CMPT 363

User Interface Design

Lisa Welburn



CMPT 363

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- http://www.cs.sfu.ca/CourseCentral/363/

Text and Additional References

- **Required**
  - Binder of selected readings purchased from SFU bookstore
- **Recommended**
  - Readings in Human Computer Interaction: Towards the Year 2000 (2nd Edition), Baecker, R., Grudin, J., Buxton, W., and Greenberg, S., Morgan Kaufmann Publishers Inc, California, 1995.
  - Usability Engineering, Nielson, Jakob, AP Professional, 1993.
  - The Non-designers Design Book, Williams, Robin, Peachpit Press/Addison Wesley, 1994.
  - Task-Centered User Interface Design: A Practical Introduction. Shareware: ftp.cs.colorado.edu/pub/cs/distribs/clewis/HCI-Design-Book Lewis, C., Rieman, J.,1994.
  - The Psychology of Everyday Things, Norman, D. A., Basic Books, 1989.

Grading

- Exams (50%)
  - Mid-term: 20%
  - Final exam: 30%
- Assignments (50%)
  - Assignment 1: 4%
  - Assignment 2: 14%
  - Assignment 3: 18%
  - Assignment 4: 14%
- Students must attain an overall passing grade on the weighted average of exams in the course in order to obtain a clear pass (C or better).
- Assignments will be due at the **beginning** of class on the assigned date.
- Unless otherwise specified, assignments will be penalized 10% for each late day.

Human Computer Interaction

A discipline concerned with the
- design
- implementation
- evaluation

of interactive computing systems for human use



Overview

- Introduction and History of HCI
- Understanding users and their tasks
- User-centered design techniques
- Prototyping techniques
- Principles for Design
- Usability Inspection
- Designing to Fit Human Capabilities
- Usability Evaluation
- Input, Output, and Interaction
- Future

Evolution of Computing

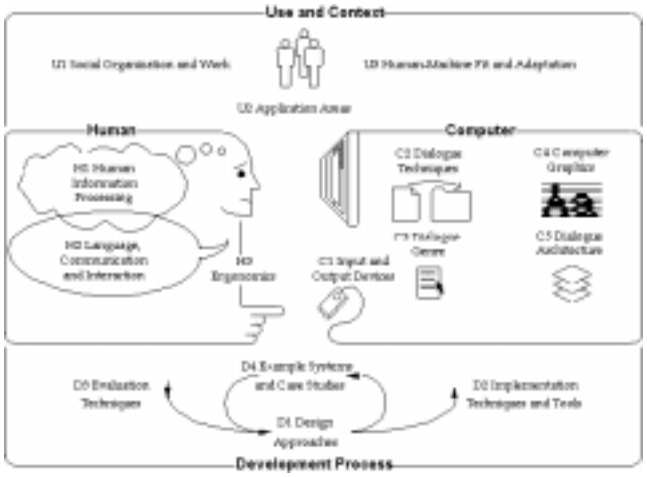
- 1950's
  - computers first appeared onto the commercial scene
  - difficult to use, cumbersome, unpredictable
- 1970's
  - first personal computers
  - provided interactive computing power for individual users at a low cost
  - wide variety of people began using computer systems
  - Man-Machine Interface (MMI)
- Mid 1980's
  - Human-Computer Interaction (HCI)

Definition of HCI

Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.

Multidisciplinary Science

- Computer science
  - provide knowledge about a technology's capability and generate ideas about how this potential can be harnessed.
- Psychology and cognitive science
  - understand human behaviour and the mental processes that underlie it.
  - understand the nature and causes of human behaviour in the social context.
- Sociology and anthropology
  - study the interactions between technology, work, and social organization.
- Industrial design
  - interactive products
- Ergonomics
  - understand the user's physical capabilities.
- Linguistics; artificial intelligence; business; graphics design; technical writing



Use and Context of Computers

Problems of fitting computers, their uses, and the context of their use together

- Social organization and work
  - understand the nature of work life
    - humans are social beings
    - models of human activity (small groups, organizations)
- Application areas
  - characteristics of application domains
    - document processing (word processors, spreadsheets)
    - communication tools (email, conferencing, news)
    - embedded systems (TV's, VCR's, microwave)
- Human-machine fit and adaptation
  - improve the fit between the designed object and its use
    - systems adapt to users (customization)
    - users adapt to the systems (training, ease of learning)
    - user guidance (help techniques, documentation, error-handling techniques)

Human Characteristics

It is important to understand humans' physical and psychological requirements along with how we process information, structure actions, and communicate.

- Human information processing
  - information processing characteristics
    - theory of memory, perception, motor skills, attention, vigilance, problem solving, learning and skill acquisition, motivation
    - human diversity
- Language, communication and interaction
  - aspects of language
    - syntax, semantics, pragmatics, conversational interaction, specialized languages
- Ergonomics
  - physiological characteristics of people and their relationship to the workplace and the environment
    - arrangement of displays and controls; cognitive and sensory limits; effects of display technologies; fatigue and health; furniture and lighting; design for stressful and hazardous environments; design for the disabled, ...

Computer system and interface architecture

Machines have specialized computer components for interacting with people

- Input and output devices
  - mechanics of particular hardware devices and performance characteristics
- Dialogue techniques
  - basic software architecture and techniques for interacting with humans
    - dialogue inputs; outputs; interaction styles; issues
- Dialogue genre
  - conceptual uses
    - interaction and content metaphors; transition management; style and aesthetics
- Computer graphics
  - computer graphic concepts useful to HCI
    - 2D and 3D geometry; modeling; colour representation
- Dialogue architecture
  - software architecture and standards
    - window managers; look and feel; standardization

Development Process

The construction and evaluation of human interfaces

- Design approaches
  - process of design
    - graphic design basics; software engineering; task analysis
- Implementation techniques and tools
  - tactics and tools for implementing interfaces
    - prototyping techniques; object-oriented methods; user interface development tools
    - MetaCard is on the CSIL PCs. Demo versions can be freely downloaded from MetaCard's website (http://www.metacard.com)
- Evaluation techniques
  - philosophy and scientific methods of evaluation
    - productivity; measure of merit (ie; time, errors, ease of learning, preference); formative and summative evaluation techniques (ie. field studies, interviewing, questionnaires, system logging)
- Example systems and case studies
  - classic designs to serve as examples of interface design genres

HCI Challenges

- How to keep abreast of changes in technology.
- How to ensure that the designs offer good HCI and harness the potential functionality of the new technology.

HCI Goals

- To produce
  - usable systems
  - safe systems
  - functional systems
- Usable and Useful

Why?

- Business view:
  - help people be more productive/effective
  - human costs outweigh hardware and software costs
- Personal view:
  - people want computers to perform as appliances
- Marketplace view:
  - wide variety of people now using computers
    - expect “easy to use” systems
    - not tolerant of poorly designed systems
    - heterogeneous group
  - if people aren’t satisfied they will chose a different product

Why?

- Human factors view:
  - humans have limitations and errors are costly
- Social view:
  - Computers contribute to critical parts of our society and cannot be ignored
    - educate our children
    - take medical history and provide expert advice
    - handle credit and financial information
    - control air traffic control and ground traffic flow
    - book travel
    - control chemical/oil/nuclear plants
    - control space missions
    - assist humans with everyday tasks (office automation)
    - control complex machines (aircraft, space shuttles, super tankers)
    - help control consumer equipment (cars, washing machines, microwave)
    - entertainment

Motivations

- Life-critical systems
  - Air traffic control, nuclear reactors, power utilities, police & fire dispatch systems
- Industrial and commercial uses
  - Banking, insurance,order entry, inventory management, reservation, billing, and point-of-sales systems
- Office, home, and entertainment applications
  - Word processing, electronic mail, computer conferencing, and video game systems
- Exploratory, creative, and cooperative systems
  - Database, artist toolkits, statistical packages, and scientific modeling systems

Why have an interface design process?

63% of large software projects go over cost

- managers gave four usability-related reasons
  - users requested changes
  - overlooked tasks
  - users did not understand their own requirements
  - insufficient user-development communication and understanding

- Usability engineering is software engineering
  - pay a little now or a lot later
  - too easy to jump into a detailed design that is:
    - founded on incorrect requirements
    - inappropriate with respect to dialogue flow
    - not easily used
    - never tested until it is too late

The Psychology of Everyday Things

- Typical frustrations:
  - The engineer who founded DEC confessed at the annual meeting that he can't figure out how to heat a cup of coffee in the company's microwave oven
  - Many people frequently turn on the wrong stove burner
- What are some artifacts that you routinely make mistakes with?
- Name some simple artifacts with functionality that you can't figure out how to use?

Fundamental principals of design

- Make things visible
- Provide appropriate clues
- Provide good mappings
- Provide appropriate feedback
- Provide a good conceptual model

Visibility

- The correct parts must be visible and they must convey the correct message.
- *natural design*
  - Natural signals are naturally interpreted without any need to be conscious of them.
  - Well designed doors may have a plate to facilitate pushing or a vertical bar to assist in pulling, and they may also have their supporting pillars displayed.
  - It is easy to put a person on hold if there is a visible “hold” button on the telephone.

Affordances

- “the perceived properties of an artifact that determine how it could possibly be used”
- affordances provide strong clues to the operations of things
  - plates are for pushing, knobs are for turning, handles are for pulling, slots are for inserting things
- When the designer takes advantage of the affordances, the user know what to do just by looking (unconscious act)
- Constraints encourage proper actions and prevent erroneous ones

Mapping

- relationship between controls and their effects on the system
- relationship between what you want to do and what appears possible
  - Leitz slide projector
- natural mappings take advantage of physical analogies and cultural standards
  - move a control up to move an object up
  - rising means more, diminishing means less
  - additive dimensions
    - louder equals more

Feedback

- Giving the user information about what action has actually been done, what result has been accomplished
  - A flashing “hold” button on a telephone signifies that a person is currently on hold.
- causality
  - Something that happens right after an action appears to be caused by that action
  - false causality is the basis for superstition

Conceptual Models

- "describes the ways in which systems are understood by different people"
- A good conceptual model allows us to predict the effects of our actions
  - People often have a good conceptual model for the operation of their automobile, but a poor conceptual model for its maintenance.

Car vs. Telephone

- Car
  - 112 controls
  - things are visible
  - good mappings
  - natural relationships between the controls and the things controlled
  - good relationship between the placement of the control and what it does
- Telephone
  - no visible structure
  - mappings are arbitrary
  - controls have multiple functions
  - no good feedback
  - capabilities aren't apparent
  - relationships among the user's intentions, the required actions, and the results are completely arbitrary

Readings for Today

- An Overview of HCI
- A Taxonomy of Human Computer Interaction, Saul Greenburg
- Article 1: The Psychopathology of Everyday Things by Donald A. Norman

Readings for Wednesday, May 12th

- Article 2: The Xerox Star: A retrospective by J. Johnson, et. al.
- Article 3: A Case Study in Interface Design: The CHI ‘89 Information Kiosk by Gitta Salomon
- Getting to know users and their tasks (chapter 2), Lewis and Rieman