Intelligent Interactive Systems (IIS):
Ubiquitous Computing Using Sensor-Based Environments
Major Design Experience

Overview

Today's world is becoming increasingly automated. This includes not only explicit interactions with automated systems, but also implicit sensing that accompanies many popular technologies. Explicit interactions include speech-based question answering with Siri and Google Voice. But what can we learn implicitly? How can we take advantage of the wealth of pervasive and ubiquitous computing platforms? How can we leverage distributed sensor environments?

The answer is that these interaction scenarios provide insight into the user, the ultimate target of any human-facing applications. We can ask a plethora of questions, building a complete model of our end user. A subset of these questions include:

- What is a user telling us through his/her behavior, gestures, speech patterns, and facial expressions?
- How can we understand who a user is?
- How can we intuit what a user needs?
- How can we decide with whom a user should interact?

These are the questions that increasingly underlie Intelligent Interactive Systems (IIS). The focus of this class will be on providing methods that can be used to answer these questions and a semester-long project that ties these questions together through a new interactive technology.

Course Description

This course covers the concepts and techniques that underlie successful interactive user environments including multiple interaction modalities and an emphasis on speech-based systems. Topics include: speech modeling, recognition, and interactive computing. Fluency in a standard object-oriented programming language is assumed. Prior experience with speech or other data modeling is neither required nor assumed.

Prerequisites:
Students should have taken EECS 280 or should have graduate standing.

Instructor:
Prof. Emily Mower Provost
Office: 3620 CSE
Office Hours: Wednesdays 9-11am
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Objectives

The goal of this course is to provide instruction in the development of human interactive systems, targeted towards human application domain.

Specifically the objectives are to:
- Provide background in applied machine learning for interaction.
- Provide background on speech modeling.
- Provide background on human-centered systems.

Honor Code

The Honor Code outlines certain standards of ethical conduct for persons associated with the College of Engineering at the University of Michigan. The policies of the Honor Code apply to graduate and undergraduate students, faculty members, and administrators. Read about the UM Honor Code here: (http://www.crlt.umich.edu/faculty/honor.html). There is also an Engineering Honor Code: (http://www.engin.umich.edu/students/honorcode/code/). In this class, as in many others at the University, you will be expected to include and sign the Honor Pledge on each assignment you submit. The Honor Pledge is as follows:

I have neither given nor received unauthorized aid on this assignment, nor have I concealed any violations of the Honor Code.

The Honor code is based on these tenets:
Engineers must possess personal integrity both as students and as professionals. They must be honorable people to ensure safety, health, fairness, and the proper use of available resources in their undertakings.
Students in the College of Engineering community are honorable and trustworthy persons.
The students, faculty members, and administrators of the College of Engineering trust each other to uphold the principles of the Honor Code. They are jointly responsible for precautions against violations of its policies.
It is dishonorable for students to receive credit for work that is not the result of their own efforts.

Among other things, the Honor Code forbids plagiarism. To plagiarize is to use another person's ideas, writings, etc. as one's own, without crediting the other person. Thus, you must credit information obtained from other sources, including web sites, e-mail or other written communications, conversations, articles, books, etc.

On team assignments, the co-authors listed on the submission should include only those team members who have contributed their fair share to the assignment. If you allow a teammate's name to appear on an assignment to which he/she has not contributed fairly, then you are violating the Honor Code.

Handling Data with Integrity
You may not falsify or misrepresent methods, data, results, or conclusions, regardless of their source.

Unfair Advantage
You may not possess, look at, use, or in any way derive advantage from the solutions of homework, exams or papers prepared in prior years, whether these solutions were former students' work products or solutions that have been made available by University of Michigan faculty or on the internet, unless this section's faculty expressly allows the use of such materials.

Grading

Course Evaluation	+1%
Homework	25%
Participation	5%
Exam	20%
Final Project	40%

- 3% draft proposal
- 12% proposal
- 5% milestone 1
- 5% milestone 2
- 60% final project status (e.g., functionality)
- 15% final report and documentation

The values are subject to slight adjustments based on the discretion of the instructor.

The Final Project presentations and exams will be administered on the dates posted on the schedule and announced in class. The Final Project write-up is due the day presentations begin.

Exceptions to presentation and project deadlines will be made on a case-by-case basis by the instructor. Requests for an exception must be made prior to the absence.

If you have a problem with the grading on a particular assignment or exam, write a brief (one-paragraph) description of the problem, and hand it to me with the assignment/exam for a regrade. Regrade requests must be submitted within one week of when the graded assignment is made available to the student. Late regrade requests will not be accepted.

Course Tools

Information about the course including supplementary readings and resources to assist in completing presentations will be posted on CTools (https://ctools.umich.edu/portal). You are expected to check the site frequently, although you usually will be automatically notified by e-mail when new materials are posted. Some materials will be posted as Adobe pdf files.

Attendance

You are expected to attend all class having already read the assigned readings to enable participation in the discussions. Your experience and your ideas are relevant, and it is important that you share them with the class.

Office Hours

I will have regularly scheduled office hours each week. You are encouraged to make use of these to discuss aspects of the course including lecture material and the homework problems. In cases where you cannot make office hours, contact the course staff to arrange an appointment; don't wait until the last minute though!

Email

I will endeavor to respond promptly to email questions. Note that emails received during the evenings and on weekends are subject to a delay in response. Email that is relatively short is probably best, while questions/concerns that are more open-ended can often be better handled during office hours or after class. If you are asking a question about the assignment that others might have already asked, please first check the course website to see if the question has already been answered either in the announcements section or associated with the specific assignment.

Project

The course includes a semester-long group project. The project will be open ended. It will require you identify a domain that would benefit from continuous sensing, methods to collect and analyze the data, and visualizations to present the results to a user population. Projects should take advantage the knowledge gained in this class and other courses in EECS.

In addition, it is imperative that the work done be in a state that others can, without undue effort, understand what you've done and make changes as needed. Your final report will not only include an overview, it will also include well-documented code, design files, and whatever else is needed. A narrative, explaining the design and not just the functionality will be required. It should be in a state that another student from the class could pick up your project and, within a few days, start making non-trivial modifications.

Your project is due near the end of the semester. That said, you will be able to make small changes and improvements to the project until the last day of class when you will turn in your system and written report to the staff.

Homework

Homework must be turned in on the date that it is due, by 11:55pm. The homework should be submitted electronically using CTools and we will use the CTools timestamp to validate turn-in time. Late homework will be penalized 10% per day (where each day starts at midnight). Homework turned in after three days will not be accepted. It is the student's responsibility to ensure that the assignment has been uploaded correctly. Homework that is not uploaded on CTools will not be graded.

Exams

The midterm will be administered on the dates posted on the schedule and announced in class. Please arrive on time. The exam will be closed book.

Disability Policy

If you have any disability as defined under the Americans with Disabilities Act that might interfere with your ability to participate in class, or to turn in assignments on time or in the form required, please contact your instructor and the Office of Students with Disabilities at the start of the term so that arrangements can be made to accommodate you.

Coverage

The course coverage is designed to provide an overview of pervasive ubiquitous computing, focusing on sensor-based environments. Every lecture, starting with section 2, will tie back into the highlighted application areas.

The lecture schedule and homework assignment schedule are posted online. Please be aware that these schedules are subject to change.

Section 1: Capturing the user implicitly

[Introduction: What can you measure and why?]

- Lecture 1: Introduction
- Lecture 2: User modeling for health
- Lecture 3: User modeling for fun

Section 2: What is a user telling us through his/her behavior?

[Behavior modeling of speech, facial expressions, phone data]

- Lecture 4: Facial recognition overview
- Lecture 5: Native phone data overview
- Lecture 6: Speech overview
- Lecture 7: Speech recognition overview and features
- Lecture 8: HMM1
- Lecture 9: HMM2
- Lecture 10: HMM3
- Lecture 11: Modern approaches (DNN, data at scale) and Kaldi

- Lecture 12: Probability
- Lecture 13: Static modeling 1
- Lecture 14: Static modeling 2

Section 3: How can we understand who a user is?

[Personalization and longitudinal collections: modeling and interaction design]

- Lecture 15: Temporal models (ARMA — Amy as guest lecture?)
- Lecture 16: Model adaptation
- Lecture 17: Interaction adaptation
- Lecture 18: Feature selection
- Lecture 19: In class exam

Section 4: How can we intuit what a user needs?

[Highlights of interaction design]

- Lecture 20: Querying a user
- Lecture 21: Correlational studies
- Lecture 22: Targeted advertising

Section 5: How can we decide with whom a user should interact?

[Modeling for health]

- Lecture 23: Identifying a population
- Lecture 24: Data collection
- Lecture 25: Privacy and ethics
- Lecture 26: Iterative design and user-in-the-loop

Project Presentations

- Lecture 27:
- Lecture 28: