Intelligent Knowledge Systems

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INTRODUCTION

In the last two decades the field of information and knowledge systems has seen enormous development. The information over the web has grown tremendously. In addition, there has been an ever increasing demand of making this information readily available. The researchers and scientists from the field of knowledge systems have been working towards the development of systems that can hold this ever increasing information, and then process it intelligently to retrieve useful knowledge.

However, with the emergence of knowledge management there have been continuous efforts to discriminate between information and knowledge (Bouthillier, 2002). As discussed by Meadow, Boyce, and Kraft (2000), information has no universally accepted meaning, but generally it carries the connotation of evaluated, validated or useful data (p. 35). Knowledge is said to involve "a higher degree of certainty or validity than information" and "has the characteristic of information shared and agreed upon within a community" (p. 38). Intelligence is a form of information but it is also "a measure of reasoning capacity" (p. 39).

Knowledge formation is one of the direct outcomes of human information management. Knowledge is defined as valid or useful information acquired through experience. A system is said to be knowledgeable by virtue of its property to validate the information stored, and to relate the pieces of information logically. The intelligence of a knowledge system is depicted through its capability to reason and acquire knowledge efficiently which can be retrieved for a purpose. This article provides an overview over the current work and the issues within the existing systems, followed by an insight into the future of intelligent knowledge systems.

BACKGROUND

Researchers in the field of information and knowledge systems have been working since early 1960s to provide a system which can represent, process, and retrieve knowledge in accordance to human information system which is brain. Graph based semantic representation have been the focus from the beginning (Sowa, 2008). Neuroscientists believe that the brain structure and function can be appropriately represented using network based approach (Sporns, 2011).

Knowledge representation has taken many forms ranging from cognitive maps (Kitchin,1994), concept maps, mind maps (Farrand, Hussain, & Hennessy, 2002), conceptual graphs and knowledge networks (Sowa, 1984; Chein & Mugnier, 2008).

Edward (1948) introduced the concept of cognitive maps, and Kosko (1993) introduced a fusion of fuzzy logic and cognitive map as Fuzzy Cognitive Maps (FCM). Cognitive maps provide mental representation of spatial information (Kitchin, 1994). Sowa (1976) developed a version of conceptual graphs (CG) as an intermediate language for mapping natural language questions and assertions to a relational database. CG provides a fixed diagram with labeled boxes and directed arrows (Figure 1).

Every semantic feature of the graph can be represented using a linear notation termed as Conceptual Graph Interchange Format (CGIF). CGIF is a concrete dialect that is capable of expressing the full Common Logic (CL) semantics. For the CG shown in Figure 1, the core CGIF is given as follows:

(∃x)(∃y)(Go(x) Person(Jess) Place(School) Bicycle(∧
∧ ∧ y)

(∧ x,Jess) Dest(∧ x, School) Inst(∧ x,y))

On the other hand concept maps are graphical tools to represent the connected concepts. It provides

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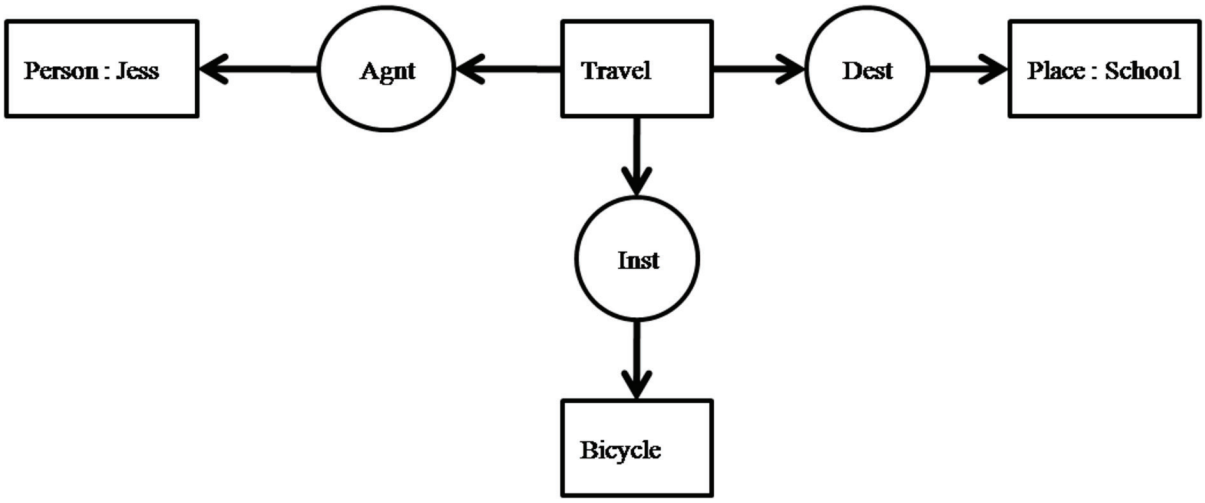
Figure 1. CG display form for Jess travel to school by bicycle



a way to represent the connected information which is used for searching a definite query from the system (Coffey, Hoffman, Cañas, & Ford, 2002). It is a hierarchical top-down structure that includes boxes with texts and labelled connected arrows. Concept map arrows represent relationship between concepts which are represented as nodes and include cross-connection among nodes. Mind map, invented by Tony Buzan, is a popular graphical way of representing a concept. Mind map is a centred-out structure, which supports organizing content related to an idea or main concept using a two-dimensional structure (Buzan & Buzan, 2010). It finds its usage in structuring and maintaining notes. Both the techniques are helpful in providing structured organization of information. However the two are not easy to implement, and face inconsistency when the information to be included increases (Eppler, 2006).

Semantic network or net as defined by Sowa (1992) is a graph structure for representing knowledge in the form of interconnected nodes and arcs. Semantic network is differentiated broadly into six kinds:

1. **Definitional Network:** Relate one concept to other concepts using subtype or is-a relationship.
2. **Assertional Network:** Make use of graph to represent the first-order logic.E.g. relational graphs, conceptual graphs..
3. **Implicational Networks:** Apply reasoning to the connectivity. They may be used to represent patterns of beliefs, causality, or inferences. Such networks are also referred as belief networks, causal networks, Bayesian networks, or truth-maintenance systems.
4. **Executable Networks:** Are network which cause change to the network by itself.
5. **Learning Networks:** Builds or extends their representations by modifying its internal representations in a way that enables the system to respond more effectively to its environment. The learning process may change the old network by adding and deleting nodes and arcs or by modifying numerical values, called weights, associated with the nodes and arcs. Neural nets are a widely-used technique for learning by changing the weights assigned to the nodes or arcs of a network.
6. **Hybrid Networks:** Combine two or more of the previous techniques, either in a single network or in separate networks, but works with closely interacting networks.

Artificial neural network (ANN) is an effort to simulate a functionality of human brain. ANN has been found useful in various fields of knowledge processing and learning, ranging from speech recognition to machine reading text, gene prediction, and LAMSTAR. LAMSTAR (LArge Memory STorage And Retrieval) uses SOM (Self Organizing Map)-based network modules. The principles of ANN were first put together by neuro-physiologist, Warren McCulloch and young mathematical prodigy Walter Pitts in 1943 (Graupe, 2007). Minsky (1961) have published a scientific paper