CS59300-HRI: Human-Computer Interaction

Fall **2024**

Instructor: Sooyeon Jeong (sooyeonj@purdue.edu)
Lecture: Tue & Thu 9am-10:15am @ BHEE 236
Office Hours: Tue & Thu 10:30am-11:30am @ LWSN 2142C

TA: TBD
Office Hours: TBD

Instructional Modality: Face-to-Face
Course Credits: 3.0
Prerequisites: There are no prerequisites but backgrounds in robotics or human-computer interaction is encouraged. Programming knowledge may be useful for completing a course project
Textbooks: No textbook is required for this course.

1 Course Description

Robots are making their way into our world and will soon interact with people in our everyday lives. For robots to perform various supportive tasks and harmoniously coexist with people in human environments (e.g., homes, schools, and hospitals), they need to be designed and developed to interface with people in natural and intuitive ways. The field of Human-Robot Interaction (HRI) is highly interdisciplinary, incorporating methods and techniques from human-computer interaction, robotics, psychology, artificial intelligence, and other fields. Students in the class will present assigned research papers and lead discussions about cutting-edge peer-reviewed HRI publications. Throughout the term, students will form small groups of teams and will complete a course project that addresses an HRI-related research question of their choice.

2 Learning Outcomes

After successfully completing this course, a student will learn a broad range of research topics in HRI for designing and developing a robot that can successfully interact with humans, including non-verbal/verbal robot behavior, learning and collaborating with humans, group interactions, and ethical considerations and challenges. Students will also learn how to conduct scientifically rigorous human-subject research to test for HRI-related research questions and hypotheses, and how HRI research is currently applied in real world applications.

3 Course Logistics

- Each reading response will need to be at least 1-2 paragraphs and include at least one proposed discussion question.
- All assignments must be completed and submitted on or before 9pm EST on the due date. Due dates and delivery time deadlines are defined as Eastern Standard Time (as used in West Lafayette, Indiana).

- 10% of the total points will be deducted for assignments received 1-6 days late; assignments received more than 1 week late will receive 0 points.

4 Instructor's Email Availability and Policies

I will be available via email daily and try to respond as soon as possible (generally within 24-48) hours. When emailing me, please place the course number/section and the topic in the subject line of the email (e.g., [CS593-HRI] Assignment 2 Question). This will help me tremendously in locating and responding to your emails quickly.

5 Assignments and Points

Your learning will be assessed through a combination of discussion participation, programming assignments, reading responses, and a final project spread throughout the semester.

- CITI training (5%)
- Three reading assignments (15%, 5% each)
- Two programming assignments (40%, 20% each)
- Class participation and discussion (10%)
- Project proposal (10%)
- Project presentation (10%)
- Project report (10%)

6 Missed or Late Work

Missed assignments may only be made up when you notify me ahead of time with an explanation and plan for completion. These requests will be accepted at my discretion. Asking for an extension does not guarantee it will be granted.

7 Course Schedule

Date	Topic	Readings and Assignments
Tue 8/20	Course Overview and Introduction to HRI	• Goodrich, M. A., & Schultz, A. C. (2008). Human–robot interaction: a survey. Foundations and Trends® in Human–Computer Interaction, 1(3), 203-275. (Chapter 1-5)

Thu 8/22	Social Robot	• Breazeal, C., & Scassellati, B. (1999, October). How to build robots that make friends and influence people. In Proceedings 1999 IEEE/RSJ international conference on intelligent robots and systems. Human and environment friendly robots with high intelligence and emotional quotients (cat. No. 99CH36289) (Vol. 2, pp. 858-863). IEEE. • Matarić, M. J., & Scassellati, B. (2016). Socially assistive robotics. Springer handbook of robotics, 1973-1994
Tue 8/27	Human-subject Research and Ethics	• Turkle, S., Taggart, W., Kidd, C. D., & Dasté, O. (2006). Relational artifacts with children and elders: the complexities of cybercompanionship. Connection Science, 18(4), 347-361. • Kahn Jr, P. H., Kanda, T., Ishiguro, H., Freier, N. G., Severson, R. L., Gill, B. T., ... & Shen, S. (2012). "Robovie, you'll have to go into the closet now": Children's social and moral relationships with a humanoid robot. Developmental psychology, 48(2), 303
Thu 8/29	Embodiment	• Bainbridge, W. A., Hart, J. W., Kim, E. S., & Scassellati, B. (2011). The benefits of interactions with physically present robots over videodisplayed agents. International Journal of Social Robotics, 3, 41-52 • Kidd, C. D., & Breazeal, C. (2008, September). Robots at home: Understanding long-term human-robot interaction. In 2008 IEEE/RSJ International Conference on Intelligent Robots and Systems (pp. 3230- 3235). IEEE. • **CITI Training Due**
Tue 9/3	Robot Morphology I	• Mori, M., MacDorman, K. F., & Kageki, N. (2012). The uncanny valley [from the field]. IEEE Robotics & automation magazine, 19(2), 98-100. • Sakamoto, D., Kanda, T., Ono, T., Ishiguro, H., & Hagita, N. (2007, March). Android as a telecommunication medium with a human-like presence. In Proceedings of the ACM/IEEE international conference on Human-robot interaction (pp. 193-200). • Dunstan, B. J., & Hoffman, G. (2023). Social Robot Morphology: Cultural Histories of Robot Design. In Cultural Robotics: Social Robots and Their Emergent Cultural Ecologies (pp. 13-34). Cham: Springer International Publishing

Thu 9/5	Robot Morphology II	• Sirkin, D., Mok, B., Yang, S., & Ju, W. (2015, March). Mechanical ottoman: how robotic furniture offers and withdraws support. In Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction (pp. 11-18). • Hoffman, G., & Vanunu, K. (2013, March). Effects of robotic companionship on music enjoyment and agent perception. In 2013 8th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 317-324). IEEE.
Tue 9/10	Robot Movements and Gestures I	• J. Lasseter, "Principles of Traditional Animation applied to 3D Computer Animation", in Computer Graphics, 1987. • Hoffman, G., & Ju, W. (2014). Designing robots with movement in mind. Journal of Human-Robot Interaction, 3(1), 91-122.
Thu 9/12	Robot Movements and Gestures II	• A. Dragan, S. Srinivasa, "Integrating Human Observer Inferences into Robot Motion Planning", Autonomous Robots, 2014. • Admoni, H., Weng, T., Hayes, B., & Scassellati, B. (2016, March). Robot nonverbal behavior improves task performance in difficult collaborations. In 2016 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 51-58). IEEE. • **Programming Assignment 1 Due**
Tue 9/17	Proxemics and Social Navigation	• Mead, R., & Matarić, M. J. (2017). Autonomous human–robot proxemics: socially aware navigation based on interaction potential. Autonomous Robots, 41(5), 1189-1201. • Yu, X., Hoggenmueller, M., & Tomitsch, M. (2023, March). Your Way Or My Way: Improving Human-Robot Co-Navigation Through Robot Intent and Pedestrian Prediction Visualisations. In Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction (pp. 211-221).

Thu 9/19	Gaze	• Gillet, S., Parreira, M. T., Vázquez, M., & Leite, I. (2022, March). Learning gaze behaviors for balancing participation in group humanrobot interactions. In 2022 17th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 265-274). IEEE. • Mutlu, B., Kanda, T., Forlizzi, J., Hodgins, J., & Ishiguro, H. (2012). Conversational gaze mechanisms for humanlike robots. ACM Transactions on Interactive Intelligent Systems (TiiS), 1(2), 1-33
Tue 9/24	Embodied Conversation	• Thomaz, A., Hoffman, G., & Cakmak, M. (2016). Computational human-robot interaction. Foundations and Trends® in Robotics, 4(2-3), page 122-133. • Murray, M., Walker, N., Nanavati, A., Alves-Oliveira, P., Filippov, N., Sauppe, A., ... & Cakmak, M. (2022, January). Learning backchanneling behaviors for a social robot via data augmentation from human-human conversations. In Conference on Robot Learning (pp. 513-525). PMLR
Thu 9/26	Emotion and Affect	• Jung, M. F. (2017, March). Affective grounding in human-robot interaction. In Proceedings of the 2017 ACM/IEEE International Conference on Human-Robot Interaction (pp. 263-273). • Gordon, G., Spaulding, S., Westlund, J. K., Lee, J. J., Plummer, L., Martinez, M., ... & Breazeal, C. (2016, March). Affective personalization of a social robot tutor for children's second language skills. In Proceedings of the AAAI conference on artificial intelligence (Vol. 30, No. 1). • **Reading Assignment 1 Due**
Tue 10/1	Theory of Mind	• Breazeal, C., Berlin, M., Brooks, A., Gray, J., & Thomaz, A. L. (2006). Using perspective taking to learn from ambiguous demonstrations. Robotics and autonomous systems, 54(5), 385-393. • Lee, J. J., Sha, F., & Breazeal, C. (2019, March). A Bayesian theory of mind approach to nonverbal communication. In 2019 14th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 487- 496). IEEE.

Thu 10/3	Robot Learning I	• Thomaz, A. L., Berlin, M., & Breazeal, C. (2005, August). An embodied computational model of social referencing. In ROMAN 2005. IEEE International Workshop on Robot and Human Interactive Communication, 2005. (pp. 591-598). IEEE. • Argall, B. D., Chernova, S., Veloso, M., & Browning, B. (2009). A survey of robot learning from demonstration. Robotics and autonomous systems, 57(5), 469-483.
Tue 10/8	No Class (Fall Break)	N/A
Thu 10/10	Robot Learning II	• McQuillin, E., Churamani, N., & Gunes, H. (2022, March). Learning socially appropriate robo-waiter behaviours through real-time user feedback. In 2022 17th ACM/IEEE International Conference on HumanRobot Interaction (HRI) (pp. 541-550). IEEE. • van Waveren, S., Pek, C., Tumova, J., & Leite, I. (2022, March). Correct me if I'm wrong: Using non-experts to repair reinforcement learning policies. In 2022 17th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 493-501). IEEE • **Programming Assignment 2 Due**
Tue 10/15	Personalization	• Shi, Z., Groechel, T., Jain, S., Chima, K., Rudovic, O., & Matarić, M. (2022). Toward Personalized Affect-Aware Socially Assistive Robot Tutors for Long-Term Interventions with Children with Autism. J. Hum.- Robot Interact. 11, 4, Article 39 (December 2022), • Brawer, J., Ghose, D., Candon, K., Qin, M., Roncone, A., Vázquez, M., & Scassellati, B. (2023). Interactive Policy Shaping for Human-Robot Collaboration with Transparent Matrix Overlays.
Thu 10/17	Human-Robot Collaboration	• Hoffman, G. (2019). Evaluating fluency in human–robot collaboration. IEEE Transactions on Human-Machine Systems, 49(3), 209-218. • Nemlekar, H., Dhanaraj, N., Guan, A., Gupta, S. K., & Nikolaidis, S. (2023, March). Transfer Learning of Human Preferences for Proactive Robot Assistance in Assembly Tasks. In Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction (pp. 575-583). • **Project Proposal Due**

Tue 10/22	Group Interaction	• Booth, S., Tompkin, J., Pfister, H., Waldo, J., Gajos, K., & Nagpal, R. (2017, March). Piggybacking robots: Human-robot overtrust in university dormitory security. In Proceedings of the 2017 ACM/IEEE International Conference on Human-Robot Interaction (pp. 426-434). • Erel, H., Carsenti, E., & Zuckerman, O. (2022, March). A carryover effect in hri: Beyond direct social effects in human-robot interaction. In 6 2022 17th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 342-352). IEEE.
Thu 10/24	Robot Roles	• Li, J., Ju, W., & Nass, C. (2015, March). Observer perception of dominance and mirroring behavior in human-robot relationships. In Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction (pp. 133-140). • Jeong, S., Aymerich-Franch, L., Alghowinem, S., Picard, R., Breazeal, C, & Park, H. (2023). A Robotic Companion for Psychological Well-being: A Long-term Investigation of Companionship and Therapeutic Alliance. Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction (HRI). • **Reading Assignment 2 Due**
Tue 10/29	Error and Repair	• Salem, M., Lakatos, G., Amirabdollahian, F., & Dautenhahn, K. (2015, March). Would you trust a (faulty) robot? Effects of error, task type and personality on human-robot cooperation and trust. In Proceedings of the tenth annual ACM/IEEE international conference on human-robot interaction (pp. 141-148). • Stiber, M., Taylor, R. H., & Huang, C. M. (2023). On Using Social Signals to Enable Flexible Error-Aware HRI

Thu 10/31	HRI in Education	• Belpaeme, T., Kennedy, J., Ramachandran, A., Scassellati, B., & Tanaka, F. (2018). Social robots for education: A review. Science robotics, 3(21), eaat5954. • Ligthart, M. E., de Droog, S. M., Bossema, M., Elloumi, L., Hoogland, K., Smakman, M. H., ... & Ben Allouch, S. (2023, March). Design Specifications for a Social Robot Math Tutor. In Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction (pp. 321-330).
Tue 11/5	HRI in Healthcare	• Scassellati, B., Boccanfuso, L., Huang, C. M., Mademtzi, M., Qin, M., Salomons, N., ... & Shic, F. (2018). Improving social skills in children with ASD using a long-term, in-home social robot. Science Robotics, 3(21), eaat7544. • Stegner, L., & Mutlu, B. (2022, June). Designing for Caregiving: Integrating Robotic Assistance in Senior Living Communities. In Designing Interactive Systems Conference (pp. 1934-1947).
Thu 11/7	HRI in Public Space	• Kamino, W., & Sabanovic, S. (2023, March). Coffee, Tea, Robots? The Performative Staging of Service Robots in'Robot Cafes' in Japan. In Proceedings of the 2023 ACM/IEEE International Conference on HumanRobot Interaction (pp. 183-191). • Brščić, D., Kidokoro, H., Suehiro, Y., & Kanda, T. (2015, March). Escaping from children's abuse of social robots. In Proceedings of the tenth annual acm/ieee international conference on human-robot interaction (pp. 59-66). • **Programming Assignment 2 Due**
Tue 11/12	HRI and Accessibility	• Neto, I., Correia, F., Rocha, F., Piedade, P., Paiva, A., & Nicolau, H. (2023, March). The Robot Made Us Hear Each Other: Fostering Inclusive Conversations among Mixed-Visual Ability Children. In Proceedings of the 2023 ACM/IEEE International Conference on HumanRobot Interaction (pp. 13-23). • Nanavati, A., Alves-Oliveira, P., Schrenk, T., Gordon, E. K., Cakmak, M., & Srinivasa, S. S. (2023, March). Design Principles for RobotAssisted Feeding in Social Contexts. In Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction (pp. 24-33)

Thu 11/14	Beyond Physical Embodiment	• Tejwani, R., Moreno, F., Jeong, S., Park, H. W., & Breazeal, C. (2020, August). Migratable AI: Effect of identity and information migration on users' perception of conversational AI agents. In 2020 29th IEEE International Conference on Robot and Human Interactive Communication (RO-MAN) (pp. 877-884). IEEE. • Luria, M., Reig, S., Tan, X. Z., Steinfeld, A., Forlizzi, J., & Zimmerman, J. (2019, June). Re-Embodiment and Co-Embodiment: Exploration of social presence for robots and conversational agents. In Proceedings of the 2019 on Designing Interactive Systems Conference (pp. 633-644).
Tue 11/19	End-user Programming	• Gao, Y., & Huang, C. M. (2019, March). PATI: a projection-based augmented table-top interface for robot programming. In Proceedings of the 24th international conference on intelligent user interfaces (pp. 345-355). • Porfirio, D., Stegner, L., Cakmak, M., Sauppé, A., Albarghouthi, A., & Mutlu, B. (2023). Sketching Robot Programs On the Fly. arXiv preprint arXiv:2302.03088.
Thu 11/21	Long-term In-the-wild HRI	• Nanavati, A., Walker, N., Taber, L., Mavrogiannis, C., Takayama, L., Cakmak, M., & Srinivasa, S. (2022, March). Not All Who Wander Are Lost: A Localization-Free System for In-the-Wild Mobile Robot Deployments. In 2022 17th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 422-431). IEEE. • Rueben, M., Syed, M., London, E., Camarena, M., Shin, E., Zhang, Y., ... & Matarić, M. J. (2021, October). Long-term, in-the-wild study of feedback about speech intelligibility for k-12 students attending class via a telepresence robot. In Proceedings of the 2021 International Conference on Multimodal Interaction (pp. 567-576). • **Reading Assignment 3 Due**

Tue 11/26	HRI and Legal Policy	• DiPaola, D., Ostrowski, A. K., Spiegel, R., Darling, K., & Breazeal, C. (2022, March). Children's perspectives of advertising with social robots: A policy investigation. In 2022 17th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 570-576). IEEE. • Darling, K., & DiPaola, D. (2022). LuLaRobot: Consumer Protection in the Face of Automated Social Marketing. Profeedings of We Robot
Thu 11/28	Thanksgiving Break	N/A
Tue 12/3	Project Presentation	N/A
Thu 12/5	Project Presentation	N/A
Sun 12/8	N/A	**Project Report Due**

*Schedule and assignments are subject to change. Any changes will be posted in the learning management system

8 Attendance Policy

Students are expected to be present for every meeting of the classes in which they are enrolled. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts or absences can be anticipated, such as for many University sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email or phone. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747.

9 Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern. Please also refer to Purdue's student guide for academic integrity.

The Purdue Honor Pledge "As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue" 8 Students are permitted to use generative AI tools (e.g., ChatGPT) for competing reading responses assignments. If such tool was used in any part of the assignment completion, students are expected to state how the tool was used in detail in the submitted work.

10 Nondiscrimination Statement

Purdue University is committed to maintaining a community, which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services, and activities consistent with applicable federal, state, and local laws, regulations, and orders and in conformance with the procedures and limitations as set forth in Executive Memorandum No. D-1, which provides specific contractual rights and remedies. Any student who believes they have been discriminated against may visit the University's website to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously.

11 Accessibility and Accommodations

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

12 Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted on the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

13 Mental Health Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack. Sign in and find information and tools at your fingertips, available to you at any time. If you need support and information about options and resources, please see the Office of the Dean of Students for drop-in hours (M-F, 8am-5pm).If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

14 Violent Behavior Policy

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promotes educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.
In our discussions, structured and unstructured, we will explore a variety of challenging issues, which can help us enhance our understanding of different experiences and perspectives. This can be challenging, but in overcoming these challenges we find the greatest rewards. While we will design guidelines as a group, everyone should remember the following points:

15 Disclaimer

This syllabus is subject to change and any changes will be posted in the learning management system.