Glossary

accumulator: The register in the 65C02 microprocessor where most computations are performed.

ACIA: Acronym for *Asychronous Communications Interface Adapter*. The ACIA is a chip that converts data from parallel to serial form and vice versa. Its internal registers control and keep track of the sending and receiving of data. Firmware and software set and change the status of these internal registers.

acronym: A word formed from the initial letters of a name or phrase, such as *ROM*, from *read-only memory*.

address: A number that specifies a single byte of memory. Addresses can be given as decimal integers or as hexadecimal integers. A 64K system has addresses ranging from 0 to 65535 (in decimal) or from $0000 to $FFFF (in hexadecimal).

algorithm: A step-by-step procedure for solving a problem or accomplishing a task.

analog: Represented in terms of a physical quantity that can vary smoothly and continuously over a range of values. For example, a conventional 12-hour clock face is an analog device that represents the time of day in terms of the angles of the clock's hands. Compare **digital**.

analog data: Data in the form of continuously variable physical quantities. Compare **digital data**.

analog signal: A signal that varies continuously over time.

analog-to-digital converter: A device that converts quantities from analog to digital form. For example, hand controls used on Apple II family computers convert the position of the control dial (an analog quantity) into a discrete number (a digital quantity) that changes abruptly even when the dial is turned smoothly.

AND: A logical operator that produces a true result if both of its operands are true, a false result if either or both of its operands are false; compare **OR**, **exclusive OR**, **NOT**.

ANSI: Acronym for *American National Standards Institute*, which sets standards for many fields and is the most common standard for terminals.

Apple IIc: A transportable personal computer in the Apple II family, with a disk drive and 80-column capability built in.

Apple IIe: A personal computer in the Apple II family.

Apple IIe 80-Column Text Card: A peripheral card that plugs into the Apple IIe's auxiliary slot and converts the computer's display of text from 40-column width to 80-column width.

Apple IIe Extended 80-Column Text Card: A peripheral card that plugs into the Apple IIe's auxiliary slot and converts the computer's display of text from 40-column width to 80-column width while extending its memory capacity by 64K bytes.

Apple II Pascal: A software system that lets you create and execute programs written in the Pascal programming language, adapted by Apple Computer from the UCSD (University of California, San Diego) Pascal Operating System and sold for use with the Apple II family of computers.

Applesoft BASIC: An extended version of the BASIC programming language used with the Apple II family of computers. An interpreter for creating and executing programs in Applesoft is built into the computer's firmware. Compare **Integer BASIC**.

application program: A program that puts the resources and capabilities of the computer to use for some specific purpose or task, such as word processing, data base management, or graphics. Compare **system program**.

argument: The value on which a function operates.

arithmetic expression: A combination of numbers and arithmetic operators (such as 3 + 5) that indicates some operation to be carried out.

arithmetic operator: An operator, such as +, that combines numeric values to produce a numeric result. Compare **relational operator**, **logical operator**.

ASCII: Acronym for *American Standard Code for Information Interchange*, pronounced *ASK ee*. A code in which the numbers from 0 to 127 stand for text characters— including the letters of the alphabet, the digits 0 through 9, punctuation marks, special characters, and control characters—used for representing text inside a computer and for transmitting text between computers or between a computer and a peripheral device.

assembler: A language translator that converts a program written in assembly language into an equivalent program in machine language.

assembly language: A low-level programming language in which individual machine-language instructions are written in a symbolic form more easily understood by a human programmer than machine language itself.

asserted: Made true (positive in positive-true logic; negative in negative-true logic).

asynchronous transmission: Not synchronized by or with a clocking signal. Transmission in which each information character is individually synchronized, usually by the use of start and stop bits. The gap between each character isn't necessarily fixed. Compare **synchronous transmission**.

auxiliary slot: The special expansion slot inside the Apple IIe used for the Apple 80-Column Text Card or Extended 80-Column Text Card.

base address: In indexed addressing, the fixed component of an address.

BASIC: Acronym for *Beginner's All-purpose Symbolic Instruction Code*. A high-level programming language designed to be easy to learn and use. Two versions of BASIC are available from Apple Computer for use with all Apple II family systems: Applesoft (built into firmware) and Integer BASIC (provided on the *ProDOS User's Disk*).

baud: Unit of signaling speed taken from the name Baudot. The speed in bauds is equal to the number of discrete conditions or signal events per second regardless of the information content of those signals. Often equated (though not precisely) with bits per second. Compare **bit rate**.

binary: The representation of numbers in terms of powers of two, using the two digits 0 and 1. Commonly used in computers because the values 0 and 1 can easily be represented in physical form in a variety of ways, such as the presence or absence of current, positive or negative voltage, or a white or black dot on the display screen. A single binary digit—a 0 or a 1—is called a **bit**.

binary digit: The smallest unit of information in the binary number system. Also called a **bit**.

binary operator: An operator that combines two operands to produce a result; for example, + is a binary arithmetic operator, < is a binary relational operator, and *OR* is a binary logical operator. Compare **unary operator**.

bit: The smallest item of useful information a computer can handle. Usually represented as a 1 or a 0. Eight bits equal one byte.

bit rate: The speed at which bits are transmitted, usually expressed as **bps** or **bits per second**. Compare **baud**.

board: See **printed-circuit board**.

body: The statements or instructions that make up a part of a program, such as a loop or a subroutine.

boot: To start up a computer by loading a program into memory from an external storage medium such as a disk. Often accomplished by first loading a small program whose purpose is to read the larger program into memory. The program is said to *pull itself up by its own bootstraps*—hence the term *bootstrapping* or *booting*.

boot disk: See **startup disk**.

bootstrap: See **boot**.

bps: See **bit rate**.

branch: To send program execution to a line or statement other than the next in sequence.

BREAK: A SPACE (0) signal, sent over a communication line, of long enough duration to interrupt the sender. This signal is often used to end a session with a time-sharing service.

BRK: An instruction that causes the 65C02 microprocessor to halt.

buffer: A memory area that holds information until it can be processed.

bug: An error in a program that causes it not to work as intended.

bus: A group of wires that transmit related information from one part of a computer system to another.

byte: A sequence of eight bits that represents an instruction, a letter, a number, or a punctuation mark.

cable: A group of wires used to carry information between two devices. How many wires are used varies with the type of connection.

call: To request the execution of a subroutine or function.

card: See **peripheral card**.

carriage return: An ASCII character (decimal 13) that ordinarily causes a printer or display device to place the subsequent character on the left margin.

carrier: The background signal on a communication channel that is modified to *carry* the information. Under RS232-C rules, the carrier signal is equivalent to a continuous MARK (1) signal; a transition to 0 then represents a start bit.

carry flag: A status bit in the 65C02 microprocessor, used to hold the high-order bit (the *carry* bit) in addition and subtraction.

central processing unit: See **processor**.

character: Any symbol that has a widely understood meaning. Some characters—such as letters, numbers, and punctuation—can be displayed on the monitor screen and printed on a printer. Others are used to control various functions of the computer. See **control character**.

character code: A number used to represent a text character for processing by a computer system.

character set: The entire set of characters that can be either shown on a monitor or used to code computer instruction. In a printer, the entire set of characters that the printer is capable of printing.

circuit board: A collection of integrated circuits (chips) on a board.

Clear To Send: An RS232-C signal from a DCE to a DTE that is normally kept false until the DCE makes it true, indicating that all circuits are ready to transfer data out.

code: (1) A number or symbol used to represent some piece of information in a compact or easily processed form. (2) The statements or instructions making up a program.

cold start: The process of starting up the Apple II when the power is first turned on (or as if the power had just been turned on) by loading the operating system into main memory, then loading and running a program.

column: A vertical arrangement of graphics points or character spaces on the monitor screen.

command: A word or character that causes the computer to do something.

compiler: A language translator that converts a program written in a high-level programming language into an equivalent program in some lower-level language (such as machine language) for later execution. Compare **interpreter**.

composite video: A video signal that includes both display information and the synchronization (and other) signals needed to display it.

computer: An electronic device that performs predefined (programmed) computations at high speed and with great accuracy. A machine that is used to store, transfer, and transform information.

computer language: See **programming language**.

computer system: A computer and its associated hardware, firmware, and software.

conditional branch: A branch that depends on the truth of a condition or the value of an expression. Compare **unconditional branch**.

configuration: The hardware and software arrangement of a system.

connector: A physical device such as a plug, socket, or jack, used to connect two devices to one another.

console: The Apple IIe's video display and keyboard together make up the console. This is the part of the Apple IIe you communicate with directly.

constant: A symbol in a program that represents a fixed, unchanging value. Compare **variable**.

CONTROL : A key that when pressed in conjunction with another key makes that other key behave differently.

CONTROL - RESET : This combination of keystrokes usually causes an Applesoft program or command to stop immediately. If a program disables the **CONTROL - RESET** feature, you need to turn the computer off to get the program to stop.

control character: A non-printing character that controls or modifies the way information is printed or displayed. Control characters have ASCII values between 0 and 31, and are typed from a keyboard by holding down **CONTROL** while pressing some other key. For example, the character Control-M (ASCII code 13) means "return to the beginning of the line" and is equivalent to pressing **RETURN**.

control code: One or more non-printing characters included in a text file whose function is to change the way a printer prints the text. See **control character**.

controller card: A peripheral card that connects a device such as a printer or disk drive to an Apple IIe and controls the operation of the device.

copy-protect: To prevent someone from duplicating the contents of a disk. Compare **write-protect**.

CPU: Abbreviation for *central processing unit*. See **processor**.

current input device: The source, such as the keyboard or a modem, from which a program is currently receiving its input.

current output device: The destination, such as the display screen or a printer, to which a program is currently sending its output.

cursor: A symbol displayed on the screen that marks where the user's next action will take effect or where the next character typed from the keyboard will appear.

DAC: See **digital-to-analog converter**.

data: Information, especially raw or unprocessed information, used or operated on by a program.

data bits: The computer sends and receives information as a string of bits. These are called *data bits*.

Data Carrier Detect: An RS232-C signal from a DCE (such as a modem) to a DTE (such as an Apple IIe) indicating that a communication connection has been established.

Data Communication Equipment: As defined by the RS232-C standard, any device that transmits or receives information. Usually this is a modem. However, when a modem eliminator is used, the Apple IIe itself looks like a DCE to the other device, and the other device looks like a DCE to the Apple IIe.

data set: A device that performs the modulation/demodulation control functions necessary to provide the compatibility between business machines and communications facilities. See **modem**.

Data Set Ready: An RS232-C signal from a DCE to a DTE indicating that the DCE has established a connection.

Data Terminal Equipment: As defined by the RS232-C standard, any device that generates or absorbs information, thus acting as a terminus of a communication connection.

Data Terminal Ready: An RS232-C signal from a DTE to a DCE indicating a readiness to transmit or receive data.

DCD: See **Data Carrier Detect**.

DCE: See **Data Communication Equipment**.

debug: To locate and correct an error or the cause of a problem or malfunction in a computer system. Typically used to refer to software-related problems. Compare **troubleshoot**.

decimal: The common form of number representation used in everyday life, in which numbers are expressed in terms of powers of ten, using the ten digits 0 through 9.

default: A value, action, or setting that is assumed or set in the absence of explicit instructions otherwise.

deferred execution: The saving of an instruction in a program for execution at a later time as part of a complete program; occurs when the statement is typed with a line number. Compare **immediate execution**.

[DELETE]**:** A key on the upper-right corner of the Apple IIe and IIc keyboards that, when pressed, usually erases the character immediately preceding the cursor.

delimiter: A character that is used to mark the beginning or end of a sequence of characters, and which therefore is not considered part of the sequence itself. For example, Applesoft uses the double quotation mark (") as a delimiter for string constants: the string *DOG* consists of the three characters *D*, *O*, and *G*, and does not include the quotation marks. In written English, the space character is used as a delimiter between words.

demodulate: To recover the information being transmitted by a modulated signal; for example, a conventional radio receiver demodulates an incoming broadcast signal to convert it into sound emitted by a speaker.

device: A piece of computer hardware—such as a disk drive, a printer, or a monitor—other than the computer itself. Devices may be built in or peripheral.

device driver: A program that manages the transfer of information between the computer and a peripheral device.

device handler: See **device driver**.

digit: (1) One of the characters 0 through 9, used to express numbers in decimal form. (2) One of the characters used to express numbers in some other form, such as 0 and 1 in binary or 0 through 9 and A through F in hexadecimal.

digital: Represented in a discrete (noncontinuous) form, such as numerical digits. For example, contemporary digital clocks display the time in numerical form (such as 2:57) instead of using the positions of a pair of hands on a clock face. Compare **analog**.

digital data: Data that can be represented by digits—that is, data that are discrete rather than continuously variable. Compare **analog data**.

digital-to-analog converter: A device that converts quantities from digital to analog form.

DIP: See **dual in-line package**.

DIP switch: A bank of tiny switches, each of which can be moved manually one way or the other to represent one of two values (usually on and off).

disassembler: A language translator that converts a machine-language program into an equivalent program in assembly language, more easily understood by a human programmer. The opposite of an **assembler**.

disk: An information-storage medium consisting of a flat, circular, magnetic surface on which information can be recorded in the form of small magnetized spots, in a manner similar to the way sounds are recorded on tape.

disk controller card: A circuit board that provides the connection between one or two disk drives and the Apple IIe.

disk drive: A device that reads information from disks into the memory of the computer and writes information from the memory of the computer onto a disk.

disk envelope: A removable protective paper sleeve used when handling or storing a disk. It must be removed before inserting the disk in a disk drive. Compare **disk jacket**.

diskette: A term sometimes used for the small (5¼-inch), flexible disks on which information is stored.

disk jacket: A permanent protective covering for a disk, usually made of black paper or plastic. The disk is never removed from the jacket, even when inserted in a disk drive. Compare **disk envelope**.

disk operating system: One of several optional software systems for the Apple II family of computers that enables the computer to control and communicate with one or more disk drives.

Disk II drive: One of a number of types of disk drive made and sold by Apple Computer for use with the Apple II family of computers. It uses 5¼-inch flexible (*floppy*) disks.

disk-resident: Stored or held permanently on a disk.

display: *v.* To exhibit information visually. *n.* (1) Information exhibited visually, especially on the screen of a display device, such as a video monitor. (2) A display device.

display color: The color currently being used to draw high-resolution or low-resolution graphics on the display screen.

display device: A device that exhibits information visually, such as a television set or video monitor.

DOS 3.2: An early Apple II operating system. DOS stands for *Disk Operating System*. 3.2 is the version number.

DOS 3.3: One of the operating systems used by the Apple II family of computers. DOS stands for *Disk Operating System*. 3.3 is the version number.

drive: See **disk drive**.

DSR: See **Data Set Ready**.

DTE: See **Data Terminal Equipment**.

DTR: See **Data Terminal Ready**.

dual in-line package: An integrated circuit packaged in a narrow rectangular box with a row of metal pins along each side. Often referred to as a **DIP switch**.

Dvorak keyboard: An alternate keyboard layout, also known as the *simplified keyboard*.

effective address: In machine-language programming, the address of the memory location on which a particular instruction actually operates, which may be arrived at by indexed addressing or some other addressing method.

80-column text card: A circuit board that converts the computer's display of text from 40 columns to 80 columns.

80/40 column switch: A switch, either hardware or software, that controls the number of horizontal columns or characters across your screen. A television can display a maximum of 40 characters across, while a video monitor can display 80 characters across the screen.

embedded: Contained within. For example, the string HUMPTY DUMPTY is said to contain an embedded space.

emulate: To behave in an identical way. The Apple II 2780/3780 Protocol Emulator and the Apple II 3270 BSC Protocol Emulator, for example, allow your Apple II, II Plus, or IIe, together with the Apple Communications Protocol Card (ACPC), to emulate the operations of IBM 3278 and 3277 terminals and 3274 and 3271 control units.

end-of-command mark: A punctuation mark used to separate commands sent to a peripheral device such as a printer or plotter. Also called a *command terminator*.

end-of-line character: Any character that tells the printer that the preceding text constitutes a full line and may now be printed.

error code: A number or other symbol representing a type of error.

error message: A message displayed or printed to notify the user of an error or problem in the execution of a program.

Escape character: An ASCII character that allows you to perform special functions when used in combination keypresses.

escape mode: A state of the computer, entered by pressing ESC, in which certain keys on the keyboard take on special meanings for positioning the cursor and controlling the display of text on the screen.

escape sequence: A sequence of keystrokes, beginning with ESC, used for positioning the cursor and controlling the display of text on the screen.

even parity: Use of an extra bit set to 0 or 1 as necessary to make the total number of 1 bits (among the data bits plus the parity bit) an even number.

even/odd parity check: A check that tests whether the number of digits in a group of binary digits is even (even parity check) or odd (odd parity check).

exclusive OR: A logical operator that produces a true result if one of its operands is true and the other false, a false result if its operands are both true or both false. Compare **OR**, **AND**, and **NOT**.

execute: To perform the actions specified by a program command or sequence of commands.

expansion slot: A connector inside the Apple IIe in which a peripheral card can be installed. Sometimes called a *peripheral slot*.

expression: A formula in a program that describes a calculation to be performed.

FIFO: First in, first out.

file: An ordered collection of information stored as a named unit on a peripheral storage medium such as a disk.

firmware: Software stored permanently in hardware: programs in read-only memory (ROM). Such programs (for example, the Applesoft Interpreter and the Monitor program) are built into the computer at the factory. They can be executed at any time but cannot be modified or erased from main memory. Compare **hardware**, **software**.

fixed-point: A method of representing numbers inside the computer in which the decimal point (more correctly, the binary point) is considered to occur at a fixed position within the number. Typically, the point is considered to

lie at the right end of the number so that the number is interpreted as an integer. Compare **floating-point**.

flag: A variable whose contents (usually 1 or 0, standing for *true* or *false*) indicate whether some condition holds or whether some event has occurred. Used to control the program's actions at some later time.

flexible disk: A disk made of flexible plastic. Often called a *floppy* disk. Compare **rigid disk**.

floating-point: A method of representing numbers inside the computer in which the decimal point (more correctly, the binary point) is permitted to *float* to different positions within the number. Some of the bits within the number itself are used to keep track of the point's position. Compare **fixed-point**.

floppy disk: See **flexible disk**.

format: *n.* The form in which information is organized or presented. *v.* (1) To specify or control the format of information. (2) To prepare a blank disk to receive information by dividing its surface into tracks and sectors. Also **initialize**.

form feed: An ASCII character (decimal 12) that causes a printer or other paper-handling device to advance to the top of the next page.

FORTRAN: A contraction of the phrase *FORmula TRANslator*. A widely used, high-level programming language especially suitable for applications requiring extensive numerical calculations, such as in mathematics, engineering, and the sciences. A version called Apple II Fortran is sold by Apple Computer for use with the Apple II Pascal Operating System.

framing error: In serial data transfer, absence of the expected stop bit(s) at the end of a received character.

frequency: The number of complete cycles transmitted per second. Usually expressed in hertz (cycles per second), kilohertz (kilocycles per second), or megahertz (megahertz per second).

full duplex: Capable of simultaneous, two-way communication. Compare *half duplex*.

function: A pre-programmed calculation that can be carried out on request from any point in a program. An instruction that converts data from one form to another.

GAME I/O connector: A special 16-pin connector inside the Apple IIe originally designed for connecting hand controls to the computer, but also used for connecting some other peripheral devices. Compare **hand-control connector**.

graphics: (1) Information presented in the form of pictures or images. (2) The display of pictures or images on a computer's video display screen. Compare **text**.

half duplex: Capable of communication in only one direction at a time. Compare **full duplex**.

hand-control connector: A 9-pin connector on the back panel of the Apple IIe, used for connecting hand controls to the computer. Compare **GAME I/O connector**.

hand controls: Optional peripheral devices, with rotating dial and pushbuttons, that can be connected to the Apple IIe hand control connector. Typically used to control game-playing programs, but can be used in more serious applications as well.

hang: For a program or system to spin its wheels indefinitely, performing no useful work.

hardware: The physical machinery that makes up a computer system. Compare **firmware**, **software**.

hertz: The unit of frequency of vibration or oscillation, also called *cycles per second*. Named for the physicist Heinrich Hertz and abbreviated Hz. The 65C02 microprocessor used in the Apple IIe operates at a clock frequency of 1 million hertz, or 1 megahertz (MHz).

hexadecimal: The representation of numbers in terms of powers of sixteen, using the ten digits 0 through 9 and the six letters A through F. Hexadecimal numbers are easier for humans to read and understand than binary numbers, but can be converted easily and directly to binary form. Each hexadecimal digit corresponds to a sequence of four binary digits, or bits. Hexadecimal numbers are preceded by a dollar sign ($).

high ASCII characters: ASCII characters with decimal values of 128 to 255. Called *high* ASCII because their high bit (first binary digit) is set to 1 (for *on*) rather than 0 (for *off*).

high-level language: A programming language that is relatively easy for humans to understand. A single statement in a high-level language typically corresponds to several instructions of machine language. High-level languages available for the Apple IIe include BASIC, Pascal, Logo, and PILOT.

high-order byte: The more significant half of a memory address or other two-byte quantity. In the 65C02 microprocessor, the low-order byte of an address is usually stored first, and the high-order byte second.

high-resolution graphics: The display of graphics on a display screen as a six-color array of points, 280 columns wide and 192 rows high. When the text window is in use, the visible high-resolution graphics display is 280 by 160 points.

hold time: In computer circuits, the amount of time a signal must remain valid after some related signal has been turned off. Compare **setup time**.

Hz: See **hertz**.

IC: See **integrated circuit**.

immediate execution: The execution of an program instruction as soon as it is typed. Occurs when the line is typed without a line number. This means that you can try out nearly every statement immediately to see how it works. Compare **deferred execution**.

implement: To realize or bring about; for example, a language translator implements a particular language.

IN#: This command designates the source of subsequent input characters. It can be used to designate a device in a slot or a machine-language routine as the source of input.

index: (1) A number used to identify a member of a list or table by its sequential position. (2) A list or table whose entries are identified by sequential position. (3) In machine-language programming, the variable component of an indexed address, contained in an index register and added to the base address to form the effective address.

indexed addressing: A method of specifying memory addresses used in machine-language programming.

index register: A register in a computer processor that holds an index for use in indexed addressing. The 65C02 has two index registers, the **X register** and the **Y register**.

index variable: A variable whose value changes on each pass through a loop. Often called *control variable* or *loop variable*.

infinite loop: A section of a program that will repeat the same sequence of actions indefinitely.

initialize: (1) To set to an initial state or value in preparation for some computation. (2) To prepare a blank disk to receive information by dividing its surface into tracks and sectors. Also **format**.

initialized disk: A disk that is organized into tracks and sectors.

input: Information transferred into a computer from some external source, such as the keyboard, a disk drive, or a modem.

input/output: Abbreviated **I/O**. The means by which information is transferred between the computer and its peripheral devices.

input routine: A machine-language routine that performs the reading of characters. The standard input routine reads characters from the keyboard. A different input routine might, for example, read them from an external terminal.

instruction: A unit of a machine-language or assembly-language program corresponding to a single action for the computer's processor to perform.

integer: A whole number represented inside the computer in fixed-point form. Compare **real number**.

Integer BASIC: A version of the BASIC programming language used by the Apple II family of computers. Integer BASIC is older than Applesoft and capable of processing numbers in integer (fixed-point) form only. Compare **Applesoft BASIC**.

integrated circuit: Networks of microfine wire that conduct electrical impulses. They are etched on silicon wafers and embedded in black plastic.

interface: The devices, rules, or conventions by which one component of a system communicates with another.

interface card: A peripheral card that implements a particular interface (such as a parallel or serial interface) by which the computer can communicate with a peripheral device such as a printer or modem.

interpreter: A language translator that reads a program instruction by instruction and immediately translates each instruction for the computer to carry out. Compare **compiler**.

interrupt: A temporary suspension in the execution of a program by a computer in order to perform some other task, typically in response to a signal from a peripheral device or other source external to the computer.

inverse video: The display of text on the computer's display screen in the form of dark dots on a light (or other single phosphor color) background, instead of the usual light dots on a dark background.

I/O: Input/output. The transfer of information into and out of a computer. See **input**, **output**.

I/O device: Input/output device. A device that transfers information into or out of a computer. See **input**, **output**, **peripheral device**.

I/O link: A fixed location that contains the address of an input/output subroutine in the computer's Monitor program.

joystick: An accessory that moves creatures and objects in game programs.

K: Two to the tenth power, or 1024 (from the Greek root *kilo*, meaning one thousand); for example, 64K equals 64 times 1024, or 65,536.

keyboard: The set of keys built into the Apple IIe, similar to a typewriter keyboard, used for entering information into the computer.

keyboard input connector: The special connector inside the Apple IIe by which the keyboard is connected to the computer.

keystroke: The act of pressing a single key or a combination of keys (such as CONTROL-C) on the keyboard.

keyword: A special word or sequence of characters that identifies a particular type of statement or command, such as *RUN* or *PRINT*.

kilobyte: A unit of information consisting of 1K (1024) bytes, or 8K (8192) bits. See **K**.

KSW: The symbolic name of the location in the computer's memory where the standard input link is stored. *KSW* stands for *keyboard switch*. See **I/O link**.

language: See **programming language**.

leading zero: A zero occurring at the beginning of a number, deleted by most computing programs.

least significant bit: The right-hand bit of a binary number as written down. Its positional value is 0 or 1.

LIFO: Acronym for *last in, first out*.

line feed: An ASCII character (decimal 10) that ordinarily causes a printer or video display to advance to the next line.

line number: A number identifying a program line in an Applesoft program. Line numbers are necessary for deferred execution.

line width: The number of characters that fit on a line on the screen or on a page.

list: A verb in computer jargon, meaning to display on a monitor, or print on a printer, the contents of the computer memory or a file.

load: To transfer information from a peripheral storage medium (such as a disk) into main memory for use; for example, to transfer a program into memory for execution.

location: See **memory location**.

logic board: See **main logic board**.

logical operator: An operator, such as AND, that combines logical values to produce a logical result. Compare **arithmetic operator**, **relational operator**.

loop: A section of a program that is executed repeatedly until a limit or condition is met, such as an index variable reaching a specified ending value.

loop variable: See **index variable**.

low-level language: A programming language that is relatively close to the form that the computer's processor can execute directly. Low-level languages available for the Apple IIe include 6502 machine language and 6502 assembly language.

low-order byte: The less significant half of a memory address or other two-byte quantity. In the 65C02 microprocessor, the low-order byte of an address is usually stored first, and the high-order byte second.

low-power Schottkey: A type of **TTL** integrated circuit having lower power and higher speed than a conventional TTL integrated circuit.

low-resolution graphics: The display of graphics on a display screen as a sixteen-color array of blocks, 40 columns wide and 48 rows high. When the text window is in use, the visible low-resolution graphics display is 40 by 40 blocks.

LS: See **low-power Schottkey**.

machine language: The form in which instructions to a computer are stored in memory for direct execution by the computer's processor. Each model of computer processor (such as the 65C02 microprocessor used in the Apple IIe) has its own form of machine language.

main logic board: A large circuit board that holds RAM, ROM, the microprocessor, custom-integrated circuits, and other components that make the computer a computer.

main memory: The memory component of a computer system that is built into the computer itself and whose contents are directly accessible to the computer.

MARK parity: A bit of value 1 appended to a binary number for transmission. The receiving device can then check for errors by looking for this value on each character.

mask: A pattern of bits for use in bit-level logical operations.

memory: A hardware component of a computer system that can store information for later retrieval. See **main memory**, **random-access memory**, **read-only memory**, **read-write memory**.

memory location: A unit of main memory that is identified by an address and can hold a single item of information of a fixed size. In the Apple IIe, a memory location holds one byte, or eight bits, of information.

memory-resident: (1) Stored permanently in main memory as firmware. (2) Held continually in main memory even while not in use. DOS is memory resident.

menu: A list of choices presented by a program, usually on the display screen, from which the user can select.

MHz: Megahertz; one million hertz. See **hertz**.

microcomputer: A computer, such as any of the Apple II family of computers, whose processor is a microprocessor.

microprocessor: A computer processor contained in a single integrated circuit, such as the 65C02 microprocessor used in the Apple IIe.

microsecond: One millionth of a second. Abbreviated μs.

millisecond: One thousandth of a second. Abbreviated ms.

mode: A state of a computer or system that determines its behavior. A manner of operating.

modem: Acronym for *MOdulator/DEModulator*; a peripheral device that enables the computer to transmit and receive information over telephone lines by converting digital signals to analog signals, and vice-versa.

modulate: To modify or alter a signal so as to transmit information. For example, conventional broadcast radio transmits sound by modulating the amplitude (amplitude modulation, or *AM*) or the frequency (frequency modulation, or *FM*) of a carrier signal.

monitor: See **video monitor**.

Monitor program: A system program built into the firmware of the Apple IIe, used for directly inspecting or changing the contents of main memory and for operating the computer at the machine-language level.

most significant bit: The leftmost bit of a binary number as written down. This bit represents 0 or 1 times 2 to the power one less than the total number of bits in the binary number. For example, in the binary number 10000, which contains five digits, the *1* represents 1 times two to the fourth power—or sixteen.

mouse: A small device that you roll around on a flat surface next to your Apple II family system. A small pointer on the screen tracks the movement of the mouse.

nanosecond: One billionth (in British usage, one thousand-millionth) of a second. Abbreviated *ns*.

nested loop: A loop contained within the body of another loop and executed repeatedly during each pass through the containing loop.

nested subroutine call: A call to a subroutine from within the body of another subroutine.

nibble: A unit of information equal to half a byte, or four bits. A nibble can hold any value from 0 to 15. Sometimes spelled *nybble*.

NOT: A unary logical operator that produces a true result if its operand is false, a false result if its operand is true. Compare **AND**, **OR**, **exclusive OR**.

NTSC: (1) Abbreviation for *National Television Standards Committee*. The committee that defined the standard format used for transmitting broadcast video signals in the United States. (2) The standard video format defined by the NTSC.

object code: See **object program**.

object program: The translated form of a program produced by a language translator such as a compiler or assembler. Also called *object code*. Compare **source program**.

odd parity: Use of an extra bit set to 0 or 1 as necessary to make the total number of 1 bits an odd number.

opcode: See **operation code**.

operand: A value to which an operator is applied. The value on which an opcode operates.

operating system: The most fundamental program in a computer. It organizes the actions of the various parts of the computer and allows it to use other programs.

operation code: The part of a machine-language instruction that specifies the operation to be performed. Often called *opcode*.

operator: A symbol or sequence of characters, such as + or *AND*, specifying an operation to be performed on one or more values (the operands) to produce a result. See **arithmetic operator**, **relational operator**, **logical operator**, **unary operator**, **binary operator**.

option: An **argument** that is optional.

OR: A logical operator that produces a true result if either or both of its operands are true, a false result if both of its operands are false. Compare **exclusive OR**, **AND**, **NOT**.

output: Information transferred from a computer to some external destination, such as the display screen, a disk drive, a printer, or a modem.

output routine: A machine-language routine that performs the sending of characters. The standard output routine writes characters to the screen. A different output routine might, for example, send them to a printer.

overflow: The condition that exists when an attempt is made to put more data into a memory area than it can hold.

override: To modify or cancel a long-standing instruction with a temporary one.

overrun: A condition that occurs when the processor does not retrieve a received character from the receive data register of the **ACIA** before the subsequent character arrives. The ACIA automatically sets bit 2 (OVR) of its status register; subsequent characters are lost. The receive data register contains the last valid data word received.

page: (1) A segment of main memory 256 bytes long and beginning at an address that is an even multiple of 256 bytes. (2) An area of main memory containing text or graphical information being displayed on the screen. (3) A screenful of information on a video display. With the Apple IIe, a page consists of 24 lines of 40 or 80 characters each.

page zero: See **zero page**.

parallel interface: An interface in which many bits of information (typically eight bits, or one byte) are transmitted simultaneously over different wires or channels. Compare **serial interface**.

parity: Maintenance of a sameness of level or count, usually the count of 1 bit in each character, for error checking.

Pascal: A high-level programming language with statements that resemble English sentences. Pascal was designed to teach programming as a systematic approach to problem solving. Named after the philosopher and mathematician, Blaise Pascal.

pass: A single execution of a loop.

PC board: See **printed-circuit board**.

peek: To read information directly from a location in the computer's memory.

peripheral: At or outside the boundaries of the computer itself, either physically (as a peripheral device) or in a logical sense (as a peripheral card).

peripheral bus: The bus used for transmitting information between the computer and peripheral devices connected to the computer's expansion slots.

peripheral card: A removable printed circuit board that plugs into one of the expansion slots in the Apple IIe. It expands or modifies the computer's capabilities by connecting a peripheral device or performing some subsidiary or peripheral function.

peripheral device: An auxiliary piece of equipment—such as a video monitor, disk drive, printer, or modem—used in conjunction with a computer and under the computer's control. Often (but not necessarily) physically separate from the computer and connected to it by wires, cables, or some other form of interface, typically by means of a peripheral card.

peripheral slot: See **expansion slot**.

phase: (1) A stage in a periodic process. A point in a cycle. For example, the 65C02 microprocessor uses a clock cycle consisting of two phases called $\phi 0$ and $\phi 1$. (2) The relationship between two periodic signals or processes. For example, in NTSC color video, the color of a point on the screen is expressed by the instantaneous phase of the video signal relative to the color reference signal.

PILOT: Acronym for *Programmed Inquiry, Learning, Or Teaching.* A high-level programming language designed to enable teachers to create computer-aided instruction (CAI) lessons that include color graphics, sound effects, lesson text, and answer checking. A version called Apple II PILOT is sold by Apple Computer for use with the Apple II family of computers.

pipelining: A feature of a processor that enables it to begin fetching the next instruction before it has finished executing the current instruction. All else being equal, processors that have this feature run faster than those without it.

plotting vector: A code representing a single step in drawing a shape on the high-resolution graphics screen, specifying whether to plot a point at the current screen position and in what direction to move (up, down, left, or right) before processing the next vector.

point of call: The point in a program from which a subroutine or function is called.

pointer: An item of information consisting of the memory address of some other item. For example, Applesoft maintains internal pointers to (among other things) the most recently stored variable, the most recently typed program line, and the most recently read data item.

poke: To store information directly into a location in the computer's memory.

pop: To remove the top entry from a stack.

power supply: A box that draws electrical power from a power outlet and converts it to the power the computer can use to do its computing.

power supply case: The metal case inside the Apple IIe that houses the power supply.

PR#: The PR# command sends output to a slot or a machine-language program. It specifies an output routine in the ROM on a peripheral card or in a machine-language routine in RAM by changing the address of the standard output routine used by the computer.

precedence: The order in which operators are applied in evaluating an expression.

printed-circuit board: A hardware component of a computer or other electronic device, consisting of a flat, rectangular piece of rigid material, commonly fiberglass, to which integrated circuits and other electronic components are connected.

procedure: In the Pascal programming language, a set of instructions that work as a unit; equivalent to the subprogram in BASIC.

processor: The hardware component of a computer that performs the actual computation by directly executing instructions represented in machine language and stored in main memory.

ProDOS: An Apple II operating system designed to support mass storage devices like the ProFile as well as flexible disk storage devices. ProDOS stands for *Professional Disk Operating System*.

ProDOS command: Any one of the 28 commands recognized by ProDOS. Each has its own syntax, all can be used within programs, and all but five (text file commands) can be used from immediate mode.

program: *n.* A set of instructions describing actions for a computer to perform in order to accomplish some task, conforming to the rules and conventions of a particular programming language. In Applesoft, a sequence of program lines, each with a different line number. *v.* To write a program.

programmer: The author of a program; one who writes programs.

programming: The activity of writing programs.

programming language: A set of rules or conventions for writing programs.

prompt: *n.* A message on the screen. *v.* To remind or signal the user that some action is expected, typically by displaying a distinctive symbol, a reminder message, or a menu of choices on the display screen.

prompt character: A text character displayed on the screen to prompt the user for some action. Often also identifies the program or component of the system that is doing the prompting; for example, the prompt character] is used by the Applesoft BASIC interpreter, > by Integer BASIC, and * by the system Monitor program. Also called *prompting* character.

prompt line: A message displayed on the screen to prompt the user for some action. Also called *prompting message*.

protocol: A set of rules for sending and receiving data on a communications line.

push: To add an entry to the top of a stack.

queue: A list in which entries are added at one end and removed at the other, causing entries to be removed in FIFO (first-in first-out) order. Compare **stack**.

radio-frequency modulator: A device that transforms your television set into a computer display device.

RAM: See **random-access memory**.

random-access memory (RAM): Memory in which the contents of individual locations can be referred to in an arbitrary or random order; the readable and writable memory of the Apple IIe. Its contents are usually filled with programs from a disk, and they are lost when the Apple IIe is turned off. This term is often used misleadingly to refer to read-write memory, but, strictly speaking, both read-only and read-write memory can be accessed in random order. Random-access means that each unit of storage has a unique address and a method by which each unit can be immediately read from or written to. Compare **read-only memory**, **read-write memory**.

random-access text file: A text file that is partitioned into an unlimited number of uniform-length compartments called records. When you open a random-access text file for the first time, you must specify its record length. No record is placed in the file until written to. Each record can be individually read from or written to—hence, *random-access*.

raster: The pattern of parallel lines making up the image on a video display screen. The image is produced by controlling the brightness of successive dots on the individual lines of the raster.

read: To transfer information into the computer's memory from a source external to the computer (such as a disk drive or modem) or into the computer's processor from a source external to the processor (such as the keyboard or main memory).

read-only memory (ROM): Memory whose contents can be read but not written; used for storing firmware. Information is written into read-only memory once, during manufacture; it then remains there permanently, even when the computer's power is turned off, and

can never be erased or changed.
Compare **random-access
memory**, **read-write memory**.

read-write memory: Memory
whose contents can be both read
and written; often misleadingly
called random-access memory, or
RAM. The information contained in
read-write memory is erased when
the computer's power is turned off,
and is permanently lost unless it
has been saved on a more
permanent storage medium, such as
a disk. Compare **random-access
memory**, **read-only memory**.

real number: A number that may
include a fractional part;
represented inside the computer in
floating-point form. Compare
integer.

register: A location in a computer
processor where an item of
information is held and modified
under program control.

relational operator: An operator,
such as >, that compares numeric
values to produce a logical result.
Compare **arithmetic operator**,
logical operator.

reserved word: A word or
sequence of characters reserved by
a programming language for some
special use, and therefore
unavailable as a variable name in a
program.

resident: See **memory-resident**,
disk-resident.

return address: The point in a
program to which control returns on
completion of a subroutine or
function.

RF modulator: See
radio-frequency modulator.

ROM: See **read-only memory**.

routine: A part of a program that
accomplishes some task subordinate
to the overall task of the program.

row: A horizontal arrangement of
character spaces or graphics points
on the screen.

RS232 cable: Any cable that is
wired in accordance with the RS232
standard, which is the common data
communications interface standard.

run: (1) To execute a program.
(2) To load a program into main
memory from a peripheral storage
medium, such as a disk, and
execute it.

save: To transfer information from
main memory to a peripheral
storage medium for later use.

scroll: To change the contents of
all or part of the display screen by
shifting information out at one end
(most often the top) to make room
for new information appearing at
the other end (most often the
bottom), producing an effect like
that of moving a scroll of paper past
a fixed viewing window. See
window.

serial interface: An interface in
which information is transmitted
sequentially, one bit at a time, over
a single wire or channel. Compare
parallel interface.

setup time: The amount of time a
signal must be valid in advance of
some event. Compare **hold time**.

silicon: A non-metallic,
semiconducting chemical element
from which integrated circuits are
made. Not to be confused with
silica—that is, silicon dioxide, such
as quartz, opal, or sand—or with
silicone, any of a group of organic
compounds containing silicon.

simple variable: A variable that is not an element of an array.

simplified keyboard: The Dvorak keyboard.

6502: The type of microprocessor used in the Apple II, II Plus, and original IIe.

65C02: The type of microprocessor used in the enchanced Apple IIe and the Apple IIc.

slot: A narrow socket inside the computer where you can install peripheral device cards.

soft switch: A means of changing some feature of the computer from within a program; specifically, a location in memory that produces some special effect whenever its contents are read or written.

software: Instructions that tell the computer what to do. They're usually stored on disks. Compare **hardware**, **firmware**.

source program: The original form of a program given to a language translator such as a compiler or assembler for conversion into another form; sometimes called *source code*. Compare **object program**.

space character: A text character whose printed representation is a blank space, typed by pressing the SPACE bar.

stack: A list in which entries are added or removed at one end only (the top of the stack), causing them to be removed in LIFO (last-in first-out) order. Compare **queue**.

standard instruction: An instruction automatically present when no superseding instruction has been received.

start up: To get the system running. For example, In the context of ProDOS, starting up is the process of reading the ProDOS program (in the files PRODOS and BASIC.SYSTEM) from the disk, and running it.

starting value: The value assigned to the index variable on the first pass through a loop.

startup disk: A disk containing an operating system and a self-starting program.

statement: A unit of a program in a high-level language that specifies an action for the computer to perform, typically corresponding to several instructions of machine language.

step value: The amount by which the index variable changes on each pass through a loop.

string: An item of information consisting of a sequence of text characters.

strobe: A signal whose change is used to trigger some action.

subroutine: A part of a program that can be executed on request from any point in the program, and which returns control to the point of the request on completion.

synchronous transmission: A transmission process that requires an integral number of unit (time) intervals between any two significant instances. In synchronous communications, the transmitter and receiver are in step with each other, and characters being transmitted follow one after the other at regular intervals. Compare **asynchronous transmission**.

syntax: The rules governing the structure of statements or instructions in a programming language; a representation of a command that specifies all the possible forms the command can take.

system: A coordinated collection of interrelated and interacting parts organized to perform some function or achieve some purpose.

system configuration: See **configuration**.

system program: A program that makes the resources and capabilities of the computer available for general purposes, such as an operating system or a language translator. Compare **application program**.

system software: The component of a computer system consisting of system programs.

TAB: An ASCII character that commands a device such as a printer to start printing at a preset location (called a tab stop). There are two such characters;: horizontal tab (hex $09) and vertical tab (hex $0B).

television set: A display device capable of receiving broadcast video signals (such as commercial television) by means of an antenna. Can be used in combination with a radio-frequency modulator as a display device for the Apple IIe. Compare **video monitor**.

terminal: A device consisting of a typewriter-like keyboard and a display device, used for communicating between a computer system and a human user. Personal computers such as those in the Apple II family of computers typically have all or part of a terminal built into them.

text: (1) Information presented in the form of characters readable by humans. (2) The display of characters on a display screen. Compare **graphics**.

text window: An area on the video display screen within which text is displayed and scrolled.

traces: Electrical roads that connect the components on a circuit board.

transistor-transistor logic (TTL): (1) A type of integrated circuit used in computers and related devices. (2) A standard for interconnecting such circuits that defines the voltages used to represent logical zeros and ones.

troubleshoot: To locate and correct the cause of a problem or malfunction in a computer system. Typically used to refer to hardware-related problems. Compare **debug**.

TTL: See **transistor-transistor logic**.

turnkey disk: A disk that executes a specific application program when you use that disk to start the computer.

turnkey program: A program, such as a game or application, that runs automatically when the disk that the program is on is used to start up the computer.

unary operator: An operator that applies to a single operand; for example, the minus sign (-) in a negative number such as -6 is a unary arithmetic operator. Compare **binary operator**.

unconditional branch: A branch that does not depend on the truth of any condition. Compare **conditional branch**.

value: An item of information that can be stored in a variable, such as a number or a string.

variable: (1) A location in the computer's memory where a value can be stored. (2) The symbol used in a program to represent such a location. Compare **constant**.

vector: (1) The starting address of a program segment, when used as a common point for transferring control from other programs. (2) A memory location used to hold a vector, or the address of such a location.

video: (1) A medium for transmitting information in the form of images to be displayed on the screen of a cathode-ray tube. (2) Information organized or transmitted in video form.

video monitor: A display device capable of receiving video signals by direct connection only, and which cannot receive broadcast signals such as commercial television. Can be connected directly to the computer as a display device. Compare **television receiver**.

volume: A general term referring to a storage device; a source or destination of information. A volume has a name and a volume directory with the same name. Its information is organized into files.

window: The portion of a collection of information (such as a document, picture, or worksheet) that is visible on the display screen.

word: A group of bits of a fixed size that is treated as a unit; the number of bits in a word is a characteristic of each particular computer.

write: To transfer information from the computer to a destination external to the computer (such as a disk drive, printer, or modem) or from the computer's processor to a destination external to the processor (such as main memory).

write-enable notch: The square cutout on one edge of a disk's jacket that permits information to be written on the disk. If there is no write-enable notch, or if it is covered with a write-protect tab, information can be read from the disk but not written onto it.

write-protect: To protect the information on a disk by covering the write-enable notch with a write-protect tab, preventing any new information from being written onto the disk. Compare **copy protect**.

write-protect tab: A small adhesive sticker used to write-protect a disk by covering the write-enable notch.

X register: One of the index registers in the 65C02 microprocessor.

Y register: One of the index registers in the 65C02 microprocessor.

zero page: The first page (256 bytes) of memory in the Apple IIe, also called page zero. Since the high-order byte of any address in this page is zero, only the low-order byte is needed to specify a zero-page address; this makes zero-page locations more efficient to address, in both time and space, than locations in any other page of memory.

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The Official Publication from Apple Computer, Inc.

Written and produced by the people at Apple Computer, this is the definitive, up-to-date reference manual for the Apple IIe computer. It was written for professional programmers, designers of peripheral equipment, and more advanced home users, and it describes—as completely as possible in one volume—the internal operation of the original and enhanced Apple IIe.

This manual provides detailed descriptions of all the IIe's hardware and firmware, including input/output features (such as mousetext), memory organization, and the use of the Monitor firmware. Appendices offer complete reference information to the 6502 and 65C02 instruction sets and built-in I/O subroutines, a complete source listing of the Monitor firmware, and more. Anyone who needs technical information on the internal workings of the original or enhanced Apple IIe will find this book an indispensable guide to one of the world's most popular computers.

The *Apple IIe Technical Reference Manual* was written and produced by the Apple II User Education Group.