Developing Teaching Aids for Distance Education

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Abstract. As web-enhanced courses become more successful, they put considerable burdens on instructors and teaching assistants. We present our work on developing software tools to support instructors by A) semi automatic grading of discussions and B) creating instructional tools that handle many student requests. We are using knowledge-based techniques in modelling course components, student queries, and relations between them. The results from our initial analysis in developing such tools are also presented.

Introduction

Web-enhanced courses and distance education courses are becoming increasingly popular. Such courses make class materials easily accessible to remote students, and increase the availability of instructors to students beyond the traditional classroom. However, as such courses become more successful, their enrollments increase, and the heavier on-line interaction places considerable burdens on instructors and teaching assistants. Thus, the ultimate success of web-based education is constrained by limited instructor time and availability. At the same time, many routine student queries and on-line activities do not necessarily require instructor or TA intervention. Software tools that can handle some student activities would allow instructors to focus on queries and activities that truly require their attention.

1. Turning quantity into quality: Development and validation of a measure to support automatic assessment of on-line discussion contributions

Engagement in on-line discussions is an important part of student activities in distance education, and instructors often use it to measure each student's contribution to the class. Although it is probably not feasible or pedagogically appropriate to completely automate the grading process, we are developing approaches to semi-automate some of the work.

There has been some prototype measures of discussion quality that relies on the quantity of discussion contributions [2], which include the number of posted comments and the number of responses that a post elicits from classmates and/or the TA or instructor. We are extending the framework to accommodate various factors. Posts that engage many different students might have a higher probability of being high quality than a post that does not elicit interest from anyone else. If a student was involved in various discussions on different topics, we may infer that he/she has broader interests than a student who contributes to only small number of topics.

We are currently collecting course data from various fields including Psychology, Mechanical Engineering and Computer Science. Here we report an initial analysis of a graduate-level Computer Science class on Advanced Operating Systems held in Fall 2003. The course had over 80 graduate students enrolled. Students were encouraged to participate in an on-line forum to discuss on general issues as well as course topics. Their participation was reflected in their grades as class participation scores, consisting up to

10% of the final grade. Table 1 presents a part of our results, showing ranks from three different groups: 5 students with highest ranks, 5 students with middle ranks, and 5 students with lowest ranks. The ranks are computed based on the following factors: A) total number of messages sent, B) average length of the threads where the student participated, C) total number of threads initiated by the student, D) average number of other students involved in the threads that the student initiated, E) total number of different threads where the student participated. The last column shows qualitative assessment of student participation by the instructor.

	A (rank)	B(rank)	C(rank)	D(rank)	E(rank)	Avg Rank	Instructor's assessment
S-high1	25(4)	7.41(31)	8(3)	3.57(16)	23(3)	11.4	strong
S-high2	23(6)	9(23)	5(5)	3.5(17)	16(7)	11.6	strong
S-high3	28(3)	7(34)	4(7)	3.75(13)	18(4)	12.2	strong
S-high4	8(14)	10.25(18)	2(15)	6(3)	7(12)	12.4	relatively strong
S-high5	104(1)	6.21(41)	16(1)	3.21(19)	37(1)	12.6	strong
S-mid1	7(17)	6(42)	1(20)	3(20)	6(14)	22.6	not strong
S-mid2	4(29)	6.26(40)	4(7)	3.8(12)	3(29)	23.4	not strong
S-mid3	4(29)	8.5(25)	2(15)	5(5)	1(43)	23.4	not strong
S-mid4	6(22)	13(8)	0(34)	0(33)	4(24)	24.2	not strong
S-mid5	7(17)	7.17(33)	0(34)	0(33)	8(10)	25.4	not strong
S-low1	1(46)	8(23)	0(34)	0(33)	1(43)	36.4	not strong
S-low2	2(40)	3.5(53)	0(34)	0(33)	2(38)	39.6	not strong
S-low3	1(46)	7(34)	0(34)	0(33)	0(54)	40.2	not strong
S-low4	1(46)	2(57)	1(20)	2(26)	0(54)	40.6	not strong
S-low5	1(46)	5(45)	0(34)	0(33)	0(54)	42.4	not strong

Table 1: Student participations in discussions.

As shown in the table, the instructor agreed that in fact the top 5 students provided strong contributions to the discussions and other students were less strong. Also, we found that there are some correlations between A,C, and E factors. We are currently validating actual correlations between these factors and analyzing other factors that can be potentially useful.

2. Developing instructional tool that semi-automatically answers student queries

The goal of this part of the work is to develop a tool that can handle many of student requests semi-automatically. The tool will seek the instructor's help only when the student needs additional help.

As an initial step, we are focusing on routine queries on general course information, administrative issues on assignments and exams, and other frequently asked questions. Instructors agree that they often spend a significant amount of time although many of them do not actually need their intervention. We are developing 1) a *course ontology* that represents generic components of distance education courses, 2) a *query ontology* that describes types of student queries and requests, and 3) general mappings between the two ontologies, i.e., how a type of query can be addressed by some course components. They are being built as general background knowledge which can support various reasoning capabilities such as classification, verification and knowledge authoring across different courses [1].

Note that these ontologies can include dependencies between different components. For example, participation to the discussion forum is *enabled* when the student knows how to access the forum class. Attendance policy is a *part of* grading policy if class participation grade counts in attendance rate. Figure 1 shows the current ontology we are developing based on the Operating Systems course described above. The left hand side shows the concepts representing the course components. The right hand side shows types of student requests. The actual class structure and its materials are being represented in terms of these concepts and their relations. For example, the course is represented in terms of its syllabus, general information (office hours, exam dates, etc.), distance education network (DEN) relevant information, etc. Each student query is mapped to query types based on the keywords in the message. In the figure the numbers next to query types mean the numbers of actual queries in the class. The lines in the figure highlight mappings between query types and course components.

By making these relations explicit, the system can map student queries to relevant course materials efficiently and the results can be sent to the students. When the system cannot find appropriate mappings or the student is not satisfied with the materials sent, the system may bring the case to the instructor's attention. All the interactions between the system and the student will be available to the instructor.

The ontologies enable the system to find answers when simple keyword based search fails.

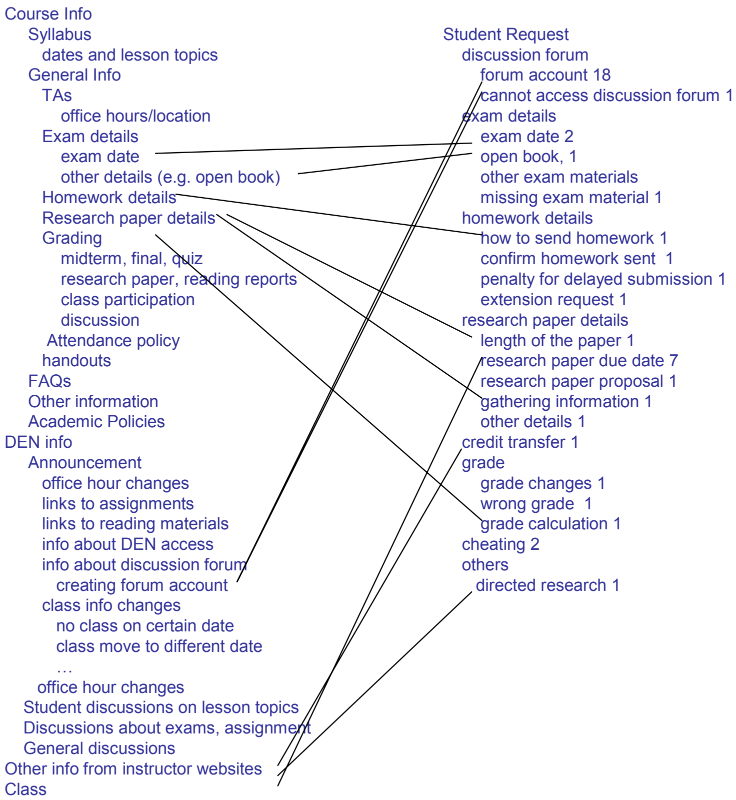

Table-2. ontology of general information about a class and its mapping to student queries

The following shows an example of such a case. Although the student is asking about message posting and registration, the actual information he needs is how to access his forum account shown below.

Student: I am unable to post message in the Class Discussion. In fact I didn't receive any activation key in e-mail upon registration. Could you please suggest me a way out ?

Course info: Your forum accounts have been created. Your username is the the username part of your school e-mail account, e.g., if your e-mail address gbush@school.edu, then your username for the forum is gbush. Your temporary password is ....

If the system simply uses the content of the message, it may retrieve other instructional components such as how to register for DEN to access DEN materials, which does not help the student in this case. In order to provide an appropriate answer, the system needs to know what information will help the student in the given situation, such as discussion forum account enables the student participation in the discussion forum.

The ontology can be also used in assisting the instructor. The system can show how certain answers were derived by tracing the concepts and their relations used during answer generation. The instructor can use the ontology in organizing their instructional materials and the system can check whether there is any missing or duplicate information by checking dependent components. We are planning to extend our ontology to take into account of the history of student activities, making the context of the queries more explicit.

Acknowledgement

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References

[1] Kim, J. and Gil, Y., Knowledge Analysis on Process Models, *Proceedings of IJCAI-2001*.

[2] Shaw, E. Assessing and Scaffolding Collaborative Learning in Online Discussions, *Proceedings of AIEd-2005*.