EXHIBIT 28

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COMPUTER DICTIONARY

SECOND EDITION

THE COMPREHENSIVE STANDARD FOR BUSINESS, SCHOOL, LIBRARY, AND HOME

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made by multiple processes or users. *See also* contention.

arcade game A coin-operated computer game that offers high-quality screen graphics, sound, and rapid action controlled by one or more players; more generally, any computer game developed in the style of an arcade game, such as those designed to run on the Nintendo Entertainment System. *See also* computer game.

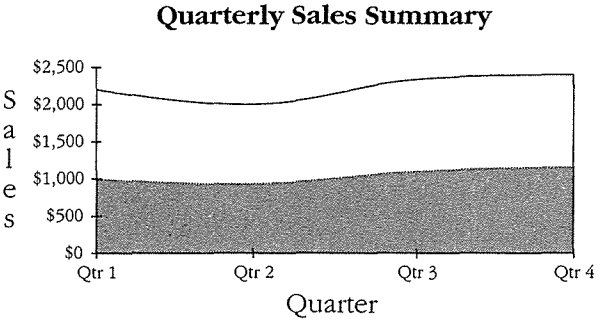
architecture A general term referring to the structure of all or part of a computer system. The term also covers the design of system software, such as the operating system, as well as referring to the combination of hardware and basic software that links the machines on a computer network. Computer architecture refers to an entire structure and to the details needed to make it functional. Thus, computer architecture covers computer systems, chips, circuits, and system programs but typically does not refer to applications, which are required to perform a task but not to make the system run.

Many computer microprocessors have a CISC (complex instruction set computing) architecture. RISC (reduced instruction set computing) processors frequently use a pipelined architecture, which fetches new processor instructions while a current instruction is still executing. A disk subsystem that uses memory to preload and retain information from a disk may be said to have a cached architecture. *See also* cache, closed architecture, CISC, open architecture, pipelining, RISC.

archive To store copies of computer programs and data to ensure against loss in the event that the original materials are deleted or damaged. Archived files can be sent to tape, to floppy disks, or to another computer system.

archive bit A bit, associated with a file, that is used by some backup and restore utility programs to determine whether the file has been backed up. Backup utilities usually alter the state of the archive bit after backing up the file. Whether a file has an archive bit depends on the underlying file system. *See also* backup, bit.

area chart A type of business graphic that uses shading or other highlighting to visually emphasize the difference between the line connecting one set of data points and the line connecting a separate but related set of data points. An area chart might, for example, be used to show quarterly sales figures for one region as a proportion of a company's total sales for the year. See the illustration.



Area chart.

area search In information management, the examination of a group of documents in order to retrieve those related to a particular subject or category.

arg *See* argument.

argument Abbreviated arg. A value or an expression used with an operator or passed to a subprogram (subroutine, procedure, or function). The program then carries out operations using the argument(s). *See also* algorithm, operator, parameter, subprogram.

arithmetic The branch of mathematics dealing with the addition, subtraction, multiplication, and division of real numbers.

arithmetic expression In computing, a series of elements joined by arithmetic operators, such as + and -, that can be calculated to produce a value. An arithmetic expression can include data names (or labels) and constants as well as numbers; for example, *PRICE X TAX* is an arithmetic expression, as is *2 X 4*. *See also* expression.

arithmetic logic unit Abbreviated ALU. The computer's circuitry for arithmetic, comparative, and logical functions. The ALU is an integral part of the computer's microprocessor chip.

arithmetic operation Any of the standard calculations performed in arithmetic—addition,

term is usually limited to describing a system with two microprocessors; a system with a microprocessor and a math coprocessor is not considered a dyadic system. In mathematics, a dyadic operation is one in which there are two operands. In Boolean algebra, a dyadic Boolean operation is, again, one in which there are two operands, both of which are significant. Dyadic Boolean operations are those such as AND and OR in which the outcome depends on both values. Such operations are commonly used to create truth tables. *Compare* unary; *see also* Boolean algebra, operand.

dye-polymer recording A type of recording technology used with optical discs in which dye embedded in a plastic polymer coating on an optical disc is used to create minute bumps on the surface that can be read by a laser. Dye-polymer bumps can be flattened and re-created, thus making an optical disc rewritable, as opposed to being recordable only once.

dynamic An adjective used to describe events or processes that occur immediately and concurrently as opposed to those planned for in advance or reacted to after the fact. *Dynamic* is used in reference to both hardware and software; in each case it describes some action or event that occurs when and as needed. In nondynamic memory management, a program is given a certain amount of memory when the program is first run and must run within that constraint. In dynamic memory management, a program is able to negotiate with the operating system when it needs more memory.

dynamic address translation Abbreviated DAT. On-the-fly conversion of memory-location references from relative addresses ("three units from the beginning of X") to absolute address ("location number 123") when a program is run. Dynamic address translation depends on conditions existing within the system at the runtime of a program; for example, it might depend on exactly where in memory a particular part of a program is loaded by the operating system.

dynamic allocation The allocation of memory during program execution according to current needs. Dynamic allocation almost always implies that dynamic deallocation is possible too, so data structures can be created and destroyed as required. *Compare* static allocation; *see also* allocate, deallocate.

dynamic binding Also called late binding. Binding (converting symbolic addresses in the program to storage-related addresses) that occurs during program execution. The term often refers to object-oriented applications that determine, during runtime, which software routines to call for particular data objects. For example, an application might define a class named "artwork," with subclasses for paintings, sculptures, ceramics, and so on. Each of these classes would have a routine named "dollarvaluenow" that would calculate the current value of a piece of art, based in part on the class's unique characteristics and also on the state of the market for art. Given an artwork object, dynamic binding would ensure that the correct "dollarvaluenow" routine was called to compute the current value. *Compare* static binding.

Dynamic Data Exchange Abbreviated DDE. A form of interprocess communication (IPC) implemented in Microsoft Windows and OS/2. When two or more programs that support DDE are running simultaneously, they can exchange information and commands. For example, a spreadsheet with a DDE link to a communications program might be capable of keeping stock prices that are displayed in the spreadsheet current with trading information received over the communications channel. *See also* interprocess communication.

dynamic dump A listing, either stored on disk or sent to a printer, of memory contents generated at the time of a break in the execution of a program; a useful tool for programmers interested in knowing what is happening at a certain point in the execution of a program.

dynamic-link library A feature of the Microsoft Windows family of operating systems and the OS/2 operating system that allows executable routines—generally serving a specific function or set of functions—to be stored separately as files with DLL extensions and to be loaded only when

needed by the program that calls them. A dynamic-link library has several advantages. First, because a dynamic-link library is loaded only when it is needed, it does not consume any memory until it is used. Second, because a dynamic-link library is a separate file, a programmer can make corrections or improvements to only that module without affecting the operation of the calling program or any other dynamic-link library. Finally, because a dynamic-link library often contains related functions—for example, routines for creating animation on a video display—a programmer can use the same dynamic-link library with other programs.

dynamic RAM Abbreviated DRAM (pronounced "dee-ram"). A form of semiconductor random access memory (RAM). Dynamic RAMs store information in integrated circuits that contain capacitors. Because capacitors lose their charge over time, dynamic RAM boards must include logic to "refresh" (recharge) the RAM chips continuously. While a dynamic RAM is being refreshed, it cannot be read by the processor; if the processor must read the RAM while it is being refreshed, one or more wait states occur. Because their internal circuitry is simple, dynamic RAMs are more commonly used than static RAMs, even though they are slower. A dynamic RAM can hold approximately four times as much data as a static RAM chip of the same complexity. *Compare* static RAM; *see also* RAM.

dynamic relocation The relocation in memory of data or of the code of a currently running program by an internal system routine. Dynamic relocation helps a computer use memory efficiently.

dynamic scheduling The management of concurrently running processes (programs), usually by the operating system.

dynamic storage A term describing information storage systems whose contents will be lost if power is removed from the system. RAM (random access memory) systems are the most common form of dynamic storage, and both dynamic RAM (DRAM) and static RAM (SRAM) are considered forms of dynamic storage. *Compare* permanent storage; *see also* dynamic RAM, static RAM.

In programming, a term describing blocks of memory that can be allocated, deallocated, or freely changed in size.

per minute (ppm), used for page printers such as laser printers.

line style In desktop publishing, printing, and high-end word processing, the form and quality of a line, such as a dotted line, a double line, or a hairline. *See also* hairline.

line surge A sudden, transient increase in the voltage or current carried by a line. A nearby lightning strike, for example, can cause a surge in power lines that can damage electrical equipment. Delicate types of equipment such as computers are often protected from line surges by surge suppressors placed in the power lines.

line voltage The voltage present in a power line. In North America, line voltage is approximately 115 volts alternating current (AC).

line width The length of a line of type measured from the left margin to the right margin on a piece of paper or on a computer screen. On a typewriter, line width is usually measured in terms of the number of monospace alphanumeric characters that can fit on the line; on a computer printer or monitor, line width is normally measured in inches, centimeters, points, or picas.

linguistics The analytic study of human language. Close ties exist between linguistics and computer science because of mutual interest in grammar, syntax, semantics, formal language theory, and natural-language processing.

link To produce an executable program from compiled modules (programs, routines, libraries) by merging the object code (assembly language object code, executable machine code, or a variation of machine code) of the program and resolving interconnecting references (such as a library routine called by a program). Also, to connect two elements in a data structure by using index variables or pointer variables. *See also* index, linker, pointer.

linkage editor *See* linker.

linked list In programming, a list of nodes or elements of a data structure connected by pointers. A singly linked list has one pointer in each node, pointing to the next node in the list; a doubly linked list has two pointers in each node, pointing to the next and previous nodes. In a circular list, the first and last nodes of the list are linked together. Both linked lists and arrays are often used to implement the list, stack, and queue data structures. Linked lists have the advantages of dynamic node allocations and no requirements that nodes all be of the same type; arrays have the advantage of direct access to a given node. *Compare* linear list; *see also* array, key, list, node.

linker A program that links compiled modules and data files to create an executable program. A linker can also have other functions, such as creation of libraries. *See also* library, link, program creation.

link time The length of time required to link a program; also, the period during which a program is being linked (for example, static binding occurs at link time, whereas dynamic binding occurs at run time). *See also* compile time, link, run time.

Linotronic Any in the series of high-quality typesetting devices known as Linotronic laser imagesetters, which can print at resolutions such as 1270 and 2540 dots per inch (dpi). These devices are commonly attached to PostScript raster image processors (RIPs) so that desktop publishing applications can typeset directly from a microcomputer. *See also* imagesetter, PostScript, raster image processor.

Linpack A benchmarking routine that solves 100 simultaneous equations in a test of CPU, floating-point, and memory-access speeds. As with many benchmarking tests, compiler efficiency is a major component in the result.

LIPS Acronym for linear inferences per second. A measure of speed for some types of artificial-intelligence machines and expert systems.

liquid crystal display Abbreviated LCD. A type of display that uses a liquid compound having a polar molecular structure, sandwiched between two transparent electrodes. When an electric field is applied, the molecules align with the field, forming a crystalline arrangement that polarizes the light passing through it. A polarized filter laminated over the electrodes blocks polarized light and transmits nonpolarized light. In this way, a grid of electrodes can selectively "turn on"