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Research on the Approach of Automatic Construct Concept Maps from Online Course

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Abstract: Concept map is a tool for representing knowledge. They have been used in many different fields, including knowledge management, business and industrial design. Concept maps also have been used as an effective learning tool to help students integrate new concepts into their existing set of knowledge. In this study we propose a concept map construction and rule-based evaluation system that is being deployed on the web. After students learned course content to construct individual concept maps for a particular topic that was presented in a course, they can then use the rule-based evaluation system to grade their concept maps against the concept map created by the course instructor. They are also useful for evaluating student learning and helping to illuminate where learning has mastered and where invalid or incomplete ideas are held by the student.

Key words: Concept map, concept map mining, online course

INTRODUCTION

Along with the development of information technology, it have been appeared Web2.0, Web3.0, service-oriented architecture (SOA), Web Service technology, grid computing, peer-to-peer networks, pervasive computing, cloud computing, social computing and so on. Information and Communications Technologies have experienced considerable advances in the last few years (Willis and Miertschin, 2010).

These technologies and their application promoted the sharing of learning resources and the solving of research problem and also created a new education mode.

With online course abundantly available, it applying wonderful method to solve the uneven distribution of education resources, getting what you want right away, regardless of where you are and whether you have the opportunity into college is common practice. With the availability of new online course, the manner which learning is implemented has changed tremendously.

The task of managing and analyzing ever-increasing amounts of online course requires the development of more efficient tools to keep pace with this growth.

Despite the numerous advantages, the facilitation and efficient in using online course is progressing relatively slowly in many cases, due to several concerns und barriers on knowledge management, pedagogical and individual levels. On an individual level, a successful implementation strategy for using online course needs to consider the learner's acceptance. Results of previous studies on learner's acceptance of online course examinations are inconsistent (Novak and Canas, 2008). Although learner today are commonly very familiar with the use of computers and the internet (Villalon and Calvo,

2008), there are several obstacle in the learning process when using the resource of online course. What's more, on knowledge management level, the main limitations with using online course lie in the management and represent of the knowledge content. Hence, there exists a need for research that examines the organization and representation knowledge method of the content provided via online course. This study aims to integrate of new technologies and method to address this need. Concept mapping was developed in the series study as a tool for assessing learner understanding and learning knowledge.

In this study, we propose an automatic construct concept maps approach to automatically construct the concept map from online course. This study is structured as follows.

Literature review of previous work and different approaches related to this research is given in the second chapter.

A procedure for constructing the concept map of textual documents in online course is proposed and described in the third chapter. The experiment results and a short discussion of proposed method are given in the fourth chapter. The fifth chapter provides a brief summary of the study and presents a plan for future research activities.

The main contributions of this study are:

- Apply Social Network Analysis Method to evaluation of created concept maps. In most evaluation of automatically created content map is performed using the method created by human annotators. Related fields experts determine the precision and accuracy of the content map which compared with the resource text of online course.

However, this approach is not appropriate because most learners are not course experts. To satisfy real needs, the system presented here evaluate the content map based on the Social Network Analysis approach

Reference to thesaurus concept extraction Fuzzy Set Theory to transform the numeric testing records of learners into symbolic data, Education Theory (Item Analysis for Norm-Referencing) to further refine it and Data Mining approach to find its grade fuzzy association rules.

- Analyze the main terms related to a content map process
- Propose a refined algorithm to automatically construct the concept map of the text from online course

PROBLEM DESCRIPTION

Concept Map (Knowledge Map) covering many areas, such as information science, philosophy Science, knowledge engineering, knowledge management and so on. Content Map which originated in the geographical map of the MRT Company's first full knowledge map is expressed with an index number or hierarchical forms and documents and information resources management. Concept map is a tool, which points to the knowledge not contain body. It is a guide rather than a collection of knowledge. Concept maps are not only point people, also point literature and other resources. We can learn from other tools and databases to collect knowledge. Preparation process is a knowledge map to individuals and small groups content map combined into a complete knowledge of a large map of the process.

The concept map mining has no uniform definition yet. This article focuses on the knowledge of the field of knowledge management maps. It is defined as: content map is an overview of the knowledge directory, is used to locate knowledge. Knowledge management facilities scattered knowledge can compile up to be effectively managed and maintenance, allow people to be able to fully access, sharing and then use that knowledge (Friedman-Hill, 2008). It consists of two aspects: First, through the knowledge acquired knowledge resources survey resource directory; second, sections of the directory is the relationship between the mesh. Content map must clearly reveal the relevant knowledge resource types, characteristics and knowledge of the interrelationship between. Content map is to give we clearly know what they are in the position of marine knowledge and guide them to find the correct path

information, are efficient and accurate way to acquire knowledge of effective.

In general, knowledge can be divided into explicit knowledge and tacit knowledge categories. In the explicit knowledge, only the body can be described by logical knowledge. It corresponds directly to a computer programmed process; this knowledge can be called Procedural knowledge (PK, Programed Knowledge). Obviously, PK can use an algorithm to replace the knowledge structure of a body, thus achieving computer solution. PK you need to use instead of manual operation, pipelining and machine mechanical operation instead.

METHOD

For achieving the highly effective learning, a predefined concept map of an online course is often used to provide learning guidance for learners. However, it is difficult and time consuming to create the concept map of an online course. Thus, how to automatically create a concept map of an online course becomes a challenging research direction in Educational Technology. This chapter proposes and describes a content map mining procedure for automatic creation of content map from texts in from online course.

Procedure outline: The proposed content map mining procedure creates content map from online course texts using statistical and knowledge discovery. The first iteration is based on statistical analysis and data mining techniques, with the usage of tokenization rules. This method is suitable for the processing of texts independent of their language origin. In second phase, to eliminate the variations a word may have, we apply the lowercasing algorithm which contains a set of morphological rules and a set of codes to apply the rules. In the third phase, we use linguistic knowledge to extract team, compute the frequency to get the key content. After that, we refer to the stop word dictionary to filter the team in fourth phase. The result of the process is determined a number of key concepts. We use a xml-based format to store the concepts, then use the software CiteSpace to general the concept map.

Depending on the results, techniques that require knowledge manage are used in the last iteration. The main steps of the proposed procedure are shown in Fig. 1.

Procedure details: The construction of concept map can be generally divided into seven kinds: analysis data sources, tokenization the text, pre-processing by linguistic technology, extracts the key concept, extract the relationship between concept, generate concept map and

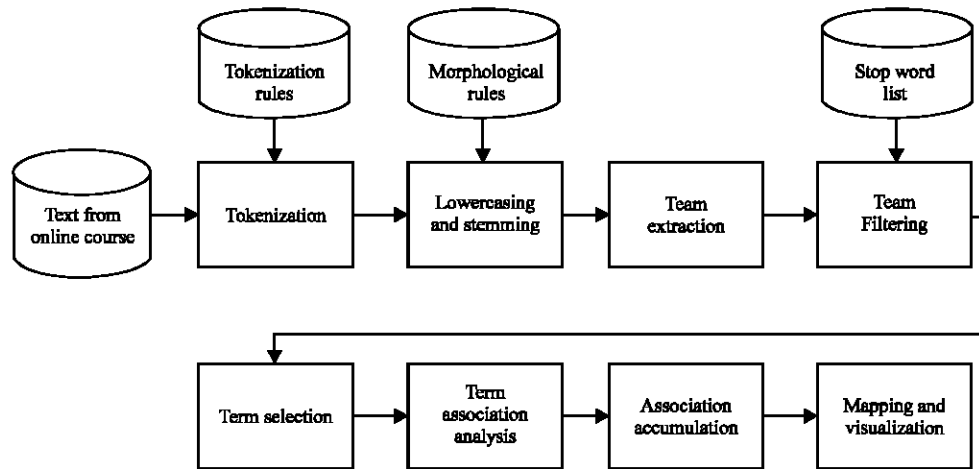


Fig. 1: The flow chart of the proposed concept map mining from online course

evaluate it. It is really a complexity and time-consuming knowledge management process.

Data source: This step focuses on analysis the structure of data source. For example, we analysis which language of the resource text is, so to make decision about apply different appropriate strategy. To obtain resources encoding is also necessary, because texts are encoded using different encoding schemes, e.g. UTF-8, GB2312, Windows-1250 etc. In order to recognize the type of the code pages, an algorithm checks HTML encoding attribute from the heading of each document. If the value of that attribute which include the key information does not exist, the algorithm uses heuristics to recognize the correct code page (Yang *et al.*, 2010). It is important to identify text and word. In addition, the analysis of resource also includes the author, the title of the article and expiry period.

In this research, we use online course as recourse, the course is consist of various HTML pages and the language is Chinese.

Tokenization: Chinese word segmentation refers to a character sequence cut into a one single word. Segmentation is a continuous sequence of words according to certain norms reassembled into word sequence of the process. We know that in the English wording in a space between words as a natural delimiter, while Chinese is just words, sentences and paragraphs obvious delimiters through simple demarcation, except without a formal word delimiter Although English is the phrase partitioning problem also exists, but in terms of this layer, the Chinese than the English are much more complex, much more difficult.

Existing segmentation algorithms can be divided into three categories: string-based matching segmentation method, based on understanding segmentation method based on statistical segmentation method. Whether the tagging process in accordance with the combination and can be divided into three sub-word segmentation and labeling methods and the combination of an integrated approach.

In this article, we use the segmentation method based on statistical segmentation method.

Concepts extraction: Concepts extraction contains the information processing structure. Enter the concepts extraction system is the original text, the output is fixed format information points. Information from various points in the document are extracted and then integrated in a uniform manner. This is the main task of concept extraction. Concept in a uniform manner would benefits to facilitate inspection and comparison. Concept extraction technology does not attempt a comprehensive understanding of the entire document, but the document contains information on the part of the analysis. As to what information is relevant, it will be laid down in the field of system design range.

In this research, we combined with prior research on the Chinese text classification, a method that by use of this semantic knowledge base to expand the text terms, so as to improve the accuracy of text classification. And the comparative experiments between traditional classification method and the method proposed in this study prove the effectiveness s of the knowledge base.

Relationships extraction: Concepts in a CM are semantically related and links between them are

established. The pattern of relationship between two concepts can be identified by the main verb in a simple sentence. For each pair of concept candidates, all words positioned in their neighborhood are temporarily saved as candidates for a link. A set of rules is created for the extraction of link candidates from that temporary storage set. Extraction rules are based on the frequency of their appearance in the concepts' neighborhood. The Relationships extraction rules, written in a symbolic notation, follow:

- S(x, y, z) AI(x, y, z) ⇒ Exact Match Action
- S(x, y, z) AI(x, y', z) Eq(y, y') ⇒ Exact Match Action
- S(x, y, z) AI(z, w, x) Inverse(y, w) ⇒ Exact Match Action
- S(x, y, z) AI(x, y', z) Inexact(y', y) ⇒ Inexact Match Action
- S(x, y, z) AI(x, y', z) ⇒ Partial Match Action
- S(x, y, z) ⇒ No Match Action

Concept map summarization and generation: The method of the summarization phase is the CM that provides an overview of the online course's contents with minimal redundancy.

In the first phase, statistical techniques are used on propositions created in the previous phase. The relative importance of propositions within online course is calculated and top propositions are extracted. Propositions with higher calculated values are positioned higher in the CM hierarchy; the strongest proposition is marked as the starting one. Based on an examination of summarization results in the first phase of research, specific technique will be chosen for use in the second part.

An optimal number of concepts in the final CM is determined and then summarized propositions are stored in CXL format (Canas *et al.*, 2006). Maps in that format are XML-based and can be visualized using different concept mapping tools.

RESULTS AND COMPARISONS

In a manual evaluation condition, students who submit a concept map assignment would receive a feedback for double weeks or more after submission.

The evaluation system that we discuss in this study reduces the amount of time the instructor spends on grading and allows teacher to spend more time on solving students' individual problems.

One teacher estimated that it took about ten min to grade a hand-drawn concept map. Although the instructor spent about the same amount of time on each concept map when students were given access to CMT, most of the time was spent correcting specific problems in the understanding of the topic among students, which from any perspective is a better use of time. We estimate that

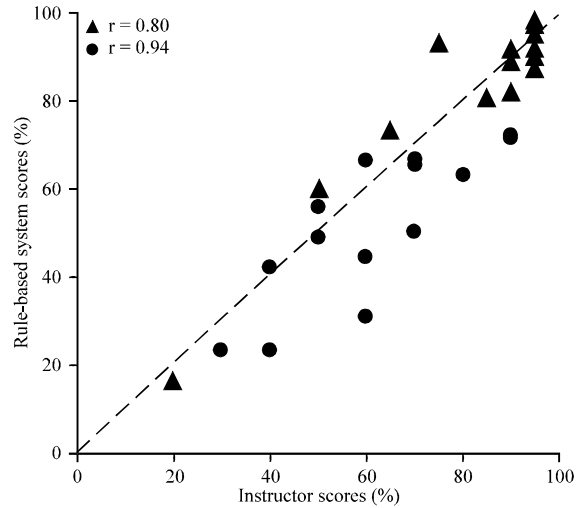


Fig. 2: Bivariate plot of instructor and rule-based evaluation system scores for two tests of the system on students' concept maps in the Introduction to educational technology course and the instructional design course ● = score comparisons for the first test and ▲ = score comparisons for the second test

it would take the rule-based system less than ten seconds to evaluate the same concept map.

Although the mean score on the student's concept maps graded by the instructor on the first test was significantly higher than the score generated by CM evaluation system, the strong positive correlation between the two evaluators is satisfying (Fig. 2).

The discrepancy between the instructor's scores and those of the rule based system on the first test of CM might be attributed to the subjectivity and higher level of inconsistency in the evaluation that is to be expected from a human evaluator.

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