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device. The composition of these strings is defined in ISO 6429. This standard does allow latitude for manufacturers to define proprietary sequences for specific purposes, and many such sequences are in use; 7-bit and 8-bit versions of the *control characters are defined. An earlier standard widely used in the US is ANSI X3.64. *See also* ESCAPE SEQUENCE.

control stack A stack mechanism that contains an instruction sequence. It is part of the control unit in a computer with stack architecture. *See* STACK PROCESSING.

control structure A syntactic form in a language to express flow of control. Common control structures are
if...then...else, while...do,
repeat...until, and case.

control total *See* CONTROL RECORD.

control unit (CU) The portion of a *central processor that contains the necessary *registers, *counters, and other elements to provide the functionality required to control the movement of information between the memory, the *ALU, and other portions of the machine.

In the simplest form of the classical von Neumann architecture, the control unit contains a *program counter, an *address register, and a register that contains and decodes the *operation code. The latter two registers are sometimes jointly called the **instruction register**. This control unit then operates in a two-step **fetch-execute** cycle. In the fetch step the instruction is obtained (fetched) from memory and the decoder determines the nature of the instruction. If it is a *memory reference instruction the execute step carries out the necessary operation(s) and memory reference(s). In some cases, e.g. a *nonmemory reference instruction, there may be no execute step. When the instruction calls for *indirect addressing, an additional step, usually called "defer", is required to obtain the indirect address from the memory. The last action during the execute step is to increment the program counter or, in some cases – e.g. a *conditional branch instruction – to set the program counter to a value determined by the instruction register, depending on the status of the *accumulator or *qualifier register (*condition-code register).

In more complex machines and non von

Neumann architectures, the control unit may contain additional registers such as *index registers, arithmetic units to provide address modifications, registers, *stacks, or *pipelines to contain forthcoming instructions, and other functional units. Control units in supercomputers have become powerful and complex; they may contain specialized hardware that allows for parallel processing of instructions which are issued sequentially.

control word 1. A word whose contents determine actions elsewhere; it may be used to control the use of a resource. 2. A word in a microprogram. *See* MICROINSTRUCTION, MICROPROGRAMMING.

convergence of an algorithm. *See* ERROR ANALYSIS.

conversational mode *See* INTERACTIVE.

converse 1. of a conditional, $P \rightarrow Q$. The statement

$$\neg P \rightarrow \neg Q$$

where $\neg$ denotes negation. *See also* CONTRAPOSITIVE, INVERSE. 2. of a binary relation. *Another name for* inverse.

convex hull The smallest convex set that contains a given set. A set is convex if for any two points in the set, the points on the straight line segment joining the two points are also contained in the set.

convolution Mathematically, the operation of combining two functions, w and f , to produce a third function, g , such that

$$g_k = \sum_{i=-\infty}^{\infty} w_i f_{k-i}$$

(or the corresponding continuous operation). This is envisaged as a transformation of an input function f to an output function g , by viewing f through a fixed window w .

In coding theory, f is considered as a *signal and w as the response of a *linear channel; g is then the effect upon that signal (regarded as a sequence of successive elements) brought about by the time response of the linear channel. The **channel time response** is the sequence of successive elements output by the channel in response to a signal that has one element of unit amplitude and all other elements zero. The input signal sequence and the channel time response are said to be **convolved**.

The inverse process is **deconvolution**: the convolved output sequence can be decon-

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