A Collaborative and Collective Concept Mapping Tool

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Abstract. This paper presents the general philosophy, features and few aspects related to the implementation and underlying technologies of MaGIA, an Internet-based multi-user system designed for a collective and collaborative construction of knowledge models represented as concept maps. The use of the system can cover a wide range of purposes, from a theoretical discussion and construction of formal models to a support for collective *brain-storming.* What makes MaGIA an interesting tool is the emphasis put on a *collective* construction of such maps. In fact, one of the distinctive features and objectives of the system is to offer an enabling tool for a multi-user, bottom-up construction, where users can intervene, freely contribute and extend concept maps and where collective and collaborative multi-user map construction can take place in asynchronous as well as in synchronous way.

Keywords: concept maps, multi-user collaborative design, Jabber.

1 Introduction

Concept maps are graphical representations of knowledge in the form of node-arc-node diagrams, where nodes represent concepts and arcs represent relationships between them. Concept maps were proposed in the 1960s and 70s by Novak [1] and since then they have been used in many educational contexts, as a knowledge-acquisition methodology and as a complement to natural language for representing and communicating knowledge. In many disciplines, various forms of concept map are used as formal methods of knowledge representation, such as semantic networks in artificial intelligence, bond graphs in mechanical engineering, Petri nets in communications, and category graphs in mathematics.

While concept maps were traditionally carried out by hand using a pencil and paper, with the development of specific software tools, they began to be enhanced and complemented by the use of hypertext, sounds, video and pictures. In general, information technology made construction, modification, maintenance and analysis of concept maps easier and more effective. Furthermore, thanks to the developments of network-based technologies, many researchers have explored the potential of collaborative construction of concept maps within such environments (e.g. [2]), offering synchronous and asynchronous communication and collaboration capabilities between

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geographically distributed participants. Nowadays, there exist many tools offering advanced features for development, visualization and analysis of enhanced concept maps (e.g. GetSmart [3], CmapTools [4], Compendium [5] and Knowledge Manager [6]). Nevertheless, more research is needed to improve the support for- and to explore aspects of collaborative and multi-user construction of concept maps.

In this paper we present a multi-user software called MaGIA, designed for a collective and collaborative construction of knowledge models represented as concept maps. The system offers a series of functions and procedures, but does not preclude in any sense the type and the nature of themes and topics that can be treated. The use of the system can – in the line of principle – cover a wide range of purposes, from a theoretical discussion and construction of formal models (for example ontology models) to a support for collective *brain-storming***.** Furthermore, it is of a particular interest the collective and "horizontal" nature of constructs obtained via the system.

2 Overview of MaGIA

The grounding information structure of any concept map are nodes (representing concepts) and arcs (representing links or relations between nodes). Generally, both nodes and arcs contain some additional information which further specify them: nodes may contain labels and descriptions, while arcs may contain propositions or linking phrases which specify the relationship between two concepts. In MaGIA, we have adopted a more elaborated internal data structure. In fact, both nodes and arcs can contain *(i)* textual descriptions or definitions provided by users, *(ii)* documentation and media content (files) that can be attached to nodes and arcs, and *(iii)* references (bibliographies and webiographies). As it will be explained more in detail below, MaGIA is a multi-user system where users can act upon nodes and arcs, and that is the reason why nodes and arcs may have multiple textual descriptions (one per user), and may contain multiple attached files and references. Furthermore, every entity of a map can receive users' "votes", expressing their rate of approval (agreement or opinion).

MaGIA allows many users to synchronously and asynchronously act upon and modify concept maps. This is obtained through a central server repository of maps which can be accessed with MaGIA client. Once authenticated and connected to the server infrastructure, users can access, view, modify and create new concept maps, based on the assigned privileges and general access-rights configuration of the server.

2.1 Map Definition and Creation

Users with map creating privileges can create new concept maps. Besides assigning a name, description and access rules and permissions, that includes also the decision about shapes and semantics of nodes and arcs whose use is to be permitted in the map construction. In other words, for a specific map, every allowed node shape (e.g. circle, rectangle, ellipsis, etc. in combination with a specific color) and every arc shape (e.g. plain line, one-directional arrow line, scattered line, etc.) can be assigned to a meaning or semantics (e.g. type of objects, processes, phenomena, etc.). On the other