Human-Computer Interaction: Foundations and Frontiers

CS 347
Parastoo Abtahi & Danaë Metaxa
Shout-out to Michael Bernstein!!!
“Wholly new forms of encyclopedias will appear, ready-made with a mesh of associative trails running through them.”
The Computer for the 21st Century
Mark Weiser, 1999
Will discuss in studio

Modern MacOS desktop

Modern fitness trackers [image from Apple]

Swipe keyboards (iOS, Android) [image from 9to5mac]


Idieum. Modern multitouch interface.
What’s next?
HCI Research

Envisioning and understanding the future of interaction between people, society, and technology
This class

Teaches foundational theories and modern frontiers
Introductions
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This is not like other HCI classes.

Your goal is not just to fashion an alignment between people and technology. Your goal is to articulate and generate entirely new ideas about that relationship.
Foundations and frontiers

You will learn the major theories and concepts that underpin HCI
You will understand the research questions that drive modern HCI frontiers
You will learn to articulate what a strong research contribution to HCI looks like, and why
You will develop your abilities to critique HCI research:

Recognizing the main idea behind an article

Developing a deep, rather than surface-level, critique of that idea

Authoring a generative, rather than evaluative, critique

These skills are central to your ability to drive the field forward and fashion your own ideas.
Methods

You will gain familiarity with the major research methods that are utilized in HCI, including:

- System building
- Experiment
- Design
- Field study
- Data analysis
- Qualitative methods
Synthesis

You will develop the ability to synthesize the earlier learning goals into a novel contribution to the HCI literature
An unnecessarily quantitative visualization of your time in 347

Time spent

- Reading
- Doing
Format

Mon and Wed

11:30-12:30  **Lectures: overview of the research area**

12:30-1:00  **Office hours**

Thu or Fri

TBD  **Studio: student-led discussion of the readings (1 hr)**
Class activity 1 of 3: Readings
Yes, you are reading in a Computer Science class.

There will be two papers to read for each class day.

This will take substantial time. It will get faster as the course proceeds and you get more used to reading papers.

Readings may be paywalled. :( If you are reading off-campus, use the Stanford library proxy linked at the top of the syllabus webpage.
Commentaries

After reading the papers for each class, you will reflect on the main ideas in each paper and submit a written commentary. These commentaries serve as a mechanism to drive deeper reflection on the concepts in each paper.

Commentaries are due before lectures (M/W 11:30 AM PT).

We will drop the two lowest commentary grades at the end of class: meaning, you may drop two days’ worth of commentaries.

We will be using these commentaries to drive discussion in studios.
Commentary strategies

Future research directions that this paper inspires for you
Why the paper does/doesn't seem important
Observations of novel methodology or methodology that seems suspect
Why the paper is/isn't effective at getting its message across
How the paper has changed your opinion or outlook on a topic
“This paper has so many problems:”

“This paper inspired me to develop an idea:”
As We May Think

This paper was fascinating because it forces us to consider technologies that nowadays we take for granted. In some ways Bush was overly optimistic; for example walnut-sized wearable cameras are uncommon (even though they are possible), likely because optical and physical constraints favor handheld sizes. In other ways he underestimated, such as the explosion of data. For example, some modern cameras can store ten thousand photos rather than a hundred.

Underestimating the data explosion is also apparent in the disconnect between the initial problem description ("publication has been extended far beyond our present ability to make real use of the record") and the first two-thirds of the paper, which describe technologies that would (and did!) exacerbate the issue by further proliferating data. Yet, he recognizes this issue later in the paper, and then goes on to predict search engines.

It is remarkable how many technologies are predicted in this paper: digital photography, speech recognition, search engines, centralized record-keeping for businesses, hypertext (even Wikipedia?). At the same time, many of the predicted implementations are distorted by technologies and practices common at the time, like "dry photography" or "a roomful of girls armed with simple keyboard punches". While these presumably served to make the hypotheses more accessible to readers of the time, is it even possible to hypothesize technology without such artifacts.

Aside from predictions, this paper is important for the way Bush frames science in the support of the human race, by augmenting the power of the human mind. It is likely that many of the scientists (and physicists in particular) that were his audience felt guilt and despair from the destruction wrought by advances in nuclear, and even conventional, weaponry in the war. In that social context, seeing science described as a powerful constructive tool for good must have been inspiring.
Class activity 2 of 3: Being a discussant
Take charge!

For half of one studio, you will be the discussant, responsible for helping us design the in-studio discussion.

This assignment is completed in groups based on the dates you’re assigned via the course application.

Discussants have three goals
Summarizing commentaries

Read the submitted commentaries before class. Put together a summary document that:

- Identifies especially insightful commentary ideas and quotes
- Clusters commentary responses into themes, with a few pull quotes per theme

Submit the document Thursday at 3 PM, so your TA can use that in the studio discussion.
Share a meta-commentary

Pick two of the themes (one per paper) that you identified, and for each one, prepare a **2-minute meta-commentary** that you can share in class to kick off discussion on that theme.

First: a synthesis of the main points being raised in that theme, using quotes as relevant.

Second: your response to the points being raised. What do you agree with, and why? What do you disagree with, and why? Can you offer an alternative perspective?
Studio overview

Paper 1

Discussant 1 (readings on Mon)

Paper 2

Discussant 2 (readings on Wed)

Paper 1

Paper 2

Meta-commentary

1 hour studio
Reviewing commentaries

By two days after studio, give check-minus/check/check-plus feedback to each submitted commentary.

We will provide a calibration exercise. We will also randomly sample and independently code a few of your commentary feedback scores as part of your grade.
Class activity 3 of 3: Project
Course project

You will have the opportunity — nay, the responsibility — to conceive, execute, and communicate a new idea in the world of HCI.

A novel contribution to any area of HCI research

An appropriate method for demonstrating that contribution: design, engineering, social science, theory, etc.

You will work together in teams of three. You have full control over the topic. We will scaffold you through the process: brainstorming, implementation, and evaluation.
Performing Under Pressure: A Biofeedback System for Stress-is-Enhancing Mindset

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ABSTRACT
Psychology research has found that the effect of stress on a subject is determined by the subject’s attitude, or mindset, about stress. Most prior research in the intersection of HCI and stress focuses primarily on mitigation, i.e. calming users down when they are experiencing stress, and the consideration of mindset is absent in these systems. In contrast, we present a biofeedback system that frames a user’s stress levels as enhancing. Key features include a real-time stress monitoring system using a heart rate sensor, and a glanceable display which reframes stress as enhancing. We conducted a preliminary evaluation by measuring user performance in timed mental arithmetic problems, but did not find a statistically significant difference in performance between users who received the biofeedback and those who did not (n = 10, p = .12). Even so, we observe a promising trend, and a qualitative analysis suggests that users found the system non-distracting and empowering.

ACM Classification Keywords

BACKGROUND
Stress Mindset

While many health psychologists, ubicomp health researchers, and the general public consider stress to be bad for health and performance, some evidence suggests a more complicated reality: Psychology research [4] has identified the challenge response, which is activated when a person faces a hurdle they believe they have the capacity to overcome. In this scenario, the body primes itself for action, resulting in immediate enhanced cognitive and physical abilities, as well as long term health benefits. The threat response, on the other hand, is evoked when a person feels they cannot reasonably overcome an obstacle, resulting in cognitive strain and long term health hazards.

Significantly, Crum et al. found that one’s mindset about the nature of stress itself is a significant factor in determining whether one experiences the beneficial challenge response or the deleterious threat response[2]. A stress-is-enhancing mindset implies you believe stress generally enhances your performance, which is the underlying assumption behind the system we present here.
Human Perception of Swarm Robot Motion

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Abstract
As robots become ubiquitous in our everyday environment, we start seeing them used in groups, rather than individually, to complete tasks. We present a study aimed at understanding how different movement patterns impact humans’ perceptions of groups of small tabletop robots. To understand this, we focus on the effects of changing the robots’ speed, smoothness, and synchronization on perceived valence, arousal, and dominance. We find that speed had the strongest correlation to these factors. With regard to human emotional response to the robots, we align with and build on prior work dealing with individual robots that correlates speed to valence and smoothness to arousal. In addition, participants noted an increase in positive affect in response to synchronized motion, though synchronization had no significant impact on measured perception. Based on our quantitative and qualitative results, we suggest design implications for swarm robot motion.

Author Keywords
Human-robot interaction (HRI); perception; affect; robot swarms; swarm user interfaces; tangible user interfaces

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous
H.5.2. User Interfaces: User-centered design
H.5.1. Information Interfaces and Presentation: Individual Interfaces
H.1.2. User Studies and User Centered Design: User-centered design
My Team Will Go On: Differentiating High and Low Viability Teams through Team Interaction

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MARK E. WHITING, University of Pennsylvania, United States
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Understanding team viability — a team’s capacity for sustained and future success — is essential for building effective teams. In this study, we aggregate features drawn from the organizational behavior literature to train a viability classification model over a dataset of 669 10-minute text conversations of online teams. We train classifiers to identify teams at the top decile (most viable teams), 50th percentile (above a median split), and bottom decile (least viable teams), then characterize the attributes of teams at each of these viability levels. We find that a lasso regression model achieves an accuracy of .74–.92 AUC ROC under different thresholds of classifying viability scores. From these models, we identify the use of exclusive language such as ‘but’ and ‘except’, and the use of second person pronouns, as the most predictive features for detecting the most viable teams, suggesting that active engagement with others’ ideas is a crucial signal of a viable team. Only a small fraction of the 10-minute discussion, as little as 70 seconds, is required for predicting the viability of team interaction. This work suggests opportunities for teams to assess, track, and visualize their own viability in real time as they collaborate.
Project Timeline

week 1
week 2 Brainstorming round 1
week 3 Form teams; brainstorming round 2
week 4 Abstract draft
week 5 Abstract revision
week 6
week 7 Project fair, round one
week 8 Project fair, round one continued
week 9 Project fair, round two
week 10 Final presentations, project paper
For Project Inspiration

STANFORD HCI GROUP

COURSES  PEOPLE  RESEARCH  CONNECT  DIRECTIONS

NEWS
- Street-Level Algorithms wins Best Paper at CHI 2019
- Professor Landay wins a Ubicomp 2018 Test of Time award for Ubifit
- Ph.D. graduate Niloufar Salehi joins the faculty at UC Berkeley; Ph.D. graduate Anh EECS. Congrats!

PAPERS

NEURIPS 2019

**HYPE: Human eYe Perceptual Evaluation of Generative Models**
Sharon Zhou*, Mitchell Gordon*, Ranjay Krishna, Austin Narcomey, Li Fei-Fei 0.5%)

CSCW 2019

**Did It Have To End This Way? Understanding the Consistency of**
Mark Whiting, Allie Blaising, Chloé Barreau, Laura Fiuza, Nik Marda, Melissa

HCOMP 2019
Administrivia
Prereqs and background

Are you prepared to complete a mini-research project?

Helpful: Depth in at least one of {computer science, social science methods, design, STS} and experience in human-computer interaction

Required:

CS or SymSys HCI track: CS 147 or CS 247

Other programs: none
Required application

Submit the course application by 11:59 tonight (PT)

Link to the application is on cs347.stanford.edu under the "Syllabus" page

We will use this application to confirm your enrollment, and to assign you to a studio
Important due dates

**Today:** Submit the course application by 11:59 tonight (PT)
Linked at cs347.stanford.edu under the "Syllabus" page

**Tomorrow:** We will assign you to your studio time
and send out a signup sheet for discussion days

**Wednesday:** Sign up for a discussion day before next lecture
by Wed at 11:30 AM (PT)
Class policy

Lecture:

  Remove distractions
  Attend and participate!

Discussion:

  Active participation
  Video on (if you can)
CS 347 in three acts

1. Introduction
2. Depth
3. Breadth
Interaction

Social Computing

Design
AI+HCI
media and algorithm audits
accessibility
programming
cognition
critiques of HCI
foundations
ICT4D
collaboration
visualization
Course Overview

week 1  Intro to Interaction;  Intro to Social Computing
week 2  Intro to Design;  Interaction pt 1
week 3  Methods;  Interaction pt 2
week 4  Social Computing
week 5  Design
week 6  AI+HCI;  Algorithm Audits
week 7  Accessibility;  ICT4D
week 8  Foundations;  Cognition
week 9  Collaboration;  Visualization
week 10  (Programming);  Critiques of HCI
Grading

20% Paper commentaries

60% Research project

4% Project Ideas (Round One), 4% Project Ideas (Round Two)
4% Project Abstract Draft, 8% Project Abstract Revision
4% Project Faire (Round One), 6% Project Faire (Round Two)
10% Final Presentation, 20% Final Paper

8% Participation and contribution in lecture 3% and studio 5%

5% Team participation

7% Discussant
CS 547: HCI Seminar

cs547.stanford.edu

Fridays 1:00pm-2:00pm

Encourage you to attend
Questions?
Introduction to Interaction
Themes of interaction research

**Ubiquitous computing:** computing embedded in environments and activities

**User interface technology:** sensing, input, output
Let's start here. The notion of ubiquitous computing is central to a wide swath of modern HCI.
Ubiquitous?
Ubiquitous?
“The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.”
The arc of ubiquitous computing

Ubiquitous computing: a vision in which computers will “vanish into the background”. This vision sparked many efforts to distribute computation into the environment.

This vision requires interactive systems to become reactive, context-aware, ambient, and embedded in everyday activities.
Giving data physical form

What Weiser calls one of the first calm technologies:

Live Wire, a wire on a stepper motor, monitoring net traffic [Jeremijenko '95]
Cohn et al. Humantenna: using the body as an antenna for real-time whole-body interaction. CHI '12.
User interface technology

Effective control of ubiquitous computing systems without the traditional input channels

Gesture, on-body, on-wall, on-floor: on any surface available
Tangible Computing

Directly-manipulable physical interfaces to data and computation

‘Pure’ form of ubicomp in that there is no computer to be seen

Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms

Hiroshi Ishii and Brygg Ullmer
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ABSTRACT
This paper presents our vision of Human Computer Interaction (HCI): "Tangible Bits." Tangible Bits allows

BITS & ATOMS
We live between two realms: our physical environment and
Follmer, Leithinger, Olwal, Hogge, Ishii. inFORM: Dynamic Physical Affordances and Constraints through Shape and Object Actuation. UIST '13.
we developed a new material that allows objects to change their color

What’s difficult about interaction research?
**Syllabus**

*Note: Stanford students can use the Stanford Library proxy for off-campus access to the readings posted on ACM Portal.*

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Readings</th>
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<tbody>
<tr>
<td></td>
<td><strong>Week 1</strong></td>
<td></td>
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<tr>
<td>Mar 29</td>
<td><strong>Class Welcome and Intro: Interaction</strong></td>
<td><strong>The Computer for the 21st Century, Mark Weiser, Scientific American, September 1991, pp. 94-104</strong></td>
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<td></td>
<td></td>
<td>This is one of the most influential, highly-cited papers in all of human-computer interaction. Weiser’s vision of ubiquitous computing articulated a vision in which computing recedes into the background rather than stands as a focal point of our attention. Researchers and practitioners have chased this vision since 1991. We read this article because it is the foundation upon which much of the Interaction component of the class sits. What do you think about Weiser's differentiation between calm computation that recedes into infrastructure, and simply spreading computers around everywhere in the environment? What are the implications of such a vision?</td>
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<tr>
<td></td>
<td><strong>Class Application due at 11:59pm</strong></td>
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<tr>
<td>Mar 29</td>
<td><strong>Intro: Social + Crowd Computing — What is (And Isn’t) HCI Research</strong></td>
<td><strong>Labeling Images with a Computer Game, Luis von Ahn, Laura Dabbish, CHI 2004</strong></td>
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<td>This is a foundational article that laid much of the groundwork and excitement behind what was later termed “crowdsourcing.” The idea of transforming a data labeling task into a game is extremely creative; the trick is whether the game can be designed well, or else it flops and you don’t get any players or data! Many of the concepts that this paper developed, for example looking for independent agreement between players to gain confidence in a result, are now part of nearly every crowdsourcing system. What kinds of tasks do you think are, and are not, applicable with this model? What design decisions that they made in the ESP Game (e.g., paired agreement) are critical to this functioning, and which could you imagine changing?</td>
</tr>
<tr>
<td>Mar 31</td>
<td><strong>I always assumed that I wasn't really that close to (her): Reasoning about Invisible Algorithms in News Feeds, Motahhare Eslami et al, CHI 2015</strong></td>
<td>This recent article is representative of a HCI trend focusing on human interaction with opaque algorithms and AI systems. The big surprise of this article was that so few people were aware that their feeds were algorithmically-mediated. What follow-up studies might help us better understand this phenomenon?</td>
</tr>
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See you on Wednesday :)  

Action items


**Before class on Wed:** sign up for discussion (will be emailed tmrw)
submit first commentary

**Before studio on Thu/Fri:** read The Computer for the 21st Century

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Email: cs347@cs.stanford.edu  
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