CS/PSY 6750
Human-Computer Interaction

John Stasko

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This material has been developed by Georgia Tech HCI faculty, and continues to evolve. Contributors include Gregory Abowd, Al Badre, Jim Foley, Elizabeth Mynatt, Jeff Pierce, Colin Potts, Chris Shaw, John Stasko, and Bruce Walker. Permission is granted to use with acknowledgement for non-profit purposes. Last revision: January 2007.

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
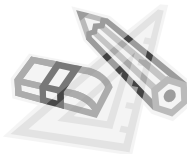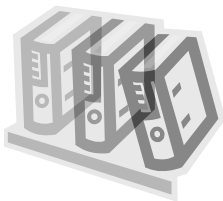
Introductions

- 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

Overly simple... but not bad

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
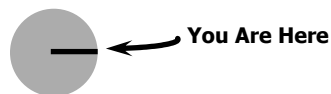
Improving Interfaces

- 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

You Are Here

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
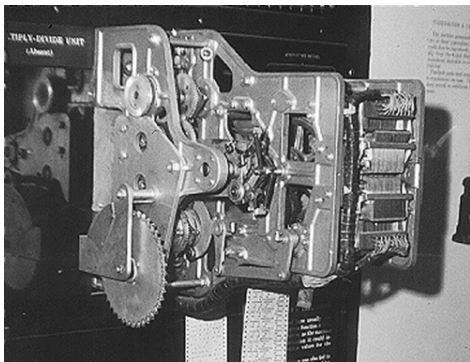

- Harvard Mark I
- 55 feet long, 8 feet high, 5 tons

Jason Hong / James Landay, UC Berkeley, Picture from http://piano.dsi.uminho.pt/museuv/indexmark.htm

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Context - Computing in 1945

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

Jason Hong / James Landay, UC Berkeley, Picture from http://www.gmcc.ab.ca/~supy/

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

Cathode

Grid

Vacuum

Anode

Vacuum Tube

- Computers still primarily scientists and engineers
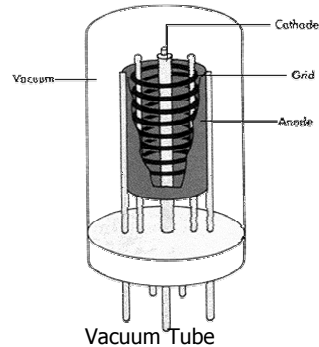
Jason Hong / James Landay, UC Berkeley

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

New paradigm

- 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
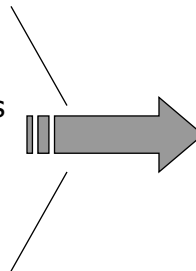
Need for HCI

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!)
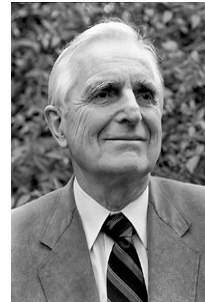
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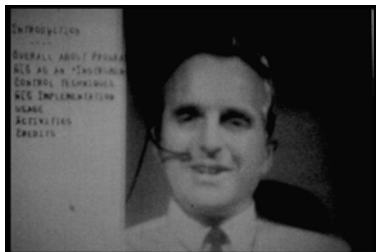
Innovator: Douglas Engelbart

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

Inventor
of mouse

Augmenting Human Intellect

http://sloan.stanford.edu/MouseSite/MouseSitePg1.html

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

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

Personal
computing

Paradigm: Personal Computing   *New paradigm*

- 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

New paradigm

- **W**indows, **I**cons, **M**enus, **P**ointers

- **G**raphical **U**ser **I**nterface

- 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
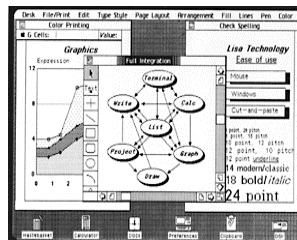 - closed architecture
  - lacking key functionality (spreadsheet)

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

New paradigm

- '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

New paradigm

- 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

New paradigm

- 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

New paradigm

- 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

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Innovator: Ted Nelson

- Computers can help people, not just business

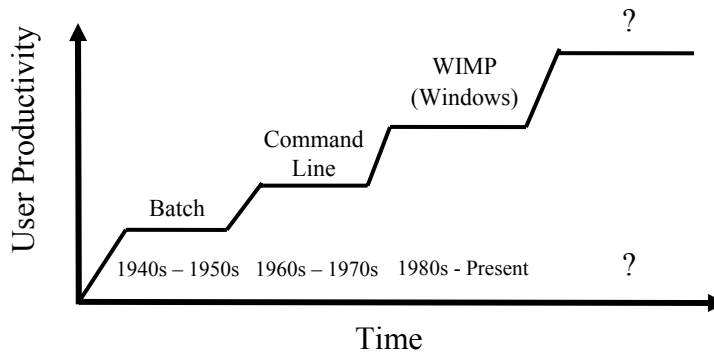- Coined and popularized term "hypertext"

Paradigm: Hypertext

New paradigm

- 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

The World-Wide Web

- Two Key Components
  - URL = Uniform Resource Locator
  - Browser

- Tim Brenners-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
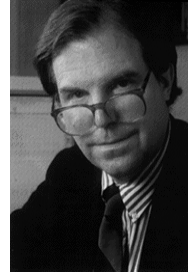
Paradigm: Language/Speech/Agents

New paradigm

- 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

New paradigm

- 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…

Dick Tracy ®&© 1999
Tribune Media
Services, Inc
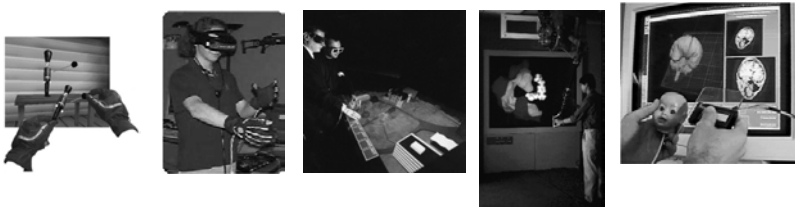
Paradigm: VR & 3D Interaction

New paradigm

- Create immersion by
  - Realistic appearance, interaction, behavior

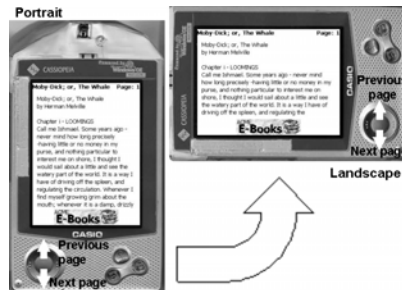- Draw on spatial memory, kinesthesis, two-handed interaction

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