

Chapter 2

Understanding

Machine understanding is the term introduced by authors to denote understanding by a machine and is referring to the new area of research the aim of which is investigating the possibility of building the machine with the ability to understand. A machine to be able to understand needs to imitate the way in which humans understand and is based on the assumption that the results of understanding by the machine (SUS) can be evaluated according to the rules applied for evaluation of human understanding. Machine understanding will be defined in Chap. 4 in the context of both human understanding and existing systems that can be regarded as the simplest understanding systems. This chapter is not intended as a survey of literature on the vast topic concerning understanding, but rather as a presentation of the point of view of selected thinkers on this topic and a discussion of some aspects of understanding considered to have implication for material presented in other chapters of this book.

Understanding appears as the result of the thinking process and can be the object of the scientific inquires. Locke [112] has no doubt that understanding can be studied like anything else: “we can observe its objects and the ways in which it operates upon them” he wrote. Understanding that is often called cognition involves processes such as learning, problem solving, perception, intuition and reasoning, and requires abilities such as intelligence. Understanding that is based on knowledge is often connected with interpretation or disclosing meaning of the language and the concept is the key element of understanding process. Understanding and thought were topics of many philosophical thinkers such as Plato, Aristotle, Locke, Berkeley, Leibnitz or Gadamer (see e.g. [17, 62, 71, 87, 95, 112, 147]) and were regarded in the context of the origins of human knowledge.

For Plato [142] understanding is a kind of vision or grasping of forms or ideas. Our mental eye that is the eye of the soul is endowed with intellectual intuition and can see Idea. Idea according to Plato is essence and an object that belongs to the intelligible world. We can see an object, essence in the light of the truth that means we know this essence when we have managed to see it, to grasp it.

According to Plato particular things in the empirical world are imperfect reflection of Ideas or archetypes. Idea, that is a part of the ideal world, is a model for the perceived thing. Plato saw that the sensible world stands to transcendental reality in the relation of a copy to a model.

According to Aristotle understanding is strictly connected with perception and abstraction. Perception points to a different notion of abstraction, a much more sophisticated cognitive operation. The concept is obtained based on the abstraction and generalization. According to Aristotle abstraction must be complemented with definition which is the determination of a concept by deriving it deductively from the higher genus and pinpointing it through its distinguishing attribute (*differentia*). Abstraction removes the more particular attributes of the more specific instances and arrives at the higher concepts. Higher concepts are poorer in content but broader in range. Aristotle established the universal as the indispensable condition of the individual thing's existence and as the very character of the perceivable object. He rejected the arbitrary choice of the attributes that can serve as the basis of generalization. The qualities of an object shared with others of its kind were not an incidental similarity but the very essence of the object. What was general in an individual was the form impressed upon it by its genus. An object existed only to the extent of its essence since the being of the object was nothing but what had been impressed upon the amorphous raw material by its form—giving genus. The object's accidental properties were mere impurities, the inevitable contribution of the raw material. When a perceptual generalization is to be made, it can only be done by recognizing the common essence of the specimens. Shared accidentals cannot serve as the basis for a genus. The important part of understanding is an object of thoughts.

Traditional Aristotelian and scholastic philosophy had distinguished between two kinds of objects of mental life [62]. The first forms or species are universals and appropriate for intellect and thoughts. The second phantasms are objects for sensory perception and are particular sensory images. Augustinian theory [61] explained the understanding (cognition) as the result of a divine illumination and was based on innate ideas. This Neo-Platonic view was that an essence of created things was 'participations' of the divine essence. God, in contemplating them, does nothing but contemplate Himself. Scotus rejected the traditional Augustinian-Franciscan theory of a special divine illumination and held, with Aquinas, that Aristotelian doctrine of the abstraction of the universal can explain the genesis of human knowledge without it being necessary to invoke either innate ideas or a special divine illumination. According to Aquinas [7] who stresses the importance of knowledge in understanding, the direct object of human intellectual knowledge is the form abstracted from matter, which is the principle of individuation, and known through the universal concept. The senses apprehend the individual thing but the mind apprehends it only indirectly, as represented in an image or phantasm. There is no intellectual intuition of the individual thing as such. The concept is a key element of knowledge that is stored in our brain. The concept was often viewed in relation to the universal terms. In the Middle Ages the problem of universal terms or class names was the topic of the many tractates [62]. These

universal terms were thought of as a hierarchical structure of the class names. Also important problem: the relation between concept and object it represents, was investigated by many philosophers.

The fundamental principles of Locke's thought concerning understanding are presented in "*An Essay Concerning Human Understanding*" [112]. This essay was the culmination of 20 years of Lock's reflection on the origins of human knowledge. The Essay is divided into four books; the first is a polemic against the doctrine of innate principles and ideas. The second deals with ideas, the third with words, and the fourth with knowledge. Lock did not distinguished between cognition and understanding. According to Locke, what we know is always properly understood as the relation between ideas. He devoted much of the Essay to an extended argument that all of our ideas—simple or complex—are ultimately derived from experience. The consequence of this empiricist approach is that our knowledge is severely limited in its scope and certainty. Our knowledge of material substances, for example, depends deeply on the secondary qualities by reference to which we name them, while their real inner natures derive from the primary qualities of their insensible parts. In Locke's terminology 'ideas' are images, sensory states, abstract thoughts or contents of such thoughts. Locke holds that discursive thinking is mentally manipulating 'abstract ideas'. He described 'abstract ideas' as attenuated images. The meaningful imagery transformation that changes the visual concept can be translated into the Lock's terminology as mentally manipulating 'abstract ideas' that are attenuated images. Lock often used the term idea for description of concept. Locke's idea means whatsoever the mind perceives in itself, or the immediate object of perception, thought or understanding [112]. Locke defines the term 'idea' as 'whatsoever is the object of understanding when a man thinks' and include sensations and sensory images amongst ideas. Sensory images become paradigm ideas and are treated as sensory or quasi-sensory images. Locke tried to solve the problem of generality of 'images' by invoking abstract general idea treated as abstract general images e.g. an idea of triangle is an image which is, at the same time, every specific kind of triangle and none in particular. On the contrary, Berkeley [17] claims that there is no sense in the idea of such an image. His alternative theory is that a particular image becomes general by representing or standing for some class of images. From the point of view of the subject, this happens when he is selecting of the relevant feature of the image. When someone is imaging an equilateral triangle, he takes it as representing all triangles by assuming that it has three sides, and ignoring their relative proportions, its size, angle, colour. Berkeley argues that we cannot form the idea of something unthought-of, for once we form such an idea its object is, ipso facto, thought of. It requires distinction between the thought and its object. The thought is in the mind, the object is not. This distinction is called the intentionality of thought. From intentionality of thought we conclude: if everything thinkable can be realized in an image as a feature of it, than the concept of mind-independent matter, and mind-independence, should be realizable. But, necessarily, such things cannot be properties of images, which are essentially mental, so we cannot have idea of them. To overcome the problem solipsism he does have a doctrine of

representation whereby an idea can stand for others. This doctrine is the source of the associationism theory, which was to be the principle empiricist account of meaning and thought until the end of the nineteenth century.

Hume's *An Enquiry Concerning Human Understanding* appeared in 1748 [7]. The central themes of the book are that very little of what we think we know can actually be derived from any idea that there are actual necessary connections between observed phenomena. We assume that certain things are connected just because they commonly occur together, but a genuine knowledge of any connection is mere habit of thought. So, a severe skepticism is the only rational view of the world. Hume's investigations into human understanding lead him to doubts. He asks on what grounds we base our judgments and investigates their rational justification. Finding certain inconsistencies in our normal procedures, for instance, that our belief in necessary connection is not rationally justified led him to a kind of consequent doubt of our mental faculties.

Descartes claimed that "natural light" of understanding is a faculty created by God [46]. We come to know not only created eternal truths but uncreated truth: that God exists, that God is not a deceiver, that God is immutable, a necessary being, *causa sui*. But God is not subject to the limits of our understanding, and we only have access to these uncreated truths through a faculty given to us by Him. If our understanding seeks some unconditional verification of God's existence and truthfulness, through means outside the scope of God's creative will, it seeks in vain. Descartes initiates a critique of the understanding itself. It is immediately aimed at "eternal truths", that is, mathematical truths which for Descartes are properly truths of the understanding.

According to Kant [87] who pointed out on the important role of the knowledge in understanding, all our knowledge begins with experience that is by means of objects which affect our senses, and partly of themselves produce representations, partly rouse our powers of understanding into activity, to compare, to connect, or to separate these, and so to convert the raw material of our sensuous impressions into a knowledge of objects. But, though all our knowledge begins with experience, it by no means follows that all arises out of experience. He claimed that our empirical knowledge is a compound of that which we receive through impressions, and that which the faculty of cognition supplies from itself. Knowledge independent of experience is called *a priori*, in contradistinction to empirical knowledge, which has its sources *a posteriori*, that is, in experience. Kant argues that 'the mind imposes its own internal conception of space and time upon the sensory information it receives' and understanding is one of the higher faculties of knowledge and, in general, can be defined as the faculty of rules. Ideas, as Kant argues are *a priori* concepts whose source lies in pure reason alone. Their only legitimate theoretical use is to regulate the understanding's cognition of objects: reason sets down the conditions under which the understanding's activity will have achieved its ideal completion in the systematic interconnection of its cognitions, i.e., in an ultimate science. Reason thereby offers the understanding of a rule against which any actually achieved system of science must be measured [87]. Because human finitude makes it impossible, in principle, for any actual system to attain the ideal maximum, reason also

spurs the understanding on towards ever new discoveries and reorganizations. Understanding requires knowledge and the concept is a key element of knowledge that is stored in our brain and for Kant concepts when they relate to objects do so by means of feature which several things may have in common. Having a concept does not imply a relation to an object. Once an object is given, it can be thought about, but what allows it to be given in the first place is its relation to intuition. According to Kant intuitions are those representations by means of which objects are given to us whereas concepts are those representations by means of which we think about objects. The distinction between intuition and concept thus corresponds to the distinction between the particular and general. An intuition is a representation of one particular, individual thing, 'a single object'. A concept is inherently general: necessarily a concept can apply to more than one particular, since to apply a concept to an object is to say that it belongs to a kind of which there are or could be other instances. According to Kant it is not images of objects, but schemata, which lie at the foundation of our pure sensible concepts. For example, no image could ever be adequate to our concept of a triangle in general. For the generality of the concept it could never attain to, as this includes under itself all triangles, whether right-angled, acute-angled, etc. whilst the image would always be limited to a single part of this sphere. The schema of the triangle can exist nowhere else than in thought, and it indicates a rule of the synthesis of the imagination in regard to pure figure in space. Still less is an object of experience, or an image of the object, ever adequate to the empirical concept. On the contrary, the concept always relates immediately to the schema of the imagination, as a rule of the determination of our intuition, in conformity with a certain general concept. For example, the concept of dog indicates the rule, according to which our imagination can delineate the figure of a four-footed animal in general. We can say—the image is a product of the empirical faculty of the productive imagination—while the schema of sensible concepts is a product of the pure imagination *a priori*. According to pure imagination *a priori* image first becomes possible, which, however, can be connected with a concept only by means of the schema which they indicate. On the other hand, the schema of the pure concept of the understanding is something that cannot be reduced into any image it is nothing else than the pure synthesis expressed by the category, conformably to the rule of unity according to concepts. It is a transcendental product of the imagination, the product which concerns the determination of the internal sense, according to conditions of its form (time) in respect to all representations.

For Schopenhauer [161] understanding is kind of grasping of ideas. Schopenhauer draws on Plato theory of ideas, according to which particular things in the empirical world are imperfect reflection of Ideas. In other words, what is seen is not a real world object (a rose, a thing) but the shape that refers to an ideal form 'an eternal Idea of a rose that any human being in any time or culture can see'. Schopenhauer's aesthetic object (Idea) is not to be confused with a concept of thing (rose), because a concept abstracts from an empirical experience, whereas an Idea is that which precedes our ordinary experience of a rose, as the rose archetype. Such Ideas are the patterns of empirical objects: they are ideal grades or levels through which the will objectifies or manifests itself in nature.

For Natorp understanding is the mode of scientific cognition. Natorp claims that the directedness towards a goal is implied by “method” that illuminates one of two senses in which his philosophy is idealistic, namely that science (and the other activities of culture) are guided by regulative ideas or limit-concepts. Given an object of scientific cognition, the cognition is conceived as a process never “definitively concluded,” but rather, “every true concept is a new question, none is a final answer” [131]. Natorp comments: “Just this is the meaning of the thing in itself as *X*: the infinite task”. In other words, the thing in itself is the ideal of an object exhaustively determined by concepts that is completely known. As with Kant, however, our cognitive finitude means that the process of conceptual determination can only approach this ideal asymptotically. This pursuit of total determination, what Natorp calls “method,” is the pursuit of science. The hypothesis as law or groundwork is for Natorp the transcendental foundation for scientific experience, i.e., for the activity of legislating and thus rationally understanding the phenomena.

For Nietzsche understanding was related to chains of metaphors. He puts forward the hypothesis that scientific concepts are chains of metaphors hardened into accepted truths [133]. On this account, metaphor begins when a nerve stimulus is copied as an image, which is then imitated in sound, giving rise, when repeated, to the word, which becomes a concept when the word is used to designate multiple instances of singular events. Conceptual metaphors are thus lies because they equate unequal things, just as the chain of metaphors moves from one level to another. Hegel’s problem with the repetition of the “this” and the “now” is thus expanded to include the repetition of instances across discontinuous gaps between kinds and levels of things.

Frege [58] started to stress the importance of the logical forms of the language in understanding. He developed predicate logic, which allowed a much greater range of sentences to be parsed into logical form than was possible with the ancient Aristotelian logic. In contrast to Husserl who attempted to show that the concept of the cardinal number is derived from psychical acts of grouping objects and counting them, Frege sought to show that mathematics and logic have their own validity, independent of the judgments or mental states of individual mathematicians and logicians.

Wittgenstein tried to find the key to understanding in one’s ability to discern the communicative goals of speakers and writers, or more directly in one’s ability to ‘pass’ linguistically, without censure. He developed a comprehensive system of logical atomism in his *Tractatus Logico-Philosophicus* [181]. He argued that the world is the totality of actual states of affairs and that these states of affairs can be expressed by the language of first-order predicate logic. Thus a picture of the world can be construed by means of expressing atomic facts in the form of atomic propositions, and linking them using logical operators. The aim of the Wittgenstein’s *Tractatus* was to reveal the relationship between language and the world: what can be said about it, and what can only be shown. Wittgenstein argues that language has an underlying logical structure, a structure that provides the limits of what can be said meaningfully, and therefore the limits of what can

be thought. For Wittgenstein, the limits of language are the limits of philosophy and anything beyond that such as religion, ethics, aesthetics, and the mystical cannot be discussed. He wrote that his philosophy will draw a limit to thinking, or rather—not to thinking, but to the expression of thoughts; for, in order to draw a limit to thinking we should have to be able to think both sides of this limit.

For Russell understanding was connected with searching for an ideal language for representing the scientific facts. Russell, during his early career, was influenced by Frege who developed predicate logic. In contrast to view that relations between things are actually internal relations, that is, properties internal to the nature of those things, Russell claimed that the world consists of independent facts [155]. The aim of his works with Wittgenstein was to create an ideal language for philosophical analysis, which would be free from the ambiguities of ordinary language. Understanding of the philosophical problems that was assumed to be language understanding was approached by using formal logic to formalize the way in which philosophical statements are made. According to Russell modern analytical empiricism differs from that of Locke, Berkeley, and Hume by its incorporation of mathematics and its development of a powerful logical technique. It is thus able, in regard to certain problems, to achieve definite answers, which have the quality of science rather than of philosophy. The logical positivist principle that there are no specifically philosophical truths and that the object of philosophy is the logical clarification of thoughts is in opposition to the traditional foundationalism, which considers philosophy to be a special science that investigates the fundamental reasons and principles of everything.

The analytic philosophy that was initiated by Russell was based on the principle that the logical clarification of thoughts can only be achieved by analysis of the logical form of philosophical propositions [120]. The logical form of a proposition is a way of representing it to show its similarity with all other propositions of the same type. Logical positivism used formal logical methods to develop an empiricist account of knowledge. Philosophers such as Carnap [32], along with other members of the Vienna Circle, claimed that the truths of logic and mathematics were tautologies, and those of science were verifiable empirical claims. These two constituted the entire universe of meaningful judgments; anything else was nonsense. Logical positivists adopted the verification principle, according to which every meaningful statement is either analytic or is capable of being verified by experience. This caused the logical positivists to reject many traditional problems of philosophy, especially those of metaphysics or ontology, as meaningless. The claims of ethics, aesthetics and theology were, accordingly, pseudo-statements, neither true nor false but simply meaningless.

According to Popper our understanding of the universe seems to improve over time because the apparent progress of scientific knowledge. As the reaction to the logical positivists, Popper stressed the role of falsification in the philosophy of science [145]. He rejected of classical empiricism, and the classical observational-inductivist account of science. Popper held that scientific theories are abstract in nature, and can be tested only indirectly, by reference to their implications and that scientific theory, and human knowledge generally, is irreducibly conjectural or

hypothetical, and is generated by the creative imagination in order to solve problems that have arisen in specific historico-cultural settings. According to Popper the truth content of our theories cannot be verified by scientific testing, but can only be falsified. Knowledge, for Popper, was objective, both in the sense that it is objectively true, and also in the sense that knowledge has an ontological status [146]. In this context he proposed three worlds [144]. World One, being the physical world, or physical states; World Two, being the world of mind, or mental states, ideas, and perceptions; and World Three, being the body of human knowledge expressed in its manifold forms, or the products of the second world made manifest in the materials of the first world (i.e., books, papers, paintings, symphonies, and all the products of the human mind).

Kuhn in his influential book *The Structure of Scientific Revolutions* [92] argued that scientists work in a series of paradigms, and that falsificationist methodologies would make science impossible. Lakatos [93] attempted to reconcile Kuhn's work with falsificationism by arguing that science progresses by the falsification of research programs rather than the more specific universal statements of naive falsificationism. However Feyerabend [54] finally rejected any prescriptive methodology, and argued that the only universal method characterizing scientific progress was anything goes.

Husserl introduced distinction between natural and phenomenological modes of understanding. Natural understanding, sense-perception in correspondence with the material realm constitutes the known reality, and understanding is premised on the accuracy of the perception and the objective knowability of what is called the real world. Phenomenological understanding strives to be rigorously 'presuppositionless' by means of what Husserl calls phenomenological reduction [72, 74–76]. The phenomenological reduction is not conditioned but rather transcendental, in Husserl's terms, pure consciousness of absolute Being. Husserl adopted Brentano's intentionality that was defined as the relationship between mental acts and the external world or the main characteristic of mental phenomena, by which they could be distinguished from physical phenomena. Every mental phenomenon, every psychological act, has a content, is directed at an object (the intentional object) [73]. Husserl noticed that in order to study understanding as the structure of consciousness, there is a need to distinguish between the act of consciousness and the phenomena at which it is directed. Knowledge of essences is possible by bracketing all assumptions about the existence of an external world, and bracketing was called epoché. Husserl concentrated on the ideal, essential structures of consciousness and proposed a radical new phenomenological way of looking at objects (understanding) by examining how we, in our many ways of being intentionally directed toward them, actually constitute them. The natural understanding, however, materially creates objects merely being figments of the imagination. In the phenomenological viewpoint, the object ceases to be something simply external and ceases to be seen as providing indicators about what it is, and becomes a grouping of perceptual and functional aspects that imply one another under the idea of a particular object or type. In Husserl's work, consciousness of any given thing calls for discerning its meaning as an intentional object. Such an object does

not simply strike the senses, to be interpreted or misinterpreted by mental reason but it has already been selected and grasped. Through sensible intuition our consciousness constitutes, what Husserl calls, a situation of affairs that is a passive constitution where objects themselves are presented to us and we are able to constitute a state of affairs through categorial intuition. One situation of affairs through objective acts of consciousness can serve as the basis for constituting multiple states of affairs. In order to better understand the world of appearances and objects, phenomenology attempts to identify the invariant features of how objects are perceived and pushes attributions of reality into their role as an attribution about the things we perceive.

For Husserl logic is a formal theory of judgment that studies the formal a priori relations among judgments using meaning categories. Husserl believed that truth-in-itself has as ontological correlate being-in-itself, just as meaning categories have formal-ontological categories as correlates. Mathematics, on the other hand, is formal ontology that studies all the possible forms of being (of objects). Therefore, for both logic and mathematics, not the sensible objects themselves but the different formal categories are the objects of study. Due to eidetic intuition we are able to grasp the possibility, impossibility, necessity and contingency among concepts and among formal categories. Categorial intuition, along with categorial abstraction and eidetic intuition, are the basis for logical and mathematical knowledge [73, 77].

Ingarden [80] did not accept transcendental idealism of Husserl which he thought would lead to relativism. In his *Dispute about existence of the world* he created his own realistic position.

Hermeneutics [64] started to emphasize the role of language in understanding. In hermeneutics understanding is the inversion of a speech act, during which the thought which was the basis of the speech must become conscious. Every utterance has a dual relationship to the totality of the language and to the whole thought of its originator, then understanding also consists of the two moments, of understanding the utterance as derived from language, and as a fact in the thinker. Hermeneutics is the art of understanding particularly the written discourse of another person correctly. A central principle of Gadamer's hermeneutics is that language conditions all understanding [59]. Hermeneutics was initially applied to the interpretation, or exegesis of scripture and emerged as a theory of human understanding beginning through the work of Schleiermacher and Dilthey [48]. Modern hermeneutics includes both verbal and nonverbal communication as well as semiotics, presuppositions, and preunderstandings. Hermeneutics consistency refers to the analysis of texts to achieve a coherent explanation of them. Philosophical hermeneutics refers primarily to the theory of knowledge initiated by Heidegger and further developed by Hans-Georg Gadamer in his work "*Truth and Method*" [59] and to the theories of Ricoeur [154].

Problem of understanding is a problem of interpretation according to Schleiermacher [160]. Schleiermacher explored the nature of understanding in relation not just to the problem of deciphering sacred texts but to all human texts and modes of communication. The interpretation of a text must proceed by framing its content in terms of the

overall organization of the work. Schleiermacher distinguished between grammatical interpretation and psychological interpretation. The grammatical interpretation studies how a work is composed from general ideas whereas the psychological interpretation studies the peculiar combinations that characterize the work as a whole. Schleiermacher claimed that every problem of interpretation is a problem of understanding. During Schleiermacher's time, a fundamental shift occurred from understanding not merely the exact words and their objective meaning, to an understanding of the writer's distinctive character and point of view.

Interpretation was related to historical objectification by broadening hermeneutics by Dilthey [48]. Understanding moves from the outer manifestations of human action and productivity to the exploration of their inner meaning and is not based on empathy. Empathy involves a direct identification with the other. Interpretation involves an indirect or mediated understanding that can only be attained by placing human expressions in their historical context. Thus, understanding is not a process of reconstructing the state of mind of the author, but one of articulating what is expressed in his work.

Heidegger's philosophical hermeneutics shifted the focus from interpretation to existential understanding, which was treated more as a direct, non-mediated and thus more authentic way of being in the world than merely as "a way of knowing" [69]. Heidegger used arguments similar to those of antipositivism when he claimed that some texts, and the people who produce them, cannot be studied by means of using the same scientific methods that are used in the natural sciences. Such texts are conventionalized expressions of the experience of the author and the interpretation of these texts will reveal something about the social context in which they were formed, and will provide the reader with a means of sharing the experiences of the author. Heidegger coined the term the hermeneutic circle to denote the reciprocity between text and context.

Gadamer's goal was to uncover the nature of human understanding and to elaborate the concept of philosophical hermeneutics. In [59] Gadamer argued that "truth" and "method" were at odds with one another and he was critical of two approaches to the human sciences—modern approaches to humanities that modeled themselves on the natural sciences and the traditional German approach to the humanities, according to which correctly interpreting a text meant recovering the original intention of the author. Gadamer argued that a text's meaning is not reducible to the author's intentions, but is dependent on the context of interpretation. Gadamer claimed that people have a historically-effected consciousness and that they are embedded in the particular history and culture that formed them and that define interpreters' prejudices as the way of how they will make interpretations. Gadamer criticized Enlightenment thinkers for harboring a prejudice against prejudices. For Gadamer, interpreting a text involves a fusion of horizons where the scholar finds the ways that the text's history articulates with their own background.

As early as the seventeenth century, both Hobbes and Spinoza believed that humans were deterministic machines, with our understanding and consciousness fully explainable in naturalistic terms and by the twentieth century many philosophers, scientists, and psychologists shared the same opinion. Skinner

was one of the most known thinkers who in various essays, lectures, and books [171] promoted view that understanding and consciousness are fully explainable by applying the scientific method. Modern philosophers motivated by the logical positivists' interest in verificationism such as logical behaviorism or functionalism regarded the problem of understanding as the problem of mind functions. Behaviorists hold that mental states were directly equivalent to behavior and dispositions to behave and claimed that imageless thoughts are the only possible form of thoughts [177]. Behaviorism was replaced by functionalism that identified mental states with brain states and tried to explain understanding in terms of cognitive theory based on the information-processing approach. Cognitive theory attempts to explain human understanding and reasoning processes by comparing the mind to a sophisticated computer system that is designed to acquire, process, store, and use information according to various programs. Recently some philosophers from analytic philosophy movement such as Chalmers as the most prominent representative [33] placed problem of understanding in the context of property dualism.

Understanding was often explained in reference thinking. Some scientist claims that thinking is purely physiological occupation of the brain and this claim is based on assumption that everything in the mind must have its counterpart in the nervous system. Under this assumption the brain contains the bodily equivalent of all concepts available to thinking as well as of all operations to which concept can be subjected. Similarly, according to Computational Theory of Mind (CTM) brain processes can be explained by computational model of the brain. CTM proposed by Putnam and developed by Fodor is based on the computer metaphor [57]. According to CTM the mind can be seen as the powerful computer and is referring to computational models of reasoning, language and perception.

The linguistic approach has an impact on the modern theory of mind such as the representational theory of the mind (RTM) that is engaging in explaining some aspects of understanding. According to RTM, thinking occurs in an internal system of representation. Beliefs and desires and other propositional attitudes enter into mental processes as internal symbols. Modern versions of RTM assume that thought that lead to understanding is not grounded in mental images and that the internal system of representation has a language-like syntax and a compositional semantics. According to RTM, much of thought is grounded in word-like mental representations and this view is often referred to as the language of thought hypothesis [56]. The latest result of philosophical investigations concerning thinking and understanding is the Language of Thought Hypothesis (LOTH) that postulates that thinking takes place in a mental language [56]. This language consists of a system of representations that is physically realized in the brain of thinkers and has a combinatorial syntax (and semantics) such that operations on representations are causally sensitive only to the syntactic properties of representations. According to LOTH, thought is, roughly, the tokening of a representation that has a syntactic structure with an appropriate semantics. Thinking consists in syntactic operations defined over such representations. Most of the arguments for LOTH derive their strength from their ability to explain certain empirical phenomena like productivity and systematicity of thought and thinking.

The problem of understanding, thought and language was investigated by philosophers and linguistics. There is a problem that until now is not solved—how big role language plays in the thought process. This problem was often formulated in the following form—if it is possible to think in words in similar way as thinking in circles, rectangles or other shapes. Many philosophers claim that the semantic properties of linguistic expressions are inherited from the intentional mental states they are conventionally used to express [57, 162]. On this view, the semantic properties of linguistic expressions are the semantic properties of the representations that are related to the conceptual structure of the linguistic forms. Martin [119], for example, claims that thought is possible without language, whereas others, such as [42] have suggested that the kind of thought human beings are capable of is not possible without language. Some philosophers maintain that concepts are prior to and independent of natural language, and that natural language is just a means for conveying thought [56]. Others maintain that at least some types of thinking occur in the internal system of representation constituting our natural language competence.

Nearly all theories concerning understanding assume that concept is the object of thought. Only few scientists such as Peacocke [138] maintain that there is possible to represent the world nonconceptually without possessing any concepts at all. According to the classical theory, a lexical concept *C* has definitional structure in that it is composed of simpler concepts that express necessary and sufficient conditions for falling under *C*. A non-classical alternative is the prototype theory. According to this theory, a lexical concept *C* doesn't have definitional structure but has probabilistic structure in that something falls under *C* just in case it satisfies a sufficient number of properties encoded by *C*'s constituents. The view that concepts are Fregean senses identifies concepts with abstract objects, as opposed to mental objects and mental states. According to this view concepts mediate between thought and language, on the one hand, and referents, on the other [138]. According to so called theory of concepts, concepts stand in relation to one another in the same way as the terms of a scientific theory and that categorization is a process that strongly resembles scientific theorizing [31]. It is generally assumed that the terms of a scientific theory are interdefined so that a theoretical term's content is determined by its unique role in the theory in which it occurs. On the contrary, according to conceptual atomism lexical concepts have no semantic structure [127] and the content of a concept is not determined by its relation to other concepts but by its relation to the world.

Searle [163] suggests that the obsession with the philosophy of language of the last century has been superseded by an emphasis on the philosophy of mind, in which functionalism is currently the dominant theory. In recent years, a central focus for research concerning understanding has been consciousness and while there is a general consensus for the global neuronal workspace model of consciousness, there are many views as to how the specifics work out. The most popular theories are Daniel Dennett's heterophenomenology [44]. The goal of Dennett's book, *Consciousness Explained*, [45] is to explain the phenomena of human consciousness in terms of the operations of a virtual machine that is

regarded as a sort of evolved (and evolving) computer program that stimulates the activities of the brain. Dennett claims that the understanding (intelligence) and consciousness of computers is testable by science, and that the question of whether computers are intelligent or conscious is answerable by the scientific method by referring to the Turing test as a scientific test. However, what these tests are attempting to do is to understand human consciousness and human understanding through the scientific method. Dennett tried to establish method to test whether human consciousness and understanding can be understood computationally. But the scientific method presupposes the conclusion that the phenomena in question are explainable in materialist terms. Searle argues that no matter how far artificial intelligence progresses a computer cannot have a mind or that a computer cannot be a mind, or that the mind cannot be reduced to a computational device manipulating symbols. The Chinese room and brain prosthesis thought experiments, and the Turing test, all explore understanding and consciousness by defining them in terms of human's understanding or consciousness. The question of whether computers can think, understand and be conscious like humans is seen explicitly as equivalent to asking whether human thought is computational: whether the intelligent human mind is reducible to the biological brain. If we define intelligence as the ability to carry out a certain task (or set of tasks), then assuming the tasks are well enough defined we can test intelligence by testing whether that task (or those tasks) can be carried out by the entity in question. The test is just an application of the definition. But the underlying definition of intelligence is the ability to think like a human. In fact, one of the underlying questions is what human consciousness is, and whether computers can be conscious like human. However, the answer depends on how we define intelligence and consciousness.

Shape Understanding System

Machine Understanding and Human Understanding

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