This course is a broad graduate-level introduction to HCI research. The course begins with seminal work on interactive systems, and moves through current and future research areas in interaction techniques and the design, prototyping, and evaluation of user interfaces. Topics include computer-supported cooperative work; audio, speech, and multimodal interfaces; user interface toolkits; design methods; evaluation methods; ubiquitous and context-aware computing; tangible interfaces; haptic interaction; and mobile interfaces.
Assistant professor in computer science, co-direct the HCI group

Work in the HCI area
  tangible user interfaces
  user interface software tools
MS/PhD in CS from UC Berkeley
BA in art-semiotics, computer science from Brown University & RISD

tell the Tarr story and the PhotoShop story
David Akers

Computer Graphics Laboratory
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Stanford University
Stanford University, Stanford, CA 94305
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E-mail: dakers@cs.stanford.edu

I'm a fourth-year PhD student in computer science with interests in visualization, educational software development, and human computer interaction. I'm pursuing new discipline visualization research in Pat Hanrahan's group.

I graduated from Brown University with an ScB in Computer Science and Mathematics in 1999. Following this, I worked for two years at Silicon Graphics on the OpenGL Toolkit under Unichrome API. I then worked for a year in the computer science department at the University of Washington on an NSF-funded educational technology initiative led by Professor Steve Tanimoto.

I also have a number of outside interests, including skiing, running, scuba diving, bicycle travel, mountaineering, international travel, and the wonderful art and culture of Scotland.

Publications


name, major, and favorite summer break activity
I’d like to do a couple things in our first class together today. I’d like to share with you my thoughts on what HCI is, and then talk about the goals and structure for the course. I hope this will be of benefit for you in providing a framing for both the intellectual content and the logistics for the course, and also help you decide whether this is an enterprise you’d like to be a part of this quarter. And at the end of class today, I’d like to close by sharing a brief overview of my own research, so you can get a sense of where I’m coming from.
Course Goals
This course provides a graduate-level introduction to human-computer interaction.

So the natural next question is, “what is human-computer interaction?”

Human-Computer Interaction, or HCI, is the study of the user experience of information technology. Or, to put it a bit more formally, it’s the design and evaluation of information technologies where the goal is user experience based. It is a field whose participants come from a number of different disciplines: the human sciences (cognitive science, psychology, and the social sciences), computer science, and the design disciplines (most notably graphic and industrial design).

------

Give Examples of Tasks:

high level:
- writing a paper
- drawing a picture

low level:
- copying a word from one paragraph to another
- coloring a line
The inventions of the 1960s and 1970s – the desktop PC, hypertext, the graphical user interface, the mouse, and the internet – are now commonplace. From a research perspective, we can largely declare victory on user interfaces for seated, able-bodied users, working individually on document processing tasks – at least in the developed world. Herb Simon, Alan Newell, Ivan Sutherland, Butler Lampson, Doug Engelbart, and Alan Kay, and Vint Cerf all won Turing awards for their efforts on the cognitive science, user interface developments, and systems research behind this work. Similarly, the basic idea of user-centered design is well known in the software industry today. This is a big win.
Major part of work for “real” programs
approximately 50% [Myers & Rosson ’92]
Stanford graduates work on “real” software
intended for users other than “us”
Bad UIs cost - money (5% ^ satisfaction -> 85% ^ in profits) - lives
User interfaces are hard to get right
-----

At this point, I see two primary opportunities for HCI research. The first is that, despite all our successes, the software industry still isn’t as good as it could be. For example, venture funding operates on a model of a 10% success rate - the one company in 10 that’s successful covers the losses created by the other 9 that aren’t. There are several major factors that contribute to this, and one of the biggest is that a lot of software fails on the user experience front. The research labs of the 60s and 70s provided the technology and research methods that fueled the successes of the 90s, and similarly, I think that significant value can be mined from more contemporary research.

The second is that changing any one of the qualifiers in “user interfaces for seated, able-bodied users, working individually on document processing tasks in the developed world” yields a great many research opportunities. Much current research is in the area of ubiquitous computing, of systems that, move beyond the monitor frame and integrate themselves more deeply into the everyday world.
There are a couple of skills that I hope the course will help you learn. When I started at Stanford in 2004, I created this course with four goals.
First, I wanted to use primary source material to tell the story of human-computer interaction. To learn about the big research ideas in the words of the people that came up with them. In reading about these ideas as they were developed, we get to see the original insight and passion. We’ll also be entertained. By now, some of the original terms (information superhighway, anyone?) have become quaint, and some of the ideas seem hopelessly naïve. But – and this is really surprising – a lot of it is pretty on the mark. (Okay, that’s why we’re reading this stuff – the “dumb ideas in HCI” is a different course 😎 ) Also, reading the original parts helps provide an understanding of the intuitions that people had and the methods that they employed to get there.
The second is that I wanted to provide an index into the HCI literature. What’s the space of topics that people have worked on? What are the larger theoretical frameworks?
One of my goals in providing this index is that, by the end of the course, you’ll be able to say, “I’m interested in X”, say, speech user interfaces. We’ll have a class on this on 11/16, so you can grab keywords, ideas, and authors from those papers, and start poking around google scholar. You might also be interested in infrastructure for these apps, and we’ll read about Jen Mankoff’s work on ambiguity on 12/05. With speech UIs, as with any area, it won’t be comprehensive – it’ll be a toehold that hopefully provides enough of a zeitgeist of the field that you know what’s out there and can go further if you want to.
The third goal of the course is to use these examples as a way of understanding research methods. There are many distinct types of research contributions in HCI, each employing different methods. For example, when Genevieve Bell of Intel is interested in the intersection of spirituality and technology, she employs **ethnographic** techniques to understand these issues. When Scott Hudson is interested in flexible software architectures for user interfaces, he employs an **existence proof** (building a system), along with **system tests** (apps built w/ the system, etc.) to demonstrate an architectural approach that enables a particular type of flexibility. And when Shumin Zhai is interested in high-performance pen input techniques, he employs a combination of **performance model analysis** and **laboratory user studies** to demonstrate the efficacy of a technique. Through the readings, we’ll come to see successful examples that will help us understand what methodological approaches are suggested by different types of research questions.
Part of what makes this interesting is that while these activities are going on, you’ll also be doing your own work, which helps situate the discussions about methodology, contribution, etc. in the context of actually doing a small piece of research.
The final goal of the course is to teach reading, writing, technical presentation, and critical thinking skills through your participation in these activities.
Syllabus Structure

9/26-10/05 **Big themes**
10/09 Proposals due
10/10-10/12 **Research methods**
10/17-12/07 **Topical depth**
12/12-12/14 Project presentations and papers
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Notes</th>
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<tbody>
<tr>
<td>28 Sep</td>
<td><strong>Seminal Ideas</strong> (ppt)</td>
<td>As We May Think, Vannvaar Bush, The Atlantic Monthly, July 1945</td>
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<td>Direct Manipulation Interfaces, Edwin L. Hutchins, James D. Hollan, and Donald A. Norman, Human-Computer Interaction, 1986, pp. 311-338</td>
</tr>
<tr>
<td>09 Oct</td>
<td><strong>Project Proposals due</strong></td>
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<tr>
<td>Date</td>
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<td>Topical Depth</td>
<td>Intelligent UIs</td>
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<td>Remote collaboration</td>
<td>Capture &amp; access</td>
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<td>Distributed cognition</td>
<td>Speech &amp; multimodal</td>
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<td>Tangible interaction</td>
<td>Vision-based interaction</td>
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<td>Design tools</td>
<td>Gestural / bimanual input</td>
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<td>Software</td>
<td>I/O Toolkits</td>
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<td>Integrating physical &amp; digital</td>
<td>Intelligent display techniques</td>
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<td>Software tools</td>
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<td>Information visualization</td>
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Structure
Administrivia

COURSE INFO
Tuesdays & Thursdays 1:15-2:30pm, Wallenberg 124
http://cs376.stanford.edu
cs376@cs.stanford.edu

MY INFO
Office Hours: Tuesdays 11:15am-12:15pm, Gates 384
http://hci.stanford.edu/srk
srk@cs.stanford.edu
Two exceptions:
1) On 10/17 I’ll be at UIST and Terry will teach class
2) On 11/07 I’ll be at CSCW and David will teach class.

**Lecture Format**

11:00-11:35 I’ll present the area
11:35-12:15 Student-led discussion

**HCI literature**
- Conferences papers (CHI, UIST, CSCW, …)
- Journal articles (TOCHI, HCI, …)
- ~4 papers/week
Grading

**CLASS**
25% Paper Critiques
25% Participation & leading in-class discussion

**PROJECTS**
20% Concept & Implementation
10% Study
20% Final Presentation & Report
Reading: Come prepared

- Email cs376@cs with 2 criticisms & 2 good points (w/ reasoning, evidence), and 1-5 rating by 7:00am the day of class.
- Send them inline (not as an attachment) using the format linked off the cs376 page
- I strongly suggest hiding in the library, distraction-free
  - Reading should take two hours per class
  - Summaries should take one hour per class
This goes to both Dave and I, and we have filters on our email so that it doesn’t end up disappearing. Send everything course related here.
I’m not going to be very sympathetic to “I didn’t understand the paper.”

I will try to give some intuitions ahead of time when possible.

**Expected background**

- In general, there are no pre-reqs. That said, the course does assume...
- Sufficient background to complete a mini-research project (of your own choosing)
- The recognition-based interface readings presume basic linear algebra
- The toolkit readings presume basic programming knowledge
- You can get through without that background, but those readings will likely take longer
Projects

- (Small) research-quality projects
- Meet with David and me about proposals
  - 1 page proposals due Monday, October 9th
- Mid-term demo/review
- Must include an evaluation & iteration
- Final report
  - 10-15 minute presentation in class (Dec. 12th)
  - 3-4 page paper in CHI format (Dec. 14th)
Many hands make light work

**Projects**

- Working in pairs is (strongly) encouraged
- A project related to your research (or another course project) is great
  - Let me know if you do this
- David and I are happy to offer project suggestions
Dynamic Speedometer: Dashboard Redesign to Discourage Drivers from Speeding

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ABSTRACT
We apply HCI design principles to redesign the dashboard of the automobile to address the problem of speeding. We prototyped and evaluated a new speedometer designed with the explicit intention of changing drivers’ speeding behavior. Our user-tests show that displaying the current speed limit as part of the speedometer visualization (i.e. the dynamic speedometer) results in safer driving behavior. Designing with the intent to achieve a particular behavior can be an effective approach for increasing the safety of mission-critical systems. This is an area in which HCI designers can have a significant impact.

Author Keywords

ACM Classification Keywords
351.m. Information interfaces and presentation (e.g., HCI); Miscellaneous.

INTRODUCTION
Speeding increases the risk of a crash and the severity of related crashes and drivers’ awareness of the speed limit allowing.

Speeding is a problem related to driver behavior. If we hope to save lives, reduce the number of accidents, associated costs, or even just the number of speeding tickets, we need to affect a change in the drivers’ behavior by making them more aware of the speed limit and steering them in realizing when they are speeding. One goal for this research was to redesign the automobile dashboard to discourage drivers from speeding by appealing to their self-monitoring to drive safely.

RELATED WORK
The most common example of a system that encourages drivers to slow down and follow the speed limit is the Speed Monitoring Awareness and Radar Trailer (SMART). The SMART speed trailer shows the driver the posted speed limit and the driver’s current speed. If the driver is driving faster than the posted speed limit, the sign flashes in order to attract the driver’s attention. The speed trailer causes drivers to slow down, albeit temporarily [4, 5].

There is active research in the area of Behavior-Based Safety (BBS) sponsored by the Federal Motor Carrier...
groupTime: Preference-Based Group Scheduling

Mike Brzozowski, Kendra Carattini, Scott R. Klemmer, Patrick Mihelich, Jiang Hu, and Andrew Y. Ng
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ABSTRACT
As our business, academic, and personal lives continue to move at an ever-faster pace, finding times for busy people to meet has become an art. One of the most perplexing challenges facing groupware is effective asynchronous group scheduling (GSS). This paper presents a lightweight interaction model for GSS that can extend its reach beyond users of current group calendaring solutions. By expressing availability in terms of preferences, we create a flexible framework for GSS that preserves pliable modularity while exerting social pressure to encourage honesty among users. We also propose an ontology that enables us to model user preferences with machine learning, predicting user responses to further lower cognitive load. The combination of visualization and direct manipulation with machine learning allows users to easily and efficiently optimize meeting times. We also suggest a set of guidelines for designing new calendaring interfaces.

Author Keywords
Machine learning, supervised learning, intelligent user interfaces, group calendaring

ACM Classification Keywords
H.5.3. Information interfaces and presentation (e.g., HCI)  
Group and Organization Interfaces, K.4.3. Organizational Impacts, Computer-supported collaborative work

People use calendar artifacts as memory protheses for events and tasks [23, 26]. A calendar serves as a “world-clock” [30] mapping, by describing a fixed schedule (e.g., “September 5 is Labor Day”), and as a “worldworld” mapping, by prescribing things that should occur (e.g., “Pay bills”). However, items on a calendar do not always directly translate to actual activity [36].

In the context of group calendaring (GCS), calendars serve as communication tools; a form of “distributed cognition” [29]. Finding a time that a group of people can meet together is often aided by some expression of each participant’s calendar, whether it be spoken dialog, email or instant messaging, or in some visual representation.

Current Group Calendaring Systems
Traditional group calendaring systems (GCS) such as Microsoft Outlook and Lotus Notes present an explicit representation of users’ schedules (typically whether they are free or busy) [3, 5]. For a group of users, finding a time so no one is busy is simply a matter of choosing a time that all users appear to be free.

Yet, this binary view of availability is often inadequate to describe users’ actual preferences. Palen’s research found that scheduling has come to be viewed as “less an ‘optimizing’ task and more often a ‘satisficing’ task” [27]. As a result, suboptimal meeting times are selected. Worse, people...
Wizard of Oz for Participatory Design: Inventing a Gestural Interface for 3D Selection of Neural Pathway Estimates

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Abstract
This paper describes a participatory design process employed to invent an interface for 3D selection of neural pathways estimated from fMRI imaging of human brains. Existing pathway selection interfaces are frustratingly difficult to use, since they require the 3D placement of regions-of-interest within the brain data using only a mouse and keyboard. The proposed system addresses these usability problems by providing an interface that is potentially more intuitive and powerful: converting 2D mouse gestures into 3D path selections. The contributions of this work are twofold: 1) we introduce a participatory design process in which users invent and test their own gestural selection interfaces using a Wizard of Oz prototype, and 2) this process has helped to yield the design of an interface for 3D pathway selection, a problem that is known to be difficult. Aspects of both the design process and the interface may generalize to other interface design problems.

Keywords
Participatory design, Wizard of Oz prototyping, 3D selection, gestural interfaces, brain visualization.
Castaway: A Context-Aware Task Management System

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Abstract
This paper describes the development of Castaway, a context-aware task management system. Specifically, we describe a three-week field study with thirty-five participants, the results of which illuminate the nature of people’s recorded tasks. We further describe in detail iterations made to our task management interface, including a map-based view, and the insights gained that will inform future design and development.

Introduction
The increasing ability to both track people’s movements and sense the environment combined with the growing ubiquity of mobile devices has lead to an exciting acceleration of research and development of context-aware computing. One potentially powerful context-aware application is the mobile management and receipt of personal tasks. Our vision of Castaway consists of three parts: 1) support for the fast and convenient input of tasks the instant they are conceived; 2) a lightweight, flexible tool to view and manage these tasks; and 3) a system for reminding users of their tasks at precisely the right place and/or time. Here we describe our progress in developing the second component. Although prior research has explored task management and the delivery of context-relevant information [1, 2, 3], the current work...
Bridging the Gap: Fluidly Connecting Paper Notecards with Digital Representations for Story/Task-Based Planning

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Abstract
Programmers use both paper and digital artifacts to aid in the process of software planning. This paper presents a prototype of a system that uses digital pen technology to integrate paper notecards and digital task plan representations, allowing programmers to utilize the affordances provided by both techniques. Through an ethnography of programmers who practice planning using both physical and digital artifacts, we discovered common actions performed by the programmers including card creation, card augmentation, card combining, and scheduling of card for completion. We designed interaction techniques to facilitate these actions and conducted a usability study (n=80) to evaluate the techniques. Through the study, we discovered that the initial prototype provided both positive and negative experiences for the user, providing insightful design implications for the future.

Keywords
Story/task-based planning, paper user interfaces, tangible user interfaces, Extreme Programming, digital pen input.
VACA: A Tool for Qualitative Video Analysis

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Abstract
In experimental research the job of analyzing data is an extremely slow and laborious process. In particular, video and audio data of human behavior are difficult to analyze, as this type of information does not lend itself to automation. Here we present VACA, an open source tool for qualitative video analysis. VACA integrates video annotations on a timeline interface and integrates external sensor data to improve the rate at which analysis can be performed. A comparative study is run against commonly used video analysis tools, and results are reported.

Keywords
Video analysis, annotation, behavioral research.

Introduction
Most disciplines of behavioral study require a significant degree of human observation, either in a lab or in the field. Many of these studies use video as their data medium, as video is perhaps the richest of the recording media. Because the data is very rich, it requires a large amount of time to analyze the qualitative content. Usability and human behavioral researchers analyze video data by watching videos on
The solution to finding a good project is the same as the solution to anything else: the web. I’d suggest two sites for inspiration – the first is google scholar, the second is the HCI group home page. The first can give you a sense of research projects broadly, the second can give you a sense of what’s going on here. And this is important because scaffolding off an existing project here gets you up and running faster with both the technology infrastructure and the intellectual ideas.
The HCI program offers a number of courses. For students interested in HCI research - this will be primarily graduate students and a few aspiring graduate students - this is the place to be. As you saw, it’s very reading-heavy, and the project is more about “doing a mini-research project” than “learning iterative design”. For a basic introduction to HCI, I suggest CS147, which Terry is teaching this fall. For a course primarily focused on the “hands-on, do iterative design” part of things, I suggest CS247 (which has CS147 as a pre-req) - Bill Verplank and I will be teaching CS247 this winter.
name, major, and favorite summer break activity
My research
Prototyping is the pivotal activity that structures innovation, collaboration, and creativity in design. Prototypes embody design hypotheses and enable designers to test them.

Goal is not artifact – it’s feedback and iteration: build some prototypes, evaluate them, and use the results to drive the next design.
In addition to prototypes, creative professionals leverage a diverse ecology of physical and digital artifacts for brainstorming and communication, but today, the two worlds live apart, and the infrastructures for moving between them - such as scanning and printing - are cumbersome, at odds with the freewheeling, organic nature of creative work.

My research focuses on the design, implementation, and evaluation of tools and interaction techniques that more seamlessly integrate physical and digital media.
Now, the search for improved tools has a long and storied history, beginning with Grace Hopper’s invention in the early 1950s of the first compiler. What’s inspirational for me is that she conceptualized how improved tools could provide a much wider audience with access to computation.
In the intervening years, good programming environments for the desktop and web enabled legions of developers to create the content that helped put a PC on every desk, and the goal of my group’s research is to enable an analogous success for ubiquitous computing. Specifically, our interest lies in the move from tools for **technology experts** toward tools for domain experts, designers.
For the past seven years, my colleagues and I have built several tools that integrate physical and digital interactions for brainstorming, prototyping, and design. My group’s work emphasizes a strong methodological grounding in the work practices of the target user community, and we leverage our proximity to silicon valley and our association with Stanford’s new design school, the d.school – as inspiration for and testbeds of our research. Today, I’ll briefly introduce three of these tools.
Our current work on prototyping is d.tools. D.tools embodies an iterative-design-centered approach to prototyping physical user interfaces, such as the music player shown in the lower right. d.tools supports early-stage prototyping through a visual, statechart-based approach that extends designers existing storyboarding practices. As designers move from early-stage prototypes to higher fidelity prototypes, d.tools augments visual authoring with textual programming. And under the hood, the d.tools architecture enables experts to extend the library of physical component support.
Perhaps most importantly, d.tools provides integrated support for testing prototypes with users and rapidly analyzing the results to inform subsequent iteration. d.tools simultaneously logs all user interactions with a prototype and records a time-synchronized video stream of the user’s interaction. The video is automatically structured through state transitions and input events. During the test, the designer can also annotate segments of the video for later review. While designers currently often record video, the hours and days of work required has limited their practical ability to use and share this data. D.tools synchronized video interactions reframe this process, enabling designers to view video and statechart interactions in parallel, visualize timeline events as they appear in the statechart, and perform direct manipulation queries to quickly view, for example, all of the video interactions in a particular state or with a particular control, and then they can share this custom video with their design team to rapidly convey the salient results. This model of integrated design/test/analysis tools that my group’s work has introduced enables rapid and insightful iterative design of ubicomp systems.
Sketchbooks are the main repository of design ideas, but currently, these ideas are locked away between their covers. Leveraging Anoto-augmented sketchbooks – which afford electronic capture, the ButterflyNet browser (shown here) enables sharing with integration of sketches, text, digital photographs, and other media, and provides a gestural interface for relating media elements.
Web designers use pens, paper, walls, and tables for **explaining, developing, and communicating** ideas during the early phases of design. These practices inspired The Designers’ Outpost. With Outpost, designers collaboratively author web site information architectures on an electronic whiteboard using **physical media** (Post-it notes and images), **structuring and annotating** that information with electronic pens. This interaction is enabled by a touch-sensitive electronic whiteboard augmented with a **computer vision** system. Outpost integrates **wall-scale, paper-based** design practices with novel electronic tools; its **affordances** include access and exploration of **design history**; and **remote collaboration**, where things that are **physical** in my world are **digital** in your world, and vice versa.
Increasingly, computation is weaving itself into the fabric of the world. In the 15 years since Weiser introduced ubiquitous computing as a goal, the field has made great strides in terms of system building. But with a few notable exceptions, there has been a dearth of iteration and evaluation because of the high overhead of these activities. To conclude, tools that enable rapid prototyping, and embody a design-test-analyze approach to ubicomp will enable us to achieve Weiser’s dream. Thank you.
Next Time... Seminal Ideas

As We May Think
Vannevar Bush

Direct Manipulation Interfaces
Edwin L. Hutchins, James D. Hollan, and
Donald A. Norman

User Technology: From Pointing to Pondering
Stuart K. Card and Thomas P. Moran
Reminder - the lecture you lead may shift, so be sure to check back in a week or so as enrollment settles.