a RNA molecule comprising:

(a) providing a sample containing at least one RNA molecule;

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1339

(b) providing a tag, wherein the tag comprises a first DNA sequence and a reporter attachment region to which are attached one or more reporter molecules that produce a signal;

(c) providing a bridge, wherein the bridge comprises a second DNA sequence that is complementary to a RNA molecule and a third DNA sequence that is complementary to the first DNA sequence of the tag; and

(d) providing a buffer;

(e) specifically annealing the RNA molecule, bridge, and tag at between 37-95°C;

(f) holding the annealed reaction at between 37-95°C;

(g) providing a ligase buffer;

(h) providing a ligase directly to annealed reaction at between 37-95°C;

(i) ligating the RNA molecule to the tag at one or more temperatures between 37-95°C; and

(j) detecting the signal.

16. A method of multiplex detection of a plurality of RNA molecules comprising:

(a) providing a sample containing a plurality of RNA molecules;

(b) providing a plurality of tags, wherein each tag comprises a first DNA sequence and at least one reporter attachment region to which are attached one or more reporter molecules that produce a signal;

(c) providing a plurality of bridges, wherein each bridge comprises a second DNA sequence that is complementary to one RNA molecule and a third DNA sequence that is complementary to the first DNA sequence of one tag, wherein each bridge specifically anneals to one species of RNA molecule and one species of tag, wherein the one species of tag produces a signal that differentially labels one species of RNA molecule compared to other species of RNA molecules when it is joined to the tag;

(d) providing a buffer;

(e) specifically annealing the RNA molecules, bridges, and tags at between 37-95°C;

(f) holding the annealed reaction at between 37-95°C;

(g) providing a ligase buffer;

(h) providing a ligase directly to annealed reaction at between 37-95°C;

(i) ligating the RNA molecules, bridges, and tags at one or more temperatures between

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1340

37-95°C; and

(j) detecting one or more signals.

17. A method of making a nucleic acid bridge molecule, comprising:

(a) selecting a RNA molecule;

(b) selecting a segment of the RNA molecule that forms a DNA/RNA heteroduplex with a DNA molecule that specifically hybridizes to the segment of the RNA molecule having a melting temperature of between 37-95°C;

(c) generating a first DNA bridge molecule that specifically hybridizes to the segment of the RNA molecule having a melting temperature of between 37-95°C;

(d) selecting a tag, wherein the tag comprises a DNA sequence that is an alien sequence;

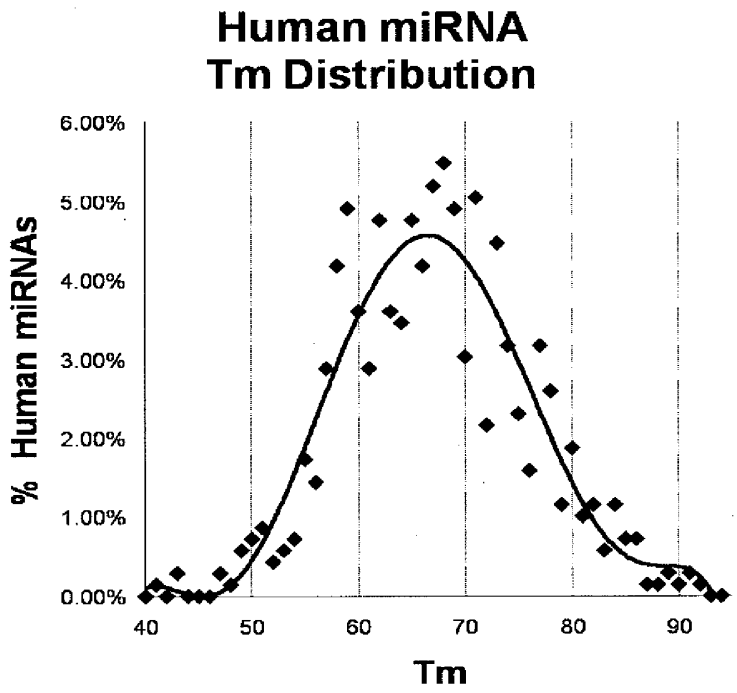
(e) selecting a segment of the tag that forms a DNA/ DNA duplex with a DNA molecule that specifically hybridizes to the segment of the tag having a melting temperature of between 37-95°C;

(f) generating a second DNA bridge molecule that specifically hybridizes to the segment of the tag having a melting temperature of between 37-95°C; and

(g) uniting the first DNA bridge molecule with the second DNA bridge molecule, thereby forming the nucleic acid DNA bridge molecule that specifically hybridizes to the segment of the target RNA molecule having a melting temperature of between 37-95°C and the segment of the tag having a melting temperature of between 37-95°C.

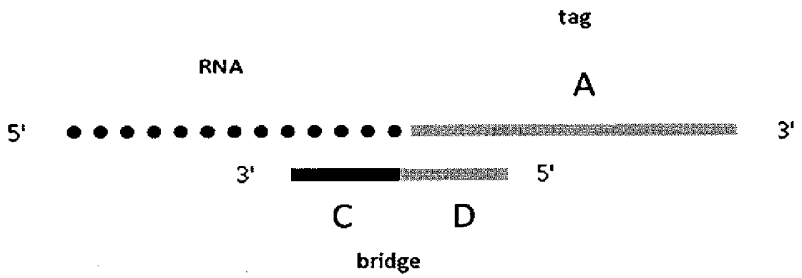
IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1341

FIGURE 1



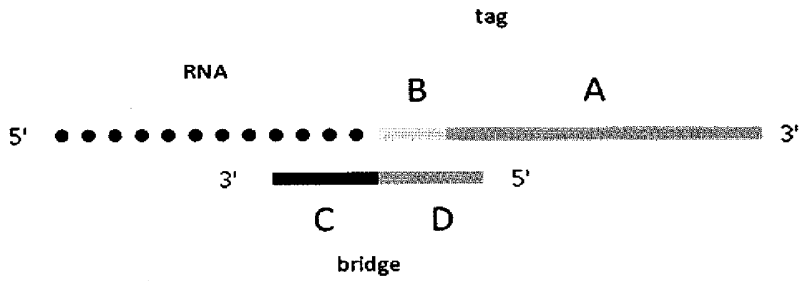
IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1342

FIGURE 2



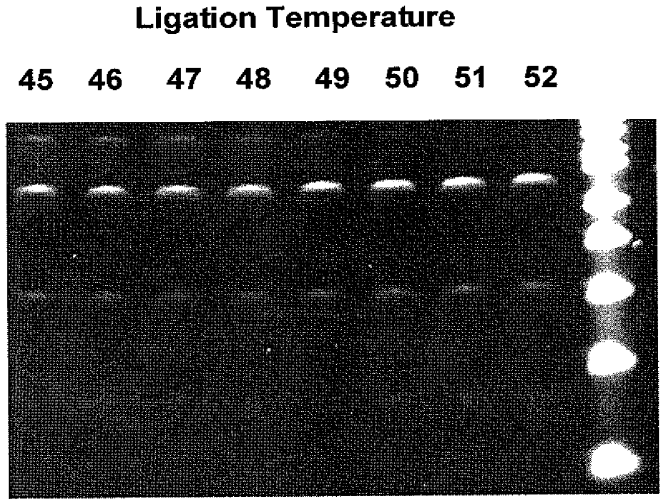
IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1343

FIGURE 3



IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1344

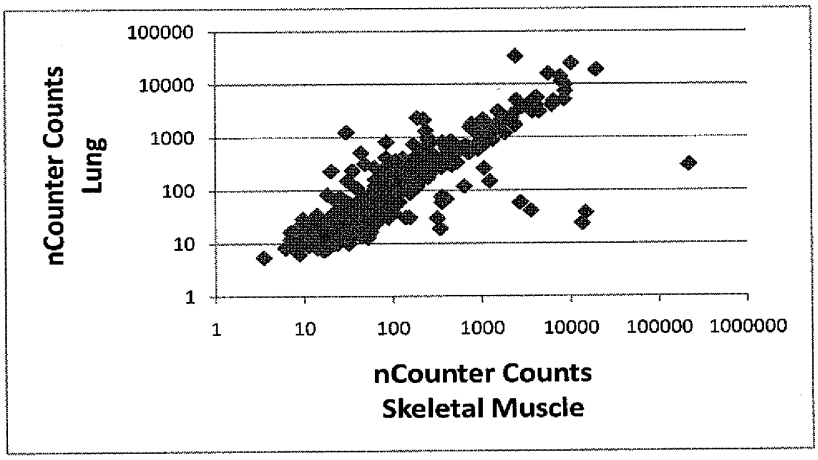
FIGURE 4



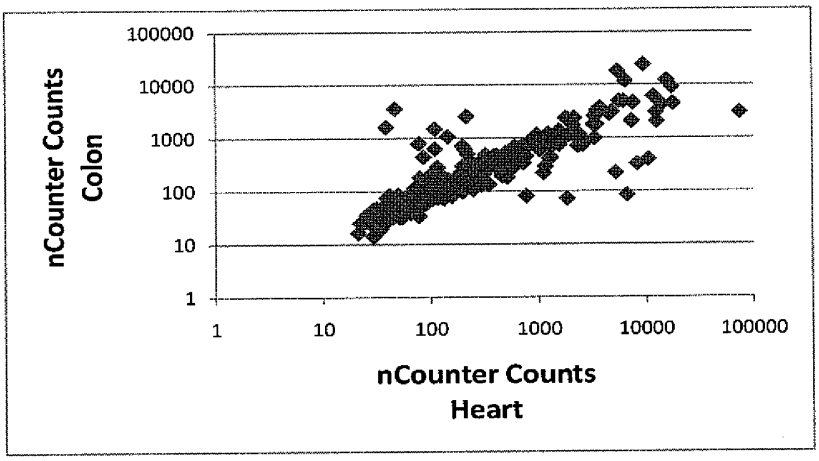
IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1345

FIGURE 5

A



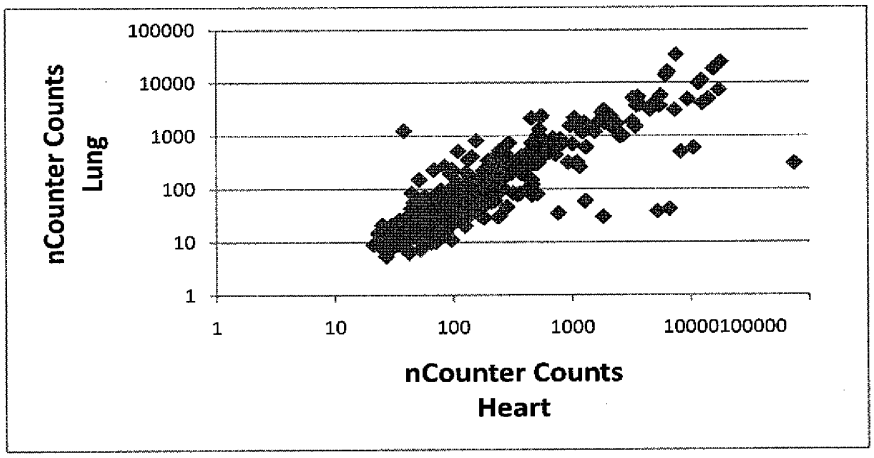
B



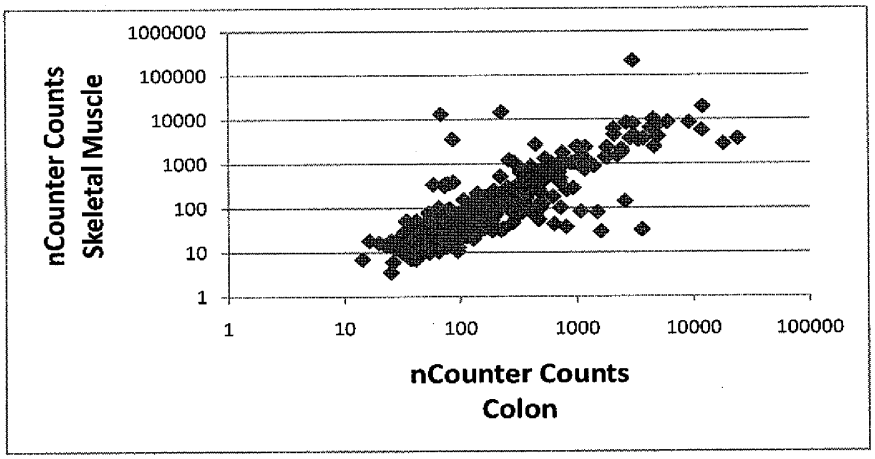
IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1346

FIGURE 5

C



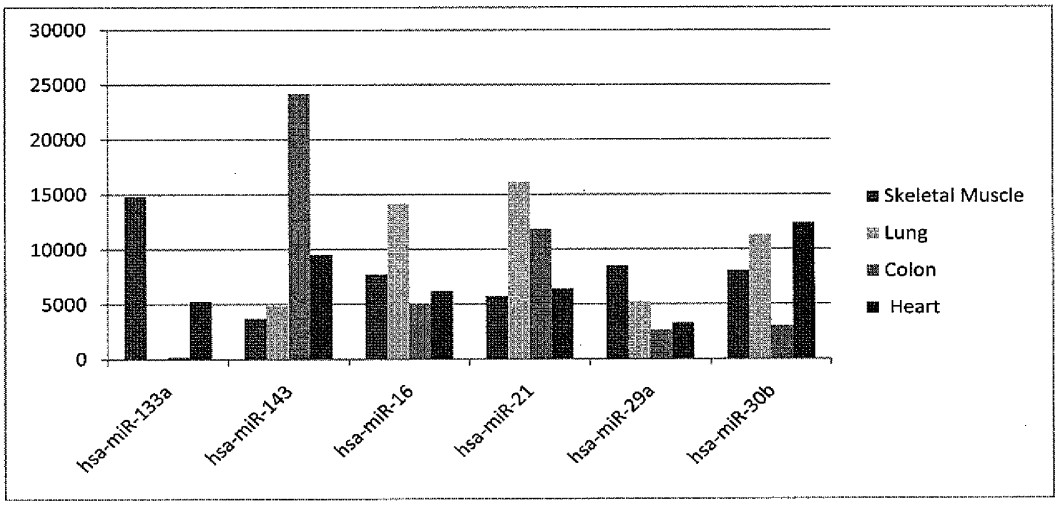
D



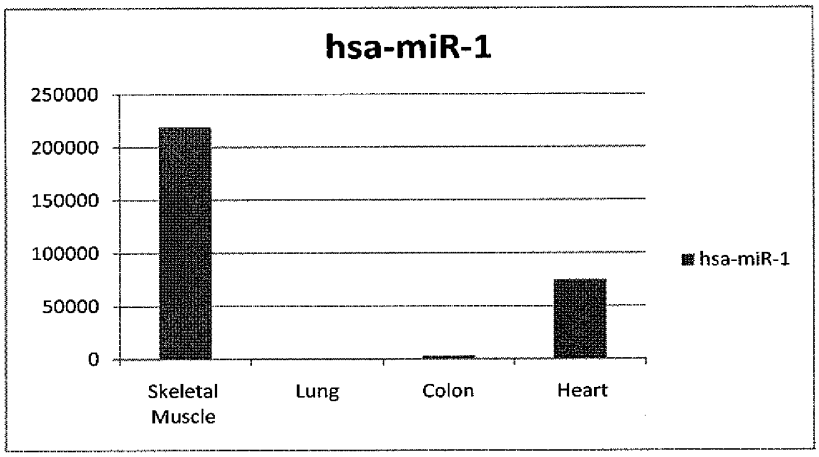
IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1347

FIGURE 6

A

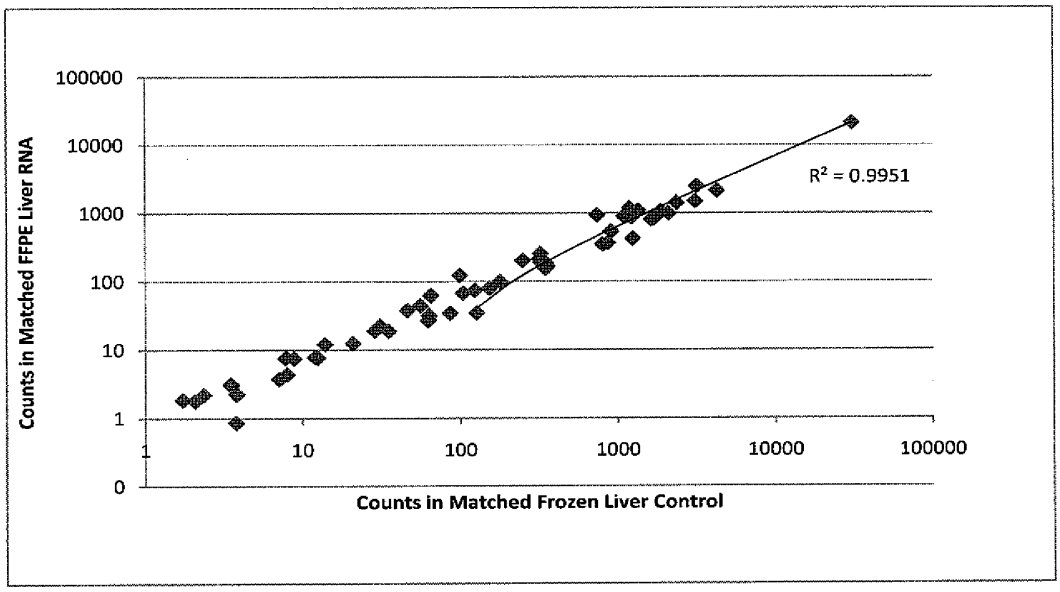


B



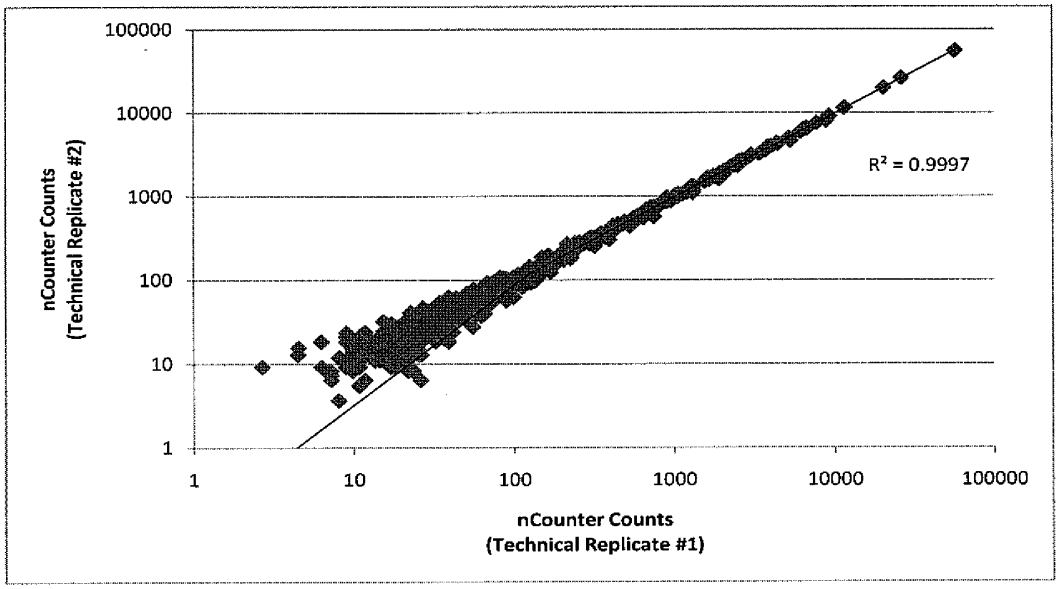
IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1348

FIGURE 7



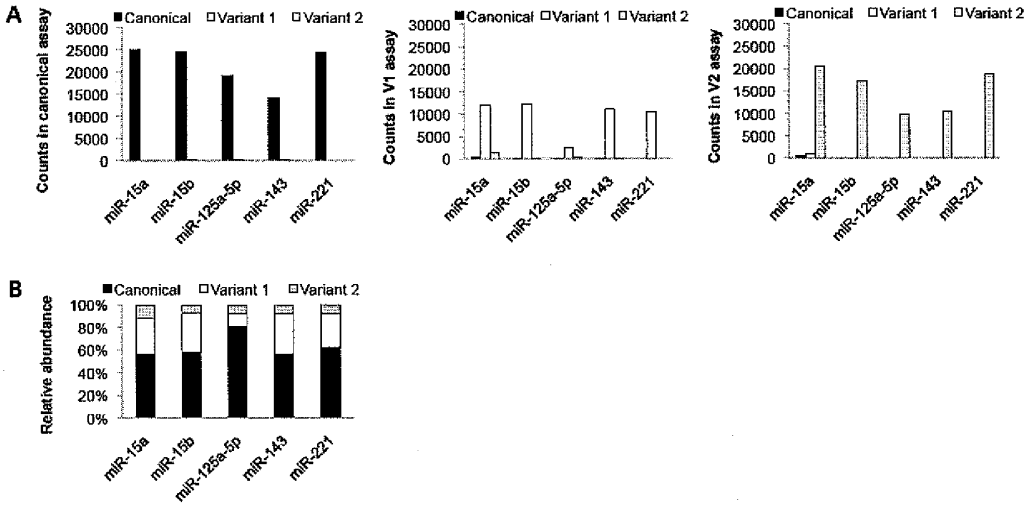
IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1349

FIGURE 8



IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1350

FIGURE 9



5315146v.1

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1351

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 August 2011 (18.08.2011)

PCT

(10) International Publication Number
WO 2011/100541 A3

(51) International Patent Classification:
C12Q 1/68 (2006.01) *C12N 15/113* (2010.01)

(21) International Application Number:
PCT/US2011/024519

(22) International Filing Date:
11 February 2011 (11.02.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/303,517 11 February 2010 (11.02.2010) US

(71) Applicant *(for all designated States except US)*: **NANOSTRING TECHNOLOGIES, INC.** [US/US]; 530 Fairview Avenue North, Suite 2000, Seattle, WA 98109 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **WEBSTER, Philippa, Jane** [US/US]; 4317 Densmore Ave. N, Seattle, WA 98103 (US). **DENNIS, Lucas, Michael** [US/US]; 4542 Orcas Street, Seattle, WA 98118 (US). **BOYKIN, Richard, Kemble** [US/US]; 16741 10th Ave NW, Shoreline, WA 98177 (US).

(74) Agents: **ELRIFI, Ivor, R.** et al.; Mintz, Levin, Cohn, Ferris, Glovsky & Popeo, P.C., One Financial Center, Boston, MA 02111 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

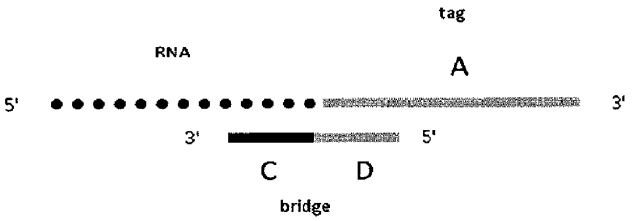
— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:
5 January 2012

(54) Title: COMPOSITIONS AND METHODS FOR THE DETECTION OF SMALL RNAS

FIGURE 2



(57) Abstract: The invention provides compositions and methods for the detection of small RNA molecules in a multiplexed reaction. The assays and kits described herein are applicable for the identification, diagnosing, and monitoring of disorders including, but not limited to cancer, developmental and degenerative disease, neurological disorders, and stem cell disorders.

WO 2011/100541 A3

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1352

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/024519

A. CLASSIFICATION OF SUBJECT MATTER

C12Q 1/68(2006.01)i, C12N 15/113(2010.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C12Q 1/68; C12P 19/34

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal), Pubmed

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MARONEY, P. A. et al. `A rapid, quantitative assay for direct detection of microRNAs and other small RNAs using splinted ligation' RNA. Vol. 13(6), pp. 930-936 (24 April 2007) See the abstract; Fig.1; p. 933, "Oligonucleotide synthesis and preparation" ; p. 935, "RNA analysis".	1-17
A	US 6355431 B1 (CHEE, M. et al.) 12 March 2002 See the abstract.	1-17
A	WO 94-26934 A2 (BAXTER DIAGNOSTICS INC.) 24 November 1994 See the abstract.	1-17
A	WO 2007-076128 A2 (NANOSTRING TECHNOLOGIES, INC. et al.) 05 July 2007 See the abstract.	1-17
A	US 2007-0178476 A1 (SHIMA, D. et al.) 02 August 2007 See the abstract.	1-17

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 OCTOBER 2011 (25.10.2011)	**25 OCTOBER 2011 (25.10.2011)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
Government Complex-Daejeon, 189 Cheongsa-ro,
Seo-gu, Daejeon 302-701, Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer
KIM, JI YUN
Telephone No. 82-42-481-8288

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2011/024519

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6355431 B1	12.03.2002	AU 2000-44769 A1	02.11.2000
		CA 2370976 A1	26.10.2000
		CA 2370976 C	20.10.2009
		EP 1196630 A2	17.04.2002
		EP 1196630 B1	05.11.2008
		EP 1923471 A1	21.05.2008
		EP 1923472 A1	21.05.2008
		EP 2264189 A1	22.12.2010
		US 2002-0177141 A1	28.11.2002
		US 2003-0108867 A1	12.06.2003
		US 2003-0207295 A1	06.11.2003
		US 2003-0215821 A1	20.11.2003
		US 2005-0100893 A1	12.05.2005
		US 2005-0181440 A1	18.08.2005
		US 2005-0191698 A1	01.09.2005
		US 2005-0244870 A1	03.11.2005
		US 2006-0275782 A1	07.12.2006
		US 2009-0186349 A1	23.07.2009
		WO 00-63437 A2	26.10.2000
		WO 00-63437 A3	26.10.2000
WO 94-26934 A2	24.11.1994	AU 6945694 A	12.12.1994
		CA 2139623 A1	24.11.1994
		EP 0655091 A1	31.05.1995
		JP 7508891 T	05.10.1995
		WO 94-26934 A3	26.01.1995
WO 2007-076128 A2	05.07.2007	AU 2006-330830 A1	05.07.2007
		CA 2640385 A1	05.07.2007
		EP 1963531 A2	03.09.2008
		EP 1963531 B1	21.09.2011
		JP 2009-521230 A	04.06.2009
		JP 2009-521230 T	04.06.2009
		US 2010-0015607 A1	21.01.2010
		WO 2007-076128 A3	29.11.2007
		WO 2007-076129 A2	05.07.2007
		WO 2007-076129 A3	06.03.2008
US 2007-0178476 A1	02.08.2007	EP 1776474 A2	25.04.2007
		JP 2008-507284 A	13.03.2008
		US 7785784 B2	31.08.2010
		WO 2006-012468 A2	02.02.2006
		WO 2006-012468 A3	02.02.2006

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1354

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 September 2011 (22.09.2011)

PCT

(10) International Publication Number
WO 2011/116088 A2

(51) International Patent Classification:
C12Q 1/68 (2006.01) *C12N 15/11* (2006.01)

(21) International Application Number:
PCT/US2011/028657

(22) International Filing Date:
16 March 2011 (16.03.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/314,491 16 March 2010 (16.03.2010) US

(71) Applicant *(for all designated States except US)*: **NANOSTRING TECHNOLOGIES, INC.** [US/US]; 530 Fairview Avenue North, Suite 2000, Seattle, WA 98109 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **HENGEN, Paul, Nevin** [US/US]; 2434 E. Mountain Street, Pasadena, CA 91104 (US). **GEISS, Gary, K.** [US/US]; 647 NW 78th Street, Seattle, WA 98117 (US). **ELLIOT, Nathan, A.** [US/US]; 1800 Eastlake Ave. E #101, Seattle, WA 98102 (US). **WEBSTER, Phillppa, Jane** [US/US]; 4317 Densmore Ave. N., Seattle, WA 98103 (US).

(74) Agents: **ELRIFI, Ivor, R.** et al.; Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C., One Financial Center, Boston, MA 02111 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

(54) **Title**: COMPOSITIONS AND METHODS FOR THE DETECTION OF GENOMIC FEATURES

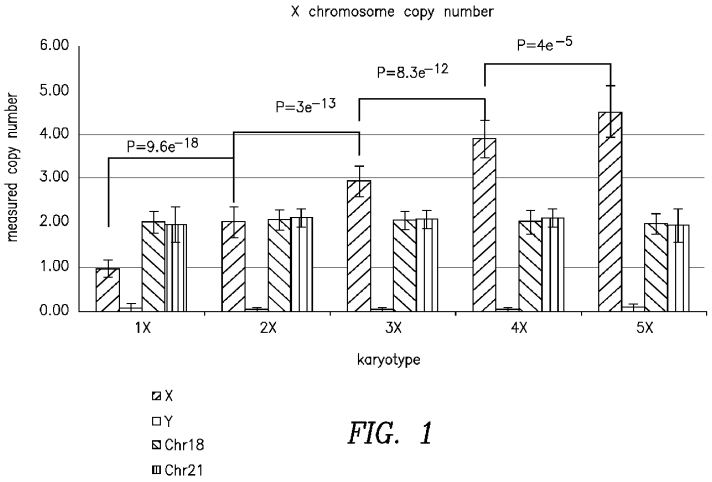


FIG. 1

(57) **Abstract**: The invention provides compositions and methods for the detection of gene copy number and/or chromosome copy number in a multiplexed reaction. The assays and kits described herein are applicable for the identification, diagnosing, and monitoring of disorders including, but not limited to cancer, developmental and degenerative disease, neurological disorders, and stem cell disorders.

WO 2011/116088 A2

COMPOSITIONS AND METHODS FOR THE DETECTION OF GENOMIC FEATURES

RELATED APPLICATION

[01] This application claims priority from U.S. Provisional Application No. 61/314,491, filed on March 16, 2010 which is incorporated by reference, herein, in its entirety.

FIELD OF THE INVENTION

[02] This invention relates generally to the field of molecular biology, and specifically, to the fields of detection, identification, and quantification of target nucleic acid molecules in mixtures.

BACKGROUND OF THE INVENTION

[03] Gene copy number and chromosomal number variations can have profound effects on biological functions. These variations are at the core of altered developmental, physiologic and pathologic processes. Therefore, identifying and quantifying the copy number of genes and chromosomes in subjects, in particular, in pre-natal subjects, can aid the early detection of pathology.

[04] Nucleic acids can be detected and quantified based on their specific polynucleotide sequences. The basic principle underlying existing methods of detection and quantification is the hybridization of a labeled complementary probe sequence to a target sequence of interest in a sample. The formation of a duplex indicates the presence of the target sequence in the sample.

[05] This technique, called molecular hybridization, has been a useful tool for identifying and analyzing specific nucleic acid sequences in complex mixtures. This technique has been used in diagnostics, for example, to detect nucleic acid sequences of various microbes in biological samples. In addition, hybridization techniques have been used to map genetic differences or polymorphisms between individuals. Furthermore, these techniques have been used to monitor changes in gene expression in different populations of cells or in cells treated with different agents.

[06] Thus, there exists a need for more accurate, quicker and more sensitive detection, identification and quantification of copy number of genes and chromosomes. Particularly, there exists a need for the specific detection of gene copy number and chromosome copy cumber in complex mixtures and multiplex reactions.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1356

SUMMARY OF THE INVENTION

[07] The invention provides a method of detecting a target DNA sequence in a genome comprising providing a first sample containing genomic DNA; fragmenting the genomic DNA; denaturing the genomic DNA; providing a first nanoreporter comprising a first probe comprising a first label attachment region to which are attached one or more label monomers that emit light constituting a first signal; a second label attachment region, which is non-over-lapping with the first label attachment region, to which are attached one or more label monomers that emit light constituting a second signal; and a first target-specific sequence attached to the first probe, wherein the target-specific sequence specifically hybridizes to the genomic DNA sequence to be detected; contacting the first probe with the fragmented genomic DNA wherein the contact is made under conditions sufficient for hybridization of the first target specific sequence to a fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected; stretching the first probe hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected using a flow-stretch, receding meniscus, or electro-stretch technique, thereby spatially separating said label monomers, and measuring a signal from the first probe, wherein said signal uniquely identifies the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected.

[08] In one embodiment of this method of the invention, the first nanoreporter further comprises a second probe comprising a second target-specific sequence; and an affinity tag; wherein the first probe and the second probe specifically hybridize to the same fragment of the fragmented genomic DNA at different sites on the fragment. In another embodiment, the first probe further comprises an affinity tag.

[09] In another embodiment, the genomic DNA is mammalian genomic DNA. Specifically, the mammal is a human.

[10] In another embodiment, the genomic DNA sample is unamplified. In another embodiment, hybridization is performed in solution.

[11] In another embodiment, the fragmentation is performed by restriction enzyme digestion. Specifically, the restriction enzyme is Alu1 or Bfa1. In another embodiment, the fragmentation is performed chemically, enzymatically (for example, using one or more restriction endonucleases or a DNAase), by mechanical shearing or sonication.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1357

[12] In another embodiment, the signal generated from the first probe hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected comprises about the same unit signal, or multiple thereof. In another embodiment, the signal generated from the first probe hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected comprises a mixture of two or more different label monomers.

[13] In another embodiment, said labels are fluorescent.

[14] The invention also provides a method of determining the copy number of the target DNA sequence to be detected as described above further including the steps of providing a reference sample comprising fragmented genomic DNA wherein the copy number of the genomic sequence the first target specific sequence specifically hybridizes to in the reference sample is known; contacting the first probe with the reference sample wherein the contact is made under conditions sufficient for hybridization of the first target specific sequence to a fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected; stretching the first probe hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected using a flow-stretch, receding meniscus, or electro-stretch technique, thereby spatially separating said label monomers; measuring a signal from the first probe, wherein said signal uniquely identifies the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected; and comparing the signal from the first sample to the signal from the reference sample, wherein the copy number of the first sample is determined by correlating the signal from the first sample with the signal from the reference sample.

[15] The reference sample can be a synthetic nucleic acid sample or a biological genomic DNA sample.

[16] The invention also provides a method of normalizing the signal generated as described above, further comprising providing at least a second nanoreporter comprising a third probe comprising a third label attachment region to which are attached one or more label monomers that emit light constituting a third signal; a fourth label attachment region, which is non-over-lapping with the third label attachment region, to which are attached one or more label monomers that emit light constituting a fourth signal; and a third target-specific sequence attached to the third

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1358

probe, wherein the target-specific sequence specifically hybridizes to a first DNA fragment from a copy number invariant region of the genome; contacting the third probe with the fragmented genomic DNA from the first sample and the reference sample wherein the contact is made under conditions sufficient for hybridization of the third target specific sequence to the first DNA fragment from a copy number invariant region of the genome; stretching the third probe hybridized to the first DNA fragment from a copy number invariant region of the genome using a flow-stretch, receding meniscus, or electro-stretch technique, thereby spatially separating said label monomers; measuring a signal from the third probe, wherein said signal uniquely identifies the first DNA fragment from a copy number invariant region of the genome; and comparing the signal from the the second nanoreporter contacted with the first sample and the second nanoreporter contacted with the reference sample, wherein the number of multiples of the quantity of signal from the second nanoreporter contacted with the first sample compared to the quantity of signal from the second nanoreporter contacted with the reference sample normalizes the signal from the first nanoreporter contacted with the first sample.

[17] In one embodiment of this method, the second nanoreporter further comprises a fourth probe comprising a fourth target-specific sequence; and an affinity tag; wherein the third probe and the fourth probe specifically hybridize to the same first DNA fragment from a copy number invariant region of the genome; at different sites on the fragment.

[18] In another embodiment, the first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence selected from the group consisting of SEQ ID NOs: 1-66. In another embodiment, the first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence selected from the group consisting of SEQ ID NOs: 2, 5, 7, 12, 13, 17, 19, 24, 25, 28, 32, 36, 38, 40, 44, 46, 50, 52, 56, 58, 62 and 66. In another embodiment, the first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence selected from the group consisting of SEQ ID NOs: 2, 5, 13, 19, 28, 46, 50, 56, 58 and 66.

[19] In another embodiment, the first probe further comprises an affinity tag. In another embodiment, the genomic target DNA is mammalian genomic DNA. Specifically, the mammal is a human.

[20] In another embodiment, the signal generated from the second probe

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1359

hybridized to the first control DNA sequence comprises a mixture of two or more different label monomers.

[21] In another embodiment, the labels or label monomers are fluorescent.

[22] The invention also provides a method of detecting a DNA sequence in a genome including the steps of providing a first sample containing genomic DNA; fragmenting the genomic DNA; denaturing the genomic DNA; providing a first nanoreporter that specifically hybridizes to the genomic DNA sequence to be detected; contacting the first nanoreporter with the fragmented genomic DNA wherein the contact is made under conditions sufficient for hybridization of the first nanoreporter to the genomic DNA sequence to be detected; stretching the first nanoreporter hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected using a flow-stretch, receding meniscus, or electro-stretch technique; and measuring a signal from the first nanoreporter, wherein said signal uniquely identifies the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected.

[23] Various embodiments of this method include the following. The first nanoreporter is a single or a dual nanoreporter. The genomic DNA can be mammalian genomic DNA. Further, this mammal can be a human.

[24] The genomic DNA sample can be unamplified. The contacting step can be performed in solution. The fragmentation can be performed by restriction enzyme digestion. The restriction enzyme can be, for example, AluI or BfaI. The fragmentation can also be performed chemically, by mechanical shearing or sonication.

[25] The invention also provides a method of determining the copy number of the target DNA sequence to be detected as described above including the steps of providing a reference sample comprising fragmented genomic DNA wherein the copy number of the genomic sequence the first nanoreporter specifically hybridizes to in the reference sample is known; contacting the first nanoreporter with the reference sample wherein the contact is made under conditions sufficient for hybridization of the first nanoreporter to a fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected; stretching the first nanoreporter hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected using a flow-stretch, receding meniscus, or electro-stretch technique, measuring a signal from the first nanoreporter, wherein said signal

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1360

uniquely identifies the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected; and comparing the signal from the first sample to the signal from the reference sample, wherein the copy number of the first sample is determined by correlating the signal from the first sample with the signal from the reference sample.

[26] The reference sample can be a synthetic nucleic acid sample or a biological genomic DNA sample.

[27] The invention also provides a method of normalizing the signal generated as described above. This method further includes the steps of providing at least a second nanoreporter; contacting the second nanoreporter with the fragmented genomic DNA from the first sample and the reference sample wherein the contact is made under conditions sufficient for hybridization of the second nanoreporter toa first DNA fragment from a copy number invariant region of the genome; stretching the second nanoreporter hybridized to the first DNA fragment from a copy number invariant region of the genome using a flow-stretch, receding meniscus, or electro-stretch technique; measuring a signal from the second nanoreporter, wherein said signal uniquely identifies the first DNA fragment from a copy number invariant region of the genome; and comparing the signal from the the second nanoreporter contacted with the first sample and the second nanoreporter contacted with the reference sample, wherein the number of multiples of the quantity of signal from the second nanoreporter contacted with the first sample compared to the quantity of signal from the second nanoreporter contacted with the reference sample normalizes the signal from the first nanoreporter contacted with the first sample.

[28] Various embodiments of this method include the following. The second nanoreporter can be a single or a dual nanoreporter.

[29] The first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence can be any of SEQ ID NOs: 1-66. Preferably, the first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence can be any of SEQ ID NOs: 2, 5, 7, 12, 13, 17, 19, 24, 25, 28, 32, 36, 38, 40, 44, 46, 50, 52, 56, 58, 62 and 66. More preferably, the first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence can be any of SEQ ID NOs: 2, 5, 13, 19, 28, 46, 50, 56, 58 and 66.

[30] The genomic DNA can be mammalian genomic DNA. Further, this mammal can be a human.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1361

[31] The signal generated from the first or second nanoreporter hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected can include a mixture of two or more different label monomers.

[32] Further, the labels or label monomers can be fluorescent.

[33] The invention also provides a method of detecting two or more DNA sequences in a genome including the steps of providing a first sample containing genomic DNA; fragmenting the genomic DNA; denaturing the genomic DNA; providing a two or more nanoreporters that each specifically hybridize to a distinct genomic DNA sequence to be detected; contacting the two or more nanoreporters with the fragmented genomic DNA wherein the contact is made under conditions sufficient for hybridization of the two or more nanoreporters to the genomic DNA sequence to be detected; stretching the two or more nanoreporters hybridized to its corresponding distinct genomic DNA sequence using a flow-stretch, receding meniscus, or electro-stretch technique, and measuring a signal from the two or more nanoreporters, wherein said signal uniquely identifies each of the corresponding distinct genomic DNA sequences thereby detecting two or more DNA sequences in a genome.

[34] Various embodiments of this method include the following. The two or more nanoreporters can be single or dual nanoreporters.

[35] The genomic DNA is mammalian genomic DNA. Further, the mammal can be a human.

[36] The genomic DNA sample can be unamplified. The contacting step can be performed in solution.

[37] The fragmentation can be performed by restriction enzyme digestion. Restriction enzymes to be used include AluI and BfaI. The fragmentation can also be performed chemically, by mechanical shearing or sonication.

[38] The invention also provides a method of determining the copy number of the target DNA sequence to be detected as described above further including the steps of providing a reference sample comprising fragmented genomic DNA wherein the copy number of the genomic sequence the first target specific sequence specifically hybridizes to in the reference sample is known; contacting the first nanoreporter with the reference sample wherein the contact is made under conditions sufficient for hybridization of the two or more nanoreporters each fragment of the fragmented

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1362

genomic DNA comprising the genomic DNA sequences to be detected; stretching the two or more nanoreporters hybridized to each fragment of the fragmented genomic DNA comprising the genomic DNA sequences to be detected using a flow-stretch, receding meniscus, or electro-stretch technique, measuring signals from the two or more nanoreporters, wherein said signal uniquely identifies each of the fragments of the fragmented genomic DNA comprising the genomic DNA sequences to be detected; comparing the signal from the first sample to the signal from the reference sample, wherein the copy number of the first sample is determined by correlating the signal from the first sample with the signal from the reference sample.

[39] The reference sample can be a synthetic nucleic acid sample or a biological genomic DNA sample.

[40] The invention also provides a method of normalizing the signal generated as described above. The method includes the steps of providing at least one invariable sequence specific nanoreporter; contacting the at least one copy number invariant sequence specific nanoreporter with the fragmented genomic DNA from the first sample and the reference sample wherein the contact is made under conditions sufficient for hybridization of the at least one invariable sequence specific nanoreporter to a first DNA fragment from a copy number invariant region of the genome; stretching the second nanoreporter hybridized to the the first DNA fragment from a copy number invariant region of the genome using a flow-stretch, receding meniscus, or electro-stretch technique; measuring a signal from the second nanoreporter, wherein said signal uniquely identifies the first DNA fragment from a copy number invariant region of the genome; and comparing the signal from the the second nanoreporter contacted with the first sample and the second nanoreporter contacted with the reference sample, wherein the number of multiples of the quantity of signal from the second nanoreporter contacted with the first sample compared to the quantity of signal from the second nanoreporter contacted with the reference sample normalizes the signal from the first nanoreporter contacted with the first sample.

[41] Various embodiments of this method include the following. The copy number invariant sequence specific nanoreporter can be a single or dual nanoreporter.

[42] The first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence can be any of SEQ ID NOs: 1-66. Preferably, the first DNA fragment from a copy number invariant region of the genome comprises a

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1363

nucleic acid sequence can be any of SEQ ID NOs: 2, 5, 7, 12, 13, 17, 19, 24, 25, 28, 32, 36, 38, 40, 44, 46, 50, 52, 56, 58, 62 and 66. More preferably, the first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence can be any of SEQ ID NOs: 2, 5, 13, 19, 28, 46, 50, 56, 58 and 66.

[43] The genomic DNA is mammalian genomic DNA. Further, the mammal can be a human.

[44] The signal generated from the two or more nanoreporters hybridized to each of the fragmented genomic DNAs comprising the genomic DNA sequence to be detected can include a mixture of two or more different label monomers. The signal generated from the invariable sequence specific nanoreporter can include a mixture of two or more different label monomers.

[45] Further, the labels or label monomers can be fluorescent.

[46] In any of the above methods, more than one invariable sequence specific nanoreporter may be used. The invariable sequences these nanoreporters specifically hybridize to can include any of SEQ ID NOs:1-66. As few as 1 and as many as 100 invariable sequence specific nanoreporters may be used at once. These nanoreporters may all specifically bind different invariable sequences. In one assay, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 invariable sequence specific nanoreporters may be used.

[47] The invention also provides a kit, comprising a first nanoreporter comprising a first probe comprising a first label attachment region to which are attached one or more label monomers that emit light constituting a first signal; a second label attachment region, which is non-over-lapping with the first label attachment region, to which are attached one or more label monomers that emit light constituting a second signal; and a first target-specific sequence attached to the first probe, wherein the target-specific sequence specifically hybridizes to a target DNA sequence; and a restriction enzyme.

[48] In one embodiment of the kit, the first probe further comprises an affinity tag. In another embodiment, the first nanoreporter further comprises a second probe comprising a second target-specific sequence; and an affinity tag; wherein the first probe and the second probe specifically hybridize to the same target DNA sequence at different sites. Specifically, the restriction enzyme is AluI or BfaI.

[49] In another embodiment, the kit further comprises a second nanoreporter comprising a third probe comprising a third label attachment region to which are attached one or more label monomers that emit light constituting a third signal; a

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1364

fourth label attachment region, which is non-over-lapping with the third label attachment region, to which are attached one or more label monomers that emit light constituting a fourth signal; and a third target-specific sequence attached to the first probe, wherein the target-specific sequence specifically hybridizes to a control DNA sequence.

[50] In another embodiment, the second nanoreporter further comprises a fourth probe comprising a fourth target-specific sequence; and an affinity tag; wherein the third probe and the fourth probe specifically hybridize to the same control DNA sequence at different sites on the sequence.

[51] In another embodiment, the first probe further comprises an affinity tag. In another embodiment, said labels are fluorescent. In another embodiment, the kit further comprises a control DNA sequence of known copy number.

[52] The invention also provides a composition comprising an isolated nucleic acid probe comprising at least 50 nucleotides of a sequence selected from the group consisting of SEQ ID NO: 1-66.

[53] The invention also provides a method of selecting probe pairs for detection of a genomic sequence comprising providing the genomic sequence; performing *in silico* restriction fragmentation of the genomic sequence; generating *in silico* probe pairs for every position on the *in silico* restriction fragments, wherein each member of each pair is 35-50 nucleotides in length, and wherein each member of each set of pairs is complementary to a contiguous sequence; discarding sets of probe pairs wherein the melting temperatures of the probe pairs differ by more than 5° C; subjecting the remaining probe pairs to BLAT scoring; and discarding sets of probe pairs with the lowest 75% of BLAT scores; thereby selecting probe pairs for detection of a genomic sequence.

[54] In one embodiment of this method of selecting probe pairs further includes scoring the fitness of the probes based on their length. Preferably, the fitness scoring is based on (i) the length of the restriction fragment the probe sequence optimized for use with the nCounter® system (also referred to as the nanoreporter code system). It can also be based on (ii) the location of the probe within the region to be analyzed. The location score is based on the number of probe pairs needed per region when the assay is designed. It can also be based on (iii) the results of the BLAT scoring, which provides a measure of whether the Reporter probe can be unambiguously mapped within the same reference genome sequence.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1365

[55] Further, any of the nanoreporters described above may be detected using the nCounter® system (alo referred to as the nanoreporter code system).

BRIEF DESCRIPTION OF THE DRAWINGS

[56] Figure 1 is a bar graph depicting detection of X chromosome copy number in comparison to Y chromosome and chromosome 18 and 21 copy number using the nCounter® system of the invention.

[57] Figure 2 is a bar graph depicting detection of X chromosome, Y chromosome and chromosome 18 and 21 copy number using the nCounter® system of the invention.

[58] Figure 3 is a bar graph depicting detection of X chromosome copy number using the nCounter® system of the invention.

[59] Figure 4 is a bar graph depicting detection of kinase and GPCR DNA copy number using the nCounter® system of the invention. These data demonstrate the ability of the nCounter® system to measure fold-changes and detect 2 copies per cell with negligible error.

[60] Figure 5 is a bar graph depicting detection of kinase and GPCR RNA molecules using the nCounter® system of the invention. These data demonstrate the ability of the nCounter® system to measure small fold-changes in other nucleic acids that are similar to DNA copy number changes expected in the CNV assay.

[61] Figure 6 shows 3 bar graphs showing copy number of genomic sequences in comparison to 23 invariant genomic regions in three different samples using the nCounter® system of the invention.

[62] Figure 7 is a line graph showing the relationship between fragment length and counts obtained via hybridization using the nCounter® system.

[63] Figure 8 is a bar graph showing a comparison of copy number for a region of chromosome 7.

[64] Figure 9 is a chart showing the number of copy calls for all 313 autosomal probes in the Human Karyotype Panel.

DETAILED DESCRIPTION

[65] The invention provides a sensitive, hybridization-based technology for determining the copy number of a given DNA sequence in a genome. For instance, the copy numbers of genes, intragenic sequences, intronic sequences, regulatory

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1366

sequences (including promotor, enhancer, and repressor elements), and gene splice forms can be determined. In certain embodiments of the invention, the nCounter® Analysis System is used. In preferred embodiments, the genomic DNA to be used with the nCounter® Analysis System is fragmented.

[66] In specific embodiments, genomic DNA is fragmented into sequences of between 100 and 5000 bp prior to use with the nCounter® Analysis System. More specifically, the fragments are on average between 100 and 1000 basepairs ("bp"), between 100 and 500 bp or between 200 and 500 bp. According to certain embodiments, the average DNA fragment size of a sample of genomic DNA for use with the nCounter® Analysis System according to the invention is within one standard deviation of 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900 or 2000 bp.

[67] In specific embodiments of the invention, fragmentation of genomic DNA is performed using enzymatic digestion, sonication, mechanical shearing or chemically. In a preferred embodiment, enzymatic digestion is performed using restriction enzymes. Preferred restriction enzymes include AluI which cuts as sequence AGCT. Another preferred restriction enzyme is BfaI which cuts at sequence CTAG. More than one restriction enzyme may be used to fragment the genomic DNA. In specific embodiments, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 restriction enzymes are used to digest the genomic DNA.

[68] According to certain embodiments, the genomic DNA must also be denatured from double stranded DNA to single stranded DNA. This denaturation may be done according to any method known in the art. In specific examples, the DNA is heat denatured. For example heat denaturation can be performed at 95°C for 5 minutes.

[69] In specific embodiments of the invention, the copy number of a genomic sequence is ascertained. First, the signal from each sample is normalized by determining the relative amount of genomic DNA in each assay. This is accomplished by including a set of probes in each assay which determine the signal generated by invariant regions in the genome. "Invariant regions" are those regions of the genome whose copy number rarely differs between individuals. In a preferred embodiment, invariant regions with a copy number of two are selected. Probes to 1-9 invariant regions can be used. In another preferred embodiment, probes to ten such invariant regions are included. The amount of input DNA in each assay can be deduced from the relative signal generated by these invariant regions in each sample,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1367

and the signal from all probes in each assay can subsequently be normalized to a common amount of input DNA.

[70] Following this sample input normalization, the copy number of any given region in an experimental sample can be determined by comparing the signal of a particular probe in the experimental sample to the signal of the same probe in a reference sample in which the copy number of the genomic target of that probe is known. The reference sample can be either a synthetic sample containing known amounts of the appropriate targets, or, in a preferred embodiment, a biological genomic DNA sample in which the copy number of the relevant regions is known.

nCounter®

[71] Probes to any of the following sequences can be used as control sequences.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1368

E-filed
Date of Deposit: March 16, 2011

Attorney Docket No. 40448-509001WO

Table 1

SEQ ID NO:	Chr	Start	End	Sequence
1	chr1	74174289	74174389	TCCCTATTACTCACCTTTCCTTTATAGTACAAGAGTTGTGTGTACTCACTCTCCTGTG
				TTACTTTCCAGCAATTATCCCTTGAACTCCTTTAACAAAGCT
2	chr1	97239054	97239154	TAACATTTGATGTGTACCGACTCCAGGTAAGTTGCTGTGTTCACATTTAACGTGTTAT
				CTCATTCAGTCCATCTGATTACCCCATGAGTTGTTGCTATCT
3	chr1	145108662	145108762	GTGAGAGTGATTAAAAGGAGCACTTATTGGGGTTTATTCTCCAATTCTCCATTCTTAT
				TTGGGCTATCTACAAGCCATCTGAAATTTACTTCTTCAAAGCT
4	chr2	83363170	83363270	ATCTTGATAAGTCATCTATCATTTGGCCAGCAACCTTTGGAATTCGAGGAACAGCAAC
				GGTGATTGATGTGTTGCTAAATCGTGAAAATTGCTTCATACA
5	chr2	137221997	137222092	GAGTTGACCACAAAGTGCTTTAGAACCAACCCTCTGATGCATAAGCCATCACACAATT
				TTGCGTTTGCAGATTTAAGACAATACTTTCATCAAAA
6	chr2	170396719	170396819	GATTCAAGATTCTTCTCCATCTCCAATCAAGAACATCCTACAGGCAACAGTCAGACAC
				TGGTGAAAAGGATTATGGCACAGAAAGATTTATTCTCATTTA
7	chr3	65580558	65580653	CCCTTGGCATTGATGTTTTATGGCTGTGAAACCAGTAAATCAGGAATTTGGAAAGCAG
				AAATGGTGTTCCTACTAAAAGAGAAAACAGGTAACAA
8	chr3	123885091	123885186	CAAGTGGACAGTCTTCCACCTGCACCAACTTTAGATCATCAACATTTAATTTTATTTA
				AGGAGAAGATGGGTTCTTACCACAAGGAACCCGACAA
9	chr3	182367754	182367854	TGATTTTACCTCCCAAATACATAATCTGTCTACTTCTCTTGTATGCTTCTGGGACCCT
				TGTCCATACACTTTATTATCTATCTCGGAACTGGTGCAATAGCT
10	chr4	87783205	87783305	TGACTACTTATAAAGGGATTTATATCCTTGCCTAAGTGAGGGAAATTGAGTCTCTTCC
				TCTGACTAATCAATCAGTCTAACACCCTAAAACCTCAAGATT
11	chr4	126464576	126464676	ATAACAAGTAGCGTAAGTAAAGGTGTATAACTGGACACATCTTTGGAATGAACAATAT
				CAGAGTCATAGTCATTAGCCTCTTACCCCAAATGTCAGAGCT
12	chr4	150216450	150216545	AAGTGGTATCAGTTAAGGTATAAAGACGTTGGATTTGGAATGTATCTGGAAGGTGGAG
				TTCATGGTATTCGATGATGGATAGGCTATGGGGCATA
13	chr5	71261235	71261335	ATAAACCCTCAGATTCCCGAATCTCCATATATCACATCCTCAACCGGTAGTGGTGTTT
				GATCATCTTCTCCAGATATACAGAAGAATCACAGGAGATCTG
14	chr5	89956484	89956584	ACTAACCCATACATCATTCTGCCCTTCAAATTAATAGGTCCTATAACGTAATTATAGA
				TATTGACTATAACTGCATTAAACTACGTGGTTTCTACGAGCT
15	chr5	92902783	92902883	TTATTGATTTCCATTGAGGGAGACTGAAAGACCATGGCTTAACATACTGTTGTTCCCA
				GGAGGAAAAAGTATAGTGAGAACTCATTTATTCTGACTGGAA

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1369

16	chr6	11423907	11424007	GCTCTTTTTCATCTCACTCTCTTTATTGAGTCTTGCCCATTTACAACAAAGGAGAGACT
				TGTTTTGTAGATCTTTAAAACACACCTGAGGATTTTGAATTC
17	chr6	41868334	41868434	GTCTCTTGTGTGTGAATGCAAATTATTCTTACCAGCAAGTTCTGAAATTATGTTACAA
				TGTCCAAATTCTTTGTATTTGTGACTGTTCATCAAATGGCTG
18	chr6	158141177	158141272	ATGGTTGCTTACAAAAGTCCCAAAGGCAGAGTGATAGAGGTAGTTTGGCTACTCA
				AATACCATGGACAACATTGCTATAGGTGATCTTTATTT
19	chr7	41541152	41541252	CGAAATTATAAATTTTGGTGTTCTGGACAGAGTTACCACCTCCCTGATTTTTAGTGGA
				GCCCTCTTAAAATAAAGCATAATGCCAACAGCAACCAAATCA
20	chr7	68962045	68962145	TAAGTGAGGCTAAAGAGATATCCCACTGGAGTAATTTTAAACCCTCTTTGCTTCCTTT
				GAAAGCACAATATCCTCAAATCTTATACAGTGGTTAATAGCT
21	chr7	84761978	84762076	TCAAAGATGTTTGTGTCCCAATCCCTTGAACATGAGAATAGTTCTATTAAAATGGCAAC
				AGGGTGTTAAATTGTAGACGGAATTAAGGCTGTCAATCAG
22	chr8	32505847	32505947	ATTCAAATTGAGTCCAGGACTGGAATAGTCATGCAATTCTCCACAATAAAGATCTCAG
				TGAAACTTTATACAAGAACCAGTCGTGTGTTGAATTAAAGCT
23	chr8	77019431	77019528	CCTAATGAAGTATCGATCGGCTGCAGTTGAGGTAAAACAAGTTGACATTCATTTAGAG
				GTAGCAATGTGAATATACCACAATGCCACCAAAGAAATA
24	chr8	93101553	93101653	ACTTGAAACACATTTTCCGCATTTATCTTAAATCTCTGTGCTCCAGAGAGTGTTCATG
				TGTATGTGGATTAGGCCTGGCTGGTTATTTCACCATCTATCT
25	chr9	72376995	72377095	ATATAGGTGGTTATTTAAGACTTTAGCATTAACGGAGACTGGGTAAGAATATACAGA
				ACAGGAATTTTGTGTACTAACTCTGCAACCTTTCTACAAATC
26	chr9	85571439	85571539	TCAGTACTATGTAACTTTTGCCATAGTCTCATTTCTACTTAACAGTCCTTTGATTGAT
				CTCTTTCTAAATTTGACAGATTCCTACAATAGCCATTCCAAA
27	chr9	139587089	139587184	GCTTTTTGCCTGATACCTGTGGATACAATAGTGACTTCGCCATGTTGGATTTCAAGTT
				TGTCTGCACCCTTTTGGATATAGTTTATCTTCCAGA
28	chr10	76411621	76411718	GAATTTTTTTATTTACACGCGCTTACCTCAAATACTGAAAGGTCTTTCCTTCGGTAAA
				TTTCATTTGCTGGAGGATGAAACCATCCACACTTCTTGG
29	chr10	97648682	97648782	TTCATTTTTCATCATAGACAGTTAATCAGAGACTTACTCCAACCCAGAAGTTTATACC
				AAAAGACTTGATTAGCGCAATAAAAGCACTAAATGAGGAGCT
30	chr10	112756032	112756132	ACAACACAACAAAAAAAAATTTGCTGCATTGCACATGGATTGTCTCATTTCACACAA
				AATGACCCATAAAAGAAATCCCAAGTAGCAAGCATCCCATTTG
31	chr11	62627341	62627441	TAGGTGCTATCATATGGTTATATGCAGAGTATTTTTGAGAAAACACAGAGGAAGTATC
				CACTTTAGCCTTAATAGGTCAGAAAAGGATTTAGGAGTTAGCT
32	chr11	93785528	93785628	CACCAGTTAGACTATTCGACAAAATCATACGATATTATAAAAGGCTGAAATTAAGGGT

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1370

					AGAGTGATAAAAATCGAAATTGTGTGAAGAAAATGACCATGT
33	chr11	120914392	120914492		CCTGTTGATTGATTGTATAATAAGATCCATAGAAGAAGGATCTCAGGTATTT
					TAGTTAAAGTGAACTCAGCCTACTGATACCAGTTAAAAGATT
34	chr12	19013949	19014049		CAATATCGATTCTCTACGTCTCTCAGAAATTGGTTGCCTAACAACTTTTTGCTCAATA
					AATTTTGGAGACTCCTGGGATTGGTGCCTTATCAGAAACATA
35	chr12	45584004	45584104		TTTTCTCTACTGAAACTTGTTCTGCTTCTCTCCCTAAAAATATACGCCAGTTGCTAAG
					TATTCAGCATTGACTTTTCTACCACAGAATACCCATAACAAC
36	chr12	87562270	87562370		GATTCAGATCTCCTCTTTTAAGATGTGATGGCCTCATTCCACTAAGTATGTAAACCAA
					ACCTTTTACCAAAGCACCAGGCATTTGATTAAAGATTCACTA
37	chr13	39406521	39406621		ATCTGAAAATGTCTCCAGGATAAGTCTATTGTGAATCACTTTGCATTAATTATACCCA
					GTAACAGATTAAGTCCATCCAATTTGAAGACCCACATCTTAC
38	chr13	45678720	45678820		ACAACATTAGAAGGGATTGCTTCCAGAGGATTTGTAACTTGGTGTATCACTTTACCCA
					AGTGTTCCTACTTTAAGAAAAGAAAAAGCAAAGTGCCTCACCC
39	chr13	100916026	100916126		CAGGGATCCTCAACCTCATACCTTCTCTTCAAAAAAGTCAGAAGTACCATACCAAATA
					TAAATGGGTGACTGTTATTTGCCAAGATCACATAGTAGATAA
40	chr14	55784606	55784706		GACATGTTCGTTGCATAAATAGCAGCATGGTAGACGCTGAAAATTATTTTTGGACTGTA
					TTTCACATTTAGGCAACTACTTTTTAATGGTTTTAAATCAACCC
41	chr14	66138914	66139014		AAAATTCGTATTCACATTTCAAGTTATATGTGTCAAAGCACTGGTGCTGAAACAGAAT
					AGGTTATCTTCTAATTTCACATCACTGAGTTATTCACTGCAG
42	chr14	88109044	88109144		GATTTTTAGCCTAAGCCAGAATTTAAAAGTACATACAAACCTCCATACTCATTTTCTC
					CGAGTTGTTTCTAAAGAACGGACTATACGTTTCTTCTTAAGCT
43	chr15	32163647	32163747		ACTACTATAAACTTGAGTCATCCCGACGTTGATCTCTTACAACTGTGTATGTTAACTT
					TTTAGCACATGTTTTGTACTTGGTACACGAGAAAACCCAGCT
44	chr15	35899734	35899833		CTTACTAAATAGTGGAATGAGGGATAGTGAGCAACAACCTTGGAGCCAGAAGATGTAG
					TAATGAGACTCTGCTTTTGTCATTCACAGTATCTGTCAGCT
45	chr15	67068813	67068910		GCAAACTTACCTAATAATGGGCTGTATGTATCATTACTTTCTGGAGTTCCTCTTATTT
					TGATGGGAACTTGCCTGCTTGGCTAAAACAGAAATGGCA
46	chr16	11026536	11026636		ATTTGACTGATTTCAGTTCTGATGTTAGGAAAGAGGTCAGACGCTAAGTCAGTTGTAA
					ATCAAGGGGTCAAAAGAAAACCACAGGGTGAATATAGTCATC
47	chr16	51412454	51412554		TGGCAAAATGGCTGTTTTTCTATCAGTTCAACCCTTGCGTCTTATAGTTGGGCCATAG
					GTAGTGAAAGGGAGTTAAAACATCTCTCTTACCTTATTTGAGCT
48	chr16	60328302	60328402		TCTATCATATGTGAAAACCGCCTGACTTTTGTGACCAATTGATATGGGCTTTTCCTTC
					CAGACCACTTTGTCACATCTCTTGTGTTTAGCAAATTAATCT

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1371

49	chr17	57079028	57079126	ACACATTTGATAAACTTTTATCTTAATGCGCCTTTCTGGAATACCAGTCTGACCTCAA TCTGAACAAAGCCTTAGTTGATGATGTTTGCAGGAGGTAG
50	chr17	60617471	60617571	AAACATATTGAAGGAAGGCACTAAACAAAACAGCATCTTCAGTCCCGATTAGTACCAT GACTTGAGTCTTACACAGTCAGAATACATGATTAGTCACATC
51	chr17	77035037	77035137	TTTGTGACATGAAGCCCTGAGATTAATTTTTTGCCTGTCTTAATTGAAGGAACCATTT AGTGCCGATTTAACTATTATTACCAAATCATCAGGATTGATG
52	chr18	20244655	20244755	ATAATTCCTGAGAATGTGTTATGTGCTGTGGTGATACGTCAGTTGCATCCTCTCCTTT ATACCCCACATTGACTAAGTCACACAAGTACCTTATGTTCTTCA
53	chr18	30352718	30352818	GAAAATATTGCTATATGTACCTCCCCCACTATACCAGGAGATATTTCAGGTGCTGCAT TCTATTAATGTTCCCGTCTTTACTACCTAATAGTGTCTCACA
54	chr18	71084633	71084733	TAGTACATAAAAAAATGTTGGACTCTCAGGCTAATTTAGGGTTGCTAAGTCAAAAGAT TGATGTTACAGGTGAAAATACATGGTGCCTGTCATTCTCCTA
55	chr19	38623780	38623871	CAGATGCCATAGGTGGGGCCAGAACCATCTAAACATTACCTGTAGGGTTGTCCATTTC AGACAACTCCAATTTGACCATTCAGAGGGTTTG
56	chr19	38818849	38818949	GCCGCATCAAATTAGCATCGACTCGTAAAACGTTACTGAATGATTCCTCAAATCTGCC AAGTCTTCAGATCAATTTTGGAGAAAGCGTCAAGAGGTTTTT
57	chr19	53490523	53490623	GGTGTAGGAGTGAGAGGGCTTAGAACACCTTGATAACTCTTTCCTGTAGTTGAGTCAT GCCAAATGCCCTGTCAAAATTTAATCCATTGGTATCAAAGCT
58	chr20	10504897	10504992	GCCCAGGGATTCTTAATGCTTCACAAATAAGCACCTCACTCTGAATCTGTGGCAAATT CACTTAGAGACAGTATAAATGTCTATCGTACCAAAGG
59	chr20	18616057	18616157	ACTATAAATACCTCCTTTTACTTCCTACAGTTCACTAAGTCTAACCTGGGCTACCACT GTGGAAGAGATTTCTCCTTTATCAGAAGGCACTTCAGCAAAC
60	chr20	49452575	49452675	CTGACCTGCTTACAATTCCATCTCTCTTGGATAAGCAAAGAGGCATATACTCAAATGT CTTAAAAGAAATGTTTGGTTAATTCCTCTAACCCCCAGAGGG
61	chr21	32806387	32806487	CATTCTCTTTCATTGGTCAATACATAGCCCTACTTTATGTCTAACGAATTACTTTTTAA TACTGTAATTAGCACCAGTGCTATGAATGCACACCCGTATAG
62	chr21	36113846	36113941	CAAATAACAAAACTCAGAAAGGCTGTTGTCAATGTAAAACTTGACTCCTAAGCAAGGA TTCCCTTGTTGAATACAAAGTAAAGAAGCAGCACTGG
63	chr21	37658395	37658495	GACCTGGTTCACAGATGAAATCCTTGTCATCTAAGAATCTTCCCATTAGATTCACTTA CAGATGTGTTTATTCATAGACTGTTCACCTTGAAAAGCAAAG
64	chr22	26799325	26799423	CTTCTCATCTTCCTTTTGCTCCAAAACTATGGGCACTCTTGGTTAATGGACATTCCTT TAGAAATTTGATCTATCCCAAGGACACAGATATATGTCCC
65	chr22	39576282	39576382	GCTCTACTACCTGAGTGATATTTGTGAGTGTGAATCATGGTGTTGGGTTAGCATATTT

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1372

					GCTTAAAGGACGTGTAAGATTAGGAGAAGGTTACCAGTAGCT
66	chr22	42509371	42509471		ACACATTCAAGACCCCATTCTTCACCGTGTAGAGTATATTCAAGGAATGGTTCCCCAA ATAAGTTCAGATCTTCTTCAAGTAAGTATTCATGAGCAAATA

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1373

[72] The sequences shown in Table 1 are sequences that can be used as invariant controls for each of the non-sex chromosomes. Of the nucleic acid sequences shown above in Table 1, SEQ ID NOs: 2, 5, 7, 12, 13, 17, 19, 24, 25, 28, 32, 36, 38, 40, 44, 46, 50, 52, 56, 58, 62 and 66 are the preferred sequence for each corresponding chromosome. Of these sequences, SEQ ID NOs: 2, 5, 13, 19, 28, 46, 50, 56, 58 and 66 are particularly preferred for use as invariant controls for use in sample input normalization.

[73] Nanoreporters can be used to detect any of the sequences of SEQ ID NOs: 1-66. Nanoreporters can also be used to detect fragments of these sequences. Fragments can be between 50 and 90 nucleotides in length. Fragments can also be 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99 nucleotides in length. The target specific regions of the nanoreporters can specifically hybridize to any of the sequences of SEQ ID NOs:1-66, any fragments thereof or any complement thereof.

[74] The invention also provides methods of detecting the copy number of multiple genomic sequences simultaneously. Multiple probes made according to the nCounter® system of the invention can be used to detect multiple genomic targets in a multiplexed format. The signal generated by the presence of a number of copies of these targets can then be compared to a standard or reference sample with a known copy number. As explained above, a control or multiple controls are used to normalize sample DNA input between different assays.

[75] The basis of the nCounter® Analysis system is the unique code assigned to each gene to be assayed (International Patent Application No. PCT/US2008/059959 and Geiss *et al.* Nature Biotechnology. 2008. 26(3): 317-325; the contents of which are each incorporated herein by reference in their entireties). The code is composed of a number of positions (visualized as "spots") and a number of colors. Colors are chosen to minimize spectral overlap during imaging. The number of positions are chosen with respect to a combination of factors that include, but are not limited to, the length of the DNA backbone, the minimum spot size that can be resolved under current imaging conditions, flexibility in code selection for modestly-sized gene sets (*i.e.* <1000 genes) and the number of potential codes for future versions of the system (for instance, in a

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1374

system with 7 positions, and 4 colors, the maximal number of specific labels is 4^7, or 16,384 labels, if all possible combinations of codes are used).

[76] Specific capture and reporter probes are synthesized in 96-well plates using a semi-automated process. Briefly, the reporter probes are pooled. Gene-specific probes are ligated to reporter molecule backbones and the ligated backbones were annealed to a unique pool of dye-coupled RNA or DNA segments corresponding to a single code. Reporter probes are then purified using a common 5'-repeat sequence at the end of each backbone to remove excess probe oligonucleotides and dye-coupled RNA or DNA segments. Capture probes were made by ligating a second sequence-specific oligonucleotide for each gene to a universal sequence containing biotin. After ligation, the capture probes were also pooled and affinity-purified using the universal sequence to remove the excess unligated gene-specific oligonucleotides. Reporter and capture probes were combined into a single "library" and used as a single reagent in subsequent hybridizations.

[77] The expression levels of all DNA:reporter molecule:capture probe duplexes are measured in a single multiplexed hybridization reaction. The sample is combined with the probe library, and hybridization occurs in solution. After hybridization, the tripartite hybridized complexes are purified in a two-step procedure using magnetic beads linked to oligonucleotides complementary to universal sequences present on the capture and reporter probes. This dual purification process allows the hybridization reaction to be driven to completion with a large excess of gene-specific probes, as they were ultimately removed, and, thus, do not interfere with binding and imaging of the sample. All post hybridization steps are handled robotically on a custom liquid-handling robot (Prep Station, NanoString Technologies).

[78] Purified reactions are deposited by the Prep Station into individual flow cells of a sample cartridge, bound to a streptavidin-coated surface via the capture probe, electrophoresed to elongate the reporter probes, and immobilized. After processing, the sample cartridge is transferred to a fully automated imaging and data collection device (Digital Analyzer, NanoString Technologies). The expression level of a gene is measured by imaging each sample in, for instance, 4 colors and counting the number of times the code for that gene is detected. For each sample, over 600 fields-of-view (FOV) are imaged (1376 X 1024 pixels) representing approximately 10 mm^2 of the binding surface.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1375

Typical imaging density is 100-200 counted reporters per field of view depending on the degree of multiplexing, the amount of RNA, and overall gene expression levels. However, the system is capable of operating at densities 5- to 10-fold higher. The Digital Analyzer can accommodate up to 6 cartridges at once and current scan times for 600 FOV are 4 hours per sample cartridge. Unattended, the system can process 72 samples in 24-hours per instrument.

[79] Image processing and code counting is performed. To minimize false positives, a reporter must meet stringent criteria concerning the number, size, brightness and spacing of the spots to ensure that the code is interpreted correctly. Reporters that do not meet all of these criteria are discarded. Using these criteria, approximately 40% of the detected molecules are typically counted. No parity schemes or error correction are employed in the current system. Data is output in simple spreadsheet format listing the number of counts per DNA, or genomic DNA fragment, per sample.

Therapeutic Applications

[80] Compositions and methods of the invention are used to detect gene or chromosome copy number in subjects who are at risk of developing an illness or disorder. Moreover, the compositions and methods of the invention are used to detect gene or chromosome copy number in subjects who have been diagnosed with an illness or disorder, and who are in need of a diagnosis or prognosis. The compositions and methods described herein are used to monitor disease progression (onset of a genetic disease or degeneration of telomeres as a consequence of aging or increased cell proliferation due to cancer) or responses to genetic therapy. Furthermore, the compositions and methods provided herein are used to screen individuals for their personal risk of developing a disorder as well as their risk of passing a disorder onto future children. Embryonic cells are tested using the compositions and methods of the invention for the presence or absence of disorders.

[81] The invention can be used to determine the risk of developing a particular biological condition, a particular disease, such as a cancer, a genetic disorder, a developmental disorder, a degenerative disorder, a neurological disorder, a stem cell disorder, or other biological condition. Furthermore, the present invention can be used to monitor the progression of a disease or responses to genetic therapy. Specifically, the invention can be used to detect, to monitor progression of, or monitor therapeutic

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1376

regimens for diseases of the heart, kidney, ureter, bladder, urethra, liver, prostate, heart, blood vessels, bone marrow, skeletal muscle, smooth muscle, various specific regions of the brain (including, but not limited to the amygdala, caudate nucleus, cerebellum, corpus callosum, fetal, hypothalamus, thalamus), spinal cord, peripheral nerves, retina, nose, trachea, lungs, mouth, salivary gland, esophagus, stomach, small intestines, large intestines, hypothalamus, pituitary, thyroid, pancreas, adrenal glands, ovaries, oviducts, uterus, placenta, vagina, mammary glands, testes, seminal vesicles, penis, lymph nodes, thymus, and spleen. The present invention can be used to detect, to monitor progression of, or monitor therapeutic regimens for a particular disease, such as a cancer, a genetic disorder, a developmental disorder, a degenerative disorder, a neurological disorder, a stem cell disorder, or other biological condition.

[82] Critically, the methods of the invention can determine the individual contributions of multiple genes to the same condition or disorder using one multiplexed reaction. Specifically, the methods of the invention can not only identify which genes are involved in a particular disorder, disease, or syndrome, but also by which mechanism, *e.g.* sequence duplication, mutation, deletion, or translocation. As such, the invention provides superior properties over all known methods of genetic screening because the methods provided elucidate the genes involved in complex multigene disorders such as Autism or Down Syndrome, which, unlike Huntington's Disease, require the participation of multiple genes. Most importantly, the methods of the invention do not require the skilled artisan to have identified or predetermined which genes may contribute to a particular disorder, disease, or syndrome prior to using these methods. If the skilled artisan applies gene specific probes that are specific for all known genes, then the abnormally increased or decreased genomic DNA copy numbers present in a sample taken from a subject having a particular disorder, disease, or syndrome will be apparent when compared to the genomic DNA copy numbers of a normal subject.

[83] In certain embodiments of these methods, the term "normal subjects" is meant to describe a person who has not been diagnosed with the disorder, disease, or syndrome under examination. Alternatively, a "normal subject" is a person of similar age, weight, gender, ethnicity and physical health who has not been diagnosed with the particular disorder, disease, or syndrome under examination. In other aspects, a "normal subject" is a person who has not been diagnosed with any genetic disorder, disease, or syndrome,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1377

and furthermore, may be of similar age, weight, gender, ethnicity and physical health to the test subject. In another aspect, a normal subject is a predetermined numerical reference based upon, for example, national or international averages or standards.

[84] The methods of the invention encompass a variety of subjects. Subjects are plants or animals. Animals are mammals. In certain embodiments, the mammal is a human, non-human primate, mouse, rat, dog, cat, horse, or cow, but is not limited to these examples. Mammals other than humans are advantageously used as subjects that represent animal models of a particular disorder. The preferred subject is human.

[85] The methods of the invention also encompass screening of subjects for pathology at various points in their lives. In certain embodiments, the detection is performed prenatally, neonatally, postnatally, at infancy, childhood, puberty, early adulthood, adulthood, and during old age. The pre-natal subject may be tested at about 1, 2, 3, 4, 5, 6, 7, 8 or 9 months prior to their expected birth date. Other subjects may be tested at the age of about 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, and 99 years of age or older.

Cancer

[86] Compositions and methods of the invention are used to identify cells and subjects at risk of developing or those cells and subjects who may have a predisposition for developing cancer. Moreover, the compositions and methods of the invention are used to differentiate cancer cell type, cancer subtype, tumor grade, or cancer stage for the purpose of diagnosing or prognosing a subject at risk of developing cancer or a subject who has developed cancer. The compositions and methods of the invention are further used to monitor to progression of a tumor, cancer, or a treatment regime. Additionally, the compositions and methods of the invention are used to screen individuals for any genetic predisposition to developing cancer.

[87] The term "cancer" includes solid tumors, as well as, hematologic tumors and/or malignancies. A "precancer cell" or "precancerous cell" is a cell manifesting a cell proliferative disorder that is a precancer or a precancerous condition. A "cancer cell" or "cancerous cell" is a cell manifesting a cell proliferative disorder that is a cancer. Any

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1378

reproducible means of measurement may be used to identify cancer cells or precancerous cells. Cancer cells or precancerous cells can be identified by histological typing or grading of a tissue sample (*e.g.*, a biopsy sample). Cancer cells or precancerous cells can be identified through the use of appropriate molecular markers.

[88] The compositions and methods of the invention are used to further determine cancer severity, as it is characterized by stage, tumor grade, and expression of factors that degrade the extracellular matrix, induce vascularization, inhibit cell adhesion and enable metastasis.

[89] Exemplary cancers include, but are not limited to, adrenocortical carcinoma, AIDS-related cancers, AIDS-related lymphoma, anal cancer, anorectal cancer, cancer of the anal canal, appendix cancer, childhood cerebellar astrocytoma, childhood cerebral astrocytoma, basal cell carcinoma, skin cancer (non-melanoma), biliary cancer, extrahepatic bile duct cancer, intrahepatic bile duct cancer, bladder cancer, uringary bladder cancer, bone and joint cancer, osteosarcoma and malignant fibrous histiocytoma, brain cancer, brain tumor, brain stem glioma, cerebellar astrocytoma, cerebral astrocytoma/malignant glioma, ependymoma, medulloblastoma, supratentorial primitive neuroectodeimal tumors, visual pathway and hypothalamic glioma, breast cancer, bronchial adenomas/carcinoids, carcinoid tumor, gastrointestinal, nervous system cancer, nervous system lymphoma, central nervous system cancer, central nervous system lymphoma, cervical cancer, childhood cancers, chronic lymphocytic leukemia, chronic myelogenous leukemia, chronic myeloproliferative disorders, colon cancer, colorectal cancer, cutaneous T-cell lymphoma, lymphoid neoplasm, mycosis fungoides, Seziary Syndrome, endometrial cancer, esophageal cancer, extracranial germ cell tumor, extragonadal germ cell tumor, extrahepatic bile duct cancer, eye cancer, intraocular melanoma, retinoblastoma, gallbladder cancer, gastric (stomach) cancer, gastrointestinal carcinoid tumor, gastrointestinal stromal tumor (GIST), germ cell tumor, ovarian germ cell tumor, gestational trophoblastic tumor glioma, head and neck cancer, hepatocellular (liver) cancer, Hodgkin lymphoma, hypopharyngeal cancer, intraocular melanoma, ocular cancer, islet cell tumors (endocrine pancreas), Kaposi Sarcoma, kidney cancer, renal cancer, kidney cancer, laryngeal cancer, acute lymphoblastic leukemia, acute myeloid leukemia, chronic lymphocytic leukemia, chronic myelogenous leukemia, hairy cell leukemia, lip and oral cavity cancer, liver cancer, lung cancer, non-small cell lung cancer,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1379

small cell lung cancer, AIDS-related lymphoma, non-Hodgkin lymphoma, primary central nervous system lymphoma, Waldenstram macroglobulinemia, medulloblastoma, melanoma, intraocular (eye) melanoma, merkel cell carcinoma, mesothelioma malignant, mesothelioma, metastatic squamous neck cancer, mouth cancer, cancer of the tongue, multiple endocrine neoplasia syndrome, mycosis fungoides, myelodysplastic syndromes, myelodysplastic/ myeloproliferative diseases, chronic myelogenous leukemia, acute myeloid leukemia, multiple myeloma, chronic myeloproliferative disorders, nasopharyngeal cancer, neuroblastoma, oral cancer, oral cavity cancer, oropharyngeal cancer, ovarian cancer, ovarian epithelial cancer, ovarian low malignant potential tumor, pancreatic cancer, islet cell pancreatic cancer, paranasal sinus and nasal cavity cancer, parathyroid cancer, penile cancer, pharyngeal cancer, pheochromocytoma, pineoblastoma and supratentorial primitive neuroectodermal tumors, pituitary tumor, plasma cell neoplasm/multiple myeloma, pleuropulmonary blastoma, prostate cancer, rectal cancer, renal pelvis and ureter, transitional cell cancer, retinoblastoma, rhabdomyosarcoma, salivary gland cancer, ewing family of sarcoma tumors, Kaposi Sarcoma, soft tissue sarcoma, uterine cancer, uterine sarcoma, skin cancer (non-melanoma), skin cancer (melanoma), merkel cell skin carcinoma, small intestine cancer, soft tissue sarcoma, squamous cell carcinoma, stomach (gastric) cancer, supratentorial primitive neuroectodermal tumors, testicular cancer, throat cancer, thymoma, thymoma and thymic carcinoma, thyroid cancer, transitional cell cancer of the renal pelvis and ureter and other urinary organs, gestational trophoblastic tumor, urethral cancer, endometrial uterine cancer, uterine sarcoma, uterine corpus cancer, vaginal cancer, vulvar cancer, and Wilm's Tumor.

Developmental and Degenerative Disorders

[90] Compositions and methods of the invention are used to identify cells and subjects at risk of developing a developmental or degenerative disorder or those cells and subjects who may have a predisposition for developing a developmental or degenerative disorder. Moreover, the compositions and methods of the invention are used to differentiate developmental disorders, degenerative disorders, or developmental from degenerative disorders for the purpose of diagnosing or prognosing a subject at risk of presenting or a subject who has been diagnosed with a developemental or degenerative disorder. The compositions and methods of the invention are further used to monitor to progression of

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1380

a developmental disorder, a degenerative disorder, or a treatment regime. Additionally, the compositions and methods of the invention are used to screen individuals for any genetic predisposition for presenting a developmental or degenerative disorder himself/herself, or for producing a child having a developmental or degenerative disorder.

[91] The term "developmental disorder" includes any disorder that initially presents in an individual during gestation or early postnatal development. Early postnatal development encompasses a period of time from birth to age 18. Although developmental disorders are often considered synonymous with mental disabilities that cause mental, emotional, or cognitive deficits, the term "developmental disorder" is meant to encompass any disorder that presents in either a fetus or a child aged 18 years or less, regardless of the specific signs or symptoms associated with the disorder. Moreover, developmental disorders are typically characterized by an inadequate or malfunctioning development of biological or psychological process. Developmental disorders are also characterized by behavioral traits, family history, brain morphology, or genetic/biomarkers that are present during development and predict or indicate the individual's risk of developing the disease in adulthood (*e.g.* Huntington's Disease, Amyotrophic lateral sclerosis or ALS, and Schizophrenia).

[92] A specific developmental disorder selectively affects one area of development, sparing essentially all other areas of development. Specific developmental disorders affect primarily hearing, vision, speech, or metabolism. However, a pervasive developmental disorder involves delays in the development of many basic skills, most notably the ability to socialize with others, because these conditions affect the child's ability to communicate and to use imagination. Pervasive developmental disorders include, but are not limited to, austism and autism spectrum disorders, Asperger's syndrome, childhood disintegrative disorder, Rett's Syndrome, attention-deficit disorder (ADD), and unspecified but pervasive disorders.

[93] Exemplary developmental disorders also include, but are not limited to, Autism spectrum disorders (ASD), Angelman Syndrome, central auditory processing disorder (CAPD), cerebral palsy, Down Sydrome, expressive language disorder, IsoDendric 15 (abbreviated idic(15)), Lanau-Kleffner Syndrome, neural tube defects, phenylketonuria (PKU), Prader-Willi Syndrome, seizure disorders, epilepsy, Tourette Syndrome,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1381

Williams Syndrome, hearing loss, deafness, blindness, vision impairment, jaundice / kernicterus, cluttering (speech disfluency), agnosias (visual, auditory, and somatosensory), anorexia nervosa disorder, acute stress disorder, adjustment disorder, bipolar disorder, body dysmorphic disorder, breathing-related sleep disorders, asthma, brief psychotic episode, bulimia nervosa, schizophrenia, Huntington's Disease (HD), multiple sclerosis (MS), amyotrophic lateral sclerosis (ALS), chronic motor or vocal tic disorder, circadian rhythm sleep disorder, conduct disorder, communication/language disorders, Cornelia de Lange Syndrome, fatal familial insomnia (FFI), Fahr's Syndrome (or idiopathic basal ganglia calcification), migraine, neoplasm (benign and malignant), Lupus erythematosus, autoimmune disorders, diabetes (type I), Wilson's Disease, Bell's Palsy, congenital heart disease, microcephaly, neonatal encephalitis, hydrocephalis, Parkinson's Disease, narcolepsy, muscular distrophy, Guillain-Barre Syndrome, neurofibromatosis, Von Hippel-Lindau Disease, dyslexia, familial hypercholesterolemia, polycystic kidney disease, hereditary spherocytosis, hereditary breast and ovarian syndrome, marfan syndrome, sickle cell anemia, sickle cell disease, cystic fibrosis, mucopolysaccharidoses, glycogen storage diseases, glactosemia, hemophilia, Androgenetic alopecia, Lebner's hereditary optic neuropathy, autoimmune disease, cleft palate, obesity, Gauchers Disease, Rett Syndrome, ataxia telagiectasia, long QT Syndrome, Alport Syndrome, male pattern baldness, SRY sex determination, achondroplasia, Cockayne syndrome, DiGeorge syndrome, fragile X syndrome, severe combined immunodeficiency, Waardenburg syndrome, Werner syndrome, Zellweger syndrome, adrenoleukodystrophy, glucose galactose malabsorption, hereditary hemochromatosis, Lesch-Nyhan syndrome, maple syrup urine disease, Menkes syndrome, Neimann-Pick syndrome, porphyria, Refsum disease, Tangier disease, Tay-Sachs disease, diastropic dysplasia, Ellis-van Creveld Syndrome (chondroectodermal dysplasia), paroxysmal nocturnal hemoglobinuria, thalassemia, Crohn's disease, Best disease, glaucoma, retinoblastoma, congenital adrenal hyperplasia, autoimmune polyglandular syndrome, multiple endocrine neoplasia, familial Mediterranean fever, immunodeficiency with hyper- IgM, Charcot-Marie-Tooth syndrome, fibrodysplasia ossificans progressive, myotonic dystrophy, essential tremor, Friedrich's Ataxia, spinal muscular atrophy, spinocerebellar ataxia, tuberous sclerosis, alpha-1-antitrypsin deficiency, and Pendred Syndrome.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1382

[94] The term "degenerative disorder" includes any disorder that initially presents in an adult individual. The term adult encompasses a period of time from age 18 to death. Although degenerative disorders are often considered synonymous with mental disabilities that cause mental, emotional, or cognitive deficits, the term "degenerative disorder" is meant to encompass any disorder that presents in an adult aged 18 years or older, regardless of the specific signs or symptoms associated with the disorder. Moreover, degenerative disorders are typically characterized by the deregulation or malfunction of an ordinarly operable biological or psychological process. Degenerative disorders can result from genetic predisposition, environmental factors, or exposure to pathogens such as a virus or prion.

[95] Exemplary degenerative disorders include, but are not limited to, Alzheimer's Disease, dementia, senility, agnosias (visual, auditory, and somatosensory), acute stress disorder, adjustment disorder, bipolar disorder, body dysmorphic disorder, breathing-related sleep disorders (sleep apnea), brief psychotic episode, bulimia nervosa, schizophrenia, Huntington's Disease (HD), Parkinson's Disease, multiple sclerosis (MS), amyotrophic lateral sclerosis (ALS), Capgras (delusion) Syndrome, chronic fatique syndrome, circadian rhythm sleep disorder, conduct disorder, communication/language disorders, Creutzfeldt-Jakob Disease (CJD), kuru, Gerstmann–Sträussler–Scheinker syndrome (GSS), fatal familial insomnia (FFI), cyclothymic disorder, acquired immune deficiency syndrome (AIDS), depression, addiction, Cushing's Syndrome (also called hyperadrenocorticism or hypercorticism), neoplasm (benign and malignant), stroke, diabetes (Type II), aneurysm, cardiovascular disease (including heart disease), Meniere's Disease, deafness, blindness, multiple system atrophy, Neiman Pick Disease, artherosclerosis, progressive supranuclear palsy, cancer, Tay-Sachs Disease, keratoconus, macular degeneration, inflammatory bowel disease (IBD), prostatis, male pattern baldness, obesity, paroxysmal nocturnal hemoglobinuria, thalassemia, Crohn's disease, Best disease, glaucoma, Gyrate atrophy of the choroid and retina, Charcot-Marie-Tooth syndrome, fibrodysplasia ossificans progressive, myotonic dystrophy,osteoarthritis, osteoporosis, arthritis, and rheumatoid arthritis.

Neurological Disorders

[96] Compositions and methods of the invention are used to identify cells and subjects at risk of developing a neurological disorder or those cells and subjects who may have a

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1383

predisposition for developing a neurological disorder. Moreover, the compositions and methods of the invention are used to differentiate neurological disorders for the purpose of diagnosing or prognosing a subject at risk of presenting or a subject who has been diagnosed with a neurological disorder. The compositions and methods of the invention are further used to monitor to progression of a neurological disorder or a treatment regime. Additionally, the compositions and methods of the invention are used to screen individuals for any genetic predisposition for presenting a neurological disorder himself/herself, or for producing a child having a neurological disorder.

[97] The term "neurological disorder" includes any disorder that initially presents within the nervous system of an individual. Neurological disorders present with a variety of signs and symptoms including, but not limited to, psychological, mood, or behaviorial changes; loss or decreased accuity of one or more senses (vision, hearing, touch); increased pain or burning sensations; lack of coordination or balance; loss of memory; loss of control over voluntary or involuntary movement; speech or balance; visual or auditory hallucinations; seizures; headaches; decreased movement; and ultimately, coma or death. Neurological disorders can result from genetic predisposition for developing the neurological disorder, one or more environmental factors that induce a the disorder to enhance the individual's genetic predisposition, or exposure of an individual to infectious agents such as a virus, a bacteria, a fungus, or a prion that induces the disorder or enhances the individual's genetic predisposition.

[98] Exemplary neurological disorders include, but are not limited to, autism spectrum disorders (ASD), Angelman Syndrome, bipolar disorder, attention-deficit disorder (ADD), central auditory processing disorder (CAPD), cerebral palsy, Down Sydrome, expressive language disorder, IsoDendric 15 (abbreviated idic(15)), Lanau-Kleffner Syndrome, neural tube defects, seizure disorders, epilepsy, Tourette Syndrome, traumatic brain injury (TBI), childhood disintegrative disorder, agnosias (visual, auditory, and somatosensory), anorexia nervosa disorder, acute stress disorder, adjustment disorder, bipolar disorder, body dysmorphic disorder, breathing-related sleep disorders, brief psychotic episode, bulimia nervosa, schizophrenia, Huntington's Disease (HD), multiple sclerosis (MS), amyotrophic lateral sclerosis (ALS), Capgras (delusion) Syndrome, chronic motor or vocal tic disorder, circadian rhythm sleep disorder, cluttering (speech disfluency), conduct disorder, communication/language disorders, Creutzfeldt-Jakob

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1384

Disease (CJD), kuru, Gerstmann–Sträussler–Scheinker syndrome (GSS), fatal familial insomnia (FFI), depression, addiction, Fahr's Syndrome (or idiopathic basal ganglia calcification), migraine, neoplasm (benign and malignant), aphasia, paralysis, Bell's Palsy, cerebrovascular disease, encephalitis, hydrocephalis, microcephaly, Parkinson's Disease, trigeminal neuralgia, narcolepsy, muscular distrophy, Guillain-Barre Syndrome, neurofibromatosis, dyslexia, Rett Syndrome, Fragile X syndrome, adrenoleukodystrophy, ataxia telangiectasia, Cockayne syndrome, deafness, Duchenne muscular dystrophy, Gaucher disease, Lesch-Nyhan syndrome, maple syrup urine disease, Menkes syndrome, phenylketonuria, Prader-Willi syndrome, spinal muscular atrophy, spinocerebellar ataxia, tuberous sclerosis, Neimann-Pick syndrome, Refsum disease, Tay-Sachs disease, Charcot-Marie-Tooth syndrome, fibrodysplasia ossificans progressive, myotonic dystrophy, and Meniere's Disease.

Stem Cell Disorders

[99] Compositions and methods of the invention are used to identify cells and subjects at risk of developing a "stem cell" disorder or those cells and subjects who may have a predisposition for developing a stem cell disorder. Moreover, the compositions and methods of the invention are used to differentiate stem cell disorders for the purpose of diagnosing or prognosing a subject at risk of presenting or a subject who has been diagnosed with a stem cell disorder. The compositions and methods of the invention are further used to monitor to progression of a stem cell disorder or a treatment regime. Additionally, the compositions and methods of the invention are used to screen individuals for any genetic predisposition for presenting a stem cell disorder himself/herself, or for producing a child having a stem cell disorder.

[100] The term "stem cell disorder" includes any disorder that initially presents within a totipotent (or omnipotent), pluripotent, multipotent, oligopotent, or unipotent stem cell of an individual. Alternatively, or in addition, a stem cell disorder includes any disorder which can be treated or prevented by administering a composition including a stem cell to the individual. Stem cells are characterized by their ability to produce daughter cells, one of which will differentiate and the other of which will remain an undifferentiated stem cell. The potency of a stem cell relates to differentiation potential of the daughter cell that becomes committed to a particular cell fate. Specifically, the terms totipotent stem cell or omnipotent stem cell describe stem cells that can give rise to both embryonic

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1385

stem cells or, alternatively, the stem cell can generate every type of cell in the human body. Pluripotent stem cells have a more restricted potential than totipotent stem cells, however, these stem cells can generate cells derived from any of the three germ layers (ectoderm, mesoderm, or endoderm). Multipotent stem cells have a more restricted potential than pluripotent stem cells, however, these stem cells can generate cells within a related lineage. Multipotent stem cells are often considered adult stem cells because they are found in, for instance, the adult brain (neural stem cells that give rise to neurons and all types of glia) and bones (bone marrow stem cells that give rise to all types of blood cells). Oligopotent stem cells have a more restricted potential than multipotent stem cells, however, these stem cells can generate a few related types of cells. For example, the corneal epithelium contains oliopotent stem cells that produce only corneal and conjunctival cells. Unipotent cells are the most restricted cell type because they can only reproduce their own cell type, however, they do maintain the ability to self-renew. Muscle stem cells are nonlimiting examples of unipotent stem cells.

[101] Exemplary stem cell disorders include, but are not limited to, autism spectrum disorders (ASD), neural tube defects, seizure disorders, epilepsy, hearing loss, deafness, blindness, vision impairment, jaundice / kernicterus, cluttering (speech disfluency), agnosias (visual, auditory, and somatosensory), Huntington's Disease (HD), multiple sclerosis (MS), amyotrophic lateral sclerosis (ALS), chronic motor or vocal tic disorder, circadian rhythm sleep disorder, Alzheimer's Disease, dementia, senility, diabetes, Parkinson's Disease, muscular distrophy, Guillain-Barre Syndrome, sickle cell anemia or sickle cell disease, ataxia telagiectasia, Cockayne syndrome, DiGeorge syndrome, severe combined immunodeficiency, porphyria, paroxysmal nocturnal hemoglobinuria, thalassemia, familial Mediterranean fever, immunodeficiency with hyper- IgM, Charcot-Marie-Tooth syndrome, fibrodysplasia ossificans progressive, myotonic dystrophy, spinal muscular atrophy, spinocerebellar ataxia, and Gauchers Disease.

[102]

Nanoreporters and nCounter® System overview

[103] The basis of the nCounter® Analysis system is the unique code assigned to each nucleic acid target to be assayed (International Patent Application No. PCT/US2008/059959 and Geiss *et al.* Nature Biotechnology. 2008. 26(3): 317-325; the contents of which are each incorporated herein by reference in their entireties). The code

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1386

is composed of an ordered series of colored fluorescent spots which create a unique barcode for each target to be assayed. A pair of probes is designed for each DNA or RNA target, a biotinylated capture probe and a reporter probe carrying the fluorescent barcode. This system is also referred to, herein, as the nanoreporter code system.

[104] Specific reporter and capture probes are synthesized for each target. Briefly, sequence-specific DNA oligonucleotide probes are attached to code-specific reporter molecules. Capture probes are made by ligating a second sequence-specific DNA oligonucleotide for each target to a universal oligonucleotide containing biotin. Reporter and capture probes are all pooled into a single hybridization mixture, the "probe library".

[105] The relative abundance of each target is measured in a single multiplexed hybridization reaction. The sample is combined with the probe library, and hybridization occurs in solution. After hybridization, the tripartite hybridized complexes are purified in a two-step procedure using magnetic beads linked to oligonucleotides complementary to universal sequences present on the capture and reporter probes. This dual purification process allows the hybridization reaction to be driven to completion with a large excess of target-specific probes, as they are ultimately removed, and, thus, do not interfere with binding and imaging of the sample. All post hybridization steps are handled robotically on a custom liquid-handling robot (Prep Station, NanoString Technologies).

[106] Purified reactions are deposited by the Prep Station into individual flow cells of a sample cartridge, bound to a streptavidin-coated surface via the capture probe, electrophoresed to elongate the reporter probes, and immobilized. After processing, the sample cartridge is transferred to a fully automated imaging and data collection device (Digital Analyzer, NanoString Technlogies). The expression level of a target is measured by imaging each sample and counting the number of times the code for that target is detected. For each sample, typically 600 fields-of-view (FOV) are imaged (1376 X 1024 pixels) representing approximately 10 mm^2 of the binding surface. Typical imaging density is 100-1200 counted reporters per field of view depending on the degree of multiplexing, the amount of sample input, and overall target abundance. Data is output in simple spreadsheet format listing the number of counts per target, per sample.

[107] Many nanoreporters, referred to as singular nanoreporters, are composed of one molecular entity. However, to increase the specificity of a nanoreporter and/or to improve the kinetics of its binding to a target molecule, a preferred nanoreporter is a dual

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1387

nanoreporter composed of two molecular entities, each containing a different target-specific sequence that binds to a different region of the same target molecule. In a dual nanoreporter, at least one of the two nanoreporter probes is labeled. This labeled nanoreporter probe is referred to herein as a "reporter probe". The other nanoreporter probe is not necessarily labeled. Such unlabeled components of dual nanoreporters are referred to herein as "capture probes" and often have affinity tags attached, such as biotin, which are useful to immobilize and/or stretch the complex containing the dual nanoreporter and the target molecule to allow visualization and/or imaging of the complex. When both probes are labeled or both have affinity tags, the probe with more label monomer attachment regions is referred to as the reporter probe and the other probe in the pair is referred to as a capture probe.

[108] For both single and dual nanoreporters, a fully assembled and labeled nanoreporter probe comprises two main portions, a target-specific sequence that is capable of binding to a target molecule, and a labeled portion which provides a "code" of signals associated with the target-specific sequence. Upon binding of the nanoreporter probe to the target molecule, the code identifies the target molecule to which the nanoreporter is bound.

[109] Nanoreporters are modular structures. In some embodiments, the nanoreporter comprises a plurality of different detectable molecules. In some embodiments, a labeled nanoreporter, is a molecular entity containing certain basic elements: (i) a plurality of unique label attachment regions attached in a particular, unique linear combination, and (ii) complementary polynucleotide sequences attached to the label attachment regions of the backbone. In some embodiments, the labeled nanoreporter comprises 2, 3, 4, 5, 6, 7, 8, 9, 10 or more unique label attachment regions attached in a particular, unique linear combination, and complementary polynucleotide sequences attached to the label attachment regions of the backbone. In some embodiments, the labeled nanoreporter comprises 6 or more unique label attachment regions attached in a particular, unique linear combination, and complementary polynucleotide sequences attached to the label attachment regions of the backbone. A nanoreporter probe further comprises a target-specific sequence, also attached to the backbone.

[110] The term label attachment region includes a region of defined polynucleotide sequence within a given backbone that may serve as an individual attachment point for a

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1388

detectable molecule. In some embodiments, the label attachment regions comprise designed sequences.

[111] In some embodiments, the label nanoreporter also comprises a backbone containing a constant region. The term constant region includes tandemly-repeated sequences of about 10 to about 25 nucleotides that are covalently attached to a nanoreporter. The constant region can be attached at either the 5' region or the 3' region of a nanoreporter, and may be utilized for capture and immobilization of a nanoreporter for imaging or detection, such as by attaching to a solid substrate a sequence that is complementary to the constant region. In certain aspects, the constant region contains 2, 3, 4, 5, 6, 7, 8, 9, 10, or more tandemly-repeated sequences, wherein the repeat sequences each comprise about 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, or more nucleotides, including about 12-18, 13-17, or about 14-16 nucleotides.

[112] The nanoreporters described herein can comprise synthetic, designed sequences. In some embodiments, the sequences contain a fairly regularly-spaced pattern of a nucleotide (*e.g.* adenine) residue in the backbone. In some embodiments, a specific nucleotide is spaced at least an average of 8, 9, 10, 12, 15, 16, 20, 30, or 50 bases apart. In some embodiments, a nucleotide is spaced at least an average of 8 to 16 bases apart. In some embodiments, a nucleotide is spaced at least an average of 8 bases apart. This allows for a regularly spaced complementary nucleotide in the complementary polynucleotide sequence having attached thereto a detectable molecule. For example, in some embodiments, when the nanoreporter sequences contain a fairly regularly-spaced pattern of adenine residues in the backbone, whose complement is a regularly-spaced pattern of uridine (U) residues in complementary RNA segments, the in vitro transcription of the segments can be done using an aminoallyl-modified uridine base, which allows the covalent amine coupling of dye molecules at regular intervals along the segment. In some embodiments, the sequences contain about the same number or percentage of a nucleotide (*e.g.* adenine) that is spaced at least an average of 8, 9, 10, 12, 15, 16, 20, 30, or 50 bases apart in the sequences. This allows for similar number or percentages in the complementary polynucleotide sequence having attached thereto a detectable molecule. Thus, in some embodiments, the sequences contain a nucleotide that is not regularly-spaced but that is spaced at least an average of 8, 9, 10, 12, 15, 16,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1389

20, 30, or 50 bases apart. In some embodiments, 20%, 30%, 50%, 60%, 70%, 80%, 90% or 100% of the complementary nucleotide is coupled to a detectable molecule. For instance, in some embodiments, when the nanoreporter sequences contain a similar percentage of adenine residues in the backbone and the in vitro transcription of the complementary segments is done using an aminoallyl-modified uridine base, 20%, 30%, 50%, 60%, 70%, 80%, 90% or 100% of the aminoallyl-modified uridine base can be coupled to a detectable molecule. Alternatively, the ratio of aminoallyl-modified uridine bases and uridine bases can be changed during the in vitro transcription process to achieve the desired number of sites which can be attached to a detectable molecule. For example, in vitro transcription process can take place in the presence of a mixture with a ratio of 1/1 of uridine to aminoallyl-modified uridine bases, when some or all the aminoallyl-modified uridine bases can be coupled to a detectable molecule.

[113] In some embodiments, the nanoreporters described herein have a fairly consistent melting temperature (Tm). Without intending to be limited to any theory, the Tm of the nanoreporters described herein provides for strong bonds between the nanoreporter backbone and the complementary polynucleotide sequence having attached thereto a detectable molecule, therefore, preventing dissociation during synthesis and hybridization procedures. In addition, the consistent Tm among a population of nanoreporters allows for the synthesis and hybridization procedures to be tightly optimized, as the optimal conditions are the same for all spots and positions. In some embodiments, the sequences of the nanoreporters have a 50% guanine/cytosine (G/C), with no more than three G's in a row. Thus, in some embodiments, the disclosure provides a population of nanoreporters in which the Tm among the nanoreporters in the population is fairly consistent. In some embodiments, the disclosure provides a population of nanoreporters in which the Tm of the complementary polynucleotide sequences when hybridized to its label attachment regions is about 80° C, 85° C, 90° C, 100° C or higher. In some embodiments, the disclosure provides a population of nanoreporters in which the Tm of the complementary polynucleotide sequences when hybridized to its label attachment regions is about 80° C or higher.

[114] In some embodiments, the nanoreporters described herein have minimal or no secondary structures, such as any stable intra-molecular base-paring interaction (*e.g.* hairpins). Without intending to be limited to any theory, the minimal secondary structure

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1390

in the nanoreporters provides for better hybridization between the nanoreporter backbone and the polynucleotide sequence having attached thereto a detectable molecule. In addition, the minimal secondary structure in the nanoreporters provides for better detection of the detectable molecules in the nanoreporters. In some embodiments, the nanoreporters described herein have no significant intra-molecular pairing under annealing conditions of 75° C, 1 X SSPE. Secondary structures can be predicted by programs known in the art such as MFOLD. In some embodiments, the nanoreporters described herein contain less than 1% of inverted repeats in each strand, wherein the inverted repeats are 9 bases or greater. In some embodiments, the nanoreporters described herein contain no inverted repeats in each strand. In some embodiments, the nanoreporters do not contain any inverted repeat of 9 nucleotides or greater across a sequence that is 1100 base pairs in length. In some embodiments, the nanoreporters do not contain any inverted repeat of 7 nucleotides or greater across any 100 base pair region. In some embodiments, the nanoreporters described herein contain less than 1% of inverted repeats in each strand, wherein the inverted repeats are 9 nucleotides or greater across a sequence that 1100 base pairs in length. In some embodiments, the nanoreporters described herein contain less than 1% of inverted repeats in each strand, wherein the inverted repeats are 7 nucleotides or greater across any 100 base pair region. In some embodiments, the nanoreporters described herein contain a skewed strand specific content such that one strand is CT-rich and the other is GA-rich.

[115] The disclosure also provides unique nanoreporters. In some embodiments, the nanoreporters described herein contain less that 1% of direct repeats. In some embodiments, the nanoreporters described herein contain no direct repeats. In some embodiments, the nanoreporters do not contain any direct repeat of 9 nucleotides or greater across a sequence that 1100 base pairs in length. In some embodiments, the labeled nanoreporters do not contain any direct repeat of 7 nucleotides or greater across any 100 base pair region. In some embodiments, the nanoreporters described herein contain less than 1% of direct repeats in each strand, wherein the direct repeats are 9 nucleotides or greater across a sequence that 1100 base pairs in length. In some embodiments, the nanoreporters described herein contain less than 1% of direct repeats in each strand, wherein the direct repeats are 7 nucleotides or greater across any 100 base pair region. In some embodiments, the nanoreporters described herein contain less than

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1391

85, 80, 70, 60, 50, 40, 30, 20, 10, or 5% homology to any other sequence used in the backbones or to any sequence described in the REFSEQ public database. In some embodiments, the nanoreporters described herein contain less than 85% homology to any other sequence used in the backbones or to any sequence described in the REFSEQ public database. In some embodiments, the nanoreporters described herein contain less than 20, 16, 15, 10, 9, 7, 5, 3, 2 contiguous bases of homology to any other sequence used in the backbones or to any sequence described in the REFSEQ public database. In some embodiments, the nanoreporters described herein have no more than 15 contiguous bases of homology and no more than 85% identity across the entire length of the nanoreporter to any other sequence used in the backbones or to any sequence described in the REFSEQ public database.

[116] In some embodiments, the sequence characteristics of the nanoreporter probes described herein provide sensitive detection of a target molecule. For instance, the binding of the nanoreporter probes to target molecules which results in the identification of the target molecules can be performed by individually detecting the presence of the nanoreporter. This can be performed by individually counting the presence of one or more of the nanoreporter molecules in a sample.

[117] The complementary polynucleotide sequences attached to a nanoreporter backbone serve to attach detectable molecules, or label monomers, to the nanoreporter backbone. The complementary polynucleotide sequences may be directly labeled, for example, by covalent incorporation of one or more detectable molecules into the complementary polynucleotide sequence. Alternatively, the complementary polynucleotide sequences may be indirectly labeled, such as by incorporation of biotin or other molecule capable of a specific ligand interaction into the complementary polynucleotide sequence. In such instances, the ligand (*e.g.*, streptavidin in the case of biotin incorporation into the complementary polynucleotide sequence) may be covalently attached to the detectable molecule. Where the detectable molecules attached to a label attachment region are not directly incorporated into the complementary polynucleotide sequence, this sequence serves as a bridge between the detectable molecule and the label attachment region, and may be referred to as a bridging molecule, *e.g.*, a bridging nucleic acid.

[118] The nucleic-acid based nanoreporter and nanoreporter-target complexes

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1392

described herein comprise nucleic acids, which may be affinity-purified or immobilized using a nucleic acid, such as an oligonucleotide, that is complementary to the constant region or the nanoreporter or target nucleic acid. As noted above, in some embodiments the nanoreporters comprise at least one constant region, which may serve as an affinity tag for purification and/or for immobilization (for example to a solid surface). The constant region typically comprises two or more tandemly-repeated regions of repeat nucleotides, such as a series of 15-base repeats. In such exemplary embodiments, the nanoreporter, whether complexed to a target molecule or otherwise, can be purified or immobilized by an affinity reagent coated with a 15-base oligonucleotide which is the reverse complement of the repeat unit.

[119] Nanoreporters, or nanoreporter-target molecule complexes, can be purified in two or more affinity selection steps. For example, in a dual nanoreporter, one probe can comprise a first affinity tag and the other probe can comprise a second (different) affinity tag. The probes are mixed with target molecules, and complexes comprising the two probes of the dual nanoreporter are separated from unbound materials (*e.g.*, the target or the individual probes of the nanoreporter) by affinity purification against one or both individual affinity tags. In the first step, the mixture can be bound to an affinity reagent for the first affinity tag, so that only probes comprising the first affinity tag and the desired complexes are purified. The bound materials are released from the first affinity reagent and optionally bound to an affinity reagent for the second affinity tag, allowing the separation of complexes from probes comprising the first affinity tag. At this point only full complexes would be bound. The complexes are finally released from the affinity reagent for the second affinity tag and then preferably stretched and imaged. The affinity reagent can be any solid surface coated with a binding partner for the affinity tag, such as a column, bead (*e.g.*, latex or magnetic bead) or slide coated with the binding partner. Immobilizing and stretching nanoreporters using affinity reagents is fully described in U.S. Publication No. 2010/0161026, which is incorporated by reference herein in its entirety.

[120] The sequence of signals provided by the label monomers associated with the various label attachment regions of the backbone of a given nanoreporter allows for the unique identification of the nanoreporter. For example, when using fluorescent labels, a nanoreporter having a unique identity or unique spectral signature is associated with a

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1393

target-specific sequence that recognizes a specific target molecule or a portion thereof. When a nanoreporter is exposed to a mixture containing the target molecule under conditions that permit binding of the target-specific sequence(s) of the nanoreporter to the target molecule, the target-specific sequence(s) preferentially bind(s) to the target molecule. Detection of the nanoreporter signal, such as the spectral code of a fluorescently labeled nanoreporter, associated with the nanoreporter allows detection of the presence of the target molecule in the mixture (qualitative analysis). Counting all the label monomers associated with a given spectral code or signature allows the counting of all the molecules in the mixture associated with the target-specific sequence coupled to the nanoreporter (quantitative analysis). Nanoreporters are thus useful for the diagnosis or prognosis of different biological states (*e.g.*, disease vs. healthy) by quantitative analysis of known biological markers or copy number variant loci.

[121] Many nanoreporters, referred to as singular nanoreporters, are composed of one molecular entity. However, to increase the specificity of a nanoreporter and/or to improve the kinetics of its binding to a target molecule, a nanoreporter can be a dual nanoreporter composed of two molecular entities, each containing a different target-specific sequence that binds to a different region of the same target molecule. In a dual nanoreporter, at least one of the two molecular entities is labeled. The other molecular entity need not necessarily be labeled. Such unlabeled components of dual nanoreporters may be used as capture probes and optionally have affinity tags attached, such as biotin, which are useful to immobilize and/or stretch the complex containing the dual nanoreporter and the target molecule to allow visualization and/or imaging of the complex. For instance, in some embodiments, a dual nanoreporter with a 6-position nanoreporter code, uses one 6-position coded nanoreporter (also referred to herein as a reporter probe) and a capture probe. In some embodiments, a dual nanoreporter with a 6-position nanoreporter code can be used, using one capture probe with an affinity tag and one 6-position nanoreporter component. In some embodiments an affinity tag is optionally included and can be used to purify the nanoreporter or to immobilize the nanoreporter (or nanoreporter-target molecule complex) for the purpose of imaging.

[122] In some embodiments, the nucleotide sequences of the individual label attachment regions within each nanoreporter are different from the nucleotide sequences of the other label attachment regions within that nanoreporter, preventing

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1394

rearrangements, such recombination, sharing or swapping of the label polynucleotide sequences. The number of label attachment regions to be formed on a backbone is based on the length and nature of the backbone, the means of labeling the nanoreporter, as well as the type of label monomers providing a signal to be attached to the label attachment regions of the backbone. In some embodiments, the complementary nucleotide sequence of each label attachment region is assigned a specific detectable molecule.

[123] The disclosure also provides labeled nanoreporters wherein one or more label attachment regions are attached to a corresponding detectable molecule, each detectable molecule providing a signal. For example, in some embodiments, a labeled nanoreporter according to the disclosure is obtained when at least three detectable molecules are attached to three corresponding label attachment regions of the backbone such that these labeled label attachment regions, or spots, are distinguishable based on their unique linear arrangement. A "spot," in the context of nanoreporter detection, is the aggregate signal detected from the label monomers attached to a single label attachment site on a nanoreporter, and which, depending on the size of the label attachment region and the nature (*e.g.*, primary emission wavelength) of the label monomer, may appear as a single point source of light when visualized under a microscope. Spots from a nanoreporter may be overlapping or non-overlapping. The nanoreporter code that identifies that target molecule can comprise any permutation of the length of a spot, its position relative to other spots, and/or the nature (*e.g.*, primary emission wavelength(s)) of its signal. Generally, for each probe or probe pair described herein, adjacent label attachment regions are non-overlapping, and/or the spots from adjacent label attachment regions are spatially and/or spectrally distinguishable, at least under the detection conditions (*e.g.*, when the nanoreporter is immobilized, stretched and observed under a microscope, as described in U.S. Publication No. 2010/0112710, incorporated herein by reference).

[124] Occasionally, reference is made to a spot size as a certain number of bases or nucleotides. As would be readily understood by one of skill in the art, this refers to the number of bases or nucleotides in the corresponding label attachment region.

[125] The order and nature (*e.g.*, primary emission wavelength(s), optionally also length) of spots from a nanoreporter serve as a nanoreporter code that identifies the target molecule capable of being bound by the nanoreporter through the nanoreporter's target specific sequence(s). When the nanoreporter is bound to a target molecule, the

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1395

nanoreporter code also identifies the target molecule. Optionally, the length of a spot can be a component of the nanoreporter code.

[126] Detectable molecules providing a signal associated with different label attachment regions of the backbone can provide signals that are indistinguishable under the detections conditions ("like" signals), or can provide signals that are distinguishable, at least under the detection conditions (*e.g.*, when the nanoreporter is immobilized, stretched and observed under a microscope).

[127] The disclosure also provides a nanoreporter wherein two or more detectable molecules are attached to a label attachment region. The signal provided by the detectable molecules associated with said label attachment region produces an aggregate signal that is detected. The aggregate signal produced may be made up of like signals or made up of at least two distinguishable signals (*e.g.*, spectrally distinguishable signals).

[128] In one embodiment, a nanoreporter includes at least three detectable molecules providing like signals attached to three corresponding label attachment regions of the backbone and said three detectable molecules are spatially distinguishable. In another embodiment, a nanoreporter includes at least three detectable molecules providing three distinguishable signals attached to three neighboring label attachment regions, for example three adjacent label attachment regions, whereby said at least three label monomers are spectrally distinguishable.

[129] In other embodiments, a nanoreporter includes spots providing like or unlike signals separated by a spacer region, whereby interposing the spacer region allows the generation of dark spots, which expand the possible combination of uniquely detectable signals. The term "dark spot" refers to a lack of signal from a label attachment site on a nanoreporter. Dark spots can be incorporated into the nanoreporter code to add more coding permutations and generate greater nanoreporter diversity in a nanoreporter population. In one embodiment, the spacer regions have a length determined by the resolution of an instrument employed in detecting the nanoreporter.

[130] In other embodiments, a nanoreporter includes one or more "double spots." Each double spot contains two or more (*e.g.*, three, four or five) adjacent spots that provide like signals without being separated by a spacer region. Double spots can be identified by their sizes.

[131] A detectable molecule providing a signal described herein may be attached

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1396

covalently or non-covalently (*e.g.*, via hybridization) to a complementary polynucleotide sequence that is attached to the label attachment region. The label monomers may also be attached indirectly to the complementary polynucleotide sequence, such as by being covalently attached to a ligand molecule (*e.g.*, streptavidin) that is attached through its interaction with a molecule incorporated into the complementary polynucleotide sequence (*e.g.*, biotin incorporated into the complementary polynucleotide sequence), which is in turn attached via hybridization to the backbone.

[132] A nanoreporter can also be associated with a uniquely detectable signal, such as a spectral code, determined by the sequence of signals provided by the label monomers attached (*e.g.*, indirectly) to label attachment regions on the backbone of the nanoreporter, whereby detection of the signal allows identification of the nanoreporter.

[133] In other embodiments, a nanoreporter also includes an affinity tag attached to the reporter probe backbone, such that attachment of the affinity tag to a support allows backbone stretching and resolution of signals provided by label monomers corresponding to different label attachment regions on the backbone. Nanoreporter stretching may involve any stretching means known in the art including but not limited to, means involving physical, hydrodynamic or electrical means. The affinity tag may comprise a constant region.

[134] In other embodiments, a nanoreporter also includes a target-specific sequence coupled to the backbone. The target-specific sequence is selected to allow the nanoreporter to recognize, bind or attach to a target molecule. The nanoreporters described herein are suitable for identification of target molecules of all types. For example, appropriate target-specific sequences can be coupled to the backbone of the nanoreporter to allow detection of a target molecule. Preferably the target molecule is DNA (including cDNA), RNA (including mRNA and cRNA), a peptide, a polypeptide, or a protein.

[135] One embodiment of the disclosure provides increased flexibility in target molecule detection with label monomers described herein. In this embodiment, a dual nanoreporter comprising two different molecular entities, each with a separate target-specific region, at least one of which is labeled, bind to the same target molecule. Thus, the target-specific sequences of the two components of the dual nanoreporter bind to different portions of a selected target molecule, whereby detection of the spectral code

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1397

associated with the dual nanoreporter provides detection of the selected target molecule in a biomolecular sample contacted with said dual nanoreporter.

[136] The disclosure also provides a method of detecting the presence of a specific target molecule in a biomolecular sample comprising: (i) contacting said sample with a nanoreporter as described herein (*e.g.*, a singular or dual nanoreporter) under conditions that allow binding of the target-specific sequences in the dual nanoreporter to the target molecule and (ii) detecting the spectral code associated with the dual nanoreporter. Depending on the nanoreporter architecture, the dual nanoreporter may be labeled before or after binding to the target molecule.

[137] The uniqueness of each nanoreporter probe in a population of probe allows for the multiplexed analysis of a plurality of target molecules. For example, in some embodiments, each nanoreporter probe contains six label attachment regions, where each label attachment region of each backbone is different from the other label attachment regions in that same backbone. If the label attachment regions are going to be labeled with one of four colors and there are 24 possible unique sequences for the label attachment regions and each label attachment region is assigned a specific color, each label attachment region in each backbone will consist of one of four sequences. There will be 4096 possible nanoreporters in this example. The number of possible nanoreporters can be increased, for example, by increasing the number of colors, increasing the number of unique sequences for the label attachment regions and/or increasing the number of label attachment regions per backbone. Likewise the number of possible nanoreporters can be decreased by decreasing the number of colors, decreasing the number of unique sequences for the label attachment regions and/or decreasing the number of label attachment regions per backbone.

[138] In certain embodiments, the methods of detection are performed in multiplex assays, whereby a plurality of target molecules are detected in the same assay (a single reaction mixture). In a preferred embodiment, the assay is a hybridization assay in which the plurality of target molecules are detected simultaneously. In certain embodiments, the plurality of target molecules detected in the same assay is, at least 2, at least 5 different target molecules, at least 10 different target molecules, at least 20 different target molecules, at least 50 different target molecules, at least 75 different target molecules, at least 100 different target molecules, at least 200 different target molecules, at least 500

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1398

different target molecules, or at least 750 different target molecules, or at least 1000 different target molecules. In other embodiments, the plurality of target molecules detected in the same assay is up to 50 different target molecules, up to 100 different target molecules, up to 150 different target molecules, up to 200 different target molecules, up to 300 different target molecules, up to 500 different target molecules, up to 750 different target molecules, up to 1000 different target molecules, up to 2000 different target molecules, or up to 5000 different target molecules. In yet other embodiments, the plurality of target molecules detected is any range in between the foregoing numbers of different target molecules, such as, but not limited to, from 20 to 50 different target molecules, from 50 to 200 different target molecules, from 100 to 1000 different target molecules, from 500 to 5000 different target molecules, and so on and so forth.

[139] Additional disclosure regarding nanoreporters can be found in International Publication No. WO 07/076129 and WO 07/076132, the contents of which are incorporated herein in their entireties. Further, the term nucleic acid probes and nanoreporters can include the rationally designed (*e.g.* synthetic sequences) described in International Publication No. WO 2010/019826, incorporated herein by reference in its entirety.

Kits

[140] Kits include a composition containing at least a first probe and a restriction enzyme. The first probe includes a first molecule containing a first label attachment region to which are attached one or more label monomers that emit light constituting a first signal; a second label attachment region, which is non-over-lapping with the first label attachment region, to which are attached one or more label monomers that emit light constituting a second signal; and a first target-specific sequence attached to the first molecule, wherein the target-specific sequence specifically hybridizes to a target DNA sequence. In certain embodiments of the kit, the first probe further includes an affinity tag. In other embodiments of the kit, the first probe includes a second molecule containing a second target-specific sequence; and an affinity tag; wherein the first molecule and the second molecule specifically hybridize to the same target DNA sequence at different sites.

[141] In other embodiments of the kit, the first molecule is a reporter probe or a capture

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1399

probe. In other embodiments, the second molecule is a reporter probe or a capture probe. Reporter probes and capture probes are provided in the kit individually or in a mixture.

[142] The restriction enzyme can be either a restriction endonuclease or a DNase. Preferably the restriction enzyme is AluI or BfaI.

[143] The kit optionally includes a second probe including a third molecule containing a third label attachment region to which are attached one or more label monomers that emit light constituting a third signal; a fourth label attachment region, which is non-overlapping with the third label attachment region, to which are attached one or more label monomers that emit light constituting a fourth signal; and a third target-specific sequence attached to the third molecule, wherein the target-specific sequence specifically hybridizes to a control DNA sequence. In certain embodiments the second probe includes a fourth molecule containing a fourth target-specific sequence and an affinity tag; wherein the third molecule and the fourth molecule specifically hybridize to the same control DNA sequence at different sites on the sequence.

[144] In other embodiments of the kit, the third molecule is a reporter probe or a capture probe. In other embodiments, the fourth molecule is a reporter probe or a capture probe. Reporter probes and capture probes are provided in the kit individually or in a mixture.

[145] In preferred embodiments of the kits, the labels and label monomers are fluorescent.

[146] Kits further include a control DNA sequence of known copy number. In other embodiments, kits contain a control probe to ensure that equivalent amounts of DNA are introduced or loaded into the nCounter® system.

[147] Kits include instructions for handling the enclosed compositions and protocols for performing singular or multiplexed fragmenting and denaturing reactions, as well as the contacting, stretching, and measuring steps described herein using the enclosed compositions. Furthermore, the instructions provide guidance for preparing the resultant tagged fragmented and hybridized genomic DNA molecule(s) for detection using the nCounter® Analysis System.

Nucleic Acids

[148] Also disclosed herein are isolated nucleic acid molecules that can be used as controls for genomic copy number assays. These nucleic acid molecules include the

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1400

sequences shown in Table 1. Of the nucleic acid sequences shown above in Table 1, SEQ ID NOs: 2, 5, 7, 12, 13, 17, 19, 24, 25, 28, 32, 36, 38, 40, 44, 46, 50, 52,56, 58, 62 and 66 are the preferred sequence for each corresponding chromosome. Of these sequences, SEQ ID NOs: 2, 5, 13, 19, 28, 46, 50, 56, 58 and 66 are particularly preferred for use as controls.

[149] Also included in the invention are nucleic acid fragments sufficient for use as controls in genomic copy number assays. These sequences can be present in the genomic sample itself or can be added to separate control samples. Probes can also be made to detect these sequences. These probes, themselves can be nucleic acid molecules comprising any of SEQ ID NOs: 1-66 or any complement thereof. As used herein, the term "nucleic acid molecule" is intended to include DNA molecules (*e.g.*, cDNA or genomic DNA), RNA molecules (*e.g.*, mRNA), analogs of the DNA or RNA generated using nucleotide analogs, and derivatives, fragments and homologs thereof. The nucleic acid molecule may be single-stranded or double-stranded, but preferably is comprised double-stranded DNA.

[150] The term "probes", as utilized herein, refers to nucleic acid sequences of variable length, preferably between at least about 10 nucleotides (nt), 100 nt, or as many as approximately, *e.g.*, 6,000 nt, depending upon the specific use. Probes are used in the detection of identical, similar, or complementary nucleic acid sequences. In specific embodiments, these probe sequences are used to construct target specific portions of nanoreporters described above.

[151] The term "isolated" nucleic acid molecule, as utilized herein, is one, which is separated from other nucleic acid molecules which are present in the natural source of the nucleic acid. Preferably, an "isolated" nucleic acid is free of sequences which naturally flank the nucleic acid (*i.e.*, sequences located at the 5'- and 3'-termini of the nucleic acid) in the genomic DNA of the organism from which the nucleic acid is derived. For example, in various embodiments, the isolated nucleic acid molecules described herein can contain less than about 5 kb, 4 kb, 3 kb, 2 kb, 1 kb, 0.5 kb or 0.1 kb of nucleotide sequences which naturally flank the nucleic acid molecule in genomic DNA of the cell/tissue from which the nucleic acid is derived (*e.g.*, brain, heart, liver, spleen, *etc.*). Moreover, an "isolated" nucleic acid molecule, such as a cDNA molecule, can be substantially free of other cellular material or culture medium when produced by

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1401

recombinant techniques, or of chemical precursors or other chemicals when chemically synthesized.

[152] A nucleic acid molecule described herein can be isolated using standard molecular biology techniques and the sequence information provided herein. Nucleic acid molecules can be isolated using standard hybridization and cloning techniques (*e.g.*, as described in Sambrook, *et al.*, (eds.), MOLECULAR CLONING: A LABORATORY MANUAL 2nd Ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989; and Ausubel, *et al.*, (eds.), CURRENT PROTOCOLS IN MOLECULAR BIOLOGY, John Wiley & Sons, New York, NY, 1993.)

[153] In another embodiment, an isolated nucleic acid molecule of the invention comprises a nucleic acid molecule that is a complement of the nucleotide sequence shown in SEQ ID NOs: 1-66, or a portion of this nucleotide sequence (*e.g.*, a fragment that can be used as a probe or primer). A nucleic acid molecule that is complementary to the nucleotide sequence shown SEQ ID NOs: 1-66 is one that is sufficiently complementary that it can hydrogen bond with little or no mismatches, thereby forming a stable duplex.

[154] As used herein, the term "complementary" refers to Watson-Crick or Hoogsteen base pairing between nucleotides units of a nucleic acid molecule, and the term "binding" means the physical or chemical interaction between two polypeptides or compounds or associated polypeptides or compounds or combinations thereof. Binding includes ionic, non-ionic, van der Waals, hydrophobic interactions, and the like. A physical interaction can be either direct or indirect. Indirect interactions may be through or due to the effects of another polypeptide or compound. Direct binding refers to interactions that do not take place through, or due to, the effect of another polypeptide or compound, but instead are without other substantial chemical intermediates.

[155] Fragments provided herein are defined as sequences of at least 6 (contiguous) nucleic acids, a length sufficient to allow for specific hybridization in the case of nucleic acids and are at most some portion less than a full length sequence. Fragments may be derived from any contiguous portion of a nucleic acid or amino acid sequence of choice. Derivatives are nucleic acid sequences from the native compounds either directly or by modification or partial substitution. Analogs are nucleic acid sequences that have a structure similar to, but not identical to, the native compound but differs from it in

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1402

respect to certain components or side chains. Analogs may be synthetic or from a different evolutionary origin and may have a similar or opposite metabolic activity compared to wild type. Homologs are nucleic acid sequences or amino acid sequences of a particular gene that are derived from different species.

[156] Derivatives and analogs may be full length or other than full length, if the derivative or analog contains a modified nucleic acid, as described below. Derivatives or analogs of the nucleic acids of the invention include, but are not limited to, molecules comprising regions that are substantially homologous to the nucleic acids of the invention, in various embodiments, by at least about 70%, 80%, or 95% identity (with a preferred identity of 80 95%) over a nucleic acid sequence of identical size or when compared to an aligned sequence in which the alignment is done by a computer homology program known in the art, or whose encoding nucleic acid is capable of hybridizing to the complement of a sequence encoding the aforementioned proteins under stringent, moderately stringent, or low stringent conditions. See *e.g.* Ausubel, *et al.*, CURRENT PROTOCOLS IN MOLECULAR BIOLOGY, John Wiley & Sons, New York, NY, 1993, and below.

[157] As used herein, the phrase "stringent hybridization conditions" refers to conditions under which a probe, primer or oligonucleotide will hybridize to its target sequence, but to substantially no other sequences. Stringent conditions are sequence-dependent and will be different in different circumstances. Longer sequences hybridize specifically at higher temperatures than shorter sequences.

[158] Stringent conditions are known to those skilled in the art and can be found in Ausubel, *et al.*, (eds.), CURRENT PROTOCOLS IN MOLECULAR BIOLOGY, John Wiley & Sons, N.Y. (1989), 6.3.1 6.3.6. Preferably, the conditions are such that sequences at least about 65%, 70%, 75%, 85%, 90%, 95%, 98%, or 99% homologous to each other typically remain hybridized to each other. A non limiting example of stringent hybridization conditions are hybridization in a high salt buffer comprising 6X SSC, 50 mM Tris HCl (pH 7.5), 1 mM EDTA, 0.02% PVP, 0.02% Ficoll, 0.02% BSA, and 500 mg/ml denatured salmon sperm DNA at 65°C, followed by one or more washes in 0.2X SSC, 0.01% BSA at 50°C.

Probe Pair Selection

[159] Genotyping of individuals based on the relative copy number of particular

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1403

genomic regions can be accomplished using a collection of probe pairs specifically designed as described below.

[160] First, a list of genomic regions is obtained with the publically available reference genome build number, chromosome, start, and end coordinates. From this list, a custom track file is generated to be used for creation of a custom user track that can be viewed within a browser, for example, the UCSC genome browser, over the Internet.

[161] After loading the track file into the genome browser, unmasked raw DNA sequences are downloaded using the genome table browser. This is generally downloaded as a multi-FASTA file containing all the regions sequences together, but sometimes it is downloaded as a single sequence FASTA file. The multi-FASTA file containing the region sequences is manipulated to strip extraneous characters from the header of each FASTA entry, leaving only necessary information such as region name, chromosome, start, and end positions.

[162] Then the multi-FASTA file of region sequences is split into separate FASTA files, one file for each region. Each region file is then passed to a computer program that creates *in silico* restriction fragments of various sizes, depending on the location of restriction enzyme recognition sites in the sequence. The size of the resulting DNA fragments will vary from about 0.1 kb to about 10 kb, with an approximate average size of 0.5 kb.

[163] When all of the regions have been processed, the resulting fragment sequences are concatenated into one big file again for loading into a database of DNA fragments. A computer program is used to read the file of region coordinates and the file of DNA fragments in order to create a data structure in the database, linking the restriction fragment sequences to the regions. When all of the fragment sequences have been loaded into the database, the Gauntlet program generates probe pairs, each probe consisting of approximately 35-50 nucleotides, specifically designed to work in the nanoString nCounter® system. Many probe pairs are created per restriction fragment during the process, with the majority failing to meet rigorous specifications for the design of matched probe pairs.

[164] Those probes that pass the physical structure and matching criteria are loaded into the database to be further scored for fitness within the CNV assay. Every passed probe for the project is sent to a local licensed version of the BLAT program to

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1404

determine the location(s) with respect to the publically available reference genome (*e.g.* hg18 or hg19) so that we can unambiguously map the location(s) and determine their potential for cross hybridization to other regions of the genome.

[165] Fitness scoring is performed on the Reporter probe of each probe pair (35-50 nucleotides in length) based on: (i) the length of the restriction fragment the probe sequence is within that we know works best in the nCounter® system. This is based on a mathematical model of performance as determined by in-house experimentation. (ii) the location of the probe within the region to be analyzed. The location score is based on the number of probe pairs the customer has requested per region when they submitted them for the assay design. (iii) the results of the BLAT scoring, which gives us a measure of whether we can unambiguously map the Reporter probe within the same reference genome sequence.

[166] The unique algorithm that was developed for fitness scoring is described in detail below. This process allows for an expansion of the number of zones (bins) per region to facilitate selection of the requested number of probe pairs evenly distributed over the entire region using the probes that will work best in the nCounter® system according to our mathematical model of fitness.

[167] The following is the flow of our unique process of probe selection for the custom CNV assay: The user specifies the value (N) of the number of probes requested per region and the maximum value (MAX) of zones to try for an iterative processing of each region. Data is gathered from the database and arranged into data structures amenable to the process. Then, for every region, and for every iteration from N to MAX, a scoring matrix is created the exact length of the region using a natural mathematical function (absolute value of a sine wave) with the cycles specified relative to N, and increasing by the value (S) at the end of each iteration cycle.

[168] For every Reporter probe, a fitness score is calculated using the value of the sine wave, the value of the fragment length model, and an adjusted BLAT score. As the algorithm passes through the entire region length of sequence from end to end, each probe score is tested against the highest score seen so far in the zone. If the score for the probe at that position is higher than the one saved previously, the probe is replaced with the higher scoring probe. When the algorithm has reached the end of each zone, the highest scoring probe is added to the list of probes to be included in the assay.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1405

[169] When the algorithm has reached the entire length of the region, the program tests if the number of probes requested (N) has been satisfied, and IF NOT, the value of N is changed to the next incremental value of N by adding S, and the process begins all over again. The cycles continue until the maximum value of zones (MAX) has been reached.

EXAMPLES

Example 1: Quantitation of Copy Number Variations.

[170] Multiple probes for designed for the X (9) and Y (9) chromosomes, as well as for chromosome 18 (6) and chromosome 21(3). Cells lines were provided with known chromosomal aberrations. Samples included cells with 1-5 copies of the X chromosome, normal males and females, and cells with trisomy at chromosome 21 and 18.

[171] Genomic DNA from the samples was digested with AluI (1hr @ 100ng/µl). 100ng of genomic DNA was used per assay. The genomic DNA was denatured prior to hybridization (5 min @ 95°C, snap cool 2 min). All experiments were performed in triplicate.

[172] For samples with cells with 1-5 copies of the X chromosome, the samples were normalized to probes on chromosome 18 (*see* Figure 1). For trisomy detection, normalization was done to the Y chromosome in the male samples (*see* Figure 2).

[173] The assay for multiple X chromosomes was repeated. Multi-X cell line genomic DNA purchased from Coriell cell repository. 1 µg of each sample was digested with 10U of AluI enzyme in a 50 µl digest at 37°C for 2 hours. The digested DNA was heat denatured at 95°C for 5 minutes and snap cooled on ice.

[174] 100 ng each digested/denatured sample was hybridized with the codeset CNV2 under standard nCounter® conditions for 16 hours. In addition to probes to other chromosomes, the CNV2 codeset contains 235 probes with 3 probes designed to bind to chromosome X. Standard conditions for the nCounter® assay are: 30 µl hybridization in 5X SSPE/0.1% Tween 20, 25 pM reporter probe, 100 pM capture probe, 100 ng genomic DNA, 65°C, with a heated lid for 16 hours. Raw counts were normalized to the average of 66 probes to invariant genomic regions, to correct for genome-equivalents input into each assay. Normalized counts were averaged for each sample triplicate. Average counts for each probe are then divided by the corresponding count for the reference sample (NA10851, Coriell Cell Repository) to generate a copy number estimate.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1406

[175] Copy number estimate is then averaged for the 3 probes to chromosome X. The graph shows the average copy number estimate and standard deviation for 3 probes to chromosome X (see Figure 3). Figures 1-3 show proof of concept that nanoreporters as described above, can be used to ascertain genomic copy number.

Example 2: Precision Counting of Gene Copies in Normal and Cancerous Colon and Breast Tissues.

[176] Hybridizations were performed in triplicate with normal and tumorous colon and breast tissues, with GPCR and Kinase panels (24 total hybridizations) according to the nCounter® probe pair methods described above. As shown in Figure 4, the genes were binned based on expression level, and the average %CV (coefficient of variance, standard deviation and mean) was calculated for all the genes detected in each bin. The total number of measurements (n) is indicated. Even for the 173 measurements of genes expressed at very low levels, the %CV averaged less than 15%. Likewise, small fractional fold changes can be detected according to these methods as shown in Figure 5. This demonstrates the precision of the nCounter® system in the counting of gene copies.

Example 3: Precision Counting of Autosomal Mutations.

[177] 78 different autosomal loci, consisting of 25 HapMapped CNV regions and other regions of interest, together with 23 invariant regions (one per chromosome), were analyzed with a single CodeSet according to the nCounter® method described above. It is easy to identify the loci that vary in copy number.

[178] Samples were, from top to bottom, NA07019, NA12877, NA10487. All the HapMap overlapping regions are 2X in these individuals. NA12877 was male; notice the single X dose in region with index 102.

Example 4: Probe Pair Selection.

[179] *Sequence Preparation:*

[180] A list of genomic regions was obtained. The list could be produced from many sources. For example, the list came, in some instances, from a commercial source and in others from scrutiny of genomic regions known to be involved in a particular disease of interest through a scientific literature search. The list of regions contained specific data concerning the publically available human reference genome that was used to identify the region, including the build identifier, chromosome number, start, and end coordinates.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1407

[181] From the list of regions, a custom track file was generated to be used for creation of a custom user track that can be viewed, for example, within the UCSC genome browser over the Internet. After loading the track file into the genome browser, unmasked raw DNA sequences were downloaded using the genome table browser. This file was generally downloaded as a multi-FASTA file containing all the regions sequences concatenated together, but sometimes it was downloaded as a single sequence FASTA file if only one region is collected.

[182] The multi-FASTA file containing the specific DNA sequences from the regions is manipulated to strip extraneous characters from the header of each FASTA entry, leaving only necessary information such as region name, chromosome, start, and end positions. This can be accomplished using the custom Perl program replace.pl.

[183] The multi-FASTA file of region sequences were then split into separate files, one file for each region using the custom Perl program splitfa.pl. Each file was named using the sequence name found in the header of the FASTA entry in the multi-FASTA file.

[184] Each FASTA sequence file was then passed to the custom Perl program fragment.pl within a Linux bash shell script. The fragment.pl program created *in silico* restriction fragments of various sizes, depending on the location of restriction enzyme recognition sites in the sequence. The size of the resulting DNA fragments varied from about 0.1 kb to about 10 kb, with an approximate average size of 0.5 kb. Parameters set within fragment.pl allowed for the exclusion of fragments smaller or larger than the desired length.

[185] When all of the sequence files had been processed, the resulting sequence fragments were concatenated into one larger file for loading into a database of DNA fragments by the custom Perl program milk.pl. This program connected to a local mySQL CNV database, to create the appropriate project within the database, and linked the data to the specific organism and genome build. It then proceeded to load the DNA sequence fragments into the database for the design of probes. The milk.pl program also read a file of region coordinates in order to create the correct data structure in the database, linking the restriction fragment sequences to the regions.

[186] *Probe Design:*

[187] When all of the fragment sequences had been loaded into the database, the custom Perl program CNV_start_pipeline.pl ran multiple instances of the custom Perl

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1408

program gauntlet.pl, that generated probe pairs specifically designed to work in the nanoString nCounter® system. Each specific probe consisted of approximately 35-50 nucleotides, with probe pairs being matched for Tm. Many probe pairs were created for each restriction fragment during the process, with the majority failing to meet rigorous specifications for the design of matched probe pairs. Those probes that pass the physical structure and matching criteria were loaded into the CNV database to be scored for fitness within the CNV assay.

[188] *BLAT Scoring:*

[189] BLAT scoring was performed on each probe pair by concatenating the reporter probe sequence and the ghost probe sequence (each approximately 35-50 nucleotides in length). The combined reporter-ghost probe sequence was sent to a local licensed version of the BLAT program to determine the location(s) with respect to the publically available reference genome (*e.g.* hg18 or hg19). This was done to unambiguously map the probes against the reference genome and determine the potential for cross-hybridization to other regions of the genome. The output of the BLAT program for each probe pair was stored in the CNV database for subsequent scoring.

[190] The BLAT score for each probe pair within a project was accomplished by running the custom Perl program CNV_BLAT_score.pl, that created a score in the arbitrary range of 0-100 based on the number of "hits" within a specified combination of "percent identity" (PID) and "alignment length" (AL), parameters set within the program, the location of the "hit" on the combined reporter-ghost probe sequence, and the expected number of "hits" for a particular region in the genome. Note that "hits" within the reporter probe portion of the combined sequence are weighted as more severe than those on the ghost probe portion due to technical considerations of detecting the labeled "spot" tag on the reporter probe.

[191] *Probe Selection:*

[192] When BLAT scores had been determined and loaded into the CNV database, the selection of the "best" probes for each region was accomplished using the custom Perl program butter.pl. This program took into consideration the following parameters for picking the best probes for a given region: (i) the length of the restriction fragment the probe sequence is within that we know works best in the nCounter® system. This was based on a mathematical model of performance as determined by in-house

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1409

experimentation, (ii) the location of the probe within the region to be analyzed, and (iii) the BLAT score as determined above in "BLAT scoring".

[193] The custom Perl program butter.pl used a unique algorithm that was developed for fitness scoring of probe pairs. The algorithm included a process that allows for an expansion of the number of zones (bins) per region to facilitate selection of the requested number of probe pairs evenly distributed over the entire region using the probes that would work best in the nCounter® system according to our mathematical model of fitness. The location score was based on the number of probe pairs that had been requested per region when they submitted them for the assay design. For example, if the desired number of probes to a region was 1, then the best probe pair would be the one that (i) resides on the optimal size restriction fragment (high fragment score), (ii) is directly in the center (equal spacing from either end) of the defined region (high spacing score), and (iii) has the expected number of "hits" (high BLAT score).

[194] The following is the flow of our unique process of probe selection for the custom CNV assay:

[195] The user specified the value of the number of probes requested per region (N) and the maximum value of zones to try for an iterative processing of each region (MAX). Data was gathered from the database and arranged into data structures amenable to the process. For each region the following steps were performed.

[196] For each iteration from N to MAX, a scoring matrix was created the exact length (L) of the region (in nucleotides). Then, using a natural mathematical function (absolute value of a sine wave) with the cycles specified relative to N, a value ranging from 0 to 1 was assigned to every position of the matrix. For example, if the length of the region was 1kb (1000 nucleotides) and the number of desired probes was 1, then L=1000 and N=1, then the value in the matrix position 1000/2 = 500 is equal to 1.0 (the upper limit of the absolute value of a sine function). Therefore, the best position score possible for a probe pair would be at position 500. If a probe pair were located at position 500 with all other parameters being equal amongst the other probe pairs available for the zone (ideal fragment length and ideal BLAT score), the 1 best probe pair selected would be the one located right in the center of the region, which is what we want.

[197] For each zone (N), the following steps were performed. For each probe pair, a fitness score was calculated using the value of the fragment length model, the value of

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1410

the sine wave at the position of the probe pair, and the BLAT score. As the algorithm passed through the entire region length of sequence from end to end, each probe pair score was tested against the highest score seen so far in the zone (there are N zones). If the score for the probe pair at that position was higher than the one saved previously, the probe pair was replaced with the higher scoring one. When the algorithm reached the end of each zone, the highest scoring probe pair is added to the list of those to be included in the assay. Then the next probe pair was scored.

[198] For the next zone, when the algorithm reached the entire length of the region, the program tests if the number of probes requested (N) has been satisfied, and IF NOT, the value of N is changed to the next incremental value of N by adding S, and the process begins all over again. The cycles continue until the maximum value of zones (MAX) has been reached. In the next iteration (N =N+S unless N=MAX). The value (N) is increased by (S) at the end of every iteration, until MAX is reached. This was then perfomed for each successive region.

Example 5. Gene Copy Number Assay Protocol.

[199] *AluI Restriction Digestion*

[200] A restriction enzyme fragmentation was set up. 200-600 ng of DNA in in 7 μL of sample was placed a 0.2 mL-0.5 mL PCR tube. Genomic DNA was generally at a concentration of at least 29 ng/μL prior to addition to the fragmentation reaction.

[201] 7 μL containing DNA 600 ng was dissolved in RNase free water, Tris pH 8.0 or similar. To this was added 1 μL 10X AluI Fragmentation Buffer; 1 μL 10X CNV DNA Prep Control; 1 μL AluI Fragmentation Enzyme; up to 10 μL of total volume.

[202] The digestion was incubated at at 37° C for at least 2 hours in a heat block or thermalcycler with heated lid turned on. Samples generally were denatured upon completion of restriction digestion.

[203] The final hybridization reaction contained the following components: 10 μL nanoreporters, 10 μL hybridization buffer, a total volume of 5 μL of sample DNA, and 5 μL Capture ProbeSet.

[204] *Hybridization Reaction*

[205] Aliquots of both reporter probes and capture probes were removed from the freezer and thawed on benchtop at room temperature. The tubes were inverted or flicked several times to mix well and spin down reagent. A master mix was created containing

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1411

130 μL of the reporter probes and 130 μL of hybridization buffer. Hybridization buffer was added directly to nanoreporter tube. Capture probes were not added to the master mix. The master mix was inverted to mix and spun down.

[206] 12 tubes were labeled. 20 μL of mastermix was added to each of the 12 tubes.

[207] *Thermocycler*

[208] AluI digestion tubes were denatured at 95°C for 5 minutes. The thermocycler was pre-heated to 65°C with heated lid turned on and "forever" time setting. The AluI digestion tubes were then immediately placed on ice for 2 minutes to minimize DNA renaturation and then briefly spun down.

[209] 5 μL AluI-digested DNA sample was addec to the hybridization tube. The remainder of the AluI-digested sample was generally stored at –20° C for future use.

[210] 5 μL of capture probe was added to each tube immediately before placing at 65°C. Tubes were capped and mixed the reagents by flicking with your finger to ensure complete mixing. Tubes were briefly spin down at < 1000 g and immediately placed in the 65°C thermocycler. The hybridization assays were incubated for at least 16 hours and were left at 65°C until ready for processing. Maximum hybridization time did not exceed 30 hours.

Example 6. Optimal Size Selection of Restriction Fragments.

[211] During the probe design process, target regions were analyzed for Alu1 sites (based on the human reference genome sequence) and the sizes of Alu1 fragments were predicted. One nCounter® CNV probe was designed per Alu1 fragment. Figure 7 shows the relationship between Alu1 fragment length in base pairs (x-axis) and the counts obtained via hybridization in the nCounter® system (y-axis). Based on this data, the probe design algorithm selected the optimal size fragments per genomic region.

Example 7. Determination of Copy Number Variations (CNV) using nCounter® copy number assay.

[212] The nCounter® copy number assay was used to measure the copy number of 20 genomic regions in 50 human genomic DNA samples containing known copy number variations (CNVs). Fifty human genomic DNAs were purchased from Coriell Cell Repository. The presence of CNVs in these samples was previously determined by genome-wide analysis using microarray methodology and the data is publically available at the public website Database of Genomic Variants (http://projects.tcag.ca/variation/).

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1412

[213] Six hundred nanograms of genomic DNA were processed via the nCounter® Copy number assay manual. Briefly, 600ng of DNA was digested with restriction enzyme AluI, sample was denatured at 95° C for 5 minutes and added directly to an nCounter® hybridization reaction. The nCounter® CodeSet used in this experiment contained 60 probes complementary to 20 genomic regions that were selected based on known variations across these samples as well as control probes. Hybridization occurred in solution for 16 hours at 65° C. Hybridized samples were purified and imaged using nCounter® PrepStation and Digital Analyzer.

[214] Raw data was normalized using the average signal for 10 invariant control probes. This step removes slight variations in DNA input amounts. Copy number calls were calculated by dividing the normalized counts of the test samples by the normalized counts in the reference and multiplying by 2 for autosomal chromosomes (1-22). The reference sample was NA10851 purchased from Coriell. The graph in Figure 8 shows a comparison of the copy number value (Y-axis) for a region of chromosome 7 between the nCounter® assay (light gray bars) and the public data (dark gray bars, determined by microarray). The nCounter® copy number calls were determined by averaging the copy number calls for the 3 probes designed to this region. There was 100% concordance in copy number calls in this region, across the 50 samples. Several examples of samples with heterozygous (1 copy) and homozygous deletions (zero copies) in this region are shown.

Example 8. Karotype Panel.

[215] The Human Karyotype Panel used below consists of 338 probe pairs designed to target known invariant regions for molecular karyotyping of the human genome. The panel has 8 probe pairs distributed across each arm of the 22 autosomes, excluding the p-arms of acrocentric chromosomes, for a total of 313 autosomal probe pairs. In addition, there are 16 X-specific and 9 Y-specific probe pairs that may be used for gender determination. The Human Karyotype Panel is provided with 10 invariant control probe pairs designed to well-characterized invariant regions on separate chromosomes to be used for normalization of digital count data, eliminating sample-to-sample variation.

[216] Figure 9 shows copy number calls (y axis) for all 313 autosomal probe pairs (x axis) within the Human Karyotype Panel. One hundred and two (102) "normal" human HapMap DNA samples purchased from the Coriell Institute for Medical Research were

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1413

tested using the standard CNV assay protocol, described above. Normalized digital counts were compared to the male HapMap sample NA10851 to determine relative copy number calls. For each HapMap sample, the copy number call value is shown as a black cross. Lines marked as "1" represent a z-score of 1 ($P<0.32$) and lines marked as "2" represent a z-score of 2 ($P<0.05$) assuming a Gaussian distribution about the expected copy number of 2 and standard deviation of 0.2. The standard deviation of copy number calls for each probe pair is shown at the bottom of the graph, overlaying the y axis for both copy number calls and standard deviation. Probe pairs are sorted by ascending standard deviation. A cut-off value of 0.2 for standard deviation is demarcated by a gray dotted line.

OTHER EMBODIMENTS

[217] While the invention has been described in conjunction with the detailed description thereof, the foregoing description is intended to illustrate and not limit the scope of the invention, which is defined by the scope of the appended claims. Other aspects, advantages, and modifications are within the scope of the following claims. The patent and scientific literature referred to herein establishes the knowledge that is available to those with skill in the art. All United States patents and published or unpublished United States patent applications cited herein are incorporated by reference. All published foreign patents and patent applications cited herein are hereby incorporated by reference. Genbank and NCBI submissions indicated by accession number cited herein are hereby incorporated by reference. All other published references, documents, manuscripts and scientific literature cited herein are hereby incorporated by reference. While this invention has been particularly shown and described with references to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the invention encompassed by the appended claims.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1414

CLAIMS

What is claimed is:

1. A method of detecting a DNA sequence in a genome comprising:

(a) providing a first sample containing genomic DNA;

(b) fragmenting the genomic DNA;

(c) denaturing the genomic DNA;

(d) providing a first nanoreporter comprising a first probe comprising

(i) a first label attachment region to which are attached one or more label monomers that emit light constituting a first signal;

(ii) a second label attachment region, which is non-over-lapping with the first label attachment region, to which are attached one or more label monomers that emit light constituting a second signal; and

(iii) a first target-specific sequence attached to the first probe, wherein the target-specific sequence specifically hybridizes to the genomic DNA sequence to be detected;

(e) contacting the first probe with the fragmented genomic DNA wherein the contact is made under conditions sufficient for hybridization of the first target specific sequence to a fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected

(f) stretching the first probe hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected using a flow-stretch, receding meniscus, or electro-stretch technique, thereby spatially separating said label monomers, and

(g) measuring a signal from the first probe, wherein said signal uniquely identifies the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected.

2. The method of claim 1, wherein the first nanoreporter further comprises a second probe comprising

(i) a second target-specific sequence; and

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1415

(ii) an affinity tag;

wherein the first probe and the second probe specifically hybridize to the same fragment of the fragmented genomic DNA at different sites on the fragment.

3. The method of claim 1, wherein the first probe further comprises an affinity tag.

4. The method of claim 1, wherein the genomic DNA is mammalian genomic DNA.

5. The method of claim 4, wherein the mammal is a human.

6. The method of claim 1, wherein the genomic DNA sample is unamplified.

7. The method of claim 1, wherein step (e) is performed in solution.

8. The method of claim 1, wherein the fragmentation is performed by restriction enzyme digestion.

9. The method of claim 8, wherein the restriction enzyme is Alu1.

10. The method of claim 8, wherein the restriction enzyme is Bfa1.

11. The method of claim 1, wherein the fragmentation is performed chemically, by mechanical shearing or sonication.

12. A method of determining the copy number of the DNA sequence to be detected of claim 1 further comprising

(a) providing a reference sample comprising fragmented genomic DNA wherein the copy number of the genomic sequence the first target specific sequence specifically hybridizes to in the reference sample is known;

(b) contacting the first probe with the reference sample wherein the contact is made under conditions sufficient for hybridization of the first target specific sequence to a fragment of the fragmented genomic DNA comprising the genomic DNA sequence to

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1416

be detected;

(c) stretching the first probe hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected using a flow-stretch, receding meniscus, or electro-stretch technique, thereby spatially separating said label monomers;

(d) measuring a signal from the first probe, wherein said signal uniquely identifies the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected; and

(e) comparing the signal from the first sample to the signal from the reference sample, wherein the copy number of the first sample is determined by correlating the signal from the first sample with the signal from the reference sample.

13. The method of claim 12, wherein the reference sample is a synthetic nucleic acid sample.

14. The method of claim 12, wherein the reference sample is a biological genomic DNA sample.

15. A method of normalizing the signal generated in claim 12 further comprising

(a) providing at least a second nanoreporter comprising a third probe comprising

(i) a third label attachment region to which are attached one or more label monomers that emit light constituting a third signal;

(ii) a fourth label attachment region, which is non-over-lapping with the third label attachment region, to which are attached one or more label monomers that emit light constituting a fourth signal; and

(iii) a third target-specific sequence attached to the third probe, wherein the target-specific sequence specifically hybridizes to a first DNA fragment from a copy number invariant region of the genome;

(b) contacting the third probe with the fragmented genomic DNA from the first sample and the reference sample wherein the contact is made under conditions sufficient for hybridization of the third target specific sequence to the first DNA fragment from a

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1417

copy number invariant region of the genome;

(c) stretching the third probe hybridized to the first DNA fragment from a copy number invariant region of the genome using a flow-stretch, receding meniscus, or electro-stretch technique, thereby spatially separating said label monomers;

(d) measuring a signal from the third probe, wherein said signal uniquely identifies the first DNA fragment from a copy number invariant region of the genome; and

(e) comparing the signal from the the second nanoreporter contacted with the first sample and the second nanoreporter contacted with the reference sample, wherein the number of multiples of the quantity of signal from the second nanoreporter contacted with the first sample compared to the quantity of signal from the second nanoreporter contacted with the reference sample normalizes the signal from the first nanoreporter contacted with the first sample.

16. The method of claim 15, wherein the second nanoreporter further comprises a fourth probe comprising

(i) a fourth target-specific sequence; and

(ii) an affinity tag;

wherein the third probe and the fourth probe specifically hybridize to the same first DNA fragment from a copy number invariant region of the genome; at different sites on the fragment.

17. The method of claim 15, wherein the first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence selected from the group consisting of SEQ ID NOs: 1-66.

18. The method of claim 15, wherein the first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence selected from the group consisting of SEQ ID NOs: 2, 5, 7, 12, 13, 17, 19, 24, 25, 28, 32, 36, 38, 40, 44, 46, 50, 52, 56, 58, 62 and 66.

19. The method of claim 15, wherein the first DNA fragment from a copy number

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1418

invariant region of the genome e comprises a nucleic acid sequence selected from the group consisting of SEQ ID NOs: 2, 5, 13, 19, 28, 46, 50, 56, 58 and 66.

20. The method of claim 15, wherein the third probe further comprises an affinity tag.

21. The method of claim 15, wherein the genomic DNA is mammalian genomic DNA.

22. The method of claim 21, wherein the mammal is a human.

23. The method of claim 1, wherein the signal generated from the first nanoreporter hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected comprises a mixture of two or more different label monomers.

24. The method of claim 15, wherein the signal generated from the second nanoreporter hybridized to the first DNA fragment from a copy number invariant region of the genome comprises a mixture of two or more different label monomers.

25. The method of claim 1, wherein said labels are fluorescent.

26. The method of claim 15, wherein said labels are fluorescent.

27. A method of detecting a DNA sequence in a genome comprising:

(a) providing a first sample containing genomic DNA;

(b) fragmenting the genomic DNA;

(c) denaturing the genomic DNA;

(d) providing a first nanoreporter that specifically hybridizes to the genomic DNA sequence to be detected;

(e) contacting the first nanoreporter with the fragmented genomic DNA wherein the contact is made under conditions sufficient for hybridization of the first nanoreporter

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1419

to the genomic DNA sequence to be detected;

(f) stretching the first nanoreporter hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected using a flow-stretch, receding meniscus, or electro-stretch technique; and

(g) measuring a signal from the first nanoreporter, wherein said signal uniquely identifies the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected.

28. A method of determining the copy number of the DNA sequence to be detected of claim 27 further comprising

(a) providing a reference sample comprising fragmented genomic DNA wherein the copy number of the genomic sequence the first nanoreporter specifically hybridizes to in the reference sample is known;

(b) contacting the first nanoreporter with the reference sample wherein the contact is made under conditions sufficient for hybridization of the first nanoreporter to a fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected;

(c) stretching the first nanoreporter hybridized to the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected using a flow-stretch, receding meniscus, or electro-stretch technique,

(d) measuring a signal from the first nanoreporter, wherein said signal uniquely identifies the at least one fragment of the fragmented genomic DNA comprising the genomic DNA sequence to be detected; and

(e) comparing the signal from the first sample to the signal from the reference sample, wherein the copy number of the first sample is determined by correlating the signal from the first sample with the signal from the reference sample.

29. A method of normalizing the signal generated in claim 28 further comprising

(a) providing at least a second nanoreporter;

(b) contacting the second nanoreporter with the the fragmented genomic DNA from the first sample and the reference sample wherein the contact is made under conditions sufficient for hybridization of the second nanoreporter toa first DNA fragment

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1420

from a copy number invariant region of the genome;

(c) stretching the second nanoreporter hybridized to the first DNA fragment from a copy number invariant region of the genome using a flow-stretch, receding meniscus, or electro-stretch technique;

(d) measuring a signal from the second nanoreporter, wherein said signal uniquely identifies the first DNA fragment from a copy number invariant region of the genome; and

(e) comparing the signal from the the second nanoreporters contacted with the first sample and the second nanoreporter contacted with the reference sample, wherein the number of multiples of the quantity of signal from the second nanoreporter contacted with the first sample compared to the quantity of signal from the second nanoreporter contacted with the reference sample normalizes the signal from the first nanoreporter contacted with the first sample.

30. The method of claim 29, wherein the first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence selected from the group consisting of SEQ ID NOs: 1-66.

31. A method of detecting two or more DNA sequences in a genome comprising:

(a) providing a first sample containing genomic DNA;

(b) fragmenting the genomic DNA;

(c) denaturing the genomic DNA;

(d) providing a two or more nanoreporters that each specifically hybridize to a distinct genomic DNA sequence to be detected;

(e) contacting the two or more nanoreporters with the fragmented genomic DNA wherein the contact is made under conditions sufficient for hybridization of the two or more nanoreporters to the genomic DNA sequence to be detected;

(f) stretching the two or more nanoreporters hybridized to its corresponding distinct genomic DNA sequence using a flow-stretch, receding meniscus, or electro-stretch technique, and

(g) measuring a signal from the two or more nanoreporters, wherein said signal uniquely identifies each of the corresponding distinct genomic DNA sequences thereby

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1421

detecting two or more DNA sequences in a genome.

32. A method of determining the copy number of the DNA sequence to be detected of claim 31 further comprising

(a) providing a reference sample comprising fragmented genomic DNA wherein the copy number of the genomic sequence the first target specific sequence specifically hybridizes to in the reference sample is known;

(b) contacting the first nanoreporter with the reference sample wherein the contact is made under conditions sufficient for hybridization of the two or more nanoreporters each fragment of the fragmented genomic DNA comprising the genomic DNA sequences to be detected;

(c) stretching the two or more nanoreporters hybridized to each fragment of the fragmented genomic DNA comprising the genomic DNA sequences to be detected using a flow-stretch, receding meniscus, or electro-stretch technique,

(d) measuring signals from the two or more nanoreporters, wherein said signal uniquely identifies each of the fragments of the fragmented genomic DNA comprising the genomic DNA sequences to be detected;

(e) comparing the signal from the first sample to the signal from the reference sample, wherein the copy number of the first sample is determined by correlating the signal from the first sample with the signal from the reference sample.

33. A method of normalizing the signal generated in claim 32 further comprising

(a) providing at least one invariable sequence specific nanoreporter;

(b) contacting the at least one copy number invariant sequence specific nanoreporter with the fragmented genomic DNA from the first sample and the reference sample wherein the contact is made under conditions sufficient for hybridization of the at least one invariable sequence specific nanoreporter to a first DNA fragment from a copy number invariant region of the genome;

(c) stretching the second nanoreporter hybridized to the the first DNA fragment from a copy number invariant region of the genome using a flow-stretch, receding meniscus, or electro-stretch technique;

(d) measuring a signal from the second nanoreporter, wherein said signal

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1422

uniquely identifies the first DNA fragment from a copy number invariant region of the genome; and

(e) comparing the signal from the the second nanoreporters contacted with the first sample and the second nanoreporter contacted with the reference sample, wherein the number of multiples of the quantity of signal from the second nanoreporter contacted with the first sample compared to the quantity of signal from the second nanoreporter contacted with the reference sample normalizes the signal from the first nanoreporter contacted with the first sample.

34. The method of claim 33, wherein the first DNA fragment from a copy number invariant region of the genome comprises a nucleic acid sequence selected from the group consisting of SEQ ID NOs: 1-66.

35. A kit, comprising

(a) a first nanoreporter comprising a first probe comprising

(i) a first label attachment region to which are attached one or more label monomers that emit light constituting a first signal;

(ii) a second label attachment region, which is non-over-lapping with the first label attachment region, to which are attached one or more label monomers that emit light constituting a second signal; and

(iii) a first target-specific sequence attached to the first probe, wherein the target-specific sequence specifically hybridizes to a target DNA sequence; and

(b) a restriction enzyme.

36. A composition comprising an isolated nucleic acid molecule comprising at least 50 nucleotides of a sequence selected from the group consisting of SEQ ID NO: 1-66.

37. A method of selecting probe pairs for detection of a genomic sequence comprising:

(a) providing the genomic sequence;

(b) performing *in silico* restriction fragmentation of the genomic sequence;

(c) generating *in silico* probe pairs for every position on the *in silico*

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1423

restriction fragments, wherein each member of each pair is 35-50 nucleotides in length, and wherein each member of each set of pairs is complementary to a contiguous sequence;

(d) discarding sets of probe pairs wherein the melting temperatures of the probe pairs differ by more than 5° C;

(e) subjecting the remaining probe pairs to BLAT scoring; and

(f) discarding sets of probe pairs with the lowest 75% of BLAT scores;

thereby selecting probe pairs for detection of a genomic sequence.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1424

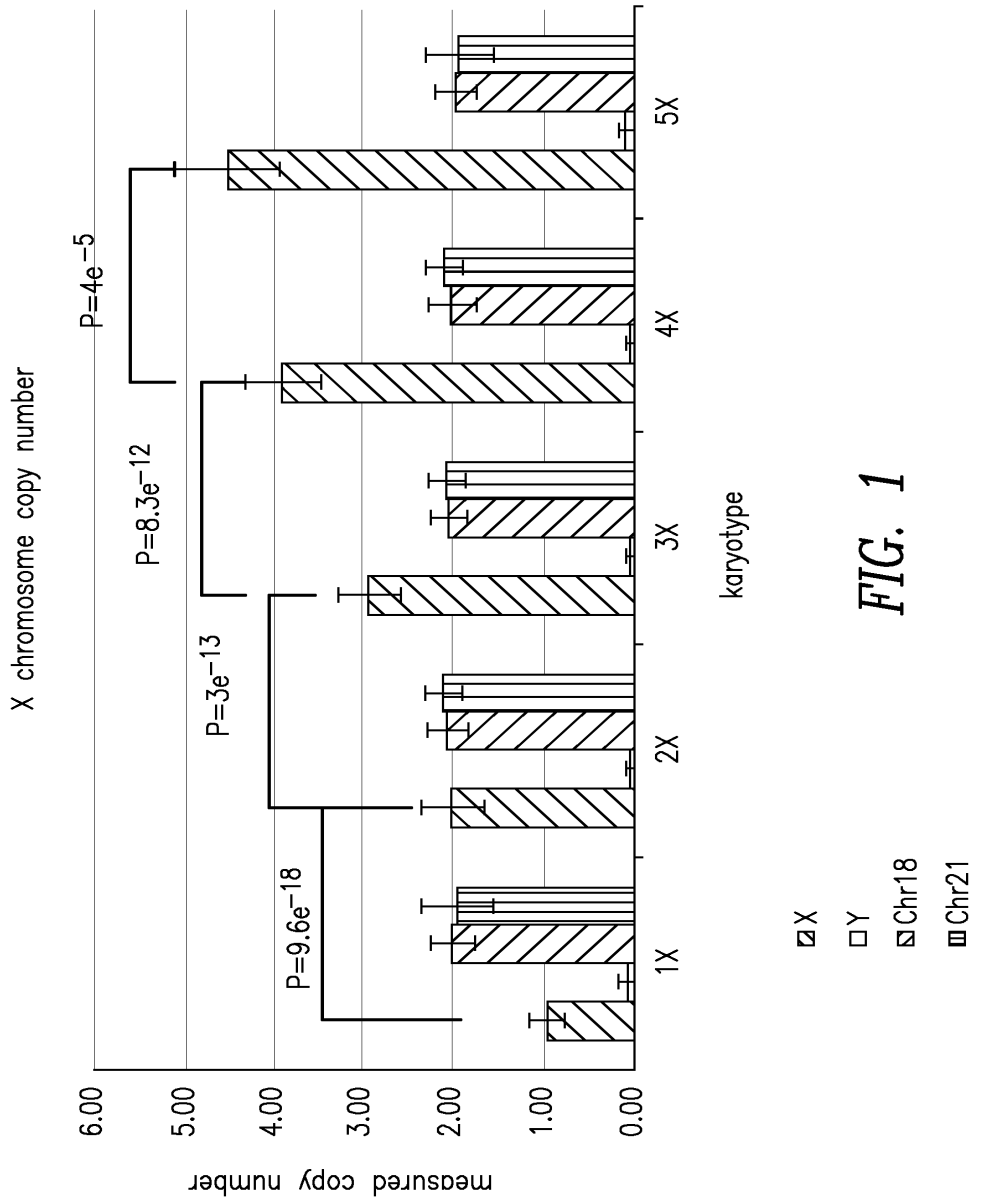


FIG. 1

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1425

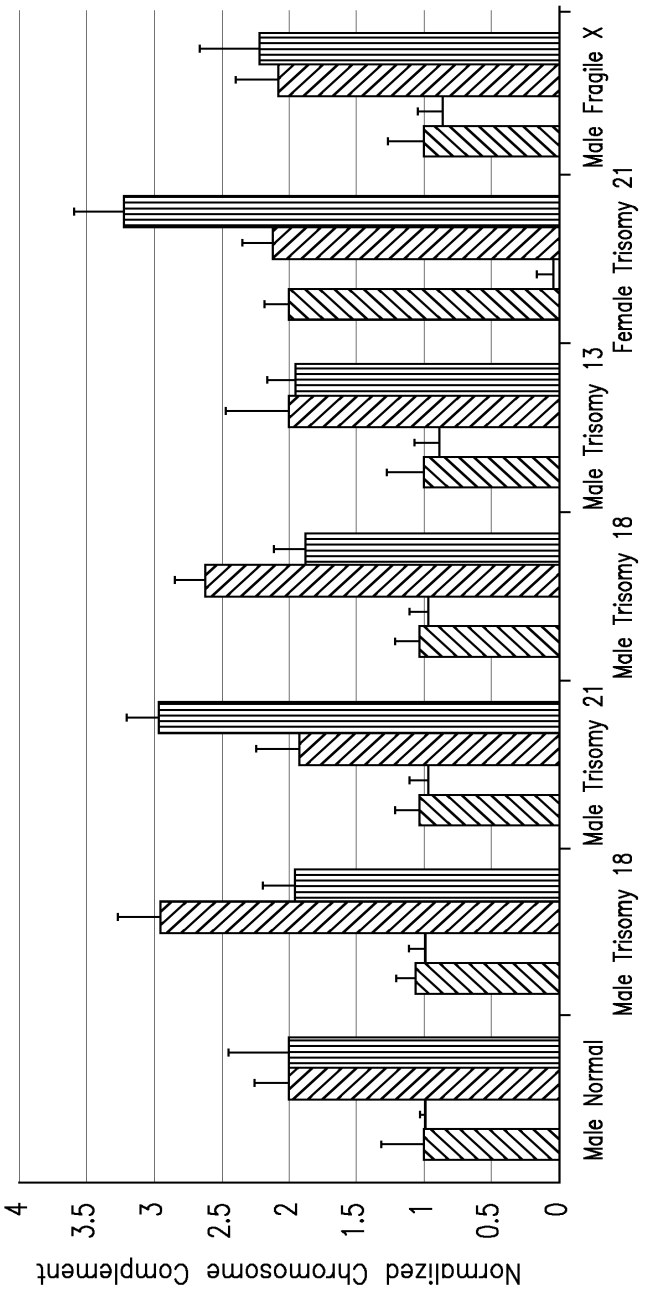


FIG. 2

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1426

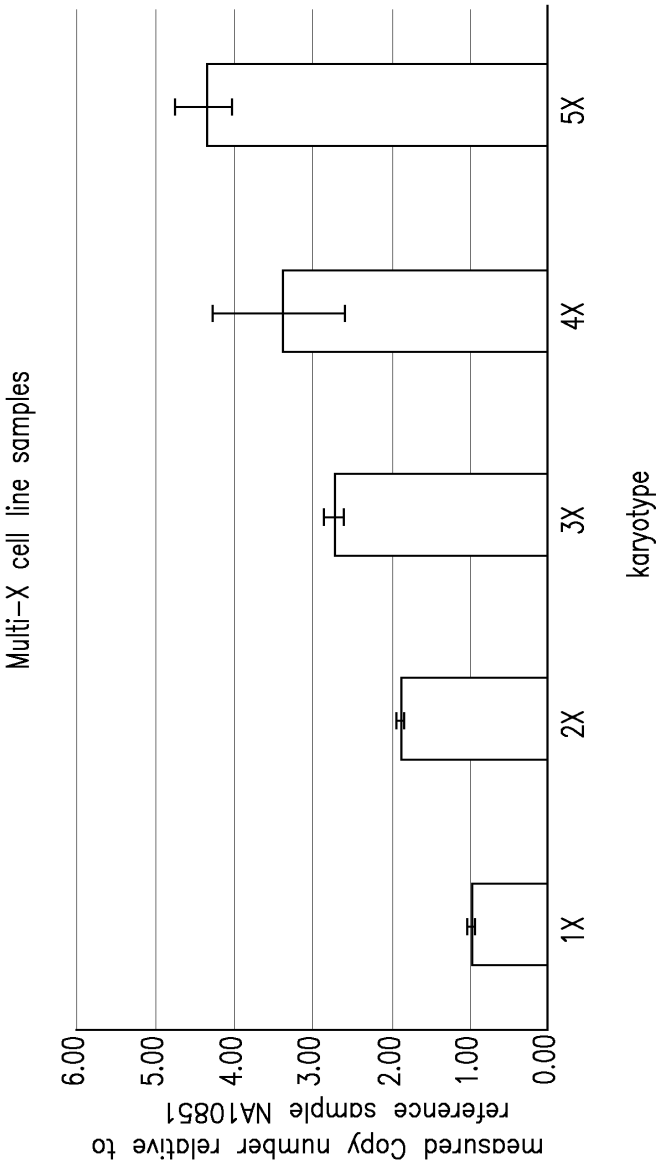


FIG. 3

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1427

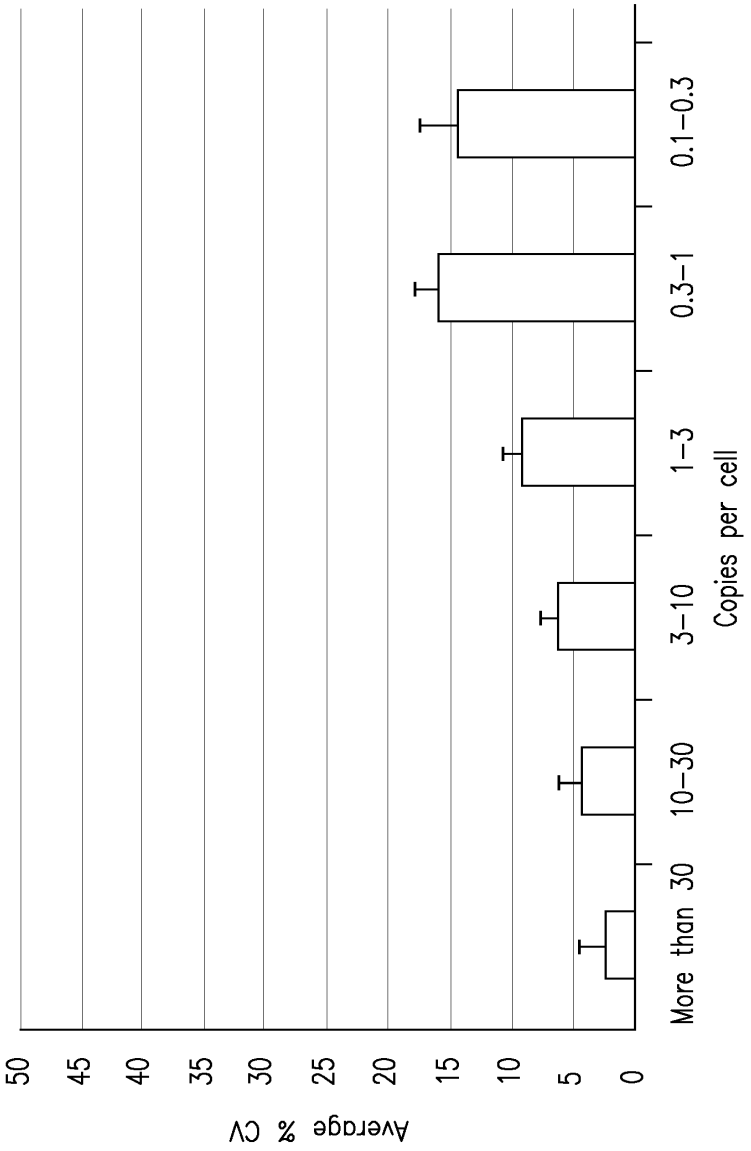


FIG. 4

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1428

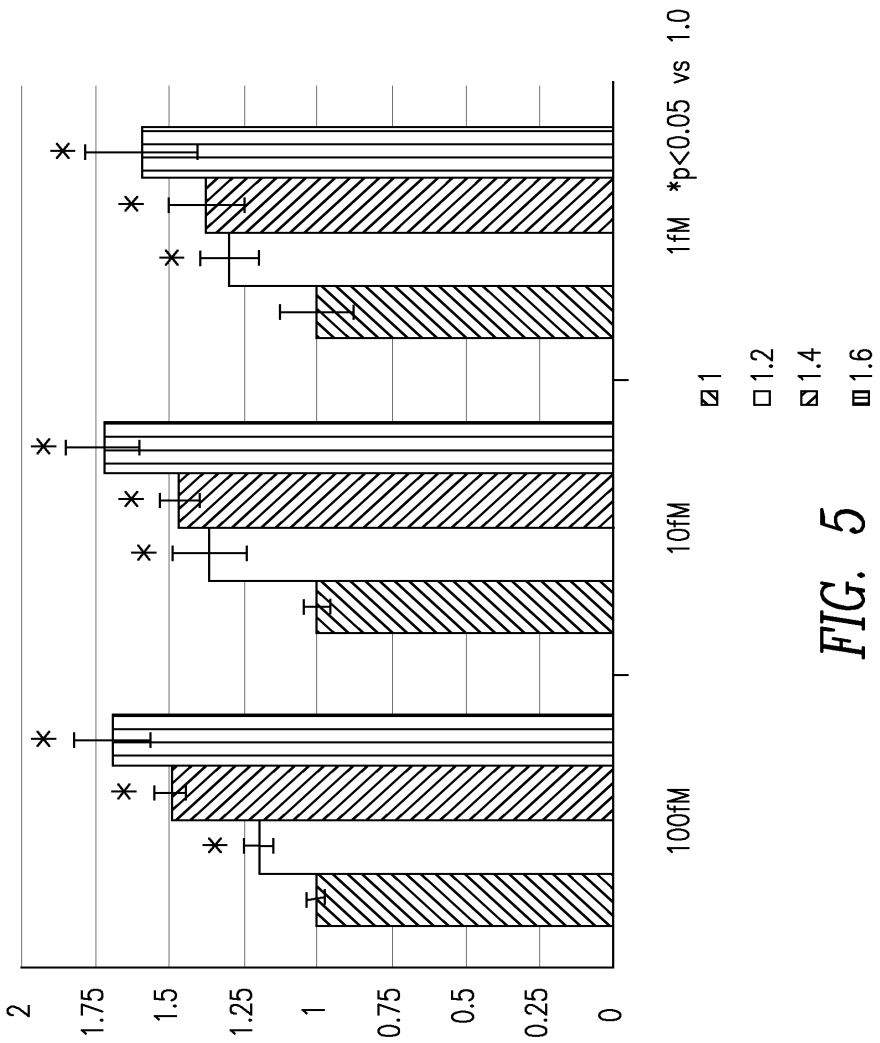


FIG. 5

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1429

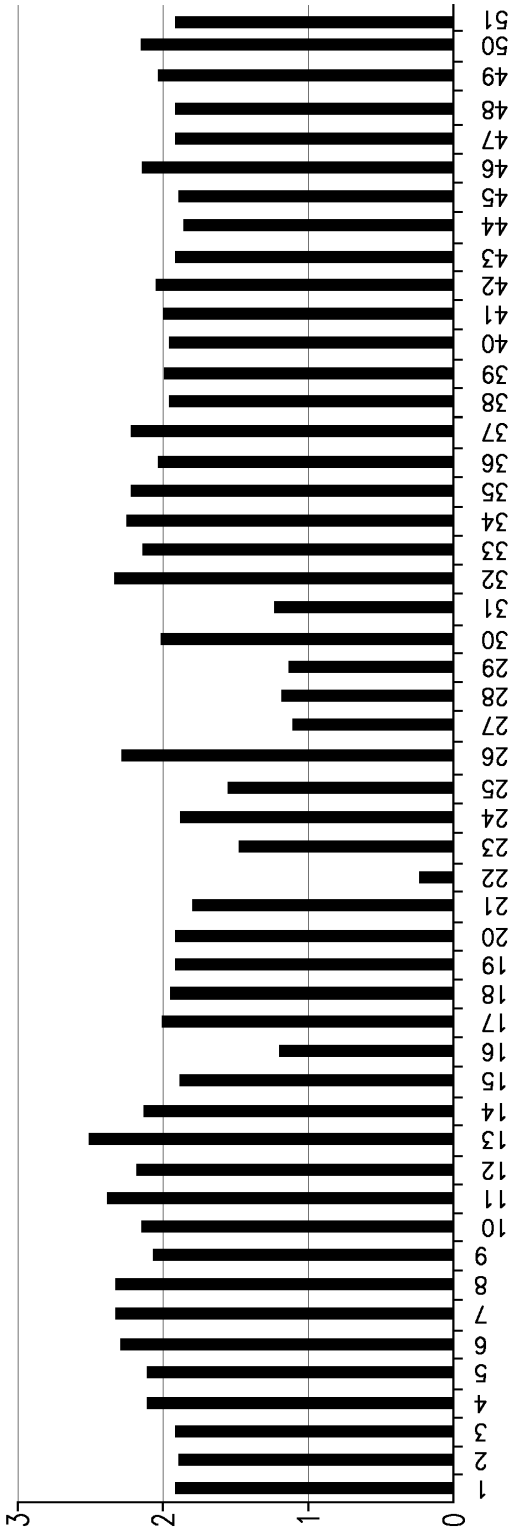


FIG. 6 1–1

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1430

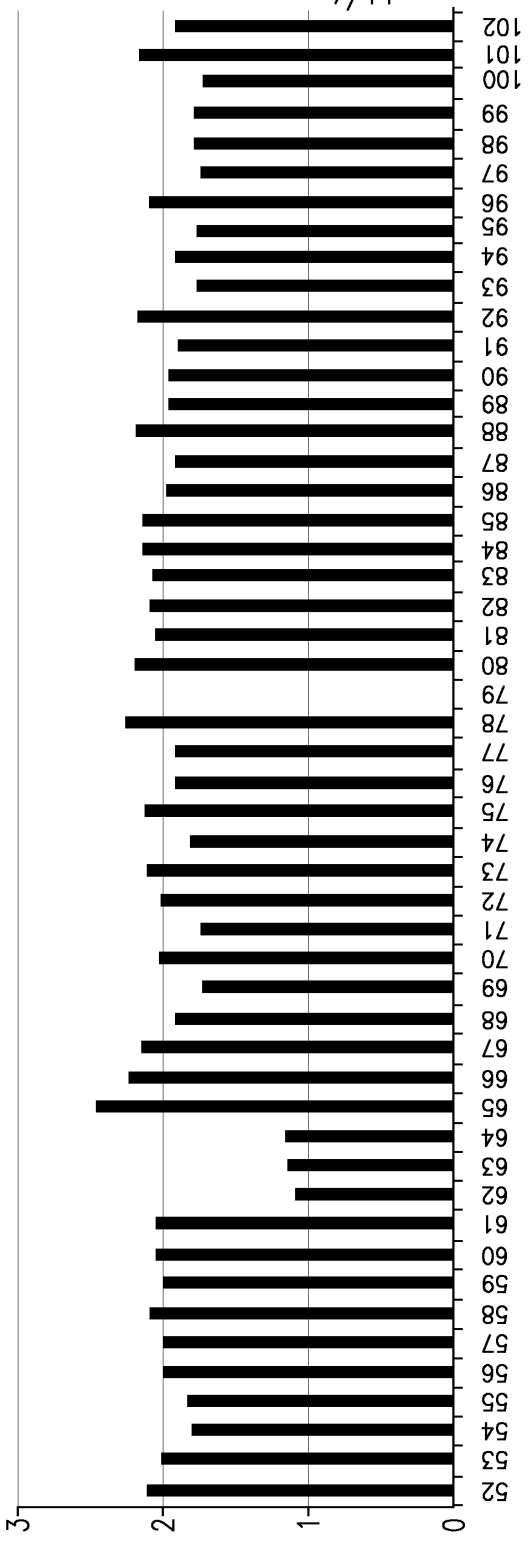


FIG. 6 1–2

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1431

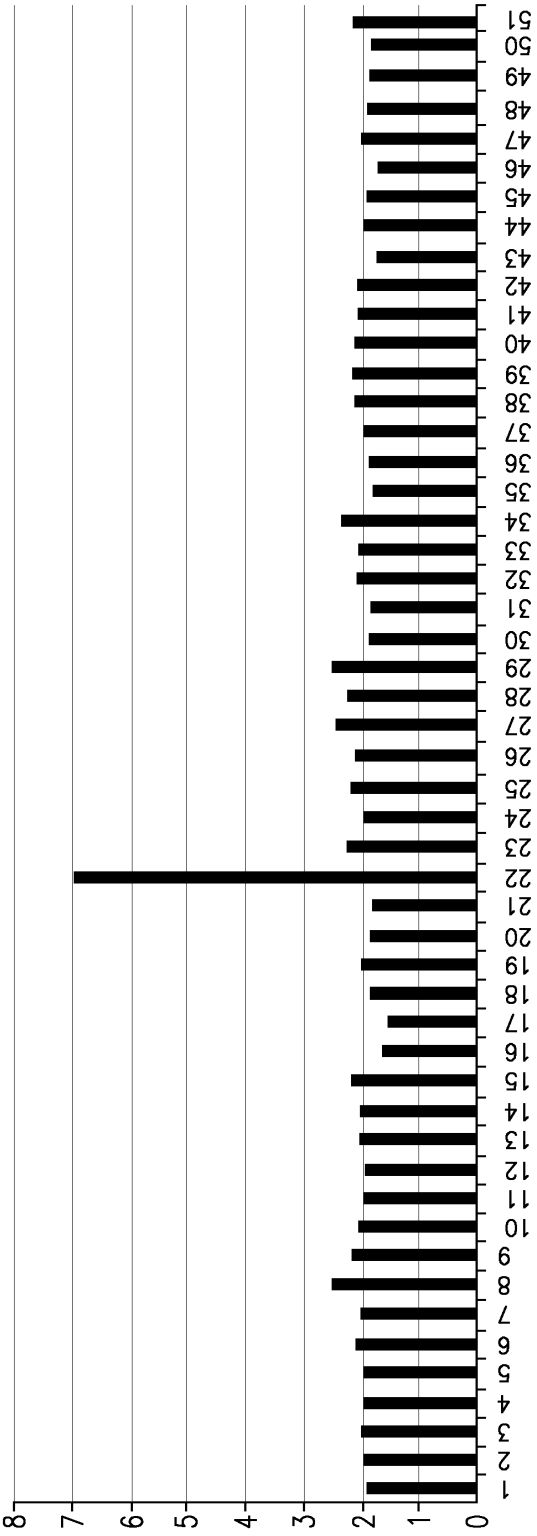


FIG. 6 2–1

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1432

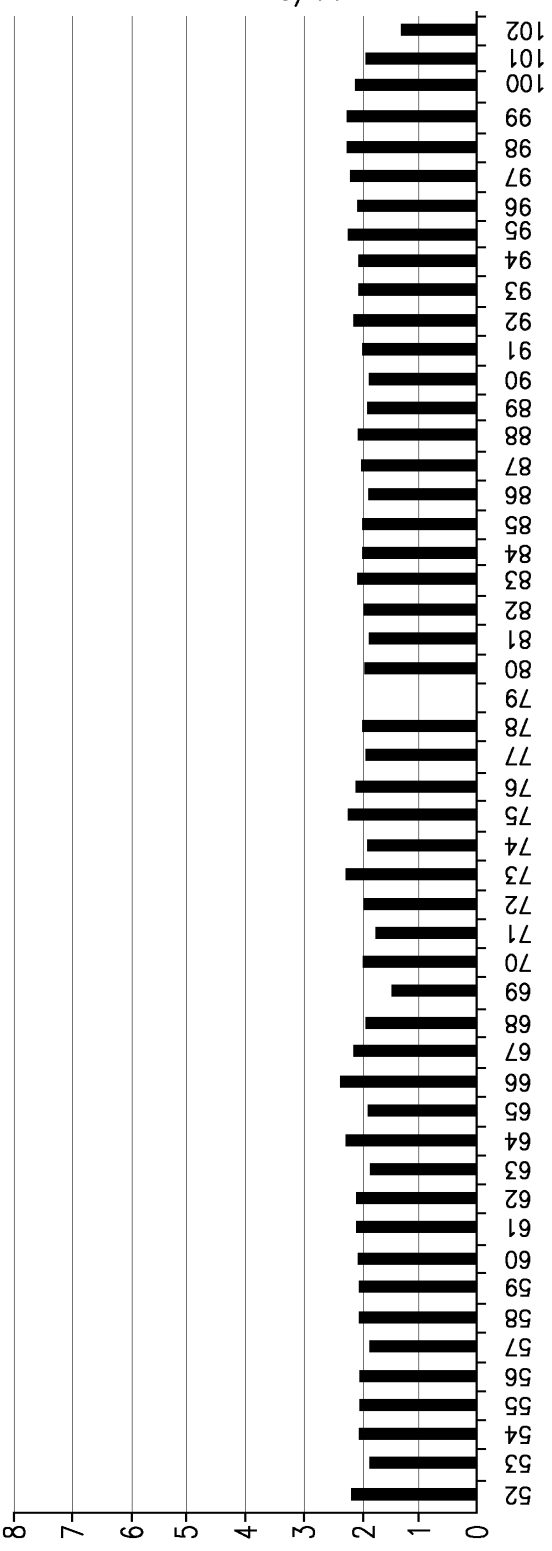


FIG. 6-2-2

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1433

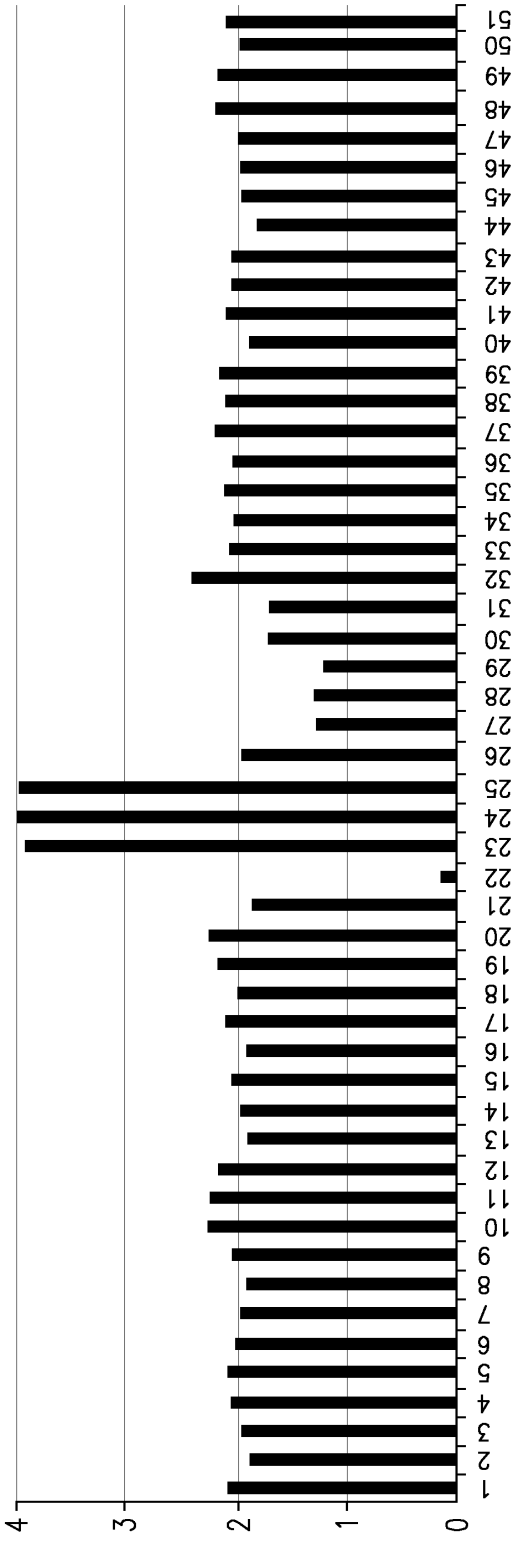


FIG. 6-3-1

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1434

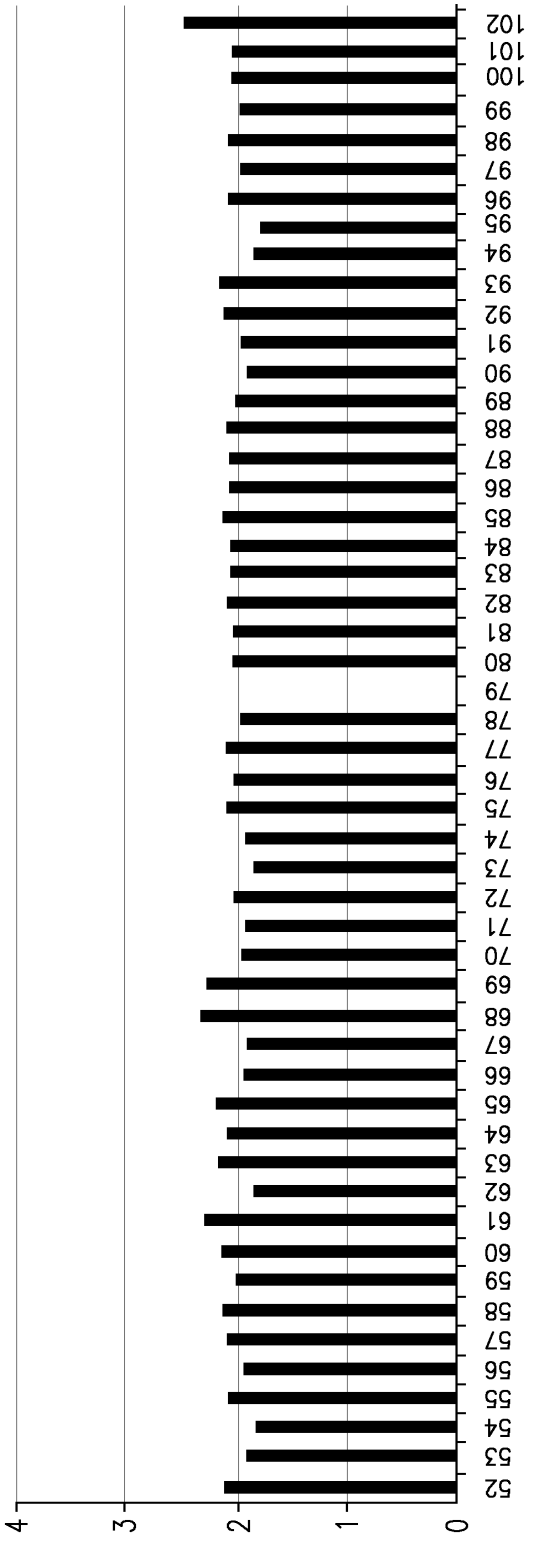


FIG. 6-3-2

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1435

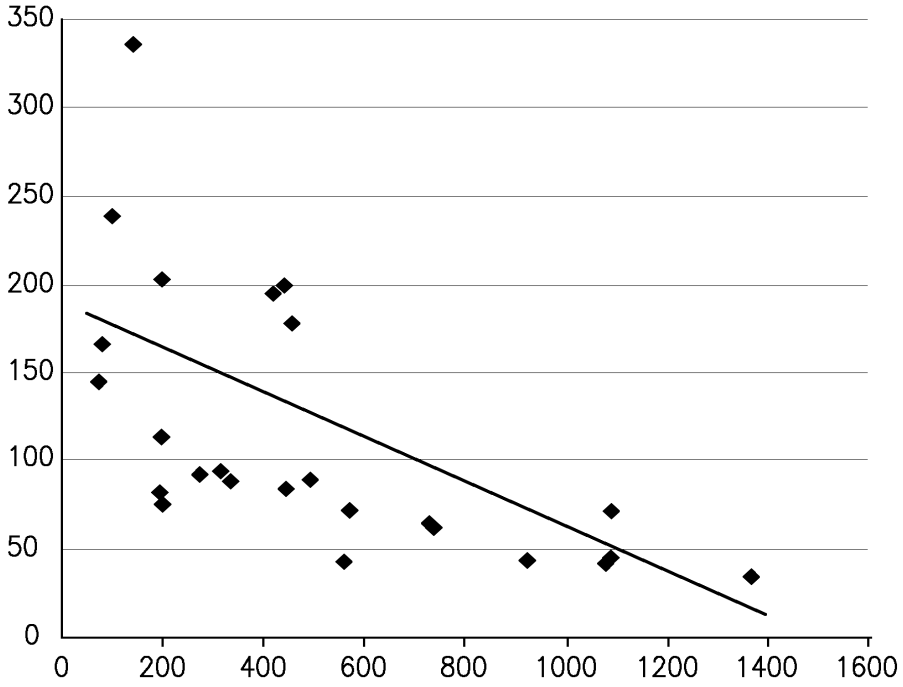


FIG. 7

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1436

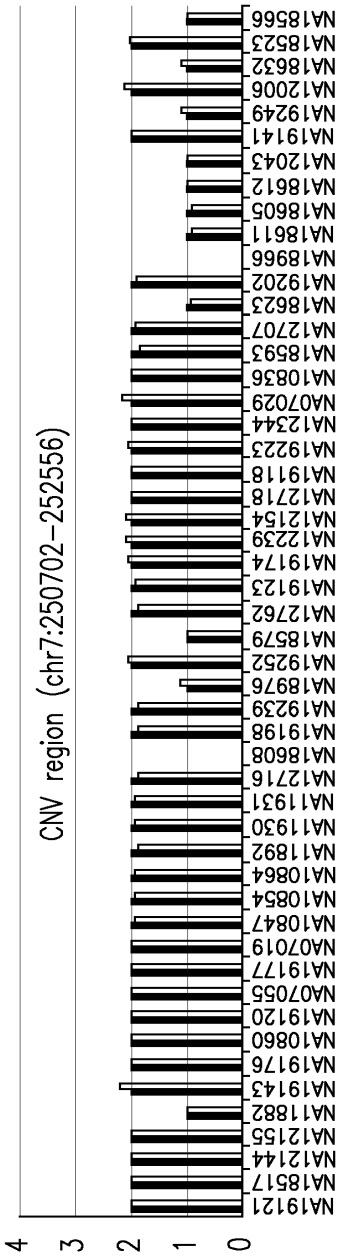

CNV region (chr7:250702-252556)
4
3
2
1
0
NA19121
NA18517
NA12144
NA12155
NA11882
NA19143
NA19176
NA10860
NA19120
NA07055
NA19177
NA07019
NA10847
NA10854
NA10864
NA11892
NA11930
NA11931
NA12716
NA18608
NA19198
NA19239
NA18976
NA19252
NA18579
NA12762
NA19123
NA19174
NA12239
NA12154
NA19118
NA12718
NA19223
NA12344
NA07029
NA10836
NA18593
NA12707
NA18623
NA19202
NA18966
NA18611
NA18605
NA18612
NA12043
NA19141
NA19249
NA12006
NA18632
NA18523
NA18566

FIG. 8

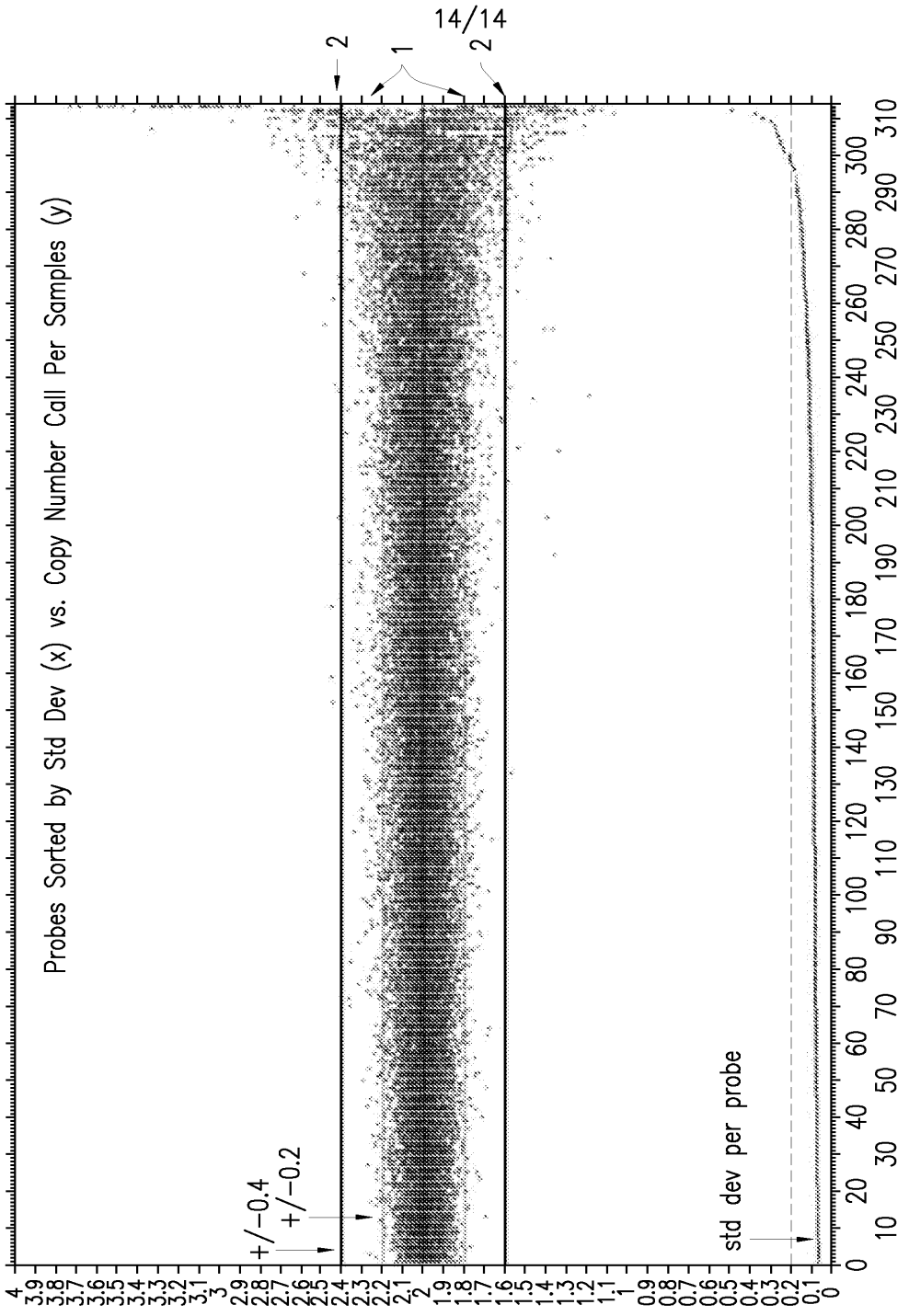


FIG. 9

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1438

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 September 2011 (22.09.2011)

PCT

(10) International Publication Number
WO 2011/116088 A3

(51) International Patent Classification:
C12Q 1/68 (2006.01) *C12N 15/11* (2006.01)

(21) International Application Number:
PCT/US2011/028657

(22) International Filing Date:
16 March 2011 (16.03.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/314,491 16 March 2010 (16.03.2010) US

(71) Applicant *(for all designated States except US)*: **NANOSTRING TECHNOLOGIES, INC.** [US/US]; 530 Fairview Avenue North, Suite 2000, Seattle, WA 98109 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **HENGEN, Paul, Nevin** [US/US]; 2434 E. Mountain Street, Pasadena, CA 91104 (US). **GEISS, Gary, K.** [US/US]; 647 NW 78th Street, Seattle, WA 98117 (US). **ELLIOT, Nathan, A.** [US/US]; 1800 Eastlake Ave. E #101, Seattle, WA 98102 (US). **WEBSTER, Phillppa, Jane** [US/US]; 4317 Densmore Ave. N., Seattle, WA 98103 (US).

(74) Agents: **ELRIFI, Ivor, R.** et al.; Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C., One Financial Center, Boston, MA 02111 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

[Continued on next page]

(54) **Title**: COMPOSITIONS AND METHODS FOR THE DETECTION OF GENOMIC FEATURES

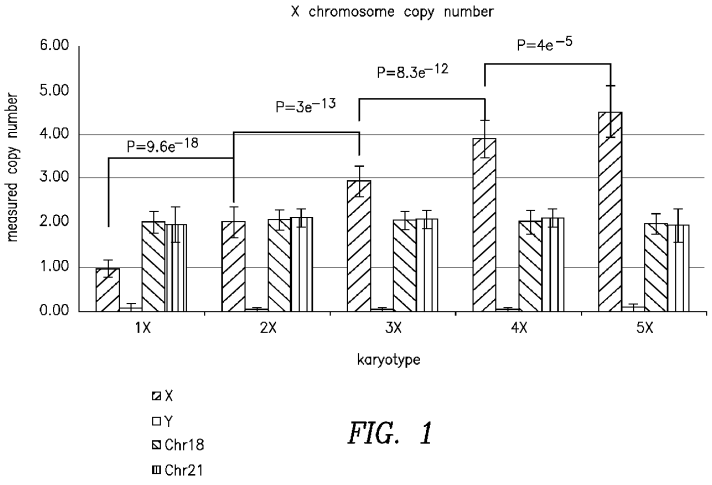


FIG. 1

(57) **Abstract**: The invention provides compositions and methods for the detection of gene copy number and/or chromosome copy number in a multiplexed reaction. The assays and kits described herein are applicable for the identification, diagnosing, and monitoring of disorders including, but not limited to cancer, developmental and degenerative disease, neurological disorders, and stem cell disorders.

WO 2011/116088 A3

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:
2 February 2012

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/028657

A. CLASSIFICATION OF SUBJECT MATTER

C12Q 1/68(2006.01)i, C12N 15/11(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C12Q 1/68; C40B 40/06; G01N 33/53

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal),Pubmed

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2007-076129 A2 (NANOSTRING TECHNOLOGIES, INC.) 05 July 2007 See claims 1-7,11;page9, line7~22, page 55, line 6~11.	1-14,23,25,27,28,31,32,35
Y		15,16,20-22,24,26,29,33
A		17-19,30,34,36,37
Y	JEON, J. et al. `A comprehensive profile of DNA copy number variations in a Korean population: identification of copy number invariant regions among Koreans' Experimental and Molecular Medicine. Vol.41(9), pp.618-628 (September 2009) See the abstract; Table 3.	15,16,20-22,24,26,29,33
A	US 2010-0047924 A1 (WEBSTER, P. et al.) 25 February 2010 See the abstract.	1-37
A	WO 2007-076132 A2 (NANOSTRING TECHNOLOGIES, INC.) 05 July 2007 See the abstract.	1-37

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 NOVEMBER 2011 (30.11.2011)	**30 NOVEMBER 2011 (30.11.2011)**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office Government Complex-Daejeon, 189 Cheongsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	KIM, JI YUN Telephone No. 82-42-481-8288

Form PCT/ISA/210 (second sheet) (July 2009)

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1441

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2011/028657

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2007-076129 A2	05.07.2007	AU 2006-330830 A1	05.07.2007
		CA 2640385 A1	05.07.2007
		EP 1963531 A2	03.09.2008
		EP 1963531 A4	21.10.2009
		EP 1963531 B1	21.09.2011
		JP 2009-521230 A	04.06.2009
		JP 2009-521230 T	04.06.2009
		US 2010-0015607 A1	21.01.2010
		WO 2007-076128 A2	05.07.2007
		WO 2007-076128 A3	29.11.2007
		WO 2007-076129 A3	06.03.2008
US 2010-0047924 A1	25.02.2010	AU 2009-281836 A1	18.02.2010
		AU 2009-281836 A8	18.02.2010
		CA 2733609 A1	18.02.2010
		EP 2331704 A1	15.06.2011
		WO 2010-019826 A1	18.02.2010
WO 2007-076132 A2	05.07.2007	AU 2006-330834 A1	05.07.2007
		CA 2635215 A1	05.07.2007
		EP 1963500 A2	03.09.2008
		EP 1963500 A4	13.01.2010
		JP 2009-521688 A	04.06.2009
		JP 2009-521688 T	04.06.2009
		US 2010-0261026 A1	14.10.2010
		WO 2007-076132 A3	07.09.2007

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1442

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 May 2012 (03.05.2012)

PCT

(10) International Publication Number
WO 2012/058638 A2

(51) International Patent Classification:
C12Q 1/68 (2006.01)

(21) International Application Number:
PCT/US2011/058458

(22) International Filing Date:
28 October 2011 (28.10.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/408,358 29 October 2010 (29.10.2010) US

(71) Applicant *(for all designated States except US)*: **PRESIDENT AND FELLOWS OF HARVARD COLLEGE** [US/US]; 17 Quincy Street, Cambridge, MA 02138 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **LIN, Chenxiang** [CN/US]; c/o President and Fellows of Harvard College, 17 Quincy Street, Cambridge, MA 02138 (US). **LI, Chao** [CN/US]; c/o President and Fellows of Harvard College, 17 Quincy Street, Cambridge, MA 02138 (US). **JUNGMANN, Ralf** [DE/US]; c/o President and Fellows of Harvard College, 17 Quincy Street, Cambridge, MA 02138 (US). **SHIH, William** [US/US]; c/o President and Fellows of Harvard College, 17 Quincy Street, Cambridge, MA 02138 (US). **YIN, Peng** [CN/US]; 99 Pond Avenue, #901, Brookline, MA 02445 (US).

(74) Agent: **TREVISAN, Maria, A.**; Wolf, Greenfield & Sacks, P.C., 600 Atlantic Avenue, Boston, MA 02210-2206 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

— *with sequence listing part of description (Rule 5.2(a))*

WO 2012/058638 A2

(54) Title: NUCLEIC ACID NANOSTRUCTURE BARCODE PROBES

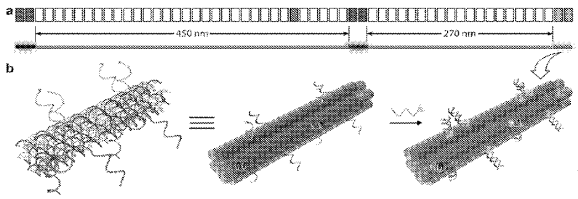


FIG.1

(57) Abstract: Provided herein are, inter alia, barcode probes comprised of transiently or stably fhiorescently labeled nucleic acid nanostructures that are fully addressable and able to be read using standard fluorescent microscope and methods of use thereof including methods of use as detectable labels for probes.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1443

NUCLEIC ACID NANOSTRUCTURE BARCODE PROBES

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application Serial No. 61/408358, filed on October 29, 2010, entitled "DNA NANOSTRUCTURE BARCODE PROBES", the entire contents of which are incorporated by reference herein.

REFERENCE TO A COMPACT DISK APPENDIX

A computer program listing is appended to this disclosure and is hereby incorporated herein by this reference. The appendix includes the file programlisting.txt which includes listings for 6ht-v5-1color-1.json and 6ht-v6-2color-1.json.

BACKGROUND OF INVENTION

A major challenge in modern biology and nanotechnology is to observe, identify and differentiate a large number of different molecular species in real time. Fluorescent microscopy is a powerful tool for non-destructively and dynamically monitoring many individual molecular events. However, the multiplexing ability of fluorescent imaging is limited by the number of spectrally non-overlapping fluorophores available. There is therefore a great need for novel addressable fluorescent probes useful in multiplex detection systems.

BRIEF SUMMARY OF INVENTION

The invention provides, inter alia, nucleic acid barcode probes that comprise a nucleic acid nanostructure comprising one or more fluorescently labeled regions that may be stably or transiently bound (and thus labeled) with fluorophore-bearing oligonucleotides. The barcode probes may further comprise a target binding moiety. The invention also provides methods of use for such barcode probes including but not limited to their use in analyte detection assays (e.g., assays for detecting and optionally quantitating one or more analytes). The nature of the fluorescent signals (e.g., the wavelength or "color", intensity, etc.) and the pattern (or orientation, or arrangement or geometry) of such signals on the barcode can also be used to identify particular analytes

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1444

in a sample. This facilitates multiplexed assays in which a plurality of analytes are detected simultaneously (or at a minimum with a single sample or a single aliquot from a sample).

In one aspect, the invention provides a method of detecting a target comprising: contacting a sample with a nucleic acid barcode probe, and determining whether the nucleic acid barcode probe binds to one or more components in the sample, wherein binding of the nucleic acid barcode probe to one or more components of the sample indicates presence of a target in the sample, and wherein the nucleic acid barcode probe comprises a nucleic acid nanostructure comprising a target binding moiety and at least two fluorescently labeled regions.

In some embodiments, the method further comprises identifying the target based on the color and/or orientation of the fluorescently labeled regions of the nucleic acid barcode probe bound to one or more components of the sample.

In some embodiments, whether the nucleic acid barcode probe binds to one or more components in the sample comprises contacting the nucleic acid barcode probe with soluble, transiently binding fluorophore-bearing oligonucleotides.

In some embodiments, the nucleic acid barcode probe comprises stably bound fluorophore-bearing oligonucleotides.

In another aspect, the invention provides a method of detecting a target comprising contacting the target with a nucleic acid barcode probe, under conditions sufficient for the target to bind to the nucleic acid barcode probe; separating the target from material that is not bound to the target; and detecting the presence of the nucleic acid barcode probe bound to the target, wherein the nucleic acid barcode probe comprises a nucleic acid nanostructure comprising a target binding moiety and at least two fluorescently labeled regions.

In some embodiments, the method further comprises identifying the target based on the color and/or orientation of the fluorescently labeled regions of the nucleic acid barcode probe bound to the target.

In some embodiments, detecting the presence of the nucleic acid barcode probe bound to the target comprises contacting the nucleic acid barcode probe with soluble, transiently bound fluorophore-bearing oligonucleotides.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1445

In some embodiments, the nucleic acid barcode probe comprises stably bound fluorophore-bearing oligonucleotides.

In another aspect, the invention provides a nucleic acid barcode probe comprising a nucleic acid nanostructure, such as a DNA barcode probe comprising a DNA nanostructure, having at least two fluorescently-labeled regions. In some embodiments, the nanostructure comprises at least three fluorescently-labeled regions, and the orientation is determinable due to asymmetric spacing of the fluorescently-labeled regions. The locations of each of the fluorescently-labeled regions on the nanostructure are such that a pattern of the fluorescent labels is determinable based on the emission of visible light by the fluorescently-labeled regions. In some embodiments, the orientation of the barcode probe is determinable based on the emission of visible light by the fluorescently-labeled regions.

In some embodiments, each of the fluorescently-labeled regions has a center that is located at least 200 nm from the centers of the other fluorescently-labeled regions. In some embodiments, each of the fluorescently-labeled regions has a center that is located at least 250 nm from the centers of the other fluorescently-labeled regions. In some embodiments, each of the fluorescently-labeled regions has a center that is located at least about 25 nm, at least about 50 nm, or at least about 75 nm, or at least about 100 nm, or at least 150 nm from the centers of the other fluorescently-labeled regions.

In some embodiments, the nanostructure comprises a scaffold strand and plurality of staple strands. In some embodiments, the scaffold strand has a sequence derived from M13 bacteriophage. In some embodiments, the fluorescently-labeled regions of the DNA nanostructure comprise fluorophore-labeled staple strands. In some embodiments, the fluorophore-labeled staple strand is a transiently binding fluorophore-labeled staple strand. In some embodiments, the fluorophore-labeled staple strand is transiently binding at room temperature. In some embodiments, the fluorophore-labeled staple strand is 7-12 nucleotides in length. In some embodiments, the fluorophore-labeled staple strand is about 9 nucleotides in length. In some embodiments, the fluorophore-labeled staple strand is a stably binding fluorophore-labeled staple strand. In some embodiments, the fluorophore-labeled staple strand is a stably binding fluorophore-labeled staple strand at room temperature. In some embodiments, the

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1446

fluorophore-labeled staple strand is at least 18 nucleotides in length, including in some embodiments 18-25 nucleotides in length.

In some embodiments, the fluorophore-labeled staple strands are directly labeled. In some embodiments, the fluorophore-labeled staple strands are indirectly labeled.

In some embodiments, the fluorophore-labeled staple strands have a staple domain hybridized to a scaffold strand and a handle domain hybridized to a fluorophore-labeled oligonucleotide. In some embodiments, the handle domain is 7-12 nucleotides in length. In some embodiments, the handle domain is about 9 nucleotides in length. In some embodiments, the handle domain is at least 18 nucleotides in length. In some embodiments, the handle domain is 18-25 nucleotides in length.

In some embodiments, the nanostructure is a nanotube. In some embodiments, the nanostructure is prepared using a DNA origami method. In some embodiments, the nanostructure comprises a single-stranded DNA tile. In some embodiments, the nanostructure comprises DNA hairpins.

In some embodiments, the barcode probe further comprises a target binding moiety. In some embodiments, the target binding moiety is a single-stranded nucleic acid complementary to a nucleic acid target. In some embodiments, the target binding moiety is an antibody. In some embodiments, the target binding moiety is a protein or peptide.

In some embodiments, wherein the nanostructure, once assembled, is sufficiently immutable in a resting state that the pattern of the fluorescent regions can be detected using light microscopy in that resting state. In some embodiments, the resting state comprises absence of an applied electric field.

In another aspect, the invention provides a composition comprising a plurality of any of the foregoing nucleic acid nanostructure barcode probes. In some embodiments, some or all members of the plurality are different from other members in the plurality. The members may differ from each other based on the target binding moiety and the signal and orientation (arrangements) of the barcode. In some embodiments, the plurality is equal to or less than 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 25, 30, 40, 50, 100, 200 or more. In some instances, the plurality is equal to or less than 216.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1447

In another aspect, the invention provides a method of identifying a target nucleic acid comprising contacting the target nucleic acid with any of the foregoing barcode probes under conditions such that the target nucleic acid binds to the barcode probe; separating the target nucleic acid from material that is not bound to the target nucleic acid; and detecting the presence of the barcode probe bound to the target nucleic acid.

In another aspect, the invention provides a method of identifying a target protein or cell comprising contacting the target protein or cell with any of the foregoing barcode probes under conditions such that the target protein or cell binds to the barcode probe; separating the target protein or cell from material that is not bound to the target protein or cell; and detecting the presence of the barcode probe bound to the target protein or cell.

In another aspect, the invention provides a method of identifying a target protein or cell comprising contacting the target protein or cell with any of the foregoing barcode probes under conditions such that the target protein or cell binds to the barcode probe; separating the target protein or cell from material that is not bound to the target protein or cell; and detecting the presence of the barcode probe bound to the target protein or cell.

In another aspect, the invention provides a method of detecting a target comprising contacting a sample with any of the foregoing nucleic acid barcode probes, and determining whether the nucleic acid barcode probe binds to one or more components in the sample, wherein binding of the nucleic acid barcode probe to one or more components in the sample indicates presence of a target in the sample.

In some embodiments, the method further comprises removing components in the sample that are not bound to the nucleic acid barcode probe following the contacting step.

In some embodiments, the target is a nucleic acid, a protein, a peptide, or a cell, or a combination thereof.

In some embodiments, the presence of the barcode probe is detected by fluorescent microscopy.

In some embodiments, the presence of the barcode probe is detected without exposing the DNA barcode probe to an electric field.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1448

In some embodiments, each probe comprises a nucleic acid nanostructure having at least two fluorescently-labeled regions and a target binding moiety, wherein the locations of each of the fluorescently-labeled regions on the nanostructure are such that a pattern of the fluorescent labels of the barcode probe and the identity of the target binding moiety is determinable based on the emission of visible light by the fluorescently-labeled regions; and each of the fluorescently-labeled regions has a center that is located at least 200 nm from the centers of the other fluorescently-labeled regions.

In another aspect, the invention provides a population of nucleic acid barcode probes such as DNA barcode probes, wherein each probe comprises a nucleic acid nanostructure such as a DNA nanostructure having at least two fluorescently-labeled regions and a target binding moiety, wherein the locations of each of the fluorescently-labeled regions on the nucleic acid nanostructure are such that a pattern of the fluorescent labels of the nucleic acid barcode probe and the identity of the target binding moiety is determinable based on the emission of visible light by the fluorescently-labeled regions.

In some embodiments, each of the fluorescently-labeled regions has a center that is located at least about 25 nm, at least about 50 nm, at least about 100 nm, at least about 200 nm, or at least about 250 nm from the centers of the other fluorescently-labeled regions.

These and other aspects and embodiments of the invention will be described in greater detail herein.

BRIEF DESCRIPTION OF DRAWINGS

The patent or application file contains at least one Figure executed in color. Copies of this patent or patent application publication with color drawing(s) will be provided by the Office upon request and payment of the necessary fee. Publication of the application includes gray-scale renderings of the Figures. Color versions of these Figures are available upon request.

FIG. 1. Design of the DNA nanotube based barcode. (A) Two schematic drawings of the Blue--Red-Green (BRG, "--" and "-" denotes larger and smaller inter-zone distance in the barcode, respectively) barcode with a segment diagram on the top and a 3D view at the bottom. The main-body of the barcode is a DNA nanotube formed from by dimerizing two origami monomers, each consisting of 28 segments with 42-bp

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1449

(13.6 nm) length. The grey segment in the middle represents the junction where the two monomers are joined together through cross-hybridization between their scaffolds and staples. Three 84-bp zones of the nanotube are fluorescently labeled (shown as blue, red and green segments) to produce the BRG barcode with an inter-zone distance of 450-nm between the first two zones and 270-nm between the last two. Note that each zone is only labeled with one fluorophore species. The resulting barcodes are thus referred as single-labeled-zone barcodes. (B) 3D cartoons showing the details of one fluorescently labeled zone. Left: a scaffold-plus-staple model of such an 84-bp zone before labeling. Each of the twelve 63-base-long staples (shown in rainbow colors) contains two parts: the 42-base region at the 5′-end weaves through three double-helices to fold the scaffold (shown in black) into a six-helix bundle nanotube; and the 21-base extension at the 3′-end protrudes out for fluorescent labeling. Middle: an identical but simplified model to emphasize the six-helix bundle structure (each helix shown as a semi-transparent grey cylinder) and the positioning of the twelve 21-base staple extensions (each shown as a light-grey curl). Right: Cartoon representation of a "green" 84-bp zone. The labeling is achieved by hybridizing the Cy3 (shown the glowing green spheres at the 3′-ends) modified strands to the staple extensions.

FIG. 2. Single-labeled-zone fluorescent barcodes. (A) Superimposed TIRF microscopy images of five barcode species (top) and the statistics from manual counting (bottom). From left to right are the BBB, BRG, BRR, GRG and RGB barcodes with a representative image on top of the corresponding bar-graph. Each bar-graph is generated based on the manual sorting and counting of the objects found in a 50 x 50 μm^2 image (~40 barcodes, the exact sample size N is noted beside the corresponding bar-graph). (B) A representative image of the equimolar mixture of 27 barcode species. (C) Statistics obtained by analyzing twenty-seven 50 x 50 μm^2 images of the 27 barcode mixture (~1,500 barcodes in total). Left: barcode counts of the 27 species (average count of 55 with a standard deviation of 9). A representative TIRF image (1.4 x 0.7 μm^2) of each barcode type is placed underneath the corresponding bar. Right: sorting result of the observed objects shown as a pie-chart. Color scheme used for the bar-graphs and the pie-chart (unrelated to the pseudo-colors of the fluorophores): blue: correct barcodes (qualified barcode with expected identity); green: incorrect barcodes (qualified barcode

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1450

with unexpected identity); red: monomer nanotubes (one spot or two connecting spots); purple: barcodes with wrong geometry (i.e., bending angle <120°); and orange: barcodes containing at least one spot with two colors. In the 27-barcode pool, correct vs. incorrect barcodes were not distinguishable because all barcode types are expected. As a result the bars and pie representing the qualified barcodes in (C) are shown in blue. Scale bars: 5 μm.

FIG. 3. Representative TIRF and software reconstructed images of BRG and GRG nano-barcodes. (A) TIRF image of BRG nano-barcodes. (B) Software constructed image of (A), inset showing calculation of barcode bending angle. (C) TIRF image of BRG nano-barcodes. (D) Software constructed image of (C). (E) Theoretical designed distances between each region of BRG (upper) and GRG (lower) nano-barcodes. Scale bar: 10 pixels or 0.714 μm.

FIG. 4. Schematic illustration and result of a 21-mer oligonucleotide detection using nano-barcodes. (A) A GRG barcode with a capture probe is biotinylated as a result of the target binding and a nude BRG barcode stays untouched. Note that the drawing is not to scale. (B) TIRF images of nano-barcodes immobilized on streptavidin coated glass cover-slip. Left: with target; Right: without target. (C) Statistical detection result showing the average barcode counts per 71.4 x 71.4 μm^2 area. Error bars represent the standard deviation.

FIG. 5. Dual-labeled-zone fluorescent barcodes. (A) Typical TIRF microscopy images of five selected barcode species, shown both in separate channels and after superimposing. Scale bar: 5 μm. (B) Statistics obtained by analyzing two 50 x 50 μm^2 images of each barcode species (~85 barcodes, the exact sample size N is noted beside the corresponding bar-graph). The barcode types are noted under the x-axis of the diagram. Color scheme (unrelated to the pseudo-colors of the fluorophores): blue: correct barcodes (correct geometry and color identity); green: incorrect barcodes (correct geometry but incorrect color identity); red: monomer nanotubes (one spot or two connecting spots); and purple: barcodes with wrong geometry (i.e., bending angle <120°). (C) Computer-aided barcode counting results of the 72-barcode pool (N=2,617) and the 216-barcode pool (N=7,243) plotted as bar-graphs with descending barcode counts from left to right (data not shown). A computer-generated reference barcode image is placed underneath the corresponding bar. (D) A table containing one

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1451

representative TIRF image (1.4×0.7 μm^2) for each of the 216 dual-labeled-zone barcode species.

FIG. 6. Super-resolution fluorescent barcodes. (A) Scheme of DNA-PAINT used for super-resolution barcode imaging. The 400 nm nanotube consists of 4 binding zones spaced by ~114 nm. Each zone can be decorated with the desired combination of "docking" sequences for red, green or blue imager strands. The orthogonal imager strands bind transiently to their respective "docking" sites on the nanotube, creating the necessary "blinking" for super-resolution reconstruction (B) Top: Segment diagram (similar to the one used in FIG. 1) of the DNA nanotube monomers used for creating five barcodes for super-resolution imaging. Bottom: super-resolution images of the five barcodes shown in each channel separately and as an overlay of all channels. Scale bar: 100 nm. (C) Super-resolution image showing all five barcodes in one mixture. Scale bar: 500 nm.

FIG. 7. Tagging yeast cells with the GRG barcodes as in situ imaging probes. (A) Cartoon illustrating the tagging mechanism. The biotinylated barcodes are anchored on the yeast cell through streptavidin molecules bound to biotinylated polyclonal antibodies coated on the yeast surface. Only two of the ten biotinylated staples on the barcode are shown here for clarity. (B) Overlaid microscope images (acquired in bright field and TIRF) of the yeast cells treated with the barcodes. Top: Yeast cells treated as illustrated in (A). Bottom: Negative control: yeast cells treated with non-biotinylated barcodes. Scale bars: 5 μm.

FIG. 8. Fluorescent barcode with non-linear geometry. (A) A schematic of three identical ~400-nm long DNA nanotubes are linked to the outer edge of a DNA ring with diameter of ~60 nm through the hybridization between staple extensions. The ring and the end of the tube are labeled by Cy3 (green) and Cy5 (red), respectively. (B) A representative TIRF microscope image of the barcode shown in (a). Scale bar: 5 μm.

DETAILED DESCRIPTION OF INVENTION

Provided herein are nucleic acid (e.g., DNA) nanostructure barcode probes that are fully addressable and able to be read using standard fluorescent microscope.

Previously described molecular barcodes are constructed using one of two strategies: (1) By combining multiple spectrally non-overlapping fluorophores in a

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1452

controlled molar ratio to generate a mixed color signature; or (2) by separating fluorophores beyond the diffraction limit (~200 nm) and arranging them in a specific geometric pattern. The first category of barcode has been made, for example, from dendrimeric DNA (*see, e.g.,* Li *et al., Nat. Biotechnol.* 23:885-889 (2005)), self-assembled 2D DNA arrays (*see, e.g.,* Lin *et al., Nano Lett.* 7:507-512 (2007)) and quantum dots (*see, e.g.,* Han *et al., Nat. Biotechnol.* 19:631-635 (2001)). The successful construction and decoding of such barcodes heavily depends on both the fluorescent labeling efficiency and the imaging instrument's ability to precisely detect different fluorescent intensity levels.

In contrast, barcodes constructed according to the second strategy are more robust, and can be constructed and detected even when the labeling efficiency and imaging conditions are sub-optimal. Furthermore, when such methods are used, the ability to multiplex increases exponentially with each additional fluorescent spot that is incorporated. Examples of barcodes that fall in this category include rare-earth doped glass microfibers (~100 μm long) (*see, e.g.,* Dejneka *et al., Proc. Nat. Acad. Sci. USA* 100:389-393 (2003)) and double-stranded linear DNA with one strand fluorescently tagged at specific locations (2–5 μm long) (*see, e.g.,* Xiao *et al., Nat. Methods* 6:199-201 (2009) and Geiss *et al., Nat. Biotechnol.* 26:317-325 (2008)). However, existing methods using this strategy are limited both in the addressability of the fluorescent spots and because, in the absence of specialized equipment, the labeled barcodes will fold into a conformation that brings the fluorescent spots within the diffraction limit of visible light, rendering the barcode unreadable using a fluorescent microscope.

The instant inventors recognized that the problems associated with existing molecular barcode strategies could be addressed by using nucleic acid nanostructures such as DNA nanostructures to create novel molecular barcode probes. Nucleic acids such as DNA may be folded into predetermined one-, two- or three-dimensional nanostructures using a variety of techniques, such as DNA origami (Rothemund US-2007/0117109 A1), single-stranded tiles (Yin et al., "Programming DNA Tube Circumferences," *Science* (2008): 321: 824-826), DNA hairpins (Yin et al. US-2009/0011956 A1; Yin et al., "Programming biomolecular self-assembly pathways," *Nature* (2008) 451:318-323), and others.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1453

In general, the DNA origami process involves the folding of one or more long, "scaffold" DNA strands into a particular shape using a plurality of rationally designed "staple" DNA strands. The sequences of the staple strands are designed such that they hybridize to particular portions of the scaffold strands and, in doing so, force the scaffold strands into a particular shape. Methods useful in the making of DNA origami structures can be found, for example, in U.S. Pat. App. Pub. Nos. 2007/0117109, 2008/0287668, 2010/0069621 and 2010/0216978, each of which is incorporated by reference in its entirety. Staple design can be facilitated using, for example, caDNAno software, available on the internet at the cadnano website.

In certain embodiments, a DNA nanostructure barcode probe may include a DNA nanostructure made of one or more scaffold strands held in a specific shape by rationally designed staple strands. The sequence listing provides the nucleotide sequence of a scaffold strand, as SEQ ID NO:1, that may be used to construct an exemplary DNA origami barcode probe. The sequence listing also provides nucleotide sequences of staple strands, as SEQ ID NOs: 13-361, that may be used to construct an exemplary DNA origami barcode probe, together with the scaffold strand represented by SEQ ID NO:1. As will be discussed in greater detail herein, SEQ ID NOs: 13-186 represent nucleotide sequences of staple strands used to form a front monomer and SEQ ID NOs: 187-361 represent nucleotide sequences of staple strands used to form a rear monomer in an exemplary DNA origami barcode probe. As used herein, the term "DNA nanostructures" is used for convenience and it is to be understood that the invention contemplates nucleic acid nanostructures generally. The nanostructures of the invention may be linear (e.g., nanorods) or non-linear (e.g., star-shaped, triangular, etc.).

The DNA nanostructure has at least two non-overlapping, fluorescently-labeled regions. In certain embodiments, the DNA nanostructure barcode probe has at least 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12 non-overlapping, fluorescently-labeled regions.

The fluorophore pattern of the probe is determined using light microscopy. In some embodiments, each of the fluorescently labeled regions can be visibly distinguished using a fluorescent light microscope. In some of these embodiments, the center of each fluorescently labeled region is separated from the centers of other fluorescently labeled regions by a distance greater than the visible light diffraction limit of visible light (*i.e.* at least 200 nm). In certain embodiments, therefore, each

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1454

fluorescently labeled region is at least 200 nm from any other fluorescently labeled region. In some embodiments, each fluorescently labeled region is at least 250 nm from any other fluorescently labeled region.

In some embodiments, even higher resolution is achievable and the fluorescently labeled regions may be spaced apart from each other at even shorter distances (i.e., a distance of less than 200 nm). Accordingly, in some embodiments, the distance between the fluorescently labeled regions may be equal to or about 175 nm, 150 nm, 125 nm, 100 nm, 75 nm, 50 nm, 25 nm, or smaller distances. When the fluorescently labeled regions are spaced apart at distances that are less than the diffraction limit of visible light, the barcoded probes are imaged using super-resolution techniques such as Point Accumulation for Imaging in Nanoscale Topography (PAINT, DNA-PAINT), Stimulated Emission Depletion Microscopy (STED), Reversible Saturable Optical Fluorescence Transitions (RESOLFT), Stochastic Optical Reconstruction Microscopy (STORM, dSTORM), Photoactivated Localization Microscopy (PALM), Blink Microscopy (BM), and any other form of super-resolution microscopy.

It is to be understood that the term "fluorescently-labeled region" embraces regions that are stably labeled and those that are transiently labeled with fluorophore-bearing moieties such as fluorophore-bearing oligonucleotides that are complementary to a handle domain or docking strand (or sequence), as described in greater detail herein. In some instances, the barcode probes of the invention are provided with such fluorophore-bearing oligonucleotides bound thereto, and therefore these probes would be fluorescent. In other instances, the barcode probes of the invention are provided without such fluorophore-bearing oligonucleotides bound thereto, and therefore these probes may not be fluorescent until they are bound to a fluorophore-bearing oligonucleotide. In these latter instances, a probe may be provided together with a plurality of fluorophore-bearing oligonucleotides that are specific for (e.g., typically, complementary to) the handle domains or docking strands of the probe. The probes and the oligonucleotides may be provided in a kit, optionally with each in a separate container within the kit.

The positions of the fluorescently labeled regions can be selected such that the orientation of the DNA nanostructure barcode may be determinable through visualization of the barcode on a fluorescent microscope (typically by some form of asymmetry in the

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1455

arrangement of the labeled regions or by some arrangement convention, such a particular color or pattern reserved to indicate an end of the barcode). In some instances, orientation information is unnecessary and the barcode pattern need not be absolutely unique. Thus, barcodes with even just two labels may be used, and the presence and/or intensity of various labels provides the information required.

In some instances, the fluorescently labeled regions are arranged in a linear manner. An examples is shown in, for example, FIG. 1. The fluorescently labeled regions may however be arranged in a non-linear manner as well. An example is shown in FIG. 8. Other non-linear arrangements will be apparent to those of ordinary skill in the art and are embraced by the invention. In some instances, a non-linear orientation (or arrangement or geometry) of the fluorescently labeled regions is used to detect and/or identify analytes. In some instances, the signal (including for example the color or color combination) of non-linearly arranged fluorescently labeled regions is used to detect and/or identify analytes. In still other instances, orientation and signal are used together to detect and/or identify analytes. Thus, it is to be understood that the nanostructure may be linear or non-linear and/or the arrangement of the fluorescently labeled regions may be linear or non-linear.

The DNA nanostructure, once assembled, is sufficiently immutable in a resting state (i.e., in the absence of external influence from e.g. an electrical field) that the spatial pattern of the fluorescent regions can be detected using light microscopy in that resting state. Portions of the nanostructure may be flexible, such as unlabeled portions. In some embodiments, a probe may include a (relatively) rigid portion carrying label and an unlabeled flexible portion. in some embodiments, a probe may have two rigid labeled regions connected by a deformable linker.

In certain embodiments, the DNA nanostructure of the DNA barcode probe can be of any one-, two- or three dimensional shape that is able to support at least three fluorescently labeled regions at least 200 nm apart from each other. As stated herein, however, the invention is not so limited as nanostructures having fluorescently labeled regions spaced at distances of less than 200 nm from each other are also contemplated.

In certain embodiments, the DNA nanostructure is a nanotube. In some embodiments, the nanotube is at least 200, 300, 400, 500, 600, 700 or 800 nm long. In certain embodiments, the DNA nanostructure is a six helix bundle dimer nanotube.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1456

Description of DNA nanotube design (via DNA origami) can be found in, for example, Douglas *et al., Proc. Natl. Acad. Sci. USA* 104:6644-6648 (2006) and U.S. Pat. App. Pub. No. 2010/0216978, each of which is incorporated by reference in its entirety.

In some embodiments, the DNA barcode probes are designed such that the orientation of the DNA barcode probe is determinable based on the emission of visible light by the fluorescently-labeled regions. Any property of the barcode can be used to render the orientation of the DNA barcode can be determinable. For example, if the DNA barcode probe has a substantially one-dimensional (linear) structure, such as a nanotube, the fluorescently labeled regions can be positioned asymmetrically along the DNA nanostructure. The orientation of a substantially one-dimensional (linear) DNA barcode probe can also be made determinable by asymmetrically using a particular fluorophore or combination of fluorophores to label one side of the DNA nanostructure consistently. If the DNA nanostructure is two- or three-dimensional, the orientation of the DNA barcode probe can also be rendered determinable based, for example, on an asymmetry of the shape of the structure itself.

In certain embodiments, the fluorescently labeled regions of the DNA barcode probe are generated by labeling specific staples of the DNA nanostructure with a fluorescent moiety. The staples can be directly labeled or indirectly labeled. As used herein, the term "directly labeled" refers to a nucleic acid that is covalently bonded to a detectable moiety. In contrast, the term "indirectly labeled" refers to a nucleic acid that is attached to a detectable moiety through one or more non-covalent interactions.

In certain embodiments, certain staples of the DNA nanostructure are directly labeled with a fluorescent moiety. In such embodiments, the staple can be, for example, synthesized with a particular fluorescent moiety attached, or covalently bonded to a fluorescent moiety prior to its incorporation into the DNA nanostructure.

Any combination of fluorescent moieties may be used in a single barcode, provided the fluorescent signal from each labeled region is detectable. Preferably, the combination of fluorescent moieties is chosen so that there is no energy transfer between the fluorescent moieties (i.e., the fluorophore combination used on a single barcode probe does not contain pairs of fluorophores that act together as a donor-acceptor pair).

In some embodiments, certain staples of the DNA nanostructure are indirectly labeled with a fluorescent moiety. In such embodiments, such staples can be synthesized

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1457

to have at least two domains, a staple domain and a handle domain. The staple domain is a region (or nucleotide sequence) of the staple that hybridizes to the scaffold strand to contribute to the formation and stability of the DNA nanostructure. The handle domain contains additional nucleic acid sequence that is not necessary for the creation of the DNA nanostructure. Before, during or after the formation of the DNA nanostructure, the handle sequences are available to be hybridized by oligonucleotides having a complementary DNA sequence. Thus, such staples can be indirectly labeled by hybridizing the handle domain to another nucleic acid that has a nucleic acid sequence complementary to the handle and that is itself either directly or indirectly labeled with a fluorescent moiety.

In some embodiments, each fluorescent region of the DNA barcode probe includes at least one fluorescently labeled staple. In certain embodiments, the fluorescently labeled region may include a plurality of fluorescently labeled staples. For example, in certain embodiments, each fluorescently labeled region may include at least 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, or more fluorescently labeled staples. In regions designed to have multiple staples labeled, all the staples may be labeled by a single type of fluorophore, or the staples may be labeled by a combination of fluorophore types. For example, in certain embodiments, a fluorescently labeled region is designed to be labeled by multiple types of fluorophores present at a predetermined ratio. An example of this latter type of labeling, referred to as dual-labeling, is demonstrated in the Examples. In dual-labeling, a single region is labeled with two fluorophores in a predetermined ratio, to yield a fluorescent signal that is distinguishable from either of the contributing fluorophores. In this way, the variety of barcode probes is increased.

In still other embodiments, the barcode probe may comprise one or more regions that are transiently labeled with fluorophore-bearing oligonucleotide strands. These embodiments may be used when the fluorescently labeled regions are within 200 nm of each other. In some embodiments, all the regions contributing to the barcode will be designed to be transiently labeled. Transient labeling of a region is achieved by using a nanostructure comprised of staple strands with handle domains that are shorter in length than those used for more permanent binding of a fluorescently labeled oligonucleotide. As an example, permanent (or stable) binding of fluorophore-bearing oligonucleotides to a handle domain of a staple strand can be achieved using

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1458

oligonucleotides and handle domains that are about 21 nucleotides in length. When shorter oligonucleotides and handle domains are used, the strength of binding between the two is reduced and accordingly they are more likely to dissociate than are longer strands. At room temperature, oligonucleotides and handle domains that are about 9 nucleotides in length associate with each other only transiently. As will be understood in the art, at higher temperatures, the length of the oligonucleotide and handle domain will typically be increased in order to achieve the same association/dissociation kinetics.

Accordingly, the invention contemplates handle domains that are directly or indirectly labeled with fluorophores as well as those that are transiently labeled with fluorophores. The length of the handle domain (and similarly its complementary oligonucleotide) will depend upon the nature of the binding (i.e., whether it is intended to be permanent or transient binding), and the reaction conditions such as but not limited to temperature, salt concentration, and the like. Such lengths may range, without limitation, from about 5 nucleotides to 30 nucleotides, or from about 7 nucleotides to about 25 nucleotides, or from about 9 nucleotides to about 21 nucleotides.

In some embodiments, the DNA barcode probe may further include a target binding moiety that acts as a binding partner for the target (or analyte) of interest. As used herein, the term "binding" refers to an association between at least two molecules due to, for example, electrostatic, hydrophobic, ionic and/or hydrogen-bond interactions under physiological conditions. Such a target binding moiety can be, for example, without limitation, a nucleic acid such as an oligonucleotide, a protein or peptide such as an antibody or antibody fragment, a carbohydrate or a polysaccharide, or a small molecule. The target binding moiety and the target to which it binds can also be viewed in a receptor and ligand relationship. In certain embodiments, the DNA barcode probe may include multiple target capture moieties, which may be identical or different.

The target capture moiety can be attached to the DNA nanostructure of the DNA barcode probe using any method known in the art. For example, the target capture moiety can be covalently bonded to a staple strand or a scaffold strand. The capture moiety can also be indirectly attached to either a staple strand or the scaffold strand by, for example, hybridizing to a handle domain of a staple strand, as described above.

In certain embodiments, the DNA barcode probe may include a target binding moiety that is an oligonucleotide or other nucleic acid capable of hybridizing to a target

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1459

nucleic acid. In general, an oligonucleotide is capable of hybridizing to a target nucleic acid if it includes a nucleic acid sequence that is substantially complementary a sequence of the target nucleic acid. In certain embodiments, the oligonucleotide may include a sequence that is perfectly complementary to a target (*i.e.* that is able to base pair at every nucleotide with the target sequence). In some embodiments, the oligonucleotide is less than perfectly complementary to the target but is still able to hybridize to a target nucleic acid under certain conditions. Thus, in certain embodiments the sequence of the oligonucleotide is at least 10%, 20%, 30%, 40%, 50%, 60%, 65%, 70%, 75%, 80%, 85%, 90% or 95% complementary to a sequence of the target nucleic acid. In certain embodiments, the DNA barcode probe may include a target binding moiety that is an aptamer.

In certain embodiments, the DNA barcode probe may include a target binding moiety that is an antibody. As used herein, the term "antibody" includes full-length antibodies and any antigen binding fragment (*i.e.*, "antigen-binding portion") or single chain thereof. The term "antibody" includes, but is not limited to, a glycoprotein comprising at least two heavy (H) chains and two light (L) chains inter-connected by disulfide bonds, or an antigen binding portion thereof. Antibodies may be polyclonal or monoclonal; xenogeneic, allogeneic, or syngeneic; or modified forms thereof (*e.g.*, humanized, chimeric).

As used herein, the phrase "antigen-binding portion" of an antibody, refers to one or more fragments of an antibody that retain the ability to specifically bind to an antigen. The antigen-binding function of an antibody can be performed by fragments of a full-length antibody. Examples of binding fragments encompassed within the term "antigen-binding portion" of an antibody include (i) a Fab fragment, a monovalent fragment consisting of the V_H, V_L, CL and CH1 domains; (ii) a $F(ab')_2$ fragment, a bivalent fragment comprising two Fab fragments linked by a disulfide bridge at the hinge region; (iii) a Fd fragment consisting of the V_H and CH1 domains; (iv) a Fv fragment consisting of the V_H and V_L domains of a single arm of an antibody, (v) a dAb fragment (Ward *et al.*, (1989) Nature 341:544 546), which consists of a V_H domain; and (vi) an isolated complementarity determining region (CDR) or (vii) a combination of two or more isolated CDRs which may optionally be joined by a synthetic linker. Furthermore, although the two domains of the Fv fragment, V_H and V_L, are coded for by separate

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1460

genes, they can be joined, using recombinant methods, by a synthetic linker that enables them to be made as a single protein chain in which the V_H and V_L regions pair to form monovalent molecules (known as single chain Fv (scFv); see *e.g.*, Bird *et al.* (1988) Science 242:423 426; and Huston *et al.* (1988) Proc. Natl. Acad. Sci. USA 85:5879 5883). Such single chain antibodies are also intended to be encompassed within the term "antigen-binding portion" of an antibody. These antibody fragments are obtained using conventional techniques known to those with skill in the art, and the fragments are screened for utility in the same manner as are intact antibodies.

In certain embodiments the target binding moiety is a protein or peptide. For example, a protein or peptide can be used to bind the DNA barcode probe to the protein's ligand. DNA barcodes having protein or peptide target binding moieties can also be used, for example, to identify antibodies or receptors such as but not limited to cell surface receptors such as but not limited to T cell receptors and B cell receptors and intracellular receptors such as but not limited to hormone receptors that are able to bind to an epitope present on the protein or peptide.

In certain embodiments, the target binding moiety is a small molecule. DNA barcode probes having small molecule target binding moieties can, for example, be used to identify molecular or cellular targets of small molecules of interest. Furthermore, libraries of small molecules, where each small molecule is individually tagged with a DNA barcode, can be used in small molecule library screens to identify small molecules that specifically bind to a target of interest.

DNA barcode probes may be provided as a population of distinct species. The number of distinct barcode probes in the population is limited only by the multiplexing capability of the particular barcodes in the population. In certain embodiments, the population contains at least 10, 50, 100, 500, 1000, 2000, 3000, 4000, 5000, 10^4, 50000, 10^5, 10^5, 10^6, 10^7, 10^8, 10^9, 10^{10}, 10^{11} distinct barcode probes. The population may contain 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, or more distinct species. The population may contain less than or equal to about 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100 or more distinct species. In some embodiments, the population comprises 216 distinct barcode probes. The barcode probes described herein are sufficiently adaptable and expandable to permit creation of such large-scale populations of distinguishable species.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1461

Methods of Use

The DNA nanostructure barcode probes can be used, inter alia, in any assay in which existing molecular barcode technologies are used. For example, the DNA barcode probes can be used according to the methods described in U.S. Pat. App. Pub. No. 2010/0015607, the content of which is incorporated by reference in its entirety.

Typically assays include detection assays including diagnostic assays, prognostic assays, patient monitoring assays, screening assays, biowarfare assays, forensic analysis assays, prenatal genomic diagnostic assays, and the like. The assay may be an in vitro assay or an in vivo assay. The sample being analyzed may be a biological sample, such as blood, sputum, lymph, mucous, stool, urine and the like. The sample may be an environmental sample such as a water sample, an air sample, a food sample, and the like. The assay may be carried out with one or more components of the binding reaction immobilized. Thus, the targets or the barcodes may be immobilized. The assay may be carried out with one or more components of the binding reaction non-immobilized. The assays may involve detection of a number of targets in a sample, essentially at the same time, in view of the multiplexing potential offered by the barcode probes of the invention. As an example, an assay may be used to detect a particular cell type (e.g., based on a specific cell surface receptor) and a particular genetic mutation in that particular cell type. In this way, an end user may be able to determine how many cells of a particular type carry the mutation of interest, as an example.

In certain embodiments, a method of identifying a target nucleic acid may include contacting the target nucleic acid with a DNA barcode having an oligonucleotide target capture moiety that includes a nucleic acid sequence capable of hybridizing to a sequence of the target nucleic acid. In certain embodiments, the target nucleic acid is contacted with a DNA barcode probe under conditions such that the target nucleic acid binds to the DNA barcode probe. In some embodiments, the target nucleic acid is then separated from at least some material that is not bound to the target nucleic acid. In certain embodiments the presence of the target nucleic acid is then determined by detecting the presence of the DNA barcode probe bound to the target nucleic acid. The detection of the DNA barcode probe can be accomplished by any appropriate method known in the art, including through fluorescent microscopy.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1462

In some embodiments, the above-described method may further include immobilizing a capture probe containing a nucleic acid sequence complementary to a second target nucleic acid sequence to a solid support. In some embodiments the target nucleic acid is contacted with both the capture probe and the DNA barcode probe. The target nucleic acid can be contacted by the capture probe first, the DNA barcode probe first, or by both probes simultaneously. The capture probe can be immobilized on the solid support before hybridizing to the target nucleic acid, after hybridizing to the target nucleic acid, or simultaneously with hybridizing to the target nucleic acid. In such embodiments, the presence of the target nucleic acid will cause the formation of a tertiary complex that includes the capture probe, the target nucleic acid and the DNA barcode probe, immobilized to a solid support. As described above, the presence of the target nucleic acid is then determined by detecting the presence of the DNA barcode probe by any appropriate method known in the art, including through fluorescent microscopy

In certain embodiments, a method of identifying a target protein or cell may include contacting the target protein or cell with a DNA barcode probe described herein. In certain embodiments, the DNA probe has a protein, peptide or antibody target capture moiety. In some embodiments, the DNA barcode probe is contacted to a target cell or protein under conditions such that the target cell or protein binds to the DNA barcode probe. In some embodiments, the method further includes the step of separating the target protein or cell from at least some material that is not bound to the target protein or cell. In certain embodiments, the method further includes identifying a target protein or cell by detecting the presence of the DNA barcode probe bound to the target protein or cell. In some embodiments, the target protein is an antibody or receptor such as but not limited to a T cell receptor.

It will be appreciated that for some of the aspects and embodiments of the invention, it is preferable for the barcode probe and/or target to remain stationary during image acquisition, particularly if a super-resolution approach is being used and/or if the imaging technique requires superimposition of separately acquired images.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1463

Super-Resolution Imaging

As discussed herein, in some aspects of the invention, the barcode probes comprise fluorescently labeled regions that are spaced at distances less than 200 nm (i.e., the diffraction limit of visible light). In some of these instances, the probe is contacted to a sample and once bound to one or more components of that sample it is exposed to soluble oligonucleotides each of which is specific for one of the regions and is labeled with fluorophores. Such soluble, transiently binding oligonucleotides may be referred to herein as "imager" strands. In some instances, the unbound components in the sample are removed prior to the addition of the fluorophore-bearing oligonucleotides. The presence of the barcode probe (and its identity based on its barcode) is then determined by imaging the remaining sample components using a series of single time lapsed images or a time lapsed movie in order to detect the binding of a fluorophore-bearing oligonucleotide to its complement on the probe. The complement on the probe may be referred to herein as a "docking" strand. The conditions are set such that at any given time only a single fluorophore-bearing oligonucleotide is bound to the barcode probe. If only a single fluorophore is bound at any given time, its color identity can be determined even if the neighboring regions are less than 200 nm away (since there would be no fluorophores bound to the neighboring regions at the same time). In this way, one is able to position adjacent "fluorescently labeled" regions at distances of less than 200 nm, and thereby generate an even greater diversity of barcodes. It is to be understood that in these embodiments, the fluorescently labeled regions are only transiently fluorescent and that the barcodes are only fluorescent when bound by imager strands.

In some embodiments, the imager and/or docking strands are about 5 to about 18 nucleotides in length, or about 6 to about 15 nucleotides in length, or about 7 to about 12 nucleotides in length. In some embodiments, the length is about 8, 9, 10, 11 or 12 nucleotides.

The art is familiar with other localization-based super-resolution fluorescence techniques including, for example, the STORM technique as described in U.S. Patent No. 7838302, the disclosure of which relating to STORM is incorporated by reference herein. The invention contemplates labeling of the nanostructure barcode probes in any manner sufficient for any super-resolution technique.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1464

In other aspects of the invention, the nanostructure barcode probes of the invention may be used to calibrate and/or confirm calibration of fluorescence microscopy equipment, including standard or conventional fluorescence microscopes, confocal microscopes, super-resolution fluorescence microscopes, and the like. Accordingly, nanostructure barcode probes may be used as calibration standards (or tools). Of particular interest in these instances are the barcode probes having "fluorescently-labeled" regions that are spaced apart at less than the diffraction limit of visible light (i.e., less than about 200 nm). When used in this manner, the probes may or may not have a target binding moiety. As an example, they may comprise a target binding moiety such as biotin or streptavidin that facilitates their immobilization for imaging purposes.

EXAMPLES

Example 1: Creation of a DNA Barcode

DNA origami barcode probes were constructed by fluorescently labeling three separate regions of an 800-nm six-helix bundle dimer nanotube (FIG. 1). Each of the approximately 28 nm long fluorescently labeled regions was modified with twelve oligonucleotides attached to one of the three fluorophores (rhodamine-green, Cy3 or Cy5). The DNA origami barcode probe was designed to be asymmetric by placing the first two labeled regions further apart (approximately 460 nm apart) than the last two (approximately 270 nm apart). It is to be understood that other arrangements, including symmetric arrangements, are also contemplated by the invention.

The main structure of the DNA origami barcode probe is a DNA six-helix bundle nanotube dimer designed using the caDNAno software available at the cadnano website. The sequence of the scaffold strand used for each monomer is provided as SEQ ID NO:1. The sequences of the staples used in the construction of the DNA origami barcode are provided as SEQ ID NOs: 13-361. Certain selected staples were elongated (after rational design) to include 21-nt single stranded overhangs (handles) for fluorescent labeling. Table 1 provides the handle and anti-handle sequences used.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1465

Table 1: DNA sequences used for fluorescently labeling nano-barcode.

Name	Sequence (SEQ. ID. NO.)
Handle 1	5'-TTCCTCTACCACCTACATCAC-3' (SEQ ID NO:2)
Handle 2	5'-TAACATTCCTAACTTCTCATA-3' (SEQ ID NO:3)
"Blue" anti-handle 1	5'-GTGATGTAGGTGGTAGAGGAA/rhodamine green/-3' (SEQ ID NO:4)
"Green" anti-handle 1	5'-GTGATGTAGGTGGTAGAGGAATTT/Cy3/-3' (SEQ ID NO:5)
"Red" anti-handle 1	5'-GTGATGTAGGTGGTAGAGGAA/Cy5/-3' (SEQ ID NO:6)
"Blue" anti-handle 2	5'-TATGAGAAGTTAGGAATGTTA/Alexa Fluor 488/-3' (SEQ ID NO:7)
"Green" anti-handle 2	5'-TATGAGAAGTTAGGAATGTTA/Cy3/-3' (SEQ ID NO:8)
"Red" anti-handle 2	5'-TATGAGAAGTTAGGAATGTTA/Cy5/-3' (SEQ ID NO:9)

Accordingly, of the staple strands provided in the Sequence Listing, SEQ ID NOs: 16, 17, 70-73, 126-129, 182 and 183 are labeled "blue"; SEQ ID NOs: 195, 196, 239, 240, 251, 252, 295, 296, 307, 308, 351 and 352 are labeled "red"; and SEQ ID NOs: 216-219, 272-275 and 328-331 are labeled "green".

caDNAno JSON files showing the arrangement of the front and rear monomers of the probe are provided in the computer program listing appendix as "6ht-v5-1color-1.json" and "6ht-v6-2color-1.json" respectively.

To assemble the DNA origami barcode probe, the front and rear monomers were each assembled and fluorescently labeled in a separate test tube and then mixed together to form the dimer. The assembly of each monomer is accomplished in one-pot reaction by mixing 100 nM scaffold strand derived from M13 bacteriophage (termed p7308) (SEQ ID NO:1) with a pool of oligonucleotide staple strands (SEQ ID NOs: 13-186 for the front monomer and 187-361 for the rear monomer; 600 nM of each; reverse-phase cartridge purified, Bioneer Inc.) in folding buffer containing 5 mM Tris, 1 mM EDTA, 20 mM $MgCl_2$, 50 mM NaCl (pH 8) and subjecting the mixture to a thermal-annealing ramp that cooled from 80°C to 60°C over the course of 80 minutes and then cooled from 60°C to 24°C over 15 hours. Excessive staples were removed by polyethylene glycol (PEG) fractionation before each monomer was incubated with anti-handles carrying appropriate fluorophores at 1:1.2 molar ratio for labeling. For

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1466

dimerization, a stoichiometric amount of the fluorescently labeled front and rear monomers were mixed and incubated a 37°C for 2 hours. The final product was purified by agarose gel (non-denaturing, 1.0%) electrophoresis. The purified nano-barcode can be stored at -20 °C for at least 3 months.

Although this example uses a barcode made of two monomers, a DNA barcode probe could include 3, 4, 5, or more monomers. The platform is therefore scalable to any desired level, and can provide any desired number of distinct probes.

Example 2: Detection of a Singly-Labeled DNA Barcode Using Fluorescent Microscopy

Two of the monomer nanotubes were folded and fluorescently labeled separately and combined together as described above to yield the nano-barcode. The final product was purified by agarose gel electrophoresis and directly deposited on a glass slide for imaging using a total internal reflection fluorescence microscope (TIRFM). In brief, 5 μL of the purified nano-barcode (~ 20 pM) was deposited on a glass slide, sandwiched by a coverslip (No. 1.5, 18 x 18 mm^2, ~0.17 mm thick) and let sit for 5 minutes before being imaged on a Leica DM16000B TIRFM. The samples were imaged sequentially through three channels, each assigned a false color (blue, green and red). For the blue channel, the 488 nm laser beam was reflected by a dichroic mirror (430/505/575/670) and shined on the sample through a 100x objective (HCX PL APO 100x/1.47 oil CORR TIRF, Leica). The emission light was collected through the same objective, filtered through the same dichroic mirror and an external emission filter (525/36) and integrated for 800 ms on an EM-CCD camera (Hamamatsu C9100-02). For the green and red channels, similar configurations were used except for the excitation laser (561 and 635 nm, respectively), emission filter (605/52 and 705/72, respectively) and exposure time (500 and 700 ms, respectively). The imaging process was automatically controlled by a Leica LAS software. The images were processed by *Image J* and a custom written software for decoding.

The following false-colors were assigned to the fluorescently labeled regions: Alexa Fluor 488/rhodamine green (blue), Cy3 (green) and Cy5 (red). TIRFM images resolved the DNA origami barcode as a strip of three distinct bright spots. Notably, the distance between blue and green spots is farther than that between green and red showing the asymmetry of the barcode (data not shown)

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1467

A DNA origami barcode system having three fluorescently labeled regions, each of which is labeled by one of three distinct fluorophores can generate 3^3 (27) distinct DNA origami barcode probes. All 27 possible DNA origami barcode probes were assembled separately and purified together by agarose gel electrophoresis.

Five distinct barcodes from the 27 members in the barcode family were randomly chosen for quality control experiments. The barcodes were assembled and purified separately and imaged under the same experimental conditions. Two distinct features of the barcode were clearly visible from the TIRF images (FIG. 2A, top panel): first, each fluorescently labeled zone on a barcode was resolved as a single-color spot and each complete barcode consisted of three of such spots; Second, two of the neighboring spots were separated by a small gap while the other 7 two neighbors sat closely together. Therefore one can visually recognize and decode those geometrically encoded barcodes based on the color identity of the spots and their relative spatial positions, even without the aid of any specialized decoding software. Using a custom-written software that localizes the center of each spot on the BRG barcodes, we measured the average center-to-center distance between the neighboring spots to be 433±53 nm (mean±s.d., N=70; larger distance) and 264±52 nm (mean±s.d., N=70; smaller distance), confirming the correct formation of the barcodes. These experimentally measured distances were slightly smaller than the designed values (478 nm and 298 nm). We attribute this discrepancy to random thermal bending of the nanotubes (persistence length of ~1–2 μm), which has been observed previously by others[23,28] and confirmed by us (data not shown) using transmission electron microscopy (TEM). It is important to note that unlike some other geometrically encoded barcoding systems (e.g., NanoString nCounter[12]), there was no molecular combing step involved in the sample preparation. The separation between the fluorescent spots was exclusively created by the inherently rigid structure of the six-helix bundle nanotube. It is also notable that the spot intensities were not perfectly uniform across the whole image, which can be explained by factors such as the uneven illumination of the sample stage and differences in labeling efficiency. Nevertheless, the TIRF images proved that the barcodes were successfully assembled and can be resolved unambiguously. We then manually investigated TIRF images with an area of 50×50 μm^2 for the selected five

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1468

barcodes (FIG. 2A, bottom panel). The objects found within the images were first sorted into qualified (i.e., three single-color spots arranged in a nearly linear and asymmetric fashion as designed) and unqualified (i.e., all other objects) barcodes. The qualified 8 barcodes were further categorized into correct and incorrect (false-positive) barcodes based on the fluorescent signatures of the composing spots to reflect whether the barcode was the expected type. The unqualified barcodes were further sorted into (1) monomer nanotubes (single spot or two "kissing" spots), (2) barcode with "wrong" geometry (i.e., extreme bending), and (3) barcode containing at least one spot with multiple colors. Our statistics revealed that more than 70% of the visible objects were qualified barcodes, which we further determined to be exclusively the expected type (i.e., zero false-positive out of 188 qualified barcodes observed). The unqualified barcodes arose likely from folding defects, sample damage during handling and overlapping nanotubes on the surface, which can be largely reduced by optimizing the sample preparation and imaging protocol.

Typically, a number of different barcode species coexist in one pool. Thus it is important to examine the robustness of our system by mixing different types of barcode together. In an initial test, we synthesized BRG and RGB barcodes separately, mixed them together at equal molar ratio and co-purified them via gel electrophoresis. The TIRF analysis of the purified mixture confirmed the 1:1 stoichiometry of the two barcodes and the overall assembly success rate (qualified barcode/all objects) of ~80%, suggesting that both barcodes maintained their integrity in the mixing and co-purification process. In addition, over 98% of the qualified barcodes fell into one of the two expected types (BRG and RGB). The 2% false-positive rate was due to an unexpected barcode namely BGB, which could be attributed to a rare occasion when the front monomer of the BRG barcode lay in proximity of the rear monomer of the RGB barcode. This can be eliminated using a more stringent purification condition to minimize the amount of leftover monomers.

We next challenged the system by imaging a pool of all 27 members of the barcode family in which all species were mixed at equimolar amount. The TIRF images (FIG. 2B) showed that all types of barcodes were resolved. Statistics by sampling twenty-seven 50×50 μm^2 images (~1,500 barcodes in total) revealed an average count of 55 per barcode type with a standard deviation of 9 (FIG. 2C), fitting

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1469

well with the expected stoichiometry considering the pipetting and sampling error. The distribution of observed objects over the four categories (note that here correct *vs.* incorrect barcodes were not distinguishable as all 27 types were included) was consistent with the values measured from the single-type barcode samples. The above observations suggest that the sub-micrometer-long DNA nanotube represents a reliable platform to construct geometrically encoded barcodes with built-in structural rigidity.

Software could be used to recognize and decode the image of different types of DNA origami barcode probes automatically. Typically, such software has three basic steps: recognition, filtering and decoding. In the first step, the fluorescent spots are identified. For each fluorescent channel (blue, red or green), the software identifies fluorescent spots based on their intensity and size, then compares them to automatically determined thresholds using overall image intensity and pre-defined spot sizes. The fluorescent spots below those thresholds are removed along with general background noise. After processing all three channels, a barcode image is constructed by merging spots identified in three channels. An example of such a barcode image is provided in FIG. 3. In the second step, the distances (calculated from (x,y) coordinates of fluorescent spots) between each region of DNA origami barcode probes and the barcode bending angle (based on the center spot) are calculated. The software then filters DNA origami barcode probes and removes those with region distances that disagreed with the theoretical region distances or had a barcode bending angle smaller than a currently arbitrarily set threshold angle of 140 degrees. As an example, the BRG barcodes were filtered using three distance rules: (1) The distance between blue and green spot cannot be greater than 15 pixels (theoretical distance was 11 pixels); (2) The distance between red and blue spot cannot be greater than 9 pixels (theoretical distance was 6.8 pixels); and (3) The distance between red and green spot cannot be greater than 6 pixels (theoretical distance was 4.2 pixels). The BRG barcodes that had a bending angle (at the red spot) smaller than 140 degrees were removed. In the last step, after all barcodes are identified and filtered, the software uses different criteria (based on theoretical distance and color) to sort barcodes into specific types. Therefore, multiple types of DNA barcode probes can be decoded based on how they were originally designed. Besides the final constructed DNA barcode probe image, the software can output statistical information

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1470

regarding the (x,y) coordinates of each DNA barcode probe fluorescent spot, distances between adjacent spots, barcode bending angle, and barcode types.

The software described above was used to detect BRG and GRG DNA origami barcode probes. As shown in FIG. 3, the BRG and GRG DNA origami barcode probes were clearly identified by the automated decoding software. The software used a number of filters to select the valid DNA origami barcode probes. As a result, 88% and 85% of BRG and GRG nano-barcodes were counted. The software generated statistical information on BRG and GRG barcodes (Table 2) that showed that the measured distances between each region on those DNA origami barcode probes were in good agreement with the theoretical region distances as designed (FIG. 3E).

Table 2

Barcode type	Barcode identified	Barcode discarded	Barcode bending angle α (degree)	Distance 1 (pixel)	Distance 2 (pixel)
BRG	70	9	165.11±10.08	6.18±0.76	3.77±0.74
GRG	81	15	161.51±11.73	6.12±0.95	3.95±0.98

Example 3: Detection of an Oligonucleotide Target Using a DNA Barcode Probe

A 42-nt DNA oligonucleotide target was detected using a DNA origami barcode probe. Two different purified barcodes Green, Red, Green (GRG) with the 21-nt oligonucleotide target capture moiety specific for a 42-nt oligonucleotide target (Target 1, *see* Table 3 for sequences) and Blue, Red, Green (BRG) without a target capture moiety, were mixed at 1:1 ratio and diluted to 20 pM in folding buffer. Biotin probe specific for Target 1 (0.2 µL of 100 nM) and Target 1 (0.4 µL of 10 nM) was added to 100 µL of the barcode mixture. In a separate test tube containing 100 µL of the barcode mixture, 0.2 µL of 100 nM biotin probe for Target 1 and 0.4 µL of 1x folding buffer was added as a negative control. The above samples were both incubated at 37 °C overnight before being run through separate channels of a micro-fluidic cell with a streptavidin coated glass cover-slip (Xenopore) substrate. Both channels were then washed with 40 µL of washing buffer (5 mM Tris-HCl pH 8.0, 500 mM NaCl) and imaged on a Leica TIRFM as described above. Ten images were taken in each channel

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1471

at random locations and the total number of DNA origami barcode probes was counted manually.

Table 3: DNA sequences used in oligonucleotide target detection

Name	Sequence (SEQ ID NO:)
Target oligo	5'-GAATCGGTCACAGTACAACCGCGCCGTAGGGCTG-ATCAAAGC-3' (SEQ ID NO:10)
Biotin probe	5'-/Biotin/ GCTTTGATCAGCCCTACGGCG-3' (SEQ ID NO:11)
Capture probe	5'-CGGTTGTACTGTGACCGATTC-3' (SEQ ID NO:12)

In the presence of the target oligonucleotide, the biotin probe hybridized to one 21 nt sequence of the target oligonucleotide, while the GRG barcode hybridized to a second 21 nt sequence of the target oligonucleotide. The BRG probe, however, lacking a target capture moiety specific for the target oligonucleotide does not hybridize to the target and therefore does not become bound by the biotin probe. (FIG. 4A). As a consequence, when the detection reaction mixture was run through the streptavidin-coated glass surface, the GRG barcode binds to the surface, while BRG barcode is washed away. TIRF images and statistical analysis supported the specificity of the detection (FIGs. 4B and C). In the presence of 40 pM oligonucleotide target, there were ~20 times more GRG barcodes than BRG barcodes bound to the surface. In the absence of the target, both barcodes did not show significant surface binding.

Example 4: Dual-Labeled Barcode Probes

In order to enhance multiplexing capability even further, the sequence of six staple extensions per zone was changed so that instead of using twelve identical fluorescent oligonucleotides for labeling, a combination of up to two fluorophores was used to create more unique fluorescence signatures (pseudo-colors) for each zone. Six pseudo-colors (B, R, G, BG, BR, and GR) were generated by this "dual-labeling" strategy using three spectrally differentiable fluorophores. Consequently, the total number of distinct barcodes was raised from 27 to 6^3 =216, which represented an order of magnitude increase in the multiplexing capability.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1472

Similar to the single-labeled-zone barcode family, 5 members from the dual-labeled-zone barcode family were chosen for quality control purpose. The barcodes can be visually decoded either solely from the superimposed image or by examining all different channels simultaneously. For example, as shown in the first column of FIG. 5A, the barcode "BG--GR-BR" ("--" and "-" denotes larger and smaller inter-zone distance in the barcode, respectively) exhibited two spots each in the blue, green and red channels but with descending gaps between them, matching its design. In the superimposed image, the barcodes were seen as Cyan--Yellow-Pink, an expected consequence of color mixing caused by the dual-labeling strategy. In a similar fashion, we further verified the correct formation of the other four selected barcodes (FIG. 5A). Although the final pseudo-color from the dual-labeled zones was not always uniform (e.g., some yellow spots were green-tinted while the others were red-tinted) due to the inconsistent labeling efficiency and minor sample displacement during imaging, the fluorescence signature of any given spot could be identified by checking the raw images acquired from the three imaging channels. We manually analyzed two 50 x 50 μm^2 images of each dual-labeled-zone barcode and plotted the statistical data in FIG. 5B. Here, objects were sorted into qualified barcodes and unqualified barcodes based on their geometry and the qualified ones were further categorized as correct and incorrect. 75–95% of the objects were qualified barcodes, among which 80–90% were the correct type (percentage varies depending on the exact type of barcode). Compared to the single-labeled-zone barcode family, the percentage of qualified barcodes remained the same, while the false positive rate increased significantly from zero to 10–20%. This observed increased false positive rate is consistent with the expected decreased robustness of the dual-labeling strategy (as compared to single-labeling). In one design, a dual-labeled zone carried 6 staple extensions for each fluorophore species, only half as many as in a single-labeled zone.

As a result, the dual-labeled-zone barcode consisted of dimmer spots that were more susceptible to damages such as photo bleaching. In this sense, a single-labeled-zone barcode can be thought of as a redundantly encoded dual-labeled-zone barcode. For instance, a single-labeled-zone barcode can still be recognized as the correct type when six fluorophores were missing from each zone, a scenario in which the dual-labeled-zone barcode could be disqualified or categorized as incorrect. In the latter case, it will increase the false positive rate. In principle, the false positive rate can be decreased by

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1473

increasing the copy number of each fluorophore species in a dual-labeled zone. The five barcodes we examined have each of their zones labeled with two distinct fluorophore species, making them likely among the most error-prone members of the dual-labeled-zone barcode family. Therefore, we would expect a smaller false-positive rate on average from the whole family.

We further tested the dual-labeled-zone barcoding system by imaging a mixture containing 72 barcode species that were individually assembled and co-purified. Custom MATLAB scripts were used to assist the decoding process in two steps. In step one, a three-channel (red, green, blue) TIRF image containing barcodes was pre-processed to remove background and thresholded so that only pixels containing qualified barcodes remained. The resulting three-channel binary image was merged to generate a single-channel binary image. Next, the software identified the location and orientation of geometrically legitimate barcodes based on their shape in the binary image. In step two, for each barcode located in step one, the corresponding region of the three-channel image was compared against a library of all possible reference barcodes. The observed barcode was assigned the identity of the reference barcode with the highest correlation. The fully automated decoding process (unsupervised mode) ended after the above two steps. In an optional supervised mode, the software presented the user with the observed barcode and its most likely identity for approval. Comparison between supervised and unsupervised decoding results confirmed >80% agreement between the computer and the user. The computer-aided (supervised mode) analysis of thirty-six 64 x 64 μm^2 three-channel images registered ~2,600 qualified barcodes that belonged to 116 different species (FIG. 5C, top panel). The expected 72 species constituted ~98% of the total barcode population with an average barcode count of 36 per species and a standard deviation of 8. In contrast, the unexpected species averaged only ~1.4 barcodes per species (maximum 4 counts).

Finally, we analyzed a mixture containing all the 216 members of the dual-labeled-zone barcode. Sixty 64 x 64 μm^2 images of this mixture were processed by the decoding software in the unsupervised mode. The fully automated analysis registered ~34 barcode counts per species (~7,200 barcodes total) with a standard deviation of 17 (FIG. 5C, bottom panel). The relatively large standard deviation could be attributed to

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1474

the decoding error in the fully automated data analysis. Our study demonstrated that 216 barcode species were successfully constructed and resolved (FIG. 5D).

Example 5: Super-Resolution Barcode Probes

Barcodes with higher spatial information density were also generated using geometrically encoded super-resolution barcodes with fluorescent features spaced by ~100-nm.

As a feasibility demonstration of the latter approach, we applied DNA-PAINT[31], a recently developed super-resolution fluorescence technique, to image the barcodes. Over the last years, several techniques have been developed that allow imaging beyond the diffraction limit using far-field fluorescence microscopy[40-44]. In most super-resolution implementations, fluorophores are switched between fluorescence ON- and OFF-states, so that individual molecules can be localized consecutively. In methods relying on targeted readout schemes such as in Stimulated Emission Depletion Microscopy[45] (STED) or other Reversible Saturable Optical Fluorescence Transitions[40] (RESOLFT) techniques, fluorescence emission is actively confined to an area below the diffraction limit. Switching of fluorescent molecules can also be carried out stochastically such as in (direct) Stochastic Optical Reconstruction Microscopy[46,47] (STORM, dSTORM), Photoactivated Localization Microscopy[48] (PALM) and Blink Microscopy[49] (BM) where most fluorescent molecules are "prepared" in a dark state and only stochastically switched on to emit fluorescence. In Point Accumulation for Imaging in Nanoscale Topography[50] (PAINT), fluorescence switching is obtained by targeting a surface with fluorescent molecules. In all stochastic approaches, fluorescence from single molecules is localized[51,52] in a diffraction-limited area to yield super-resolved images. DNA-PAINT uses transient binding of fluorescently labeled oligonucleotides (imager strands) to complementary "docking" strands on DNA nanostructures to obtain switching between a fluorescence ON- and OFF-state, which is necessary for localization-based super-resolution microscopy (cf. FIG. 6A). By adjusting the length of the imager/docking strand duplex and the concentration of imager strands in solution, fluorescence ON- and OFF-times can be tuned independently.

For this study, we extended the DNA-PAINT technique to three-color imaging using orthogonal imager strand sequences coupled to three spectrally distinct dyes

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1475

(Atto488 for blue, Cy3b for green and Atto655 for red excitation). To demonstrate the feasibility of the three-color super-resolution barcode system, we designed a DNA nanotube monomer with 4 binding zones in a symmetric arrangement. The neighboring zones were separated by ~114 nm (i.e., well below the diffraction limit). Each binding zone consists of 18 staple strands, which can be extended to display three groups of orthogonal sequences (six per group) for the red, green or blue imager strands to bind. As a proof-of-principle experiment, we designed five different barcodes (FIG. 6A and top panel of B). The bottom panel of FIG. 6B shows the super-resolution reconstruction of the five barcodes for each channel separately as well as an overlay of all channels. FIG. 6C shows a larger area containing all five barcodes. The unique pattern of the barcodes in all three channels can be resolved. Some barcodes moved during the sequential imaging of all three color channels, but were still resolvable. Imaging could be improved by alternating excitation and faster image acquisition to prevent this effect. The transient, repetitive binding of imager strands to docking sequences on the nanotube not only creates the necessary "blinking" behavior for localization but also makes the imaging protocol more robust, as DNA-PAINT is not prone to photo-bleaching or incorrectly labeled strands. With the microscope setup we used, DNA-PAINT provides a resolution of ~46 nm (FWHM of a Gaussian fit to the reconstructed PSF) in the red, ~25 nm in the green and ~29 nm in the blue channel. The lower resolution in the red imaging channel is a result from weaker laser excitation power. When using a higher power TIRF system, a resolution of 24 nm, similar to the green and blue channel can be obtained. The obtainable resolution and imaging specificity suggests that 6 positions on one nanotube monomer could be robustly resolved while keeping the geometrical asymmetry of the barcode, which would lead to $6^7 = 279{,}936$ possible different barcodes. Furthermore the modularity of the nanotube design enables the customized reengineering of barcodes with inter-zone distances tailored to the resolving power of the used microscope, thus making it applicable for a wide range of microscope setups.

Example 6: In Situ Labeling

In a proof-of-principle experiment, the GRG barcode was used to tag wild-type *Candida albicans* yeast. The yeast cells were first mixed with a biotinylated polyclonal antibody specific to *C. albicans*, then coated with a layer of streptavidin, and finally

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1476

incubated with biotinylated GRG barcodes (FIG. 7A). TIRF microscopy revealed the barcodes attached to the bottom surface of the yeast cells (FIG. 7B, top panel). While some of the nanotubes landed awkwardly on the uneven cell walls of the yeast cells, a number of GRG barcodes can be clearly visualized. In contrast, no barcode tagging was observed when non-biotinylated antibodies or barcodes were used to treat the yeasts (FIG. 7B, bottom panel), suggesting that little to no non-specific interaction existed between the barcode and the cell surface.

Example 7: Non-Linear Labeled Nanostructures

DNA nanostructures with non-linear geometry could be assembled to generate more sophisticated barcodes. FIG. 8 shows an example where three ~400 nm DNA tubes were linked to the outer edge of a ~60 nm DNA ring through hybridization between the staple extensions (FIG. 8A, inset). Fluorescently labeling the ring and the far end of the nanotubes generated a three-point-star-like structure clearly resolvable under fluorescence microscopy. TIRF microscopy and TEM studies (FIG. 8B) revealed that about 50% of successfully folded barcodes featured three nanotubes surrounding the ring with roughly 120° angle between each other as designed, while many other barcodes had significantly biased angles between neighboring nanotubes due to the semi-flexible double-stranded DNA linker between the ring and the nanotubes. It is conceivable that using similar design to connect three identical "satellite" linear barcodes to a central hub (here the three satellite barcodes may share the hub as a common fluorescently labeled zone), one can construct barcodes with triplicated encoding redundancy that feature outstanding reliability. In addition, more rigid linkers between the ring and the protrusions (e.g., multi-helix DNA with strand crossovers) could be employed to enforce better-defined barcode geometry.

REFERENCES

1 Han, M., Gao, X., Su, J. Z. & Nie, S. Quantum-dot-tagged microbeads for multiplexed optical coding of biomolecules. Nature biotechnology 19, 631-635, doi:10.1038/90228 (2001).

2 Xu, H. et al. Multiplexed SNP genotyping using the Qbead system: a quantum dot-encoded microsphere-based assay. Nucleic Acids Research 31, e43 (2003).

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1477

3 Li, Y., Cu, Y. T. H. & Luo, D. Multiplexed detection of pathogen DNA with DNA-based fluorescence nanobarcodes. Nature biotechnology 23, 885-889, doi:10.1038/nbt1106 (2005).

4 Livet, J. et al. Transgenic strategies for combinatorial expression of fluorescent proteins in the nervous system. Nature 450, 56-62, doi:10.1038/nature06293 (2007).

5 Fournier Bidoz, S. et al. Facile and Rapid One-Step Mass Preparation of Quantum-Dot Barcodes. Angewandte Chemie International Edition 47, 5577-5581, doi:10.1002/anie.200800409 (2008).

6 Lin, C., Liu, Y. & Yan, H. Self-assembled combinatorial encoding nanoarrays for multiplexed biosensing. Nano letters 7, 507-512, doi:10.1021/nl062998n (2007).

7 Marcon, L. et al. 'On-the-fly' optical encoding of combinatorial peptide libraries for profiling of protease specificity. Molecular bioSystems 6, 225-233, doi:10.1039/b909087h (2010).

8 Nicewarner-Pena, S. R. Submicrometer Metallic Barcodes. Science 294, 137-141, doi:10.1126/science.294.5540.137 (2001).

9 Gudiksen, M. S., Lauhon, L. J., Wang, J., Smith, D. C. & Lieber, C. M. Growth of nanowire superlattice structures for nanoscale photonics and electronics. Nature 415, 617-620, doi:10.1038/415617a (2002).

10 Braeckmans, K. et al. Encoding microcarriers by spatial selective photobleaching. Nature materials 2, 169-173, doi:10.1038/nmat828 (2003).

11 Dejneka, M. J. et al. Rare earth-doped glass microbarcodes. Proceedings of the National Academy of Sciences of the United States of America 100, 389-393, doi:10.1073/pnas.0236044100 (2003).

12 Geiss, G. K. et al. Direct multiplexed measurement of gene expression with color-coded probe pairs. Nature biotechnology 26, 317-325, doi:10.1038/nbt1385 (2008).

13 Pregibon, D. C., Toner, M. & Doyle, P. S. Multifunctional encoded particles for high-throughput biomolecule analysis. Science 315, 1393-1396, doi:10.1126/science.1134929 (2007).

14 Xiao, M. et al. Direct determination of haplotypes from single DNA molecules. Nature methods 6, 199-201, doi:10.1038/nmeth.1301 (2009).

15 Li, X. et al. Controlled fabrication of fluorescent barcode nanorods. ACS nano 4, 4350-4360, doi:10.1021/nn9017137 (2010).

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1478

16 Levsky, J. M., Shenoy, S. M., Pezo, R. C. & Singer, R. H. Single-cell gene expression profiling. Science 297, 836-840, doi:10.1126/science.1072241 (2002).

17 Seeman, N. C. Nucleic acid junctions and lattices. Journal of Theoretical Biology 99, 237-247 (1982).

18 Aldaye, F. A., Palmer, A. L. & Sleiman, H. F. Assembling materials with DNA as the guide. Science 321, 1795-1799, doi:10.1126/science.1154533 (2008).

19 Lin, C., Liu, Y. & Yan, H. Designer DNA nanoarchitectures. Biochemistry 48, 1663-1674, doi:10.1021/bi802324w (2009).

20 Nangreave, J., Han, D., Liu, Y. & Yan, H. DNA origami: a history and current perspective. Current opinion in chemical biology 14, 608-615, doi:10.1016/j.cbpa.2010.06.182 (2010).

21 Shih, W. M. & Lin, C. Knitting complex weaves with DNA origami. Current opinion in structural biology 20, 276-282, doi:10.1016/j.sbi.2010.03.009 (2010).

22 Tørring, T., Voigt, N. V., Nangreave, J., Yan, H. & Gothelf, K. V. DNA origami: a quantum leap for self-assembly of complex structures. Chemical Society Reviews, doi:10.1039/c1cs15057j (2011).

23 Rothemund, P. W. K. Folding DNA to create nanoscale shapes and patterns. Nature 440, 297-302, doi:10.1038/nature04586 (2006).

24 Douglas, S. M. et al. Self-assembly of DNA into nanoscale three-dimensional shapes. Nature 459, 414-418, doi:10.1038/nature08016 (2009).

25 Dietz, H., Douglas, S. M. & Shih, W. M. Folding DNA into twisted and curved nanoscale shapes. Science 325, 725-730, doi:10.1126/science.1174251 (2009).

26 Ke, Y. et al. Multilayer DNA origami packed on a square lattice. Journal of the American Chemical Society 131, 15903-15908, doi:10.1021/ja906381y (2009).

27 Andersen, E. S. et al. Self-assembly of a nanoscale DNA box with a controllable lid. Nature 459, 73-76, doi:10.1038/nature07971 (2009).

28 Han, D., Pal, S., Liu, Y. & Yan, H. Folding and cutting DNA into reconfigurable topological nanostructures. Nature nanotechnology 5, 712-717, doi:10.1038/nnano.2010.193 (2010).

29 Liedl, T., Högberg, B., Tytell, J., Ingber, D. E. & Shih, W. M. Self-assembly of three-dimensional prestressed tensegrity structures from DNA. Nature nanotechnology 5, 520-524, doi:10.1038/nnano.2010.107 (2010).

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1479

30 Han, D. et al. DNA Origami with Complex Curvatures in Three-Dimensional Space. Science 332, 342-346, doi:10.1126/science.1202998 (2011).

31 Jungmann, R. et al. Single-Molecule Kinetics and Super-Resolution Microscopy by Fluorescence Imaging of Transient Binding on DNA Origami. Nano letters, doi:10.1021/nl1103427w (2010).

32 Steinhauer, C., Jungmann, R., Sobey, T. L., Simmel, F. C. & Tinnefeld, P. DNA origami as a nanoscopic ruler for super-resolution microscopy. Angewandte Chemie (International ed in English) 48, 8870-8873, doi:10.1002/anie.200903308 (2009).

33 Lund, K. et al. Molecular robots guided by prescriptive landscapes. Nature 465, 206-210, doi:10.1038/nature09012 (2010).

34 Pal, S., Deng, Z., Ding, B., Yan, H. & Liu, Y. DNA-origami-directed self-assembly of discrete silver-nanoparticle architectures. Angewandte Chemie (International ed in English) 49, 2700-2704, doi:10.1002/anie.201000330 (2010).

35 Bui, H. et al. Programmable Periodicity of Quantum Dot Arrays with DNA Origami Nanotubes. Nano letters 10, 3367-3372, doi:10.1021/nl101079u (2010).

36 Liu, W., Zhong, H., Wang, R. & Seeman, N. C. Crystalline two-dimensional DNA-origami arrays. Angewandte Chemie (International ed in English) 50, 264-267, doi:10.1002/anie.201005911 (2011).

37 Woo, S. & Rothemund, P. W. K. Programmable molecular recognition based on the geometry of DNA nanostructures. Nature Chemistry 3, 620-627, doi:10.1038/nchem.1070 (2011).

38 Douglas, S. M., Chou, J. J. & Shih, W. M. DNA-nanotube-induced alignment of membrane proteins for NMR structure determination. Proceedings of the National Academy of Sciences of the United States of America 104, 6644-6648, doi:10.1073/pnas.0700930104 (2007).

39 Aitken, C. E., Marshall, R. A. & Puglisi, J. D. An oxygen scavenging system for improvement of dye stability in single-molecule fluorescence experiments. Biophysical journal 94, 1826-1835, doi:10.1529/biophysj.107.117689 (2008).

40 Hell, S. W. Far-field optical nanoscopy. Science 316, 1153-1158, doi:10.1126/science.1137395 (2007).

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1480

41 Hell, S. W. Microscopy and its focal switch. Nature methods 6, 24-32, doi:10.1038/nmeth.1291 (2009).

42 Huang, B., Babcock, H. & Zhuang, X. Breaking the diffraction barrier: super-resolution imaging of cells. Cell 143, 1047-1058, doi:10.1016/j.cell.2010.12.002 (2010).

43 Vogelsang, J. et al. Make them blink: probes for super-resolution microscopy. Chemphyschem 11, 2475-2490, doi:10.1002/cphc.201000189 (2010).

44 Walter, N. G., Huang, C. Y., Manzo, A. J. & Sobhy, M. A. Do-it-yourself guide: how to use the modern single-molecule toolkit. Nature Methods 5, 475-489, doi:10.1038/nmeth.1215 (2008).

45 Hell, S. W. & Wichmann, J. Breaking the Diffraction Resolution Limit by Stimulated-Emission - Stimulated-Emission-Depletion Fluorescence Microscopy. Opt Lett 19, 780-782 (1994).

46 Heilemann, M. et al. Subdiffraction-resolution fluorescence imaging with conventional fluorescent probes. Angew Chem Int Ed Engl 47, 6172-6176, doi:10.1002/anie.200802376 (2008).

47 Rust, M. J., Bates, M. & Zhuang, X. Sub-diffraction-limit imaging by stochastic optical reconstruction microscopy (STORM). Nat Methods 3, 793-795 (2006).

48 Betzig, E. et al. Imaging intracellular fluorescent proteins at nanometer resolution. Science 313, 1642-1645 (2006).

49 Steinhauer, C., Forthmann, C., Vogelsang, J. & Tinnefeld, P. Superresolution Microscopy on the Basis of Engineered Dark States. Journal of the American Chemical Society 130, 16840-16841, doi:Doi 10.1021/Ja806590m (2008).

50 Sharonov, A. & Hochstrasser, R. M. Wide-field subdiffraction imaging by accumulated binding of diffusing probes. Proceedings of the National Academy of Sciences of the United States of America 103, 18911-18916 (2006).

51 Yildiz, A. et al. Myosin V walks hand-over-hand: single fluorophore imaging with 1.5-nm localization. Science 300, 2061-2065, doi:10.1126/science.1084398 (2003).

52 Yildiz, A., Tomishige, M., Vale, R. D. & Selvin, P. R. Kinesin walks hand-over-hand. Science 303, 676-678, doi:10.1126/science.1093753 (2004).

53 Gautier, A. et al. An engineered protein tag for multiprotein labeling in living cells. Chem Biol 15, 128-136, doi:10.1016/j.chembiol.2008.01.007 (2008).

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1481

54 Jones, S. A., Shim, S. H., He, J. & Zhuang, X. Fast, three-dimensional super-resolution imaging of live cells. Nature methods 8, 499-508, doi:10.1038/nmeth.1605 (2011).

55 Keppler, A. et al. A general method for the covalent labeling of fusion proteins with small molecules in vivo. Nature biotechnology 21, 86-89, doi:10.1038/nbt765 (2003).

56 Klein, T. et al. Live-cell dSTORM with SNAP-tag fusion proteins. Nature methods 8, 7-9, doi:10.1038/nmeth0111-7b (2011).

57 Cunin, F. et al. Biomolecular screening with encoded porous-silicon photonic crystals. Nature materials 1, 39-41, doi:10.1038/nmat702 (2002).

58 Bellot, G., Mcclintock, M. A., Lin, C. & Shih, W. M. Recovery of intact DNA nanostructures after agarose gel-based separation. Nature methods 8, 192-194, doi:10.1038/nmeth0311-192 (2011).

59 Rajendran, A., Endo, M., Katsuda, Y., Hidaka, K. & Sugiyama, H. Photo-cross-linking-assisted thermal stability of DNA origami structures and its application for higher-temperature self-assembly. Journal of the American Chemical Society 133, 14488-14491, doi:10.1021/ja204546h (2011).

EQUIVALENTS

Those skilled in the art will recognize, or be able to ascertain using no more than routine experimentation, many equivalents of the specific embodiments of the subject matter described herein. Such equivalents are intended to be encompassed by the following claims.

All publications, patents, and patent applications cited in this specification are herein incorporated by reference to the same extent as if each individual publication or patent application was specifically and individually indicated to be incorporated by reference.

What is claimed is:

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1482

Listing for 6ht-v5-1color-1.json:

{"name":"Sat Aug 21 2010 16:03:57 GMT-
0400","vstrands":[{"stap_colors":[[83,1507550],[125,1507550],[167,8947848],
[209,8947848],[251,8947848],[293,8947848],[335,8947848],[377,8947848],[419,
8947848],[461,8947848],[503,8947848],[545,8947848],[587,8947848],[629,89478
48],[671,8947848],[713,8947848],[755,8947848],[797,8947848],[839,8947848],[
881,8947848],[923,8947848],[965,8947848],[1007,8947848],[1049,8947848],[109
1,8947848],[1133,8947848],[1175,8947848],[1217,8947848],[1259,3355443]],"st
ap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[0,41,-1,-
1],[0,42,0,40],[0,43,0,41],[0,44,0,42],[0,45,0,43],[0,46,0,44],[0,47,0,45],
[0,48,0,46],[0,49,0,47],[0,50,0,48],[0,51,0,49],[0,52,0,50],[0,53,0,51],[0,
54,0,52],[0,55,0,53],[1,55,0,54],[0,57,1,56],[0,58,0,56],[0,59,0,57],[0,60,
0,58],[0,61,0,59],[0,62,0,60],[0,63,0,61],[0,64,0,62],[0,65,0,63],[0,66,0,6
4],[0,67,0,65],[0,68,0,66],[0,69,0,67],[5,69,0,68],[0,71,5,70],[0,72,0,70],
[0,73,0,71],[0,74,0,72],[0,75,0,73],[0,76,0,74],[0,77,0,75],[0,78,0,76],[0,
79,0,77],[0,80,0,78],[0,81,0,79],[0,82,0,80],[0,83,0,81],[-1,-
1,0,82],[0,85,-1,-
1],[0,86,0,84],[0,87,0,85],[0,88,0,86],[0,89,0,87],[0,90,0,88],[0,91,0,89],
[0,92,0,90],[0,93,0,91],[0,94,0,92],[0,95,0,93],[0,96,0,94],[0,97,0,95],[1,
97,0,96],[0,99,1,98],[0,100,0,98],[0,101,0,99],[0,102,0,100],[0,103,0,101],
[0,104,0,102],[0,105,0,103],[0,106,0,104],[0,107,0,105],[0,108,0,106],[0,10
9,0,107],[0,110,0,108],[0,111,0,109],[5,111,0,110],[0,113,5,112],[0,114,0,1
12],[0,115,0,113],[0,116,0,114],[0,117,0,115],[0,118,0,116],[0,119,0,117],[
0,120,0,118],[0,121,0,119],[0,122,0,120],[0,123,0,121],[0,124,0,122],[0,125
,0,123],[-1,-1,0,124],[0,127,-1,-
1],[0,128,0,126],[0,129,0,127],[0,130,0,128],[0,131,0,129],[0,132,0,130],[0
,133,0,131],[0,134,0,132],[0,135,0,133],[0,136,0,134],[0,137,0,135],[0,138,
0,136],[0,139,0,137],[1,139,0,138],[0,141,1,140],[0,142,0,140],[0,143,0,141
],[0,144,0,142],[0,145,0,143],[0,146,0,144],[0,147,0,145],[0,148,0,146],[0,
149,0,147],[0,150,0,148],[0,151,0,149],[0,152,0,150],[0,153,0,151],[5,153,0
,152],[0,155,5,154],[0,156,0,154],[0,157,0,155],[0,158,0,156],[0,159,0,157]
,[0,160,0,158],[0,161,0,159],[0,162,0,160],[0,163,0,161],[0,164,0,162],[0,1
65,0,163],[0,166,0,164],[0,167,0,165],[-1,-1,0,166],[0,169,-1,-
1],[0,170,0,168],[0,171,0,169],[0,172,0,170],[0,173,0,171],[0,174,0,172],[0
,175,0,173],[0,176,0,174],[0,177,0,175],[0,178,0,176],[0,179,0,177],[0,180,
0,178],[0,181,0,179],[1,181,0,180],[0,183,1,182],[0,184,0,182],[0,185,0,183
],[0,186,0,184],[0,187,0,185],[0,188,0,186],[0,189,0,187],[0,190,0,188],[0,
191,0,189],[0,192,0,190],[0,193,0,191],[0,194,0,192],[0,195,0,193],[5,195,0
,194],[0,197,5,196],[0,198,0,196],[0,199,0,197],[0,200,0,198],[0,201,0,199]
,[0,202,0,200],[0,203,0,201],[0,204,0,202],[0,205,0,203],[0,206,0,204],[0,2
07,0,205],[0,208,0,206],[0,209,0,207],[-1,-1,0,208],[0,211,-1,-
1],[0,212,0,210],[0,213,0,211],[0,214,0,212],[0,215,0,213],[0,216,0,214],[0
,217,0,215],[0,218,0,216],[0,219,0,217],[0,220,0,218],[0,221,0,219],[0,222,
0,220],[0,223,0,221],[1,223,0,222],[0,225,1,224],[0,226,0,224],[0,227,0,225
],[0,228,0,226],[0,229,0,227],[0,230,0,228],[0,231,0,229],[0,232,0,230],[0,
233,0,231],[0,234,0,232],[0,235,0,233],[0,236,0,234],[0,237,0,235],[5,237,0

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1483

,236],[0,239,5,238],[0,240,0,238],[0,241,0,239],[0,242,0,240],[0,243,0,241]
,[0,244,0,242],[0,245,0,243],[0,246,0,244],[0,247,0,245],[0,248,0,246],[0,2
49,0,247],[0,250,0,248],[0,251,0,249],[-1,-1,0,250],[0,253,-1,-
1],[0,254,0,252],[0,255,0,253],[0,256,0,254],[0,257,0,255],[0,258,0,256],[0
,259,0,257],[0,260,0,258],[0,261,0,259],[0,262,0,260],[0,263,0,261],[0,264,
0,262],[0,265,0,263],[1,265,0,264],[0,267,1,266],[0,268,0,266],[0,269,0,267
],[0,270,0,268],[0,271,0,269],[0,272,0,270],[0,273,0,271],[0,274,0,272],[0,
275,0,273],[0,276,0,274],[0,277,0,275],[0,278,0,276],[0,279,0,277],[5,279,0
,278],[0,281,5,280],[0,282,0,280],[0,283,0,281],[0,284,0,282],[0,285,0,283]
,[0,286,0,284],[0,287,0,285],[0,288,0,286],[0,289,0,287],[0,290,0,288],[0,2
91,0,289],[0,292,0,290],[0,293,0,291],[-1,-1,0,292],[0,295,-1,-
1],[0,296,0,294],[0,297,0,295],[0,298,0,296],[0,299,0,297],[0,300,0,298],[0
,301,0,299],[0,302,0,300],[0,303,0,301],[0,304,0,302],[0,305,0,303],[0,306,
0,304],[0,307,0,305],[1,307,0,306],[0,309,1,308],[0,310,0,308],[0,311,0,309
],[0,312,0,310],[0,313,0,311],[0,314,0,312],[0,315,0,313],[0,316,0,314],[0,
317,0,315],[0,318,0,316],[0,319,0,317],[0,320,0,318],[0,321,0,319],[5,321,0
,320],[0,323,5,322],[0,324,0,322],[0,325,0,323],[0,326,0,324],[0,327,0,325]
,[0,328,0,326],[0,329,0,327],[0,330,0,328],[0,331,0,329],[0,332,0,330],[0,3
33,0,331],[0,334,0,332],[0,335,0,333],[-1,-1,0,334],[0,337,-1,-
1],[0,338,0,336],[0,339,0,337],[0,340,0,338],[0,341,0,339],[0,342,0,340],[0
,343,0,341],[0,344,0,342],[0,345,0,343],[0,346,0,344],[0,347,0,345],[0,348,
0,346],[0,349,0,347],[1,349,0,348],[0,351,1,350],[0,352,0,350],[0,353,0,351
],[0,354,0,352],[0,355,0,353],[0,356,0,354],[0,357,0,355],[0,358,0,356],[0,
359,0,357],[0,360,0,358],[0,361,0,359],[0,362,0,360],[0,363,0,361],[5,363,0
,362],[0,365,5,364],[0,366,0,364],[0,367,0,365],[0,368,0,366],[0,369,0,367]
,[0,370,0,368],[0,371,0,369],[0,372,0,370],[0,373,0,371],[0,374,0,372],[0,3
75,0,373],[0,376,0,374],[0,377,0,375],[-1,-1,0,376],[0,379,-1,-
1],[0,380,0,378],[0,381,0,379],[0,382,0,380],[0,383,0,381],[0,384,0,382],[0
,385,0,383],[0,386,0,384],[0,387,0,385],[0,388,0,386],[0,389,0,387],[0,390,
0,388],[0,391,0,389],[1,391,0,390],[0,393,1,392],[0,394,0,392],[0,395,0,393
],[0,396,0,394],[0,397,0,395],[0,398,0,396],[0,399,0,397],[0,400,0,398],[0,
401,0,399],[0,402,0,400],[0,403,0,401],[0,404,0,402],[0,405,0,403],[5,405,0
,404],[0,407,5,406],[0,408,0,406],[0,409,0,407],[0,410,0,408],[0,411,0,409]
,[0,412,0,410],[0,413,0,411],[0,414,0,412],[0,415,0,413],[0,416,0,414],[0,4
17,0,415],[0,418,0,416],[0,419,0,417],[-1,-1,0,418],[0,421,-1,-
1],[0,422,0,420],[0,423,0,421],[0,424,0,422],[0,425,0,423],[0,426,0,424],[0
,427,0,425],[0,428,0,426],[0,429,0,427],[0,430,0,428],[0,431,0,429],[0,432,
0,430],[0,433,0,431],[1,433,0,432],[0,435,1,434],[0,436,0,434],[0,437,0,435
],[0,438,0,436],[0,439,0,437],[0,440,0,438],[0,441,0,439],[0,442,0,440],[0,
443,0,441],[0,444,0,442],[0,445,0,443],[0,446,0,444],[0,447,0,445],[5,447,0
,446],[0,449,5,448],[0,450,0,448],[0,451,0,449],[0,452,0,450],[0,453,0,451]
,[0,454,0,452],[0,455,0,453],[0,456,0,454],[0,457,0,455],[0,458,0,456],[0,4
59,0,457],[0,460,0,458],[0,461,0,459],[-1,-1,0,460],[0,463,-1,-
1],[0,464,0,462],[0,465,0,463],[0,466,0,464],[0,467,0,465],[0,468,0,466],[0
,469,0,467],[0,470,0,468],[0,471,0,469],[0,472,0,470],[0,473,0,471],[0,474,
0,472],[0,475,0,473],[1,475,0,474],[0,477,1,476],[0,478,0,476],[0,479,0,477
],[0,480,0,478],[0,481,0,479],[0,482,0,480],[0,483,0,481],[0,484,0,482],[0,
485,0,483],[0,486,0,484],[0,487,0,485],[0,488,0,486],[0,489,0,487],[5,489,0
,488],[0,491,5,490],[0,492,0,490],[0,493,0,491],[0,494,0,492],[0,495,0,493]
,[0,496,0,494],[0,497,0,495],[0,498,0,496],[0,499,0,497],[0,500,0,498],[0,5
01,0,499],[0,502,0,500],[0,503,0,501],[-1,-1,0,502],[0,505,-1,-
1],[0,506,0,504],[0,507,0,505],[0,508,0,506],[0,509,0,507],[0,510,0,508],[0
,511,0,509],[0,512,0,510],[0,513,0,511],[0,514,0,512],[0,515,0,513],[0,516,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1484

0,514],[0,517,0,515],[1,517,0,516],[0,519,1,518],[0,520,0,518],[0,521,0,519
],[0,522,0,520],[0,523,0,521],[0,524,0,522],[0,525,0,523],[0,526,0,524],[0,
527,0,525],[0,528,0,526],[0,529,0,527],[0,530,0,528],[0,531,0,529],[5,531,0
,530],[0,533,5,532],[0,534,0,532],[0,535,0,533],[0,536,0,534],[0,537,0,535]
,[0,538,0,536],[0,539,0,537],[0,540,0,538],[0,541,0,539],[0,542,0,540],[0,5
43,0,541],[0,544,0,542],[0,545,0,543],[-1,-1,0,544],[0,547,-1,-
1],[0,548,0,546],[0,549,0,547],[0,550,0,548],[0,551,0,549],[0,552,0,550],[0
,553,0,551],[0,554,0,552],[0,555,0,553],[0,556,0,554],[0,557,0,555],[0,558,
0,556],[0,559,0,557],[1,559,0,558],[0,561,1,560],[0,562,0,560],[0,563,0,561
],[0,564,0,562],[0,565,0,563],[0,566,0,564],[0,567,0,565],[0,568,0,566],[0,
569,0,567],[0,570,0,568],[0,571,0,569],[0,572,0,570],[0,573,0,571],[5,573,0
,572],[0,575,5,574],[0,576,0,574],[0,577,0,575],[0,578,0,576],[0,579,0,577]
,[0,580,0,578],[0,581,0,579],[0,582,0,580],[0,583,0,581],[0,584,0,582],[0,5
85,0,583],[0,586,0,584],[0,587,0,585],[-1,-1,0,586],[0,589,-1,-
1],[0,590,0,588],[0,591,0,589],[0,592,0,590],[0,593,0,591],[0,594,0,592],[0
,595,0,593],[0,596,0,594],[0,597,0,595],[0,598,0,596],[0,599,0,597],[0,600,
0,598],[0,601,0,599],[1,601,0,600],[0,603,1,602],[0,604,0,602],[0,605,0,603
],[0,606,0,604],[0,607,0,605],[0,608,0,606],[0,609,0,607],[0,610,0,608],[0,
611,0,609],[0,612,0,610],[0,613,0,611],[0,614,0,612],[0,615,0,613],[5,615,0
,614],[0,617,5,616],[0,618,0,616],[0,619,0,617],[0,620,0,618],[0,621,0,619]
,[0,622,0,620],[0,623,0,621],[0,624,0,622],[0,625,0,623],[0,626,0,624],[0,6
27,0,625],[0,628,0,626],[0,629,0,627],[-1,-1,0,628],[0,631,-1,-
1],[0,632,0,630],[0,633,0,631],[0,634,0,632],[0,635,0,633],[0,636,0,634],[0
,637,0,635],[0,638,0,636],[0,639,0,637],[0,640,0,638],[0,641,0,639],[0,642,
0,640],[0,643,0,641],[1,643,0,642],[0,645,1,644],[0,646,0,644],[0,647,0,645
],[0,648,0,646],[0,649,0,647],[0,650,0,648],[0,651,0,649],[0,652,0,650],[0,
653,0,651],[0,654,0,652],[0,655,0,653],[0,656,0,654],[0,657,0,655],[5,657,0
,656],[0,659,5,658],[0,660,0,658],[0,661,0,659],[0,662,0,660],[0,663,0,661]
,[0,664,0,662],[0,665,0,663],[0,666,0,664],[0,667,0,665],[0,668,0,666],[0,6
69,0,667],[0,670,0,668],[0,671,0,669],[-1,-1,0,670],[0,673,-1,-
1],[0,674,0,672],[0,675,0,673],[0,676,0,674],[0,677,0,675],[0,678,0,676],[0
,679,0,677],[0,680,0,678],[0,681,0,679],[0,682,0,680],[0,683,0,681],[0,684,
0,682],[0,685,0,683],[1,685,0,684],[0,687,1,686],[0,688,0,686],[0,689,0,687
],[0,690,0,688],[0,691,0,689],[0,692,0,690],[0,693,0,691],[0,694,0,692],[0,
695,0,693],[0,696,0,694],[0,697,0,695],[0,698,0,696],[0,699,0,697],[5,699,0
,698],[0,701,5,700],[0,702,0,700],[0,703,0,701],[0,704,0,702],[0,705,0,703]
,[0,706,0,704],[0,707,0,705],[0,708,0,706],[0,709,0,707],[0,710,0,708],[0,7
11,0,709],[0,712,0,710],[0,713,0,711],[-1,-1,0,712],[0,715,-1,-
1],[0,716,0,714],[0,717,0,715],[0,718,0,716],[0,719,0,717],[0,720,0,718],[0
,721,0,719],[0,722,0,720],[0,723,0,721],[0,724,0,722],[0,725,0,723],[0,726,
0,724],[0,727,0,725],[1,727,0,726],[0,729,1,728],[0,730,0,728],[0,731,0,729
],[0,732,0,730],[0,733,0,731],[0,734,0,732],[0,735,0,733],[0,736,0,734],[0,
737,0,735],[0,738,0,736],[0,739,0,737],[0,740,0,738],[0,741,0,739],[5,741,0
,740],[0,743,5,742],[0,744,0,742],[0,745,0,743],[0,746,0,744],[0,747,0,745]
,[0,748,0,746],[0,749,0,747],[0,750,0,748],[0,751,0,749],[0,752,0,750],[0,7
53,0,751],[0,754,0,752],[0,755,0,753],[-1,-1,0,754],[0,757,-1,-
1],[0,758,0,756],[0,759,0,757],[0,760,0,758],[0,761,0,759],[0,762,0,760],[0
,763,0,761],[0,764,0,762],[0,765,0,763],[0,766,0,764],[0,767,0,765],[0,768,
0,766],[0,769,0,767],[1,769,0,768],[0,771,1,770],[0,772,0,770],[0,773,0,771
],[0,774,0,772],[0,775,0,773],[0,776,0,774],[0,777,0,775],[0,778,0,776],[0,
779,0,777],[0,780,0,778],[0,781,0,779],[0,782,0,780],[0,783,0,781],[5,783,0
,782],[0,785,5,784],[0,786,0,784],[0,787,0,785],[0,788,0,786],[0,789,0,787]
,[0,790,0,788],[0,791,0,789],[0,792,0,790],[0,793,0,791],[0,794,0,792],[0,7

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1485

95,0,793],[0,796,0,794],[0,797,0,795],[-1,-1,0,796],[0,799,-1,-
1],[0,800,0,798],[0,801,0,799],[0,802,0,800],[0,803,0,801],[0,804,0,802],[0
,805,0,803],[0,806,0,804],[0,807,0,805],[0,808,0,806],[0,809,0,807],[0,810,
0,808],[0,811,0,809],[1,811,0,810],[0,813,1,812],[0,814,0,812],[0,815,0,813
],[0,816,0,814],[0,817,0,815],[0,818,0,816],[0,819,0,817],[0,820,0,818],[0,
821,0,819],[0,822,0,820],[0,823,0,821],[0,824,0,822],[0,825,0,823],[5,825,0
,824],[0,827,5,826],[0,828,0,826],[0,829,0,827],[0,830,0,828],[0,831,0,829]
,[0,832,0,830],[0,833,0,831],[0,834,0,832],[0,835,0,833],[0,836,0,834],[0,8
37,0,835],[0,838,0,836],[0,839,0,837],[-1,-1,0,838],[0,841,-1,-
1],[0,842,0,840],[0,843,0,841],[0,844,0,842],[0,845,0,843],[0,846,0,844],[0
,847,0,845],[0,848,0,846],[0,849,0,847],[0,850,0,848],[0,851,0,849],[0,852,
0,850],[0,853,0,851],[1,853,0,852],[0,855,1,854],[0,856,0,854],[0,857,0,855
],[0,858,0,856],[0,859,0,857],[0,860,0,858],[0,861,0,859],[0,862,0,860],[0,
863,0,861],[0,864,0,862],[0,865,0,863],[0,866,0,864],[0,867,0,865],[5,867,0
,866],[0,869,5,868],[0,870,0,868],[0,871,0,869],[0,872,0,870],[0,873,0,871]
,[0,874,0,872],[0,875,0,873],[0,876,0,874],[0,877,0,875],[0,878,0,876],[0,8
79,0,877],[0,880,0,878],[0,881,0,879],[-1,-1,0,880],[0,883,-1,-
1],[0,884,0,882],[0,885,0,883],[0,886,0,884],[0,887,0,885],[0,888,0,886],[0
,889,0,887],[0,890,0,888],[0,891,0,889],[0,892,0,890],[0,893,0,891],[0,894,
0,892],[0,895,0,893],[1,895,0,894],[0,897,1,896],[0,898,0,896],[0,899,0,897
],[0,900,0,898],[0,901,0,899],[0,902,0,900],[0,903,0,901],[0,904,0,902],[0,
905,0,903],[0,906,0,904],[0,907,0,905],[0,908,0,906],[0,909,0,907],[5,909,0
,908],[0,911,5,910],[0,912,0,910],[0,913,0,911],[0,914,0,912],[0,915,0,913]
,[0,916,0,914],[0,917,0,915],[0,918,0,916],[0,919,0,917],[0,920,0,918],[0,9
21,0,919],[0,922,0,920],[0,923,0,921],[-1,-1,0,922],[0,925,-1,-
1],[0,926,0,924],[0,927,0,925],[0,928,0,926],[0,929,0,927],[0,930,0,928],[0
,931,0,929],[0,932,0,930],[0,933,0,931],[0,934,0,932],[0,935,0,933],[0,936,
0,934],[0,937,0,935],[1,937,0,936],[0,939,1,938],[0,940,0,938],[0,941,0,939
],[0,942,0,940],[0,943,0,941],[0,944,0,942],[0,945,0,943],[0,946,0,944],[0,
947,0,945],[0,948,0,946],[0,949,0,947],[0,950,0,948],[0,951,0,949],[5,951,0
,950],[0,953,5,952],[0,954,0,952],[0,955,0,953],[0,956,0,954],[0,957,0,955]
,[0,958,0,956],[0,959,0,957],[0,960,0,958],[0,961,0,959],[0,962,0,960],[0,9
63,0,961],[0,964,0,962],[0,965,0,963],[-1,-1,0,964],[0,967,-1,-
1],[0,968,0,966],[0,969,0,967],[0,970,0,968],[0,971,0,969],[0,972,0,970],[0
,973,0,971],[0,974,0,972],[0,975,0,973],[0,976,0,974],[0,977,0,975],[0,978,
0,976],[0,979,0,977],[1,979,0,978],[0,981,1,980],[0,982,0,980],[0,983,0,981
],[0,984,0,982],[0,985,0,983],[0,986,0,984],[0,987,0,985],[0,988,0,986],[0,
989,0,987],[0,990,0,988],[0,991,0,989],[0,992,0,990],[0,993,0,991],[5,993,0
,992],[0,995,5,994],[0,996,0,994],[0,997,0,995],[0,998,0,996],[0,999,0,997]
,[0,1000,0,998],[0,1001,0,999],[0,1002,0,1000],[0,1003,0,1001],[0,1004,0,10
02],[0,1005,0,1003],[0,1006,0,1004],[0,1007,0,1005],[-1,-
1,0,1006],[0,1009,-1,-
1],[0,1010,0,1008],[0,1011,0,1009],[0,1012,0,1010],[0,1013,0,1011],[0,1014,
0,1012],[0,1015,0,1013],[0,1016,0,1014],[0,1017,0,1015],[0,1018,0,1016],[0,
1019,0,1017],[0,1020,0,1018],[0,1021,0,1019],[1,1021,0,1020],[0,1023,1,1022
],[0,1024,0,1022],[0,1025,0,1023],[0,1026,0,1024],[0,1027,0,1025],[0,1028,0
,1026],[0,1029,0,1027],[0,1030,0,1028],[0,1031,0,1029],[0,1032,0,1030],[0,1
033,0,1031],[0,1034,0,1032],[0,1035,0,1033],[5,1035,0,1034],[0,1037,5,1036]
,[0,1038,0,1036],[0,1039,0,1037],[0,1040,0,1038],[0,1041,0,1039],[0,1042,0,
1040],[0,1043,0,1041],[0,1044,0,1042],[0,1045,0,1043],[0,1046,0,1044],[0,10
47,0,1045],[0,1048,0,1046],[0,1049,0,1047],[-1,-1,0,1048],[0,1051,-1,-
1],[0,1052,0,1050],[0,1053,0,1051],[0,1054,0,1052],[0,1055,0,1053],[0,1056,
0,1054],[0,1057,0,1055],[0,1058,0,1056],[0,1059,0,1057],[0,1060,0,1058],[0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1486

1061,0,1059],[0,1062,0,1060],[0,1063,0,1061],[1,1063,0,1062],[0,1065,1,1064
],[0,1066,0,1064],[0,1067,0,1065],[0,1068,0,1066],[0,1069,0,1067],[0,1070,0
,1068],[0,1071,0,1069],[0,1072,0,1070],[0,1073,0,1071],[0,1074,0,1072],[0,1
075,0,1073],[0,1076,0,1074],[0,1077,0,1075],[5,1077,0,1076],[0,1079,5,1078]
,[0,1080,0,1078],[0,1081,0,1079],[0,1082,0,1080],[0,1083,0,1081],[0,1084,0,
1082],[0,1085,0,1083],[0,1086,0,1084],[0,1087,0,1085],[0,1088,0,1086],[0,10
89,0,1087],[0,1090,0,1088],[0,1091,0,1089],[-1,-1,0,1090],[0,1093,-1,-
1],[0,1094,0,1092],[0,1095,0,1093],[0,1096,0,1094],[0,1097,0,1095],[0,1098,
0,1096],[0,1099,0,1097],[0,1100,0,1098],[0,1101,0,1099],[0,1102,0,1100],[0,
1103,0,1101],[0,1104,0,1102],[0,1105,0,1103],[1,1105,0,1104],[0,1107,1,1106
],[0,1108,0,1106],[0,1109,0,1107],[0,1110,0,1108],[0,1111,0,1109],[0,1112,0
,1110],[0,1113,0,1111],[0,1114,0,1112],[0,1115,0,1113],[0,1116,0,1114],[0,1
117,0,1115],[0,1118,0,1116],[0,1119,0,1117],[5,1119,0,1118],[0,1121,5,1120]
,[0,1122,0,1120],[0,1123,0,1121],[0,1124,0,1122],[0,1125,0,1123],[0,1126,0,
1124],[0,1127,0,1125],[0,1128,0,1126],[0,1129,0,1127],[0,1130,0,1128],[0,11
31,0,1129],[0,1132,0,1130],[0,1133,0,1131],[-1,-1,0,1132],[0,1135,-1,-
1],[0,1136,0,1134],[0,1137,0,1135],[0,1138,0,1136],[0,1139,0,1137],[0,1140,
0,1138],[0,1141,0,1139],[0,1142,0,1140],[0,1143,0,1141],[0,1144,0,1142],[0,
1145,0,1143],[0,1146,0,1144],[0,1147,0,1145],[1,1147,0,1146],[0,1149,1,1148
],[0,1150,0,1148],[0,1151,0,1149],[0,1152,0,1150],[0,1153,0,1151],[0,1154,0
,1152],[0,1155,0,1153],[0,1156,0,1154],[0,1157,0,1155],[0,1158,0,1156],[0,1
159,0,1157],[0,1160,0,1158],[0,1161,0,1159],[5,1161,0,1160],[0,1163,5,1162]
,[0,1164,0,1162],[0,1165,0,1163],[0,1166,0,1164],[0,1167,0,1165],[0,1168,0,
1166],[0,1169,0,1167],[0,1170,0,1168],[0,1171,0,1169],[0,1172,0,1170],[0,11
73,0,1171],[0,1174,0,1172],[0,1175,0,1173],[-1,-1,0,1174],[0,1177,-1,-
1],[0,1178,0,1176],[0,1179,0,1177],[0,1180,0,1178],[0,1181,0,1179],[0,1182,
0,1180],[0,1183,0,1181],[0,1184,0,1182],[0,1185,0,1183],[0,1186,0,1184],[0,
1187,0,1185],[0,1188,0,1186],[0,1189,0,1187],[1,1189,0,1188],[0,1191,1,1190
],[0,1192,0,1190],[0,1193,0,1191],[0,1194,0,1192],[0,1195,0,1193],[0,1196,0
,1194],[0,1197,0,1195],[0,1198,0,1196],[0,1199,0,1197],[0,1200,0,1198],[0,1
201,0,1199],[0,1202,0,1200],[0,1203,0,1201],[5,1203,0,1202],[0,1205,5,1204]
,[0,1206,0,1204],[0,1207,0,1205],[0,1208,0,1206],[0,1209,0,1207],[0,1210,0,
1208],[0,1211,0,1209],[0,1212,0,1210],[0,1213,0,1211],[0,1214,0,1212],[0,12
15,0,1213],[0,1216,0,1214],[0,1217,0,1215],[-1,-1,0,1216],[0,1219,-1,-
1],[0,1220,0,1218],[0,1221,0,1219],[0,1222,0,1220],[0,1223,0,1221],[0,1224,
0,1222],[0,1225,0,1223],[0,1226,0,1224],[0,1227,0,1225],[0,1228,0,1226],[0,
1229,0,1227],[0,1230,0,1228],[0,1231,0,1229],[1,1231,0,1230],[0,1233,1,1232
],[0,1234,0,1232],[0,1235,0,1233],[0,1236,0,1234],[0,1237,0,1235],[0,1238,0
,1236],[0,1239,0,1237],[0,1240,0,1238],[0,1241,0,1239],[0,1242,0,1240],[0,1
243,0,1241],[0,1244,0,1242],[0,1245,0,1243],[5,1245,0,1244],[0,1247,5,1246]
,[0,1248,0,1246],[0,1249,0,1247],[0,1250,0,1248],[0,1251,0,1249],[0,1252,0,
1250],[0,1253,0,1251],[0,1254,0,1252],[0,1255,0,1253],[0,1256,0,1254],[0,12
57,0,1255],[0,1258,0,1256],[0,1259,0,1257],[-1,-1,0,1258],[0,1261,-1,-
1],[0,1262,0,1260],[0,1263,0,1261],[0,1264,0,1262],[0,1265,0,1263],[0,1266,
0,1264],[0,1267,0,1265],[0,1268,0,1266],[0,1269,0,1267],[0,1270,0,1268],[0,
1271,0,1269],[0,1272,0,1270],[0,1273,0,1271],[1,1273,0,1272],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1487

1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"col":12,"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1488

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-
1],[1,40,0,41],[0,40,0,42],[0,41,0,43],[0,42,0,44],[0,43,0,45],[0,44,0,46],
[0,45,0,47],[0,46,0,48],[0,47,0,49],[0,48,0,50],[0,49,0,51],[0,50,0,52],[0,
51,0,53],[0,52,0,54],[0,53,0,55],[0,54,0,56],[0,55,0,57],[0,56,0,58],[0,57,
0,59],[0,58,0,60],[0,59,0,61],[0,60,0,62],[0,61,0,63],[0,62,0,64],[0,63,0,6
5],[0,64,0,66],[0,65,0,67],[0,66,0,68],[0,67,0,69],[0,68,0,70],[0,69,0,71],
[0,70,0,72],[0,71,0,73],[0,72,0,74],[0,73,0,75],[0,74,0,76],[0,75,0,77],[0,
76,0,78],[0,77,0,79],[0,78,0,80],[0,79,0,81],[0,80,0,82],[0,81,0,83],[0,82,
0,84],[0,83,0,85],[0,84,0,86],[0,85,0,87],[0,86,0,88],[0,87,0,89],[0,88,0,9
0],[0,89,0,91],[0,90,0,92],[0,91,0,93],[0,92,0,94],[0,93,0,95],[0,94,0,96],
[0,95,0,97],[0,96,0,98],[0,97,0,99],[0,98,0,100],[0,99,0,101],[0,100,0,102]
,[0,101,0,103],[0,102,0,104],[0,103,0,105],[0,104,0,106],[0,105,0,107],[0,1
06,0,108],[0,107,0,109],[0,108,0,110],[0,109,0,111],[0,110,0,112],[0,111,0,
113],[0,112,0,114],[0,113,0,115],[0,114,0,116],[0,115,0,117],[0,116,0,118],
[0,117,0,119],[0,118,0,120],[0,119,0,121],[0,120,0,122],[0,121,0,123],[0,12
2,0,124],[0,123,0,125],[0,124,0,126],[0,125,0,127],[0,126,0,128],[0,127,0,1
29],[0,128,0,130],[0,129,0,131],[0,130,0,132],[0,131,0,133],[0,132,0,134],[
0,133,0,135],[0,134,0,136],[0,135,0,137],[0,136,0,138],[0,137,0,139],[0,138
,0,140],[0,139,0,141],[0,140,0,142],[0,141,0,143],[0,142,0,144],[0,143,0,14

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1489

5],[0,144,0,146],[0,145,0,147],[0,146,0,148],[0,147,0,149],[0,148,0,150],[0
,149,0,151],[0,150,0,152],[0,151,0,153],[0,152,0,154],[0,153,0,155],[0,154,
0,156],[0,155,0,157],[0,156,0,158],[0,157,0,159],[0,158,0,160],[0,159,0,161
],[0,160,0,162],[0,161,0,163],[0,162,0,164],[0,163,0,165],[0,164,0,166],[0,
165,0,167],[0,166,0,168],[0,167,0,169],[0,168,0,170],[0,169,0,171],[0,170,0
,172],[0,171,0,173],[0,172,0,174],[0,173,0,175],[0,174,0,176],[0,175,0,177]
,[0,176,0,178],[0,177,0,179],[0,178,0,180],[0,179,0,181],[0,180,0,182],[0,1
81,0,183],[0,182,0,184],[0,183,0,185],[0,184,0,186],[0,185,0,187],[0,186,0,
188],[0,187,0,189],[0,188,0,190],[0,189,0,191],[0,190,0,192],[0,191,0,193],
[0,192,0,194],[0,193,0,195],[0,194,0,196],[0,195,0,197],[0,196,0,198],[0,19
7,0,199],[0,198,0,200],[0,199,0,201],[0,200,0,202],[0,201,0,203],[0,202,0,2
04],[0,203,0,205],[0,204,0,206],[0,205,0,207],[0,206,0,208],[0,207,0,209],[
0,208,0,210],[0,209,0,211],[0,210,0,212],[0,211,0,213],[0,212,0,214],[0,213
,0,215],[0,214,0,216],[0,215,0,217],[0,216,0,218],[0,217,0,219],[0,218,0,22
0],[0,219,0,221],[0,220,0,222],[0,221,0,223],[0,222,0,224],[0,223,0,225],[0
,224,0,226],[0,225,0,227],[0,226,0,228],[0,227,0,229],[0,228,0,230],[0,229,
0,231],[0,230,0,232],[0,231,0,233],[0,232,0,234],[0,233,0,235],[0,234,0,236
],[0,235,0,237],[0,236,0,238],[0,237,0,239],[0,238,0,240],[0,239,0,241],[0,
240,0,242],[0,241,0,243],[0,242,0,244],[0,243,0,245],[0,244,0,246],[0,245,0
,247],[0,246,0,248],[0,247,0,249],[0,248,0,250],[0,249,0,251],[0,250,0,252]
,[0,251,0,253],[0,252,0,254],[0,253,0,255],[0,254,0,256],[0,255,0,257],[0,2
56,0,258],[0,257,0,259],[0,258,0,260],[0,259,0,261],[0,260,0,262],[0,261,0,
263],[0,262,0,264],[0,263,0,265],[0,264,0,266],[0,265,0,267],[0,266,0,268],
[0,267,0,269],[0,268,0,270],[0,269,0,271],[0,270,0,272],[0,271,0,273],[0,27
2,0,274],[0,273,0,275],[0,274,0,276],[0,275,0,277],[0,276,0,278],[0,277,0,2
79],[0,278,0,280],[0,279,0,281],[0,280,0,282],[0,281,0,283],[0,282,0,284],[
0,283,0,285],[0,284,0,286],[0,285,0,287],[0,286,0,288],[0,287,0,289],[0,288
,0,290],[0,289,0,291],[0,290,0,292],[0,291,0,293],[0,292,0,294],[0,293,0,29
5],[0,294,0,296],[0,295,0,297],[0,296,0,298],[0,297,0,299],[0,298,0,300],[0
,299,0,301],[0,300,0,302],[0,301,0,303],[0,302,0,304],[0,303,0,305],[0,304,
0,306],[0,305,0,307],[0,306,0,308],[0,307,0,309],[0,308,0,310],[0,309,0,311
],[0,310,0,312],[0,311,0,313],[0,312,0,314],[0,313,0,315],[0,314,0,316],[0,
315,0,317],[0,316,0,318],[0,317,0,319],[0,318,0,320],[0,319,0,321],[0,320,0
,322],[0,321,0,323],[0,322,0,324],[0,323,0,325],[0,324,0,326],[0,325,0,327]
,[0,326,0,328],[0,327,0,329],[0,328,0,330],[0,329,0,331],[0,330,0,332],[0,3
31,0,333],[0,332,0,334],[0,333,0,335],[0,334,0,336],[0,335,0,337],[0,336,0,
338],[0,337,0,339],[0,338,0,340],[0,339,0,341],[0,340,0,342],[0,341,0,343],
[0,342,0,344],[0,343,0,345],[0,344,0,346],[0,345,0,347],[0,346,0,348],[0,34
7,0,349],[0,348,0,350],[0,349,0,351],[0,350,0,352],[0,351,0,353],[0,352,0,3
54],[0,353,0,355],[0,354,0,356],[0,355,0,357],[0,356,0,358],[0,357,0,359],[
0,358,0,360],[0,359,0,361],[0,360,0,362],[0,361,0,363],[0,362,0,364],[0,363
,0,365],[0,364,0,366],[0,365,0,367],[0,366,0,368],[0,367,0,369],[0,368,0,37
0],[0,369,0,371],[0,370,0,372],[0,371,0,373],[0,372,0,374],[0,373,0,375],[0
,374,0,376],[0,375,0,377],[0,376,0,378],[0,377,0,379],[0,378,0,380],[0,379,
0,381],[0,380,0,382],[0,381,0,383],[0,382,0,384],[0,383,0,385],[0,384,0,386
],[0,385,0,387],[0,386,0,388],[0,387,0,389],[0,388,0,390],[0,389,0,391],[0,
390,0,392],[0,391,0,393],[0,392,0,394],[0,393,0,395],[0,394,0,396],[0,395,0
,397],[0,396,0,398],[0,397,0,399],[0,398,0,400],[0,399,0,401],[0,400,0,402]
,[0,401,0,403],[0,402,0,404],[0,403,0,405],[0,404,0,406],[0,405,0,407],[0,4
06,0,408],[0,407,0,409],[0,408,0,410],[0,409,0,411],[0,410,0,412],[0,411,0,
413],[0,412,0,414],[0,413,0,415],[0,414,0,416],[0,415,0,417],[0,416,0,418],
[0,417,0,419],[0,418,0,420],[0,419,0,421],[0,420,0,422],[0,421,0,423],[0,42
2,0,424],[0,423,0,425],[0,424,0,426],[0,425,0,427],[0,426,0,428],[0,427,0,4

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1490

29],[0,428,0,430],[0,429,0,431],[0,430,0,432],[0,431,0,433],[0,432,0,434],[0,433,0,435],[0,434,0,436],[0,435,0,437],[0,436,0,438],[0,437,0,439],[0,438,0,440],[0,439,0,441],[0,440,0,442],[0,441,0,443],[0,442,0,444],[0,443,0,445],[0,444,0,446],[0,445,0,447],[0,446,0,448],[0,447,0,449],[0,448,0,450],[0,449,0,451],[0,450,0,452],[0,451,0,453],[0,452,0,454],[0,453,0,455],[0,454,0,456],[0,455,0,457],[0,456,0,458],[0,457,0,459],[0,458,0,460],[0,459,0,461],[0,460,0,462],[0,461,0,463],[0,462,0,464],[0,463,0,465],[0,464,0,466],[0,465,0,467],[0,466,0,468],[0,467,0,469],[0,468,0,470],[0,469,0,471],[0,470,0,472],[0,471,0,473],[0,472,0,474],[0,473,0,475],[0,474,0,476],[0,475,0,477],[0,476,0,478],[0,477,0,479],[0,478,0,480],[0,479,0,481],[0,480,0,482],[0,481,0,483],[0,482,0,484],[0,483,0,485],[0,484,0,486],[0,485,0,487],[0,486,0,488],[0,487,0,489],[0,488,0,490],[0,489,0,491],[0,490,0,492],[0,491,0,493],[0,492,0,494],[0,493,0,495],[0,494,0,496],[0,495,0,497],[0,496,0,498],[0,497,0,499],[0,498,0,500],[0,499,0,501],[0,500,0,502],[0,501,0,503],[0,502,0,504],[0,503,0,505],[0,504,0,506],[0,505,0,507],[0,506,0,508],[0,507,0,509],[0,508,0,510],[0,509,0,511],[0,510,0,512],[0,511,0,513],[0,512,0,514],[0,513,0,515],[0,514,0,516],[0,515,0,517],[0,516,0,518],[0,517,0,519],[0,518,0,520],[0,519,0,521],[0,520,0,522],[0,521,0,523],[0,522,0,524],[0,523,0,525],[0,524,0,526],[0,525,0,527],[0,526,0,528],[0,527,0,529],[0,528,0,530],[0,529,0,531],[0,530,0,532],[0,531,0,533],[0,532,0,534],[0,533,0,535],[0,534,0,536],[0,535,0,537],[0,536,0,538],[0,537,0,539],[0,538,0,540],[0,539,0,541],[0,540,0,542],[0,541,0,543],[0,542,0,544],[0,543,0,545],[0,544,0,546],[0,545,0,547],[0,546,0,548],[0,547,0,549],[0,548,0,550],[0,549,0,551],[0,550,0,552],[0,551,0,553],[0,552,0,554],[0,553,0,555],[0,554,0,556],[0,555,0,557],[0,556,0,558],[0,557,0,559],[0,558,0,560],[0,559,0,561],[0,560,0,562],[0,561,0,563],[0,562,0,564],[0,563,0,565],[0,564,0,566],[0,565,0,567],[0,566,0,568],[0,567,0,569],[0,568,0,570],[0,569,0,571],[0,570,0,572],[0,571,0,573],[0,572,0,574],[0,573,0,575],[0,574,0,576],[0,575,0,577],[0,576,0,578],[0,577,0,579],[0,578,0,580],[0,579,0,581],[0,580,0,582],[0,581,0,583],[0,582,0,584],[0,583,0,585],[0,584,0,586],[0,585,0,587],[0,586,0,588],[0,587,0,589],[0,588,0,590],[0,589,0,591],[0,590,0,592],[0,591,0,593],[0,592,0,594],[0,593,0,595],[0,594,0,596],[0,595,0,597],[0,596,0,598],[0,597,0,599],[0,598,0,600],[0,599,0,601],[0,600,0,602],[0,601,0,603],[0,602,0,604],[0,603,0,605],[0,604,0,606],[0,605,0,607],[0,606,0,608],[0,607,0,609],[0,608,0,610],[0,609,0,611],[0,610,0,612],[0,611,0,613],[0,612,0,614],[0,613,0,615],[0,614,0,616],[0,615,0,617],[0,616,0,618],[0,617,0,619],[0,618,0,620],[0,619,0,621],[0,620,0,622],[0,621,0,623],[0,622,0,624],[0,623,0,625],[0,624,0,626],[0,625,0,627],[0,626,0,628],[0,627,0,629],[0,628,0,630],[0,629,0,631],[0,630,0,632],[0,631,0,633],[0,632,0,634],[0,633,0,635],[0,634,0,636],[0,635,0,637],[0,636,0,638],[0,637,0,639],[0,638,0,640],[0,639,0,641],[0,640,0,642],[0,641,0,643],[0,642,0,644],[0,643,0,645],[0,644,0,646],[0,645,0,647],[0,646,0,648],[0,647,0,649],[0,648,0,650],[0,649,0,651],[0,650,0,652],[0,651,0,653],[0,652,0,654],[0,653,0,655],[0,654,0,656],[0,655,0,657],[0,656,0,658],[0,657,0,659],[0,658,0,660],[0,659,0,661],[0,660,0,662],[0,661,0,663],[0,662,0,664],[0,663,0,665],[0,664,0,666],[0,665,0,667],[0,666,0,668],[0,667,0,669],[0,668,0,670],[0,669,0,671],[0,670,0,672],[0,671,0,673],[0,672,0,674],[0,673,0,675],[0,674,0,676],[0,675,0,677],[0,676,0,678],[0,677,0,679],[0,678,0,680],[0,679,0,681],[0,680,0,682],[0,681,0,683],[0,682,0,684],[0,683,0,685],[0,684,0,686],[0,685,0,687],[0,686,0,688],[0,687,0,689],[0,688,0,690],[0,689,0,691],[0,690,0,692],[0,691,0,693],[0,692,0,694],[0,693,0,695],[0,694,0,696],[0,695,0,697],[0,696,0,698],[0,697,0,699],[0,698,0,700],[0,699,0,701],[0,700,0,702],[0,701,0,703],[0,702,0,704],[0,703,0,705],[0,704,0,706],[0,705,0,707],[0,706,0,708],[0,707,0,709],[0,708,0,710],[0,709,0,711],[0,710,0,712],[0,711,0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1491

713],[0,712,0,714],[0,713,0,715],[0,714,0,716],[0,715,0,717],[0,716,0,718],
[0,717,0,719],[0,718,0,720],[0,719,0,721],[0,720,0,722],[0,721,0,723],[0,72
2,0,724],[0,723,0,725],[0,724,0,726],[0,725,0,727],[0,726,0,728],[0,727,0,7
29],[0,728,0,730],[0,729,0,731],[0,730,0,732],[0,731,0,733],[0,732,0,734],[
0,733,0,735],[0,734,0,736],[0,735,0,737],[0,736,0,738],[0,737,0,739],[0,738
,0,740],[0,739,0,741],[0,740,0,742],[0,741,0,743],[0,742,0,744],[0,743,0,74
5],[0,744,0,746],[0,745,0,747],[0,746,0,748],[0,747,0,749],[0,748,0,750],[0
,749,0,751],[0,750,0,752],[0,751,0,753],[0,752,0,754],[0,753,0,755],[0,754,
0,756],[0,755,0,757],[0,756,0,758],[0,757,0,759],[0,758,0,760],[0,759,0,761
],[0,760,0,762],[0,761,0,763],[0,762,0,764],[0,763,0,765],[0,764,0,766],[0,
765,0,767],[0,766,0,768],[0,767,0,769],[0,768,0,770],[0,769,0,771],[0,770,0
,772],[0,771,0,773],[0,772,0,774],[0,773,0,775],[0,774,0,776],[0,775,0,777]
,[0,776,0,778],[0,777,0,779],[0,778,0,780],[0,779,0,781],[0,780,0,782],[0,7
81,0,783],[0,782,0,784],[0,783,0,785],[0,784,0,786],[0,785,0,787],[0,786,0,
788],[0,787,0,789],[0,788,0,790],[0,789,0,791],[0,790,0,792],[0,791,0,793],
[0,792,0,794],[0,793,0,795],[0,794,0,796],[0,795,0,797],[0,796,0,798],[0,79
7,0,799],[0,798,0,800],[0,799,0,801],[0,800,0,802],[0,801,0,803],[0,802,0,8
04],[0,803,0,805],[0,804,0,806],[0,805,0,807],[0,806,0,808],[0,807,0,809],[
0,808,0,810],[0,809,0,811],[0,810,0,812],[0,811,0,813],[0,812,0,814],[0,813
,0,815],[0,814,0,816],[0,815,0,817],[0,816,0,818],[0,817,0,819],[0,818,0,82
0],[0,819,0,821],[0,820,0,822],[0,821,0,823],[0,822,0,824],[0,823,0,825],[0
,824,0,826],[0,825,0,827],[0,826,0,828],[0,827,0,829],[0,828,0,830],[0,829,
0,831],[0,830,0,832],[0,831,0,833],[0,832,0,834],[0,833,0,835],[0,834,0,836
],[0,835,0,837],[0,836,0,838],[0,837,0,839],[0,838,0,840],[0,839,0,841],[0,
840,0,842],[0,841,0,843],[0,842,0,844],[0,843,0,845],[0,844,0,846],[0,845,0
,847],[0,846,0,848],[0,847,0,849],[0,848,0,850],[0,849,0,851],[0,850,0,852]
,[0,851,0,853],[0,852,0,854],[0,853,0,855],[0,854,0,856],[0,855,0,857],[0,8
56,0,858],[0,857,0,859],[0,858,0,860],[0,859,0,861],[0,860,0,862],[0,861,0,
863],[0,862,0,864],[0,863,0,865],[0,864,0,866],[0,865,0,867],[0,866,0,868],
[0,867,0,869],[0,868,0,870],[0,869,0,871],[0,870,0,872],[0,871,0,873],[0,87
2,0,874],[0,873,0,875],[0,874,0,876],[0,875,0,877],[0,876,0,878],[0,877,0,8
79],[0,878,0,880],[0,879,0,881],[0,880,0,882],[0,881,0,883],[0,882,0,884],[
0,883,0,885],[0,884,0,886],[0,885,0,887],[0,886,0,888],[0,887,0,889],[0,888
,0,890],[0,889,0,891],[0,890,0,892],[0,891,0,893],[0,892,0,894],[0,893,0,89
5],[0,894,0,896],[0,895,0,897],[0,896,0,898],[0,897,0,899],[0,898,0,900],[0
,899,0,901],[0,900,0,902],[0,901,0,903],[0,902,0,904],[0,903,0,905],[0,904,
0,906],[0,905,0,907],[0,906,0,908],[0,907,0,909],[0,908,0,910],[0,909,0,911
],[0,910,0,912],[0,911,0,913],[0,912,0,914],[0,913,0,915],[0,914,0,916],[0,
915,0,917],[0,916,0,918],[0,917,0,919],[0,918,0,920],[0,919,0,921],[0,920,0
,922],[0,921,0,923],[0,922,0,924],[0,923,0,925],[0,924,0,926],[0,925,0,927]
,[0,926,0,928],[0,927,0,929],[0,928,0,930],[0,929,0,931],[0,930,0,932],[0,9
31,0,933],[0,932,0,934],[0,933,0,935],[0,934,0,936],[0,935,0,937],[0,936,0,
938],[0,937,0,939],[0,938,0,940],[0,939,0,941],[0,940,0,942],[0,941,0,943],
[0,942,0,944],[0,943,0,945],[0,944,0,946],[0,945,0,947],[0,946,0,948],[0,94
7,0,949],[0,948,0,950],[0,949,0,951],[0,950,0,952],[0,951,0,953],[0,952,0,9
54],[0,953,0,955],[0,954,0,956],[0,955,0,957],[0,956,0,958],[0,957,0,959],[
0,958,0,960],[0,959,0,961],[0,960,0,962],[0,961,0,963],[0,962,0,964],[0,963
,0,965],[0,964,0,966],[0,965,0,967],[0,966,0,968],[0,967,0,969],[0,968,0,97
0],[0,969,0,971],[0,970,0,972],[0,971,0,973],[0,972,0,974],[0,973,0,975],[0
,974,0,976],[0,975,0,977],[0,976,0,978],[0,977,0,979],[0,978,0,980],[0,979,
0,981],[0,980,0,982],[0,981,0,983],[0,982,0,984],[0,983,0,985],[0,984,0,986
],[0,985,0,987],[0,986,0,988],[0,987,0,989],[0,988,0,990],[0,989,0,991],[0,
990,0,992],[0,991,0,993],[0,992,0,994],[0,993,0,995],[0,994,0,996],[0,995,0

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1492

,997],[0,996,0,998],[0,997,0,999],[0,998,0,1000],[0,999,0,1001],[0,1000,0,1
002],[0,1001,0,1003],[0,1002,0,1004],[0,1003,0,1005],[0,1004,0,1006],[0,100
5,0,1007],[0,1006,0,1008],[0,1007,0,1009],[0,1008,0,1010],[0,1009,0,1011],[
0,1010,0,1012],[0,1011,0,1013],[0,1012,0,1014],[0,1013,0,1015],[0,1014,0,10
16],[0,1015,0,1017],[0,1016,0,1018],[0,1017,0,1019],[0,1018,0,1020],[0,1019
,0,1021],[0,1020,0,1022],[0,1021,0,1023],[0,1022,0,1024],[0,1023,0,1025],[0
,1024,0,1026],[0,1025,0,1027],[0,1026,0,1028],[0,1027,0,1029],[0,1028,0,103
0],[0,1029,0,1031],[0,1030,0,1032],[0,1031,0,1033],[0,1032,0,1034],[0,1033,
0,1035],[0,1034,0,1036],[0,1035,0,1037],[0,1036,0,1038],[0,1037,0,1039],[0,
1038,0,1040],[0,1039,0,1041],[0,1040,0,1042],[0,1041,0,1043],[0,1042,0,1044
],[0,1043,0,1045],[0,1044,0,1046],[0,1045,0,1047],[0,1046,0,1048],[0,1047,0
,1049],[0,1048,0,1050],[0,1049,0,1051],[0,1050,0,1052],[0,1051,0,1053],[0,1
052,0,1054],[0,1053,0,1055],[0,1054,0,1056],[0,1055,0,1057],[0,1056,0,1058]
,[0,1057,0,1059],[0,1058,0,1060],[0,1059,0,1061],[0,1060,0,1062],[0,1061,0,
1063],[0,1062,0,1064],[0,1063,0,1065],[0,1064,0,1066],[0,1065,0,1067],[0,10
66,0,1068],[0,1067,0,1069],[0,1068,0,1070],[0,1069,0,1071],[0,1070,0,1072],
[0,1071,0,1073],[0,1072,0,1074],[0,1073,0,1075],[0,1074,0,1076],[0,1075,0,1
077],[0,1076,0,1078],[0,1077,0,1079],[0,1078,0,1080],[0,1079,0,1081],[0,108
0,0,1082],[0,1081,0,1083],[0,1082,0,1084],[0,1083,0,1085],[0,1084,0,1086],[
0,1085,0,1087],[0,1086,0,1088],[0,1087,0,1089],[0,1088,0,1090],[0,1089,-1,-
1],[-1,-
1,0,1092],[0,1091,0,1093],[0,1092,0,1094],[0,1093,0,1095],[0,1094,0,1096],[
0,1095,0,1097],[0,1096,0,1098],[0,1097,0,1099],[0,1098,0,1100],[0,1099,0,11
01],[0,1100,0,1102],[0,1101,0,1103],[0,1102,0,1104],[0,1103,0,1105],[0,1104
,0,1106],[0,1105,0,1107],[0,1106,0,1108],[0,1107,0,1109],[0,1108,0,1110],[0
,1109,0,1111],[0,1110,0,1112],[0,1111,0,1113],[0,1112,0,1114],[0,1113,0,111
5],[0,1114,0,1116],[0,1115,0,1117],[0,1116,0,1118],[0,1117,0,1119],[0,1118,
0,1120],[0,1119,0,1121],[0,1120,0,1122],[0,1121,0,1123],[0,1122,0,1124],[0,
1123,0,1125],[0,1124,0,1126],[0,1125,0,1127],[0,1126,0,1128],[0,1127,0,1129
],[0,1128,0,1130],[0,1129,0,1131],[0,1130,0,1132],[0,1131,0,1133],[0,1132,0
,1134],[0,1133,0,1135],[0,1134,0,1136],[0,1135,0,1137],[0,1136,0,1138],[0,1
137,0,1139],[0,1138,0,1140],[0,1139,0,1141],[0,1140,0,1142],[0,1141,0,1143]
,[0,1142,0,1144],[0,1143,0,1145],[0,1144,0,1146],[0,1145,0,1147],[0,1146,0,
1148],[0,1147,0,1149],[0,1148,0,1150],[0,1149,0,1151],[0,1150,0,1152],[0,11
51,0,1153],[0,1152,0,1154],[0,1153,0,1155],[0,1154,0,1156],[0,1155,0,1157],
[0,1156,0,1158],[0,1157,0,1159],[0,1158,0,1160],[0,1159,0,1161],[0,1160,0,1
162],[0,1161,0,1163],[0,1162,0,1164],[0,1163,0,1165],[0,1164,0,1166],[0,116
5,0,1167],[0,1166,0,1168],[0,1167,0,1169],[0,1168,0,1170],[0,1169,0,1171],[
0,1170,0,1172],[0,1171,0,1173],[0,1172,0,1174],[0,1173,0,1175],[0,1174,0,11
76],[0,1175,0,1177],[0,1176,0,1178],[0,1177,0,1179],[0,1178,0,1180],[0,1179
,0,1181],[0,1180,0,1182],[0,1181,0,1183],[0,1182,0,1184],[0,1183,0,1185],[0
,1184,0,1186],[0,1185,0,1187],[0,1186,0,1188],[0,1187,0,1189],[0,1188,0,119
0],[0,1189,0,1191],[0,1190,0,1192],[0,1191,0,1193],[0,1192,0,1194],[0,1193,
0,1195],[0,1194,0,1196],[0,1195,0,1197],[0,1196,0,1198],[0,1197,0,1199],[0,
1198,0,1200],[0,1199,0,1201],[0,1200,0,1202],[0,1201,0,1203],[0,1202,0,1204
],[0,1203,0,1205],[0,1204,0,1206],[0,1205,0,1207],[0,1206,0,1208],[0,1207,0
,1209],[0,1208,0,1210],[0,1209,0,1211],[0,1210,0,1212],[0,1211,0,1213],[0,1
212,0,1214],[0,1213,0,1215],[0,1214,0,1216],[0,1215,0,1217],[0,1216,0,1218]
,[0,1217,0,1219],[0,1218,0,1220],[0,1219,0,1221],[0,1220,0,1222],[0,1221,0,
1223],[0,1222,0,1224],[0,1223,0,1225],[0,1224,0,1226],[0,1225,0,1227],[0,12
26,0,1228],[0,1227,0,1229],[0,1228,0,1230],[0,1229,0,1231],[0,1230,0,1232],
[0,1231,0,1233],[0,1232,0,1234],[0,1233,0,1235],[0,1234,0,1236],[0,1235,0,1
237],[0,1236,0,1238],[0,1237,0,1239],[0,1238,0,1240],[0,1239,0,1241],[0,124

0,0,1242],[0,1241,0,1243],[0,1242,0,1244],[0,1243,0,1245],[0,1244,0,1246],[
0,1245,0,1247],[0,1246,0,1248],[0,1247,0,1249],[0,1248,0,1250],[0,1249,0,12
51],[0,1250,0,1252],[0,1251,0,1253],[0,1252,0,1254],[0,1253,0,1255],[0,1254
,0,1256],[0,1255,0,1257],[0,1256,1,1257],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1]],"row":16,"num":0},{"stap_colors":[[40,3355443],[70,1507550],[112,150755
0],[154,8947848],[197,8947848],[239,8947848],[280,8947848],[322,8947848],[3
64,8947848],[406,8947848],[448,8947848],[490,8947848],[532,8947848],[574,89
47848],[616,8947848],[658,8947848],[700,8947848],[742,8947848],[784,8947848
],[826,8947848],[868,8947848],[910,8947848],[952,8947848],[994,8947848],[10
36,8947848],[1078,8947848],[1120,8947848],[1162,8947848],[1204,8947848],[12
46,3355443]],"stap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,1,41],[1,40,1,42],[1,41,1,43],[1,42,1,44],[1,43,1,45],[1,44,1,46],[1,45,1
,47],[1,46,1,48],[1,47,1,49],[1,48,1,50],[1,49,1,51],[1,50,1,52],[1,51,1,53
],[1,52,1,54],[1,53,1,55],[1,54,0,55],[0,56,1,57],[1,56,1,58],[1,57,1,59],[
1,58,1,60],[1,59,1,61],[1,60,1,62],[1,61,1,63],[1,62,1,64],[1,63,1,65],[1,6
4,1,66],[1,65,1,67],[1,66,1,68],[1,67,1,69],[1,68,-1,-1],[-1,-
1,1,71],[1,70,1,72],[1,71,1,73],[1,72,1,74],[1,73,1,75],[1,74,1,76],[1,75,1
,77],[1,76,1,78],[1,77,1,79],[1,78,1,80],[1,79,1,81],[1,80,1,82],[1,81,1,83
],[1,82,2,83],[2,84,1,85],[1,84,1,86],[1,85,1,87],[1,86,1,88],[1,87,1,89],[
1,88,1,90],[1,89,1,91],[1,90,1,92],[1,91,1,93],[1,92,1,94],[1,93,1,95],[1,9
4,1,96],[1,95,1,97],[1,96,0,97],[0,98,1,99],[1,98,1,100],[1,99,1,101],[1,10
0,1,102],[1,101,1,103],[1,102,1,104],[1,103,1,105],[1,104,1,106],[1,105,1,1
07],[1,106,1,108],[1,107,1,109],[1,108,1,110],[1,109,1,111],[1,110,-1,-
1],[-1,-
1,1,113],[1,112,1,114],[1,113,1,115],[1,114,1,116],[1,115,1,117],[1,116,1,1
18],[1,117,1,119],[1,118,1,120],[1,119,1,121],[1,120,1,122],[1,121,1,123],[
1,122,1,124],[1,123,1,125],[1,124,2,125],[2,126,1,127],[1,126,1,128],[1,127
,1,129],[1,128,1,130],[1,129,1,131],[1,130,1,132],[1,131,1,133],[1,132,1,13
4],[1,133,1,135],[1,134,1,136],[1,135,1,137],[1,136,1,138],[1,137,1,139],[1
,138,0,139],[0,140,1,141],[1,140,1,142],[1,141,1,143],[1,142,1,144],[1,143,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1494

1,145],[1,144,1,146],[1,145,1,147],[1,146,1,148],[1,147,1,149],[1,148,1,150
],[1,149,1,151],[1,150,1,152],[1,151,1,153],[1,152,-1,-1],[-1,-
1,1,155],[1,154,1,156],[1,155,1,157],[1,156,1,158],[1,157,1,159],[1,158,1,1
60],[1,159,1,161],[1,160,1,162],[1,161,1,163],[1,162,1,164],[1,163,1,165],[
1,164,1,166],[1,165,1,167],[1,166,2,167],[2,168,1,169],[1,168,1,170],[1,169
,1,171],[1,170,1,172],[1,171,1,173],[1,172,1,174],[1,173,1,175],[1,174,1,17
6],[1,175,1,177],[1,176,1,178],[1,177,1,179],[1,178,1,180],[1,179,1,181],[1
,180,0,181],[0,182,1,183],[1,182,1,184],[1,183,1,185],[1,184,1,186],[1,185,
1,187],[1,186,1,188],[1,187,1,189],[1,188,1,190],[1,189,1,191],[1,190,1,192
],[1,191,1,193],[1,192,1,194],[1,193,1,195],[1,194,1,196],[1,195,-1,-1],[-
1,-
1,1,198],[1,197,1,199],[1,198,1,200],[1,199,1,201],[1,200,1,202],[1,201,1,2
03],[1,202,1,204],[1,203,1,205],[1,204,1,206],[1,205,1,207],[1,206,1,208],[
1,207,1,209],[1,208,2,209],[2,210,1,211],[1,210,1,212],[1,211,1,213],[1,212
,1,214],[1,213,1,215],[1,214,1,216],[1,215,1,217],[1,216,1,218],[1,217,1,21
9],[1,218,1,220],[1,219,1,221],[1,220,1,222],[1,221,1,223],[1,222,0,223],[0
,224,1,225],[1,224,1,226],[1,225,1,227],[1,226,1,228],[1,227,1,229],[1,228,
1,230],[1,229,1,231],[1,230,1,232],[1,231,1,233],[1,232,1,234],[1,233,1,235
],[1,234,1,236],[1,235,1,237],[1,236,1,238],[1,237,-1,-1],[-1,-
1,1,240],[1,239,1,241],[1,240,1,242],[1,241,1,243],[1,242,1,244],[1,243,1,2
45],[1,244,1,246],[1,245,1,247],[1,246,1,248],[1,247,1,249],[1,248,1,250],[
1,249,1,251],[1,250,2,251],[2,252,1,253],[1,252,1,254],[1,253,1,255],[1,254
,1,256],[1,255,1,257],[1,256,1,258],[1,257,1,259],[1,258,1,260],[1,259,1,26
1],[1,260,1,262],[1,261,1,263],[1,262,1,264],[1,263,1,265],[1,264,0,265],[0
,266,1,267],[1,266,1,268],[1,267,1,269],[1,268,1,270],[1,269,1,271],[1,270,
1,272],[1,271,1,273],[1,272,1,274],[1,273,1,275],[1,274,1,276],[1,275,1,277
],[1,276,1,278],[1,277,1,279],[1,278,-1,-1],[-1,-
1,1,281],[1,280,1,282],[1,281,1,283],[1,282,1,284],[1,283,1,285],[1,284,1,2
86],[1,285,1,287],[1,286,1,288],[1,287,1,289],[1,288,1,290],[1,289,1,291],[
1,290,1,292],[1,291,1,293],[1,292,2,293],[2,294,1,295],[1,294,1,296],[1,295
,1,297],[1,296,1,298],[1,297,1,299],[1,298,1,300],[1,299,1,301],[1,300,1,30
2],[1,301,1,303],[1,302,1,304],[1,303,1,305],[1,304,1,306],[1,305,1,307],[1
,306,0,307],[0,308,1,309],[1,308,1,310],[1,309,1,311],[1,310,1,312],[1,311,
1,313],[1,312,1,314],[1,313,1,315],[1,314,1,316],[1,315,1,317],[1,316,1,318
],[1,317,1,319],[1,318,1,320],[1,319,1,321],[1,320,-1,-1],[-1,-
1,1,323],[1,322,1,324],[1,323,1,325],[1,324,1,326],[1,325,1,327],[1,326,1,3
28],[1,327,1,329],[1,328,1,330],[1,329,1,331],[1,330,1,332],[1,331,1,333],[
1,332,1,334],[1,333,1,335],[1,334,2,335],[2,336,1,337],[1,336,1,338],[1,337
,1,339],[1,338,1,340],[1,339,1,341],[1,340,1,342],[1,341,1,343],[1,342,1,34
4],[1,343,1,345],[1,344,1,346],[1,345,1,347],[1,346,1,348],[1,347,1,349],[1
,348,0,349],[0,350,1,351],[1,350,1,352],[1,351,1,353],[1,352,1,354],[1,353,
1,355],[1,354,1,356],[1,355,1,357],[1,356,1,358],[1,357,1,359],[1,358,1,360
],[1,359,1,361],[1,360,1,362],[1,361,1,363],[1,362,-1,-1],[-1,-
1,1,365],[1,364,1,366],[1,365,1,367],[1,366,1,368],[1,367,1,369],[1,368,1,3
70],[1,369,1,371],[1,370,1,372],[1,371,1,373],[1,372,1,374],[1,373,1,375],[
1,374,1,376],[1,375,1,377],[1,376,2,377],[2,378,1,379],[1,378,1,380],[1,379
,1,381],[1,380,1,382],[1,381,1,383],[1,382,1,384],[1,383,1,385],[1,384,1,38
6],[1,385,1,387],[1,386,1,388],[1,387,1,389],[1,388,1,390],[1,389,1,391],[1
,390,0,391],[0,392,1,393],[1,392,1,394],[1,393,1,395],[1,394,1,396],[1,395,
1,397],[1,396,1,398],[1,397,1,399],[1,398,1,400],[1,399,1,401],[1,400,1,402
],[1,401,1,403],[1,402,1,404],[1,403,1,405],[1,404,-1,-1],[-1,-
1,1,407],[1,406,1,408],[1,407,1,409],[1,408,1,410],[1,409,1,411],[1,410,1,4
12],[1,411,1,413],[1,412,1,414],[1,413,1,415],[1,414,1,416],[1,415,1,417],[

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1495

1,416,1,418],[1,417,1,419],[1,418,2,419],[2,420,1,421],[1,420,1,422],[1,421
,1,423],[1,422,1,424],[1,423,1,425],[1,424,1,426],[1,425,1,427],[1,426,1,42
8],[1,427,1,429],[1,428,1,430],[1,429,1,431],[1,430,1,432],[1,431,1,433],[1
,432,0,433],[0,434,1,435],[1,434,1,436],[1,435,1,437],[1,436,1,438],[1,437,
1,439],[1,438,1,440],[1,439,1,441],[1,440,1,442],[1,441,1,443],[1,442,1,444
],[1,443,1,445],[1,444,1,446],[1,445,1,447],[1,446,-1,-1],[-1,-
1,1,449],[1,448,1,450],[1,449,1,451],[1,450,1,452],[1,451,1,453],[1,452,1,4
54],[1,453,1,455],[1,454,1,456],[1,455,1,457],[1,456,1,458],[1,457,1,459],[
1,458,1,460],[1,459,1,461],[1,460,2,461],[2,462,1,463],[1,462,1,464],[1,463
,1,465],[1,464,1,466],[1,465,1,467],[1,466,1,468],[1,467,1,469],[1,468,1,47
0],[1,469,1,471],[1,470,1,472],[1,471,1,473],[1,472,1,474],[1,473,1,475],[1
,474,0,475],[0,476,1,477],[1,476,1,478],[1,477,1,479],[1,478,1,480],[1,479,
1,481],[1,480,1,482],[1,481,1,483],[1,482,1,484],[1,483,1,485],[1,484,1,486
],[1,485,1,487],[1,486,1,488],[1,487,1,489],[1,488,-1,-1],[-1,-
1,1,491],[1,490,1,492],[1,491,1,493],[1,492,1,494],[1,493,1,495],[1,494,1,4
96],[1,495,1,497],[1,496,1,498],[1,497,1,499],[1,498,1,500],[1,499,1,501],[
1,500,1,502],[1,501,1,503],[1,502,2,503],[2,504,1,505],[1,504,1,506],[1,505
,1,507],[1,506,1,508],[1,507,1,509],[1,508,1,510],[1,509,1,511],[1,510,1,51
2],[1,511,1,513],[1,512,1,514],[1,513,1,515],[1,514,1,516],[1,515,1,517],[1
,516,0,517],[0,518,1,519],[1,518,1,520],[1,519,1,521],[1,520,1,522],[1,521,
1,523],[1,522,1,524],[1,523,1,525],[1,524,1,526],[1,525,1,527],[1,526,1,528
],[1,527,1,529],[1,528,1,530],[1,529,1,531],[1,530,-1,-1],[-1,-
1,1,533],[1,532,1,534],[1,533,1,535],[1,534,1,536],[1,535,1,537],[1,536,1,5
38],[1,537,1,539],[1,538,1,540],[1,539,1,541],[1,540,1,542],[1,541,1,543],[
1,542,1,544],[1,543,1,545],[1,544,2,545],[2,546,1,547],[1,546,1,548],[1,547
,1,549],[1,548,1,550],[1,549,1,551],[1,550,1,552],[1,551,1,553],[1,552,1,55
4],[1,553,1,555],[1,554,1,556],[1,555,1,557],[1,556,1,558],[1,557,1,559],[1
,558,0,559],[0,560,1,561],[1,560,1,562],[1,561,1,563],[1,562,1,564],[1,563,
1,565],[1,564,1,566],[1,565,1,567],[1,566,1,568],[1,567,1,569],[1,568,1,570
],[1,569,1,571],[1,570,1,572],[1,571,1,573],[1,572,-1,-1],[-1,-
1,1,575],[1,574,1,576],[1,575,1,577],[1,576,1,578],[1,577,1,579],[1,578,1,5
80],[1,579,1,581],[1,580,1,582],[1,581,1,583],[1,582,1,584],[1,583,1,585],[
1,584,1,586],[1,585,1,587],[1,586,2,587],[2,588,1,589],[1,588,1,590],[1,589
,1,591],[1,590,1,592],[1,591,1,593],[1,592,1,594],[1,593,1,595],[1,594,1,59
6],[1,595,1,597],[1,596,1,598],[1,597,1,599],[1,598,1,600],[1,599,1,601],[1
,600,0,601],[0,602,1,603],[1,602,1,604],[1,603,1,605],[1,604,1,606],[1,605,
1,607],[1,606,1,608],[1,607,1,609],[1,608,1,610],[1,609,1,611],[1,610,1,612
],[1,611,1,613],[1,612,1,614],[1,613,1,615],[1,614,-1,-1],[-1,-
1,1,617],[1,616,1,618],[1,617,1,619],[1,618,1,620],[1,619,1,621],[1,620,1,6
22],[1,621,1,623],[1,622,1,624],[1,623,1,625],[1,624,1,626],[1,625,1,627],[
1,626,1,628],[1,627,1,629],[1,628,2,629],[2,630,1,631],[1,630,1,632],[1,631
,1,633],[1,632,1,634],[1,633,1,635],[1,634,1,636],[1,635,1,637],[1,636,1,63
8],[1,637,1,639],[1,638,1,640],[1,639,1,641],[1,640,1,642],[1,641,1,643],[1
,642,0,643],[0,644,1,645],[1,644,1,646],[1,645,1,647],[1,646,1,648],[1,647,
1,649],[1,648,1,650],[1,649,1,651],[1,650,1,652],[1,651,1,653],[1,652,1,654
],[1,653,1,655],[1,654,1,656],[1,655,1,657],[1,656,-1,-1],[-1,-
1,1,659],[1,658,1,660],[1,659,1,661],[1,660,1,662],[1,661,1,663],[1,662,1,6
64],[1,663,1,665],[1,664,1,666],[1,665,1,667],[1,666,1,668],[1,667,1,669],[
1,668,1,670],[1,669,1,671],[1,670,2,671],[2,672,1,673],[1,672,1,674],[1,673
,1,675],[1,674,1,676],[1,675,1,677],[1,676,1,678],[1,677,1,679],[1,678,1,68
0],[1,679,1,681],[1,680,1,682],[1,681,1,683],[1,682,1,684],[1,683,1,685],[1
,684,0,685],[0,686,1,687],[1,686,1,688],[1,687,1,689],[1,688,1,690],[1,689,
1,691],[1,690,1,692],[1,691,1,693],[1,692,1,694],[1,693,1,695],[1,694,1,696

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1496

],[1,695,1,697],[1,696,1,698],[1,697,1,699],[1,698,-1,-1],[-1,-
1,1,701],[1,700,1,702],[1,701,1,703],[1,702,1,704],[1,703,1,705],[1,704,1,7
06],[1,705,1,707],[1,706,1,708],[1,707,1,709],[1,708,1,710],[1,709,1,711],[
1,710,1,712],[1,711,1,713],[1,712,2,713],[2,714,1,715],[1,714,1,716],[1,715
,1,717],[1,716,1,718],[1,717,1,719],[1,718,1,720],[1,719,1,721],[1,720,1,72
2],[1,721,1,723],[1,722,1,724],[1,723,1,725],[1,724,1,726],[1,725,1,727],[1
,726,0,727],[0,728,1,729],[1,728,1,730],[1,729,1,731],[1,730,1,732],[1,731,
1,733],[1,732,1,734],[1,733,1,735],[1,734,1,736],[1,735,1,737],[1,736,1,738
],[1,737,1,739],[1,738,1,740],[1,739,1,741],[1,740,-1,-1],[-1,-
1,1,743],[1,742,1,744],[1,743,1,745],[1,744,1,746],[1,745,1,747],[1,746,1,7
48],[1,747,1,749],[1,748,1,750],[1,749,1,751],[1,750,1,752],[1,751,1,753],[
1,752,1,754],[1,753,1,755],[1,754,2,755],[2,756,1,757],[1,756,1,758],[1,757
,1,759],[1,758,1,760],[1,759,1,761],[1,760,1,762],[1,761,1,763],[1,762,1,76
4],[1,763,1,765],[1,764,1,766],[1,765,1,767],[1,766,1,768],[1,767,1,769],[1
,768,0,769],[0,770,1,771],[1,770,1,772],[1,771,1,773],[1,772,1,774],[1,773,
1,775],[1,774,1,776],[1,775,1,777],[1,776,1,778],[1,777,1,779],[1,778,1,780
],[1,779,1,781],[1,780,1,782],[1,781,1,783],[1,782,-1,-1],[-1,-
1,1,785],[1,784,1,786],[1,785,1,787],[1,786,1,788],[1,787,1,789],[1,788,1,7
90],[1,789,1,791],[1,790,1,792],[1,791,1,793],[1,792,1,794],[1,793,1,795],[
1,794,1,796],[1,795,1,797],[1,796,2,797],[2,798,1,799],[1,798,1,800],[1,799
,1,801],[1,800,1,802],[1,801,1,803],[1,802,1,804],[1,803,1,805],[1,804,1,80
6],[1,805,1,807],[1,806,1,808],[1,807,1,809],[1,808,1,810],[1,809,1,811],[1
,810,0,811],[0,812,1,813],[1,812,1,814],[1,813,1,815],[1,814,1,816],[1,815,
1,817],[1,816,1,818],[1,817,1,819],[1,818,1,820],[1,819,1,821],[1,820,1,822
],[1,821,1,823],[1,822,1,824],[1,823,1,825],[1,824,-1,-1],[-1,-
1,1,827],[1,826,1,828],[1,827,1,829],[1,828,1,830],[1,829,1,831],[1,830,1,8
32],[1,831,1,833],[1,832,1,834],[1,833,1,835],[1,834,1,836],[1,835,1,837],[
1,836,1,838],[1,837,1,839],[1,838,2,839],[2,840,1,841],[1,840,1,842],[1,841
,1,843],[1,842,1,844],[1,843,1,845],[1,844,1,846],[1,845,1,847],[1,846,1,84
8],[1,847,1,849],[1,848,1,850],[1,849,1,851],[1,850,1,852],[1,851,1,853],[1
,852,0,853],[0,854,1,855],[1,854,1,856],[1,855,1,857],[1,856,1,858],[1,857,
1,859],[1,858,1,860],[1,859,1,861],[1,860,1,862],[1,861,1,863],[1,862,1,864
],[1,863,1,865],[1,864,1,866],[1,865,1,867],[1,866,-1,-1],[-1,-
1,1,869],[1,868,1,870],[1,869,1,871],[1,870,1,872],[1,871,1,873],[1,872,1,8
74],[1,873,1,875],[1,874,1,876],[1,875,1,877],[1,876,1,878],[1,877,1,879],[
1,878,1,880],[1,879,1,881],[1,880,2,881],[2,882,1,883],[1,882,1,884],[1,883
,1,885],[1,884,1,886],[1,885,1,887],[1,886,1,888],[1,887,1,889],[1,888,1,89
0],[1,889,1,891],[1,890,1,892],[1,891,1,893],[1,892,1,894],[1,893,1,895],[1
,894,0,895],[0,896,1,897],[1,896,1,898],[1,897,1,899],[1,898,1,900],[1,899,
1,901],[1,900,1,902],[1,901,1,903],[1,902,1,904],[1,903,1,905],[1,904,1,906
],[1,905,1,907],[1,906,1,908],[1,907,1,909],[1,908,-1,-1],[-1,-
1,1,911],[1,910,1,912],[1,911,1,913],[1,912,1,914],[1,913,1,915],[1,914,1,9
16],[1,915,1,917],[1,916,1,918],[1,917,1,919],[1,918,1,920],[1,919,1,921],[
1,920,1,922],[1,921,1,923],[1,922,2,923],[2,924,1,925],[1,924,1,926],[1,925
,1,927],[1,926,1,928],[1,927,1,929],[1,928,1,930],[1,929,1,931],[1,930,1,93
2],[1,931,1,933],[1,932,1,934],[1,933,1,935],[1,934,1,936],[1,935,1,937],[1
,936,0,937],[0,938,1,939],[1,938,1,940],[1,939,1,941],[1,940,1,942],[1,941,
1,943],[1,942,1,944],[1,943,1,945],[1,944,1,946],[1,945,1,947],[1,946,1,948
],[1,947,1,949],[1,948,1,950],[1,949,1,951],[1,950,-1,-1],[-1,-
1,1,953],[1,952,1,954],[1,953,1,955],[1,954,1,956],[1,955,1,957],[1,956,1,9
58],[1,957,1,959],[1,958,1,960],[1,959,1,961],[1,960,1,962],[1,961,1,963],[
1,962,1,964],[1,963,1,965],[1,964,2,965],[2,966,1,967],[1,966,1,968],[1,967
,1,969],[1,968,1,970],[1,969,1,971],[1,970,1,972],[1,971,1,973],[1,972,1,97

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1497

4],[1,973,1,975],[1,974,1,976],[1,975,1,977],[1,976,1,978],[1,977,1,979],[1
,978,0,979],[0,980,1,981],[1,980,1,982],[1,981,1,983],[1,982,1,984],[1,983,
1,985],[1,984,1,986],[1,985,1,987],[1,986,1,988],[1,987,1,989],[1,988,1,990
],[1,989,1,991],[1,990,1,992],[1,991,1,993],[1,992,-1,-1],[-1,-
1,1,995],[1,994,1,996],[1,995,1,997],[1,996,1,998],[1,997,1,999],[1,998,1,1
000],[1,999,1,1001],[1,1000,1,1002],[1,1001,1,1003],[1,1002,1,1004],[1,1003
,1,1005],[1,1004,1,1006],[1,1005,1,1007],[1,1006,2,1007],[2,1008,1,1009],[1
,1008,1,1010],[1,1009,1,1011],[1,1010,1,1012],[1,1011,1,1013],[1,1012,1,101
4],[1,1013,1,1015],[1,1014,1,1016],[1,1015,1,1017],[1,1016,1,1018],[1,1017,
1,1019],[1,1018,1,1020],[1,1019,1,1021],[1,1020,0,1021],[0,1022,1,1023],[1,
1022,1,1024],[1,1023,1,1025],[1,1024,1,1026],[1,1025,1,1027],[1,1026,1,1028
],[1,1027,1,1029],[1,1028,1,1030],[1,1029,1,1031],[1,1030,1,1032],[1,1031,1
,1033],[1,1032,1,1034],[1,1033,1,1035],[1,1034,-1,-1],[-1,-
1,1,1037],[1,1036,1,1038],[1,1037,1,1039],[1,1038,1,1040],[1,1039,1,1041],[
1,1040,1,1042],[1,1041,1,1043],[1,1042,1,1044],[1,1043,1,1045],[1,1044,1,10
46],[1,1045,1,1047],[1,1046,1,1048],[1,1047,1,1049],[1,1048,2,1049],[2,1050
,1,1051],[1,1050,1,1052],[1,1051,1,1053],[1,1052,1,1054],[1,1053,1,1055],[1
,1054,1,1056],[1,1055,1,1057],[1,1056,1,1058],[1,1057,1,1059],[1,1058,1,106
0],[1,1059,1,1061],[1,1060,1,1062],[1,1061,1,1063],[1,1062,0,1063],[0,1064,
1,1065],[1,1064,1,1066],[1,1065,1,1067],[1,1066,1,1068],[1,1067,1,1069],[1,
1068,1,1070],[1,1069,1,1071],[1,1070,1,1072],[1,1071,1,1073],[1,1072,1,1074
],[1,1073,1,1075],[1,1074,1,1076],[1,1075,1,1077],[1,1076,-1,-1],[-1,-
1,1,1079],[1,1078,1,1080],[1,1079,1,1081],[1,1080,1,1082],[1,1081,1,1083],[
1,1082,1,1084],[1,1083,1,1085],[1,1084,1,1086],[1,1085,1,1087],[1,1086,1,10
88],[1,1087,1,1089],[1,1088,1,1090],[1,1089,1,1091],[1,1090,2,1091],[2,1092
,1,1093],[1,1092,1,1094],[1,1093,1,1095],[1,1094,1,1096],[1,1095,1,1097],[1
,1096,1,1098],[1,1097,1,1099],[1,1098,1,1100],[1,1099,1,1101],[1,1100,1,110
2],[1,1101,1,1103],[1,1102,1,1104],[1,1103,1,1105],[1,1104,0,1105],[0,1106,
1,1107],[1,1106,1,1108],[1,1107,1,1109],[1,1108,1,1110],[1,1109,1,1111],[1,
1110,1,1112],[1,1111,1,1113],[1,1112,1,1114],[1,1113,1,1115],[1,1114,1,1116
],[1,1115,1,1117],[1,1116,1,1118],[1,1117,1,1119],[1,1118,-1,-1],[-1,-
1,1,1121],[1,1120,1,1122],[1,1121,1,1123],[1,1122,1,1124],[1,1123,1,1125],[
1,1124,1,1126],[1,1125,1,1127],[1,1126,1,1128],[1,1127,1,1129],[1,1128,1,11
30],[1,1129,1,1131],[1,1130,1,1132],[1,1131,1,1133],[1,1132,2,1133],[2,1134
,1,1135],[1,1134,1,1136],[1,1135,1,1137],[1,1136,1,1138],[1,1137,1,1139],[1
,1138,1,1140],[1,1139,1,1141],[1,1140,1,1142],[1,1141,1,1143],[1,1142,1,114
4],[1,1143,1,1145],[1,1144,1,1146],[1,1145,1,1147],[1,1146,0,1147],[0,1148,
1,1149],[1,1148,1,1150],[1,1149,1,1151],[1,1150,1,1152],[1,1151,1,1153],[1,
1152,1,1154],[1,1153,1,1155],[1,1154,1,1156],[1,1155,1,1157],[1,1156,1,1158
],[1,1157,1,1159],[1,1158,1,1160],[1,1159,1,1161],[1,1160,-1,-1],[-1,-
1,1,1163],[1,1162,1,1164],[1,1163,1,1165],[1,1164,1,1166],[1,1165,1,1167],[
1,1166,1,1168],[1,1167,1,1169],[1,1168,1,1170],[1,1169,1,1171],[1,1170,1,11
72],[1,1171,1,1173],[1,1172,1,1174],[1,1173,1,1175],[1,1174,2,1175],[2,1176
,1,1177],[1,1176,1,1178],[1,1177,1,1179],[1,1178,1,1180],[1,1179,1,1181],[1
,1180,1,1182],[1,1181,1,1183],[1,1182,1,1184],[1,1183,1,1185],[1,1184,1,118
6],[1,1185,1,1187],[1,1186,1,1188],[1,1187,1,1189],[1,1188,0,1189],[0,1190,
1,1191],[1,1190,1,1192],[1,1191,1,1193],[1,1192,1,1194],[1,1193,1,1195],[1,
1194,1,1196],[1,1195,1,1197],[1,1196,1,1198],[1,1197,1,1199],[1,1198,1,1200
],[1,1199,1,1201],[1,1200,1,1202],[1,1201,1,1203],[1,1202,-1,-1],[-1,-
1,1,1205],[1,1204,1,1206],[1,1205,1,1207],[1,1206,1,1208],[1,1207,1,1209],[
1,1208,1,1210],[1,1209,1,1211],[1,1210,1,1212],[1,1211,1,1213],[1,1212,1,12
14],[1,1213,1,1215],[1,1214,1,1216],[1,1215,1,1217],[1,1216,2,1217],[2,1218
,1,1219],[1,1218,1,1220],[1,1219,1,1221],[1,1220,1,1222],[1,1221,1,1223],[1

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1498

,1222,1,1224],[1,1223,1,1225],[1,1224,1,1226],[1,1225,1,1227],[1,1226,1,122
8],[1,1227,1,1229],[1,1228,1,1230],[1,1229,1,1231],[1,1230,0,1231],[0,1232,
1,1233],[1,1232,1,1234],[1,1233,1,1235],[1,1234,1,1236],[1,1235,1,1237],[1,
1236,1,1238],[1,1237,1,1239],[1,1238,1,1240],[1,1239,1,1241],[1,1240,1,1242
],[1,1241,1,1243],[1,1242,1,1244],[1,1243,1,1245],[1,1244,-1,-1],[-1,-
1,1,1247],[1,1246,1,1248],[1,1247,1,1249],[1,1248,1,1250],[1,1249,1,1251],[
1,1250,1,1252],[1,1251,1,1253],[1,1252,1,1254],[1,1253,1,1255],[1,1254,1,12
56],[1,1255,1,1257],[1,1256,1,1258],[1,1257,1,1259],[1,1258,2,1259],[2,1260
,1,1261],[1,1260,1,1262],[1,1261,1,1263],[1,1262,1,1264],[1,1263,1,1265],[1
,1264,1,1266],[1,1265,1,1267],[1,1266,1,1268],[1,1267,1,1269],[1,1268,1,127
0],[1,1269,1,1271],[1,1270,1,1272],[1,1271,1,1273],[1,1272,0,1273],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1499

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"col":12,"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1500

1],[1,41,0,40],[1,42,1,40],[1,43,1,41],[1,44,1,42],[1,45,1,43],[1,46,1,44],[1,47,1,45],[1,48,1,46],[1,49,1,47],[1,50,1,48],[1,51,1,49],[1,52,1,50],[1,53,1,51],[1,54,1,52],[1,55,1,53],[1,56,1,54],[1,57,1,55],[1,58,1,56],[1,59,1,57],[1,60,1,58],[1,61,1,59],[1,62,1,60],[1,63,1,61],[1,64,1,62],[1,65,1,63],[1,66,1,64],[1,67,1,65],[1,68,1,66],[1,69,1,67],[1,70,1,68],[1,71,1,69],[1,72,1,70],[1,73,1,71],[1,74,1,72],[1,75,1,73],[1,76,1,74],[1,77,1,75],[1,78,1,76],[1,79,1,77],[1,80,1,78],[1,81,1,79],[1,82,1,80],[1,83,1,81],[1,84,1,82],[1,85,1,83],[1,86,1,84],[1,87,1,85],[1,88,1,86],[1,89,1,87],[1,90,1,88],[1,91,1,89],[1,92,1,90],[1,93,1,91],[1,94,1,92],[1,95,1,93],[1,96,1,94],[1,97,1,95],[1,98,1,96],[1,99,1,97],[1,100,1,98],[1,101,1,99],[1,102,1,100],[1,103,1,101],[1,104,1,102],[1,105,1,103],[1,106,1,104],[1,107,1,105],[1,108,1,106],[1,109,1,107],[1,110,1,108],[1,111,1,109],[1,112,1,110],[1,113,1,111],[1,114,1,112],[1,115,1,113],[1,116,1,114],[1,117,1,115],[1,118,1,116],[1,119,1,117],[1,120,1,118],[1,121,1,119],[1,122,1,120],[1,123,1,121],[1,124,1,122],[1,125,1,123],[1,126,1,124],[1,127,1,125],[1,128,1,126],[1,129,1,127],[1,130,1,128],[1,131,1,129],[1,132,1,130],[1,133,1,131],[1,134,1,132],[1,135,1,133],[1,136,1,134],[1,137,1,135],[1,138,1,136],[1,139,1,137],[1,140,1,138],[1,141,1,139],[1,142,1,140],[1,143,1,141],[1,144,1,142],[1,145,1,143],[1,146,1,144],[1,147,1,145],[1,148,1,146],[1,149,1,147],[1,150,1,148],[1,151,1,149],[1,152,1,150],[1,153,1,151],[1,154,1,152],[1,155,1,153],[1,156,1,154],[1,157,1,155],[1,158,1,156],[1,159,1,157],[1,160,1,158],[1,161,1,159],[1,162,1,160],[1,163,1,161],[1,164,1,162],[1,165,1,163],[1,166,1,164],[1,167,1,165],[1,168,1,166],[1,169,1,167],[1,170,1,168],[1,171,1,169],[1,172,1,170],[1,173,1,171],[1,174,1,172],[1,175,1,173],[1,176,1,174],[1,177,1,175],[1,178,1,176],[1,179,1,177],[1,180,1,178],[1,181,1,179],[1,182,1,180],[1,183,1,181],[1,184,1,182],[1,185,1,183],[1,186,1,184],[1,187,1,185],[1,188,1,186],[1,189,1,187],[1,190,1,188],[1,191,1,189],[1,192,1,190],[1,193,1,191],[1,194,1,192],[1,195,1,193],[1,196,1,194],[1,197,1,195],[1,198,1,196],[1,199,1,197],[1,200,1,198],[1,201,1,199],[1,202,1,200],[1,203,1,201],[1,204,1,202],[1,205,1,203],[1,206,1,204],[1,207,1,205],[1,208,1,206],[1,209,1,207],[1,210,1,208],[1,211,1,209],[1,212,1,210],[1,213,1,211],[1,214,1,212],[1,215,1,213],[1,216,1,214],[1,217,1,215],[1,218,1,216],[1,219,1,217],[1,220,1,218],[1,221,1,219],[1,222,1,220],[1,223,1,221],[1,224,1,222],[1,225,1,223],[1,226,1,224],[1,227,1,225],[1,228,1,226],[1,229,1,227],[1,230,1,228],[1,231,1,229],[1,232,1,230],[1,233,1,231],[1,234,1,232],[1,235,1,233],[1,236,1,234],[1,237,1,235],[1,238,1,236],[1,239,1,237],[1,240,1,238],[1,241,1,239],[1,242,1,240],[1,243,1,241],[1,244,1,242],[1,245,1,243],[1,246,1,244],[1,247,1,245],[1,248,1,246],[1,249,1,247],[1,250,1,248],[1,251,1,249],[1,252,1,250],[1,253,1,251],[1,254,1,252],[1,255,1,253],[1,256,1,254],[1,257,1,255],[1,258,1,256],[1,259,1,257],[1,260,1,258],[1,261,1,259],[1,262,1,260],[1,263,1,261],[1,264,1,262],[1,265,1,263],[1,266,1,264],[1,267,1,265],[1,268,1,266],[1,269,1,267],[1,270,1,268],[1,271,1,269],[1,272,1,270],[1,273,1,271],[1,274,1,272],[1,275,1,273],[1,276,1,274],[1,277,1,275],[1,278,1,276],[1,279,1,277],[1,280,1,278],[1,281,1,279],[1,282,1,280],[1,283,1,281],[1,284,1,282],[1,285,1,283],[1,286,1,284],[1,287,1,285],[1,288,1,286],[1,289,1,287],[1,290,1,288],[1,291,1,289],[1,292,1,290],[1,293,1,291],[1,294,1,292],[1,295,1,293],[1,296,1,294],[1,297,1,295],[1,298,1,296],[1,299,1,297],[1,300,1,298],[1,301,1,299],[1,302,1,300],[1,303,1,301],[1,304,1,302],[1,305,1,303],[1,306,1,304],[1,307,1,305],[1,308,1,306],[1,309,1,307],[1,310,1,308],[1,311,1,309],[1,312,1,310],[1,313,1,311],[1,314,1,312],[1,315,1,313],[1,316,1,314],[1,317,1,315],[1,318,1,316],[1,319,1,317],[1,320,1,318],[1,321,1,319],[1,322,1,320],[1,323,1,321],[1,324,1,322],[1,325,1,323],[1,326,1,324],[1,327,1,325],[1,328,1,326],[1,329,1,327],[1,330,1,328],[1,331,1,329],[1,332,1,330],[1,3

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1501

33,1,331],[1,334,1,332],[1,335,1,333],[1,336,1,334],[1,337,1,335],[1,338,1,336],[1,339,1,337],[1,340,1,338],[1,341,1,339],[1,342,1,340],[1,343,1,341],[1,344,1,342],[1,345,1,343],[1,346,1,344],[1,347,1,345],[1,348,1,346],[1,349,1,347],[1,350,1,348],[1,351,1,349],[1,352,1,350],[1,353,1,351],[1,354,1,352],[1,355,1,353],[1,356,1,354],[1,357,1,355],[1,358,1,356],[1,359,1,357],[1,360,1,358],[1,361,1,359],[1,362,1,360],[1,363,1,361],[1,364,1,362],[1,365,1,363],[1,366,1,364],[1,367,1,365],[1,368,1,366],[1,369,1,367],[1,370,1,368],[1,371,1,369],[1,372,1,370],[1,373,1,371],[1,374,1,372],[1,375,1,373],[1,376,1,374],[1,377,1,375],[1,378,1,376],[1,379,1,377],[1,380,1,378],[1,381,1,379],[1,382,1,380],[1,383,1,381],[1,384,1,382],[1,385,1,383],[1,386,1,384],[1,387,1,385],[1,388,1,386],[1,389,1,387],[1,390,1,388],[1,391,1,389],[1,392,1,390],[1,393,1,391],[1,394,1,392],[1,395,1,393],[1,396,1,394],[1,397,1,395],[1,398,1,396],[1,399,1,397],[1,400,1,398],[1,401,1,399],[1,402,1,400],[1,403,1,401],[1,404,1,402],[1,405,1,403],[1,406,1,404],[1,407,1,405],[1,408,1,406],[1,409,1,407],[1,410,1,408],[1,411,1,409],[1,412,1,410],[1,413,1,411],[1,414,1,412],[1,415,1,413],[1,416,1,414],[1,417,1,415],[1,418,1,416],[1,419,1,417],[1,420,1,418],[1,421,1,419],[1,422,1,420],[1,423,1,421],[1,424,1,422],[1,425,1,423],[1,426,1,424],[1,427,1,425],[1,428,1,426],[1,429,1,427],[1,430,1,428],[1,431,1,429],[1,432,1,430],[1,433,1,431],[1,434,1,432],[1,435,1,433],[1,436,1,434],[1,437,1,435],[1,438,1,436],[1,439,1,437],[1,440,1,438],[1,441,1,439],[1,442,1,440],[1,443,1,441],[1,444,1,442],[1,445,1,443],[1,446,1,444],[1,447,1,445],[1,448,1,446],[1,449,1,447],[1,450,1,448],[1,451,1,449],[1,452,1,450],[1,453,1,451],[1,454,1,452],[1,455,1,453],[1,456,1,454],[1,457,1,455],[1,458,1,456],[1,459,1,457],[1,460,1,458],[1,461,1,459],[1,462,1,460],[1,463,1,461],[1,464,1,462],[1,465,1,463],[1,466,1,464],[1,467,1,465],[1,468,1,466],[1,469,1,467],[1,470,1,468],[1,471,1,469],[1,472,1,470],[1,473,1,471],[1,474,1,472],[1,475,1,473],[1,476,1,474],[1,477,1,475],[1,478,1,476],[1,479,1,477],[1,480,1,478],[1,481,1,479],[1,482,1,480],[1,483,1,481],[1,484,1,482],[1,485,1,483],[1,486,1,484],[1,487,1,485],[1,488,1,486],[1,489,1,487],[1,490,1,488],[1,491,1,489],[1,492,1,490],[1,493,1,491],[1,494,1,492],[1,495,1,493],[1,496,1,494],[1,497,1,495],[1,498,1,496],[1,499,1,497],[1,500,1,498],[1,501,1,499],[1,502,1,500],[1,503,1,501],[1,504,1,502],[1,505,1,503],[1,506,1,504],[1,507,1,505],[1,508,1,506],[1,509,1,507],[1,510,1,508],[1,511,1,509],[1,512,1,510],[1,513,1,511],[1,514,1,512],[1,515,1,513],[1,516,1,514],[1,517,1,515],[1,518,1,516],[1,519,1,517],[1,520,1,518],[1,521,1,519],[1,522,1,520],[1,523,1,521],[1,524,1,522],[1,525,1,523],[1,526,1,524],[1,527,1,525],[1,528,1,526],[1,529,1,527],[1,530,1,528],[1,531,1,529],[1,532,1,530],[1,533,1,531],[1,534,1,532],[1,535,1,533],[1,536,1,534],[1,537,1,535],[1,538,1,536],[1,539,1,537],[1,540,1,538],[1,541,1,539],[1,542,1,540],[1,543,1,541],[1,544,1,542],[1,545,1,543],[1,546,1,544],[1,547,1,545],[1,548,1,546],[1,549,1,547],[1,550,1,548],[1,551,1,549],[1,552,1,550],[1,553,1,551],[1,554,1,552],[1,555,1,553],[1,556,1,554],[1,557,1,555],[1,558,1,556],[1,559,1,557],[1,560,1,558],[1,561,1,559],[1,562,1,560],[1,563,1,561],[1,564,1,562],[1,565,1,563],[1,566,1,564],[1,567,1,565],[1,568,1,566],[1,569,1,567],[1,570,1,568],[1,571,1,569],[1,572,1,570],[1,573,1,571],[1,574,1,572],[1,575,1,573],[1,576,1,574],[1,577,1,575],[1,578,1,576],[1,579,1,577],[1,580,1,578],[1,581,1,579],[1,582,1,580],[1,583,1,581],[1,584,1,582],[1,585,1,583],[1,586,1,584],[1,587,1,585],[1,588,1,586],[1,589,1,587],[1,590,1,588],[1,591,1,589],[1,592,1,590],[1,593,1,591],[1,594,1,592],[1,595,1,593],[1,596,1,594],[1,597,1,595],[1,598,1,596],[1,599,1,597],[1,600,1,598],[1,601,1,599],[1,602,1,600],[1,603,1,601],[1,604,1,602],[1,605,1,603],[1,606,1,604],[1,607,1,605],[1,608,1,606],[1,609,1,607],[1,610,1,608],[1,611,1,609],[1,612,1,610],[1,613,1,611],[1,614,1,612],[1,615,1,613],[1,616,1,614],[1,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1502

617,1,615],[1,618,1,616],[1,619,1,617],[1,620,1,618],[1,621,1,619],[1,622,1
,620],[1,623,1,621],[1,624,1,622],[1,625,1,623],[1,626,1,624],[1,627,1,625]
,[1,628,1,626],[1,629,1,627],[1,630,1,628],[1,631,1,629],[1,632,1,630],[1,6
33,1,631],[1,634,1,632],[1,635,1,633],[1,636,1,634],[1,637,1,635],[1,638,1,
636],[1,639,1,637],[1,640,1,638],[1,641,1,639],[1,642,1,640],[1,643,1,641],
[1,644,1,642],[1,645,1,643],[2,645,1,644],[1,647,2,646],[1,648,1,646],[1,64
9,1,647],[1,650,1,648],[1,651,1,649],[1,652,1,650],[1,653,1,651],[1,654,1,6
52],[1,655,1,653],[1,656,1,654],[1,657,1,655],[1,658,1,656],[1,659,1,657],[
1,660,1,658],[1,661,1,659],[1,662,1,660],[1,663,1,661],[1,664,1,662],[1,665
,1,663],[1,666,1,664],[1,667,1,665],[1,668,1,666],[1,669,1,667],[1,670,1,66
8],[1,671,1,669],[1,672,1,670],[1,673,1,671],[1,674,1,672],[1,675,1,673],[1
,676,1,674],[1,677,1,675],[1,678,1,676],[1,679,1,677],[1,680,1,678],[1,681,
1,679],[1,682,1,680],[1,683,1,681],[1,684,1,682],[1,685,1,683],[1,686,1,684
],[1,687,1,685],[1,688,1,686],[1,689,1,687],[1,690,1,688],[1,691,1,689],[1,
692,1,690],[1,693,1,691],[1,694,1,692],[1,695,1,693],[1,696,1,694],[1,697,1
,695],[1,698,1,696],[1,699,1,697],[1,700,1,698],[1,701,1,699],[1,702,1,700]
,[1,703,1,701],[1,704,1,702],[1,705,1,703],[1,706,1,704],[1,707,1,705],[1,7
08,1,706],[1,709,1,707],[1,710,1,708],[1,711,1,709],[1,712,1,710],[1,713,1,
711],[1,714,1,712],[1,715,1,713],[1,716,1,714],[1,717,1,715],[1,718,1,716],
[1,719,1,717],[1,720,1,718],[1,721,1,719],[1,722,1,720],[1,723,1,721],[1,72
4,1,722],[1,725,1,723],[1,726,1,724],[1,727,1,725],[1,728,1,726],[1,729,1,7
27],[1,730,1,728],[1,731,1,729],[1,732,1,730],[1,733,1,731],[1,734,1,732],[
1,735,1,733],[1,736,1,734],[1,737,1,735],[1,738,1,736],[1,739,1,737],[1,740
,1,738],[1,741,1,739],[1,742,1,740],[1,743,1,741],[1,744,1,742],[1,745,1,74
3],[1,746,1,744],[1,747,1,745],[1,748,1,746],[1,749,1,747],[1,750,1,748],[1
,751,1,749],[1,752,1,750],[1,753,1,751],[1,754,1,752],[1,755,1,753],[1,756,
1,754],[1,757,1,755],[1,758,1,756],[1,759,1,757],[1,760,1,758],[1,761,1,759
],[1,762,1,760],[1,763,1,761],[1,764,1,762],[1,765,1,763],[1,766,1,764],[1,
767,1,765],[1,768,1,766],[1,769,1,767],[1,770,1,768],[1,771,1,769],[1,772,1
,770],[1,773,1,771],[1,774,1,772],[1,775,1,773],[1,776,1,774],[1,777,1,775]
,[1,778,1,776],[1,779,1,777],[1,780,1,778],[1,781,1,779],[1,782,1,780],[1,7
83,1,781],[1,784,1,782],[1,785,1,783],[1,786,1,784],[1,787,1,785],[1,788,1,
786],[1,789,1,787],[1,790,1,788],[1,791,1,789],[1,792,1,790],[1,793,1,791],
[1,794,1,792],[1,795,1,793],[1,796,1,794],[1,797,1,795],[1,798,1,796],[1,79
9,1,797],[1,800,1,798],[1,801,1,799],[1,802,1,800],[1,803,1,801],[1,804,1,8
02],[1,805,1,803],[1,806,1,804],[1,807,1,805],[1,808,1,806],[1,809,1,807],[
1,810,1,808],[1,811,1,809],[1,812,1,810],[1,813,1,811],[1,814,1,812],[1,815
,1,813],[1,816,1,814],[1,817,1,815],[1,818,1,816],[1,819,1,817],[1,820,1,81
8],[1,821,1,819],[1,822,1,820],[1,823,1,821],[1,824,1,822],[1,825,1,823],[1
,826,1,824],[1,827,1,825],[1,828,1,826],[1,829,1,827],[1,830,1,828],[1,831,
1,829],[1,832,1,830],[1,833,1,831],[1,834,1,832],[1,835,1,833],[1,836,1,834
],[1,837,1,835],[1,838,1,836],[1,839,1,837],[1,840,1,838],[1,841,1,839],[1,
842,1,840],[1,843,1,841],[1,844,1,842],[1,845,1,843],[1,846,1,844],[1,847,1
,845],[1,848,1,846],[1,849,1,847],[1,850,1,848],[1,851,1,849],[1,852,1,850]
,[1,853,1,851],[1,854,1,852],[1,855,1,853],[1,856,1,854],[1,857,1,855],[1,8
58,1,856],[1,859,1,857],[1,860,1,858],[1,861,1,859],[1,862,1,860],[1,863,1,
861],[1,864,1,862],[1,865,1,863],[1,866,1,864],[1,867,1,865],[1,868,1,866],
[1,869,1,867],[1,870,1,868],[1,871,1,869],[1,872,1,870],[1,873,1,871],[1,87
4,1,872],[1,875,1,873],[1,876,1,874],[1,877,1,875],[1,878,1,876],[1,879,1,8
77],[1,880,1,878],[1,881,1,879],[1,882,1,880],[1,883,1,881],[1,884,1,882],[
1,885,1,883],[1,886,1,884],[1,887,1,885],[1,888,1,886],[1,889,1,887],[1,890
,1,888],[1,891,1,889],[1,892,1,890],[1,893,1,891],[1,894,1,892],[1,895,1,89
3],[1,896,1,894],[1,897,1,895],[1,898,1,896],[1,899,1,897],[1,900,1,898],[1

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1503

,901,1,899],[1,902,1,900],[1,903,1,901],[1,904,1,902],[1,905,1,903],[1,906,1,904],[1,907,1,905],[1,908,1,906],[1,909,1,907],[1,910,1,908],[1,911,1,909],[1,912,1,910],[1,913,1,911],[1,914,1,912],[1,915,1,913],[1,916,1,914],[1,917,1,915],[1,918,1,916],[1,919,1,917],[1,920,1,918],[1,921,1,919],[1,922,1,920],[1,923,1,921],[1,924,1,922],[1,925,1,923],[1,926,1,924],[1,927,1,925],[1,928,1,926],[1,929,1,927],[1,930,1,928],[1,931,1,929],[1,932,1,930],[1,933,1,931],[1,934,1,932],[1,935,1,933],[1,936,1,934],[1,937,1,935],[1,938,1,936],[1,939,1,937],[1,940,1,938],[1,941,1,939],[1,942,1,940],[1,943,1,941],[1,944,1,942],[1,945,1,943],[1,946,1,944],[1,947,1,945],[1,948,1,946],[1,949,1,947],[1,950,1,948],[1,951,1,949],[1,952,1,950],[1,953,1,951],[1,954,1,952],[1,955,1,953],[1,956,1,954],[1,957,1,955],[1,958,1,956],[1,959,1,957],[1,960,1,958],[1,961,1,959],[1,962,1,960],[1,963,1,961],[1,964,1,962],[1,965,1,963],[1,966,1,964],[1,967,1,965],[1,968,1,966],[1,969,1,967],[1,970,1,968],[1,971,1,969],[1,972,1,970],[1,973,1,971],[1,974,1,972],[1,975,1,973],[1,976,1,974],[1,977,1,975],[1,978,1,976],[1,979,1,977],[1,980,1,978],[1,981,1,979],[1,982,1,980],[1,983,1,981],[1,984,1,982],[1,985,1,983],[1,986,1,984],[1,987,1,985],[1,988,1,986],[1,989,1,987],[1,990,1,988],[1,991,1,989],[1,992,1,990],[1,993,1,991],[1,994,1,992],[1,995,1,993],[1,996,1,994],[1,997,1,995],[1,998,1,996],[1,999,1,997],[1,1000,1,998],[1,1001,1,999],[1,1002,1,1000],[1,1003,1,1001],[1,1004,1,1002],[1,1005,1,1003],[1,1006,1,1004],[1,1007,1,1005],[1,1008,1,1006],[1,1009,1,1007],[1,1010,1,1008],[1,1011,1,1009],[1,1012,1,1010],[1,1013,1,1011],[1,1014,1,1012],[1,1015,1,1013],[1,1016,1,1014],[1,1017,1,1015],[1,1018,1,1016],[1,1019,1,1017],[1,1020,1,1018],[1,1021,1,1019],[1,1022,1,1020],[1,1023,1,1021],[1,1024,1,1022],[1,1025,1,1023],[1,1026,1,1024],[1,1027,1,1025],[1,1028,1,1026],[1,1029,1,1027],[1,1030,1,1028],[1,1031,1,1029],[1,1032,1,1030],[1,1033,1,1031],[1,1034,1,1032],[1,1035,1,1033],[1,1036,1,1034],[1,1037,1,1035],[1,1038,1,1036],[1,1039,1,1037],[1,1040,1,1038],[1,1041,1,1039],[1,1042,1,1040],[1,1043,1,1041],[1,1044,1,1042],[1,1045,1,1043],[1,1046,1,1044],[1,1047,1,1045],[1,1048,1,1046],[1,1049,1,1047],[1,1050,1,1048],[1,1051,1,1049],[1,1052,1,1050],[1,1053,1,1051],[1,1054,1,1052],[1,1055,1,1053],[1,1056,1,1054],[1,1057,1,1055],[1,1058,1,1056],[1,1059,1,1057],[1,1060,1,1058],[1,1061,1,1059],[1,1062,1,1060],[1,1063,1,1061],[1,1064,1,1062],[1,1065,1,1063],[1,1066,1,1064],[1,1067,1,1065],[1,1068,1,1066],[1,1069,1,1067],[1,1070,1,1068],[1,1071,1,1069],[1,1072,1,1070],[1,1073,1,1071],[1,1074,1,1072],[1,1075,1,1073],[1,1076,1,1074],[1,1077,1,1075],[1,1078,1,1076],[1,1079,1,1077],[1,1080,1,1078],[1,1081,1,1079],[1,1082,1,1080],[1,1083,1,1081],[1,1084,1,1082],[1,1085,1,1083],[1,1086,1,1084],[1,1087,1,1085],[1,1088,1,1086],[1,1089,1,1087],[1,1090,1,1088],[1,1091,1,1089],[1,1092,1,1090],[1,1093,1,1091],[1,1094,1,1092],[1,1095,1,1093],[1,1096,1,1094],[1,1097,1,1095],[1,1098,1,1096],[1,1099,1,1097],[1,1100,1,1098],[1,1101,1,1099],[1,1102,1,1100],[1,1103,1,1101],[1,1104,1,1102],[1,1105,1,1103],[1,1106,1,1104],[1,1107,1,1105],[1,1108,1,1106],[1,1109,1,1107],[1,1110,1,1108],[1,1111,1,1109],[1,1112,1,1110],[1,1113,1,1111],[1,1114,1,1112],[1,1115,1,1113],[1,1116,1,1114],[1,1117,1,1115],[1,1118,1,1116],[1,1119,1,1117],[1,1120,1,1118],[1,1121,1,1119],[1,1122,1,1120],[1,1123,1,1121],[1,1124,1,1122],[1,1125,1,1123],[1,1126,1,1124],[1,1127,1,1125],[1,1128,1,1126],[1,1129,1,1127],[1,1130,1,1128],[1,1131,1,1129],[1,1132,1,1130],[1,1133,1,1131],[1,1134,1,1132],[1,1135,1,1133],[1,1136,1,1134],[1,1137,1,1135],[1,1138,1,1136],[1,1139,1,1137],[1,1140,1,1138],[1,1141,1,1139],[1,1142,1,1140],[1,1143,1,1141],[1,1144,1,1142],[1,1145,1,1143],[1,1146,1,1144],[1,1147,1,1145],[1,1148,1,1146],[1,1149,1,1147],[1,1150,1,1148],[1,1151,1,1149],[1,1152,1,1150],[1,1153,1,1151],[1,1154,1,1152],[1,1155,1,1153],[1,1156,1,1154],[1,1157,1,1155],[1,1158,1,1156],[1,1159,1,1157],[1,1160,1,1158],[1,1161,1,1159],[

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1504

1,1162,1,1160],[1,1163,1,1161],[1,1164,1,1162],[1,1165,1,1163],[1,1166,1,11
64],[1,1167,1,1165],[1,1168,1,1166],[1,1169,1,1167],[1,1170,1,1168],[1,1171
,1,1169],[1,1172,1,1170],[1,1173,1,1171],[1,1174,1,1172],[1,1175,1,1173],[1
,1176,1,1174],[1,1177,1,1175],[1,1178,1,1176],[1,1179,1,1177],[1,1180,1,117
8],[1,1181,1,1179],[1,1182,1,1180],[1,1183,1,1181],[1,1184,1,1182],[1,1185,
1,1183],[1,1186,1,1184],[1,1187,1,1185],[1,1188,1,1186],[1,1189,1,1187],[1,
1190,1,1188],[1,1191,1,1189],[1,1192,1,1190],[1,1193,1,1191],[1,1194,1,1192
],[1,1195,1,1193],[1,1196,1,1194],[1,1197,1,1195],[1,1198,1,1196],[1,1199,1
,1197],[1,1200,1,1198],[1,1201,1,1199],[1,1202,1,1200],[1,1203,1,1201],[1,1
204,1,1202],[1,1205,1,1203],[1,1206,1,1204],[1,1207,1,1205],[1,1208,1,1206]
,[1,1209,1,1207],[1,1210,1,1208],[1,1211,1,1209],[1,1212,1,1210],[1,1213,1,
1211],[1,1214,1,1212],[1,1215,1,1213],[1,1216,1,1214],[1,1217,1,1215],[1,12
18,1,1216],[1,1219,1,1217],[1,1220,1,1218],[1,1221,1,1219],[1,1222,1,1220],
[1,1223,1,1221],[1,1224,1,1222],[1,1225,1,1223],[1,1226,1,1224],[1,1227,1,1
225],[1,1228,1,1226],[1,1229,1,1227],[1,1230,1,1228],[1,1231,1,1229],[1,123
2,1,1230],[1,1233,1,1231],[1,1234,1,1232],[1,1235,1,1233],[1,1236,1,1234],[
1,1237,1,1235],[1,1238,1,1236],[1,1239,1,1237],[1,1240,1,1238],[1,1241,1,12
39],[1,1242,1,1240],[1,1243,1,1241],[1,1244,1,1242],[1,1245,1,1243],[1,1246
,1,1244],[1,1247,1,1245],[1,1248,1,1246],[1,1249,1,1247],[1,1250,1,1248],[1
,1251,1,1249],[1,1252,1,1250],[1,1253,1,1251],[1,1254,1,1252],[1,1255,1,125
3],[1,1256,1,1254],[1,1257,1,1255],[0,1257,1,1256],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-
1]],"row":15,"num":1},{"stap_colors":[[97,1507550],[139,1507550],[181,89478
48],[223,8947848],[265,8947848],[307,8947848],[349,8947848],[391,8947848],[
433,8947848],[475,8947848],[517,8947848],[559,8947848],[601,8947848],[643,8
947848],[685,8947848],[727,8947848],[769,8947848],[811,8947848],[853,894784
8],[895,8947848],[937,8947848],[979,8947848],[1021,8947848],[1063,8947848],
[1105,8947848],[1147,8947848],[1189,8947848],[1231,8947848],[1273,3355443]]
,"stap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-

SUBSTITUTE SHEET (RULE 26)

1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[2,57,-1,-
1],[2,58,2,56],[2,59,2,57],[2,60,2,58],[2,61,2,59],[2,62,2,60],[2,63,2,61],
[2,64,2,62],[2,65,2,63],[2,66,2,64],[2,67,2,65],[2,68,2,66],[2,69,2,67],[3,
69,2,68],[2,71,3,70],[2,72,2,70],[2,73,2,71],[2,74,2,72],[2,75,2,73],[2,76,
2,74],[2,77,2,75],[2,78,2,76],[2,79,2,77],[2,80,2,78],[2,81,2,79],[2,82,2,8
0],[2,83,2,81],[1,83,2,82],[2,85,1,84],[2,86,2,84],[2,87,2,85],[2,88,2,86],
[2,89,2,87],[2,90,2,88],[2,91,2,89],[2,92,2,90],[2,93,2,91],[2,94,2,92],[2,
95,2,93],[2,96,2,94],[2,97,2,95],[-1,-1,2,96],[2,99,-1,-
1],[2,100,2,98],[2,101,2,99],[2,102,2,100],[2,103,2,101],[2,104,2,102],[2,1
05,2,103],[2,106,2,104],[2,107,2,105],[2,108,2,106],[2,109,2,107],[2,110,2,
108],[2,111,2,109],[3,111,2,110],[2,113,3,112],[2,114,2,112],[2,115,2,113],
[2,116,2,114],[2,117,2,115],[2,118,2,116],[2,119,2,117],[2,120,2,118],[2,12
1,2,119],[2,122,2,120],[2,123,2,121],[2,124,2,122],[2,125,2,123],[1,125,2,1
24],[2,127,1,126],[2,128,2,126],[2,129,2,127],[2,130,2,128],[2,131,2,129],[
2,132,2,130],[2,133,2,131],[2,134,2,132],[2,135,2,133],[2,136,2,134],[2,137
,2,135],[2,138,2,136],[2,139,2,137],[-1,-1,2,138],[2,141,-1,-
1],[2,142,2,140],[2,143,2,141],[2,144,2,142],[2,145,2,143],[2,146,2,144],[2
,147,2,145],[2,148,2,146],[2,149,2,147],[2,150,2,148],[2,151,2,149],[2,152,
2,150],[2,153,2,151],[3,153,2,152],[2,155,3,154],[2,156,2,154],[2,157,2,155
],[2,158,2,156],[2,159,2,157],[2,160,2,158],[2,161,2,159],[2,162,2,160],[2,
163,2,161],[2,164,2,162],[2,165,2,163],[2,166,2,164],[2,167,2,165],[1,167,2
,166],[2,169,1,168],[2,170,2,168],[2,171,2,169],[2,172,2,170],[2,173,2,171]
,[2,174,2,172],[2,175,2,173],[2,176,2,174],[2,177,2,175],[2,178,2,176],[2,1
79,2,177],[2,180,2,178],[2,181,2,179],[-1,-1,2,180],[2,183,-1,-
1],[2,184,2,182],[2,185,2,183],[2,186,2,184],[2,187,2,185],[2,188,2,186],[2
,189,2,187],[2,190,2,188],[2,191,2,189],[2,192,2,190],[2,193,2,191],[2,194,
2,192],[2,195,2,193],[3,195,2,194],[2,197,3,196],[2,198,2,196],[2,199,2,197
],[2,200,2,198],[2,201,2,199],[2,202,2,200],[2,203,2,201],[2,204,2,202],[2,
205,2,203],[2,206,2,204],[2,207,2,205],[2,208,2,206],[2,209,2,207],[1,209,2
,208],[2,211,1,210],[2,212,2,210],[2,213,2,211],[2,214,2,212],[2,215,2,213]
,[2,216,2,214],[2,217,2,215],[2,218,2,216],[2,219,2,217],[2,220,2,218],[2,2
21,2,219],[2,222,2,220],[2,223,2,221],[-1,-1,2,222],[2,225,-1,-
1],[2,226,2,224],[2,227,2,225],[2,228,2,226],[2,229,2,227],[2,230,2,228],[2
,231,2,229],[2,232,2,230],[2,233,2,231],[2,234,2,232],[2,235,2,233],[2,236,
2,234],[2,237,2,235],[3,237,2,236],[2,239,3,238],[2,240,2,238],[2,241,2,239
],[2,242,2,240],[2,243,2,241],[2,244,2,242],[2,245,2,243],[2,246,2,244],[2,
247,2,245],[2,248,2,246],[2,249,2,247],[2,250,2,248],[2,251,2,249],[1,251,2
,250],[2,253,1,252],[2,254,2,252],[2,255,2,253],[2,256,2,254],[2,257,2,255]
,[2,258,2,256],[2,259,2,257],[2,260,2,258],[2,261,2,259],[2,262,2,260],[2,2
63,2,261],[2,264,2,262],[2,265,2,263],[-1,-1,2,264],[2,267,-1,-
1],[2,268,2,266],[2,269,2,267],[2,270,2,268],[2,271,2,269],[2,272,2,270],[2
,273,2,271],[2,274,2,272],[2,275,2,273],[2,276,2,274],[2,277,2,275],[2,278,
2,276],[2,279,2,277],[3,279,2,278],[2,281,3,280],[2,282,2,280],[2,283,2,281
],[2,284,2,282],[2,285,2,283],[2,286,2,284],[2,287,2,285],[2,288,2,286],[2,
289,2,287],[2,290,2,288],[2,291,2,289],[2,292,2,290],[2,293,2,291],[1,293,2
,292],[2,295,1,294],[2,296,2,294],[2,297,2,295],[2,298,2,296],[2,299,2,297]
,[2,300,2,298],[2,301,2,299],[2,302,2,300],[2,303,2,301],[2,304,2,302],[2,3
05,2,303],[2,306,2,304],[2,307,2,305],[-1,-1,2,306],[2,309,-1,-
1],[2,310,2,308],[2,311,2,309],[2,312,2,310],[2,313,2,311],[2,314,2,312],[2
,315,2,313],[2,316,2,314],[2,317,2,315],[2,318,2,316],[2,319,2,317],[2,320,
2,318],[2,321,2,319],[3,321,2,320],[2,323,3,322],[2,324,2,322],[2,325,2,323
],[2,326,2,324],[2,327,2,325],[2,328,2,326],[2,329,2,327],[2,330,2,328],[2,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1506

331,2,329],[2,332,2,330],[2,333,2,331],[2,334,2,332],[2,335,2,333],[1,335,2
,334],[2,337,1,336],[2,338,2,336],[2,339,2,337],[2,340,2,338],[2,341,2,339]
,[2,342,2,340],[2,343,2,341],[2,344,2,342],[2,345,2,343],[2,346,2,344],[2,3
47,2,345],[2,348,2,346],[2,349,2,347],[-1,-1,2,348],[2,351,-1,-
1],[2,352,2,350],[2,353,2,351],[2,354,2,352],[2,355,2,353],[2,356,2,354],[2
,357,2,355],[2,358,2,356],[2,359,2,357],[2,360,2,358],[2,361,2,359],[2,362,
2,360],[2,363,2,361],[3,363,2,362],[2,365,3,364],[2,366,2,364],[2,367,2,365
],[2,368,2,366],[2,369,2,367],[2,370,2,368],[2,371,2,369],[2,372,2,370],[2,
373,2,371],[2,374,2,372],[2,375,2,373],[2,376,2,374],[2,377,2,375],[1,377,2
,376],[2,379,1,378],[2,380,2,378],[2,381,2,379],[2,382,2,380],[2,383,2,381]
,[2,384,2,382],[2,385,2,383],[2,386,2,384],[2,387,2,385],[2,388,2,386],[2,3
89,2,387],[2,390,2,388],[2,391,2,389],[-1,-1,2,390],[2,393,-1,-
1],[2,394,2,392],[2,395,2,393],[2,396,2,394],[2,397,2,395],[2,398,2,396],[2
,399,2,397],[2,400,2,398],[2,401,2,399],[2,402,2,400],[2,403,2,401],[2,404,
2,402],[2,405,2,403],[3,405,2,404],[2,407,3,406],[2,408,2,406],[2,409,2,407
],[2,410,2,408],[2,411,2,409],[2,412,2,410],[2,413,2,411],[2,414,2,412],[2,
415,2,413],[2,416,2,414],[2,417,2,415],[2,418,2,416],[2,419,2,417],[1,419,2
,418],[2,421,1,420],[2,422,2,420],[2,423,2,421],[2,424,2,422],[2,425,2,423]
,[2,426,2,424],[2,427,2,425],[2,428,2,426],[2,429,2,427],[2,430,2,428],[2,4
31,2,429],[2,432,2,430],[2,433,2,431],[-1,-1,2,432],[2,435,-1,-
1],[2,436,2,434],[2,437,2,435],[2,438,2,436],[2,439,2,437],[2,440,2,438],[2
,441,2,439],[2,442,2,440],[2,443,2,441],[2,444,2,442],[2,445,2,443],[2,446,
2,444],[2,447,2,445],[3,447,2,446],[2,449,3,448],[2,450,2,448],[2,451,2,449
],[2,452,2,450],[2,453,2,451],[2,454,2,452],[2,455,2,453],[2,456,2,454],[2,
457,2,455],[2,458,2,456],[2,459,2,457],[2,460,2,458],[2,461,2,459],[1,461,2
,460],[2,463,1,462],[2,464,2,462],[2,465,2,463],[2,466,2,464],[2,467,2,465]
,[2,468,2,466],[2,469,2,467],[2,470,2,468],[2,471,2,469],[2,472,2,470],[2,4
73,2,471],[2,474,2,472],[2,475,2,473],[-1,-1,2,474],[2,477,-1,-
1],[2,478,2,476],[2,479,2,477],[2,480,2,478],[2,481,2,479],[2,482,2,480],[2
,483,2,481],[2,484,2,482],[2,485,2,483],[2,486,2,484],[2,487,2,485],[2,488,
2,486],[2,489,2,487],[3,489,2,488],[2,491,3,490],[2,492,2,490],[2,493,2,491
],[2,494,2,492],[2,495,2,493],[2,496,2,494],[2,497,2,495],[2,498,2,496],[2,
499,2,497],[2,500,2,498],[2,501,2,499],[2,502,2,500],[2,503,2,501],[1,503,2
,502],[2,505,1,504],[2,506,2,504],[2,507,2,505],[2,508,2,506],[2,509,2,507]
,[2,510,2,508],[2,511,2,509],[2,512,2,510],[2,513,2,511],[2,514,2,512],[2,5
15,2,513],[2,516,2,514],[2,517,2,515],[-1,-1,2,516],[2,519,-1,-
1],[2,520,2,518],[2,521,2,519],[2,522,2,520],[2,523,2,521],[2,524,2,522],[2
,525,2,523],[2,526,2,524],[2,527,2,525],[2,528,2,526],[2,529,2,527],[2,530,
2,528],[2,531,2,529],[3,531,2,530],[2,533,3,532],[2,534,2,532],[2,535,2,533
],[2,536,2,534],[2,537,2,535],[2,538,2,536],[2,539,2,537],[2,540,2,538],[2,
541,2,539],[2,542,2,540],[2,543,2,541],[2,544,2,542],[2,545,2,543],[1,545,2
,544],[2,547,1,546],[2,548,2,546],[2,549,2,547],[2,550,2,548],[2,551,2,549]
,[2,552,2,550],[2,553,2,551],[2,554,2,552],[2,555,2,553],[2,556,2,554],[2,5
57,2,555],[2,558,2,556],[2,559,2,557],[-1,-1,2,558],[2,561,-1,-
1],[2,562,2,560],[2,563,2,561],[2,564,2,562],[2,565,2,563],[2,566,2,564],[2
,567,2,565],[2,568,2,566],[2,569,2,567],[2,570,2,568],[2,571,2,569],[2,572,
2,570],[2,573,2,571],[3,573,2,572],[2,575,3,574],[2,576,2,574],[2,577,2,575
],[2,578,2,576],[2,579,2,577],[2,580,2,578],[2,581,2,579],[2,582,2,580],[2,
583,2,581],[2,584,2,582],[2,585,2,583],[2,586,2,584],[2,587,2,585],[1,587,2
,586],[2,589,1,588],[2,590,2,588],[2,591,2,589],[2,592,2,590],[2,593,2,591]
,[2,594,2,592],[2,595,2,593],[2,596,2,594],[2,597,2,595],[2,598,2,596],[2,5
99,2,597],[2,600,2,598],[2,601,2,599],[-1,-1,2,600],[2,603,-1,-
1],[2,604,2,602],[2,605,2,603],[2,606,2,604],[2,607,2,605],[2,608,2,606],[2

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1507

,609,2,607],[2,610,2,608],[2,611,2,609],[2,612,2,610],[2,613,2,611],[2,614,
2,612],[2,615,2,613],[3,615,2,614],[2,617,3,616],[2,618,2,616],[2,619,2,617
],[2,620,2,618],[2,621,2,619],[2,622,2,620],[2,623,2,621],[2,624,2,622],[2,
625,2,623],[2,626,2,624],[2,627,2,625],[2,628,2,626],[2,629,2,627],[1,629,2
,628],[2,631,1,630],[2,632,2,630],[2,633,2,631],[2,634,2,632],[2,635,2,633]
,[2,636,2,634],[2,637,2,635],[2,638,2,636],[2,639,2,637],[2,640,2,638],[2,6
41,2,639],[2,642,2,640],[2,643,2,641],[-1,-1,2,642],[2,645,-1,-
1],[2,646,2,644],[2,647,2,645],[2,648,2,646],[2,649,2,647],[2,650,2,648],[2
,651,2,649],[2,652,2,650],[2,653,2,651],[2,654,2,652],[2,655,2,653],[2,656,
2,654],[2,657,2,655],[3,657,2,656],[2,659,3,658],[2,660,2,658],[2,661,2,659
],[2,662,2,660],[2,663,2,661],[2,664,2,662],[2,665,2,663],[2,666,2,664],[2,
667,2,665],[2,668,2,666],[2,669,2,667],[2,670,2,668],[2,671,2,669],[1,671,2
,670],[2,673,1,672],[2,674,2,672],[2,675,2,673],[2,676,2,674],[2,677,2,675]
,[2,678,2,676],[2,679,2,677],[2,680,2,678],[2,681,2,679],[2,682,2,680],[2,6
83,2,681],[2,684,2,682],[2,685,2,683],[-1,-1,2,684],[2,687,-1,-
1],[2,688,2,686],[2,689,2,687],[2,690,2,688],[2,691,2,689],[2,692,2,690],[2
,693,2,691],[2,694,2,692],[2,695,2,693],[2,696,2,694],[2,697,2,695],[2,698,
2,696],[2,699,2,697],[3,699,2,698],[2,701,3,700],[2,702,2,700],[2,703,2,701
],[2,704,2,702],[2,705,2,703],[2,706,2,704],[2,707,2,705],[2,708,2,706],[2,
709,2,707],[2,710,2,708],[2,711,2,709],[2,712,2,710],[2,713,2,711],[1,713,2
,712],[2,715,1,714],[2,716,2,714],[2,717,2,715],[2,718,2,716],[2,719,2,717]
,[2,720,2,718],[2,721,2,719],[2,722,2,720],[2,723,2,721],[2,724,2,722],[2,7
25,2,723],[2,726,2,724],[2,727,2,725],[-1,-1,2,726],[2,729,-1,-
1],[2,730,2,728],[2,731,2,729],[2,732,2,730],[2,733,2,731],[2,734,2,732],[2
,735,2,733],[2,736,2,734],[2,737,2,735],[2,738,2,736],[2,739,2,737],[2,740,
2,738],[2,741,2,739],[3,741,2,740],[2,743,3,742],[2,744,2,742],[2,745,2,743
],[2,746,2,744],[2,747,2,745],[2,748,2,746],[2,749,2,747],[2,750,2,748],[2,
751,2,749],[2,752,2,750],[2,753,2,751],[2,754,2,752],[2,755,2,753],[1,755,2
,754],[2,757,1,756],[2,758,2,756],[2,759,2,757],[2,760,2,758],[2,761,2,759]
,[2,762,2,760],[2,763,2,761],[2,764,2,762],[2,765,2,763],[2,766,2,764],[2,7
67,2,765],[2,768,2,766],[2,769,2,767],[-1,-1,2,768],[2,771,-1,-
1],[2,772,2,770],[2,773,2,771],[2,774,2,772],[2,775,2,773],[2,776,2,774],[2
,777,2,775],[2,778,2,776],[2,779,2,777],[2,780,2,778],[2,781,2,779],[2,782,
2,780],[2,783,2,781],[3,783,2,782],[2,785,3,784],[2,786,2,784],[2,787,2,785
],[2,788,2,786],[2,789,2,787],[2,790,2,788],[2,791,2,789],[2,792,2,790],[2,
793,2,791],[2,794,2,792],[2,795,2,793],[2,796,2,794],[2,797,2,795],[1,797,2
,796],[2,799,1,798],[2,800,2,798],[2,801,2,799],[2,802,2,800],[2,803,2,801]
,[2,804,2,802],[2,805,2,803],[2,806,2,804],[2,807,2,805],[2,808,2,806],[2,8
09,2,807],[2,810,2,808],[2,811,2,809],[-1,-1,2,810],[2,813,-1,-
1],[2,814,2,812],[2,815,2,813],[2,816,2,814],[2,817,2,815],[2,818,2,816],[2
,819,2,817],[2,820,2,818],[2,821,2,819],[2,822,2,820],[2,823,2,821],[2,824,
2,822],[2,825,2,823],[3,825,2,824],[2,827,3,826],[2,828,2,826],[2,829,2,827
],[2,830,2,828],[2,831,2,829],[2,832,2,830],[2,833,2,831],[2,834,2,832],[2,
835,2,833],[2,836,2,834],[2,837,2,835],[2,838,2,836],[2,839,2,837],[1,839,2
,838],[2,841,1,840],[2,842,2,840],[2,843,2,841],[2,844,2,842],[2,845,2,843]
,[2,846,2,844],[2,847,2,845],[2,848,2,846],[2,849,2,847],[2,850,2,848],[2,8
51,2,849],[2,852,2,850],[2,853,2,851],[-1,-1,2,852],[2,855,-1,-
1],[2,856,2,854],[2,857,2,855],[2,858,2,856],[2,859,2,857],[2,860,2,858],[2
,861,2,859],[2,862,2,860],[2,863,2,861],[2,864,2,862],[2,865,2,863],[2,866,
2,864],[2,867,2,865],[3,867,2,866],[2,869,3,868],[2,870,2,868],[2,871,2,869
],[2,872,2,870],[2,873,2,871],[2,874,2,872],[2,875,2,873],[2,876,2,874],[2,
877,2,875],[2,878,2,876],[2,879,2,877],[2,880,2,878],[2,881,2,879],[1,881,2
,880],[2,883,1,882],[2,884,2,882],[2,885,2,883],[2,886,2,884],[2,887,2,885]

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1508

,[2,888,2,886],[2,889,2,887],[2,890,2,888],[2,891,2,889],[2,892,2,890],[2,8
93,2,891],[2,894,2,892],[2,895,2,893],[-1,-1,2,894],[2,897,-1,-
1],[2,898,2,896],[2,899,2,897],[2,900,2,898],[2,901,2,899],[2,902,2,900],[2
,903,2,901],[2,904,2,902],[2,905,2,903],[2,906,2,904],[2,907,2,905],[2,908,
2,906],[2,909,2,907],[3,909,2,908],[2,911,3,910],[2,912,2,910],[2,913,2,911
],[2,914,2,912],[2,915,2,913],[2,916,2,914],[2,917,2,915],[2,918,2,916],[2,
919,2,917],[2,920,2,918],[2,921,2,919],[2,922,2,920],[2,923,2,921],[1,923,2
,922],[2,925,1,924],[2,926,2,924],[2,927,2,925],[2,928,2,926],[2,929,2,927]
,[2,930,2,928],[2,931,2,929],[2,932,2,930],[2,933,2,931],[2,934,2,932],[2,9
35,2,933],[2,936,2,934],[2,937,2,935],[-1,-1,2,936],[2,939,-1,-
1],[2,940,2,938],[2,941,2,939],[2,942,2,940],[2,943,2,941],[2,944,2,942],[2
,945,2,943],[2,946,2,944],[2,947,2,945],[2,948,2,946],[2,949,2,947],[2,950,
2,948],[2,951,2,949],[3,951,2,950],[2,953,3,952],[2,954,2,952],[2,955,2,953
],[2,956,2,954],[2,957,2,955],[2,958,2,956],[2,959,2,957],[2,960,2,958],[2,
961,2,959],[2,962,2,960],[2,963,2,961],[2,964,2,962],[2,965,2,963],[1,965,2
,964],[2,967,1,966],[2,968,2,966],[2,969,2,967],[2,970,2,968],[2,971,2,969]
,[2,972,2,970],[2,973,2,971],[2,974,2,972],[2,975,2,973],[2,976,2,974],[2,9
77,2,975],[2,978,2,976],[2,979,2,977],[-1,-1,2,978],[2,981,-1,-
1],[2,982,2,980],[2,983,2,981],[2,984,2,982],[2,985,2,983],[2,986,2,984],[2
,987,2,985],[2,988,2,986],[2,989,2,987],[2,990,2,988],[2,991,2,989],[2,992,
2,990],[2,993,2,991],[3,993,2,992],[2,995,3,994],[2,996,2,994],[2,997,2,995
],[2,998,2,996],[2,999,2,997],[2,1000,2,998],[2,1001,2,999],[2,1002,2,1000]
,[2,1003,2,1001],[2,1004,2,1002],[2,1005,2,1003],[2,1006,2,1004],[2,1007,2,
1005],[1,1007,2,1006],[2,1009,1,1008],[2,1010,2,1008],[2,1011,2,1009],[2,10
12,2,1010],[2,1013,2,1011],[2,1014,2,1012],[2,1015,2,1013],[2,1016,2,1014],
[2,1017,2,1015],[2,1018,2,1016],[2,1019,2,1017],[2,1020,2,1018],[2,1021,2,1
019],[-1,-1,2,1020],[2,1023,-1,-
1],[2,1024,2,1022],[2,1025,2,1023],[2,1026,2,1024],[2,1027,2,1025],[2,1028,
2,1026],[2,1029,2,1027],[2,1030,2,1028],[2,1031,2,1029],[2,1032,2,1030],[2,
1033,2,1031],[2,1034,2,1032],[2,1035,2,1033],[3,1035,2,1034],[2,1037,3,1036
],[2,1038,2,1036],[2,1039,2,1037],[2,1040,2,1038],[2,1041,2,1039],[2,1042,2
,1040],[2,1043,2,1041],[2,1044,2,1042],[2,1045,2,1043],[2,1046,2,1044],[2,1
047,2,1045],[2,1048,2,1046],[2,1049,2,1047],[1,1049,2,1048],[2,1051,1,1050]
,[2,1052,2,1050],[2,1053,2,1051],[2,1054,2,1052],[2,1055,2,1053],[2,1056,2,
1054],[2,1057,2,1055],[2,1058,2,1056],[2,1059,2,1057],[2,1060,2,1058],[2,10
61,2,1059],[2,1062,2,1060],[2,1063,2,1061],[-1,-1,2,1062],[2,1065,-1,-
1],[2,1066,2,1064],[2,1067,2,1065],[2,1068,2,1066],[2,1069,2,1067],[2,1070,
2,1068],[2,1071,2,1069],[2,1072,2,1070],[2,1073,2,1071],[2,1074,2,1072],[2,
1075,2,1073],[2,1076,2,1074],[2,1077,2,1075],[3,1077,2,1076],[2,1079,3,1078
],[2,1080,2,1078],[2,1081,2,1079],[2,1082,2,1080],[2,1083,2,1081],[2,1084,2
,1082],[2,1085,2,1083],[2,1086,2,1084],[2,1087,2,1085],[2,1088,2,1086],[2,1
089,2,1087],[2,1090,2,1088],[2,1091,2,1089],[1,1091,2,1090],[2,1093,1,1092]
,[2,1094,2,1092],[2,1095,2,1093],[2,1096,2,1094],[2,1097,2,1095],[2,1098,2,
1096],[2,1099,2,1097],[2,1100,2,1098],[2,1101,2,1099],[2,1102,2,1100],[2,11
03,2,1101],[2,1104,2,1102],[2,1105,2,1103],[-1,-1,2,1104],[2,1107,-1,-
1],[2,1108,2,1106],[2,1109,2,1107],[2,1110,2,1108],[2,1111,2,1109],[2,1112,
2,1110],[2,1113,2,1111],[2,1114,2,1112],[2,1115,2,1113],[2,1116,2,1114],[2,
1117,2,1115],[2,1118,2,1116],[2,1119,2,1117],[3,1119,2,1118],[2,1121,3,1120
],[2,1122,2,1120],[2,1123,2,1121],[2,1124,2,1122],[2,1125,2,1123],[2,1126,2
,1124],[2,1127,2,1125],[2,1128,2,1126],[2,1129,2,1127],[2,1130,2,1128],[2,1
131,2,1129],[2,1132,2,1130],[2,1133,2,1131],[1,1133,2,1132],[2,1135,1,1134]
,[2,1136,2,1134],[2,1137,2,1135],[2,1138,2,1136],[2,1139,2,1137],[2,1140,2,
1138],[2,1141,2,1139],[2,1142,2,1140],[2,1143,2,1141],[2,1144,2,1142],[2,11

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1509

45,2,1143],[2,1146,2,1144],[2,1147,2,1145],[-1,-1,2,1146],[2,1149,-1,-
1],[2,1150,2,1148],[2,1151,2,1149],[2,1152,2,1150],[2,1153,2,1151],[2,1154,
2,1152],[2,1155,2,1153],[2,1156,2,1154],[2,1157,2,1155],[2,1158,2,1156],[2,
1159,2,1157],[2,1160,2,1158],[2,1161,2,1159],[3,1161,2,1160],[2,1163,3,1162
],[2,1164,2,1162],[2,1165,2,1163],[2,1166,2,1164],[2,1167,2,1165],[2,1168,2
,1166],[2,1169,2,1167],[2,1170,2,1168],[2,1171,2,1169],[2,1172,2,1170],[2,1
173,2,1171],[2,1174,2,1172],[2,1175,2,1173],[1,1175,2,1174],[2,1177,1,1176]
,[2,1178,2,1176],[2,1179,2,1177],[2,1180,2,1178],[2,1181,2,1179],[2,1182,2,
1180],[2,1183,2,1181],[2,1184,2,1182],[2,1185,2,1183],[2,1186,2,1184],[2,11
87,2,1185],[2,1188,2,1186],[2,1189,2,1187],[-1,-1,2,1188],[2,1191,-1,-
1],[2,1192,2,1190],[2,1193,2,1191],[2,1194,2,1192],[2,1195,2,1193],[2,1196,
2,1194],[2,1197,2,1195],[2,1198,2,1196],[2,1199,2,1197],[2,1200,2,1198],[2,
1201,2,1199],[2,1202,2,1200],[2,1203,2,1201],[3,1203,2,1202],[2,1205,3,1204
],[2,1206,2,1204],[2,1207,2,1205],[2,1208,2,1206],[2,1209,2,1207],[2,1210,2
,1208],[2,1211,2,1209],[2,1212,2,1210],[2,1213,2,1211],[2,1214,2,1212],[2,1
215,2,1213],[2,1216,2,1214],[2,1217,2,1215],[1,1217,2,1216],[2,1219,1,1218]
,[2,1220,2,1218],[2,1221,2,1219],[2,1222,2,1220],[2,1223,2,1221],[2,1224,2,
1222],[2,1225,2,1223],[2,1226,2,1224],[2,1227,2,1225],[2,1228,2,1226],[2,12
29,2,1227],[2,1230,2,1228],[2,1231,2,1229],[-1,-1,2,1230],[2,1233,-1,-
1],[2,1234,2,1232],[2,1235,2,1233],[2,1236,2,1234],[2,1237,2,1235],[2,1238,
2,1236],[2,1239,2,1237],[2,1240,2,1238],[2,1241,2,1239],[2,1242,2,1240],[2,
1243,2,1241],[2,1244,2,1242],[2,1245,2,1243],[3,1245,2,1244],[2,1247,3,1246
],[2,1248,2,1246],[2,1249,2,1247],[2,1250,2,1248],[2,1251,2,1249],[2,1252,2
,1250],[2,1253,2,1251],[2,1254,2,1252],[2,1255,2,1253],[2,1256,2,1254],[2,1
257,2,1255],[2,1258,2,1256],[2,1259,2,1257],[1,1259,2,1258],[2,1261,1,1260]
,[2,1262,2,1260],[2,1263,2,1261],[2,1264,2,1262],[2,1265,2,1263],[2,1266,2,
1264],[2,1267,2,1265],[2,1268,2,1266],[2,1269,2,1267],[2,1270,2,1268],[2,12
71,2,1269],[2,1272,2,1270],[2,1273,2,1271],[-1,-1,2,1272],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1510

,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"col":13,"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1511

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[3,54,2,55],[2,54,2,56],[2,55,2,57],[2,56,2,58],[2,57,2,59],[2,58,2,60],
[2,59,2,61],[2,60,2,62],[2,61,2,63],[2,62,2,64],[2,63,2,65],[2,64,2,66],[2,
65,2,67],[2,66,2,68],[2,67,2,69],[2,68,2,70],[2,69,2,71],[2,70,2,72],[2,71,
2,73],[2,72,2,74],[2,73,2,75],[2,74,2,76],[2,75,2,77],[2,76,2,78],[2,77,2,7
9],[2,78,2,80],[2,79,2,81],[2,80,2,82],[2,81,2,83],[2,82,2,84],[2,83,2,85],
[2,84,2,86],[2,85,2,87],[2,86,2,88],[2,87,2,89],[2,88,2,90],[2,89,2,91],[2,
90,2,92],[2,91,2,93],[2,92,2,94],[2,93,2,95],[2,94,2,96],[2,95,2,97],[2,96,
2,98],[2,97,2,99],[2,98,2,100],[2,99,2,101],[2,100,2,102],[2,101,2,103],[2,
102,2,104],[2,103,2,105],[2,104,2,106],[2,105,2,107],[2,106,2,108],[2,107,2
,109],[2,108,2,110],[2,109,2,111],[2,110,2,112],[2,111,2,113],[2,112,2,114]
,[2,113,2,115],[2,114,2,116],[2,115,2,117],[2,116,2,118],[2,117,2,119],[2,1
18,2,120],[2,119,2,121],[2,120,2,122],[2,121,2,123],[2,122,2,124],[2,123,2,
125],[2,124,2,126],[2,125,2,127],[2,126,2,128],[2,127,2,129],[2,128,2,130],
[2,129,2,131],[2,130,2,132],[2,131,2,133],[2,132,2,134],[2,133,2,135],[2,13
4,2,136],[2,135,2,137],[2,136,2,138],[2,137,2,139],[2,138,2,140],[2,139,2,1
41],[2,140,2,142],[2,141,2,143],[2,142,2,144],[2,143,2,145],[2,144,2,146],[
2,145,2,147],[2,146,2,148],[2,147,2,149],[2,148,2,150],[2,149,2,151],[2,150
,2,152],[2,151,2,153],[2,152,2,154],[2,153,2,155],[2,154,2,156],[2,155,2,15
7],[2,156,2,158],[2,157,2,159],[2,158,2,160],[2,159,2,161],[2,160,2,162],[2
,161,2,163],[2,162,2,164],[2,163,2,165],[2,164,2,166],[2,165,2,167],[2,166,
2,168],[2,167,2,169],[2,168,2,170],[2,169,2,171],[2,170,2,172],[2,171,2,173
],[2,172,2,174],[2,173,2,175],[2,174,2,176],[2,175,2,177],[2,176,2,178],[2,
177,2,179],[2,178,2,180],[2,179,2,181],[2,180,2,182],[2,181,2,183],[2,182,2
,184],[2,183,2,185],[2,184,2,186],[2,185,2,187],[2,186,2,188],[2,187,2,189]
,[2,188,2,190],[2,189,2,191],[2,190,2,192],[2,191,2,193],[2,192,2,194],[2,1
93,2,195],[2,194,2,196],[2,195,2,197],[2,196,2,198],[2,197,2,199],[2,198,2,
200],[2,199,2,201],[2,200,2,202],[2,201,2,203],[2,202,2,204],[2,203,2,205],
[2,204,2,206],[2,205,2,207],[2,206,2,208],[2,207,2,209],[2,208,2,210],[2,20
9,2,211],[2,210,2,212],[2,211,2,213],[2,212,2,214],[2,213,2,215],[2,214,2,2
16],[2,215,2,217],[2,216,2,218],[2,217,2,219],[2,218,2,220],[2,219,2,221],[
2,220,2,222],[2,221,2,223],[2,222,2,224],[2,223,2,225],[2,224,2,226],[2,225
,2,227],[2,226,2,228],[2,227,2,229],[2,228,2,230],[2,229,2,231],[2,230,2,23
2],[2,231,2,233],[2,232,2,234],[2,233,2,235],[2,234,2,236],[2,235,2,237],[2
,236,2,238],[2,237,2,239],[2,238,2,240],[2,239,2,241],[2,240,2,242],[2,241,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1512

2,243],[2,242,2,244],[2,243,2,245],[2,244,2,246],[2,245,2,247],[2,246,2,248
],[2,247,2,249],[2,248,2,250],[2,249,2,251],[2,250,2,252],[2,251,2,253],[2,
252,2,254],[2,253,2,255],[2,254,2,256],[2,255,2,257],[2,256,2,258],[2,257,2
,259],[2,258,2,260],[2,259,2,261],[2,260,2,262],[2,261,2,263],[2,262,2,264]
,[2,263,2,265],[2,264,2,266],[2,265,2,267],[2,266,2,268],[2,267,2,269],[2,2
68,2,270],[2,269,2,271],[2,270,2,272],[2,271,2,273],[2,272,2,274],[2,273,2,
275],[2,274,2,276],[2,275,2,277],[2,276,2,278],[2,277,2,279],[2,278,2,280],
[2,279,2,281],[2,280,2,282],[2,281,2,283],[2,282,2,284],[2,283,2,285],[2,28
4,2,286],[2,285,2,287],[2,286,2,288],[2,287,2,289],[2,288,2,290],[2,289,2,2
91],[2,290,2,292],[2,291,2,293],[2,292,2,294],[2,293,2,295],[2,294,2,296],[
2,295,2,297],[2,296,2,298],[2,297,2,299],[2,298,2,300],[2,299,2,301],[2,300
,2,302],[2,301,2,303],[2,302,2,304],[2,303,2,305],[2,304,2,306],[2,305,2,30
7],[2,306,2,308],[2,307,2,309],[2,308,2,310],[2,309,2,311],[2,310,2,312],[2
,311,2,313],[2,312,2,314],[2,313,2,315],[2,314,2,316],[2,315,2,317],[2,316,
2,318],[2,317,2,319],[2,318,2,320],[2,319,2,321],[2,320,2,322],[2,321,2,323
],[2,322,2,324],[2,323,2,325],[2,324,2,326],[2,325,2,327],[2,326,2,328],[2,
327,2,329],[2,328,2,330],[2,329,2,331],[2,330,2,332],[2,331,2,333],[2,332,2
,334],[2,333,2,335],[2,334,2,336],[2,335,2,337],[2,336,2,338],[2,337,2,339]
,[2,338,2,340],[2,339,2,341],[2,340,2,342],[2,341,2,343],[2,342,2,344],[2,3
43,2,345],[2,344,2,346],[2,345,2,347],[2,346,2,348],[2,347,2,349],[2,348,2,
350],[2,349,2,351],[2,350,2,352],[2,351,2,353],[2,352,2,354],[2,353,2,355],
[2,354,2,356],[2,355,2,357],[2,356,2,358],[2,357,2,359],[2,358,2,360],[2,35
9,2,361],[2,360,2,362],[2,361,2,363],[2,362,2,364],[2,363,2,365],[2,364,2,3
66],[2,365,2,367],[2,366,2,368],[2,367,2,369],[2,368,2,370],[2,369,2,371],[
2,370,2,372],[2,371,2,373],[2,372,2,374],[2,373,2,375],[2,374,2,376],[2,375
,2,377],[2,376,2,378],[2,377,2,379],[2,378,2,380],[2,379,2,381],[2,380,2,38
2],[2,381,2,383],[2,382,2,384],[2,383,2,385],[2,384,2,386],[2,385,2,387],[2
,386,2,388],[2,387,2,389],[2,388,2,390],[2,389,2,391],[2,390,2,392],[2,391,
2,393],[2,392,2,394],[2,393,2,395],[2,394,2,396],[2,395,2,397],[2,396,2,398
],[2,397,2,399],[2,398,2,400],[2,399,2,401],[2,400,2,402],[2,401,2,403],[2,
402,2,404],[2,403,2,405],[2,404,2,406],[2,405,2,407],[2,406,2,408],[2,407,2
,409],[2,408,2,410],[2,409,2,411],[2,410,2,412],[2,411,2,413],[2,412,2,414]
,[2,413,2,415],[2,414,2,416],[2,415,2,417],[2,416,2,418],[2,417,2,419],[2,4
18,2,420],[2,419,2,421],[2,420,2,422],[2,421,2,423],[2,422,2,424],[2,423,2,
425],[2,424,2,426],[2,425,2,427],[2,426,2,428],[2,427,2,429],[2,428,2,430],
[2,429,2,431],[2,430,2,432],[2,431,2,433],[2,432,2,434],[2,433,2,435],[2,43
4,2,436],[2,435,2,437],[2,436,2,438],[2,437,2,439],[2,438,2,440],[2,439,2,4
41],[2,440,2,442],[2,441,2,443],[2,442,2,444],[2,443,2,445],[2,444,2,446],[
2,445,2,447],[2,446,2,448],[2,447,2,449],[2,448,2,450],[2,449,2,451],[2,450
,2,452],[2,451,2,453],[2,452,2,454],[2,453,2,455],[2,454,2,456],[2,455,2,45
7],[2,456,2,458],[2,457,2,459],[2,458,2,460],[2,459,2,461],[2,460,2,462],[2
,461,2,463],[2,462,2,464],[2,463,2,465],[2,464,2,466],[2,465,2,467],[2,466,
2,468],[2,467,2,469],[2,468,2,470],[2,469,2,471],[2,470,2,472],[2,471,2,473
],[2,472,2,474],[2,473,2,475],[2,474,2,476],[2,475,2,477],[2,476,2,478],[2,
477,2,479],[2,478,2,480],[2,479,2,481],[2,480,2,482],[2,481,2,483],[2,482,2
,484],[2,483,2,485],[2,484,2,486],[2,485,2,487],[2,486,2,488],[2,487,2,489]
,[2,488,2,490],[2,489,2,491],[2,490,2,492],[2,491,2,493],[2,492,2,494],[2,4
93,2,495],[2,494,2,496],[2,495,2,497],[2,496,2,498],[2,497,2,499],[2,498,2,
500],[2,499,2,501],[2,500,2,502],[2,501,2,503],[2,502,2,504],[2,503,2,505],
[2,504,2,506],[2,505,2,507],[2,506,2,508],[2,507,2,509],[2,508,2,510],[2,50
9,2,511],[2,510,2,512],[2,511,2,513],[2,512,2,514],[2,513,2,515],[2,514,2,5
16],[2,515,2,517],[2,516,2,518],[2,517,2,519],[2,518,2,520],[2,519,2,521],[
2,520,2,522],[2,521,2,523],[2,522,2,524],[2,523,2,525],[2,524,2,526],[2,525

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1513

,2,527],[2,526,2,528],[2,527,2,529],[2,528,2,530],[2,529,2,531],[2,530,2,53
2],[2,531,2,533],[2,532,2,534],[2,533,2,535],[2,534,2,536],[2,535,2,537],[2
,536,2,538],[2,537,2,539],[2,538,2,540],[2,539,2,541],[2,540,2,542],[2,541,
2,543],[2,542,2,544],[2,543,2,545],[2,544,2,546],[2,545,2,547],[2,546,2,548
],[2,547,2,549],[2,548,2,550],[2,549,2,551],[2,550,2,552],[2,551,2,553],[2,
552,2,554],[2,553,2,555],[2,554,2,556],[2,555,2,557],[2,556,2,558],[2,557,2
,559],[2,558,2,560],[2,559,2,561],[2,560,2,562],[2,561,2,563],[2,562,2,564]
,[2,563,2,565],[2,564,2,566],[2,565,2,567],[2,566,2,568],[2,567,2,569],[2,5
68,2,570],[2,569,2,571],[2,570,2,572],[2,571,2,573],[2,572,2,574],[2,573,2,
575],[2,574,2,576],[2,575,2,577],[2,576,2,578],[2,577,2,579],[2,578,2,580],
[2,579,2,581],[2,580,2,582],[2,581,2,583],[2,582,2,584],[2,583,2,585],[2,58
4,2,586],[2,585,2,587],[2,586,2,588],[2,587,2,589],[2,588,2,590],[2,589,2,5
91],[2,590,2,592],[2,591,2,593],[2,592,2,594],[2,593,2,595],[2,594,2,596],[
2,595,2,597],[2,596,2,598],[2,597,2,599],[2,598,2,600],[2,599,2,601],[2,600
,2,602],[2,601,2,603],[2,602,2,604],[2,603,2,605],[2,604,2,606],[2,605,2,60
7],[2,606,2,608],[2,607,2,609],[2,608,2,610],[2,609,2,611],[2,610,2,612],[2
,611,2,613],[2,612,2,614],[2,613,2,615],[2,614,2,616],[2,615,2,617],[2,616,
2,618],[2,617,2,619],[2,618,2,620],[2,619,2,621],[2,620,2,622],[2,621,2,623
],[2,622,2,624],[2,623,2,625],[2,624,2,626],[2,625,2,627],[2,626,2,628],[2,
627,2,629],[2,628,2,630],[2,629,2,631],[2,630,2,632],[2,631,2,633],[2,632,2
,634],[2,633,2,635],[2,634,2,636],[2,635,2,637],[2,636,2,638],[2,637,2,639]
,[2,638,2,640],[2,639,2,641],[2,640,2,642],[2,641,2,643],[2,642,2,644],[2,6
43,2,645],[2,644,1,645],[1,646,2,647],[2,646,2,648],[2,647,2,649],[2,648,2,
650],[2,649,2,651],[2,650,2,652],[2,651,2,653],[2,652,2,654],[2,653,2,655],
[2,654,2,656],[2,655,2,657],[2,656,2,658],[2,657,2,659],[2,658,2,660],[2,65
9,2,661],[2,660,2,662],[2,661,2,663],[2,662,2,664],[2,663,2,665],[2,664,2,6
66],[2,665,2,667],[2,666,2,668],[2,667,2,669],[2,668,2,670],[2,669,2,671],[
2,670,2,672],[2,671,2,673],[2,672,2,674],[2,673,2,675],[2,674,2,676],[2,675
,2,677],[2,676,2,678],[2,677,2,679],[2,678,2,680],[2,679,2,681],[2,680,2,68
2],[2,681,2,683],[2,682,2,684],[2,683,2,685],[2,684,2,686],[2,685,2,687],[2
,686,2,688],[2,687,2,689],[2,688,2,690],[2,689,2,691],[2,690,2,692],[2,691,
2,693],[2,692,2,694],[2,693,2,695],[2,694,2,696],[2,695,2,697],[2,696,2,698
],[2,697,2,699],[2,698,2,700],[2,699,2,701],[2,700,2,702],[2,701,2,703],[2,
702,2,704],[2,703,2,705],[2,704,2,706],[2,705,2,707],[2,706,2,708],[2,707,2
,709],[2,708,2,710],[2,709,2,711],[2,710,2,712],[2,711,2,713],[2,712,2,714]
,[2,713,2,715],[2,714,2,716],[2,715,2,717],[2,716,2,718],[2,717,2,719],[2,7
18,2,720],[2,719,2,721],[2,720,2,722],[2,721,2,723],[2,722,2,724],[2,723,2,
725],[2,724,2,726],[2,725,2,727],[2,726,2,728],[2,727,2,729],[2,728,2,730],
[2,729,2,731],[2,730,2,732],[2,731,2,733],[2,732,2,734],[2,733,2,735],[2,73
4,2,736],[2,735,2,737],[2,736,2,738],[2,737,2,739],[2,738,2,740],[2,739,2,7
41],[2,740,2,742],[2,741,2,743],[2,742,2,744],[2,743,2,745],[2,744,2,746],[
2,745,2,747],[2,746,2,748],[2,747,2,749],[2,748,2,750],[2,749,2,751],[2,750
,2,752],[2,751,2,753],[2,752,2,754],[2,753,2,755],[2,754,2,756],[2,755,2,75
7],[2,756,2,758],[2,757,2,759],[2,758,2,760],[2,759,2,761],[2,760,2,762],[2
,761,2,763],[2,762,2,764],[2,763,2,765],[2,764,2,766],[2,765,2,767],[2,766,
2,768],[2,767,2,769],[2,768,2,770],[2,769,2,771],[2,770,2,772],[2,771,2,773
],[2,772,2,774],[2,773,2,775],[2,774,2,776],[2,775,2,777],[2,776,2,778],[2,
777,2,779],[2,778,2,780],[2,779,2,781],[2,780,2,782],[2,781,2,783],[2,782,2
,784],[2,783,2,785],[2,784,2,786],[2,785,2,787],[2,786,2,788],[2,787,2,789]
,[2,788,2,790],[2,789,2,791],[2,790,2,792],[2,791,2,793],[2,792,2,794],[2,7
93,2,795],[2,794,2,796],[2,795,2,797],[2,796,2,798],[2,797,2,799],[2,798,2,
800],[2,799,2,801],[2,800,2,802],[2,801,2,803],[2,802,2,804],[2,803,2,805],
[2,804,2,806],[2,805,2,807],[2,806,2,808],[2,807,2,809],[2,808,2,810],[2,80

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1514

9,2,811],[2,810,2,812],[2,811,2,813],[2,812,2,814],[2,813,2,815],[2,814,2,8
16],[2,815,2,817],[2,816,2,818],[2,817,2,819],[2,818,2,820],[2,819,2,821],[
2,820,2,822],[2,821,2,823],[2,822,2,824],[2,823,2,825],[2,824,2,826],[2,825
,2,827],[2,826,2,828],[2,827,2,829],[2,828,2,830],[2,829,2,831],[2,830,2,83
2],[2,831,2,833],[2,832,2,834],[2,833,2,835],[2,834,2,836],[2,835,2,837],[2
,836,2,838],[2,837,2,839],[2,838,2,840],[2,839,2,841],[2,840,2,842],[2,841,
2,843],[2,842,2,844],[2,843,2,845],[2,844,2,846],[2,845,2,847],[2,846,2,848
],[2,847,2,849],[2,848,2,850],[2,849,2,851],[2,850,2,852],[2,851,2,853],[2,
852,2,854],[2,853,2,855],[2,854,2,856],[2,855,2,857],[2,856,2,858],[2,857,2
,859],[2,858,2,860],[2,859,2,861],[2,860,2,862],[2,861,2,863],[2,862,2,864]
,[2,863,2,865],[2,864,2,866],[2,865,2,867],[2,866,2,868],[2,867,2,869],[2,8
68,2,870],[2,869,2,871],[2,870,2,872],[2,871,2,873],[2,872,2,874],[2,873,2,
875],[2,874,2,876],[2,875,2,877],[2,876,2,878],[2,877,2,879],[2,878,2,880],
[2,879,2,881],[2,880,2,882],[2,881,2,883],[2,882,2,884],[2,883,2,885],[2,88
4,2,886],[2,885,2,887],[2,886,2,888],[2,887,2,889],[2,888,2,890],[2,889,2,8
91],[2,890,2,892],[2,891,2,893],[2,892,2,894],[2,893,2,895],[2,894,2,896],[
2,895,2,897],[2,896,2,898],[2,897,2,899],[2,898,2,900],[2,899,2,901],[2,900
,2,902],[2,901,2,903],[2,902,2,904],[2,903,2,905],[2,904,2,906],[2,905,2,90
7],[2,906,2,908],[2,907,2,909],[2,908,2,910],[2,909,2,911],[2,910,2,912],[2
,911,2,913],[2,912,2,914],[2,913,2,915],[2,914,2,916],[2,915,2,917],[2,916,
2,918],[2,917,2,919],[2,918,2,920],[2,919,2,921],[2,920,2,922],[2,921,2,923
],[2,922,2,924],[2,923,2,925],[2,924,2,926],[2,925,2,927],[2,926,2,928],[2,
927,2,929],[2,928,2,930],[2,929,2,931],[2,930,2,932],[2,931,2,933],[2,932,2
,934],[2,933,2,935],[2,934,2,936],[2,935,2,937],[2,936,2,938],[2,937,2,939]
,[2,938,2,940],[2,939,2,941],[2,940,2,942],[2,941,2,943],[2,942,2,944],[2,9
43,2,945],[2,944,2,946],[2,945,2,947],[2,946,2,948],[2,947,2,949],[2,948,2,
950],[2,949,2,951],[2,950,2,952],[2,951,2,953],[2,952,2,954],[2,953,2,955],
[2,954,2,956],[2,955,2,957],[2,956,2,958],[2,957,2,959],[2,958,2,960],[2,95
9,2,961],[2,960,2,962],[2,961,2,963],[2,962,2,964],[2,963,2,965],[2,964,2,9
66],[2,965,2,967],[2,966,2,968],[2,967,2,969],[2,968,2,970],[2,969,2,971],[
2,970,2,972],[2,971,2,973],[2,972,2,974],[2,973,2,975],[2,974,2,976],[2,975
,2,977],[2,976,2,978],[2,977,2,979],[2,978,2,980],[2,979,2,981],[2,980,2,98
2],[2,981,2,983],[2,982,2,984],[2,983,2,985],[2,984,2,986],[2,985,2,987],[2
,986,2,988],[2,987,2,989],[2,988,2,990],[2,989,2,991],[2,990,2,992],[2,991,
2,993],[2,992,2,994],[2,993,2,995],[2,994,2,996],[2,995,2,997],[2,996,2,998
],[2,997,2,999],[2,998,2,1000],[2,999,2,1001],[2,1000,2,1002],[2,1001,2,100
3],[2,1002,2,1004],[2,1003,2,1005],[2,1004,2,1006],[2,1005,2,1007],[2,1006,
2,1008],[2,1007,2,1009],[2,1008,2,1010],[2,1009,2,1011],[2,1010,2,1012],[2,
1011,2,1013],[2,1012,2,1014],[2,1013,2,1015],[2,1014,2,1016],[2,1015,2,1017
],[2,1016,2,1018],[2,1017,2,1019],[2,1018,2,1020],[2,1019,2,1021],[2,1020,2
,1022],[2,1021,2,1023],[2,1022,2,1024],[2,1023,2,1025],[2,1024,2,1026],[2,1
025,2,1027],[2,1026,2,1028],[2,1027,2,1029],[2,1028,2,1030],[2,1029,2,1031]
,[2,1030,2,1032],[2,1031,2,1033],[2,1032,2,1034],[2,1033,2,1035],[2,1034,2,
1036],[2,1035,2,1037],[2,1036,2,1038],[2,1037,2,1039],[2,1038,2,1040],[2,10
39,2,1041],[2,1040,2,1042],[2,1041,2,1043],[2,1042,2,1044],[2,1043,2,1045],
[2,1044,2,1046],[2,1045,2,1047],[2,1046,2,1048],[2,1047,2,1049],[2,1048,2,1
050],[2,1049,2,1051],[2,1050,2,1052],[2,1051,2,1053],[2,1052,2,1054],[2,105
3,2,1055],[2,1054,2,1056],[2,1055,2,1057],[2,1056,2,1058],[2,1057,2,1059],[
2,1058,2,1060],[2,1059,2,1061],[2,1060,2,1062],[2,1061,2,1063],[2,1062,2,10
64],[2,1063,2,1065],[2,1064,2,1066],[2,1065,2,1067],[2,1066,2,1068],[2,1067
,2,1069],[2,1068,2,1070],[2,1069,2,1071],[2,1070,2,1072],[2,1071,2,1073],[2
,1072,2,1074],[2,1073,2,1075],[2,1074,2,1076],[2,1075,2,1077],[2,1076,2,107
8],[2,1077,2,1079],[2,1078,2,1080],[2,1079,2,1081],[2,1080,2,1082],[2,1081,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1515

2,1083],[2,1082,2,1084],[2,1083,2,1085],[2,1084,2,1086],[2,1085,2,1087],[2,
1086,2,1088],[2,1087,2,1089],[2,1088,2,1090],[2,1089,2,1091],[2,1090,2,1092
],[2,1091,2,1093],[2,1092,2,1094],[2,1093,2,1095],[2,1094,2,1096],[2,1095,2
,1097],[2,1096,2,1098],[2,1097,2,1099],[2,1098,2,1100],[2,1099,2,1101],[2,1
100,2,1102],[2,1101,2,1103],[2,1102,2,1104],[2,1103,2,1105],[2,1104,2,1106]
,[2,1105,2,1107],[2,1106,2,1108],[2,1107,2,1109],[2,1108,2,1110],[2,1109,2,
1111],[2,1110,2,1112],[2,1111,2,1113],[2,1112,2,1114],[2,1113,2,1115],[2,11
14,2,1116],[2,1115,2,1117],[2,1116,2,1118],[2,1117,2,1119],[2,1118,2,1120],
[2,1119,2,1121],[2,1120,2,1122],[2,1121,2,1123],[2,1122,2,1124],[2,1123,2,1
125],[2,1124,2,1126],[2,1125,2,1127],[2,1126,2,1128],[2,1127,2,1129],[2,112
8,2,1130],[2,1129,2,1131],[2,1130,2,1132],[2,1131,2,1133],[2,1132,2,1134],[
2,1133,2,1135],[2,1134,2,1136],[2,1135,2,1137],[2,1136,2,1138],[2,1137,2,11
39],[2,1138,2,1140],[2,1139,2,1141],[2,1140,2,1142],[2,1141,2,1143],[2,1142
,2,1144],[2,1143,2,1145],[2,1144,2,1146],[2,1145,2,1147],[2,1146,2,1148],[2
,1147,2,1149],[2,1148,2,1150],[2,1149,2,1151],[2,1150,2,1152],[2,1151,2,115
3],[2,1152,2,1154],[2,1153,2,1155],[2,1154,2,1156],[2,1155,2,1157],[2,1156,
2,1158],[2,1157,2,1159],[2,1158,2,1160],[2,1159,2,1161],[2,1160,2,1162],[2,
1161,2,1163],[2,1162,2,1164],[2,1163,2,1165],[2,1164,2,1166],[2,1165,2,1167
],[2,1166,2,1168],[2,1167,2,1169],[2,1168,2,1170],[2,1169,2,1171],[2,1170,2
,1172],[2,1171,2,1173],[2,1172,2,1174],[2,1173,2,1175],[2,1174,2,1176],[2,1
175,2,1177],[2,1176,2,1178],[2,1177,2,1179],[2,1178,2,1180],[2,1179,2,1181]
,[2,1180,2,1182],[2,1181,2,1183],[2,1182,2,1184],[2,1183,2,1185],[2,1184,2,
1186],[2,1185,2,1187],[2,1186,2,1188],[2,1187,2,1189],[2,1188,2,1190],[2,11
89,2,1191],[2,1190,2,1192],[2,1191,2,1193],[2,1192,2,1194],[2,1193,2,1195],
[2,1194,2,1196],[2,1195,2,1197],[2,1196,2,1198],[2,1197,2,1199],[2,1198,2,1
200],[2,1199,2,1201],[2,1200,2,1202],[2,1201,2,1203],[2,1202,2,1204],[2,120
3,2,1205],[2,1204,2,1206],[2,1205,2,1207],[2,1206,2,1208],[2,1207,2,1209],[
2,1208,2,1210],[2,1209,2,1211],[2,1210,2,1212],[2,1211,2,1213],[2,1212,2,12
14],[2,1213,2,1215],[2,1214,2,1216],[2,1215,2,1217],[2,1216,2,1218],[2,1217
,2,1219],[2,1218,2,1220],[2,1219,2,1221],[2,1220,2,1222],[2,1221,2,1223],[2
,1222,2,1224],[2,1223,2,1225],[2,1224,2,1226],[2,1225,2,1227],[2,1226,2,122
8],[2,1227,2,1229],[2,1228,2,1230],[2,1229,2,1231],[2,1230,2,1232],[2,1231,
2,1233],[2,1232,2,1234],[2,1233,2,1235],[2,1234,2,1236],[2,1235,2,1237],[2,
1236,2,1238],[2,1237,2,1239],[2,1238,2,1240],[2,1239,2,1241],[2,1240,2,1242
],[2,1241,2,1243],[2,1242,2,1244],[2,1243,2,1245],[2,1244,2,1246],[2,1245,2
,1247],[2,1246,2,1248],[2,1247,2,1249],[2,1248,2,1250],[2,1249,2,1251],[2,1
250,2,1252],[2,1251,2,1253],[2,1252,2,1254],[2,1253,2,1255],[2,1254,2,1256]
,[2,1255,2,1257],[2,1256,2,1258],[2,1257,2,1259],[2,1258,2,1260],[2,1259,2,
1261],[2,1260,2,1262],[2,1261,2,1263],[2,1262,2,1264],[2,1263,2,1265],[2,12
64,2,1266],[2,1265,2,1267],[2,1266,2,1268],[2,1267,2,1269],[2,1268,2,1270],
[2,1269,2,1271],[2,1270,3,1271],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1516

1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-
1]],"row":15,"num":2},{"stap_colors":[[84,1507550],[126,1507550],[168,89478
48],[210,8947848],[252,8947848],[294,8947848],[336,8947848],[378,8947848],[
420,8947848],[462,8947848],[504,8947848],[546,8947848],[588,8947848],[630,8
947848],[672,8947848],[714,8947848],[756,8947848],[798,8947848],[840,894784
8],[882,8947848],[924,8947848],[966,8947848],[1008,8947848],[1050,8947848],
[1092,8947848],[1134,8947848],[1176,8947848],[1218,8947848],[1260,3355443]]
,"stap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[4,56,3,57],[3,56,3,58],[3,57,3,59],[3,58,3,60],[3,59,3,61],[3,60,3,62],
[3,61,3,63],[3,62,3,64],[3,63,3,65],[3,64,3,66],[3,65,3,67],[3,66,3,68],[3,
67,3,69],[3,68,2,69],[2,70,3,71],[3,70,3,72],[3,71,3,73],[3,72,3,74],[3,73,
3,75],[3,74,3,76],[3,75,3,77],[3,76,3,78],[3,77,3,79],[3,78,3,80],[3,79,3,8
1],[3,80,3,82],[3,81,3,83],[3,82,-1,-1],[-1,-
1,3,85],[3,84,3,86],[3,85,3,87],[3,86,3,88],[3,87,3,89],[3,88,3,90],[3,89,3
,91],[3,90,3,92],[3,91,3,93],[3,92,3,94],[3,93,3,95],[3,94,3,96],[3,95,3,97
],[3,96,4,97],[4,98,3,99],[3,98,3,100],[3,99,3,101],[3,100,3,102],[3,101,3,
103],[3,102,3,104],[3,103,3,105],[3,104,3,106],[3,105,3,107],[3,106,3,108],
[3,107,3,109],[3,108,3,110],[3,109,3,111],[3,110,2,111],[2,112,3,113],[3,11
2,3,114],[3,113,3,115],[3,114,3,116],[3,115,3,117],[3,116,3,118],[3,117,3,1
19],[3,118,3,120],[3,119,3,121],[3,120,3,122],[3,121,3,123],[3,122,3,124],[
3,123,3,125],[3,124,-1,-1],[-1,-
1,3,127],[3,126,3,128],[3,127,3,129],[3,128,3,130],[3,129,3,131],[3,130,3,1
32],[3,131,3,133],[3,132,3,134],[3,133,3,135],[3,134,3,136],[3,135,3,137],[
3,136,3,138],[3,137,3,139],[3,138,4,139],[4,140,3,141],[3,140,3,142],[3,141
,3,143],[3,142,3,144],[3,143,3,145],[3,144,3,146],[3,145,3,147],[3,146,3,14
8],[3,147,3,149],[3,148,3,150],[3,149,3,151],[3,150,3,152],[3,151,3,153],[3
,152,2,153],[2,154,3,155],[3,154,3,156],[3,155,3,157],[3,156,3,158],[3,157,
3,159],[3,158,3,160],[3,159,3,161],[3,160,3,162],[3,161,3,163],[3,162,3,164
],[3,163,3,165],[3,164,3,166],[3,165,3,167],[3,166,-1,-1],[-1,-
1,3,169],[3,168,3,170],[3,169,3,171],[3,170,3,172],[3,171,3,173],[3,172,3,1
74],[3,173,3,175],[3,174,3,176],[3,175,3,177],[3,176,3,178],[3,177,3,179],[
3,178,3,180],[3,179,3,181],[3,180,4,181],[4,182,3,183],[3,182,3,184],[3,183
,3,185],[3,184,3,186],[3,185,3,187],[3,186,3,188],[3,187,3,189],[3,188,3,19
0],[3,189,3,191],[3,190,3,192],[3,191,3,193],[3,192,3,194],[3,193,3,195],[3
,194,2,195],[2,196,3,197],[3,196,3,198],[3,197,3,199],[3,198,3,200],[3,199,
3,201],[3,200,3,202],[3,201,3,203],[3,202,3,204],[3,203,3,205],[3,204,3,206
],[3,205,3,207],[3,206,3,208],[3,207,3,209],[3,208,-1,-1],[-1,-
1,3,211],[3,210,3,212],[3,211,3,213],[3,212,3,214],[3,213,3,215],[3,214,3,2
16],[3,215,3,217],[3,216,3,218],[3,217,3,219],[3,218,3,220],[3,219,3,221],[
3,220,3,222],[3,221,3,223],[3,222,4,223],[4,224,3,225],[3,224,3,226],[3,225
,3,227],[3,226,3,228],[3,227,3,229],[3,228,3,230],[3,229,3,231],[3,230,3,23
2],[3,231,3,233],[3,232,3,234],[3,233,3,235],[3,234,3,236],[3,235,3,237],[3

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1517

,236,2,237],[2,238,3,239],[3,238,3,240],[3,239,3,241],[3,240,3,242],[3,241,
3,243],[3,242,3,244],[3,243,3,245],[3,244,3,246],[3,245,3,247],[3,246,3,248
],[3,247,3,249],[3,248,3,250],[3,249,3,251],[3,250,-1,-1],[-1,-
1,3,253],[3,252,3,254],[3,253,3,255],[3,254,3,256],[3,255,3,257],[3,256,3,2
58],[3,257,3,259],[3,258,3,260],[3,259,3,261],[3,260,3,262],[3,261,3,263],[
3,262,3,264],[3,263,3,265],[3,264,4,265],[4,266,3,267],[3,266,3,268],[3,267
,3,269],[3,268,3,270],[3,269,3,271],[3,270,3,272],[3,271,3,273],[3,272,3,27
4],[3,273,3,275],[3,274,3,276],[3,275,3,277],[3,276,3,278],[3,277,3,279],[3
,278,2,279],[2,280,3,281],[3,280,3,282],[3,281,3,283],[3,282,3,284],[3,283,
3,285],[3,284,3,286],[3,285,3,287],[3,286,3,288],[3,287,3,289],[3,288,3,290
],[3,289,3,291],[3,290,3,292],[3,291,3,293],[3,292,-1,-1],[-1,-
1,3,295],[3,294,3,296],[3,295,3,297],[3,296,3,298],[3,297,3,299],[3,298,3,3
00],[3,299,3,301],[3,300,3,302],[3,301,3,303],[3,302,3,304],[3,303,3,305],[
3,304,3,306],[3,305,3,307],[3,306,4,307],[4,308,3,309],[3,308,3,310],[3,309
,3,311],[3,310,3,312],[3,311,3,313],[3,312,3,314],[3,313,3,315],[3,314,3,31
6],[3,315,3,317],[3,316,3,318],[3,317,3,319],[3,318,3,320],[3,319,3,321],[3
,320,2,321],[2,322,3,323],[3,322,3,324],[3,323,3,325],[3,324,3,326],[3,325,
3,327],[3,326,3,328],[3,327,3,329],[3,328,3,330],[3,329,3,331],[3,330,3,332
],[3,331,3,333],[3,332,3,334],[3,333,3,335],[3,334,-1,-1],[-1,-
1,3,337],[3,336,3,338],[3,337,3,339],[3,338,3,340],[3,339,3,341],[3,340,3,3
42],[3,341,3,343],[3,342,3,344],[3,343,3,345],[3,344,3,346],[3,345,3,347],[
3,346,3,348],[3,347,3,349],[3,348,4,349],[4,350,3,351],[3,350,3,352],[3,351
,3,353],[3,352,3,354],[3,353,3,355],[3,354,3,356],[3,355,3,357],[3,356,3,35
8],[3,357,3,359],[3,358,3,360],[3,359,3,361],[3,360,3,362],[3,361,3,363],[3
,362,2,363],[2,364,3,365],[3,364,3,366],[3,365,3,367],[3,366,3,368],[3,367,
3,369],[3,368,3,370],[3,369,3,371],[3,370,3,372],[3,371,3,373],[3,372,3,374
],[3,373,3,375],[3,374,3,376],[3,375,3,377],[3,376,-1,-1],[-1,-
1,3,379],[3,378,3,380],[3,379,3,381],[3,380,3,382],[3,381,3,383],[3,382,3,3
84],[3,383,3,385],[3,384,3,386],[3,385,3,387],[3,386,3,388],[3,387,3,389],[
3,388,3,390],[3,389,3,391],[3,390,4,391],[4,392,3,393],[3,392,3,394],[3,393
,3,395],[3,394,3,396],[3,395,3,397],[3,396,3,398],[3,397,3,399],[3,398,3,40
0],[3,399,3,401],[3,400,3,402],[3,401,3,403],[3,402,3,404],[3,403,3,405],[3
,404,2,405],[2,406,3,407],[3,406,3,408],[3,407,3,409],[3,408,3,410],[3,409,
3,411],[3,410,3,412],[3,411,3,413],[3,412,3,414],[3,413,3,415],[3,414,3,416
],[3,415,3,417],[3,416,3,418],[3,417,3,419],[3,418,-1,-1],[-1,-
1,3,421],[3,420,3,422],[3,421,3,423],[3,422,3,424],[3,423,3,425],[3,424,3,4
26],[3,425,3,427],[3,426,3,428],[3,427,3,429],[3,428,3,430],[3,429,3,431],[
3,430,3,432],[3,431,3,433],[3,432,4,433],[4,434,3,435],[3,434,3,436],[3,435
,3,437],[3,436,3,438],[3,437,3,439],[3,438,3,440],[3,439,3,441],[3,440,3,44
2],[3,441,3,443],[3,442,3,444],[3,443,3,445],[3,444,3,446],[3,445,3,447],[3
,446,2,447],[2,448,3,449],[3,448,3,450],[3,449,3,451],[3,450,3,452],[3,451,
3,453],[3,452,3,454],[3,453,3,455],[3,454,3,456],[3,455,3,457],[3,456,3,458
],[3,457,3,459],[3,458,3,460],[3,459,3,461],[3,460,-1,-1],[-1,-
1,3,463],[3,462,3,464],[3,463,3,465],[3,464,3,466],[3,465,3,467],[3,466,3,4
68],[3,467,3,469],[3,468,3,470],[3,469,3,471],[3,470,3,472],[3,471,3,473],[
3,472,3,474],[3,473,3,475],[3,474,4,475],[4,476,3,477],[3,476,3,478],[3,477
,3,479],[3,478,3,480],[3,479,3,481],[3,480,3,482],[3,481,3,483],[3,482,3,48
4],[3,483,3,485],[3,484,3,486],[3,485,3,487],[3,486,3,488],[3,487,3,489],[3
,488,2,489],[2,490,3,491],[3,490,3,492],[3,491,3,493],[3,492,3,494],[3,493,
3,495],[3,494,3,496],[3,495,3,497],[3,496,3,498],[3,497,3,499],[3,498,3,500
],[3,499,3,501],[3,500,3,502],[3,501,3,503],[3,502,-1,-1],[-1,-
1,3,505],[3,504,3,506],[3,505,3,507],[3,506,3,508],[3,507,3,509],[3,508,3,5
10],[3,509,3,511],[3,510,3,512],[3,511,3,513],[3,512,3,514],[3,513,3,515],[

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1518

3,514,3,516],[3,515,3,517],[3,516,4,517],[4,518,3,519],[3,518,3,520],[3,519
,3,521],[3,520,3,522],[3,521,3,523],[3,522,3,524],[3,523,3,525],[3,524,3,52
6],[3,525,3,527],[3,526,3,528],[3,527,3,529],[3,528,3,530],[3,529,3,531],[3
,530,2,531],[2,532,3,533],[3,532,3,534],[3,533,3,535],[3,534,3,536],[3,535,
3,537],[3,536,3,538],[3,537,3,539],[3,538,3,540],[3,539,3,541],[3,540,3,542
],[3,541,3,543],[3,542,3,544],[3,543,3,545],[3,544,-1,-1],[-1,-
1,3,547],[3,546,3,548],[3,547,3,549],[3,548,3,550],[3,549,3,551],[3,550,3,5
52],[3,551,3,553],[3,552,3,554],[3,553,3,555],[3,554,3,556],[3,555,3,557],[
3,556,3,558],[3,557,3,559],[3,558,4,559],[4,560,3,561],[3,560,3,562],[3,561
,3,563],[3,562,3,564],[3,563,3,565],[3,564,3,566],[3,565,3,567],[3,566,3,56
8],[3,567,3,569],[3,568,3,570],[3,569,3,571],[3,570,3,572],[3,571,3,573],[3
,572,2,573],[2,574,3,575],[3,574,3,576],[3,575,3,577],[3,576,3,578],[3,577,
3,579],[3,578,3,580],[3,579,3,581],[3,580,3,582],[3,581,3,583],[3,582,3,584
],[3,583,3,585],[3,584,3,586],[3,585,3,587],[3,586,-1,-1],[-1,-
1,3,589],[3,588,3,590],[3,589,3,591],[3,590,3,592],[3,591,3,593],[3,592,3,5
94],[3,593,3,595],[3,594,3,596],[3,595,3,597],[3,596,3,598],[3,597,3,599],[
3,598,3,600],[3,599,3,601],[3,600,4,601],[4,602,3,603],[3,602,3,604],[3,603
,3,605],[3,604,3,606],[3,605,3,607],[3,606,3,608],[3,607,3,609],[3,608,3,61
0],[3,609,3,611],[3,610,3,612],[3,611,3,613],[3,612,3,614],[3,613,3,615],[3
,614,2,615],[2,616,3,617],[3,616,3,618],[3,617,3,619],[3,618,3,620],[3,619,
3,621],[3,620,3,622],[3,621,3,623],[3,622,3,624],[3,623,3,625],[3,624,3,626
],[3,625,3,627],[3,626,3,628],[3,627,3,629],[3,628,-1,-1],[-1,-
1,3,631],[3,630,3,632],[3,631,3,633],[3,632,3,634],[3,633,3,635],[3,634,3,6
36],[3,635,3,637],[3,636,3,638],[3,637,3,639],[3,638,3,640],[3,639,3,641],[
3,640,3,642],[3,641,3,643],[3,642,4,643],[4,644,3,645],[3,644,3,646],[3,645
,3,647],[3,646,3,648],[3,647,3,649],[3,648,3,650],[3,649,3,651],[3,650,3,65
2],[3,651,3,653],[3,652,3,654],[3,653,3,655],[3,654,3,656],[3,655,3,657],[3
,656,2,657],[2,658,3,659],[3,658,3,660],[3,659,3,661],[3,660,3,662],[3,661,
3,663],[3,662,3,664],[3,663,3,665],[3,664,3,666],[3,665,3,667],[3,666,3,668
],[3,667,3,669],[3,668,3,670],[3,669,3,671],[3,670,-1,-1],[-1,-
1,3,673],[3,672,3,674],[3,673,3,675],[3,674,3,676],[3,675,3,677],[3,676,3,6
78],[3,677,3,679],[3,678,3,680],[3,679,3,681],[3,680,3,682],[3,681,3,683],[
3,682,3,684],[3,683,3,685],[3,684,4,685],[4,686,3,687],[3,686,3,688],[3,687
,3,689],[3,688,3,690],[3,689,3,691],[3,690,3,692],[3,691,3,693],[3,692,3,69
4],[3,693,3,695],[3,694,3,696],[3,695,3,697],[3,696,3,698],[3,697,3,699],[3
,698,2,699],[2,700,3,701],[3,700,3,702],[3,701,3,703],[3,702,3,704],[3,703,
3,705],[3,704,3,706],[3,705,3,707],[3,706,3,708],[3,707,3,709],[3,708,3,710
],[3,709,3,711],[3,710,3,712],[3,711,3,713],[3,712,-1,-1],[-1,-
1,3,715],[3,714,3,716],[3,715,3,717],[3,716,3,718],[3,717,3,719],[3,718,3,7
20],[3,719,3,721],[3,720,3,722],[3,721,3,723],[3,722,3,724],[3,723,3,725],[
3,724,3,726],[3,725,3,727],[3,726,4,727],[4,728,3,729],[3,728,3,730],[3,729
,3,731],[3,730,3,732],[3,731,3,733],[3,732,3,734],[3,733,3,735],[3,734,3,73
6],[3,735,3,737],[3,736,3,738],[3,737,3,739],[3,738,3,740],[3,739,3,741],[3
,740,2,741],[2,742,3,743],[3,742,3,744],[3,743,3,745],[3,744,3,746],[3,745,
3,747],[3,746,3,748],[3,747,3,749],[3,748,3,750],[3,749,3,751],[3,750,3,752
],[3,751,3,753],[3,752,3,754],[3,753,3,755],[3,754,-1,-1],[-1,-
1,3,757],[3,756,3,758],[3,757,3,759],[3,758,3,760],[3,759,3,761],[3,760,3,7
62],[3,761,3,763],[3,762,3,764],[3,763,3,765],[3,764,3,766],[3,765,3,767],[
3,766,3,768],[3,767,3,769],[3,768,4,769],[4,770,3,771],[3,770,3,772],[3,771
,3,773],[3,772,3,774],[3,773,3,775],[3,774,3,776],[3,775,3,777],[3,776,3,77
8],[3,777,3,779],[3,778,3,780],[3,779,3,781],[3,780,3,782],[3,781,3,783],[3
,782,2,783],[2,784,3,785],[3,784,3,786],[3,785,3,787],[3,786,3,788],[3,787,
3,789],[3,788,3,790],[3,789,3,791],[3,790,3,792],[3,791,3,793],[3,792,3,794

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1519

],[3,793,3,795],[3,794,3,796],[3,795,3,797],[3,796,-1,-1],[-1,-
1,3,799],[3,798,3,800],[3,799,3,801],[3,800,3,802],[3,801,3,803],[3,802,3,8
04],[3,803,3,805],[3,804,3,806],[3,805,3,807],[3,806,3,808],[3,807,3,809],[
3,808,3,810],[3,809,3,811],[3,810,4,811],[4,812,3,813],[3,812,3,814],[3,813
,3,815],[3,814,3,816],[3,815,3,817],[3,816,3,818],[3,817,3,819],[3,818,3,82
0],[3,819,3,821],[3,820,3,822],[3,821,3,823],[3,822,3,824],[3,823,3,825],[3
,824,2,825],[2,826,3,827],[3,826,3,828],[3,827,3,829],[3,828,3,830],[3,829,
3,831],[3,830,3,832],[3,831,3,833],[3,832,3,834],[3,833,3,835],[3,834,3,836
],[3,835,3,837],[3,836,3,838],[3,837,3,839],[3,838,-1,-1],[-1,-
1,3,841],[3,840,3,842],[3,841,3,843],[3,842,3,844],[3,843,3,845],[3,844,3,8
46],[3,845,3,847],[3,846,3,848],[3,847,3,849],[3,848,3,850],[3,849,3,851],[
3,850,3,852],[3,851,3,853],[3,852,4,853],[4,854,3,855],[3,854,3,856],[3,855
,3,857],[3,856,3,858],[3,857,3,859],[3,858,3,860],[3,859,3,861],[3,860,3,86
2],[3,861,3,863],[3,862,3,864],[3,863,3,865],[3,864,3,866],[3,865,3,867],[3
,866,2,867],[2,868,3,869],[3,868,3,870],[3,869,3,871],[3,870,3,872],[3,871,
3,873],[3,872,3,874],[3,873,3,875],[3,874,3,876],[3,875,3,877],[3,876,3,878
],[3,877,3,879],[3,878,3,880],[3,879,3,881],[3,880,-1,-1],[-1,-
1,3,883],[3,882,3,884],[3,883,3,885],[3,884,3,886],[3,885,3,887],[3,886,3,8
88],[3,887,3,889],[3,888,3,890],[3,889,3,891],[3,890,3,892],[3,891,3,893],[
3,892,3,894],[3,893,3,895],[3,894,4,895],[4,896,3,897],[3,896,3,898],[3,897
,3,899],[3,898,3,900],[3,899,3,901],[3,900,3,902],[3,901,3,903],[3,902,3,90
4],[3,903,3,905],[3,904,3,906],[3,905,3,907],[3,906,3,908],[3,907,3,909],[3
,908,2,909],[2,910,3,911],[3,910,3,912],[3,911,3,913],[3,912,3,914],[3,913,
3,915],[3,914,3,916],[3,915,3,917],[3,916,3,918],[3,917,3,919],[3,918,3,920
],[3,919,3,921],[3,920,3,922],[3,921,3,923],[3,922,-1,-1],[-1,-
1,3,925],[3,924,3,926],[3,925,3,927],[3,926,3,928],[3,927,3,929],[3,928,3,9
30],[3,929,3,931],[3,930,3,932],[3,931,3,933],[3,932,3,934],[3,933,3,935],[
3,934,3,936],[3,935,3,937],[3,936,4,937],[4,938,3,939],[3,938,3,940],[3,939
,3,941],[3,940,3,942],[3,941,3,943],[3,942,3,944],[3,943,3,945],[3,944,3,94
6],[3,945,3,947],[3,946,3,948],[3,947,3,949],[3,948,3,950],[3,949,3,951],[3
,950,2,951],[2,952,3,953],[3,952,3,954],[3,953,3,955],[3,954,3,956],[3,955,
3,957],[3,956,3,958],[3,957,3,959],[3,958,3,960],[3,959,3,961],[3,960,3,962
],[3,961,3,963],[3,962,3,964],[3,963,3,965],[3,964,-1,-1],[-1,-
1,3,967],[3,966,3,968],[3,967,3,969],[3,968,3,970],[3,969,3,971],[3,970,3,9
72],[3,971,3,973],[3,972,3,974],[3,973,3,975],[3,974,3,976],[3,975,3,977],[
3,976,3,978],[3,977,3,979],[3,978,4,979],[4,980,3,981],[3,980,3,982],[3,981
,3,983],[3,982,3,984],[3,983,3,985],[3,984,3,986],[3,985,3,987],[3,986,3,98
8],[3,987,3,989],[3,988,3,990],[3,989,3,991],[3,990,3,992],[3,991,3,993],[3
,992,2,993],[2,994,3,995],[3,994,3,996],[3,995,3,997],[3,996,3,998],[3,997,
3,999],[3,998,3,1000],[3,999,3,1001],[3,1000,3,1002],[3,1001,3,1003],[3,100
2,3,1004],[3,1003,3,1005],[3,1004,3,1006],[3,1005,3,1007],[3,1006,-1,-1],[-
1,-
1,3,1009],[3,1008,3,1010],[3,1009,3,1011],[3,1010,3,1012],[3,1011,3,1013],[
3,1012,3,1014],[3,1013,3,1015],[3,1014,3,1016],[3,1015,3,1017],[3,1016,3,10
18],[3,1017,3,1019],[3,1018,3,1020],[3,1019,3,1021],[3,1020,4,1021],[4,1022
,3,1023],[3,1022,3,1024],[3,1023,3,1025],[3,1024,3,1026],[3,1025,3,1027],[3
,1026,3,1028],[3,1027,3,1029],[3,1028,3,1030],[3,1029,3,1031],[3,1030,3,103
2],[3,1031,3,1033],[3,1032,3,1034],[3,1033,3,1035],[3,1034,2,1035],[2,1036,
3,1037],[3,1036,3,1038],[3,1037,3,1039],[3,1038,3,1040],[3,1039,3,1041],[3,
1040,3,1042],[3,1041,3,1043],[3,1042,3,1044],[3,1043,3,1045],[3,1044,3,1046
],[3,1045,3,1047],[3,1046,3,1048],[3,1047,3,1049],[3,1048,-1,-1],[-1,-
1,3,1051],[3,1050,3,1052],[3,1051,3,1053],[3,1052,3,1054],[3,1053,3,1055],[
3,1054,3,1056],[3,1055,3,1057],[3,1056,3,1058],[3,1057,3,1059],[3,1058,3,10

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1520

60],[3,1059,3,1061],[3,1060,3,1062],[3,1061,3,1063],[3,1062,4,1063],[4,1064
,3,1065],[3,1064,3,1066],[3,1065,3,1067],[3,1066,3,1068],[3,1067,3,1069],[3
,1068,3,1070],[3,1069,3,1071],[3,1070,3,1072],[3,1071,3,1073],[3,1072,3,107
4],[3,1073,3,1075],[3,1074,3,1076],[3,1075,3,1077],[3,1076,2,1077],[2,1078,
3,1079],[3,1078,3,1080],[3,1079,3,1081],[3,1080,3,1082],[3,1081,3,1083],[3,
1082,3,1084],[3,1083,3,1085],[3,1084,3,1086],[3,1085,3,1087],[3,1086,3,1088
],[3,1087,3,1089],[3,1088,3,1090],[3,1089,3,1091],[3,1090,-1,-1],[-1,-
1,3,1093],[3,1092,3,1094],[3,1093,3,1095],[3,1094,3,1096],[3,1095,3,1097],[
3,1096,3,1098],[3,1097,3,1099],[3,1098,3,1100],[3,1099,3,1101],[3,1100,3,11
02],[3,1101,3,1103],[3,1102,3,1104],[3,1103,3,1105],[3,1104,4,1105],[4,1106
,3,1107],[3,1106,3,1108],[3,1107,3,1109],[3,1108,3,1110],[3,1109,3,1111],[3
,1110,3,1112],[3,1111,3,1113],[3,1112,3,1114],[3,1113,3,1115],[3,1114,3,111
6],[3,1115,3,1117],[3,1116,3,1118],[3,1117,3,1119],[3,1118,2,1119],[2,1120,
3,1121],[3,1120,3,1122],[3,1121,3,1123],[3,1122,3,1124],[3,1123,3,1125],[3,
1124,3,1126],[3,1125,3,1127],[3,1126,3,1128],[3,1127,3,1129],[3,1128,3,1130
],[3,1129,3,1131],[3,1130,3,1132],[3,1131,3,1133],[3,1132,-1,-1],[-1,-
1,3,1135],[3,1134,3,1136],[3,1135,3,1137],[3,1136,3,1138],[3,1137,3,1139],[
3,1138,3,1140],[3,1139,3,1141],[3,1140,3,1142],[3,1141,3,1143],[3,1142,3,11
44],[3,1143,3,1145],[3,1144,3,1146],[3,1145,3,1147],[3,1146,4,1147],[4,1148
,3,1149],[3,1148,3,1150],[3,1149,3,1151],[3,1150,3,1152],[3,1151,3,1153],[3
,1152,3,1154],[3,1153,3,1155],[3,1154,3,1156],[3,1155,3,1157],[3,1156,3,115
8],[3,1157,3,1159],[3,1158,3,1160],[3,1159,3,1161],[3,1160,2,1161],[2,1162,
3,1163],[3,1162,3,1164],[3,1163,3,1165],[3,1164,3,1166],[3,1165,3,1167],[3,
1166,3,1168],[3,1167,3,1169],[3,1168,3,1170],[3,1169,3,1171],[3,1170,3,1172
],[3,1171,3,1173],[3,1172,3,1174],[3,1173,3,1175],[3,1174,-1,-1],[-1,-
1,3,1177],[3,1176,3,1178],[3,1177,3,1179],[3,1178,3,1180],[3,1179,3,1181],[
3,1180,3,1182],[3,1181,3,1183],[3,1182,3,1184],[3,1183,3,1185],[3,1184,3,11
86],[3,1185,3,1187],[3,1186,3,1188],[3,1187,3,1189],[3,1188,4,1189],[4,1190
,3,1191],[3,1190,3,1192],[3,1191,3,1193],[3,1192,3,1194],[3,1193,3,1195],[3
,1194,3,1196],[3,1195,3,1197],[3,1196,3,1198],[3,1197,3,1199],[3,1198,3,120
0],[3,1199,3,1201],[3,1200,3,1202],[3,1201,3,1203],[3,1202,2,1203],[2,1204,
3,1205],[3,1204,3,1206],[3,1205,3,1207],[3,1206,3,1208],[3,1207,3,1209],[3,
1208,3,1210],[3,1209,3,1211],[3,1210,3,1212],[3,1211,3,1213],[3,1212,3,1214
],[3,1213,3,1215],[3,1214,3,1216],[3,1215,3,1217],[3,1216,-1,-1],[-1,-
1,3,1219],[3,1218,3,1220],[3,1219,3,1221],[3,1220,3,1222],[3,1221,3,1223],[
3,1222,3,1224],[3,1223,3,1225],[3,1224,3,1226],[3,1225,3,1227],[3,1226,3,12
28],[3,1227,3,1229],[3,1228,3,1230],[3,1229,3,1231],[3,1230,4,1231],[4,1232
,3,1233],[3,1232,3,1234],[3,1233,3,1235],[3,1234,3,1236],[3,1235,3,1237],[3
,1236,3,1238],[3,1237,3,1239],[3,1238,3,1240],[3,1239,3,1241],[3,1240,3,124
2],[3,1241,3,1243],[3,1242,3,1244],[3,1243,3,1245],[3,1244,2,1245],[2,1246,
3,1247],[3,1246,3,1248],[3,1247,3,1249],[3,1248,3,1250],[3,1249,3,1251],[3,
1250,3,1252],[3,1251,3,1253],[3,1252,3,1254],[3,1253,3,1255],[3,1254,3,1256
],[3,1255,3,1257],[3,1256,3,1258],[3,1257,3,1259],[3,1258,-1,-1],[-1,-
1,3,1261],[3,1260,3,1262],[3,1261,3,1263],[3,1262,3,1264],[3,1263,3,1265],[
3,1264,3,1266],[3,1265,3,1267],[3,1266,3,1268],[3,1267,3,1269],[3,1268,3,12
70],[3,1269,3,1271],[3,1270,3,1272],[3,1271,3,1273],[3,1272,4,1273],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1521

1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"col":14,"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1522

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[3,55,2,54],[3,56,3,54],[3,57,3,55],[3,58,3,56],[3,59,3,57],[3,60,3,58],
[3,61,3,59],[3,62,3,60],[3,63,3,61],[3,64,3,62],[3,65,3,63],[3,66,3,64],[3,
67,3,65],[3,68,3,66],[3,69,3,67],[3,70,3,68],[3,71,3,69],[3,72,3,70],[3,73,
3,71],[3,74,3,72],[3,75,3,73],[3,76,3,74],[3,77,3,75],[3,78,3,76],[3,79,3,7
7],[3,80,3,78],[3,81,3,79],[3,82,3,80],[3,83,3,81],[3,84,3,82],[3,85,3,83],
[3,86,3,84],[3,87,3,85],[3,88,3,86],[3,89,3,87],[3,90,3,88],[3,91,3,89],[3,
92,3,90],[3,93,3,91],[3,94,3,92],[3,95,3,93],[3,96,3,94],[3,97,3,95],[3,98,
3,96],[3,99,3,97],[3,100,3,98],[3,101,3,99],[3,102,3,100],[3,103,3,101],[3,
104,3,102],[3,105,3,103],[3,106,3,104],[3,107,3,105],[3,108,3,106],[3,109,3
,107],[3,110,3,108],[3,111,3,109],[3,112,3,110],[3,113,3,111],[3,114,3,112]
,[3,115,3,113],[3,116,3,114],[3,117,3,115],[3,118,3,116],[3,119,3,117],[3,1
20,3,118],[3,121,3,119],[3,122,3,120],[3,123,3,121],[3,124,3,122],[3,125,3,
123],[3,126,3,124],[3,127,3,125],[3,128,3,126],[3,129,3,127],[3,130,3,128],
[3,131,3,129],[3,132,3,130],[3,133,3,131],[3,134,3,132],[3,135,3,133],[3,13
6,3,134],[3,137,3,135],[3,138,3,136],[3,139,3,137],[3,140,3,138],[3,141,3,1
39],[3,142,3,140],[3,143,3,141],[3,144,3,142],[3,145,3,143],[3,146,3,144],[

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1523

3,147,3,145],[3,148,3,146],[3,149,3,147],[3,150,3,148],[3,151,3,149],[3,152
,3,150],[3,153,3,151],[3,154,3,152],[3,155,3,153],[3,156,3,154],[3,157,3,15
5],[3,158,3,156],[3,159,3,157],[3,160,3,158],[3,161,3,159],[3,162,3,160],[3
,163,3,161],[3,164,3,162],[3,165,3,163],[3,166,3,164],[3,167,3,165],[3,168,
3,166],[3,169,3,167],[3,170,3,168],[3,171,3,169],[3,172,3,170],[3,173,3,171
],[3,174,3,172],[3,175,3,173],[3,176,3,174],[3,177,3,175],[3,178,3,176],[3,
179,3,177],[3,180,3,178],[3,181,3,179],[3,182,3,180],[3,183,3,181],[3,184,3
,182],[3,185,3,183],[3,186,3,184],[3,187,3,185],[3,188,3,186],[3,189,3,187]
,[3,190,3,188],[3,191,3,189],[3,192,3,190],[3,193,3,191],[3,194,3,192],[3,1
95,3,193],[3,196,3,194],[3,197,3,195],[3,198,3,196],[3,199,3,197],[3,200,3,
198],[3,201,3,199],[3,202,3,200],[3,203,3,201],[3,204,3,202],[3,205,3,203],
[3,206,3,204],[3,207,3,205],[3,208,3,206],[3,209,3,207],[3,210,3,208],[3,21
1,3,209],[3,212,3,210],[3,213,3,211],[3,214,3,212],[3,215,3,213],[3,216,3,2
14],[3,217,3,215],[3,218,3,216],[3,219,3,217],[3,220,3,218],[3,221,3,219],[
3,222,3,220],[3,223,3,221],[3,224,3,222],[3,225,3,223],[3,226,3,224],[3,227
,3,225],[3,228,3,226],[3,229,3,227],[3,230,3,228],[3,231,3,229],[3,232,3,23
0],[3,233,3,231],[3,234,3,232],[3,235,3,233],[3,236,3,234],[3,237,3,235],[3
,238,3,236],[3,239,3,237],[3,240,3,238],[3,241,3,239],[3,242,3,240],[3,243,
3,241],[3,244,3,242],[3,245,3,243],[3,246,3,244],[3,247,3,245],[3,248,3,246
],[3,249,3,247],[3,250,3,248],[3,251,3,249],[3,252,3,250],[3,253,3,251],[3,
254,3,252],[3,255,3,253],[3,256,3,254],[3,257,3,255],[3,258,3,256],[3,259,3
,257],[3,260,3,258],[3,261,3,259],[3,262,3,260],[3,263,3,261],[3,264,3,262]
,[3,265,3,263],[3,266,3,264],[3,267,3,265],[3,268,3,266],[3,269,3,267],[3,2
70,3,268],[3,271,3,269],[3,272,3,270],[3,273,3,271],[3,274,3,272],[3,275,3,
273],[3,276,3,274],[3,277,3,275],[3,278,3,276],[3,279,3,277],[3,280,3,278],
[3,281,3,279],[3,282,3,280],[3,283,3,281],[3,284,3,282],[3,285,3,283],[3,28
6,3,284],[3,287,3,285],[3,288,3,286],[3,289,3,287],[3,290,3,288],[3,291,3,2
89],[3,292,3,290],[3,293,3,291],[3,294,3,292],[3,295,3,293],[3,296,3,294],[
3,297,3,295],[3,298,3,296],[3,299,3,297],[3,300,3,298],[3,301,3,299],[3,302
,3,300],[3,303,3,301],[3,304,3,302],[3,305,3,303],[3,306,3,304],[3,307,3,30
5],[3,308,3,306],[3,309,3,307],[3,310,3,308],[3,311,3,309],[3,312,3,310],[3
,313,3,311],[3,314,3,312],[3,315,3,313],[3,316,3,314],[3,317,3,315],[3,318,
3,316],[3,319,3,317],[3,320,3,318],[3,321,3,319],[3,322,3,320],[3,323,3,321
],[3,324,3,322],[3,325,3,323],[3,326,3,324],[3,327,3,325],[3,328,3,326],[3,
329,3,327],[3,330,3,328],[3,331,3,329],[3,332,3,330],[3,333,3,331],[3,334,3
,332],[3,335,3,333],[3,336,3,334],[3,337,3,335],[3,338,3,336],[3,339,3,337]
,[3,340,3,338],[3,341,3,339],[3,342,3,340],[3,343,3,341],[3,344,3,342],[3,3
45,3,343],[3,346,3,344],[3,347,3,345],[3,348,3,346],[3,349,3,347],[3,350,3,
348],[3,351,3,349],[3,352,3,350],[3,353,3,351],[3,354,3,352],[3,355,3,353],
[3,356,3,354],[3,357,3,355],[3,358,3,356],[3,359,3,357],[3,360,3,358],[3,36
1,3,359],[3,362,3,360],[3,363,3,361],[3,364,3,362],[3,365,3,363],[3,366,3,3
64],[3,367,3,365],[3,368,3,366],[3,369,3,367],[3,370,3,368],[3,371,3,369],[
3,372,3,370],[3,373,3,371],[3,374,3,372],[3,375,3,373],[3,376,3,374],[3,377
,3,375],[3,378,3,376],[3,379,3,377],[3,380,3,378],[3,381,3,379],[3,382,3,38
0],[3,383,3,381],[3,384,3,382],[3,385,3,383],[3,386,3,384],[3,387,3,385],[3
,388,3,386],[3,389,3,387],[3,390,3,388],[3,391,3,389],[3,392,3,390],[3,393,
3,391],[3,394,3,392],[3,395,3,393],[3,396,3,394],[3,397,3,395],[3,398,3,396
],[3,399,3,397],[3,400,3,398],[3,401,3,399],[3,402,3,400],[3,403,3,401],[3,
404,3,402],[3,405,3,403],[3,406,3,404],[3,407,3,405],[3,408,3,406],[3,409,3
,407],[3,410,3,408],[3,411,3,409],[3,412,3,410],[3,413,3,411],[3,414,3,412]
,[3,415,3,413],[3,416,3,414],[3,417,3,415],[3,418,3,416],[3,419,3,417],[3,4
20,3,418],[3,421,3,419],[3,422,3,420],[3,423,3,421],[3,424,3,422],[3,425,3,
423],[3,426,3,424],[3,427,3,425],[3,428,3,426],[3,429,3,427],[3,430,3,428],

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1524

[3,431,3,429],[3,432,3,430],[3,433,3,431],[3,434,3,432],[3,435,3,433],[3,436,3,434],[3,437,3,435],[3,438,3,436],[3,439,3,437],[3,440,3,438],[3,441,3,439],[3,442,3,440],[3,443,3,441],[3,444,3,442],[3,445,3,443],[3,446,3,444],[3,447,3,445],[3,448,3,446],[3,449,3,447],[3,450,3,448],[3,451,3,449],[3,452,3,450],[3,453,3,451],[3,454,3,452],[3,455,3,453],[3,456,3,454],[3,457,3,455],[3,458,3,456],[3,459,3,457],[3,460,3,458],[3,461,3,459],[3,462,3,460],[3,463,3,461],[3,464,3,462],[3,465,3,463],[3,466,3,464],[3,467,3,465],[3,468,3,466],[3,469,3,467],[3,470,3,468],[3,471,3,469],[3,472,3,470],[3,473,3,471],[3,474,3,472],[3,475,3,473],[3,476,3,474],[3,477,3,475],[3,478,3,476],[3,479,3,477],[3,480,3,478],[3,481,3,479],[3,482,3,480],[3,483,3,481],[3,484,3,482],[3,485,3,483],[3,486,3,484],[3,487,3,485],[3,488,3,486],[3,489,3,487],[3,490,3,488],[3,491,3,489],[3,492,3,490],[3,493,3,491],[3,494,3,492],[3,495,3,493],[3,496,3,494],[3,497,3,495],[3,498,3,496],[3,499,3,497],[3,500,3,498],[3,501,3,499],[3,502,3,500],[3,503,3,501],[3,504,3,502],[3,505,3,503],[3,506,3,504],[3,507,3,505],[3,508,3,506],[3,509,3,507],[3,510,3,508],[3,511,3,509],[3,512,3,510],[3,513,3,511],[3,514,3,512],[3,515,3,513],[3,516,3,514],[3,517,3,515],[3,518,3,516],[3,519,3,517],[3,520,3,518],[3,521,3,519],[3,522,3,520],[3,523,3,521],[3,524,3,522],[3,525,3,523],[3,526,3,524],[3,527,3,525],[3,528,3,526],[3,529,3,527],[3,530,3,528],[3,531,3,529],[3,532,3,530],[3,533,3,531],[3,534,3,532],[3,535,3,533],[3,536,3,534],[3,537,3,535],[3,538,3,536],[3,539,3,537],[3,540,3,538],[3,541,3,539],[3,542,3,540],[3,543,3,541],[3,544,3,542],[3,545,3,543],[3,546,3,544],[3,547,3,545],[3,548,3,546],[3,549,3,547],[3,550,3,548],[3,551,3,549],[3,552,3,550],[3,553,3,551],[3,554,3,552],[3,555,3,553],[3,556,3,554],[3,557,3,555],[3,558,3,556],[3,559,3,557],[3,560,3,558],[3,561,3,559],[3,562,3,560],[3,563,3,561],[3,564,3,562],[3,565,3,563],[3,566,3,564],[3,567,3,565],[3,568,3,566],[3,569,3,567],[3,570,3,568],[3,571,3,569],[3,572,3,570],[3,573,3,571],[3,574,3,572],[3,575,3,573],[3,576,3,574],[3,577,3,575],[3,578,3,576],[3,579,3,577],[3,580,3,578],[3,581,3,579],[3,582,3,580],[3,583,3,581],[3,584,3,582],[3,585,3,583],[3,586,3,584],[3,587,3,585],[3,588,3,586],[3,589,3,587],[3,590,3,588],[3,591,3,589],[3,592,3,590],[3,593,3,591],[3,594,3,592],[3,595,3,593],[3,596,3,594],[3,597,3,595],[3,598,3,596],[3,599,3,597],[3,600,3,598],[3,601,3,599],[3,602,3,600],[3,603,3,601],[3,604,3,602],[3,605,3,603],[3,606,3,604],[3,607,3,605],[3,608,3,606],[3,609,3,607],[3,610,3,608],[3,611,3,609],[3,612,3,610],[3,613,3,611],[3,614,3,612],[3,615,3,613],[3,616,3,614],[3,617,3,615],[4,617,3,616],[3,619,4,618],[3,620,3,618],[3,621,3,619],[3,622,3,620],[3,623,3,621],[3,624,3,622],[3,625,3,623],[3,626,3,624],[3,627,3,625],[3,628,3,626],[3,629,3,627],[3,630,3,628],[3,631,3,629],[3,632,3,630],[3,633,3,631],[3,634,3,632],[3,635,3,633],[3,636,3,634],[3,637,3,635],[3,638,3,636],[3,639,3,637],[3,640,3,638],[3,641,3,639],[3,642,3,640],[3,643,3,641],[3,644,3,642],[3,645,3,643],[3,646,3,644],[3,647,3,645],[3,648,3,646],[3,649,3,647],[3,650,3,648],[3,651,3,649],[3,652,3,650],[3,653,3,651],[3,654,3,652],[3,655,3,653],[3,656,3,654],[3,657,3,655],[3,658,3,656],[3,659,3,657],[3,660,3,658],[3,661,3,659],[3,662,3,660],[3,663,3,661],[3,664,3,662],[3,665,3,663],[3,666,3,664],[3,667,3,665],[3,668,3,666],[3,669,3,667],[3,670,3,668],[3,671,3,669],[3,672,3,670],[3,673,3,671],[3,674,3,672],[3,675,3,673],[3,676,3,674],[3,677,3,675],[3,678,3,676],[3,679,3,677],[3,680,3,678],[3,681,3,679],[3,682,3,680],[3,683,3,681],[3,684,3,682],[3,685,3,683],[3,686,3,684],[3,687,3,685],[3,688,3,686],[3,689,3,687],[3,690,3,688],[3,691,3,689],[3,692,3,690],[3,693,3,691],[3,694,3,692],[3,695,3,693],[3,696,3,694],[3,697,3,695],[3,698,3,696],[3,699,3,697],[3,700,3,698],[3,701,3,699],[3,702,3,700],[3,703,3,701],[3,704,3,702],[3,705,3,703],[3,706,3,704],[3,707,3,705],[3,708,3,706],[3,709,3,707],[3,710,3,708],[3,711,3,709],[3,712,3,710],[3,713,3,711],[3,714,3,712]

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1525

,[3,715,3,713],[3,716,3,714],[3,717,3,715],[3,718,3,716],[3,719,3,717],[3,720,3,718],[3,721,3,719],[3,722,3,720],[3,723,3,721],[3,724,3,722],[3,725,3,723],[3,726,3,724],[3,727,3,725],[3,728,3,726],[3,729,3,727],[3,730,3,728],[3,731,3,729],[3,732,3,730],[3,733,3,731],[3,734,3,732],[3,735,3,733],[3,736,3,734],[3,737,3,735],[3,738,3,736],[3,739,3,737],[3,740,3,738],[3,741,3,739],[3,742,3,740],[3,743,3,741],[3,744,3,742],[3,745,3,743],[3,746,3,744],[3,747,3,745],[3,748,3,746],[3,749,3,747],[3,750,3,748],[3,751,3,749],[3,752,3,750],[3,753,3,751],[3,754,3,752],[3,755,3,753],[3,756,3,754],[3,757,3,755],[3,758,3,756],[3,759,3,757],[3,760,3,758],[3,761,3,759],[3,762,3,760],[3,763,3,761],[3,764,3,762],[3,765,3,763],[3,766,3,764],[3,767,3,765],[3,768,3,766],[3,769,3,767],[3,770,3,768],[3,771,3,769],[3,772,3,770],[3,773,3,771],[3,774,3,772],[3,775,3,773],[3,776,3,774],[3,777,3,775],[3,778,3,776],[3,779,3,777],[3,780,3,778],[3,781,3,779],[3,782,3,780],[3,783,3,781],[3,784,3,782],[3,785,3,783],[3,786,3,784],[3,787,3,785],[3,788,3,786],[3,789,3,787],[3,790,3,788],[3,791,3,789],[3,792,3,790],[3,793,3,791],[3,794,3,792],[3,795,3,793],[3,796,3,794],[3,797,3,795],[3,798,3,796],[3,799,3,797],[3,800,3,798],[3,801,3,799],[3,802,3,800],[3,803,3,801],[3,804,3,802],[3,805,3,803],[3,806,3,804],[3,807,3,805],[3,808,3,806],[3,809,3,807],[3,810,3,808],[3,811,3,809],[3,812,3,810],[3,813,3,811],[3,814,3,812],[3,815,3,813],[3,816,3,814],[3,817,3,815],[3,818,3,816],[3,819,3,817],[3,820,3,818],[3,821,3,819],[3,822,3,820],[3,823,3,821],[3,824,3,822],[3,825,3,823],[3,826,3,824],[3,827,3,825],[3,828,3,826],[3,829,3,827],[3,830,3,828],[3,831,3,829],[3,832,3,830],[3,833,3,831],[3,834,3,832],[3,835,3,833],[3,836,3,834],[3,837,3,835],[3,838,3,836],[3,839,3,837],[3,840,3,838],[3,841,3,839],[3,842,3,840],[3,843,3,841],[3,844,3,842],[3,845,3,843],[3,846,3,844],[3,847,3,845],[3,848,3,846],[3,849,3,847],[3,850,3,848],[3,851,3,849],[3,852,3,850],[3,853,3,851],[3,854,3,852],[3,855,3,853],[3,856,3,854],[3,857,3,855],[3,858,3,856],[3,859,3,857],[3,860,3,858],[3,861,3,859],[3,862,3,860],[3,863,3,861],[3,864,3,862],[3,865,3,863],[3,866,3,864],[3,867,3,865],[3,868,3,866],[3,869,3,867],[3,870,3,868],[3,871,3,869],[3,872,3,870],[3,873,3,871],[3,874,3,872],[3,875,3,873],[3,876,3,874],[3,877,3,875],[3,878,3,876],[3,879,3,877],[3,880,3,878],[3,881,3,879],[3,882,3,880],[3,883,3,881],[3,884,3,882],[3,885,3,883],[3,886,3,884],[3,887,3,885],[3,888,3,886],[3,889,3,887],[3,890,3,888],[3,891,3,889],[3,892,3,890],[3,893,3,891],[3,894,3,892],[3,895,3,893],[3,896,3,894],[3,897,3,895],[3,898,3,896],[3,899,3,897],[3,900,3,898],[3,901,3,899],[3,902,3,900],[3,903,3,901],[3,904,3,902],[3,905,3,903],[3,906,3,904],[3,907,3,905],[3,908,3,906],[3,909,3,907],[3,910,3,908],[3,911,3,909],[3,912,3,910],[3,913,3,911],[3,914,3,912],[3,915,3,913],[3,916,3,914],[3,917,3,915],[3,918,3,916],[3,919,3,917],[3,920,3,918],[3,921,3,919],[3,922,3,920],[3,923,3,921],[3,924,3,922],[3,925,3,923],[3,926,3,924],[3,927,3,925],[3,928,3,926],[3,929,3,927],[3,930,3,928],[3,931,3,929],[3,932,3,930],[3,933,3,931],[3,934,3,932],[3,935,3,933],[3,936,3,934],[3,937,3,935],[3,938,3,936],[3,939,3,937],[3,940,3,938],[3,941,3,939],[3,942,3,940],[3,943,3,941],[3,944,3,942],[3,945,3,943],[3,946,3,944],[3,947,3,945],[3,948,3,946],[3,949,3,947],[3,950,3,948],[3,951,3,949],[3,952,3,950],[3,953,3,951],[3,954,3,952],[3,955,3,953],[3,956,3,954],[3,957,3,955],[3,958,3,956],[3,959,3,957],[3,960,3,958],[3,961,3,959],[3,962,3,960],[3,963,3,961],[3,964,3,962],[3,965,3,963],[3,966,3,964],[3,967,3,965],[3,968,3,966],[3,969,3,967],[3,970,3,968],[3,971,3,969],[3,972,3,970],[3,973,3,971],[3,974,3,972],[3,975,3,973],[3,976,3,974],[3,977,3,975],[3,978,3,976],[3,979,3,977],[3,980,3,978],[3,981,3,979],[3,982,3,980],[3,983,3,981],[3,984,3,982],[3,985,3,983],[3,986,3,984],[3,987,3,985],[3,988,3,986],[3,989,3,987],[3,990,3,988],[3,991,3,989],[3,992,3,990],[3,993,3,991],[3,994,3,992],[3,995,3,993],[3,996,3,994],[3,997,3,995],[3,998,3,996

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1526

],[3,999,3,997],[3,1000,3,998],[3,1001,3,999],[3,1002,3,1000],[3,1003,3,100
1],[3,1004,3,1002],[3,1005,3,1003],[3,1006,3,1004],[3,1007,3,1005],[3,1008,
3,1006],[3,1009,3,1007],[3,1010,3,1008],[3,1011,3,1009],[3,1012,3,1010],[3,
1013,3,1011],[3,1014,3,1012],[3,1015,3,1013],[3,1016,3,1014],[3,1017,3,1015
],[3,1018,3,1016],[3,1019,3,1017],[3,1020,3,1018],[3,1021,3,1019],[3,1022,3
,1020],[3,1023,3,1021],[3,1024,3,1022],[3,1025,3,1023],[3,1026,3,1024],[3,1
027,3,1025],[3,1028,3,1026],[3,1029,3,1027],[3,1030,3,1028],[3,1031,3,1029]
,[3,1032,3,1030],[3,1033,3,1031],[3,1034,3,1032],[3,1035,3,1033],[3,1036,3,
1034],[3,1037,3,1035],[3,1038,3,1036],[3,1039,3,1037],[3,1040,3,1038],[3,10
41,3,1039],[3,1042,3,1040],[3,1043,3,1041],[3,1044,3,1042],[3,1045,3,1043],
[3,1046,3,1044],[3,1047,3,1045],[3,1048,3,1046],[3,1049,3,1047],[3,1050,3,1
048],[3,1051,3,1049],[3,1052,3,1050],[3,1053,3,1051],[3,1054,3,1052],[3,105
5,3,1053],[3,1056,3,1054],[3,1057,3,1055],[3,1058,3,1056],[3,1059,3,1057],[
3,1060,3,1058],[3,1061,3,1059],[3,1062,3,1060],[3,1063,3,1061],[3,1064,3,10
62],[3,1065,3,1063],[3,1066,3,1064],[3,1067,3,1065],[3,1068,3,1066],[3,1069
,3,1067],[3,1070,3,1068],[3,1071,3,1069],[3,1072,3,1070],[3,1073,3,1071],[3
,1074,3,1072],[3,1075,3,1073],[3,1076,3,1074],[3,1077,3,1075],[3,1078,3,107
6],[3,1079,3,1077],[3,1080,3,1078],[3,1081,3,1079],[3,1082,3,1080],[3,1083,
3,1081],[3,1084,3,1082],[3,1085,3,1083],[3,1086,3,1084],[3,1087,3,1085],[3,
1088,3,1086],[3,1089,3,1087],[3,1090,3,1088],[3,1091,3,1089],[3,1092,3,1090
],[3,1093,3,1091],[3,1094,3,1092],[3,1095,3,1093],[3,1096,3,1094],[3,1097,3
,1095],[3,1098,3,1096],[3,1099,3,1097],[3,1100,3,1098],[3,1101,3,1099],[3,1
102,3,1100],[3,1103,3,1101],[3,1104,3,1102],[3,1105,3,1103],[3,1106,3,1104]
,[3,1107,3,1105],[3,1108,3,1106],[3,1109,3,1107],[3,1110,3,1108],[3,1111,3,
1109],[3,1112,3,1110],[3,1113,3,1111],[3,1114,3,1112],[3,1115,3,1113],[3,11
16,3,1114],[3,1117,3,1115],[3,1118,3,1116],[3,1119,3,1117],[3,1120,3,1118],
[3,1121,3,1119],[3,1122,3,1120],[3,1123,3,1121],[3,1124,3,1122],[3,1125,3,1
123],[3,1126,3,1124],[3,1127,3,1125],[3,1128,3,1126],[3,1129,3,1127],[3,113
0,3,1128],[3,1131,3,1129],[3,1132,3,1130],[3,1133,3,1131],[3,1134,3,1132],[
3,1135,3,1133],[3,1136,3,1134],[3,1137,3,1135],[3,1138,3,1136],[3,1139,3,11
37],[3,1140,3,1138],[3,1141,3,1139],[3,1142,3,1140],[3,1143,3,1141],[3,1144
,3,1142],[3,1145,3,1143],[3,1146,3,1144],[3,1147,3,1145],[3,1148,3,1146],[3
,1149,3,1147],[3,1150,3,1148],[3,1151,3,1149],[3,1152,3,1150],[3,1153,3,115
1],[3,1154,3,1152],[3,1155,3,1153],[3,1156,3,1154],[3,1157,3,1155],[3,1158,
3,1156],[3,1159,3,1157],[3,1160,3,1158],[3,1161,3,1159],[3,1162,3,1160],[3,
1163,3,1161],[3,1164,3,1162],[3,1165,3,1163],[3,1166,3,1164],[3,1167,3,1165
],[3,1168,3,1166],[3,1169,3,1167],[3,1170,3,1168],[3,1171,3,1169],[3,1172,3
,1170],[3,1173,3,1171],[3,1174,3,1172],[3,1175,3,1173],[3,1176,3,1174],[3,1
177,3,1175],[3,1178,3,1176],[3,1179,3,1177],[3,1180,3,1178],[3,1181,3,1179]
,[3,1182,3,1180],[3,1183,3,1181],[3,1184,3,1182],[3,1185,3,1183],[3,1186,3,
1184],[3,1187,3,1185],[3,1188,3,1186],[3,1189,3,1187],[3,1190,3,1188],[3,11
91,3,1189],[3,1192,3,1190],[3,1193,3,1191],[3,1194,3,1192],[3,1195,3,1193],
[3,1196,3,1194],[3,1197,3,1195],[3,1198,3,1196],[3,1199,3,1197],[3,1200,3,1
198],[3,1201,3,1199],[3,1202,3,1200],[3,1203,3,1201],[3,1204,3,1202],[3,120
5,3,1203],[3,1206,3,1204],[3,1207,3,1205],[3,1208,3,1206],[3,1209,3,1207],[
3,1210,3,1208],[3,1211,3,1209],[3,1212,3,1210],[3,1213,3,1211],[3,1214,3,12
12],[3,1215,3,1213],[3,1216,3,1214],[3,1217,3,1215],[3,1218,3,1216],[3,1219
,3,1217],[3,1220,3,1218],[3,1221,3,1219],[3,1222,3,1220],[3,1223,3,1221],[3
,1224,3,1222],[3,1225,3,1223],[3,1226,3,1224],[3,1227,3,1225],[3,1228,3,122
6],[3,1229,3,1227],[3,1230,3,1228],[3,1231,3,1229],[3,1232,3,1230],[3,1233,
3,1231],[3,1234,3,1232],[3,1235,3,1233],[3,1236,3,1234],[3,1237,3,1235],[3,
1238,3,1236],[3,1239,3,1237],[3,1240,3,1238],[3,1241,3,1239],[3,1242,3,1240
],[3,1243,3,1241],[3,1244,3,1242],[3,1245,3,1243],[3,1246,3,1244],[3,1247,3

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1527

,1245],[3,1248,3,1246],[3,1249,3,1247],[3,1250,3,1248],[3,1251,3,1249],[3,1
252,3,1250],[3,1253,3,1251],[3,1254,3,1252],[3,1255,3,1253],[3,1256,3,1254]
,[3,1257,3,1255],[3,1258,3,1256],[3,1259,3,1257],[3,1260,3,1258],[3,1261,3,
1259],[3,1262,3,1260],[3,1263,3,1261],[3,1264,3,1262],[3,1265,3,1263],[3,12
66,3,1264],[3,1267,3,1265],[3,1268,3,1266],[3,1269,3,1267],[3,1270,3,1268],
[3,1271,3,1269],[2,1271,3,1270],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-
1]],"row":15,"num":3},{"stap_colors":[[55,3355443],[69,1507550],[111,150755
0],[153,8947848],[195,8947848],[237,8947848],[279,8947848],[321,8947848],[3
63,8947848],[405,8947848],[447,8947848],[489,8947848],[531,8947848],[573,89
47848],[615,8947848],[657,8947848],[699,8947848],[741,8947848],[783,8947848
],[825,8947848],[867,8947848],[909,8947848],[951,8947848],[993,8947848],[10
35,8947848],[1077,8947848],[1119,8947848],[1161,8947848],[1203,8947848],[12
45,3355443]],"stap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[4,17,-1,-
1],[4,18,4,16],[4,19,4,17],[4,20,4,18],[4,21,4,19],[4,22,4,20],[4,23,4,21],
[4,24,4,22],[4,25,4,23],[4,26,4,24],[4,27,4,25],[4,28,4,26],[4,29,4,27],[4,
30,4,28],[4,31,4,29],[4,32,4,30],[4,33,4,31],[4,34,4,32],[4,35,4,33],[4,36,
4,34],[4,37,4,35],[4,38,4,36],[4,39,4,37],[4,40,4,38],[4,41,4,39],[4,42,4,4
0],[4,43,4,41],[4,44,4,42],[4,45,4,43],[4,46,4,44],[4,47,4,45],[4,48,4,46],
[4,49,4,47],[4,50,4,48],[4,51,4,49],[4,52,4,50],[4,53,4,51],[4,54,4,52],[4,
55,4,53],[-1,-
1,4,54],[4,57,3,56],[4,58,4,56],[4,59,4,57],[4,60,4,58],[4,61,4,59],[4,62,4
,60],[4,63,4,61],[4,64,4,62],[4,65,4,63],[4,66,4,64],[4,67,4,65],[4,68,4,66
],[4,69,4,67],[-1,-1,4,68],[4,71,-1,-
1],[4,72,4,70],[4,73,4,71],[4,74,4,72],[4,75,4,73],[4,76,4,74],[4,77,4,75],
[4,78,4,76],[4,79,4,77],[4,80,4,78],[4,81,4,79],[4,82,4,80],[4,83,4,81],[5,
83,4,82],[4,85,5,84],[4,86,4,84],[4,87,4,85],[4,88,4,86],[4,89,4,87],[4,90,
4,88],[4,91,4,89],[4,92,4,90],[4,93,4,91],[4,94,4,92],[4,95,4,93],[4,96,4,9
4],[4,97,4,95],[3,97,4,96],[4,99,3,98],[4,100,4,98],[4,101,4,99],[4,102,4,1
00],[4,103,4,101],[4,104,4,102],[4,105,4,103],[4,106,4,104],[4,107,4,105],[
4,108,4,106],[4,109,4,107],[4,110,4,108],[4,111,4,109],[-1,-
1,4,110],[4,113,-1,-
1],[4,114,4,112],[4,115,4,113],[4,116,4,114],[4,117,4,115],[4,118,4,116],[4
,119,4,117],[4,120,4,118],[4,121,4,119],[4,122,4,120],[4,123,4,121],[4,124,
4,122],[4,125,4,123],[5,125,4,124],[4,127,5,126],[4,128,4,126],[4,129,4,127
],[4,130,4,128],[4,131,4,129],[4,132,4,130],[4,133,4,131],[4,134,4,132],[4,
135,4,133],[4,136,4,134],[4,137,4,135],[4,138,4,136],[4,139,4,137],[3,139,4

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1528

,138],[4,141,3,140],[4,142,4,140],[4,143,4,141],[4,144,4,142],[4,145,4,143]
,[4,146,4,144],[4,147,4,145],[4,148,4,146],[4,149,4,147],[4,150,4,148],[4,1
51,4,149],[4,152,4,150],[4,153,4,151],[-1,-1,4,152],[4,155,-1,-
1],[4,156,4,154],[4,157,4,155],[4,158,4,156],[4,159,4,157],[4,160,4,158],[4
,161,4,159],[4,162,4,160],[4,163,4,161],[4,164,4,162],[4,165,4,163],[4,166,
4,164],[4,167,4,165],[5,167,4,166],[4,169,5,168],[4,170,4,168],[4,171,4,169
],[4,172,4,170],[4,173,4,171],[4,174,4,172],[4,175,4,173],[4,176,4,174],[4,
177,4,175],[4,178,4,176],[4,179,4,177],[4,180,4,178],[4,181,4,179],[3,181,4
,180],[4,183,3,182],[4,184,4,182],[4,185,4,183],[4,186,4,184],[4,187,4,185]
,[4,188,4,186],[4,189,4,187],[4,190,4,188],[4,191,4,189],[4,192,4,190],[4,1
93,4,191],[4,194,4,192],[4,195,4,193],[-1,-1,4,194],[4,197,-1,-
1],[4,198,4,196],[4,199,4,197],[4,200,4,198],[4,201,4,199],[4,202,4,200],[4
,203,4,201],[4,204,4,202],[4,205,4,203],[4,206,4,204],[4,207,4,205],[4,208,
4,206],[4,209,4,207],[5,209,4,208],[4,211,5,210],[4,212,4,210],[4,213,4,211
],[4,214,4,212],[4,215,4,213],[4,216,4,214],[4,217,4,215],[4,218,4,216],[4,
219,4,217],[4,220,4,218],[4,221,4,219],[4,222,4,220],[4,223,4,221],[3,223,4
,222],[4,225,3,224],[4,226,4,224],[4,227,4,225],[4,228,4,226],[4,229,4,227]
,[4,230,4,228],[4,231,4,229],[4,232,4,230],[4,233,4,231],[4,234,4,232],[4,2
35,4,233],[4,236,4,234],[4,237,4,235],[-1,-1,4,236],[4,239,-1,-
1],[4,240,4,238],[4,241,4,239],[4,242,4,240],[4,243,4,241],[4,244,4,242],[4
,245,4,243],[4,246,4,244],[4,247,4,245],[4,248,4,246],[4,249,4,247],[4,250,
4,248],[4,251,4,249],[5,251,4,250],[4,253,5,252],[4,254,4,252],[4,255,4,253
],[4,256,4,254],[4,257,4,255],[4,258,4,256],[4,259,4,257],[4,260,4,258],[4,
261,4,259],[4,262,4,260],[4,263,4,261],[4,264,4,262],[4,265,4,263],[3,265,4
,264],[4,267,3,266],[4,268,4,266],[4,269,4,267],[4,270,4,268],[4,271,4,269]
,[4,272,4,270],[4,273,4,271],[4,274,4,272],[4,275,4,273],[4,276,4,274],[4,2
77,4,275],[4,278,4,276],[4,279,4,277],[-1,-1,4,278],[4,281,-1,-
1],[4,282,4,280],[4,283,4,281],[4,284,4,282],[4,285,4,283],[4,286,4,284],[4
,287,4,285],[4,288,4,286],[4,289,4,287],[4,290,4,288],[4,291,4,289],[4,292,
4,290],[4,293,4,291],[5,293,4,292],[4,295,5,294],[4,296,4,294],[4,297,4,295
],[4,298,4,296],[4,299,4,297],[4,300,4,298],[4,301,4,299],[4,302,4,300],[4,
303,4,301],[4,304,4,302],[4,305,4,303],[4,306,4,304],[4,307,4,305],[3,307,4
,306],[4,309,3,308],[4,310,4,308],[4,311,4,309],[4,312,4,310],[4,313,4,311]
,[4,314,4,312],[4,315,4,313],[4,316,4,314],[4,317,4,315],[4,318,4,316],[4,3
19,4,317],[4,320,4,318],[4,321,4,319],[-1,-1,4,320],[4,323,-1,-
1],[4,324,4,322],[4,325,4,323],[4,326,4,324],[4,327,4,325],[4,328,4,326],[4
,329,4,327],[4,330,4,328],[4,331,4,329],[4,332,4,330],[4,333,4,331],[4,334,
4,332],[4,335,4,333],[5,335,4,334],[4,337,5,336],[4,338,4,336],[4,339,4,337
],[4,340,4,338],[4,341,4,339],[4,342,4,340],[4,343,4,341],[4,344,4,342],[4,
345,4,343],[4,346,4,344],[4,347,4,345],[4,348,4,346],[4,349,4,347],[3,349,4
,348],[4,351,3,350],[4,352,4,350],[4,353,4,351],[4,354,4,352],[4,355,4,353]
,[4,356,4,354],[4,357,4,355],[4,358,4,356],[4,359,4,357],[4,360,4,358],[4,3
61,4,359],[4,362,4,360],[4,363,4,361],[-1,-1,4,362],[4,365,-1,-
1],[4,366,4,364],[4,367,4,365],[4,368,4,366],[4,369,4,367],[4,370,4,368],[4
,371,4,369],[4,372,4,370],[4,373,4,371],[4,374,4,372],[4,375,4,373],[4,376,
4,374],[4,377,4,375],[5,377,4,376],[4,379,5,378],[4,380,4,378],[4,381,4,379
],[4,382,4,380],[4,383,4,381],[4,384,4,382],[4,385,4,383],[4,386,4,384],[4,
387,4,385],[4,388,4,386],[4,389,4,387],[4,390,4,388],[4,391,4,389],[3,391,4
,390],[4,393,3,392],[4,394,4,392],[4,395,4,393],[4,396,4,394],[4,397,4,395]
,[4,398,4,396],[4,399,4,397],[4,400,4,398],[4,401,4,399],[4,402,4,400],[4,4
03,4,401],[4,404,4,402],[4,405,4,403],[-1,-1,4,404],[4,407,-1,-
1],[4,408,4,406],[4,409,4,407],[4,410,4,408],[4,411,4,409],[4,412,4,410],[4
,413,4,411],[4,414,4,412],[4,415,4,413],[4,416,4,414],[4,417,4,415],[4,418,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1529

4,416],[4,419,4,417],[5,419,4,418],[4,421,5,420],[4,422,4,420],[4,423,4,421
],[4,424,4,422],[4,425,4,423],[4,426,4,424],[4,427,4,425],[4,428,4,426],[4,
429,4,427],[4,430,4,428],[4,431,4,429],[4,432,4,430],[4,433,4,431],[3,433,4
,432],[4,435,3,434],[4,436,4,434],[4,437,4,435],[4,438,4,436],[4,439,4,437]
,[4,440,4,438],[4,441,4,439],[4,442,4,440],[4,443,4,441],[4,444,4,442],[4,4
45,4,443],[4,446,4,444],[4,447,4,445],[-1,-1,4,446],[4,449,-1,-
1],[4,450,4,448],[4,451,4,449],[4,452,4,450],[4,453,4,451],[4,454,4,452],[4
,455,4,453],[4,456,4,454],[4,457,4,455],[4,458,4,456],[4,459,4,457],[4,460,
4,458],[4,461,4,459],[5,461,4,460],[4,463,5,462],[4,464,4,462],[4,465,4,463
],[4,466,4,464],[4,467,4,465],[4,468,4,466],[4,469,4,467],[4,470,4,468],[4,
471,4,469],[4,472,4,470],[4,473,4,471],[4,474,4,472],[4,475,4,473],[3,475,4
,474],[4,477,3,476],[4,478,4,476],[4,479,4,477],[4,480,4,478],[4,481,4,479]
,[4,482,4,480],[4,483,4,481],[4,484,4,482],[4,485,4,483],[4,486,4,484],[4,4
87,4,485],[4,488,4,486],[4,489,4,487],[-1,-1,4,488],[4,491,-1,-
1],[4,492,4,490],[4,493,4,491],[4,494,4,492],[4,495,4,493],[4,496,4,494],[4
,497,4,495],[4,498,4,496],[4,499,4,497],[4,500,4,498],[4,501,4,499],[4,502,
4,500],[4,503,4,501],[5,503,4,502],[4,505,5,504],[4,506,4,504],[4,507,4,505
],[4,508,4,506],[4,509,4,507],[4,510,4,508],[4,511,4,509],[4,512,4,510],[4,
513,4,511],[4,514,4,512],[4,515,4,513],[4,516,4,514],[4,517,4,515],[3,517,4
,516],[4,519,3,518],[4,520,4,518],[4,521,4,519],[4,522,4,520],[4,523,4,521]
,[4,524,4,522],[4,525,4,523],[4,526,4,524],[4,527,4,525],[4,528,4,526],[4,5
29,4,527],[4,530,4,528],[4,531,4,529],[-1,-1,4,530],[4,533,-1,-
1],[4,534,4,532],[4,535,4,533],[4,536,4,534],[4,537,4,535],[4,538,4,536],[4
,539,4,537],[4,540,4,538],[4,541,4,539],[4,542,4,540],[4,543,4,541],[4,544,
4,542],[4,545,4,543],[5,545,4,544],[4,547,5,546],[4,548,4,546],[4,549,4,547
],[4,550,4,548],[4,551,4,549],[4,552,4,550],[4,553,4,551],[4,554,4,552],[4,
555,4,553],[4,556,4,554],[4,557,4,555],[4,558,4,556],[4,559,4,557],[3,559,4
,558],[4,561,3,560],[4,562,4,560],[4,563,4,561],[4,564,4,562],[4,565,4,563]
,[4,566,4,564],[4,567,4,565],[4,568,4,566],[4,569,4,567],[4,570,4,568],[4,5
71,4,569],[4,572,4,570],[4,573,4,571],[-1,-1,4,572],[4,575,-1,-
1],[4,576,4,574],[4,577,4,575],[4,578,4,576],[4,579,4,577],[4,580,4,578],[4
,581,4,579],[4,582,4,580],[4,583,4,581],[4,584,4,582],[4,585,4,583],[4,586,
4,584],[4,587,4,585],[5,587,4,586],[4,589,5,588],[4,590,4,588],[4,591,4,589
],[4,592,4,590],[4,593,4,591],[4,594,4,592],[4,595,4,593],[4,596,4,594],[4,
597,4,595],[4,598,4,596],[4,599,4,597],[4,600,4,598],[4,601,4,599],[3,601,4
,600],[4,603,3,602],[4,604,4,602],[4,605,4,603],[4,606,4,604],[4,607,4,605]
,[4,608,4,606],[4,609,4,607],[4,610,4,608],[4,611,4,609],[4,612,4,610],[4,6
13,4,611],[4,614,4,612],[4,615,4,613],[-1,-1,4,614],[4,617,-1,-
1],[4,618,4,616],[4,619,4,617],[4,620,4,618],[4,621,4,619],[4,622,4,620],[4
,623,4,621],[4,624,4,622],[4,625,4,623],[4,626,4,624],[4,627,4,625],[4,628,
4,626],[4,629,4,627],[5,629,4,628],[4,631,5,630],[4,632,4,630],[4,633,4,631
],[4,634,4,632],[4,635,4,633],[4,636,4,634],[4,637,4,635],[4,638,4,636],[4,
639,4,637],[4,640,4,638],[4,641,4,639],[4,642,4,640],[4,643,4,641],[3,643,4
,642],[4,645,3,644],[4,646,4,644],[4,647,4,645],[4,648,4,646],[4,649,4,647]
,[4,650,4,648],[4,651,4,649],[4,652,4,650],[4,653,4,651],[4,654,4,652],[4,6
55,4,653],[4,656,4,654],[4,657,4,655],[-1,-1,4,656],[4,659,-1,-
1],[4,660,4,658],[4,661,4,659],[4,662,4,660],[4,663,4,661],[4,664,4,662],[4
,665,4,663],[4,666,4,664],[4,667,4,665],[4,668,4,666],[4,669,4,667],[4,670,
4,668],[4,671,4,669],[5,671,4,670],[4,673,5,672],[4,674,4,672],[4,675,4,673
],[4,676,4,674],[4,677,4,675],[4,678,4,676],[4,679,4,677],[4,680,4,678],[4,
681,4,679],[4,682,4,680],[4,683,4,681],[4,684,4,682],[4,685,4,683],[3,685,4
,684],[4,687,3,686],[4,688,4,686],[4,689,4,687],[4,690,4,688],[4,691,4,689]
,[4,692,4,690],[4,693,4,691],[4,694,4,692],[4,695,4,693],[4,696,4,694],[4,6

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1530

97,4,695],[4,698,4,696],[4,699,4,697],[-1,-1,4,698],[4,701,-1,-
1],[4,702,4,700],[4,703,4,701],[4,704,4,702],[4,705,4,703],[4,706,4,704],[4
,707,4,705],[4,708,4,706],[4,709,4,707],[4,710,4,708],[4,711,4,709],[4,712,
4,710],[4,713,4,711],[5,713,4,712],[4,715,5,714],[4,716,4,714],[4,717,4,715
],[4,718,4,716],[4,719,4,717],[4,720,4,718],[4,721,4,719],[4,722,4,720],[4,
723,4,721],[4,724,4,722],[4,725,4,723],[4,726,4,724],[4,727,4,725],[3,727,4
,726],[4,729,3,728],[4,730,4,728],[4,731,4,729],[4,732,4,730],[4,733,4,731]
,[4,734,4,732],[4,735,4,733],[4,736,4,734],[4,737,4,735],[4,738,4,736],[4,7
39,4,737],[4,740,4,738],[4,741,4,739],[-1,-1,4,740],[4,743,-1,-
1],[4,744,4,742],[4,745,4,743],[4,746,4,744],[4,747,4,745],[4,748,4,746],[4
,749,4,747],[4,750,4,748],[4,751,4,749],[4,752,4,750],[4,753,4,751],[4,754,
4,752],[4,755,4,753],[5,755,4,754],[4,757,5,756],[4,758,4,756],[4,759,4,757
],[4,760,4,758],[4,761,4,759],[4,762,4,760],[4,763,4,761],[4,764,4,762],[4,
765,4,763],[4,766,4,764],[4,767,4,765],[4,768,4,766],[4,769,4,767],[3,769,4
,768],[4,771,3,770],[4,772,4,770],[4,773,4,771],[4,774,4,772],[4,775,4,773]
,[4,776,4,774],[4,777,4,775],[4,778,4,776],[4,779,4,777],[4,780,4,778],[4,7
81,4,779],[4,782,4,780],[4,783,4,781],[-1,-1,4,782],[4,785,-1,-
1],[4,786,4,784],[4,787,4,785],[4,788,4,786],[4,789,4,787],[4,790,4,788],[4
,791,4,789],[4,792,4,790],[4,793,4,791],[4,794,4,792],[4,795,4,793],[4,796,
4,794],[4,797,4,795],[5,797,4,796],[4,799,5,798],[4,800,4,798],[4,801,4,799
],[4,802,4,800],[4,803,4,801],[4,804,4,802],[4,805,4,803],[4,806,4,804],[4,
807,4,805],[4,808,4,806],[4,809,4,807],[4,810,4,808],[4,811,4,809],[3,811,4
,810],[4,813,3,812],[4,814,4,812],[4,815,4,813],[4,816,4,814],[4,817,4,815]
,[4,818,4,816],[4,819,4,817],[4,820,4,818],[4,821,4,819],[4,822,4,820],[4,8
23,4,821],[4,824,4,822],[4,825,4,823],[-1,-1,4,824],[4,827,-1,-
1],[4,828,4,826],[4,829,4,827],[4,830,4,828],[4,831,4,829],[4,832,4,830],[4
,833,4,831],[4,834,4,832],[4,835,4,833],[4,836,4,834],[4,837,4,835],[4,838,
4,836],[4,839,4,837],[5,839,4,838],[4,841,5,840],[4,842,4,840],[4,843,4,841
],[4,844,4,842],[4,845,4,843],[4,846,4,844],[4,847,4,845],[4,848,4,846],[4,
849,4,847],[4,850,4,848],[4,851,4,849],[4,852,4,850],[4,853,4,851],[3,853,4
,852],[4,855,3,854],[4,856,4,854],[4,857,4,855],[4,858,4,856],[4,859,4,857]
,[4,860,4,858],[4,861,4,859],[4,862,4,860],[4,863,4,861],[4,864,4,862],[4,8
65,4,863],[4,866,4,864],[4,867,4,865],[-1,-1,4,866],[4,869,-1,-
1],[4,870,4,868],[4,871,4,869],[4,872,4,870],[4,873,4,871],[4,874,4,872],[4
,875,4,873],[4,876,4,874],[4,877,4,875],[4,878,4,876],[4,879,4,877],[4,880,
4,878],[4,881,4,879],[5,881,4,880],[4,883,5,882],[4,884,4,882],[4,885,4,883
],[4,886,4,884],[4,887,4,885],[4,888,4,886],[4,889,4,887],[4,890,4,888],[4,
891,4,889],[4,892,4,890],[4,893,4,891],[4,894,4,892],[4,895,4,893],[3,895,4
,894],[4,897,3,896],[4,898,4,896],[4,899,4,897],[4,900,4,898],[4,901,4,899]
,[4,902,4,900],[4,903,4,901],[4,904,4,902],[4,905,4,903],[4,906,4,904],[4,9
07,4,905],[4,908,4,906],[4,909,4,907],[-1,-1,4,908],[4,911,-1,-
1],[4,912,4,910],[4,913,4,911],[4,914,4,912],[4,915,4,913],[4,916,4,914],[4
,917,4,915],[4,918,4,916],[4,919,4,917],[4,920,4,918],[4,921,4,919],[4,922,
4,920],[4,923,4,921],[5,923,4,922],[4,925,5,924],[4,926,4,924],[4,927,4,925
],[4,928,4,926],[4,929,4,927],[4,930,4,928],[4,931,4,929],[4,932,4,930],[4,
933,4,931],[4,934,4,932],[4,935,4,933],[4,936,4,934],[4,937,4,935],[3,937,4
,936],[4,939,3,938],[4,940,4,938],[4,941,4,939],[4,942,4,940],[4,943,4,941]
,[4,944,4,942],[4,945,4,943],[4,946,4,944],[4,947,4,945],[4,948,4,946],[4,9
49,4,947],[4,950,4,948],[4,951,4,949],[-1,-1,4,950],[4,953,-1,-
1],[4,954,4,952],[4,955,4,953],[4,956,4,954],[4,957,4,955],[4,958,4,956],[4
,959,4,957],[4,960,4,958],[4,961,4,959],[4,962,4,960],[4,963,4,961],[4,964,
4,962],[4,965,4,963],[5,965,4,964],[4,967,5,966],[4,968,4,966],[4,969,4,967
],[4,970,4,968],[4,971,4,969],[4,972,4,970],[4,973,4,971],[4,974,4,972],[4,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1531

975,4,973],[4,976,4,974],[4,977,4,975],[4,978,4,976],[4,979,4,977],[3,979,4
,978],[4,981,3,980],[4,982,4,980],[4,983,4,981],[4,984,4,982],[4,985,4,983]
,[4,986,4,984],[4,987,4,985],[4,988,4,986],[4,989,4,987],[4,990,4,988],[4,9
91,4,989],[4,992,4,990],[4,993,4,991],[-1,-1,4,992],[4,995,-1,-
1],[4,996,4,994],[4,997,4,995],[4,998,4,996],[4,999,4,997],[4,1000,4,998],[
4,1001,4,999],[4,1002,4,1000],[4,1003,4,1001],[4,1004,4,1002],[4,1005,4,100
3],[4,1006,4,1004],[4,1007,4,1005],[5,1007,4,1006],[4,1009,5,1008],[4,1010,
4,1008],[4,1011,4,1009],[4,1012,4,1010],[4,1013,4,1011],[4,1014,4,1012],[4,
1015,4,1013],[4,1016,4,1014],[4,1017,4,1015],[4,1018,4,1016],[4,1019,4,1017
],[4,1020,4,1018],[4,1021,4,1019],[3,1021,4,1020],[4,1023,3,1022],[4,1024,4
,1022],[4,1025,4,1023],[4,1026,4,1024],[4,1027,4,1025],[4,1028,4,1026],[4,1
029,4,1027],[4,1030,4,1028],[4,1031,4,1029],[4,1032,4,1030],[4,1033,4,1031]
,[4,1034,4,1032],[4,1035,4,1033],[-1,-1,4,1034],[4,1037,-1,-
1],[4,1038,4,1036],[4,1039,4,1037],[4,1040,4,1038],[4,1041,4,1039],[4,1042,
4,1040],[4,1043,4,1041],[4,1044,4,1042],[4,1045,4,1043],[4,1046,4,1044],[4,
1047,4,1045],[4,1048,4,1046],[4,1049,4,1047],[5,1049,4,1048],[4,1051,5,1050
],[4,1052,4,1050],[4,1053,4,1051],[4,1054,4,1052],[4,1055,4,1053],[4,1056,4
,1054],[4,1057,4,1055],[4,1058,4,1056],[4,1059,4,1057],[4,1060,4,1058],[4,1
061,4,1059],[4,1062,4,1060],[4,1063,4,1061],[3,1063,4,1062],[4,1065,3,1064]
,[4,1066,4,1064],[4,1067,4,1065],[4,1068,4,1066],[4,1069,4,1067],[4,1070,4,
1068],[4,1071,4,1069],[4,1072,4,1070],[4,1073,4,1071],[4,1074,4,1072],[4,10
75,4,1073],[4,1076,4,1074],[4,1077,4,1075],[-1,-1,4,1076],[4,1079,-1,-
1],[4,1080,4,1078],[4,1081,4,1079],[4,1082,4,1080],[4,1083,4,1081],[4,1084,
4,1082],[4,1085,4,1083],[4,1086,4,1084],[4,1087,4,1085],[4,1088,4,1086],[4,
1089,4,1087],[4,1090,4,1088],[4,1091,4,1089],[5,1091,4,1090],[4,1093,5,1092
],[4,1094,4,1092],[4,1095,4,1093],[4,1096,4,1094],[4,1097,4,1095],[4,1098,4
,1096],[4,1099,4,1097],[4,1100,4,1098],[4,1101,4,1099],[4,1102,4,1100],[4,1
103,4,1101],[4,1104,4,1102],[4,1105,4,1103],[3,1105,4,1104],[4,1107,3,1106]
,[4,1108,4,1106],[4,1109,4,1107],[4,1110,4,1108],[4,1111,4,1109],[4,1112,4,
1110],[4,1113,4,1111],[4,1114,4,1112],[4,1115,4,1113],[4,1116,4,1114],[4,11
17,4,1115],[4,1118,4,1116],[4,1119,4,1117],[-1,-1,4,1118],[4,1121,-1,-
1],[4,1122,4,1120],[4,1123,4,1121],[4,1124,4,1122],[4,1125,4,1123],[4,1126,
4,1124],[4,1127,4,1125],[4,1128,4,1126],[4,1129,4,1127],[4,1130,4,1128],[4,
1131,4,1129],[4,1132,4,1130],[4,1133,4,1131],[5,1133,4,1132],[4,1135,5,1134
],[4,1136,4,1134],[4,1137,4,1135],[4,1138,4,1136],[4,1139,4,1137],[4,1140,4
,1138],[4,1141,4,1139],[4,1142,4,1140],[4,1143,4,1141],[4,1144,4,1142],[4,1
145,4,1143],[4,1146,4,1144],[4,1147,4,1145],[3,1147,4,1146],[4,1149,3,1148]
,[4,1150,4,1148],[4,1151,4,1149],[4,1152,4,1150],[4,1153,4,1151],[4,1154,4,
1152],[4,1155,4,1153],[4,1156,4,1154],[4,1157,4,1155],[4,1158,4,1156],[4,11
59,4,1157],[4,1160,4,1158],[4,1161,4,1159],[-1,-1,4,1160],[4,1163,-1,-
1],[4,1164,4,1162],[4,1165,4,1163],[4,1166,4,1164],[4,1167,4,1165],[4,1168,
4,1166],[4,1169,4,1167],[4,1170,4,1168],[4,1171,4,1169],[4,1172,4,1170],[4,
1173,4,1171],[4,1174,4,1172],[4,1175,4,1173],[5,1175,4,1174],[4,1177,5,1176
],[4,1178,4,1176],[4,1179,4,1177],[4,1180,4,1178],[4,1181,4,1179],[4,1182,4
,1180],[4,1183,4,1181],[4,1184,4,1182],[4,1185,4,1183],[4,1186,4,1184],[4,1
187,4,1185],[4,1188,4,1186],[4,1189,4,1187],[3,1189,4,1188],[4,1191,3,1190]
,[4,1192,4,1190],[4,1193,4,1191],[4,1194,4,1192],[4,1195,4,1193],[4,1196,4,
1194],[4,1197,4,1195],[4,1198,4,1196],[4,1199,4,1197],[4,1200,4,1198],[4,12
01,4,1199],[4,1202,4,1200],[4,1203,4,1201],[-1,-1,4,1202],[4,1205,-1,-
1],[4,1206,4,1204],[4,1207,4,1205],[4,1208,4,1206],[4,1209,4,1207],[4,1210,
4,1208],[4,1211,4,1209],[4,1212,4,1210],[4,1213,4,1211],[4,1214,4,1212],[4,
1215,4,1213],[4,1216,4,1214],[4,1217,4,1215],[5,1217,4,1216],[4,1219,5,1218
],[4,1220,4,1218],[4,1221,4,1219],[4,1222,4,1220],[4,1223,4,1221],[4,1224,4

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1532

,1222],[4,1225,4,1223],[4,1226,4,1224],[4,1227,4,1225],[4,1228,4,1226],[4,1
229,4,1227],[4,1230,4,1228],[4,1231,4,1229],[3,1231,4,1230],[4,1233,3,1232]
,[4,1234,4,1232],[4,1235,4,1233],[4,1236,4,1234],[4,1237,4,1235],[4,1238,4,
1236],[4,1239,4,1237],[4,1240,4,1238],[4,1241,4,1239],[4,1242,4,1240],[4,12
43,4,1241],[4,1244,4,1242],[4,1245,4,1243],[-1,-1,4,1244],[4,1247,-1,-
1],[4,1248,4,1246],[4,1249,4,1247],[4,1250,4,1248],[4,1251,4,1249],[4,1252,
4,1250],[4,1253,4,1251],[4,1254,4,1252],[4,1255,4,1253],[4,1256,4,1254],[4,
1257,4,1255],[4,1258,4,1256],[4,1259,4,1257],[5,1259,4,1258],[4,1261,5,1260
],[4,1262,4,1260],[4,1263,4,1261],[4,1264,4,1262],[4,1265,4,1263],[4,1266,4
,1264],[4,1267,4,1265],[4,1268,4,1266],[4,1269,4,1267],[4,1270,4,1268],[4,1
271,4,1269],[4,1272,4,1270],[4,1273,4,1271],[3,1273,4,1272],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1533

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"col":14,"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[5,16,4,17],[4,16,4,18],[4,17,4,19],[4,18,4,20],[4,19,4,21],[4,20,4,22],
[4,21,4,23],[4,22,4,24],[4,23,4,25],[4,24,4,26],[4,25,4,27],[4,26,4,28],[4,
27,4,29],[4,28,4,30],[4,29,4,31],[4,30,4,32],[4,31,4,33],[4,32,4,34],[4,33,
4,35],[4,34,4,36],[4,35,4,37],[4,36,4,38],[4,37,4,39],[4,38,4,40],[4,39,4,4
1],[4,40,4,42],[4,41,4,43],[4,42,4,44],[4,43,4,45],[4,44,4,46],[4,45,4,47],

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1534

[4,46,4,48],[4,47,4,49],[4,48,4,50],[4,49,4,51],[4,50,4,52],[4,51,4,53],[4,52,4,54],[4,53,4,55],[4,54,4,56],[4,55,4,57],[4,56,4,58],[4,57,4,59],[4,58,4,60],[4,59,4,61],[4,60,4,62],[4,61,4,63],[4,62,4,64],[4,63,4,65],[4,64,4,66],[4,65,4,67],[4,66,4,68],[4,67,4,69],[4,68,4,70],[4,69,4,71],[4,70,4,72],[4,71,4,73],[4,72,4,74],[4,73,4,75],[4,74,4,76],[4,75,4,77],[4,76,4,78],[4,77,4,79],[4,78,4,80],[4,79,4,81],[4,80,4,82],[4,81,4,83],[4,82,4,84],[4,83,4,85],[4,84,4,86],[4,85,4,87],[4,86,4,88],[4,87,4,89],[4,88,4,90],[4,89,4,91],[4,90,4,92],[4,91,4,93],[4,92,4,94],[4,93,4,95],[4,94,4,96],[4,95,4,97],[4,96,4,98],[4,97,4,99],[4,98,4,100],[4,99,4,101],[4,100,4,102],[4,101,4,103],[4,102,4,104],[4,103,4,105],[4,104,4,106],[4,105,4,107],[4,106,4,108],[4,107,4,109],[4,108,4,110],[4,109,4,111],[4,110,4,112],[4,111,4,113],[4,112,4,114],[4,113,4,115],[4,114,4,116],[4,115,4,117],[4,116,4,118],[4,117,4,119],[4,118,4,120],[4,119,4,121],[4,120,4,122],[4,121,4,123],[4,122,4,124],[4,123,4,125],[4,124,4,126],[4,125,4,127],[4,126,4,128],[4,127,4,129],[4,128,4,130],[4,129,4,131],[4,130,4,132],[4,131,4,133],[4,132,4,134],[4,133,4,135],[4,134,4,136],[4,135,4,137],[4,136,4,138],[4,137,4,139],[4,138,4,140],[4,139,4,141],[4,140,4,142],[4,141,4,143],[4,142,4,144],[4,143,4,145],[4,144,4,146],[4,145,4,147],[4,146,4,148],[4,147,4,149],[4,148,4,150],[4,149,4,151],[4,150,4,152],[4,151,4,153],[4,152,4,154],[4,153,4,155],[4,154,4,156],[4,155,4,157],[4,156,4,158],[4,157,4,159],[4,158,4,160],[4,159,4,161],[4,160,4,162],[4,161,4,163],[4,162,4,164],[4,163,4,165],[4,164,4,166],[4,165,4,167],[4,166,4,168],[4,167,4,169],[4,168,4,170],[4,169,4,171],[4,170,4,172],[4,171,4,173],[4,172,4,174],[4,173,4,175],[4,174,4,176],[4,175,4,177],[4,176,4,178],[4,177,4,179],[4,178,4,180],[4,179,4,181],[4,180,4,182],[4,181,4,183],[4,182,4,184],[4,183,4,185],[4,184,4,186],[4,185,4,187],[4,186,4,188],[4,187,4,189],[4,188,4,190],[4,189,4,191],[4,190,4,192],[4,191,4,193],[4,192,4,194],[4,193,4,195],[4,194,4,196],[4,195,4,197],[4,196,4,198],[4,197,4,199],[4,198,4,200],[4,199,4,201],[4,200,4,202],[4,201,4,203],[4,202,4,204],[4,203,4,205],[4,204,4,206],[4,205,4,207],[4,206,4,208],[4,207,4,209],[4,208,4,210],[4,209,4,211],[4,210,4,212],[4,211,4,213],[4,212,4,214],[4,213,4,215],[4,214,4,216],[4,215,4,217],[4,216,4,218],[4,217,4,219],[4,218,4,220],[4,219,4,221],[4,220,4,222],[4,221,4,223],[4,222,4,224],[4,223,4,225],[4,224,4,226],[4,225,4,227],[4,226,4,228],[4,227,4,229],[4,228,4,230],[4,229,4,231],[4,230,4,232],[4,231,4,233],[4,232,4,234],[4,233,4,235],[4,234,4,236],[4,235,4,237],[4,236,4,238],[4,237,4,239],[4,238,4,240],[4,239,4,241],[4,240,4,242],[4,241,4,243],[4,242,4,244],[4,243,4,245],[4,244,4,246],[4,245,4,247],[4,246,4,248],[4,247,4,249],[4,248,4,250],[4,249,4,251],[4,250,4,252],[4,251,4,253],[4,252,4,254],[4,253,4,255],[4,254,4,256],[4,255,4,257],[4,256,4,258],[4,257,4,259],[4,258,4,260],[4,259,4,261],[4,260,4,262],[4,261,4,263],[4,262,4,264],[4,263,4,265],[4,264,4,266],[4,265,4,267],[4,266,4,268],[4,267,4,269],[4,268,4,270],[4,269,4,271],[4,270,4,272],[4,271,4,273],[4,272,4,274],[4,273,4,275],[4,274,4,276],[4,275,4,277],[4,276,4,278],[4,277,4,279],[4,278,4,280],[4,279,4,281],[4,280,4,282],[4,281,4,283],[4,282,4,284],[4,283,4,285],[4,284,4,286],[4,285,4,287],[4,286,4,288],[4,287,4,289],[4,288,4,290],[4,289,4,291],[4,290,4,292],[4,291,4,293],[4,292,4,294],[4,293,4,295],[4,294,4,296],[4,295,4,297],[4,296,4,298],[4,297,4,299],[4,298,4,300],[4,299,4,301],[4,300,4,302],[4,301,4,303],[4,302,4,304],[4,303,4,305],[4,304,4,306],[4,305,4,307],[4,306,4,308],[4,307,4,309],[4,308,4,310],[4,309,4,311],[4,310,4,312],[4,311,4,313],[4,312,4,314],[4,313,4,315],[4,314,4,316],[4,315,4,317],[4,316,4,318],[4,317,4,319],[4,318,4,320],[4,319,4,321],[4,320,4,322],[4,321,4,323],[4,322,4,324],[4,323,4,325],[4,324,4,326],[4,325,4,327],[4,326,4,328],[4,327,4,329],[4,328,4,330],[4,329,4,331],[4,330,4,332],[4,331,4,333],[4,332,4,334],[4,333,4,335],[4,334,4,336],[4,335,4,337],[4,336,4,338],[4,337,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1535

4,339],[4,338,4,340],[4,339,4,341],[4,340,4,342],[4,341,4,343],[4,342,4,344
],[4,343,4,345],[4,344,4,346],[4,345,4,347],[4,346,4,348],[4,347,4,349],[4,
348,4,350],[4,349,4,351],[4,350,4,352],[4,351,4,353],[4,352,4,354],[4,353,4
,355],[4,354,4,356],[4,355,4,357],[4,356,4,358],[4,357,4,359],[4,358,4,360]
,[4,359,4,361],[4,360,4,362],[4,361,4,363],[4,362,4,364],[4,363,4,365],[4,3
64,4,366],[4,365,4,367],[4,366,4,368],[4,367,4,369],[4,368,4,370],[4,369,4,
371],[4,370,4,372],[4,371,4,373],[4,372,4,374],[4,373,4,375],[4,374,4,376],
[4,375,4,377],[4,376,4,378],[4,377,4,379],[4,378,4,380],[4,379,4,381],[4,38
0,4,382],[4,381,4,383],[4,382,4,384],[4,383,4,385],[4,384,4,386],[4,385,4,3
87],[4,386,4,388],[4,387,4,389],[4,388,4,390],[4,389,4,391],[4,390,4,392],[
4,391,4,393],[4,392,4,394],[4,393,4,395],[4,394,4,396],[4,395,4,397],[4,396
,4,398],[4,397,4,399],[4,398,4,400],[4,399,4,401],[4,400,4,402],[4,401,4,40
3],[4,402,4,404],[4,403,4,405],[4,404,4,406],[4,405,4,407],[4,406,4,408],[4
,407,4,409],[4,408,4,410],[4,409,4,411],[4,410,4,412],[4,411,4,413],[4,412,
4,414],[4,413,4,415],[4,414,4,416],[4,415,4,417],[4,416,4,418],[4,417,4,419
],[4,418,4,420],[4,419,4,421],[4,420,4,422],[4,421,4,423],[4,422,4,424],[4,
423,4,425],[4,424,4,426],[4,425,4,427],[4,426,4,428],[4,427,4,429],[4,428,4
,430],[4,429,4,431],[4,430,4,432],[4,431,4,433],[4,432,4,434],[4,433,4,435]
,[4,434,4,436],[4,435,4,437],[4,436,4,438],[4,437,4,439],[4,438,4,440],[4,4
39,4,441],[4,440,4,442],[4,441,4,443],[4,442,4,444],[4,443,4,445],[4,444,4,
446],[4,445,4,447],[4,446,4,448],[4,447,4,449],[4,448,4,450],[4,449,4,451],
[4,450,4,452],[4,451,4,453],[4,452,4,454],[4,453,4,455],[4,454,4,456],[4,45
5,4,457],[4,456,4,458],[4,457,4,459],[4,458,4,460],[4,459,4,461],[4,460,4,4
62],[4,461,4,463],[4,462,4,464],[4,463,4,465],[4,464,4,466],[4,465,4,467],[
4,466,4,468],[4,467,4,469],[4,468,4,470],[4,469,4,471],[4,470,4,472],[4,471
,4,473],[4,472,4,474],[4,473,4,475],[4,474,4,476],[4,475,4,477],[4,476,4,47
8],[4,477,4,479],[4,478,4,480],[4,479,4,481],[4,480,4,482],[4,481,4,483],[4
,482,4,484],[4,483,4,485],[4,484,4,486],[4,485,4,487],[4,486,4,488],[4,487,
4,489],[4,488,4,490],[4,489,4,491],[4,490,4,492],[4,491,4,493],[4,492,4,494
],[4,493,4,495],[4,494,4,496],[4,495,4,497],[4,496,4,498],[4,497,4,499],[4,
498,4,500],[4,499,4,501],[4,500,4,502],[4,501,4,503],[4,502,4,504],[4,503,4
,505],[4,504,4,506],[4,505,4,507],[4,506,4,508],[4,507,4,509],[4,508,4,510]
,[4,509,4,511],[4,510,4,512],[4,511,4,513],[4,512,4,514],[4,513,4,515],[4,5
14,4,516],[4,515,4,517],[4,516,4,518],[4,517,4,519],[4,518,4,520],[4,519,4,
521],[4,520,4,522],[4,521,4,523],[4,522,4,524],[4,523,4,525],[4,524,4,526],
[4,525,4,527],[4,526,4,528],[4,527,4,529],[4,528,4,530],[4,529,4,531],[4,53
0,4,532],[4,531,4,533],[4,532,4,534],[4,533,4,535],[4,534,4,536],[4,535,4,5
37],[4,536,4,538],[4,537,4,539],[4,538,4,540],[4,539,4,541],[4,540,4,542],[
4,541,4,543],[4,542,4,544],[4,543,4,545],[4,544,4,546],[4,545,4,547],[4,546
,4,548],[4,547,4,549],[4,548,4,550],[4,549,4,551],[4,550,4,552],[4,551,4,55
3],[4,552,4,554],[4,553,4,555],[4,554,4,556],[4,555,4,557],[4,556,4,558],[4
,557,4,559],[4,558,4,560],[4,559,4,561],[4,560,4,562],[4,561,4,563],[4,562,
4,564],[4,563,4,565],[4,564,4,566],[4,565,4,567],[4,566,4,568],[4,567,4,569
],[4,568,4,570],[4,569,4,571],[4,570,4,572],[4,571,4,573],[4,572,4,574],[4,
573,4,575],[4,574,4,576],[4,575,4,577],[4,576,4,578],[4,577,4,579],[4,578,4
,580],[4,579,4,581],[4,580,4,582],[4,581,4,583],[4,582,4,584],[4,583,4,585]
,[4,584,4,586],[4,585,4,587],[4,586,4,588],[4,587,4,589],[4,588,4,590],[4,5
89,4,591],[4,590,4,592],[4,591,4,593],[4,592,4,594],[4,593,4,595],[4,594,4,
596],[4,595,4,597],[4,596,4,598],[4,597,4,599],[4,598,4,600],[4,599,4,601],
[4,600,4,602],[4,601,4,603],[4,602,4,604],[4,603,4,605],[4,604,4,606],[4,60
5,4,607],[4,606,4,608],[4,607,4,609],[4,608,4,610],[4,609,4,611],[4,610,4,6
12],[4,611,4,613],[4,612,4,614],[4,613,4,615],[4,614,4,616],[4,615,4,617],[
4,616,3,617],[3,618,4,619],[4,618,4,620],[4,619,4,621],[4,620,4,622],[4,621

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1536

,4,623],[4,622,4,624],[4,623,4,625],[4,624,4,626],[4,625,4,627],[4,626,4,62
8],[4,627,4,629],[4,628,4,630],[4,629,4,631],[4,630,4,632],[4,631,4,633],[4
,632,4,634],[4,633,4,635],[4,634,4,636],[4,635,4,637],[4,636,4,638],[4,637,
4,639],[4,638,4,640],[4,639,4,641],[4,640,4,642],[4,641,4,643],[4,642,4,644
],[4,643,4,645],[4,644,4,646],[4,645,4,647],[4,646,4,648],[4,647,4,649],[4,
648,4,650],[4,649,4,651],[4,650,4,652],[4,651,4,653],[4,652,4,654],[4,653,4
,655],[4,654,4,656],[4,655,4,657],[4,656,4,658],[4,657,4,659],[4,658,4,660]
,[4,659,4,661],[4,660,4,662],[4,661,4,663],[4,662,4,664],[4,663,4,665],[4,6
64,4,666],[4,665,4,667],[4,666,4,668],[4,667,4,669],[4,668,4,670],[4,669,4,
671],[4,670,4,672],[4,671,4,673],[4,672,4,674],[4,673,4,675],[4,674,4,676],
[4,675,4,677],[4,676,4,678],[4,677,4,679],[4,678,4,680],[4,679,4,681],[4,68
0,4,682],[4,681,4,683],[4,682,4,684],[4,683,4,685],[4,684,4,686],[4,685,4,6
87],[4,686,4,688],[4,687,4,689],[4,688,4,690],[4,689,4,691],[4,690,4,692],[
4,691,4,693],[4,692,4,694],[4,693,4,695],[4,694,4,696],[4,695,4,697],[4,696
,4,698],[4,697,4,699],[4,698,4,700],[4,699,4,701],[4,700,4,702],[4,701,4,70
3],[4,702,4,704],[4,703,4,705],[4,704,4,706],[4,705,4,707],[4,706,4,708],[4
,707,4,709],[4,708,4,710],[4,709,4,711],[4,710,4,712],[4,711,4,713],[4,712,
4,714],[4,713,4,715],[4,714,4,716],[4,715,4,717],[4,716,4,718],[4,717,4,719
],[4,718,4,720],[4,719,4,721],[4,720,4,722],[4,721,4,723],[4,722,4,724],[4,
723,4,725],[4,724,4,726],[4,725,4,727],[4,726,4,728],[4,727,4,729],[4,728,4
,730],[4,729,4,731],[4,730,4,732],[4,731,4,733],[4,732,4,734],[4,733,4,735]
,[4,734,4,736],[4,735,4,737],[4,736,4,738],[4,737,4,739],[4,738,4,740],[4,7
39,4,741],[4,740,4,742],[4,741,4,743],[4,742,4,744],[4,743,4,745],[4,744,4,
746],[4,745,4,747],[4,746,4,748],[4,747,4,749],[4,748,4,750],[4,749,4,751],
[4,750,4,752],[4,751,4,753],[4,752,4,754],[4,753,4,755],[4,754,4,756],[4,75
5,4,757],[4,756,4,758],[4,757,4,759],[4,758,4,760],[4,759,4,761],[4,760,4,7
62],[4,761,4,763],[4,762,4,764],[4,763,4,765],[4,764,4,766],[4,765,4,767],[
4,766,4,768],[4,767,4,769],[4,768,4,770],[4,769,4,771],[4,770,4,772],[4,771
,4,773],[4,772,4,774],[4,773,4,775],[4,774,4,776],[4,775,4,777],[4,776,4,77
8],[4,777,4,779],[4,778,4,780],[4,779,4,781],[4,780,4,782],[4,781,4,783],[4
,782,4,784],[4,783,4,785],[4,784,4,786],[4,785,4,787],[4,786,4,788],[4,787,
4,789],[4,788,4,790],[4,789,4,791],[4,790,4,792],[4,791,4,793],[4,792,4,794
],[4,793,4,795],[4,794,4,796],[4,795,4,797],[4,796,4,798],[4,797,4,799],[4,
798,4,800],[4,799,4,801],[4,800,4,802],[4,801,4,803],[4,802,4,804],[4,803,4
,805],[4,804,4,806],[4,805,4,807],[4,806,4,808],[4,807,4,809],[4,808,4,810]
,[4,809,4,811],[4,810,4,812],[4,811,4,813],[4,812,4,814],[4,813,4,815],[4,8
14,4,816],[4,815,4,817],[4,816,4,818],[4,817,4,819],[4,818,4,820],[4,819,4,
821],[4,820,4,822],[4,821,4,823],[4,822,4,824],[4,823,4,825],[4,824,4,826],
[4,825,4,827],[4,826,4,828],[4,827,4,829],[4,828,4,830],[4,829,4,831],[4,83
0,4,832],[4,831,4,833],[4,832,4,834],[4,833,4,835],[4,834,4,836],[4,835,4,8
37],[4,836,4,838],[4,837,4,839],[4,838,4,840],[4,839,4,841],[4,840,4,842],[
4,841,4,843],[4,842,4,844],[4,843,4,845],[4,844,4,846],[4,845,4,847],[4,846
,4,848],[4,847,4,849],[4,848,4,850],[4,849,4,851],[4,850,4,852],[4,851,4,85
3],[4,852,4,854],[4,853,4,855],[4,854,4,856],[4,855,4,857],[4,856,4,858],[4
,857,4,859],[4,858,4,860],[4,859,4,861],[4,860,4,862],[4,861,4,863],[4,862,
4,864],[4,863,4,865],[4,864,4,866],[4,865,4,867],[4,866,4,868],[4,867,4,869
],[4,868,4,870],[4,869,4,871],[4,870,4,872],[4,871,4,873],[4,872,4,874],[4,
873,4,875],[4,874,4,876],[4,875,4,877],[4,876,4,878],[4,877,4,879],[4,878,4
,880],[4,879,4,881],[4,880,4,882],[4,881,4,883],[4,882,4,884],[4,883,4,885]
,[4,884,4,886],[4,885,4,887],[4,886,4,888],[4,887,4,889],[4,888,4,890],[4,8
89,4,891],[4,890,4,892],[4,891,4,893],[4,892,4,894],[4,893,4,895],[4,894,4,
896],[4,895,4,897],[4,896,4,898],[4,897,4,899],[4,898,4,900],[4,899,4,901],
[4,900,4,902],[4,901,4,903],[4,902,4,904],[4,903,4,905],[4,904,4,906],[4,90

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1537

5,4,907],[4,906,4,908],[4,907,4,909],[4,908,4,910],[4,909,4,911],[4,910,4,912],[4,911,4,913],[4,912,4,914],[4,913,4,915],[4,914,4,916],[4,915,4,917],[4,916,4,918],[4,917,4,919],[4,918,4,920],[4,919,4,921],[4,920,4,922],[4,921,4,923],[4,922,4,924],[4,923,4,925],[4,924,4,926],[4,925,4,927],[4,926,4,928],[4,927,4,929],[4,928,4,930],[4,929,4,931],[4,930,4,932],[4,931,4,933],[4,932,4,934],[4,933,4,935],[4,934,4,936],[4,935,4,937],[4,936,4,938],[4,937,4,939],[4,938,4,940],[4,939,4,941],[4,940,4,942],[4,941,4,943],[4,942,4,944],[4,943,4,945],[4,944,4,946],[4,945,4,947],[4,946,4,948],[4,947,4,949],[4,948,4,950],[4,949,4,951],[4,950,4,952],[4,951,4,953],[4,952,4,954],[4,953,4,955],[4,954,4,956],[4,955,4,957],[4,956,4,958],[4,957,4,959],[4,958,4,960],[4,959,4,961],[4,960,4,962],[4,961,4,963],[4,962,4,964],[4,963,4,965],[4,964,4,966],[4,965,4,967],[4,966,4,968],[4,967,4,969],[4,968,4,970],[4,969,4,971],[4,970,4,972],[4,971,4,973],[4,972,4,974],[4,973,4,975],[4,974,4,976],[4,975,4,977],[4,976,4,978],[4,977,4,979],[4,978,4,980],[4,979,4,981],[4,980,4,982],[4,981,4,983],[4,982,4,984],[4,983,4,985],[4,984,4,986],[4,985,4,987],[4,986,4,988],[4,987,4,989],[4,988,4,990],[4,989,4,991],[4,990,4,992],[4,991,4,993],[4,992,4,994],[4,993,4,995],[4,994,4,996],[4,995,4,997],[4,996,4,998],[4,997,4,999],[4,998,4,1000],[4,999,4,1001],[4,1000,4,1002],[4,1001,4,1003],[4,1002,4,1004],[4,1003,4,1005],[4,1004,4,1006],[4,1005,4,1007],[4,1006,4,1008],[4,1007,4,1009],[4,1008,4,1010],[4,1009,4,1011],[4,1010,4,1012],[4,1011,4,1013],[4,1012,4,1014],[4,1013,4,1015],[4,1014,4,1016],[4,1015,4,1017],[4,1016,4,1018],[4,1017,4,1019],[4,1018,4,1020],[4,1019,4,1021],[4,1020,4,1022],[4,1021,4,1023],[4,1022,4,1024],[4,1023,4,1025],[4,1024,4,1026],[4,1025,4,1027],[4,1026,4,1028],[4,1027,4,1029],[4,1028,4,1030],[4,1029,4,1031],[4,1030,4,1032],[4,1031,4,1033],[4,1032,4,1034],[4,1033,4,1035],[4,1034,4,1036],[4,1035,4,1037],[4,1036,4,1038],[4,1037,4,1039],[4,1038,4,1040],[4,1039,4,1041],[4,1040,4,1042],[4,1041,4,1043],[4,1042,4,1044],[4,1043,4,1045],[4,1044,4,1046],[4,1045,4,1047],[4,1046,4,1048],[4,1047,4,1049],[4,1048,4,1050],[4,1049,4,1051],[4,1050,4,1052],[4,1051,4,1053],[4,1052,4,1054],[4,1053,4,1055],[4,1054,4,1056],[4,1055,4,1057],[4,1056,4,1058],[4,1057,4,1059],[4,1058,4,1060],[4,1059,4,1061],[4,1060,4,1062],[4,1061,4,1063],[4,1062,4,1064],[4,1063,4,1065],[4,1064,4,1066],[4,1065,4,1067],[4,1066,4,1068],[4,1067,4,1069],[4,1068,4,1070],[4,1069,4,1071],[4,1070,4,1072],[4,1071,4,1073],[4,1072,4,1074],[4,1073,4,1075],[4,1074,4,1076],[4,1075,4,1077],[4,1076,4,1078],[4,1077,4,1079],[4,1078,4,1080],[4,1079,4,1081],[4,1080,4,1082],[4,1081,4,1083],[4,1082,4,1084],[4,1083,4,1085],[4,1084,4,1086],[4,1085,4,1087],[4,1086,4,1088],[4,1087,4,1089],[4,1088,4,1090],[4,1089,4,1091],[4,1090,4,1092],[4,1091,4,1093],[4,1092,4,1094],[4,1093,4,1095],[4,1094,4,1096],[4,1095,4,1097],[4,1096,4,1098],[4,1097,4,1099],[4,1098,4,1100],[4,1099,4,1101],[4,1100,4,1102],[4,1101,4,1103],[4,1102,4,1104],[4,1103,4,1105],[4,1104,4,1106],[4,1105,4,1107],[4,1106,4,1108],[4,1107,4,1109],[4,1108,4,1110],[4,1109,4,1111],[4,1110,4,1112],[4,1111,4,1113],[4,1112,4,1114],[4,1113,4,1115],[4,1114,4,1116],[4,1115,4,1117],[4,1116,4,1118],[4,1117,4,1119],[4,1118,4,1120],[4,1119,4,1121],[4,1120,4,1122],[4,1121,4,1123],[4,1122,4,1124],[4,1123,4,1125],[4,1124,4,1126],[4,1125,4,1127],[4,1126,4,1128],[4,1127,4,1129],[4,1128,4,1130],[4,1129,4,1131],[4,1130,4,1132],[4,1131,4,1133],[4,1132,4,1134],[4,1133,4,1135],[4,1134,4,1136],[4,1135,4,1137],[4,1136,4,1138],[4,1137,4,1139],[4,1138,4,1140],[4,1139,4,1141],[4,1140,4,1142],[4,1141,4,1143],[4,1142,4,1144],[4,1143,4,1145],[4,1144,4,1146],[4,1145,4,1147],[4,1146,4,1148],[4,1147,4,1149],[4,1148,4,1150],[4,1149,4,1151],[4,1150,4,1152],[4,1151,4,1153],[4,1152,4,1154],[4,1153,4,1155],[4,1154,4,1156],[4,1155,4,1157],[4,1156,4,1158],[4,1157,4,1159],[4,1158,4,1160],[4,1159,4,1161],[4,1160,4,1162],[4,1161,4,1163],[4,1162,4,1164],[4,1163,4,1165],[4,1164,4,1166],[4,1165,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1538

4,1167],[4,1166,4,1168],[4,1167,4,1169],[4,1168,4,1170],[4,1169,4,1171],[4,
1170,4,1172],[4,1171,4,1173],[4,1172,4,1174],[4,1173,4,1175],[4,1174,4,1176
],[4,1175,4,1177],[4,1176,4,1178],[4,1177,4,1179],[4,1178,4,1180],[4,1179,4
,1181],[4,1180,4,1182],[4,1181,4,1183],[4,1182,4,1184],[4,1183,4,1185],[4,1
184,4,1186],[4,1185,4,1187],[4,1186,4,1188],[4,1187,4,1189],[4,1188,4,1190]
,[4,1189,4,1191],[4,1190,4,1192],[4,1191,4,1193],[4,1192,4,1194],[4,1193,4,
1195],[4,1194,4,1196],[4,1195,4,1197],[4,1196,4,1198],[4,1197,4,1199],[4,11
98,4,1200],[4,1199,4,1201],[4,1200,4,1202],[4,1201,4,1203],[4,1202,4,1204],
[4,1203,4,1205],[4,1204,4,1206],[4,1205,4,1207],[4,1206,4,1208],[4,1207,4,1
209],[4,1208,4,1210],[4,1209,4,1211],[4,1210,4,1212],[4,1211,4,1213],[4,121
2,4,1214],[4,1213,4,1215],[4,1214,4,1216],[4,1215,4,1217],[4,1216,4,1218],[
4,1217,4,1219],[4,1218,4,1220],[4,1219,4,1221],[4,1220,4,1222],[4,1221,4,12
23],[4,1222,4,1224],[4,1223,4,1225],[4,1224,4,1226],[4,1225,4,1227],[4,1226
,4,1228],[4,1227,4,1229],[4,1228,4,1230],[4,1229,4,1231],[4,1230,4,1232],[4
,1231,4,1233],[4,1232,5,1233],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-
1]],"row":16,"num":4},{"stap_colors":[[16,3355443],[56,1507550],[98,1507550
],[140,8947848],[182,8947848],[224,8947848],[266,8947848],[308,8947848],[35
0,8947848],[392,8947848],[434,8947848],[476,8947848],[518,8947848],[560,894
7848],[602,8947848],[644,8947848],[686,8947848],[728,8947848],[770,8947848]
,[812,8947848],[854,8947848],[896,8947848],[938,8947848],[980,8947848],[102
2,8947848],[1064,8947848],[1106,8947848],[1148,8947848],[1190,8947848],[123
2,3355443]],"stap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-
1,5,17],[5,16,5,18],[5,17,5,19],[5,18,5,20],[5,19,5,21],[5,20,5,22],[5,21,5
,23],[5,22,5,24],[5,23,5,25],[5,24,5,26],[5,25,5,27],[5,26,5,28],[5,27,5,29
],[5,28,5,30],[5,29,5,31],[5,30,5,32],[5,31,5,33],[5,32,5,34],[5,33,5,35],[
5,34,5,36],[5,35,5,37],[5,36,5,38],[5,37,5,39],[5,38,5,40],[5,39,5,41],[5,4
0,5,42],[5,41,5,43],[5,42,5,44],[5,43,5,45],[5,44,5,46],[5,45,5,47],[5,46,5
,48],[5,47,5,49],[5,48,5,50],[5,49,5,51],[5,50,5,52],[5,51,5,53],[5,52,5,54
],[5,53,5,55],[5,54,-1,-1],[-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1539

1,5,57],[5,56,5,58],[5,57,5,59],[5,58,5,60],[5,59,5,61],[5,60,5,62],[5,61,5
,63],[5,62,5,64],[5,63,5,65],[5,64,5,66],[5,65,5,67],[5,66,5,68],[5,67,5,69
],[5,68,0,69],[0,70,5,71],[5,70,5,72],[5,71,5,73],[5,72,5,74],[5,73,5,75],[
5,74,5,76],[5,75,5,77],[5,76,5,78],[5,77,5,79],[5,78,5,80],[5,79,5,81],[5,8
0,5,82],[5,81,5,83],[5,82,4,83],[4,84,5,85],[5,84,5,86],[5,85,5,87],[5,86,5
,88],[5,87,5,89],[5,88,5,90],[5,89,5,91],[5,90,5,92],[5,91,5,93],[5,92,5,94
],[5,93,5,95],[5,94,5,96],[5,95,5,97],[5,96,-1,-1],[-1,-
1,5,99],[5,98,5,100],[5,99,5,101],[5,100,5,102],[5,101,5,103],[5,102,5,104]
,[5,103,5,105],[5,104,5,106],[5,105,5,107],[5,106,5,108],[5,107,5,109],[5,1
08,5,110],[5,109,5,111],[5,110,0,111],[0,112,5,113],[5,112,5,114],[5,113,5,
115],[5,114,5,116],[5,115,5,117],[5,116,5,118],[5,117,5,119],[5,118,5,120],
[5,119,5,121],[5,120,5,122],[5,121,5,123],[5,122,5,124],[5,123,5,125],[5,12
4,4,125],[4,126,5,127],[5,126,5,128],[5,127,5,129],[5,128,5,130],[5,129,5,1
31],[5,130,5,132],[5,131,5,133],[5,132,5,134],[5,133,5,135],[5,134,5,136],[
5,135,5,137],[5,136,5,138],[5,137,5,139],[5,138,-1,-1],[-1,-
1,5,141],[5,140,5,142],[5,141,5,143],[5,142,5,144],[5,143,5,145],[5,144,5,1
46],[5,145,5,147],[5,146,5,148],[5,147,5,149],[5,148,5,150],[5,149,5,151],[
5,150,5,152],[5,151,5,153],[5,152,0,153],[0,154,5,155],[5,154,5,156],[5,155
,5,157],[5,156,5,158],[5,157,5,159],[5,158,5,160],[5,159,5,161],[5,160,5,16
2],[5,161,5,163],[5,162,5,164],[5,163,5,165],[5,164,5,166],[5,165,5,167],[5
,166,4,167],[4,168,5,169],[5,168,5,170],[5,169,5,171],[5,170,5,172],[5,171,
5,173],[5,172,5,174],[5,173,5,175],[5,174,5,176],[5,175,5,177],[5,176,5,178
],[5,177,5,179],[5,178,5,180],[5,179,5,181],[5,180,-1,-1],[-1,-
1,5,183],[5,182,5,184],[5,183,5,185],[5,184,5,186],[5,185,5,187],[5,186,5,1
88],[5,187,5,189],[5,188,5,190],[5,189,5,191],[5,190,5,192],[5,191,5,193],[
5,192,5,194],[5,193,5,195],[5,194,0,195],[0,196,5,197],[5,196,5,198],[5,197
,5,199],[5,198,5,200],[5,199,5,201],[5,200,5,202],[5,201,5,203],[5,202,5,20
4],[5,203,5,205],[5,204,5,206],[5,205,5,207],[5,206,5,208],[5,207,5,209],[5
,208,4,209],[4,210,5,211],[5,210,5,212],[5,211,5,213],[5,212,5,214],[5,213,
5,215],[5,214,5,216],[5,215,5,217],[5,216,5,218],[5,217,5,219],[5,218,5,220
],[5,219,5,221],[5,220,5,222],[5,221,5,223],[5,222,-1,-1],[-1,-
1,5,225],[5,224,5,226],[5,225,5,227],[5,226,5,228],[5,227,5,229],[5,228,5,2
30],[5,229,5,231],[5,230,5,232],[5,231,5,233],[5,232,5,234],[5,233,5,235],[
5,234,5,236],[5,235,5,237],[5,236,0,237],[0,238,5,239],[5,238,5,240],[5,239
,5,241],[5,240,5,242],[5,241,5,243],[5,242,5,244],[5,243,5,245],[5,244,5,24
6],[5,245,5,247],[5,246,5,248],[5,247,5,249],[5,248,5,250],[5,249,5,251],[5
,250,4,251],[4,252,5,253],[5,252,5,254],[5,253,5,255],[5,254,5,256],[5,255,
5,257],[5,256,5,258],[5,257,5,259],[5,258,5,260],[5,259,5,261],[5,260,5,262
],[5,261,5,263],[5,262,5,264],[5,263,5,265],[5,264,-1,-1],[-1,-
1,5,267],[5,266,5,268],[5,267,5,269],[5,268,5,270],[5,269,5,271],[5,270,5,2
72],[5,271,5,273],[5,272,5,274],[5,273,5,275],[5,274,5,276],[5,275,5,277],[
5,276,5,278],[5,277,5,279],[5,278,0,279],[0,280,5,281],[5,280,5,282],[5,281
,5,283],[5,282,5,284],[5,283,5,285],[5,284,5,286],[5,285,5,287],[5,286,5,28
8],[5,287,5,289],[5,288,5,290],[5,289,5,291],[5,290,5,292],[5,291,5,293],[5
,292,4,293],[4,294,5,295],[5,294,5,296],[5,295,5,297],[5,296,5,298],[5,297,
5,299],[5,298,5,300],[5,299,5,301],[5,300,5,302],[5,301,5,303],[5,302,5,304
],[5,303,5,305],[5,304,5,306],[5,305,5,307],[5,306,-1,-1],[-1,-
1,5,309],[5,308,5,310],[5,309,5,311],[5,310,5,312],[5,311,5,313],[5,312,5,3
14],[5,313,5,315],[5,314,5,316],[5,315,5,317],[5,316,5,318],[5,317,5,319],[
5,318,5,320],[5,319,5,321],[5,320,0,321],[0,322,5,323],[5,322,5,324],[5,323
,5,325],[5,324,5,326],[5,325,5,327],[5,326,5,328],[5,327,5,329],[5,328,5,33
0],[5,329,5,331],[5,330,5,332],[5,331,5,333],[5,332,5,334],[5,333,5,335],[5
,334,4,335],[4,336,5,337],[5,336,5,338],[5,337,5,339],[5,338,5,340],[5,339,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1540

5,341],[5,340,5,342],[5,341,5,343],[5,342,5,344],[5,343,5,345],[5,344,5,346
],[5,345,5,347],[5,346,5,348],[5,347,5,349],[5,348,-1,-1],[-1,-
1,5,351],[5,350,5,352],[5,351,5,353],[5,352,5,354],[5,353,5,355],[5,354,5,3
56],[5,355,5,357],[5,356,5,358],[5,357,5,359],[5,358,5,360],[5,359,5,361],[
5,360,5,362],[5,361,5,363],[5,362,0,363],[0,364,5,365],[5,364,5,366],[5,365
,5,367],[5,366,5,368],[5,367,5,369],[5,368,5,370],[5,369,5,371],[5,370,5,37
2],[5,371,5,373],[5,372,5,374],[5,373,5,375],[5,374,5,376],[5,375,5,377],[5
,376,4,377],[4,378,5,379],[5,378,5,380],[5,379,5,381],[5,380,5,382],[5,381,
5,383],[5,382,5,384],[5,383,5,385],[5,384,5,386],[5,385,5,387],[5,386,5,388
],[5,387,5,389],[5,388,5,390],[5,389,5,391],[5,390,-1,-1],[-1,-
1,5,393],[5,392,5,394],[5,393,5,395],[5,394,5,396],[5,395,5,397],[5,396,5,3
98],[5,397,5,399],[5,398,5,400],[5,399,5,401],[5,400,5,402],[5,401,5,403],[
5,402,5,404],[5,403,5,405],[5,404,0,405],[0,406,5,407],[5,406,5,408],[5,407
,5,409],[5,408,5,410],[5,409,5,411],[5,410,5,412],[5,411,5,413],[5,412,5,41
4],[5,413,5,415],[5,414,5,416],[5,415,5,417],[5,416,5,418],[5,417,5,419],[5
,418,4,419],[4,420,5,421],[5,420,5,422],[5,421,5,423],[5,422,5,424],[5,423,
5,425],[5,424,5,426],[5,425,5,427],[5,426,5,428],[5,427,5,429],[5,428,5,430
],[5,429,5,431],[5,430,5,432],[5,431,5,433],[5,432,-1,-1],[-1,-
1,5,435],[5,434,5,436],[5,435,5,437],[5,436,5,438],[5,437,5,439],[5,438,5,4
40],[5,439,5,441],[5,440,5,442],[5,441,5,443],[5,442,5,444],[5,443,5,445],[
5,444,5,446],[5,445,5,447],[5,446,0,447],[0,448,5,449],[5,448,5,450],[5,449
,5,451],[5,450,5,452],[5,451,5,453],[5,452,5,454],[5,453,5,455],[5,454,5,45
6],[5,455,5,457],[5,456,5,458],[5,457,5,459],[5,458,5,460],[5,459,5,461],[5
,460,4,461],[4,462,5,463],[5,462,5,464],[5,463,5,465],[5,464,5,466],[5,465,
5,467],[5,466,5,468],[5,467,5,469],[5,468,5,470],[5,469,5,471],[5,470,5,472
],[5,471,5,473],[5,472,5,474],[5,473,5,475],[5,474,-1,-1],[-1,-
1,5,477],[5,476,5,478],[5,477,5,479],[5,478,5,480],[5,479,5,481],[5,480,5,4
82],[5,481,5,483],[5,482,5,484],[5,483,5,485],[5,484,5,486],[5,485,5,487],[
5,486,5,488],[5,487,5,489],[5,488,0,489],[0,490,5,491],[5,490,5,492],[5,491
,5,493],[5,492,5,494],[5,493,5,495],[5,494,5,496],[5,495,5,497],[5,496,5,49
8],[5,497,5,499],[5,498,5,500],[5,499,5,501],[5,500,5,502],[5,501,5,503],[5
,502,4,503],[4,504,5,505],[5,504,5,506],[5,505,5,507],[5,506,5,508],[5,507,
5,509],[5,508,5,510],[5,509,5,511],[5,510,5,512],[5,511,5,513],[5,512,5,514
],[5,513,5,515],[5,514,5,516],[5,515,5,517],[5,516,-1,-1],[-1,-
1,5,519],[5,518,5,520],[5,519,5,521],[5,520,5,522],[5,521,5,523],[5,522,5,5
24],[5,523,5,525],[5,524,5,526],[5,525,5,527],[5,526,5,528],[5,527,5,529],[
5,528,5,530],[5,529,5,531],[5,530,0,531],[0,532,5,533],[5,532,5,534],[5,533
,5,535],[5,534,5,536],[5,535,5,537],[5,536,5,538],[5,537,5,539],[5,538,5,54
0],[5,539,5,541],[5,540,5,542],[5,541,5,543],[5,542,5,544],[5,543,5,545],[5
,544,4,545],[4,546,5,547],[5,546,5,548],[5,547,5,549],[5,548,5,550],[5,549,
5,551],[5,550,5,552],[5,551,5,553],[5,552,5,554],[5,553,5,555],[5,554,5,556
],[5,555,5,557],[5,556,5,558],[5,557,5,559],[5,558,-1,-1],[-1,-
1,5,561],[5,560,5,562],[5,561,5,563],[5,562,5,564],[5,563,5,565],[5,564,5,5
66],[5,565,5,567],[5,566,5,568],[5,567,5,569],[5,568,5,570],[5,569,5,571],[
5,570,5,572],[5,571,5,573],[5,572,0,573],[0,574,5,575],[5,574,5,576],[5,575
,5,577],[5,576,5,578],[5,577,5,579],[5,578,5,580],[5,579,5,581],[5,580,5,58
2],[5,581,5,583],[5,582,5,584],[5,583,5,585],[5,584,5,586],[5,585,5,587],[5
,586,4,587],[4,588,5,589],[5,588,5,590],[5,589,5,591],[5,590,5,592],[5,591,
5,593],[5,592,5,594],[5,593,5,595],[5,594,5,596],[5,595,5,597],[5,596,5,598
],[5,597,5,599],[5,598,5,600],[5,599,5,601],[5,600,-1,-1],[-1,-
1,5,603],[5,602,5,604],[5,603,5,605],[5,604,5,606],[5,605,5,607],[5,606,5,6
08],[5,607,5,609],[5,608,5,610],[5,609,5,611],[5,610,5,612],[5,611,5,613],[
5,612,5,614],[5,613,5,615],[5,614,0,615],[0,616,5,617],[5,616,5,618],[5,617

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1541

,5,619],[5,618,5,620],[5,619,5,621],[5,620,5,622],[5,621,5,623],[5,622,5,62
4],[5,623,5,625],[5,624,5,626],[5,625,5,627],[5,626,5,628],[5,627,5,629],[5
,628,4,629],[4,630,5,631],[5,630,5,632],[5,631,5,633],[5,632,5,634],[5,633,
5,635],[5,634,5,636],[5,635,5,637],[5,636,5,638],[5,637,5,639],[5,638,5,640
],[5,639,5,641],[5,640,5,642],[5,641,5,643],[5,642,-1,-1],[-1,-
1,5,645],[5,644,5,646],[5,645,5,647],[5,646,5,648],[5,647,5,649],[5,648,5,6
50],[5,649,5,651],[5,650,5,652],[5,651,5,653],[5,652,5,654],[5,653,5,655],[
5,654,5,656],[5,655,5,657],[5,656,0,657],[0,658,5,659],[5,658,5,660],[5,659
,5,661],[5,660,5,662],[5,661,5,663],[5,662,5,664],[5,663,5,665],[5,664,5,66
6],[5,665,5,667],[5,666,5,668],[5,667,5,669],[5,668,5,670],[5,669,5,671],[5
,670,4,671],[4,672,5,673],[5,672,5,674],[5,673,5,675],[5,674,5,676],[5,675,
5,677],[5,676,5,678],[5,677,5,679],[5,678,5,680],[5,679,5,681],[5,680,5,682
],[5,681,5,683],[5,682,5,684],[5,683,5,685],[5,684,-1,-1],[-1,-
1,5,687],[5,686,5,688],[5,687,5,689],[5,688,5,690],[5,689,5,691],[5,690,5,6
92],[5,691,5,693],[5,692,5,694],[5,693,5,695],[5,694,5,696],[5,695,5,697],[
5,696,5,698],[5,697,5,699],[5,698,0,699],[0,700,5,701],[5,700,5,702],[5,701
,5,703],[5,702,5,704],[5,703,5,705],[5,704,5,706],[5,705,5,707],[5,706,5,70
8],[5,707,5,709],[5,708,5,710],[5,709,5,711],[5,710,5,712],[5,711,5,713],[5
,712,4,713],[4,714,5,715],[5,714,5,716],[5,715,5,717],[5,716,5,718],[5,717,
5,719],[5,718,5,720],[5,719,5,721],[5,720,5,722],[5,721,5,723],[5,722,5,724
],[5,723,5,725],[5,724,5,726],[5,725,5,727],[5,726,-1,-1],[-1,-
1,5,729],[5,728,5,730],[5,729,5,731],[5,730,5,732],[5,731,5,733],[5,732,5,7
34],[5,733,5,735],[5,734,5,736],[5,735,5,737],[5,736,5,738],[5,737,5,739],[
5,738,5,740],[5,739,5,741],[5,740,0,741],[0,742,5,743],[5,742,5,744],[5,743
,5,745],[5,744,5,746],[5,745,5,747],[5,746,5,748],[5,747,5,749],[5,748,5,75
0],[5,749,5,751],[5,750,5,752],[5,751,5,753],[5,752,5,754],[5,753,5,755],[5
,754,4,755],[4,756,5,757],[5,756,5,758],[5,757,5,759],[5,758,5,760],[5,759,
5,761],[5,760,5,762],[5,761,5,763],[5,762,5,764],[5,763,5,765],[5,764,5,766
],[5,765,5,767],[5,766,5,768],[5,767,5,769],[5,768,-1,-1],[-1,-
1,5,771],[5,770,5,772],[5,771,5,773],[5,772,5,774],[5,773,5,775],[5,774,5,7
76],[5,775,5,777],[5,776,5,778],[5,777,5,779],[5,778,5,780],[5,779,5,781],[
5,780,5,782],[5,781,5,783],[5,782,0,783],[0,784,5,785],[5,784,5,786],[5,785
,5,787],[5,786,5,788],[5,787,5,789],[5,788,5,790],[5,789,5,791],[5,790,5,79
2],[5,791,5,793],[5,792,5,794],[5,793,5,795],[5,794,5,796],[5,795,5,797],[5
,796,4,797],[4,798,5,799],[5,798,5,800],[5,799,5,801],[5,800,5,802],[5,801,
5,803],[5,802,5,804],[5,803,5,805],[5,804,5,806],[5,805,5,807],[5,806,5,808
],[5,807,5,809],[5,808,5,810],[5,809,5,811],[5,810,-1,-1],[-1,-
1,5,813],[5,812,5,814],[5,813,5,815],[5,814,5,816],[5,815,5,817],[5,816,5,8
18],[5,817,5,819],[5,818,5,820],[5,819,5,821],[5,820,5,822],[5,821,5,823],[
5,822,5,824],[5,823,5,825],[5,824,0,825],[0,826,5,827],[5,826,5,828],[5,827
,5,829],[5,828,5,830],[5,829,5,831],[5,830,5,832],[5,831,5,833],[5,832,5,83
4],[5,833,5,835],[5,834,5,836],[5,835,5,837],[5,836,5,838],[5,837,5,839],[5
,838,4,839],[4,840,5,841],[5,840,5,842],[5,841,5,843],[5,842,5,844],[5,843,
5,845],[5,844,5,846],[5,845,5,847],[5,846,5,848],[5,847,5,849],[5,848,5,850
],[5,849,5,851],[5,850,5,852],[5,851,5,853],[5,852,-1,-1],[-1,-
1,5,855],[5,854,5,856],[5,855,5,857],[5,856,5,858],[5,857,5,859],[5,858,5,8
60],[5,859,5,861],[5,860,5,862],[5,861,5,863],[5,862,5,864],[5,863,5,865],[
5,864,5,866],[5,865,5,867],[5,866,0,867],[0,868,5,869],[5,868,5,870],[5,869
,5,871],[5,870,5,872],[5,871,5,873],[5,872,5,874],[5,873,5,875],[5,874,5,87
6],[5,875,5,877],[5,876,5,878],[5,877,5,879],[5,878,5,880],[5,879,5,881],[5
,880,4,881],[4,882,5,883],[5,882,5,884],[5,883,5,885],[5,884,5,886],[5,885,
5,887],[5,886,5,888],[5,887,5,889],[5,888,5,890],[5,889,5,891],[5,890,5,892
],[5,891,5,893],[5,892,5,894],[5,893,5,895],[5,894,-1,-1],[-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1542

1,5,897],[5,896,5,898],[5,897,5,899],[5,898,5,900],[5,899,5,901],[5,900,5,9
02],[5,901,5,903],[5,902,5,904],[5,903,5,905],[5,904,5,906],[5,905,5,907],[
5,906,5,908],[5,907,5,909],[5,908,0,909],[0,910,5,911],[5,910,5,912],[5,911
,5,913],[5,912,5,914],[5,913,5,915],[5,914,5,916],[5,915,5,917],[5,916,5,91
8],[5,917,5,919],[5,918,5,920],[5,919,5,921],[5,920,5,922],[5,921,5,923],[5
,922,4,923],[4,924,5,925],[5,924,5,926],[5,925,5,927],[5,926,5,928],[5,927,
5,929],[5,928,5,930],[5,929,5,931],[5,930,5,932],[5,931,5,933],[5,932,5,934
],[5,933,5,935],[5,934,5,936],[5,935,5,937],[5,936,-1,-1],[-1,-
1,5,939],[5,938,5,940],[5,939,5,941],[5,940,5,942],[5,941,5,943],[5,942,5,9
44],[5,943,5,945],[5,944,5,946],[5,945,5,947],[5,946,5,948],[5,947,5,949],[
5,948,5,950],[5,949,5,951],[5,950,0,951],[0,952,5,953],[5,952,5,954],[5,953
,5,955],[5,954,5,956],[5,955,5,957],[5,956,5,958],[5,957,5,959],[5,958,5,96
0],[5,959,5,961],[5,960,5,962],[5,961,5,963],[5,962,5,964],[5,963,5,965],[5
,964,4,965],[4,966,5,967],[5,966,5,968],[5,967,5,969],[5,968,5,970],[5,969,
5,971],[5,970,5,972],[5,971,5,973],[5,972,5,974],[5,973,5,975],[5,974,5,976
],[5,975,5,977],[5,976,5,978],[5,977,5,979],[5,978,-1,-1],[-1,-
1,5,981],[5,980,5,982],[5,981,5,983],[5,982,5,984],[5,983,5,985],[5,984,5,9
86],[5,985,5,987],[5,986,5,988],[5,987,5,989],[5,988,5,990],[5,989,5,991],[
5,990,5,992],[5,991,5,993],[5,992,0,993],[0,994,5,995],[5,994,5,996],[5,995
,5,997],[5,996,5,998],[5,997,5,999],[5,998,5,1000],[5,999,5,1001],[5,1000,5
,1002],[5,1001,5,1003],[5,1002,5,1004],[5,1003,5,1005],[5,1004,5,1006],[5,1
005,5,1007],[5,1006,4,1007],[4,1008,5,1009],[5,1008,5,1010],[5,1009,5,1011]
,[5,1010,5,1012],[5,1011,5,1013],[5,1012,5,1014],[5,1013,5,1015],[5,1014,5,
1016],[5,1015,5,1017],[5,1016,5,1018],[5,1017,5,1019],[5,1018,5,1020],[5,10
19,5,1021],[5,1020,-1,-1],[-1,-
1,5,1023],[5,1022,5,1024],[5,1023,5,1025],[5,1024,5,1026],[5,1025,5,1027],[
5,1026,5,1028],[5,1027,5,1029],[5,1028,5,1030],[5,1029,5,1031],[5,1030,5,10
32],[5,1031,5,1033],[5,1032,5,1034],[5,1033,5,1035],[5,1034,0,1035],[0,1036
,5,1037],[5,1036,5,1038],[5,1037,5,1039],[5,1038,5,1040],[5,1039,5,1041],[5
,1040,5,1042],[5,1041,5,1043],[5,1042,5,1044],[5,1043,5,1045],[5,1044,5,104
6],[5,1045,5,1047],[5,1046,5,1048],[5,1047,5,1049],[5,1048,4,1049],[4,1050,
5,1051],[5,1050,5,1052],[5,1051,5,1053],[5,1052,5,1054],[5,1053,5,1055],[5,
1054,5,1056],[5,1055,5,1057],[5,1056,5,1058],[5,1057,5,1059],[5,1058,5,1060
],[5,1059,5,1061],[5,1060,5,1062],[5,1061,5,1063],[5,1062,-1,-1],[-1,-
1,5,1065],[5,1064,5,1066],[5,1065,5,1067],[5,1066,5,1068],[5,1067,5,1069],[
5,1068,5,1070],[5,1069,5,1071],[5,1070,5,1072],[5,1071,5,1073],[5,1072,5,10
74],[5,1073,5,1075],[5,1074,5,1076],[5,1075,5,1077],[5,1076,0,1077],[0,1078
,5,1079],[5,1078,5,1080],[5,1079,5,1081],[5,1080,5,1082],[5,1081,5,1083],[5
,1082,5,1084],[5,1083,5,1085],[5,1084,5,1086],[5,1085,5,1087],[5,1086,5,108
8],[5,1087,5,1089],[5,1088,5,1090],[5,1089,5,1091],[5,1090,4,1091],[4,1092,
5,1093],[5,1092,5,1094],[5,1093,5,1095],[5,1094,5,1096],[5,1095,5,1097],[5,
1096,5,1098],[5,1097,5,1099],[5,1098,5,1100],[5,1099,5,1101],[5,1100,5,1102
],[5,1101,5,1103],[5,1102,5,1104],[5,1103,5,1105],[5,1104,-1,-1],[-1,-
1,5,1107],[5,1106,5,1108],[5,1107,5,1109],[5,1108,5,1110],[5,1109,5,1111],[
5,1110,5,1112],[5,1111,5,1113],[5,1112,5,1114],[5,1113,5,1115],[5,1114,5,11
16],[5,1115,5,1117],[5,1116,5,1118],[5,1117,5,1119],[5,1118,0,1119],[0,1120
,5,1121],[5,1120,5,1122],[5,1121,5,1123],[5,1122,5,1124],[5,1123,5,1125],[5
,1124,5,1126],[5,1125,5,1127],[5,1126,5,1128],[5,1127,5,1129],[5,1128,5,113
0],[5,1129,5,1131],[5,1130,5,1132],[5,1131,5,1133],[5,1132,4,1133],[4,1134,
5,1135],[5,1134,5,1136],[5,1135,5,1137],[5,1136,5,1138],[5,1137,5,1139],[5,
1138,5,1140],[5,1139,5,1141],[5,1140,5,1142],[5,1141,5,1143],[5,1142,5,1144
],[5,1143,5,1145],[5,1144,5,1146],[5,1145,5,1147],[5,1146,-1,-1],[-1,-
1,5,1149],[5,1148,5,1150],[5,1149,5,1151],[5,1150,5,1152],[5,1151,5,1153],[

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1543

5,1152,5,1154],[5,1153,5,1155],[5,1154,5,1156],[5,1155,5,1157],[5,1156,5,11
58],[5,1157,5,1159],[5,1158,5,1160],[5,1159,5,1161],[5,1160,0,1161],[0,1162
,5,1163],[5,1162,5,1164],[5,1163,5,1165],[5,1164,5,1166],[5,1165,5,1167],[5
,1166,5,1168],[5,1167,5,1169],[5,1168,5,1170],[5,1169,5,1171],[5,1170,5,117
2],[5,1171,5,1173],[5,1172,5,1174],[5,1173,5,1175],[5,1174,4,1175],[4,1176,
5,1177],[5,1176,5,1178],[5,1177,5,1179],[5,1178,5,1180],[5,1179,5,1181],[5,
1180,5,1182],[5,1181,5,1183],[5,1182,5,1184],[5,1183,5,1185],[5,1184,5,1186
],[5,1185,5,1187],[5,1186,5,1188],[5,1187,5,1189],[5,1188,-1,-1],[-1,-
1,5,1191],[5,1190,5,1192],[5,1191,5,1193],[5,1192,5,1194],[5,1193,5,1195],[
5,1194,5,1196],[5,1195,5,1197],[5,1196,5,1198],[5,1197,5,1199],[5,1198,5,12
00],[5,1199,5,1201],[5,1200,5,1202],[5,1201,5,1203],[5,1202,0,1203],[0,1204
,5,1205],[5,1204,5,1206],[5,1205,5,1207],[5,1206,5,1208],[5,1207,5,1209],[5
,1208,5,1210],[5,1209,5,1211],[5,1210,5,1212],[5,1211,5,1213],[5,1212,5,121
4],[5,1213,5,1215],[5,1214,5,1216],[5,1215,5,1217],[5,1216,4,1217],[4,1218,
5,1219],[5,1218,5,1220],[5,1219,5,1221],[5,1220,5,1222],[5,1221,5,1223],[5,
1222,5,1224],[5,1223,5,1225],[5,1224,5,1226],[5,1225,5,1227],[5,1226,5,1228
],[5,1227,5,1229],[5,1228,5,1230],[5,1229,5,1231],[5,1230,-1,-1],[-1,-
1,5,1233],[5,1232,5,1234],[5,1233,5,1235],[5,1234,5,1236],[5,1235,5,1237],[
5,1236,5,1238],[5,1237,5,1239],[5,1238,5,1240],[5,1239,5,1241],[5,1240,5,12
42],[5,1241,5,1243],[5,1242,5,1244],[5,1243,5,1245],[5,1244,0,1245],[0,1246
,5,1247],[5,1246,5,1248],[5,1247,5,1249],[5,1248,5,1250],[5,1249,5,1251],[5
,1250,5,1252],[5,1251,5,1253],[5,1252,5,1254],[5,1253,5,1255],[5,1254,5,125
6],[5,1255,5,1257],[5,1256,5,1258],[5,1257,5,1259],[5,1258,4,1259],[4,1260,
5,1261],[5,1260,5,1262],[5,1261,5,1263],[5,1262,5,1264],[5,1263,5,1265],[5,
1264,5,1266],[5,1265,5,1267],[5,1266,5,1268],[5,1267,5,1269],[5,1268,5,1270
],[5,1269,5,1271],[5,1270,5,1272],[5,1271,5,1273],[5,1272,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1544

,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"col":13,"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1545

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[5,17,4,16],[5,18,5,16],[5,19,5,17],[5,20,5,18],[5,21,5,19],[5,22,5,20],
[5,23,5,21],[5,24,5,22],[5,25,5,23],[5,26,5,24],[5,27,5,25],[5,28,5,26],[5,
29,5,27],[5,30,5,28],[5,31,5,29],[5,32,5,30],[5,33,5,31],[5,34,5,32],[5,35,
5,33],[5,36,5,34],[5,37,5,35],[5,38,5,36],[5,39,5,37],[5,40,5,38],[5,41,5,3
9],[5,42,5,40],[5,43,5,41],[5,44,5,42],[5,45,5,43],[5,46,5,44],[5,47,5,45],
[5,48,5,46],[5,49,5,47],[5,50,5,48],[5,51,5,49],[5,52,5,50],[5,53,5,51],[5,
54,5,52],[5,55,5,53],[5,56,5,54],[5,57,5,55],[5,58,5,56],[5,59,5,57],[5,60,
5,58],[5,61,5,59],[5,62,5,60],[5,63,5,61],[5,64,5,62],[5,65,5,63],[5,66,5,6
4],[5,67,5,65],[5,68,5,66],[5,69,5,67],[5,70,5,68],[5,71,5,69],[5,72,5,70],
[5,73,5,71],[5,74,5,72],[5,75,5,73],[5,76,5,74],[5,77,5,75],[5,78,5,76],[5,
79,5,77],[5,80,5,78],[5,81,5,79],[5,82,5,80],[5,83,5,81],[5,84,5,82],[5,85,
5,83],[5,86,5,84],[5,87,5,85],[5,88,5,86],[5,89,5,87],[5,90,5,88],[5,91,5,8
9],[5,92,5,90],[5,93,5,91],[5,94,5,92],[5,95,5,93],[5,96,5,94],[5,97,5,95],
[5,98,5,96],[5,99,5,97],[5,100,5,98],[5,101,5,99],[5,102,5,100],[5,103,5,10
1],[5,104,5,102],[5,105,5,103],[5,106,5,104],[5,107,5,105],[5,108,5,106],[5
,109,5,107],[5,110,5,108],[5,111,5,109],[5,112,5,110],[5,113,5,111],[5,114,
5,112],[5,115,5,113],[5,116,5,114],[5,117,5,115],[5,118,5,116],[5,119,5,117
],[5,120,5,118],[5,121,5,119],[5,122,5,120],[5,123,5,121],[5,124,5,122],[5,
125,5,123],[5,126,5,124],[5,127,5,125],[5,128,5,126],[5,129,5,127],[5,130,5
,128],[5,131,5,129],[5,132,5,130],[5,133,5,131],[5,134,5,132],[5,135,5,133]
,[5,136,5,134],[5,137,5,135],[5,138,5,136],[5,139,5,137],[5,140,5,138],[5,1
41,5,139],[5,142,5,140],[5,143,5,141],[5,144,5,142],[5,145,5,143],[5,146,5,
144],[5,147,5,145],[5,148,5,146],[5,149,5,147],[5,150,5,148],[5,151,5,149],
[5,152,5,150],[5,153,5,151],[5,154,5,152],[5,155,5,153],[5,156,5,154],[5,15
7,5,155],[5,158,5,156],[5,159,5,157],[5,160,5,158],[5,161,5,159],[5,162,5,1
60],[5,163,5,161],[5,164,5,162],[5,165,5,163],[5,166,5,164],[5,167,5,165],[
5,168,5,166],[5,169,5,167],[5,170,5,168],[5,171,5,169],[5,172,5,170],[5,173
,5,171],[5,174,5,172],[5,175,5,173],[5,176,5,174],[5,177,5,175],[5,178,5,17
6],[5,179,5,177],[5,180,5,178],[5,181,5,179],[5,182,5,180],[5,183,5,181],[5
,184,5,182],[5,185,5,183],[5,186,5,184],[5,187,5,185],[5,188,5,186],[5,189,
5,187],[5,190,5,188],[5,191,5,189],[5,192,5,190],[5,193,5,191],[5,194,5,192
],[5,195,5,193],[5,196,5,194],[5,197,5,195],[5,198,5,196],[5,199,5,197],[5,
200,5,198],[5,201,5,199],[5,202,5,200],[5,203,5,201],[5,204,5,202],[5,205,5
,203],[5,206,5,204],[5,207,5,205],[5,208,5,206],[5,209,5,207],[5,210,5,208]
,[5,211,5,209],[5,212,5,210],[5,213,5,211],[5,214,5,212],[5,215,5,213],[5,2
16,5,214],[5,217,5,215],[5,218,5,216],[5,219,5,217],[5,220,5,218],[5,221,5,
219],[5,222,5,220],[5,223,5,221],[5,224,5,222],[5,225,5,223],[5,226,5,224],
[5,227,5,225],[5,228,5,226],[5,229,5,227],[5,230,5,228],[5,231,5,229],[5,23
2,5,230],[5,233,5,231],[5,234,5,232],[5,235,5,233],[5,236,5,234],[5,237,5,2
35],[5,238,5,236],[5,239,5,237],[5,240,5,238],[5,241,5,239],[5,242,5,240],[
5,243,5,241],[5,244,5,242],[5,245,5,243],[5,246,5,244],[5,247,5,245],[5,248
,5,246],[5,249,5,247],[5,250,5,248],[5,251,5,249],[5,252,5,250],[5,253,5,25
1],[5,254,5,252],[5,255,5,253],[5,256,5,254],[5,257,5,255],[5,258,5,256],[5

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1546

,259,5,257],[5,260,5,258],[5,261,5,259],[5,262,5,260],[5,263,5,261],[5,264,5,262],[5,265,5,263],[5,266,5,264],[5,267,5,265],[5,268,5,266],[5,269,5,267],[5,270,5,268],[5,271,5,269],[5,272,5,270],[5,273,5,271],[5,274,5,272],[5,275,5,273],[5,276,5,274],[5,277,5,275],[5,278,5,276],[5,279,5,277],[5,280,5,278],[5,281,5,279],[5,282,5,280],[5,283,5,281],[5,284,5,282],[5,285,5,283],[5,286,5,284],[5,287,5,285],[5,288,5,286],[5,289,5,287],[5,290,5,288],[5,291,5,289],[5,292,5,290],[5,293,5,291],[5,294,5,292],[5,295,5,293],[5,296,5,294],[5,297,5,295],[5,298,5,296],[5,299,5,297],[5,300,5,298],[5,301,5,299],[5,302,5,300],[5,303,5,301],[5,304,5,302],[5,305,5,303],[5,306,5,304],[5,307,5,305],[5,308,5,306],[5,309,5,307],[5,310,5,308],[5,311,5,309],[5,312,5,310],[5,313,5,311],[5,314,5,312],[5,315,5,313],[5,316,5,314],[5,317,5,315],[5,318,5,316],[5,319,5,317],[5,320,5,318],[5,321,5,319],[5,322,5,320],[5,323,5,321],[5,324,5,322],[5,325,5,323],[5,326,5,324],[5,327,5,325],[5,328,5,326],[5,329,5,327],[5,330,5,328],[5,331,5,329],[5,332,5,330],[5,333,5,331],[5,334,5,332],[5,335,5,333],[5,336,5,334],[5,337,5,335],[5,338,5,336],[5,339,5,337],[5,340,5,338],[5,341,5,339],[5,342,5,340],[5,343,5,341],[5,344,5,342],[5,345,5,343],[5,346,5,344],[5,347,5,345],[5,348,5,346],[5,349,5,347],[5,350,5,348],[5,351,5,349],[5,352,5,350],[5,353,5,351],[5,354,5,352],[5,355,5,353],[5,356,5,354],[5,357,5,355],[5,358,5,356],[5,359,5,357],[5,360,5,358],[5,361,5,359],[5,362,5,360],[5,363,5,361],[5,364,5,362],[5,365,5,363],[5,366,5,364],[5,367,5,365],[5,368,5,366],[5,369,5,367],[5,370,5,368],[5,371,5,369],[5,372,5,370],[5,373,5,371],[5,374,5,372],[5,375,5,373],[5,376,5,374],[5,377,5,375],[5,378,5,376],[5,379,5,377],[5,380,5,378],[5,381,5,379],[5,382,5,380],[5,383,5,381],[5,384,5,382],[5,385,5,383],[5,386,5,384],[5,387,5,385],[5,388,5,386],[5,389,5,387],[5,390,5,388],[5,391,5,389],[5,392,5,390],[5,393,5,391],[5,394,5,392],[5,395,5,393],[5,396,5,394],[5,397,5,395],[5,398,5,396],[5,399,5,397],[5,400,5,398],[5,401,5,399],[5,402,5,400],[5,403,5,401],[5,404,5,402],[5,405,5,403],[5,406,5,404],[5,407,5,405],[5,408,5,406],[5,409,5,407],[5,410,5,408],[5,411,5,409],[5,412,5,410],[5,413,5,411],[5,414,5,412],[5,415,5,413],[5,416,5,414],[5,417,5,415],[5,418,5,416],[5,419,5,417],[5,420,5,418],[5,421,5,419],[5,422,5,420],[5,423,5,421],[5,424,5,422],[5,425,5,423],[5,426,5,424],[5,427,5,425],[5,428,5,426],[5,429,5,427],[5,430,5,428],[5,431,5,429],[5,432,5,430],[5,433,5,431],[5,434,5,432],[5,435,5,433],[5,436,5,434],[5,437,5,435],[5,438,5,436],[5,439,5,437],[5,440,5,438],[5,441,5,439],[5,442,5,440],[5,443,5,441],[5,444,5,442],[5,445,5,443],[5,446,5,444],[5,447,5,445],[5,448,5,446],[5,449,5,447],[5,450,5,448],[5,451,5,449],[5,452,5,450],[5,453,5,451],[5,454,5,452],[5,455,5,453],[5,456,5,454],[5,457,5,455],[5,458,5,456],[5,459,5,457],[5,460,5,458],[5,461,5,459],[5,462,5,460],[5,463,5,461],[5,464,5,462],[5,465,5,463],[5,466,5,464],[5,467,5,465],[5,468,5,466],[5,469,5,467],[5,470,5,468],[5,471,5,469],[5,472,5,470],[5,473,5,471],[5,474,5,472],[5,475,5,473],[5,476,5,474],[5,477,5,475],[5,478,5,476],[5,479,5,477],[5,480,5,478],[5,481,5,479],[5,482,5,480],[5,483,5,481],[5,484,5,482],[5,485,5,483],[5,486,5,484],[5,487,5,485],[5,488,5,486],[5,489,5,487],[5,490,5,488],[5,491,5,489],[5,492,5,490],[5,493,5,491],[5,494,5,492],[5,495,5,493],[5,496,5,494],[5,497,5,495],[5,498,5,496],[5,499,5,497],[5,500,5,498],[5,501,5,499],[5,502,5,500],[5,503,5,501],[5,504,5,502],[5,505,5,503],[5,506,5,504],[5,507,5,505],[5,508,5,506],[5,509,5,507],[5,510,5,508],[5,511,5,509],[5,512,5,510],[5,513,5,511],[5,514,5,512],[5,515,5,513],[5,516,5,514],[5,517,5,515],[5,518,5,516],[5,519,5,517],[5,520,5,518],[5,521,5,519],[5,522,5,520],[5,523,5,521],[5,524,5,522],[5,525,5,523],[5,526,5,524],[5,527,5,525],[5,528,5,526],[5,529,5,527],[5,530,5,528],[5,531,5,529],[5,532,5,530],[5,533,5,531],[5,534,5,532],[5,535,5,533],[5,536,5,534],[5,537,5,535],[5,538,5,536],[5,539,5,537],[5,540,5,538],[5,541,5,539],[5,542,5,540],[

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1547

5,543,5,541],[5,544,5,542],[5,545,5,543],[5,546,5,544],[5,547,5,545],[5,548
,5,546],[5,549,5,547],[5,550,5,548],[5,551,5,549],[5,552,5,550],[5,553,5,55
1],[5,554,5,552],[5,555,5,553],[5,556,5,554],[5,557,5,555],[5,558,5,556],[5
,559,5,557],[5,560,5,558],[5,561,5,559],[5,562,5,560],[5,563,5,561],[5,564,
5,562],[5,565,5,563],[5,566,5,564],[5,567,5,565],[5,568,5,566],[5,569,5,567
],[5,570,5,568],[5,571,5,569],[5,572,5,570],[5,573,5,571],[5,574,5,572],[5,
575,5,573],[5,576,5,574],[5,577,5,575],[5,578,5,576],[5,579,5,577],[5,580,5
,578],[5,581,5,579],[5,582,5,580],[5,583,5,581],[5,584,5,582],[5,585,5,583]
,[5,586,5,584],[5,587,5,585],[5,588,5,586],[5,589,5,587],[5,590,5,588],[5,5
91,5,589],[5,592,5,590],[5,593,5,591],[5,594,5,592],[5,595,5,593],[5,596,5,
594],[5,597,5,595],[5,598,5,596],[5,599,5,597],[5,600,5,598],[5,601,5,599],
[5,602,5,600],[5,603,5,601],[5,604,5,602],[5,605,5,603],[5,606,5,604],[5,60
7,5,605],[5,608,5,606],[5,609,5,607],[5,610,5,608],[5,611,5,609],[5,612,5,6
10],[5,613,5,611],[5,614,5,612],[5,615,5,613],[5,616,5,614],[5,617,5,615],[
5,618,5,616],[5,619,5,617],[5,620,5,618],[5,621,5,619],[5,622,5,620],[5,623
,5,621],[5,624,5,622],[5,625,5,623],[5,626,5,624],[5,627,5,625],[5,628,5,62
6],[5,629,5,627],[5,630,5,628],[5,631,5,629],[5,632,5,630],[5,633,5,631],[5
,634,5,632],[5,635,5,633],[5,636,5,634],[5,637,5,635],[5,638,5,636],[5,639,
5,637],[5,640,5,638],[5,641,5,639],[5,642,5,640],[5,643,5,641],[5,644,5,642
],[5,645,5,643],[5,646,5,644],[5,647,5,645],[5,648,5,646],[5,649,5,647],[5,
650,5,648],[5,651,5,649],[5,652,5,650],[5,653,5,651],[5,654,5,652],[5,655,5
,653],[5,656,5,654],[5,657,5,655],[5,658,5,656],[5,659,5,657],[5,660,5,658]
,[5,661,5,659],[5,662,5,660],[5,663,5,661],[5,664,5,662],[5,665,5,663],[5,6
66,5,664],[5,667,5,665],[5,668,5,666],[5,669,5,667],[5,670,5,668],[5,671,5,
669],[5,672,5,670],[5,673,5,671],[5,674,5,672],[5,675,5,673],[5,676,5,674],
[5,677,5,675],[5,678,5,676],[5,679,5,677],[5,680,5,678],[5,681,5,679],[5,68
2,5,680],[5,683,5,681],[5,684,5,682],[5,685,5,683],[5,686,5,684],[5,687,5,6
85],[5,688,5,686],[5,689,5,687],[5,690,5,688],[5,691,5,689],[5,692,5,690],[
5,693,5,691],[5,694,5,692],[5,695,5,693],[5,696,5,694],[5,697,5,695],[5,698
,5,696],[5,699,5,697],[5,700,5,698],[5,701,5,699],[5,702,5,700],[5,703,5,70
1],[5,704,5,702],[5,705,5,703],[5,706,5,704],[5,707,5,705],[5,708,5,706],[5
,709,5,707],[5,710,5,708],[5,711,5,709],[5,712,5,710],[5,713,5,711],[5,714,
5,712],[5,715,5,713],[5,716,5,714],[5,717,5,715],[5,718,5,716],[5,719,5,717
],[5,720,5,718],[5,721,5,719],[5,722,5,720],[5,723,5,721],[5,724,5,722],[5,
725,5,723],[5,726,5,724],[5,727,5,725],[5,728,5,726],[5,729,5,727],[5,730,5
,728],[5,731,5,729],[5,732,5,730],[5,733,5,731],[5,734,5,732],[5,735,5,733]
,[5,736,5,734],[5,737,5,735],[5,738,5,736],[5,739,5,737],[5,740,5,738],[5,7
41,5,739],[5,742,5,740],[5,743,5,741],[5,744,5,742],[5,745,5,743],[5,746,5,
744],[5,747,5,745],[5,748,5,746],[5,749,5,747],[5,750,5,748],[5,751,5,749],
[5,752,5,750],[5,753,5,751],[5,754,5,752],[5,755,5,753],[5,756,5,754],[5,75
7,5,755],[5,758,5,756],[5,759,5,757],[5,760,5,758],[5,761,5,759],[5,762,5,7
60],[5,763,5,761],[5,764,5,762],[5,765,5,763],[5,766,5,764],[5,767,5,765],[
5,768,5,766],[5,769,5,767],[5,770,5,768],[5,771,5,769],[5,772,5,770],[5,773
,5,771],[5,774,5,772],[5,775,5,773],[5,776,5,774],[5,777,5,775],[5,778,5,77
6],[5,779,5,777],[5,780,5,778],[5,781,5,779],[5,782,5,780],[5,783,5,781],[5
,784,5,782],[5,785,5,783],[5,786,5,784],[5,787,5,785],[5,788,5,786],[5,789,
5,787],[5,790,5,788],[5,791,5,789],[5,792,5,790],[5,793,5,791],[5,794,5,792
],[5,795,5,793],[5,796,5,794],[5,797,5,795],[5,798,5,796],[5,799,5,797],[5,
800,5,798],[5,801,5,799],[5,802,5,800],[5,803,5,801],[5,804,5,802],[5,805,5
,803],[5,806,5,804],[5,807,5,805],[5,808,5,806],[5,809,5,807],[5,810,5,808]
,[5,811,5,809],[5,812,5,810],[5,813,5,811],[5,814,5,812],[5,815,5,813],[5,8
16,5,814],[5,817,5,815],[5,818,5,816],[5,819,5,817],[5,820,5,818],[5,821,5,
819],[5,822,5,820],[5,823,5,821],[5,824,5,822],[5,825,5,823],[5,826,5,824],

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1548

[5,827,5,825],[5,828,5,826],[5,829,5,827],[5,830,5,828],[5,831,5,829],[5,832,5,830],[5,833,5,831],[5,834,5,832],[5,835,5,833],[5,836,5,834],[5,837,5,835],[5,838,5,836],[5,839,5,837],[5,840,5,838],[5,841,5,839],[5,842,5,840],[5,843,5,841],[5,844,5,842],[5,845,5,843],[5,846,5,844],[5,847,5,845],[5,848,5,846],[5,849,5,847],[5,850,5,848],[5,851,5,849],[5,852,5,850],[5,853,5,851],[5,854,5,852],[5,855,5,853],[5,856,5,854],[5,857,5,855],[5,858,5,856],[5,859,5,857],[5,860,5,858],[5,861,5,859],[5,862,5,860],[5,863,5,861],[5,864,5,862],[5,865,5,863],[5,866,5,864],[5,867,5,865],[5,868,5,866],[5,869,5,867],[5,870,5,868],[5,871,5,869],[5,872,5,870],[5,873,5,871],[5,874,5,872],[5,875,5,873],[5,876,5,874],[5,877,5,875],[5,878,5,876],[5,879,5,877],[5,880,5,878],[5,881,5,879],[5,882,5,880],[5,883,5,881],[5,884,5,882],[5,885,5,883],[5,886,5,884],[5,887,5,885],[5,888,5,886],[5,889,5,887],[5,890,5,888],[5,891,5,889],[5,892,5,890],[5,893,5,891],[5,894,5,892],[5,895,5,893],[5,896,5,894],[5,897,5,895],[5,898,5,896],[5,899,5,897],[5,900,5,898],[5,901,5,899],[5,902,5,900],[5,903,5,901],[5,904,5,902],[5,905,5,903],[5,906,5,904],[5,907,5,905],[5,908,5,906],[5,909,5,907],[5,910,5,908],[5,911,5,909],[5,912,5,910],[5,913,5,911],[5,914,5,912],[5,915,5,913],[5,916,5,914],[5,917,5,915],[5,918,5,916],[5,919,5,917],[5,920,5,918],[5,921,5,919],[5,922,5,920],[5,923,5,921],[5,924,5,922],[5,925,5,923],[5,926,5,924],[5,927,5,925],[5,928,5,926],[5,929,5,927],[5,930,5,928],[5,931,5,929],[5,932,5,930],[5,933,5,931],[5,934,5,932],[5,935,5,933],[5,936,5,934],[5,937,5,935],[5,938,5,936],[5,939,5,937],[5,940,5,938],[5,941,5,939],[5,942,5,940],[5,943,5,941],[5,944,5,942],[5,945,5,943],[5,946,5,944],[5,947,5,945],[5,948,5,946],[5,949,5,947],[5,950,5,948],[5,951,5,949],[5,952,5,950],[5,953,5,951],[5,954,5,952],[5,955,5,953],[5,956,5,954],[5,957,5,955],[5,958,5,956],[5,959,5,957],[5,960,5,958],[5,961,5,959],[5,962,5,960],[5,963,5,961],[5,964,5,962],[5,965,5,963],[5,966,5,964],[5,967,5,965],[5,968,5,966],[5,969,5,967],[5,970,5,968],[5,971,5,969],[5,972,5,970],[5,973,5,971],[5,974,5,972],[5,975,5,973],[5,976,5,974],[5,977,5,975],[5,978,5,976],[5,979,5,977],[5,980,5,978],[5,981,5,979],[5,982,5,980],[5,983,5,981],[5,984,5,982],[5,985,5,983],[5,986,5,984],[5,987,5,985],[5,988,5,986],[5,989,5,987],[5,990,5,988],[5,991,5,989],[5,992,5,990],[5,993,5,991],[5,994,5,992],[5,995,5,993],[5,996,5,994],[5,997,5,995],[5,998,5,996],[5,999,5,997],[5,1000,5,998],[5,1001,5,999],[5,1002,5,1000],[5,1003,5,1001],[5,1004,5,1002],[5,1005,5,1003],[5,1006,5,1004],[5,1007,5,1005],[5,1008,5,1006],[5,1009,5,1007],[5,1010,5,1008],[5,1011,5,1009],[5,1012,5,1010],[5,1013,5,1011],[5,1014,5,1012],[5,1015,5,1013],[5,1016,5,1014],[5,1017,5,1015],[5,1018,5,1016],[5,1019,5,1017],[5,1020,5,1018],[5,1021,5,1019],[5,1022,5,1020],[5,1023,5,1021],[5,1024,5,1022],[5,1025,5,1023],[5,1026,5,1024],[5,1027,5,1025],[5,1028,5,1026],[5,1029,5,1027],[5,1030,5,1028],[5,1031,5,1029],[5,1032,5,1030],[5,1033,5,1031],[5,1034,5,1032],[5,1035,5,1033],[5,1036,5,1034],[5,1037,5,1035],[5,1038,5,1036],[5,1039,5,1037],[5,1040,5,1038],[5,1041,5,1039],[5,1042,5,1040],[5,1043,5,1041],[5,1044,5,1042],[5,1045,5,1043],[5,1046,5,1044],[5,1047,5,1045],[5,1048,5,1046],[5,1049,5,1047],[5,1050,5,1048],[5,1051,5,1049],[5,1052,5,1050],[5,1053,5,1051],[5,1054,5,1052],[5,1055,5,1053],[5,1056,5,1054],[5,1057,5,1055],[5,1058,5,1056],[5,1059,5,1057],[5,1060,5,1058],[5,1061,5,1059],[5,1062,5,1060],[5,1063,5,1061],[5,1064,5,1062],[5,1065,5,1063],[5,1066,5,1064],[5,1067,5,1065],[5,1068,5,1066],[5,1069,5,1067],[5,1070,5,1068],[5,1071,5,1069],[5,1072,5,1070],[5,1073,5,1071],[5,1074,5,1072],[5,1075,5,1073],[5,1076,5,1074],[5,1077,5,1075],[5,1078,5,1076],[5,1079,5,1077],[5,1080,5,1078],[5,1081,5,1079],[5,1082,5,1080],[5,1083,5,1081],[5,1084,5,1082],[5,1085,5,1083],[5,1086,5,1084],[5,1087,5,1085],[5,1088,5,1086],[5,1089,5,1087],[5,1090,5,1088],[5,1091,5,1089],[5,1092,5,1090],[5,1093,5,1091],[5,1094,5,1092],[5,1095,5,1093],[5,1096,5,1094],[5,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1549

1097,5,1095],[5,1098,5,1096],[5,1099,5,1097],[5,1100,5,1098],[5,1101,5,1099
],[5,1102,5,1100],[5,1103,5,1101],[5,1104,5,1102],[5,1105,5,1103],[5,1106,5
,1104],[5,1107,5,1105],[5,1108,5,1106],[5,1109,5,1107],[5,1110,5,1108],[5,1
111,5,1109],[5,1112,5,1110],[5,1113,5,1111],[5,1114,5,1112],[5,1115,5,1113]
,[5,1116,5,1114],[5,1117,5,1115],[5,1118,5,1116],[5,1119,5,1117],[5,1120,5,
1118],[5,1121,5,1119],[5,1122,5,1120],[5,1123,5,1121],[5,1124,5,1122],[5,11
25,5,1123],[5,1126,5,1124],[5,1127,5,1125],[5,1128,5,1126],[5,1129,5,1127],
[5,1130,5,1128],[5,1131,5,1129],[5,1132,5,1130],[5,1133,5,1131],[5,1134,5,1
132],[5,1135,5,1133],[5,1136,5,1134],[5,1137,5,1135],[5,1138,5,1136],[5,113
9,5,1137],[5,1140,5,1138],[5,1141,5,1139],[5,1142,5,1140],[5,1143,5,1141],[
5,1144,5,1142],[5,1145,5,1143],[5,1146,5,1144],[5,1147,5,1145],[5,1148,5,11
46],[5,1149,5,1147],[5,1150,5,1148],[5,1151,5,1149],[5,1152,5,1150],[5,1153
,5,1151],[5,1154,5,1152],[5,1155,5,1153],[5,1156,5,1154],[5,1157,5,1155],[5
,1158,5,1156],[5,1159,5,1157],[5,1160,5,1158],[5,1161,5,1159],[5,1162,5,116
0],[5,1163,5,1161],[5,1164,5,1162],[5,1165,5,1163],[5,1166,5,1164],[5,1167,
5,1165],[5,1168,5,1166],[5,1169,5,1167],[5,1170,5,1168],[5,1171,5,1169],[5,
1172,5,1170],[5,1173,5,1171],[5,1174,5,1172],[5,1175,5,1173],[5,1176,5,1174
],[5,1177,5,1175],[5,1178,5,1176],[5,1179,5,1177],[5,1180,5,1178],[5,1181,5
,1179],[5,1182,5,1180],[5,1183,5,1181],[5,1184,5,1182],[5,1185,5,1183],[5,1
186,5,1184],[5,1187,5,1185],[5,1188,5,1186],[5,1189,5,1187],[5,1190,5,1188]
,[5,1191,5,1189],[5,1192,5,1190],[5,1193,5,1191],[5,1194,5,1192],[5,1195,5,
1193],[5,1196,5,1194],[5,1197,5,1195],[5,1198,5,1196],[5,1199,5,1197],[5,12
00,5,1198],[5,1201,5,1199],[5,1202,5,1200],[5,1203,5,1201],[5,1204,5,1202],
[5,1205,5,1203],[5,1206,5,1204],[5,1207,5,1205],[5,1208,5,1206],[5,1209,5,1
207],[5,1210,5,1208],[5,1211,5,1209],[5,1212,5,1210],[5,1213,5,1211],[5,121
4,5,1212],[5,1215,5,1213],[5,1216,5,1214],[5,1217,5,1215],[5,1218,5,1216],[
5,1219,5,1217],[5,1220,5,1218],[5,1221,5,1219],[5,1222,5,1220],[5,1223,5,12
21],[5,1224,5,1222],[5,1225,5,1223],[5,1226,5,1224],[5,1227,5,1225],[5,1228
,5,1226],[5,1229,5,1227],[5,1230,5,1228],[5,1231,5,1229],[5,1232,5,1230],[5
,1233,5,1231],[4,1233,5,1232],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1]],"row":16,"num":5}]}

Listing for 6ht-v6-2color-1.json:

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1550

{"vstrands":[{"stap_colors":[[41,3355443],[83,8947848],[125,8947848],[167,8947848],[209,8947848],[251,8947848],[293,13369344],[335,13369344],[377,8947848],[419,8947848],[461,8947848],[503,8947848],[545,8947848],[587,8947848],[629,8947848],[671,8947848],[713,8947848],[755,8947848],[797,8947848],[839,8947848],[881,8947848],[923,8947848],[965,8947848],[1007,8947848],[1049,8947848],[1091,8947848],[1133,8947848],[1175,29184],[1217,29184],[1257,3355443]],"col":12,"stap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[0,15,1,14],[0,16,0,14],[0,17,0,15],[0,18,0,16],[0,19,0,17],[0,20,0,18],[0,21,0,19],[0,22,0,20],[0,23,0,21],[0,24,0,22],[0,25,0,23],[0,26,0,24],[0,27,0,25],[5,27,0,26],[0,29,5,28],[0,30,0,28],[0,31,0,29],[0,32,0,30],[0,33,0,31],[0,34,0,32],[0,35,0,33],[0,36,0,34],[0,37,0,35],[0,38,0,36],[0,39,0,37],[0,40,0,38],[0,41,0,39],[-1,-1,0,40],[0,43,-1,-1],[0,44,0,42],[0,45,0,43],[0,46,0,44],[0,47,0,45],[0,48,0,46],[0,49,0,47],[0,50,0,48],[0,51,0,49],[0,52,0,50],[0,53,0,51],[0,54,0,52],[0,55,0,53],[1,55,0,54],[0,57,1,56],[0,58,0,56],[0,59,0,57],[0,60,0,58],[0,61,0,59],[0,62,0,60],[0,63,0,61],[0,64,0,62],[0,65,0,63],[0,66,0,64],[0,67,0,65],[0,68,0,66],[0,69,0,67],[5,69,0,68],[0,71,5,70],[0,72,0,70],[0,73,0,71],[0,74,0,72],[0,75,0,73],[0,76,0,74],[0,77,0,75],[0,78,0,76],[0,79,0,77],[0,80,0,78],[0,81,0,79],[0,82,0,80],[0,83,0,81],[-1,-1,0,82],[0,85,-1,-1],[0,86,0,84],[0,87,0,85],[0,88,0,86],[0,89,0,87],[0,90,0,88],[0,91,0,89],[0,92,0,90],[0,93,0,91],[0,94,0,92],[0,95,0,93],[0,96,0,94],[0,97,0,95],[1,97,0,96],[0,99,1,98],[0,100,0,98],[0,101,0,99],[0,102,0,100],[0,103,0,101],[0,104,0,102],[0,105,0,103],[0,106,0,104],[0,107,0,105],[0,108,0,106],[0,109,0,107],[0,110,0,108],[0,111,0,109],[5,111,0,110],[0,113,5,112],[0,114,0,112],[0,115,0,113],[0,116,0,114],[0,117,0,115],[0,118,0,116],[0,119,0,117],[0,120,0,118],[0,121,0,119],[0,122,0,120],[0,123,0,121],[0,124,0,122],[0,125,0,123],[-1,-1,0,124],[0,127,-1,-1],[0,128,0,126],[0,129,0,127],[0,130,0,128],[0,131,0,129],[0,132,0,130],[0,133,0,131],[0,134,0,132],[0,135,0,133],[0,136,0,134],[0,137,0,135],[0,138,0,136],[0,139,0,137],[1,139,0,138],[0,141,1,140],[0,142,0,140],[0,143,0,141],[0,144,0,142],[0,145,0,143],[0,146,0,144],[0,147,0,145],[0,148,0,146],[0,149,0,147],[0,150,0,148],[0,151,0,149],[0,152,0,150],[0,153,0,151],[5,153,0,152],[0,155,5,154],[0,156,0,154],[0,157,0,155],[0,158,0,156],[0,159,0,157],[0,160,0,158],[0,161,0,159],[0,162,0,160],[0,163,0,161],[0,164,0,162],[0,165,0,163],[0,166,0,164],[0,167,0,165],[-1,-1,0,166],[0,169,-1,-1],[0,170,0,168],[0,171,0,169],[0,172,0,170],[0,173,0,171],[0,174,0,172],[0,175,0,173],[0,176,0,174],[0,177,0,175],[0,178,0,176],[0,179,0,177],[0,180,0,178],[0,181,0,179],[1,181,0,180],[0,183,1,182],[0,184,0,182],[0,185,0,183],[0,186,0,184],[0,187,0,185],[0,188,0,186],[0,189,0,187],[0,190,0,188],[0,191,0,189],[0,192,0,190],[0,193,0,191],[0,194,0,192],[0,195,0,193],[5,195,0,194],[0,197,5,196],[0,198,0,196],[0,199,0,197],[0,200,0,198],[0,201,0,199],[0,202,0,200],[0,203,0,201],[0,204,0,202],[0,205,0,203],[0,206,0,204],[0,207,0,205],[0,208,0,206],[0,209,0,207],[-1,-1,0,208],[0,211,-1,-1],[0,212,0,210],[0,213,0,211],[0,214,0,212],[0,215,0,213],[0,216,0,214],[0,217,0,215],[0,218,0,216],[0,219,0,217],[0,220,0,218],[0,221,0,219],[0,222,0,220],[0,223,0,221],[1,223,0,222],[0,225,1,224],[0,226,0,224],[0,227,0,225],[0,228,0,226],[0,229,0,227],[0,230,0,228],[0,231,0,229],[0,232,0,230],[0,233,0,231],[0,234,0,232],[0,235,0,233],[0,236,0,234],[0,237,0,235],[5,237,0,236],[0,239,5,238],[0,240,0,238],[0,241,0,239],[0,242,0,240],[0,243,0,241],[0,244,0,242],[0,245,0,243],[0,246,0,244],[0,247,0,245],[0,248,0,246],[0,249,0,247],[0,250,0,248],[0,251,0,249],[-1,-1,0,250],[0,253,-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1551

1],[0,254,0,252],[0,255,0,253],[0,256,0,254],[0,257,0,255],[0,258,0,256],[0
,259,0,257],[0,260,0,258],[0,261,0,259],[0,262,0,260],[0,263,0,261],[0,264,
0,262],[0,265,0,263],[1,265,0,264],[0,267,1,266],[0,268,0,266],[0,269,0,267
],[0,270,0,268],[0,271,0,269],[0,272,0,270],[0,273,0,271],[0,274,0,272],[0,
275,0,273],[0,276,0,274],[0,277,0,275],[0,278,0,276],[0,279,0,277],[5,279,0
,278],[0,281,5,280],[0,282,0,280],[0,283,0,281],[0,284,0,282],[0,285,0,283]
,[0,286,0,284],[0,287,0,285],[0,288,0,286],[0,289,0,287],[0,290,0,288],[0,2
91,0,289],[0,292,0,290],[0,293,0,291],[-1,-1,0,292],[0,295,-1,-
1],[0,296,0,294],[0,297,0,295],[0,298,0,296],[0,299,0,297],[0,300,0,298],[0
,301,0,299],[0,302,0,300],[0,303,0,301],[0,304,0,302],[0,305,0,303],[0,306,
0,304],[0,307,0,305],[1,307,0,306],[0,309,1,308],[0,310,0,308],[0,311,0,309
],[0,312,0,310],[0,313,0,311],[0,314,0,312],[0,315,0,313],[0,316,0,314],[0,
317,0,315],[0,318,0,316],[0,319,0,317],[0,320,0,318],[0,321,0,319],[5,321,0
,320],[0,323,5,322],[0,324,0,322],[0,325,0,323],[0,326,0,324],[0,327,0,325]
,[0,328,0,326],[0,329,0,327],[0,330,0,328],[0,331,0,329],[0,332,0,330],[0,3
33,0,331],[0,334,0,332],[0,335,0,333],[-1,-1,0,334],[0,337,-1,-
1],[0,338,0,336],[0,339,0,337],[0,340,0,338],[0,341,0,339],[0,342,0,340],[0
,343,0,341],[0,344,0,342],[0,345,0,343],[0,346,0,344],[0,347,0,345],[0,348,
0,346],[0,349,0,347],[1,349,0,348],[0,351,1,350],[0,352,0,350],[0,353,0,351
],[0,354,0,352],[0,355,0,353],[0,356,0,354],[0,357,0,355],[0,358,0,356],[0,
359,0,357],[0,360,0,358],[0,361,0,359],[0,362,0,360],[0,363,0,361],[5,363,0
,362],[0,365,5,364],[0,366,0,364],[0,367,0,365],[0,368,0,366],[0,369,0,367]
,[0,370,0,368],[0,371,0,369],[0,372,0,370],[0,373,0,371],[0,374,0,372],[0,3
75,0,373],[0,376,0,374],[0,377,0,375],[-1,-1,0,376],[0,379,-1,-
1],[0,380,0,378],[0,381,0,379],[0,382,0,380],[0,383,0,381],[0,384,0,382],[0
,385,0,383],[0,386,0,384],[0,387,0,385],[0,388,0,386],[0,389,0,387],[0,390,
0,388],[0,391,0,389],[1,391,0,390],[0,393,1,392],[0,394,0,392],[0,395,0,393
],[0,396,0,394],[0,397,0,395],[0,398,0,396],[0,399,0,397],[0,400,0,398],[0,
401,0,399],[0,402,0,400],[0,403,0,401],[0,404,0,402],[0,405,0,403],[5,405,0
,404],[0,407,5,406],[0,408,0,406],[0,409,0,407],[0,410,0,408],[0,411,0,409]
,[0,412,0,410],[0,413,0,411],[0,414,0,412],[0,415,0,413],[0,416,0,414],[0,4
17,0,415],[0,418,0,416],[0,419,0,417],[-1,-1,0,418],[0,421,-1,-
1],[0,422,0,420],[0,423,0,421],[0,424,0,422],[0,425,0,423],[0,426,0,424],[0
,427,0,425],[0,428,0,426],[0,429,0,427],[0,430,0,428],[0,431,0,429],[0,432,
0,430],[0,433,0,431],[1,433,0,432],[0,435,1,434],[0,436,0,434],[0,437,0,435
],[0,438,0,436],[0,439,0,437],[0,440,0,438],[0,441,0,439],[0,442,0,440],[0,
443,0,441],[0,444,0,442],[0,445,0,443],[0,446,0,444],[0,447,0,445],[5,447,0
,446],[0,449,5,448],[0,450,0,448],[0,451,0,449],[0,452,0,450],[0,453,0,451]
,[0,454,0,452],[0,455,0,453],[0,456,0,454],[0,457,0,455],[0,458,0,456],[0,4
59,0,457],[0,460,0,458],[0,461,0,459],[-1,-1,0,460],[0,463,-1,-
1],[0,464,0,462],[0,465,0,463],[0,466,0,464],[0,467,0,465],[0,468,0,466],[0
,469,0,467],[0,470,0,468],[0,471,0,469],[0,472,0,470],[0,473,0,471],[0,474,
0,472],[0,475,0,473],[1,475,0,474],[0,477,1,476],[0,478,0,476],[0,479,0,477
],[0,480,0,478],[0,481,0,479],[0,482,0,480],[0,483,0,481],[0,484,0,482],[0,
485,0,483],[0,486,0,484],[0,487,0,485],[0,488,0,486],[0,489,0,487],[5,489,0
,488],[0,491,5,490],[0,492,0,490],[0,493,0,491],[0,494,0,492],[0,495,0,493]
,[0,496,0,494],[0,497,0,495],[0,498,0,496],[0,499,0,497],[0,500,0,498],[0,5
01,0,499],[0,502,0,500],[0,503,0,501],[-1,-1,0,502],[0,505,-1,-
1],[0,506,0,504],[0,507,0,505],[0,508,0,506],[0,509,0,507],[0,510,0,508],[0
,511,0,509],[0,512,0,510],[0,513,0,511],[0,514,0,512],[0,515,0,513],[0,516,
0,514],[0,517,0,515],[1,517,0,516],[0,519,1,518],[0,520,0,518],[0,521,0,519
],[0,522,0,520],[0,523,0,521],[0,524,0,522],[0,525,0,523],[0,526,0,524],[0,
527,0,525],[0,528,0,526],[0,529,0,527],[0,530,0,528],[0,531,0,529],[5,531,0

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1552

,530],[0,533,5,532],[0,534,0,532],[0,535,0,533],[0,536,0,534],[0,537,0,535]
,[0,538,0,536],[0,539,0,537],[0,540,0,538],[0,541,0,539],[0,542,0,540],[0,5
43,0,541],[0,544,0,542],[0,545,0,543],[-1,-1,0,544],[0,547,-1,-
1],[0,548,0,546],[0,549,0,547],[0,550,0,548],[0,551,0,549],[0,552,0,550],[0
,553,0,551],[0,554,0,552],[0,555,0,553],[0,556,0,554],[0,557,0,555],[0,558,
0,556],[0,559,0,557],[1,559,0,558],[0,561,1,560],[0,562,0,560],[0,563,0,561
],[0,564,0,562],[0,565,0,563],[0,566,0,564],[0,567,0,565],[0,568,0,566],[0,
569,0,567],[0,570,0,568],[0,571,0,569],[0,572,0,570],[0,573,0,571],[5,573,0
,572],[0,575,5,574],[0,576,0,574],[0,577,0,575],[0,578,0,576],[0,579,0,577]
,[0,580,0,578],[0,581,0,579],[0,582,0,580],[0,583,0,581],[0,584,0,582],[0,5
85,0,583],[0,586,0,584],[0,587,0,585],[-1,-1,0,586],[0,589,-1,-
1],[0,590,0,588],[0,591,0,589],[0,592,0,590],[0,593,0,591],[0,594,0,592],[0
,595,0,593],[0,596,0,594],[0,597,0,595],[0,598,0,596],[0,599,0,597],[0,600,
0,598],[0,601,0,599],[1,601,0,600],[0,603,1,602],[0,604,0,602],[0,605,0,603
],[0,606,0,604],[0,607,0,605],[0,608,0,606],[0,609,0,607],[0,610,0,608],[0,
611,0,609],[0,612,0,610],[0,613,0,611],[0,614,0,612],[0,615,0,613],[5,615,0
,614],[0,617,5,616],[0,618,0,616],[0,619,0,617],[0,620,0,618],[0,621,0,619]
,[0,622,0,620],[0,623,0,621],[0,624,0,622],[0,625,0,623],[0,626,0,624],[0,6
27,0,625],[0,628,0,626],[0,629,0,627],[-1,-1,0,628],[0,631,-1,-
1],[0,632,0,630],[0,633,0,631],[0,634,0,632],[0,635,0,633],[0,636,0,634],[0
,637,0,635],[0,638,0,636],[0,639,0,637],[0,640,0,638],[0,641,0,639],[0,642,
0,640],[0,643,0,641],[1,643,0,642],[0,645,1,644],[0,646,0,644],[0,647,0,645
],[0,648,0,646],[0,649,0,647],[0,650,0,648],[0,651,0,649],[0,652,0,650],[0,
653,0,651],[0,654,0,652],[0,655,0,653],[0,656,0,654],[0,657,0,655],[5,657,0
,656],[0,659,5,658],[0,660,0,658],[0,661,0,659],[0,662,0,660],[0,663,0,661]
,[0,664,0,662],[0,665,0,663],[0,666,0,664],[0,667,0,665],[0,668,0,666],[0,6
69,0,667],[0,670,0,668],[0,671,0,669],[-1,-1,0,670],[0,673,-1,-
1],[0,674,0,672],[0,675,0,673],[0,676,0,674],[0,677,0,675],[0,678,0,676],[0
,679,0,677],[0,680,0,678],[0,681,0,679],[0,682,0,680],[0,683,0,681],[0,684,
0,682],[0,685,0,683],[1,685,0,684],[0,687,1,686],[0,688,0,686],[0,689,0,687
],[0,690,0,688],[0,691,0,689],[0,692,0,690],[0,693,0,691],[0,694,0,692],[0,
695,0,693],[0,696,0,694],[0,697,0,695],[0,698,0,696],[0,699,0,697],[5,699,0
,698],[0,701,5,700],[0,702,0,700],[0,703,0,701],[0,704,0,702],[0,705,0,703]
,[0,706,0,704],[0,707,0,705],[0,708,0,706],[0,709,0,707],[0,710,0,708],[0,7
11,0,709],[0,712,0,710],[0,713,0,711],[-1,-1,0,712],[0,715,-1,-
1],[0,716,0,714],[0,717,0,715],[0,718,0,716],[0,719,0,717],[0,720,0,718],[0
,721,0,719],[0,722,0,720],[0,723,0,721],[0,724,0,722],[0,725,0,723],[0,726,
0,724],[0,727,0,725],[1,727,0,726],[0,729,1,728],[0,730,0,728],[0,731,0,729
],[0,732,0,730],[0,733,0,731],[0,734,0,732],[0,735,0,733],[0,736,0,734],[0,
737,0,735],[0,738,0,736],[0,739,0,737],[0,740,0,738],[0,741,0,739],[5,741,0
,740],[0,743,5,742],[0,744,0,742],[0,745,0,743],[0,746,0,744],[0,747,0,745]
,[0,748,0,746],[0,749,0,747],[0,750,0,748],[0,751,0,749],[0,752,0,750],[0,7
53,0,751],[0,754,0,752],[0,755,0,753],[-1,-1,0,754],[0,757,-1,-
1],[0,758,0,756],[0,759,0,757],[0,760,0,758],[0,761,0,759],[0,762,0,760],[0
,763,0,761],[0,764,0,762],[0,765,0,763],[0,766,0,764],[0,767,0,765],[0,768,
0,766],[0,769,0,767],[1,769,0,768],[0,771,1,770],[0,772,0,770],[0,773,0,771
],[0,774,0,772],[0,775,0,773],[0,776,0,774],[0,777,0,775],[0,778,0,776],[0,
779,0,777],[0,780,0,778],[0,781,0,779],[0,782,0,780],[0,783,0,781],[5,783,0
,782],[0,785,5,784],[0,786,0,784],[0,787,0,785],[0,788,0,786],[0,789,0,787]
,[0,790,0,788],[0,791,0,789],[0,792,0,790],[0,793,0,791],[0,794,0,792],[0,7
95,0,793],[0,796,0,794],[0,797,0,795],[-1,-1,0,796],[0,799,-1,-
1],[0,800,0,798],[0,801,0,799],[0,802,0,800],[0,803,0,801],[0,804,0,802],[0
,805,0,803],[0,806,0,804],[0,807,0,805],[0,808,0,806],[0,809,0,807],[0,810,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1553

0,808],[0,811,0,809],[1,811,0,810],[0,813,1,812],[0,814,0,812],[0,815,0,813
],[0,816,0,814],[0,817,0,815],[0,818,0,816],[0,819,0,817],[0,820,0,818],[0,
821,0,819],[0,822,0,820],[0,823,0,821],[0,824,0,822],[0,825,0,823],[5,825,0
,824],[0,827,5,826],[0,828,0,826],[0,829,0,827],[0,830,0,828],[0,831,0,829]
,[0,832,0,830],[0,833,0,831],[0,834,0,832],[0,835,0,833],[0,836,0,834],[0,8
37,0,835],[0,838,0,836],[0,839,0,837],[-1,-1,0,838],[0,841,-1,-
1],[0,842,0,840],[0,843,0,841],[0,844,0,842],[0,845,0,843],[0,846,0,844],[0
,847,0,845],[0,848,0,846],[0,849,0,847],[0,850,0,848],[0,851,0,849],[0,852,
0,850],[0,853,0,851],[1,853,0,852],[0,855,1,854],[0,856,0,854],[0,857,0,855
],[0,858,0,856],[0,859,0,857],[0,860,0,858],[0,861,0,859],[0,862,0,860],[0,
863,0,861],[0,864,0,862],[0,865,0,863],[0,866,0,864],[0,867,0,865],[5,867,0
,866],[0,869,5,868],[0,870,0,868],[0,871,0,869],[0,872,0,870],[0,873,0,871]
,[0,874,0,872],[0,875,0,873],[0,876,0,874],[0,877,0,875],[0,878,0,876],[0,8
79,0,877],[0,880,0,878],[0,881,0,879],[-1,-1,0,880],[0,883,-1,-
1],[0,884,0,882],[0,885,0,883],[0,886,0,884],[0,887,0,885],[0,888,0,886],[0
,889,0,887],[0,890,0,888],[0,891,0,889],[0,892,0,890],[0,893,0,891],[0,894,
0,892],[0,895,0,893],[1,895,0,894],[0,897,1,896],[0,898,0,896],[0,899,0,897
],[0,900,0,898],[0,901,0,899],[0,902,0,900],[0,903,0,901],[0,904,0,902],[0,
905,0,903],[0,906,0,904],[0,907,0,905],[0,908,0,906],[0,909,0,907],[5,909,0
,908],[0,911,5,910],[0,912,0,910],[0,913,0,911],[0,914,0,912],[0,915,0,913]
,[0,916,0,914],[0,917,0,915],[0,918,0,916],[0,919,0,917],[0,920,0,918],[0,9
21,0,919],[0,922,0,920],[0,923,0,921],[-1,-1,0,922],[0,925,-1,-
1],[0,926,0,924],[0,927,0,925],[0,928,0,926],[0,929,0,927],[0,930,0,928],[0
,931,0,929],[0,932,0,930],[0,933,0,931],[0,934,0,932],[0,935,0,933],[0,936,
0,934],[0,937,0,935],[1,937,0,936],[0,939,1,938],[0,940,0,938],[0,941,0,939
],[0,942,0,940],[0,943,0,941],[0,944,0,942],[0,945,0,943],[0,946,0,944],[0,
947,0,945],[0,948,0,946],[0,949,0,947],[0,950,0,948],[0,951,0,949],[5,951,0
,950],[0,953,5,952],[0,954,0,952],[0,955,0,953],[0,956,0,954],[0,957,0,955]
,[0,958,0,956],[0,959,0,957],[0,960,0,958],[0,961,0,959],[0,962,0,960],[0,9
63,0,961],[0,964,0,962],[0,965,0,963],[-1,-1,0,964],[0,967,-1,-
1],[0,968,0,966],[0,969,0,967],[0,970,0,968],[0,971,0,969],[0,972,0,970],[0
,973,0,971],[0,974,0,972],[0,975,0,973],[0,976,0,974],[0,977,0,975],[0,978,
0,976],[0,979,0,977],[1,979,0,978],[0,981,1,980],[0,982,0,980],[0,983,0,981
],[0,984,0,982],[0,985,0,983],[0,986,0,984],[0,987,0,985],[0,988,0,986],[0,
989,0,987],[0,990,0,988],[0,991,0,989],[0,992,0,990],[0,993,0,991],[5,993,0
,992],[0,995,5,994],[0,996,0,994],[0,997,0,995],[0,998,0,996],[0,999,0,997]
,[0,1000,0,998],[0,1001,0,999],[0,1002,0,1000],[0,1003,0,1001],[0,1004,0,10
02],[0,1005,0,1003],[0,1006,0,1004],[0,1007,0,1005],[-1,-
1,0,1006],[0,1009,-1,-
1],[0,1010,0,1008],[0,1011,0,1009],[0,1012,0,1010],[0,1013,0,1011],[0,1014,
0,1012],[0,1015,0,1013],[0,1016,0,1014],[0,1017,0,1015],[0,1018,0,1016],[0,
1019,0,1017],[0,1020,0,1018],[0,1021,0,1019],[1,1021,0,1020],[0,1023,1,1022
],[0,1024,0,1022],[0,1025,0,1023],[0,1026,0,1024],[0,1027,0,1025],[0,1028,0
,1026],[0,1029,0,1027],[0,1030,0,1028],[0,1031,0,1029],[0,1032,0,1030],[0,1
033,0,1031],[0,1034,0,1032],[0,1035,0,1033],[5,1035,0,1034],[0,1037,5,1036]
,[0,1038,0,1036],[0,1039,0,1037],[0,1040,0,1038],[0,1041,0,1039],[0,1042,0,
1040],[0,1043,0,1041],[0,1044,0,1042],[0,1045,0,1043],[0,1046,0,1044],[0,10
47,0,1045],[0,1048,0,1046],[0,1049,0,1047],[-1,-1,0,1048],[0,1051,-1,-
1],[0,1052,0,1050],[0,1053,0,1051],[0,1054,0,1052],[0,1055,0,1053],[0,1056,
0,1054],[0,1057,0,1055],[0,1058,0,1056],[0,1059,0,1057],[0,1060,0,1058],[0,
1061,0,1059],[0,1062,0,1060],[0,1063,0,1061],[1,1063,0,1062],[0,1065,1,1064
],[0,1066,0,1064],[0,1067,0,1065],[0,1068,0,1066],[0,1069,0,1067],[0,1070,0
,1068],[0,1071,0,1069],[0,1072,0,1070],[0,1073,0,1071],[0,1074,0,1072],[0,1

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1554

075,0,1073],[0,1076,0,1074],[0,1077,0,1075],[5,1077,0,1076],[0,1079,5,1078]
,[0,1080,0,1078],[0,1081,0,1079],[0,1082,0,1080],[0,1083,0,1081],[0,1084,0,
1082],[0,1085,0,1083],[0,1086,0,1084],[0,1087,0,1085],[0,1088,0,1086],[0,10
89,0,1087],[0,1090,0,1088],[0,1091,0,1089],[-1,-1,0,1090],[0,1093,-1,-
1],[0,1094,0,1092],[0,1095,0,1093],[0,1096,0,1094],[0,1097,0,1095],[0,1098,
0,1096],[0,1099,0,1097],[0,1100,0,1098],[0,1101,0,1099],[0,1102,0,1100],[0,
1103,0,1101],[0,1104,0,1102],[0,1105,0,1103],[1,1105,0,1104],[0,1107,1,1106
],[0,1108,0,1106],[0,1109,0,1107],[0,1110,0,1108],[0,1111,0,1109],[0,1112,0
,1110],[0,1113,0,1111],[0,1114,0,1112],[0,1115,0,1113],[0,1116,0,1114],[0,1
117,0,1115],[0,1118,0,1116],[0,1119,0,1117],[5,1119,0,1118],[0,1121,5,1120]
,[0,1122,0,1120],[0,1123,0,1121],[0,1124,0,1122],[0,1125,0,1123],[0,1126,0,
1124],[0,1127,0,1125],[0,1128,0,1126],[0,1129,0,1127],[0,1130,0,1128],[0,11
31,0,1129],[0,1132,0,1130],[0,1133,0,1131],[-1,-1,0,1132],[0,1135,-1,-
1],[0,1136,0,1134],[0,1137,0,1135],[0,1138,0,1136],[0,1139,0,1137],[0,1140,
0,1138],[0,1141,0,1139],[0,1142,0,1140],[0,1143,0,1141],[0,1144,0,1142],[0,
1145,0,1143],[0,1146,0,1144],[0,1147,0,1145],[1,1147,0,1146],[0,1149,1,1148
],[0,1150,0,1148],[0,1151,0,1149],[0,1152,0,1150],[0,1153,0,1151],[0,1154,0
,1152],[0,1155,0,1153],[0,1156,0,1154],[0,1157,0,1155],[0,1158,0,1156],[0,1
159,0,1157],[0,1160,0,1158],[0,1161,0,1159],[5,1161,0,1160],[0,1163,5,1162]
,[0,1164,0,1162],[0,1165,0,1163],[0,1166,0,1164],[0,1167,0,1165],[0,1168,0,
1166],[0,1169,0,1167],[0,1170,0,1168],[0,1171,0,1169],[0,1172,0,1170],[0,11
73,0,1171],[0,1174,0,1172],[0,1175,0,1173],[-1,-1,0,1174],[0,1177,-1,-
1],[0,1178,0,1176],[0,1179,0,1177],[0,1180,0,1178],[0,1181,0,1179],[0,1182,
0,1180],[0,1183,0,1181],[0,1184,0,1182],[0,1185,0,1183],[0,1186,0,1184],[0,
1187,0,1185],[0,1188,0,1186],[0,1189,0,1187],[1,1189,0,1188],[0,1191,1,1190
],[0,1192,0,1190],[0,1193,0,1191],[0,1194,0,1192],[0,1195,0,1193],[0,1196,0
,1194],[0,1197,0,1195],[0,1198,0,1196],[0,1199,0,1197],[0,1200,0,1198],[0,1
201,0,1199],[0,1202,0,1200],[0,1203,0,1201],[5,1203,0,1202],[0,1205,5,1204]
,[0,1206,0,1204],[0,1207,0,1205],[0,1208,0,1206],[0,1209,0,1207],[0,1210,0,
1208],[0,1211,0,1209],[0,1212,0,1210],[0,1213,0,1211],[0,1214,0,1212],[0,12
15,0,1213],[0,1216,0,1214],[0,1217,0,1215],[-1,-1,0,1216],[0,1219,-1,-
1],[0,1220,0,1218],[0,1221,0,1219],[0,1222,0,1220],[0,1223,0,1221],[0,1224,
0,1222],[0,1225,0,1223],[0,1226,0,1224],[0,1227,0,1225],[0,1228,0,1226],[0,
1229,0,1227],[0,1230,0,1228],[0,1231,0,1229],[1,1231,0,1230],[0,1233,-1,-
1],[0,1234,0,1232],[0,1235,0,1233],[0,1236,0,1234],[0,1237,0,1235],[0,1238,
0,1236],[0,1239,0,1237],[0,1240,0,1238],[0,1241,0,1239],[0,1242,0,1240],[0,
1243,0,1241],[0,1244,0,1242],[0,1245,0,1243],[0,1246,0,1244],[0,1247,0,1245
],[0,1248,0,1246],[0,1249,0,1247],[0,1250,0,1248],[0,1251,0,1249],[0,1252,0
,1250],[0,1253,0,1251],[0,1254,0,1252],[0,1255,0,1253],[0,1256,0,1254],[0,1
257,0,1255],[-1,-1,0,1256],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1555

1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1556

,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-
1],[1,40,0,41],[0,40,0,42],[0,41,0,43],[0,42,0,44],[0,43,0,45],[0,44,0,46],
[0,45,0,47],[0,46,0,48],[0,47,0,49],[0,48,0,50],[0,49,0,51],[0,50,0,52],[0,
51,0,53],[0,52,0,54],[0,53,0,55],[0,54,0,56],[0,55,0,57],[0,56,0,58],[0,57,
0,59],[0,58,0,60],[0,59,0,61],[0,60,0,62],[0,61,0,63],[0,62,0,64],[0,63,0,6
5],[0,64,0,66],[0,65,0,67],[0,66,0,68],[0,67,0,69],[0,68,0,70],[0,69,0,71],
[0,70,0,72],[0,71,0,73],[0,72,0,74],[0,73,0,75],[0,74,0,76],[0,75,0,77],[0,
76,0,78],[0,77,0,79],[0,78,0,80],[0,79,0,81],[0,80,0,82],[0,81,0,83],[0,82,
0,84],[0,83,0,85],[0,84,0,86],[0,85,0,87],[0,86,0,88],[0,87,0,89],[0,88,0,9
0],[0,89,0,91],[0,90,0,92],[0,91,0,93],[0,92,0,94],[0,93,0,95],[0,94,0,96],
[0,95,0,97],[0,96,0,98],[0,97,0,99],[0,98,0,100],[0,99,0,101],[0,100,0,102]
,[0,101,0,103],[0,102,0,104],[0,103,0,105],[0,104,0,106],[0,105,0,107],[0,1
06,0,108],[0,107,0,109],[0,108,0,110],[0,109,0,111],[0,110,0,112],[0,111,0,
113],[0,112,0,114],[0,113,0,115],[0,114,0,116],[0,115,0,117],[0,116,0,118],
[0,117,0,119],[0,118,0,120],[0,119,0,121],[0,120,0,122],[0,121,0,123],[0,12
2,0,124],[0,123,0,125],[0,124,0,126],[0,125,0,127],[0,126,0,128],[0,127,0,1
29],[0,128,0,130],[0,129,0,131],[0,130,0,132],[0,131,0,133],[0,132,0,134],[
0,133,0,135],[0,134,0,136],[0,135,0,137],[0,136,0,138],[0,137,0,139],[0,138
,0,140],[0,139,0,141],[0,140,0,142],[0,141,0,143],[0,142,0,144],[0,143,0,14
5],[0,144,0,146],[0,145,0,147],[0,146,0,148],[0,147,0,149],[0,148,0,150],[0
,149,0,151],[0,150,0,152],[0,151,0,153],[0,152,0,154],[0,153,0,155],[0,154,
0,156],[0,155,0,157],[0,156,0,158],[0,157,0,159],[0,158,0,160],[0,159,0,161
],[0,160,0,162],[0,161,0,163],[0,162,0,164],[0,163,0,165],[0,164,0,166],[0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1557

165,0,167],[0,166,0,168],[0,167,0,169],[0,168,0,170],[0,169,0,171],[0,170,0
,172],[0,171,0,173],[0,172,0,174],[0,173,0,175],[0,174,0,176],[0,175,0,177]
,[0,176,0,178],[0,177,0,179],[0,178,0,180],[0,179,0,181],[0,180,0,182],[0,1
81,0,183],[0,182,0,184],[0,183,0,185],[0,184,0,186],[0,185,0,187],[0,186,0,
188],[0,187,0,189],[0,188,0,190],[0,189,0,191],[0,190,0,192],[0,191,0,193],
[0,192,0,194],[0,193,0,195],[0,194,0,196],[0,195,0,197],[0,196,0,198],[0,19
7,0,199],[0,198,0,200],[0,199,0,201],[0,200,0,202],[0,201,0,203],[0,202,0,2
04],[0,203,0,205],[0,204,0,206],[0,205,0,207],[0,206,0,208],[0,207,0,209],[
0,208,0,210],[0,209,0,211],[0,210,0,212],[0,211,0,213],[0,212,0,214],[0,213
,0,215],[0,214,0,216],[0,215,0,217],[0,216,0,218],[0,217,0,219],[0,218,0,22
0],[0,219,0,221],[0,220,0,222],[0,221,0,223],[0,222,0,224],[0,223,0,225],[0
,224,0,226],[0,225,0,227],[0,226,0,228],[0,227,0,229],[0,228,0,230],[0,229,
0,231],[0,230,0,232],[0,231,0,233],[0,232,0,234],[0,233,0,235],[0,234,0,236
],[0,235,0,237],[0,236,0,238],[0,237,0,239],[0,238,0,240],[0,239,0,241],[0,
240,0,242],[0,241,0,243],[0,242,0,244],[0,243,0,245],[0,244,0,246],[0,245,0
,247],[0,246,0,248],[0,247,0,249],[0,248,0,250],[0,249,0,251],[0,250,0,252]
,[0,251,0,253],[0,252,0,254],[0,253,0,255],[0,254,0,256],[0,255,0,257],[0,2
56,0,258],[0,257,0,259],[0,258,0,260],[0,259,0,261],[0,260,0,262],[0,261,0,
263],[0,262,0,264],[0,263,0,265],[0,264,0,266],[0,265,0,267],[0,266,0,268],
[0,267,0,269],[0,268,0,270],[0,269,0,271],[0,270,0,272],[0,271,0,273],[0,27
2,0,274],[0,273,0,275],[0,274,0,276],[0,275,0,277],[0,276,0,278],[0,277,0,2
79],[0,278,0,280],[0,279,0,281],[0,280,0,282],[0,281,0,283],[0,282,0,284],[
0,283,0,285],[0,284,0,286],[0,285,0,287],[0,286,0,288],[0,287,0,289],[0,288
,0,290],[0,289,0,291],[0,290,0,292],[0,291,0,293],[0,292,0,294],[0,293,0,29
5],[0,294,0,296],[0,295,0,297],[0,296,0,298],[0,297,0,299],[0,298,0,300],[0
,299,0,301],[0,300,0,302],[0,301,0,303],[0,302,0,304],[0,303,0,305],[0,304,
0,306],[0,305,0,307],[0,306,0,308],[0,307,0,309],[0,308,0,310],[0,309,0,311
],[0,310,0,312],[0,311,0,313],[0,312,0,314],[0,313,0,315],[0,314,0,316],[0,
315,0,317],[0,316,0,318],[0,317,0,319],[0,318,0,320],[0,319,0,321],[0,320,0
,322],[0,321,0,323],[0,322,0,324],[0,323,0,325],[0,324,0,326],[0,325,0,327]
,[0,326,0,328],[0,327,0,329],[0,328,0,330],[0,329,0,331],[0,330,0,332],[0,3
31,0,333],[0,332,0,334],[0,333,0,335],[0,334,0,336],[0,335,0,337],[0,336,0,
338],[0,337,0,339],[0,338,0,340],[0,339,0,341],[0,340,0,342],[0,341,0,343],
[0,342,0,344],[0,343,0,345],[0,344,0,346],[0,345,0,347],[0,346,0,348],[0,34
7,0,349],[0,348,0,350],[0,349,0,351],[0,350,0,352],[0,351,0,353],[0,352,0,3
54],[0,353,0,355],[0,354,0,356],[0,355,0,357],[0,356,0,358],[0,357,0,359],[
0,358,0,360],[0,359,0,361],[0,360,0,362],[0,361,0,363],[0,362,0,364],[0,363
,0,365],[0,364,0,366],[0,365,0,367],[0,366,0,368],[0,367,0,369],[0,368,0,37
0],[0,369,0,371],[0,370,0,372],[0,371,0,373],[0,372,0,374],[0,373,0,375],[0
,374,0,376],[0,375,0,377],[0,376,0,378],[0,377,0,379],[0,378,0,380],[0,379,
0,381],[0,380,0,382],[0,381,0,383],[0,382,0,384],[0,383,0,385],[0,384,0,386
],[0,385,0,387],[0,386,0,388],[0,387,0,389],[0,388,0,390],[0,389,0,391],[0,
390,0,392],[0,391,0,393],[0,392,0,394],[0,393,0,395],[0,394,0,396],[0,395,0
,397],[0,396,0,398],[0,397,0,399],[0,398,0,400],[0,399,0,401],[0,400,0,402]
,[0,401,0,403],[0,402,0,404],[0,403,0,405],[0,404,0,406],[0,405,0,407],[0,4
06,0,408],[0,407,0,409],[0,408,0,410],[0,409,0,411],[0,410,0,412],[0,411,0,
413],[0,412,0,414],[0,413,0,415],[0,414,0,416],[0,415,0,417],[0,416,0,418],
[0,417,0,419],[0,418,0,420],[0,419,0,421],[0,420,0,422],[0,421,0,423],[0,42
2,0,424],[0,423,0,425],[0,424,0,426],[0,425,0,427],[0,426,0,428],[0,427,0,4
29],[0,428,0,430],[0,429,0,431],[0,430,0,432],[0,431,0,433],[0,432,0,434],[
0,433,0,435],[0,434,0,436],[0,435,0,437],[0,436,0,438],[0,437,0,439],[0,438
,0,440],[0,439,0,441],[0,440,0,442],[0,441,0,443],[0,442,0,444],[0,443,0,44
5],[0,444,0,446],[0,445,0,447],[0,446,0,448],[0,447,0,449],[0,448,0,450],[0

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1558

,449,0,451],[0,450,0,452],[0,451,0,453],[0,452,0,454],[0,453,0,455],[0,454,0,456],[0,455,0,457],[0,456,0,458],[0,457,0,459],[0,458,0,460],[0,459,0,461],[0,460,0,462],[0,461,0,463],[0,462,0,464],[0,463,0,465],[0,464,0,466],[0,465,0,467],[0,466,0,468],[0,467,0,469],[0,468,0,470],[0,469,0,471],[0,470,0,472],[0,471,0,473],[0,472,0,474],[0,473,0,475],[0,474,0,476],[0,475,0,477],[0,476,0,478],[0,477,0,479],[0,478,0,480],[0,479,0,481],[0,480,0,482],[0,481,0,483],[0,482,0,484],[0,483,0,485],[0,484,0,486],[0,485,0,487],[0,486,0,488],[0,487,0,489],[0,488,0,490],[0,489,0,491],[0,490,0,492],[0,491,0,493],[0,492,0,494],[0,493,0,495],[0,494,0,496],[0,495,0,497],[0,496,0,498],[0,497,0,499],[0,498,0,500],[0,499,0,501],[0,500,0,502],[0,501,0,503],[0,502,0,504],[0,503,0,505],[0,504,0,506],[0,505,0,507],[0,506,0,508],[0,507,0,509],[0,508,0,510],[0,509,0,511],[0,510,0,512],[0,511,0,513],[0,512,0,514],[0,513,0,515],[0,514,0,516],[0,515,0,517],[0,516,0,518],[0,517,0,519],[0,518,0,520],[0,519,0,521],[0,520,0,522],[0,521,0,523],[0,522,0,524],[0,523,0,525],[0,524,0,526],[0,525,0,527],[0,526,0,528],[0,527,0,529],[0,528,0,530],[0,529,0,531],[0,530,0,532],[0,531,0,533],[0,532,0,534],[0,533,0,535],[0,534,0,536],[0,535,0,537],[0,536,0,538],[0,537,0,539],[0,538,0,540],[0,539,0,541],[0,540,0,542],[0,541,0,543],[0,542,0,544],[0,543,0,545],[0,544,0,546],[0,545,0,547],[0,546,0,548],[0,547,0,549],[0,548,0,550],[0,549,0,551],[0,550,0,552],[0,551,0,553],[0,552,0,554],[0,553,0,555],[0,554,0,556],[0,555,0,557],[0,556,0,558],[0,557,0,559],[0,558,0,560],[0,559,0,561],[0,560,0,562],[0,561,0,563],[0,562,0,564],[0,563,0,565],[0,564,0,566],[0,565,0,567],[0,566,0,568],[0,567,0,569],[0,568,0,570],[0,569,0,571],[0,570,0,572],[0,571,0,573],[0,572,0,574],[0,573,0,575],[0,574,0,576],[0,575,0,577],[0,576,0,578],[0,577,0,579],[0,578,0,580],[0,579,0,581],[0,580,0,582],[0,581,0,583],[0,582,0,584],[0,583,0,585],[0,584,0,586],[0,585,0,587],[0,586,0,588],[0,587,0,589],[0,588,0,590],[0,589,0,591],[0,590,0,592],[0,591,0,593],[0,592,0,594],[0,593,0,595],[0,594,0,596],[0,595,0,597],[0,596,0,598],[0,597,0,599],[0,598,0,600],[0,599,0,601],[0,600,0,602],[0,601,0,603],[0,602,0,604],[0,603,0,605],[0,604,0,606],[0,605,0,607],[0,606,0,608],[0,607,0,609],[0,608,0,610],[0,609,0,611],[0,610,0,612],[0,611,0,613],[0,612,0,614],[0,613,0,615],[0,614,0,616],[0,615,0,617],[0,616,0,618],[0,617,0,619],[0,618,0,620],[0,619,0,621],[0,620,0,622],[0,621,0,623],[0,622,0,624],[0,623,0,625],[0,624,0,626],[0,625,0,627],[0,626,0,628],[0,627,0,629],[0,628,0,630],[0,629,0,631],[0,630,0,632],[0,631,0,633],[0,632,0,634],[0,633,0,635],[0,634,0,636],[0,635,0,637],[0,636,0,638],[0,637,0,639],[0,638,0,640],[0,639,0,641],[0,640,0,642],[0,641,0,643],[0,642,0,644],[0,643,0,645],[0,644,0,646],[0,645,0,647],[0,646,0,648],[0,647,0,649],[0,648,0,650],[0,649,0,651],[0,650,0,652],[0,651,0,653],[0,652,0,654],[0,653,0,655],[0,654,0,656],[0,655,0,657],[0,656,0,658],[0,657,0,659],[0,658,0,660],[0,659,0,661],[0,660,0,662],[0,661,0,663],[0,662,0,664],[0,663,0,665],[0,664,0,666],[0,665,0,667],[0,666,0,668],[0,667,0,669],[0,668,0,670],[0,669,0,671],[0,670,0,672],[0,671,0,673],[0,672,0,674],[0,673,0,675],[0,674,0,676],[0,675,0,677],[0,676,0,678],[0,677,0,679],[0,678,0,680],[0,679,0,681],[0,680,0,682],[0,681,0,683],[0,682,0,684],[0,683,0,685],[0,684,0,686],[0,685,0,687],[0,686,0,688],[0,687,0,689],[0,688,0,690],[0,689,0,691],[0,690,0,692],[0,691,0,693],[0,692,0,694],[0,693,0,695],[0,694,0,696],[0,695,0,697],[0,696,0,698],[0,697,0,699],[0,698,0,700],[0,699,0,701],[0,700,0,702],[0,701,0,703],[0,702,0,704],[0,703,0,705],[0,704,0,706],[0,705,0,707],[0,706,0,708],[0,707,0,709],[0,708,0,710],[0,709,0,711],[0,710,0,712],[0,711,0,713],[0,712,0,714],[0,713,0,715],[0,714,0,716],[0,715,0,717],[0,716,0,718],[0,717,0,719],[0,718,0,720],[0,719,0,721],[0,720,0,722],[0,721,0,723],[0,722,0,724],[0,723,0,725],[0,724,0,726],[0,725,0,727],[0,726,0,728],[0,727,0,729],[0,728,0,730],[0,729,0,731],[0,730,0,732],[0,731,0,733],[0,732,0,734],[

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1559

0,733,0,735],[0,734,0,736],[0,735,0,737],[0,736,0,738],[0,737,0,739],[0,738
,0,740],[0,739,0,741],[0,740,0,742],[0,741,0,743],[0,742,0,744],[0,743,0,74
5],[0,744,0,746],[0,745,0,747],[0,746,0,748],[0,747,0,749],[0,748,0,750],[0
,749,0,751],[0,750,0,752],[0,751,0,753],[0,752,0,754],[0,753,0,755],[0,754,
0,756],[0,755,0,757],[0,756,0,758],[0,757,0,759],[0,758,0,760],[0,759,0,761
],[0,760,0,762],[0,761,0,763],[0,762,0,764],[0,763,0,765],[0,764,0,766],[0,
765,0,767],[0,766,0,768],[0,767,0,769],[0,768,0,770],[0,769,0,771],[0,770,0
,772],[0,771,0,773],[0,772,0,774],[0,773,0,775],[0,774,0,776],[0,775,0,777]
,[0,776,0,778],[0,777,0,779],[0,778,0,780],[0,779,0,781],[0,780,0,782],[0,7
81,0,783],[0,782,0,784],[0,783,0,785],[0,784,0,786],[0,785,0,787],[0,786,0,
788],[0,787,0,789],[0,788,0,790],[0,789,0,791],[0,790,0,792],[0,791,0,793],
[0,792,0,794],[0,793,0,795],[0,794,0,796],[0,795,0,797],[0,796,0,798],[0,79
7,0,799],[0,798,0,800],[0,799,0,801],[0,800,0,802],[0,801,0,803],[0,802,0,8
04],[0,803,0,805],[0,804,0,806],[0,805,0,807],[0,806,0,808],[0,807,0,809],[
0,808,0,810],[0,809,0,811],[0,810,0,812],[0,811,0,813],[0,812,0,814],[0,813
,0,815],[0,814,0,816],[0,815,0,817],[0,816,0,818],[0,817,0,819],[0,818,0,82
0],[0,819,0,821],[0,820,0,822],[0,821,0,823],[0,822,0,824],[0,823,0,825],[0
,824,0,826],[0,825,0,827],[0,826,0,828],[0,827,0,829],[0,828,0,830],[0,829,
0,831],[0,830,0,832],[0,831,0,833],[0,832,0,834],[0,833,0,835],[0,834,0,836
],[0,835,0,837],[0,836,0,838],[0,837,0,839],[0,838,0,840],[0,839,0,841],[0,
840,0,842],[0,841,0,843],[0,842,0,844],[0,843,0,845],[0,844,0,846],[0,845,0
,847],[0,846,0,848],[0,847,0,849],[0,848,0,850],[0,849,0,851],[0,850,0,852]
,[0,851,0,853],[0,852,0,854],[0,853,0,855],[0,854,0,856],[0,855,0,857],[0,8
56,0,858],[0,857,0,859],[0,858,0,860],[0,859,0,861],[0,860,0,862],[0,861,0,
863],[0,862,0,864],[0,863,0,865],[0,864,0,866],[0,865,0,867],[0,866,0,868],
[0,867,0,869],[0,868,0,870],[0,869,0,871],[0,870,0,872],[0,871,0,873],[0,87
2,0,874],[0,873,0,875],[0,874,0,876],[0,875,0,877],[0,876,0,878],[0,877,0,8
79],[0,878,0,880],[0,879,0,881],[0,880,0,882],[0,881,0,883],[0,882,0,884],[
0,883,0,885],[0,884,0,886],[0,885,0,887],[0,886,0,888],[0,887,0,889],[0,888
,0,890],[0,889,0,891],[0,890,0,892],[0,891,0,893],[0,892,0,894],[0,893,0,89
5],[0,894,0,896],[0,895,0,897],[0,896,0,898],[0,897,0,899],[0,898,0,900],[0
,899,0,901],[0,900,0,902],[0,901,0,903],[0,902,0,904],[0,903,0,905],[0,904,
0,906],[0,905,0,907],[0,906,0,908],[0,907,0,909],[0,908,0,910],[0,909,0,911
],[0,910,0,912],[0,911,0,913],[0,912,0,914],[0,913,0,915],[0,914,0,916],[0,
915,0,917],[0,916,0,918],[0,917,0,919],[0,918,0,920],[0,919,0,921],[0,920,0
,922],[0,921,0,923],[0,922,0,924],[0,923,0,925],[0,924,0,926],[0,925,0,927]
,[0,926,0,928],[0,927,0,929],[0,928,0,930],[0,929,0,931],[0,930,0,932],[0,9
31,0,933],[0,932,0,934],[0,933,0,935],[0,934,0,936],[0,935,0,937],[0,936,0,
938],[0,937,0,939],[0,938,0,940],[0,939,0,941],[0,940,0,942],[0,941,0,943],
[0,942,0,944],[0,943,0,945],[0,944,0,946],[0,945,0,947],[0,946,0,948],[0,94
7,0,949],[0,948,0,950],[0,949,0,951],[0,950,0,952],[0,951,0,953],[0,952,0,9
54],[0,953,0,955],[0,954,0,956],[0,955,0,957],[0,956,0,958],[0,957,0,959],[
0,958,0,960],[0,959,0,961],[0,960,0,962],[0,961,0,963],[0,962,0,964],[0,963
,0,965],[0,964,0,966],[0,965,0,967],[0,966,0,968],[0,967,0,969],[0,968,0,97
0],[0,969,0,971],[0,970,0,972],[0,971,0,973],[0,972,0,974],[0,973,0,975],[0
,974,0,976],[0,975,0,977],[0,976,0,978],[0,977,0,979],[0,978,0,980],[0,979,
0,981],[0,980,0,982],[0,981,0,983],[0,982,0,984],[0,983,0,985],[0,984,0,986
],[0,985,0,987],[0,986,0,988],[0,987,0,989],[0,988,0,990],[0,989,-1,-1],[-
1,-
1,0,992],[0,991,0,993],[0,992,0,994],[0,993,0,995],[0,994,0,996],[0,995,0,9
97],[0,996,0,998],[0,997,0,999],[0,998,0,1000],[0,999,0,1001],[0,1000,0,100
2],[0,1001,0,1003],[0,1002,0,1004],[0,1003,0,1005],[0,1004,0,1006],[0,1005,
0,1007],[0,1006,0,1008],[0,1007,0,1009],[0,1008,0,1010],[0,1009,0,1011],[0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1560

1010,0,1012],[0,1011,0,1013],[0,1012,0,1014],[0,1013,0,1015],[0,1014,0,1016
],[0,1015,0,1017],[0,1016,0,1018],[0,1017,0,1019],[0,1018,0,1020],[0,1019,0
,1021],[0,1020,0,1022],[0,1021,0,1023],[0,1022,0,1024],[0,1023,0,1025],[0,1
024,0,1026],[0,1025,0,1027],[0,1026,0,1028],[0,1027,0,1029],[0,1028,0,1030]
,[0,1029,0,1031],[0,1030,0,1032],[0,1031,0,1033],[0,1032,0,1034],[0,1033,0,
1035],[0,1034,0,1036],[0,1035,0,1037],[0,1036,0,1038],[0,1037,0,1039],[0,10
38,0,1040],[0,1039,0,1041],[0,1040,0,1042],[0,1041,0,1043],[0,1042,0,1044],
[0,1043,0,1045],[0,1044,0,1046],[0,1045,0,1047],[0,1046,0,1048],[0,1047,0,1
049],[0,1048,0,1050],[0,1049,0,1051],[0,1050,0,1052],[0,1051,0,1053],[0,105
2,0,1054],[0,1053,0,1055],[0,1054,0,1056],[0,1055,0,1057],[0,1056,0,1058],[
0,1057,0,1059],[0,1058,0,1060],[0,1059,0,1061],[0,1060,0,1062],[0,1061,0,10
63],[0,1062,0,1064],[0,1063,0,1065],[0,1064,0,1066],[0,1065,0,1067],[0,1066
,0,1068],[0,1067,0,1069],[0,1068,0,1070],[0,1069,0,1071],[0,1070,0,1072],[0
,1071,0,1073],[0,1072,0,1074],[0,1073,0,1075],[0,1074,0,1076],[0,1075,0,107
7],[0,1076,0,1078],[0,1077,0,1079],[0,1078,0,1080],[0,1079,0,1081],[0,1080,
0,1082],[0,1081,0,1083],[0,1082,0,1084],[0,1083,0,1085],[0,1084,0,1086],[0,
1085,0,1087],[0,1086,0,1088],[0,1087,0,1089],[0,1088,0,1090],[0,1089,0,1091
],[0,1090,0,1092],[0,1091,0,1093],[0,1092,0,1094],[0,1093,0,1095],[0,1094,0
,1096],[0,1095,0,1097],[0,1096,0,1098],[0,1097,0,1099],[0,1098,0,1100],[0,1
099,0,1101],[0,1100,0,1102],[0,1101,0,1103],[0,1102,0,1104],[0,1103,0,1105]
,[0,1104,0,1106],[0,1105,0,1107],[0,1106,0,1108],[0,1107,0,1109],[0,1108,0,
1110],[0,1109,0,1111],[0,1110,0,1112],[0,1111,0,1113],[0,1112,0,1114],[0,11
13,0,1115],[0,1114,0,1116],[0,1115,0,1117],[0,1116,0,1118],[0,1117,0,1119],
[0,1118,0,1120],[0,1119,0,1121],[0,1120,0,1122],[0,1121,0,1123],[0,1122,0,1
124],[0,1123,0,1125],[0,1124,0,1126],[0,1125,0,1127],[0,1126,0,1128],[0,112
7,0,1129],[0,1128,0,1130],[0,1129,0,1131],[0,1130,0,1132],[0,1131,0,1133],[
0,1132,0,1134],[0,1133,0,1135],[0,1134,0,1136],[0,1135,0,1137],[0,1136,0,11
38],[0,1137,0,1139],[0,1138,0,1140],[0,1139,0,1141],[0,1140,0,1142],[0,1141
,0,1143],[0,1142,0,1144],[0,1143,0,1145],[0,1144,0,1146],[0,1145,0,1147],[0
,1146,0,1148],[0,1147,0,1149],[0,1148,0,1150],[0,1149,0,1151],[0,1150,0,115
2],[0,1151,0,1153],[0,1152,0,1154],[0,1153,0,1155],[0,1154,0,1156],[0,1155,
0,1157],[0,1156,0,1158],[0,1157,0,1159],[0,1158,0,1160],[0,1159,0,1161],[0,
1160,0,1162],[0,1161,0,1163],[0,1162,0,1164],[0,1163,0,1165],[0,1164,0,1166
],[0,1165,0,1167],[0,1166,0,1168],[0,1167,0,1169],[0,1168,0,1170],[0,1169,0
,1171],[0,1170,0,1172],[0,1171,0,1173],[0,1172,0,1174],[0,1173,0,1175],[0,1
174,0,1176],[0,1175,0,1177],[0,1176,0,1178],[0,1177,0,1179],[0,1178,0,1180]
,[0,1179,0,1181],[0,1180,0,1182],[0,1181,0,1183],[0,1182,0,1184],[0,1183,0,
1185],[0,1184,0,1186],[0,1185,0,1187],[0,1186,0,1188],[0,1187,0,1189],[0,11
88,0,1190],[0,1189,0,1191],[0,1190,0,1192],[0,1191,0,1193],[0,1192,0,1194],
[0,1193,0,1195],[0,1194,0,1196],[0,1195,0,1197],[0,1196,0,1198],[0,1197,0,1
199],[0,1198,0,1200],[0,1199,0,1201],[0,1200,0,1202],[0,1201,0,1203],[0,120
2,0,1204],[0,1203,0,1205],[0,1204,0,1206],[0,1205,0,1207],[0,1206,0,1208],[
0,1207,0,1209],[0,1208,0,1210],[0,1209,0,1211],[0,1210,0,1212],[0,1211,0,12
13],[0,1212,0,1214],[0,1213,0,1215],[0,1214,0,1216],[0,1215,0,1217],[0,1216
,0,1218],[0,1217,0,1219],[0,1218,0,1220],[0,1219,0,1221],[0,1220,0,1222],[0
,1221,0,1223],[0,1222,0,1224],[0,1223,0,1225],[0,1224,0,1226],[0,1225,0,122
7],[0,1226,0,1228],[0,1227,0,1229],[0,1228,0,1230],[0,1229,0,1231],[0,1230,
0,1232],[0,1231,0,1233],[0,1232,0,1234],[0,1233,0,1235],[0,1234,0,1236],[0,
1235,0,1237],[0,1236,0,1238],[0,1237,0,1239],[0,1238,0,1240],[0,1239,0,1241
],[0,1240,0,1242],[0,1241,0,1243],[0,1242,0,1244],[0,1243,0,1245],[0,1244,0
,1246],[0,1245,0,1247],[0,1246,0,1248],[0,1247,0,1249],[0,1248,0,1250],[0,1
249,0,1251],[0,1250,0,1252],[0,1251,0,1253],[0,1252,0,1254],[0,1253,0,1255]
,[0,1254,0,1256],[0,1255,0,1257],[0,1256,1,1257],[-1,-1,-1,-1],[-1,-1,-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1561

1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1]],"num":0,"row":16},{"stap_colors":[[28,3355443],[70,8947848],[112,894784
8],[154,8947848],[197,8947848],[239,8947848],[280,13369344],[322,13369344],
[364,8947848],[406,8947848],[448,8947848],[490,8947848],[532,8947848],[574,
8947848],[616,8947848],[658,8947848],[700,8947848],[742,8947848],[784,89478
48],[826,8947848],[868,8947848],[910,8947848],[952,8947848],[994,8947848],[
1036,8947848],[1078,8947848],[1120,8947848],[1162,29184],[1204,29184],[1232
,3355443]],"col":12,"stap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[0,14,1,15],[1,14,1,16],[1,15,1,17],[1,16,1,18],[1,17,1,19],[1,18,1,20],
[1,19,1,21],[1,20,1,22],[1,21,1,23],[1,22,1,24],[1,23,1,25],[1,24,1,26],[1,
25,1,27],[1,26,-1,-1],[-1,-
1,1,29],[1,28,1,30],[1,29,1,31],[1,30,1,32],[1,31,1,33],[1,32,1,34],[1,33,1
,35],[1,34,1,36],[1,35,1,37],[1,36,1,38],[1,37,1,39],[1,38,1,40],[1,39,1,41
],[1,40,2,41],[2,42,1,43],[1,42,1,44],[1,43,1,45],[1,44,1,46],[1,45,1,47],[
1,46,1,48],[1,47,1,49],[1,48,1,50],[1,49,1,51],[1,50,1,52],[1,51,1,53],[1,5
2,1,54],[1,53,1,55],[1,54,0,55],[0,56,1,57],[1,56,1,58],[1,57,1,59],[1,58,1
,60],[1,59,1,61],[1,60,1,62],[1,61,1,63],[1,62,1,64],[1,63,1,65],[1,64,1,66
],[1,65,1,67],[1,66,1,68],[1,67,1,69],[1,68,-1,-1],[-1,-
1,1,71],[1,70,1,72],[1,71,1,73],[1,72,1,74],[1,73,1,75],[1,74,1,76],[1,75,1
,77],[1,76,1,78],[1,77,1,79],[1,78,1,80],[1,79,1,81],[1,80,1,82],[1,81,1,83
],[1,82,2,83],[2,84,1,85],[1,84,1,86],[1,85,1,87],[1,86,1,88],[1,87,1,89],[
1,88,1,90],[1,89,1,91],[1,90,1,92],[1,91,1,93],[1,92,1,94],[1,93,1,95],[1,9
4,1,96],[1,95,1,97],[1,96,0,97],[0,98,1,99],[1,98,1,100],[1,99,1,101],[1,10
0,1,102],[1,101,1,103],[1,102,1,104],[1,103,1,105],[1,104,1,106],[1,105,1,1
07],[1,106,1,108],[1,107,1,109],[1,108,1,110],[1,109,1,111],[1,110,-1,-
1],[-1,-
1,1,113],[1,112,1,114],[1,113,1,115],[1,114,1,116],[1,115,1,117],[1,116,1,1
18],[1,117,1,119],[1,118,1,120],[1,119,1,121],[1,120,1,122],[1,121,1,123],[
1,122,1,124],[1,123,1,125],[1,124,2,125],[2,126,1,127],[1,126,1,128],[1,127
,1,129],[1,128,1,130],[1,129,1,131],[1,130,1,132],[1,131,1,133],[1,132,1,13
4],[1,133,1,135],[1,134,1,136],[1,135,1,137],[1,136,1,138],[1,137,1,139],[1
,138,0,139],[0,140,1,141],[1,140,1,142],[1,141,1,143],[1,142,1,144],[1,143,
1,145],[1,144,1,146],[1,145,1,147],[1,146,1,148],[1,147,1,149],[1,148,1,150
],[1,149,1,151],[1,150,1,152],[1,151,1,153],[1,152,-1,-1],[-1,-
1,1,155],[1,154,1,156],[1,155,1,157],[1,156,1,158],[1,157,1,159],[1,158,1,1
60],[1,159,1,161],[1,160,1,162],[1,161,1,163],[1,162,1,164],[1,163,1,165],[

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1562

1,164,1,166],[1,165,1,167],[1,166,2,167],[2,168,1,169],[1,168,1,170],[1,169
,1,171],[1,170,1,172],[1,171,1,173],[1,172,1,174],[1,173,1,175],[1,174,1,17
6],[1,175,1,177],[1,176,1,178],[1,177,1,179],[1,178,1,180],[1,179,1,181],[1
,180,0,181],[0,182,1,183],[1,182,1,184],[1,183,1,185],[1,184,1,186],[1,185,
1,187],[1,186,1,188],[1,187,1,189],[1,188,1,190],[1,189,1,191],[1,190,1,192
],[1,191,1,193],[1,192,1,194],[1,193,1,195],[1,194,1,196],[1,195,-1,-1],[-
1,-
1,1,198],[1,197,1,199],[1,198,1,200],[1,199,1,201],[1,200,1,202],[1,201,1,2
03],[1,202,1,204],[1,203,1,205],[1,204,1,206],[1,205,1,207],[1,206,1,208],[
1,207,1,209],[1,208,2,209],[2,210,1,211],[1,210,1,212],[1,211,1,213],[1,212
,1,214],[1,213,1,215],[1,214,1,216],[1,215,1,217],[1,216,1,218],[1,217,1,21
9],[1,218,1,220],[1,219,1,221],[1,220,1,222],[1,221,1,223],[1,222,0,223],[0
,224,1,225],[1,224,1,226],[1,225,1,227],[1,226,1,228],[1,227,1,229],[1,228,
1,230],[1,229,1,231],[1,230,1,232],[1,231,1,233],[1,232,1,234],[1,233,1,235
],[1,234,1,236],[1,235,1,237],[1,236,1,238],[1,237,-1,-1],[-1,-
1,1,240],[1,239,1,241],[1,240,1,242],[1,241,1,243],[1,242,1,244],[1,243,1,2
45],[1,244,1,246],[1,245,1,247],[1,246,1,248],[1,247,1,249],[1,248,1,250],[
1,249,1,251],[1,250,2,251],[2,252,1,253],[1,252,1,254],[1,253,1,255],[1,254
,1,256],[1,255,1,257],[1,256,1,258],[1,257,1,259],[1,258,1,260],[1,259,1,26
1],[1,260,1,262],[1,261,1,263],[1,262,1,264],[1,263,1,265],[1,264,0,265],[0
,266,1,267],[1,266,1,268],[1,267,1,269],[1,268,1,270],[1,269,1,271],[1,270,
1,272],[1,271,1,273],[1,272,1,274],[1,273,1,275],[1,274,1,276],[1,275,1,277
],[1,276,1,278],[1,277,1,279],[1,278,-1,-1],[-1,-
1,1,281],[1,280,1,282],[1,281,1,283],[1,282,1,284],[1,283,1,285],[1,284,1,2
86],[1,285,1,287],[1,286,1,288],[1,287,1,289],[1,288,1,290],[1,289,1,291],[
1,290,1,292],[1,291,1,293],[1,292,2,293],[2,294,1,295],[1,294,1,296],[1,295
,1,297],[1,296,1,298],[1,297,1,299],[1,298,1,300],[1,299,1,301],[1,300,1,30
2],[1,301,1,303],[1,302,1,304],[1,303,1,305],[1,304,1,306],[1,305,1,307],[1
,306,0,307],[0,308,1,309],[1,308,1,310],[1,309,1,311],[1,310,1,312],[1,311,
1,313],[1,312,1,314],[1,313,1,315],[1,314,1,316],[1,315,1,317],[1,316,1,318
],[1,317,1,319],[1,318,1,320],[1,319,1,321],[1,320,-1,-1],[-1,-
1,1,323],[1,322,1,324],[1,323,1,325],[1,324,1,326],[1,325,1,327],[1,326,1,3
28],[1,327,1,329],[1,328,1,330],[1,329,1,331],[1,330,1,332],[1,331,1,333],[
1,332,1,334],[1,333,1,335],[1,334,2,335],[2,336,1,337],[1,336,1,338],[1,337
,1,339],[1,338,1,340],[1,339,1,341],[1,340,1,342],[1,341,1,343],[1,342,1,34
4],[1,343,1,345],[1,344,1,346],[1,345,1,347],[1,346,1,348],[1,347,1,349],[1
,348,0,349],[0,350,1,351],[1,350,1,352],[1,351,1,353],[1,352,1,354],[1,353,
1,355],[1,354,1,356],[1,355,1,357],[1,356,1,358],[1,357,1,359],[1,358,1,360
],[1,359,1,361],[1,360,1,362],[1,361,1,363],[1,362,-1,-1],[-1,-
1,1,365],[1,364,1,366],[1,365,1,367],[1,366,1,368],[1,367,1,369],[1,368,1,3
70],[1,369,1,371],[1,370,1,372],[1,371,1,373],[1,372,1,374],[1,373,1,375],[
1,374,1,376],[1,375,1,377],[1,376,2,377],[2,378,1,379],[1,378,1,380],[1,379
,1,381],[1,380,1,382],[1,381,1,383],[1,382,1,384],[1,383,1,385],[1,384,1,38
6],[1,385,1,387],[1,386,1,388],[1,387,1,389],[1,388,1,390],[1,389,1,391],[1
,390,0,391],[0,392,1,393],[1,392,1,394],[1,393,1,395],[1,394,1,396],[1,395,
1,397],[1,396,1,398],[1,397,1,399],[1,398,1,400],[1,399,1,401],[1,400,1,402
],[1,401,1,403],[1,402,1,404],[1,403,1,405],[1,404,-1,-1],[-1,-
1,1,407],[1,406,1,408],[1,407,1,409],[1,408,1,410],[1,409,1,411],[1,410,1,4
12],[1,411,1,413],[1,412,1,414],[1,413,1,415],[1,414,1,416],[1,415,1,417],[
1,416,1,418],[1,417,1,419],[1,418,2,419],[2,420,1,421],[1,420,1,422],[1,421
,1,423],[1,422,1,424],[1,423,1,425],[1,424,1,426],[1,425,1,427],[1,426,1,42
8],[1,427,1,429],[1,428,1,430],[1,429,1,431],[1,430,1,432],[1,431,1,433],[1
,432,0,433],[0,434,1,435],[1,434,1,436],[1,435,1,437],[1,436,1,438],[1,437,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1563

1,439],[1,438,1,440],[1,439,1,441],[1,440,1,442],[1,441,1,443],[1,442,1,444
],[1,443,1,445],[1,444,1,446],[1,445,1,447],[1,446,-1,-1],[-1,-
1,1,449],[1,448,1,450],[1,449,1,451],[1,450,1,452],[1,451,1,453],[1,452,1,4
54],[1,453,1,455],[1,454,1,456],[1,455,1,457],[1,456,1,458],[1,457,1,459],[
1,458,1,460],[1,459,1,461],[1,460,2,461],[2,462,1,463],[1,462,1,464],[1,463
,1,465],[1,464,1,466],[1,465,1,467],[1,466,1,468],[1,467,1,469],[1,468,1,47
0],[1,469,1,471],[1,470,1,472],[1,471,1,473],[1,472,1,474],[1,473,1,475],[1
,474,0,475],[0,476,1,477],[1,476,1,478],[1,477,1,479],[1,478,1,480],[1,479,
1,481],[1,480,1,482],[1,481,1,483],[1,482,1,484],[1,483,1,485],[1,484,1,486
],[1,485,1,487],[1,486,1,488],[1,487,1,489],[1,488,-1,-1],[-1,-
1,1,491],[1,490,1,492],[1,491,1,493],[1,492,1,494],[1,493,1,495],[1,494,1,4
96],[1,495,1,497],[1,496,1,498],[1,497,1,499],[1,498,1,500],[1,499,1,501],[
1,500,1,502],[1,501,1,503],[1,502,2,503],[2,504,1,505],[1,504,1,506],[1,505
,1,507],[1,506,1,508],[1,507,1,509],[1,508,1,510],[1,509,1,511],[1,510,1,51
2],[1,511,1,513],[1,512,1,514],[1,513,1,515],[1,514,1,516],[1,515,1,517],[1
,516,0,517],[0,518,1,519],[1,518,1,520],[1,519,1,521],[1,520,1,522],[1,521,
1,523],[1,522,1,524],[1,523,1,525],[1,524,1,526],[1,525,1,527],[1,526,1,528
],[1,527,1,529],[1,528,1,530],[1,529,1,531],[1,530,-1,-1],[-1,-
1,1,533],[1,532,1,534],[1,533,1,535],[1,534,1,536],[1,535,1,537],[1,536,1,5
38],[1,537,1,539],[1,538,1,540],[1,539,1,541],[1,540,1,542],[1,541,1,543],[
1,542,1,544],[1,543,1,545],[1,544,2,545],[2,546,1,547],[1,546,1,548],[1,547
,1,549],[1,548,1,550],[1,549,1,551],[1,550,1,552],[1,551,1,553],[1,552,1,55
4],[1,553,1,555],[1,554,1,556],[1,555,1,557],[1,556,1,558],[1,557,1,559],[1
,558,0,559],[0,560,1,561],[1,560,1,562],[1,561,1,563],[1,562,1,564],[1,563,
1,565],[1,564,1,566],[1,565,1,567],[1,566,1,568],[1,567,1,569],[1,568,1,570
],[1,569,1,571],[1,570,1,572],[1,571,1,573],[1,572,-1,-1],[-1,-
1,1,575],[1,574,1,576],[1,575,1,577],[1,576,1,578],[1,577,1,579],[1,578,1,5
80],[1,579,1,581],[1,580,1,582],[1,581,1,583],[1,582,1,584],[1,583,1,585],[
1,584,1,586],[1,585,1,587],[1,586,2,587],[2,588,1,589],[1,588,1,590],[1,589
,1,591],[1,590,1,592],[1,591,1,593],[1,592,1,594],[1,593,1,595],[1,594,1,59
6],[1,595,1,597],[1,596,1,598],[1,597,1,599],[1,598,1,600],[1,599,1,601],[1
,600,0,601],[0,602,1,603],[1,602,1,604],[1,603,1,605],[1,604,1,606],[1,605,
1,607],[1,606,1,608],[1,607,1,609],[1,608,1,610],[1,609,1,611],[1,610,1,612
],[1,611,1,613],[1,612,1,614],[1,613,1,615],[1,614,-1,-1],[-1,-
1,1,617],[1,616,1,618],[1,617,1,619],[1,618,1,620],[1,619,1,621],[1,620,1,6
22],[1,621,1,623],[1,622,1,624],[1,623,1,625],[1,624,1,626],[1,625,1,627],[
1,626,1,628],[1,627,1,629],[1,628,2,629],[2,630,1,631],[1,630,1,632],[1,631
,1,633],[1,632,1,634],[1,633,1,635],[1,634,1,636],[1,635,1,637],[1,636,1,63
8],[1,637,1,639],[1,638,1,640],[1,639,1,641],[1,640,1,642],[1,641,1,643],[1
,642,0,643],[0,644,1,645],[1,644,1,646],[1,645,1,647],[1,646,1,648],[1,647,
1,649],[1,648,1,650],[1,649,1,651],[1,650,1,652],[1,651,1,653],[1,652,1,654
],[1,653,1,655],[1,654,1,656],[1,655,1,657],[1,656,-1,-1],[-1,-
1,1,659],[1,658,1,660],[1,659,1,661],[1,660,1,662],[1,661,1,663],[1,662,1,6
64],[1,663,1,665],[1,664,1,666],[1,665,1,667],[1,666,1,668],[1,667,1,669],[
1,668,1,670],[1,669,1,671],[1,670,2,671],[2,672,1,673],[1,672,1,674],[1,673
,1,675],[1,674,1,676],[1,675,1,677],[1,676,1,678],[1,677,1,679],[1,678,1,68
0],[1,679,1,681],[1,680,1,682],[1,681,1,683],[1,682,1,684],[1,683,1,685],[1
,684,0,685],[0,686,1,687],[1,686,1,688],[1,687,1,689],[1,688,1,690],[1,689,
1,691],[1,690,1,692],[1,691,1,693],[1,692,1,694],[1,693,1,695],[1,694,1,696
],[1,695,1,697],[1,696,1,698],[1,697,1,699],[1,698,-1,-1],[-1,-
1,1,701],[1,700,1,702],[1,701,1,703],[1,702,1,704],[1,703,1,705],[1,704,1,7
06],[1,705,1,707],[1,706,1,708],[1,707,1,709],[1,708,1,710],[1,709,1,711],[
1,710,1,712],[1,711,1,713],[1,712,2,713],[2,714,1,715],[1,714,1,716],[1,715

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1564

,1,717],[1,716,1,718],[1,717,1,719],[1,718,1,720],[1,719,1,721],[1,720,1,72
2],[1,721,1,723],[1,722,1,724],[1,723,1,725],[1,724,1,726],[1,725,1,727],[1
,726,0,727],[0,728,1,729],[1,728,1,730],[1,729,1,731],[1,730,1,732],[1,731,
1,733],[1,732,1,734],[1,733,1,735],[1,734,1,736],[1,735,1,737],[1,736,1,738
],[1,737,1,739],[1,738,1,740],[1,739,1,741],[1,740,-1,-1],[-1,-
1,1,743],[1,742,1,744],[1,743,1,745],[1,744,1,746],[1,745,1,747],[1,746,1,7
48],[1,747,1,749],[1,748,1,750],[1,749,1,751],[1,750,1,752],[1,751,1,753],[
1,752,1,754],[1,753,1,755],[1,754,2,755],[2,756,1,757],[1,756,1,758],[1,757
,1,759],[1,758,1,760],[1,759,1,761],[1,760,1,762],[1,761,1,763],[1,762,1,76
4],[1,763,1,765],[1,764,1,766],[1,765,1,767],[1,766,1,768],[1,767,1,769],[1
,768,0,769],[0,770,1,771],[1,770,1,772],[1,771,1,773],[1,772,1,774],[1,773,
1,775],[1,774,1,776],[1,775,1,777],[1,776,1,778],[1,777,1,779],[1,778,1,780
],[1,779,1,781],[1,780,1,782],[1,781,1,783],[1,782,-1,-1],[-1,-
1,1,785],[1,784,1,786],[1,785,1,787],[1,786,1,788],[1,787,1,789],[1,788,1,7
90],[1,789,1,791],[1,790,1,792],[1,791,1,793],[1,792,1,794],[1,793,1,795],[
1,794,1,796],[1,795,1,797],[1,796,2,797],[2,798,1,799],[1,798,1,800],[1,799
,1,801],[1,800,1,802],[1,801,1,803],[1,802,1,804],[1,803,1,805],[1,804,1,80
6],[1,805,1,807],[1,806,1,808],[1,807,1,809],[1,808,1,810],[1,809,1,811],[1
,810,0,811],[0,812,1,813],[1,812,1,814],[1,813,1,815],[1,814,1,816],[1,815,
1,817],[1,816,1,818],[1,817,1,819],[1,818,1,820],[1,819,1,821],[1,820,1,822
],[1,821,1,823],[1,822,1,824],[1,823,1,825],[1,824,-1,-1],[-1,-
1,1,827],[1,826,1,828],[1,827,1,829],[1,828,1,830],[1,829,1,831],[1,830,1,8
32],[1,831,1,833],[1,832,1,834],[1,833,1,835],[1,834,1,836],[1,835,1,837],[
1,836,1,838],[1,837,1,839],[1,838,2,839],[2,840,1,841],[1,840,1,842],[1,841
,1,843],[1,842,1,844],[1,843,1,845],[1,844,1,846],[1,845,1,847],[1,846,1,84
8],[1,847,1,849],[1,848,1,850],[1,849,1,851],[1,850,1,852],[1,851,1,853],[1
,852,0,853],[0,854,1,855],[1,854,1,856],[1,855,1,857],[1,856,1,858],[1,857,
1,859],[1,858,1,860],[1,859,1,861],[1,860,1,862],[1,861,1,863],[1,862,1,864
],[1,863,1,865],[1,864,1,866],[1,865,1,867],[1,866,-1,-1],[-1,-
1,1,869],[1,868,1,870],[1,869,1,871],[1,870,1,872],[1,871,1,873],[1,872,1,8
74],[1,873,1,875],[1,874,1,876],[1,875,1,877],[1,876,1,878],[1,877,1,879],[
1,878,1,880],[1,879,1,881],[1,880,2,881],[2,882,1,883],[1,882,1,884],[1,883
,1,885],[1,884,1,886],[1,885,1,887],[1,886,1,888],[1,887,1,889],[1,888,1,89
0],[1,889,1,891],[1,890,1,892],[1,891,1,893],[1,892,1,894],[1,893,1,895],[1
,894,0,895],[0,896,1,897],[1,896,1,898],[1,897,1,899],[1,898,1,900],[1,899,
1,901],[1,900,1,902],[1,901,1,903],[1,902,1,904],[1,903,1,905],[1,904,1,906
],[1,905,1,907],[1,906,1,908],[1,907,1,909],[1,908,-1,-1],[-1,-
1,1,911],[1,910,1,912],[1,911,1,913],[1,912,1,914],[1,913,1,915],[1,914,1,9
16],[1,915,1,917],[1,916,1,918],[1,917,1,919],[1,918,1,920],[1,919,1,921],[
1,920,1,922],[1,921,1,923],[1,922,2,923],[2,924,1,925],[1,924,1,926],[1,925
,1,927],[1,926,1,928],[1,927,1,929],[1,928,1,930],[1,929,1,931],[1,930,1,93
2],[1,931,1,933],[1,932,1,934],[1,933,1,935],[1,934,1,936],[1,935,1,937],[1
,936,0,937],[0,938,1,939],[1,938,1,940],[1,939,1,941],[1,940,1,942],[1,941,
1,943],[1,942,1,944],[1,943,1,945],[1,944,1,946],[1,945,1,947],[1,946,1,948
],[1,947,1,949],[1,948,1,950],[1,949,1,951],[1,950,-1,-1],[-1,-
1,1,953],[1,952,1,954],[1,953,1,955],[1,954,1,956],[1,955,1,957],[1,956,1,9
58],[1,957,1,959],[1,958,1,960],[1,959,1,961],[1,960,1,962],[1,961,1,963],[
1,962,1,964],[1,963,1,965],[1,964,2,965],[2,966,1,967],[1,966,1,968],[1,967
,1,969],[1,968,1,970],[1,969,1,971],[1,970,1,972],[1,971,1,973],[1,972,1,97
4],[1,973,1,975],[1,974,1,976],[1,975,1,977],[1,976,1,978],[1,977,1,979],[1
,978,0,979],[0,980,1,981],[1,980,1,982],[1,981,1,983],[1,982,1,984],[1,983,
1,985],[1,984,1,986],[1,985,1,987],[1,986,1,988],[1,987,1,989],[1,988,1,990
],[1,989,1,991],[1,990,1,992],[1,991,1,993],[1,992,-1,-1],[-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1565

1,1,995],[1,994,1,996],[1,995,1,997],[1,996,1,998],[1,997,1,999],[1,998,1,1
000],[1,999,1,1001],[1,1000,1,1002],[1,1001,1,1003],[1,1002,1,1004],[1,1003
,1,1005],[1,1004,1,1006],[1,1005,1,1007],[1,1006,2,1007],[2,1008,1,1009],[1
,1008,1,1010],[1,1009,1,1011],[1,1010,1,1012],[1,1011,1,1013],[1,1012,1,101
4],[1,1013,1,1015],[1,1014,1,1016],[1,1015,1,1017],[1,1016,1,1018],[1,1017,
1,1019],[1,1018,1,1020],[1,1019,1,1021],[1,1020,0,1021],[0,1022,1,1023],[1,
1022,1,1024],[1,1023,1,1025],[1,1024,1,1026],[1,1025,1,1027],[1,1026,1,1028
],[1,1027,1,1029],[1,1028,1,1030],[1,1029,1,1031],[1,1030,1,1032],[1,1031,1
,1033],[1,1032,1,1034],[1,1033,1,1035],[1,1034,-1,-1],[-1,-
1,1,1037],[1,1036,1,1038],[1,1037,1,1039],[1,1038,1,1040],[1,1039,1,1041],[
1,1040,1,1042],[1,1041,1,1043],[1,1042,1,1044],[1,1043,1,1045],[1,1044,1,10
46],[1,1045,1,1047],[1,1046,1,1048],[1,1047,1,1049],[1,1048,2,1049],[2,1050
,1,1051],[1,1050,1,1052],[1,1051,1,1053],[1,1052,1,1054],[1,1053,1,1055],[1
,1054,1,1056],[1,1055,1,1057],[1,1056,1,1058],[1,1057,1,1059],[1,1058,1,106
0],[1,1059,1,1061],[1,1060,1,1062],[1,1061,1,1063],[1,1062,0,1063],[0,1064,
1,1065],[1,1064,1,1066],[1,1065,1,1067],[1,1066,1,1068],[1,1067,1,1069],[1,
1068,1,1070],[1,1069,1,1071],[1,1070,1,1072],[1,1071,1,1073],[1,1072,1,1074
],[1,1073,1,1075],[1,1074,1,1076],[1,1075,1,1077],[1,1076,-1,-1],[-1,-
1,1,1079],[1,1078,1,1080],[1,1079,1,1081],[1,1080,1,1082],[1,1081,1,1083],[
1,1082,1,1084],[1,1083,1,1085],[1,1084,1,1086],[1,1085,1,1087],[1,1086,1,10
88],[1,1087,1,1089],[1,1088,1,1090],[1,1089,1,1091],[1,1090,2,1091],[2,1092
,1,1093],[1,1092,1,1094],[1,1093,1,1095],[1,1094,1,1096],[1,1095,1,1097],[1
,1096,1,1098],[1,1097,1,1099],[1,1098,1,1100],[1,1099,1,1101],[1,1100,1,110
2],[1,1101,1,1103],[1,1102,1,1104],[1,1103,1,1105],[1,1104,0,1105],[0,1106,
1,1107],[1,1106,1,1108],[1,1107,1,1109],[1,1108,1,1110],[1,1109,1,1111],[1,
1110,1,1112],[1,1111,1,1113],[1,1112,1,1114],[1,1113,1,1115],[1,1114,1,1116
],[1,1115,1,1117],[1,1116,1,1118],[1,1117,1,1119],[1,1118,-1,-1],[-1,-
1,1,1121],[1,1120,1,1122],[1,1121,1,1123],[1,1122,1,1124],[1,1123,1,1125],[
1,1124,1,1126],[1,1125,1,1127],[1,1126,1,1128],[1,1127,1,1129],[1,1128,1,11
30],[1,1129,1,1131],[1,1130,1,1132],[1,1131,1,1133],[1,1132,2,1133],[2,1134
,1,1135],[1,1134,1,1136],[1,1135,1,1137],[1,1136,1,1138],[1,1137,1,1139],[1
,1138,1,1140],[1,1139,1,1141],[1,1140,1,1142],[1,1141,1,1143],[1,1142,1,114
4],[1,1143,1,1145],[1,1144,1,1146],[1,1145,1,1147],[1,1146,0,1147],[0,1148,
1,1149],[1,1148,1,1150],[1,1149,1,1151],[1,1150,1,1152],[1,1151,1,1153],[1,
1152,1,1154],[1,1153,1,1155],[1,1154,1,1156],[1,1155,1,1157],[1,1156,1,1158
],[1,1157,1,1159],[1,1158,1,1160],[1,1159,1,1161],[1,1160,-1,-1],[-1,-
1,1,1163],[1,1162,1,1164],[1,1163,1,1165],[1,1164,1,1166],[1,1165,1,1167],[
1,1166,1,1168],[1,1167,1,1169],[1,1168,1,1170],[1,1169,1,1171],[1,1170,1,11
72],[1,1171,1,1173],[1,1172,1,1174],[1,1173,1,1175],[1,1174,2,1175],[2,1176
,1,1177],[1,1176,1,1178],[1,1177,1,1179],[1,1178,1,1180],[1,1179,1,1181],[1
,1180,1,1182],[1,1181,1,1183],[1,1182,1,1184],[1,1183,1,1185],[1,1184,1,118
6],[1,1185,1,1187],[1,1186,1,1188],[1,1187,1,1189],[1,1188,0,1189],[0,1190,
1,1191],[1,1190,1,1192],[1,1191,1,1193],[1,1192,1,1194],[1,1193,1,1195],[1,
1194,1,1196],[1,1195,1,1197],[1,1196,1,1198],[1,1197,1,1199],[1,1198,1,1200
],[1,1199,1,1201],[1,1200,1,1202],[1,1201,1,1203],[1,1202,-1,-1],[-1,-
1,1,1205],[1,1204,1,1206],[1,1205,1,1207],[1,1206,1,1208],[1,1207,1,1209],[
1,1208,1,1210],[1,1209,1,1211],[1,1210,1,1212],[1,1211,1,1213],[1,1212,1,12
14],[1,1213,1,1215],[1,1214,1,1216],[1,1215,1,1217],[1,1216,2,1217],[2,1218
,1,1219],[1,1218,1,1220],[1,1219,1,1221],[1,1220,1,1222],[1,1221,1,1223],[1
,1222,1,1224],[1,1223,1,1225],[1,1224,1,1226],[1,1225,1,1227],[1,1226,1,122
8],[1,1227,1,1229],[1,1228,1,1230],[1,1229,1,1231],[1,1230,0,1231],[-1,-
1,1,1233],[1,1232,1,1234],[1,1233,1,1235],[1,1234,1,1236],[1,1235,1,1237],[
1,1236,1,1238],[1,1237,1,1239],[1,1238,1,1240],[1,1239,1,1241],[1,1240,1,12

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1566

42],[1,1241,1,1243],[1,1242,1,1244],[1,1243,1,1245],[1,1244,1,1246],[1,1245
,1,1247],[1,1246,1,1248],[1,1247,1,1249],[1,1248,1,1250],[1,1249,1,1251],[1
,1250,1,1252],[1,1251,1,1253],[1,1252,1,1254],[1,1253,1,1255],[1,1254,1,125
6],[1,1255,1,1257],[1,1256,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1567

,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-
1],[1,41,0,40],[1,42,1,40],[1,43,1,41],[1,44,1,42],[1,45,1,43],[1,46,1,44],
[1,47,1,45],[1,48,1,46],[1,49,1,47],[1,50,1,48],[1,51,1,49],[1,52,1,50],[1,
53,1,51],[1,54,1,52],[1,55,1,53],[1,56,1,54],[1,57,1,55],[1,58,1,56],[1,59,
1,57],[1,60,1,58],[1,61,1,59],[1,62,1,60],[1,63,1,61],[1,64,1,62],[1,65,1,6
3],[1,66,1,64],[1,67,1,65],[1,68,1,66],[1,69,1,67],[1,70,1,68],[1,71,1,69],

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1568

[1,72,1,70],[1,73,1,71],[1,74,1,72],[1,75,1,73],[1,76,1,74],[1,77,1,75],[1,78,1,76],[1,79,1,77],[1,80,1,78],[1,81,1,79],[1,82,1,80],[1,83,1,81],[1,84,1,82],[1,85,1,83],[1,86,1,84],[1,87,1,85],[1,88,1,86],[1,89,1,87],[1,90,1,88],[1,91,1,89],[1,92,1,90],[1,93,1,91],[1,94,1,92],[1,95,1,93],[1,96,1,94],[1,97,1,95],[1,98,1,96],[1,99,1,97],[1,100,1,98],[1,101,1,99],[1,102,1,100],[1,103,1,101],[1,104,1,102],[1,105,1,103],[1,106,1,104],[1,107,1,105],[1,108,1,106],[1,109,1,107],[1,110,1,108],[1,111,1,109],[1,112,1,110],[1,113,1,111],[1,114,1,112],[1,115,1,113],[1,116,1,114],[1,117,1,115],[1,118,1,116],[1,119,1,117],[1,120,1,118],[1,121,1,119],[1,122,1,120],[1,123,1,121],[1,124,1,122],[1,125,1,123],[1,126,1,124],[1,127,1,125],[1,128,1,126],[1,129,1,127],[1,130,1,128],[1,131,1,129],[1,132,1,130],[1,133,1,131],[1,134,1,132],[1,135,1,133],[1,136,1,134],[1,137,1,135],[1,138,1,136],[1,139,1,137],[1,140,1,138],[1,141,1,139],[1,142,1,140],[1,143,1,141],[1,144,1,142],[1,145,1,143],[1,146,1,144],[1,147,1,145],[1,148,1,146],[1,149,1,147],[1,150,1,148],[1,151,1,149],[1,152,1,150],[1,153,1,151],[1,154,1,152],[1,155,1,153],[1,156,1,154],[1,157,1,155],[1,158,1,156],[1,159,1,157],[1,160,1,158],[1,161,1,159],[1,162,1,160],[1,163,1,161],[1,164,1,162],[1,165,1,163],[1,166,1,164],[1,167,1,165],[1,168,1,166],[1,169,1,167],[1,170,1,168],[1,171,1,169],[1,172,1,170],[1,173,1,171],[1,174,1,172],[1,175,1,173],[1,176,1,174],[1,177,1,175],[1,178,1,176],[1,179,1,177],[1,180,1,178],[1,181,1,179],[1,182,1,180],[1,183,1,181],[1,184,1,182],[1,185,1,183],[1,186,1,184],[1,187,1,185],[1,188,1,186],[1,189,1,187],[1,190,1,188],[1,191,1,189],[1,192,1,190],[1,193,1,191],[1,194,1,192],[1,195,1,193],[1,196,1,194],[1,197,1,195],[1,198,1,196],[1,199,1,197],[1,200,1,198],[1,201,1,199],[1,202,1,200],[1,203,1,201],[1,204,1,202],[1,205,1,203],[1,206,1,204],[1,207,1,205],[1,208,1,206],[1,209,1,207],[1,210,1,208],[1,211,1,209],[1,212,1,210],[1,213,1,211],[1,214,1,212],[1,215,1,213],[1,216,1,214],[1,217,1,215],[1,218,1,216],[1,219,1,217],[1,220,1,218],[1,221,1,219],[1,222,1,220],[1,223,1,221],[1,224,1,222],[1,225,1,223],[1,226,1,224],[1,227,1,225],[1,228,1,226],[1,229,1,227],[1,230,1,228],[1,231,1,229],[1,232,1,230],[1,233,1,231],[1,234,1,232],[1,235,1,233],[1,236,1,234],[1,237,1,235],[1,238,1,236],[1,239,1,237],[1,240,1,238],[1,241,1,239],[1,242,1,240],[1,243,1,241],[1,244,1,242],[1,245,1,243],[1,246,1,244],[1,247,1,245],[1,248,1,246],[1,249,1,247],[1,250,1,248],[1,251,1,249],[1,252,1,250],[1,253,1,251],[1,254,1,252],[1,255,1,253],[1,256,1,254],[1,257,1,255],[1,258,1,256],[1,259,1,257],[1,260,1,258],[1,261,1,259],[1,262,1,260],[1,263,1,261],[1,264,1,262],[1,265,1,263],[1,266,1,264],[1,267,1,265],[1,268,1,266],[1,269,1,267],[1,270,1,268],[1,271,1,269],[1,272,1,270],[1,273,1,271],[1,274,1,272],[1,275,1,273],[1,276,1,274],[1,277,1,275],[1,278,1,276],[1,279,1,277],[1,280,1,278],[1,281,1,279],[1,282,1,280],[1,283,1,281],[1,284,1,282],[1,285,1,283],[1,286,1,284],[1,287,1,285],[1,288,1,286],[1,289,1,287],[1,290,1,288],[1,291,1,289],[1,292,1,290],[1,293,1,291],[1,294,1,292],[1,295,1,293],[1,296,1,294],[1,297,1,295],[1,298,1,296],[1,299,1,297],[1,300,1,298],[1,301,1,299],[1,302,1,300],[1,303,1,301],[1,304,1,302],[1,305,1,303],[1,306,1,304],[1,307,1,305],[1,308,1,306],[1,309,1,307],[1,310,1,308],[1,311,1,309],[1,312,1,310],[1,313,1,311],[1,314,1,312],[1,315,1,313],[1,316,1,314],[1,317,1,315],[1,318,1,316],[1,319,1,317],[1,320,1,318],[1,321,1,319],[1,322,1,320],[1,323,1,321],[1,324,1,322],[1,325,1,323],[1,326,1,324],[1,327,1,325],[1,328,1,326],[1,329,1,327],[1,330,1,328],[1,331,1,329],[1,332,1,330],[1,333,1,331],[1,334,1,332],[1,335,1,333],[1,336,1,334],[1,337,1,335],[1,338,1,336],[1,339,1,337],[1,340,1,338],[1,341,1,339],[1,342,1,340],[1,343,1,341],[1,344,1,342],[1,345,1,343],[1,346,1,344],[1,347,1,345],[1,348,1,346],[1,349,1,347],[1,350,1,348],[1,351,1,349],[1,352,1,350],[1,353,1,351],[1,354,1,352],[1,355,1,353],[1,356,1,354],[1,357,1,355],[1,358,1,356],[1,359,1,357],[

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1569

1,360,1,358],[1,361,1,359],[1,362,1,360],[1,363,1,361],[1,364,1,362],[1,365
,1,363],[1,366,1,364],[1,367,1,365],[1,368,1,366],[1,369,1,367],[1,370,1,36
8],[1,371,1,369],[1,372,1,370],[1,373,1,371],[1,374,1,372],[1,375,1,373],[1
,376,1,374],[1,377,1,375],[1,378,1,376],[1,379,1,377],[1,380,1,378],[1,381,
1,379],[1,382,1,380],[1,383,1,381],[1,384,1,382],[1,385,1,383],[1,386,1,384
],[1,387,1,385],[1,388,1,386],[1,389,1,387],[1,390,1,388],[1,391,1,389],[1,
392,1,390],[1,393,1,391],[1,394,1,392],[1,395,1,393],[1,396,1,394],[1,397,1
,395],[1,398,1,396],[1,399,1,397],[1,400,1,398],[1,401,1,399],[1,402,1,400]
,[1,403,1,401],[1,404,1,402],[1,405,1,403],[1,406,1,404],[1,407,1,405],[1,4
08,1,406],[1,409,1,407],[1,410,1,408],[1,411,1,409],[1,412,1,410],[1,413,1,
411],[1,414,1,412],[1,415,1,413],[1,416,1,414],[1,417,1,415],[1,418,1,416],
[1,419,1,417],[1,420,1,418],[1,421,1,419],[1,422,1,420],[1,423,1,421],[1,42
4,1,422],[1,425,1,423],[1,426,1,424],[1,427,1,425],[1,428,1,426],[1,429,1,4
27],[1,430,1,428],[1,431,1,429],[1,432,1,430],[1,433,1,431],[1,434,1,432],[
1,435,1,433],[1,436,1,434],[1,437,1,435],[1,438,1,436],[1,439,1,437],[1,440
,1,438],[1,441,1,439],[1,442,1,440],[1,443,1,441],[1,444,1,442],[1,445,1,44
3],[1,446,1,444],[1,447,1,445],[1,448,1,446],[1,449,1,447],[1,450,1,448],[1
,451,1,449],[1,452,1,450],[1,453,1,451],[1,454,1,452],[1,455,1,453],[1,456,
1,454],[1,457,1,455],[1,458,1,456],[1,459,1,457],[1,460,1,458],[1,461,1,459
],[1,462,1,460],[1,463,1,461],[1,464,1,462],[1,465,1,463],[1,466,1,464],[1,
467,1,465],[1,468,1,466],[1,469,1,467],[1,470,1,468],[1,471,1,469],[1,472,1
,470],[1,473,1,471],[1,474,1,472],[1,475,1,473],[1,476,1,474],[1,477,1,475]
,[1,478,1,476],[1,479,1,477],[1,480,1,478],[1,481,1,479],[1,482,1,480],[1,4
83,1,481],[1,484,1,482],[1,485,1,483],[1,486,1,484],[1,487,1,485],[1,488,1,
486],[1,489,1,487],[1,490,1,488],[1,491,1,489],[1,492,1,490],[1,493,1,491],
[1,494,1,492],[1,495,1,493],[1,496,1,494],[1,497,1,495],[1,498,1,496],[1,49
9,1,497],[1,500,1,498],[1,501,1,499],[1,502,1,500],[1,503,1,501],[1,504,1,5
02],[1,505,1,503],[1,506,1,504],[1,507,1,505],[1,508,1,506],[1,509,1,507],[
1,510,1,508],[1,511,1,509],[1,512,1,510],[1,513,1,511],[1,514,1,512],[1,515
,1,513],[1,516,1,514],[1,517,1,515],[1,518,1,516],[1,519,1,517],[1,520,1,51
8],[1,521,1,519],[1,522,1,520],[1,523,1,521],[1,524,1,522],[1,525,1,523],[1
,526,1,524],[1,527,1,525],[1,528,1,526],[1,529,1,527],[1,530,1,528],[1,531,
1,529],[1,532,1,530],[1,533,1,531],[1,534,1,532],[1,535,1,533],[1,536,1,534
],[1,537,1,535],[1,538,1,536],[1,539,1,537],[1,540,1,538],[1,541,1,539],[1,
542,1,540],[1,543,1,541],[1,544,1,542],[1,545,1,543],[1,546,1,544],[1,547,1
,545],[1,548,1,546],[1,549,1,547],[1,550,1,548],[1,551,1,549],[1,552,1,550]
,[1,553,1,551],[1,554,1,552],[1,555,1,553],[1,556,1,554],[1,557,1,555],[1,5
58,1,556],[1,559,1,557],[1,560,1,558],[1,561,1,559],[1,562,1,560],[1,563,1,
561],[1,564,1,562],[1,565,1,563],[1,566,1,564],[1,567,1,565],[1,568,1,566],
[1,569,1,567],[1,570,1,568],[1,571,1,569],[1,572,1,570],[1,573,1,571],[1,57
4,1,572],[1,575,1,573],[1,576,1,574],[1,577,1,575],[1,578,1,576],[1,579,1,5
77],[1,580,1,578],[1,581,1,579],[1,582,1,580],[1,583,1,581],[1,584,1,582],[
1,585,1,583],[1,586,1,584],[1,587,1,585],[1,588,1,586],[1,589,1,587],[1,590
,1,588],[1,591,1,589],[1,592,1,590],[1,593,1,591],[1,594,1,592],[1,595,1,59
3],[1,596,1,594],[1,597,1,595],[1,598,1,596],[1,599,1,597],[1,600,1,598],[1
,601,1,599],[1,602,1,600],[1,603,1,601],[1,604,1,602],[1,605,1,603],[1,606,
1,604],[1,607,1,605],[1,608,1,606],[1,609,1,607],[1,610,1,608],[1,611,1,609
],[1,612,1,610],[1,613,1,611],[1,614,1,612],[1,615,1,613],[1,616,1,614],[1,
617,1,615],[1,618,1,616],[1,619,1,617],[1,620,1,618],[1,621,1,619],[1,622,1
,620],[1,623,1,621],[1,624,1,622],[1,625,1,623],[1,626,1,624],[1,627,1,625]
,[1,628,1,626],[1,629,1,627],[1,630,1,628],[1,631,1,629],[1,632,1,630],[1,6
33,1,631],[1,634,1,632],[1,635,1,633],[1,636,1,634],[1,637,1,635],[1,638,1,
636],[1,639,1,637],[1,640,1,638],[1,641,1,639],[1,642,1,640],[1,643,1,641],

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1570

[1,644,1,642],[1,645,1,643],[2,645,1,644],[1,647,2,646],[1,648,1,646],[1,649,1,647],[1,650,1,648],[1,651,1,649],[1,652,1,650],[1,653,1,651],[1,654,1,652],[1,655,1,653],[1,656,1,654],[1,657,1,655],[1,658,1,656],[1,659,1,657],[1,660,1,658],[1,661,1,659],[1,662,1,660],[1,663,1,661],[1,664,1,662],[1,665,1,663],[1,666,1,664],[1,667,1,665],[1,668,1,666],[1,669,1,667],[1,670,1,668],[1,671,1,669],[1,672,1,670],[1,673,1,671],[1,674,1,672],[1,675,1,673],[1,676,1,674],[1,677,1,675],[1,678,1,676],[1,679,1,677],[1,680,1,678],[1,681,1,679],[1,682,1,680],[1,683,1,681],[1,684,1,682],[1,685,1,683],[1,686,1,684],[1,687,1,685],[1,688,1,686],[1,689,1,687],[1,690,1,688],[1,691,1,689],[1,692,1,690],[1,693,1,691],[1,694,1,692],[1,695,1,693],[1,696,1,694],[1,697,1,695],[1,698,1,696],[1,699,1,697],[1,700,1,698],[1,701,1,699],[1,702,1,700],[1,703,1,701],[1,704,1,702],[1,705,1,703],[1,706,1,704],[1,707,1,705],[1,708,1,706],[1,709,1,707],[1,710,1,708],[1,711,1,709],[1,712,1,710],[1,713,1,711],[1,714,1,712],[1,715,1,713],[1,716,1,714],[1,717,1,715],[1,718,1,716],[1,719,1,717],[1,720,1,718],[1,721,1,719],[1,722,1,720],[1,723,1,721],[1,724,1,722],[1,725,1,723],[1,726,1,724],[1,727,1,725],[1,728,1,726],[1,729,1,727],[1,730,1,728],[1,731,1,729],[1,732,1,730],[1,733,1,731],[1,734,1,732],[1,735,1,733],[1,736,1,734],[1,737,1,735],[1,738,1,736],[1,739,1,737],[1,740,1,738],[1,741,1,739],[1,742,1,740],[1,743,1,741],[1,744,1,742],[1,745,1,743],[1,746,1,744],[1,747,1,745],[1,748,1,746],[1,749,1,747],[1,750,1,748],[1,751,1,749],[1,752,1,750],[1,753,1,751],[1,754,1,752],[1,755,1,753],[1,756,1,754],[1,757,1,755],[1,758,1,756],[1,759,1,757],[1,760,1,758],[1,761,1,759],[1,762,1,760],[1,763,1,761],[1,764,1,762],[1,765,1,763],[1,766,1,764],[1,767,1,765],[1,768,1,766],[1,769,1,767],[1,770,1,768],[1,771,1,769],[1,772,1,770],[1,773,1,771],[1,774,1,772],[1,775,1,773],[1,776,1,774],[1,777,1,775],[1,778,1,776],[1,779,1,777],[1,780,1,778],[1,781,1,779],[1,782,1,780],[1,783,1,781],[1,784,1,782],[1,785,1,783],[1,786,1,784],[1,787,1,785],[1,788,1,786],[1,789,1,787],[1,790,1,788],[1,791,1,789],[1,792,1,790],[1,793,1,791],[1,794,1,792],[1,795,1,793],[1,796,1,794],[1,797,1,795],[1,798,1,796],[1,799,1,797],[1,800,1,798],[1,801,1,799],[1,802,1,800],[1,803,1,801],[1,804,1,802],[1,805,1,803],[1,806,1,804],[1,807,1,805],[1,808,1,806],[1,809,1,807],[1,810,1,808],[1,811,1,809],[1,812,1,810],[1,813,1,811],[1,814,1,812],[1,815,1,813],[1,816,1,814],[1,817,1,815],[1,818,1,816],[1,819,1,817],[1,820,1,818],[1,821,1,819],[1,822,1,820],[1,823,1,821],[1,824,1,822],[1,825,1,823],[1,826,1,824],[1,827,1,825],[1,828,1,826],[1,829,1,827],[1,830,1,828],[1,831,1,829],[1,832,1,830],[1,833,1,831],[1,834,1,832],[1,835,1,833],[1,836,1,834],[1,837,1,835],[1,838,1,836],[1,839,1,837],[1,840,1,838],[1,841,1,839],[1,842,1,840],[1,843,1,841],[1,844,1,842],[1,845,1,843],[1,846,1,844],[1,847,1,845],[1,848,1,846],[1,849,1,847],[1,850,1,848],[1,851,1,849],[1,852,1,850],[1,853,1,851],[1,854,1,852],[1,855,1,853],[1,856,1,854],[1,857,1,855],[1,858,1,856],[1,859,1,857],[1,860,1,858],[1,861,1,859],[1,862,1,860],[1,863,1,861],[1,864,1,862],[1,865,1,863],[1,866,1,864],[1,867,1,865],[1,868,1,866],[1,869,1,867],[1,870,1,868],[1,871,1,869],[1,872,1,870],[1,873,1,871],[1,874,1,872],[1,875,1,873],[1,876,1,874],[1,877,1,875],[1,878,1,876],[1,879,1,877],[1,880,1,878],[1,881,1,879],[1,882,1,880],[1,883,1,881],[1,884,1,882],[1,885,1,883],[1,886,1,884],[1,887,1,885],[1,888,1,886],[1,889,1,887],[1,890,1,888],[1,891,1,889],[1,892,1,890],[1,893,1,891],[1,894,1,892],[1,895,1,893],[1,896,1,894],[1,897,1,895],[1,898,1,896],[1,899,1,897],[1,900,1,898],[1,901,1,899],[1,902,1,900],[1,903,1,901],[1,904,1,902],[1,905,1,903],[1,906,1,904],[1,907,1,905],[1,908,1,906],[1,909,1,907],[1,910,1,908],[1,911,1,909],[1,912,1,910],[1,913,1,911],[1,914,1,912],[1,915,1,913],[1,916,1,914],[1,917,1,915],[1,918,1,916],[1,919,1,917],[1,920,1,918],[1,921,1,919],[1,922,1,920],[1,923,1,921],[1,924,1,922],[1,925,1,923],[1,926,1,924],[1,927,1,925]

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1571

,[1,928,1,926],[1,929,1,927],[1,930,1,928],[1,931,1,929],[1,932,1,930],[1,933,1,931],[1,934,1,932],[1,935,1,933],[1,936,1,934],[1,937,1,935],[1,938,1,936],[1,939,1,937],[1,940,1,938],[1,941,1,939],[1,942,1,940],[1,943,1,941],[1,944,1,942],[1,945,1,943],[1,946,1,944],[1,947,1,945],[1,948,1,946],[1,949,1,947],[1,950,1,948],[1,951,1,949],[1,952,1,950],[1,953,1,951],[1,954,1,952],[1,955,1,953],[1,956,1,954],[1,957,1,955],[1,958,1,956],[1,959,1,957],[1,960,1,958],[1,961,1,959],[1,962,1,960],[1,963,1,961],[1,964,1,962],[1,965,1,963],[1,966,1,964],[1,967,1,965],[1,968,1,966],[1,969,1,967],[1,970,1,968],[1,971,1,969],[1,972,1,970],[1,973,1,971],[1,974,1,972],[1,975,1,973],[1,976,1,974],[1,977,1,975],[1,978,1,976],[1,979,1,977],[1,980,1,978],[1,981,1,979],[1,982,1,980],[1,983,1,981],[1,984,1,982],[1,985,1,983],[1,986,1,984],[1,987,1,985],[1,988,1,986],[1,989,1,987],[1,990,1,988],[1,991,1,989],[1,992,1,990],[1,993,1,991],[1,994,1,992],[1,995,1,993],[1,996,1,994],[1,997,1,995],[1,998,1,996],[1,999,1,997],[1,1000,1,998],[1,1001,1,999],[1,1002,1,1000],[1,1003,1,1001],[1,1004,1,1002],[1,1005,1,1003],[1,1006,1,1004],[1,1007,1,1005],[1,1008,1,1006],[1,1009,1,1007],[1,1010,1,1008],[1,1011,1,1009],[1,1012,1,1010],[1,1013,1,1011],[1,1014,1,1012],[1,1015,1,1013],[1,1016,1,1014],[1,1017,1,1015],[1,1018,1,1016],[1,1019,1,1017],[1,1020,1,1018],[1,1021,1,1019],[1,1022,1,1020],[1,1023,1,1021],[1,1024,1,1022],[1,1025,1,1023],[1,1026,1,1024],[1,1027,1,1025],[1,1028,1,1026],[1,1029,1,1027],[1,1030,1,1028],[1,1031,1,1029],[1,1032,1,1030],[1,1033,1,1031],[1,1034,1,1032],[1,1035,1,1033],[1,1036,1,1034],[1,1037,1,1035],[1,1038,1,1036],[1,1039,1,1037],[1,1040,1,1038],[1,1041,1,1039],[1,1042,1,1040],[1,1043,1,1041],[1,1044,1,1042],[1,1045,1,1043],[1,1046,1,1044],[1,1047,1,1045],[1,1048,1,1046],[1,1049,1,1047],[1,1050,1,1048],[1,1051,1,1049],[1,1052,1,1050],[1,1053,1,1051],[1,1054,1,1052],[1,1055,1,1053],[1,1056,1,1054],[1,1057,1,1055],[1,1058,1,1056],[1,1059,1,1057],[1,1060,1,1058],[1,1061,1,1059],[1,1062,1,1060],[1,1063,1,1061],[1,1064,1,1062],[1,1065,1,1063],[1,1066,1,1064],[1,1067,1,1065],[1,1068,1,1066],[1,1069,1,1067],[1,1070,1,1068],[1,1071,1,1069],[1,1072,1,1070],[1,1073,1,1071],[1,1074,1,1072],[1,1075,1,1073],[1,1076,1,1074],[1,1077,1,1075],[1,1078,1,1076],[1,1079,1,1077],[1,1080,1,1078],[1,1081,1,1079],[1,1082,1,1080],[1,1083,1,1081],[1,1084,1,1082],[1,1085,1,1083],[1,1086,1,1084],[1,1087,1,1085],[1,1088,1,1086],[1,1089,1,1087],[1,1090,1,1088],[1,1091,1,1089],[1,1092,1,1090],[1,1093,1,1091],[1,1094,1,1092],[1,1095,1,1093],[1,1096,1,1094],[1,1097,1,1095],[1,1098,1,1096],[1,1099,1,1097],[1,1100,1,1098],[1,1101,1,1099],[1,1102,1,1100],[1,1103,1,1101],[1,1104,1,1102],[1,1105,1,1103],[1,1106,1,1104],[1,1107,1,1105],[1,1108,1,1106],[1,1109,1,1107],[1,1110,1,1108],[1,1111,1,1109],[1,1112,1,1110],[1,1113,1,1111],[1,1114,1,1112],[1,1115,1,1113],[1,1116,1,1114],[1,1117,1,1115],[1,1118,1,1116],[1,1119,1,1117],[1,1120,1,1118],[1,1121,1,1119],[1,1122,1,1120],[1,1123,1,1121],[1,1124,1,1122],[1,1125,1,1123],[1,1126,1,1124],[1,1127,1,1125],[1,1128,1,1126],[1,1129,1,1127],[1,1130,1,1128],[1,1131,1,1129],[1,1132,1,1130],[1,1133,1,1131],[1,1134,1,1132],[1,1135,1,1133],[1,1136,1,1134],[1,1137,1,1135],[1,1138,1,1136],[1,1139,1,1137],[1,1140,1,1138],[1,1141,1,1139],[1,1142,1,1140],[1,1143,1,1141],[1,1144,1,1142],[1,1145,1,1143],[1,1146,1,1144],[1,1147,1,1145],[1,1148,1,1146],[1,1149,1,1147],[1,1150,1,1148],[1,1151,1,1149],[1,1152,1,1150],[1,1153,1,1151],[1,1154,1,1152],[1,1155,1,1153],[1,1156,1,1154],[1,1157,1,1155],[1,1158,1,1156],[1,1159,1,1157],[1,1160,1,1158],[1,1161,1,1159],[1,1162,1,1160],[1,1163,1,1161],[1,1164,1,1162],[1,1165,1,1163],[1,1166,1,1164],[1,1167,1,1165],[1,1168,1,1166],[1,1169,1,1167],[1,1170,1,1168],[1,1171,1,1169],[1,1172,1,1170],[1,1173,1,1171],[1,1174,1,1172],[1,1175,1,1173],[1,1176,1,1174],[1,1177,1,1175],[1,1178,1,1176],[1,1179,1,1177],[1,1180,1,1178],[1,1181,1,1179],[1,1182,1,1180],[1,1183,1,1181],[1,1184,1,1182],[1,1185,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1572

1,1183],[1,1186,1,1184],[1,1187,1,1185],[1,1188,1,1186],[1,1189,1,1187],[1,
1190,1,1188],[1,1191,1,1189],[1,1192,1,1190],[1,1193,1,1191],[1,1194,1,1192
],[1,1195,1,1193],[1,1196,1,1194],[1,1197,1,1195],[1,1198,1,1196],[1,1199,1
,1197],[1,1200,1,1198],[1,1201,1,1199],[1,1202,1,1200],[1,1203,1,1201],[1,1
204,1,1202],[1,1205,1,1203],[1,1206,1,1204],[1,1207,1,1205],[1,1208,1,1206]
,[1,1209,1,1207],[1,1210,1,1208],[1,1211,1,1209],[1,1212,1,1210],[1,1213,1,
1211],[1,1214,1,1212],[1,1215,1,1213],[1,1216,1,1214],[1,1217,1,1215],[1,12
18,1,1216],[1,1219,1,1217],[1,1220,1,1218],[1,1221,1,1219],[1,1222,1,1220],
[1,1223,1,1221],[1,1224,1,1222],[1,1225,1,1223],[1,1226,1,1224],[1,1227,1,1
225],[1,1228,1,1226],[1,1229,1,1227],[1,1230,1,1228],[1,1231,1,1229],[1,123
2,1,1230],[1,1233,1,1231],[1,1234,1,1232],[1,1235,1,1233],[1,1236,1,1234],[
1,1237,1,1235],[1,1238,1,1236],[1,1239,1,1237],[1,1240,1,1238],[1,1241,1,12
39],[1,1242,1,1240],[1,1243,1,1241],[1,1244,1,1242],[1,1245,1,1243],[1,1246
,1,1244],[1,1247,1,1245],[1,1248,1,1246],[1,1249,1,1247],[1,1250,1,1248],[1
,1251,1,1249],[1,1252,1,1250],[1,1253,1,1251],[1,1254,1,1252],[1,1255,1,125
3],[1,1256,1,1254],[1,1257,1,1255],[0,1257,1,1256],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-
1]],"num":1,"row":15},{"stap_colors":[[55,3355443],[97,8947848],[139,894784
8],[181,8947848],[223,8947848],[265,8947848],[307,13369344],[349,13369344],
[391,8947848],[433,8947848],[475,8947848],[517,8947848],[559,8947848],[601,
8947848],[643,8947848],[685,8947848],[727,8947848],[769,8947848],[811,89478
48],[853,8947848],[895,8947848],[937,8947848],[979,8947848],[1021,8947848],
[1063,8947848],[1105,8947848],[1147,8947848],[1189,29184],[1231,29184],[127
1,3355443]],"col":13,"stap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[2,15,-1,-
1],[2,16,2,14],[2,17,2,15],[2,18,2,16],[2,19,2,17],[2,20,2,18],[2,21,2,19],
[2,22,2,20],[2,23,2,21],[2,24,2,22],[2,25,2,23],[2,26,2,24],[2,27,2,25],[3,
27,2,26],[2,29,3,28],[2,30,2,28],[2,31,2,29],[2,32,2,30],[2,33,2,31],[2,34,
2,32],[2,35,2,33],[2,36,2,34],[2,37,2,35],[2,38,2,36],[2,39,2,37],[2,40,2,3
8],[2,41,2,39],[1,41,2,40],[2,43,1,42],[2,44,2,42],[2,45,2,43],[2,46,2,44],
[2,47,2,45],[2,48,2,46],[2,49,2,47],[2,50,2,48],[2,51,2,49],[2,52,2,50],[2,
53,2,51],[2,54,2,52],[2,55,2,53],[-1,-1,2,54],[2,57,-1,-
1],[2,58,2,56],[2,59,2,57],[2,60,2,58],[2,61,2,59],[2,62,2,60],[2,63,2,61],
[2,64,2,62],[2,65,2,63],[2,66,2,64],[2,67,2,65],[2,68,2,66],[2,69,2,67],[3,
69,2,68],[2,71,3,70],[2,72,2,70],[2,73,2,71],[2,74,2,72],[2,75,2,73],[2,76,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1573

2,74],[2,77,2,75],[2,78,2,76],[2,79,2,77],[2,80,2,78],[2,81,2,79],[2,82,2,8
0],[2,83,2,81],[1,83,2,82],[2,85,1,84],[2,86,2,84],[2,87,2,85],[2,88,2,86],
[2,89,2,87],[2,90,2,88],[2,91,2,89],[2,92,2,90],[2,93,2,91],[2,94,2,92],[2,
95,2,93],[2,96,2,94],[2,97,2,95],[-1,-1,2,96],[2,99,-1,-
1],[2,100,2,98],[2,101,2,99],[2,102,2,100],[2,103,2,101],[2,104,2,102],[2,1
05,2,103],[2,106,2,104],[2,107,2,105],[2,108,2,106],[2,109,2,107],[2,110,2,
108],[2,111,2,109],[3,111,2,110],[2,113,3,112],[2,114,2,112],[2,115,2,113],
[2,116,2,114],[2,117,2,115],[2,118,2,116],[2,119,2,117],[2,120,2,118],[2,12
1,2,119],[2,122,2,120],[2,123,2,121],[2,124,2,122],[2,125,2,123],[1,125,2,1
24],[2,127,1,126],[2,128,2,126],[2,129,2,127],[2,130,2,128],[2,131,2,129],[
2,132,2,130],[2,133,2,131],[2,134,2,132],[2,135,2,133],[2,136,2,134],[2,137
,2,135],[2,138,2,136],[2,139,2,137],[-1,-1,2,138],[2,141,-1,-
1],[2,142,2,140],[2,143,2,141],[2,144,2,142],[2,145,2,143],[2,146,2,144],[2
,147,2,145],[2,148,2,146],[2,149,2,147],[2,150,2,148],[2,151,2,149],[2,152,
2,150],[2,153,2,151],[3,153,2,152],[2,155,3,154],[2,156,2,154],[2,157,2,155
],[2,158,2,156],[2,159,2,157],[2,160,2,158],[2,161,2,159],[2,162,2,160],[2,
163,2,161],[2,164,2,162],[2,165,2,163],[2,166,2,164],[2,167,2,165],[1,167,2
,166],[2,169,1,168],[2,170,2,168],[2,171,2,169],[2,172,2,170],[2,173,2,171]
,[2,174,2,172],[2,175,2,173],[2,176,2,174],[2,177,2,175],[2,178,2,176],[2,1
79,2,177],[2,180,2,178],[2,181,2,179],[-1,-1,2,180],[2,183,-1,-
1],[2,184,2,182],[2,185,2,183],[2,186,2,184],[2,187,2,185],[2,188,2,186],[2
,189,2,187],[2,190,2,188],[2,191,2,189],[2,192,2,190],[2,193,2,191],[2,194,
2,192],[2,195,2,193],[3,195,2,194],[2,197,3,196],[2,198,2,196],[2,199,2,197
],[2,200,2,198],[2,201,2,199],[2,202,2,200],[2,203,2,201],[2,204,2,202],[2,
205,2,203],[2,206,2,204],[2,207,2,205],[2,208,2,206],[2,209,2,207],[1,209,2
,208],[2,211,1,210],[2,212,2,210],[2,213,2,211],[2,214,2,212],[2,215,2,213]
,[2,216,2,214],[2,217,2,215],[2,218,2,216],[2,219,2,217],[2,220,2,218],[2,2
21,2,219],[2,222,2,220],[2,223,2,221],[-1,-1,2,222],[2,225,-1,-
1],[2,226,2,224],[2,227,2,225],[2,228,2,226],[2,229,2,227],[2,230,2,228],[2
,231,2,229],[2,232,2,230],[2,233,2,231],[2,234,2,232],[2,235,2,233],[2,236,
2,234],[2,237,2,235],[3,237,2,236],[2,239,3,238],[2,240,2,238],[2,241,2,239
],[2,242,2,240],[2,243,2,241],[2,244,2,242],[2,245,2,243],[2,246,2,244],[2,
247,2,245],[2,248,2,246],[2,249,2,247],[2,250,2,248],[2,251,2,249],[1,251,2
,250],[2,253,1,252],[2,254,2,252],[2,255,2,253],[2,256,2,254],[2,257,2,255]
,[2,258,2,256],[2,259,2,257],[2,260,2,258],[2,261,2,259],[2,262,2,260],[2,2
63,2,261],[2,264,2,262],[2,265,2,263],[-1,-1,2,264],[2,267,-1,-
1],[2,268,2,266],[2,269,2,267],[2,270,2,268],[2,271,2,269],[2,272,2,270],[2
,273,2,271],[2,274,2,272],[2,275,2,273],[2,276,2,274],[2,277,2,275],[2,278,
2,276],[2,279,2,277],[3,279,2,278],[2,281,3,280],[2,282,2,280],[2,283,2,281
],[2,284,2,282],[2,285,2,283],[2,286,2,284],[2,287,2,285],[2,288,2,286],[2,
289,2,287],[2,290,2,288],[2,291,2,289],[2,292,2,290],[2,293,2,291],[1,293,2
,292],[2,295,1,294],[2,296,2,294],[2,297,2,295],[2,298,2,296],[2,299,2,297]
,[2,300,2,298],[2,301,2,299],[2,302,2,300],[2,303,2,301],[2,304,2,302],[2,3
05,2,303],[2,306,2,304],[2,307,2,305],[-1,-1,2,306],[2,309,-1,-
1],[2,310,2,308],[2,311,2,309],[2,312,2,310],[2,313,2,311],[2,314,2,312],[2
,315,2,313],[2,316,2,314],[2,317,2,315],[2,318,2,316],[2,319,2,317],[2,320,
2,318],[2,321,2,319],[3,321,2,320],[2,323,3,322],[2,324,2,322],[2,325,2,323
],[2,326,2,324],[2,327,2,325],[2,328,2,326],[2,329,2,327],[2,330,2,328],[2,
331,2,329],[2,332,2,330],[2,333,2,331],[2,334,2,332],[2,335,2,333],[1,335,2
,334],[2,337,1,336],[2,338,2,336],[2,339,2,337],[2,340,2,338],[2,341,2,339]
,[2,342,2,340],[2,343,2,341],[2,344,2,342],[2,345,2,343],[2,346,2,344],[2,3
47,2,345],[2,348,2,346],[2,349,2,347],[-1,-1,2,348],[2,351,-1,-
1],[2,352,2,350],[2,353,2,351],[2,354,2,352],[2,355,2,353],[2,356,2,354],[2

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1574

,357,2,355],[2,358,2,356],[2,359,2,357],[2,360,2,358],[2,361,2,359],[2,362,2,360],[2,363,2,361],[3,363,2,362],[2,365,3,364],[2,366,2,364],[2,367,2,365],[2,368,2,366],[2,369,2,367],[2,370,2,368],[2,371,2,369],[2,372,2,370],[2,373,2,371],[2,374,2,372],[2,375,2,373],[2,376,2,374],[2,377,2,375],[1,377,2,376],[2,379,1,378],[2,380,2,378],[2,381,2,379],[2,382,2,380],[2,383,2,381],[2,384,2,382],[2,385,2,383],[2,386,2,384],[2,387,2,385],[2,388,2,386],[2,389,2,387],[2,390,2,388],[2,391,2,389],[-1,-1,2,390],[2,393,-1,-1],[2,394,2,392],[2,395,2,393],[2,396,2,394],[2,397,2,395],[2,398,2,396],[2,399,2,397],[2,400,2,398],[2,401,2,399],[2,402,2,400],[2,403,2,401],[2,404,2,402],[2,405,2,403],[3,405,2,404],[2,407,3,406],[2,408,2,406],[2,409,2,407],[2,410,2,408],[2,411,2,409],[2,412,2,410],[2,413,2,411],[2,414,2,412],[2,415,2,413],[2,416,2,414],[2,417,2,415],[2,418,2,416],[2,419,2,417],[1,419,2,418],[2,421,1,420],[2,422,2,420],[2,423,2,421],[2,424,2,422],[2,425,2,423],[2,426,2,424],[2,427,2,425],[2,428,2,426],[2,429,2,427],[2,430,2,428],[2,431,2,429],[2,432,2,430],[2,433,2,431],[-1,-1,2,432],[2,435,-1,-1],[2,436,2,434],[2,437,2,435],[2,438,2,436],[2,439,2,437],[2,440,2,438],[2,441,2,439],[2,442,2,440],[2,443,2,441],[2,444,2,442],[2,445,2,443],[2,446,2,444],[2,447,2,445],[3,447,2,446],[2,449,3,448],[2,450,2,448],[2,451,2,449],[2,452,2,450],[2,453,2,451],[2,454,2,452],[2,455,2,453],[2,456,2,454],[2,457,2,455],[2,458,2,456],[2,459,2,457],[2,460,2,458],[2,461,2,459],[1,461,2,460],[2,463,1,462],[2,464,2,462],[2,465,2,463],[2,466,2,464],[2,467,2,465],[2,468,2,466],[2,469,2,467],[2,470,2,468],[2,471,2,469],[2,472,2,470],[2,473,2,471],[2,474,2,472],[2,475,2,473],[-1,-1,2,474],[2,477,-1,-1],[2,478,2,476],[2,479,2,477],[2,480,2,478],[2,481,2,479],[2,482,2,480],[2,483,2,481],[2,484,2,482],[2,485,2,483],[2,486,2,484],[2,487,2,485],[2,488,2,486],[2,489,2,487],[3,489,2,488],[2,491,3,490],[2,492,2,490],[2,493,2,491],[2,494,2,492],[2,495,2,493],[2,496,2,494],[2,497,2,495],[2,498,2,496],[2,499,2,497],[2,500,2,498],[2,501,2,499],[2,502,2,500],[2,503,2,501],[1,503,2,502],[2,505,1,504],[2,506,2,504],[2,507,2,505],[2,508,2,506],[2,509,2,507],[2,510,2,508],[2,511,2,509],[2,512,2,510],[2,513,2,511],[2,514,2,512],[2,515,2,513],[2,516,2,514],[2,517,2,515],[-1,-1,2,516],[2,519,-1,-1],[2,520,2,518],[2,521,2,519],[2,522,2,520],[2,523,2,521],[2,524,2,522],[2,525,2,523],[2,526,2,524],[2,527,2,525],[2,528,2,526],[2,529,2,527],[2,530,2,528],[2,531,2,529],[3,531,2,530],[2,533,3,532],[2,534,2,532],[2,535,2,533],[2,536,2,534],[2,537,2,535],[2,538,2,536],[2,539,2,537],[2,540,2,538],[2,541,2,539],[2,542,2,540],[2,543,2,541],[2,544,2,542],[2,545,2,543],[1,545,2,544],[2,547,1,546],[2,548,2,546],[2,549,2,547],[2,550,2,548],[2,551,2,549],[2,552,2,550],[2,553,2,551],[2,554,2,552],[2,555,2,553],[2,556,2,554],[2,557,2,555],[2,558,2,556],[2,559,2,557],[-1,-1,2,558],[2,561,-1,-1],[2,562,2,560],[2,563,2,561],[2,564,2,562],[2,565,2,563],[2,566,2,564],[2,567,2,565],[2,568,2,566],[2,569,2,567],[2,570,2,568],[2,571,2,569],[2,572,2,570],[2,573,2,571],[3,573,2,572],[2,575,3,574],[2,576,2,574],[2,577,2,575],[2,578,2,576],[2,579,2,577],[2,580,2,578],[2,581,2,579],[2,582,2,580],[2,583,2,581],[2,584,2,582],[2,585,2,583],[2,586,2,584],[2,587,2,585],[1,587,2,586],[2,589,1,588],[2,590,2,588],[2,591,2,589],[2,592,2,590],[2,593,2,591],[2,594,2,592],[2,595,2,593],[2,596,2,594],[2,597,2,595],[2,598,2,596],[2,599,2,597],[2,600,2,598],[2,601,2,599],[-1,-1,2,600],[2,603,-1,-1],[2,604,2,602],[2,605,2,603],[2,606,2,604],[2,607,2,605],[2,608,2,606],[2,609,2,607],[2,610,2,608],[2,611,2,609],[2,612,2,610],[2,613,2,611],[2,614,2,612],[2,615,2,613],[3,615,2,614],[2,617,3,616],[2,618,2,616],[2,619,2,617],[2,620,2,618],[2,621,2,619],[2,622,2,620],[2,623,2,621],[2,624,2,622],[2,625,2,623],[2,626,2,624],[2,627,2,625],[2,628,2,626],[2,629,2,627],[1,629,2,628],[2,631,1,630],[2,632,2,630],[2,633,2,631],[2,634,2,632],[2,635,2,633]

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1575

,[2,636,2,634],[2,637,2,635],[2,638,2,636],[2,639,2,637],[2,640,2,638],[2,6
41,2,639],[2,642,2,640],[2,643,2,641],[-1,-1,2,642],[2,645,-1,-
1],[2,646,2,644],[2,647,2,645],[2,648,2,646],[2,649,2,647],[2,650,2,648],[2
,651,2,649],[2,652,2,650],[2,653,2,651],[2,654,2,652],[2,655,2,653],[2,656,
2,654],[2,657,2,655],[3,657,2,656],[2,659,3,658],[2,660,2,658],[2,661,2,659
],[2,662,2,660],[2,663,2,661],[2,664,2,662],[2,665,2,663],[2,666,2,664],[2,
667,2,665],[2,668,2,666],[2,669,2,667],[2,670,2,668],[2,671,2,669],[1,671,2
,670],[2,673,1,672],[2,674,2,672],[2,675,2,673],[2,676,2,674],[2,677,2,675]
,[2,678,2,676],[2,679,2,677],[2,680,2,678],[2,681,2,679],[2,682,2,680],[2,6
83,2,681],[2,684,2,682],[2,685,2,683],[-1,-1,2,684],[2,687,-1,-
1],[2,688,2,686],[2,689,2,687],[2,690,2,688],[2,691,2,689],[2,692,2,690],[2
,693,2,691],[2,694,2,692],[2,695,2,693],[2,696,2,694],[2,697,2,695],[2,698,
2,696],[2,699,2,697],[3,699,2,698],[2,701,3,700],[2,702,2,700],[2,703,2,701
],[2,704,2,702],[2,705,2,703],[2,706,2,704],[2,707,2,705],[2,708,2,706],[2,
709,2,707],[2,710,2,708],[2,711,2,709],[2,712,2,710],[2,713,2,711],[1,713,2
,712],[2,715,1,714],[2,716,2,714],[2,717,2,715],[2,718,2,716],[2,719,2,717]
,[2,720,2,718],[2,721,2,719],[2,722,2,720],[2,723,2,721],[2,724,2,722],[2,7
25,2,723],[2,726,2,724],[2,727,2,725],[-1,-1,2,726],[2,729,-1,-
1],[2,730,2,728],[2,731,2,729],[2,732,2,730],[2,733,2,731],[2,734,2,732],[2
,735,2,733],[2,736,2,734],[2,737,2,735],[2,738,2,736],[2,739,2,737],[2,740,
2,738],[2,741,2,739],[3,741,2,740],[2,743,3,742],[2,744,2,742],[2,745,2,743
],[2,746,2,744],[2,747,2,745],[2,748,2,746],[2,749,2,747],[2,750,2,748],[2,
751,2,749],[2,752,2,750],[2,753,2,751],[2,754,2,752],[2,755,2,753],[1,755,2
,754],[2,757,1,756],[2,758,2,756],[2,759,2,757],[2,760,2,758],[2,761,2,759]
,[2,762,2,760],[2,763,2,761],[2,764,2,762],[2,765,2,763],[2,766,2,764],[2,7
67,2,765],[2,768,2,766],[2,769,2,767],[-1,-1,2,768],[2,771,-1,-
1],[2,772,2,770],[2,773,2,771],[2,774,2,772],[2,775,2,773],[2,776,2,774],[2
,777,2,775],[2,778,2,776],[2,779,2,777],[2,780,2,778],[2,781,2,779],[2,782,
2,780],[2,783,2,781],[3,783,2,782],[2,785,3,784],[2,786,2,784],[2,787,2,785
],[2,788,2,786],[2,789,2,787],[2,790,2,788],[2,791,2,789],[2,792,2,790],[2,
793,2,791],[2,794,2,792],[2,795,2,793],[2,796,2,794],[2,797,2,795],[1,797,2
,796],[2,799,1,798],[2,800,2,798],[2,801,2,799],[2,802,2,800],[2,803,2,801]
,[2,804,2,802],[2,805,2,803],[2,806,2,804],[2,807,2,805],[2,808,2,806],[2,8
09,2,807],[2,810,2,808],[2,811,2,809],[-1,-1,2,810],[2,813,-1,-
1],[2,814,2,812],[2,815,2,813],[2,816,2,814],[2,817,2,815],[2,818,2,816],[2
,819,2,817],[2,820,2,818],[2,821,2,819],[2,822,2,820],[2,823,2,821],[2,824,
2,822],[2,825,2,823],[3,825,2,824],[2,827,3,826],[2,828,2,826],[2,829,2,827
],[2,830,2,828],[2,831,2,829],[2,832,2,830],[2,833,2,831],[2,834,2,832],[2,
835,2,833],[2,836,2,834],[2,837,2,835],[2,838,2,836],[2,839,2,837],[1,839,2
,838],[2,841,1,840],[2,842,2,840],[2,843,2,841],[2,844,2,842],[2,845,2,843]
,[2,846,2,844],[2,847,2,845],[2,848,2,846],[2,849,2,847],[2,850,2,848],[2,8
51,2,849],[2,852,2,850],[2,853,2,851],[-1,-1,2,852],[2,855,-1,-
1],[2,856,2,854],[2,857,2,855],[2,858,2,856],[2,859,2,857],[2,860,2,858],[2
,861,2,859],[2,862,2,860],[2,863,2,861],[2,864,2,862],[2,865,2,863],[2,866,
2,864],[2,867,2,865],[3,867,2,866],[2,869,3,868],[2,870,2,868],[2,871,2,869
],[2,872,2,870],[2,873,2,871],[2,874,2,872],[2,875,2,873],[2,876,2,874],[2,
877,2,875],[2,878,2,876],[2,879,2,877],[2,880,2,878],[2,881,2,879],[1,881,2
,880],[2,883,1,882],[2,884,2,882],[2,885,2,883],[2,886,2,884],[2,887,2,885]
,[2,888,2,886],[2,889,2,887],[2,890,2,888],[2,891,2,889],[2,892,2,890],[2,8
93,2,891],[2,894,2,892],[2,895,2,893],[-1,-1,2,894],[2,897,-1,-
1],[2,898,2,896],[2,899,2,897],[2,900,2,898],[2,901,2,899],[2,902,2,900],[2
,903,2,901],[2,904,2,902],[2,905,2,903],[2,906,2,904],[2,907,2,905],[2,908,
2,906],[2,909,2,907],[3,909,2,908],[2,911,3,910],[2,912,2,910],[2,913,2,911

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1576

],[2,914,2,912],[2,915,2,913],[2,916,2,914],[2,917,2,915],[2,918,2,916],[2,919,2,917],[2,920,2,918],[2,921,2,919],[2,922,2,920],[2,923,2,921],[1,923,2,922],[2,925,1,924],[2,926,2,924],[2,927,2,925],[2,928,2,926],[2,929,2,927],[2,930,2,928],[2,931,2,929],[2,932,2,930],[2,933,2,931],[2,934,2,932],[2,935,2,933],[2,936,2,934],[2,937,2,935],[-1,-1,2,936],[2,939,-1,-1],[2,940,2,938],[2,941,2,939],[2,942,2,940],[2,943,2,941],[2,944,2,942],[2,945,2,943],[2,946,2,944],[2,947,2,945],[2,948,2,946],[2,949,2,947],[2,950,2,948],[2,951,2,949],[3,951,2,950],[2,953,3,952],[2,954,2,952],[2,955,2,953],[2,956,2,954],[2,957,2,955],[2,958,2,956],[2,959,2,957],[2,960,2,958],[2,961,2,959],[2,962,2,960],[2,963,2,961],[2,964,2,962],[2,965,2,963],[1,965,2,964],[2,967,1,966],[2,968,2,966],[2,969,2,967],[2,970,2,968],[2,971,2,969],[2,972,2,970],[2,973,2,971],[2,974,2,972],[2,975,2,973],[2,976,2,974],[2,977,2,975],[2,978,2,976],[2,979,2,977],[-1,-1,2,978],[2,981,-1,-1],[2,982,2,980],[2,983,2,981],[2,984,2,982],[2,985,2,983],[2,986,2,984],[2,987,2,985],[2,988,2,986],[2,989,2,987],[2,990,2,988],[2,991,2,989],[2,992,2,990],[2,993,2,991],[3,993,2,992],[2,995,3,994],[2,996,2,994],[2,997,2,995],[2,998,2,996],[2,999,2,997],[2,1000,2,998],[2,1001,2,999],[2,1002,2,1000],[2,1003,2,1001],[2,1004,2,1002],[2,1005,2,1003],[2,1006,2,1004],[2,1007,2,1005],[1,1007,2,1006],[2,1009,1,1008],[2,1010,2,1008],[2,1011,2,1009],[2,1012,2,1010],[2,1013,2,1011],[2,1014,2,1012],[2,1015,2,1013],[2,1016,2,1014],[2,1017,2,1015],[2,1018,2,1016],[2,1019,2,1017],[2,1020,2,1018],[2,1021,2,1019],[-1,-1,2,1020],[2,1023,-1,-1],[2,1024,2,1022],[2,1025,2,1023],[2,1026,2,1024],[2,1027,2,1025],[2,1028,2,1026],[2,1029,2,1027],[2,1030,2,1028],[2,1031,2,1029],[2,1032,2,1030],[2,1033,2,1031],[2,1034,2,1032],[2,1035,2,1033],[3,1035,2,1034],[2,1037,3,1036],[2,1038,2,1036],[2,1039,2,1037],[2,1040,2,1038],[2,1041,2,1039],[2,1042,2,1040],[2,1043,2,1041],[2,1044,2,1042],[2,1045,2,1043],[2,1046,2,1044],[2,1047,2,1045],[2,1048,2,1046],[2,1049,2,1047],[1,1049,2,1048],[2,1051,1,1050],[2,1052,2,1050],[2,1053,2,1051],[2,1054,2,1052],[2,1055,2,1053],[2,1056,2,1054],[2,1057,2,1055],[2,1058,2,1056],[2,1059,2,1057],[2,1060,2,1058],[2,1061,2,1059],[2,1062,2,1060],[2,1063,2,1061],[-1,-1,2,1062],[2,1065,-1,-1],[2,1066,2,1064],[2,1067,2,1065],[2,1068,2,1066],[2,1069,2,1067],[2,1070,2,1068],[2,1071,2,1069],[2,1072,2,1070],[2,1073,2,1071],[2,1074,2,1072],[2,1075,2,1073],[2,1076,2,1074],[2,1077,2,1075],[3,1077,2,1076],[2,1079,3,1078],[2,1080,2,1078],[2,1081,2,1079],[2,1082,2,1080],[2,1083,2,1081],[2,1084,2,1082],[2,1085,2,1083],[2,1086,2,1084],[2,1087,2,1085],[2,1088,2,1086],[2,1089,2,1087],[2,1090,2,1088],[2,1091,2,1089],[1,1091,2,1090],[2,1093,1,1092],[2,1094,2,1092],[2,1095,2,1093],[2,1096,2,1094],[2,1097,2,1095],[2,1098,2,1096],[2,1099,2,1097],[2,1100,2,1098],[2,1101,2,1099],[2,1102,2,1100],[2,1103,2,1101],[2,1104,2,1102],[2,1105,2,1103],[-1,-1,2,1104],[2,1107,-1,-1],[2,1108,2,1106],[2,1109,2,1107],[2,1110,2,1108],[2,1111,2,1109],[2,1112,2,1110],[2,1113,2,1111],[2,1114,2,1112],[2,1115,2,1113],[2,1116,2,1114],[2,1117,2,1115],[2,1118,2,1116],[2,1119,2,1117],[3,1119,2,1118],[2,1121,3,1120],[2,1122,2,1120],[2,1123,2,1121],[2,1124,2,1122],[2,1125,2,1123],[2,1126,2,1124],[2,1127,2,1125],[2,1128,2,1126],[2,1129,2,1127],[2,1130,2,1128],[2,1131,2,1129],[2,1132,2,1130],[2,1133,2,1131],[1,1133,2,1132],[2,1135,1,1134],[2,1136,2,1134],[2,1137,2,1135],[2,1138,2,1136],[2,1139,2,1137],[2,1140,2,1138],[2,1141,2,1139],[2,1142,2,1140],[2,1143,2,1141],[2,1144,2,1142],[2,1145,2,1143],[2,1146,2,1144],[2,1147,2,1145],[-1,-1,2,1146],[2,1149,-1,-1],[2,1150,2,1148],[2,1151,2,1149],[2,1152,2,1150],[2,1153,2,1151],[2,1154,2,1152],[2,1155,2,1153],[2,1156,2,1154],[2,1157,2,1155],[2,1158,2,1156],[2,1159,2,1157],[2,1160,2,1158],[2,1161,2,1159],[3,1161,2,1160],[2,1163,3,1162],[2,1164,2,1162],[2,1165,2,1163],[2,1166,2,1164],[2,1167,2,1165],[2,1168,2

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1577

,1166],[2,1169,2,1167],[2,1170,2,1168],[2,1171,2,1169],[2,1172,2,1170],[2,1
173,2,1171],[2,1174,2,1172],[2,1175,2,1173],[1,1175,2,1174],[2,1177,1,1176]
,[2,1178,2,1176],[2,1179,2,1177],[2,1180,2,1178],[2,1181,2,1179],[2,1182,2,
1180],[2,1183,2,1181],[2,1184,2,1182],[2,1185,2,1183],[2,1186,2,1184],[2,11
87,2,1185],[2,1188,2,1186],[2,1189,2,1187],[-1,-1,2,1188],[2,1191,-1,-
1],[2,1192,2,1190],[2,1193,2,1191],[2,1194,2,1192],[2,1195,2,1193],[2,1196,
2,1194],[2,1197,2,1195],[2,1198,2,1196],[2,1199,2,1197],[2,1200,2,1198],[2,
1201,2,1199],[2,1202,2,1200],[2,1203,2,1201],[3,1203,2,1202],[2,1205,3,1204
],[2,1206,2,1204],[2,1207,2,1205],[2,1208,2,1206],[2,1209,2,1207],[2,1210,2
,1208],[2,1211,2,1209],[2,1212,2,1210],[2,1213,2,1211],[2,1214,2,1212],[2,1
215,2,1213],[2,1216,2,1214],[2,1217,2,1215],[1,1217,2,1216],[2,1219,1,1218]
,[2,1220,2,1218],[2,1221,2,1219],[2,1222,2,1220],[2,1223,2,1221],[2,1224,2,
1222],[2,1225,2,1223],[2,1226,2,1224],[2,1227,2,1225],[2,1228,2,1226],[2,12
29,2,1227],[2,1230,2,1228],[2,1231,2,1229],[-1,-1,2,1230],[2,1233,-1,-
1],[2,1234,2,1232],[2,1235,2,1233],[2,1236,2,1234],[2,1237,2,1235],[2,1238,
2,1236],[2,1239,2,1237],[2,1240,2,1238],[2,1241,2,1239],[2,1242,2,1240],[2,
1243,2,1241],[2,1244,2,1242],[2,1245,2,1243],[2,1246,2,1244],[2,1247,2,1245
],[2,1248,2,1246],[2,1249,2,1247],[2,1250,2,1248],[2,1251,2,1249],[2,1252,2
,1250],[2,1253,2,1251],[2,1254,2,1252],[2,1255,2,1253],[2,1256,2,1254],[2,1
257,2,1255],[2,1258,2,1256],[2,1259,2,1257],[2,1260,2,1258],[2,1261,2,1259]
,[2,1262,2,1260],[2,1263,2,1261],[2,1264,2,1262],[2,1265,2,1263],[2,1266,2,
1264],[2,1267,2,1265],[2,1268,2,1266],[2,1269,2,1267],[2,1270,2,1268],[2,12
71,2,1269],[-1,-1,2,1270],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1578

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[3,54,2,55],[2,54,2,56],[2,55,2,57],[2,56,2,58],[2,57,2,59],[2,58,2,60],
[2,59,2,61],[2,60,2,62],[2,61,2,63],[2,62,2,64],[2,63,2,65],[2,64,2,66],[2,
65,2,67],[2,66,2,68],[2,67,2,69],[2,68,2,70],[2,69,2,71],[2,70,2,72],[2,71,
2,73],[2,72,2,74],[2,73,2,75],[2,74,2,76],[2,75,2,77],[2,76,2,78],[2,77,2,7
9],[2,78,2,80],[2,79,2,81],[2,80,2,82],[2,81,2,83],[2,82,2,84],[2,83,2,85],
[2,84,2,86],[2,85,2,87],[2,86,2,88],[2,87,2,89],[2,88,2,90],[2,89,2,91],[2,
90,2,92],[2,91,2,93],[2,92,2,94],[2,93,2,95],[2,94,2,96],[2,95,2,97],[2,96,
2,98],[2,97,2,99],[2,98,2,100],[2,99,2,101],[2,100,2,102],[2,101,2,103],[2,
102,2,104],[2,103,2,105],[2,104,2,106],[2,105,2,107],[2,106,2,108],[2,107,2
,109],[2,108,2,110],[2,109,2,111],[2,110,2,112],[2,111,2,113],[2,112,2,114]
,[2,113,2,115],[2,114,2,116],[2,115,2,117],[2,116,2,118],[2,117,2,119],[2,1
18,2,120],[2,119,2,121],[2,120,2,122],[2,121,2,123],[2,122,2,124],[2,123,2,
125],[2,124,2,126],[2,125,2,127],[2,126,2,128],[2,127,2,129],[2,128,2,130],
[2,129,2,131],[2,130,2,132],[2,131,2,133],[2,132,2,134],[2,133,2,135],[2,13
4,2,136],[2,135,2,137],[2,136,2,138],[2,137,2,139],[2,138,2,140],[2,139,2,1
41],[2,140,2,142],[2,141,2,143],[2,142,2,144],[2,143,2,145],[2,144,2,146],[
2,145,2,147],[2,146,2,148],[2,147,2,149],[2,148,2,150],[2,149,2,151],[2,150
,2,152],[2,151,2,153],[2,152,2,154],[2,153,2,155],[2,154,2,156],[2,155,2,15
7],[2,156,2,158],[2,157,2,159],[2,158,2,160],[2,159,2,161],[2,160,2,162],[2
,161,2,163],[2,162,2,164],[2,163,2,165],[2,164,2,166],[2,165,2,167],[2,166,
2,168],[2,167,2,169],[2,168,2,170],[2,169,2,171],[2,170,2,172],[2,171,2,173
],[2,172,2,174],[2,173,2,175],[2,174,2,176],[2,175,2,177],[2,176,2,178],[2,
177,2,179],[2,178,2,180],[2,179,2,181],[2,180,2,182],[2,181,2,183],[2,182,2
,184],[2,183,2,185],[2,184,2,186],[2,185,2,187],[2,186,2,188],[2,187,2,189]
,[2,188,2,190],[2,189,2,191],[2,190,2,192],[2,191,2,193],[2,192,2,194],[2,1
93,2,195],[2,194,2,196],[2,195,2,197],[2,196,2,198],[2,197,2,199],[2,198,2,
200],[2,199,2,201],[2,200,2,202],[2,201,2,203],[2,202,2,204],[2,203,2,205],
[2,204,2,206],[2,205,2,207],[2,206,2,208],[2,207,2,209],[2,208,2,210],[2,20
9,2,211],[2,210,2,212],[2,211,2,213],[2,212,2,214],[2,213,2,215],[2,214,2,2
16],[2,215,2,217],[2,216,2,218],[2,217,2,219],[2,218,2,220],[2,219,2,221],[
2,220,2,222],[2,221,2,223],[2,222,2,224],[2,223,2,225],[2,224,2,226],[2,225
,2,227],[2,226,2,228],[2,227,2,229],[2,228,2,230],[2,229,2,231],[2,230,2,23
2],[2,231,2,233],[2,232,2,234],[2,233,2,235],[2,234,2,236],[2,235,2,237],[2
,236,2,238],[2,237,2,239],[2,238,2,240],[2,239,2,241],[2,240,2,242],[2,241,
2,243],[2,242,2,244],[2,243,2,245],[2,244,2,246],[2,245,2,247],[2,246,2,248
],[2,247,2,249],[2,248,2,250],[2,249,2,251],[2,250,2,252],[2,251,2,253],[2,
252,2,254],[2,253,2,255],[2,254,2,256],[2,255,2,257],[2,256,2,258],[2,257,2
,259],[2,258,2,260],[2,259,2,261],[2,260,2,262],[2,261,2,263],[2,262,2,264]
,[2,263,2,265],[2,264,2,266],[2,265,2,267],[2,266,2,268],[2,267,2,269],[2,2

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1580

68,2,270],[2,269,2,271],[2,270,2,272],[2,271,2,273],[2,272,2,274],[2,273,2,
275],[2,274,2,276],[2,275,2,277],[2,276,2,278],[2,277,2,279],[2,278,2,280],
[2,279,2,281],[2,280,2,282],[2,281,2,283],[2,282,2,284],[2,283,2,285],[2,28
4,2,286],[2,285,2,287],[2,286,2,288],[2,287,2,289],[2,288,2,290],[2,289,2,2
91],[2,290,2,292],[2,291,2,293],[2,292,2,294],[2,293,2,295],[2,294,2,296],[
2,295,2,297],[2,296,2,298],[2,297,2,299],[2,298,2,300],[2,299,2,301],[2,300
,2,302],[2,301,2,303],[2,302,2,304],[2,303,2,305],[2,304,2,306],[2,305,2,30
7],[2,306,2,308],[2,307,2,309],[2,308,2,310],[2,309,2,311],[2,310,2,312],[2
,311,2,313],[2,312,2,314],[2,313,2,315],[2,314,2,316],[2,315,2,317],[2,316,
2,318],[2,317,2,319],[2,318,2,320],[2,319,2,321],[2,320,2,322],[2,321,2,323
],[2,322,2,324],[2,323,2,325],[2,324,2,326],[2,325,2,327],[2,326,2,328],[2,
327,2,329],[2,328,2,330],[2,329,2,331],[2,330,2,332],[2,331,2,333],[2,332,2
,334],[2,333,2,335],[2,334,2,336],[2,335,2,337],[2,336,2,338],[2,337,2,339]
,[2,338,2,340],[2,339,2,341],[2,340,2,342],[2,341,2,343],[2,342,2,344],[2,3
43,2,345],[2,344,2,346],[2,345,2,347],[2,346,2,348],[2,347,2,349],[2,348,2,
350],[2,349,2,351],[2,350,2,352],[2,351,2,353],[2,352,2,354],[2,353,2,355],
[2,354,2,356],[2,355,2,357],[2,356,2,358],[2,357,2,359],[2,358,2,360],[2,35
9,2,361],[2,360,2,362],[2,361,2,363],[2,362,2,364],[2,363,2,365],[2,364,2,3
66],[2,365,2,367],[2,366,2,368],[2,367,2,369],[2,368,2,370],[2,369,2,371],[
2,370,2,372],[2,371,2,373],[2,372,2,374],[2,373,2,375],[2,374,2,376],[2,375
,2,377],[2,376,2,378],[2,377,2,379],[2,378,2,380],[2,379,2,381],[2,380,2,38
2],[2,381,2,383],[2,382,2,384],[2,383,2,385],[2,384,2,386],[2,385,2,387],[2
,386,2,388],[2,387,2,389],[2,388,2,390],[2,389,2,391],[2,390,2,392],[2,391,
2,393],[2,392,2,394],[2,393,2,395],[2,394,2,396],[2,395,2,397],[2,396,2,398
],[2,397,2,399],[2,398,2,400],[2,399,2,401],[2,400,2,402],[2,401,2,403],[2,
402,2,404],[2,403,2,405],[2,404,2,406],[2,405,2,407],[2,406,2,408],[2,407,2
,409],[2,408,2,410],[2,409,2,411],[2,410,2,412],[2,411,2,413],[2,412,2,414]
,[2,413,2,415],[2,414,2,416],[2,415,2,417],[2,416,2,418],[2,417,2,419],[2,4
18,2,420],[2,419,2,421],[2,420,2,422],[2,421,2,423],[2,422,2,424],[2,423,2,
425],[2,424,2,426],[2,425,2,427],[2,426,2,428],[2,427,2,429],[2,428,2,430],
[2,429,2,431],[2,430,2,432],[2,431,2,433],[2,432,2,434],[2,433,2,435],[2,43
4,2,436],[2,435,2,437],[2,436,2,438],[2,437,2,439],[2,438,2,440],[2,439,2,4
41],[2,440,2,442],[2,441,2,443],[2,442,2,444],[2,443,2,445],[2,444,2,446],[
2,445,2,447],[2,446,2,448],[2,447,2,449],[2,448,2,450],[2,449,2,451],[2,450
,2,452],[2,451,2,453],[2,452,2,454],[2,453,2,455],[2,454,2,456],[2,455,2,45
7],[2,456,2,458],[2,457,2,459],[2,458,2,460],[2,459,2,461],[2,460,2,462],[2
,461,2,463],[2,462,2,464],[2,463,2,465],[2,464,2,466],[2,465,2,467],[2,466,
2,468],[2,467,2,469],[2,468,2,470],[2,469,2,471],[2,470,2,472],[2,471,2,473
],[2,472,2,474],[2,473,2,475],[2,474,2,476],[2,475,2,477],[2,476,2,478],[2,
477,2,479],[2,478,2,480],[2,479,2,481],[2,480,2,482],[2,481,2,483],[2,482,2
,484],[2,483,2,485],[2,484,2,486],[2,485,2,487],[2,486,2,488],[2,487,2,489]
,[2,488,2,490],[2,489,2,491],[2,490,2,492],[2,491,2,493],[2,492,2,494],[2,4
93,2,495],[2,494,2,496],[2,495,2,497],[2,496,2,498],[2,497,2,499],[2,498,2,
500],[2,499,2,501],[2,500,2,502],[2,501,2,503],[2,502,2,504],[2,503,2,505],
[2,504,2,506],[2,505,2,507],[2,506,2,508],[2,507,2,509],[2,508,2,510],[2,50
9,2,511],[2,510,2,512],[2,511,2,513],[2,512,2,514],[2,513,2,515],[2,514,2,5
16],[2,515,2,517],[2,516,2,518],[2,517,2,519],[2,518,2,520],[2,519,2,521],[
2,520,2,522],[2,521,2,523],[2,522,2,524],[2,523,2,525],[2,524,2,526],[2,525
,2,527],[2,526,2,528],[2,527,2,529],[2,528,2,530],[2,529,2,531],[2,530,2,53
2],[2,531,2,533],[2,532,2,534],[2,533,2,535],[2,534,2,536],[2,535,2,537],[2
,536,2,538],[2,537,2,539],[2,538,2,540],[2,539,2,541],[2,540,2,542],[2,541,
2,543],[2,542,2,544],[2,543,2,545],[2,544,2,546],[2,545,2,547],[2,546,2,548
],[2,547,2,549],[2,548,2,550],[2,549,2,551],[2,550,2,552],[2,551,2,553],[2,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1581

552,2,554],[2,553,2,555],[2,554,2,556],[2,555,2,557],[2,556,2,558],[2,557,2
,559],[2,558,2,560],[2,559,2,561],[2,560,2,562],[2,561,2,563],[2,562,2,564]
,[2,563,2,565],[2,564,2,566],[2,565,2,567],[2,566,2,568],[2,567,2,569],[2,5
68,2,570],[2,569,2,571],[2,570,2,572],[2,571,2,573],[2,572,2,574],[2,573,2,
575],[2,574,2,576],[2,575,2,577],[2,576,2,578],[2,577,2,579],[2,578,2,580],
[2,579,2,581],[2,580,2,582],[2,581,2,583],[2,582,2,584],[2,583,2,585],[2,58
4,2,586],[2,585,2,587],[2,586,2,588],[2,587,2,589],[2,588,2,590],[2,589,2,5
91],[2,590,2,592],[2,591,2,593],[2,592,2,594],[2,593,2,595],[2,594,2,596],[
2,595,2,597],[2,596,2,598],[2,597,2,599],[2,598,2,600],[2,599,2,601],[2,600
,2,602],[2,601,2,603],[2,602,2,604],[2,603,2,605],[2,604,2,606],[2,605,2,60
7],[2,606,2,608],[2,607,2,609],[2,608,2,610],[2,609,2,611],[2,610,2,612],[2
,611,2,613],[2,612,2,614],[2,613,2,615],[2,614,2,616],[2,615,2,617],[2,616,
2,618],[2,617,2,619],[2,618,2,620],[2,619,2,621],[2,620,2,622],[2,621,2,623
],[2,622,2,624],[2,623,2,625],[2,624,2,626],[2,625,2,627],[2,626,2,628],[2,
627,2,629],[2,628,2,630],[2,629,2,631],[2,630,2,632],[2,631,2,633],[2,632,2
,634],[2,633,2,635],[2,634,2,636],[2,635,2,637],[2,636,2,638],[2,637,2,639]
,[2,638,2,640],[2,639,2,641],[2,640,2,642],[2,641,2,643],[2,642,2,644],[2,6
43,2,645],[2,644,1,645],[1,646,2,647],[2,646,2,648],[2,647,2,649],[2,648,2,
650],[2,649,2,651],[2,650,2,652],[2,651,2,653],[2,652,2,654],[2,653,2,655],
[2,654,2,656],[2,655,2,657],[2,656,2,658],[2,657,2,659],[2,658,2,660],[2,65
9,2,661],[2,660,2,662],[2,661,2,663],[2,662,2,664],[2,663,2,665],[2,664,2,6
66],[2,665,2,667],[2,666,2,668],[2,667,2,669],[2,668,2,670],[2,669,2,671],[
2,670,2,672],[2,671,2,673],[2,672,2,674],[2,673,2,675],[2,674,2,676],[2,675
,2,677],[2,676,2,678],[2,677,2,679],[2,678,2,680],[2,679,2,681],[2,680,2,68
2],[2,681,2,683],[2,682,2,684],[2,683,2,685],[2,684,2,686],[2,685,2,687],[2
,686,2,688],[2,687,2,689],[2,688,2,690],[2,689,2,691],[2,690,2,692],[2,691,
2,693],[2,692,2,694],[2,693,2,695],[2,694,2,696],[2,695,2,697],[2,696,2,698
],[2,697,2,699],[2,698,2,700],[2,699,2,701],[2,700,2,702],[2,701,2,703],[2,
702,2,704],[2,703,2,705],[2,704,2,706],[2,705,2,707],[2,706,2,708],[2,707,2
,709],[2,708,2,710],[2,709,2,711],[2,710,2,712],[2,711,2,713],[2,712,2,714]
,[2,713,2,715],[2,714,2,716],[2,715,2,717],[2,716,2,718],[2,717,2,719],[2,7
18,2,720],[2,719,2,721],[2,720,2,722],[2,721,2,723],[2,722,2,724],[2,723,2,
725],[2,724,2,726],[2,725,2,727],[2,726,2,728],[2,727,2,729],[2,728,2,730],
[2,729,2,731],[2,730,2,732],[2,731,2,733],[2,732,2,734],[2,733,2,735],[2,73
4,2,736],[2,735,2,737],[2,736,2,738],[2,737,2,739],[2,738,2,740],[2,739,2,7
41],[2,740,2,742],[2,741,2,743],[2,742,2,744],[2,743,2,745],[2,744,2,746],[
2,745,2,747],[2,746,2,748],[2,747,2,749],[2,748,2,750],[2,749,2,751],[2,750
,2,752],[2,751,2,753],[2,752,2,754],[2,753,2,755],[2,754,2,756],[2,755,2,75
7],[2,756,2,758],[2,757,2,759],[2,758,2,760],[2,759,2,761],[2,760,2,762],[2
,761,2,763],[2,762,2,764],[2,763,2,765],[2,764,2,766],[2,765,2,767],[2,766,
2,768],[2,767,2,769],[2,768,2,770],[2,769,2,771],[2,770,2,772],[2,771,2,773
],[2,772,2,774],[2,773,2,775],[2,774,2,776],[2,775,2,777],[2,776,2,778],[2,
777,2,779],[2,778,2,780],[2,779,2,781],[2,780,2,782],[2,781,2,783],[2,782,2
,784],[2,783,2,785],[2,784,2,786],[2,785,2,787],[2,786,2,788],[2,787,2,789]
,[2,788,2,790],[2,789,2,791],[2,790,2,792],[2,791,2,793],[2,792,2,794],[2,7
93,2,795],[2,794,2,796],[2,795,2,797],[2,796,2,798],[2,797,2,799],[2,798,2,
800],[2,799,2,801],[2,800,2,802],[2,801,2,803],[2,802,2,804],[2,803,2,805],
[2,804,2,806],[2,805,2,807],[2,806,2,808],[2,807,2,809],[2,808,2,810],[2,80
9,2,811],[2,810,2,812],[2,811,2,813],[2,812,2,814],[2,813,2,815],[2,814,2,8
16],[2,815,2,817],[2,816,2,818],[2,817,2,819],[2,818,2,820],[2,819,2,821],[
2,820,2,822],[2,821,2,823],[2,822,2,824],[2,823,2,825],[2,824,2,826],[2,825
,2,827],[2,826,2,828],[2,827,2,829],[2,828,2,830],[2,829,2,831],[2,830,2,83
2],[2,831,2,833],[2,832,2,834],[2,833,2,835],[2,834,2,836],[2,835,2,837],[2

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1582

,836,2,838],[2,837,2,839],[2,838,2,840],[2,839,2,841],[2,840,2,842],[2,841,2,843],[2,842,2,844],[2,843,2,845],[2,844,2,846],[2,845,2,847],[2,846,2,848],[2,847,2,849],[2,848,2,850],[2,849,2,851],[2,850,2,852],[2,851,2,853],[2,852,2,854],[2,853,2,855],[2,854,2,856],[2,855,2,857],[2,856,2,858],[2,857,2,859],[2,858,2,860],[2,859,2,861],[2,860,2,862],[2,861,2,863],[2,862,2,864],[2,863,2,865],[2,864,2,866],[2,865,2,867],[2,866,2,868],[2,867,2,869],[2,868,2,870],[2,869,2,871],[2,870,2,872],[2,871,2,873],[2,872,2,874],[2,873,2,875],[2,874,2,876],[2,875,2,877],[2,876,2,878],[2,877,2,879],[2,878,2,880],[2,879,2,881],[2,880,2,882],[2,881,2,883],[2,882,2,884],[2,883,2,885],[2,884,2,886],[2,885,2,887],[2,886,2,888],[2,887,2,889],[2,888,2,890],[2,889,2,891],[2,890,2,892],[2,891,2,893],[2,892,2,894],[2,893,2,895],[2,894,2,896],[2,895,2,897],[2,896,2,898],[2,897,2,899],[2,898,2,900],[2,899,2,901],[2,900,2,902],[2,901,2,903],[2,902,2,904],[2,903,2,905],[2,904,2,906],[2,905,2,907],[2,906,2,908],[2,907,2,909],[2,908,2,910],[2,909,2,911],[2,910,2,912],[2,911,2,913],[2,912,2,914],[2,913,2,915],[2,914,2,916],[2,915,2,917],[2,916,2,918],[2,917,2,919],[2,918,2,920],[2,919,2,921],[2,920,2,922],[2,921,2,923],[2,922,2,924],[2,923,2,925],[2,924,2,926],[2,925,2,927],[2,926,2,928],[2,927,2,929],[2,928,2,930],[2,929,2,931],[2,930,2,932],[2,931,2,933],[2,932,2,934],[2,933,2,935],[2,934,2,936],[2,935,2,937],[2,936,2,938],[2,937,2,939],[2,938,2,940],[2,939,2,941],[2,940,2,942],[2,941,2,943],[2,942,2,944],[2,943,2,945],[2,944,2,946],[2,945,2,947],[2,946,2,948],[2,947,2,949],[2,948,2,950],[2,949,2,951],[2,950,2,952],[2,951,2,953],[2,952,2,954],[2,953,2,955],[2,954,2,956],[2,955,2,957],[2,956,2,958],[2,957,2,959],[2,958,2,960],[2,959,2,961],[2,960,2,962],[2,961,2,963],[2,962,2,964],[2,963,2,965],[2,964,2,966],[2,965,2,967],[2,966,2,968],[2,967,2,969],[2,968,2,970],[2,969,2,971],[2,970,2,972],[2,971,2,973],[2,972,2,974],[2,973,2,975],[2,974,2,976],[2,975,2,977],[2,976,2,978],[2,977,2,979],[2,978,2,980],[2,979,2,981],[2,980,2,982],[2,981,2,983],[2,982,2,984],[2,983,2,985],[2,984,2,986],[2,985,2,987],[2,986,2,988],[2,987,2,989],[2,988,2,990],[2,989,2,991],[2,990,2,992],[2,991,2,993],[2,992,2,994],[2,993,2,995],[2,994,2,996],[2,995,2,997],[2,996,2,998],[2,997,2,999],[2,998,2,1000],[2,999,2,1001],[2,1000,2,1002],[2,1001,2,1003],[2,1002,2,1004],[2,1003,2,1005],[2,1004,2,1006],[2,1005,2,1007],[2,1006,2,1008],[2,1007,2,1009],[2,1008,2,1010],[2,1009,2,1011],[2,1010,2,1012],[2,1011,2,1013],[2,1012,2,1014],[2,1013,2,1015],[2,1014,2,1016],[2,1015,2,1017],[2,1016,2,1018],[2,1017,2,1019],[2,1018,2,1020],[2,1019,2,1021],[2,1020,2,1022],[2,1021,2,1023],[2,1022,2,1024],[2,1023,2,1025],[2,1024,2,1026],[2,1025,2,1027],[2,1026,2,1028],[2,1027,2,1029],[2,1028,2,1030],[2,1029,2,1031],[2,1030,2,1032],[2,1031,2,1033],[2,1032,2,1034],[2,1033,2,1035],[2,1034,2,1036],[2,1035,2,1037],[2,1036,2,1038],[2,1037,2,1039],[2,1038,2,1040],[2,1039,2,1041],[2,1040,2,1042],[2,1041,2,1043],[2,1042,2,1044],[2,1043,2,1045],[2,1044,2,1046],[2,1045,2,1047],[2,1046,2,1048],[2,1047,2,1049],[2,1048,2,1050],[2,1049,2,1051],[2,1050,2,1052],[2,1051,2,1053],[2,1052,2,1054],[2,1053,2,1055],[2,1054,2,1056],[2,1055,2,1057],[2,1056,2,1058],[2,1057,2,1059],[2,1058,2,1060],[2,1059,2,1061],[2,1060,2,1062],[2,1061,2,1063],[2,1062,2,1064],[2,1063,2,1065],[2,1064,2,1066],[2,1065,2,1067],[2,1066,2,1068],[2,1067,2,1069],[2,1068,2,1070],[2,1069,2,1071],[2,1070,2,1072],[2,1071,2,1073],[2,1072,2,1074],[2,1073,2,1075],[2,1074,2,1076],[2,1075,2,1077],[2,1076,2,1078],[2,1077,2,1079],[2,1078,2,1080],[2,1079,2,1081],[2,1080,2,1082],[2,1081,2,1083],[2,1082,2,1084],[2,1083,2,1085],[2,1084,2,1086],[2,1085,2,1087],[2,1086,2,1088],[2,1087,2,1089],[2,1088,2,1090],[2,1089,2,1091],[2,1090,2,1092],[2,1091,2,1093],[2,1092,2,1094],[2,1093,2,1095],[2,1094,2,1096],[2,1095,2,1097],[2,1096,2,1098],[2,1097,2,1099],[2,1098,2,1100],[2,1099,2,1101],[2,1100,2,1102],[2,1101,2,1103],[2,1102,2,1104],[2,1103,2,1105],[2,1104,2,1106]

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1583

,[2,1105,2,1107],[2,1106,2,1108],[2,1107,2,1109],[2,1108,2,1110],[2,1109,2,
1111],[2,1110,2,1112],[2,1111,2,1113],[2,1112,2,1114],[2,1113,2,1115],[2,11
14,2,1116],[2,1115,2,1117],[2,1116,2,1118],[2,1117,2,1119],[2,1118,2,1120],
[2,1119,2,1121],[2,1120,2,1122],[2,1121,2,1123],[2,1122,2,1124],[2,1123,2,1
125],[2,1124,2,1126],[2,1125,2,1127],[2,1126,2,1128],[2,1127,2,1129],[2,112
8,2,1130],[2,1129,2,1131],[2,1130,2,1132],[2,1131,2,1133],[2,1132,2,1134],[
2,1133,2,1135],[2,1134,2,1136],[2,1135,2,1137],[2,1136,2,1138],[2,1137,2,11
39],[2,1138,2,1140],[2,1139,2,1141],[2,1140,2,1142],[2,1141,2,1143],[2,1142
,2,1144],[2,1143,2,1145],[2,1144,2,1146],[2,1145,2,1147],[2,1146,2,1148],[2
,1147,2,1149],[2,1148,2,1150],[2,1149,2,1151],[2,1150,2,1152],[2,1151,2,115
3],[2,1152,2,1154],[2,1153,2,1155],[2,1154,2,1156],[2,1155,2,1157],[2,1156,
2,1158],[2,1157,2,1159],[2,1158,2,1160],[2,1159,2,1161],[2,1160,2,1162],[2,
1161,2,1163],[2,1162,2,1164],[2,1163,2,1165],[2,1164,2,1166],[2,1165,2,1167
],[2,1166,2,1168],[2,1167,2,1169],[2,1168,2,1170],[2,1169,2,1171],[2,1170,2
,1172],[2,1171,2,1173],[2,1172,2,1174],[2,1173,2,1175],[2,1174,2,1176],[2,1
175,2,1177],[2,1176,2,1178],[2,1177,2,1179],[2,1178,2,1180],[2,1179,2,1181]
,[2,1180,2,1182],[2,1181,2,1183],[2,1182,2,1184],[2,1183,2,1185],[2,1184,2,
1186],[2,1185,2,1187],[2,1186,2,1188],[2,1187,2,1189],[2,1188,2,1190],[2,11
89,2,1191],[2,1190,2,1192],[2,1191,2,1193],[2,1192,2,1194],[2,1193,2,1195],
[2,1194,2,1196],[2,1195,2,1197],[2,1196,2,1198],[2,1197,2,1199],[2,1198,2,1
200],[2,1199,2,1201],[2,1200,2,1202],[2,1201,2,1203],[2,1202,2,1204],[2,120
3,2,1205],[2,1204,2,1206],[2,1205,2,1207],[2,1206,2,1208],[2,1207,2,1209],[
2,1208,2,1210],[2,1209,2,1211],[2,1210,2,1212],[2,1211,2,1213],[2,1212,2,12
14],[2,1213,2,1215],[2,1214,2,1216],[2,1215,2,1217],[2,1216,2,1218],[2,1217
,2,1219],[2,1218,2,1220],[2,1219,2,1221],[2,1220,2,1222],[2,1221,2,1223],[2
,1222,2,1224],[2,1223,2,1225],[2,1224,2,1226],[2,1225,2,1227],[2,1226,2,122
8],[2,1227,2,1229],[2,1228,2,1230],[2,1229,2,1231],[2,1230,2,1232],[2,1231,
2,1233],[2,1232,2,1234],[2,1233,2,1235],[2,1234,2,1236],[2,1235,2,1237],[2,
1236,2,1238],[2,1237,2,1239],[2,1238,2,1240],[2,1239,2,1241],[2,1240,2,1242
],[2,1241,2,1243],[2,1242,2,1244],[2,1243,2,1245],[2,1244,2,1246],[2,1245,2
,1247],[2,1246,2,1248],[2,1247,2,1249],[2,1248,2,1250],[2,1249,2,1251],[2,1
250,2,1252],[2,1251,2,1253],[2,1252,2,1254],[2,1253,2,1255],[2,1254,2,1256]
,[2,1255,2,1257],[2,1256,2,1258],[2,1257,2,1259],[2,1258,2,1260],[2,1259,2,
1261],[2,1260,2,1262],[2,1261,2,1263],[2,1262,2,1264],[2,1263,2,1265],[2,12
64,2,1266],[2,1265,2,1267],[2,1266,2,1268],[2,1267,2,1269],[2,1268,2,1270],
[2,1269,2,1271],[2,1270,3,1271],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-
1]],"num":2,"row":15},{"stap_colors":[[42,3355443],[84,8947848],[126,894784
8],[168,8947848],[210,8947848],[252,8947848],[294,13369344],[336,13369344],
[378,8947848],[420,8947848],[462,8947848],[504,8947848],[546,8947848],[588,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1584

8947848],[630,8947848],[672,8947848],[714,8947848],[756,8947848],[798,89478
48],[840,8947848],[882,8947848],[924,8947848],[966,8947848],[1008,8947848],
[1050,8947848],[1092,8947848],[1134,8947848],[1176,29184],[1218,29184],[123
2,3355443]],"col":14,"stap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-
1],[4,14,3,15],[3,14,3,16],[3,15,3,17],[3,16,3,18],[3,17,3,19],[3,18,3,20],
[3,19,3,21],[3,20,3,22],[3,21,3,23],[3,22,3,24],[3,23,3,25],[3,24,3,26],[3,
25,3,27],[3,26,2,27],[2,28,3,29],[3,28,3,30],[3,29,3,31],[3,30,3,32],[3,31,
3,33],[3,32,3,34],[3,33,3,35],[3,34,3,36],[3,35,3,37],[3,36,3,38],[3,37,3,3
9],[3,38,3,40],[3,39,3,41],[3,40,-1,-1],[-1,-
1,3,43],[3,42,3,44],[3,43,3,45],[3,44,3,46],[3,45,3,47],[3,46,3,48],[3,47,3
,49],[3,48,3,50],[3,49,3,51],[3,50,3,52],[3,51,3,53],[3,52,3,54],[3,53,3,55
],[3,54,4,55],[4,56,3,57],[3,56,3,58],[3,57,3,59],[3,58,3,60],[3,59,3,61],[
3,60,3,62],[3,61,3,63],[3,62,3,64],[3,63,3,65],[3,64,3,66],[3,65,3,67],[3,6
6,3,68],[3,67,3,69],[3,68,2,69],[2,70,3,71],[3,70,3,72],[3,71,3,73],[3,72,3
,74],[3,73,3,75],[3,74,3,76],[3,75,3,77],[3,76,3,78],[3,77,3,79],[3,78,3,80
],[3,79,3,81],[3,80,3,82],[3,81,3,83],[3,82,-1,-1],[-1,-
1,3,85],[3,84,3,86],[3,85,3,87],[3,86,3,88],[3,87,3,89],[3,88,3,90],[3,89,3
,91],[3,90,3,92],[3,91,3,93],[3,92,3,94],[3,93,3,95],[3,94,3,96],[3,95,3,97
],[3,96,4,97],[4,98,3,99],[3,98,3,100],[3,99,3,101],[3,100,3,102],[3,101,3,
103],[3,102,3,104],[3,103,3,105],[3,104,3,106],[3,105,3,107],[3,106,3,108],
[3,107,3,109],[3,108,3,110],[3,109,3,111],[3,110,2,111],[2,112,3,113],[3,11
2,3,114],[3,113,3,115],[3,114,3,116],[3,115,3,117],[3,116,3,118],[3,117,3,1
19],[3,118,3,120],[3,119,3,121],[3,120,3,122],[3,121,3,123],[3,122,3,124],[
3,123,3,125],[3,124,-1,-1],[-1,-
1,3,127],[3,126,3,128],[3,127,3,129],[3,128,3,130],[3,129,3,131],[3,130,3,1
32],[3,131,3,133],[3,132,3,134],[3,133,3,135],[3,134,3,136],[3,135,3,137],[
3,136,3,138],[3,137,3,139],[3,138,4,139],[4,140,3,141],[3,140,3,142],[3,141
,3,143],[3,142,3,144],[3,143,3,145],[3,144,3,146],[3,145,3,147],[3,146,3,14
8],[3,147,3,149],[3,148,3,150],[3,149,3,151],[3,150,3,152],[3,151,3,153],[3
,152,2,153],[2,154,3,155],[3,154,3,156],[3,155,3,157],[3,156,3,158],[3,157,
3,159],[3,158,3,160],[3,159,3,161],[3,160,3,162],[3,161,3,163],[3,162,3,164
],[3,163,3,165],[3,164,3,166],[3,165,3,167],[3,166,-1,-1],[-1,-
1,3,169],[3,168,3,170],[3,169,3,171],[3,170,3,172],[3,171,3,173],[3,172,3,1
74],[3,173,3,175],[3,174,3,176],[3,175,3,177],[3,176,3,178],[3,177,3,179],[
3,178,3,180],[3,179,3,181],[3,180,4,181],[4,182,3,183],[3,182,3,184],[3,183
,3,185],[3,184,3,186],[3,185,3,187],[3,186,3,188],[3,187,3,189],[3,188,3,19
0],[3,189,3,191],[3,190,3,192],[3,191,3,193],[3,192,3,194],[3,193,3,195],[3
,194,2,195],[2,196,3,197],[3,196,3,198],[3,197,3,199],[3,198,3,200],[3,199,
3,201],[3,200,3,202],[3,201,3,203],[3,202,3,204],[3,203,3,205],[3,204,3,206
],[3,205,3,207],[3,206,3,208],[3,207,3,209],[3,208,-1,-1],[-1,-
1,3,211],[3,210,3,212],[3,211,3,213],[3,212,3,214],[3,213,3,215],[3,214,3,2
16],[3,215,3,217],[3,216,3,218],[3,217,3,219],[3,218,3,220],[3,219,3,221],[
3,220,3,222],[3,221,3,223],[3,222,4,223],[4,224,3,225],[3,224,3,226],[3,225
,3,227],[3,226,3,228],[3,227,3,229],[3,228,3,230],[3,229,3,231],[3,230,3,23
2],[3,231,3,233],[3,232,3,234],[3,233,3,235],[3,234,3,236],[3,235,3,237],[3
,236,2,237],[2,238,3,239],[3,238,3,240],[3,239,3,241],[3,240,3,242],[3,241,
3,243],[3,242,3,244],[3,243,3,245],[3,244,3,246],[3,245,3,247],[3,246,3,248
],[3,247,3,249],[3,248,3,250],[3,249,3,251],[3,250,-1,-1],[-1,-
1,3,253],[3,252,3,254],[3,253,3,255],[3,254,3,256],[3,255,3,257],[3,256,3,2
58],[3,257,3,259],[3,258,3,260],[3,259,3,261],[3,260,3,262],[3,261,3,263],[

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1585

3,262,3,264],[3,263,3,265],[3,264,4,265],[4,266,3,267],[3,266,3,268],[3,267
,3,269],[3,268,3,270],[3,269,3,271],[3,270,3,272],[3,271,3,273],[3,272,3,27
4],[3,273,3,275],[3,274,3,276],[3,275,3,277],[3,276,3,278],[3,277,3,279],[3
,278,2,279],[2,280,3,281],[3,280,3,282],[3,281,3,283],[3,282,3,284],[3,283,
3,285],[3,284,3,286],[3,285,3,287],[3,286,3,288],[3,287,3,289],[3,288,3,290
],[3,289,3,291],[3,290,3,292],[3,291,3,293],[3,292,-1,-1],[-1,-
1,3,295],[3,294,3,296],[3,295,3,297],[3,296,3,298],[3,297,3,299],[3,298,3,3
00],[3,299,3,301],[3,300,3,302],[3,301,3,303],[3,302,3,304],[3,303,3,305],[
3,304,3,306],[3,305,3,307],[3,306,4,307],[4,308,3,309],[3,308,3,310],[3,309
,3,311],[3,310,3,312],[3,311,3,313],[3,312,3,314],[3,313,3,315],[3,314,3,31
6],[3,315,3,317],[3,316,3,318],[3,317,3,319],[3,318,3,320],[3,319,3,321],[3
,320,2,321],[2,322,3,323],[3,322,3,324],[3,323,3,325],[3,324,3,326],[3,325,
3,327],[3,326,3,328],[3,327,3,329],[3,328,3,330],[3,329,3,331],[3,330,3,332
],[3,331,3,333],[3,332,3,334],[3,333,3,335],[3,334,-1,-1],[-1,-
1,3,337],[3,336,3,338],[3,337,3,339],[3,338,3,340],[3,339,3,341],[3,340,3,3
42],[3,341,3,343],[3,342,3,344],[3,343,3,345],[3,344,3,346],[3,345,3,347],[
3,346,3,348],[3,347,3,349],[3,348,4,349],[4,350,3,351],[3,350,3,352],[3,351
,3,353],[3,352,3,354],[3,353,3,355],[3,354,3,356],[3,355,3,357],[3,356,3,35
8],[3,357,3,359],[3,358,3,360],[3,359,3,361],[3,360,3,362],[3,361,3,363],[3
,362,2,363],[2,364,3,365],[3,364,3,366],[3,365,3,367],[3,366,3,368],[3,367,
3,369],[3,368,3,370],[3,369,3,371],[3,370,3,372],[3,371,3,373],[3,372,3,374
],[3,373,3,375],[3,374,3,376],[3,375,3,377],[3,376,-1,-1],[-1,-
1,3,379],[3,378,3,380],[3,379,3,381],[3,380,3,382],[3,381,3,383],[3,382,3,3
84],[3,383,3,385],[3,384,3,386],[3,385,3,387],[3,386,3,388],[3,387,3,389],[
3,388,3,390],[3,389,3,391],[3,390,4,391],[4,392,3,393],[3,392,3,394],[3,393
,3,395],[3,394,3,396],[3,395,3,397],[3,396,3,398],[3,397,3,399],[3,398,3,40
0],[3,399,3,401],[3,400,3,402],[3,401,3,403],[3,402,3,404],[3,403,3,405],[3
,404,2,405],[2,406,3,407],[3,406,3,408],[3,407,3,409],[3,408,3,410],[3,409,
3,411],[3,410,3,412],[3,411,3,413],[3,412,3,414],[3,413,3,415],[3,414,3,416
],[3,415,3,417],[3,416,3,418],[3,417,3,419],[3,418,-1,-1],[-1,-
1,3,421],[3,420,3,422],[3,421,3,423],[3,422,3,424],[3,423,3,425],[3,424,3,4
26],[3,425,3,427],[3,426,3,428],[3,427,3,429],[3,428,3,430],[3,429,3,431],[
3,430,3,432],[3,431,3,433],[3,432,4,433],[4,434,3,435],[3,434,3,436],[3,435
,3,437],[3,436,3,438],[3,437,3,439],[3,438,3,440],[3,439,3,441],[3,440,3,44
2],[3,441,3,443],[3,442,3,444],[3,443,3,445],[3,444,3,446],[3,445,3,447],[3
,446,2,447],[2,448,3,449],[3,448,3,450],[3,449,3,451],[3,450,3,452],[3,451,
3,453],[3,452,3,454],[3,453,3,455],[3,454,3,456],[3,455,3,457],[3,456,3,458
],[3,457,3,459],[3,458,3,460],[3,459,3,461],[3,460,-1,-1],[-1,-
1,3,463],[3,462,3,464],[3,463,3,465],[3,464,3,466],[3,465,3,467],[3,466,3,4
68],[3,467,3,469],[3,468,3,470],[3,469,3,471],[3,470,3,472],[3,471,3,473],[
3,472,3,474],[3,473,3,475],[3,474,4,475],[4,476,3,477],[3,476,3,478],[3,477
,3,479],[3,478,3,480],[3,479,3,481],[3,480,3,482],[3,481,3,483],[3,482,3,48
4],[3,483,3,485],[3,484,3,486],[3,485,3,487],[3,486,3,488],[3,487,3,489],[3
,488,2,489],[2,490,3,491],[3,490,3,492],[3,491,3,493],[3,492,3,494],[3,493,
3,495],[3,494,3,496],[3,495,3,497],[3,496,3,498],[3,497,3,499],[3,498,3,500
],[3,499,3,501],[3,500,3,502],[3,501,3,503],[3,502,-1,-1],[-1,-
1,3,505],[3,504,3,506],[3,505,3,507],[3,506,3,508],[3,507,3,509],[3,508,3,5
10],[3,509,3,511],[3,510,3,512],[3,511,3,513],[3,512,3,514],[3,513,3,515],[
3,514,3,516],[3,515,3,517],[3,516,4,517],[4,518,3,519],[3,518,3,520],[3,519
,3,521],[3,520,3,522],[3,521,3,523],[3,522,3,524],[3,523,3,525],[3,524,3,52
6],[3,525,3,527],[3,526,3,528],[3,527,3,529],[3,528,3,530],[3,529,3,531],[3
,530,2,531],[2,532,3,533],[3,532,3,534],[3,533,3,535],[3,534,3,536],[3,535,
3,537],[3,536,3,538],[3,537,3,539],[3,538,3,540],[3,539,3,541],[3,540,3,542

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1586

],[3,541,3,543],[3,542,3,544],[3,543,3,545],[3,544,-1,-1],[-1,-
1,3,547],[3,546,3,548],[3,547,3,549],[3,548,3,550],[3,549,3,551],[3,550,3,5
52],[3,551,3,553],[3,552,3,554],[3,553,3,555],[3,554,3,556],[3,555,3,557],[
3,556,3,558],[3,557,3,559],[3,558,4,559],[4,560,3,561],[3,560,3,562],[3,561
,3,563],[3,562,3,564],[3,563,3,565],[3,564,3,566],[3,565,3,567],[3,566,3,56
8],[3,567,3,569],[3,568,3,570],[3,569,3,571],[3,570,3,572],[3,571,3,573],[3
,572,2,573],[2,574,3,575],[3,574,3,576],[3,575,3,577],[3,576,3,578],[3,577,
3,579],[3,578,3,580],[3,579,3,581],[3,580,3,582],[3,581,3,583],[3,582,3,584
],[3,583,3,585],[3,584,3,586],[3,585,3,587],[3,586,-1,-1],[-1,-
1,3,589],[3,588,3,590],[3,589,3,591],[3,590,3,592],[3,591,3,593],[3,592,3,5
94],[3,593,3,595],[3,594,3,596],[3,595,3,597],[3,596,3,598],[3,597,3,599],[
3,598,3,600],[3,599,3,601],[3,600,4,601],[4,602,3,603],[3,602,3,604],[3,603
,3,605],[3,604,3,606],[3,605,3,607],[3,606,3,608],[3,607,3,609],[3,608,3,61
0],[3,609,3,611],[3,610,3,612],[3,611,3,613],[3,612,3,614],[3,613,3,615],[3
,614,2,615],[2,616,3,617],[3,616,3,618],[3,617,3,619],[3,618,3,620],[3,619,
3,621],[3,620,3,622],[3,621,3,623],[3,622,3,624],[3,623,3,625],[3,624,3,626
],[3,625,3,627],[3,626,3,628],[3,627,3,629],[3,628,-1,-1],[-1,-
1,3,631],[3,630,3,632],[3,631,3,633],[3,632,3,634],[3,633,3,635],[3,634,3,6
36],[3,635,3,637],[3,636,3,638],[3,637,3,639],[3,638,3,640],[3,639,3,641],[
3,640,3,642],[3,641,3,643],[3,642,4,643],[4,644,3,645],[3,644,3,646],[3,645
,3,647],[3,646,3,648],[3,647,3,649],[3,648,3,650],[3,649,3,651],[3,650,3,65
2],[3,651,3,653],[3,652,3,654],[3,653,3,655],[3,654,3,656],[3,655,3,657],[3
,656,2,657],[2,658,3,659],[3,658,3,660],[3,659,3,661],[3,660,3,662],[3,661,
3,663],[3,662,3,664],[3,663,3,665],[3,664,3,666],[3,665,3,667],[3,666,3,668
],[3,667,3,669],[3,668,3,670],[3,669,3,671],[3,670,-1,-1],[-1,-
1,3,673],[3,672,3,674],[3,673,3,675],[3,674,3,676],[3,675,3,677],[3,676,3,6
78],[3,677,3,679],[3,678,3,680],[3,679,3,681],[3,680,3,682],[3,681,3,683],[
3,682,3,684],[3,683,3,685],[3,684,4,685],[4,686,3,687],[3,686,3,688],[3,687
,3,689],[3,688,3,690],[3,689,3,691],[3,690,3,692],[3,691,3,693],[3,692,3,69
4],[3,693,3,695],[3,694,3,696],[3,695,3,697],[3,696,3,698],[3,697,3,699],[3
,698,2,699],[2,700,3,701],[3,700,3,702],[3,701,3,703],[3,702,3,704],[3,703,
3,705],[3,704,3,706],[3,705,3,707],[3,706,3,708],[3,707,3,709],[3,708,3,710
],[3,709,3,711],[3,710,3,712],[3,711,3,713],[3,712,-1,-1],[-1,-
1,3,715],[3,714,3,716],[3,715,3,717],[3,716,3,718],[3,717,3,719],[3,718,3,7
20],[3,719,3,721],[3,720,3,722],[3,721,3,723],[3,722,3,724],[3,723,3,725],[
3,724,3,726],[3,725,3,727],[3,726,4,727],[4,728,3,729],[3,728,3,730],[3,729
,3,731],[3,730,3,732],[3,731,3,733],[3,732,3,734],[3,733,3,735],[3,734,3,73
6],[3,735,3,737],[3,736,3,738],[3,737,3,739],[3,738,3,740],[3,739,3,741],[3
,740,2,741],[2,742,3,743],[3,742,3,744],[3,743,3,745],[3,744,3,746],[3,745,
3,747],[3,746,3,748],[3,747,3,749],[3,748,3,750],[3,749,3,751],[3,750,3,752
],[3,751,3,753],[3,752,3,754],[3,753,3,755],[3,754,-1,-1],[-1,-
1,3,757],[3,756,3,758],[3,757,3,759],[3,758,3,760],[3,759,3,761],[3,760,3,7
62],[3,761,3,763],[3,762,3,764],[3,763,3,765],[3,764,3,766],[3,765,3,767],[
3,766,3,768],[3,767,3,769],[3,768,4,769],[4,770,3,771],[3,770,3,772],[3,771
,3,773],[3,772,3,774],[3,773,3,775],[3,774,3,776],[3,775,3,777],[3,776,3,77
8],[3,777,3,779],[3,778,3,780],[3,779,3,781],[3,780,3,782],[3,781,3,783],[3
,782,2,783],[2,784,3,785],[3,784,3,786],[3,785,3,787],[3,786,3,788],[3,787,
3,789],[3,788,3,790],[3,789,3,791],[3,790,3,792],[3,791,3,793],[3,792,3,794
],[3,793,3,795],[3,794,3,796],[3,795,3,797],[3,796,-1,-1],[-1,-
1,3,799],[3,798,3,800],[3,799,3,801],[3,800,3,802],[3,801,3,803],[3,802,3,8
04],[3,803,3,805],[3,804,3,806],[3,805,3,807],[3,806,3,808],[3,807,3,809],[
3,808,3,810],[3,809,3,811],[3,810,4,811],[4,812,3,813],[3,812,3,814],[3,813
,3,815],[3,814,3,816],[3,815,3,817],[3,816,3,818],[3,817,3,819],[3,818,3,82

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1587

0],[3,819,3,821],[3,820,3,822],[3,821,3,823],[3,822,3,824],[3,823,3,825],[3
,824,2,825],[2,826,3,827],[3,826,3,828],[3,827,3,829],[3,828,3,830],[3,829,
3,831],[3,830,3,832],[3,831,3,833],[3,832,3,834],[3,833,3,835],[3,834,3,836
],[3,835,3,837],[3,836,3,838],[3,837,3,839],[3,838,-1,-1],[-1,-
1,3,841],[3,840,3,842],[3,841,3,843],[3,842,3,844],[3,843,3,845],[3,844,3,8
46],[3,845,3,847],[3,846,3,848],[3,847,3,849],[3,848,3,850],[3,849,3,851],[
3,850,3,852],[3,851,3,853],[3,852,4,853],[4,854,3,855],[3,854,3,856],[3,855
,3,857],[3,856,3,858],[3,857,3,859],[3,858,3,860],[3,859,3,861],[3,860,3,86
2],[3,861,3,863],[3,862,3,864],[3,863,3,865],[3,864,3,866],[3,865,3,867],[3
,866,2,867],[2,868,3,869],[3,868,3,870],[3,869,3,871],[3,870,3,872],[3,871,
3,873],[3,872,3,874],[3,873,3,875],[3,874,3,876],[3,875,3,877],[3,876,3,878
],[3,877,3,879],[3,878,3,880],[3,879,3,881],[3,880,-1,-1],[-1,-
1,3,883],[3,882,3,884],[3,883,3,885],[3,884,3,886],[3,885,3,887],[3,886,3,8
88],[3,887,3,889],[3,888,3,890],[3,889,3,891],[3,890,3,892],[3,891,3,893],[
3,892,3,894],[3,893,3,895],[3,894,4,895],[4,896,3,897],[3,896,3,898],[3,897
,3,899],[3,898,3,900],[3,899,3,901],[3,900,3,902],[3,901,3,903],[3,902,3,90
4],[3,903,3,905],[3,904,3,906],[3,905,3,907],[3,906,3,908],[3,907,3,909],[3
,908,2,909],[2,910,3,911],[3,910,3,912],[3,911,3,913],[3,912,3,914],[3,913,
3,915],[3,914,3,916],[3,915,3,917],[3,916,3,918],[3,917,3,919],[3,918,3,920
],[3,919,3,921],[3,920,3,922],[3,921,3,923],[3,922,-1,-1],[-1,-
1,3,925],[3,924,3,926],[3,925,3,927],[3,926,3,928],[3,927,3,929],[3,928,3,9
30],[3,929,3,931],[3,930,3,932],[3,931,3,933],[3,932,3,934],[3,933,3,935],[
3,934,3,936],[3,935,3,937],[3,936,4,937],[4,938,3,939],[3,938,3,940],[3,939
,3,941],[3,940,3,942],[3,941,3,943],[3,942,3,944],[3,943,3,945],[3,944,3,94
6],[3,945,3,947],[3,946,3,948],[3,947,3,949],[3,948,3,950],[3,949,3,951],[3
,950,2,951],[2,952,3,953],[3,952,3,954],[3,953,3,955],[3,954,3,956],[3,955,
3,957],[3,956,3,958],[3,957,3,959],[3,958,3,960],[3,959,3,961],[3,960,3,962
],[3,961,3,963],[3,962,3,964],[3,963,3,965],[3,964,-1,-1],[-1,-
1,3,967],[3,966,3,968],[3,967,3,969],[3,968,3,970],[3,969,3,971],[3,970,3,9
72],[3,971,3,973],[3,972,3,974],[3,973,3,975],[3,974,3,976],[3,975,3,977],[
3,976,3,978],[3,977,3,979],[3,978,4,979],[4,980,3,981],[3,980,3,982],[3,981
,3,983],[3,982,3,984],[3,983,3,985],[3,984,3,986],[3,985,3,987],[3,986,3,98
8],[3,987,3,989],[3,988,3,990],[3,989,3,991],[3,990,3,992],[3,991,3,993],[3
,992,2,993],[2,994,3,995],[3,994,3,996],[3,995,3,997],[3,996,3,998],[3,997,
3,999],[3,998,3,1000],[3,999,3,1001],[3,1000,3,1002],[3,1001,3,1003],[3,100
2,3,1004],[3,1003,3,1005],[3,1004,3,1006],[3,1005,3,1007],[3,1006,-1,-1],[-
1,-
1,3,1009],[3,1008,3,1010],[3,1009,3,1011],[3,1010,3,1012],[3,1011,3,1013],[
3,1012,3,1014],[3,1013,3,1015],[3,1014,3,1016],[3,1015,3,1017],[3,1016,3,10
18],[3,1017,3,1019],[3,1018,3,1020],[3,1019,3,1021],[3,1020,4,1021],[4,1022
,3,1023],[3,1022,3,1024],[3,1023,3,1025],[3,1024,3,1026],[3,1025,3,1027],[3
,1026,3,1028],[3,1027,3,1029],[3,1028,3,1030],[3,1029,3,1031],[3,1030,3,103
2],[3,1031,3,1033],[3,1032,3,1034],[3,1033,3,1035],[3,1034,2,1035],[2,1036,
3,1037],[3,1036,3,1038],[3,1037,3,1039],[3,1038,3,1040],[3,1039,3,1041],[3,
1040,3,1042],[3,1041,3,1043],[3,1042,3,1044],[3,1043,3,1045],[3,1044,3,1046
],[3,1045,3,1047],[3,1046,3,1048],[3,1047,3,1049],[3,1048,-1,-1],[-1,-
1,3,1051],[3,1050,3,1052],[3,1051,3,1053],[3,1052,3,1054],[3,1053,3,1055],[
3,1054,3,1056],[3,1055,3,1057],[3,1056,3,1058],[3,1057,3,1059],[3,1058,3,10
60],[3,1059,3,1061],[3,1060,3,1062],[3,1061,3,1063],[3,1062,4,1063],[4,1064
,3,1065],[3,1064,3,1066],[3,1065,3,1067],[3,1066,3,1068],[3,1067,3,1069],[3
,1068,3,1070],[3,1069,3,1071],[3,1070,3,1072],[3,1071,3,1073],[3,1072,3,107
4],[3,1073,3,1075],[3,1074,3,1076],[3,1075,3,1077],[3,1076,2,1077],[2,1078,
3,1079],[3,1078,3,1080],[3,1079,3,1081],[3,1080,3,1082],[3,1081,3,1083],[3,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1588

1082,3,1084],[3,1083,3,1085],[3,1084,3,1086],[3,1085,3,1087],[3,1086,3,1088
],[3,1087,3,1089],[3,1088,3,1090],[3,1089,3,1091],[3,1090,-1,-1],[-1,-
1,3,1093],[3,1092,3,1094],[3,1093,3,1095],[3,1094,3,1096],[3,1095,3,1097],[
3,1096,3,1098],[3,1097,3,1099],[3,1098,3,1100],[3,1099,3,1101],[3,1100,3,11
02],[3,1101,3,1103],[3,1102,3,1104],[3,1103,3,1105],[3,1104,4,1105],[4,1106
,3,1107],[3,1106,3,1108],[3,1107,3,1109],[3,1108,3,1110],[3,1109,3,1111],[3
,1110,3,1112],[3,1111,3,1113],[3,1112,3,1114],[3,1113,3,1115],[3,1114,3,111
6],[3,1115,3,1117],[3,1116,3,1118],[3,1117,3,1119],[3,1118,2,1119],[2,1120,
3,1121],[3,1120,3,1122],[3,1121,3,1123],[3,1122,3,1124],[3,1123,3,1125],[3,
1124,3,1126],[3,1125,3,1127],[3,1126,3,1128],[3,1127,3,1129],[3,1128,3,1130
],[3,1129,3,1131],[3,1130,3,1132],[3,1131,3,1133],[3,1132,-1,-1],[-1,-
1,3,1135],[3,1134,3,1136],[3,1135,3,1137],[3,1136,3,1138],[3,1137,3,1139],[
3,1138,3,1140],[3,1139,3,1141],[3,1140,3,1142],[3,1141,3,1143],[3,1142,3,11
44],[3,1143,3,1145],[3,1144,3,1146],[3,1145,3,1147],[3,1146,4,1147],[4,1148
,3,1149],[3,1148,3,1150],[3,1149,3,1151],[3,1150,3,1152],[3,1151,3,1153],[3
,1152,3,1154],[3,1153,3,1155],[3,1154,3,1156],[3,1155,3,1157],[3,1156,3,115
8],[3,1157,3,1159],[3,1158,3,1160],[3,1159,3,1161],[3,1160,2,1161],[2,1162,
3,1163],[3,1162,3,1164],[3,1163,3,1165],[3,1164,3,1166],[3,1165,3,1167],[3,
1166,3,1168],[3,1167,3,1169],[3,1168,3,1170],[3,1169,3,1171],[3,1170,3,1172
],[3,1171,3,1173],[3,1172,3,1174],[3,1173,3,1175],[3,1174,-1,-1],[-1,-
1,3,1177],[3,1176,3,1178],[3,1177,3,1179],[3,1178,3,1180],[3,1179,3,1181],[
3,1180,3,1182],[3,1181,3,1183],[3,1182,3,1184],[3,1183,3,1185],[3,1184,3,11
86],[3,1185,3,1187],[3,1186,3,1188],[3,1187,3,1189],[3,1188,4,1189],[4,1190
,3,1191],[3,1190,3,1192],[3,1191,3,1193],[3,1192,3,1194],[3,1193,3,1195],[3
,1194,3,1196],[3,1195,3,1197],[3,1196,3,1198],[3,1197,3,1199],[3,1198,3,120
0],[3,1199,3,1201],[3,1200,3,1202],[3,1201,3,1203],[3,1202,2,1203],[2,1204,
3,1205],[3,1204,3,1206],[3,1205,3,1207],[3,1206,3,1208],[3,1207,3,1209],[3,
1208,3,1210],[3,1209,3,1211],[3,1210,3,1212],[3,1211,3,1213],[3,1212,3,1214
],[3,1213,3,1215],[3,1214,3,1216],[3,1215,3,1217],[3,1216,-1,-1],[-1,-
1,3,1219],[3,1218,3,1220],[3,1219,3,1221],[3,1220,3,1222],[3,1221,3,1223],[
3,1222,3,1224],[3,1223,3,1225],[3,1224,3,1226],[3,1225,3,1227],[3,1226,3,12
28],[3,1227,3,1229],[3,1228,3,1230],[3,1229,3,1231],[3,1230,4,1231],[-1,-
1,3,1233],[3,1232,3,1234],[3,1233,3,1235],[3,1234,3,1236],[3,1235,3,1237],[
3,1236,3,1238],[3,1237,3,1239],[3,1238,3,1240],[3,1239,3,1241],[3,1240,3,12
42],[3,1241,3,1243],[3,1242,3,1244],[3,1243,3,1245],[3,1244,3,1246],[3,1245
,3,1247],[3,1246,3,1248],[3,1247,3,1249],[3,1248,3,1250],[3,1249,3,1251],[3
,1250,3,1252],[3,1251,3,1253],[3,1252,3,1254],[3,1253,3,1255],[3,1254,3,125
6],[3,1255,3,1257],[3,1256,3,1258],[3,1257,3,1259],[3,1258,3,1260],[3,1259,
3,1261],[3,1260,3,1262],[3,1261,3,1263],[3,1262,3,1264],[3,1263,3,1265],[3,
1264,3,1266],[3,1265,3,1267],[3,1266,3,1268],[3,1267,3,1269],[3,1268,3,1270
],[3,1269,3,1271],[3,1270,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1589

1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1590

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[3,55,2,54],[3,56,3,54],[3,57,3,55],[3,58,3,56],[3,59,3,57],[3,60,3,58],
[3,61,3,59],[3,62,3,60],[3,63,3,61],[3,64,3,62],[3,65,3,63],[3,66,3,64],[3,
67,3,65],[3,68,3,66],[3,69,3,67],[3,70,3,68],[3,71,3,69],[3,72,3,70],[3,73,
3,71],[3,74,3,72],[3,75,3,73],[3,76,3,74],[3,77,3,75],[3,78,3,76],[3,79,3,7
7],[3,80,3,78],[3,81,3,79],[3,82,3,80],[3,83,3,81],[3,84,3,82],[3,85,3,83],
[3,86,3,84],[3,87,3,85],[3,88,3,86],[3,89,3,87],[3,90,3,88],[3,91,3,89],[3,
92,3,90],[3,93,3,91],[3,94,3,92],[3,95,3,93],[3,96,3,94],[3,97,3,95],[3,98,
3,96],[3,99,3,97],[3,100,3,98],[3,101,3,99],[3,102,3,100],[3,103,3,101],[3,
104,3,102],[3,105,3,103],[3,106,3,104],[3,107,3,105],[3,108,3,106],[3,109,3
,107],[3,110,3,108],[3,111,3,109],[3,112,3,110],[3,113,3,111],[3,114,3,112]
,[3,115,3,113],[3,116,3,114],[3,117,3,115],[3,118,3,116],[3,119,3,117],[3,1
20,3,118],[3,121,3,119],[3,122,3,120],[3,123,3,121],[3,124,3,122],[3,125,3,
123],[3,126,3,124],[3,127,3,125],[3,128,3,126],[3,129,3,127],[3,130,3,128],
[3,131,3,129],[3,132,3,130],[3,133,3,131],[3,134,3,132],[3,135,3,133],[3,13
6,3,134],[3,137,3,135],[3,138,3,136],[3,139,3,137],[3,140,3,138],[3,141,3,1
39],[3,142,3,140],[3,143,3,141],[3,144,3,142],[3,145,3,143],[3,146,3,144],[
3,147,3,145],[3,148,3,146],[3,149,3,147],[3,150,3,148],[3,151,3,149],[3,152
,3,150],[3,153,3,151],[3,154,3,152],[3,155,3,153],[3,156,3,154],[3,157,3,15
5],[3,158,3,156],[3,159,3,157],[3,160,3,158],[3,161,3,159],[3,162,3,160],[3
,163,3,161],[3,164,3,162],[3,165,3,163],[3,166,3,164],[3,167,3,165],[3,168,
3,166],[3,169,3,167],[3,170,3,168],[3,171,3,169],[3,172,3,170],[3,173,3,171

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1591

],[3,174,3,172],[3,175,3,173],[3,176,3,174],[3,177,3,175],[3,178,3,176],[3,179,3,177],[3,180,3,178],[3,181,3,179],[3,182,3,180],[3,183,3,181],[3,184,3,182],[3,185,3,183],[3,186,3,184],[3,187,3,185],[3,188,3,186],[3,189,3,187],[3,190,3,188],[3,191,3,189],[3,192,3,190],[3,193,3,191],[3,194,3,192],[3,195,3,193],[3,196,3,194],[3,197,3,195],[3,198,3,196],[3,199,3,197],[3,200,3,198],[3,201,3,199],[3,202,3,200],[3,203,3,201],[3,204,3,202],[3,205,3,203],[3,206,3,204],[3,207,3,205],[3,208,3,206],[3,209,3,207],[3,210,3,208],[3,211,3,209],[3,212,3,210],[3,213,3,211],[3,214,3,212],[3,215,3,213],[3,216,3,214],[3,217,3,215],[3,218,3,216],[3,219,3,217],[3,220,3,218],[3,221,3,219],[3,222,3,220],[3,223,3,221],[3,224,3,222],[3,225,3,223],[3,226,3,224],[3,227,3,225],[3,228,3,226],[3,229,3,227],[3,230,3,228],[3,231,3,229],[3,232,3,230],[3,233,3,231],[3,234,3,232],[3,235,3,233],[3,236,3,234],[3,237,3,235],[3,238,3,236],[3,239,3,237],[3,240,3,238],[3,241,3,239],[3,242,3,240],[3,243,3,241],[3,244,3,242],[3,245,3,243],[3,246,3,244],[3,247,3,245],[3,248,3,246],[3,249,3,247],[3,250,3,248],[3,251,3,249],[3,252,3,250],[3,253,3,251],[3,254,3,252],[3,255,3,253],[3,256,3,254],[3,257,3,255],[3,258,3,256],[3,259,3,257],[3,260,3,258],[3,261,3,259],[3,262,3,260],[3,263,3,261],[3,264,3,262],[3,265,3,263],[3,266,3,264],[3,267,3,265],[3,268,3,266],[3,269,3,267],[3,270,3,268],[3,271,3,269],[3,272,3,270],[3,273,3,271],[3,274,3,272],[3,275,3,273],[3,276,3,274],[3,277,3,275],[3,278,3,276],[3,279,3,277],[3,280,3,278],[3,281,3,279],[3,282,3,280],[3,283,3,281],[3,284,3,282],[3,285,3,283],[3,286,3,284],[3,287,3,285],[3,288,3,286],[3,289,3,287],[3,290,3,288],[3,291,3,289],[3,292,3,290],[3,293,3,291],[3,294,3,292],[3,295,3,293],[3,296,3,294],[3,297,3,295],[3,298,3,296],[3,299,3,297],[3,300,3,298],[3,301,3,299],[3,302,3,300],[3,303,3,301],[3,304,3,302],[3,305,3,303],[3,306,3,304],[3,307,3,305],[3,308,3,306],[3,309,3,307],[3,310,3,308],[3,311,3,309],[3,312,3,310],[3,313,3,311],[3,314,3,312],[3,315,3,313],[3,316,3,314],[3,317,3,315],[3,318,3,316],[3,319,3,317],[3,320,3,318],[3,321,3,319],[3,322,3,320],[3,323,3,321],[3,324,3,322],[3,325,3,323],[3,326,3,324],[3,327,3,325],[3,328,3,326],[3,329,3,327],[3,330,3,328],[3,331,3,329],[3,332,3,330],[3,333,3,331],[3,334,3,332],[3,335,3,333],[3,336,3,334],[3,337,3,335],[3,338,3,336],[3,339,3,337],[3,340,3,338],[3,341,3,339],[3,342,3,340],[3,343,3,341],[3,344,3,342],[3,345,3,343],[3,346,3,344],[3,347,3,345],[3,348,3,346],[3,349,3,347],[3,350,3,348],[3,351,3,349],[3,352,3,350],[3,353,3,351],[3,354,3,352],[3,355,3,353],[3,356,3,354],[3,357,3,355],[3,358,3,356],[3,359,3,357],[3,360,3,358],[3,361,3,359],[3,362,3,360],[3,363,3,361],[3,364,3,362],[3,365,3,363],[3,366,3,364],[3,367,3,365],[3,368,3,366],[3,369,3,367],[3,370,3,368],[3,371,3,369],[3,372,3,370],[3,373,3,371],[3,374,3,372],[3,375,3,373],[3,376,3,374],[3,377,3,375],[3,378,3,376],[3,379,3,377],[3,380,3,378],[3,381,3,379],[3,382,3,380],[3,383,3,381],[3,384,3,382],[3,385,3,383],[3,386,3,384],[3,387,3,385],[3,388,3,386],[3,389,3,387],[3,390,3,388],[3,391,3,389],[3,392,3,390],[3,393,3,391],[3,394,3,392],[3,395,3,393],[3,396,3,394],[3,397,3,395],[3,398,3,396],[3,399,3,397],[3,400,3,398],[3,401,3,399],[3,402,3,400],[3,403,3,401],[3,404,3,402],[3,405,3,403],[3,406,3,404],[3,407,3,405],[3,408,3,406],[3,409,3,407],[3,410,3,408],[3,411,3,409],[3,412,3,410],[3,413,3,411],[3,414,3,412],[3,415,3,413],[3,416,3,414],[3,417,3,415],[3,418,3,416],[3,419,3,417],[3,420,3,418],[3,421,3,419],[3,422,3,420],[3,423,3,421],[3,424,3,422],[3,425,3,423],[3,426,3,424],[3,427,3,425],[3,428,3,426],[3,429,3,427],[3,430,3,428],[3,431,3,429],[3,432,3,430],[3,433,3,431],[3,434,3,432],[3,435,3,433],[3,436,3,434],[3,437,3,435],[3,438,3,436],[3,439,3,437],[3,440,3,438],[3,441,3,439],[3,442,3,440],[3,443,3,441],[3,444,3,442],[3,445,3,443],[3,446,3,444],[3,447,3,445],[3,448,3,446],[3,449,3,447],[3,450,3,448],[3,451,3,449],[3,452,3,450],[3,453,3,451],[3,454,3,452],[3,455,3,453],[3,456,3,454],[3,457,3,45

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1592

5],[3,458,3,456],[3,459,3,457],[3,460,3,458],[3,461,3,459],[3,462,3,460],[3
,463,3,461],[3,464,3,462],[3,465,3,463],[3,466,3,464],[3,467,3,465],[3,468,
3,466],[3,469,3,467],[3,470,3,468],[3,471,3,469],[3,472,3,470],[3,473,3,471
],[3,474,3,472],[3,475,3,473],[3,476,3,474],[3,477,3,475],[3,478,3,476],[3,
479,3,477],[3,480,3,478],[3,481,3,479],[3,482,3,480],[3,483,3,481],[3,484,3
,482],[3,485,3,483],[3,486,3,484],[3,487,3,485],[3,488,3,486],[3,489,3,487]
,[3,490,3,488],[3,491,3,489],[3,492,3,490],[3,493,3,491],[3,494,3,492],[3,4
95,3,493],[3,496,3,494],[3,497,3,495],[3,498,3,496],[3,499,3,497],[3,500,3,
498],[3,501,3,499],[3,502,3,500],[3,503,3,501],[3,504,3,502],[3,505,3,503],
[3,506,3,504],[3,507,3,505],[3,508,3,506],[3,509,3,507],[3,510,3,508],[3,51
1,3,509],[3,512,3,510],[3,513,3,511],[3,514,3,512],[3,515,3,513],[3,516,3,5
14],[3,517,3,515],[3,518,3,516],[3,519,3,517],[3,520,3,518],[3,521,3,519],[
3,522,3,520],[3,523,3,521],[3,524,3,522],[3,525,3,523],[3,526,3,524],[3,527
,3,525],[3,528,3,526],[3,529,3,527],[3,530,3,528],[3,531,3,529],[3,532,3,53
0],[3,533,3,531],[3,534,3,532],[3,535,3,533],[3,536,3,534],[3,537,3,535],[3
,538,3,536],[3,539,3,537],[3,540,3,538],[3,541,3,539],[3,542,3,540],[3,543,
3,541],[3,544,3,542],[3,545,3,543],[3,546,3,544],[3,547,3,545],[3,548,3,546
],[3,549,3,547],[3,550,3,548],[3,551,3,549],[3,552,3,550],[3,553,3,551],[3,
554,3,552],[3,555,3,553],[3,556,3,554],[3,557,3,555],[3,558,3,556],[3,559,3
,557],[3,560,3,558],[3,561,3,559],[3,562,3,560],[3,563,3,561],[3,564,3,562]
,[3,565,3,563],[3,566,3,564],[3,567,3,565],[3,568,3,566],[3,569,3,567],[3,5
70,3,568],[3,571,3,569],[3,572,3,570],[3,573,3,571],[3,574,3,572],[3,575,3,
573],[3,576,3,574],[3,577,3,575],[3,578,3,576],[3,579,3,577],[3,580,3,578],
[3,581,3,579],[3,582,3,580],[3,583,3,581],[3,584,3,582],[3,585,3,583],[3,58
6,3,584],[3,587,3,585],[3,588,3,586],[3,589,3,587],[3,590,3,588],[3,591,3,5
89],[3,592,3,590],[3,593,3,591],[3,594,3,592],[3,595,3,593],[3,596,3,594],[
3,597,3,595],[3,598,3,596],[3,599,3,597],[3,600,3,598],[3,601,3,599],[3,602
,3,600],[3,603,3,601],[3,604,3,602],[3,605,3,603],[3,606,3,604],[3,607,3,60
5],[3,608,3,606],[3,609,3,607],[3,610,3,608],[3,611,3,609],[3,612,3,610],[3
,613,3,611],[3,614,3,612],[3,615,3,613],[3,616,3,614],[3,617,3,615],[4,617,
3,616],[3,619,4,618],[3,620,3,618],[3,621,3,619],[3,622,3,620],[3,623,3,621
],[3,624,3,622],[3,625,3,623],[3,626,3,624],[3,627,3,625],[3,628,3,626],[3,
629,3,627],[3,630,3,628],[3,631,3,629],[3,632,3,630],[3,633,3,631],[3,634,3
,632],[3,635,3,633],[3,636,3,634],[3,637,3,635],[3,638,3,636],[3,639,3,637]
,[3,640,3,638],[3,641,3,639],[3,642,3,640],[3,643,3,641],[3,644,3,642],[3,6
45,3,643],[3,646,3,644],[3,647,3,645],[3,648,3,646],[3,649,3,647],[3,650,3,
648],[3,651,3,649],[3,652,3,650],[3,653,3,651],[3,654,3,652],[3,655,3,653],
[3,656,3,654],[3,657,3,655],[3,658,3,656],[3,659,3,657],[3,660,3,658],[3,66
1,3,659],[3,662,3,660],[3,663,3,661],[3,664,3,662],[3,665,3,663],[3,666,3,6
64],[3,667,3,665],[3,668,3,666],[3,669,3,667],[3,670,3,668],[3,671,3,669],[
3,672,3,670],[3,673,3,671],[3,674,3,672],[3,675,3,673],[3,676,3,674],[3,677
,3,675],[3,678,3,676],[3,679,3,677],[3,680,3,678],[3,681,3,679],[3,682,3,68
0],[3,683,3,681],[3,684,3,682],[3,685,3,683],[3,686,3,684],[3,687,3,685],[3
,688,3,686],[3,689,3,687],[3,690,3,688],[3,691,3,689],[3,692,3,690],[3,693,
3,691],[3,694,3,692],[3,695,3,693],[3,696,3,694],[3,697,3,695],[3,698,3,696
],[3,699,3,697],[3,700,3,698],[3,701,3,699],[3,702,3,700],[3,703,3,701],[3,
704,3,702],[3,705,3,703],[3,706,3,704],[3,707,3,705],[3,708,3,706],[3,709,3
,707],[3,710,3,708],[3,711,3,709],[3,712,3,710],[3,713,3,711],[3,714,3,712]
,[3,715,3,713],[3,716,3,714],[3,717,3,715],[3,718,3,716],[3,719,3,717],[3,7
20,3,718],[3,721,3,719],[3,722,3,720],[3,723,3,721],[3,724,3,722],[3,725,3,
723],[3,726,3,724],[3,727,3,725],[3,728,3,726],[3,729,3,727],[3,730,3,728],
[3,731,3,729],[3,732,3,730],[3,733,3,731],[3,734,3,732],[3,735,3,733],[3,73
6,3,734],[3,737,3,735],[3,738,3,736],[3,739,3,737],[3,740,3,738],[3,741,3,7

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1593

39],[3,742,3,740],[3,743,3,741],[3,744,3,742],[3,745,3,743],[3,746,3,744],[3,747,3,745],[3,748,3,746],[3,749,3,747],[3,750,3,748],[3,751,3,749],[3,752,3,750],[3,753,3,751],[3,754,3,752],[3,755,3,753],[3,756,3,754],[3,757,3,755],[3,758,3,756],[3,759,3,757],[3,760,3,758],[3,761,3,759],[3,762,3,760],[3,763,3,761],[3,764,3,762],[3,765,3,763],[3,766,3,764],[3,767,3,765],[3,768,3,766],[3,769,3,767],[3,770,3,768],[3,771,3,769],[3,772,3,770],[3,773,3,771],[3,774,3,772],[3,775,3,773],[3,776,3,774],[3,777,3,775],[3,778,3,776],[3,779,3,777],[3,780,3,778],[3,781,3,779],[3,782,3,780],[3,783,3,781],[3,784,3,782],[3,785,3,783],[3,786,3,784],[3,787,3,785],[3,788,3,786],[3,789,3,787],[3,790,3,788],[3,791,3,789],[3,792,3,790],[3,793,3,791],[3,794,3,792],[3,795,3,793],[3,796,3,794],[3,797,3,795],[3,798,3,796],[3,799,3,797],[3,800,3,798],[3,801,3,799],[3,802,3,800],[3,803,3,801],[3,804,3,802],[3,805,3,803],[3,806,3,804],[3,807,3,805],[3,808,3,806],[3,809,3,807],[3,810,3,808],[3,811,3,809],[3,812,3,810],[3,813,3,811],[3,814,3,812],[3,815,3,813],[3,816,3,814],[3,817,3,815],[3,818,3,816],[3,819,3,817],[3,820,3,818],[3,821,3,819],[3,822,3,820],[3,823,3,821],[3,824,3,822],[3,825,3,823],[3,826,3,824],[3,827,3,825],[3,828,3,826],[3,829,3,827],[3,830,3,828],[3,831,3,829],[3,832,3,830],[3,833,3,831],[3,834,3,832],[3,835,3,833],[3,836,3,834],[3,837,3,835],[3,838,3,836],[3,839,3,837],[3,840,3,838],[3,841,3,839],[3,842,3,840],[3,843,3,841],[3,844,3,842],[3,845,3,843],[3,846,3,844],[3,847,3,845],[3,848,3,846],[3,849,3,847],[3,850,3,848],[3,851,3,849],[3,852,3,850],[3,853,3,851],[3,854,3,852],[3,855,3,853],[3,856,3,854],[3,857,3,855],[3,858,3,856],[3,859,3,857],[3,860,3,858],[3,861,3,859],[3,862,3,860],[3,863,3,861],[3,864,3,862],[3,865,3,863],[3,866,3,864],[3,867,3,865],[3,868,3,866],[3,869,3,867],[3,870,3,868],[3,871,3,869],[3,872,3,870],[3,873,3,871],[3,874,3,872],[3,875,3,873],[3,876,3,874],[3,877,3,875],[3,878,3,876],[3,879,3,877],[3,880,3,878],[3,881,3,879],[3,882,3,880],[3,883,3,881],[3,884,3,882],[3,885,3,883],[3,886,3,884],[3,887,3,885],[3,888,3,886],[3,889,3,887],[3,890,3,888],[3,891,3,889],[3,892,3,890],[3,893,3,891],[3,894,3,892],[3,895,3,893],[3,896,3,894],[3,897,3,895],[3,898,3,896],[3,899,3,897],[3,900,3,898],[3,901,3,899],[3,902,3,900],[3,903,3,901],[3,904,3,902],[3,905,3,903],[3,906,3,904],[3,907,3,905],[3,908,3,906],[3,909,3,907],[3,910,3,908],[3,911,3,909],[3,912,3,910],[3,913,3,911],[3,914,3,912],[3,915,3,913],[3,916,3,914],[3,917,3,915],[3,918,3,916],[3,919,3,917],[3,920,3,918],[3,921,3,919],[3,922,3,920],[3,923,3,921],[3,924,3,922],[3,925,3,923],[3,926,3,924],[3,927,3,925],[3,928,3,926],[3,929,3,927],[3,930,3,928],[3,931,3,929],[3,932,3,930],[3,933,3,931],[3,934,3,932],[3,935,3,933],[3,936,3,934],[3,937,3,935],[3,938,3,936],[3,939,3,937],[3,940,3,938],[3,941,3,939],[3,942,3,940],[3,943,3,941],[3,944,3,942],[3,945,3,943],[3,946,3,944],[3,947,3,945],[3,948,3,946],[3,949,3,947],[3,950,3,948],[3,951,3,949],[3,952,3,950],[3,953,3,951],[3,954,3,952],[3,955,3,953],[3,956,3,954],[3,957,3,955],[3,958,3,956],[3,959,3,957],[3,960,3,958],[3,961,3,959],[3,962,3,960],[3,963,3,961],[3,964,3,962],[3,965,3,963],[3,966,3,964],[3,967,3,965],[3,968,3,966],[3,969,3,967],[3,970,3,968],[3,971,3,969],[3,972,3,970],[3,973,3,971],[3,974,3,972],[3,975,3,973],[3,976,3,974],[3,977,3,975],[3,978,3,976],[3,979,3,977],[3,980,3,978],[3,981,3,979],[3,982,3,980],[3,983,3,981],[3,984,3,982],[3,985,3,983],[3,986,3,984],[3,987,3,985],[3,988,3,986],[3,989,3,987],[3,990,3,988],[3,991,3,989],[3,992,3,990],[3,993,3,991],[3,994,3,992],[3,995,3,993],[3,996,3,994],[3,997,3,995],[3,998,3,996],[3,999,3,997],[3,1000,3,998],[3,1001,3,999],[3,1002,3,1000],[3,1003,3,1001],[3,1004,3,1002],[3,1005,3,1003],[3,1006,3,1004],[3,1007,3,1005],[3,1008,3,1006],[3,1009,3,1007],[3,1010,3,1008],[3,1011,3,1009],[3,1012,3,1010],[3,1013,3,1011],[3,1014,3,1012],[3,1015,3,1013],[3,1016,3,1014],[3,1017,3,1015],[3,1018,3,1016],[3,1019,3,1017],[3,1020,3,1018],[3,1021,3,1019],[3,1022,3

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1594

,1020],[3,1023,3,1021],[3,1024,3,1022],[3,1025,3,1023],[3,1026,3,1024],[3,1
027,3,1025],[3,1028,3,1026],[3,1029,3,1027],[3,1030,3,1028],[3,1031,3,1029]
,[3,1032,3,1030],[3,1033,3,1031],[3,1034,3,1032],[3,1035,3,1033],[3,1036,3,
1034],[3,1037,3,1035],[3,1038,3,1036],[3,1039,3,1037],[3,1040,3,1038],[3,10
41,3,1039],[3,1042,3,1040],[3,1043,3,1041],[3,1044,3,1042],[3,1045,3,1043],
[3,1046,3,1044],[3,1047,3,1045],[3,1048,3,1046],[3,1049,3,1047],[3,1050,3,1
048],[3,1051,3,1049],[3,1052,3,1050],[3,1053,3,1051],[3,1054,3,1052],[3,105
5,3,1053],[3,1056,3,1054],[3,1057,3,1055],[3,1058,3,1056],[3,1059,3,1057],[
3,1060,3,1058],[3,1061,3,1059],[3,1062,3,1060],[3,1063,3,1061],[3,1064,3,10
62],[3,1065,3,1063],[3,1066,3,1064],[3,1067,3,1065],[3,1068,3,1066],[3,1069
,3,1067],[3,1070,3,1068],[3,1071,3,1069],[3,1072,3,1070],[3,1073,3,1071],[3
,1074,3,1072],[3,1075,3,1073],[3,1076,3,1074],[3,1077,3,1075],[3,1078,3,107
6],[3,1079,3,1077],[3,1080,3,1078],[3,1081,3,1079],[3,1082,3,1080],[3,1083,
3,1081],[3,1084,3,1082],[3,1085,3,1083],[3,1086,3,1084],[3,1087,3,1085],[3,
1088,3,1086],[3,1089,3,1087],[3,1090,3,1088],[3,1091,3,1089],[3,1092,3,1090
],[3,1093,3,1091],[3,1094,3,1092],[3,1095,3,1093],[3,1096,3,1094],[3,1097,3
,1095],[3,1098,3,1096],[3,1099,3,1097],[3,1100,3,1098],[3,1101,3,1099],[3,1
102,3,1100],[3,1103,3,1101],[3,1104,3,1102],[3,1105,3,1103],[3,1106,3,1104]
,[3,1107,3,1105],[3,1108,3,1106],[3,1109,3,1107],[3,1110,3,1108],[3,1111,3,
1109],[3,1112,3,1110],[3,1113,3,1111],[3,1114,3,1112],[3,1115,3,1113],[3,11
16,3,1114],[3,1117,3,1115],[3,1118,3,1116],[3,1119,3,1117],[3,1120,3,1118],
[3,1121,3,1119],[3,1122,3,1120],[3,1123,3,1121],[3,1124,3,1122],[3,1125,3,1
123],[3,1126,3,1124],[3,1127,3,1125],[3,1128,3,1126],[3,1129,3,1127],[3,113
0,3,1128],[3,1131,3,1129],[3,1132,3,1130],[3,1133,3,1131],[3,1134,3,1132],[
3,1135,3,1133],[3,1136,3,1134],[3,1137,3,1135],[3,1138,3,1136],[3,1139,3,11
37],[3,1140,3,1138],[3,1141,3,1139],[3,1142,3,1140],[3,1143,3,1141],[3,1144
,3,1142],[3,1145,3,1143],[3,1146,3,1144],[3,1147,3,1145],[3,1148,3,1146],[3
,1149,3,1147],[3,1150,3,1148],[3,1151,3,1149],[3,1152,3,1150],[3,1153,3,115
1],[3,1154,3,1152],[3,1155,3,1153],[3,1156,3,1154],[3,1157,3,1155],[3,1158,
3,1156],[3,1159,3,1157],[3,1160,3,1158],[3,1161,3,1159],[3,1162,3,1160],[3,
1163,3,1161],[3,1164,3,1162],[3,1165,3,1163],[3,1166,3,1164],[3,1167,3,1165
],[3,1168,3,1166],[3,1169,3,1167],[3,1170,3,1168],[3,1171,3,1169],[3,1172,3
,1170],[3,1173,3,1171],[3,1174,3,1172],[3,1175,3,1173],[3,1176,3,1174],[3,1
177,3,1175],[3,1178,3,1176],[3,1179,3,1177],[3,1180,3,1178],[3,1181,3,1179]
,[3,1182,3,1180],[3,1183,3,1181],[3,1184,3,1182],[3,1185,3,1183],[3,1186,3,
1184],[3,1187,3,1185],[3,1188,3,1186],[3,1189,3,1187],[3,1190,3,1188],[3,11
91,3,1189],[3,1192,3,1190],[3,1193,3,1191],[3,1194,3,1192],[3,1195,3,1193],
[3,1196,3,1194],[3,1197,3,1195],[3,1198,3,1196],[3,1199,3,1197],[3,1200,3,1
198],[3,1201,3,1199],[3,1202,3,1200],[3,1203,3,1201],[3,1204,3,1202],[3,120
5,3,1203],[3,1206,3,1204],[3,1207,3,1205],[3,1208,3,1206],[3,1209,3,1207],[
3,1210,3,1208],[3,1211,3,1209],[3,1212,3,1210],[3,1213,3,1211],[3,1214,3,12
12],[3,1215,3,1213],[3,1216,3,1214],[3,1217,3,1215],[3,1218,3,1216],[3,1219
,3,1217],[3,1220,3,1218],[3,1221,3,1219],[3,1222,3,1220],[3,1223,3,1221],[3
,1224,3,1222],[3,1225,3,1223],[3,1226,3,1224],[3,1227,3,1225],[3,1228,3,122
6],[3,1229,3,1227],[3,1230,3,1228],[3,1231,3,1229],[3,1232,3,1230],[3,1233,
3,1231],[3,1234,3,1232],[3,1235,3,1233],[3,1236,3,1234],[3,1237,3,1235],[3,
1238,3,1236],[3,1239,3,1237],[3,1240,3,1238],[3,1241,3,1239],[3,1242,3,1240
],[3,1243,3,1241],[3,1244,3,1242],[3,1245,3,1243],[3,1246,3,1244],[3,1247,3
,1245],[3,1248,3,1246],[3,1249,3,1247],[3,1250,3,1248],[3,1251,3,1249],[3,1
252,3,1250],[3,1253,3,1251],[3,1254,3,1252],[3,1255,3,1253],[3,1256,3,1254]
,[3,1257,3,1255],[3,1258,3,1256],[3,1259,3,1257],[3,1260,3,1258],[3,1261,3,
1259],[3,1262,3,1260],[3,1263,3,1261],[3,1264,3,1262],[3,1265,3,1263],[3,12
66,3,1264],[3,1267,3,1265],[3,1268,3,1266],[3,1269,3,1267],[3,1270,3,1268],

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1595

[3,1271,3,1269],[2,1271,3,1270],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-
1]],"num":3,"row":15},{"stap_colors":[[27,3355443],[69,8947848],[111,894784
8],[153,8947848],[195,8947848],[237,8947848],[279,13369344],[321,13369344],
[363,8947848],[405,8947848],[447,8947848],[489,8947848],[531,8947848],[573,
8947848],[615,8947848],[657,8947848],[699,8947848],[741,8947848],[783,89478
48],[825,8947848],[867,8947848],[909,8947848],[951,8947848],[993,8947848],[
1035,8947848],[1077,8947848],[1119,8947848],[1161,29184],[1203,29184]],"col
":14,"stap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[4,15,3,14],[4,16,4,14],[4,17,4,15],[4,18,4,16],[4,19,4,17],[4,20,4,18],
[4,21,4,19],[4,22,4,20],[4,23,4,21],[4,24,4,22],[4,25,4,23],[4,26,4,24],[4,
27,4,25],[-1,-1,4,26],[4,29,-1,-
1],[4,30,4,28],[4,31,4,29],[4,32,4,30],[4,33,4,31],[4,34,4,32],[4,35,4,33],
[4,36,4,34],[4,37,4,35],[4,38,4,36],[4,39,4,37],[4,40,4,38],[4,41,4,39],[5,
41,4,40],[4,43,5,42],[4,44,4,42],[4,45,4,43],[4,46,4,44],[4,47,4,45],[4,48,
4,46],[4,49,4,47],[4,50,4,48],[4,51,4,49],[4,52,4,50],[4,53,4,51],[4,54,4,5
2],[4,55,4,53],[3,55,4,54],[4,57,3,56],[4,58,4,56],[4,59,4,57],[4,60,4,58],
[4,61,4,59],[4,62,4,60],[4,63,4,61],[4,64,4,62],[4,65,4,63],[4,66,4,64],[4,
67,4,65],[4,68,4,66],[4,69,4,67],[-1,-1,4,68],[4,71,-1,-
1],[4,72,4,70],[4,73,4,71],[4,74,4,72],[4,75,4,73],[4,76,4,74],[4,77,4,75],
[4,78,4,76],[4,79,4,77],[4,80,4,78],[4,81,4,79],[4,82,4,80],[4,83,4,81],[5,
83,4,82],[4,85,5,84],[4,86,4,84],[4,87,4,85],[4,88,4,86],[4,89,4,87],[4,90,
4,88],[4,91,4,89],[4,92,4,90],[4,93,4,91],[4,94,4,92],[4,95,4,93],[4,96,4,9
4],[4,97,4,95],[3,97,4,96],[4,99,3,98],[4,100,4,98],[4,101,4,99],[4,102,4,1
00],[4,103,4,101],[4,104,4,102],[4,105,4,103],[4,106,4,104],[4,107,4,105],[
4,108,4,106],[4,109,4,107],[4,110,4,108],[4,111,4,109],[-1,-
1,4,110],[4,113,-1,-
1],[4,114,4,112],[4,115,4,113],[4,116,4,114],[4,117,4,115],[4,118,4,116],[4
,119,4,117],[4,120,4,118],[4,121,4,119],[4,122,4,120],[4,123,4,121],[4,124,
4,122],[4,125,4,123],[5,125,4,124],[4,127,5,126],[4,128,4,126],[4,129,4,127
],[4,130,4,128],[4,131,4,129],[4,132,4,130],[4,133,4,131],[4,134,4,132],[4,
135,4,133],[4,136,4,134],[4,137,4,135],[4,138,4,136],[4,139,4,137],[3,139,4
,138],[4,141,3,140],[4,142,4,140],[4,143,4,141],[4,144,4,142],[4,145,4,143]
,[4,146,4,144],[4,147,4,145],[4,148,4,146],[4,149,4,147],[4,150,4,148],[4,1
51,4,149],[4,152,4,150],[4,153,4,151],[-1,-1,4,152],[4,155,-1,-
1],[4,156,4,154],[4,157,4,155],[4,158,4,156],[4,159,4,157],[4,160,4,158],[4
,161,4,159],[4,162,4,160],[4,163,4,161],[4,164,4,162],[4,165,4,163],[4,166,
4,164],[4,167,4,165],[5,167,4,166],[4,169,5,168],[4,170,4,168],[4,171,4,169

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1596

],[4,172,4,170],[4,173,4,171],[4,174,4,172],[4,175,4,173],[4,176,4,174],[4,177,4,175],[4,178,4,176],[4,179,4,177],[4,180,4,178],[4,181,4,179],[3,181,4,180],[4,183,3,182],[4,184,4,182],[4,185,4,183],[4,186,4,184],[4,187,4,185],[4,188,4,186],[4,189,4,187],[4,190,4,188],[4,191,4,189],[4,192,4,190],[4,193,4,191],[4,194,4,192],[4,195,4,193],[-1,-1,4,194],[4,197,-1,-1],[4,198,4,196],[4,199,4,197],[4,200,4,198],[4,201,4,199],[4,202,4,200],[4,203,4,201],[4,204,4,202],[4,205,4,203],[4,206,4,204],[4,207,4,205],[4,208,4,206],[4,209,4,207],[5,209,4,208],[4,211,5,210],[4,212,4,210],[4,213,4,211],[4,214,4,212],[4,215,4,213],[4,216,4,214],[4,217,4,215],[4,218,4,216],[4,219,4,217],[4,220,4,218],[4,221,4,219],[4,222,4,220],[4,223,4,221],[3,223,4,222],[4,225,3,224],[4,226,4,224],[4,227,4,225],[4,228,4,226],[4,229,4,227],[4,230,4,228],[4,231,4,229],[4,232,4,230],[4,233,4,231],[4,234,4,232],[4,235,4,233],[4,236,4,234],[4,237,4,235],[-1,-1,4,236],[4,239,-1,-1],[4,240,4,238],[4,241,4,239],[4,242,4,240],[4,243,4,241],[4,244,4,242],[4,245,4,243],[4,246,4,244],[4,247,4,245],[4,248,4,246],[4,249,4,247],[4,250,4,248],[4,251,4,249],[5,251,4,250],[4,253,5,252],[4,254,4,252],[4,255,4,253],[4,256,4,254],[4,257,4,255],[4,258,4,256],[4,259,4,257],[4,260,4,258],[4,261,4,259],[4,262,4,260],[4,263,4,261],[4,264,4,262],[4,265,4,263],[3,265,4,264],[4,267,3,266],[4,268,4,266],[4,269,4,267],[4,270,4,268],[4,271,4,269],[4,272,4,270],[4,273,4,271],[4,274,4,272],[4,275,4,273],[4,276,4,274],[4,277,4,275],[4,278,4,276],[4,279,4,277],[-1,-1,4,278],[4,281,-1,-1],[4,282,4,280],[4,283,4,281],[4,284,4,282],[4,285,4,283],[4,286,4,284],[4,287,4,285],[4,288,4,286],[4,289,4,287],[4,290,4,288],[4,291,4,289],[4,292,4,290],[4,293,4,291],[5,293,4,292],[4,295,5,294],[4,296,4,294],[4,297,4,295],[4,298,4,296],[4,299,4,297],[4,300,4,298],[4,301,4,299],[4,302,4,300],[4,303,4,301],[4,304,4,302],[4,305,4,303],[4,306,4,304],[4,307,4,305],[3,307,4,306],[4,309,3,308],[4,310,4,308],[4,311,4,309],[4,312,4,310],[4,313,4,311],[4,314,4,312],[4,315,4,313],[4,316,4,314],[4,317,4,315],[4,318,4,316],[4,319,4,317],[4,320,4,318],[4,321,4,319],[-1,-1,4,320],[4,323,-1,-1],[4,324,4,322],[4,325,4,323],[4,326,4,324],[4,327,4,325],[4,328,4,326],[4,329,4,327],[4,330,4,328],[4,331,4,329],[4,332,4,330],[4,333,4,331],[4,334,4,332],[4,335,4,333],[5,335,4,334],[4,337,5,336],[4,338,4,336],[4,339,4,337],[4,340,4,338],[4,341,4,339],[4,342,4,340],[4,343,4,341],[4,344,4,342],[4,345,4,343],[4,346,4,344],[4,347,4,345],[4,348,4,346],[4,349,4,347],[3,349,4,348],[4,351,3,350],[4,352,4,350],[4,353,4,351],[4,354,4,352],[4,355,4,353],[4,356,4,354],[4,357,4,355],[4,358,4,356],[4,359,4,357],[4,360,4,358],[4,361,4,359],[4,362,4,360],[4,363,4,361],[-1,-1,4,362],[4,365,-1,-1],[4,366,4,364],[4,367,4,365],[4,368,4,366],[4,369,4,367],[4,370,4,368],[4,371,4,369],[4,372,4,370],[4,373,4,371],[4,374,4,372],[4,375,4,373],[4,376,4,374],[4,377,4,375],[5,377,4,376],[4,379,5,378],[4,380,4,378],[4,381,4,379],[4,382,4,380],[4,383,4,381],[4,384,4,382],[4,385,4,383],[4,386,4,384],[4,387,4,385],[4,388,4,386],[4,389,4,387],[4,390,4,388],[4,391,4,389],[3,391,4,390],[4,393,3,392],[4,394,4,392],[4,395,4,393],[4,396,4,394],[4,397,4,395],[4,398,4,396],[4,399,4,397],[4,400,4,398],[4,401,4,399],[4,402,4,400],[4,403,4,401],[4,404,4,402],[4,405,4,403],[-1,-1,4,404],[4,407,-1,-1],[4,408,4,406],[4,409,4,407],[4,410,4,408],[4,411,4,409],[4,412,4,410],[4,413,4,411],[4,414,4,412],[4,415,4,413],[4,416,4,414],[4,417,4,415],[4,418,4,416],[4,419,4,417],[5,419,4,418],[4,421,5,420],[4,422,4,420],[4,423,4,421],[4,424,4,422],[4,425,4,423],[4,426,4,424],[4,427,4,425],[4,428,4,426],[4,429,4,427],[4,430,4,428],[4,431,4,429],[4,432,4,430],[4,433,4,431],[3,433,4,432],[4,435,3,434],[4,436,4,434],[4,437,4,435],[4,438,4,436],[4,439,4,437],[4,440,4,438],[4,441,4,439],[4,442,4,440],[4,443,4,441],[4,444,4,442],[4,445,4,443],[4,446,4,444],[4,447,4,445],[-1,-1,4,446],[4,449,-1,-

1],[4,450,4,448],[4,451,4,449],[4,452,4,450],[4,453,4,451],[4,454,4,452],[4
,455,4,453],[4,456,4,454],[4,457,4,455],[4,458,4,456],[4,459,4,457],[4,460,
4,458],[4,461,4,459],[5,461,4,460],[4,463,5,462],[4,464,4,462],[4,465,4,463
],[4,466,4,464],[4,467,4,465],[4,468,4,466],[4,469,4,467],[4,470,4,468],[4,
471,4,469],[4,472,4,470],[4,473,4,471],[4,474,4,472],[4,475,4,473],[3,475,4
,474],[4,477,3,476],[4,478,4,476],[4,479,4,477],[4,480,4,478],[4,481,4,479]
,[4,482,4,480],[4,483,4,481],[4,484,4,482],[4,485,4,483],[4,486,4,484],[4,4
87,4,485],[4,488,4,486],[4,489,4,487],[-1,-1,4,488],[4,491,-1,-
1],[4,492,4,490],[4,493,4,491],[4,494,4,492],[4,495,4,493],[4,496,4,494],[4
,497,4,495],[4,498,4,496],[4,499,4,497],[4,500,4,498],[4,501,4,499],[4,502,
4,500],[4,503,4,501],[5,503,4,502],[4,505,5,504],[4,506,4,504],[4,507,4,505
],[4,508,4,506],[4,509,4,507],[4,510,4,508],[4,511,4,509],[4,512,4,510],[4,
513,4,511],[4,514,4,512],[4,515,4,513],[4,516,4,514],[4,517,4,515],[3,517,4
,516],[4,519,3,518],[4,520,4,518],[4,521,4,519],[4,522,4,520],[4,523,4,521]
,[4,524,4,522],[4,525,4,523],[4,526,4,524],[4,527,4,525],[4,528,4,526],[4,5
29,4,527],[4,530,4,528],[4,531,4,529],[-1,-1,4,530],[4,533,-1,-
1],[4,534,4,532],[4,535,4,533],[4,536,4,534],[4,537,4,535],[4,538,4,536],[4
,539,4,537],[4,540,4,538],[4,541,4,539],[4,542,4,540],[4,543,4,541],[4,544,
4,542],[4,545,4,543],[5,545,4,544],[4,547,5,546],[4,548,4,546],[4,549,4,547
],[4,550,4,548],[4,551,4,549],[4,552,4,550],[4,553,4,551],[4,554,4,552],[4,
555,4,553],[4,556,4,554],[4,557,4,555],[4,558,4,556],[4,559,4,557],[3,559,4
,558],[4,561,3,560],[4,562,4,560],[4,563,4,561],[4,564,4,562],[4,565,4,563]
,[4,566,4,564],[4,567,4,565],[4,568,4,566],[4,569,4,567],[4,570,4,568],[4,5
71,4,569],[4,572,4,570],[4,573,4,571],[-1,-1,4,572],[4,575,-1,-
1],[4,576,4,574],[4,577,4,575],[4,578,4,576],[4,579,4,577],[4,580,4,578],[4
,581,4,579],[4,582,4,580],[4,583,4,581],[4,584,4,582],[4,585,4,583],[4,586,
4,584],[4,587,4,585],[5,587,4,586],[4,589,5,588],[4,590,4,588],[4,591,4,589
],[4,592,4,590],[4,593,4,591],[4,594,4,592],[4,595,4,593],[4,596,4,594],[4,
597,4,595],[4,598,4,596],[4,599,4,597],[4,600,4,598],[4,601,4,599],[3,601,4
,600],[4,603,3,602],[4,604,4,602],[4,605,4,603],[4,606,4,604],[4,607,4,605]
,[4,608,4,606],[4,609,4,607],[4,610,4,608],[4,611,4,609],[4,612,4,610],[4,6
13,4,611],[4,614,4,612],[4,615,4,613],[-1,-1,4,614],[4,617,-1,-
1],[4,618,4,616],[4,619,4,617],[4,620,4,618],[4,621,4,619],[4,622,4,620],[4
,623,4,621],[4,624,4,622],[4,625,4,623],[4,626,4,624],[4,627,4,625],[4,628,
4,626],[4,629,4,627],[5,629,4,628],[4,631,5,630],[4,632,4,630],[4,633,4,631
],[4,634,4,632],[4,635,4,633],[4,636,4,634],[4,637,4,635],[4,638,4,636],[4,
639,4,637],[4,640,4,638],[4,641,4,639],[4,642,4,640],[4,643,4,641],[3,643,4
,642],[4,645,3,644],[4,646,4,644],[4,647,4,645],[4,648,4,646],[4,649,4,647]
,[4,650,4,648],[4,651,4,649],[4,652,4,650],[4,653,4,651],[4,654,4,652],[4,6
55,4,653],[4,656,4,654],[4,657,4,655],[-1,-1,4,656],[4,659,-1,-
1],[4,660,4,658],[4,661,4,659],[4,662,4,660],[4,663,4,661],[4,664,4,662],[4
,665,4,663],[4,666,4,664],[4,667,4,665],[4,668,4,666],[4,669,4,667],[4,670,
4,668],[4,671,4,669],[5,671,4,670],[4,673,5,672],[4,674,4,672],[4,675,4,673
],[4,676,4,674],[4,677,4,675],[4,678,4,676],[4,679,4,677],[4,680,4,678],[4,
681,4,679],[4,682,4,680],[4,683,4,681],[4,684,4,682],[4,685,4,683],[3,685,4
,684],[4,687,3,686],[4,688,4,686],[4,689,4,687],[4,690,4,688],[4,691,4,689]
,[4,692,4,690],[4,693,4,691],[4,694,4,692],[4,695,4,693],[4,696,4,694],[4,6
97,4,695],[4,698,4,696],[4,699,4,697],[-1,-1,4,698],[4,701,-1,-
1],[4,702,4,700],[4,703,4,701],[4,704,4,702],[4,705,4,703],[4,706,4,704],[4
,707,4,705],[4,708,4,706],[4,709,4,707],[4,710,4,708],[4,711,4,709],[4,712,
4,710],[4,713,4,711],[5,713,4,712],[4,715,5,714],[4,716,4,714],[4,717,4,715
],[4,718,4,716],[4,719,4,717],[4,720,4,718],[4,721,4,719],[4,722,4,720],[4,
723,4,721],[4,724,4,722],[4,725,4,723],[4,726,4,724],[4,727,4,725],[3,727,4

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1598

,726],[4,729,3,728],[4,730,4,728],[4,731,4,729],[4,732,4,730],[4,733,4,731]
,[4,734,4,732],[4,735,4,733],[4,736,4,734],[4,737,4,735],[4,738,4,736],[4,7
39,4,737],[4,740,4,738],[4,741,4,739],[-1,-1,4,740],[4,743,-1,-
1],[4,744,4,742],[4,745,4,743],[4,746,4,744],[4,747,4,745],[4,748,4,746],[4
,749,4,747],[4,750,4,748],[4,751,4,749],[4,752,4,750],[4,753,4,751],[4,754,
4,752],[4,755,4,753],[5,755,4,754],[4,757,5,756],[4,758,4,756],[4,759,4,757
],[4,760,4,758],[4,761,4,759],[4,762,4,760],[4,763,4,761],[4,764,4,762],[4,
765,4,763],[4,766,4,764],[4,767,4,765],[4,768,4,766],[4,769,4,767],[3,769,4
,768],[4,771,3,770],[4,772,4,770],[4,773,4,771],[4,774,4,772],[4,775,4,773]
,[4,776,4,774],[4,777,4,775],[4,778,4,776],[4,779,4,777],[4,780,4,778],[4,7
81,4,779],[4,782,4,780],[4,783,4,781],[-1,-1,4,782],[4,785,-1,-
1],[4,786,4,784],[4,787,4,785],[4,788,4,786],[4,789,4,787],[4,790,4,788],[4
,791,4,789],[4,792,4,790],[4,793,4,791],[4,794,4,792],[4,795,4,793],[4,796,
4,794],[4,797,4,795],[5,797,4,796],[4,799,5,798],[4,800,4,798],[4,801,4,799
],[4,802,4,800],[4,803,4,801],[4,804,4,802],[4,805,4,803],[4,806,4,804],[4,
807,4,805],[4,808,4,806],[4,809,4,807],[4,810,4,808],[4,811,4,809],[3,811,4
,810],[4,813,3,812],[4,814,4,812],[4,815,4,813],[4,816,4,814],[4,817,4,815]
,[4,818,4,816],[4,819,4,817],[4,820,4,818],[4,821,4,819],[4,822,4,820],[4,8
23,4,821],[4,824,4,822],[4,825,4,823],[-1,-1,4,824],[4,827,-1,-
1],[4,828,4,826],[4,829,4,827],[4,830,4,828],[4,831,4,829],[4,832,4,830],[4
,833,4,831],[4,834,4,832],[4,835,4,833],[4,836,4,834],[4,837,4,835],[4,838,
4,836],[4,839,4,837],[5,839,4,838],[4,841,5,840],[4,842,4,840],[4,843,4,841
],[4,844,4,842],[4,845,4,843],[4,846,4,844],[4,847,4,845],[4,848,4,846],[4,
849,4,847],[4,850,4,848],[4,851,4,849],[4,852,4,850],[4,853,4,851],[3,853,4
,852],[4,855,3,854],[4,856,4,854],[4,857,4,855],[4,858,4,856],[4,859,4,857]
,[4,860,4,858],[4,861,4,859],[4,862,4,860],[4,863,4,861],[4,864,4,862],[4,8
65,4,863],[4,866,4,864],[4,867,4,865],[-1,-1,4,866],[4,869,-1,-
1],[4,870,4,868],[4,871,4,869],[4,872,4,870],[4,873,4,871],[4,874,4,872],[4
,875,4,873],[4,876,4,874],[4,877,4,875],[4,878,4,876],[4,879,4,877],[4,880,
4,878],[4,881,4,879],[5,881,4,880],[4,883,5,882],[4,884,4,882],[4,885,4,883
],[4,886,4,884],[4,887,4,885],[4,888,4,886],[4,889,4,887],[4,890,4,888],[4,
891,4,889],[4,892,4,890],[4,893,4,891],[4,894,4,892],[4,895,4,893],[3,895,4
,894],[4,897,3,896],[4,898,4,896],[4,899,4,897],[4,900,4,898],[4,901,4,899]
,[4,902,4,900],[4,903,4,901],[4,904,4,902],[4,905,4,903],[4,906,4,904],[4,9
07,4,905],[4,908,4,906],[4,909,4,907],[-1,-1,4,908],[4,911,-1,-
1],[4,912,4,910],[4,913,4,911],[4,914,4,912],[4,915,4,913],[4,916,4,914],[4
,917,4,915],[4,918,4,916],[4,919,4,917],[4,920,4,918],[4,921,4,919],[4,922,
4,920],[4,923,4,921],[5,923,4,922],[4,925,5,924],[4,926,4,924],[4,927,4,925
],[4,928,4,926],[4,929,4,927],[4,930,4,928],[4,931,4,929],[4,932,4,930],[4,
933,4,931],[4,934,4,932],[4,935,4,933],[4,936,4,934],[4,937,4,935],[3,937,4
,936],[4,939,3,938],[4,940,4,938],[4,941,4,939],[4,942,4,940],[4,943,4,941]
,[4,944,4,942],[4,945,4,943],[4,946,4,944],[4,947,4,945],[4,948,4,946],[4,9
49,4,947],[4,950,4,948],[4,951,4,949],[-1,-1,4,950],[4,953,-1,-
1],[4,954,4,952],[4,955,4,953],[4,956,4,954],[4,957,4,955],[4,958,4,956],[4
,959,4,957],[4,960,4,958],[4,961,4,959],[4,962,4,960],[4,963,4,961],[4,964,
4,962],[4,965,4,963],[5,965,4,964],[4,967,5,966],[4,968,4,966],[4,969,4,967
],[4,970,4,968],[4,971,4,969],[4,972,4,970],[4,973,4,971],[4,974,4,972],[4,
975,4,973],[4,976,4,974],[4,977,4,975],[4,978,4,976],[4,979,4,977],[3,979,4
,978],[4,981,3,980],[4,982,4,980],[4,983,4,981],[4,984,4,982],[4,985,4,983]
,[4,986,4,984],[4,987,4,985],[4,988,4,986],[4,989,4,987],[4,990,4,988],[4,9
91,4,989],[4,992,4,990],[4,993,4,991],[-1,-1,4,992],[4,995,-1,-
1],[4,996,4,994],[4,997,4,995],[4,998,4,996],[4,999,4,997],[4,1000,4,998],[
4,1001,4,999],[4,1002,4,1000],[4,1003,4,1001],[4,1004,4,1002],[4,1005,4,100

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1599

3],[4,1006,4,1004],[4,1007,4,1005],[5,1007,4,1006],[4,1009,5,1008],[4,1010,
4,1008],[4,1011,4,1009],[4,1012,4,1010],[4,1013,4,1011],[4,1014,4,1012],[4,
1015,4,1013],[4,1016,4,1014],[4,1017,4,1015],[4,1018,4,1016],[4,1019,4,1017
],[4,1020,4,1018],[4,1021,4,1019],[3,1021,4,1020],[4,1023,3,1022],[4,1024,4
,1022],[4,1025,4,1023],[4,1026,4,1024],[4,1027,4,1025],[4,1028,4,1026],[4,1
029,4,1027],[4,1030,4,1028],[4,1031,4,1029],[4,1032,4,1030],[4,1033,4,1031]
,[4,1034,4,1032],[4,1035,4,1033],[-1,-1,4,1034],[4,1037,-1,-
1],[4,1038,4,1036],[4,1039,4,1037],[4,1040,4,1038],[4,1041,4,1039],[4,1042,
4,1040],[4,1043,4,1041],[4,1044,4,1042],[4,1045,4,1043],[4,1046,4,1044],[4,
1047,4,1045],[4,1048,4,1046],[4,1049,4,1047],[5,1049,4,1048],[4,1051,5,1050
],[4,1052,4,1050],[4,1053,4,1051],[4,1054,4,1052],[4,1055,4,1053],[4,1056,4
,1054],[4,1057,4,1055],[4,1058,4,1056],[4,1059,4,1057],[4,1060,4,1058],[4,1
061,4,1059],[4,1062,4,1060],[4,1063,4,1061],[3,1063,4,1062],[4,1065,3,1064]
,[4,1066,4,1064],[4,1067,4,1065],[4,1068,4,1066],[4,1069,4,1067],[4,1070,4,
1068],[4,1071,4,1069],[4,1072,4,1070],[4,1073,4,1071],[4,1074,4,1072],[4,10
75,4,1073],[4,1076,4,1074],[4,1077,4,1075],[-1,-1,4,1076],[4,1079,-1,-
1],[4,1080,4,1078],[4,1081,4,1079],[4,1082,4,1080],[4,1083,4,1081],[4,1084,
4,1082],[4,1085,4,1083],[4,1086,4,1084],[4,1087,4,1085],[4,1088,4,1086],[4,
1089,4,1087],[4,1090,4,1088],[4,1091,4,1089],[5,1091,4,1090],[4,1093,5,1092
],[4,1094,4,1092],[4,1095,4,1093],[4,1096,4,1094],[4,1097,4,1095],[4,1098,4
,1096],[4,1099,4,1097],[4,1100,4,1098],[4,1101,4,1099],[4,1102,4,1100],[4,1
103,4,1101],[4,1104,4,1102],[4,1105,4,1103],[3,1105,4,1104],[4,1107,3,1106]
,[4,1108,4,1106],[4,1109,4,1107],[4,1110,4,1108],[4,1111,4,1109],[4,1112,4,
1110],[4,1113,4,1111],[4,1114,4,1112],[4,1115,4,1113],[4,1116,4,1114],[4,11
17,4,1115],[4,1118,4,1116],[4,1119,4,1117],[-1,-1,4,1118],[4,1121,-1,-
1],[4,1122,4,1120],[4,1123,4,1121],[4,1124,4,1122],[4,1125,4,1123],[4,1126,
4,1124],[4,1127,4,1125],[4,1128,4,1126],[4,1129,4,1127],[4,1130,4,1128],[4,
1131,4,1129],[4,1132,4,1130],[4,1133,4,1131],[5,1133,4,1132],[4,1135,5,1134
],[4,1136,4,1134],[4,1137,4,1135],[4,1138,4,1136],[4,1139,4,1137],[4,1140,4
,1138],[4,1141,4,1139],[4,1142,4,1140],[4,1143,4,1141],[4,1144,4,1142],[4,1
145,4,1143],[4,1146,4,1144],[4,1147,4,1145],[3,1147,4,1146],[4,1149,3,1148]
,[4,1150,4,1148],[4,1151,4,1149],[4,1152,4,1150],[4,1153,4,1151],[4,1154,4,
1152],[4,1155,4,1153],[4,1156,4,1154],[4,1157,4,1155],[4,1158,4,1156],[4,11
59,4,1157],[4,1160,4,1158],[4,1161,4,1159],[-1,-1,4,1160],[4,1163,-1,-
1],[4,1164,4,1162],[4,1165,4,1163],[4,1166,4,1164],[4,1167,4,1165],[4,1168,
4,1166],[4,1169,4,1167],[4,1170,4,1168],[4,1171,4,1169],[4,1172,4,1170],[4,
1173,4,1171],[4,1174,4,1172],[4,1175,4,1173],[5,1175,4,1174],[4,1177,5,1176
],[4,1178,4,1176],[4,1179,4,1177],[4,1180,4,1178],[4,1181,4,1179],[4,1182,4
,1180],[4,1183,4,1181],[4,1184,4,1182],[4,1185,4,1183],[4,1186,4,1184],[4,1
187,4,1185],[4,1188,4,1186],[4,1189,4,1187],[3,1189,4,1188],[4,1191,3,1190]
,[4,1192,4,1190],[4,1193,4,1191],[4,1194,4,1192],[4,1195,4,1193],[4,1196,4,
1194],[4,1197,4,1195],[4,1198,4,1196],[4,1199,4,1197],[4,1200,4,1198],[4,12
01,4,1199],[4,1202,4,1200],[4,1203,4,1201],[-1,-1,4,1202],[4,1205,-1,-
1],[4,1206,4,1204],[4,1207,4,1205],[4,1208,4,1206],[4,1209,4,1207],[4,1210,
4,1208],[4,1211,4,1209],[4,1212,4,1210],[4,1213,4,1211],[4,1214,4,1212],[4,
1215,4,1213],[4,1216,4,1214],[4,1217,4,1215],[5,1217,4,1216],[4,1219,5,1218
],[4,1220,4,1218],[4,1221,4,1219],[4,1222,4,1220],[4,1223,4,1221],[4,1224,4
,1222],[4,1225,4,1223],[4,1226,4,1224],[4,1227,4,1225],[4,1228,4,1226],[4,1
229,4,1227],[4,1230,4,1228],[4,1231,4,1229],[3,1231,4,1230],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1600

1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1601

,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[5,16,4,17],[4,16,4,18],[4,17,4,19],[4,18,4,20],[4,19,4,21],[4,20,4,22],
[4,21,4,23],[4,22,4,24],[4,23,4,25],[4,24,4,26],[4,25,4,27],[4,26,4,28],[4,
27,4,29],[4,28,4,30],[4,29,4,31],[4,30,4,32],[4,31,4,33],[4,32,4,34],[4,33,
4,35],[4,34,4,36],[4,35,4,37],[4,36,4,38],[4,37,4,39],[4,38,4,40],[4,39,4,4
1],[4,40,4,42],[4,41,4,43],[4,42,4,44],[4,43,4,45],[4,44,4,46],[4,45,4,47],
[4,46,4,48],[4,47,4,49],[4,48,4,50],[4,49,4,51],[4,50,4,52],[4,51,4,53],[4,
52,4,54],[4,53,4,55],[4,54,4,56],[4,55,4,57],[4,56,4,58],[4,57,4,59],[4,58,
4,60],[4,59,4,61],[4,60,4,62],[4,61,4,63],[4,62,4,64],[4,63,4,65],[4,64,4,6
6],[4,65,4,67],[4,66,4,68],[4,67,4,69],[4,68,4,70],[4,69,4,71],[4,70,4,72],
[4,71,4,73],[4,72,4,74],[4,73,4,75],[4,74,4,76],[4,75,4,77],[4,76,4,78],[4,
77,4,79],[4,78,4,80],[4,79,4,81],[4,80,4,82],[4,81,4,83],[4,82,4,84],[4,83,
4,85],[4,84,4,86],[4,85,4,87],[4,86,4,88],[4,87,4,89],[4,88,4,90],[4,89,4,9

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1602

1],[4,90,4,92],[4,91,4,93],[4,92,4,94],[4,93,4,95],[4,94,4,96],[4,95,4,97],
[4,96,4,98],[4,97,4,99],[4,98,4,100],[4,99,4,101],[4,100,4,102],[4,101,4,10
3],[4,102,4,104],[4,103,4,105],[4,104,4,106],[4,105,4,107],[4,106,4,108],[4
,107,4,109],[4,108,4,110],[4,109,4,111],[4,110,4,112],[4,111,4,113],[4,112,
4,114],[4,113,4,115],[4,114,4,116],[4,115,4,117],[4,116,4,118],[4,117,4,119
],[4,118,4,120],[4,119,4,121],[4,120,4,122],[4,121,4,123],[4,122,4,124],[4,
123,4,125],[4,124,4,126],[4,125,4,127],[4,126,4,128],[4,127,4,129],[4,128,4
,130],[4,129,4,131],[4,130,4,132],[4,131,4,133],[4,132,4,134],[4,133,4,135]
,[4,134,4,136],[4,135,4,137],[4,136,4,138],[4,137,4,139],[4,138,4,140],[4,1
39,4,141],[4,140,4,142],[4,141,4,143],[4,142,4,144],[4,143,4,145],[4,144,4,
146],[4,145,4,147],[4,146,4,148],[4,147,4,149],[4,148,4,150],[4,149,4,151],
[4,150,4,152],[4,151,4,153],[4,152,4,154],[4,153,4,155],[4,154,4,156],[4,15
5,4,157],[4,156,4,158],[4,157,4,159],[4,158,4,160],[4,159,4,161],[4,160,4,1
62],[4,161,4,163],[4,162,4,164],[4,163,4,165],[4,164,4,166],[4,165,4,167],[
4,166,4,168],[4,167,4,169],[4,168,4,170],[4,169,4,171],[4,170,4,172],[4,171
,4,173],[4,172,4,174],[4,173,4,175],[4,174,4,176],[4,175,4,177],[4,176,4,17
8],[4,177,4,179],[4,178,4,180],[4,179,4,181],[4,180,4,182],[4,181,4,183],[4
,182,4,184],[4,183,4,185],[4,184,4,186],[4,185,4,187],[4,186,4,188],[4,187,
4,189],[4,188,4,190],[4,189,4,191],[4,190,4,192],[4,191,4,193],[4,192,4,194
],[4,193,4,195],[4,194,4,196],[4,195,4,197],[4,196,4,198],[4,197,4,199],[4,
198,4,200],[4,199,4,201],[4,200,4,202],[4,201,4,203],[4,202,4,204],[4,203,4
,205],[4,204,4,206],[4,205,4,207],[4,206,4,208],[4,207,4,209],[4,208,4,210]
,[4,209,4,211],[4,210,4,212],[4,211,4,213],[4,212,4,214],[4,213,4,215],[4,2
14,4,216],[4,215,4,217],[4,216,4,218],[4,217,4,219],[4,218,4,220],[4,219,4,
221],[4,220,4,222],[4,221,4,223],[4,222,4,224],[4,223,4,225],[4,224,4,226],
[4,225,4,227],[4,226,4,228],[4,227,4,229],[4,228,4,230],[4,229,4,231],[4,23
0,4,232],[4,231,4,233],[4,232,4,234],[4,233,4,235],[4,234,4,236],[4,235,4,2
37],[4,236,4,238],[4,237,4,239],[4,238,4,240],[4,239,4,241],[4,240,4,242],[
4,241,4,243],[4,242,4,244],[4,243,4,245],[4,244,4,246],[4,245,4,247],[4,246
,4,248],[4,247,4,249],[4,248,4,250],[4,249,4,251],[4,250,4,252],[4,251,4,25
3],[4,252,4,254],[4,253,4,255],[4,254,4,256],[4,255,4,257],[4,256,4,258],[4
,257,4,259],[4,258,4,260],[4,259,4,261],[4,260,4,262],[4,261,4,263],[4,262,
4,264],[4,263,4,265],[4,264,4,266],[4,265,4,267],[4,266,4,268],[4,267,4,269
],[4,268,4,270],[4,269,4,271],[4,270,4,272],[4,271,4,273],[4,272,4,274],[4,
273,4,275],[4,274,4,276],[4,275,4,277],[4,276,4,278],[4,277,4,279],[4,278,4
,280],[4,279,4,281],[4,280,4,282],[4,281,4,283],[4,282,4,284],[4,283,4,285]
,[4,284,4,286],[4,285,4,287],[4,286,4,288],[4,287,4,289],[4,288,4,290],[4,2
89,4,291],[4,290,4,292],[4,291,4,293],[4,292,4,294],[4,293,4,295],[4,294,4,
296],[4,295,4,297],[4,296,4,298],[4,297,4,299],[4,298,4,300],[4,299,4,301],
[4,300,4,302],[4,301,4,303],[4,302,4,304],[4,303,4,305],[4,304,4,306],[4,30
5,4,307],[4,306,4,308],[4,307,4,309],[4,308,4,310],[4,309,4,311],[4,310,4,3
12],[4,311,4,313],[4,312,4,314],[4,313,4,315],[4,314,4,316],[4,315,4,317],[
4,316,4,318],[4,317,4,319],[4,318,4,320],[4,319,4,321],[4,320,4,322],[4,321
,4,323],[4,322,4,324],[4,323,4,325],[4,324,4,326],[4,325,4,327],[4,326,4,32
8],[4,327,4,329],[4,328,4,330],[4,329,4,331],[4,330,4,332],[4,331,4,333],[4
,332,4,334],[4,333,4,335],[4,334,4,336],[4,335,4,337],[4,336,4,338],[4,337,
4,339],[4,338,4,340],[4,339,4,341],[4,340,4,342],[4,341,4,343],[4,342,4,344
],[4,343,4,345],[4,344,4,346],[4,345,4,347],[4,346,4,348],[4,347,4,349],[4,
348,4,350],[4,349,4,351],[4,350,4,352],[4,351,4,353],[4,352,4,354],[4,353,4
,355],[4,354,4,356],[4,355,4,357],[4,356,4,358],[4,357,4,359],[4,358,4,360]
,[4,359,4,361],[4,360,4,362],[4,361,4,363],[4,362,4,364],[4,363,4,365],[4,3
64,4,366],[4,365,4,367],[4,366,4,368],[4,367,4,369],[4,368,4,370],[4,369,4,
371],[4,370,4,372],[4,371,4,373],[4,372,4,374],[4,373,4,375],[4,374,4,376],

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1603

[4,375,4,377],[4,376,4,378],[4,377,4,379],[4,378,4,380],[4,379,4,381],[4,380,4,382],[4,381,4,383],[4,382,4,384],[4,383,4,385],[4,384,4,386],[4,385,4,387],[4,386,4,388],[4,387,4,389],[4,388,4,390],[4,389,4,391],[4,390,4,392],[4,391,4,393],[4,392,4,394],[4,393,4,395],[4,394,4,396],[4,395,4,397],[4,396,4,398],[4,397,4,399],[4,398,4,400],[4,399,4,401],[4,400,4,402],[4,401,4,403],[4,402,4,404],[4,403,4,405],[4,404,4,406],[4,405,4,407],[4,406,4,408],[4,407,4,409],[4,408,4,410],[4,409,4,411],[4,410,4,412],[4,411,4,413],[4,412,4,414],[4,413,4,415],[4,414,4,416],[4,415,4,417],[4,416,4,418],[4,417,4,419],[4,418,4,420],[4,419,4,421],[4,420,4,422],[4,421,4,423],[4,422,4,424],[4,423,4,425],[4,424,4,426],[4,425,4,427],[4,426,4,428],[4,427,4,429],[4,428,4,430],[4,429,4,431],[4,430,4,432],[4,431,4,433],[4,432,4,434],[4,433,4,435],[4,434,4,436],[4,435,4,437],[4,436,4,438],[4,437,4,439],[4,438,4,440],[4,439,4,441],[4,440,4,442],[4,441,4,443],[4,442,4,444],[4,443,4,445],[4,444,4,446],[4,445,4,447],[4,446,4,448],[4,447,4,449],[4,448,4,450],[4,449,4,451],[4,450,4,452],[4,451,4,453],[4,452,4,454],[4,453,4,455],[4,454,4,456],[4,455,4,457],[4,456,4,458],[4,457,4,459],[4,458,4,460],[4,459,4,461],[4,460,4,462],[4,461,4,463],[4,462,4,464],[4,463,4,465],[4,464,4,466],[4,465,4,467],[4,466,4,468],[4,467,4,469],[4,468,4,470],[4,469,4,471],[4,470,4,472],[4,471,4,473],[4,472,4,474],[4,473,4,475],[4,474,4,476],[4,475,4,477],[4,476,4,478],[4,477,4,479],[4,478,4,480],[4,479,4,481],[4,480,4,482],[4,481,4,483],[4,482,4,484],[4,483,4,485],[4,484,4,486],[4,485,4,487],[4,486,4,488],[4,487,4,489],[4,488,4,490],[4,489,4,491],[4,490,4,492],[4,491,4,493],[4,492,4,494],[4,493,4,495],[4,494,4,496],[4,495,4,497],[4,496,4,498],[4,497,4,499],[4,498,4,500],[4,499,4,501],[4,500,4,502],[4,501,4,503],[4,502,4,504],[4,503,4,505],[4,504,4,506],[4,505,4,507],[4,506,4,508],[4,507,4,509],[4,508,4,510],[4,509,4,511],[4,510,4,512],[4,511,4,513],[4,512,4,514],[4,513,4,515],[4,514,4,516],[4,515,4,517],[4,516,4,518],[4,517,4,519],[4,518,4,520],[4,519,4,521],[4,520,4,522],[4,521,4,523],[4,522,4,524],[4,523,4,525],[4,524,4,526],[4,525,4,527],[4,526,4,528],[4,527,4,529],[4,528,4,530],[4,529,4,531],[4,530,4,532],[4,531,4,533],[4,532,4,534],[4,533,4,535],[4,534,4,536],[4,535,4,537],[4,536,4,538],[4,537,4,539],[4,538,4,540],[4,539,4,541],[4,540,4,542],[4,541,4,543],[4,542,4,544],[4,543,4,545],[4,544,4,546],[4,545,4,547],[4,546,4,548],[4,547,4,549],[4,548,4,550],[4,549,4,551],[4,550,4,552],[4,551,4,553],[4,552,4,554],[4,553,4,555],[4,554,4,556],[4,555,4,557],[4,556,4,558],[4,557,4,559],[4,558,4,560],[4,559,4,561],[4,560,4,562],[4,561,4,563],[4,562,4,564],[4,563,4,565],[4,564,4,566],[4,565,4,567],[4,566,4,568],[4,567,4,569],[4,568,4,570],[4,569,4,571],[4,570,4,572],[4,571,4,573],[4,572,4,574],[4,573,4,575],[4,574,4,576],[4,575,4,577],[4,576,4,578],[4,577,4,579],[4,578,4,580],[4,579,4,581],[4,580,4,582],[4,581,4,583],[4,582,4,584],[4,583,4,585],[4,584,4,586],[4,585,4,587],[4,586,4,588],[4,587,4,589],[4,588,4,590],[4,589,4,591],[4,590,4,592],[4,591,4,593],[4,592,4,594],[4,593,4,595],[4,594,4,596],[4,595,4,597],[4,596,4,598],[4,597,4,599],[4,598,4,600],[4,599,4,601],[4,600,4,602],[4,601,4,603],[4,602,4,604],[4,603,4,605],[4,604,4,606],[4,605,4,607],[4,606,4,608],[4,607,4,609],[4,608,4,610],[4,609,4,611],[4,610,4,612],[4,611,4,613],[4,612,4,614],[4,613,4,615],[4,614,4,616],[4,615,4,617],[4,616,3,617],[3,618,4,619],[4,618,4,620],[4,619,4,621],[4,620,4,622],[4,621,4,623],[4,622,4,624],[4,623,4,625],[4,624,4,626],[4,625,4,627],[4,626,4,628],[4,627,4,629],[4,628,4,630],[4,629,4,631],[4,630,4,632],[4,631,4,633],[4,632,4,634],[4,633,4,635],[4,634,4,636],[4,635,4,637],[4,636,4,638],[4,637,4,639],[4,638,4,640],[4,639,4,641],[4,640,4,642],[4,641,4,643],[4,642,4,644],[4,643,4,645],[4,644,4,646],[4,645,4,647],[4,646,4,648],[4,647,4,649],[4,648,4,650],[4,649,4,651],[4,650,4,652],[4,651,4,653],[4,652,4,654],[4,653,4,655],[4,654,4,656],[4,655,4,657],[4,656,4,658],[4,657,4,659],[4,658,4,660]

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1604

,[4,659,4,661],[4,660,4,662],[4,661,4,663],[4,662,4,664],[4,663,4,665],[4,6
64,4,666],[4,665,4,667],[4,666,4,668],[4,667,4,669],[4,668,4,670],[4,669,4,
671],[4,670,4,672],[4,671,4,673],[4,672,4,674],[4,673,4,675],[4,674,4,676],
[4,675,4,677],[4,676,4,678],[4,677,4,679],[4,678,4,680],[4,679,4,681],[4,68
0,4,682],[4,681,4,683],[4,682,4,684],[4,683,4,685],[4,684,4,686],[4,685,4,6
87],[4,686,4,688],[4,687,4,689],[4,688,4,690],[4,689,4,691],[4,690,4,692],[
4,691,4,693],[4,692,4,694],[4,693,4,695],[4,694,4,696],[4,695,4,697],[4,696
,4,698],[4,697,4,699],[4,698,4,700],[4,699,4,701],[4,700,4,702],[4,701,4,70
3],[4,702,4,704],[4,703,4,705],[4,704,4,706],[4,705,4,707],[4,706,4,708],[4
,707,4,709],[4,708,4,710],[4,709,4,711],[4,710,4,712],[4,711,4,713],[4,712,
4,714],[4,713,4,715],[4,714,4,716],[4,715,4,717],[4,716,4,718],[4,717,4,719
],[4,718,4,720],[4,719,4,721],[4,720,4,722],[4,721,4,723],[4,722,4,724],[4,
723,4,725],[4,724,4,726],[4,725,4,727],[4,726,4,728],[4,727,4,729],[4,728,4
,730],[4,729,4,731],[4,730,4,732],[4,731,4,733],[4,732,4,734],[4,733,4,735]
,[4,734,4,736],[4,735,4,737],[4,736,4,738],[4,737,4,739],[4,738,4,740],[4,7
39,4,741],[4,740,4,742],[4,741,4,743],[4,742,4,744],[4,743,4,745],[4,744,4,
746],[4,745,4,747],[4,746,4,748],[4,747,4,749],[4,748,4,750],[4,749,4,751],
[4,750,4,752],[4,751,4,753],[4,752,4,754],[4,753,4,755],[4,754,4,756],[4,75
5,4,757],[4,756,4,758],[4,757,4,759],[4,758,4,760],[4,759,4,761],[4,760,4,7
62],[4,761,4,763],[4,762,4,764],[4,763,4,765],[4,764,4,766],[4,765,4,767],[
4,766,4,768],[4,767,4,769],[4,768,4,770],[4,769,4,771],[4,770,4,772],[4,771
,4,773],[4,772,4,774],[4,773,4,775],[4,774,4,776],[4,775,4,777],[4,776,4,77
8],[4,777,4,779],[4,778,4,780],[4,779,4,781],[4,780,4,782],[4,781,4,783],[4
,782,4,784],[4,783,4,785],[4,784,4,786],[4,785,4,787],[4,786,4,788],[4,787,
4,789],[4,788,4,790],[4,789,4,791],[4,790,4,792],[4,791,4,793],[4,792,4,794
],[4,793,4,795],[4,794,4,796],[4,795,4,797],[4,796,4,798],[4,797,4,799],[4,
798,4,800],[4,799,4,801],[4,800,4,802],[4,801,4,803],[4,802,4,804],[4,803,4
,805],[4,804,4,806],[4,805,4,807],[4,806,4,808],[4,807,4,809],[4,808,4,810]
,[4,809,4,811],[4,810,4,812],[4,811,4,813],[4,812,4,814],[4,813,4,815],[4,8
14,4,816],[4,815,4,817],[4,816,4,818],[4,817,4,819],[4,818,4,820],[4,819,4,
821],[4,820,4,822],[4,821,4,823],[4,822,4,824],[4,823,4,825],[4,824,4,826],
[4,825,4,827],[4,826,4,828],[4,827,4,829],[4,828,4,830],[4,829,4,831],[4,83
0,4,832],[4,831,4,833],[4,832,4,834],[4,833,4,835],[4,834,4,836],[4,835,4,8
37],[4,836,4,838],[4,837,4,839],[4,838,4,840],[4,839,4,841],[4,840,4,842],[
4,841,4,843],[4,842,4,844],[4,843,4,845],[4,844,4,846],[4,845,4,847],[4,846
,4,848],[4,847,4,849],[4,848,4,850],[4,849,4,851],[4,850,4,852],[4,851,4,85
3],[4,852,4,854],[4,853,4,855],[4,854,4,856],[4,855,4,857],[4,856,4,858],[4
,857,4,859],[4,858,4,860],[4,859,4,861],[4,860,4,862],[4,861,4,863],[4,862,
4,864],[4,863,4,865],[4,864,4,866],[4,865,4,867],[4,866,4,868],[4,867,4,869
],[4,868,4,870],[4,869,4,871],[4,870,4,872],[4,871,4,873],[4,872,4,874],[4,
873,4,875],[4,874,4,876],[4,875,4,877],[4,876,4,878],[4,877,4,879],[4,878,4
,880],[4,879,4,881],[4,880,4,882],[4,881,4,883],[4,882,4,884],[4,883,4,885]
,[4,884,4,886],[4,885,4,887],[4,886,4,888],[4,887,4,889],[4,888,4,890],[4,8
89,4,891],[4,890,4,892],[4,891,4,893],[4,892,4,894],[4,893,4,895],[4,894,4,
896],[4,895,4,897],[4,896,4,898],[4,897,4,899],[4,898,4,900],[4,899,4,901],
[4,900,4,902],[4,901,4,903],[4,902,4,904],[4,903,4,905],[4,904,4,906],[4,90
5,4,907],[4,906,4,908],[4,907,4,909],[4,908,4,910],[4,909,4,911],[4,910,4,9
12],[4,911,4,913],[4,912,4,914],[4,913,4,915],[4,914,4,916],[4,915,4,917],[
4,916,4,918],[4,917,4,919],[4,918,4,920],[4,919,4,921],[4,920,4,922],[4,921
,4,923],[4,922,4,924],[4,923,4,925],[4,924,4,926],[4,925,4,927],[4,926,4,92
8],[4,927,4,929],[4,928,4,930],[4,929,4,931],[4,930,4,932],[4,931,4,933],[4
,932,4,934],[4,933,4,935],[4,934,4,936],[4,935,4,937],[4,936,4,938],[4,937,
4,939],[4,938,4,940],[4,939,4,941],[4,940,4,942],[4,941,4,943],[4,942,4,944

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1605

],[4,943,4,945],[4,944,4,946],[4,945,4,947],[4,946,4,948],[4,947,4,949],[4,948,4,950],[4,949,4,951],[4,950,4,952],[4,951,4,953],[4,952,4,954],[4,953,4,955],[4,954,4,956],[4,955,4,957],[4,956,4,958],[4,957,4,959],[4,958,4,960],[4,959,4,961],[4,960,4,962],[4,961,4,963],[4,962,4,964],[4,963,4,965],[4,964,4,966],[4,965,4,967],[4,966,4,968],[4,967,4,969],[4,968,4,970],[4,969,4,971],[4,970,4,972],[4,971,4,973],[4,972,4,974],[4,973,4,975],[4,974,4,976],[4,975,4,977],[4,976,4,978],[4,977,4,979],[4,978,4,980],[4,979,4,981],[4,980,4,982],[4,981,4,983],[4,982,4,984],[4,983,4,985],[4,984,4,986],[4,985,4,987],[4,986,4,988],[4,987,4,989],[4,988,4,990],[4,989,4,991],[4,990,4,992],[4,991,4,993],[4,992,4,994],[4,993,4,995],[4,994,4,996],[4,995,4,997],[4,996,4,998],[4,997,4,999],[4,998,4,1000],[4,999,4,1001],[4,1000,4,1002],[4,1001,4,1003],[4,1002,4,1004],[4,1003,4,1005],[4,1004,4,1006],[4,1005,4,1007],[4,1006,4,1008],[4,1007,4,1009],[4,1008,4,1010],[4,1009,4,1011],[4,1010,4,1012],[4,1011,4,1013],[4,1012,4,1014],[4,1013,4,1015],[4,1014,4,1016],[4,1015,4,1017],[4,1016,4,1018],[4,1017,4,1019],[4,1018,4,1020],[4,1019,4,1021],[4,1020,4,1022],[4,1021,4,1023],[4,1022,4,1024],[4,1023,4,1025],[4,1024,4,1026],[4,1025,4,1027],[4,1026,4,1028],[4,1027,4,1029],[4,1028,4,1030],[4,1029,4,1031],[4,1030,4,1032],[4,1031,4,1033],[4,1032,4,1034],[4,1033,4,1035],[4,1034,4,1036],[4,1035,4,1037],[4,1036,4,1038],[4,1037,4,1039],[4,1038,4,1040],[4,1039,4,1041],[4,1040,4,1042],[4,1041,4,1043],[4,1042,4,1044],[4,1043,4,1045],[4,1044,4,1046],[4,1045,4,1047],[4,1046,4,1048],[4,1047,4,1049],[4,1048,4,1050],[4,1049,4,1051],[4,1050,4,1052],[4,1051,4,1053],[4,1052,4,1054],[4,1053,4,1055],[4,1054,4,1056],[4,1055,4,1057],[4,1056,4,1058],[4,1057,4,1059],[4,1058,4,1060],[4,1059,4,1061],[4,1060,4,1062],[4,1061,4,1063],[4,1062,4,1064],[4,1063,4,1065],[4,1064,4,1066],[4,1065,4,1067],[4,1066,4,1068],[4,1067,4,1069],[4,1068,4,1070],[4,1069,4,1071],[4,1070,4,1072],[4,1071,4,1073],[4,1072,4,1074],[4,1073,4,1075],[4,1074,4,1076],[4,1075,4,1077],[4,1076,4,1078],[4,1077,4,1079],[4,1078,4,1080],[4,1079,4,1081],[4,1080,4,1082],[4,1081,4,1083],[4,1082,4,1084],[4,1083,4,1085],[4,1084,4,1086],[4,1085,4,1087],[4,1086,4,1088],[4,1087,4,1089],[4,1088,4,1090],[4,1089,4,1091],[4,1090,4,1092],[4,1091,4,1093],[4,1092,4,1094],[4,1093,4,1095],[4,1094,4,1096],[4,1095,4,1097],[4,1096,4,1098],[4,1097,4,1099],[4,1098,4,1100],[4,1099,4,1101],[4,1100,4,1102],[4,1101,4,1103],[4,1102,4,1104],[4,1103,4,1105],[4,1104,4,1106],[4,1105,4,1107],[4,1106,4,1108],[4,1107,4,1109],[4,1108,4,1110],[4,1109,4,1111],[4,1110,4,1112],[4,1111,4,1113],[4,1112,4,1114],[4,1113,4,1115],[4,1114,4,1116],[4,1115,4,1117],[4,1116,4,1118],[4,1117,4,1119],[4,1118,4,1120],[4,1119,4,1121],[4,1120,4,1122],[4,1121,4,1123],[4,1122,4,1124],[4,1123,4,1125],[4,1124,4,1126],[4,1125,4,1127],[4,1126,4,1128],[4,1127,4,1129],[4,1128,4,1130],[4,1129,4,1131],[4,1130,4,1132],[4,1131,4,1133],[4,1132,4,1134],[4,1133,4,1135],[4,1134,4,1136],[4,1135,4,1137],[4,1136,4,1138],[4,1137,4,1139],[4,1138,4,1140],[4,1139,4,1141],[4,1140,4,1142],[4,1141,4,1143],[4,1142,4,1144],[4,1143,4,1145],[4,1144,4,1146],[4,1145,4,1147],[4,1146,4,1148],[4,1147,4,1149],[4,1148,4,1150],[4,1149,4,1151],[4,1150,4,1152],[4,1151,4,1153],[4,1152,4,1154],[4,1153,4,1155],[4,1154,4,1156],[4,1155,4,1157],[4,1156,4,1158],[4,1157,4,1159],[4,1158,4,1160],[4,1159,4,1161],[4,1160,4,1162],[4,1161,4,1163],[4,1162,4,1164],[4,1163,4,1165],[4,1164,4,1166],[4,1165,4,1167],[4,1166,4,1168],[4,1167,4,1169],[4,1168,4,1170],[4,1169,4,1171],[4,1170,4,1172],[4,1171,4,1173],[4,1172,4,1174],[4,1173,4,1175],[4,1174,4,1176],[4,1175,4,1177],[4,1176,4,1178],[4,1177,4,1179],[4,1178,4,1180],[4,1179,4,1181],[4,1180,4,1182],[4,1181,4,1183],[4,1182,4,1184],[4,1183,4,1185],[4,1184,4,1186],[4,1185,4,1187],[4,1186,4,1188],[4,1187,4,1189],[4,1188,4,1190],[4,1189,4,1191],[4,1190,4,1192],[4,1191,4,1193],[4,1192,4,1194],[4,1193,4,1195],[4,1194,4,1196],[4,1195,4,1197],[4,1196,4,1198],[4,1197,4,1199],[4,11

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1606

98,4,1200],[4,1199,4,1201],[4,1200,4,1202],[4,1201,4,1203],[4,1202,4,1204],
[4,1203,4,1205],[4,1204,4,1206],[4,1205,4,1207],[4,1206,4,1208],[4,1207,4,1
209],[4,1208,4,1210],[4,1209,4,1211],[4,1210,4,1212],[4,1211,4,1213],[4,121
2,4,1214],[4,1213,4,1215],[4,1214,4,1216],[4,1215,4,1217],[4,1216,4,1218],[
4,1217,4,1219],[4,1218,4,1220],[4,1219,4,1221],[4,1220,4,1222],[4,1221,4,12
23],[4,1222,4,1224],[4,1223,4,1225],[4,1224,4,1226],[4,1225,4,1227],[4,1226
,4,1228],[4,1227,4,1229],[4,1228,4,1230],[4,1229,4,1231],[4,1230,4,1232],[4
,1231,4,1233],[4,1232,5,1233],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-
1]],"num":4,"row":16},{"stap_colors":[[14,3355443],[56,8947848],[98,8947848
],[140,8947848],[182,8947848],[224,8947848],[266,13369344],[308,13369344],[
350,8947848],[392,8947848],[434,8947848],[476,8947848],[518,8947848],[560,8
947848],[602,8947848],[644,8947848],[686,8947848],[728,8947848],[770,894784
8],[812,8947848],[854,8947848],[896,8947848],[938,8947848],[980,8947848],[1
022,8947848],[1064,8947848],[1106,8947848],[1148,29184],[1190,29184]],"col"
:13,"stap":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1,5,15],[5,14,5,16],[5,15,5,17],[5,16,5,18],[5,17,5,19],[5,18,5,20],[5,19,5
,21],[5,20,5,22],[5,21,5,23],[5,22,5,24],[5,23,5,25],[5,24,5,26],[5,25,5,27
],[5,26,0,27],[0,28,5,29],[5,28,5,30],[5,29,5,31],[5,30,5,32],[5,31,5,33],[
5,32,5,34],[5,33,5,35],[5,34,5,36],[5,35,5,37],[5,36,5,38],[5,37,5,39],[5,3
8,5,40],[5,39,5,41],[5,40,4,41],[4,42,5,43],[5,42,5,44],[5,43,5,45],[5,44,5
,46],[5,45,5,47],[5,46,5,48],[5,47,5,49],[5,48,5,50],[5,49,5,51],[5,50,5,52
],[5,51,5,53],[5,52,5,54],[5,53,5,55],[5,54,-1,-1],[-1,-
1,5,57],[5,56,5,58],[5,57,5,59],[5,58,5,60],[5,59,5,61],[5,60,5,62],[5,61,5
,63],[5,62,5,64],[5,63,5,65],[5,64,5,66],[5,65,5,67],[5,66,5,68],[5,67,5,69
],[5,68,0,69],[0,70,5,71],[5,70,5,72],[5,71,5,73],[5,72,5,74],[5,73,5,75],[
5,74,5,76],[5,75,5,77],[5,76,5,78],[5,77,5,79],[5,78,5,80],[5,79,5,81],[5,8
0,5,82],[5,81,5,83],[5,82,4,83],[4,84,5,85],[5,84,5,86],[5,85,5,87],[5,86,5
,88],[5,87,5,89],[5,88,5,90],[5,89,5,91],[5,90,5,92],[5,91,5,93],[5,92,5,94
],[5,93,5,95],[5,94,5,96],[5,95,5,97],[5,96,-1,-1],[-1,-
1,5,99],[5,98,5,100],[5,99,5,101],[5,100,5,102],[5,101,5,103],[5,102,5,104]

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1607

,[5,103,5,105],[5,104,5,106],[5,105,5,107],[5,106,5,108],[5,107,5,109],[5,1
08,5,110],[5,109,5,111],[5,110,0,111],[0,112,5,113],[5,112,5,114],[5,113,5,
115],[5,114,5,116],[5,115,5,117],[5,116,5,118],[5,117,5,119],[5,118,5,120],
[5,119,5,121],[5,120,5,122],[5,121,5,123],[5,122,5,124],[5,123,5,125],[5,12
4,4,125],[4,126,5,127],[5,126,5,128],[5,127,5,129],[5,128,5,130],[5,129,5,1
31],[5,130,5,132],[5,131,5,133],[5,132,5,134],[5,133,5,135],[5,134,5,136],[
5,135,5,137],[5,136,5,138],[5,137,5,139],[5,138,-1,-1],[-1,-
1,5,141],[5,140,5,142],[5,141,5,143],[5,142,5,144],[5,143,5,145],[5,144,5,1
46],[5,145,5,147],[5,146,5,148],[5,147,5,149],[5,148,5,150],[5,149,5,151],[
5,150,5,152],[5,151,5,153],[5,152,0,153],[0,154,5,155],[5,154,5,156],[5,155
,5,157],[5,156,5,158],[5,157,5,159],[5,158,5,160],[5,159,5,161],[5,160,5,16
2],[5,161,5,163],[5,162,5,164],[5,163,5,165],[5,164,5,166],[5,165,5,167],[5
,166,4,167],[4,168,5,169],[5,168,5,170],[5,169,5,171],[5,170,5,172],[5,171,
5,173],[5,172,5,174],[5,173,5,175],[5,174,5,176],[5,175,5,177],[5,176,5,178
],[5,177,5,179],[5,178,5,180],[5,179,5,181],[5,180,-1,-1],[-1,-
1,5,183],[5,182,5,184],[5,183,5,185],[5,184,5,186],[5,185,5,187],[5,186,5,1
88],[5,187,5,189],[5,188,5,190],[5,189,5,191],[5,190,5,192],[5,191,5,193],[
5,192,5,194],[5,193,5,195],[5,194,0,195],[0,196,5,197],[5,196,5,198],[5,197
,5,199],[5,198,5,200],[5,199,5,201],[5,200,5,202],[5,201,5,203],[5,202,5,20
4],[5,203,5,205],[5,204,5,206],[5,205,5,207],[5,206,5,208],[5,207,5,209],[5
,208,4,209],[4,210,5,211],[5,210,5,212],[5,211,5,213],[5,212,5,214],[5,213,
5,215],[5,214,5,216],[5,215,5,217],[5,216,5,218],[5,217,5,219],[5,218,5,220
],[5,219,5,221],[5,220,5,222],[5,221,5,223],[5,222,-1,-1],[-1,-
1,5,225],[5,224,5,226],[5,225,5,227],[5,226,5,228],[5,227,5,229],[5,228,5,2
30],[5,229,5,231],[5,230,5,232],[5,231,5,233],[5,232,5,234],[5,233,5,235],[
5,234,5,236],[5,235,5,237],[5,236,0,237],[0,238,5,239],[5,238,5,240],[5,239
,5,241],[5,240,5,242],[5,241,5,243],[5,242,5,244],[5,243,5,245],[5,244,5,24
6],[5,245,5,247],[5,246,5,248],[5,247,5,249],[5,248,5,250],[5,249,5,251],[5
,250,4,251],[4,252,5,253],[5,252,5,254],[5,253,5,255],[5,254,5,256],[5,255,
5,257],[5,256,5,258],[5,257,5,259],[5,258,5,260],[5,259,5,261],[5,260,5,262
],[5,261,5,263],[5,262,5,264],[5,263,5,265],[5,264,-1,-1],[-1,-
1,5,267],[5,266,5,268],[5,267,5,269],[5,268,5,270],[5,269,5,271],[5,270,5,2
72],[5,271,5,273],[5,272,5,274],[5,273,5,275],[5,274,5,276],[5,275,5,277],[
5,276,5,278],[5,277,5,279],[5,278,0,279],[0,280,5,281],[5,280,5,282],[5,281
,5,283],[5,282,5,284],[5,283,5,285],[5,284,5,286],[5,285,5,287],[5,286,5,28
8],[5,287,5,289],[5,288,5,290],[5,289,5,291],[5,290,5,292],[5,291,5,293],[5
,292,4,293],[4,294,5,295],[5,294,5,296],[5,295,5,297],[5,296,5,298],[5,297,
5,299],[5,298,5,300],[5,299,5,301],[5,300,5,302],[5,301,5,303],[5,302,5,304
],[5,303,5,305],[5,304,5,306],[5,305,5,307],[5,306,-1,-1],[-1,-
1,5,309],[5,308,5,310],[5,309,5,311],[5,310,5,312],[5,311,5,313],[5,312,5,3
14],[5,313,5,315],[5,314,5,316],[5,315,5,317],[5,316,5,318],[5,317,5,319],[
5,318,5,320],[5,319,5,321],[5,320,0,321],[0,322,5,323],[5,322,5,324],[5,323
,5,325],[5,324,5,326],[5,325,5,327],[5,326,5,328],[5,327,5,329],[5,328,5,33
0],[5,329,5,331],[5,330,5,332],[5,331,5,333],[5,332,5,334],[5,333,5,335],[5
,334,4,335],[4,336,5,337],[5,336,5,338],[5,337,5,339],[5,338,5,340],[5,339,
5,341],[5,340,5,342],[5,341,5,343],[5,342,5,344],[5,343,5,345],[5,344,5,346
],[5,345,5,347],[5,346,5,348],[5,347,5,349],[5,348,-1,-1],[-1,-
1,5,351],[5,350,5,352],[5,351,5,353],[5,352,5,354],[5,353,5,355],[5,354,5,3
56],[5,355,5,357],[5,356,5,358],[5,357,5,359],[5,358,5,360],[5,359,5,361],[
5,360,5,362],[5,361,5,363],[5,362,0,363],[0,364,5,365],[5,364,5,366],[5,365
,5,367],[5,366,5,368],[5,367,5,369],[5,368,5,370],[5,369,5,371],[5,370,5,37
2],[5,371,5,373],[5,372,5,374],[5,373,5,375],[5,374,5,376],[5,375,5,377],[5
,376,4,377],[4,378,5,379],[5,378,5,380],[5,379,5,381],[5,380,5,382],[5,381,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1608

5,383],[5,382,5,384],[5,383,5,385],[5,384,5,386],[5,385,5,387],[5,386,5,388
],[5,387,5,389],[5,388,5,390],[5,389,5,391],[5,390,-1,-1],[-1,-
1,5,393],[5,392,5,394],[5,393,5,395],[5,394,5,396],[5,395,5,397],[5,396,5,3
98],[5,397,5,399],[5,398,5,400],[5,399,5,401],[5,400,5,402],[5,401,5,403],[
5,402,5,404],[5,403,5,405],[5,404,0,405],[0,406,5,407],[5,406,5,408],[5,407
,5,409],[5,408,5,410],[5,409,5,411],[5,410,5,412],[5,411,5,413],[5,412,5,41
4],[5,413,5,415],[5,414,5,416],[5,415,5,417],[5,416,5,418],[5,417,5,419],[5
,418,4,419],[4,420,5,421],[5,420,5,422],[5,421,5,423],[5,422,5,424],[5,423,
5,425],[5,424,5,426],[5,425,5,427],[5,426,5,428],[5,427,5,429],[5,428,5,430
],[5,429,5,431],[5,430,5,432],[5,431,5,433],[5,432,-1,-1],[-1,-
1,5,435],[5,434,5,436],[5,435,5,437],[5,436,5,438],[5,437,5,439],[5,438,5,4
40],[5,439,5,441],[5,440,5,442],[5,441,5,443],[5,442,5,444],[5,443,5,445],[
5,444,5,446],[5,445,5,447],[5,446,0,447],[0,448,5,449],[5,448,5,450],[5,449
,5,451],[5,450,5,452],[5,451,5,453],[5,452,5,454],[5,453,5,455],[5,454,5,45
6],[5,455,5,457],[5,456,5,458],[5,457,5,459],[5,458,5,460],[5,459,5,461],[5
,460,4,461],[4,462,5,463],[5,462,5,464],[5,463,5,465],[5,464,5,466],[5,465,
5,467],[5,466,5,468],[5,467,5,469],[5,468,5,470],[5,469,5,471],[5,470,5,472
],[5,471,5,473],[5,472,5,474],[5,473,5,475],[5,474,-1,-1],[-1,-
1,5,477],[5,476,5,478],[5,477,5,479],[5,478,5,480],[5,479,5,481],[5,480,5,4
82],[5,481,5,483],[5,482,5,484],[5,483,5,485],[5,484,5,486],[5,485,5,487],[
5,486,5,488],[5,487,5,489],[5,488,0,489],[0,490,5,491],[5,490,5,492],[5,491
,5,493],[5,492,5,494],[5,493,5,495],[5,494,5,496],[5,495,5,497],[5,496,5,49
8],[5,497,5,499],[5,498,5,500],[5,499,5,501],[5,500,5,502],[5,501,5,503],[5
,502,4,503],[4,504,5,505],[5,504,5,506],[5,505,5,507],[5,506,5,508],[5,507,
5,509],[5,508,5,510],[5,509,5,511],[5,510,5,512],[5,511,5,513],[5,512,5,514
],[5,513,5,515],[5,514,5,516],[5,515,5,517],[5,516,-1,-1],[-1,-
1,5,519],[5,518,5,520],[5,519,5,521],[5,520,5,522],[5,521,5,523],[5,522,5,5
24],[5,523,5,525],[5,524,5,526],[5,525,5,527],[5,526,5,528],[5,527,5,529],[
5,528,5,530],[5,529,5,531],[5,530,0,531],[0,532,5,533],[5,532,5,534],[5,533
,5,535],[5,534,5,536],[5,535,5,537],[5,536,5,538],[5,537,5,539],[5,538,5,54
0],[5,539,5,541],[5,540,5,542],[5,541,5,543],[5,542,5,544],[5,543,5,545],[5
,544,4,545],[4,546,5,547],[5,546,5,548],[5,547,5,549],[5,548,5,550],[5,549,
5,551],[5,550,5,552],[5,551,5,553],[5,552,5,554],[5,553,5,555],[5,554,5,556
],[5,555,5,557],[5,556,5,558],[5,557,5,559],[5,558,-1,-1],[-1,-
1,5,561],[5,560,5,562],[5,561,5,563],[5,562,5,564],[5,563,5,565],[5,564,5,5
66],[5,565,5,567],[5,566,5,568],[5,567,5,569],[5,568,5,570],[5,569,5,571],[
5,570,5,572],[5,571,5,573],[5,572,0,573],[0,574,5,575],[5,574,5,576],[5,575
,5,577],[5,576,5,578],[5,577,5,579],[5,578,5,580],[5,579,5,581],[5,580,5,58
2],[5,581,5,583],[5,582,5,584],[5,583,5,585],[5,584,5,586],[5,585,5,587],[5
,586,4,587],[4,588,5,589],[5,588,5,590],[5,589,5,591],[5,590,5,592],[5,591,
5,593],[5,592,5,594],[5,593,5,595],[5,594,5,596],[5,595,5,597],[5,596,5,598
],[5,597,5,599],[5,598,5,600],[5,599,5,601],[5,600,-1,-1],[-1,-
1,5,603],[5,602,5,604],[5,603,5,605],[5,604,5,606],[5,605,5,607],[5,606,5,6
08],[5,607,5,609],[5,608,5,610],[5,609,5,611],[5,610,5,612],[5,611,5,613],[
5,612,5,614],[5,613,5,615],[5,614,0,615],[0,616,5,617],[5,616,5,618],[5,617
,5,619],[5,618,5,620],[5,619,5,621],[5,620,5,622],[5,621,5,623],[5,622,5,62
4],[5,623,5,625],[5,624,5,626],[5,625,5,627],[5,626,5,628],[5,627,5,629],[5
,628,4,629],[4,630,5,631],[5,630,5,632],[5,631,5,633],[5,632,5,634],[5,633,
5,635],[5,634,5,636],[5,635,5,637],[5,636,5,638],[5,637,5,639],[5,638,5,640
],[5,639,5,641],[5,640,5,642],[5,641,5,643],[5,642,-1,-1],[-1,-
1,5,645],[5,644,5,646],[5,645,5,647],[5,646,5,648],[5,647,5,649],[5,648,5,6
50],[5,649,5,651],[5,650,5,652],[5,651,5,653],[5,652,5,654],[5,653,5,655],[
5,654,5,656],[5,655,5,657],[5,656,0,657],[0,658,5,659],[5,658,5,660],[5,659

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1609

,5,661],[5,660,5,662],[5,661,5,663],[5,662,5,664],[5,663,5,665],[5,664,5,66
6],[5,665,5,667],[5,666,5,668],[5,667,5,669],[5,668,5,670],[5,669,5,671],[5
,670,4,671],[4,672,5,673],[5,672,5,674],[5,673,5,675],[5,674,5,676],[5,675,
5,677],[5,676,5,678],[5,677,5,679],[5,678,5,680],[5,679,5,681],[5,680,5,682
],[5,681,5,683],[5,682,5,684],[5,683,5,685],[5,684,-1,-1],[-1,-
1,5,687],[5,686,5,688],[5,687,5,689],[5,688,5,690],[5,689,5,691],[5,690,5,6
92],[5,691,5,693],[5,692,5,694],[5,693,5,695],[5,694,5,696],[5,695,5,697],[
5,696,5,698],[5,697,5,699],[5,698,0,699],[0,700,5,701],[5,700,5,702],[5,701
,5,703],[5,702,5,704],[5,703,5,705],[5,704,5,706],[5,705,5,707],[5,706,5,70
8],[5,707,5,709],[5,708,5,710],[5,709,5,711],[5,710,5,712],[5,711,5,713],[5
,712,4,713],[4,714,5,715],[5,714,5,716],[5,715,5,717],[5,716,5,718],[5,717,
5,719],[5,718,5,720],[5,719,5,721],[5,720,5,722],[5,721,5,723],[5,722,5,724
],[5,723,5,725],[5,724,5,726],[5,725,5,727],[5,726,-1,-1],[-1,-
1,5,729],[5,728,5,730],[5,729,5,731],[5,730,5,732],[5,731,5,733],[5,732,5,7
34],[5,733,5,735],[5,734,5,736],[5,735,5,737],[5,736,5,738],[5,737,5,739],[
5,738,5,740],[5,739,5,741],[5,740,0,741],[0,742,5,743],[5,742,5,744],[5,743
,5,745],[5,744,5,746],[5,745,5,747],[5,746,5,748],[5,747,5,749],[5,748,5,75
0],[5,749,5,751],[5,750,5,752],[5,751,5,753],[5,752,5,754],[5,753,5,755],[5
,754,4,755],[4,756,5,757],[5,756,5,758],[5,757,5,759],[5,758,5,760],[5,759,
5,761],[5,760,5,762],[5,761,5,763],[5,762,5,764],[5,763,5,765],[5,764,5,766
],[5,765,5,767],[5,766,5,768],[5,767,5,769],[5,768,-1,-1],[-1,-
1,5,771],[5,770,5,772],[5,771,5,773],[5,772,5,774],[5,773,5,775],[5,774,5,7
76],[5,775,5,777],[5,776,5,778],[5,777,5,779],[5,778,5,780],[5,779,5,781],[
5,780,5,782],[5,781,5,783],[5,782,0,783],[0,784,5,785],[5,784,5,786],[5,785
,5,787],[5,786,5,788],[5,787,5,789],[5,788,5,790],[5,789,5,791],[5,790,5,79
2],[5,791,5,793],[5,792,5,794],[5,793,5,795],[5,794,5,796],[5,795,5,797],[5
,796,4,797],[4,798,5,799],[5,798,5,800],[5,799,5,801],[5,800,5,802],[5,801,
5,803],[5,802,5,804],[5,803,5,805],[5,804,5,806],[5,805,5,807],[5,806,5,808
],[5,807,5,809],[5,808,5,810],[5,809,5,811],[5,810,-1,-1],[-1,-
1,5,813],[5,812,5,814],[5,813,5,815],[5,814,5,816],[5,815,5,817],[5,816,5,8
18],[5,817,5,819],[5,818,5,820],[5,819,5,821],[5,820,5,822],[5,821,5,823],[
5,822,5,824],[5,823,5,825],[5,824,0,825],[0,826,5,827],[5,826,5,828],[5,827
,5,829],[5,828,5,830],[5,829,5,831],[5,830,5,832],[5,831,5,833],[5,832,5,83
4],[5,833,5,835],[5,834,5,836],[5,835,5,837],[5,836,5,838],[5,837,5,839],[5
,838,4,839],[4,840,5,841],[5,840,5,842],[5,841,5,843],[5,842,5,844],[5,843,
5,845],[5,844,5,846],[5,845,5,847],[5,846,5,848],[5,847,5,849],[5,848,5,850
],[5,849,5,851],[5,850,5,852],[5,851,5,853],[5,852,-1,-1],[-1,-
1,5,855],[5,854,5,856],[5,855,5,857],[5,856,5,858],[5,857,5,859],[5,858,5,8
60],[5,859,5,861],[5,860,5,862],[5,861,5,863],[5,862,5,864],[5,863,5,865],[
5,864,5,866],[5,865,5,867],[5,866,0,867],[0,868,5,869],[5,868,5,870],[5,869
,5,871],[5,870,5,872],[5,871,5,873],[5,872,5,874],[5,873,5,875],[5,874,5,87
6],[5,875,5,877],[5,876,5,878],[5,877,5,879],[5,878,5,880],[5,879,5,881],[5
,880,4,881],[4,882,5,883],[5,882,5,884],[5,883,5,885],[5,884,5,886],[5,885,
5,887],[5,886,5,888],[5,887,5,889],[5,888,5,890],[5,889,5,891],[5,890,5,892
],[5,891,5,893],[5,892,5,894],[5,893,5,895],[5,894,-1,-1],[-1,-
1,5,897],[5,896,5,898],[5,897,5,899],[5,898,5,900],[5,899,5,901],[5,900,5,9
02],[5,901,5,903],[5,902,5,904],[5,903,5,905],[5,904,5,906],[5,905,5,907],[
5,906,5,908],[5,907,5,909],[5,908,0,909],[0,910,5,911],[5,910,5,912],[5,911
,5,913],[5,912,5,914],[5,913,5,915],[5,914,5,916],[5,915,5,917],[5,916,5,91
8],[5,917,5,919],[5,918,5,920],[5,919,5,921],[5,920,5,922],[5,921,5,923],[5
,922,4,923],[4,924,5,925],[5,924,5,926],[5,925,5,927],[5,926,5,928],[5,927,
5,929],[5,928,5,930],[5,929,5,931],[5,930,5,932],[5,931,5,933],[5,932,5,934
],[5,933,5,935],[5,934,5,936],[5,935,5,937],[5,936,-1,-1],[-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1610

1,5,939],[5,938,5,940],[5,939,5,941],[5,940,5,942],[5,941,5,943],[5,942,5,9
44],[5,943,5,945],[5,944,5,946],[5,945,5,947],[5,946,5,948],[5,947,5,949],[
5,948,5,950],[5,949,5,951],[5,950,0,951],[0,952,5,953],[5,952,5,954],[5,953
,5,955],[5,954,5,956],[5,955,5,957],[5,956,5,958],[5,957,5,959],[5,958,5,96
0],[5,959,5,961],[5,960,5,962],[5,961,5,963],[5,962,5,964],[5,963,5,965],[5
,964,4,965],[4,966,5,967],[5,966,5,968],[5,967,5,969],[5,968,5,970],[5,969,
5,971],[5,970,5,972],[5,971,5,973],[5,972,5,974],[5,973,5,975],[5,974,5,976
],[5,975,5,977],[5,976,5,978],[5,977,5,979],[5,978,-1,-1],[-1,-
1,5,981],[5,980,5,982],[5,981,5,983],[5,982,5,984],[5,983,5,985],[5,984,5,9
86],[5,985,5,987],[5,986,5,988],[5,987,5,989],[5,988,5,990],[5,989,5,991],[
5,990,5,992],[5,991,5,993],[5,992,0,993],[0,994,5,995],[5,994,5,996],[5,995
,5,997],[5,996,5,998],[5,997,5,999],[5,998,5,1000],[5,999,5,1001],[5,1000,5
,1002],[5,1001,5,1003],[5,1002,5,1004],[5,1003,5,1005],[5,1004,5,1006],[5,1
005,5,1007],[5,1006,4,1007],[4,1008,5,1009],[5,1008,5,1010],[5,1009,5,1011]
,[5,1010,5,1012],[5,1011,5,1013],[5,1012,5,1014],[5,1013,5,1015],[5,1014,5,
1016],[5,1015,5,1017],[5,1016,5,1018],[5,1017,5,1019],[5,1018,5,1020],[5,10
19,5,1021],[5,1020,-1,-1],[-1,-
1,5,1023],[5,1022,5,1024],[5,1023,5,1025],[5,1024,5,1026],[5,1025,5,1027],[
5,1026,5,1028],[5,1027,5,1029],[5,1028,5,1030],[5,1029,5,1031],[5,1030,5,10
32],[5,1031,5,1033],[5,1032,5,1034],[5,1033,5,1035],[5,1034,0,1035],[0,1036
,5,1037],[5,1036,5,1038],[5,1037,5,1039],[5,1038,5,1040],[5,1039,5,1041],[5
,1040,5,1042],[5,1041,5,1043],[5,1042,5,1044],[5,1043,5,1045],[5,1044,5,104
6],[5,1045,5,1047],[5,1046,5,1048],[5,1047,5,1049],[5,1048,4,1049],[4,1050,
5,1051],[5,1050,5,1052],[5,1051,5,1053],[5,1052,5,1054],[5,1053,5,1055],[5,
1054,5,1056],[5,1055,5,1057],[5,1056,5,1058],[5,1057,5,1059],[5,1058,5,1060
],[5,1059,5,1061],[5,1060,5,1062],[5,1061,5,1063],[5,1062,-1,-1],[-1,-
1,5,1065],[5,1064,5,1066],[5,1065,5,1067],[5,1066,5,1068],[5,1067,5,1069],[
5,1068,5,1070],[5,1069,5,1071],[5,1070,5,1072],[5,1071,5,1073],[5,1072,5,10
74],[5,1073,5,1075],[5,1074,5,1076],[5,1075,5,1077],[5,1076,0,1077],[0,1078
,5,1079],[5,1078,5,1080],[5,1079,5,1081],[5,1080,5,1082],[5,1081,5,1083],[5
,1082,5,1084],[5,1083,5,1085],[5,1084,5,1086],[5,1085,5,1087],[5,1086,5,108
8],[5,1087,5,1089],[5,1088,5,1090],[5,1089,5,1091],[5,1090,4,1091],[4,1092,
5,1093],[5,1092,5,1094],[5,1093,5,1095],[5,1094,5,1096],[5,1095,5,1097],[5,
1096,5,1098],[5,1097,5,1099],[5,1098,5,1100],[5,1099,5,1101],[5,1100,5,1102
],[5,1101,5,1103],[5,1102,5,1104],[5,1103,5,1105],[5,1104,-1,-1],[-1,-
1,5,1107],[5,1106,5,1108],[5,1107,5,1109],[5,1108,5,1110],[5,1109,5,1111],[
5,1110,5,1112],[5,1111,5,1113],[5,1112,5,1114],[5,1113,5,1115],[5,1114,5,11
16],[5,1115,5,1117],[5,1116,5,1118],[5,1117,5,1119],[5,1118,0,1119],[0,1120
,5,1121],[5,1120,5,1122],[5,1121,5,1123],[5,1122,5,1124],[5,1123,5,1125],[5
,1124,5,1126],[5,1125,5,1127],[5,1126,5,1128],[5,1127,5,1129],[5,1128,5,113
0],[5,1129,5,1131],[5,1130,5,1132],[5,1131,5,1133],[5,1132,4,1133],[4,1134,
5,1135],[5,1134,5,1136],[5,1135,5,1137],[5,1136,5,1138],[5,1137,5,1139],[5,
1138,5,1140],[5,1139,5,1141],[5,1140,5,1142],[5,1141,5,1143],[5,1142,5,1144
],[5,1143,5,1145],[5,1144,5,1146],[5,1145,5,1147],[5,1146,-1,-1],[-1,-
1,5,1149],[5,1148,5,1150],[5,1149,5,1151],[5,1150,5,1152],[5,1151,5,1153],[
5,1152,5,1154],[5,1153,5,1155],[5,1154,5,1156],[5,1155,5,1157],[5,1156,5,11
58],[5,1157,5,1159],[5,1158,5,1160],[5,1159,5,1161],[5,1160,0,1161],[0,1162
,5,1163],[5,1162,5,1164],[5,1163,5,1165],[5,1164,5,1166],[5,1165,5,1167],[5
,1166,5,1168],[5,1167,5,1169],[5,1168,5,1170],[5,1169,5,1171],[5,1170,5,117
2],[5,1171,5,1173],[5,1172,5,1174],[5,1173,5,1175],[5,1174,4,1175],[4,1176,
5,1177],[5,1176,5,1178],[5,1177,5,1179],[5,1178,5,1180],[5,1179,5,1181],[5,
1180,5,1182],[5,1181,5,1183],[5,1182,5,1184],[5,1183,5,1185],[5,1184,5,1186
],[5,1185,5,1187],[5,1186,5,1188],[5,1187,5,1189],[5,1188,-1,-1],[-1,-

1,5,1191],[5,1190,5,1192],[5,1191,5,1193],[5,1192,5,1194],[5,1193,5,1195],[
5,1194,5,1196],[5,1195,5,1197],[5,1196,5,1198],[5,1197,5,1199],[5,1198,5,12
00],[5,1199,5,1201],[5,1200,5,1202],[5,1201,5,1203],[5,1202,0,1203],[0,1204
,5,1205],[5,1204,5,1206],[5,1205,5,1207],[5,1206,5,1208],[5,1207,5,1209],[5
,1208,5,1210],[5,1209,5,1211],[5,1210,5,1212],[5,1211,5,1213],[5,1212,5,121
4],[5,1213,5,1215],[5,1214,5,1216],[5,1215,5,1217],[5,1216,4,1217],[4,1218,
5,1219],[5,1218,5,1220],[5,1219,5,1221],[5,1220,5,1222],[5,1221,5,1223],[5,
1222,5,1224],[5,1223,5,1225],[5,1224,5,1226],[5,1225,5,1227],[5,1226,5,1228
],[5,1227,5,1229],[5,1228,5,1230],[5,1229,5,1231],[5,1230,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-
1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-
1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-
1]],"loop":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1612

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
,"scafLoop":[],"stapLoop":[],"skip":[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0],"scaf":[[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-
1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-1],[-1,-

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1613

1,-1,-1],[-1,-1,-1,-1],[-1,-1,-1,-
1],[5,17,4,16],[5,18,5,16],[5,19,5,17],[5,20,5,18],[5,21,5,19],[5,22,5,20],
[5,23,5,21],[5,24,5,22],[5,25,5,23],[5,26,5,24],[5,27,5,25],[5,28,5,26],[5,
29,5,27],[5,30,5,28],[5,31,5,29],[5,32,5,30],[5,33,5,31],[5,34,5,32],[5,35,
5,33],[5,36,5,34],[5,37,5,35],[5,38,5,36],[5,39,5,37],[5,40,5,38],[5,41,5,3
9],[5,42,5,40],[5,43,5,41],[5,44,5,42],[5,45,5,43],[5,46,5,44],[5,47,5,45],
[5,48,5,46],[5,49,5,47],[5,50,5,48],[5,51,5,49],[5,52,5,50],[5,53,5,51],[5,
54,5,52],[5,55,5,53],[5,56,5,54],[5,57,5,55],[5,58,5,56],[5,59,5,57],[5,60,
5,58],[5,61,5,59],[5,62,5,60],[5,63,5,61],[5,64,5,62],[5,65,5,63],[5,66,5,6
4],[5,67,5,65],[5,68,5,66],[5,69,5,67],[5,70,5,68],[5,71,5,69],[5,72,5,70],
[5,73,5,71],[5,74,5,72],[5,75,5,73],[5,76,5,74],[5,77,5,75],[5,78,5,76],[5,
79,5,77],[5,80,5,78],[5,81,5,79],[5,82,5,80],[5,83,5,81],[5,84,5,82],[5,85,
5,83],[5,86,5,84],[5,87,5,85],[5,88,5,86],[5,89,5,87],[5,90,5,88],[5,91,5,8
9],[5,92,5,90],[5,93,5,91],[5,94,5,92],[5,95,5,93],[5,96,5,94],[5,97,5,95],
[5,98,5,96],[5,99,5,97],[5,100,5,98],[5,101,5,99],[5,102,5,100],[5,103,5,10
1],[5,104,5,102],[5,105,5,103],[5,106,5,104],[5,107,5,105],[5,108,5,106],[5
,109,5,107],[5,110,5,108],[5,111,5,109],[5,112,5,110],[5,113,5,111],[5,114,
5,112],[5,115,5,113],[5,116,5,114],[5,117,5,115],[5,118,5,116],[5,119,5,117
],[5,120,5,118],[5,121,5,119],[5,122,5,120],[5,123,5,121],[5,124,5,122],[5,
125,5,123],[5,126,5,124],[5,127,5,125],[5,128,5,126],[5,129,5,127],[5,130,5
,128],[5,131,5,129],[5,132,5,130],[5,133,5,131],[5,134,5,132],[5,135,5,133]
,[5,136,5,134],[5,137,5,135],[5,138,5,136],[5,139,5,137],[5,140,5,138],[5,1
41,5,139],[5,142,5,140],[5,143,5,141],[5,144,5,142],[5,145,5,143],[5,146,5,
144],[5,147,5,145],[5,148,5,146],[5,149,5,147],[5,150,5,148],[5,151,5,149],
[5,152,5,150],[5,153,5,151],[5,154,5,152],[5,155,5,153],[5,156,5,154],[5,15
7,5,155],[5,158,5,156],[5,159,5,157],[5,160,5,158],[5,161,5,159],[5,162,5,1
60],[5,163,5,161],[5,164,5,162],[5,165,5,163],[5,166,5,164],[5,167,5,165],[
5,168,5,166],[5,169,5,167],[5,170,5,168],[5,171,5,169],[5,172,5,170],[5,173
,5,171],[5,174,5,172],[5,175,5,173],[5,176,5,174],[5,177,5,175],[5,178,5,17
6],[5,179,5,177],[5,180,5,178],[5,181,5,179],[5,182,5,180],[5,183,5,181],[5
,184,5,182],[5,185,5,183],[5,186,5,184],[5,187,5,185],[5,188,5,186],[5,189,
5,187],[5,190,5,188],[5,191,5,189],[5,192,5,190],[5,193,5,191],[5,194,5,192
],[5,195,5,193],[5,196,5,194],[5,197,5,195],[5,198,5,196],[5,199,5,197],[5,
200,5,198],[5,201,5,199],[5,202,5,200],[5,203,5,201],[5,204,5,202],[5,205,5
,203],[5,206,5,204],[5,207,5,205],[5,208,5,206],[5,209,5,207],[5,210,5,208]
,[5,211,5,209],[5,212,5,210],[5,213,5,211],[5,214,5,212],[5,215,5,213],[5,2
16,5,214],[5,217,5,215],[5,218,5,216],[5,219,5,217],[5,220,5,218],[5,221,5,
219],[5,222,5,220],[5,223,5,221],[5,224,5,222],[5,225,5,223],[5,226,5,224],
[5,227,5,225],[5,228,5,226],[5,229,5,227],[5,230,5,228],[5,231,5,229],[5,23
2,5,230],[5,233,5,231],[5,234,5,232],[5,235,5,233],[5,236,5,234],[5,237,5,2
35],[5,238,5,236],[5,239,5,237],[5,240,5,238],[5,241,5,239],[5,242,5,240],[
5,243,5,241],[5,244,5,242],[5,245,5,243],[5,246,5,244],[5,247,5,245],[5,248
,5,246],[5,249,5,247],[5,250,5,248],[5,251,5,249],[5,252,5,250],[5,253,5,25
1],[5,254,5,252],[5,255,5,253],[5,256,5,254],[5,257,5,255],[5,258,5,256],[5
,259,5,257],[5,260,5,258],[5,261,5,259],[5,262,5,260],[5,263,5,261],[5,264,
5,262],[5,265,5,263],[5,266,5,264],[5,267,5,265],[5,268,5,266],[5,269,5,267
],[5,270,5,268],[5,271,5,269],[5,272,5,270],[5,273,5,271],[5,274,5,272],[5,
275,5,273],[5,276,5,274],[5,277,5,275],[5,278,5,276],[5,279,5,277],[5,280,5
,278],[5,281,5,279],[5,282,5,280],[5,283,5,281],[5,284,5,282],[5,285,5,283]
,[5,286,5,284],[5,287,5,285],[5,288,5,286],[5,289,5,287],[5,290,5,288],[5,2
91,5,289],[5,292,5,290],[5,293,5,291],[5,294,5,292],[5,295,5,293],[5,296,5,
294],[5,297,5,295],[5,298,5,296],[5,299,5,297],[5,300,5,298],[5,301,5,299],
[5,302,5,300],[5,303,5,301],[5,304,5,302],[5,305,5,303],[5,306,5,304],[5,30

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1614

7,5,305],[5,308,5,306],[5,309,5,307],[5,310,5,308],[5,311,5,309],[5,312,5,3
10],[5,313,5,311],[5,314,5,312],[5,315,5,313],[5,316,5,314],[5,317,5,315],[
5,318,5,316],[5,319,5,317],[5,320,5,318],[5,321,5,319],[5,322,5,320],[5,323
,5,321],[5,324,5,322],[5,325,5,323],[5,326,5,324],[5,327,5,325],[5,328,5,32
6],[5,329,5,327],[5,330,5,328],[5,331,5,329],[5,332,5,330],[5,333,5,331],[5
,334,5,332],[5,335,5,333],[5,336,5,334],[5,337,5,335],[5,338,5,336],[5,339,
5,337],[5,340,5,338],[5,341,5,339],[5,342,5,340],[5,343,5,341],[5,344,5,342
],[5,345,5,343],[5,346,5,344],[5,347,5,345],[5,348,5,346],[5,349,5,347],[5,
350,5,348],[5,351,5,349],[5,352,5,350],[5,353,5,351],[5,354,5,352],[5,355,5
,353],[5,356,5,354],[5,357,5,355],[5,358,5,356],[5,359,5,357],[5,360,5,358]
,[5,361,5,359],[5,362,5,360],[5,363,5,361],[5,364,5,362],[5,365,5,363],[5,3
66,5,364],[5,367,5,365],[5,368,5,366],[5,369,5,367],[5,370,5,368],[5,371,5,
369],[5,372,5,370],[5,373,5,371],[5,374,5,372],[5,375,5,373],[5,376,5,374],
[5,377,5,375],[5,378,5,376],[5,379,5,377],[5,380,5,378],[5,381,5,379],[5,38
2,5,380],[5,383,5,381],[5,384,5,382],[5,385,5,383],[5,386,5,384],[5,387,5,3
85],[5,388,5,386],[5,389,5,387],[5,390,5,388],[5,391,5,389],[5,392,5,390],[
5,393,5,391],[5,394,5,392],[5,395,5,393],[5,396,5,394],[5,397,5,395],[5,398
,5,396],[5,399,5,397],[5,400,5,398],[5,401,5,399],[5,402,5,400],[5,403,5,40
1],[5,404,5,402],[5,405,5,403],[5,406,5,404],[5,407,5,405],[5,408,5,406],[5
,409,5,407],[5,410,5,408],[5,411,5,409],[5,412,5,410],[5,413,5,411],[5,414,
5,412],[5,415,5,413],[5,416,5,414],[5,417,5,415],[5,418,5,416],[5,419,5,417
],[5,420,5,418],[5,421,5,419],[5,422,5,420],[5,423,5,421],[5,424,5,422],[5,
425,5,423],[5,426,5,424],[5,427,5,425],[5,428,5,426],[5,429,5,427],[5,430,5
,428],[5,431,5,429],[5,432,5,430],[5,433,5,431],[5,434,5,432],[5,435,5,433]
,[5,436,5,434],[5,437,5,435],[5,438,5,436],[5,439,5,437],[5,440,5,438],[5,4
41,5,439],[5,442,5,440],[5,443,5,441],[5,444,5,442],[5,445,5,443],[5,446,5,
444],[5,447,5,445],[5,448,5,446],[5,449,5,447],[5,450,5,448],[5,451,5,449],
[5,452,5,450],[5,453,5,451],[5,454,5,452],[5,455,5,453],[5,456,5,454],[5,45
7,5,455],[5,458,5,456],[5,459,5,457],[5,460,5,458],[5,461,5,459],[5,462,5,4
60],[5,463,5,461],[5,464,5,462],[5,465,5,463],[5,466,5,464],[5,467,5,465],[
5,468,5,466],[5,469,5,467],[5,470,5,468],[5,471,5,469],[5,472,5,470],[5,473
,5,471],[5,474,5,472],[5,475,5,473],[5,476,5,474],[5,477,5,475],[5,478,5,47
6],[5,479,5,477],[5,480,5,478],[5,481,5,479],[5,482,5,480],[5,483,5,481],[5
,484,5,482],[5,485,5,483],[5,486,5,484],[5,487,5,485],[5,488,5,486],[5,489,
5,487],[5,490,5,488],[5,491,5,489],[5,492,5,490],[5,493,5,491],[5,494,5,492
],[5,495,5,493],[5,496,5,494],[5,497,5,495],[5,498,5,496],[5,499,5,497],[5,
500,5,498],[5,501,5,499],[5,502,5,500],[5,503,5,501],[5,504,5,502],[5,505,5
,503],[5,506,5,504],[5,507,5,505],[5,508,5,506],[5,509,5,507],[5,510,5,508]
,[5,511,5,509],[5,512,5,510],[5,513,5,511],[5,514,5,512],[5,515,5,513],[5,5
16,5,514],[5,517,5,515],[5,518,5,516],[5,519,5,517],[5,520,5,518],[5,521,5,
519],[5,522,5,520],[5,523,5,521],[5,524,5,522],[5,525,5,523],[5,526,5,524],
[5,527,5,525],[5,528,5,526],[5,529,5,527],[5,530,5,528],[5,531,5,529],[5,53
2,5,530],[5,533,5,531],[5,534,5,532],[5,535,5,533],[5,536,5,534],[5,537,5,5
35],[5,538,5,536],[5,539,5,537],[5,540,5,538],[5,541,5,539],[5,542,5,540],[
5,543,5,541],[5,544,5,542],[5,545,5,543],[5,546,5,544],[5,547,5,545],[5,548
,5,546],[5,549,5,547],[5,550,5,548],[5,551,5,549],[5,552,5,550],[5,553,5,55
1],[5,554,5,552],[5,555,5,553],[5,556,5,554],[5,557,5,555],[5,558,5,556],[5
,559,5,557],[5,560,5,558],[5,561,5,559],[5,562,5,560],[5,563,5,561],[5,564,
5,562],[5,565,5,563],[5,566,5,564],[5,567,5,565],[5,568,5,566],[5,569,5,567
],[5,570,5,568],[5,571,5,569],[5,572,5,570],[5,573,5,571],[5,574,5,572],[5,
575,5,573],[5,576,5,574],[5,577,5,575],[5,578,5,576],[5,579,5,577],[5,580,5
,578],[5,581,5,579],[5,582,5,580],[5,583,5,581],[5,584,5,582],[5,585,5,583]
,[5,586,5,584],[5,587,5,585],[5,588,5,586],[5,589,5,587],[5,590,5,588],[5,5

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1615

91,5,589],[5,592,5,590],[5,593,5,591],[5,594,5,592],[5,595,5,593],[5,596,5,
594],[5,597,5,595],[5,598,5,596],[5,599,5,597],[5,600,5,598],[5,601,5,599],
[5,602,5,600],[5,603,5,601],[5,604,5,602],[5,605,5,603],[5,606,5,604],[5,60
7,5,605],[5,608,5,606],[5,609,5,607],[5,610,5,608],[5,611,5,609],[5,612,5,6
10],[5,613,5,611],[5,614,5,612],[5,615,5,613],[5,616,5,614],[5,617,5,615],[
5,618,5,616],[5,619,5,617],[5,620,5,618],[5,621,5,619],[5,622,5,620],[5,623
,5,621],[5,624,5,622],[5,625,5,623],[5,626,5,624],[5,627,5,625],[5,628,5,62
6],[5,629,5,627],[5,630,5,628],[5,631,5,629],[5,632,5,630],[5,633,5,631],[5
,634,5,632],[5,635,5,633],[5,636,5,634],[5,637,5,635],[5,638,5,636],[5,639,
5,637],[5,640,5,638],[5,641,5,639],[5,642,5,640],[5,643,5,641],[5,644,5,642
],[5,645,5,643],[5,646,5,644],[5,647,5,645],[5,648,5,646],[5,649,5,647],[5,
650,5,648],[5,651,5,649],[5,652,5,650],[5,653,5,651],[5,654,5,652],[5,655,5
,653],[5,656,5,654],[5,657,5,655],[5,658,5,656],[5,659,5,657],[5,660,5,658]
,[5,661,5,659],[5,662,5,660],[5,663,5,661],[5,664,5,662],[5,665,5,663],[5,6
66,5,664],[5,667,5,665],[5,668,5,666],[5,669,5,667],[5,670,5,668],[5,671,5,
669],[5,672,5,670],[5,673,5,671],[5,674,5,672],[5,675,5,673],[5,676,5,674],
[5,677,5,675],[5,678,5,676],[5,679,5,677],[5,680,5,678],[5,681,5,679],[5,68
2,5,680],[5,683,5,681],[5,684,5,682],[5,685,5,683],[5,686,5,684],[5,687,5,6
85],[5,688,5,686],[5,689,5,687],[5,690,5,688],[5,691,5,689],[5,692,5,690],[
5,693,5,691],[5,694,5,692],[5,695,5,693],[5,696,5,694],[5,697,5,695],[5,698
,5,696],[5,699,5,697],[5,700,5,698],[5,701,5,699],[5,702,5,700],[5,703,5,70
1],[5,704,5,702],[5,705,5,703],[5,706,5,704],[5,707,5,705],[5,708,5,706],[5
,709,5,707],[5,710,5,708],[5,711,5,709],[5,712,5,710],[5,713,5,711],[5,714,
5,712],[5,715,5,713],[5,716,5,714],[5,717,5,715],[5,718,5,716],[5,719,5,717
],[5,720,5,718],[5,721,5,719],[5,722,5,720],[5,723,5,721],[5,724,5,722],[5,
725,5,723],[5,726,5,724],[5,727,5,725],[5,728,5,726],[5,729,5,727],[5,730,5
,728],[5,731,5,729],[5,732,5,730],[5,733,5,731],[5,734,5,732],[5,735,5,733]
,[5,736,5,734],[5,737,5,735],[5,738,5,736],[5,739,5,737],[5,740,5,738],[5,7
41,5,739],[5,742,5,740],[5,743,5,741],[5,744,5,742],[5,745,5,743],[5,746,5,
744],[5,747,5,745],[5,748,5,746],[5,749,5,747],[5,750,5,748],[5,751,5,749],
[5,752,5,750],[5,753,5,751],[5,754,5,752],[5,755,5,753],[5,756,5,754],[5,75
7,5,755],[5,758,5,756],[5,759,5,757],[5,760,5,758],[5,761,5,759],[5,762,5,7
60],[5,763,5,761],[5,764,5,762],[5,765,5,763],[5,766,5,764],[5,767,5,765],[
5,768,5,766],[5,769,5,767],[5,770,5,768],[5,771,5,769],[5,772,5,770],[5,773
,5,771],[5,774,5,772],[5,775,5,773],[5,776,5,774],[5,777,5,775],[5,778,5,77
6],[5,779,5,777],[5,780,5,778],[5,781,5,779],[5,782,5,780],[5,783,5,781],[5
,784,5,782],[5,785,5,783],[5,786,5,784],[5,787,5,785],[5,788,5,786],[5,789,
5,787],[5,790,5,788],[5,791,5,789],[5,792,5,790],[5,793,5,791],[5,794,5,792
],[5,795,5,793],[5,796,5,794],[5,797,5,795],[5,798,5,796],[5,799,5,797],[5,
800,5,798],[5,801,5,799],[5,802,5,800],[5,803,5,801],[5,804,5,802],[5,805,5
,803],[5,806,5,804],[5,807,5,805],[5,808,5,806],[5,809,5,807],[5,810,5,808]
,[5,811,5,809],[5,812,5,810],[5,813,5,811],[5,814,5,812],[5,815,5,813],[5,8
16,5,814],[5,817,5,815],[5,818,5,816],[5,819,5,817],[5,820,5,818],[5,821,5,
819],[5,822,5,820],[5,823,5,821],[5,824,5,822],[5,825,5,823],[5,826,5,824],
[5,827,5,825],[5,828,5,826],[5,829,5,827],[5,830,5,828],[5,831,5,829],[5,83
2,5,830],[5,833,5,831],[5,834,5,832],[5,835,5,833],[5,836,5,834],[5,837,5,8
35],[5,838,5,836],[5,839,5,837],[5,840,5,838],[5,841,5,839],[5,842,5,840],[
5,843,5,841],[5,844,5,842],[5,845,5,843],[5,846,5,844],[5,847,5,845],[5,848
,5,846],[5,849,5,847],[5,850,5,848],[5,851,5,849],[5,852,5,850],[5,853,5,85
1],[5,854,5,852],[5,855,5,853],[5,856,5,854],[5,857,5,855],[5,858,5,856],[5
,859,5,857],[5,860,5,858],[5,861,5,859],[5,862,5,860],[5,863,5,861],[5,864,
5,862],[5,865,5,863],[5,866,5,864],[5,867,5,865],[5,868,5,866],[5,869,5,867
],[5,870,5,868],[5,871,5,869],[5,872,5,870],[5,873,5,871],[5,874,5,872],[5,

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1616

875,5,873],[5,876,5,874],[5,877,5,875],[5,878,5,876],[5,879,5,877],[5,880,5
,878],[5,881,5,879],[5,882,5,880],[5,883,5,881],[5,884,5,882],[5,885,5,883]
,[5,886,5,884],[5,887,5,885],[5,888,5,886],[5,889,5,887],[5,890,5,888],[5,8
91,5,889],[5,892,5,890],[5,893,5,891],[5,894,5,892],[5,895,5,893],[5,896,5,
894],[5,897,5,895],[5,898,5,896],[5,899,5,897],[5,900,5,898],[5,901,5,899],
[5,902,5,900],[5,903,5,901],[5,904,5,902],[5,905,5,903],[5,906,5,904],[5,90
7,5,905],[5,908,5,906],[5,909,5,907],[5,910,5,908],[5,911,5,909],[5,912,5,9
10],[5,913,5,911],[5,914,5,912],[5,915,5,913],[5,916,5,914],[5,917,5,915],[
5,918,5,916],[5,919,5,917],[5,920,5,918],[5,921,5,919],[5,922,5,920],[5,923
,5,921],[5,924,5,922],[5,925,5,923],[5,926,5,924],[5,927,5,925],[5,928,5,92
6],[5,929,5,927],[5,930,5,928],[5,931,5,929],[5,932,5,930],[5,933,5,931],[5
,934,5,932],[5,935,5,933],[5,936,5,934],[5,937,5,935],[5,938,5,936],[5,939,
5,937],[5,940,5,938],[5,941,5,939],[5,942,5,940],[5,943,5,941],[5,944,5,942
],[5,945,5,943],[5,946,5,944],[5,947,5,945],[5,948,5,946],[5,949,5,947],[5,
950,5,948],[5,951,5,949],[5,952,5,950],[5,953,5,951],[5,954,5,952],[5,955,5
,953],[5,956,5,954],[5,957,5,955],[5,958,5,956],[5,959,5,957],[5,960,5,958]
,[5,961,5,959],[5,962,5,960],[5,963,5,961],[5,964,5,962],[5,965,5,963],[5,9
66,5,964],[5,967,5,965],[5,968,5,966],[5,969,5,967],[5,970,5,968],[5,971,5,
969],[5,972,5,970],[5,973,5,971],[5,974,5,972],[5,975,5,973],[5,976,5,974],
[5,977,5,975],[5,978,5,976],[5,979,5,977],[5,980,5,978],[5,981,5,979],[5,98
2,5,980],[5,983,5,981],[5,984,5,982],[5,985,5,983],[5,986,5,984],[5,987,5,9
85],[5,988,5,986],[5,989,5,987],[5,990,5,988],[5,991,5,989],[5,992,5,990],[
5,993,5,991],[5,994,5,992],[5,995,5,993],[5,996,5,994],[5,997,5,995],[5,998
,5,996],[5,999,5,997],[5,1000,5,998],[5,1001,5,999],[5,1002,5,1000],[5,1003
,5,1001],[5,1004,5,1002],[5,1005,5,1003],[5,1006,5,1004],[5,1007,5,1005],[5
,1008,5,1006],[5,1009,5,1007],[5,1010,5,1008],[5,1011,5,1009],[5,1012,5,101
0],[5,1013,5,1011],[5,1014,5,1012],[5,1015,5,1013],[5,1016,5,1014],[5,1017,
5,1015],[5,1018,5,1016],[5,1019,5,1017],[5,1020,5,1018],[5,1021,5,1019],[5,
1022,5,1020],[5,1023,5,1021],[5,1024,5,1022],[5,1025,5,1023],[5,1026,5,1024
],[5,1027,5,1025],[5,1028,5,1026],[5,1029,5,1027],[5,1030,5,1028],[5,1031,5
,1029],[5,1032,5,1030],[5,1033,5,1031],[5,1034,5,1032],[5,1035,5,1033],[5,1
036,5,1034],[5,1037,5,1035],[5,1038,5,1036],[5,1039,5,1037],[5,1040,5,1038]
,[5,1041,5,1039],[5,1042,5,1040],[5,1043,5,1041],[5,1044,5,1042],[5,1045,5,
1043],[5,1046,5,1044],[5,1047,5,1045],[5,1048,5,1046],[5,1049,5,1047],[5,10
50,5,1048],[5,1051,5,1049],[5,1052,5,1050],[5,1053,5,1051],[5,1054,5,1052],
[5,1055,5,1053],[5,1056,5,1054],[5,1057,5,1055],[5,1058,5,1056],[5,1059,5,1
057],[5,1060,5,1058],[5,1061,5,1059],[5,1062,5,1060],[5,1063,5,1061],[5,106
4,5,1062],[5,1065,5,1063],[5,1066,5,1064],[5,1067,5,1065],[5,1068,5,1066],[
5,1069,5,1067],[5,1070,5,1068],[5,1071,5,1069],[5,1072,5,1070],[5,1073,5,10
71],[5,1074,5,1072],[5,1075,5,1073],[5,1076,5,1074],[5,1077,5,1075],[5,1078
,5,1076],[5,1079,5,1077],[5,1080,5,1078],[5,1081,5,1079],[5,1082,5,1080],[5
,1083,5,1081],[5,1084,5,1082],[5,1085,5,1083],[5,1086,5,1084],[5,1087,5,108
5],[5,1088,5,1086],[5,1089,5,1087],[5,1090,5,1088],[5,1091,5,1089],[5,1092,
5,1090],[5,1093,5,1091],[5,1094,5,1092],[5,1095,5,1093],[5,1096,5,1094],[5,
1097,5,1095],[5,1098,5,1096],[5,1099,5,1097],[5,1100,5,1098],[5,1101,5,1099
],[5,1102,5,1100],[5,1103,5,1101],[5,1104,5,1102],[5,1105,5,1103],[5,1106,5
,1104],[5,1107,5,1105],[5,1108,5,1106],[5,1109,5,1107],[5,1110,5,1108],[5,1
111,5,1109],[5,1112,5,1110],[5,1113,5,1111],[5,1114,5,1112],[5,1115,5,1113]
,[5,1116,5,1114],[5,1117,5,1115],[5,1118,5,1116],[5,1119,5,1117],[5,1120,5,
1118],[5,1121,5,1119],[5,1122,5,1120],[5,1123,5,1121],[5,1124,5,1122],[5,11
25,5,1123],[5,1126,5,1124],[5,1127,5,1125],[5,1128,5,1126],[5,1129,5,1127],
[5,1130,5,1128],[5,1131,5,1129],[5,1132,5,1130],[5,1133,5,1131],[5,1134,5,1
132],[5,1135,5,1133],[5,1136,5,1134],[5,1137,5,1135],[5,1138,5,1136],[5,113

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1617

9,5,1137],[5,1140,5,1138],[5,1141,5,1139],[5,1142,5,1140],[5,1143,5,1141],[5,1144,5,1142],[5,1145,5,1143],[5,1146,5,1144],[5,1147,5,1145],[5,1148,5,1146],[5,1149,5,1147],[5,1150,5,1148],[5,1151,5,1149],[5,1152,5,1150],[5,1153,5,1151],[5,1154,5,1152],[5,1155,5,1153],[5,1156,5,1154],[5,1157,5,1155],[5,1158,5,1156],[5,1159,5,1157],[5,1160,5,1158],[5,1161,5,1159],[5,1162,5,1160],[5,1163,5,1161],[5,1164,5,1162],[5,1165,5,1163],[5,1166,5,1164],[5,1167,5,1165],[5,1168,5,1166],[5,1169,5,1167],[5,1170,5,1168],[5,1171,5,1169],[5,1172,5,1170],[5,1173,5,1171],[5,1174,5,1172],[5,1175,5,1173],[5,1176,5,1174],[5,1177,5,1175],[5,1178,5,1176],[5,1179,5,1177],[5,1180,5,1178],[5,1181,5,1179],[5,1182,5,1180],[5,1183,5,1181],[5,1184,5,1182],[5,1185,5,1183],[5,1186,5,1184],[5,1187,5,1185],[5,1188,5,1186],[5,1189,5,1187],[5,1190,5,1188],[5,1191,5,1189],[5,1192,5,1190],[5,1193,5,1191],[5,1194,5,1192],[5,1195,5,1193],[5,1196,5,1194],[5,1197,5,1195],[5,1198,5,1196],[5,1199,5,1197],[5,1200,5,1198],[5,1201,5,1199],[5,1202,5,1200],[5,1203,5,1201],[5,1204,5,1202],[5,1205,5,1203],[5,1206,5,1204],[5,1207,5,1205],[5,1208,5,1206],[5,1209,5,1207],[5,1210,5,1208],[5,1211,5,1209],[5,1212,5,1210],[5,1213,5,1211],[5,1214,5,1212],[5,1215,5,1213],[5,1216,5,1214],[5,1217,5,1215],[5,1218,5,1216],[5,1219,5,1217],[5,1220,5,1218],[5,1221,5,1219],[5,1222,5,1220],[5,1223,5,1221],[5,1224,5,1222],[5,1225,5,1223],[5,1226,5,1224],[5,1227,5,1225],[5,1228,5,1226],[5,1229,5,1227],[5,1230,5,1228],[5,1231,5,1229],[5,1232,5,1230],[5,1233,5,1231],[4,1233,5,1232],[-1,-1,-1,-1]],"num":5,"row":16}],"name":"Sat Aug 21 2010 16:08:47 GMT-0400"}

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1618

CLAIMS

1. A method of detecting a target comprising:

contacting a sample with a nucleic acid barcode probe, and

determining whether the nucleic acid barcode probe binds to one or more components in the sample,

wherein binding of the nucleic acid barcode probe to one or more components of the sample indicates presence of a target in the sample, and wherein the nucleic acid barcode probe comprises a nucleic acid nanostructure comprising a target binding moiety and at least two fluorescently labeled regions.

2. The method of claim 1, further comprising identifying the target based on the color and/or orientation of the fluorescently labeled regions of the nucleic acid barcode probe bound to one or more components of the sample.

3. The method of claim 1 or 2, wherein whether the nucleic acid barcode probe binds to one or more components in the sample comprises contacting the nucleic acid barcode probe with soluble, transiently binding fluorophore-bearing oligonucleotides.

4. The method of claim 1 or 2, wherein the nucleic acid barcode probe comprises stably bound fluorophore-bearing oligonucleotides.

5. A method of detecting a target comprising

contacting the target with a nucleic acid barcode probe, under conditions sufficient for the target to bind to the nucleic acid barcode probe;

separating the target from material that is not bound to the target; and

detecting the presence of the nucleic acid barcode probe bound to the target,

wherein the nucleic acid barcode probe comprises a nucleic acid nanostructure comprising a target binding moiety and at least two fluorescently labeled regions.

6. The method of claim 5, further comprising identifying the target based on the color and/or orientation of the fluorescently labeled regions of the nucleic acid barcode probe bound to the target.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1619

7. The method of claim 5 or 6, wherein detecting the presence of the nucleic acid barcode probe bound to the target comprises contacting the nucleic acid barcode probe with soluble, transiently bound fluorophore-bearing oligonucleotides.

8. The method of claim 5 or 6, wherein the nucleic acid barcode probe comprises stably bound fluorophore-bearing oligonucleotides.

9. A composition comprising

a sample, and

a nucleic acid barcode probe comprising a nucleic acid nanostructure having at least two fluorescently-labeled regions, wherein:

the locations of each of the fluorescently-labeled regions on the nucleic acid nanostructure are such that a pattern of the fluorescent labels is determinable based on the emission of visible light by the fluorescently-labeled regions.

10. The composition of claim 9, wherein the nucleic acid nanostructure comprises a scaffold strand and a plurality of staple strands.

11. The composition of claim 9 or 10, wherein the fluorescently-labeled regions comprise fluorophore-labeled staple strands.

12. The composition of claim 11, wherein the fluorophore-labeled staple strands comprise (a) a staple domain hybridized to a scaffold strand and (b) a handle domain.

13. The composition of claim 12, wherein the handle domain is hybridized to a fluorophore-labeled oligonucleotide.

14. The composition of any one of claims 9-13, wherein the nucleic acid nanostructure is a DNA nanostructure.

15. The composition of claim 14, wherein the DNA nanostructure is a nanotube.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1620

16. The composition of any of claims 9-15, wherein the nucleic acid nanostructure comprises at least three fluorescently-labeled regions or at least four fluorescently-labeled regions.

17. The composition of claim 16, wherein orientation of the at least three or at least four fluorescently labeled regions is determinable based on asymmetric spacing of the fluorescently-labeled regions.

18. The composition of any of claims 9-17, wherein each of the fluorescently-labeled regions has a center that is located at least about 50 nm or at least about 100 nm from the centers of the other fluorescently-labeled regions.

19. The composition of any of claims 9-18, wherein each of the fluorescently-labeled regions has a center that is located at least 200 nm from the centers of the other fluorescently-labeled regions.

20. The composition of any one of claims 9-19, wherein the center of each of the fluorescently-labeled regions is located at least 250 nm from the center of any other fluorescently labeled region.

21. The composition of any one of claims 9-20, wherein the nucleic acid nanostructure further comprises a target binding moiety.

22. The composition of claim 21, wherein the target binding moiety is a single-stranded nucleic acid.

23. The composition of claim 21, wherein the target binding moiety is an antibody.

24. The composition of claim 21, wherein the target binding moiety is a protein or peptide.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1621

25. A method of identifying a target nucleic acid comprising:

contacting the target nucleic acid with a nucleic acid barcode probe of any one of the claims 9-24, under conditions such that the target nucleic acid binds to the nucleic acid barcode probe;

separating the target nucleic acid from material that is not bound to the target nucleic acid; and

detecting the presence of the nucleic acid barcode probe bound to the target nucleic acid.

26. A method of identifying a target protein or cell comprising:

contacting the target protein or cell with a nucleic acid barcode probe of any one of claims 9-24, under conditions such that the target protein or cell binds to the nucleic acid barcode probe;

separating the target protein or cell from material that is not bound to the target protein or cell; and

detecting the presence of the nucleic acid barcode probe bound to the target protein or cell.

27. A method of identifying a target protein or cell comprising:

contacting the target protein or cell with a nucleic acid barcode probe of any one of claims 9-24, under conditions such that the target protein or cell binds to the nucleic acid barcode probe;

separating the target protein or cell from material that is not bound to the target protein or cell; and

detecting the presence of the nucleic acid barcode probe bound to the target protein or cell.

28. A method of detecting a target comprising:

contacting a sample with a nucleic acid barcode probe of any one of claims 9-24, and

determining whether the nucleic acid barcode probe binds to one or more components in the sample.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1622

wherein binding of the nucleic acid barcode probe to one or more components in the sample indicates presence of a target in the sample.

29. The method of claim 28, further comprising removing components in the sample that are not bound to the nucleic acid barcode probe following the contacting step.

30. The method of claim 28 or 29, wherein the target is a nucleic acid, a protein, a peptide, or a cell, or a combination thereof.

31. The method of any one of claims 25-30, wherein the presence of the nucleic acid barcode probe is detected by fluorescent microscopy.

32. The method of any one of claims 25-30, wherein the presence of the nucleic acid barcode probe is detected without exposing the nucleic acid barcode probe to an electric field.

33. A population of nucleic acid barcode probes, wherein each probe comprises a nucleic acid nanostructure having at least two fluorescently-labeled regions and a target binding moiety,

wherein the locations of each of the fluorescently-labeled regions on the nucleic acid nanostructure are such that a pattern of the fluorescent labels of the nucleic acid barcode probe and the identity of the target binding moiety is determinable based on the emission of visible light by the fluorescently-labeled regions.

34. The population of claim 33, wherein each of the fluorescently-labeled regions has a center that is located at least about 50 nm, at least about 100 nm, at least about 200 nm, or at least about 250 nm from the centers of the other fluorescently-labeled regions.

IPR2024-01177
California Institute of Technology - Ex. 2003 Page 1623

FIG.1

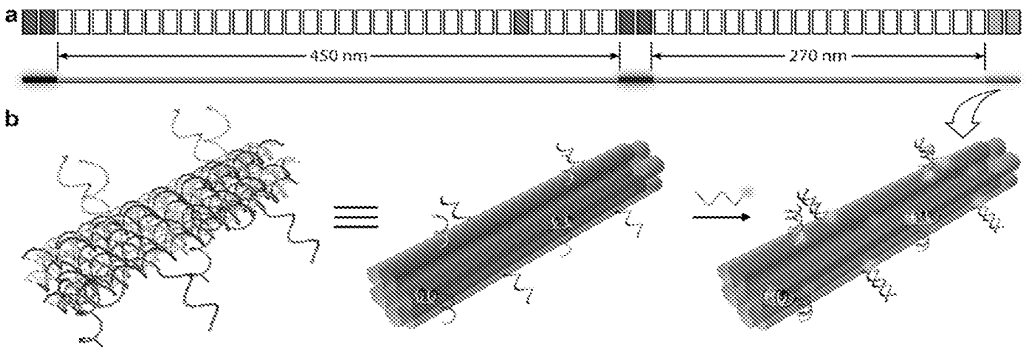


FIG. 2

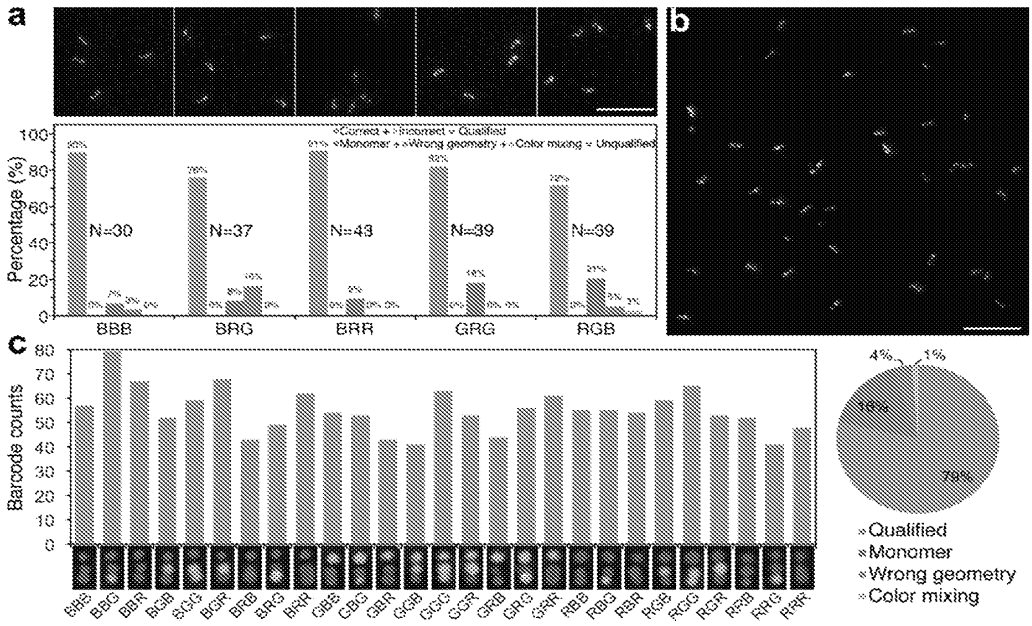

a
b
c
Correct
Incorrect
Qualified
Monomer
Wrong geometry
Color mixing
Unqualified
Percentage (%)
N=30
N=37
N=43
N=39
N=39
BBB
BRG
BRR
GRG
RGB
Barcode counts
4%
1%
75%
20%
Qualified
Monomer
Wrong geometry
Color mixing

FIG. 3

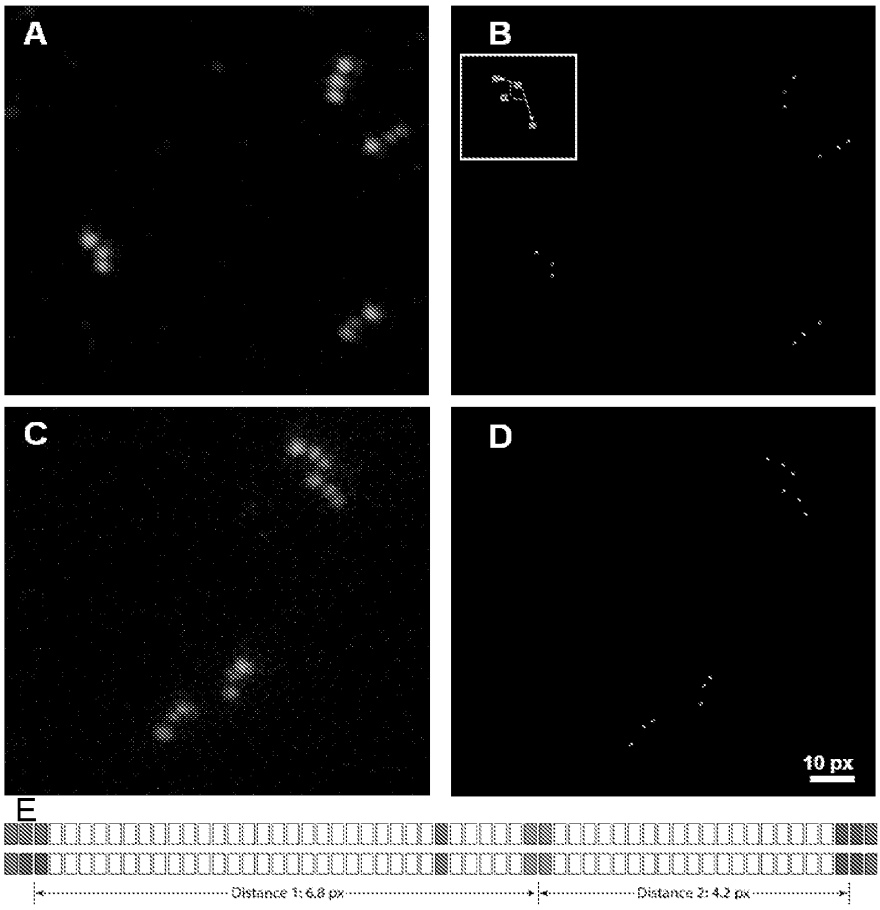


FIG. 4

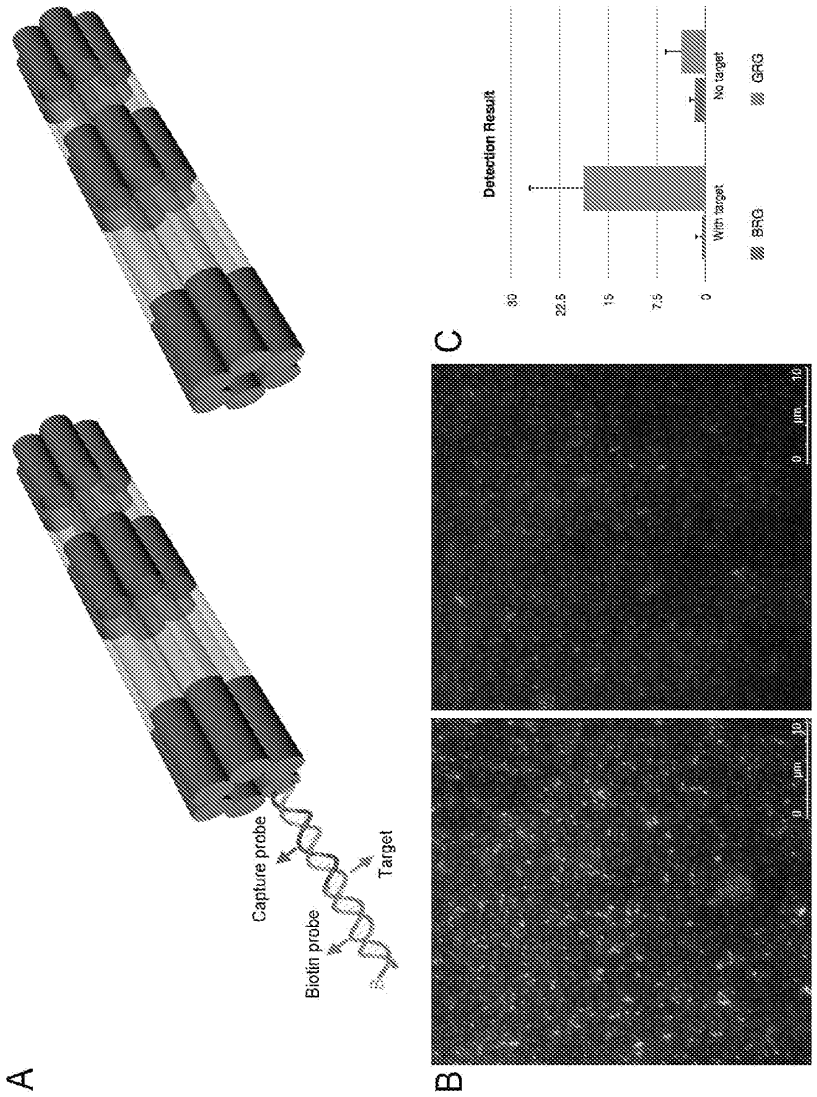

A
Capture probe
Biotin probe
Target
B
C
Detection Result
30
22.5
15
7.5
0
With target
No target
BRG
GRG

FIG. 5

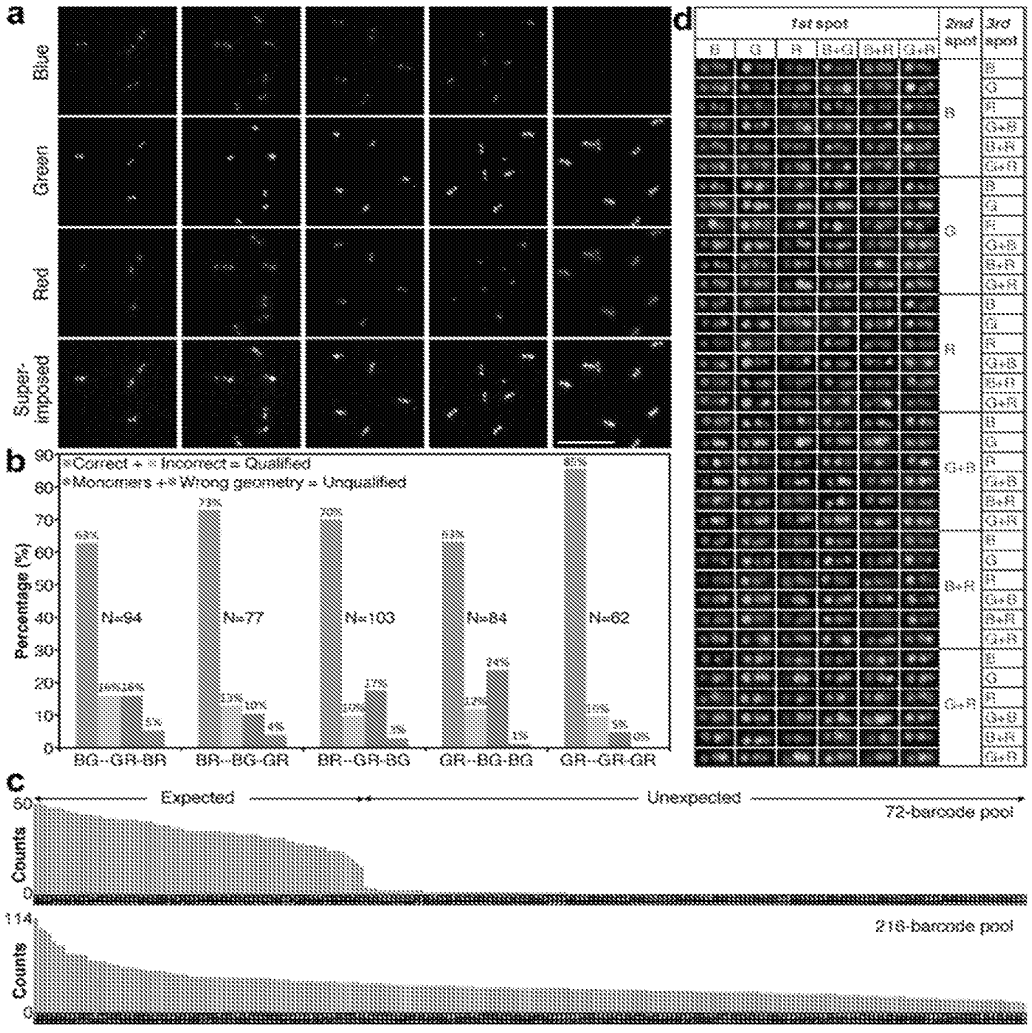

a
Blue
Green
Red
Super-imposed
b
Correct + ≈ Incorrect = Qualified
Monomers + ≠ Wrong geometry = Unqualified
Percentage (%)
N=94
N=77
N=103
N=84
N=62
BG--GR-BR
BR--BG-GR
BR--GR-BG
GR--BG-BG
GR--GR-GR
c
Expected
Unexpected
72-barcode pool
216-barcode pool
Counts
d
1st spot
2nd spot
3rd spot
B
G
R
B+G
B+R
G+R

FIG. 6

