A Dictionary of

Computing

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encapsulation **1.** *See* OBJECT, INFORMATION HIDING. **2.** *See* INTERNETWORKING.

encoder **1.** The means by which an encoding process is effected (*see* CODE). It may be implemented in hardware or software, the process being algorithmic in nature. **2.** A logic circuit, usually an integrated circuit, that generates a unique n-bit binary word, indicating which of its 2^n input lines is active, i.e. at logic 1. A **keyboard encoder**, for example, may be required to generate a unique binary code indicating which key on the keyboard has been pressed.

If two or more of the device inputs can be active simultaneously then a **priority encoder** is required, which usually encodes only the highest-order data input.

encoding **1.** The transformation of a message into an encoded form. *See* CODE. **2.** The representation of symbols in some alphabet by symbols or strings of symbols in some other alphabet. A common example is *binary encoding.

encryption The processing of a message by a sender in order to render it unintelligible to other than authorized recipients. *See also* CRYPTOGRAPHY.

end-around-carry A type of carry that is required when a *radix-minus-one complement representation of integers is used and two integers so represented are summed. If a carry is generated at the most significant end of the two numbers, then this carry must be added to the digit at the least significant end of the result to give the radix-minus-one complement representation of the sum.

end-around shift *Another name for* circular shift. *See* SHIFT.

endomorphism A *homomorphism from an *algebra to itself.

endorder traversal *Another name for* postorder traversal.

end-to-end control Control acting between two applications that are communicating across one or more networks. Data traversing a network must be protected against a number of possible forms of error. An individual unit of data may be corrupted, lost completely, or delivered more than once; successive units of data may be delivered in the wrong order. The sender may attempt to transmit data more quickly than the receiver can receive it, or some part of the route can actually carry it. Within the network, the transmitter and receiver at the two ends of an individual link will cooperate to control some of these errors, and this is known as **point-to-point control**. However, it may also be necessary to require the applications at each end of the overall connection to cooperate in protecting against other forms of error, and this is end-to-end control.

end-to-end encryption The transfer of an encrypted message across a system without intermediate stages of decryption and reencryption. *Compare* LINK ENCRYPTION.

energizer A hardware or software mechanism that is used as an aid in testing the behavior of a subsystem. The intention is that the energizer should drive the subsystem in a way that simulates its actual application, and should at the same time analyze the responses from the subsystem in order to detect any erroneous behavior.

engine **1.** A component of a software system that handles a specific aspect of processing. Engines thus form part, or possibly the whole, of an application's *back end. For example, a database engine provides database services other parts of the system; a search engine provides searching services; and so on. Engines can be shared among several applications – for example, through the *client/server model – and are often bought from a third-party specialist supplier. **2.** *Another name for* back end.

engineering of computer-based systems (ECBS) A narrower form of *systems engineering that addresses only those systems which are computer-based. This is a very important subset of systems engineering, but is still very much wider than *software engineering. It encourages a holistic view of a system, its environment, and its components. Often the components of computer-based systems are also (lower-level) computer-based systems. ECBS pays great attention to addressing nonfunctional properties of a proposed design, and the need for give-and-take between different design options prior to committing to an implementation. Give-and-take is seen as a crucial aspect of such developments because it is here that competing requirements and

informatics The use of computers to maintain and analyze large amounts of data. The term is applied particularly with respect to databases of chemical compounds or reactions (**chemoinformatics**) or databases in biochemistry or cell biology (**bioinformatics**).

information Generally, information is whatever is capable of causing a human mind to change its opinion about the current state of the real world. Formally, and especially in science and engineering, information is whatever contributes to a reduction in the uncertainty of the state of a system; in this case, uncertainty is usually expressed in an objectively measurable form. Commonly, this is done by means of Shannon's *entropy. Nevertheless, this formula for uncertainty involves probabilities, and these may well have to be subjective. If that is so, the formal measurement must be qualified as depending on subjective probabilities, and "uncertainty" must be replaced by "opinion, or personal estimate, of uncertainty".

Information must be distinguished from any medium that is capable of carrying it. A physical medium (such as a magnetic disk) may carry a logical medium (data, such as binary or text symbols). The information content of any physical objects, or logical data, cannot be measured or discussed until it is known what range of possibilities existed before and after they were received. The information lies in the reduction in uncertainty resulting from the receipt of the objects or the data, and not in the size or complexity of the objects or data themselves. Questions of the form, function, and semantic import of data are only relevant to information inasmuch as they contribute to the reduction of uncertainty. If an identical memorandum is received twice, it does not convey twice the information that its first occurrence conveyed: the second occurrence conveys no information at all, unless, by prior agreement, the number of occurrences is itself to be regarded as significant.

Information has ramifications in security, politics, culture, and the economy, as well as in science and engineering. The extent to which information is used as an economic commodity is one of the defining characteristics of the "post-industrial" society, hence the phrase "the information society".

information destination *See* SHANNON'S MODEL.

information engineering The engineering approach applied to *information systems. The term shows considerable variation in scope. At its broadest, it refers to the engineering discipline covering a spectrum from *software engineering and *systems engineering to device-level electronics. At its most limited (but perhaps best known), it is the name of a specific proprietary method for the development of organizational information systems, primarily associated with James Martin; this method begins with *enterprise modeling and carries through to the generation of program code, and a number of software toolsets are available for its support.

information hiding A principle, used when developing an overall *program structure, that each component of a program should **encapsulate** or hide a single design decision. The principle was first expounded by David Parnas, who advocated an approach to program development in which a list is prepared of design decisions that are particularly difficult or likely to change; individual components, known as **modules**, are then defined so that each encapsulates one such decision. The interface to each module is defined in such a way as to reveal as little as possible about its inner workings.

This approach leads to modules that are readily understood and can be developed independently. More important, it also leads to programs that are easy to change, with many desired changes requiring modification of only the inner workings of a single module.

information management system A term sometimes used synonymously with *database management system (DBMS) although normally used in a more general sense. The term has no widely accepted definition and thus can be applied to any system of software that facilitates the storage, organization, and retrieval of information within a computer system, without the implication that it need have all the essential characteristics of a DBMS. The information held may include sound fragments, images, and video sequences in addition to the usual textual and numerical information. These newer forms of computer-held information are sometimes argued as being a defining

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