

Review

A Cartesian critique of the artificial intelligence

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This paper deals with the philosophical problems concerned with research in the field of artificial intelligence (AI), in particular with problems arising out of claims that AI exhibits 'consciousness', 'thinking' and other 'inner' processes and that they simulate human intelligence and cognitive processes in general. The argument is to show how Cartesian mind is non-mechanical. Descartes' concept of 'I think' presupposes subjective experience, because it is 'I' who experiences the world. Likewise, Descartes' notion of 'I' negates the notion of computability of the mind. The essence of mind is thought and the acts of thoughts are identified with the acts of consciousness. Therefore, it follows that cognitive acts are conscious acts, but not computational acts. Thus, for Descartes, one of the most important aspects of cognitive states and processes is their phenomenality, because our judgments, understanding, etc. can be defined and explained only in relation to consciousness and not in relation to computability. We can only find computability in machines and not in the mind, which wills, understands and judges.

Key words: Cartesian mind, artificial intelligence, physical symbols, non-mechanical mind, thought, intelligence, cognitive, intentionality, subjectivity.

INTRODUCTION

It is not wrong to compare Descartes' idea with the idea of artificial intelligence (AI). Although the association of Descartes' name with the notion of AI is bound to cause some surprise both to the followers of Descartes and AI scientists, the term 'AI', even though unnamed, was already born in the period when Descartes was alive. It is true that AI is a distinct discipline, yet its philosophical problems are very important in the present scenario. In the modern philosophy, we find that Descartes was wondering whether or not it would be possible to create a machine that would be phenomenologically indistinguishable from man. He also advocated that animals are simply machines and human beings, if someone is set to possess an immaterial soul, might also simply be considered as machines. One important concern is manifestation of his consideration of what it would mean to say that a machine thinks (Descartes, 2003).

We know what AI is and what it does in our unreflective moments. As such, when AI scientists ascribe the mental qualities or mind to machines, then this mechanistic construction of mind brings about many philosophical issues. This paper deals with philosophical problems connected with research in the field of AI, in particular

with problems arising from claims that AI exhibits 'consciousness', 'thinking' and other 'inner' processes and that they simulate human intelligence and cognitive process in general. This paper deals with how Descartes' idea of mind is non-mechanistic. The study shall begin by giving a brief characterization of AI and how it defines mind. Secondly, an attempt will be made to understand the nature of mind presupposed by artificial intelligence. As such, the study shall discuss about the nature of mind because without proper understanding of Descartes' notion of mind, it is impossible to discuss contemporary philosophy of mind. Lastly, there is an argument that Descartes' idea of mind is non-mechanistic because the way AI scientists define mind is completely mechanistic and to which the notion of computability is applicable and the mental qualities are credible to machines, but not to minds. The main aim in this paper is to clarify Descartes' notion of mind from a subjective point of view. It is believed that Descartes' notion of mind cannot be explained or characterized in an artificial intelligence approach and that they are the subjective mental states which we can see from the first-person perspective of their proper understanding.

ARTIFICIAL INTELLIGENCE

Artificial intelligence attempts to understand intelligent entities; but unlike philosophy, which is concerned with intelligence, AI strives to build intelligent entities as well as understand them. There are many philosophers and many scientists who define AI differently. Haugeland defines artificial intelligence as, “the exciting new effort to make computers think.... machines with minds, in the full and literal sense” (Haugeland, 1989). On the other hand, according to Bellman, it is “the automation of activities that we associate with human thinking and activities such as decision making, problem of solving learning...” (Bellman, 1978). Let us look at these two definitions from different angles. Here, Haugeland and Bellman point out that artificial intelligence is concerned with thought process and reasoning. They have explained the machines as a mind that is completely associated with human thinking, that is to say, computers do think. People with widely varying back-grounds and professional knowledge are contributing new ideas and introducing new tools in this discipline. Cognitive psychologists have developed new models of the mind based on the fundamental concepts of artificial intelligence, symbols, systems and information processing. Linguists are also interested in these basic notions while developing different models in computational linguistics, and philosophers, in considering the progress, problems and potential of this work towards non-human intelligence, have sometimes found solution to the age-old problems of the nature of mind and knowledge.

However, we know that artificial intelligence is a part of computer science in which there are designed intelligent systems that exhibit the characteristics we associate with intelligence in human behaviour, understanding language learning, reasoning, problem solving and so on. It is believed that insights into the nature of the mind can be gained by studying the operation of such systems. Artificial intelligence researchers have invented dozens of programming techniques that support intelligent behaviour. As such, artificial intelligence research may have impact on science and technology in the following way:

- (i) It can solve some difficult problems in chemistry, biology, geology, engineering and medicine.
- (ii) It can manipulate robotic devices to perform some useful, repetitive and sensory-motor tasks.

Besides, artificial intelligence researchers investigated different kinds of computation and different ways of describing computation in an effort not just to create intelligent artifacts, but also to understand what intelligence is. According to Charniak and McDermott, (Tanimoto, 1987), their basic tenet is to create computers which think. Thus artificial intelligence expands the field

of intelligent activity of human beings in various ways.

The hypothesis of artificial intelligence and its corollaries are empirical in nature whose truth or falsity is to be determined by experiment and empirical test. The method of testing the results of artificial intelligence comprises the following:

- (i) In the narrow sense, artificial intelligence is part of computer science, aimed at exploring the range of tasks over which computers can be programmed to behave intelligently. Thus, it is the study of the ways computers can be made to perform cognitive tasks, which generally human beings undertake.
- (ii) In the wider sense, artificial intelligence is aimed at programs that simulate the actual processes that human beings undergo in their intelligent behavior, and these simulated programs are taken as theories describing and explaining human performance. Moreover, they are tested by comparing the computer output with the human behaviour to determine whether both the result and also the actual behaviour of computers and persons are closely similar (Simon, 1987).

A digital computer is also an example of a physical symbol system, a system that has the capability of input, output, storing, etc., following different courses of operation. These systems are capable of producing intelligence depending on the level of mechanical sophistication they have. The computers with these capabilities behave intelligently like human beings, according to the AI researchers.

MIND IN ARTIFICIAL INTELLIGENCE

Here, the states of mind in artificial intelligence will be explored. As we know, the main aim of artificial intelligence is to reproduce mental mechanisms in machines. That is to say, AI aims at producing machines with mind. Therefore, artificial intelligence is the discipline that attempts to understand the nature of human intelligence through the construction of computer programs that imitate intelligent behavior. It also emphasizes the functions of the human brain and the analogical functioning of the digital computer. If we say that machines have minds, then we have to ascribe certain ‘belief’, ‘knowledge’, ‘free will’, ‘intention’, ‘observations’, etc. to a machine. In that case, the machines will perform intelligent tasks and thus will behave like human beings. According to one extreme view, the human brain is just a digital computer and the mind is a computer program. This view, as John Searle calls it, is strong artificial intelligence (Searle, 1996).

According to strong artificial intelligence, “the appropriately programmed computer with the right inputs and outputs literally has a mind in exactly the same sense that we all do” (Searle, 1987). This shows that the

devices would not only refer to being intelligent and have minds, but mental qualities of a sort that can be attributed to teleological functioning of any computational device, even to the very simplest mechanical ones such as a thermostat. Here, the idea is that mental activity is simply the carrying out of some well-defined operations, frequently referred to as an algorithm. We may ask here as to what an algorithm actually is. It will be adequate to define an algorithm simply as a calculation procedure of some kind, but in the case of thermostat, the algorithm is extremely simple: the device registers whether the temperature is greater or smaller than the setting and then, it arranges for the circuit to be disconnected in the former case and to remain connected in the latter. For understanding any significant kind of mental activity of a human brain, a very complex set of algorithms has to be designed to capture the complexity of the human mental activities. As such, the digital computers are approximations of the complex human brain.

The strong artificial intelligence view is that the differences between the essential functioning of a human being (including all its conscious manifestations) and that of a computer lie only in the much greater complication in the case of the brain. All mental qualities such as thinking, feeling, intelligence, etc., are to be regarded, according to this view, merely as aspects of this complicated functioning of the brain; that is to say that they are the features of the algorithm being carried out by the brain. The brain functions like a digital computer according to this view. Therefore, the supporters of strong AI hold that the human brain functions like a Turing machine which carries out all sets of complicated computations. The brain is naturally designed like a computing machine to think, calculate and carry out algorithmic activities. To strong AI supporters, the activities of the brain are simply algorithmic activities which give rise to all mental phenomena like thinking, feeling, willing, etc.

The field of artificial intelligence is devoted in large part to the goal of reproducing mental activities in computational machines. The supporters of strong AI argue that we have every reason to believe that eventually computers will truly have minds. Winston says, "Intelligent robots must sense, move and reason" (Winston, 1984). Accordingly, intelligent behaviour is interpreted as giving rise to abstract automation. That is to say that an artificial, non-biological system could thus be the sort of thing that could give rise to conscious experience. For the supporters of strong AI, humans are indeed machines and in particular, our mental behaviour is finally the result of the mechanical activities of the brain. The basic idea of the computer model of the mind is that the mind is the software and the brain is the hardware of a computational system. The slogan is: "the mind is to the program, as the brain is to the hardware" (Searle, 1990). For strong AI, there is no distinction between brain processes and mental processes, because

the process which is happening in the brain is a computational process and the mind is the alternative name of the brain which is a machine.

The theory of computation deals wholly with abstract objects such as turning machine, Pascal program, finite-state-automation and so on. These abstract objects are formal structures which are implemented in formal systems. However, the notion of implementation is the relation between abstract computational objects and physical systems. Thus, computations are often implemented in synthetic silicon based computers, whereas, the computational systems are abstract objects with a formal structure determined by their states and state transition relations, in which the physical systems are concrete objects with a causal structure determined by their internal states and the causal relations between the states. It may be pointed out that a physical system implements a computation when the casual structure of the system mirrors the formal structure of the computation. The system implements the computation, if there is a way of mapping the system states into the computations states so that the physical states which are causally related to the formal states are correspondingly related formally (Chalmers, 1996).

The fact is that there is rich causal dynamics inside computers, as there is in the brain. There is real causation going on between various units of brain activity, precisely mirroring patterns of causation between the neurons. For each neuron, there is a specific causal link with other neurons. It is the causal patterns among the neurons in the brain that are responsible for any conscious experiences that may arise. The brain, as Marvin Minsky says, "Happens to be a meat machine" (Pamela, 1979). He points out that the brain is an electrical and chemical mechanism, whose organization is enormously complex and whose evaluation is barely understood, and as such, produces complex behavior in response to an even more complex environment. Artificial intelligence understands the nature of human intelligence in terms of the computational model of the mind.

Now the question is: What would the world be like if we had intelligent machines? What would the existence of such machines say about the nature of human beings and their relation to the world around them? These questions have raised profound philosophical issues which will be discussed in due course.

DESCARTES' REMARKS ON MIND AND ARTIFICIAL INTELLIGENCE

So far, we have discussed artificial intelligence and its presuppositions of mind. In the Cartesian scheme of mind, there is no place for computability because the thought act is due to the subjective thinking thing, which is the self. Again, this subjective thinking thing or the self is that which "doubts, understands, affirms, denies, is

willing, is unwilling and also imagines and has sensory perceptions" (Descartes, 1984). The existence of the thinking thing is the same as the existence of the subjective thinking thing, because it is the subject, who thinks. All these subjective activities are non-computational because the subjective activity is the first person perspective. The mental processes, for Descartes, are intentional and are the free acts of the thinking subject. Therefore, this subjective attitude of mind cannot be mapped mechanically in an algorithmic system.

Descartes' concept of 'I think' presupposes subjective experience, because it is 'I' who experiences the world. Likewise, Descartes' notion of 'I' negates the notion of computability of the mind. The essence of mind is thought and the acts of thoughts are identified with acts of consciousness. Therefore, it follows that cognitive acts are conscious acts, but not computational or mechanical acts. Thus for Descartes, one of the most important aspects of cognitive states and processes is their phenomenality because of our judgments, understanding, etc. that can be defined and explained only in relation to consciousness and not in relation to computability. We can only find computability in machines and not in the mind, which wills, understands and judges. Descartes' dictum, "I think, therefore, I am" (Descartes, 1984). not only establishes the existence of the self which thinks and acts but also its freedom from mechanistic laws to which the human body is subjected to.

Moreover, when Descartes makes the distinction between mind and body, he did not claim that the idea of the mind is that of a ghost, although he did say that the idea of the body is that of a machine. Following this, Ryle in his book, 'The Concept of Mind' says that Descartes' distinction between mind and body is a myth. He argues, "I shall often speak of it, with deliberate abusiveness, as 'the dogma of the ghost in the machine'. I hope to prove that it is entirely false, and false not in detail but in principle" (Ryle, 1985). According to Ryle, Descartes' distinction between mind and body commits a category-mistake (Ryle, 1985).

As Ryle said, "my destructive purpose is to show that a family of radical category mistake is the source of the double-life theory. The representation of a person as a ghost mysteriously ensconced in a machine derived from this argument, because, as is true, a person's thinking, feeling and purposive doing cannot be described solely in the idioms of physics, chemistry and physiology. Therefore they must be described in counterpart idioms. As the human body is a complex organized unit, so the human mind must be another complex organized unit, though one made of a different sort of stuff and with a different sort of structure. Likewise, again, as the human body, like any other parcel of matter, is a field of causes and effects, so the mind must be another field of causes and effects, though not (Heaven be praised) mechanical causes and effects" (Ryle, 1985).

In Ryle's understanding of mind, mind becomes as much mechanical as the body and is therefore non-different from the body. However, Descartes refutes the mechanistic reading of mind. As we have seen, Descartes is a dualist, rather than a mentalist. Descartes' argument for the mind, which is distinct from the body, needs to be understood as an argument for the logical possibility of their separate existence and not for the fact that they exist independent of each other. The separability argument is as follows: "First, I know that everything, which clearly and distinctly understands is capable of being created by God so as to correspond exactly with my understanding of it. Hence, the fact that I can clearly and distinctly understand one thing apart from another is enough to make certain that two things are distinct, since they are capable of being separated at least by God. The question of what kind of power is required to bring about such a separation does not affect the judgment that the two things are distinct. Thus, simply by knowing that I exist and seeing at the same time that absolutely nothing else belongs to my nature or essence except that I am a thinking thing, I can infer correctly that my essence consists solely in the fact that I am a thinking thing. It is true that I may have (or, to anticipate, that I certainly have) a body that is very closely joined to me, nevertheless, on the one hand, I have a clear and distinct idea of myself, in so far as I am simply a thinking, non-extended thing; and on the other hand, I have a distinct idea of the body, in so far as this is simply an extended non-thinking thing. Accordingly, it is certain that I am really distinct from my body and can exist without it" (Descartes, 1984).

Descartes has already proved in the 'Second Meditation' the existence of a thinking being that has a clear and distinct perception of the mind as a thinking, non-extended thing. This is a proof of the non-mechanical mind which is different from the body subject to mechanical laws. Similarly, in the 'Fifth Meditation', he has shown that he has a clear and distinct idea of a body as extended and a non-thinking substance. This is to suggest that the mechanically existing body is ontologically distinct from the non-computational mind.

The afore-described distinction between mind and body supposes that there is no 'ghost' in the human body or 'ghost in the machine'. However, Descartes did not admit the existence of ghost in the machine. Had Descartes admitted that there was a ghost in the human body, then the mind itself would become computational, and there would be no necessary distinction between the mind and the body, because the ghost itself is a body; but Descartes admits the distinction between mind and body and this shows that the mind is non-computational. It is mind, which has the capacity of intelligence and understanding. The Cartesian way of understanding the concept of intelligence is anti-physicalist and anti-behaviourist and hence is anti-mechanical.

The human mind is beyond the sphere of

computationality, because the human mind has innate ideas, which are embedded as the innate dispositions of the human mind. These ideas are *a priori* in the human mind and are the basic in-born propensities. Descartes observes, “my understanding of what a thing is, what truth is and what thought is, seems to be derived simply from my own nature, but my hearing a noise, as I do now, or seeing the sun, or feeling the fire, comes from the thing which is located outside of me, or so I have hitherto judged. Lastly, sirens, hippogriffs and the likes are my own invention” (Descartes, 1984).

The afore-said observation of Descartes shows that innate ideas are not produced in us by the senses. If the ideas were conveyed to us by the senses like heat, sound, etc., we would not have to refer to anything outside ourselves, because they too would be innate. For Descartes, “the ideas of pain, colours, sounds and the likes must be all the more innate, if, on the occasion of certain corporeal motions, our mind is to be capable of representing them to itself, for there is no similarity between these ideas and the corporeal motions.” (Descartes, 1985). Here, it follows that there is a distinction between innate and adventitious ideas and that innate ideas are universal ideas, whereas adventitious ideas are particular ideas. As such, Descartes points out that hearing a noise, seeing the scene and feeling the fire are all particular ideas. (Descartes, 1984). Again, it must be noted that the perception of the particular is not possible without the universal. Innate universal ideas are a necessary requirement for the cognition of the particular objects in the world.

Following Descartes, Chomsky established that language too is an innate faculty of the human species. Language becomes the essence that defines what it is to be human. Language is purely a syntactic system, according to Chomsky, and it therefore has a logical form which is universal and innate to the world. Language must also have an essence, something that makes language what it is and inheres in all languages. That essence is called ‘universal grammar’ (George and Mark, 1999). Language does not arise from anything bodily. Studying the brain and body can give us no additional insight into language. The basic tenets of Chomsky’s linguistics are taken directly from Descartes. The only major tenet of Descartes that Chomsky rejects is the existence of the mental substance different from the human brain. Chomsky accepts that the human brain embodies the innate grammatical structures.

Like Chomsky, Quine also affirms that there can be no philosophical study of the mind outside psychology: progress in philosophical understanding of the mind is inseparable from progress in psychology, because, psychology is a ‘natural science’ studying a natural phenomenon, that is, a physical human subject. Quine argued, “a dualism of mind and body is an idle redundancy” (Quine, 1994), and holds “corresponding to

every mental state, however fleeting or remotely intellectual, the dualist is bound to admit the existence of a bodily state that is obtained when and only when the mental one is obtained. The bodily state is trivially specifiable in the dualist’s own terms, simply as the state of accompanying a mind, which is in the mental state. Instead, one state is ascribed to the mind, and then, we may equivalently ascribe the other to the body. The mind goes by the board and will not be missed” (Quine, 1985).

Quine’s position is that there are irreducible psychological properties, but all explanation is ultimately physical. His account of our mental concepts emerges as he examines how we acquire them, how we learn them, etc.

He explains, “such terms are applied in the light of publicly observable symptoms: bodily symptoms strictly of bodily states and the mind strictly of mind state. Someone observes my joyful or anxious expression, or perhaps observes my gratifying or threatening situation itself, or hears me talk about it. He then applies the word ‘joy’ or ‘anxiety’. After another such lesson or two, I find myself applying those words to some of my subsequent states in cases where no outward signs are to be observed beyond my report itself. Without the outward signs, to begin with, mentalistic terms could not be learnt at all” (Quine, 1994). Quine opposes the Cartesian dualism and therefore arrives at a behaviourist and functionalist conception of mind. He reduces the mental states like beliefs and other propositional attitudes to functional states. If both Chomsky and Quine are right about the nature of mind, then Descartes’ view of mind is wrong. That is, if that human brain is the cause of the mental states, then we cannot but arrive at the conclusion that the mental states are causally computable within a physical system. Chomsky and Quine define the mental qualities in terms of physical qualities. Therefore, they define mind in terms of the computational functions of the brain. However, Descartes claims that all ideas in the mind are mental representations (Descartes, 1984).

In the ‘third meditation’, Descartes gives an extensive account of ideas. He says, “thus when I will (or am afraid, or affirm, or deny), there is always a particular thing which I take as the subject of my thought, but my thought includes something more than the likeness of that thing. Some thoughts in this category are called volitions or emotions, which others called judgments” (Descartes, 1984). The afore-said quotation shows that some thoughts are images of things, that is, they represent things in the world. In other words, they have an object or content by which they are individuated as an idea of this particular thing or being. Moreover, Descartes also considers an ‘idea’ to refer to the ‘form’ of any thought. In his words, “I understand this term to mean the form of any given thought, the immediate perception of which makes me aware of the thought. Hence, whenever, I express something in words, and I understand what I am saying, this very fact makes it certain that there is within

me an idea of what is signified by the words in question” (Descartes, 1984). Therefore, the ideas, for Descartes are thus representational and intentional in character.

Descartes, unlike Hobbes and Gassendi, is not a naturalist and keeps the thought content free from naturalization to which Hobbes and Gassendi are committed to. For them, thoughts are mechanical processes in the brain (Hobbes, 2003). In reply to Descartes, Gassendi says, “I thus realize that none of these things the imagination enables me to grasp is at all relevant to this knowledge of which I possess, and that the mind must therefore be most carefully diverted from such things if it is to perceive its own nature as distinctly as possible” (Hatfield, 2003). On the contrary, Descartes holds that individual acts of imagination, in as much as they are experiences, are relevant to grasping the nature of mind, because the mind is a thinking thing free from the mechanistic processes of the brain. What separates Descartes’ dualism from contemporary functionalism and identity theories is not so much his distinction between an immaterial mind and extended material body, as his notion of the human being is a unity of mind and body, with the properties not reducible to either mind or body, but dependent precisely on their ‘substantial’ union.

Descartes holds that thinking cannot be explained mechanically. His argument that brutes cannot think is equivalent to an argument that machines cannot think. He thinks that no machine could have the capacity of using the linguistic and other signs to express thoughts and to give appropriate responses to meaningful speech, and the capacity to act intelligently or rationally in all sorts of situations (Descartes, 1985). But what is so special about human language use and what does it show that the behaviour of any mechanism fails to show? A machine could be construed to utter words corresponding to bodily change in its origin, but could never use spoken words or other signs that are composed as we do to declare our thoughts to others, because “It is not conceivable that the machine should produce different arrangements of words so as to give an appropriately meaningful answer to whatever is said in its presence, as the dualist of men can do. Secondly, even though such machines might do some things as well as we do them, or perhaps even better, they would inevitably fail in others, which could reveal that they were acting not through understanding but only from the disposition of their organs. For the fact that reason is a universal instrument which can be used in all kind of situations, these organs need some particular disposition for each particular action, hence it is morally impossible to have enough different ones in a machine to make it act in all contingencies of life in the way in which our reason makes us act” ((Descartes, 1985).

What Descartes is drawing attention to here is firstly, no machine could have the capacity to use linguistic and other signs to express thoughts and give appropriate responses to meaningful speech, and secondly, machine

would not have the capacity to act intelligently in all sorts of situations. Here, animal communication have not offered counter evidence to Descartes’ assumption that human language is based on an entirely distinct principle, nor has modern linguistic philosophers dealt with their observations in serious way. For Chomsky, the main lessons to be learnt from the ‘Cartesian’ tradition in linguistic are the idea of an innate, universal grammar and the idea that the study of the structure of this argument will reveal the structure of thought or mind.

Descartes’ argument that brutes or machines cannot think in the light of the general question of what makes an utterance or a symbolic structure meaningful is noteworthy. The kind of automatic, rule governed computation or symbol processing that a turing machine instantiates and that can be performed by electronic computers would not count as thinking in Descartes’ sense, nor would the mechanical operations of a computer or robot, no matter how ingenious or intelligent, count as rational behaviour as he understands it. Not only did such a view makes thinking too narrow, it is based on precisely the kind of category mistake that Ryle attributes to the Cartesians which have been discussed earlier.

Descartes is not a reductionist as he thinks that mind cannot be reduced to anything else and it must have an autonomous existence alongside the existence of the material body. The ‘I think’ of the mental reality does not deny the ‘I exist’ character in the world, rather it is an affirmation of it. In that sense, we cannot say that Descartes has subjectivized the mental world and thus made it into a private world. He made every effort to keep an objective constraint on the subjective mind and thus forestalled all skeptical questions about the existence of other minds. (Pradhan, 2001). This is because Cartesian doctrine of the mind and its inner experience do assume that we know other minds as much as we know our own. That is the reason why Descartes called the ‘I think’ the absolute basis of all our knowledge-claims about others and the external world. Thus, the self or mind is irreducible/not explainable in terms of the body or machines whether of Descartes or another’s. In view of this, we can say that the Cartesian philosophy of the mind is not based on a mistake and as such, it has shown the right way to the understanding of the mind.

Of course Descartes would not have accepted the idea of mechanical or computational artificial intelligence, because he may still be considered an important forerunner of cognitive and computational view of the mind. The essence of the mind is rational thinking and rational thought or cognition can be studied independently of other phenomena, like sensation and emotions, in that Descartes stated that the body is dependent on mental phenomena, to which the mind is referred to as consciousness. Although Descartes did not identify mental thought with consciousness, emotions, awareness, etc., he regarded that all these are conditions of thought. While arguing the existence of mind,

Descartes talks about the mind acting in some particular location in the brain. As such, this is comparable to contemporary literal talk about mental processes as computational activity in the brain. Moreover, Descartes would not have accepted the mechanical application of rules on syntactic structures as a sufficient condition for rational symbol manipulation. The kind of automatic, rule-governed computation or symbol processing that a Turing machine instantiates and that can be performed by electronic computers would not count as thinking from the Cartesian point of view. Therefore, Cartesian thinking is neither reducible to a narrowly understood rational capacity nor to consciousness because he clearly mentions that consciousness is a necessary condition for thought.

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