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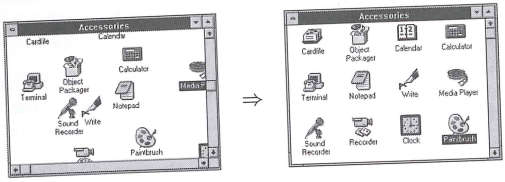

FIGURE 14. "ARRANGE ICONS"

arctan *see* ARC TANGENT.

arc tangent the inverse of the trigonometric tangent function. If $x = \tan y$, then $y = \arctan x$. In BASIC, the arc tangent function is called `ATN`. *See* TRIGONOMETRIC FUNCTIONS.

arguments (**actual parameters**) values passed to a function or procedure by the calling program. *See* ACTUAL PARAMETER.

ARPANET a computer network originally developed for the U.S. Defense Advanced Research Projects Agency (ARPA, now known as DARPA) to link research institutions. ARPANET introduced the TCP/IP protocols and eventually developed into the Internet. *See* INTERNET; WIDE AREA NETWORK; TCP/IP.

arrange

1. to place the icons on the screen in neat rows and columns, retrieving any that have been moved off the edge of the screen (Fig. 14).

In Windows 95 and 98, "Arrange Icons" is on the menu that pops up when you right-click on an empty area of the desktop; it is also on the "View" menu of individual windows. In Windows 3.1, it is usually on a menu titled "Windows" or "View."

If you want the computer to keep the icons arranged automatically, turn on the "Auto arrange" feature; a check mark shows that it is selected. *See also* CASCADE; TILE.

2. to place an item in relation to other items. In drawing programs, there is usually an Arrange menu that contains commands (ALIGN, SEND TO FRONT, BACK ONE, etc.) relating to the placement of selected objects. Objects are layered as if they were opaque pieces of paper.

array a collection of data items that are given a single name and distinguished by numbers (subscripts). For example, in BASIC, the declaration

```
DIM X(5)
```

creates an array of five elements that can be referred to as `X(1)`, `X(2)`, `X(3)`, `X(4)`, and `X(5)`.

FIGURE 15. ARRAY (ONE-DIMENSIONAL)

You can store numbers in these elements with statements such as:

```
X(1) = 10
X(2) = 43
X(3) = 8
X(4) = 91
X(5) = -5
```

just as if each element were a separate variable. You can also use INPUT and READ statements on array elements just as if they were ordinary variables.

Arrays are useful because they let you use arithmetic to decide which element to use at any particular moment. For example, you can find the total of the numbers in the five-element array **X** by executing the statements:

```
TOTAL = 0
FOR I = 1 TO 5
  TOTAL = TOTAL + X(I)
NEXT I
PRINT TOTAL
```

Here **TOTAL** starts out as 0 and then gets each element of **X** added to it.

Arrays can have more than one dimension. For example, the declaration **DIM Y(3,5)** creates a 3×5 array whose elements are:

```
Y(1,1)   Y(1,2)   Y(1,3)   Y(1,4)   Y(1,5)
Y(2,1)   Y(2,2)   Y(2,3)   Y(2,4)   Y(2,5)
Y(3,1)   Y(3,2)   Y(3,3)   Y(3,4)   Y(3,5)
```

31	17	95	43	60
32	95	86	72	40
27	45	93	43	81

FIGURE 16. ARRAY (TWO-DIMENSIONAL, 3×5)

Multidimensional arrays are useful for storing tables of data, such as three test grades for each of five students. *See also* DATA STRUCTURES; SORT.

arrow keys keys that move the cursor up, down, or to the left or right. The effect of these keys depends on the software being used. In a GUI environment, the arrow keys are basically an alternative to a mouse. Some drawing environments let you NUDGE the selected object with the arrow keys, giving you greater precision. Touch typists sometimes prefer the arrow keys to a mouse because it allows them to keep their hands on the keyboard. *See* NUDGE; KEYBOARD (diagram); MOUSE.

Arrow keys do not have ASCII codes. Instead, each of them is read in a way that depends on the particular computer and software. Be cautious about using arrow keys when communicating with another computer; even if your cursor moves in the intended way, the other computer may not understand what you are doing, unless you are emulating a standard type of terminal (such as VT-100) and have identified your terminal type to it.

artificial intelligence (**AI**) the use of computers to simulate human thinking. Artificial intelligence is concerned with building computer programs that can solve problems creatively, rather than simply working through the steps of a solution designed by the programmer.

For example, consider computer game playing. Some games, such as tic-tac-toe, are so simple that the programmer can specify in advance a procedure that guarantees that the computer will play a perfect game. With a game such as chess, however, no such procedure is known; the computer must instead use a *heuristic,* that is, a procedure for discovering and evaluating good moves.

One possible heuristic for chess would be for the computer to identify every possible move from a given position and then evaluate the moves by calculating, for each one, all the possible ways the game could proceed. Chess is so complicated that this would take an impossibly long time (millions of years with present-day computers).

A better strategy would be to take shortcuts. Calculating only five or six moves into the future is sufficient to eliminate most of the possible moves as not worth pursuing. The rest can be evaluated on the basis of general principles about board positions. In fact, an ideal heuristic chess-playing machine would be able to modify its own strategy on the basis of experience. Like a human chess player, it would realize that its opponent is also following a heuristic and would try to predict her behavior.

One of the main problems of AI is how to represent knowledge in the computer in a form that can be *used* rather than merely reproduced. In fact, some workers define AI as the construction of computer programs that utilize a knowledge base. A computer that gives the call number of a library book is not displaying artificial intelligence; it is merely echoing back what was put into it. Artificial intelligence would

come into play if the computer used its knowledge base to make generalizations about the library's holdings or construct bibliographies on selected subjects. (*See* EXPERT SYSTEM.)

Computer vision and *robotics* are important areas of AI. Although it is easy to take the image from a TV camera and store it in a computer's memory, it is hard to devise ways to make the computer recognize the objects it "sees." Likewise, there are many unsolved problems associated with getting robots to move about in three-dimensional space—to walk, for instance, and to find and grasp objects—even though human beings do these things naturally.

Another unsolved problem is *natural language processing*—getting computers to understand speech, or at least typewritten input, in a language such as English. In the late 1950s it was expected that computers would soon be programmed to accept natural-language input, translate Russian into English, and the like. But human languages have proved to be more complex than was expected, and progress has been slow. The English speaking computers of *Star Wars* and *2001* are still some years away. *See* NATURAL LANGUAGE PROCESSING.

The important philosophical question remains: Do computers really think? Artificial intelligence theorist Alan Turing proposed a criterion that has since become known as the Turing test: A computer is manifesting human-like intelligence if a person communicating with it by teletype, cannot distinguish it from a human being. Critics have pointed out that it makes little sense to build a machine whose purpose is to deceive its makers. Increasing numbers of AI workers are taking the position that computers are not artificial minds, but merely tools to assist the human mind, and that this is true no matter how closely they can be made to imitate human behavior. *See also* ELIZA.

ASC the function, in BASIC, that finds the ASCII code number associated with a given character. (*See* ASCII.) For example, `ASC("A")` is 65 because the ASCII code of the character *A* is 65 (expressed in decimal).

FIGURE 17. ASCENDERS

ascender the part of a printed character that rises above the body of the letter. For instance, the letter *d* has an ascender and the letter *o* does not. *See* DESCENDER; TYPEFACE; X-HEIGHT.

ASCII (American Standard Code for Information Interchange) a standard code for representing characters as numbers that is used on

3. *Network layer.* How does one machine establish a connection with the other? This covers such things as telephone dialing and the routing of packets. For examples, see HAYES COMPATIBILITY (command chart); PACKET; X.25.

4. *Transport layer.* How can the sender be sure the message has been received correctly? For examples, see XMODEM and KERMIT.

5. *Session layer.* How do the machines identify each other? How do users sign on and identify themselves?

6. *Presentation layer.* What does the information look like when received on the user's machine?

7. *Application layer.* How does the information fit into the system of software that will be used to process it?

The OSI standard does not specify what any of these layers should look like; it merely defines a framework in terms of which future standards can be expressed. In a simple system, some of the layers are handled manually or are trivially simple.

data compression the storage of data in a way that makes it occupy less space than if it were stored in its original form. For example, long sequences of repeated characters can be replaced with short codes that mean "The following character is repeated 35 times," or the like. A more thorough form of data compression involves using codes of different lengths for different character sequences so that the most common sequences take up less space.

Most text files can be compressed to about half their normal size. Digitized images can often be compressed to 10 percent of their original size (or even more if some loss of fine detail can be tolerated), but machine-language programs sometimes cannot be compressed at all because they contain no recurrent patterns. *See also* ZIP FILE; STUFFIT; PCX; JPEG; MPEG.

datagram a PACKET of information transmitted by NETWORK.

data rate *see* BAUD.

data set

1. (in older telephone company nomenclature) a MODEM.
2. (in OS/360 and related IBM operating systems) a file, referred to under the name by which it is known to the operating system. (The file is known to any particular program by another name, the "filename," specified by the JCL `DD` statement, TSO `allocate` command, or CMS `filedef` command.)

data structures ways of arranging information in the memory of a computer. In computer programming, it is often necessary to store

large numbers of items in such a manner as to reflect a relationship between them. The three basic ways of doing this are the following:

1. An *array* consists of many items of the same type, identified by number. The examination scores of a college class might be represented as an array of numbers. A picture can be represented as a large array of brightness readings, one for each of the thousands of cells into which the picture is divided.

2. A *record* consists of items of different types, stored together. For example, the teacher's record of an individual student might consist of a name (character data), number of absences (an integer), and a grade average (a floating-point number). Records and arrays can be combined. The teacher's records of the entire class form an array of individual records; each record might contain, among other things, an array of test scores.

3. A *linked list* is like an array except that the physical memory locations in which the items are stored are not necessarily consecutive; instead, the location of the next item is stored alongside each item. This makes it possible to insert items in the middle of the list without moving other items to make room. More complex linked structures, such as *trees,* can be constructed by storing more than one address with each item.

See ARRAY; RECORD; LINKED LIST.

data types ranges of possible values that a data item might have. Some possible data types include integers, real numbers, Boolean values, and character strings. Some languages, such as Pascal and Java, are very strict about requiring that the type of each variable be declared before it can be used, and an error message occurs if a program attempts to assign an inappropriate value to a variable. Other languages make default assumptions about the types for variables if they are not declared (*see* FORTRAN.)

The advantage of requiring data types to be declared is that it forces programmers to be more disciplined with their use of variables, and the computer can detect certain types of errors. There also can be disadvantages with a language requiring strict declaration of data types. For example, some operations (such as swapping the values of two variables) are essentially the same for any data type, so it should not be necessary to include separate subroutines for each type.

Individual data items can be arranged into various types of structures. *See* DATA STRUCTURES.

daughterboard, daughtercard a small circuit board that plugs into a larger one. *Contrast* MOTHERBOARD.

dB abbreviation for DECIBEL.