

CS 889  
Advanced Topics in Human-  
Computer Interaction  
Experimental Design  
Spring 2020  
Covid-19 Edition

# Experimental Design

- This course is about designing experiments in HCI
  - Experimentation defined broadly
  - Can include quantitative and/or qualitative approaches
  - Can be modeling or scientific approach
- More broadly, goals are:
  - To understand strengths and weaknesses of different experimental method in HCI
  - To develop an appreciation for experimental HCI research
  - To be able to apply these techniques to do HCI research

# Course Mods

- Challenges with project
  - No direct contact with human subjects
  - Pilot studies
  - Use of data = obtain protocol yourself
- Lectures
  - 1 hour lecture = 20 minutes screen cast
  - 2.5 hours = ~40 minutes
  - But additional work adds to workload

# Overview

- Video 1:
  - A brief overview of HCI
- Video 2:
  - Experimental Methods overview
- Video 3:
  - Administrivia
    - Scheduling
    - Syllabus and course details

# Task 1

- Piazza is the primary mechanism for discussion in this course.
  - [piazza.com/uwaterloo.ca/summer2020/cs889](https://piazza.com/uwaterloo.ca/summer2020/cs889)
- Task 1: Properly link discussions in posts, introduce yourself, include a photo.
  - Join piazza and introduce yourself, including:
    - Your name and preferred mode of address.
    - A bit about you from a research perspective, including your area and what you want out of the course.
    - A recent, pre-covid photo of life “before”.
  - Details in course website. Join link above.

# HCI Overview

# Human-Computer Interaction

- The discipline concerned with designing products that are useful, usable, and used.
  - Problems with this definition?
- Design systems that are:
  - Learnable, flexible, robust?
  - More Efficient?
  - That people “like better”?
- Contrast “like better” with “usable”
  - Which is more quantitative a metric?

# Two Sides to HCI Practice

- Interactive System Design (CS 449/649)
  - Understand current work practice of users
  - Identify breakdowns
  - Re-design work
  - Design architecture of system
  - Draw UI sketches
  - Evaluate with users
  - Redesign
  - Implement Prototypes and evaluate
- User interface implementation (CS 349)
  - Graphic output and input
  - Events
  - GUI toolkits, toolkit architectures
  - Undo and Errors
  - Screen design and layout
  - Custom controls
  - Computationally intensive tasks
  - Scripting languages

**BUT ... CS 889 is a research-based course**



# HCI Research

- Areas
  - User interfaces systems and technology
  - Computer supported cooperative work
  - Ubiquitous computing
  - Designing interactive systems/Designing user experiences
  - Mobile interaction
  - Etc.
- Most research has some experimental or evaluation component to them

# HCI Research (2)

- What is computer science research?
- Arguably: Build a better mousetrap
  - Maximize the “efficacy” of computing systems
- HCI:
  - Maximize the “efficacy” of computing systems vis a vis end-user goals, characteristics.

# Experimental Methods Overview

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# Goals of experiments/evaluation

- Understand real world
  - How users use technology
  - Can design be improved, can work be automated, can we help a potential user group?
- Compare things
  - Best/better/worse
- Engineering toward a target
  - Essential features
  - Is design good enough
- Check conformance to a standard
  - Microsoft design guidelines
  - Mac interface guidelines

# Research-Based Evaluation

- Two broad approaches
  - Quantitative methods
    - Positivist/post-positivist
  - Qualitative methods
    - Constructivist
- Combined in mixed methods research
  - Two approaches to mixed methods
    - Sequential
    - Concurrent

# Quantitative Approaches

- Hypothesis driven or model driven
  - Testing a theory
  - Statistics
  - Correlation
- **Post-positivist** => hard to be absolutely sure
  - Causes probably determine effects and outcomes
- Goal is to be able to say that it is unlikely to see effect by chance
  - $P \leq 0.05$
  - Correlation with model significant and  $R^2 \sim 1.0$

# Quantitative Metrics

- Need to be measurable
  - Time
  - Error rate
  - User satisfaction
  - Cognitive load (NASA TLX)
  - Learning curve (time/efficiency)
  - Clicks
- All indirect measures of “better” interface
  - All relative measures
- Correlation with model
  - $R^2 \sim 1.0$  (depending on number of data points)



# Qualitative Approaches

- Research starts with data collection
- Collection motivated by questions that are broad and non-leading
  - How do people use smartphones for gaming?
  - Establish meaning from views of participants
- Process
  - Look for patterns
  - Build theory from ground up

# Mixed Methods

- Collect diverse types of data
- Can do sequentially
  - Typically starts broad using qualitative or quantitative data
  - Then focuses using another methodology
- Can do concurrently
  - Use multiple types of data simultaneously to develop a more complete picture
- Triangulates data
  - Uses different sources to develop a full understanding

# Administrivia

# A note on scheduling

- Course is scheduled to run double time as follow:
  - 4 or 5 weeks (to end of first week June) of approximately double load
  - Project work through early July to project check point.
  - Project work through end of July, final presentation
- Anticipate **6 weeks equivalent with no classes**
- Goal is to front load learning so that later part of course focuses on data collection and projects

# Covid-19 Mods

- First content work due May 14<sup>th</sup> due to Covid-19.
- Course will be delivered as a mixed model, primarily asynchronous with synchronous components
- Starting week 3, there will be *Program Committee* style meetings
  - Class will be divided into two “sub-committees”
  - Will be expected to participate in discussions for your sub-committee.
  - Will act as “external reviewers” for other subcommittee
  - Will be scheduled via Doodle at appropriate time
  - I will assign individuals to sub-committees
- Anticipate 2X2 hour meetings per week

# Syllabus

- Three components
  - Individual – 35%
    - Research papers
    - Commentary on forums (quality and quantity)
  - Groups of one or two
    - Exercises – 15%
    - Course project – 50%

# Research papers – 35%

- Starting this week, assigned readings
  - Working on format, but something like by 9pm, each student posts a summary of every paper under discussion of exactly 4 sentences on course wiki
    - Summary of research question of paper
    - Summary of results
    - Some value judgement on paper including one sentence on strengths and one on weaknesses.
- Early in the course (~ two weeks), I will present material on and around papers and class will discuss papers
  - Then class discussion, scaffolded by in-class presentation, on Piazza
- Later, students program-committee style discussion of papers
  - Number of PC-style meetings and in-class discussions will depend on eventual enrollment.

# Exercises – 15%

- Posted by next week
- Early exercises give some experience with data collection and analysis
- Still being refined in terms of format



# Project – 50%

- Goal is to perform a HCI study
- Suggest you leverage papers that you will present to identify either methodology or domain
  - If you don't have a topic, check out CHI 2020 proceedings for papers
  - Skim topics that interest you
  - Reading order: abstract, introduction, conclusion to identify papers
  - If you find a paper that you are suspicious of wrt results, this might be a good target for replication.

# Project – 50% (2)

- What to do in an age of Covid-19
- Some experience with on-line data collection
  - Williams/Kuzminykh papers
  - Papers under submission (with permission of authors, working on this)

# Course Resources

- Website
  - Will include links to readings
  - Readings are typically in ACM DL, currently freely available
  - Must be on-campus or using library's/campus's proxy connection to access once closed
- Free eBooks
  - Basics of qualitative research : techniques and procedures for developing grounded theory, Corbin and Strauss
  - Practical Statistics 4 HCI (Wobbrock)
- Statistics help desk, any book in statistical analysis.

# Course Enrollment

- Course is full!
- Please make decisions early regarding enrollment
  - I have some flexibility and will sign in starting next week with priority to CS grad students
  - However, max enrollment is ~25 students to preserve seminar format

**Post Questions on Piazza!**