Human-Computer Interaction: Foundations and Frontiers

CS 347 - Spr 2022
Maneesh Agrawala
Shout out to Parastoo Abtahi, Danaë Metaxa and Tom Holland Michael Bernstein
As we may think.

Vannevar Bush, 1945.

First appeared in The Atlantic, later that year a condensed version in Life
“Wholly new forms of encyclopedias will appear, ready-made with a mesh of associative trails running through them.”
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A scientist of the future records experiments with a tiny camera fitted with universal-focus lens. The small square in the eyeglass at the left sights the object (LIFE 19(11), p. 112).
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The Computer for the 21st Century
Mark Weiser, 1991
reading for today, will discuss in section Thu/Fri
Tabs

Boards

Pads

Modern MacOS desktop

Modern mouse

Swipe keyboards (iOS, Android)

Modern recommender systems

Modern fitness trackers

Apple Watch handwashing detection 2020
HCI Research

Envisioning and understanding the future of interaction between people, society, and technology
Introductions
Maneesh Agrawala
Professor of Computer Science
HCI/Graphics/Visualization
Office hours: Wed 2-3pm, Coupa Cafe Y2E2 & Zoom
TA: Mark Miller

PhD student in Computer Science, expert in AR/VR

Office hours: Thu 4-5pm Zoom
TA: Jacob Ritchie

PhD student in Computer Science, expert in Visualization

Office hours: Thu 8-9pm
Gates Rm 398 & Zoom
TA: Jackie Yang

PhD student in Computer Science, expert in Multimodal Interfaces, Chatbots, AR/VR

Office hours: Tue 2-3pm, Thu 2-3pm, Zoom
Contact us

Slack: connect to Slack via Canvas — best way to reach us

Course website: http://cs347.stanford.edu
Readings, policies, entertainment

Anonymous Feedback: https://forms.gle/zz7FsfE4qyc4h1v79
Learning goals
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
Research commentaries

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
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

- Reading
- Doing
Format

Mon and Wed

11:00 - noon   Lectures: overview of the research areas

Thu or Fri,  9:45am or 1:30pm

TBD (1hr)   Section: student-led discussion of readings
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.

Typically, two papers, one foundational that is HCI canon, and one recent that exposes you to a modern instantiation of the area.
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.

Commentaries are due at 3am before lectures (M/W 3am).

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

We use these commentaries to drive discussion in section.
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 section you will be a discussant, responsible for helping us design the in-section discussion.

Discussants have three goals—details on each one in a moment:

- Summarize the submitted commentaries into themes
- Write a meta-commentary to setup the in-section discussion on 2 themes
- Peer assess the commentary submissions (check-plus, check, check-minus)

This assignment is completed in groups based on the dates you’re assigned to be the discussant.
Summarizing commentaries

Read the submitted commentaries before section. 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 by 3am Thu, so you and the TAs can use them in the discussion sections.
Share a meta-commentary

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

First: a synthesis of the main points 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?
Section overview

- Meta-commentary

Paper 1

Discussant 1 (readings on Mon)

Paper 2

Paper 1

Discussant 2 (readings on Wed)

1 hour studio
Peer reviewing commentaries

By **two days after section**, 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 in teams of 4. You have full control over the topic.

We will scaffold you through the process: brainstorming, implementation, and evaluation.
Human Perception of Swarm Robot Motion

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.5.2 [Information interfaces and presentation]: User interfaces; User-centered design
Eevee: Transforming Images by Bridging High-level Goals and Low-level Edit Operations

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ABSTRACT

There is a significant gap between the high-level, semantic manner in which we reason about image edits and the low-level, pixel-oriented way in which we execute these edits. While existing image-editing tools provide a great deal of flexibility for professionals, they can be disorienting to novice users. Eevee aims to close this gap by enabling users to specify their edits in a more natural, semantic way while allowing the tool to perform the underlying pixel-level edits. Eevee achieves this by combining deep learning techniques for image manipulation with interactive design tools that allow users to create their own rules for how images should be edited.

Figure 1: The Eevee system, which enables users to specify their edits in a more natural, semantic way while allowing the tool to perform the underlying pixel-level edits.
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 video, round one
week 8
week 9  Project video, round two
week 10 Final project paper and presentations
finals
For Project Inspiration

NEWS
- Professor Bernstein and collaborators win the Patrick J. McGovern Tech for Humanity Prize
- Coupling Simulation and Hardware for Interactive Circuit Debugging wins Best Paper at CHI 2021
- Professor Follmer wins a Sloan Fellowship
- Professor Agrawala elected to the SIGCHI Academy
- Who Is Zuki wins Best Paper at CHI 2020
- Professor Bernstein wins a UIST 2020 Lasting Impact award for Soylent

PAPERS
CSCW 2022
A "Distance Matters" Paradox: Facilitating Intra-Team Collaboration Can Harm Inter-Team Collaboration Xinlan Emily Hu, Rebecca Hinds, Melissa A. Valentine, Michael S. Bernstein

Assessing the Fairness of AI Systems: AI Practitioners' Processes, Challenges, and Needs for Support Michael Madaio, Lisa Egede, Hariharan Subramonyam, Jenn Wortman Vaughan, Hanna Wallach

Prereqs and background

Most important: are you prepared to complete a mini-research project of your own choosing?

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 and/or CS 247
Required application

Submit the course application by 6pm tonight

Link to 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 section.

Later tonight or tomorrow we will ask you to rank which lecture you would like to be a discussant for.
Class policies

**Lecture:** will be live on ohyay and in person (we would prefer you attend in person if possible)

- Remove distractions
- Attend and participate! (unsure when/if recordings will be available)

**Discussion:** in person only

- Attendance is **required**
- Active participation
- No laptop
CS 347 in three acts

1. Introduction
2. Depth
3. Breadth
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 Video (Round One), 6%  Project Video (Round Two)
10%  Final Presentation, 20%  Final Paper

8%  Discussion participation 3% in lecture, 5% in section

5%  Team participation

7%  Discussant
Questions?
Introduction to Interaction
Themes of interaction research

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

**User interface:** technology: sensing, input, output
Ubiquitous computing

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 (or ambient) 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 people to interact with data and computation using physical interfaces. This allows for a "Pure" form of ubicomp, or ubiquitous computing, where there is no computer to be seen.

BITS & ATOMS
We live between two realms: our physical environment and cyberspace. These realms are currently separated (physical space vs. screens), but we are developing Tangible Bits to bridge these gaps. Tangible Bits enable users to be aware of a change in weather or to rejoin the richness of the physical world in HCI.

INTRODUCTION: FROM THE MUSEUM
We began our work with real physical objects. Alas, much of this richness has been lost to the rapid flood of digital technologies. We were introduced to the concept of Tangible Bits at an exhibition at the Computer Museum in Boston, MA, in 1995. We were particularly taken by the Collection of Historical Scientific Instruments at Harvard University (Fig. 1).

From Desktop to Physical Environment
In 1981, the Xerox PARC introduced the "personal computer," which elevated the interaction from command-and-control mode to point-and-click.
Urp: a luminous-tangible workbench for urban planning and design.
See you on Wednesday!

Action items

**Today:** submit application by 6pm (cs347.stanford.edu/syllabus)

**Tuesday:** signup for discussant role (emailed tonight/tomorrow)

**Before 3am on Wed:** submit commentaries (see readings on syllabus)

Website: cs347.stanford.edu