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Cognitive Computing: Building a Smarter Planet

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ABSTRACT
Cognitive computing is the simulation of human thought processes in a computerized model. Cognitive systems are complex information processing ones, capable of acquiring information, putting it into action and transmitting knowledge. Cognitive computing involves self-learning systems that use data mining, pattern recognition and natural language processing to mimic the way the human brain works. Cognitive Systems will require innovation breakthroughs at every layer of information technology, starting with nanotechnology and progressing through computing systems design, information management, programming and machine learning, and, finally, the interfaces between machines and humans. Advances on this scale will require remarkable efforts and collaboration, calling forth the best minds—and the combined resources–of academia, government and industry.
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I. INTRODUCTION

Cognitive Computing (CC) is an emerging paradigm of intelligent computing theories and technologies based on cognitive informatics, which implements computational intelligence by autonomous inferences and perceptions mimicking the mechanisms of the brain. Cognitive computing is the simulation of human thought processes in a computerized model.

Cognitive computing involves self-learning systems that use data mining, pattern recognition and natural language processing to mimic the way the human brain works. The goal of cognitive computing is to create automated IT systems that are capable of solving problems without requiring human assistance.

Cognitive computing has its roots in the 1950s, when computer companies first began to develop intelligent computer systems. Most of these systems were limited, however, because they could not learn from their experiences. Early artificial intelligence could be taught a set of parameters, but was not capable of making decisions for itself or intelligently analyzing a situation and coming up with a solution. Enthusiasm for the technology began to wane, as scientists feared that an intelligent computer could never be developed.

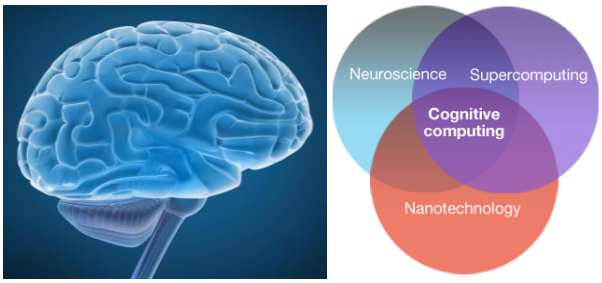

Fig. 1 Cognitive computer systems are modeled after the human brain

However, with major advances in cognitive science, researchers interested in computer intelligence became enthused. Deeper biological understanding of how the brain worked allowed scientists to build computer systems modeled after the mind, and most importantly to build a computer that could integrate past experiences into its system. Cognitive computing was reborn, with researchers at the turn of the 21st century developing computers which operated at a higher rate of speed than the human brain did.

According to IBM Senior Vice President John E. Kelly, there have been two eras of computing thus far:

- **The Tabulating Era:** original calculators, tabulating machines, vacuum systems. "In the first era of data we basically fed data in on punch cards."
- **The Programmable Era:** later vacuum tube systems up to our current microprocessing computers. "It was about taking processes and putting them into the machine. It's completely

controlled by the programming we inflict on the system."

According to Kelly, the next era will be:

- **The Cognitive Computing Era:** computers work directly with humans in a more synergetic association where the relationships between human and computer essentially blur and both interact in such a way that the computer helps the human unravel vast stores of information through its advanced processing speeds, but the creativity of the human creates the environment for such an "unlocking" to occur.

Cognitive computing integrates the idea of a neural network, a series of events and experiences which the computer organizes to make decisions. The neural network contributes to the computer's body of knowledge about a situation and allows it to make an informed choice, and potentially to work around an obstacle or a problem. Researchers argue that the brain is a type of machine, and can therefore potentially be replicated. The development of neural networks was a large step in this direction.

As the body of knowledge about the brain grows and scientists experiment more with cognitive computing, intelligent computers are the result. Smart computers which are capable of recognizing voice commands and acting upon them, for example, are used in many corporate phone systems. Cognitive computing is also used in many navigation systems onboard aircraft and boats, and while these systems often cannot handle crises, they can operate the craft under normal conditions.

At the turn of the 21st century, many researchers believed that cognitive computing was the hope of a near future. By replicating the human brain in computer form, researchers hope to improve conditions for humans as well as gaining a deeper understanding of the biological reactions that power the brain.

II. WORKING OF A COGNITIVE SYSTEM

The systems of today have delivered tremendous business and societal benefits by automating tabulation and harnessing computational processing and programming to deliver enterprise and personal productivity. The machines of tomorrow – cognitive systems -- will forever change the way people interact with computing systems to help people extend their expertise across any domain of knowledge and make complex decisions involving extraordinary volumes of fast moving Big Data.

A cognitive system works this way.

1. Understands natural language and human communication
2. Generates and evaluates evidence based hypothesis
3. Adapts and learns from user selections and responses

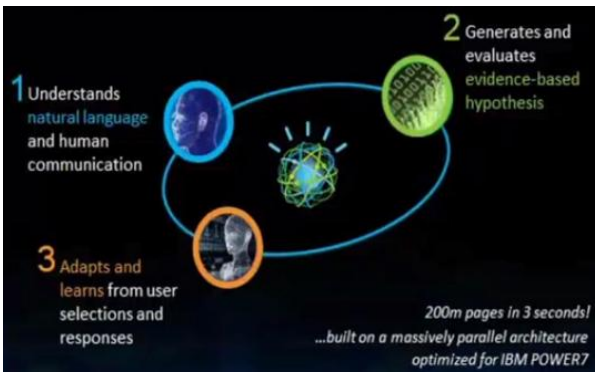

Fig. 2 IBM Watson combines transformational technologies to help computers understand and engage with us

In healthcare, IBM Watson for Oncology, trained by Memorial Sloan Kettering, helps oncologists treat cancer patients with individualized evidence-based treatment options by analyzing patient data against thousands of historical cases trained through more than 5,000 MSK MD and analyst hours. Watson can help doctors narrow down the options and pick the best treatments for their patients. The doctor still does most of the thinking. Watson is there to make sense of the data and help make the process faster and more accurate. For city leaders, these new systems can help them prepare for major storms to predict electrical outages, plan evacuations and prepare emergency management equipment and personnel to respond in the areas that will need it most.

A. When Computers Become Brains

Cognitive computing systems learn and interact naturally with people to extend what either humans or machine could do on their own. They help human experts make better decisions by penetrating the complexity of Big Data.

The human brain integrates memory and processing together, weighs less than 3 lbs, occupies about a two-liter volume, and uses less power than a light bulb. It operates as a massively parallel distributed processor. It is event driven, that is, it reacts to things in its environment, uses little power when active and evens less while resting. It is a reconfigurable, fault-tolerant learning system. It is excellent at pattern recognition and teasing out relationships.

A computer, on the other hand, has separate memory and processing. It does its work sequentially for the most part and is run by a clock. The clock, like a drum majorette in a military band, drives every instruction and piece of data to its next location — musical chairs with enough chairs. As clock

rates increase to drive data faster, power consumption goes up dramatically, and even at rest these machines need a lot of electricity. More importantly, computers have to be programmed. They are hard wired and fault prone. They are good at executing defined algorithms and performing analytics.

III. COGNITIVE EXPERIENCE

Cognitive computing refers to the development of computer systems modeled after the human brain. Originally referred to as artificial intelligence, researchers began to use the modern term instead in the 1990s, to indicate that the science was designed to teach computers to think like a human mind, rather than developing an artificial system. This type of computing integrates technology and biology in an attempt to re-engineer the brain, one of the most efficient and effective computers on Earth.

A. Human-computer collaboration at the speed of thought

Every era of computing delivers a new experience. In this era of cognitive computing, we envision a partnership between humans and learning systems that augment our individual and group cognitive capabilities, particularly those associated with insight and discovery. How would this work? As people inhabit and move across many physical environments, we see a fluid, coherent computing experience through space and time, connected by an ecosystem of cognitive environments inhabited by a society of specialized software agents called cogs. Cogs work in a mutually beneficial partnership with humans to enable better complex data-driven decision-making.

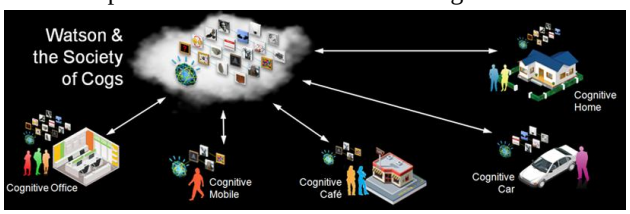

Fig. 3 The era of cognitive computing

B. Distributed Cognition

Cognition does not occur solely (or even mostly) within an individual human mind, but rather is distributed across people, artifacts and environments. The notion of building a society of cogs as the core of a cognitive environment is based upon this belief. Cogs are designed to follow and interact with humans and other cogs across a variety of everyday environments. They engage individually or collectively with humans through a combination of traditional interfaces and adaptive multi-modal interfaces based upon spoken dialog, gesture, and advanced visualization and navigation techniques. They learn and leverage sophisticated models of human characteristics, preferences and biases so they can communicate naturally.

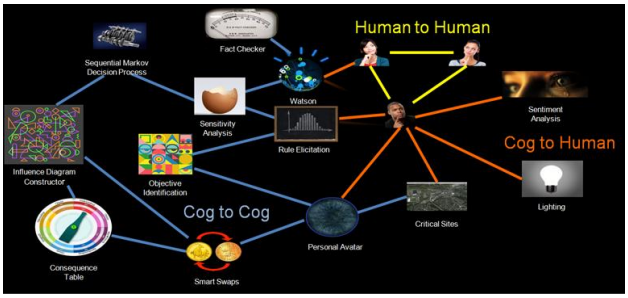

Fig. 4 Distributed Cogs across people

C. The Cognitive Environment

A cognitive environment is an infrastructure inhabited by the society of cogs and the devices that let them behave as one shared integrated resource, enabling "human-computer collaboration at the speed of thought." Cognitive Environments can look and feel very different (from decision rooms in the workplace, to cars, to homes, to mobile), but by being connected to one another they will feel seamless.

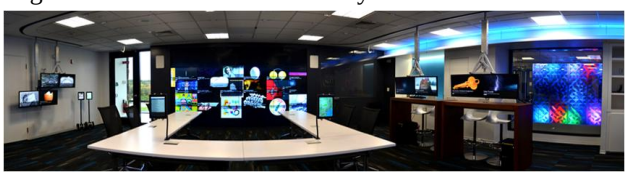

Fig. 5 Research infrastructure for the Cognitive Environments Laboratory

IV. PRACTICAL APPLICATIONS OF COGNITIVE EXPERIENCE

Cognitive computing systems learn and interact naturally with people to extend what either humans or machine could do on their own. Cognitive computing refers to the development of computer systems modeled after the human brain. Cognitive environments enhance the ability of business managers, emergency planners, and executives to make more effective strategic decisions. The relationship goes beyond interface and interaction, to trusted long term collaboration between cognitive computers and human beings.

Fig. 6 Field of oil and gas

In the field of oil and gas, a deeply interactive and significantly more collaborative cognitive environment enables geologists, geophysicists, petrochemical engineers, economists, planners, and developers to come together in a single environment that leverages their individual and unique skills, tools and applications, to collectively influence the course, plan, and direction of strategic decisions for higher quality outcomes.

Fig. 7 Merger and Acquisition

Merger and Acquisition is an essential part of strategy for profitable growth. Yet optimal identification and successful integration of the right target company is complex. Firms using a cognitive environment can more naturally highlight value and synergy opportunities, visualize trade-offs, and explore what-if scenarios to ensure that the right decision is made.

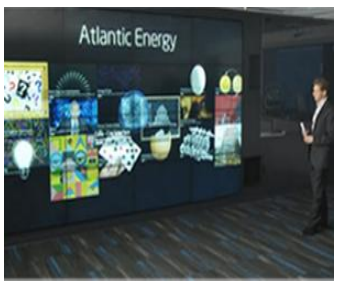

Fig. 8 Emergency planning

Emergency planning requires quick and accurate decision making, and can benefit from a set of cognitive agents who can quickly explore successes and failures from past data to recommend options and trade-offs for allocating scarce funds and deploying emergency crews in the most vulnerable locations.

V. CONCLUSION

Cognitive computing is about man and machine to both become smarter. That is the promise of **cognitive systems**--a category of technologies that uses **natural language processing** and **machine learning** to enable people and machines to interact more naturally to extend and magnify human expertise and cognition. These systems will learn and interact to provide expert assistance to scientists, engineers, lawyers, and other professionals in a fraction of the time it now takes. Far from replacing our thinking, cognitive systems will extend our cognition and free us to think more creatively. In so doing, they will speed innovations and ultimately help build a Smarter Planet.

REFERENCES

[1] Allport, A. (1989). Visual attention. In M. I. Posner (Ed.), Foundations of cognitive science (pp. 631-682). Cambridge, MA: The MIT Press.

[2] http://whatis.techtarget.com/definition/cognitive-computing

[3] http://www.duperrin.com/english/2014/05/27/whats-cognitive-computing-ibm-watson-example/

[4] Banich, M. T., Milham, M. P., Atchley, R., Cohen, N. J., Webb, A., Wszalek, T., et al. (2000). fMRI studies of Stroop tasks reveal unique roles of anterior and posterior brain systems in attentional selection. Journal of Cognitive Neuroscience, 12(6), 988-1000.

[5] http://www.dataversity.net/brief-history-cognitive-computing/

[6] http://www.forbes.com/sites/rogerkay/2011/12/09/cognitive-computing-when-computers-become-brains/

[7] Sun, Wang, Lu, Zhang, Zhang, Kinsner, & Zedah. (Eds.). (2010). In *Proceedings of the 9th IEEE International Conference on Cognitive Informatics (ICCI'10)*, Tsinghua University, Beijing, China. Washington, DC: IEEE.

[8] http://asmarterplanet.com/blog/2014/04/ibm-watson-ecosystem-platform-innovation.html

[9] http://www.research.ibm.com/cognitive-computing/why-cognitive-systems.shtml

[10] Wang, Y. (2002a). Keynote: On Cognitive Informatics. In *Proceedings of the 1st IEEE International Conference on Cognitive Informatics (ICCI'02)*, Calgary, Canada (pp. 34-42). Washington, DC: IEEE.

[11] http://www.ucalgary.ca/icic/files/icic/17-IJSSCI-2403-CoP.pdf