Fall 2022 – CS Special Topics

1. **CS 294* – Hayes – Web App Development**
2. **CS 494 – Soni – Natural User Interactions**
3. **CS 594 – Ziebart – Imitation Learning**

*CS Undergraduate students must submit a modification of major to use the class as a free elective.

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CS 294 – Web App Development

- Instructor: David Hayes
- Meeting time: MWF 5-5:50pm
- CRN: 47562

Build Apps

Learn the tools to build installable mobile (and desktop) PWA apps. The Progressive Web App architecture is used in many popular apps: Spotify, Pinterest, Starbucks, Twitter, Forbes, Alibaba, Lancome and more. You'll be able to build and share apps that work on Android and Apple phones and on Windows.

Build Your Portfolio

At the end of the semester, you'll have several apps in your GitHub portfolio; these will be useful when you are interviewing. Your apps will include a variety of features: data manipulation, geolocation, camera input, remote data, Google Maps, visualization, Google Machine Learning APIs, text-to-speech and more.

Build Your Knowledge and Skills

You'll learn a little about a lot of things: we need to learn HTML, CSS and frameworks to build user interfaces (UI); JavaScript to manipulate the UI and interact with web servers and device features; visualization APIs like Google Maps and Google Charts; animation and gaming in the browser; working with data APIs; Chrome Developer Tools to build and test our work; GitHub for version control and to host our apps; and more.

Who should take the course?

You! If you want to understand how the web works, enjoy learning a little about a lot of things, have the desire to build things, and have some programming experience beyond an introductory course. If you've taken CS211 and CS251, you're ready for the course. Students with less experience but a lot of motivation can succeed in the course but should talk with Professor Hayes before enrolling.

Scan the QR code or navigate to https://bit.ly/CS294-PWA for more info.

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CS 494 – Natural User Interactions

- Instructor: Nikita Soni
- Meeting time: TR 11-12:15pm
- CRN: 45500/45501

Course Description

Rapid advances in computer technology have increased the opportunities for developing advanced user interfaces that allow users to interact in *natural* ways (i.e., in the same way as people might interact with other people and physical objects around them). However, what does it mean for an interface to be natural? Also, how do you design natural user interfaces? This class will introduce students to the design, development, and evaluation of a range of Natural User Interaction (NUI) technologies. Unlike keyboard and mouse-based interaction technologies, NUI allows users to interact with technology through a range of human abilities such as touch, gestures, voice, or whole-body movements. Some examples of NUI are touchscreen interactions with smartphones, mid-air gestures with augmented or virtual reality (AR/VR) environments, whole-body interactions with Microsoft Kinect's console, and voice interactions with voice-based interfaces such as Apple's Siri.

Beyond traditional keyboard and mouse interfaces, NUI interfaces have added a new level of complexity to the interface design process. There is an increasing demand for researchers and programmers with skills to design advanced user input technologies. The projects students will do in the class will strengthen their portfolios to showcase skills in developing advanced user interfaces that leverage users' natural interaction capabilities.

Coursework (subject to change)

In this course, students will engage with the learning material through reading relevant literature, participating in group discussions and class presentations, working on hands-on individual and group projects, as well as attending guest lectures. In-class lectures will include discussions of hardware-to-software NUI pipeline, NUI design principles, and key considerations when developing NUI software, including existing platforms, toolkits, and APIs. Students will apply their knowledge in a project of their choice where they will design, implement, and evaluate a NUI prototype.

Prerequisite

CS 342 Software Design. Experience with one or more of the listed programming languages is recommended for this course: Java, Python, C#, or Objective C. Students who have taken CS422 (User Interface Design and Programming) or CS522 (Human-Computer Interaction) will feel more comfortable with this course, but it is not a pre-requisite.

Course Outline (Tentative)*

Week	Topics / In-Class Activities
Week 1	Syllabus, HCI, NUI introduction Designing NUI: Human Factors and Interaction Design Methods

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Week 2	Developing NUI: Recognition-Based Interaction And Current NUI Frameworks And Algorithms In-Class Activity: Project Discussion
Week 3	In-Class Demo For Current NUI Frameworks Touch/Gesture, Voice, And Whole-Body Interaction Interfaces. In-Class Presentations: Group Project Outlines
Week 4	Evaluating NUI: Live User Studies and Offline Testing In-Class Activity: Project Updates + Group Working / Meeting Time
Week 5	Touch and Gesture Interaction I: NUI Principles Of Designing Touch Interactions In-Class Activity: Project Updates + Group Working / Meeting Time
Week 6	Touch and Gesture Interaction II: Toolkits and APIs for Designing Touchscreen Software Applications In-Class Activity: Project Updates + Group Working / Meeting Time
Week 7	Working with Users and the IRB In-Class Activity: Project Updates + Group Working / Meeting Time
Week 8	Motion and Whole-Body Interaction I: NUI Principles Of Designing Whole-Body Interactions In-Class Activity: Project Prototype Video Demos (8-10 min per group)
Week 9	Motion and Whole-Body Interaction II: Toolkits and APIs for Designing Whole-Body Interaction Software Applications In-Class Activity: Project Updates + Group Working / Meeting Time
Week 10	Speech and Voice Interaction I: NUI Principles Of Designing Whole-Body Interactions In-Class Activity: Project Updates + Group Working / Meeting Time
Week 11	Speech and Voice Interaction II: Toolkits and APIs for Designing Voice-Based Software Applications In-Class Activity: User Study Report Presentations (8-10 min per group)
Week 12	NUI for Feedback: Haptics, Auditory Interfaces, and more In-Class Activity: Project Updates + Group Working / Meeting Time
Week 13	Guest lecture on NUIs for AR/VR Research Topic and Opportunities: NUIs and Children / Skeptical Views of NUIs
Week 14	Guest lecture In-Class Activity: Project Presentations & Final Demos
Week 15	In-Class Activity: Project Presentations & Final Demos

Dept. of Computer Science
University of Illinois at Chicago

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CS 594 – Imitation Learning

- Instructor: Brian Ziebart
- Meeting time: MW 9:30-10:45
- CRN: 43915

Course Description: Enabling artificial intelligence (AI) systems to behave like humans is an increasingly important challenge for applications ranging from self-driving vehicles to surgical robotics. Imitation learning seeks to address this challenge by using machine learning techniques to enable the AI system to learn from human demonstrations. Two main approaches have emerged: behavioral cloning directly mimics the policy of the human (i.e., the action taken in different situations) to sequence together behavior; and inverse reinforcement learning (also known as inverse optimal control) seeks to learn a reward or cost function that rationalizes demonstrated behavior and induces optimal behavior that is similar to that of the demonstrator.

Goal: The primary goal of this course is to prepare students to conduct research in imitation learning--either in the development of improved imitation learning methods or the application of imitation learning techniques to new domains. Students will gain familiarity with the key technical challenges surrounding imitation learning and state-of-the-art imitation learning methods.

Student Deliverables/Evaluation:

• **Quizzes / Final Exam**. Students will complete a combination of in-class and out-of-class quizzes and a final exam to assess understanding of lecture materials.

• **Research Paper Readings**. Students will be required to read all papers. Each student will present at least once, and students will be required to participate in paper discussion. To ensure that students read all assigned papers, they will be required to turn in a summary for each paper before class. Students will be graded based on their presentation as well as their participation during paper discussions.

• **Research**. Students will submit research proposals at the 3rd/ 4th week, a project status update at the end of the 8th week, and a final write-up towards the end of the course (structured as a research paper). Each team will also provide a 20-minute presentation of their project in class.

Prerequisites: Students are required to have taken and received an 'A' or 'B' in CS 411 and CS 412; or taken and received an 'A' in CS 594 (Reinforcement Learning).

Exams: A comprehensive final exam assess understanding of lecture materials.

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Tentative Schedule of Topics:

Week	Topic
1	Overview
2	Optimal Control: MDPs, POMDPs, Influence Diagrams, LQR, iLQR, MPC
3	Reinforcement Learning: Model-based; Model-free
4	Behavioral Cloning, Neural Networks
5	On-Policy vs. Off-Policy Imitation
6	Preference Elicitation; Active Learning
7	Probabilistic Model-based Inverse Reinforcement Learning
8	Discriminative Model-based Inverse Reinforcement Learning
9	Model-Free Inverse Reinforcement Learning
10	Deep Inverse Reinforcement Learning
11	Adversarial Inverse Reinforcement Learning
12	Shared Autonomy
13	Value Alignment & AI Safety
14	Project Presentations
15	Project Presentations / Recap for Final Exam