

Application of Cognitive Map in Knowledge Management



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INTRODUCTION

Cognitive map methodologies consist of a set of procedures to capture perceived relationships of attributes related to ill-structured decision problems that decision makers have to face. This article provides an overview of the application of cognitive maps (CMs) in the design and development of intelligent information systems. Here, CM is used as a set of techniques to identify subjective beliefs and to portray those beliefs externally as follows:

- Causal mapping is used to investigate the cognition of decision-makers. A causal map represents a set of causal relationships (i.e., cause and effect relationships) among constructs within a system. For example, Figure 1 shows that better sanitation facilities, causing an initial improvement in health, led to an increase in the city’s population. This growth led to more garbage, more bacteria, and therefore more disease. Causal map aids: 1) in identification of irrelevant data, 2) to evaluate the factors that affect a given class of decisions, and 3) enhances the overall understanding of a decision maker’s environment, particularly when it is ill-structured.

- Semantic mapping, also known as *idea mapping*, is used to explore an idea without the constraints of a superimposed structure. A semantic map visually organizes related concepts around a main concept with tree-like branches. Figure 2 depicts different types of transportation, organized in three categories: land, water, and air. This technique facilitates communication between end-users and system analysts in support of information requirements analysis.
- Concept mapping is a useful tool for organizing and representing concepts (events or objects) and their interrelationships in a particular domain. Each concept is designated with a label. The relationship between two concepts in a concept map is referred to as a proposition; propositions connect concepts to form a meaningful statement. Relationships between concepts are associative. For example, in Figure 3, two concepts of “plants” and “flowers” are associated via “may have” that form the proposition of “plants may have flowers.” Describing complex structures with simple propositions improve quality of conceptual modeling in the development of information systems.

Figure 1. Causal map for public health issues

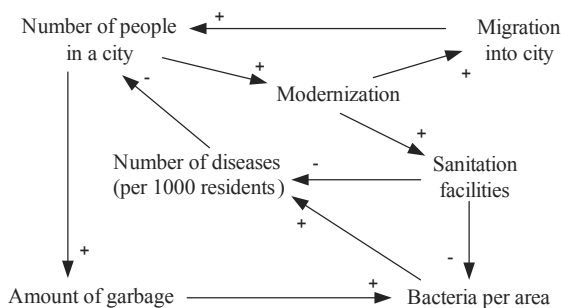


Figure 2. Semantic map for different types of transportation

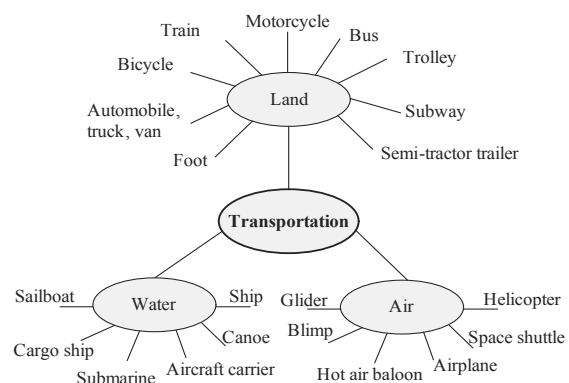
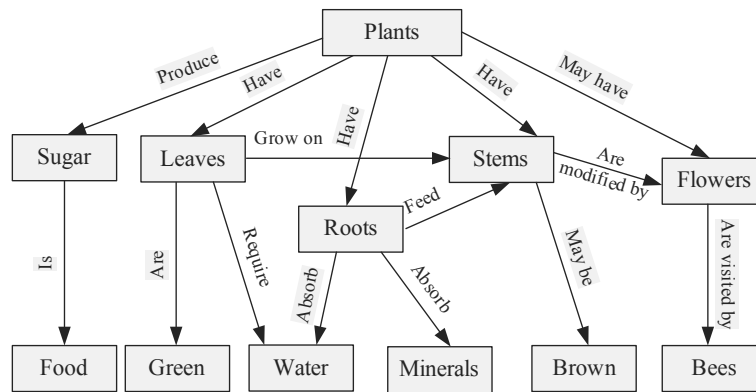


Figure 3. Concept map for plants



BACKGROUND

Cognitive Map (CM) has been employed to capture, store and retrieve expert knowledge in support of the design and development of intelligent information systems. CM is a representation of the relationships that are perceived to exist among the elements of a given environment. Taking any two of these elements, the concern is whether the state or movement of the one is perceived to have an influence on the state or movement of the other (both static and dynamic relationships can be considered) (Montazemi & Conrath, 1986). CMs have been used to describe experts' tacit knowledge about a certain problem, particularly in ill-structured decision problems (Axelrod, 1976; Montazemi & Chan, 1990). Tacit knowledge is personal knowledge, shared and exchanged through direct and face-to-face contact among actors (Eden, 1988).

There are different perspectives of knowledge within organizations (Nonaka, 1994). Thus, it seems appropriate to use knowledge management categories to identify different applications of cognitive map in the design and development of intelligent information systems. Alavi and Leidner (2001) provide a framework that is grounded in the sociology of knowledge and is based on the view of organizations as social collectives and "knowledge systems." They contend that organizations as knowledge systems consist of four sets of socially enacted "knowledge processes" as follows:

- **Knowledge application:** Those activities concerned with deploying knowledge in order to produce goods and services. Information technology can enhance knowledge application by facilitating capture, updating and accessibility of organizational directives.
- **Knowledge storage/retrieval:** This is also referred to as *organizational memory*, which includes knowledge

residing in various component forms, including written documentation, structured information stored in electronic databases, codified human knowledge stored in expert systems, and tacit knowledge acquired by individuals.

- **Knowledge transfer:** Transfer of knowledge to locations where it is needed and can be used. This can occur at various levels: transfer of knowledge between individuals, from individuals to explicit sources, from individuals to groups, between groups, across groups, and from groups to the organization.
- **Knowledge creation:** Developing new content or replacing existing content within the organization's tacit and explicit knowledge. Through social and collaborative processes as well as through the cognitive processes of the individual, knowledge is created, shared, amplified, enlarged and justified in organizational settings.

A literature search shows that application of CMs in intelligent information systems can be found in support of the above four categories of knowledge processes, as depicted in the Appendix. A brief description of each of the above four categories within the context of CMs is presented next.

KNOWLEDGE PROCESSING THROUGH CMs

Knowledge Application

CM techniques (e.g., causal mapping, semantic mapping and concept mapping) have been used to improve the processes of the design and development of information systems. They

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