

OVERVIEW OF THE COGNITIVE SYSTEMS ENGINEERING

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Abstract—Cognitive Science, often called cognitive revolution, emerged as an intellectual movement in the 1950s. Cognitive science is an interdisciplinary scientific study of mind and thought processes, including philosophy, psychology, artificial intelligence, neuroscience, linguistics and anthropology. It examines the nature, functions and tasks of cognition. There have been some differences between the cognitive revolution in infancy and the current cognitive revolution. In today's cognitive revolution; artificial cognitive systems, as well as the results of the investigation of organisms and behavior are discussed. In studies on cognitive systems, it is important to draw attention to the potential benefits of the application and to emphasize its importance. The aim of this study is to examine the meaning of the cognitive system and the related disciplines and to examine the general researches on this subject.

Keywords—Cognitive, Cognitive Sciences, Cognitive Revolution, Reverse-Engineer.

1. INTRODUCTION

STUDIES show that cognitive science was born in the mid-1950s [1-3]. After the birth of cognitive science, researchers in various fields have begun to develop theories of mind based on complex representations and calculation procedures. Griffiths showed how cognitive science has changed from the beginning in his study published in 2015. Cognitive science is based on the study of various fields of study including, the philosophy that formulates the right questions to guide any search for scientific knowledge, anthropology to understand the history and present of human culture, psychology and linguistics as a reflection of mental processes on behavior, and cognitive modeling which seeks to understand and translate the processes of neuroscience and mind processes that investigate the biological mechanisms of the brain [2, 4, 5, 8, 9]. Figure 1.1 shows the areas contributing to the emergence of cognitive science. Each line in the figure represents an interdisciplinary field of research involving disciplines to which it is connected [1,2].

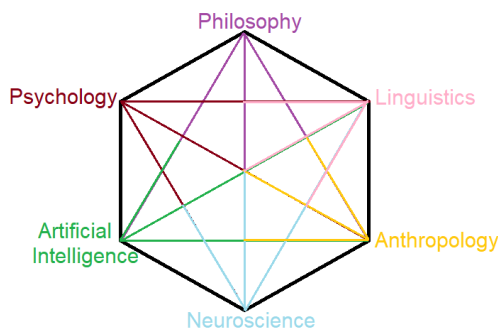


Fig.1.1. Illustrating the fields that contributed to the birth of cognitive science [1,2].

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Cognitive science is the study of thought, learning and mental processes that address the characteristics of psychology, linguistics, philosophy and computer modeling. It examines the nature, functions and duties of cognition [6-13, and references therein]. Cognitive scientists examine the nervous system, intelligence and behavior by focusing on how the nervous systems represent, process, and transform knowledge [10,11]. Kell's study shows that researchers have been researching cognitive skills from past to present [14]. Cognitive science, some of the most complex and unclear processes that occur in our brain, is intended to apply these processes to machines as in reverse engineering [12, and references therein, 15]. In this sense, at the beginning of 1980, it was a version of movement or man-machine architecture to establish machine expert systems in artificial intelligence [16]. Figure 1.2 shows a schematic representation of the study in question [17].

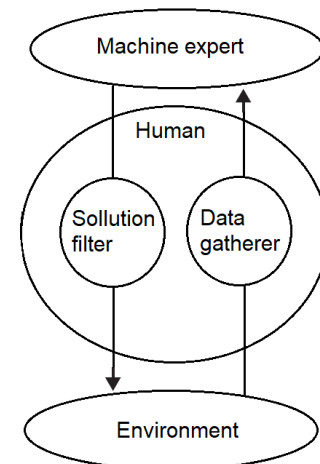


Fig.1.2. A version of an either/or human-machine architecture from the movement to build machine expert systems in AI in the early 1980s. [17].

Hollnagel and Woods (2005) examined the foundations of Cognitive System Engineering in detail. Cognitive Systems Engineering uses application, structure, purpose and restriction analysis to inform the design of process and technology when performing human-system integration [16-19]. When the analysis of cognitive science is made, it is seen that it covers many process levels ranging from learning, decision making, logic and planning to both the neural circuits and modular brain circuits [4,17]. It aims to produce new technologies that work like the human brain with the best understanding of the representation structures in mind and the calculation procedures working on these structures. For this purpose of cognitive systems, cognitive robots appear in the field of engineering [19-23].

From the 1950s to the present, cognitive science hypotheses have been subjected to various experiments while creating cognitive models. As mentioned above, the impact on many disciplines continues to grow. Because they study cognitive assets and interactions, social sciences are considerably enriched by a cognitive turn. Cognitive economy is included in

this movement of social sciences. This turn can be defined as broad restrictions on the integration of individual and collective cognitive processes into economic theory and the specific constraints of dynamic interactions in economic processes [24]. The cognitive approach to economics proposes an interdisciplinary approach to human problem solving, selection, decision making and change studies to explain the nature and development of institutions and economic institutions in a context characterized by structural uncertainty [25].

2. COGNITIVE APPLICATIONS

Cognitive Systems Engineering applications appear in every aspect of our lives. These applications are increasing day by day in the field of health sector, restaurant, defense-security, economy-banking, consulting, company analysis and education. For example, digital assistants are designed to understand the problem and find solutions. It is a calculation in which the user and the application work together to determine what the problem is. Digital assistants have long been used in the healthcare industry and in customer engagement applications such as call centers. They also appear as personal investment consultants or investment advisor assistants in financial services. These practices address a specific problem, such as diagnosing a disease and recommending treatment for a particular individual. They can also help a call center representative solve a problem for a particular customer. Digital assistants offer sequential recommendations with supportive evidence at a given time, within the specific user's needs.

In contrast, recommendation practices follow news, activities or markets over time. It is the next step beyond a simple warning because they operate in a fluid environment where data, desires and company status can change. They understand business objectives, relationships between companies and people, past records of achievements or failures.

Searching for an unknown is another area of use for such cognitive applications. For instance, pharmaceutical companies use this application to combine data on patient outcomes, disease, clinical trials, and molecular structures in order to recommend previously unknown molecules as good candidates for new drug development.

Threats that emerged as the first common cognitive computer application were also identified. As they try to keep up with data attacks, banks, credit risk companies, government customs organizations or security agencies invest in cognitive information processing [26].

The studies of cognitive applications of firms such as O'Reilly AI, IBM's World of Watson, HP's Big Data Summit, Dataversity's SmartData and SAS Institute's Analytics Experience strongly emphasize the importance of cognitive systems.

3. CONCLUSION

In this study, the studies on the definition of cognitive science and interdisciplinary relations are examined. The study also examined the application areas of cognitive systems. The studies, and especially the investments made by the pioneering organizations in this field, show that it is a focus of interest with the increasing acceleration from the beginning of Cognitive Science. With the advancing technology and cognitive science, will it be possible to make machines that make their own decisions?

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BIOGRAPHIES

Ufuk Korkmaz was born in Turkey. He received the BSc, MSc and PhD degrees from the Ondokuz Mayıs University (OMU), Physics Department, in 2006, 2010 and 2014 respectively. He starting researches as Post-Doc in Istanbul Technical University (ITU) in 2018. His research interests are IR and UV spectroscopy, X-ray single crystal diffraction, Understanding the nature of H bonds in supramolecular structure, Quantum Mechanics and Quantum information theory.