User Interface Design

Part 1

User Interfaces

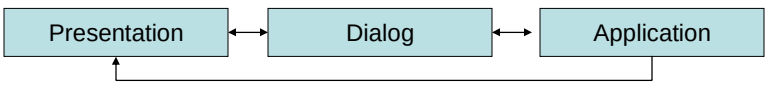
- “Today, user needs are recognized to be important in designing interactive computer systems, but as recently as 1980, they received little emphasis.” J. Grudin
- “We can’t worry about these user interface issues now. We haven’t even gotten this thing to work yet!” Mulligan

UI

- The User Interface today is often one of the most critical factors regarding the success or failure of a computer system
- Good UI design:
  - Increases efficiency
  - Improves productivity
  - Reduces errors
  - Reduces training
  - Improves acceptance
- Approach: The UI is the system
- Things to consider
  - Technical issues in creating the UI
  - User's mental model
  - Conceptual model

Where is the UI?

- Seeheim Model
  - Describes the UI as the outer layer of the system
  - Agent responsible for interaction between the user and application
  - Consists of two sub-layers
    - Presentation
      - Perceptible aspects including screen design, keyboard layout
    - Dialog
      - Syntax of interaction including meta-communication (e.g. help)
      - Might include a natural language component



Seeheim Model

- Advantages
  - Could use the same outer layer for different applications
    - E.g. same look and feel for different products
  - Single application could be implemented with different outer layers
    - E.g. for different platforms, PDA, speech, etc.
- Assumed changes are likely to occure in the interface while the application remains largely unaffected

MVC

- Model-View-Controller – discussed previously
  - Similar advantages to Seeheim model

Human Factors in HCI

- Relevant disciplines
  - Humanities
    - Psychological approaches to how people remember, think, feel
    - E.g., don't require user to remember more than 7 items at a time
  - Arts
    - Graphic arts, impact of layout, colors, spatial arrangement
    - Increasingly includes sound, music, animation, aspects of cinematography
  - Cognitive Ergonomics
    - Methods to allow humans to adapt to software artifacts
    - Try to adapt software to the task, not user to the software

Role of Models

- Models represent relevant characteristics of a part of reality that we need to understand
- But models are abstract
- Internal Models
  - Models for "execution". Used by an agent to make decisions.
  - If a human is the agent, this is a mental model
  - If a machine is the agent, this is a program or knowledge system
- External Models
  - Models for communication.
  - Represent some formalism of the domain, e.g. automata or structure charts or UML diagrams
- Some models could be both, e.g. task knowledge models
  - E.g. knowledge about the work domain

Model of Human Information Processing

- Example of an external model
- Human Input is considered to proceed through a number of phases
  - Edge detection
    - Unstructured information structured into sketch
  - Gestalt formation
    - Small number of understandable structures formed, e.g. triangle or phoneme
  - Combination
    - Gestalts combined into groups of segments that belong together, e.g. phonemes to a word
  - Recognition
    - Segments recognized semantically, e.g. a word's meaning, a picture of a tree
- Whole process takes less than a second and less automatic down the chain
  - Familiar stimulus is processed faster
  - So we may design our system or train our users for important signals

Model of Human Information Processing

- Human Output
  - Movement
  - Gestures, sounds, manipulations of tools
  - Human "CPU" decides on the meaning of the output, but leaves execution to motor processes that are running "unattended"
- Only in cases of problems is attention needed
  - E.g. location to click is awkward, can't hear own voice in a spoken command
  - Limited capacity for simultaneous processing

Working Memory

- Modern psychology presumes separation from current-term and long-term memory
  - Current memory consists of 5-9 activated elements from long term memory
    - Chunking: 85884 to one chunk instead of five
  - Long-term memory is highly structured
    - Indexed by current memory at time of activation
    - Also part-of, member-of, generalization relationships between objects

Mental Models of Information Systems

- Planning the use of the technology
  - Users will apply their mental model to find out for what part of their task the system could be used and the conditions for use
- Execution of a task with a system
  - Continuous need for fine-tuning of user actions toward system events
- System has performed some task and produced output
  - The user must evaluate the results using their mental model, translate to the goals and needs of the user
- Multiple processes
  - User must cope with unexpected system events and interpret the system's behavior in relation to the intended task
  - E.g. accept slow response to query due to network congestion

Mental Models

- Just models – abstract aspects the user considers to be relevant and usable
- General characteristics:
  - Incomplete
    - Users generally aware that they do not really know all details of the system
  - They can only partly be “run”
    - May know how to express search/replace start and end situations, but not how the effect is obtained
  - They are unstable
    - Changes over time from user experiences
  - They have vague boundaries
    - People mix models, e.g. app with OS with network
  - They are parsimonious
    - People like models that are not too complicated
  - Elements of superstition for situations they do not really understand
    - E.g. manually park the hard drive prior to shutdown
- All of these characteristics can be used to help assess a UI

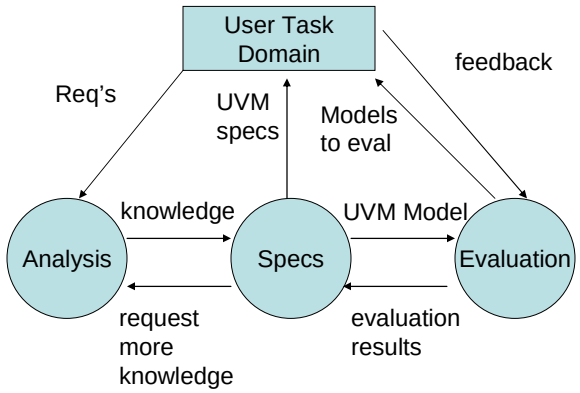
Design of Interactive Systems

- User Interface concept: UVM – User’s Virtual Machine
  - UVM includes the user and all systems that the user touches for the application
  - E.g. Networking, remote sources of data and computing
    - In considering a web browser, it is relevant to understand the network, caching, refreshing, reloading, etc. in terms of data and time
    - Newer applications include collaboration and groupware

Process Model for UI Design

- The book proposes a cyclical process devoted to analysis, specifications, and evaluation
- Analysis
  - Task analysis
    - Model task situation for a single user, Task 1
      - Use ethnography, psychological knowledge, validity analysis
      - Alternate ways to perform tasks may be considered
    - Model task domain for multiple users, Task 2
      - Specifications, negotiation, compromises, constraints, feedback
- Specification
  - Specs based on task model, includes cooperation technology and user-relevant system structures and network
- Evaluation
  - Design decisions made, guidelines and standards should be considered. Prototyping might be considered.

Process Model for UI Design



Design as Multi-Disciplinary Collaboration

- Take into account individual users, clients, structure and organization of the group for the system
  - Must know individuals' knowledge, group knowledge and dynamics
- Example: bank setting
  - Client and employee on different sides of a counter, client doesn't know what clerk is doing on the screen
  - More service-oriented if the client and clerk look at the screen together?
- Detailed design decisions
  - An early evaluation needs to include analytical methods
    - Formal evaluation
    - Cognitive walkthroughs
    - Usability testing
      - Users in different roles
      - Ethnography, Focus, Interviews