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# ENCYCLOPEDIA OF COMPUTER SCIENCE AND TECHNOLOGY

HARRY HENDERSON

REVISED EDITION

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Facts On File
*An imprint of Infobase Publishing*

*In memory of my brother,*
*Bruce Henderson,*
*who gave me my first opportunity to explore*
*personal computing almost 30 years ago.*

ENCYCLOPEDIA OF COMPUTER SCIENCE AND TECHNOLOGY, Revised Edition



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Blogging can also be seen as part of a larger trend toward Web users taking an active role in expressing and sharing opinion and resources (see USER-CREATED CONTENT, FILE-SHARING AND P2P NETWORKS, and YOUTUBE).

### *Social and Economic Impact*

Blogs first emerged in popular consciousness as a new way in which people caught in the midst of a tragedy such as the September 11, 2001, attacks could reassure friends about their safety while describing often harrowing accounts. The Iraq war that began in 2003 was the first war to be blogged on a large scale. Like their journalistic counterparts, bloggers, whether American or Iraqi, were "embedded" in the often-violent heart of the protracted conflict, but they were also effectively beyond the control of government or military authorities. (See also POLITICAL ACTIVISM AND THE INTERNET.)

Blogs are also being used widely in business. Within a company, a blog can highlight ongoing activities and relevant resources that might otherwise be overlooked in a large corporate network. Software developers can also report on the progress of bug fixes or enhancements and solicit comments from end users. There has been some concern, however, that corporate blogs are not sufficiently supervised to prevent the dissemination of sensitive information or the posting of libelous or inflammatory material. (For the collaborative creation of large bodies of structured knowledge, see WIKIS AND WIKIPEDIA.)

Blogs have provided an outlet where other means of expression are unavailable because of war (as in Iraq), disaster (Hurricane Katrina), or government censorship—although China in particular has hired hundreds of censors to remove offending postings as well as requiring blog providers such as MSN to police their content (see CENSORSHIP AND THE INTERNET).

#### Further Reading


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## Bluetooth

Loosely named after a 10th-century Danish king, Bluetooth is a wireless data communications and networking system designed for relatively short-range operation (generally within the same room, although it can be used over longer distances up to several hundred feet [tens of meters]). The radio transmission is in the 2.4-GHz band and is typically low power, making it suitable for battery-powered devices such as laptops.

### *Applications*

Bluetooth was originally developed by Ericsson Corporation to provide a wireless connection for mobile telephone headsets. Today it is often used to "sync" (update data) between a PDA such as a Blackberry or Palm (see PDA) with a Bluetooth-equipped laptop or desktop. Many cell phones are also equipped with Bluetooth, allowing them to be dialed from a PDA, although the growing use of phones that combine telephony and PDA functions is making this scenario less common (see SMARTPHONE). Bluetooth can also be used for wireless keyboards, mice, or printers.

It is possible to connect PDAs or PCs to the Internet and local area networks using a Bluetooth wireless access point (WAP) attached to a router, but faster and longer range Wifi (802.11) wireless connections are much more widely used for this application (see WIFI).

Bluetooth connections between devices are specified using profiles. Profiles have been developed for common kinds of devices, specifying how data is formatted and exchanged. For example, there are profiles for controlling telephones, printers and faxes, digital cameras, and audio devices. Most modern operating systems (including Windows Mobile, Linux, Palm OS, and Mac OS X) include support for basic Bluetooth profiles. Functions fundamental to all Bluetooth operations are found in Bluetooth Core Specifications (version 2.1 as of August 2007). Planned future enhancements include accommodation for ultra-wide band (UWB) radio technology, allowing for data transfer up to 480 megabits per second. At the same time, Bluetooth is extending the ultra-low-power modes that are particularly important for wearable or implanted medical devices.

#### Further Reading


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## Boolean operators

In 1847, British mathematician George Boole proposed a system of algebra that could be used to manipulate propositions, that is, assertions that could be either true or false. In his system, called propositional calculus or Boolean Algebra, propositions can be combined using the "and" and "or"

operators (called Boolean operators), yielding a new proposition that is also either true or false. For example:

"A cat is an animal" AND "The sun is a star" is true because both of the component propositions are true.

"A square has four sides" AND "The Earth is flat" is false because only one of the component propositions is true.

However "A square has four sides" OR "The Earth is flat" is true, because *at least one* of the component propositions is true.

A chart called a truth table can be used to summarize the AND and OR operations. Here 1 means true and 0 means false, and you read across from the side and down from the top to see the result of each combination.

**AND TABLE**

| | 0 | 1 |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 0 | 1 |

**OR TABLE**

| | 0 | 1 |
|---|---|---|
| 0 | 0 | 1 |
| 1 | 1 | 1 |

A variant of the OR operator is the "exclusive OR," sometimes called "XOR" operator. The XOR operator yields a result of true (1) if *only one* of the component propositions is true:

**XOR TABLE**

| | 0 | 1 |
|---|---|---|
| 0 | 0 | 1 |
| 1 | 1 | 0 |

Additionally, there is a NOT operator that simply reverses the truth value of a proposition. That is, NOT 1 is 0 and NOT 0 is 1.

### *Applications*

Note the correspondence between the two values of Boolean logic and the binary number system in which each digit can have only the values of 1 or 0. Electronic digital computers are possible because circuits can be designed to follow the rules of Boolean logic, and logical operations can be harnessed to perform arithmetic calculations.

Besides being essential to computer design, Boolean operations are also used to manipulate individual bits in memory (see BITWISE OPERATIONS), storing and extracting information needed for device control and other purposes. Computer programs also use Boolean logic to make decisions using branching statements such as If and loop statements such as While. For example, the Basic loop

```
While (Not Eof()) OR (Line = 50)
  Read (Line$)
  Print (Line$)
  Line = Line + 1

Endwhile
```

will read and print lines from the previously opened file until *either* the Eof (end of file) function returns a value of True or the value of Line reaches 50. (In some programming languages different symbols are used for the operators. In C, for example, AND is &&, OR is ||, and NOT is !.)

Users of databases and Web search engines are also familiar with the use of Boolean statements for defining search criteria. In many search engines, the search phrase "computer science" AND "graduate" will match sites that have both the phrase "computer science" and the word "graduate," while sites that have only one or the other will either not be listed or will be listed after those that have both (see SEARCH ENGINE).

### Further Reading

University at Albany Libraries. "Boolean Searching on the Internet." Available online. URL: http://www.albany.edu/library/internet/boolean.html.

Whitesitt, J. E. *Boolean Algebra and Its Applications*. New York: Dover, 1995.

## boot sequence

All computers are faced with the problem that they need instructions in order to be able to read in the instructions they need to operate. The usual solution to this conundrum is to store a small program called a "loader" in a ROM (read-only memory) chip. When the computer is switched on, this chip is activated and runs the loader. The loader program has the instructions needed to be able to access the disk containing the full operating system. This process is called booting (short for "bootstrapping").

### *Booting a PC*

While the details of the boot sequence vary with the hardware and operating system used, a look at the booting of a "Wintel" machine (IBM architecture PC running DOS and Microsoft Windows) can serve as a practical example.

When the power is turned on, a chip called the BIOS (basic input-output system) begins to execute a small program (see BIOS). The first thing it does is to run a routine called the POST (power-on self test) that sends a query over the system bus (see BUS) to each of the key devices (memory, keyboard, video display, and so on) for a response that indicates it is functioning properly. If an error is detected, the system generates a series of beeps, the number of which indicates the area where the problem was found, and then halts.

Assuming the test runs successfully (sometimes indicated by a single beep), the BIOS program then queries the devices to see if they have their own BIOS chips, and if so, executes their programs to initialize the devices, such as the video card and disk controllers. At this point, since the video display is available, informational and error messages can be displayed as appropriate. The BIOS also sets various parameters such as the organization of the disk drive, using information stored in a CMOS chip. (There is generally a way the user can access and change these information screens, such as when installing additional memory chips.)

The BIOS now looks for a disk drive that is bootable—that is, that contains files with the code needed to load the operating system. This is generally a hard drive, but could be a floppy disk or even a CD-ROM or USB device. (The order in which devices are checked can be configured.) On a hard drive, the code needed to start the operating system is found in a "master boot record."

The booting of the operating system (DOS) involves the determination of the disk structure and file system and the loading of the operating system kernel (found in files called IO.SYS and MSDOS.SYS), and a command interpreter (COMMAND.COM). The latter can then read the contents of the files AUTOEXEC.BAT and CONFIG.SYS, which specify system parameters, device drivers, and other programs to be loaded into memory at startup. If the system is to run Microsoft Windows, that more elaborate operating system will then take over, building upon or replacing the foundation of DOS.

**Further Reading**

PC Guide. "System Boot Sequence." Available online. URL: http://www.pcguide.com/_ref/mbsys/bios/bootSequence-c.html. Accessed April 10, 2008.

## branching statements

The simplest calculating machines (see CALCULATOR) could only execute a series of calculations in an unalterable sequence. Part of the transition from calculator to full computer is the ability to choose different paths of execution according to particular values—in some sense, to make decisions.

Branching statements (also called decision statements or selection statements) give programs the ability to choose one or more different paths of execution depending on the results of a logical test. The general form for a branching statement in most programming languages is

```
if (Boolean expression)

statement

else statement
```

For example, a blackjack game written in C might have a statement that reads:

```
if ((Card_Count + Value(This_Card)) > 21)
  printf ("You're busted!");
```

Here the Boolean expression in parenthesis following the if keyword is evaluated. If it is true, then the following statement (beginning with printf) is executed. (The Boolean expression can be any combination of expressions, function calls, or even assignment statements, as long as they evaluate to true or false—see also BOOLEAN OPERATORS.)

The else clause allows the specification of an alternative statement to be executed if the Boolean expression is *not* true. The preceding example could be expanded to:

```
if (Card_Count + Value (This_Card) > 21)
  printf ("You're busted!");
else
  printf("Do you want another card?");
```

In most languages if statements can be nested so that a second if statement is executed only if the first one is true. For example:

```
if (Turn > Max_Turns)
  {
  if (Winner() )
    PrintScore();
  }
```

Here the first if test determines whether the maximum number of turns in the game has been exceeded. If it has, the second if statement is executed, and the Winner() function is called to determine whether there is a winner. If there is a winner, the PrintScore() function is called. This example also illustrates the general rule in most languages that wherever a single statement can be used a block of statements can also be used. (The block is delimited by braces in the C family of languages, while Pascal uses Begin . . . End.)

The switch or case statement found in many languages is a variant of the if statement that allows for easy testing of several possible values of a condition. One could write:

```
if (Category = = "A")
  AStuff();

else if (Category = = "B")
  BStuff();

else if (Category = = "C")
  CStuff();

else
  printf "(None of the above\n");
```

However, C, Pascal, and many other languages provide a more convenient multiway branching statement (called switch in C and case in Pascal). Using a switch statement, the preceding test can be rewritten in C as:

```
switch (Category) {
case "A":
  AStuff();
  break;
case "B":
  BStuff();
  break;
case "C"
  CStuff();
  break;
default:
  printf ("None of the above\n");
}
```

(Here the break statements are needed to prevent execution from continuing on through the other alternatives when only one branch should be followed.)

**Further Reading**

Sebesta, Robert W. *Concepts of Programming Languages*. 8th ed. Boston: Addison-Wesley, 2008.