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Cognitive Computing Applications

Ms. Nikita S. Lanjewar, Mr. Dhiraj Rane
[1]*Department Of Computer Science, MCA-Sem5, RTMNU, Nagpur, Maharashtra.*
[2]*Department Of Computer Science, MCA, RTMNU, Nagpur, Maharashtra.*

Abstract: *The goal of Cognitive computing is to simulate human thought process in a computerized model. The result is cognitive computing – a combination of cognitive science and computer science. Cognitive computing models provide a realistic roadmap to achieve artificial intelligence. Cognitive computing represents self-learning systems that utilize machine learning models to mimic the way brain works." Eventually, this technology will facilitate the creation of automated IT models which are capable of solving problems without human assistance Cognition comes from the human brain.*

Keywords:*Cognitive science, Human brain, Artificial Intelligence*

I. Introduction

Cognitive computing represents the third era of computing. In the first era, (19th century) Charles Babbage, also known as 'father of the computer' introduced the concept of a programmable computer. Used in the navigational calculation, his computer was designed to tabulate polynomial functions. The second era (1950) experienced digital programming computers such as ENIAC and ushered an era of modern computing and programmable systems. And now to cognitive computing which works on deep learning algorithms and big data analytics to provide insights. Thus the brain of a cognitive system is the neural network, fundamental concept behind deep learning. The neural network is a system of hardware and software mimicked after the central nervous system of humans, to estimate functions that depend on the huge amount of unknown inputs.

A computer with a brain that thinks and behaves like a human being? Nothing is impossible with this technological revolution that continues to surprise us day after day! Today, one can give "eyes and a brain" to his computer: thus, he can become able to replace humans for repetitive tasks and facilitate enormously our daily life! This concept is known today as "Cognitive Computing". Indeed, computers might not possess cognitive abilities, but they are capable of executing operations which completely rely on human perceptions. It's always possible to use the power of automation: from handwriting recognition, face identification and behavioral pattern determination to any task requiring cognitive skills, computers are capable of delivering the right solutions.

Artificial intelligence has been a far-flung goal of computing since the conception of the computer, but we may be getting closer than ever with new cognitive computing models. Cognitive computing comes from a mashup of cognitive science—the study of the human brain and how it functions—and computer science. Nowadays, researchers are developing new systems that amalgamate the incredibly intricate processes of the human brain with the vast data stores of a computer. Cognitive computing is based on self-learning systems that use machine-learning techniques to perform specific, human-like tasks in an intelligent way.

The goal of cognitive computing is to simulate human thought processes in a computerized model. Using self-learning algorithms that use data mining, pattern recognition and natural language processing, the computer can mimic the way the human brain works.

Some people say that cognitive computing represents the third era of computing: we went from computers that could tabulate sums (1900s) to programmable systems (1950s), and now to cognitive systems.

Cognitive technology empowers the IT infrastructure of an enterprise. As the result, business organizations are better equipped to make cost cut-downs by ensuring increased productivity and enhanced operational speed.

Deloitte refers to cognitive computing as "more encompassing than the traditional, narrow view of artificial intelligence". Indeed, AI has been primarily used to describe technologies capable of performing tasks normally requiring human intelligence, he says.

Cognitive technology: Cognitive technology is a field of computer science that mimics functions of the human brain through various means, including natural language processing, data mining and pattern recognition. It is expected to have a drastic effect on the way that humans interact with technology in coming years, particularly in the fields of automation, machine learning and information technology.

Cognitive technology is a subset of the broader field of artificial intelligence, which itself could be considered a subset of biomimetics. Although artificial intelligence has been the subject of research for a very long time, cognitive technology evolved mostly out of the internet (particularly the web and the cloud).

Cognitive science: Cognitive science is essentially the study of thought. It is a kind of broad-based term for studying the nature and functionality of how the brain works. However, experts have come up with more specific concrete models for what constitutes cognitive science – for instance, describing it as the intersection of psychology, philosophy, linguistics, anthropology, neuroscience and, last but not least, artificial intelligence.
Cognitive science can be classified into many various sub-fields such as psychology and philosophy. Brain imaging can constitute a cognitive science project. So can a research project focusing on evidence-based behavioral trends. Language processing projects can also have a primary cognitive science component.

One of the biggest recent changes in the ways that people use cognitive science relates to technology – prior to the beginning of the 21st century, cognitive science was mainly seen as an academic field related to human biology. Now, with breakthrough developments in artificial intelligence, all of that has changed. These days, a cognitive science project is just as likely to utilize artificial intelligence tools such as networks to simulate biological cognitive function. This is rapidly changing the field of cognitive science as well as some sub-fields such as neuroscience – for example, where neuroscience used to treat the human brain only based on biological research and some data modeling, new neuroscience projects can now focus on learning about the human brain through examining artificial intelligence as well.

Essentially, cognitive science has bloomed and developed as artificial intelligence has evolved. It has become entwined and interconnected with the study of technology.

II. Cognitive Computing Features

With the present state of cognitive function computing, basic solution can play an excellent role of an assistant or virtual advisor. Siri, Google assistant, Cortana, and Alexa are good examples of personal assistants. Virtual advisor such as Dr. AI by Health Tap is a cognitive solution. It relies on individual patients' medical profiles and knowledge gleaned from 105,000 physicians. It compiles a prioritized list of the symptoms and connects to a doctor if required. Now, experts are working on implementing cognitive solutions in enterprise systems. Some use cases are fraud detection using machine learning, predictive analytics solution, predicting oil spills in Oil and Gas production cycle etc.

The purpose of cognitive computing is the creation of computing frameworks that can solve complicated problems without constant human intervention. In order to implement cognitive function computing in commercial and widespread applications, Cognitive Computing consortium has recommended the following features for the computing systems –

1. Adaptive

This is the first step in making a machine learning based cognitive system. The solutions should mimic the ability of human brain to learn and adapt from the surroundings. The systems can't be programmed for an isolated task. It needs to be dynamic in data gathering, understanding goals, and requirements.

2 Interactive

Similar to brain the cognitive solution must interact with all elements in the system – processor, devices, cloud services and user. Cognitive systems should interact bi-directionally. It should understand human input and provide relevant results using natural language processing and deep learning. Some skilled intelligent chat bots such as Mitsuku have already achieved this feature.

3 Iterative and stateful

The system should "remember" previous interactions in a process and return information that is suitable for the specific application at that point in time. It should be able to define the problem by asking questions or finding an additional source. This feature needs a careful application of the data quality and validation methodologies in order to ensure that the system is always provided with enough information and that the data sources it operates on to deliver reliable and up-to-date input.

4 Contextual

They must understand, identify, and extract contextual elements such as meaning, syntax, time, location, appropriate domain, regulations, user's profile, process, task, and goal. They may draw on multiple sources of information, including both structured and unstructured digital information, as well as sensory inputs (visual, gestural, auditory, or sensor-provided).

III. Scope Of Cognitive Computing

While computers have been faster at calculations and processing than humans for decades. But they have failed miserably to accomplish tasks that humans take for granted, like understanding the natural language or recognizing unique objects in an image. Thus cognitive technology makes such new class of problems computable. They can respond to complex situations characterized by ambiguity and have far-reaching impacts on our private lives, healthcare, business, etc.

According to a study by the IBM Institute for Business Value, "Your Cognitive Future," scope of cognitive computing consists of engagement, decision, and discovery. These 3 capabilities are related to ways people think and demonstrate their cognitive abilities in everyday life.

1. Engagement

The cognitive systems have vast repositories of structured and unstructured data. These have the ability to develop deep domain insights and provide expert assistance. The models build by these systems include the contextual relationships between various entities in a system's world that enable it to form hypotheses and arguments. These can reconcile ambiguous and even self-contradictory data. Thus these systems are able to engage in deep dialogue with humans. The Chabot technology is a good example of engagement model. Many of the AI chat bots are pre-trained with domain knowledge for quick adoption in different business-specific applications.

2. Decision

A step ahead of engagement systems, these have decision-making capabilities. These systems are modeled using reinforcement learning. Decisions made by cognitive systems continually evolve based on new information, outcomes, and actions. Autonomous decision making depends on the ability to trace why the particular decision was made and change the confidence score of a systems response. A popular use case of this model is the use of IBM Watson in healthcare. The system can collate and analyze data of patient including his history and diagnosis. The solution bases recommendations on its ability to interpret the meaning and analyze queries in the context of complex medical data and natural language, including doctors' notes, patient records, medical annotations and clinical feedback. As the solution learns, it becomes increasingly more accurate. Providing decision support capabilities and reducing paperwork allows clinicians to spend more time with patients.

3. Discovery

Discovery is the most advanced scope of cognitive computing. Discovery involves finding insights and understanding vast amount of information and developing skills. These models are built on deep learning and unsupervised machine learning. With ever-increasing volumes of data, there is a clear need for systems that help exploit information more effectively than humans could on their own. While still in the early stages, some discovery capabilities have already emerged, and the value propositions for future applications are compelling. Cognitive Information Management (CIM) shell at Louisiana State University (LSU) is one of the cognitive solutions. The distributed intelligent agents in the model collect streaming data, like text and video, to create an interactive sensing, inspection, and visualization system that provides real-time monitoring and analysis. The CIM Shell not only sends an alert but reconfigures on the fly in order to isolate a critical event and fix the failure.

IV. Algorithm For Cognitive Computing

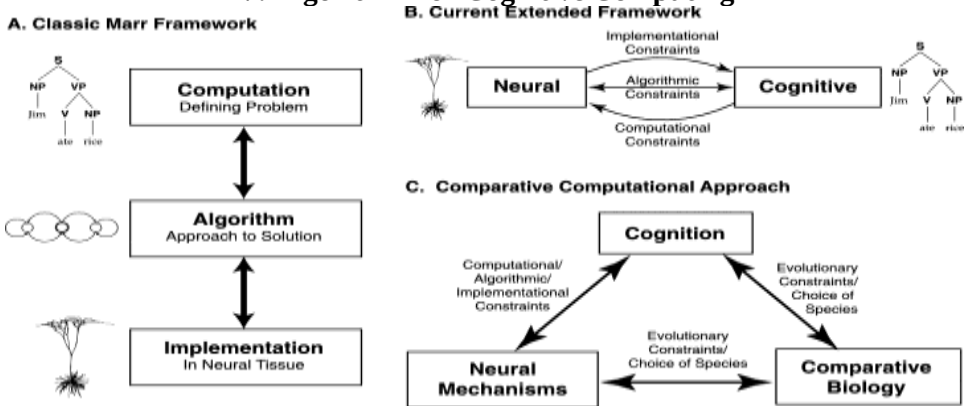

Figure 1. Algorithm for cognitive computing

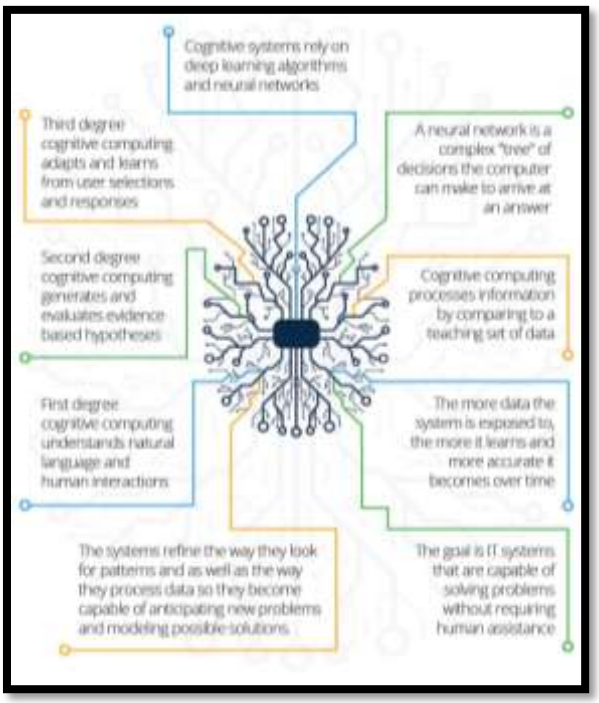

Figure 2: Working of Cognitive computing

V. Examples Of Cognitive Computing Products

Today, cognitive computing impacts every area of our lives, from travel, sports, and entertainment, to fitness, health and wellness—including the health of our pets. In the following article, you'll learn about six trailblazing companies showcasing cognitive computing in these various industries. It originally appeared in the February 2016 issue of UBM.

Entrepreneurs from a wide variety of industries have already created products and services based on cognitive technologies. Their business models provide good examples of some of the ways these applications will enhance and transform our lives in the future.

- **Vantage Software**

Industry: Finance

Challenge: Providing accurate, fact-based investment recommendations to financial managers

Investment managers have a difficult job. They need to absorb and understand huge volumes of information and use that information to make split-second, reliable decisions about where and when to invest client funds in a highly volatile market.

To help with that challenge, Vantage Software provides reporting and analytics capabilities to private equity firms and small hedge funds. The company's latest product, Coalesce, is powered by IBM Watson's cognitive computing technology. "With Watson, we can examine tens of millions of pages of documents, explore available market intelligence, risk profiles, and financial profile data to provide better information to analysts," explains Greg Woolf, founder and CEO of Vantage Software.

- **Welltok**

Industry: Healthcare

Challenge: Giving consumers access to reliable, up-to-date health information

It seems as if new — and often conflicting — health research is being published every day. As a result, many people find it difficult to obtain accurate answers to their medical questions.

Welltok offers a cognitive-powered tool called CaféWell Concierge that can process vast volumes of data instantly to answer individuals' questions and make intelligent, personalized recommendations. Welltok offers CaféWell Concierge to health insurers, providers, and similar organizations as a way to help their subscribers and patients improve their overall health. "We must transform beyond the current 'sick-care' system built for patients, to one that optimizes each consumer's health status," said Jeff Margolis, chairman and CEO of Welltok. "To do so, the industry needs a practical, but radically different approach to engage the 85% of the nation's population who are making daily choices that impact their health."

- **LifeLearn**

Industry: Veterinary Care
Challenge: Helping veterinarians diagnose and treat illness in their patients
Cognitive computing isn't helping only humans; it's also helping veterinarians take better care of the animals that come into their practices. LifeLearn offers an award-winning veterinary clinical decision-support tool called Sofie that analyzes hundreds of thousands of veterinary medical resources and offers relevant, evidence-based treatment options.
To use Sofie, veterinarians simply ask a question in much the same way they would if another colleague were in the room. Sofie provides resources and recommendations instantly, allowing busy vets to save time and provide their patients with quality care.

- **WayBlazer**

Industry: Travel
Challenge: Simplifying the trip-planning process
When you planned your last trip, how many websites did you visit to set up your flights, book your hotel, and plan your activities? 10? 20? 30 or more? If you're like most vacationers, you visited 20 or more websites when planning your trip, which has become a very time-consuming and complex task.
WayBlazer helps make that task more manageable and enjoyable with a cognitive-powered personal travel concierge. The tool allows travelers to ask natural language questions about travel and provides customized results based on a wealth of travel data, as well as insights gleaned about individual vacationers' preferences. Already, travel suppliers are using the tool as a way to increase bookings and improve customer satisfaction.

- **Edge Up Sports**

Industry: Sports & Entertainment
Challenge: Helping fantasy football enthusiasts manage their teams
More than 33 million people play fantasy football, and many of them spend hours poring over the latest stats and news to make their weekly picks. Some fantasy team managers are gaining an advantage on the competition by leveraging the cognitive computing technologies of Edge Up Sports to help them draft their teams.
Edge Up's mobile app allows users to ask questions such as, "Do the Panthers play better on grass or turf?" or "Are the Cowboys emotionally ready for the game this Sunday?" The app sorts through a wealth of data, news reports, social media comments, weather reports, and more to provide insightful answers that can help fantasy football team managers make better decisions.

- **BrightMinded**

Industry: Health and Wellness
Challenge: Developing personalized fitness plans and tracking client progress toward goals
Most personal trainers still rely on pen and paper to track their clients' progress toward their fitness goals. Bright Minded wants to change that with a cognitive-enabled app called TRAIN ME that learns from clinical research and tracks each user's individual data to find what works for him or her. It then recommends a personalized exercise and fitness regimen.
Personal trainers working with the app have a wealth of research on their tablets or smartphones, as well as access to their clients' information from wearable devices or manual entry. The app allows these trainers to provide a much more detailed and customized level of training to their clients.

VI. Limitations Of Cognitive Computing

Presently, there are problems and limitations in cognitive systems that we need to be conscious of and to figure out how to solve such issues.

With this technology, there is a limited analysis of risk which is missing in the unstructured data. This includes socio-economic factors, culture, political environments, and people. We can take the example of a predictive model discovering a location for oil exploration. The fact is that if the country is undergoing a change in government, the cognitive model should take this factor into consideration. Thus human intervention is necessary for complete risk analysis and final decision making.

Also, cognitive systems need a meticulous training data process. The laborious process of training cognitive systems is most likely the reason for its slow adoption. Moreover, the complex and expensive process of using cognitive systems makes it even worse.

Another thing is that cognitive computing systems are most effective as assistants which are more like intelligence augmentation instead of artificial intelligence. It supplements human thinking and analysis but depends on humans to take the critical decisions.

What is also going to be a main challenge to tackle in this sector is about privacy. Access to data is easy and vulnerable for organizations, so measures should be taken to safeguard the right to privacy.
So cognitive computing is definitely the next step in computing started by automation. It sets a benchmark for computing systems to reach the level of the human brain. But presently it has some limitations which make AI difficult to apply in situations with a high level of uncertainty, rapid change or creative demands. The complexity of problem grows with the number of data sources.

We can say that cognitive computing is going to be a big deal as it's a powerful tool in the making. Nevertheless, humans having this tool must decide how to best use it and must know the art of incorporating it. If this technology is used correctly, the power of cognitive and artificial intelligence will take-off towards unsurpassed excellence in the next 5 years.

VII. Conclusion

To sum up, Cognitive Computing doesn't bring a drastic novelty into the AI and Big Data industry. Rather it urges digital solutions to meet human-centric requirements: act, think, and behave like a human in order to achieve maximum synergy from human-machine interaction.

In this article, we tried to translate this broad and high-level concept into specific technological challenges and provide some practical recommendations on the way they can be addressed.
We believe that soon every digital system will be measured on its cognitive abilities. Like User Experience was the next big step for improving application usability, Cognitive Computing will be a significant step towards digital humanism.

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