THE INSTITUTE OF RADIO ENGINEERS, INC.
1 East 79 Street, New York 21, New York

October, 1948

FIRST LIST OF DEFINITIONS
of the
DEFINITIONS SUBCOMMITTEE, IRE ELECTRONIC COMPUTERS COMMITTEE

It should be clearly understood that the sources given are sources of material for the Subcommittee and are not to be miscontrued as origins of the definitions or terms.

ABBREVIATION	SOURCE
Bu. S.	Bureau of Standards, Electronic Computers Section
EMCCo.	Eckert-Mauchly Computer Corp.
IAS	Institute for Advanced Study, Computer Project
IRE	IRE Electronic Computers Committee, Definitions Subcommittee
IRE.S	IRE Electronic Computers Committee, Subcommittee on Storage
James Math. Dict.	James, "Mathematics Dictionary", Digest Press, 1946
J.A.R.	Jan A. Rajchman
J.W.T.	J. W. Tukey
MacC.	LeRoy A. MacColl, "Fund. Theory of Servomechanisms"
MIT	Mass. Institute of Technology. Project Whirlwind
ONR	Office of Naval Research, Special Devices Center
Ray	Raytheon
RCA.L.	RCA Laboratories, Princeton, N. J.
Webster	Webster's Dictionary

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ACCESS TIME

The time required to transfer a word to or from storage. (MIT.Mod.)

ACCUMULATOR

A storage organ which can receive a number and add it to the one already in it, which is also able to clear its contents and which can transmit what it contains. (IAS).

ACCURACY

The quality of correctness or freedom from error. Distinguished from precision as in the examples: (a)"...this procedure measures the precision (reproducibility) of the test, not its accuracy (closeness to the true value)." (L. E. Simon, An Engineer's Manual of Statistical Methods.) (b) A four-place table correctly computed is more accurate but less precise than a six-place table containing errors. (Bu.S.)

ADDEND

A number to be added to another. (Webster) (Cf. Augend, Summand) (Bu.S.)

ADDER

A device capable of performing, in some number representation, the arithmetic operation of addition. (Bu.S.)

ADDRESS

The designation of the source or destination for the transmission of a word, used to control the appropriate switching. (Bu.S.)

A number which designates a particular cell. (Bu.S.)

ANALOG

A physical representation of a device or problem, which, for mathematical purposes, is equivalent to the device or problem itself. (RCA.L.)

ANALOG COMPUTER

A computer in which numbers are represented by physical magnitudes such as rotation of a shaft or quantity of charge in a condenser. (MIT)

AND CIRCUIT

Same as gate circuit. (in the sense of coincidence gate). (Bu.S.)

ARITHMETIC ELEMENT

The part of a computer that performs the actual arithmetic operations. (MIT. Mod.) Equivalent to "Organ" (IAS) or "Unit" (Ray).

AUGEND

A number to which another is to be added. (Cf. Addend, Summand). (Bu.S.)

BASE (of a system of numbers)

The number of units in a given digit's place or decimal place which must be taken to denote 1 in the next higher place. (James, Math. Dict.). Syn. "Radix".

BINARY

Said of a number system or a logical process in which two stable states or alternatives are involved. (IRE)

BINARY CELL, ELEMENTARY

An element storing information in the memory which can have one or the other of two stable states. For example, it may be one flip-flop circuit, the element of surface of an electron target in an electronic tube, or an elementary volume in a tank of mercury whose coordinate changes at the speed of propagation of an acoustic disturbance. (IRE.S)

BINARY CODED DECIMAL

A system of number representation in which the decimal digits of a number are expressed by binary representations. (Bu.S.)

BINARY DIGIT

A digit of a binary number. The binary system uses only the digits 0 and 1. Binary numbers contain an average of approximately 3 1/3 times as many digits as corresponding decimal numbers. (MIT. Mod.)

BINARY NUMBER SYSTEM

A system in which the digits of a number are the coefficients of powers of the base 2, just as in the decimal system the digits are coefficients of powers of the base 10. (MIT)

BIT

A binary digit. (J.W.T.)

BLOCK

A group of words which are transferred by one instruction to or from storage. (EMCCo. Mod.)

BRANCH

A synonym for "jump" (Bu.S.)

BUFFER

An isolating circuit used to avoid reaction of the driven circuit upon the driving circuit. (IRE)

BUS

A group of conductors used for transmitting a complete number or order. (MIT)

CARRY

An overflow in a single digit column following an addition. The carry must be added from one digit column to the next. See high speed carry. (MIT)

CHECK PROBLEM

A test problem whose incorrect solution indicates that a computer is not functioning correctly. (MIT Mod.)

CLEAR

A command to clear a flip-flop or a register of the number stored in it; the process of pulsing the reset terminal of a flip-flop, or of all the flip-flops in a register. (MIT. Mod.)

To restore a storage (memory) device to a prescribed state, usually that denoting zero. (Bu.S.)

To replace all digits with zeros. (Bu.S.)

CLOCK

(Master) The primary source of the pulses which are used to operate a computer. (MIT. Mod.)

The source of regularly recurring pulses to which all other pulses are synchronized. (Bu.S.)

CLOCK PULSE

One of the regularly recurring pulses supplied by the clock. (Bu.S.)

CODE (Noun)

A compact symbolic representation of information. (EMCCo.)

The language which a machine is built to understand (or interpret and act upon). (Bu.S.)

CODE (Verb)

To transform a problem from its mathematical formulation into a symbolism understandable by a machine. (Ray Mod.)

CODE, EXCESS 3

A pulse code for numerical data in which each decimal digit d is represented by the binary number (d + 3) (EMCCo.)

CODE, INSTRUCTION

The various combinations of letters and digits used to represent the elementary operations which a machine can perform. (EMCCo.)

CODE, PULSE

The various combinations of electrical or other pulses used to represent numbers, letters, and special characters. (EMCCo.)

CODING

The formulation of orders for the computer operations required to solve a problem. (MIT. Mod.)

COINCIDENCE CIRCUIT

A circuit designed to respond to the coincidence of certain definite signals. (IRE)

COMPARATOR

The element in a Verifier directly comparing one record or inscription against the reference record or inscription. (Bu.S.)

COMPLEMENT

A number whose representation is derived from the finite positional notation of another by one of the following rules:
(a) True complement: Subtract each digit from the radix less 1, then add 1 to the least significant digit, executing any carries required.
(b) (Radix -1)'s complement: Subtract each digit from the radix less 1. (Bu. S.)

CONDITIONAL TRANSFER ORDER

An order which will, depending upon the sign of a given number, cause the proper one of two routines to be executed. (IAS)
(Cf. Control, Transfer of, jump)

CONTROL

That part of the computer which controls its operation. (MIT. Mod.)

COUNTER

A device capable of changing from one to the next of a sequence of distinguishable states upon each receipt of a discrete input signal. (Bu.S.)

CYCLIC SHIFT

An operation which produces a word whose digits are obtained by a cyclic permutation of the digits of a given word. (Bu.S.)

DECIMAL NUMBER SYSTEM

The scheme of positional notation (which see) using 10 as the radix (base). (Bu.S)

DECIMAL POINT

The radix point in the decimal number notation. (Bu.S)

DIFFERENCE

In arithmetic, the number resulting from a subtraction. (Bu.S.)

DIGIT

In a number system, a symbol for an integer. More generally, an elementary unit of the language. (IRE)

One of the integer symbols required for the representation of a number in positional notation. (Bu.S.)

DIGITAL COMPUTER

One in which a number system, or language, is explicitely used. (IRE)

DISPATCHER

That part of a digital computer which performs the switching determining the sources and destinations for the transfer of words. (Bu.S.)

DIVIDEND

A number to be divided by another. (Bu.S.)

DIVIDER

A device which divides. (Webster)

DIVISOR

A number by which another is to be divided. (Bu. S)

DOUBLE PRECISION NUMBER

A number occupying two word positions thus having about twice the usual number of digits. (Bu.S.)

DYADIC

Rarely used synonym of binary. (Bu.S.)

DYNAMIC SEQUENCE CONTROL

A method of operation in which a machine can alter orders and the sequence in which orders are performed can be determined by the computation. (ONR Mod.) (Cf. Sequence Control).

ELECTROSTATIC STORAGE TUBE

A special cathode-ray tube in which binary digits are stored as positive or negative charges on a dielectric surface. (MIT)

ENIAC (Electronic Numerical Integrator and Computer)

General purpose automatic electronic computing machine developed by the Moore School of Electrical Engineering for the Army Ordnance Dept. It contains approximately 18000 vacuum tubes and 1500 relays. (RCA.L.)

See: Goldstine, Herman H. and Goldstine, Adele,: "The Electronic Numerical Integrator and Computer" Math. Tables and other Aids to Computation, Vol. 2, p. 97-110, 1946, (1 plate).

EQUATION SOLVER

A computing device, often of the analog type, which is designed to:

1) Solve systems of linear simultaneous (non-differential) equations.

or: 2) Find the roots of polynomials, or both. (RCA.L.)

ERASE

To restore a memory device to its original condition preparatory to the inscription of new data. (Bu.S.)

ERROR

The difference between a calculated value and another one which is considered exact. (Webster modified)

EXTRACT

A general name which applies to any order which produces a word by combining parts of other words, (logical multiplication is the most important example). (Bu.S.)

FEED-BACK AMPLIFIER

A type of amplifier in which a portion of the output signal is introduced in the input circuit. (RCA.L.)

FIXED-POINT SYSTEM

A computing system in which the scale-factor (and thus the location of the radix point) is assigned by the operator when the problem is initially coded. See "floating-point system". (MIT. Mod.)

In a computing machine, the system in which numbers are represented by a single sequence of digits without reference to the location of the radix point. (Bu.S.)

FLIP-FLOP

A circuit having two stable states of operation; often used as a memory for a single binary digit. (EMCCo. Mod.)

FLIP-FLOP STORAGE

Flip-flop registers used as high-speed memory elements. (MIT)

FLOATING-POINT SYSTEM

A computing system in which the scale factor (and thus the location of the radix point) associated with each number is stored in the machine. This scale factor is changed during computation so as to keep the significant digits of a number within the machine register. See "fixed-point system." (MIT. Mod.)

In a computing machine, the system in which numbers are represented and operated upon in a form such as to include the location of the radix point. (Bu. S.)

GATE CIRCUIT

A circuit having an output and a multiplicity of inputs so designed that the output is energized only when certain definite input conditions are met. (IRE)

HALF ADDER

A circuit with two input and two output terminals obeying the following rules:

A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

(So-called because two half adders are required to form one adder.) (Bu.S)

HARMONIC ANALYZER

A device to determine, implicitely or explicitely, the amplitude and phase of the various frequency components of, usually, a periodic function.

A device for obtaining similar information concerning a particular electrical or acoustical wave, etc. (RCA.L.)

HIGH-SPEED CARRY

A system in which all carries in all digit columns are executed simultaneously. (MIT)

INPUT EQUIPMENT

The equipment used for supplying information to a computer. (MIT. Mod.)

INSCRIBER

An input transcriber for a computing machine, for example one providing a keyboard for a data typist to prepare a perforated paper tape from a written manuscript, automatic means for checking this for errors against a similar tape, interpreting and changing the code, and transferring the data to another form as magnetized areas distributed along a magnetic wire. (Bu.S.)

INTEGRATOR

A device which integrates. (Webster)

JUMP

An order which gives the address of an order which may be executed next. (Also called a transfer or transfer of control): There are jumps of the following types:
(a) Unconditional Jump: A jump which is executed without regard to conditions.
(b) Conditional Jump: (also called a test or branch): a jump whose execution depends on a condition, such as one of the following:
(c) Sign Conditional Jump: A jump whose execution depends on the sign of a given number.
(d) Zero Conditional Jump: A jump whose execution depends on whether a given word is zero.
(e) Comparison: A jump whose execution depends on which of two given numbers is greater.
(f) Equality Test: A jump whose execution depends on whether two given numbers are equal. (Bu.S.)

LINK

An unconditional jump placed at the end of a sub-routine to transfer control back to the proper part of the main routine. (Bu.S.)

LOGICAL MULTIPLICATION

An operation in which a word is produced whose binary digits are the products of corresponding digits of two given words. (Bu.S.) (For binary systems only)

LOGICAL PRODUCT

The word produced in a logical multiplication. (Bu.S.)

MARK I (Automatic Sequence Controlled Calculator)

Large size electromechanical computing machine built by the International Business Machines Corporation for Harvard University. (RCA.L.)

See: Aiken, H.H. and Hopper, G.M.: "The Automatic Sequence Controlled Calculator", Electrical Engineering, Vol. 65, No. 8-9, Aug-Sept. 1946, p. 384-391.

MEMORY

1) The memory in a machine for handling information, such as a computer, is a storage device into which signals characterising the information can be introduced, identified by their location in the device and extracted at a subsequent indefinite time when called by a location identifying signal. The memory thus defined is essentially internal to the machine, does not furnish a dead record for filing purposes; does not require expendable materials or manual controls, and its purpose is to allow automatic successive steps in the manipulation of information. (IRE.S)

2) In general, any device into which alphabetic or numerical data can be entered, and then abstracted at a later time. (EMCCo.)

3) That mechanical or electrical device within a digital computer which stores numbers or orders temporarily or permanently. (ONR)

Definition 1) is preferred.

MEMORY: STORAGE CAPACITY

The maximum number of different stable states in which the storage device can find itself is a measure of its capacity. It is most convenient to use the logarithm in the base two of that number of alternatives as a numerical measure of the capacity, because that is the number of elementary binary cells physically existent statically in the device or virtual in its operation. (IRE.S)

MAJOR CYCLE

In a serial digital machine using a cyclic memory, one period of recirculation of the memory. (Bu.S.)

MULTIPLE-ADDRESS CODE

Orders in general consist of an instructional operation code plus the positions or addresses of one or more of the words in the storage. Orders are called single- or multiple- address orders depending on whether there are one or more references to storage for each operation. (MIT)

MULTIPLICAND

A number that is to be multiplied. (Webster)

MULTIPLIER

A device which multiplies. (Webster)

NYQUIST DIAGRAM

A plot in polar coordinates of the amplitude and phase characteristics of a feed-back system (amplifier or servo) whose feed-back loop is open, expressed as the ratio of the output to the input at the point where the loop is open. This diagram is commonly used to determine whether a feed-back system is stable or unstable. (RCA.L.)

OPERAND

A word on which an operation is to be performed. (Bu.S.)

ORDER

A coded instruction used by a machine in carrying out its operations.) (MIT. Mod.)

ORGAN

Largest subdivisions of a computer or computing system, i.e. arithmetic, control, etc. (IAS).

OUTPUT EQUIPMENT

The equipment used for extracting information from a computer. (MIT. Mod.)

OUTSCRIBER

An output transcriber for a computing machine, for example one which automatically transfers the computing machine output data on magnetized wire or tape to corresponding data in the form of perforated paper tape, subsequently converting from this intermediate or auxiliary form to a printed page, the equipment including monitoring and signal interpreting or sorting functions as needed. (Bu.S.)

OVERFLOW INDICATION

An automatic stoppage of the computer or transfer of control that occurs whenever an overflow occurs or a division by zero is attempted. (Bu.S.)

PARALLEL ARITHMETIC UNIT

The type of arithmetic unit in which all the digits of a number are operated on simultaneously. (Contr. Serial--) (ONR)

PARALLEL TRANSMISSION

The system of data transmission in which the digits of a number are transmitted simultaneously over separate lines, as contrasted to serial transmission. (MIT)

POINT (RADIX)

The index which separates the digits associated with negative powers from those associated with the zero and positive powers of the base of the number system in which a quantity is represented. E.g., binary point, decimal point. (MIT)

POSITIONAL NOTATION

One of the schemes of representing real numbers, characterized by the arrangement in sequence of digits (symbols for integers) with the understanding that successive digits are to be interpreted as the coefficients of successive integer powers of a number called the base or radix of the notation.

The representation of a real number by the notation: $a_n a_{n-1} \cdots a_2 a_1 a_0 . a_{-1} a_{-2}$ which is an abbreviation for the sum:

$$\sum_{i=0}^{i=m} a_i \prod_{j=1}^{j=i} r_j$$

where the . is called the radix point, the a_i are integers called digits and the r_j are non-zero integers called radices. Examples: if r_j is ten for even j, and six for odd j, this notation is called sexagesimal; if r_j is alternately two and five the notation is called biquinary. If $r_j = r$ is constant for all j it is called the radix of the notation, and the above sum reduces to:

$$\sum_{i=-\infty}^{i=m} a_i r^i$$

Examples: if r =2, the notation is called binary; if r = 10, the notation is called decimal. (Bu.S.)

PRECISION

Quality of being exactly or sharply defined or stated. (Webster) See "Accuracy".

PRELIMINARY PERFORATOR

A keyboard perforator in one type of inscriber employed to prepare a preliminary paper tape for monitoring purposes. (Bu.S.)

PRINTING EDITOR

A device for automatically printing a message, as from electrical signals, while inserting routine statements and positioning the printing on the page according to an established plan of timing or recognition. (Associated with Outscriber equipment) (Bu.S.)

PROGRAM (noun)

A general verbal description of the method of solving a particular problem on a computer, including the logical relationships between the constituent parts of the routine. (Bu.S.)

PROGRAM (Verb)

To write a program (contr. with "to code"). (Bu.S.)

PROGRAM CONTROL

The part of the control which sets up each operation prior to its arithmetic execution. (MIT)

PULSE-REPETITION FREQUENCY (PRF)

Number of pulses generated per second. (MIT)

The Frequency of the clock pulse. (Bu.S.)

See Repetition Rate.

PULSE TIME

The time elapsed from the beginning of one pulse to the beginning of the next. It is equal to the reciprocal of the pulse repetition rate. (EMCCo.)

One period of the clock pulse. (Bu.S.)

RADIX

The integer in a positional notation for numbers, of which the digits are coefficients of successive powers. Symbolically:

$\ldots + a_2 r^2 + a_1 r + a_0 + a_{-1} r^{-1} + a_{-2} r^{-2} + \ldots$ is written

$\ldots a_2 a_1 a_0 . a_{-1} a_{-2} a_{-3} \ldots$

Where r is the radix and the a_i are the integers $0 \leq a_i \leq r-1$. (Syn. Base) (Cf. Positional notation) (Bu.S.)

Any of the r_j in a positional notation. (Bu.S.)

RADIX (DECIMAL, BINARY, ETC.) POINT

In a positional notation (which see), a point between the digits which are coefficients of the zeroth and minus first powers of the radix. (Bu.S.)

The dot used in a positional notation to indicate the end of the integral part of the number. (Bu.S.)

See positional notation. (Bu.S.)

READ

To extract information from storage. (IRE)

READ IN

A command to introduce a number into a register by pulsing selected flip-flops of a register or by writing digits in storage-tube registers. (MIT)

READ OUT

A command to extract a number from a register by pulsing the read-out gate tubes of flip-flop registers or by reading the contents of storage-tube registers. (MIT)

REGISTER

1) A group of storage units (flip-flops, charged spots on storage surfaces, etc.) used in a machine to store a single number or order. (MIT, Mod.)

2) A single unit of the memory having a capacity of n words, or one of the other storage units having a capacity of one or more words. (EMCCo.)

Definition 1) is preferred.

REGISTER, STATIC

A memory device consisting of one or more flip-flops, each capable of storing one binary digit. The memory of a static register is not based upon a cyclic process. (EMCCo.)

REMAINDER

The number which is the undivided portion of the dividend left upon the termination of a division. (Bu.S.)

REPETITION RATE

The rate at which clock pulses occur. (EMCCo. Mod.)

See Pulse Repetition Frequency.

ROUND OFF

To delete less significant digits from a number and possibly apply some rule of correction to the part retained. (Bu.S.)

ROUND OFF ERROR

Error resulting from rounding off. (Bu.S.)

ROUTINE

A sequence of operations which a computer performs, or the sequence of orders which cause these operations. (Bu.S.)

A set of orders ready to be executed by a digital computer in the course of solving a problem. (Bu.S.)

SCALE FACTOR

The arbitrary factor associated with each number in the machine which, by adjusting the position of the radix point, determines the magnitude of the number so that its significant digits occupy a specified range of the powers of the base. (MIT. Mod.)

SELECTRON

The selectron is a vacuum tube in which on-off type of electrical signals are stored selectively in the form of one or the other of two intrinsically stable potentials of a number of insulated elements of material bombarded by a common shower of electrons. This electron shower is intercepted by two orthogonal sets of spaced, parallel, elongated conductors forming a matrix matching the storing elements.

The selection is obtained by energizing the conductors connected in a relatively small number of combinatorial groups so that only one window formed by two orthogonal pairs has all four sides positive, all others having at least one side negative. The writing consists of overpowering the stabilizing mechanism and driving the selected element to the desired potential. For reading from the tube, an electron or a displacement current, or a light signal, is obtained from the interrogation of the selected element.

The selectron is primarily intended as the inner memory organ of electronic high-speed digital computers. (JAR)

SERIAL TRANSMISSION

The system of data transmission in which the digits of a word are transmitted in sequence over a single line, as contrasted to parallel digit transmission. (MIT)

SEQUENCE CONTROL

The manner of operation in which orders to the machine are set up in sequence on some form of tape or cards and are fed constantly to the machine during the solution of a problem. (ONR) (Cf. Dynamic Sequence Control)

SERIAL ARITHMETIC UNIT

The type of arithmetic unit in which the digits of a number input are operated on in succession. (ONR) (Contr. Parallel -)

SERVO-AMPLIFIER

An amplifier used within the closed loop of a servo system. (RCA.L.)

SERVOMECHANISM

...the essential function of a servomechanism is to impose upon the output signal y(t) the same functional form as the input signal x(t), subject to the restriction that the energy associated with y(t) shall be derived from a local source, and shall not be furnished directly by the input signal.

A servomechanism is a system which performs the essential function of a servomechanism stated above and which is so constructed that the effective cause which operates the system is proportional to the following combination of the input and output signals:

$$\epsilon(t) = kx(t) - y(t)$$

(MacC.)

SHIFT

Movement of a word in a register one or more places to right or left; equivalent to multiplying or dividing the number by a power of the radix. (MIT. Mod.)

SIGN DIGIT

A single digit of a word used to designate algebraic sign. (MIT. Mod.)

SIMULATION

The representation of physical systems by a computer and associated equipment. (MIT)

SINGLE-ADDRESS CODE

Orders in general consist of an instructional operation code plus the positions or addresses of one or more of the words in the storage. Orders are called single - or multiple - address orders depending on whether there are one or more references to storage for each operation. (MIT)

STATIC REGISTER

A memory device which, while remembering, has a constant state as contrasted with a device which remembers by delaying and recirculating i.e., dynamically. (Bu.S.)

STATICIZER

A circuit for converting a time sequence of pulses on one wire into a combination of static voltages on several wires. (British) (Bu.S.)

STORAGE

That part of the computer that holds the numbers and orders used by the computer. (MIT. Mod.)

SUBPROGRAM (Syn. - Subroutine)

A subdivision sequence of orders which may be inserted in the main sequence of orders whenever desired. (MIT)

SUBROUTINE

A routine (which see) within a routine, especially one to be repeated several times in a performance of the latter. (Bu.S.)

SUM

In arithmetic, the number resulting from addition. (Bu.S.)

SUMMAND

One of a set of numbers to be added. (Cf. Addend, Augend) (Bu.S.)

TIME SCALE TRANSFORMATION

In the computing machine solution of a problem involving functions of time, the substitution of kt for t, where k is a constant. (RCA.L.)

TRANSCRIBER, (TRANSCRIBING SYSTEM)

See "Transcribe"

Equipment associated with a computing machine for the purpose of transferring input(or output) data from a manuscript to the medium used by the computing machine proper, or from the computing machine to a printed page, usually by intermediate forms of recording. (Bu.S.)

TROUBLE LOCATION PROBLEM

A test problem whose incorrect solution offers information on the location of faulty equipment; used after a check problem has showed that a fault exists. (MIT)

VERIFIER

A type of monitoring system. The portion of an Inscriber devoted to automatically checking one data typing or recording process against a previous record. A mechanical or automatic proof-reading device. (Bu.S.)

VOLATILE

The property of a memory device that the stored data are lost in the event of a power interruption. (Bu.S.)

WHIRLWIND I

The first prototype of the high-speed parallel type electronic digital computers to be designed by Project Whirlwind of the Servomechanisms Laboratory, Mass. Inst. of Technology (under Contract N5-ori- 60 with the Special Devices Center, Office of Naval Research.) Register length will be sixteen binary digits, storage capacity 2048 sixteen-digit words. (MIT)

WHIRLWIND II

The second of the computers of Project Whirlwind. See Whirlwind I. (MIT)