Independent Study Proposal – Rapport-building in Peer Tutoring

Independent study educational goals
Students are invited to work within an interdisciplinary team of HCI and LTI graduate students and post-doctoral fellows to gain hands-on experience with research. In this independent study, students will work directly with an existing corpus of data in the ArticuLab that focuses on reciprocal peer Algebra tutoring. Through working with this data set and guidance from their mentor, students will learn research skills in human behavior analysis and perform independent research to explore self-chosen topics afforded by the empirical data. They will also situate themselves within this research lab by helping to address existing research questions alongside the mentors and other lab members, attending group meetings, and participating in undergraduate student reading groups.

This independent study is designed for the student to (1) build expertise with a specific project grounded in fields such as HCI, education, linguistics, and psychology; (2) gain experience working as part of an interdisciplinary research team through attending group intern meetings, and occasionally working along with other lab members from other projects; (3) perform independent research relating to rapport-building, tutoring, and dyadic interaction in learning contexts.

In order to achieve these educational goals, the independent study student is invited to find a topic of personal interest within the domain described above, and to work through the 3 essential parts of empirical research of this sort: (1) conducting a literature review of prior work and coming up with a hypothesis for their own work; (2) preparing the data for analyses to adduce evidence for their research, either through new data annotations or through the use of existing annotations; and (3) carrying out analyses and writing up the results in a final paper.

Topic
Good teachers know (and research has shown) that there’s more to teaching than just conveying the information. The best teachers build a bond with the students (what we refer to as their “rapport”, or interpersonal closeness), which helps to “grease the wheels” of the teaching, and helps motivate students to work harder, persist in the face of failure, and engage in other beneficial learning behaviors.

The goal of the “Rapport-Aligned Peer Tutor” (RAPT) project is to develop a computational model of rapport-building in peer tutoring and embed it in an intelligent and social virtual peer, which can provide both the task moves of Algebra tutoring and the social moves that contribute to rapport-building, in order to
improve student learning and empirically validate hypotheses about the pedagogical benefits of rapport.

This syllabus is subject to change, and all changes will be handed out on a revised version of the syllabus. In addition, as a member of the Carnegie Mellon community, the student is expected to fulfill the standards of the CMU academic integrity policy during the independent study (https://www.cmu.edu/academic-integrity/).

Independent Study Assignments/Deliverables

Assignment 1: Literature Review. Conduct a review of the literature and write a 3-4 page summary of that literature review on a topic chosen by the student, related to rapport-building, tutoring behaviors, and their interaction in a peer tutoring learning context, that aligns with the on-going research focus of RAPT. The student will discuss the specific topic with his supervisor at the start of the study, and will search for, read, and synthesize in written form the relevant peer-reviewed literature for that topic, in order to develop research questions and hypotheses for their independent study from that literature. The paper should be based on 10-15 peer-reviewed papers, should be structured according to various sub-topics, being explicit about the gaps in the literature and how our work will contribute. The final section should be the hypotheses and research questions you will investigate. The initial draft will receive written feedback from the mentor which should be incorporated in a revision included as part of the final paper. [20% score]

Assignment 2: Data Preparation. The student will work with the data to become familiar with learning and social interaction phenomena. This allows the student to refine their research questions and turn the research questions into hypotheses. To achieve this, the student may take part in transcribing or annotating verbal and nonverbal human behaviors related to their topic of interest in the domain of rapport and learning. They may also develop data cleaning and preparation methods that transform raw data or existing annotations into forms of data that are usable for analyses. As part of this assignment, the student may learn and demonstrate knowledge of video and audio annotation techniques, data cleaning and preparation techniques, and may contribute to the development and refinement of coding schema. [20% score]

Assignment 3: Data Analysis. Based on the literature review and familiarization with the empirical data of the in-lab study, the student will carry out independent research through some combination of (1) finalizing their research hypotheses and developing a data analysis plan, (2) identifying, annotating and categorizing social and tutoring behaviors, (3) conducting qualitative or/and quantitative analysis to investigate the relationship between target verbal and nonverbal behaviors with rapport and learning, and (4) relating findings to the design of the computational
model of rapport and the development of a virtual peer tutoring dialogue system. [40%]

Assignment 4: **Research Paper and Presentation**. Using the initial literature review to situate and ground your work, write an 8-10 page conference paper in a format you choose with your mentor (e.g. CHI, AIED, etc). The report should include, in this order, 1) an introduction section which motivates and summarizes the work, 2) a related work section, which will be the initial lit review, with revisions from the feedback given on Assignment 1, and which should situate this work in previous research and describe how it differs from previous work, 3) a research methods section describing what, how, and why you did what you did, 4) a results section, where you describe what you found, and 5) a discussion section, where you discuss what your findings mean, in light of the previous work, and where they lead you (or us) next. You will also present this work in a 20 minute presentation at our group lab meeting in a final week of the semester. [20% score]

**General Timeline**

**Sept., 2016**
 Conduct literature review of at least 10 relevant papers and write the draft of the literature review, addressing the relationship between the chosen topic and the RAPT project. Learn relevant human behavior analysis techniques; get familiar with empirical data.

**Oct., 2016**
 Develop research questions and hypotheses as an outgrowth of the literature review; engage in data preparation (e.g. coding scheme development, annotation, data cleaning).

**Nov., 2016**
 Continue with data preparation as needed; engage in data analysis, sharing preliminary results with mentor and with other interns during the intern weekly meeting.

**Dec., 2016**
 Write up work in the independent study paper, including revisions to the literature review, results, and discussion; and give a 20-minute presentation on completed work at our group lab meeting.
Specific Timeline
I encourage you to meet with your graduate student mentor before each date to make sure you are on track. Make sure you request help if you need it and set up meetings to talk about progress done and next steps.

Sept 9th: Propose a topic of interest to graduate student mentor. Talk with mentor about this topic and settle on a topic for your literature review (and, thus, independent study project). Mutually draft a 1-page independent study proposal outlining what you will study and how you will study it:
  (a) build an annotation scheme and hand-annotate data,
  (b) develop a method to computationally annotate or analyze data, or
  (c) use an existing method to computationally annotate or analyze data.

Sept 16th: Outline of literature review, with initial citations for each sub-topic discussed with graduate mentor.

Sept 23rd: Check in to discuss readings and progress towards writing the literature review.

Sept: 30th: Assignment 1 due. A 3-4 page single-space literature review on your topic of interest, based on 10-15 peer-reviewed papers, and structured with various sub-topics, being explicit about the gaps in the literature and how our work will contribute. The final section should be the hypotheses and research questions you will investigate.

Oct 7th: Begin familiarizing yourself with the data. Should know what data cleaning or preparation is needed, if any.

Oct 14th: Discuss with your graduate student mentor the first draft of the annotation scheme / computational analysis method / plan for analysis. Data cleaning / preparation done, if necessary (Assignment 2).

November 11th: All data annotated or first analyses done. Meet with mentor regularly throughout to discuss preliminary results and changes needed.

November 28th: Next steps for analyses or annotations completed. If applicable, summary statistics, descriptive analyses, and other analyses done on the data you’ve annotated (Assignment 3 “due”).

December 9th: First draft of paper about your results written up. You should be working on the write-up of various portions throughout the process. Submit to mentor for feedback (to be returned by December 12th).

December 14th: Present work in a 20 minute presentation at the ArticuLab lab meeting.
December 18th: Turn in final version of paper to your mentor (Assignment 4 due).

The student is expected to communicate with their supervisor to discuss any obstacles in completing assigned task in advance of each task deadline. If the student is having any obstacles with the independent study he/she is invited to contact the director of the Articulab, Professor Justine Cassell <justine@cs.cmu.edu>.

Expectation of student’s weekly activities
For a 9 unit independent study:

4.5 hours per week working independently on readings, assignments, and your independent research.

4.5 hours per week working with the group on the RAPT project, including opportunities such as learning about and getting practice with our processes for data collection, data annotation, and data analysis. This may include meeting with your graduate student mentor and attending occasional reading groups and other intern meetings as they fit into your schedule.

Important Note:
Take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at http://www.cmu.edu/counseling/. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

If you or someone you know is feeling suicidal or in danger of self-harm, call someone immediately, day or night:

CaPS: 412-268-2922
Re:solve Crisis Network: 888-796-8226

If the situation is life threatening, call the police:
   On campus: CMU Police: 412-268-2323
   Off campus: 911

If you have questions about this or your coursework, please let me know.
For the Rapport-Aligned Peer Tutor (RAPT) project, we have both applied and basic research goals, which are to 1) build a tutoring dialogue system that can build a rapport, or interpersonal bond, with the students with which it works, in order to 2) better understand the process of rapport-building and how it impacts the learning process. To do this, we want to better understand the dynamic temporal process by which social utterances, tutoring/learning utterances, and nonverbal behaviors interact to positively or negatively impact rapport and learning, and how the rapport state in turn impact their use of social and tutoring/learning utterances. To that end, there may be a variety of time series analysis methods or sequential rule mining approaches which may be appropriate, depending on the particular hypotheses of interest (methods including, but not limited to: temporal association rules, lagged sequential rule mining, granger causality, POMDP, and other approaches). In this independent study, Rae will survey the literature on various types of time series and sequential rule mining methods, working with her graduate student mentor to develop testable hypotheses of interest for the RAPT project, and choosing one method to use. She will then work with human-human tutoring dataset to discover temporal relationships between social behaviors, tutoring behaviors, and rapport, to inform the design of various modules of a peer tutoring dialogue system, such as the rapport estimation module, social reasoner, and task reasoner.