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THE TURING MACHINE AND FUNCTIONALISM

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RESEARCH ARTICLE

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Abstract

Turing machine functionalism is one of the famous versions of functionalism. Here Alan Turing's proposal and the development of his idea into the Computational theory of mind is the main topic. A mathematical logician, Alan Turing believed that human behaviour might be understood in terms of computation & his views inspired contemporary computational theories of mind, here he proposed a comparative test for machine intelligence, namely, the 'Turing Test'. Some early functionalists, most notably Hilary Putnam, compared the mental states of a person with the machine table states of a Turing machine. He at first rejected any identification between mental states and machine table states, though he defended such identification in his later writings. Like several other philosophers, Jerry, Fodor defended a functionalist view of the mind. Ile developed a more literal application of this model than the other functionalists. Fodor claimed that thinking is performing computational operations on mental representations. These inner representations form a system with many of the basic properties of a language, so the system can be called 'the language of thought'. This inner language of thought is not public, like English, but innate. Like Fodor, Ramsey, Frank Plumpton, also defended the theory of machine functionalism. He defined mental states by their cause, effects and interactions. Like Ramsey's and Fodor's theories, connectionism is also an approach to computation that uses connectionist networks. A connectionist network is composed of information processing units or modes. Units process information only locally, respond to their specific input line by changing their activation values. As a result of such local unit processing, networks themselves can behave in rule like ways to compute functions. But the Turing Machine described by Turing is abstract machines. The physical realization of them is the Von Neumann computers or classical symbolic systems. A computer is regarded as a machine which processes representations in a systematic way.

Keywords: *Computation, Comparative test, Machine intelligence, Turing Test, Artificial intelligence, Computational processes of perception, reasoning and decision making, Computational operating, Algorithm, Computational approach to the mind, Turing Machine Functionalism*

Alan Turing was a mathematical logician who made fundamental contributions to the theory of computation. Turing believed that human behaviour might be understood in terms of computation and his views inspired contemporary computational theories of mind. He proposed a comparative test for machine intelligence, the ‘Turing Test’, with which a human interrogator tries to distinguish a computer from a human by interacting with them only over a tele-typewriter. Although the validity of the Turing test is controversial, the test and modifications of it remain influential measures for evaluating artificial intelligence.

The concept of a Turing machine furnishes a theoretical foundation for much work in cognitive science and artificial intelligence, where the driving idea is that cognitive process like all our mental processes, are ultimately computational processes of perception, reasoning and decision making. In other words, these are to be explained in terms of computational operating. A version of this computational approach to the mind is called “Turing Machine Functionalism”.

One of the philosophically most important consequence of Turing's proposal is that it provides a method of explaining all our mental activities in simple mechanical terms. This is concerned with the simple mechanical components whose operations can be understood purely in terms of physical causation.

Turing not only provide a rigorous account of computation in terms of Turing machines, but also proposed a classic test for examining machine mentality. His test, the Turing test, is designed to examine the ability of computers to initiate humans. In the Turing test a human interrogator or judge; puts questions to two unseen subjects – one a computer and the other a human.

The task of the interrogator is to determine, based on a tele-typewriter communication with the two unseen subjects, which one is the computer and which one the human. The goal of the computer is to intimate a human, including the imitation of typical human strengths and weakness. To use Turing's own example, when the computer subject is asked to dd 34,957 and 70,764, it does not respond immediately but waits about 30 seconds and then responds with 105621 rather than the correct answer 105,721. Turing, however does not specify, whether it is reasonable to assume that the interrogator is allowed to ask many questions over an extended period of time. The computer passes the test if and only if the interrogator is unable to distinguish (better than chance) between the computer and the human responses.

The Turing test has a number of virtues as a scientific test, the test is conducted with blind impartiality. The interrogator in the test cannot judge the computer to be non-intelligent, because of its appearance alone. The sophistication of the behaviour is the crucial variable, and linguistic behaviour in the test can be evaluated without subtle bias due to appearance. Second, the test is re-producible. If the computer really has intelligence, then it has a cluster of abilities that can be demonstrated over and over again.

Turing also argued that the class of functions calculable by means of an algorithmic procedure (a mechanical, stepwise, deterministic procedure) is to be identified with the class of functions computable by Turing machine. An algorithm is a 'mechanical' step-by-step procedure operating on systematically well-defined symbols in a way that captures relations among the things that symbols represent. Alan Turing developed a general account of algorithms, conceiving what are called 'Turing Machines', perfectly mechanical computing devices that arrive at a determinate answer or 'output' to a question, given certain data or 'input'. According to the influential 'Church-Turing-Thesis', Turing Machines can systematically compute anything that is intuitively 'computable'. This idea is the inspiration for much of the modern computer industry. CTM extends it to psychology: the suggestion is that all intelligent processes can be systematically decomposed in to algorithms consisting of steps that can be executed by primitive processes of a machine.

Some versions of functionalism are connected with the notion of a Turing machine, while others are not. The particular type of functionalism is called 'Machine Functionalism'. The well-known functionalist, Hillary Putnum, pointed out that any programmed computer can be abstractly characterized as a Turing machine, independently of its 'hardware' or 'physical make-up'. He then went further and argued that any two systems will share mental states as long as they have the same Turing machine description.

A Turing machine is specified by two functions: one from inputs and state to outputs, and one from inputs and states to states, inputs and outputs, and the two functions specify a set of conditionals, one for each combination of state and input, the conditionals are in this form: "if the machine is in state S and receives input I, it will then emit output O and go into next states". This set of conditionals is often expressed in the form of a machine table (see below). Any system that has a set of inputs, outputs and states related in the way specified by the machine table is described by the machine table and is a realization of the abstract automaton specified by the machine table (this definition actually characterized a finite automaton, which is just one kind of Turing machine).

One very simple version of machine functionalism states that each system that has mental states is described by at least one Turing machine table of a certain specific sort; it also states that each type of mental state of the system is identical to one of the machine table states specified in the machine table. We can consider for example, the Turing machine described in the following "coke machine"[2] table.

Coke Machine Table

Nickel input	Emit no output-Go to S^2	Emit a Coke-Go to S^1
Dime input	Emit a Coke-stay in S^1	Emit a Coke and a Nickel-Go to S^1

One can get a crude picture of the simple version of Machine Functionalism, described above by considering the claim that S1=dime-desire and S2=nickel-desire. Off course, no functionalist would claim that a coke machine desires anything. Rather, the simple version of machine functionalism described above makes an analogous claim with respect to a much more complex machine table.

Machine versions of functionalism are useful for many purposes, but they do not provide the most general characterization of functionalism. One can achieve more generality by characterizing functionalism as the view that what makes a pain a pain (and generally, what makes any mental states the mental state it is) is it's having a certain causal role. But this formulation buys generality at the price of vagueness.

Now the question can be raised that, how does all these relate to functionalism as a theory of mind? Well, the proposal is simply that we conceive of the human mind as an enormously complex machine table, incarnated in the neurological processes of the brain. Like Coke-machines, human beings take input in the form of sensory and perceptual information, and output them in the form of behaviour. For example, information is received through one's eyes that the bull in the field one is crossing is about to charge. This information is processed in one's brain and a behavioural output results, namely that one should run for the gate (The implementation of a different part of mental machine table might, alternatively, mean that one could stand on one's ground if, for example, one had the experience in handling bulls before and knows how to cope with emergency situation involving them)

The machine table comprising the human mind would be incredibly complex, but, for the Turing machine computational functionalist, that is how human beings do function internally. Doubtless, the table comprising human (and animal) mentality would contain systems within systems, arranged hierarchically, beginning at the lowest or most basic level with the simplest elements that cannot be broken down into simple functions, and becoming increasingly more complex as the hierarchy is ascended, until the final and complete functional structure may be discerned. Such complex systems are exemplified by the organization charts of large companies, which details the functions and internal structures of various departments together with their relationship to other departments, so that the aim of the company as a whole may be carried out. Machines, too, consist of sub-systems, which enable the various functions of the machine as a whole to be served.

In the case of human beings, these simple elements, it may be conjectured, will be the molecules (and ultimately the atoms) which make up the nerve cells that help to constitute the brain and certain nervous system. At higher levels we will find such structures as the hippocampus, which is responsible for the laying down of long-term memories, or the lateral geniculate bodies, which act as a staging-post for the transfer of neural impulses from the optic nerves to the occipital region of the cerebral cortex, which is known to deal with visual perception.

In this way, computational functionalism offers us an information-processing model of the mind which can explain our abilities. It cannot, after all, be by magic-pixie dust in the synapses-which we possess the capacities we do for face recognition or the use of language, for example. The computational theory of the mind offers us our best chances yet of understanding why human beings are the creatures they are. This is what the computationalists claim. Putnum (1960) compared the mental states of a person with the machine table's states of a Turin machine. He then rejected any identification of mental states with machine table's states, but in a series of articles over the years he moved closer to such identification, a pattern culminating in "Psychological Predicates" (1967). In this article, Putnum came closer to advocating a view-which he defended in his philosophy of Mind lectures in late 1960s-that mental states can be identified with machine table states.

Jerry Fodor developed a similar view (though it was not couched in terms of Turing machine) in the context of a functional-analysis view of psychological explanation.

Putnam's as well as Fodor's positions were characterized in part by their opposition to physicalism, the view that each type of mental state is a physical state. Their argument is with regard to the simple version of Turing machine functionalism (described above), the view that pain, for instance, is a machine table state.

Jerry Fodor has been one of the most influential figures in the philosophy of psychology, and 'cognitive science' during the latter part of the twentieth century.

His primary concern has been to argue (vigorously) for a certain view of the nature of thought. According to this view, thinking is information processing within 'the language of thought'. The mind can be understood as a computer which directs action with the aid of internal representations of the world.

Like several other philosophers, Fodor in the 1960s defended a functionalist view of the mind. Functionalism makes possible a physicalist world-view but does not seek simply to reduce sciences such as psychology to physics. The computer model of the mind has been central to functionalism. Fodor, however, developed a more literal application of this model than other functionalists.

For Fodor, the value of the computer-model lies in the light it sheds on reasoning. Belief, planning and other intelligent thought processes (He does not see functionalism as a way of explaining the first-person 'feel' of experience). Fodor claims that thinking is performing computational operations on mental representations. These inner representations form a system with many of the basic properties of a language, so the system can be called 'the language of thought' (Fodor 1975). This internal language is not identical to any public language, such as English. Rather, it is used in learning public languages. Thus, the language of thought is both innate and universal.[3]

Fodor holds that to believe that limes contain vitamin C, for example, is to have in one's head a certain sentence-like formula in the language of thought. A formula is a belief that limes contain vitamin C in virtue of both its internal causal role, which makes it a belief rather than a hope or desire, and also in virtue of connections to the external world, which determine its content. These formulae are made up of mental 'terms' with their own properties of meaning and reference. The terms combine to generate the truth condition of the whole. There are also 'implicit' beliefs which follow trivially from the explicitly represented ones, but only explicitly represented beliefs contribute to thought processes.

Though the inner formulae have semantic properties, their causal contributions to thought depend only on their formal or 'syntactic' properties; these are the properties relevant in computational processed. Indeed, these semantic properties depend partly on the nature of the thinker's environment, and what is outside the head cannot directly affect the production of behaviour. Nonetheless, Fodor insists that there are many psychological generalizations that are naturally and perhaps, necessarily expressed in terms of the semantic content of thoughts. For sometimes Fodor posited inner code with representational properties, but did not have a theory of how such representations were possible. He tried to solve this problem with his 'asymmetric dependence' theory of meaning (Fodor 1990). This is a variety of informational or indicator semantics, based on causal and law-like connections between thoughts and their objects. We cannot simply say that whatever can cause a representational state is represented by that state, since then error would be impossible. Fodor's proposal is that an inner symbol 'horse' represents horses if occurrences of this symbol do so because of the connection between the 'horse' and 'horses'. These are the central elements of Fodor's view, or the Computational Representational Theory of Mind.

Frank Plumpton Ramsey was one of the supporters of functionalism. In defining a belief's strength by its effects on our actions, Ramsey foreshadows the later theories which define mental states by their causes, effects and interactions.

The Turing Machine described by Turing are abstract machines. The physical realization of them is the Von Neumann computers or classical symbolic systems. A computer is regarded as a machine which processes representations in a systematic way. Two ideas are involved here: (1) processes in a systematic way and (2) representations. Both the ideas are captured by the notion of a Turing Machine. The first idea is explained in terms of algorithm. The second idea is explained by the symbols which are interpreted as representing something. The first analogue to mind is provided by the computationalist theory of mind, the second is revealed by connectionism or parallel distributed processing-that brains consisted of a network of simple electrical processing units which stimulated and inhibited each-other.

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