

A free-text scoring system that generates conceptual models of the students' knowledge with the aid of clarifying questions*

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Abstract. In this paper, we outline Willow [1], an adaptive system for assessing free-text student answers able to (a) automatically generate a representation of the student's knowledge as a concept map; (b) to guide the student to the correct answer with clarification questions.

1 Introduction

Knowledge models are increasingly used in educational applications. A few systems, e.g. HYLITE+ [2] or STyLE-OLM [3], are able to elicit users' conceptual models by means of dialog interfaces. However, up to our knowledge, all of them require some form of ontology or conceptual graph to represent the domain knowledge.

2 Approach followed

Conceptual model Our approach consists in automatically generating the conceptual model of a student. It takes advantage of the free-text scoring system Willow [4], a system that allows teachers to create collections of questions about a course, so that students can practise answering free-text answers and be evaluated automatically. From the structure of the course, provided by the teacher, it is possible to extract two kinds of nodes: an *area-of-knowledge concept*, which corresponds to the course's topic, and *topic concept*, which corresponds to the question sets, i.e. subdivisions of the course. Furthermore, the system analyses the questions with Term Identification techniques to identify term candidates that are added to the concept map as *basic concepts*. The map is extended with relationships between AC-TC and between TC-BC, automatically extracted from the course's structure, and between basic concepts, automatically extracted from the students' answers. The automatic evaluation of the student answers is also used to score every node with confidence-level value that indicates how well the student knows that concept.

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Automatic generation of clarifying questions Given that Willow is not a summative assessment tool but a formative one, the stress is set not on the score itself, but on helping as much as possible in the student's learning process. Therefore, whenever a student answers a question, rather than simply providing a score with some feedback, the information stored in the student's conceptual model is used to generate several clarification questions to help the student answer correctly:

1. Initially, if the answer was wrong, the system simply asks *Please, explain more your previous answer.*
2. Next, if the answer is still unsatisfactory, it chooses a BC X with a low confidence score, and rejoins *Please, tell me more about X .*
3. Finally, if the student is not able to answer second-level questions, it constructs a *true/false* question automatically by taking a random sentence from the reference answers and, occasionally, falsifying it by negating the main verb or substituting relevant words with their antonyms.

Willow always reevaluates the answer given by the student to each clarification question, bearing in mind the information given in previous answers, until the total score reaches the minimum score to pass. If the third-level questions are answered wrongly, the student fails. Every time an answer is reevaluated, the confidence-values associated to each concept in the student's conceptual model are recalculated, the questions of the dialog are also updated according to the new confidence-values.

Discussion In this paper, we briefly overview a system that automatically represents the student's knowledge as a concept map, that does not require any manually defined map or ontology. Clarification questions both help the students towards the right answer and update their concept map as they progress. In the future, we plan to build a full-fledged Natural Language Generation module to generate a dialogue more similar to a Socratic tutor.

References

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