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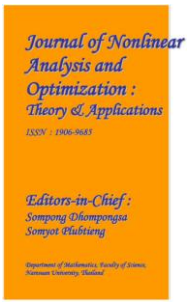

PERSPECTIVES ON COGNITIVE COMPUTING AND APPLICATIONS

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ABSTRACT
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. The development of Cognitive Computers (CC) is centric in cognitive computing methodologies. A (CC) is an intelligent computer for knowledge processing as that of a conventional von Neumann computer for data processing. This paper summarizes the presentations of a set of 6 position papers presented in the ICCI'10 Plenary Panel on Cognitive Computing and Applications contributed from invited panelists who are part of the world's renowned researchers and scholars in the field of cognitive informatics and cognitive computing.
Keywords: Artificial Intelligence, Cognitive Computing, Denotation Mathematics, eBrain, Engineering Applications, Granular Algebra, Machinable Intelligence

1.INTRODUCTION
A wide range of international efforts has been focused on the studies of the new generation of intelligent computers known as cognitive computers, which also known as intelligent computers, brain-like computers, artificial brains, and human centric computers in related research. A *Cognitive Computer* (CC) is an intelligent computer for knowledge processing as that of a conventional von Neumann computer for data processing.

Cognitive Informatics and Cognitive Computing versusComputing With Information Granules
One of the most talked about social networking applications on the web today is Location Awareness (LA). Until recently, almost all the content generated on the internet has been mostly in a temporal setting, i.e., time-stamped, e.g., News items, blog articles, reports, proposals, etc. Only recently, location awareness has captured the vision of social network platform developers such as Facebook , Foursquare, Twitter, QQ, and many others. It is this new wave of Internet applications that has taken the web content generation to the next level. Location awareness is now the new dimension in the global cognitive process. It is in this expanded information exchange space that common reference points are established and new self- organizing social structures emerge. In this position statement, I show that spatiotemporal referencing is primordial in high- frequency communication interactions.

2.High-Frequency Temporal Referencing: High-frequency information exchange (HFIE) exhibits strong temporal synchronization effects. For example, most of us have experienced dynamically attempting to converge to a meeting location established by frequent mobile calls as individuals seek for each other in a crowded urban environment or large indoor complex, such a convention center. Jack Dorsey, the creator and co- founder of Twitter, in his 99% conference speech in New York, in April 2010, admits his early passion for urban flow and the rapid changes in the urban environment.

The idea of high-frequency information exchange, although painfully simplistic, was not obvious in the past in the context of social networks. However, the value of HFIE emerged as users quickly realized the temporal synchronization of possible high-impact events that could lead to critical decision making or life-threatening situations

High-Frequency Spatial Referencing: The next level of high-frequency information exchange is now

converging towards high-frequency location awareness. More than ever, location has become the primordial factor of spatio-temporal referencing of information exchange. It is in this domain that we attempt to advance the level of cooperative development to a new global cognitive process. The additional dimension for information exchange is now *Location Referencing*.

High-frequency Location Awareness (HFLA) automatically tracks and projects motion trajectories of individual users similar to a GPS, but at a more refined scale in indoor environments. The challenge is of course the large indoor complexes which are not directly accessible by GPS location systems. Recently, we (Sysomos, 2010; Eddie et al., 2010a, 2010b; Chan et al., 2008, 2009a, 2009b) have developed an HFLAsystem on a Google Android HTC Nexus smart phone,

HFLA is also currently under development by Foursquare, an internet development company that will provide social network application based on high density location tracking of individuals in urban environments.

High-Frequency Cognitive Processes: High-frequency cognitive processes are currently perceived asbeneficial to critical decision making and ultimately to a higher predictive power on immediate future andthe impact of events in our society. Whether this is good or bad remains to be seen. relevant to the immediate perception of reality but provide a feedback loop on the immediate

Figure 2. Nexus-based indoor tracking system

Take for example the real-time subversive camera transmitting video of the deepwater horizon spill in theGulf of Mexico.

In the context of natural disasters, global warming, intensified large scale events, this simple video stream significantly affects our perception of reality, from the valuation of BP by international markets to fear of excessive toxicity levels in the aquatic food chain and increased probability of cataclysmic events.

3.IMPORTANCE OF RESEARCH ON KNOWLEDGE RESOURCES

Research of Artificial Intelligence started when modern computers were invented about sixty yearsago. Many important findings have been discovered in the past six decades, from block worlds andGeneral Problem Solver in early stages, Expert Systems in 1970's, Neural Net-work in 1980's, tomost recent developments in Information Retrieval and Natural Language Processing. However, a clear understanding of human-level intelligence is still far from reality, and any prospect for a computer system to pass Turing's test is still remote.

Figure 3. Impact of high-frequency cognitive process

Existing work in this area is scarce and often adopts manual acquisition methods, such as Cyc, Word Net, and Concept Net. Manual approach is labor- intensive. Even with long-time efforts (both Word Net and Cyc started about twenty years ago) of many human beings (about 12,000 people contributed to Concept Net), building a comprehensive knowledge base is still remote. Moreover, knowledge is dynamic and changes over time, so knowledge base construction requires continuous efforts on

knowledge updating and collecting.

4.HUMAN FACE COGNITION: FROM 2D TO 3D

Human beings are born with a natural capacity of recovering shapes from merely a single image. However, it remainsa significant challenge in cognitive computing and AI to let a computer obtain such ability. As we know, human vision system (HVS) is the key to restore 3D shape from 2D space. Simulating the underlying cognitive principle of HVS may provide a promising route for enhancements of 3D face modeling from an image. Inspiredby the basic idea of 3DMM (Blanz & Vetter, 2003), to make computers recognize well about the facial shape, wepropose a two-step face modeling (TSFM) scheme to make use of the prior knowledge learned from a large scale 3D face database in this paper.

5. GRANULAR COMPUTING ANDCONCEPTUAL MODELING IN COGNITIVE COMPUTING

Conceptual modeling is an important perspective on cognitive informatics (Wang, 2002a, 2003) and cognitive computing (Wang, 2009b). Cognitive computing involves extremely complicated processes because its carrier is the brain. A suitable conceptual model enables us to focus on the main features at a more abstract level, without being overloaded with minute details and without worrying about physical or biological implementations.

In particular, the following results are very relevant to the modeling of cognitive computing and processing based on granular computing:

- The classical work of Miller (1956) on the limited human information processing capacity and chunking, i.e., information granulation.
- The massive modularity hypothesis in evolutionary psychology (Downes, 2010).
- The Pandemonium model proposed by Selfridge (1959), consisting of demons organized intoa hierarchical multilevel structure, as well as its inspired human information processing models (Lindsay & Norman, 1997).
- The simple brain model proposed by Min-sky (2007), consisting of many resources.
- The hierarchical, memory based prediction framework proposed by Hawkins (Hawkins & Blakeslee, 2004).
- The layered reference model of the brain (LRMB) proposed by Wang et al. (2006).

The notions of granules, levels, and hierarchical structures may be used to suggest an expressive language for describing the above results. For instance, information chunks, information processing modules, demons, and resources are related to granules of different nature, and their hierarchical organization is related to granular structures. Therefore, granular processing may find practical applications in cognitive computing.

6.COGNITIVE COMPUTING VS ARTIFICIAL INTELLIGENCE

While there are many similarities between the methods of the two technologies, the provided outcome is very different. Both computing systems can learn and act based on provided input and experiences, remember past experiences, as well as adapt to new or unfamiliar data. Both cognitive computing applications and AI can analyze large sets of data, AI might provide a suggestion or course of action based on the algorithm-collected data, whereas cognitive computing technology might offer the user the relevant information to assist them in a decision.

Cognitive Technology Applications:

We know that AI is already being used to some degree by apps like the Amazon voice assistant Alexia or the Netflix and Amazon algorithms that suggest what you might want to buy or watch next Some of the industries that can benefit from this type of technology include:

Finance and investment firms: Investment firms can use cognitive computing applications to analyze the market in specific ways for their clients, and work with the software to make valuable suggestions.

Healthcare and veterinary medicine: With access to past patient records and a database of medical information, this kind of cognitive computing tool can allow a physician to interact with it and ask

questions about treatment.

CONCLUSION

It has been described that Cognitive Computing (CC) is an emerging paradigm of intelligent computing methodologies and systems based on cognitive informatics that implements computational intelligence by autonomous inferences and perceptions mimicking the mechanisms of the brain. Many position papers have elaborated that the theoretical foundations underpinning cognitive computing are cognitive informatics – the science of cognitive and intelligent information and knowledge processing.

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