The Implications of Temporal Association Rules in the Design of Intelligent Tutoring Systems

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Background. In this project, I seek to further work in the area of socially aware virtual agents that act as peer tutors. To inform the dialog of such virtual agents, we first examine conversation between human peer tutors to discover the most effective tutoring and conversational strategies. Then, an automated framework is built and used to enable the system to detect the student's behaviors and speech patterns and respond appropriately.

Abstract. Identifying and understanding the associations between behavioral patterns and conversational strategies and rapport is a key issue in the design of an intelligent tutoring system. Rapport is used as a measure of interpersonal closeness and in previous work has been shown to have a positive effect on learning gains in students engaging in peer tutoring.

In this research project, I use a temporal association framework to discover relationships between behavior patterns and immediate rapport outcomes in human-human reciprocal peer tutoring. A dialog corpus of middle school students was annotated for both verbal and non-verbal behaviors, including social and tutoring strategies such as inclusive language and types of questions. Rapport was measured at 30 second intervals using thin-slicing, by which naive raters watch the 30 second clips and rate the interpersonal closeness of the dyad on the Likert scale of 1 (no rapport) to 7 (extremely high rapport).

After processing and standardizing the data files, I used the TITARL framework to generate over 20,000 rules relating behavior patterns to rapport. I created two separate sets of of data, one that associated behaviors to absolute rapport levels, and the other to rapport delta (the change in each slice from the previous slice). I then pruned the set of rules by minimum confidence, support, and number of appearances of the pattern. To verify hypotheses, I examined the distribution of rapport levels that were associated with patterns that contained a specific behavior (or behaviors).

Prior work used the "code-and-count" method to analyze the impact of particular behaviors, however the method limits results to observations at the hour-long tutoring session level. The rules generated using this method are able to test hypotheses at a much finer-grained level. In addition, the rules can be used to automatically assess rapport state using machine detectable behaviors.

It is our goal to use the rules generated from this approach to build an intelligent tutoring system capable of automatically assessing and managing rapport through real-time analysis of identifiable behavior. The results of this research project suggest that the temporal association rules that I generated verify and build upon previous findings from the aggregation method, as well as provide additional insight into the interaction between different behaviors. This work has direct implications in the design of dialogue for data-driven reciprocal peer tutoring systems.