CS/PSY 6750
Human-Computer Interaction

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Agenda

• Introductions
• Course Administratia
• HCI Overview
  – Objectives
  – Principles
• History of HCI
Introductions

- **Instructor**
  - John Stasko
  - Computing & GVU

- **HCI - Info. Interfaces**
  - Info. visualization
  - Peripheral awareness
  - Software agents
  - Software visualization

Introductions

- **TA**
  - James Eagan
  - HCI PhD student
  - Peripheral awareness, infovis, end-user customization
Introductions

• Your turn
  – Demographics
    • Major
    • Program
    • Major x Program

Course Information

• Books
  – *Human-Computer Interaction* (3rd ed.) by Dix, Finlay, Abowd, Beale, 2004
  – *The Design of Everyday Things* by Norman, 1990
Course Information

- Web Site
  - Syllabus
  - Grading
  - Assignments
  - Instructor
  - TA
  - HCI resources
  - Swiki

http://www.cc.gatech.edu/classes/AY2007/cs6750_spring
http://www.cc.gatech.edu/~john.stasko/6750

Course Information

- Grading
  - Mid-term (15%) & final exams (20%)
  - Group project, 4 parts (48%)
    - More to come next time...
  - Homeworks (10%)
    - One week to do, likely 3
  - Participation (7%)
    - Class involvement and peer review
Advice

• Learn from and use the past
  – Look to previous courses, courses elsewhere, info on the web, ...
    • Content, lectures, projects, ...

• Go further
  – Move beyond lectures & book
  – Further courses
  – Step into research

HCI

• What is it?
  – Can you define/describe it?
HCI

- What happens when a human and a computer get together to perform a task
  - Task - write document, calculate budget, solve equation, learn about Bosnia, drive home, ...
  - Task might be play, learning, communicating, ...
  - Not just desktop computers

Why is this important?

- 1. Computers (in one way or another) now affect every person in society
  - Increasing % utilize computers in work

- 2. Product success may depend on ease of use, not necessarily power
Interfaces in the World

• Not just computers!
  – VCR
  – Mouse
  – Phone
  – Copier
  – Car
  – Plane cockpit
  – Airline reservation
  – Air traffic control

Course Aims

• 1. Consciousness raising
  – Make you aware of these issues

• 2. Design critic
  – Question bad design
Course Aims

- 3. Learn design process
  - Software interfaces and other artifacts

- 4. Improve your HCI design & evaluation skills
  - Go forth and do good work

Goals of HCI

- Allow users to carry out tasks
  - Safely
    - Effectively
    - Efficiently
    - Enjoyably
Usability

- Important issue
- Combination of
  - Ease of learning
  - High speed of user task performance
  - Low user error rate
  - Subjective user satisfaction
  - User retention over time

Famous Quotations

“It is easy to make things hard. It is hard to make things easy.” – Al Chapanis, 1982

“Learning to use a computer system is like learning to use a parachute – if a person fails on the first try, odds are he won’t try again.” – anonymous
Key Historical Event (Personal)

- Grad school in '84
- John Sculley, Mac

Moving Forward

- How do we improve interfaces?
  - 1. Educate software professionals
    - Good UI cannot be pasted on at end
  - 2. Draw upon fast accumulating body of knowledge regarding H-C interface design
  - 3. Integrate UI design methods & techniques into standard software development methodologies now in place
Improving Interfaces

• Know the User!
  – Physical abilities
  – Cognitive abilities
  – Personality differences
  – Skill differences
  – Cultural diversity
  – Motivation
  – Special needs

Two Crucial Errors

• Assume all users are alike
• Assume all users are like you
Design Evaluation

- “Looks good to me” not good enough
- Both subjective and objective metrics
- Some things we can measure
  - Time to learn
  - Speed of performance
  - Rate of errors by user
  - Retention over time
  - Subjective satisfaction

Course Overview

- Human abilities
- Requirements gathering
- Evaluation (without users)
- Design
- Dialog & interaction styles
- Evaluation (with users)
- Special topics
  - CSCW, InfoVis, Ubicomp, Agents
The Evolution & History of HCI

- Series of technological advances
  - lead to and are sometimes facilitated by a

- Series of paradigm shifts
  - that in turn are created by a

- Series of key people and events

Why Study History?

- Understanding where you’ve come from can help a lot in figuring out where you’re going – repeat positive lessons

- “Those who don’t know history are doomed to repeat it” - avoid negative lessons

- Knowledge of an area implies an appreciation of its history
Paradigms

- Predominant theoretical frameworks or scientific world views
  - e.g., Aristotelian, Newtonian, Einsteinian (relativistic) paradigms in physics

- Understanding HCI history is largely about understanding a series of paradigm shifts
  - Not all coming on next slides are really “paradigm” shifts, but you get the idea

Howard Rheingold – *Tools for Thought*

- History of interactive breakthroughs
  - On-line at http://www.rheingold.com/texts/tft/

- One of several good sources
Example Paradigm Shifts

- Cards, tape -> VDU
- Mainframe -> PC
- Glass tty -> WIMP interface
- Commands -> Direct manipulation
- Direct manipulation -> Agents
- Visual -> Multimedia
- Linear -> Web-like
- Desktop -> Ubiquitous, Mobile
- Single user -> CSCW
- Purposeful use -> Situated use

History of HCI

- Digital computer grounded in ideas from 1700’s & 1800’s

- Technology became available in the 1940’s and 1950’s
In the Beginning – Computing in 1945

- Harvard Mark I
- 55 feet long, 8 feet high, 5 tons

Context - Computing in 1945

- Ballistics calculations
- Physical switches (before microprocessor)
- Paper tape
- Simple arithmetic & fixed calculations (before programs)
- 3 seconds to multiply
Batch Processing

- Computer had one task, performed sequentially
- No “interaction” between operator and computer after starting the run
- Punch cards, tapes for input
- Serial operations

Innovator: Vannevar Bush

- “As We May Think” - 1945 *Atlantic Monthly*

“...publication has been extended far beyond our present ability to make real use of the record.”
Bush

- Postulated **Memex** device
  - Can store all records/articles/communications
  - Large memory
  - Items retrieved by indexing, keywords, cross references
  - Can make a trail of links through material
  - etc.

- Envisioned as microfilm, not computer

“As We May Think”

- Futuristic inventions / trends
  - Wearable cameras for photographic records
  - Encyclopedia Brittanica for a nickel
  - Automatic transcripts of speech
  - Memex, Trails of discovery
  - Direct capture of nerve impulses
Context - Computing in 1960s

- Transistor (1948)
- ARPA (1958)
- Timesharing (1950s)
- Terminals and keyboards

- Computers still primarily for scientists and engineers

Innovator: J.R. Licklider

- 1960 - Postulated “man-computer symbiosis”

- Couple human brains and computing machines tightly to revolutionize information handling
Vision/Goals

**Immed**
- Time sharing
- Electronic I/O
- Interactive, real-time system
- Large scale information storage and retrieval

**Intermed**
- Combined speech recognition, character recognition, light-pen editing

**Long-term**
- Natural language understanding
- Speech recognition of arbitrary users
- Heuristic programming

Technological Advance: Interactive Graphics

- More suitable medium than paper - picture worth a thousand words
- Sutherland’s SketchPad as landmark system
- Start of *Direct Manipulation*
- Computers used for visualizing and manipulating data
Innovator: Ivan Sutherland

- **SketchPad** - '63 PhD thesis at MIT
  - Hierarchy - pictures & subpictures
  - Master picture with instances (ie, OOP)
  - Constraints
  - Icons
  - Copying
  - Light pen as input device
  - Recursive operations

Technological Advance / Paradigm Shift: Time Sharing

- Mid-1960’s
- Command line – teletypes, then “glass teletypes”
- Computers too expensive for individuals -> timesharing
  - increased accessibility
  - interactive systems, not jobs
  - text processing, editing
  - email, shared file system

Need for HCI
The Ubiquitous ASR 33 Teletype

- ASR: Automatic Send / Receive
- Save programs on punched paper tape
- The first direct human-computer interface experience for many in the 1960s
- About 10 characters per second - 110 bps

The Ubiquitous Glass Teletype

- 24 x 80 characters
- Up to 19,200 bps (Wow - was big stuff!)

Source: http://www.columbia.edu/acis/history/vt100.html
Innovator: Douglas Engelbart

- Landmark system/demo:
  - hierarchical hypertext, multimedia, mouse, high-res display, windows, shared files, electronic messaging, CSCW, teleconferencing, ...

Inventor of mouse

Augmenting Human Intellect

- 1968 Fall Joint Computer Conference (SF)
- Video of NLS (oNLine System)
- All this took place before
  - Unix and C (1970s)
  - ARPAnet (1969) & later Internet

http://sloan.stanford.edu/MouseSite/MouseSitePg1.html
Augmenting Human Intellect

- First mouse
- First hypertext
- First word processing
- First 2D editing and windows
- First document version control
- First groupware (shared screen teleconferencing)
- First context-sensitive help
- First distributed client-server
- Many, many more!

The dawn of the desktop – Xerox PARC

- Established 1970
  - Bob Taylor heads CSL - Computer Systems Lab
- 1971
  - Laser printer (Gary Starkweather)
- 1973
  - Ethernet (Bob Metcalfe)
  - Alto personal computer (Chuck Thacker)
Innovator: Alan Kay

- Dynabook - Notebook sized computer loaded with multimedia and can store everything

Desktop Interface

Overlapping windows

Paradigm: Personal Computing

- System is more powerful if it’s easier to use
- Small, powerful machines dedicated to individual
- Importance of networks and time-sharing
- Kay’s Dynabook, IBM PC
Personal Computers

- 1974 IBM 5100
- 1981 Databaster
- 1981 IBM XT/AT
  - Text and command-based
  - Sold lots
  - Performed lots of tasks the general public wanted done
- A good basic toolkit
- 1978 VisiCalc

Paradigm: WIMP / GUI

- Windows, Icons, Menus, Pointers
- Graphical User Interface
- Timesharing=multi-user; now we need multitasking
- WIMP interface allows you to do several things simultaneously
- Has become the familiar GUI interface
- Xerox Alto, Star; early Apples
PCs with GUIs

- Xerox PARC - mid 1970’s
  - Alto
    - local processor, bitmap display, mouse
    - Precursor to modern GUI, windows, menus, scrollbars
    - LAN - ethernet

Xerox Star - ‘81

- First commercial PC designed for “business professionals”
  - desktop metaphor, pointing, WYSIWYG, high degree of consistency and simplicity

- First system based on usability engineering
  - Paper prototyping and analysis
  - Usability testing and iterative refinement
Star

- Commercial flop
  - $15k cost
  - closed architecture
  - lacking key functionality (spreadsheet)

Apple Lisa - ‘82

- Based on ideas of Star

- More personal rather than office tool
  - Still $$$

- Failure
Apple Macintosh - ’84

- Aggressive pricing - $2500
- Not trailblazer, smart copier
- Good interface guidelines
- 3rd party applications
- High quality graphics and laser printer

Paradigm: Direct Manipulation

- ’82 Shneiderman describes appeal of rapidly-developing graphically-based interaction
  - object visibility
  - incremental action and rapid feedback
  - reversibility encourages exploration
  - replace language with action
  - syntactic correctness of all actions
- WYSIWYG, Apple Mac
Paradigm: Metaphor

- All use is problem-solving or learning to some extent
- Relating computing to real-world activity is effective learning mechanism
  - File management on office desktop
  - Financial analysis as spreadsheets

Paradigm/Technology: Person-to-Person Communications

- Enabled by several technologies
  - Ethernet and TCP/IP protocol
  - Personal computer
  - Telephone network and modems
- And by killer-app software
  - Email, Instant Messaging, Chat, Bulletin Boards
- CSCW - conferencing, shared white boards
  - Not quite yet a killer-app
- Micro-sociological phenomenon are central to successes (and failures)
Paradigm: CSCW

- Computer-Supported Cooperative Work
- No longer single user/single system
- Micro-social aspects are crucial
- E-mail as prominent success but other groupware still not widely used

Innovator: Ted Nelson

- Computers can help people, not just business
- Coined and popularized term “hypertext”
Paradigm: Hypertext

- Think of information not as linear flow but as interconnected nodes
- Bush’s MEMEX, Nelson’s hypertext
- Non-linear browsing structure
- WWW ‘93

The WIMP Plateau

User Productivity

Batch

Command Line

WIMP (Windows)

1940s – 1950s  1960s – 1970s  1980s - Present

Time
The World-Wide Web

- Two Key Components
  - URL = Uniform Resource Locator
  - Browser
- Tim Banners-Lee did both

- See http://www.w3.org/History.html for more web history

Paradigm: Multi-modality

- Mode is a human communication channel
  - Not just the senses
    - e.g. speech and non-speech audio are two modes
- Emphasis on simultaneous use of multiple channels for I/O
Innovator: Nicholas Negroponte

- MIT machine architecture & AI group
  ‘69–’80s
- Ideas:
  - wall-sized displays, video disks, AI in interfaces (agents), speech recognition, multimedia with hypertext

Paradigm: Language/Speech/Agents

- Actions do not always speak louder than words
- Interface as mediator or agent
- Language paradigm
- How good does it need to be?
  - “Tricks”, vocabulary, domains
- How “human” do we want it to be?
  - HAL, Bob, Paper Clip
Innovator: Mark Weiser

-Introduced notion of “calm technology”
  - It’s everywhere, but recedes quietly into background

-CTO of Xerox PARC

Paradigm: Ubiquity

- Person is no longer user of virtual device but occupant of virtual, computationally-rich environment
- Many computers to one person
- Can no longer neglect macro-social aspects
- Off the desktop to the laptop, PDAs, cell phones, ...
Computing is Everywhere, ...

- From the desk-top to the set-top to the palm-top to the flip-top to the wrist-top...

Paradigm: VR & 3D Interaction

- Create immersion by
  - Realistic appearance, interaction, behavior

- Draw on spatial memory, kinesthesia, two-handed interaction
Paradigm: Mobile Computing

- Devices used in a variety of contexts
- Employ sensors to understand how user is working with devices
- Wireless communication
- PDAs, Cell Phones, GPSs, etc etc etc

What Next?

- What are the next paradigm shifts?
- What are the next technical innovations?

- Who knows? I don’t

- But, more importantly...
Who Will...

• Drive future technical breakthroughs?
• Lead future paradigm shifts?

• It just might be YOU!

To Do

• Add yourself to co-web
• Be looking over Project part 0
• Start reading...
  – DFAB, DOET
Upcoming

- Project planning and introduction
- IRB
- Usability Principles
- User-Centered Design Process
- Human abilities