ROB 498/599: Computational Human-Robot Interaction Fall 2025

Units: 3

Instructor: Christoforos Mavrogiannis (cmavro at umich dot edu)

GSI: Andrew Stratton (arstr at umich dot edu)

Lectures: Mon/Wed 13:30 - 15:00 (3150 DOW)

Office hours:
- Christoforos: Wednesday, 3:00-4:00pm, FRB 3248.
- Andrew: TBD.

Course material:
- Piazza: https://piazza.com/umich/fall2025/rob498599
- Canvas: https://umich.instructure.com/courses/799991

Course description: This 3-units, special-topics course covers computational techniques that enable robots to work with and around people. Topics include estimation, planning, and control techniques, discussed in the context of applications like crowd navigation and collaborative manipulation. Besides algorithmic foundations, the course will explore topics in experiment design, discussing evaluation methodologies that will enable smooth deployment of robots in human environments. Through student-led paper presentations and a team project, students will gain exposure to the state of the art in computational HRI. The class will be split in roughly two parts: in the first, the instructor will cover some of the essential topics in computational HRI, and in the second, students will present and discuss foundational and state-of-the-art papers. The class will also feature experts from different areas of HRI that will discuss their research and interact with students. The class will close with presentations of students' projects.

Learning objectives: In this class, students will gain exposure to computational techniques used to develop human-robot interaction applications and systems and get familiar with the process of interpreting and presenting research. Specifically, by the end of the class, students will be able to:

- Recognize and understand the components of an HRI system.
- Understand the importance of accounting for users when developing algorithmic frameworks for HRI.
- Understand the landscape of essential computational tools for developing HRI applications.
- Design a user study to evaluate an HRI system.
- Interpret and critically analyze the methodology of research papers in HRI (and beyond).
- Communicate effectively research methodologies and evidence to a peer audience.

Prerequisites: There are no formal prerequisites but mathematical maturity (e.g., ROB 101, Math 215, IOE 265) and programming background (e.g., ROB 320 or EECS 281) are expected. A foundation on the design of human-robot systems (e.g., ROB 204) is recommended.

Textbook: There is no official textbook. Background for most of the course components can be found in the book Computational Human-Robot Interaction by Thomaz, Hoffman and Cakmak (pdf). Background on probability and filtering can be found in Probabilistic Robotics by Thrun, Burgard, and Fox (pdf). Additional background on planning can be found in Planning Algorithms by Lavalle (pdf).

Expectations: You can expect me to come to class on time, clearly communicate expectations and feedback for presentations and projects in a timely manner, adjust lecture material based on performance on presentations and quizzes.

I can expect you to come to class on time, be attentive and engaged, ask questions when something is not clear, spend an adequate amount of time on the readings each week (at least 3 hours), spend 40-50 hours on your final project. You may use laptops/tablets for taking notes but please be mindful of others.

Deliverables and grading

1. **Paper Presentations** (30%): Students will present assigned papers in class, on a rotating schedule. Evaluation will be based on demonstrated effort in understanding the technical content, the depth of the discussion and its relationship to the class themes, the clarity, structure and timing of the presentation, and the ability to respond to questions.
2. **Assignments** (30%): Over the course of the semester, there will be 4 assignments based on topics covered in class. These are not meant to be demanding or lengthy; they are meant to provide a hands-on experience on important topics covered in class.
3. **Project** (30%): Students will develop and work on team projects to solidify their understanding of Computational HRI and get practical experience. Students are expected to devote between 40-50 hours over November and December to the project. Project teams will be graded based on their demonstrated mastery of the literature and the technical content, the novelty of the contribution the insight in the categorization of previous work, and the quality of their update and final presentations.
4. **Participation** (10%): This class is intended to be interactive, and discussion driven. Thus, all students are expected to ask questions and participate in the discussions. Every class will feature a dedicated time for questions and discussion.

Tentative schedule

Note: the schedule is subject to change. Please check back here and on Piazza for updates. Golden font indicates student-led discussion.

#	Date	Topic	Reading	Release	Deadline
1	Mon Aug 25	*Introduction*	Minerva | textbook		Knowledge survey

2	Wed Aug 27	*Bayesian inference*	PR Ch 2 | Bayes	Assignment 0	Team formation
	Mon Sep 1	Labor Day	No class		
3	Wed Sep 3	*Filtering*	PR Ch 3, 4 | PF | KF	Assignment 1	Assignment 0
4	Mon Sep 8	Simulation	paper 1 | paper 2		
5	Wed Sep 10	*Motion planning*	A* | RRT | CHOMP		
6	Mon Sep 15	HRI systems	paper 1 | paper 2		
7	Wed Sep 17	*Model Predictive Control*	MPPI | application	Assignment 2	Assignment 1
8	Mon Sep 22	Verbal communication	paper 1 | paper 2		
9	Wed Sep 24	*Planning under uncertainty*	MDPs | application		
10	Mon Sep 29	Nonverbal communication	paper 1 | paper 2		
11	Wed Oct 1	**Andrey Rudenko (TUM)**	motion prediction	Assignment 3	Assignment 2
12	Mon Oct 6	Robots in the wild	paper 1 | paper 2		
13	Wed Oct 8	**Vinitha Ranganeni (Hello Robot)**	Navigation Assistant		
	Mon Oct 13	Fall study break	No class		

14	Wed Oct 15	*Learning*	Imitation learning	Assignment 4	Assignment 3
15	Mon Oct 20	Groups and teams	paper 1 | paper 2		
16	Wed Oct 22	**Vaibhav Unhelkar (Rice)**	ASTRID		
17	Mon Oct 27	Human-robot collaboration	paper 1 | paper 2		
18	Wed Oct 29	*Social robot navigation*	core challenges		Assignment 4
19	Mon Nov 3	Shared control	paper 1 | paper 2		
20	Wed Nov 5	**Kushal Kedia (Cornell)**	MOSAIC		Project proposal
21	Mon Nov 10	Assistive robotics	paper 1 | paper 2		
22	Wed Nov 12	**Dimosthenes Kontogiorgos (MIT)**	Questioning the robot		
23	Mon Nov 17	*Experiment design*	primer		
24	Wed Nov 19	Project update presentations			
25	Mon Nov 24	Ethics	paper 1 | paper 2		
	Wed Nov 26	Thanksgiving break	No class		
26	Mon Dec 1	Final project presentations			

27	Wed Dec 3	Final project presentations			
	Mon Dec 8		No class		
	Wed Dec 10		No class		Final report

Statements

Diversity, Equity, and Inclusion
We consider this classroom to be a place where you will be treated with respect, and we welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

We are dedicated to helping each of you achieve all that you can in this class. We may, either in lecture or smaller interactions, accidentally use language that creates offense or discomfort. Should we do this, please contact us and help us understand so that we may avoid making the same mistake again.

Lived Name/Pronoun
We will gladly honor your request to address you by an alternate name or gender pronoun. Please advise a member of the teaching staff of this preference early in the semester so that we may respond appropriately and make any needed changes to our records. You may also update your name and pronouns on Wolverine Access.
For more information about lived name/pronoun updating:
https://spectrumcenter.umich.edu/student-support/trans-guide.

Academic integrity
The College of Engineering Honor Code is a statement of ethical standards by which the faculty and students in the College of engineering conduct themselves. Students are bound by the provisions of the Honor Code; ignorance of it is no excuse to infringe upon it. You are expected to read and abide by the Honor Code:
http://elc.engin.umich.edu/wp-content/uploads/sites/19/2019/03/Honor-Code-Pamphlet-2018.pdf.

Disability statement
The University of Michigan recognizes disability as an integral part of diversity and is committed to creating an inclusive and equitable educational environment for students with disabilities. Students who are experiencing a disability-related barrier should contact Services for Students

with Disabilities https://ssd.umich.edu/; 734-763-3000 or ssdoffice@umich.edu). For students who are connected with SSD, accommodation requests can be made in Accommodate. If you have any questions or concerns please contact your SSD Coordinator or visit SSD's Current Student webpage. SSD considers aspects of the course design, course learning objects and the individual academic and course barriers experienced by the student. Further conversation with SSD, instructors, and the student may be warranted to ensure an accessible course experience.

Mental health and well-being

Students may experience stressors that can impact both their academic experience and their personal well-being. These may include academic pressure and challenges associated with relationships, mental health, alcohol or other drugs, identities, finances, etc. If you are experiencing concerns, seeking help is a courageous thing to do for yourself and those who care about you. If the source of your stressors is academic, please contact us so that we can find solutions together. For personal concerns, U-M offers many resources, some of which are listed at Resources for Student Well-being on the Well-being for U-M Students website. You can also search for additional resources on that website.

Sexual misconduct policy

Title IX prohibits discrimination on the basis of sex, which includes sexual misconduct — including harassment, domestic and dating violence, sexual assault, and stalking. We understand that sexual violence can undermine students' academic success and we encourage anyone dealing with sexual misconduct to talk to someone about their experience, so they can get the support they need. Confidential support and academic advocacy can be found with the Sexual Assault Prevention and Awareness Center (SAPAC) on their 24-hour crisis line, 734.936.3333 and at sapac.umich.edu. Alleged violations can be non-confidentially reported to the Equity, Civil Rights, and Title IX Office (ECRT) at ecrtoffice@umich.edu.