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FUNCTION IN MATHEMATICS AND METHODS

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A **function** from a set X to a set Y is an assignment of an element of Y to each element of X. The set X is called the domain of the function and the set Y is called the codomain of the function.

A function, its domain, and its codomain, are declared by the notation $f: X \to Y$, and the value of a function f at an element x of X, denoted by $f(x)$, is called the *image* of x under f, or the *value* of f applied to the *argument* x.

Functions are also called *maps* or *mappings*, though some authors make some distinction between "maps" and "functions" (see § Other terms).

Two functions f and g are equal if their domain and codomain sets are the same and their output values agree on the whole domain. More formally, given $f: X \to Y$ and $g: X \to Y$, we have $f = g$ if and only if $f(x) = g(x)$ for all $x \in X$.

The domain and codomain are not always explicitly given when a function is defined, and, without some (possibly difficult) computation, one might only know that the domain is contained in a larger set. Typically, this occurs in mathematical analysis, where "a function from X to Y often refers to a function that may have a proper subset of X as domain. For example, a "function from the reals to the reals" may refer to a real-valued function of a real variable. However, a "function from the reals to the reals" does not mean that the domain of the function is the whole set of the real numbers, but only that the domain is a set of real numbers that contains a non-empty open interval. Such a function is then called a partial function. For example, if f is a function that has the real numbers as domain and codomain, then a function mapping the value x to the value $g(x) = 1/f(x)$ is a function g from the reals to the reals, whose domain is the set of the reals x, such that $f(x) \neq 0$.

The range or image of a function is the set of the images of all elements in the domain.

Relational approach

In the relational approach, a function $f: X \to Y$ is a binary relation between X and Y that associates to each element of X exactly one element of Y. That is, f is defined by a set G of ordered pairs (x, y) with $x \in X$, $y \in Y$, such that every element of X is the first component of exactly one ordered pair in G. In other words, for every x in X, there is exactly one element y such that the ordered pair (x, y) belongs to the set of pairs defining the function f. The set G is called the graph of f. Some authors identify it with the function; however, in common usage, the function is generally distinguished from its graph. In this approach, a function is defined as an ordered triple (X, Y, G). In this notation, whether a function is surjective (see below) depends on the choice of Y.

Any subset of the Cartesian product of two sets X and Y defines a binary relation $R \subseteq X \times Y$ between these two sets. It is immediate that an arbitrary relation may contain pairs that violate the necessary conditions for a function given above.

A binary relation is functional (also called right-unique) if

A binary relation is serial (also called left-total) if

A partial function is a binary relation that is functional.

A function is a binary relation that is functional and serial. Various properties of functions and function composition may be reformulated in the language of relations. For example, a function is injective if the converse relation $R^{T} \subseteq Y \times X$ is functional, where the converse relation is defined as $R^{T} = \{(y, x) \mid (x, y) \in R\}$.

Set exponentiation[edit]

See also: Exponentiation § Sets as exponents

The set of all functions from a set *X* to a set *Y* is commonly denoted as

which is read as *Y to the power X*.

This notation is the same as the notation for the Cartesian product of a family of copies of *Y* indexed by *X*:

The identity of these two notations is motivated by the fact that a function *f* can be identified with the element of the Cartesian product such that the component of index *x* is *f*(*x*).

When *Y* has two elements, is commonly denoted and called the powerset of *X*. It can be identified with the set of all subsets of *X*, through the one-to-one correspondence that associates to each subset the function *f* such that if and otherwise.

Reference

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