

A Dictionary of
Computing

SIXTH EDITION

OXFORD
UNIVERSITY PRESS

lululemon v. NIKE, Inc.
IPR2023-00424
Patent No. 10,923,225
Ex. 2003

OXFORD

UNIVERSITY PRESS

Great Clarendon Street, Oxford OX2 6DP

Oxford University Press is a department of the University of Oxford.

It furthers the University's objective of excellence in research, scholarship,
and education by publishing worldwide in

Oxford New York

Auckland Cape Town Dar es Salaam Hong Kong Karachi

Kuala Lumpur Madrid Melbourne Mexico City Nairobi

New Delhi Shanghai Taipei Toronto

With offices in

Argentina Austria Brazil Chile Czech Republic France Greece

Guatemala Hungary Italy Japan Poland Portugal Singapore

South Korea Switzerland Thailand Turkey Ukraine Vietnam

Oxford is a registered trade mark of Oxford University Press
in the UK and in certain other countries

Published in the United States

by Oxford University Press Inc., New York

© Market House Books Ltd, 1983, 1986, 1990, 2004, 2008

The moral rights of the author have been asserted

Database right Oxford University Press (maker)

First edition 1983

Second edition 1986

Third edition 1990

Fourth edition 1996

Fifth edition 2004

Sixth edition 2008

All rights reserved. No part of this publication may be reproduced,
stored in a retrieval system, or transmitted in any form or by any means,
without the prior permission in writing of Oxford University Press,
or as expressly permitted by law, or under terms agreed with the appropriate
reprographics rights organization. Enquiries concerning reproduction
outside the scope of the above should be sent to the Rights Department,
Oxford University Press, at the address above

You must not circulate this book in any other binding or cover
and you must impose this same condition on any acquirer

British Library Cataloguing in Publication Data

Data available

Library of Congress Cataloging in Publication Data

Data available

Typeset by Market House Books Ltd.

Printed in Great Britain

on acid-free paper by

Clays Ltd, St Ives plc

ISBN 978-0-19-923401-1

10 9 8 7 6 5 4 3 2 1

Pages 1-123 Omitted

d

data 1. *Information, in any form, on which computer programs operate. The distinction between program (instructions) and data is a fundamental one in computing (*see* VON NEUMANN MACHINE). It is in this fundamental sense that the word is used in terms such as *data, *data break, *data bus, *data cartridge, *data communications, *data compression, *data name, *data protection, *data subject, and *data type.

2. In a more limited sense, data is distinguished from other contrasting forms of information on which computers operate, such as text, graphics, speech, and image. The distinguishing characteristic is that it is organized in a structured, repetitive, and often compressed way. Typically the structure takes the form of sets of *fields, where the field names are omitted (this omission being a main means of achieving compression). The "meaning" of such data is not apparent to anyone who does not know what each field signifies (for example, only a very limited meaning can be attached to "1234" unless you know that it occupies the "employee number" field). That characteristic gives rise to the popular fallacy that "data is meaningless".

Terms such as *database, *data dictionary, *data hierarchy, *data independence, *data model, *data preparation, and *data processing normally carry this second sense – though not invariably; the context should determine which sense is intended.

3. *See* STATISTICS, STATISTICAL METHODS.

data abstraction The principle of defining a *data type in terms of the operations that apply to objects of the type, with the constraint that the values of such objects can be modified and observed only by use of these operations. This application of the general principle of *abstraction leads to the concept of an *abstract data type.

Data abstraction is of very considerable importance in modern programming, especially for the coarse structuring of programs. Such use yields several benefits. The abstract data type provides a natural unit for specification and verification purposes (*see* MODULE SPECIFICATION). It provides some basis for high-level design, and is consistent with the principles of *information hiding. The specification of the data type in terms of available operations provides all the information needed to make use of the data type while leaving maximum freedom of imple-

mentation, which indeed can be changed if required without affecting the users. There is also the possibility of developing a "library" of useful data abstractions – stacks, queues, etc.

The typical implementation of an abstract data type within a program is by means of a multiprocedure module. This module has local data that can be used to represent a value of the type, and each procedure implements one of the operations associated with the type. The local data of the module can only be accessed by these procedures, so that the user of the data type can only access the operations and has no direct access to the representation. The implementer is therefore free to choose the representation, which remains "invisible" to the users and can be changed if required. Each instance of the abstract data type employs one instance of the local data of the module to represent its value.

Proper support for such multiprocedure modules demands that the concept be recognized by the programming language, which must, for example, allow for the clustering of modules and data and have scope rules reflecting the desired restrictions on access. The first language to provide such support was SIMULA with its CLASS. Many modern languages now offer a similar facility. *See* PACKAGE.

data acquisition Data capture and/or data collection often with some filtering of the input signal, which may, for example, recover signals in a noisy environment. Such data will normally be derived from transducers which convert some parameter to electrical form.

databank A system that offers facilities for the deposit and withdrawal of data to a community of users on a particular topic (e.g. biological species, trade statistics, commodity prices). While it need not be an open public facility, the usual imp This material may be pro the user community is widespread. Access to a databank may be, for instance, via a *videotex facility, or via any other form of *network, or even via the postal service. The data itself may be organized as a *database or as one or more *files.

database 1. Normally and strictly, a body of information held within a computer system using the facilities of a *database management system. All accessing and updating

Pages 125-341 Omitted

tions of n variables, i.e. they do not involve derivatives or integrals. This in both theory and practice is a very difficult problem. Such systems of equations arise in many areas, e.g. in numerical methods for nonlinear *ordinary and *partial differential equations. When $n = 1$ the single equation can be solved by a variety of effective techniques (all involving *iteration); the case of *polynomial equations can give rise to complex solutions. For systems of equations, *Newton's method and principally its many variants are widely used. For cases of extreme difficulty where, for example, only poor starting approximations are available, methods based on the idea of *continuation can be of value.

nonlinear regression model *See* REGRESSION ANALYSIS.

nonlocal entity *See* LOCAL.

nonmemory reference instruction An instruction that can be carried out without having to obtain an operand from, or return a result to, memory. Immediate instructions and some branch instructions are examples. *See also* ZERO-ADDRESS INSTRUCTION.

n nonmonotonic reasoning A form of reasoning in which the acquisition of new knowledge can cause earlier conclusions to be withdrawn, so that the body of inferred knowledge does not grow monotonically (i.e. does not increase consistently) with the body of received knowledge. Various systems of nonmonotonic reasoning have been developed, among which are nonmonotonic logic, circumscription, default reasoning, autoepistemic logic, and negation as failure.

nonparametric techniques *Statistical methods that make no assumptions about the precise form of the *frequency distribution from which the data are sampled. They are mainly of use for hypothesis testing using the information in the rank order within each sample. For example, the **Mann Whitney U-test** may be used to test whether two samples are drawn from the same distribution, and the **rank correlation coefficient** may be used to test whether two variables are independent.

These methods can be contrasted with **parametric techniques**, which require specific models with *parameters to be estimated.

nonpreemptive allocation An alloca-

tion that does not preempt a resource from a process to which it is already allocated. *Compare* PREEMPTIVE ALLOCATION.

nonprocedural language *Another name for* declarative language.

nonreturn to zero *See* NRZ.

nonsingular matrix A square matrix, A , of numbers whose *determinant is nonzero. A is nonsingular if and only if it is invertible (*see* INVERSE MATRIX).

nonstop processing The use of multiple computers in a redundant configuration to provide high *availability of computing service and tolerance to failures of service in a single computer.

nonterminal (nonterminal symbol) *See* GRAMMAR.

nonterminal node (interior node) of a tree. Any node that is not a terminal node (i.e. a leaf node) and hence has one or more children.

nonvolatile memory A type of memory whose contents are not lost when power to the memory is removed. *ROM and *PROM are examples. *Compare* VOLATILE MEMORY.

non von Neumann architecture Any computer architecture in which the underlying model of computation is different from what has come to be called the standard von Neumann model (*see* VON NEUMANN MACHINE). A non von Neumann machine may thus be without the concept of sequential flow of control (i.e. without any register corresponding to a "program counter" that indicates the current point that has been reached in execution of a program) and/or without the concept of a variable (i.e. without "named" storage locations in which a value may be stored and subsequently referenced or changed).

Examples of non von Neumann machines are the *dataflow machines and the *reduction machines. In both of these cases there is a high degree of parallelism, and instead of variables there are immutable bindings between names and constant values.

Note that the term non von Neumann is usually reserved for machines that represent a radical departure from the von Neumann model, and is therefore not normally applied to multiprocessor or multicomputer archi-

tectures, which effectively offer a set of cooperating von Neumann machines.

no-op instruction (pass instruction, do-nothing instruction) An instruction that causes no action to take place in the computer except for consumption of time and instruction storage space. There are several uses for this instruction including time adjustment of a program, filling out program space in a system where instruction boundaries do not always coincide with word boundaries, and replacement of unwanted instructions without having to recompute all other program addresses.

NOR gate An electronic *logic gate whose output is logic 1 (true) only when all (two or more) inputs are logic 0 (false), otherwise it is logic 0. It thus implements the logical *NOR operation and has the same truth table. The diagram shows the usual circuit symbol of a two-input gate (which implies by the small circle that it is an inclusive *OR gate whose output has been inverted) and the associated truth table. *See also* EXCLUSIVE-NOR GATE.



inputs	A1	0	0	1	1
	A2	0	1	0	1
output	B	1	0	0	0

NOR gate. Two-input NOR gate, circuit symbol and truth table

norm *See* APPROXIMATION THEORY.

normal distribution (Gaussian distribution) An important *probability distribution for data in the form of continuous measurements. The frequency function is given by

$$(2\pi\sigma^2)^{-1/2} \exp[-1/2(x-\mu)^2/\sigma^2]$$

The distribution is symmetric about the mean, μ , and its variance is σ^2 . The range of x is infinite $(-\infty, \infty)$. Many sampling distributions tend to the normal form as the sample size tends to infinity.

normal forms **1.** A term applied to a relation (table) in a relational database. A table is said to be in **first normal form** if it conforms to the constraint of the *relational model

that each entry is an elementary data item. In defining further normal forms the concept of **functional dependency** is used. This concept is quite distinct from that of *function since it requires the context of relation for its definition. A functional dependency thus exists only within a particular relation.

Given two attributes A and B of a relation, then B is functionally dependent on A if whenever any two tuples (rows) of the relation have the same value for A , they will necessarily also have the same value for B . Notationally this is written $A \rightarrow B$, often colloquially expressed as " A determines B ". This definition is readily generalized to the case where A and B are arbitrary subsets of attributes, which is the definition used in the theoretical development. A logical consequence of the definition is that if the values of a particular attribute in a relation are necessarily all distinct (e.g. if it is a key) then all other attributes of the relation are functionally dependent on it, and similarly for a set of attributes (e.g. a compound key).

A relation is in **second normal form** if it has a single attribute that can serve as a key or, if having a compound key, all other attributes are functionally dependent on the whole of the key and not just part of it. A relation is in **third normal form** if it contains no functional dependencies among its non-key attributes. The concepts of second and third normal form are widely understood and used in practical database design, the functional dependencies usually being a reflection within the tables of real-world functions that exist in the application domain.

Further normal forms, less used in practice, are Boyce-Codd, fourth and fifth. Fourth normal form also uses the concept of multivalued dependency and fifth normal form that of join dependency. **2.** *See* ABSTRACT REDUCTION SYSTEM.

normalization **1.** The action of reorganizing a *relational database so that its data conforms to a higher *normal form. **2.** The action of removing unimportant differences from data, especially text, to simplify subsequent processing. For example, the different conventions for denoting new lines in text files are often detected automatically when a file is read and translated to a single consistent representation before the data is presented to the rest of the program for processing.

Pages 344-548 Omitted

out of order, be delayed, be lost and require retransmission, etc., is severely limited. There are currently (2008) two main standards used to implement VoIP: the ITU's H323 and the IETF's SIP.

 SEE WEB LINKS

- The H323 specification
- The SIP specification

volatile memory A type of memory whose contents are destroyed on the removal of power to the memory. When volatile memories are used for crucial applications, they can be backed up with temporary battery-power supplies. *Compare* NONVOLATILE MEMORY.

Volterra integral equation *See* INTEGRAL EQUATION.

volume A logical unit of data storage. A volume can be a single unit of a physical storage medium (e.g. one fixed disk may be a single volume), but it can correspond to part of a physical unit (e.g. one of several *partitions on a fixed disk) or to more than one physical unit (e.g. multiple partitions on several fixed disks).

volume label *See* LABEL.

volume visualization A *visualization technique based on splitting the projected picture into three-dimensional voxels (volume equivalents of pixels) and applying *rendering techniques to the voxels before the mapping to two dimensions.

von Neumann, John (born Margittai Neumann János Lajos; 1903–57) Hungarian-born US mathematician. Already a noted mathematician, von Neumann emigrated to the USA in 1930 and joined the faculty of Princeton University. His major contribution to computer science was his "First Draft of a Report on the EDVAC" (1945), which described an architecture that has since been regarded as standard for digital computers (*see* EDVAC; VON NEUMANN MACHINE). However, this was only a part of his life's work, which also included major contributions to game theory, quantum physics, and statistics and numerical analysis as well as work on the atomic bomb during World War II.

von Neumann machine Any computer characterized by the following concepts:

- (a) the main units are a *control unit,

*ALU, *memory, and input and output facilities;

- (b) programs and data share the same memory, thus the concept of a *stored program is fundamental;

- (c) the control unit and ALU, usually combined into a *central processor (which may contain internal storage – accumulators and other registers), determine the actions to be carried out by reading instructions from the memory.

It follows that a program for a von Neumann machine consists of a set of instructions that are examined one after another; a *program counter in the control unit indicates the next location in the memory from which an instruction is to be taken. It also follows that the data on which the program operates may include *variables: storage locations can be named so that the stored value may be subsequently referenced or changed during execution of the program.

The vast majority of present-day computers are von Neumann machines. The name is taken from that of the American, John von Neumann. *Compare* NON VON NEUMANN ARCHITECTURE.

V operation (up operation) *See* SEMAPHORE.

Voronoi diagram A breakdown of a plane into Voronoi regions (also called Dirichlet regions) based on a set of points. For each point P in the set, the corresponding Voronoi region consists of the set of points closer to P than to any other point in the set.

voting logic *See* COMPARATOR.

voxel The three-dimensional equivalent of a *pixel. It is an axis-aligned box, typically an element in a space-subdivision structure.

VPN *Acronym for* virtual private network. A connection between two computers or other endpoints in which packets sent over a shared network, for example, the Internet, are automatically encrypted and decrypted by the endpoints. Although the packets are carried on a shared network, their contents are protected from unauthorized access between the endpoints. Virtual private networks are commonly used to connect branch offices to a headquarters when the cost of a physically separate communications link cannot be justified, or to allow workers to access their company network across the Internet when they are not on the

V

Remaining Pages Omitted