



Computational Human Robot Interaction

Units: 4

Schedule: Fall term, Tue & Thu, 10:00am -
11:50am

Location: LVL13

Instructor: Stefanos Nikolaidis

Office: SAL 242

Office Hours: Tuesday, 1.30pm - 3.30pm (by
appointment)

Contact Info: snikolai@alumni.cmu.edu

Course Description

In this advanced graduate-level class, you will learn about the theory and algorithms that enable robots to account for people in their decision making in a principled way. The course will contrast decision-theoretic and learning-based paradigms that allow robots to reason in the presence of uncertainty with studies in human-robot interaction. It will then focus on what makes some of these algorithms particularly effective and scalable in real-world human-robot interaction scenarios. By the end of this class, you will be able to describe and compare algorithms for deployed robotic systems interacting with people, design user studies to evaluate these algorithms and communicate your ideas to a peer audience. Evaluation is mainly based on student presentations, a final project and short weekly quizzes based on the assigned reading material.

Learning Objectives

In this course, you will gain knowledge about planning and learning algorithms in human-robot interaction and skills in interpreting and presenting research. By the end of this course you should be able to:

- identify and discuss the different components that make up decision-theoretic reasoning (e.g., MDPs, POMDPs) and learning-based techniques (learning from demonstration, reinforcement learning) that support human-robot interaction
- explain the computational and practical challenges of applying these techniques in real-world interaction settings and compare them in terms of robustness, scalability and performance
- analyze the design and implementation of a user study to evaluate algorithms for HRI
- critique a research paper's methods and analysis
- communicate effectively scientific research to a peer audience

Tentative List of Topics

- Bayesian Inference
- Task planning
- Experimental design
- Shared mental models and human team training
- Collaboration in human-robot teams
- Learning from demonstration
- Reinforcement learning and learning with human feedback
- Verbal communication

- Multi-modal communication and signaling
- Algorithmic teaching and pedagogical reasoning

Prerequisites

There are no formal prerequisites, but knowledge of probability theory and linear algebra is encouraged.

Grading

Component	Percentage
Paper Presentations	30%
Final Project	40%
Weekly Quizzes	15%
Participation	10%
Scribing	5%

Assessment of Assignments

- **Paper Presentations:** Each week, students will present assigned papers in class, on a rotating schedule. Presentations will be about 20 minutes long. You will be evaluated based on your demonstrated understanding of the technical content, how you relate the paper to the lectures and previous readings, the clarity, structure and timing of the presentation and how well you answer questions.
- **Final Project:** It should be a substantial piece of work and is expected to take between 60-80 hours over 8 weeks. In the beginning of the class, we will discuss your background and research interests, and we will work together to find potential projects that relate to the course material and that match your interests. The project can be a research project or an extensive in-depth, publication quality literature review. You will write a project proposal, work on the project upon approval and present it at the end of the term. You are strongly encouraged to work on something related to your research and think of the project as preliminary work for a paper at a selective, peer-reviewed conference. You will be evaluated based on proposal quality, demonstrated mastery of content, novelty of contribution or categorization of previous work and identification of gaps in the case of a survey, and quality of the final presentation.

- **Weekly Quizzes:** Before each student presentation day, there will be a short (10 minute) quiz on the material from the previous lecture and the readings for the day. The quiz will frequently connect different concepts from multiple readings and/or the material. This quiz is intended to ensure that you are keeping pace with the material and are prepared for the day's presentations, and is not meant to be onerous. I will drop your lowest quiz grade when calculating your final grade in the course.
- **Participation:** Students will get the most out of this class if they are active and engaged. This includes asking questions and participating in discussions. There will be explicit time for questions and discussion after each student presentation. I expect students to participate during all lecture sessions.
- **Scribing:** You will take turns compiling the lecture notes. The notes do not need to be very detailed, but should include the main concepts of the lecture.

Expectations

You can expect me to come to class on time, clearly communicate expectations for the presentations structure, format and clarity, give you feedback on a timely manner, adjust lecture material based on performance on presentations and quizzes and be available to meet regularly to discuss the progress of your project. I can expect you to come to class on time, be attentive and engaged in class, take notes and ask questions when something is not clear, spend an adequate amount of time on the readings each week (at least 3 hours), spend 60-80 hours on your final project.

Additional Policies

Unless you are assigned to compile lecture notes, please refrain from using laptops or other electronic devices during class.

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Support Systems:

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. engemannshc.usc.edu/counseling

National Suicide Prevention Lifeline – 1 (800) 273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. engemannshc.usc.edu/rsvp

Sexual Assault Resource Center

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: sarc.usc.edu

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086

Works with faculty, staff, visitors, applicants, and students around issues of protected class. equity.usc.edu

Bias Assessment Response and Support

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. studentaffairs.usc.edu/bias-assessment-response-support

The Office of Disability Services and Programs

Provides certification for students with disabilities and helps arrange relevant accommodations. dsp.usc.edu

Student Support and Advocacy – (213) 821-4710

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. studentaffairs.usc.edu/ssa

Diversity at USC

Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. diversity.usc.edu

USC Emergency Information

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. emergency.usc.edu

USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.

Provides overall safety to USC community. dps.usc.edu