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THE FACTS ON FILE  
DICTIONARY OF

# COMPUTER SCIENCE

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**The Facts On File Dictionary of Computer Science**

Fourth Edition

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This book is based on a *Minidictionary* Oxford University Press in 1986 a dictionary now contains over 230 computer science. An extensive A bols, file extensions, domain nam

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logic OPERANDS have to be placed in a special register called the ACCUMULATOR, while in other processors any register may be used. The result of the operation is subsequently transferred back to the main store. The movement of data between main store and ALU is under the direction of the CONTROL UNIT. The arithmetic or logic operations to be performed in the ALU are specified in the operation part of MACHINE INSTRUCTIONS. The control unit interprets each instruction as it is fetched from main store and directs the ALU as to which operation (if any) is required.

**arithmetic instruction** A machine instruction specifying an ARITHMETIC OPERATION and the OPERAND or operands on which the arithmetic operation is to be performed. An example, expressed in ASSEMBLY LANGUAGE, might be

ADDI 3 4

This is an instruction to add 4 to contents of register 3, placing the result in register 3 and setting the carry bit if the result is too big to fit.

See also logic instruction.

**arithmetic/logic unit** See arithmetic and logic unit.

**arithmetic operation** An operation that follows the rules of arithmetic, the most commonly occurring examples being addition, subtraction, multiplication, and division. In computing, arithmetic operations may be carried out on signed or unsigned INTEGERS or REAL NUMBERS. They are normally performed in the ARITHMETIC AND LOGIC UNIT of a computer. See also arithmetic operator; operand.

**arithmetic operator** A symbol representing a simple arithmetic operation (e.g. addition or multiplication) that is to be performed on numerical data, quantities, etc. The operators used in a particular programming language may differ from those in general use, as shown in the table. The operations

7 multiplied by 2  
6 divided by 3

#### ARITHMETIC OPERATORS

Operation	Operators	
	In general use	In Basic
addition	+	+
subtraction	-	-
multiplication	× or .	*
division	+ or /	/
exponentiation	$5^2$	$5 \uparrow 2$

would thus be written as  $7*2$  and  $6/3$  in most high-level languages. Some languages have separate operators for integer division and remaindering (see integer arithmetic). Some languages do not have an operator for EXPONENTIATION.

An example of how arithmetic operations are used, in Basic, is as follows:

$$10 \quad D = \text{SQR}((X(1) - X(0)) \uparrow 2 + X(2)*3)$$

This is equivalent to

$$D = \sqrt{(X_1 - X_0)^2 + 3X_2}$$

**arithmetic shift** See shift.

**arithmetic unit** See arithmetic and logic unit.

**ARP** See address resolution protocol.

**ARPANET** (Advanced Research Project Agency Network) A network introduced in 1969 connecting a small number of research institutions, funded by the US Department of Defense. ARPANET used PACKET SWITCHING and pioneered many of the protocols used in network operation. It was the forerunner of the INTERNET.

**array** One form in which a collection of data items can be stored in computer memory. The data items in an array are arranged in a particular order or pattern and are all of the same type, for example all integers or all real numbers. This collection of data items is referred to as an array. More usually, however, the word array

refers to the set of storage LOCATIONS in which the data items are placed, keeping their original arrangement.

The set of locations forming an array is referenced by a single IDENTIFIER, chosen by the programmer. Each element in an array (i.e. a location or its contents) can be specified by combining one or more subscript values with the identifier. Subscripts are usually integers and are generally placed in brackets after the identifier. The number of subscripts required to specify an element gives the *dimension* of the array.

The simplest array is a single sequence of elements. This is a *one-dimensional array*, only one subscript being necessary to select a particular element. For example, a list of peoples' ages could form an array named AGE; the age of the eighth person in the list is found by specifying AGE(8). The subscript may be a VARIABLE. A one-dimensional array is also known as a *vector*.

In a *two-dimensional array* (also called a *matrix*), the elements are arranged in the form of a table with a fixed number of rows and a fixed number of columns. Each element is distinguished by a pair of subscripts; the first subscript gives the row number, the second gives the column number. For example, A(3 7) refers to the element in row three and column seven of the array A. Again, the subscripts may be variables.

The values of a subscript range from a lower limit (usually 1 or 0 unless otherwise specified) to an upper limit. These limits specify the total number of elements in an

## arrow keys

array, and are called *bounds*. The bounds of an array can be declared in various ways, depending on the programming language. In Basic, for example, a DIMENSION statement is used:

```
110 DIM X(4 10)
```

This is a declaration of a two-dimensional array, X, with 5 rows and 11 columns, since the default lower bound in Basic is zero.

**arrow keys** Four keys on a KEYBOARD that are labeled with up, down, left, and right arrow symbols and can be used for control of the CURSOR on a display screen.

**artificial intelligence (AI)** The branch of computer science concerned with programs that carry out tasks requiring intelligence when done by humans. Many of these tasks involve a lot more computation than is immediately apparent because much of the computation is unconscious in humans, making it hard to simulate. Programs now exist that play chess and other games at the highest level, take decisions based on available evidence, prove theorems in certain branches of mathematics, recognize connected speech using a limited vocabulary, and use television cameras to recognize objects. Although these examples sound impressive, the programs have limited ability, no creativity, and each can only carry out a limited range of tasks. There is still a lot more research to be done before the ultimate goal of artificial intelligence is achieved, which is to understand intelligence well enough to make computers more intelligent than people. In fact there is considerable controversy about the whole subject, with many people that the human thought process is different in kind to the computational operation of computer processes.

*See also* expert system; robot.

**artificial life** A branch of ARTIFICIAL-INTELLIGENCE research concerned with investigations into the behavior of living organisms. Computer simulations are used to show how self-replicating organisms might behave.

**ascending order** The arrangement of a set of data in order starting with the lowest character value, as in A to Z or 1 to 50.

**ASCII** (pronounced ass-key) American National Standard Code for Information Interchange, a standard code for the interchange of information between computer systems, data communication systems, and associated equipment. Since it is a standard code (rather than one developed by a particular manufacturer), it allows equipment of different manufacturers to exchange information. It is thus widely used. ASCII encoding produces coded characters of 7 bits, and hence provides  $2^7$ , i.e. 128, distinct bit patterns. (An 8th bit is included for a PARITY CHECK.) These 128 characters make up the ASCII CHARACTER SET: they consist of ALPHANUMERIC CHARACTERS, the SPACE CHARACTER, SPECIAL CHARACTERS, and CONTROL CHARACTERS. The character set is shown in the diagram opposite, while the control characters are explained in the table below it. The binary encodings shown in the diagram are for the character

$b_7b_6b_5b_4b_3b_2b_1$

Thus the encoding for G is 1000111 and the encoding for g is 1100111. The coding from values 129 to 256 is called *extended ASCII*. *See also* character set; ISO-7.

**aspect ratio** The ratio of width to height for a rectangular shape, such as an illustration or window.

**assembler** A program that takes as input a program written in ASSEMBLY LANGUAGE and translates it into MACHINE CODE. Each instruction in assembly language is usually converted into one machine instruction. The input to the assembler is called the *source program*; the output is called the *object program*. The translation process is known as *assembly* and the program that is translated is said to have been *assembled*. The entire program must be assembled before it can be executed. *See also* compiler; interpreter.

**assembly language** A type of PROGRAMMING LANGUAGE that is a readable and convenient notation (in human terms)