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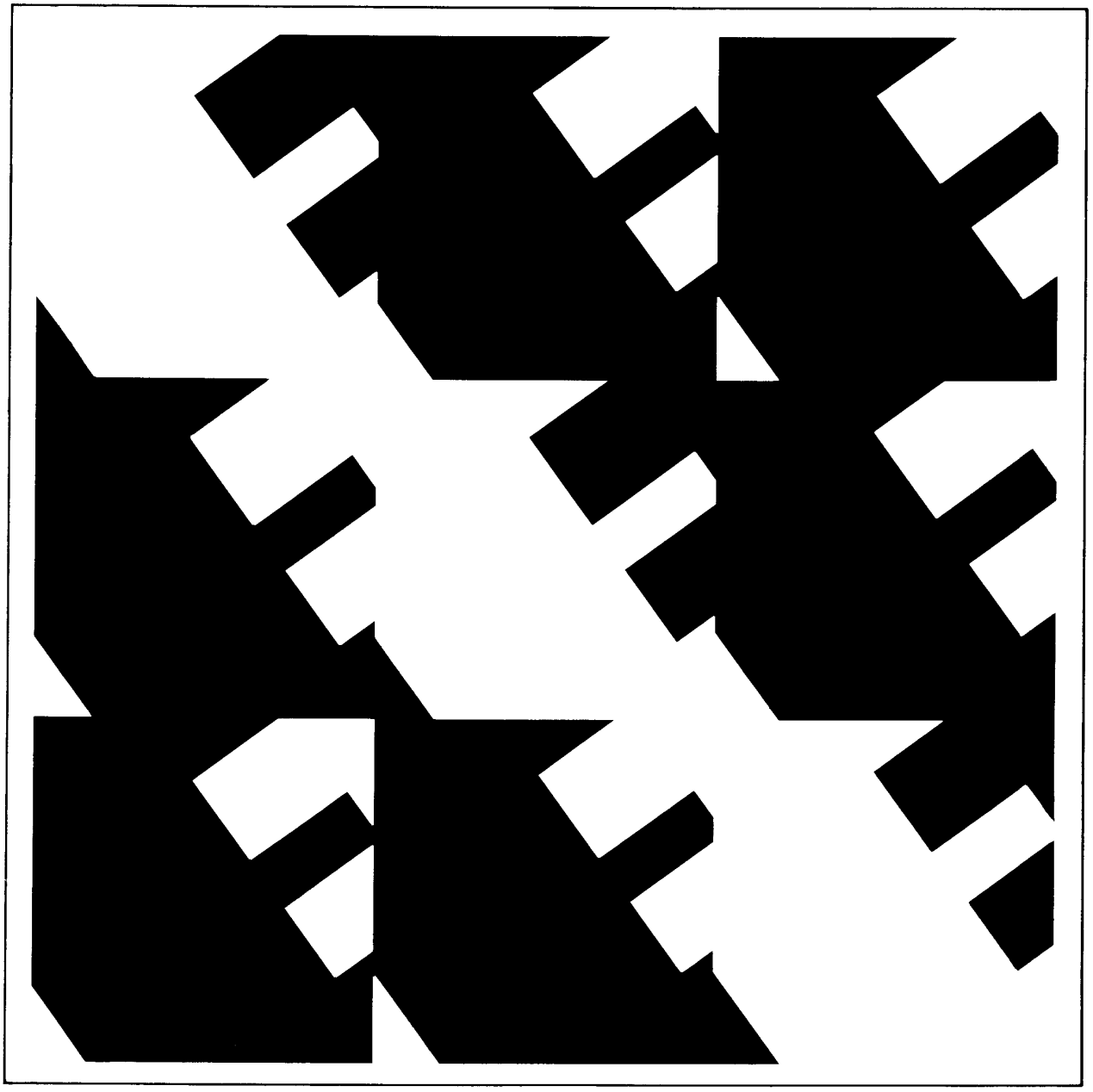
# IEEE Standard Definitions of Terms for Electronic Digital Computers



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## INTRODUCTORY NOTES

Analog terms have been kept to a minimum because they are included in a different IEEE Standard.

Programming terms have been kept to a minimum because they are not primarily engineering terms and are included in Standards prepared by other professional societies.

Multi-word terms are defined under the first word and cross-referenced by *italics* in an entry under the last word.

**Boldface** is used for alphabetic entries.

*Italics* are used to show that the *italicized* term is defined elsewhere in the list of definitions.


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This publication was prepared by the Digital Computer Definitions Subcommittee of the Electronic Computers Committee. The Subcommittee is composed of:

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# *DEFINITIONS OF TERMS*

## *for*

# ELECTRONIC DIGITAL COMPUTERS

**access time.** A time interval that is characteristic of a storage device, and is essentially a measure of the time required to communicate with that device. Many definitions of the beginning and ending of this interval are in common use.

**accumulator.** 1) A device that retains a number (the augend) adds to it another number (the addend) and replaces the augend with the sum.

2) Sometimes only the part of (1) that retains the sum.

**accuracy.** The degree of freedom from error, that is, the degree of conformity to truth or to a rule. Accuracy is contrasted with *precision;* e.g., four-place numbers are less precise than six-place numbers; nevertheless a properly computed four-place number might be more accurate than an improperly computed six-place number.

**adder.** A device whose output is a representation of the sum of the quantities represented by the inputs.

See *half-adder.*

**address.** An expression, usually numerical, that designates a particular location in a *storage* or memory device or other source or destination of data. See also *instruction, address part.*

See *four-address, multiple-address, one-address, one-plus-one-address, single-address, three-address, three-plus-one-address, triple-address, two-address, two-plus-one-address.*

**address part.** A part of an *instruction* that usually is an *address,* but that may be used in some instructions for another purpose.

**AND gate.** A *combinational logic element* such that the output channel is in its "one "state if and only if each input channel is in its "one" state.

**associative storage.** A storage device in which storage locations may be identified by specifying part or all of their contents. Also called parallel-search storage or content-addressed storage.

**automatic check.** A *check* performed by equipment built into the computer specifically for that purpose, and automatically accomplished each time the pertinent operation is performed. Sometimes referred to as a built-in check.

**band (in Electronic Computers).** A group of *tracks* on a moving storage medium such as film, drum, tape, or disc.

**base (of Number System).** An integer whose successive powers are multiplied by coefficients in a *positional notation* system.

**base-minus-ones complement.** A number representation that can be derived from another by subtracting each digit from one less than the base. *Nines complements* and *ones complements* are base-minus-ones complements.

**binary.** 1) Pertaining to the number-representation system with a *base* of two.

2) Pertaining to the number "two".

**binary code.** Any *code* employing two *character* designs.

**binary-coded-decimal.** Pertaining to a number-representation system in which each decimal digit is represented by a unique arrangement of binary digits (usually four), e.g., *excess-three code.*

**bit (in Electronic Computers).** 1) A binary digit.

2) In a *language* employing exactly two distinct kinds of characters, a single occurrence of a *character.*

3) A unit of *storage capacity.*

See *check bit.*

**block.** A group of associated *words* or *characters.*

**borrow.** In direct subtraction, a *carry* that arises when the result of the subtraction in a given digit place is less than zero.

**branch (in Electronic Computers).** Same as *conditional jump.*

**breakpoint.** 1) Pertaining to a type of instruction, instruction digit, or other condition used to interrupt or stop a computer at a particular place in a *routine* when manually requested.

2) A place in a *routine* where such an interruption occurs or can be made to occur.

**buffer.** 1) An isolating circuit used to avoid reaction of a driven circuit on any driving circuit.

2) A storage device used to compensate for a difference in rate of flow of data or time of occurrence of events when transmitting data from one device to another.

**bus (in Electronic Computers).** One or more conductors used for transmitting signals or power from one or more sources to one or more destinations.

**capacity.** See *storage capacity.*

**carry.** 1) A character or characters, produced in connection with an arithmetic operation on one digit *place* of two or more number representations in *positional notation,* and forwarded to another digit place for processing there.

2) The number represented by the character or characters in (1).

3) Most commonly, a character as defined in (1) that

arises in adding when the sum of two or more *digits* equals or exceeds the *base* of the number-representation system.

4) Less commonly, a *borrow*.

5) The act of forwarding a carry.

6) The command directing that a carry be forwarded.

See *cascaded carry, complete carry, end-around carry, high-speed carry, partial carry, standing-on-nines carry.*

**cascaded carry.** A carry process that uses the normal means for adding when generating any new carry. Contrasted with *high-speed carry.*

**cell.** An elementary unit of storage, e.g., binary cell, decimal cell.

**channel (in Electronic Computers).** 1) A path along which signals can be sent, e.g., data channel, output channel.

2) The portion of a storage medium that is accessible to a given reading station. See also *track.*

**character (in Electronic Computers).** 1) An elementary mark or event that may be combined with others, usually in the form of a linear string, to form data or represent information. If necessary to distinguish from (2) below, such a mark may be called a character event.

2) A class of equivalent elementary marks or events as in (1) having properties in common, such as shape or amplitude. If necessary to distinguish from (1) above, such a class may be called a character design. There are usually only a finite set of character designs in a given language.

*Note 1:* In "bookkeeper" there are six character designs and ten character events, while in "1010010" there are two character designs and seven character events.

*Note 2:* A group of characters, in one context, may be considered as a single character in another, as in the *binary-coded-decimal* system.

**check.** A process of partial or complete testing of a) the correctness of machine operations, or b) the existence of certain prescribed conditions within the computer. A check of any of these conditions may be made automatically by the equipment or may be programmed. See also *error-detecting code, forbidden combination, self-checking code, test, verify.*

See *automatic check, machine check, marginal check, mathematical check, parity check, programmed check, selection check, transfer check.*

**check bit.** A binary *check digit.*

**check digit.** A digit used for checking purposes but otherwise *redundant.*

**check problem.** A routine or problem that is designed primarily to indicate whether a fault exists in the computer, without giving detailed information on the location of the fault. Also called check routine. See also *diagnostic, test.*

**check routine.** Same as *check problem.*

**circulating register.** A register that retains data by inserting it into a delaying means, and regenerating and reinserting the data into the register.

**clear.** 1) To preset a storage or memory device to a prescribed state, usually that denoting zero.

2) To place a binary cell in the "zero" state.

See *reset, set.*

**clock.** 1) A primary source of synchronizing signals.

2) A device for measuring and indicating time.

**code (in Electronic Computers).** 1) The characters or expressions of an originating or source language, each correlated with its equivalent expression in an intermediate or target language, e.g., alphanumeric characters correlated with their equivalent 6-bit expressions in a binary machine language.

2) Frequently, an expression in the target language.

3) Frequently, the set of expressions in the target language that represent the set of *characters* of the source language.

4) To *encode.*

5) To translate the program for the solution of a problem on a given computer into a sequence of machine-language or pseudo instructions acceptable to that computer.

See *binary code, error-detecting code, excess-three code, operation code, self-checking code.*

**column.** 1) A vertical arrangement of characters or other expressions.

2) Loosely: *place.*

**combination.** See *forbidden combination.*

**combinational logic element.** 1) A device having zero or more input channels and one output channel, each of which is always in one of exactly two possible physical states, except during switching transients. On each of the input channels and the output channel, a single state is designated arbitrarily as the "one" state, for that input channel or output channel, as the case may be. For each input channel and output channel, the other state may be referred to as the "zero" state. The device has the property that the output channel state is determined completely by the contemporaneous input-channel-state combination, to within switching transients.

2) By extension, a device similar to (1) except that one or more of the input channels or the output channel, or both, have a finite number, but more than two, possible physical states each of which is designated as a distinct logic state. The output channel state is determined completely by the contemporaneous input-channel-state combination, to within switching transients.

3) A device similar to (1) or (2) except that it has more than one output channel.

See *AND gate, OR gate.*

**command.** 1) One of a set of several signals (or groups of signals) that occurs as a result of interpreting an

*instruction;* the commands initiate the individual steps that form the process of executing the instruction's *operation.*

2) Loosely: *instruction.*

3) Loosely: *operation.*

**complement.** 1) A *true complement* or *base-minus-ones complement.*

2) To form the complement of a number.

*Note:* In many machines, a negative number is represented by the complement of the representation of the positive number of the same absolute value.

See *nines complement, ones complement, tens complement, twos complement.*

**complete carry.** A carry process in which a carry resulting from addition of carries is allowed to propagate. Contrasted with *partial carry.*

**computer.** 1) A machine for carrying out calculations.

2) By extension, a machine for carrying out specified transformations on information.

3) A stored-program data-processing system.

**conditional jump.** To cause, or an instruction that causes, the proper one of two (or more) addresses to be used in obtaining the next instruction, depending upon some property of one or more numerical expressions or other conditions. Sometimes called a branch. See also *jump.*

**conditional transfer of control.** Same as *conditional jump.*

**control.** 1) Those parts of a digital computer that effect the obtaining of instructions in proper sequence, the interpretation of each instruction, and the application of the proper signals to the arithmetic unit and other parts in accordance with this interpretation.

2) One or more of the components in any mechanism responsible for interpreting and carrying out manually initiated directions. Sometimes called manual control.

3) In some business applications of mathematics, a *mathematical check.*

See also *transfer of control, conditional transfer of control, unconditional transfer of control.*

**copy.** 1) To produce a sequence of *character* events equivalent, character by character, to another sequence of character events.

2) The sequence of character events produced in (1).

**core.** See *magnetic core.*

**correction.** A quantity (equal in absolute value to the *error*) added to a calculated or observed value to obtain the true value.

**counter.** A device capable of changing from one to the next of a cycle of distinguishable states upon each receipt of an input signal.

See *ring counter.*

**cycle.** See *major cycle, minor cycle.*

**cyclic shift.** An operation that produces a *word* whose *characters* are obtained by a cyclic permutation of the characters of a given word.

**decimal.** Pertaining to the number representation system with a *base* of ten.

See *binary-coded-decimal.*

**decode.** 1) To recover the original message from a coded form of the message.

2) To produce a single output signal from each combination of a group of input signals.

See also *translate, matrix, encode.*

**delay.** The amount of time by which a signal is delayed. It may be expressed in time (milliseconds, microseconds, etc.) or in number of characters (pulse times, word times, major cycles, minor cycles, etc.).

**delay line.** A *sequential logic element* or device with one input channel in which the output-channel state at a given instant, $t$, is the same as the input-channel state at the instant $t\text{-}n$, i.e., the input sequence undergoes a *delay* of $n$ units. There may be additional taps yielding output channels with smaller values of $n$.

**design.** See *logic design.*

**device.** See *storage device.*

**diagnostic.** Pertaining to finding the location of either a *malfunction* or a *mistake.* See also *check problem.*

**diagram.** See *logic diagram.*

**digit.** 1) In *positional notation,* a *character* that stands for an integer.

2) Loosely, the integer that the digit stands for.

3) Loosely, any *character.*

See *check digit, sign digit.*

**digital.** Pertaining to data in the form of *digits.*

**disc.** See *magnetic disc.*

**double length.** Pertaining to twice the normal length of a unit of data or a storage device in a given computing system; e.g., a double-length register would have the capacity to store twice as much data as a single-length or normal register; a double-length word would have twice the number of characters or digits as a normal or single-length word. See also *double precision.*

**double precision.** Pertaining to the use of a *double-length* expression in order to preserve or gain precision.

**drum.** See *magnetic drum.*

**element.** See *combinational logic element, logic element, sequential logic element, threshold element.*

**encode.** 1) To express a single character or a message in terms of a code.

2) To produce a unique combination of a group of

output signals in response to each of a group of input signals.

See also *matrix, decode, translate.*

**end-around carry.** A *carry* generated in the most significant *place* and forwarded directly to the least significant place, e.g., when adding two negative numbers using nines complement.

**error.** 1) In mathematics, the difference between the true value and a calculated or observed value. See also *correction.*

2) In a computer or data-processing system, any incorrect step, process, or result. The term is often commonly used to refer to machine *malfunctions* as "machine errors" and to human *mistakes* as "human errors."

**error-detecting code.** Same as *self-checking code.*

**excess-three code.** A *binary-coded-decimal* system as follows:

| DECIMAL DIGIT | EXCESS-THREE CODE |
|---|---|
| 0 | 0011 |
| 1 | 0100 |
| 2 | 0101 |
| 3 | 0110 |
| 4 | 0111 |
| 5 | 1000 |
| 6 | 1001 |
| 7 | 1010 |
| 8 | 1011 |
| 9 | 1100 |

**expression.** An ordered set of one or more *characters.* See also *word.*

**extract instruction.** An instruction that requests the formation of a new *expression* by selecting segments of given expressions.

**feed.** 1) To supply the material to be operated upon to a machine.

2) A device capable of feeding as in (1).

**film.** See *magnetic thin film.*

**fixed point.** Pertaining to a system in which the location of the *point* is assumed to remain fixed with respect to one end of the numerical expressions, according to some convention.

**flip-flop.** 1) A circuit or device, containing active elements, capable of assuming either one of two stable states at a given time, the particular state being dependent upon (a) the nature of an input signal, e.g., its polarity, amplitude, and duration, and (b) which of two input terminals last received the signal. The input and output coupling networks, and indicators, may be considered as an integral part of the flip-flop.

2) A device, as in (1) above, that is capable of counting modulo 2, in which case it might have only one input terminal.

3) A *sequential logic element* having properties similar to (1) or (2) above.

**floating point.** Pertaining to a system in which the location of the *point* does not remain fixed with respect to one end of the numerical expressions, but is regularly recalculated. The location of the point is usually given by expressing a power of the base.

**forbidden combination.** A code expression that is defined to be nonpermissible and whose occurrence indicates a mistake or malfunction.

**four-address.** Pertaining to an *instruction* code in which each instruction has four address parts. In a typical four-address instruction the addresses specify the location of two operands, the destination of the result, and the location of the next instruction to be interpreted.

See also *three-plus-one-address.*

**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 contemporaneous input channel states, to within switching transients.

2) A *combinational logic element* having at least one input channel.

3) An *AND gate.*

4) An *OR gate.*

**half-adder.** A *combinational logic element* that has two input and two output channels for binary digits and whose output digits represent the sum of the input digits. Two half-adders can be used to make one binary *adder* that is capable of adding two binary digits and the carry from the preceding digit *place.*

**hardware.** 1) Physical entities such as computers, circuits, tape readers, etc. Contrasted with *software.*

2) Parts made of metal such as fasteners, hinges, etc.

**high-speed carry.** A carry process such that if the current sum in a digit *place* is exactly one less than the base, the carry input is bypassed to the next place. The processing necessary to allow the bypass occurs before the carry input arrives. Further processing required in the place as a result of the carry input, occurs after the carry has passed by. Contrasted with *cascaded carry.*

See also *standing-on-nines carry.*

**inhibit.** 1) To prevent an event from taking place.

2) To prevent a device or logic element from producing a specified output.

**input.** 1) A *channel* for impressing a state on a device or *logic element.*

2) The state, or sequence of states, occurring on a specified input channel.

**instruction.** A *word* or expression that specifies an *operation* and the values or locations of all *operands.* The

instruction may specify some operands by the definition of the operation, and may use one or more addresses to specify the location in storage of other operands, where the result is to be stored, the next instruction, etc. See also *command*.

See *extract instruction*.

**instruction repertory.** The set of *operations* that can be represented in a given *instruction* code.

**integrator.** In a digital differential analyzer, a device using an *accumulator* for numerically accomplishing an approximation to the mathematical process of integration.

**jump.** 1) To (conditionally or unconditionally) cause the next instruction to be obtained from a storage location specified by an address part of the current instruction when otherwise it would be specified by some convention. See also *conditional jump, unconditional jump*.

2) An instruction that specifies a jump.

*Note:* If every instruction in the *instruction* code specifies the location of the next instruction (e.g., in a *three-plus-one-address* code), then each one is not called a jump instruction unless it has two or more address parts that are conditionally selected for the jump.

**language (in Electronic Computers).** 1) A system consisting of a) a well defined, usually finite, set of characters; b) rules for combining characters with one another to form words or other expressions; and c) a specific assignment of meaning to some of the words or expressions, usually for communicating information or data among a group of people, machines, etc.

2) A system similar to the above but without any specific assignment of meanings. Such systems may be distinguished from (1) above, when necessary, by referring to them as formal or uninterpreted languages.

See also *code, machine language*.

**length (in Electronic Computers).** 1) A measure of the magnitude of a unit of data, usually expressed as a number of subunits, e.g., the length of a record is 32 blocks, the length of a *word* is 40 binary digits, etc.

2) The number of subunits of data, usually digits or characters, that can be simultaneously stored linearly in a given device, e.g., the length of the register is 12 decimal digits or the length of the counter is 40 binary digits. See also *storage capacity*.

3) A measure of the amount of time that data is delayed when being transmitted from point to point, e.g., the length of the *delay line* is 384 microseconds.

See *double length*.

**line.** See *delay line*.

**logic.** 1) The result of planning a data-processing system or of synthesizing a network of *logic elements* to perform a specified function.

2) Pertaining to the type or physical realization of logic elements used, e.g., "diode logic", "AND logic".

**logic design.** 1) The synthesizing of a network of *logic elements* to perform a specified function.

2) Loosely, the planning of a computer or data-processing system prior to its detailed engineering design.

3) The result of (1) above, which frequently is called the *logic* of the system, machine, or network.

**logic diagram.** A diagram representing the *logic elements* and their interconnections without necessarily expressing construction or engineering details.

**logic element.** A *combinational logic element* or *sequential logic element*.

**logic operation.** 1) Nonarithmetic operations that are expressible in terms of the propositional calculus or a two-valued Boolean algebra operating on individual pairs of bits.

2) Sometimes, nonarithmetic operations such as: compare, *shift*, and *jump*.

**logic symbol.** 1) A symbol used to represent a *logic element* graphically.

2) A symbol used to represent a logic connective.

**machine check.** 1) An *automatic check*.

2) A *programmed check* of machine functions.

**machine language.** 1) A *language*, occurring within a machine, ordinarily not perceptible or intelligible to persons without special equipment or training.

2) A translation or transliteration of (1) above into more conventional characters but frequently still not intelligible to persons without special training.

**magnetic core.** A configuration of magnetic material that is, or is intended to be, placed in a rigid spatial relationship to current-carrying conductors and whose magnetic properties are essential to its use. For example, it may be used:

(a) to concentrate an induced magnetic field as in a transformer, induction coil, or armature, (b) to retain a magnetic polarization for the purpose of storing data, or (c) for its non-linear properties as in a logic element. It may be made of iron wires, iron oxide, coils of magnetic tape, ferrite, thin film, etc.

**magnetic disc.** A flat circular plate with a magnetic surface on which data can be stored by selective polarization of portions of the flat surface.

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

**magnetic storage.** A method of storage that uses the magnetic properties of matter to store data by magnetization of materials such as cores, films, or plates, or of material located on the surfaces of tapes, discs, or drums, etc.

See also *magnetic core, magnetic drum, magnetic tape*.

**magnetic tape.** 1) A tape with a magnetic surface on which data can be stored by selective polarization of portions of the surface.

2) A tape of magnetic material used as the constituent in some forms of magnetic cores.

**magnetic thin film.** A layer of magnetic material, usually less than 10,000 Angstroms thick. In electronic computers, magnetic thin films may be used for logic or storage elements. See also *magnetic core.*

**major cycle.** In a storage device that provides *serial* access to storage positions, the time interval between successive appearances of a given storage position.

**malfunction.** An *error* that results from failure in the *hardware.*

**marginal check.** A preventive maintenance procedure in which certain operating conditions, (e.g., supply voltage or frequency) are varied about their nominal values in order to detect and locate incipient defective parts. See also *check.*

**mathematical check.** A programmed check of a sequence of operations that makes use of the mathematical properties of the sequence. Sometimes called a *control.*

**matrix (in Electronic Computers).** A logic network whose configuration is an array of intersections of its input-output leads, with elements connected at some of these intersections. The network usually functions as an encoder or decoder. See also *encode, decode, translate.*

*Note:* A translating matrix develops several output signals in response to several input signals; a decoder develops a single output signal in response to several input signals (therefore sometimes called an AND matrix); an encoder develops several output signals in response to a single input signal and a given output signal may be generated by a number of different input signals (therefore sometimes called an OR matrix).

**memory.** Same as *storage.*

**minor cycle.** In a storage device that provides *serial* access to storage positions, the time interval between the appearance of corresponding parts of successive words.

**mistake.** A human *error* that results from incorrect programming, coding, manual operation, etc.

**multiple-address.** Pertaining to an *instruction* code in which each instruction has more than one address part.

**nines complement.** A *base-minus-ones complement* with a *base* of ten.

**noise (in Electronic Computers).** 1) Random variations of one or more characteristics of any entity, such as voltage, current, data, etc.

2) Any disturbance tending to interfere with the normal operation of a device or system.

**notation.** See *positional notation.*

**number.** 1) Formally, an abstract mathematical entity that is a generalization of a concept used to indicate quantity, direction, etc. In this sense a number is independent of the manner of its representation.

2) Commonly: A representation of a number as defined above (e.g., the binary number "10110", the decimal number "3695", or a sequence of pulses).

3) An expression, composed wholly or partly of digits, that does not necessarily represent the abstract entity mentioned in the first meaning.

*Note:* Whenever there is a possibility of confusion between meaning (1) and meaning (2) or (3), it is usually possible to make an unambiguous statement by using "number" for meaning (1) and "numerical expression" for meaning (2) or (3).

**octal.** Pertaining to the number representation system with a *base* of eight. Originally called *octonary.*

**octonary.** Same as *octal.*

**one-address.** Pertaining to an *instruction* code in which each instruction has one *address part.* Also called single-address. In a typical one-address instruction the *address* may specify either the location of an operand to be taken from storage, the destination of a previously prepared result, or the location of the next instruction to be interpreted. In a one-address machine, the arithmetic unit usually contains at least two storage locations, one of which is an accumulator. For example, operations requiring two operands may obtain one operand from the main storage and the other from the storage location in the arithmetic unit that is specified by the operation part.

**one-plus-one-address.** Pertaining to a *two-address* code in which one address part always specifies the location of the next instruction to be interpreted.

**ones complement.** A *base-minus-ones complement* with a *base* of two.

**operand.** That which is, or is to be, operated upon.

**operation.** 1) A program step undertaken or executed by a computer, e.g., addition, multiplication, extraction, comparison, shift, or transfer. The operation is usually specified by the *operation part* of an *instruction.* See also *operation code.*

2) The event or specific action performed by a logic element.

3) Loosely: *command.*

See *logic operation.*

**operation code.** 1) The operations that a computing system is capable of executing, each correlated with its equivalent in another language; e.g., the binary or alphanumeric codes in machine language along with their English equivalents; the English description of operations along with statements in a programming language such as COBOL, ALGOL or FORTRAN.

2) The code that represents or describes a specific operation. The operation code is usually the *operation part* of the instruction.

**operation part.** The part of an *instruction* that usually specifies the kind of operation to be performed.

**OR gate.** A *combinational logic element* such that the

output channel is in its "one" state if and only if at least one of the input channels is in its "one" state.

**order.** 1) Same as *instruction.*

2) Same as *command.*

3) Loosely, same as *operation part.*

*Note:* The use of "order" in the computer field as a synonym for terms similar to the above is losing favor owing to the ambiguity between these meanings and the more common meanings in mathematics and business.

**output.** 1) A *channel* for expressing a state from a device or *logic element.*

2) The state, or sequence of states, occurring on a specified output channel.

**overflow.** 1) The condition that arises when the result of an arithmetic operation exceeds the capacity of the number representation in a digital computer.

2) The *carry* digit arising from this condition.

**parallel (in Electronic Computers).** 1) Pertaining to the simultaneity of two or more processes.

2) Pertaining to the simultaneity of two or more similar or identical processes.

3) Pertaining to simultaneous processing of the individual parts of a whole, such as the bits of a character and the characters of a word, using separate facilities for the various parts.

See also *serial-parallel.*

**parity.** Pertaining to the use of a self-checking code employing binary digits in which the total number of 1's (or 0's) in each permissible code expression is always even or always odd. A check may be made for either even parity or odd parity.

**parity check.** An *automatic check* based on *parity.*

**part.** See *address part, operation part.*

**partial carry.** A carry process in which a carry resulting from the addition of previous carries is temporarily not forwarded to another place, e.g., when forming the partial product by left-hand and right-hand components in multiplication. Contrasted with complete carry.

**place.** In *positional notation,* a position corresponding to a given power of the base, a given cumulated product, or a digit cycle of a given length. It can usually be specified as the $n$th character from one end of the numerical expression.

**point.** In *positional notation,* the *character,* or implied location of such a character, that separates the integral part of a numerical expression from the fractional part. Since the place to the left of the point has unit weight in the most commonly used systems, the point is sometimes called the units point, although it is frequently called the binary point in binary notation and the decimal point in decimal notation.

See *breakpoint, fixed point, floating point.*

**positional notation.** 1) A number-representation system having the property that each number is represented by a sequence of characters such that successive characters of the sequence represent integral coefficients of successive integral powers of a given integer, called the *base,* and such that the sum of these powers, each multiplied by its coefficient, equals the number. Each occurrence of a given character represents the same coefficient value. (See note below.)

2) A number-representation system having the property that each number is represented by a sequence of characters such that successive characters of the sequence represent integral coefficients of accumulated products of a sequence of integers (or reciprocals of integers) and such that the sum of these products, each multiplied by its coefficient, equals the number. Each occurrence of a given character represents the same coefficient value. (See note below.)

3) A number-representation system such that if the representations are arranged vertically in order of magnitude with digits of like significance in the same column, then each column of digits consists of recurring identical cycles (for numbers sufficiently large in absolute value) whose length is an integral multiple of the cycle length in the column containing the next-less-significant digits. (See note below.)

*Note:* The *binary* and *decimal* systems are examples of (1), (2), and (3), above. The biquinary system is an example of (2) and (3). The Gray code system is an example of (3) only.

**precision.** The quality of being exactly or sharply defined or stated. A measure of the precision of a representation is the number of distinguishable alternatives from which it was selected, which is sometimes indicated by the number of significant digits it contains. See also *accuracy.*

See *double precision.*

**problem.** See *check problem.*

**program.** 1) A plan for the solution of a problem. See also *routine.*

2) To prepare a program.

**programmed check.** A *check* performed by programmed operations.

**radix.** Same as *base.*

**read.** To acquire data, usually from some form of storage. See also *write.*

**redundant.** Pertaining to characters that do not contribute to the information content. Redundant characters are often used for checking purposes or to improve reliability. See also *parity, self-checking code, error-detecting code, forbidden-combination, check digit.*

**regenerate.** 1) To bring something into existence again after decay of its own accord or after intentional destruction.

2) (In Storage Tubes) to replace charge to over-

come decay effects, including loss of charge by reading.

3) (In storage devices in which physical states used to represent data deteriorate) to restore the device to its latest undeteriorated state.

See also *rewrite.*

**register.** A device capable of retaining a small amount of data, usually that contained in a single *word.*

See *circulating register.*

**repertory.** See *instruction repertory.*

**reset.** 1) To restore a storage device to a prescribed state not necessarily that denoting zero.

2) Same as *clear (2).*

See also *set.*

**rewrite.** 1) To write again.

2) In a destructive-read storage device, to return the data to the state it had prior to reading.

See also *regenerate.*

**ring counter.** A loop of interconnected bistable elements such that one and only one is in a specified state at any given time and such that, as input signals are counted, the position of the one specified state moves in an ordered sequence around the loop.

**routine.** A set of instructions arranged in proper sequence to cause a computer to perform a desired task.

See *check routine.*

**selection check.** A *check* (usually an *automatic check*) to verify that the correct register, or other device, is selected in the interpretation of an instruction.

**self-checking code.** A code that uses expressions such that one (or more) error(s) in a code expression produces a *forbidden combination.* Also called an error-detecting code.

See also *parity.*

**sequential logic element.** A device similar to a *combinational logic element* except that, for a given sequence of instants of time measured from some starting point, the output channel state for each instant is determined completely by the input-channel-state combinations occurring at that and all or some previous instants of time.

**serial.** 1) Pertaining to the time-sequencing of two or more processes.

2) Pertaining to the time-sequencing of two or more similar or identical processes, using the same facilities for the successive processes.

3) Pertaining to the time-sequential processing of the individual parts of a whole, such as the bits of a character, the characters of a word, etc., using the same facilities for successive parts.

See also *serial-parallel.*

**serial-parallel.** Pertaining to processing that includes both *serial* and *parallel* processing, such as one that handles decimal digits serially but handles the bits that comprise a digit in parallel.

**set.** 1) To place a storage device in a specified state.

2) To place a binary cell in the "one" state.

See also *clear, reset.*

**sexadecimal.** Pertaining to the number representation system with a *base* of sixteen.

**shift.** Displacement of an ordered set of characters one or more places to the left or right. If the characters are the digits of a numerical expression, a shift might be equivalent to multiplying by a power of the base.

See *cyclic shift.*

**sign digit.** A character used to designate the algebraic sign of a number.

**single-address.** Same as *one-address.*

**software.** 1) Computer programs, programming languages and systems.

2) The collection of related utility, assembly, and other programs that are desirable for properly presenting a given machine to a user.

3) Detailed procedures to be followed, whether expressed as programs for a computer or as procedures for an operator or other person.

4) Documents, including hardware manuals and drawings, computer-program listings and diagrams, etc.

5) Items such as those in (1), (2), (3) and (4) as contrasted with *hardware.*

**standing-on-nines carry.** A *high-speed carry* in the decimal system.

**staticize.** To convert serial or time-dependent parallel data into static form.

**storage.** 1) Pertaining to a *storage device.*

2) Same as *storage device.*

3) In a computer, a *unit* used primarily to retain data. Also called memory.

See *associative storage, magnetic storage.*

**storage capacity.** The amount of data that can be contained in a storage device. The units of capacity are bits, characters, words, etc. For example, capacity might be "32 bits," "10,000 decimal digits," "16,384 words with ten alphanumeric characters each."

*Note 1:* When comparisons are made among devices using different character sets and word lengths, it may be convenient to express the capacity in equivalent *bits,* which is the number obtained by taking the logarithm to the base 2 of the number of usable distinguishable states in which the storage can exist.

*Note 2:* The "storage (or memory) capacity of a computer" usually refers only to the internal storage section.

**storage device.** A device in which data can be stored and from which it can be copied at a later time. The means

of storing data may be chemical, electrical, mechanical, etc.

**store.** 1) To retain data in a device from which it can be copied at a later time.

2) To put data into a *storage device.*

3) Sometimes, a device capable of storing as in (1).

**symbol.** See *logic symbol.*

**tape.** See *magnetic tape.*

**tens complement.** A *true complement* with a *base* of ten.

**ternary.** Pertaining to the number-representation system with a *base* of three.

**test.** 1) To ascertain the state or condition of an element, device, program, etc.

2) Sometimes used as a general term to include both check and *diagnostic* procedures.

3) Loosely, same as *check.*

**thin film.** See *magnetic thin film.*

**three-address.** Pertaining to an *instruction* code in which each instruction has three address parts. Also called triple-address. In a typical three-address instruction the addresses specify the location of two operands and the destination of the result, and the instructions are taken from storage in a preassigned order. See also *two-plus-one-address.*

**three-plus-one-address.** Pertaining to a *four-address* code in which one address part always specifies the location of the next instruction to be interpreted.

**threshold element.** 1) A *combinational logic element* such that the output channel is in its "one" state if and only if at least $n$ input channels are in their "one" states, where $n$ is a specified fixed non-negative integer, called the threshold of the element.

2) By extension, a similar element whose output channel is in its "one" state if and only if at least $n$ input channels are in states specified for them, not necessarily the "one" state but a fixed state for each input channel.

**time.** See *access time, word time.*

**track (in Electronic Computers).** The portion of a moving-type storage medium that is accessible to a given reading station; e.g., as on film, drum, tapes, or discs. See also *band.*

**transcribe.** To convert data recorded in a given medium to the medium used by a digital computing machine (or vice versa).

**transfer.** 1) To transmit data from one device to another.

2) To *jump.*

3) The act of transferring.

**transfer check.** A *check* (usually an *automatic check*) on the accuracy of the transfer of a word.

**transfer of control.** Same as *jump.*

**translate.** 1) To *encode* or *decode.* See also *matrix.*

2) To convert expressions in one language to synonymous expressions in another language.

**triple-address.** Same as *three-address.*

**true complement.** A number representation that can be derived from another by subtracting each digit from one less than the base and then adding one to the least significant digit and executing all carries required. *Tens complements* and *twos complements* are true complements.

**two-address.** Pertaining to an *instruction* code in which each instruction has two address parts. Some two-address instructions use the addresses to specify the location of one operand and the destination of the result, but more often they are *one-plus-one-address* instructions.

**two-plus-one-address.** Pertaining to a *three-address* code in which one address part always specifies the location of the next instruction to be interpreted.

**twos complement.** A *true complement* with a *base* of two.

**unconditional jump.** An instruction that interrupts the normal process of obtaining instructions in an ordered sequence, and specifies the location of the next instruction. See *jump.*

**unconditional transfer of control.** Same as *unconditional jump.*

**unit.** A portion of a computer that constitutes the means of accomplishing some inclusive operation or function, as: arithmetic unit.

**verify.** To compare the results of one transcription against the results of another transcription of the same data.

See also *check.*

**volatile.** Pertaining to a storage device in which data cannot be retained without continuous power dissipation.

*Note:* Storage devices or systems employing non-volatile media may or may not retain data in the event of planned or accidental power removal.

**word (in Electronic Computers).** An ordered set of *characters* that is the normal unit in which data may be stored, transmitted, or operated upon within a given computer.

**word time.** Same as *minor cycle.*

**write.** To introduce data, usually into some form of storage. See also *read.*