Advanced Materials Research *Online: 2013-08-30*
ISSN: 1662-8985, Vols. 753-755, pp 3039-3042
doi:10.4028/www.scientific.net/AMR.753-755.3039
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Design And Implementation of an Automatic Scoring Subjective Question System Based on Domain Ontology

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Keywords: Ontology, Automated Assessment, Word Segmentation , Similarity Calculation.

Abstract. Automated assessment technology for subjective tests is one of the key techniques of exam systems. A model based on domain ontology is proposed in this paper, which can be used in exam systems to estimate subjective tests. After analysing the present research status of subjective automated assessment technology, the paper makes a study on the construction method of domain ontology by taking software engineering domain as an example. Semantic similarity calculation based on domain ontology is used for automatic assessment in this paper. The automatic assessment system can divide a sentence into a series of phrases by using the natural language processing technology and get the score by evaluating the semantic similarity of the student's answer. The experiments show that the results of the system which has certain valuable feasibility and applicability are credible and the scoring errors are acceptable.

Introduction

With the rapid development of computer technology, the Computer Aided Test (CAT) that can compensate for the disadvantages of the traditional test system is gaining increasing concern. The automatic scoring technology which is used for objective questions has been applied in the large-scale examination systems because it is fashionable and mature. An automatic scoring system full of objective questions is no longer enough to evaluate the learning effect in that it can not test the student's ability completely. For example, an examinee can select an answer randomly when he or she does not really understand the meaning of the questions. There is another reason to be pointed. Now, the assessment of subjective questions mainly depends on manual labor. The result is influenced by some factors, such as the calligraphy of the examinees, the working conditions of the teachers and so on. Besides, computers can be used in the evaluation of subject questions with the high speed and perfect performance.

Related Research

These automatic scoring algorithms are realized by evaluating the similarity of the student's answer and the standard one textually. However，the differences in the students' modes of expression and comprehension abilities lead to the answers of the subject problems are not unique.

When a student describes the same thing by using different choices of words or pronouns ,it is possible to occur miscarriages.Studies on automatic scoring algorithms have become prominent in academia at home and abroad. A backpropagation neural network and Latent Semantic Analysis were used by Chanunya Loraksa etal to assess the quality of Thai-language essays written by high school students in the subject matter of historical royal Thai literatures[1]. Sargur Srihari etal researched the automatic scoring of short handwritten essays in reading comprehension tests[2]. Ghosh S etal designed an automated essay grading system in Indian Context[3]. Li Bin etal presented the K-Nearest Neighbor algorithm for automatic essay scoring[4]. Xingyuan Peng etal studies the methods of automated Chinese essay scoring based on word scores[5].

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Construction of domain Ontology

Ontology plays a backbone for meaning-centered reconfiguration of syntactic structure, which is one aspect of semantic technology[6].It is necessary to establish an automatic scoring subjective question system. Ontology plays an important role in soft engineering. Shower of technical terms offered by ontology can be communicated by users.

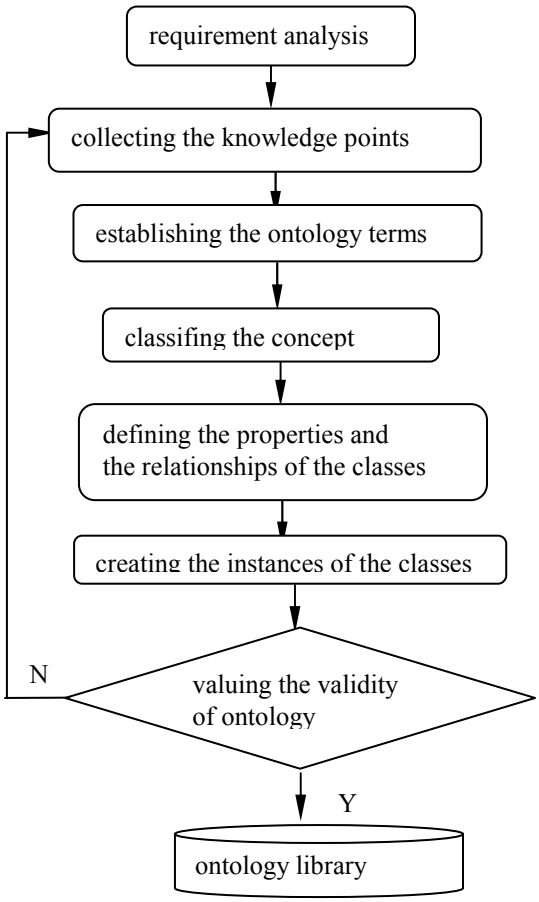

Figure 1:The construction process of software engineering course's ontology

The construction process of software engineering course's ontology is shown in Figure 1. Firstly, requirements analysis is an important step in the construction of domain ontology. There are some questions should be understood such as scope of the course ontology, the objects of ontology construction, the requests for the working hours and so on. Secondly, the important conception is extracted from the course. We collect the knowledge points and analyze the relationship of them carefully so as to establish the ontology terms. Thirdly, we classify the concept and define the properties and the relationships of the classes. Fourthly, we create the instances of the classes under the guidance of domain experts. Fifthly, the validity of ontology is valued. The validity of classified fusion contributes to the establishment of ontology library. Otherwise, if the categorization is unreasonable, what we should do is recollecting the knowledge points.

Automatic assessment of subjective examination

When a person weighs and ranks the informations, he usually looks through the documents to see if there are the objects. If there is no fields , the person may skip the files and look for the information in other ones. Otherwise, the person may analyze if the characterization can match his needs exactly and make a score according to details of the description.

Chinese Word Segmentation

As everyone knows, words are separated by spaces in English while there are no space as a boundary tag as between two words in Chinese. Chinese Word Segmentation means that a sentence is divided into a series of word. Institute of Computing Technology Chinese Academy of Sciences developed ICTCLAS(Institute of Computing Technology, Chinese Lexical Analysis System) based on years of research experiences[7].

The Word Similarity

HowNet is a common sense knowledge base proposed by Zhendong Dong. It is a common sense ontology describing semantic relations between concepts (represented by Chinese and English words) and semantic relations between the attributes of concepts[8]. HowNet and software engineering ontology we build are regarded as the semantic knowledge resource of system. W1 and W2 each stands for a Chinese Word. One word may contain one or more concepts such as C11,C12...C1n.Therefore,what we do next is calculating the similarity of two concepts.the similarity of W1 and W2 is the maximum similarity of these concepts[9].

$$Sim(W_1, W_2) = \max_{i=1..n, j=1..m} Sim(C_{1i}, C_{2j}) \tag{1}$$

The similarity calculation of concepts is equals to calculating the similarity calculation of sememe because concepts are expressed by sememe.

$$Sim(S_1, S_2) = \frac{\alpha}{d + \alpha} \tag{2}$$

S1 and S2 are two sememes, d is the distance between S1 and S2. α is a parameter that can be adjusted ,which means the distance between words when the similarity is 0.5.To calculate the sentence similarity which is based on the word similarity, we use the following formula presents by Liuqun [10].

$$Sim(S_1, S_2) = \sum_{i=1}^{4} \beta_i \prod_{j=1}^{i} Sim_j(S_1, S_2) \tag{3}$$

Experiments

An automatic scoring subjective question system based on domain ontology has been established according to the theoretical studies above. The domain dictionary loads automatically when the program starts. After the system figures out the standard answer and student's one, the user may click the "run" command button and get the scores. The interface of the system is shown in Figure 2.

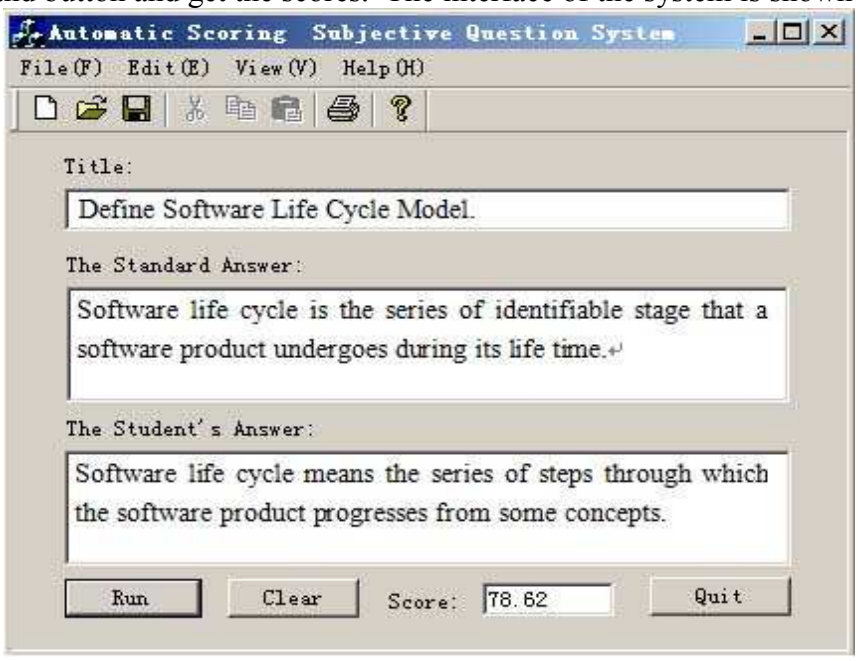

Figure 2: The interface of the system

In order to identify the validity of the construction of the ontology and the precision of the system, over 3200 questions are collected. The ontology thesaurus which includes all the key words of the software engineering is built. The similarity degree between the student's answer and the standard one is computed automatically. The outcome of the experiments shows the scores made by the system coincide with human scores.

Conclusions

In this paper, a domain ontology regarding software engineering is built. HowNet is used as the underlying knowledge base. An algorithm is used to measure semantic similarity between the student's answer and the standard one. Based on the computation and the result of the experiments, an automatic assessment system is built. Of course, the parameter settings used in the evaluation should be changed for different subjects in the actual application. In the further research, the algorithm parameter correction should be taken the focus on.

Acknowledgements

This work is financially supported by the Foundation of Fujian Educational Committee under the grant number JK2012063.

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10.4028/www.scientific.net/AMR.753-755

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