International Journal of Scientific Engineering and Technology ISSN : 2277-1581
Volume No. 7, Issue No. 8, PP : 74-75 1 Aug. 2018

Cognitive Computing

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Abstract : Cognitive systems provide digital solutions to meet human-centric requirements: acting, thinking, and behaving like a human. It mimics the ability of humans to learn and improve from experience. It is basically a new computing paradigm for solving real world problems. It has been recognized as a key enabling technology for turning big data into insights. This paper provides a brief introduction to cognitive computing.

Keywords : Cognitive computing, systems, artificial, computational intelligence

I. Introduction

Cognitive computing (CC) refers to hardware and/or software that mimics the way the human brain works. It involves self-learning systems that use *data mining*, pattern recognition and *machine learning algorithms* to mimic the functioning of the human brain. Cognitive computing systems are adaptive in that they can learn as information and requirements change. They can resolve ambiguity and tolerate unpredictability. The goal of cognitive computing is to create systems that are capable of solving problems without human intervention [1]. In other words, CC endows computer systems with the faculties of knowing, thinking, and feeling. We will be directly interacting with cognitive systems on a daily basis in the future.

Cognitive computing differs from traditional computing in that it handles human kinds of problems such as facial recognition, speech understanding, medical diagnosis, risk assessment, fraud detection, and sentiment analysis. Such problems are challenging and almost intractable for traditional computing techniques. The relationship between CC and other related areas is shown in Figure 1 [2].

Artificial intelligence (AI) has been described as technologies capable of performing tasks normally requiring human intelligence. Cognitive computing seeks to overcome the boundaries of conventional programmable (von Neumann) computers. Watson, IBM's first cognitive system, demonstrated through a Jeopardy exhibition match, that it was capable of answering complex questions as effectively as the world's human champions.

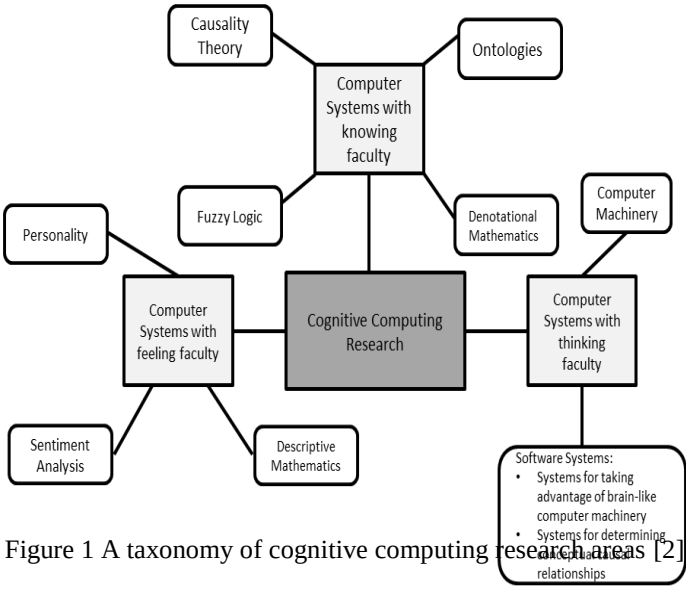

Figure 1 A taxonomy of cognitive computing research areas [2]

In February 2011, Watson defeated Ken Jennings and Brad Rutter at Jeopardy! [3]. Watson has been configured to support life sciences research. This modified version of Watson includes medical literature, patents, genomics, and pharmacological data.

II. Applications

Cognitive computing can be applied across just about every major industry that relies on data-driven decision-making to improve outcomes. CC applications utilize tools such as natural language processing, image recognition, intelligent search, and decision analysis to adapt their underlying computational algorithms in solving problems. As cognitive computing platforms become commercially available, real-world applications are starting to emerge. Examples of such real-world applications include the following:

- *Enterprise:* Enterprise CC applications seek to pursue one of three distinct business objectives: driving operational excellence, delighting customers, or creating a superior experience for employees. Some applications strengthen customer loyalty and trust [4].
- *Health care:* The greatest disruption resulting from the rise of cognitive computing will likely occur in the field of health care, which is being disrupted and transformed by an exponential growth in data. Cognitive computing enables researchers to uncover relationships among genes, proteins, and diseases [5]. IBM and other companies are developing various cognitive computing tools for gaining insight into various aspects of health care information.

- *Astronomy:* Astronomers have the unique opportunity to adopt new technologies and methodologies because the impact can be profound and highly beneficial to effecting rapid progress in the field. Projects like DOME are important vehicles for ensuring engagement of the astronomy community with cognitive systems [6].
- *Education:* The IBM Watson cognitive system has been used to teach parallel programming since the system is capable of learning through the user's input and can be taught by experts. The system enables a dialog-based interaction with programmers. [7].

Other applications include fraud detection in business/finance, investment risk management, astronomy, commerce recommender systems, predictive maintenance in manufacturing, robotics, information management, and sign language.

III. Challenges

Some CC applications critically and completely depend on massive amounts of data. There are three challenges concerning data. The first is identifying the right data. The second challenge is ensuring that needed data is available. The third challenge is getting the data into the right format [4].

When developing large-scale simulations with cognitive capacities, some researchers believe that the main challenge lies in improving the realism of the simulations. They believe that simulations should incorporate as much biological detail as possible. In other words, if you use biological brains as templates for designing cognitive computing systems, then you should take account of as much biological detail as possible [8]. It is challenging to build a general-purpose system of systems that can learn, reason, and interact in a human natural way. Deciding which aspects of a business process are routine enough to be handed over to the machine and which aspects need to be retained by human users is often difficult. Organizations face the challenge of ongoing supervision of some CC applications. There appears to be a continuum of tasks of increasing difficulty in this area.

IV. Conclusion

Total words should not be more than 50 words (10).

CC is the simulation of reasoning processes and is multidisciplinary. It emulates human brain functions such as perception, knowledge accumulation, goal planning, experience, and logical inference. Cognitive systems learn, reason, and interact with us to perform complex tasks better than humans. Digital system performance will be measured based on system cognitive ability in the future.

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