Human-Computer Interaction Research

CS 347 (previously CS 376)
Michael Bernstein
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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“There is a new profession of trail blazers, those who find delight in the task of establishing useful trails through the enormous mass of the common record. The inheritance from the [trail blazer] becomes, not only [their] additions to the world’s record, but for [their] disciples the entire scaffolding by which they were erected.”
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Modern MacOS desktop

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

Modern recommender systems [image from HBS]

Modern fitness trackers [image from Apple]


Idieum. Modern multitouch interface.
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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Readings, policies, entertainment: cs347.stanford.edu
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.
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

- Reading
- Doing
Format

1:30-2:15  Lecture: overview of the research area

— break and split into two rooms —

2:20-2:50  Discussion of the 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.

Typically, I've chosen the two papers to have one foundational paper that is central HCI canon, and one recent paper that exposes you to a modern instantiation of the same 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 on the concepts in each paper:

Commentaries are due at 5pm the night before class.

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 class.
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 one class day, you will be the discussant, responsible for helping us design the in-class discussion.

Discussants will have three main goals:

- Summarize the commentaries into themes
- Provide a meta-commentary in class discussion on two of the themes
- Peer assess the commentary submissions (check-plus, check, check-minus)

This assignment is completed in groups based on the dates you’re assigned via the course application.
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 by noon the day of class, so the staff can print out copies for us and bring them with us.
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 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?

Your group will be split into two different rooms, so make sure that each of you can present this meta-commentary.
Reviewing commentaries

By two days after class, 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
H.5.m. Information Interfaces and Presentation: Misc.

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 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, while a stress-is-debilitating mindset implies you believe stress generally undermines your performance, 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.
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 addresses this gap by providing a semantic, user-friendly interface that maps high-level semantic goals to low-level image edits in a way that is intuitive and straightforward. Our system allows users to easily specify the semantic changes they want to make to an image by selecting a goal and providing input theme(s) and an example that captures the essence of the desired transformation. Eevee then automatically proposes the low-level edits needed to achieve these high-level goals, with both visual and textual representation of the edits. This not only enables non-experts to make sophisticated image edits with ease but also provides a practical solution to a wide range of applications in image editing, including creative art, content creation, and enhanced photo manipulation.
Best project gets a $1500 trip

Michael will pay for one team member of the best project team to attend an appropriate top-tier HCI conference and present their work in the poster track.

Funding is contingent on your poster submission getting accepted.

Everyone is welcome to submit, but others have to find their own funding (undergrads: UAR student grants!)
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

week 8  Project fair, round one

week 9

week 10  Project fair, round two

finals  Final project paper and presentations
For Project Inspiration

STANFORD HCI GROUP

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 Niloofar Salehi joins the faculty at UC Berkeley; Ph.D. graduate An EECS. Congrats!

PAPERS
- HYPE: Human eYe Perceptual Evaluation of Generative Models
  Sharon Zhou*, Mitchell Gordon*, Ranjay Krishna, Austin Narcomey, Li Fei-Fei (0.5%)
- Did It Have To End This Way? Understanding the Consistency of T
  Mark Whiting, Allie Blaizing, Chloe Barreau, Laura Fiuza, Nik Marda, Melissa

COURSES PEOPLe RESEARCH CONNECT DIRECTIONS

PEOPLE
Christina Wodtke · James Landay · Julie Stanford · Maneesh Agrawala · Michael Bernstein · Sean Follmer · Stu Card · Terry Winograd · Affiliated Faculty · Students · Visitors · Alumni

CO-CONSPIRATORS
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}
- Experience in human-computer interaction (e.g., CS 147, CS 247)

Required:

- CS or SymSys HCI track: A- or better in CS 147 or CS 247
- Other programs: none
Required application

Submit the course application by 11:59 tonight

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 a discussant date
Laptop policy

Lecture: take notes if you want

(But science says you’ll remember more if you do it on paper, because handwriting is slower so you have to synthesize, filter, and compress the information)

Discussion: no laptops
CS 376 in three acts

1. Introduction
2. Depth
3. Breadth
AI+HCI  media and creativity  foundations  ICT4D
accessibility  programming  collaboration  visualization
cognition  critiques of HCI
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; Media and Creativity
week 7  Accessibility; ICT4D
week 8  Foundations; Cognition
week 9  Collaboration; Programming
week 10 Visualization; Critiques of HCI
Grading

25% 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 Final Paper

5% In-class discussion participation

5% Team participation

5% Discussant
CS 547: HCI Seminar

cs547.stanford.edu

Fridays 11:30am-12:30pm, Gates B1

This quarter’s guests include leading luminaries in cognition, social computing, haptics, collaboration, and accessibility.
Questions?
Introduction to Interaction

CS 347
Michael Bernstein
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 technologies: Live Wire, a wire on a stepper motor, monitoring net traffic [Jeremijenko '95]
Themes of interaction research

Ubiquitous computing: computing embedded in environments and activities

User interface technology: sensing, input, output
Activity Recognition from User-Annotated Acceleration Data

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Abstract. In this work, algorithms are developed and evaluated to detect physical activities from data acquired using five small biaxial accelerometers worn simultaneously on different parts of the body. Acceleration data was collected from 20 subjects without researcher supervision or observation. Subjects were asked to perform a sequence of everyday tasks but not told specifically where or how to do them. Mean, energy, frequency-domain entropy, and correlation of acceleration data was calculated and several classifiers using these features were tested. Decision tree classifiers showed the best performance recognizing everyday activities with an overall accuracy rate of 84%. The results show that although some activities are recognized well with subject-independent training data, others appear to require subject-specific training data. The results suggest that multiple accelerometers aid in recognition because conjunctions in acceleration feature values can effectively discriminate many activities. With just two biaxial accelerometers – thigh and wrist – the recognition performance dropped only slightly. This is the first work to investigate performance of recognition algorithms with multiple, wire-free accelerometers on 20 activities using datasets annotated by the subjects themselves.

1 Introduction

One of the key difficulties in creating useful and robust ubiquitous, context-aware computer applications is developing the algorithms that can detect context from noisy and often ambiguous sensor data. One facet of the user's context is his physical activity. Although prior work discusses physical activity recognition using acceleration (e.g. [17,5,23]) or a fusion of acceleration and other data modalities (e.g. [18]), it is unclear how most prior systems will perform under real-world conditions. Most of these works compute recognition results with data collected from subjects under artificially constrained laboratory settings. Some also evaluate recognition performance on data collected in natural, out-of-lab settings but only use limited data sets collected from one individual (e.g. [22]). A number of works use naturalistic data but do not quantify recognition accuracy. Lastly, research using naturalistic data collected from multiple subjects has focused on A. Ferscha and F. Mattern (Eds.): PERVASIVE 2004, LNCS 3001, pp. 1–17, 2004.

Sense the user's physical state by using minimally invasive sensors

For example, wearing five 2d accelerometers and predicting tasks like walking, watching TV, reading, eating...
Activity recognition

Detecting the user's state is powerful, but often involves invasive sensors.

So, monitor the environment rather than the user: energy use, water use, activities of an aging population.
Cohn et al. Humantenna: using the body as an antenna for real-time whole-body interaction. CHI '12.
Effective control of ubiquitous computing systems without the traditional input channels

Gesture, on-body, on-wall, on-floor: on any surface available
Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms

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ABSTRACT
This paper presents our vision of Human Computer Interaction (HCI): "Tangible Bits," Tangible Bits allows users to "grasp & manipulate" direct access to data and computation. Despite the advent of personal computers, much of the richness of the physical world has disappeared. By bridging the gaps between the present and the past, we propose a solution to any one single problem. Tangible Bits allows seamless couplings between the physical and the computational worlds. The goal of Tangible Bits is to rejoin the richness of the physical world in HCI.

BITS & ATOMS
We live between two realms: our physical environment and cyberspace. The goal of Tangible Bits is to construct seamless couplings between them. The coupling of bits with the periphery of human perception using ambient display and spatially manipulating items in the virtual environment is a first generation of "Tangible Bits." Tangible Bits allows users to "look to the past" to draw on the rich affordances of these beautiful artifacts and "look to the future" to project the movement of time. Tangible Bits is intended to introduce design projects to rejoin the richness of the physical world in HCI. This paper presents our vision of Human Computer Interaction (HCI): "Tangible Bits," Tangible Bits allows users to "grasp & manipulate" direct access to data and computation.
Urp: a luminous-tangible workbench for urban planning and design.
Urp: a luminous-tangible workbench for urban planning and design.
Ryokai, Marti, Ishii. I/O Brush: Drawing with Everyday Objects as Ink. CHI '04.
we developed a new material that allows objects to change their color.
In-class reading
The Computer for the 21st Century
Mark Weiser, 1999
Link on http://cs347.stanford.edu syllabus
15 minutes to read
10 minutes
5 minutes
1 minute
What was most prescient?
What is still coming?
What might not come?