

function, mathematical

function, mathematical. See ALGORITHM, MATHEMATICAL FUNCTION.

function, probability. See BAYESIAN RATIONALITY.

function, state. See QUANTUM MECHANICS.

function, teleological. See TELEOLOGY.

functional. See RELATION.

functional abstraction. See COMBINATORY LOGIC.

functional calculus, lower. See FORMAL LOGIC.

functional completeness. See COMPLETENESS.

functional dependence, a relationship between variable magnitudes (especially physical magnitudes) and certain properties or processes. In modern physical science there are two types of laws stating such relationships.

(1) There are numerical laws stating concomitant variation of certain quantities, where a variation in any one is accompanied by variations in the others. An example is the law for ideal gases: $pV = aT$, where p is the pressure of the gas, V its volume, T its absolute temperature, and a a constant derived from the mass and the nature of the gas. Such laws say nothing about the temporal order of the variations, and tests of the laws can involve variation of any of the relevant magnitudes. Concomitant variation, not causal sequence, is what is tested for.

(2) Other numerical laws state variations of physical magnitudes correlated with times. Galileo's law of free fall asserts that the change in the unit time of a freely falling body (in a vacuum) in the direction of the earth is equal to gt , where g is a constant and t is the time of the fall, and where the rate of time changes of g is correlative with the temporal interval. The law is true of any body in a state of free fall and for any duration. Such laws are also called "dynamical" because they refer to temporal processes usually explained by the postulation of forces acting on the objects in question. R.E.B.

functional explanation. See PHILOSOPHY OF THE SOCIAL SCIENCES.

functionalism, the view that mental states are defined by their causes and effects. As a metaphysical thesis about the nature of mental states, functionalism holds that what makes an inner state mental is not an intrinsic property of the

functionalism

state, but rather its *relations* to sensory stimulation (input), to other inner states, and to behavior (output). For example, what makes an inner state a pain is its being a type of state (typically) caused by pinpricks, sunburns, and so on, a type that causes other mental states (e.g., worry), and a type that causes behavior (e.g., saying "ouch"). Propositional attitudes also are identified with functional states: an inner state is a desire for water partly in virtue of its causing a person to pick up a glass and drink its contents when the person believes that the glass contains water.

The basic distinction needed for functionalism is that between *role* (in terms of which a type of mental state is defined) and *occupant* (the particular thing that occupies a role). Functional states exhibit *multiple realizability*: in different kinds of beings (humans, computers, Martians), a particular kind of causal role may have different occupants – e.g., the causal role definitive of a belief that p , say, may be occupied by a neural state in a human, but occupied (perhaps) by a hydraulic state in a Martian. Functionalism, like behaviorism, thus entails that mental states may be shared by physically dissimilar systems. Although functionalism does not automatically rule out the existence of immaterial souls, its motivation has been to provide a materialistic account of mentality.

The advent of the computer gave impetus to functionalism. First, the distinction between software and hardware suggested the distinction between role (function) and occupant (structure). Second, since computers are automated, they demonstrate how inner states can be causes of output in the absence of a homunculus (i.e., a "little person" intelligently directing output). Third, the Turing machine provided a model for one of the earliest versions of functionalism. A Turing machine is defined by a table that specifies transitions from current state and input to next state (or to output). According to Turing machine functionalism, any being with psychological states has a unique best description, and each psychological state is identical to a machine table state relative to that description. To be in mental state type M is to instantiate or realize Turing machine T in state S .

Turing machine functionalism, developed largely by Putnam, has been criticized by Putnam, Ned Block, and Fodor. To cite just one serious problem: two machine table states – and hence, according to Turing machine functionalism, two psychological states – are distinct if they are followed by different states or by different outputs. So, if a pinprick causes A to say "Ouch"

and causes B to say "Oh," then, if Turing machine functionalism were true, A's and B's states of pain would be different psychological states. But we do not individuate psychological states so finely, nor should we: such fine-grained individuation would be unsuitable for psychology. Moreover, if we assume that there is a path from any state to any other state, Turing machine functionalism has the unacceptable consequence that no two systems have any of their states in common unless they have all their states in common.

Perhaps the most prominent version of functionalism is the *causal theory of mind*. Whereas Turing machine functionalism is based on a technical computational or psychological theory, the causal theory of mind relies on commonsense understanding: according to the causal theory of mind, the concept of a mental state is the concept of a state apt for bringing about certain kinds of behavior (Armstrong). Mental state terms are defined by the commonsense platitudes in which they appear (David Lewis). Philosophers can determine a priori what mental states are (by conceptual analysis or by definition). Then scientists determine what physical states occupy the causal roles definitive of mental states. If it turned out that there was no physical state that occupied the causal role of, say, pain (i.e., was caused by pinpricks, etc., and caused worry, etc.), it would follow, on the causal theory, that pain does not exist. To be in mental state type *M* is to be in a physical state *N* that occupies causal role *R*.

A third version is teleological or "homuncular" functionalism, associated with William G. Lycan and early Dennett. According to homuncular functionalism, a human being is analogous to a large corporation, made up of cooperating departments, each with its own job to perform; these departments interpret stimuli and produce behavioral responses. Each department (at the highest subpersonal level) is in turn constituted by further units (at a sub-subpersonal level) and so on down until the neurological level is reached. The role-occupant distinction is thus relativized to level: an occupant at one level is a role at the next level down. On this view, to be in a mental state type *M* is to have a sub-... subpersonal ϕ -er that is in its characteristic state $S(\phi)$.

All versions of functionalism face problems about the qualitative nature of mental states. The difficulty is that functionalism individuates states in purely relational terms, but the acrid odor of, say, a paper mill seems to have a non-relational, qualitative character that functionalism misses altogether. If two people, on seeing a ripe

banana, are in states with the same causes and effects, then, by functionalist definition, they are in the same mental state – say, having a sensation of yellow. But it seems possible that one has an "inverted spectrum" relative to the other, and hence that their states are qualitatively different. Imagine that, on seeing the banana, one of the two is in a state qualitatively indistinguishable from the state that the other would be in on seeing a ripe tomato. Despite widespread intuitions that such inverted spectra are possible, according to functionalism, they are not. A related problem is that of "absent qualia." The population of China, or even the economy of Bolivia, could be functionally equivalent to a human brain – i.e., there could be a function that mapped the relations between inputs, outputs, and internal states of the population of China onto those of a human brain; yet the population of China, no matter how its members interact with one another and with other nations, intuitively does not have mental states. The status of these arguments remains controversial.

See also BEHAVIORISM, INTENTIONALITY, PHILOSOPHY OF MIND, TURING MACHINE.

L.R.B.

~~functionalism, analytical. See PHILOSOPHY OF MIND.~~

~~functionalism, machine state. See PHILOSOPHY OF MIND.~~

~~functionalism, Turing machine. See FUNCTIONALISM.~~

~~functional jurisprudence. See JURISPRUDENCE.~~

~~functor. See FORMAL LOGIC.~~

~~*fundamentum divisionis* (Latin, 'foundation of a division'), term in Scholastic logic and ontology meaning 'grounds for a distinction'. Some distinctions categorize separately existing things, such as men and beasts. This is a *real* distinction, and the *fundamentum divisionis* exists in reality. Some distinctions categorize things that cannot exist separately but can be distinguished mentally, such as the difference between being a human being and having a sense of humor, or the difference between a soul and one of its powers, say, the power of thinking. A *mental* distinction is also called a *formal* distinction. Duns Scotus is well known for the idea of *formalis distinctio cum fundamento ex parte rei* (a formal distinction with a foundation in the thing), primarily in order to handle logical problems with~~