CS59200: Computational Interaction

Spring 2026

Course Description

Computational Interaction explores how to model human behavior and interaction and then use those models to design better computing interfaces. In this course, we'll explore this data-driven view of human-computer interaction that combines classic HCI (e.g., cognition, design) with machine learning (e.g., optimization, preference modeling). This course will be a mix of instructor lectures, student-led presentations, discussions, and hands-on learning through a course project.

By taking this course, you will become familiar with the following topics:

- Foundations of HCI
    - Intro to HCI and Design
    - Framework for Computational Interaction
    - Basics of Human Subjects Research
- Modeling Techniques
    - Basic Optimization
    - Basic Modeling
- Real-world applications through case studies
    - Examples: Text Entry, User Interfaces, Graphics, Text
- Skills for understanding and presenting scientific literature

Administrative Matters

- **Instructor:** Jason Wu (wu2694@purdue.edu)
- **Course Credits:** 3 credit hours
- **Modality:** In-person instruction - attendance required. Materials and discussion may occur online
- **Lecture schedule:** TBD
- **Location:** TBD
- **Prerequisites:**
    - First-year and second-year graduate students in CS should be comfortable in this class.
    - Basic programming knowledge (Python, JavaScript, Java) is highly recommended. It will likely be useful for completing the course project.
    - Knowledge or interest in human-computer interaction is encouraged.
    - Knowledge or interest in machine learning is encouraged.
- **Required Materials:** No textbook is required for this course. Required materials (papers and articles) are either publicly available or will be provided to students.

Course Grading

Your grade in the course will be based on a combination of factors

- **CITI Training (5%)**: Students must complete the CITI training to learn about ethical human subjects research and conduct human subjects research. Students may choose to perform human subjects research as a part of their course project.
- **Reading Discussions (10%)**: Students are expected to complete the required weekly readings and post discussion comments in an online forum.
- **Participation/Attendance (5%)**: Students are expected to attend class and actively engage with the instructor and their peers.
- **Presentations (20%):** Students will present both an existing paper and their course project
    - **Paper Presentation (10%):** Students will present and lead in-class discussions/activities for papers from the course reading list or another instructor-approved paper. Presentations should be roughly 10-15 minutes and present the paper content in a digestible way. Activities designed by the presenting students can include designing discussion-based activities or presenting interactive demos to illustrate the paper.
    - **Project Presentation (10%)**: Students will present their course project at the end of the semester.
- **Course Project (60%):** The largest component of students' grades will be the course project, which will allow students to get hands-on experience applying some material learned from readings. Students may work in groups of 2-4 people and work on a topic of their choosing (to be approved by the instructor).
    - **Project Proposal (10%):** Students will form a group and submit a 2-3 page project proposal for a sufficiently substantial replication of an existing paper or a new project idea related to the course content. The project proposal must 1) motivate and describe the chosen problem, 2) describe related work, and 3) propose a feasible plan for execution (may be "proof of concept")
    - **Midterm Report (25%)**: Groups will refine their original project proposal document with 1) methodological details, 2) experimental progress, and 3) possible partial results. The total length should be roughly 5-6 pages.
    - **Final Report (25%):** Groups will refine their midterm report with 1) final results, 2) a discussion of the findings (are they expected, was there anything interesting?). The total length should be roughly 8 pages.

Course Schedule

Here is a rough breakdown of the course schedule.

- **Weeks 1-3:** Course Introduction; Foundational Topics in HCI, Design, and Modeling

- **Weeks 4-11:** Students' Paper Presentations, Paper Discussions/Activities, Guided Project Working Sessions. Instructor-delivered content may be interspersed in this period.
- **Weeks 12-14:** Course Project Presentations

Possible scheduling of topics (subject to change):

- **Week 1**
  - Lecture: Course Introduction, Introduction to HCI, Why is Designing Interaction Difficult?
  - Lecture: Framework for Computational Interaction: Introduction, Formulation, and Example Applications
- **Week 2**
  - Lecture: Evaluation: Designing, and Conducting Human Subjects Research
  - Lecture: Walkthrough of Modeling and Optimization (I)
- **Week 3**
  - Lecture: Walkthrough of Modeling and Optimization (II) Goodhart's Law
  - Lecture: Case Study in User Interfaces
- **Week 4**
  - Student paper presentation, activity
  - Guided working session for project proposal
- **Week 5**
  - Student paper presentation, activity
  - Guided working session for project proposal
- **Week 6**
  - Student paper presentation, activity
  - Lecture: Case Study in Text Entry
- **Week 7**
  - Student paper presentation, activity
  - Guided working session for project
- **Week 8**
  - Student paper presentation, activity
  - Lecture: Case Study in Language Interfaces
- **Week 9**
  - Student paper presentation, activity
  - Guided working session for project
- **Week 10**
  - Spring break?
- **Week 11**
  - Student paper presentation, activity
  - Student paper presentation, activity
- **Week 12**
  - Guided project working session
  - Group 1 presents course project
- **Week 13**

    - Groups 2, 3 presents course project
- **Week 14**
    - Groups 4, 5 presents course project

Reading List

Here is a list of readings (to be updated) that students will read and discuss throughout the course.
Note: Some of these readings will be optional, and some may be talk recordings

1. Antti Oulasvirta: “Optimizing human-computer interaction” https://www.youtube.com/watch?v=RXMDNdA4asQ
2. Vannevar Bush, As We May Think https://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/303881/
3. Zhai et al. The metropolis keyboard https://dl.acm.org/doi/10.1145/354401.354424
4. Gajos et al. SUPPLE https://www.eecs.harvard.edu/~kgajos/papers/2004/supple-iui04.pdf
5. Stuart Card. The Model Human Processor https://iihm.imag.fr/blanch/ens/2011-2012/M1/EIHM/cours/1986-Card-HumanProcessor.pdf
6. MacKenzie et al. A Comparison of Input Devices in Elemental Pointing and Dragging Tasks https://www.yorku.ca/mack/CHI91.html
7. Lambert et al. Illustrating RLHF https://huggingface.co/blog/rlhf
8. Oulasvirta et al. Computational Rationality as a Theory of Interaction https://dl.acm.org/doi/10.1145/3491102.3517739
9. Herb Simon. Sciences of the Artificial 3rd Edition. Chapter 5 https://monoskop.org/images/9/9c/Simon_Herbert_A_The_Sciences_of_the_Artificial_3rd_ed.pdf
10. John Schulman. Proxy Objectives in Reinforcement Learning from Human Feedback. https://www.youtube.com/watch?v=e2Dp90pi6Fg
11. Todi et al. Adapting User Interfaces with Model-based Reinforcement Learning https://dl.acm.org/doi/pdf/10.1145/3411764.3445497
12. Feit et al. AZERTY Ameliore https://dl.acm.org/doi/pdf/10.1145/3382035
13. Le et al. Fingers’ Range and Comfortable Area for One-Handed Smartphone Interaction Beyond the Touchscreen https://dl.acm.org/doi/10.1145/3173574.3173605
14. Liao et al. Rediscovering Affordance. https://arxiv.org/pdf/2112.12886
15. Gordon et al. Jury Learning. https://arxiv.org/abs/2202.02950
16. Nielsen and Molich. Heuristic evaluation of user interfaces. https://dl.acm.org/doi/10.1145/97243.97281
17. Tatsukawa et al. FontCraft. https://arxiv.org/pdf/2502.11399
18. Zheng et al. Judging LLM-as-a-judge with MT-bench and Chatbot Arena. https://arxiv.org/pdf/2306.05685
19. Banovic et al. Modeling and Understanding Human Routine Behavior https://dl.acm.org/doi/10.1145/2858036.2858557

20. Moon et al. Real-time 3D Target Inference via Biomechanical Simulation. https://dl.acm.org/doi/fullHtml/10.1145/3613904.3642131
21. Todi et al. Sketchplore. https://dl.acm.org/doi/10.1145/2901790.2901817
22. Christiano et al. Deep Reinforcement Learning from Human Preferences. https://arxiv.org/pdf/1706.03741
23. Wu et al. UIClip. https://arxiv.org/abs/2404.12500
24. Wu et al. UICoder. https://arxiv.org/abs/2406.07739
25. Reinecke et al. Predicting Users' First Impressions of Website Aesthetics With a Quantification of Perceived Visual Complexity and Colorfulness. https://iis.seas.harvard.edu/papers/2013/reinecke13aesthetics.pdf
26. Ivory et al. Empirically Validated Web Page Design Metrics. https://flamenco.berkeley.edu/papers/chi2001.pdf
27. Lindlbauer et al. Context-aware online adaptation of mixed reality interfaces. https://3dvar.com/Lindlbauer2019Context.pdf
28. Wobbrock et al. Ability-Based Design. https://kgajos.seas.harvard.edu/papers/wobbrock11abd.pdf
29. Gajos and Weld. Preference Elicitation for Interface Optimization. https://www.eecs.harvard.edu/~kgajos/papers/2005/kgajos-uist05.pdf
30. Louis von Ahn. Massive-scale online collaboration. https://www.ted.com/talks/luis_von_ahn_massive_scale_online_collaboration