

A Dictionary of
Computing

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semiconductor materials that will be used to fabricate the IC are then associated with this geometric definition so that electric simulation of the behavior of the IC can be carried out. The geometric definition forms the basis of the masks that will be used for fabrication of the device by a process of photolithography. *See also* SEMICUSTOM.

full duplex *Another name for duplex.*

full-motion video (FMV) The real-time display of full-screen motion video. The large data rates involved and the need to decompress images in real time means that it is difficult to achieve.

full subtractor *See* SUBTRACTOR.

full text retrieval (free text retrieval) A form of *information retrieval in which the full text of a document is stored, and retrieval is achieved by searching for occurrences of a given string in the text. This technique can be compared with the alternative of retrieving information by matching one of a set of predetermined keywords.

full tree A tree of *degree m and *depth k in which every node at depth less than k has m children and thus, in particular, all leaf nodes are at depth k .

function 1. from one set X to another set Y . A *relation R defined on the *Cartesian product $x \times y$ in which for each element x in X there is precisely one element y in Y with the property that (x, y) is a member of R . It is then customary to talk about a function f , say, and to write

$$f: X \rightarrow Y$$

The unique association between elements x and y is denoted by

$$y = f(x) \text{ or } y = fx$$

X is called the **domain** of f , Y the **codomain** of f . Further, y is the **value** of f at the point x or the **image** of x under f . We say that f is a **mapping** or **transformation** between sets X and Y or that f maps X into Y , and that f maps x into y . When the domain X is the Cartesian product of n sets then f is a function of n variables. Otherwise it is a function of one variable.

Examples of functions are readily obtained from the mathematical equivalents of standard functions and operations typically supplied in programming languages. The usual trigonometric functions **sin**, **cos**, and **tan** are

functions of one variable. The rule for converting from characters into their integer codes or equivalents is a function.

Functions are often represented pictorially as *graphs.

See also BIJECTION, INJECTION, SURJECTION, OPERATION, HOMOMORPHISM.

2. A *program unit that given values for input parameters computes a value. Examples include the standard functions such as $\sin(x)$, $\cos(x)$, $\exp(x)$; in addition most languages permit user-defined functions. A function is a "black box" that can be used without any knowledge or understanding of the detail of its internal working. In some languages a function may have *side effects.

functional cohesion *See* COHESION.

functional dependency *See* NORMAL FORMS.

functional design A design method in which the system is seen from the functional viewpoint. The design concentrates on isolating high-level functions that can then be decomposed into and synthesized from lower-level functions. Development proceeds as a series of *stepwise refinements of functionality. *Compare* DATA-DRIVEN DESIGN.

functional languages (applicative languages) A class of programming languages whose programs compute *functions. In practice, the class of functional languages are a subclass of the *declarative languages, and are based on *lambda calculus or *recursion equations. Typically a program in a functional language consists of an unordered set of equations that characterize functions and their values. Functions are specified by use of recursion, other functions, and values. Values are characterized as functions applied to other values. Ultimately the set of equations that is the program must characterize all functions and values in terms of the primitive functions and values provided by the language. The values characterized by the equations include the values computed by executing the program.

functional partitioning A technique of system or program decomposition in which the primary criterion is that each identified module should contain only elements that all contribute to the achievement of a single goal. Thus each module should perform a single function in the broad sense of an identified job of work (the definition of

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