Chapter 16
Automated Detection and Removal of Cycles in a Concept Map

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ABSTRACT

Over the years, concept maps have been used by several researchers to construct online learning systems. This is due to their flexibility in organizing knowledge. However, for effective use of concept maps in education, detection, and removal of cycles within them is necessary. Cycles in a concept map may result in ambiguity and confusion as one concept can lead back to itself. This study first gives brief details about concept maps and their applications in the field of education. A popular algorithm of graph theory depth-first search is then used for detection of cycles. If any cycles are found, they are removed from the graph in an iterative fashion until there are no more cycles in the graph. A Java program was written to simulate the proposed algorithm and found to yield desired results on sample graphs. Finally, the future uses of concept maps have been discussed.

INTRODUCTION

Advancement in the domain of computer networks and communication technology has led to the use of internet (Alsabawy et. al., 2013) in various applications. Education was one of the fields that quickly adapted to this development. Internet was particularly useful in imparting education to the students who are physically separated from their teachers. It also imparted a flavor of ubiquitous learning, i.e. students

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can learn at their own time and location. A new set of pedagogy (Ausubel, 2000) was thus proposed by educators which lead to the development of web based learning systems for various learning applications. Web based learning may be implemented in various ways (Martins & Quadros, 2006). Earliest form of this is Electronic Learning (E-Learning) in which learning is done from any device that are electronic in nature such as television, computer, laptop etc. (Sharma, 2005). A major disadvantage of this form of learning is that it is location dependent. With the advancement in the field of mobile communications in the last two decades, Mobile Learning (M-Learning) evolved (Cherian & William, 2008). It added mobility to E-Learning. This enabled the students to learn independently of place and time using devices such as Personal Digital Assistants (PDA), and smart-phones (Moore et. al.,2011).

Over the years, web-based learning has been a blessing for students who are widely separated from their instructors (Georgeiv, 2008). Plenty of course material is available to them over the internet. This explosion of information had led to a new type of challenge (Yengin et. al., 2010). To enable the learners to use these benefits, certain tools are required to organize information (Palvia et. al., 2018). Such tools used for organizing and structuring knowledge have often been called mind tools (Raja & Khan, 2018) in relevant literature. It is a computer-based knowledge construction tool used by the learners to organize the subject they are studying. One such mind tool is concept map (Canas et. al., 2004). They include concepts, usually enclosed in circles or boxes of some type, and relationships between concepts indicated by a directed line linking two concepts. Words written along the line segment, referred to as linking words or linking phrases, specifying the relationship between the two concepts. Concept is defined as a perceived regularity or pattern in events or objects, or records of events or objects, designated by a label. The label for most concepts is a word, although sometimes symbols are used such as + or %, and sometimes more than one word is used. Concept Maps tend to be read progressing from the top downward fashion. The directed line segment indicates the sequence a learner should follow to learn a topic (Ausubel, 2000). Figure 1 shown below represents a concept map where the root concept is labeled 'Concept Maps'. It is used to show the various syntax that may be used for construction of concept map. The information flows downwards with the help of two relationships, namely, 'represent' and 'help to answer', which connects the root concept to two other concepts, 'Organized Knowledge' and '"Focus Question(s)"' respectively. The rest of the map flows in a similar fashion.

Concept mapping can be a powerful tool in the world of education, helping students to perform at higher cognitive levels and helping teachers to explain complicated subjects and assess student understanding (Novak & Gowin, 1984). Students can use concept mapping to:

- Organize and structure new material.
- Map out relationships between things such as vocabulary words, characters in a story, events in history, etc.
- Brainstorm new ideas.
- Create study guides.

[Teachers can use concept mapping to (Deneen et. al, 2013):

- Plan curriculum.
- Assess understanding or diagnose misunderstanding of students.
- Explain complex ideas
- Assist struggling readers