Appendix and Glossary

absolute address: 1. An address that is permanently assigned by the machine designer to a storage location. 2. A pattern of characters that identifies a unique storage location without further modification. 3. Synonymous with machine address, specific address.

access time: The time interval between the request for information and the instant this information is available.

accumulator: A device which stores a number and which, on receipt of another number, adds the two and stores the sum.

address: An expression, usually numerical, which designates a specific location in a storage or memory device.

address format: 1. The arrangement of the address parts of an instruction. The expression "plus-one" is frequently used to indicate that one of the addresses specifies the location of the next instruction to be executed, such as one-plus-one, two-plus-one, three-plus-one, four-plus-one. 2. The arrangement of the parts of a single address, such as those required for identifying channel, module, track, etc., in a disc system.

address register: A register in which an address is stored.

ALGOL: ALGOrithmic Language. A language primarily used to express computer programs by algorithms.

algorithm: A term used by mathematicians to describe a set of procedures by which a given result is obtained.

alphanumeric: Pertaining to a character set that contains letters, digits, and usually other characters such as punctuation marks.

ALU: Arithmetic Logic Unit, a computational subsystem which performs the mathematical operations of a digital system.

analog: Electric analog information is information represented by a variable property of electricity, such as voltage, current, amplitude of waves or pulses, or frequency of waves or pulses. Analog circuitry, also called "linear" circuitry, is circuitry that varies certain properties of electricity continuously and smoothly over a certain range, rather than switching suddenly between certain levels.

AND: A logic operator having the property that if P is a statement, Q is a statement, R is a statement . . . , then the AND of P, Q, R . . . is true if all statements are true, false if any statement is false. P AND Q is often represented by P•Q or PQ. Synonymous with logical multiply.

arithmetic shift: 1. A shift that does not affect the sign position. 2. A shift that is equivalent to the multiplication of a number by a positive or negative integral power of the radix.

ASCII: (American National Standard Code for Information Interchange, 1968) The standard code, using a coded character set consisting of 7-bit coded characters (8 bits including parity check), used for information interchange among data processing systems, communication systems, and associated equipment. The ASCII set consists of control characters and graphic characters. Synonymous with USASCII.

assemble: To prepare a machine language program from a symbolic language program by substituting absolute operation codes for symbolic operation codes and absolute or relocatable addresses for symbolic addresses.

assembler: A computer program that assembles.

asynchronous device: A device in which the speed of operation is not related to any frequency in th system to which it is connected.

base: 1. a reference value. 2. A number that is multiplied by itself as many times as indicated by an exponent. 3. Same as radix.

base address: A given address from which an absolute address is derived by combination with a relative address.

baud: A unit of signaling speed equal to the number of discrete conditions or signal events per second. For example, one baud equals one-half dot cycle per second in Morse code, one bit per second in a train of binary signals, and one 3-bit value per second in a train of signals each of which can assume one of eight different states.

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BCD: Binary coded decimal notation.

benchmark problem: A problem used to evaluate the performance of hardware or software or both.

binary: 1. Pertaining to a characteristic or property involving a selection, choice, or condition in which there are two possibilities. 2. Pertaining to the number representation system with a radix of two.

binary coded decimal (BCD): A binary numbering system for coding decimal numbers in groups of 4 bits. The binary value of these 4-bit groups ranges from 0000 to 1001, and codes the decimal digits "0" through "9". To count to 9 takes 4 bits; to count to 99 takes two groups of 4 bits; to count to 999 takes three groups of 4 bits, etc.

block diagram: A diagram of a system, instrument, or computer in which the principal parts are represented by suitable associated geometrical figures to show both the basic functions and the functional relationships among the parts.

block transfer: The process of transmitting one or more blocks of data where the data are organized in such blocks.

bootstrap: A technique or device designed to bring itself into a desired state by means of its own action, e.g., a machine routine whose first few instructions are sufficient to bring the rest of itself into the computer from an input device.

borrow: An arithmetically negative carry.

branch: 1. A set of instructions that is executed between two successive decision instructions. 2. To select a branch as in definition 1. 3. A direct path joining two nodes of a network or graph. 4. Loosely, a conditional jump.

branching: A method of selecting, on the basis of results, the next operation to execute while the program is in progress.

breakpoint: A place in a routine specified by an instruction, instruction digit, or other condition, where the routine may be interrupted by external intervention or by a monitor routine.

buffer: An isolating circuit used to avoid reaction of a driven circuit on the corresponding driver circuit. Also, a storage device used to compensate for a difference in the rate of flow of information or the time of occurrence of events when transmitting information from one device to another.

bus: One or more conductors used for transmitting signals or power.

byte: A sequence of adjacent binary digits operated upon as a unit and usually shorter than a computer word. Usually 8 bits.

carry: One or more digits, produced in connection with an arithmetic operation on one digit place of two or more numerals in positional notation, that are forwarded to another digit place for processing there.

CCD: Charge-coupled device. A means for very dense serial-access storage of bits as tiny packets of electric charge moving along the surface of a semiconductor chip.

central processor unit (CPU): Part of a computer system which contains the main storage, arithmetic unit, and special register groups. It performs arithmetic operations, controls instruction processing, and provides timing signals and other housekeeping operations.

character: A letter, digit, or other symbol that is used as part of the organization, control, or representation of data. A character is often in the form of a spatial arrangement of adjacent or connected strokes.

character check: A check that verifies the observance of rules for the formation of characters.

check bit: A binary check digit, e.g., a parity bit.

check digit: A digit used for purpose of performing a check.

checkpoint: A place in a routine where a check or a recording of data for restart purposes, is performed.

chip-enable input: A control input that when active permits operation of the integrated circuit for input, internal transfer, manipulation, refreshing, and/or output of data and when inactive causes the integrated circuit to be in a reduced-power standby mode.

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circulating register: A shift register in which data moved out of one end of the register are reentered into the other end as in a closed loop.

clock: 1. A device that generates periodic signals used for synchronization. 2. A register whose content changes at regular intervals in such a way as to measure time.

COBOL: (Common Business Oriented Language) A business data processing language.

code: 1. A set of unambiguous rules specifying the way in which data may be represented, e.g., the set of correspondences in the standard code for information interchange. Synonymous with coding scheme. 2. In telecommunications, a system of rules and conventions according to which the signals representing data can be formed, transmitted, received, and processed. 3. In data processing, to represent data or a computer program in a symbolic form that can be accepted by a data processor.

communication link: The physical means of connecting one location to another for the purpose of transmitting and receiving data.

compile: To prepare a machine language program from a computer program written in another programming language by making use of the overall logic structure of the program, or generating more than one machine instruction for each symbolic statement, or both, as well as performing the function of an assembler.

compiler: A program that compiles.

complement: A number that can be derived from a specified number by subtracting it from a second specified number. For example, in radix notation, the second specified number may be a given power of the radix or one less than a given power of the radix. The negative of a number is often represented by its complement.

computer: A data processor that can perform substantial computation, including numerous arithmetic or logic operations, without intervention by a human operator during the run.

conditional jump: A jump that occurs if specified criteria are met.

controller: Digital subsystem responsible for implementing "how" a system is to function. Not to be confused with "timing" as timing tells the system "when" to perform its function.

counter: A circuit which counts input pulses and will give an output pulse after receiving a predetermined number of input pulses.

CRU: Communications Register Unit: a command-driven bit addressable I/O interface. The processor instruction can set, reset, or test any bit in the CRU array or move data between the memory and CRU data fields.

cycle: 1. An interval of space or time in which one set of events or phenomena is completed. 2. Any set of operations that is repeated regularly in the same sequence. The operations may be subject to variations on each repetition.

data: 1. A representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or automatic means. 2. Any representations such as characters or analog quantities to which meaning is or might be assigned.

data bus: One method of input-output for a system where data are moved into or out of the digital system by way of a common bus connected to several subsystems.

data processing: The execution of a systematic sequence of operations performed upon data. Synonymous with information processing.

data selector: A combinational building-block that routes data from one of several inputs to a single output, according to control signals. Also called "multiplexer." Two or more such one-bit selectors operating in parallel would be called a "two-bit data selector," etc.

debug: To detect, locate, and remove mistakes from a routine or malfunctions from a computer. Synonymous with troubleshoot.

decimal: 1. Pertaining to a characteristic or property involving a selection, choice, or condition in which there are ten possibilities. 2. Pertaining to the number representation system with a radix of ten.

decimal digit: In decimal notation, one of the characters 0 through 9.

decoder: A conversion circuit that accepts digital input information — in the memory case, binary address information — that appears as a small number of lines and selects and activates one line of a large number of output lines.

digital: 1. Pertaining to data in the form of digits. 2. Contrast with analog. 3. Information in discrete or quantized form; not continuous.

direct access: Pertaining to the process of obtaining data from, or placing data into, storage where the time required for such access is independent of the location of the data most recently obtained or placed in storage.

direct addressing: Method of programming that has the address pointing to the location of data or the instruction that is to be used.

direct memory access channel (DMA): A method of input-output for a system that uses a small processor whose sole task is that of controlling input-output. With DMA, data are moved into or out of the system without program intervention.

double precision: Pertaining to the use of two computer words to represent a number

dump: 1. To copy the contents of all or part of a storage, usually from an internal storage into an external storage. 2. A process as in definition 1 above. 3. The data resulting from the process as in definition 1 above.

duplex: In communications, pertaining to a simultaneous two-way independent transmission in both directions. Contrast with half duplex. Synonymous with full duplex.

edge triggering: Activation of a circuit at the edge of the pulse as it begins its change. Circuits then trigger at the edge of the input pulse rather than sensing a level change.

edit: To modify the form or format of data, e.g., to insert or delete characters such as page numbers or decimal points.

effective address: The address that is derived by applying any specified indexing or indirect addressing results to the specified address and that is actually used to identify the current operand.

emulate: To imitate one system with another such that the imitating system accepts the same data, executes the same programs, and achieves the same results as the imitated system.

encode: To apply a set of unambiguous rules specifying the way in which data may be represented such that a subsequent decoding is possible. Synonymous with code.

entry point: In a routine, any place to which control can be passed.

EPROM: Eraseable and programmable read-only memory. An IC memory chip whose stored data can be read at random. The data can be erased and new data can be stored, but only by a special system other than the one in which the memory is used.

erase: To obliterate information from a storage medium, e.g., to clear, to overwrite.

error: Any discrepancy between a computed, observed, or measured quantity and the true, specified, or theoretically correct value or condition.

exclusive-OR function: A modified form of the OR function which has a logic equation equal to the sum output of the half-adder.

execute: That portion of a computer cycle during which a selected control word or instruction is accomplished.

exponent: In a floating-point representation, the numeral, of a pair of numerals representing a number, that indicates the power to which the base is raised.

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family: A family of digital integrated circuits is a group of ICs that use the same general design style for all gates, and processed during manufacture in much the same way, and whose input and output signals are all "compatible" with one another so that one can transmit to another.

fetch: That portion of a computer cycle during which the next instruction is retrieved from memory.

field: In a record, a specified area used for a particular category of data, e.g., a group of card columns used to represent a wage rate, a set of bit locations in a computer word used to express the address of the operand.

first-in first-out (FIFO) memory: A memory from which data bytes or words can be read in the same order, but not necessarily at the same rate, as that of the data entry.

fixed-point representation: A positional representation in which each number is represented by a single set of digits, the position of the radix point being fixed with respect to one end of the set, according to some convention.

flag: 1. Any of various types of indicators used for identification, e.g., a wordmark. 2. A character that signals the occurrence of some condition, such as the end of a word. 3. Synonymous with mark, sentinel, tag.

flip-flop (storage element): A circuit having two stable states and the capability of changing from one state to another with the application of a control signal and remaining in that state after removal of signals.

flow chart: A graphical representation for definition, analysis, or solution of a problem, in which symbols are used to represent operations, data, flow, equipment, etc.

format: The arrangement of data.

FORTRAN: (FORmula TRANslating system) A language primarily used to express computer programs by arithmetic formulas.

function: 1. A specific purpose of an entity, or its characteristic action. 2. In communications, a machine action such as a carriage return or line feed.

gate: 1. A device having one output channel and one or more input channels, such that the output channel state is completely determined by the input channel states, except during switching transients. 2. A combinational logic element having at least one input channel. 3. An AND gate. 4. An OR gate.

general-purpose computer: A computer that is designed to handle a wide variety of problems.

generate: To produce a program by selection of subsets from a set of skeletal coding under the control of parameters.

half duplex: In communications, pertaining to an alternate, one way at a time, independent transmission. Contrast with duplex.

hardware: Physical equipment, as opposed to the computer program or method of use, e.g., mechanical, magnetic, electrical, or electronic devices.

hold time: Hold time, t_h. The interval during which a signal is retained at a specified input terminal after an active transition occurs at another specified input terminal.

immediate address: Pertaining to an instruction in which an address part contains the value of an operand rather than its address. Synonymous with zero-level address.

indexed address: An address that is modified by the content of an index register prior to or during the execution of a computer instruction.

indexing: In computers, a method of address modification that is implemented by means of index registers.

index register: A register whose content may be added to or subtracted from the operand address prior to or during the execution of a computer instruction.

indirect addressing: Programming method that has the initial address being the storage location of a word that contains another address. This indirect address is then used to obtain the data to be operated upon.

input/output devices (I/O): Computer hardware by which data is entered into a digital system or by which data are recorded for immediate or future use.

instruction: A statement that specifies an operation and the values or locations of its operands.

instruction cycle: The period of time during which a programmed system obeys a particular instruction.

instruction register: A register that stores an instruction for execution.

interface: A shared boundary. An interface might be a hardware component to link two devices or it might be a portion of storage or registers accessed by two or more computer programs.

interrupt: To stop a process in such a way that it can be resumed.

jump: A departure from the normal sequence of executing instructions in a computer.

jump conditions: Conditions defined in a transition table that determine the changes of flip-flops from one state to another state.

label: One or more characters used to identify a statement or an item of data in a computer program.

language: A set of representations, conventions, and rules used to convey information.

large scale integration (LSI): The simultaneous realization of large area chips and optimum component packing density, resulting in cost reduction by maximizing the number of system connections done at the chip level. Circuit complexity above 100 gates.

level: The degree of subordination in a hierarchy.

linkage: In programming, coding that connects two separately coded routines.

load: In programming, to enter data into storage or working registers.

location: Any place in which data may be stored.

logic diagram: A diagram that represents a logic design and sometimes the hardware implementation.

logic shift: A shift that affects all positions.

logic symbol: 1. A symbol used to represent a logic element graphically. 2. A symbol used to represent a logic operator.

loop: A sequence of instructions that is executed repeatedly until a terminal condition prevails.

LSB: Least significant bit.

machine code: An operation code that a machine is designed to recognize. Usually expressed in ones and zeros.

macroinstruction: An instruction in a source language that is equivalent to a specified sequence of machine instructions.

macroprogramming: Programming with macroinstructions.

magnetic bubble: A tiny moveable magnetized region formed under certain conditions in a thin film of magnetic garnet crystal fabricated similar to an IC. Such bubbles provide very dense serial-access storage of bits.

magnetic drum: A right circular cylinder with a magnetic surface on which data can be stored by selective magnetization of portions of the curved surface.

main storage: The general-purpose storage of a computer. Usually, main storage can be accessed directly by the operating registers. Contrast with auxiliary storage.

mask: 1. A pattern of characters that is used to control the retention or elimination of portions of another pattern of characters. 2. A filter.

microprocessor: An IC (or set of a few ICs) that can be programmed with stored instructions to perform a wide variety of functions, consisting at least of a controller, some registers, and some sort of ALU (that is, the basic parts of a simple CPU.)

mnemonic symbol: A symbol chosen to assist the human memory, e.g., an abbreviation such as "mpy" for "multiply".

modem: (MOdulator — DEModulator) A device that modulates and demodulates signals transmitted over communication facilities.

MSB: Most significant bit.

multiplex: To interleave or simultaneously transmit two or more messages on a single channel.

multiprocessing: 1. Pertaining to the simultaneous execution of two or more computer programs or sequences of instructions by a computer or computer network. 2. Loosely, parallel processing.

multiprocessor: A computer employing two or more processing units under integrated control.

multiprogramming: Pertaining to the concurrent execution of two or more programs by a computer.

MUX: Multiplexer.

NAND: A logic operator having the property that if P is a statement, Q is a statement, R is a statement, . . . , then the NAND of P, Q, R, . . . is true if at least one statement is false, false if all statements are true. Synonymous with NOT-AND, Sheffer stroke.

nest: To imbed subroutines or data in other subroutines or data at a different hierarchical level such that the different levels of routines or data can be executed or accessed recursively.

noise: Any signal that isn't supposed to be there. Electrical noise may be caused by small, irregular sparks when a switch is opened or closed. Or it may be caused by radio waves or by electric or magnetic fields generated by one wire and picked up by another.

NOR: A logic operator having the property that if P is a statement, Q is a statement, R is a statement, . . . , then the NOR of P, Q, R, . . . is true if all statements are false, false if at least one statement is true. P NOR Q is often represented by a combination of "OR" and "NOT" symbols, such as (P + Q). P NOR Q is also called "neither P nor Q". Synonymous with NOT-or.

NOT: A logic operator having the property that if P is a statement, then the NOT of P is true if P is false, false if P is true. The NOT of P is often represented by P.

object code: Output from a compiler or assembler which is itself executable machine code or is suitable for processing to produce executable machine code.

object language: The language to which a statement is translated.

operand: That which is operated upon. An operand is usually identified by an address part of an instruction.

operating system: Software which controls the execution of computer programs and which may provide scheduling, debugging, input/output control, accounting, compilation, storage assignment, data management, and related services.

operation: 1. A defined action, namely, the act of obtaining a result from one or more operands in accordance with a rule that completely specifies the result for any permissible combination of operands. 2. The set of such acts specified by such a rule, or the rule itself. 3. The act specified by a single computer instruction. 4. A program step undertaken or executed by a computer, e.g., addition, multiplication, extraction, comparison, shift, transfer. The operation is usually specified by the operator part of an instruction. 5. The specific action performed by a logic element.

pack: To compress data in a storage medium by taking advantage of known characteristics of the data, in such a way that the original data can be recovered, e.g., to compress data in a storage medium by making use of bit or byte locations that would otherwise go unused.

parallel operation: The organization of data manipulating within circuitry wherein all the digits of a word are transmitted simultaneously or separate lines in order to speed up operation.

parity check: A check that tests whether the number of ones (or zeros) in an array of binary digits is odd or even. Synonymous with odd-even check.
PC: Program counter.

peripheral equipment: Units which work in conjunction with a computer but are not part of it.

phase: The time interval for each clock "cycle" in a system may be divided into two or more "phases". The phases are defined by pulses in a separate network of wires for each phase. During a particular phase, the signal in that clock network is in the state defined as "active". The clock cycles are repeated over and over again, phase by phase. The phases provide a method of making several things happen in the proper order during one clock cycle.

PLA (programmable logic array): An integrated circuit that employs ROM matrices to combine sum and product terms of logic networks.

positive logic: Logic in which the more-positive voltage represents the "1" state; the less positive voltage represents the "0" state.

priority interrupt: Designation given to method of providing some commands to have precedence over others thus giving one condition of operation priority over another.

problem oriented language: A programming language designed for the convenient expression of a given class of problems.

processor: 1. In hardware, a data processor. 2. In software, a computer program that includes the compiling, assembling, translating, and related functions for a specific programming language, COBOL processor, or FORTRAN processor.

program: 1. A series of actions proposed in order to achieve a certain result. 2. Loosely, a routine. 3. To design, write, and test a program as in definition 1 above. 4. Loosely, to write a routine.

programmable read only memory (PROM): A fixed program, read only, semiconductor memory storage element that can be programmed after packaging.

PROM: Programmable read only memory.

propagation delay: The time required for a change in logic level to be transmitted through an element or a chain of elements.

pulse width: Pulse width, t_w The time interval between specified reference points on the leading and trailing edges of the pulse waveform.

pushdown list: A list that is constructed and maintained so that the item to be retrieved is the most recently stored item in the list, i.e., last in, first out.

pushdown stack: A set of registers which implement a pushdown list.

RAM: Random access memory.

random access memory (RAM): A memory from which all information can be obtained at the output with approximately the same time delay by choosing an address randomly and without first searching through a vast amount of irrelevant data.

read only memory (ROM) A fixed program semiconductor storage element that has been preprogrammed at the factory with a permanent program.

real time: 1. Pertaining to the actual time during which a physical process transpires. 2. Pertaining to the performance of a computation during the actual time that the related physical process transpires, in order that results of the computation can be used in guiding the physical process.

recovery time: Sense Recovery time, t_{SR} The time interval needed to switch a memory from a write mode to a read mode and to obtain valid data signals at the output.

refresh: Method which restores charge on capacitance which deteriorates because of leakage.

register: Temporary storage for digital data.

Relative address: The number that specifies the difference between the absolute address and the base address.

relocate: In computer programming, to move a routine from one portion of storage to another and to adjust the necessary address references so that the routine, in its new location, can be executed.

ROM: Read only memory.

routine: An ordered set of instructions that may have some general or frequent use.

sequencing: Control method used to cause a set of steps to occur in a particular order.

sequential logic systems: Digital system utilizing memory elements.

serial: 1. Pertaining to the sequential or consecutive occurrence of two or more related activities in a single device or channel. 2. Pertaining to the sequencing of two or more processes. 3. Pertaining to the sequential processing of the individual parts of a whole such as the bits of a character or the characters of a word, using the same facilities of successive parts. 4. Contrast with parallel.

serial operation: The organization of data manipulation within circuitry wherein the digits of a word are transmitted one at a time along a single line. The serial mode of operation is slower than parallel operation, but utilizes less complex circuitry.

set-up time: The minimum amount of time that data must be present at an input to ensure data acceptance when the device is clocked.

shift: A movement of data to the right or left.

shift register: A register in which the stored data can be moved to the right or left.

sign-and magnitude notation: A system of notation where binary numbers are represented by a sign-bit and one or more number bits:

significant digit: A digit that is needed for a certain purpose, particularly one that must be kept to preserve a specific accuracy or presicion.

sign position: A position, normally located at one end of a number, that contains an indication of the algebraic sign of the number.

simulate: 1. To represent certain features of the behavior of a physical or abstract system by the behavior of another system. 2. To represent the functioning of a device, system, computer program by another, e.g., to represent the functioning of one computer by another, to represent the behavior of a physical system by the execution of a computer program, to represent a biological system by a mathematical model.

simulator: A device, system, or computer program that represents certain features of the behavior of a physical or abstract system.

software: A set of computer programs, procedures, and possibly associated documentation concerned with the operation of a data processing system, e.g., compilers, library routines, manuals, circuit diagrams.

source language: The language from which a statement is translated.

source program: A computer program written in a source language.

state: The condition of an input or output of a circuit as to whether it is a logic "1" or a logic "0". The state of a circuit (gate or flip-flop) refers to its output. A flip-flop is said to he in the "1" state when its Q output is "1". A gate is in the "1" state when its output is "1".

static storage elements: Storage elements which contain storage cells that retain their information as long as power is applied unless the information is altered by external excitation.

stored program: A set of instructions in memory specifying the operations to be performed.

stored program computer: A computer controlled by internally stored instructions that can synthesize, store, and in some cases alter instruction as though they were data and that can subsequently execute these instructions.

subroutine: A routine that can be part of another routine.

synchronous: Refers to two or more things made to happen in a system at the same time, by means of a common clock signal.

temporary storage: In programming, storage locations reserved for intermediate results. Synonymous with working storage.

terminal: A point in a system or communication network at which data can either enter or leave.

transmit: To send data from one location and to receive the data at another location. Synonymous with transfer definition 2, move.

TTL: Bipolar semiconductor transistor-transistor coupled logic circuits.

USASCII: United States of America Standard Code for Information Interchange. The standard code used by the United State for transmission of data. Sometimes simply referred to as the "as'ki" code.

variable: A quantity that can assume any of a given set of values.

volatile storage: A storage device in which stored data are lost when the applied power is removed.

word: A character string or a bit string considered as an entity

working storage: Same as temporary storage.

WR: Working register.

workspace: In the 9900, a set of 16 consecutive words of memory referred to by many of the instructions.

write: To record data in a storage device or a data medium. The recording need not be permanent, such as the writing on a cathode ray tube display device.