

# Contribution of Cognitive Science and Artificial Intelligence in the Simulation of the Complex Human Mind

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**Abstract:** *The research incorporated encircles the interdisciplinary theory of cognitive science in the branch of artificial intelligence. It has always been the end goal that better understanding of the idea can be guaranteed. Besides, a portion of the real-time uses of cognitive science artificial intelligence have been taken into consideration as the establishment for more enhancements. Before going into the scopes of future, there are many complexities that occur in real-time which have been uncovered. Cognitive science is the interdisciplinary, scientific study of the brain and its procedures. It inspects the nature, the activities, and the elements of cognition. Cognitive researchers study intelligence and behavior, with an emphasis on how sensory systems speak to, process, and change data. Intellectual capacities of concern to cognitive researchers incorporate recognition, language, memory, alertness, thinking, and feeling; to comprehend these resources, cognitive researchers acquire from fields, for example, psychology, artificial intelligence, philosophy, neuroscience, semantics, and anthropology. The analytic study of cognitive science ranges numerous degrees of association, from learning and choice to logic and planning; from neural hardware to modular mind organization. The crucial idea of cognitive science is that "thinking can best be understood in terms of representational structures in the mind and computational procedures that operate on those structures."*

**Keywords:** *Artificial intelligence, ACT-R, Android's feature of Text-to-speech, bimodal stimuli, cognitive science, Microsoft Azure, SOAR, Turing test.*

## I. INTRODUCTION

Since 1800s, psychology was considered an important branch to include in academics with a few scientists scanning for regular yet explicit human brain attributes. First featured in the 1930s, cognitive science has been center of psychology as this idea is viewed as a marker of response to particular stimulus. With time, this idea was supported up with PC models which empowered simulation levels which have known to enhance human reasoning [1]. Cognitive science is basically the research of everything related to brain and incorporates assortments of research in the fields of philosophy, artificial intelligence (AI), education, neuroscience, anthropology and semantics. Scientists, who study behavior as well as knowledge, stressing on working of the central nervous system, change and modify data. Point of

cognitive science has always been to comprehend standards of intelligence so as to reach a better cognizance of brain and intellect can be encouraged. Artificial intelligence is also, the result of continuous increase in human intelligence, prepared by automated frameworks. This empowered securing of data and utilizing real-time guidelines to arrive at a definite decision with the end goal that self-correction can be acquired [2].

## II. ROLE OF AI IN COGNITIVE SCIENCE

At first, the part of AI underscored on cognitive behavior of machines, nonetheless, technical headways permitted AI to exemplify ideas of cognitive science and center so progressively that human or machine could store data. This prompted the advancement of intelligent machines which were also equipped with speech or emotion acknowledgment, learning along with organization; critical thinking and reasoning have become relatively more feasible [3]. It is likewise the way that customary artificial intelligent methods offered limited advantages, as far as optimistic view of results, which along with time got viable with innovation of cognitive intelligent robots. As per the proposals of [4], robots with diverse range of intellectual forces are widely known as cognitive robots. It is viable for these robots to carry-out unfinished tasks without human assistance. Coordination with a devoted handling mechanism has empowered these robots to widen their learning abilities and appropriately react to confusing circumstances. Information procurement is in any case, yet to be investigated because of vast need of programs used for prediction like artificial neural network. Symbolic modeling is a software engineering prototype which is known to make viable use of knowledge-based systems and incorporates such with an ethical aspect. Examination of models which portray human-like intelligence began in 1990s where the use of SOAR came into picture. Sub-symbolic modeling on the opposite comprises of neural network models which also depends on the way that the mind is a profound mixture of a few single nodes. Because of this, the problem solving capability is seen as a derivative from the association between these nodes [3]. Subsequently, various methodologies of organizing mind are known widely as they are seen to simulating, beginning from production of various artificial neurons to representing the mind as an assortment of rules, symbols and plans.

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## III. COMPARISON OF PAST AND ONGOING RESEARCH IN COGNITIVE SCIENCE AND AI

Technological progressions and advancements made sure that it was feasible for researchers to invigorate human mind on electronic program with significantly more exactness and precision. At the end of the day, it is the AI in cognitive science that has guaranteed viable usage of power of PCs to enhance reasoning capability of people. Computer simulation which is used in AI can, thus, be named as the production of a framework's behavior with the end goal that simple and complex objectives can be accomplished [5]. In any case, there was a time at the point when the capacity of AI to engineer minds was addressed because of need for progressive idea on utilization of computation as a standard modeling for language recognition. Additionally, there are a few past explores works that repudiated with the present reality that artificial intelligence are indistinguishable with those done in cognitive science. This is on the grounds that that time set out artificial intelligence for understanding intelligence all in all and not for people. Moreover, so as to get profound understanding about the complexity of human mind, the chief objective is gradual development of machine as well as human-level knowledge. One of the critical difficulties that developed because of unrecognizable cognitive agents and human-level intelligence was the Turing test [6]. Purpose of this test was to analyze these intelligent agents about how they come across various circumstances because of deficient data. Subsequently, encoding information for these circumstances has become a constrained methodology to simulate human-level intelligence. Every one of these ideas together confined earlier by scientists and researchers to engineer intelligent agents which are programmed beforehand with an ability to simulate human-level intelligence and has the capacity to likewise solve related issues. These made it compulsory for structured intelligent agents to be furnished with the capability to take decisions relying upon the accessible data [7]. Simultaneously, this uncovered the necessity to re-examine past arrangements with the end goal that future decision making procedures can be upgraded. Thus, this prompts a progressively essential comprehension about ways human mind learns to solve these issues. This, thus, encouraged the need to plan development of intelligent systems that was programmed to have a degree of intelligence similar to that of the human brain. Be that as it may, as time passed by, technological progressions have extended up several applications of AI to encourage a normal interaction. In particular, speech recognition along with handwriting recognition is the most regular zones of artificial intelligence in cognitive science which noted the consideration of scientists. For example, the article, Speech Recognition and Cognitive Skills in Bimodal Cochlear Implant Users' stressed on the connection that speech recognition had with cognitive abilities. Furthermore, for this, the cognitive test was performed on 17 clients of cochlear implant that were picked. Objective behind this was to record the speed of processing, memory limit and execution of tasks by clients. Every setting drove the scientists to uncover that speech recognition, in addition to, bimodal testing has resulted an upgrade their

speech [8]. Simultaneously, it was featured that processes carried out by bimodal stimuli is identified with various cognitive abilities. It has too been examined that thirty-two percent users delineate voice recognition as the most generally utilized AI in their organizations.

### A. Architecture of SOAR

This framework based on cognitive programming has been created at the University of Michigan so as to mimic the human mind. This framework can be alluded to as an elective methodology due to the originality that SOAR system is known for storing and recovering data from working memory [7]. Reinforcement learning estimates the rules and in a way, helps in making numeric inclinations is moreover bolstered by the cognitive system. SOAR is also responsible for the incitement of virtual people that bolsters in-person collaboration and exchanges [9]. Notwithstanding the way that this application has coordinated abilities of natural language comprehension, emotional acknowledgement, activity and control of body but, it has a limited use as it is suitable just for the virtual world. Regardless of whether parts of mind should be limited with the end goal to enhance the estimation of the information level of processing of symbols can be obtained is as yet under topic. This is on the grounds that SOAR architecture endeavors to recreate the developmental plan process which will lead to bringing about an enhanced version of the symbol system.

### B. ACT-R (Adaptive Control of Thought-Rational)

ACT-R is an automatic simulation or cognitive system which points at characterizing fundamental and unchangeable perceptual as well as cognitive tasks. As roused from various psychological speculations, each activity performed by humans is a blend or arrangement of separate activities. ACT-R can along these lines be viewed as a strategy to determine ways in which a human mind can be sorted out in order to process several aspects of production of cognition [10]. Like SOAR, this cognitive system depends on computational execution of extraordinary coded language. The scientist would have to download the ACRT-R code and run it into a Common Lisp distribution for getting access as an ACT-R mediator. Doing as such, would empower determining of human intelligence which would be as an ACT-R code. On effectively executing this whole process, programmed bit-by-bit simulation of human behavior is likely to be created. Furthermore, it is feasible to take cognitive activities like memory encoding, mental symbolic manipulation other than visual and sound-related encoding. Human memory could be displayed in its declarative memory program which had been planned in a specific manner. Simultaneously, this system has permitted modeling of comprehension and creation of natural language. Complicated activities like apprehending of how individuals can explain mathematical theorems have additionally been feasible with the utilization of ACT-R [11].

### C. Stimulation of Creativity

A large portion of the current research identified with simulation of human level intelligence inside the procedure of making decisions which have been seen to underline on criticalness of impersonating creativity. The reality past encounters and information is the establishment of decisions taken and furthermore to recommend for changes. Be that as it may, creativity is portrayed to be a skilled capacity of people with which, it is feasible to resolve issues, think, object and create. Creativity has three categories to be specific, concrete, abstract and artistic [12]. Creativity in the field of designing applications is essentially concrete: this type is about the generating creativity, new and one-of-a-kind solutions in a situation brimming with conditions and limitations. Time has prevailing with regards to accomplishing these concepts which were when only a supposition. For example, AI empowered educated creative decisions to mainly communicate with people and to rouse creativity. Expanding utilization of AI for expanding human capacities has guaranteed tremendous creativity and helped human brain in a manner where accomplishment of better outcomes in a brief timeframe was made feasible. This period of a competition between man and machine has now turned out to be the truth as regular human-centric tasks are presently done consequently, with no need of manual help. For example, giving introduction of clients or conduction of meetings doesn't require physical presence of people [13].

## IV. IMPORTANCE AND APPLICATIONS OF COGNITIVE SCIENCE AI

In light of the conversations made above, it tends to be included that there is a wide scope of significance alongside various applications of cognitive science AI. The idea of artificial intelligence in cognitive science has experienced huge changes over a period of time such that it has now become feasible to create programs that would take into account the cognitive capacities to tackle complicated reasoning challenges. EvBrain is a case of mind programmed simulation that is intended to create artificial mind models. Accordingly, with utilization of this product, artificial animals with minds can be made that would effectively thrive in the challenging situation. Propelled intelligence is, hence, fundamental to think about a lot of data and furthermore to explain complicated logical problems in a brief timeframe range [10]. Alongside this, advancement of agents with human level intelligence has represented a copy of the human mind and it is relatively simpler to learn about the human brain. Purpose for gaining profundity comprehension and intellect about practical human cognition simulations is to draw speculations that in turn feature human instinct, thinking about real-time constraints. It is besides, presumed that primary objectives of cognitive science, particularly the manners by which intellect and creativity in mind would be known to all [14]. Literature surveys in the past accounted for the better comprehension of the procedure learning by human mind which includes recovery of data may prompt improved knowledge-gaining strategies. This human advancement, thus, has chances to be actualized in education systems where brains or mind of people are acquiring knowledge of new

concepts every day. Additionally, this would attract changes in existing concepts and would lead to advancement of clinical solutions for people, managing brain trauma. Some appreciable utilizations of artificial intelligence in cognitive science are as per the following:

### A. Speech-to-text and text-to-speech

Combination of artificial intelligence with cognitive science has prompted the turn of events of speech to text applications which then have presented people with a various scope of capacities. For example, use of these applications would bolster a few interpretation situations involving speech or dialogue transcript and custom conversation interpretation. The main sort was intended to change over audio into text. All that is required is to call the API for perceiving the origin of the provided audio, while it's been streaming [15]. The next kind of utilization is well-suited for one-on-one person gatherings as one can capture conversations continuously with the use of this application. Not just this, fairly this up-gradation has cultivated easy recording of conversations, distinguishing proof which include the speaker, the time recorded and likewise development. Across the broad demand of artificial intelligence has led researchers and analysts to coordinate text to speech conversion or speech to text conversion with the Android base. Two regular instances of the two kinds incorporate Android's Text-to-Speech feature, Voice Aloud Reader, Google Assistant and OneNote. The primary model continuously in tune with Google applications that present the read aloud feature. Moreover, it can control the pitch, speech and are accessible at various dialects. Preeminent case of speech to text actually, permitted audio to text conversion by utilizing neural network models. This application in addition, accompanies a geographic adaptable reminder, radio, etc. [16].

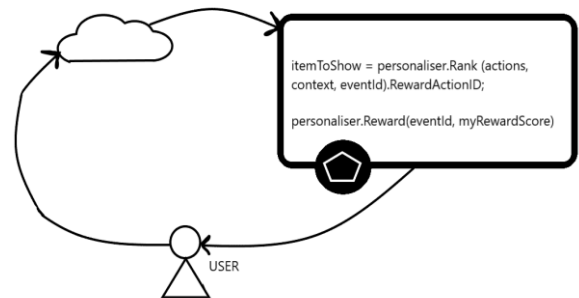


Fig. 1.

### B. Personalize

Utilization of customized communications is the result of use of artificial intelligence in cognitive science in this way permitting people to rely on and create rich and customized encounters for clients. To be progressively explicit, this current application allows association to organize substance to enhance the experience of clients. As the significance of the substance increases, the clients are more satisfied. Cognitive benefits, also offered by Microsoft Azure, incorporate Personaliser Preview which functions mainly on reinforcement learning.



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Propelled by the discoveries of various examinations performed, reinforcement learning has been proven to be a strategy that permits AI to advance objectives, in view of individualized design [16]. Fig. 1 can likewise be alluded to as personaliser which incorporates reinforcement learning cycle. Explanation is that this cycle allows clients to accomplish strategic objectives by gaining knowledge from constant cooperation with clients.

## V. COMPLEXITY ASSOCIATED WITH ACHIEVING BRAIN SIMULATION

In light of today's situation, the learning procedure has turned progressively intelligent working with brain simulation programming that imitates neural networks specifically of the human mind. Simultaneously, it is likewise the reality that examination of working of mind with computational modeling is perplexing. This is a direct result of extraordinary accuracy, effectiveness and precision required to demonstrate a huge number of neurons that are presently functioning in the human brain [17]. Accomplishing the ideal level of mind simulation is restricted as the major part of intellectual operations inside a human mind relies upon discrete exchanges, while an electronic system is digitalized. Subsequently, simulation of complicated and sensitive tasks like spike frequencies, neurotransmitter concentration, capability of membrane and metabolic inclinations are still to be taken into consideration. As such, current mind simulation which utilizes artificial intelligence concepts requires boundaries like extracellular interactions within the mind along with receptor binding. Be that as it may, this is still not a way to determine the extracellular interaction of the human mind, as it is identified by the ways which of extracellular matrix as well as pH in order to impact exchange among receptors along with matrix ligands [18]. Nonetheless, there is absence of proofs in regards to estimating of pH in an automated framework. This, thus, needs the immediate generation of algorithms that would be established on the functioning principles of mind.

This has besides, encouraged the necessity of working combination to secure information regarding how unique areas of brain continue to work together in the processing of data. Notwithstanding, inaccessibility of top-down and bottom-up models have limited projecting of mind in this way limiting the range of theory-examining programs and continuing with average simulations[19]. Also, there is an absence of proof with respect to clearing the Turing Test with artificial intelligence permitting complete simulation of human mind. Next impersonation of automated simulation of knowledge that is appreciable is identified with rate and limit of equipment needed for computing processes. Explanation for this is there aren't any technologies that helps run simulations on a huge-scale than in the real-time. Altogether development of human mind and cognitive frameworks has experienced immense challenges due to accessibility of man-made bots [13]. These artificial bots gained popularity among an enormous number of humans and gave them the predicament regardless if they are in any event, interacting with different people.

## VI. RESULTS AND FUTURE WORKS IN SIMULATING THE HUMAN BRAIN

Taking into account the continuous enhancements and technological advancement, it tends to be referenced as it is stirring for AI specialists for the following two decades. This is on the grounds that the human brain has a phenomenal ability to carry out different mental just as physical activities, without straining the brain. The introduction of nanotechnology which planned for speeding up and enhancing memory for computing hardware is evaluated to be the eventual fate of the simulation of human mind. However, present day role of artificial intelligence in cognitive science speculations are studied to encourage enhanced comprehension of brain as well as mind [16]. Parallel progressions in the areas of cognitive science and psychological science has empowered differing comprehension of human behavior in this way making way for intelligent agents. In setting to the point of view of cognitive science, there is a large scope of extensions to continue cognitive simulation on a huge-scale, which is alluded to as macro-modeling. The vast majority of the cognitive simulations of the present day focus on just procedure as it were. Contributions to these simulations are manually generated though yields are manually assessed. Accordingly, it becomes dangerous for individuals to manage enormous piles of information [9]. Rise of macro-modeling is, in this way, thought as a useful tool in recording a wider point of view or extent of human behavior.

## VII. CONCLUSION

It can along these lines, be inferred that artificial intelligence is a valuable asset in the research branch of cognitive science due to the better comprehension of human mind brought about by this technological advancement. Valuable bits of knowledge regarding human acknowledgement were feasible with AI-based applications which included speech to text conversion program, text to speech conversion program, understanding of normal language and personaliser. It is besides, assessed so that intelligence agents could improve the simulation capacity of human mind. In any case, there are sure challenges that may lead to constraining extent of mind simulation regarding which upgrades are available like nanotechnology and artificial intelligence in cognitive science speculations are needed. These hypotheses, explicitly, empower complete comprehension of human brain other than considering challenging issues.

## REFERENCES

1. Booth, J.L., McGinn, K.M., Barbieri, C., et al.: 'Evidence for cognitive science principles that impact learning in mathematics', 'Acquisition of complex arithmetic skills and higher-order mathematics concepts', (Academic Press, USA, 2017), pp. 297-325.
2. Collins, A., Bobrow, D.G. (Eds.): 'Representation and understanding: studies in cognitive science' (Elsevier, Amsterdam, Netherlands, 2019), pp. 131-146.

3. Laird, J.E., Lebiere, C., Rosenbloom, P.S.: 'A standard model of the mind: toward a common computational framework across artificial intelligence, cognitive science, neuroscience, and robotics', *AI Mag.*, 2017, 38, (4), pp. 13–26.
4. Varela, F.J.: 'The re-enchantment of the concrete: some biological ingredients for a nouvelle cognitive science', in 'The artificial life route to artificial intelligence' (Routledge, Taylor & Francis Group, Abingdon, Routledge, 2018), pp. 11–22.
5. Hassabis, D., Kumaran, D., Summerfield, C., et al.: 'Neuroscience-inspired artificial intelligence', *Neuron*, 2017, 95, (2), pp. 245–258.
6. Geman, D., Geman, S., Hallonquist, N., et al.: 'Visual Turing test for computer vision systems', *Proc. Natl. Acad. Sci.*, 2015, 112, (12), pp. 3618–3623.
7. Luber, S.: 'Cognitive science artificial intelligence: simulating the human mind to achieve goals'. 2011 3rd Int. Conf. on Computer Research and Development, Shanghai, China, March 2011, vol. 1, pp. 207–210.
8. Hua, H., Johansson, B., Magnusson, L., et al.: 'Speech recognition and cognitive skills in bimodal cochlear implant users', *J. Speech Lang. Hear. Res.*, 2017, 60, (9), pp. 2752–2763.
9. Vandierendonck, A.: 'A working memory system with distributed executive control', *Perspect. Psychol. Sci.*, 2016, 11, (1), pp. 74–100.
10. Pentecost, D., Sennersten, C., Ollington, R., et al.: 'Predictive ACT-R (PACTR): using a physics engine and simulation for physical prediction in a cognitive architecture'. 8th Int. Conf. on Advanced Cognitive Technologies and Applications, Rome, Italy, December 2016, pp. 22–32.
11. Deng, C., Cao, S., Wu, C., et al.: 'Predicting drivers' direction sign reading reaction time using an integrated cognitive architecture', *IET Intell. Transp. Syst.*, 2018, 13, (4), pp. 622–627.
12. Indurkha, B.: 'On the role of computers in creativity-support systems', in 'Knowledge, information and creativity support systems: recent trends, advances and solutions' (Springer, Cham, 2016), pp. 213–227.
13. Zheng, H., Feng, Y., Tan, J., et al.: 'Research on intelligent product conceptual design based on cognitive process', *Proc. Inst. Mech. Eng. C, J. Mech. Eng. Sci.*, 2016, 230, (12), pp. 2060–2072.
14. Beaty, R.E., Kaufman, S.B., Benedek, M., et al.: 'Personality and complex brain networks: the role of openness to experience in default network efficiency', *Hum. Brain Mapp.*, 2016, 37, (2), pp. 773–779.
15. Di Nuovo, A., Varrasi, S., Conti, D., et al.: 'Usability evaluation of a robotic system for cognitive testing'. 2019 14th ACM/IEEE Int. Conf. on HumanRobot Interaction (HRI), Daegu, Korea, March 2019, pp. 588–589.
16. Arora, M.R., Sharma, J., Mali, U., et al.: 'Microsoft cognitive services', *Int. J. Eng. Sci.*, 2018, 8, (4), p. 17323.
17. Li, D., Du, Y.: 'Artificial intelligence with uncertainty' (CRC press, Florida, USA, 2017).
18. Dzyubenko, E., Gottschling, C., Faissner, A.: 'Neuron-glia interactions in neural plasticity: contributions of neural extracellular matrix and perineuronal nets', *Neural Plast.*, 2016, 2016, pp. 170–195.
19. Gaohua, L., Neuhoff, S., Johnson, T.N., et al.: 'Development of a permeability-limited model of the human brain and cerebrospinal fluid (CSF) to integrate known physiological and biological knowledge: estimating time varying CSF drug concentrations and their variability using in vitro data', *Drug Metab. Pharmacokinet.*, 2016, 31, (3), pp. 224–237.
20. Prajval Mohan, Pranav Narayan, Lakshya Sharma, Tejas Jambhale, Simran Koul, "Iterative SARSA: The Modified SARSA Algorithm for Finding the Optimal Path". *International Journal of Recent Technology and Engineering (IJRTE)*. ISSN: 2277-3878, Volume-8 Issue-6, March 2020.
21. Prajval Mohan, Adiksha Sood, Lakshya Sharma, Simran Koul, Simriti Koul, "PC-SWT: A Hybrid Image Fusion Algorithm of Stationary Wavelet Transform and Principal Component Analysis". *International Journal of Engineering and Advanced Technology (IJEAT)*, ISSN: 2249-8958, Volume-9 Issue-5, June 2020.
22. Simran Koul, "Contribution of Artificial Intelligence and Virtual Worlds Towards Development of Super Intelligent AI Agents", *International Journal of Engineering and Advanced Technology (IJEAT)*, ISSN: 2249-8958, Volume-9 Issue-5, 30 June 2020.
23. Simran Koul, Yash Raj, Simriti Koul, "Analyzing Cyber Trends in Online Financial Frauds using Digital Forensics Techniques", *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, ISSN: 2278-3075, Volume-9 Issue-9, 15 July 2020.

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