Computer Graphics and Human Computer Interaction

Lecture 3 Usability

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About this course

- Purpose

  This subject examines the design, evaluation and implementation of interactive computing systems for human use (HCI) and the major phenomena surrounding them. Also considered are joint performance of tasks by humans and machines, structure of human machine communication, social and organizational interactions with machine design, human capabilities to use machines including their learn ability, engineering concerns that arise in designing interfaces, the process of specification design, implementation and evaluation of interfaces and design tradeoffs.

- Assessment
  - Individual courseworks (40%)
  - Quiz (10%)
  - Final (50%)

About this course

- Topics
  - Introduction
  - Frameworks for Cognition and Theories
  - Usability
  - Graphics and Sound
  - Design Methods and Process
  - Usability testing
  - CSCW
  - Mobile and Ubiquitous Interaction

Interaction Design

4 Basic Activities:

- Identifying needs and establishing requirements
- Developing alternative design that meet those requirements
- Building interactive versions of the designs so that they can be communicated and assessed
- Evaluating what is being built throughout the process

User needs analysis

Uncovering:

- goals a user has
- capabilities needed from a technology to assist the user in meeting those goals.

This involves understanding the target audience, their typical tasks, and their specific constraints, usually through a combination of observational techniques, including interviews, surveys, artifact analysis, and consulting with domain experts. The results provide user interface objectives, system requirements, and feature requirements.

Usability: what is it?

- The match between what the system provides and how users want to do their work determines whether the system is experienced as disruptive or usable
- usability of a system is the capability in human functional terms to be used easily and effectively by the specified range of users, given specified training and user support, to fulfill the specified range of tasks, within the specified range of environmental scenarios

What is usability?

The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

- **Effectiveness :** The accuracy and completeness with which users achieve specified goals.
- **Efficiency :** The resources expended in relation to the accuracy and completeness with which users achieve goals.
- **Satisfaction :** The comfort and acceptability of use (attitude of users, including perceptions, feelings and opinions of the product)

Process for User Needs Analysis

- User Consulting
  - Sample people who use service
  - Ask questions on quality of service, successful resolution of problem or not, unmet needs
  - Fold input into development and modification of user consulting
- Testing of system upgrades
  - Use flagship models in test suite
  - Continue to identify additional tests to add to suite based on user problems

Process for User Needs Analysis (continued)

- User Training
  - Conduct in-depth phone interviews on a regular basis
  - Ask questions on training needs and delivery methods
  - Fold input into development and modification of user training

Process for User Needs Analysis (continued)

- User Documentation
  - Use email or web questionnaires on documentation needs and reviews of new documents
  - Follow-up with phone interviews as needed
  - Use feedback to develop and improve documentation content and structure

Process for User Needs Analysis (continued)

- Software
  - Elicit information on software needs for new computers
    - Contact people and sites experienced on the selected OS/platform as part of RFP process
    - Contact users with unique model/code requirements
    - Survey users during test phase on needs, experience, and problem areas
  - Survey users on application needs on existing systems
  - Track and respond to unsolicited requests for new software
  - Investigate complaints on existing software

Usability Inspection

a class of techniques for evaluating a user interface by examining and critiquing it, as opposed to, for instance, testing the interface on users. The critique would normally be based on experience, psychological principles, or a set of previously-defined guidelines.

Watch VDO: GPS Usability

Usability Guidelines, Goals & Principles

Usability Goals **Preece, Rogers, & Sharp**

- Effective to use (effectiveness)
- Efficient to use (efficiency)
- Safe to use (safety)
- Have good utility (utility)
- Easy to learn (learnability)
- Easy to remember how to use (memorability)

Effective to use

- *Effectiveness* refers to how well a System accomplishes its Functions
- A System that completes tasks in a Robust and Transparent manner will provide Comfort and Trust in a User
- Minimizing Eye and Hand Movements will lead to Optimized User Operations
- Designing Predictable Movements between Screen Elements will lead to Optimized User Operations
- Navigational Systems should Support User-desired Actions

Effective to use (effectiveness)

Effectiveness metrics

- *Task effectiveness: What proportion of the task is completed* correctly*?*
- *Task completion: What proportion of the tasks are completed?*
- *Error frequency: What is the frequency of errors?*

Efficient to use (efficiency)

- *Efficiency* refers to how well a System Supports User-initiated Tasks
- Task Completion Time and number of Errors made reflect the Functional Efficiency of a System
- Task Efficiency is defined as the Minimum amount of Information needed to complete a Task, divided by the amount of Information that has to be provided by the User
- If User Input is Equal to or Below the threshold of Efficiency, User Productivity is Optimized

Efficient to use (efficiency)

Productivity metrics

- Task time: How long does it take to complete a task?
- Waiting time: What proportion of the time do users spend waiting for the system to respond?
- Task efficiency: How efficient are the users?
- Economic productivity: How cost-effective is the user?
- Productive proportion: What proportion of the time is the user performing productive actions?
- Relative user productivity: How productive is a user compared to an expert?
- Help frequency: What is the frequency of use of help?

Watch VDO Usability speed test on iPhone

Safe to use (safety)

- Avoid danger while operating technology
- Avoid dangerous situations caused by interaction with technology
- Provide users quick ways to recover
- Examples
  - BlackBerry thumbs (injury due to repeated use)
  - Mizuho trade blunder
- Sometimes difficult to evaluate
- How could a criminal use the technology?
- Privacy
- Data security

Safe to use (safety)

Safety metrics

- *User health and safety: What is the incidence of health problems* among users of the product?
- *Safety of people affected by use of the system: What is the* incidence of hazard to people affected by use of the system?
- *Economic damage: What is the incidence of economic damage?*
- *Software damage: What is the incidence of software corruption?*

Have good utility (utility)

- *Utility* refers to how well the System Provides the Functionality needed by the User
- Unavailable Options should be made Visually Distinctive by Dimming or Graying the On-screen Object
- The User Interface should be Free of Ambiguities, Errors, and Side-Effects

Example:

- Does the CS Department's website offer sufficient information on how to complete a degree?
- Beware of creeping featurism
- Adding rarely used features can affect usability for most users
- Easy access to commonly used features
- Access to rarely used features for experts

Have good utility (utility)

Satisfaction metrics

- *Satisfaction scale: How satisfied is the user?*
- *Satisfaction questionnaire: How satisfied is the user with* specific software features?
- *Discretionary usage: What proportion of potential users choose to* use the system?

Easy to learn (learnability)

- Ease of *Learning* refers to the Ease of Learning a System
- Consistency is a Strong Determinant of a successful System
- Systems whose Components are arranged in a Consistent manner will be easier to Learn
- Addressing usability problems through training is not cost effective
- Enable expert users to concentrate on tasks rather than dealing with interface
- Experts willing to take time to learn if tool proves powerful once learned
  - Example: driving a car

Easy to learn (learnability)

Learnability metrics

- *Ease of function learning: How long does the user take to learn to* use a function?
- *Ease of learning to perform a task in use: How long does the* user take to learn how to perform the specified task efficiently?
- *Help Accessibility: What proportion of the help topics can the* user locate?
- *Effectiveness of the user documentation and/or help system:* What proportion of tasks can be completed correctly after using the user documentation and/or help system?
- *Effectiveness of user documentation and help systems in use:* What proportion of functions can be used correctly after reading the documentation or using help systems?

Easy to remember how to use (memorability)

- System Navigations and Functions that are easily Remembered
- A Well-designed Screen supports Information and Options that are easily Located and Identified
- A Well-designed Screen captures and Directs the User's Attention to the Material relevant to the Users current needs
- Important for repeated, infrequent tasks

Example:

- Riding a bike
- Changing your car's oil
- Submitting travel expense reports

Easy to remember how to use (memorability)

- How interface helps member to carry out tasks?
  - Way interface group menu ans submenu
  - Icon

Memorability Metrices

- Number of errors made when carrying out a given tasks over time?

Play vs Record using DVD Player

- How long it should take to learn how to use the product?
- How long does it actually take most people to learn them?
- How memorable are they?

Using a Dreamweaver to create website

- How long it should take to learn how to use the product?
- How long does it actually take most people to learn them?
- How memorable are they?

User Experience Goals

- Satisfying
- Enjoyable
- Fun
- Entertaining
- Helpful
- Motivating
- Aesthetically pleasing
- Supportive of creativity
- Rewarding
- Emotionally fulfilling

Research paper:
Designing for user experience: what to expect from mobile 3d tv and video?
http://dl.acm.org/citation.cfm?doid=1453805.1453841

Usability Goals and User Experience Goals

- How do usability goals differ from user experience goals?
  - Usability experience goals = enhance user experience
- Are there trade-offs between the two kinds of goals?
  - e.g. can a product be both fun and safe?
- How easy is it to measure usability versus user experience goals?

Ten Usability Principles *Jakob Nielsen*

These are ten general principles for user interface design.

They are called "heuristics" when used in practice because they are more in the nature of rules of thumb than specific usability guidelines.

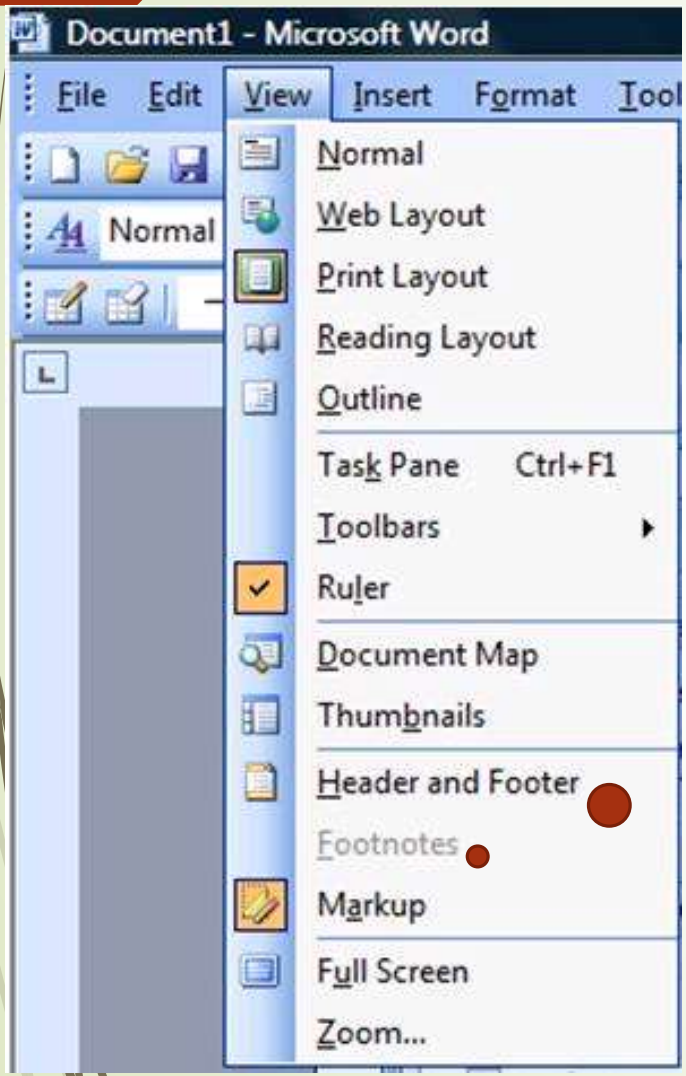
Ten Usability Principle *Jakob Nielsen*

1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognize, diagnose, and recover from errors
10. Help and documentation

Design Principles *Norman (1988)*

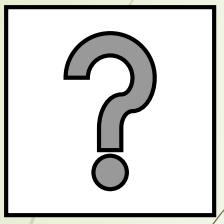
- Visibility
- Feedback
- Constraints
  - Physical
  - Logical
  - Cultural
- Mapping
- Consistency
- Affordance

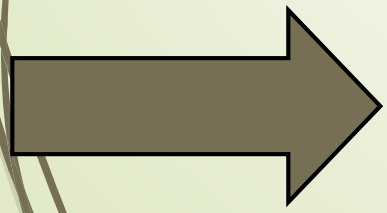
Constraints



Can’ t select when it is not available!

Which are universal and which are culturally-specific?





Physical affordances

How do the following physical objects afford? Are they obvious?

Watch VDO: Affordances

Mapping

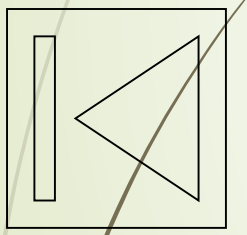
- Mapping is the Relationship between a device's Controls and their Movements and their Mirroring of the world
- 2 examples: Turning a Steering Wheel Clockwise moves an Object to the Right, Pressing a Button causes it to Engage
- Mapping is based on Physical and Cultural analogies
- Spatial Relationship of Controls should be Direct and Arranged in a manner Consistent with the expected Operation of the System

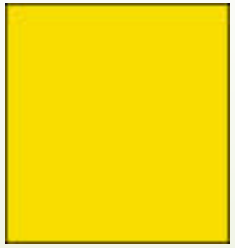
Virtual affordances

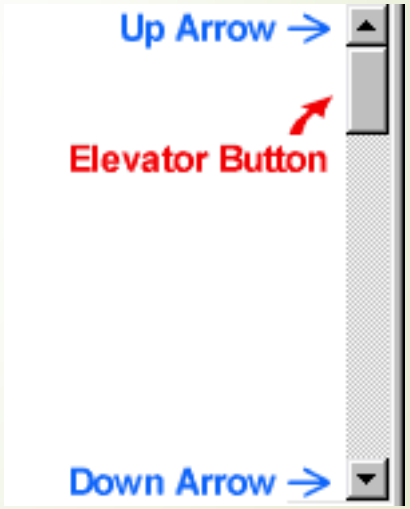
How do the following screen objects afford?

What if you were a novice user?

Would you know what to do with them?







Example of bad and good design

- Elevator controls and labels on the bottom row all look the same, so it is easy to push a label by mistake instead of a control button

- People do not make same mistake for the labels and buttons on the top row. Why not?

From: www.baddesigns.com

Shneiderman: HCI Design Principles: I

- Recognize the Diversity
  - User Diversity:
    - Expert vs. Novice
    - Native Speaker or not
  - Device Diversity
    - Hardware Difference (CPU, Memory)
    - Screen Resolution
    - Network Speed
    - Browser Type
    - Browser Version

Shneiderman: HCI Design Principles: II

- Use the ***Eight Golden Rules of Interface Design***:

Rule 1: Strive for Consistency

Rule 2: Allow Users to use Shortcuts

Rule 3: Offer Informative Feedback

Rule 4: Design Dialogs that yield Closure

Rule 5: Provide Error Prevention and Error Handling

Rule 6: Allow easy Reversal of Actions

Rule 7: Support Internal Locus of Control

Rule 8: Reduce Short-Term Memory Load

Rule 1:Consistency

- Well-designed Software maintains Consistency of:
  - Functionality
  - Layout
  - Terminology
  - Color Scheme
  - Font Choice
  - Text Case
- Consistency in Design leads to an Effective User Interface
- Consistency in Design leads to User satisfaction
- The Consistency Rule is most frequently Violated by Designers

Rule 2: Shortcuts

- Shortcuts assist in increasing Workflow
- Shortcuts and Macros should be included in an Application when Appropriate
- Shortcuts lead to Short Response Times and Fast Display Rates
- Shortcuts include:
  - Abbreviations
  - Special Keystrokes
  - Hidden Commands

Rule 3: Feedback

- Each User Action should be followed by System Feedback
- All User Actions should Initiate relevant System Feedback in the form of:
  - Visual Feedback
  - Audio Feedback
  - Visual and Audio Feedback

Rule 4: Closure

- Dialogs should always yield Closure
- Actions should be Designed with a Beginning, Middle, and an End
- System feedback should clearly designate the End of an Action
- The System should always provide clear evidence to the User that an Action has been completed

Rule 5: Error Prevention

- Software must be Designed to:
  - Prevent Errors
  - Detect Errors
  - Correct Errors
- Software should provide Specific and Accurate Instructions for Error Handling
- Design Systems that discourage User Errors by incorporating Menus as much as possible

Rule 6: Action Reversal

- Software should permit easy Reversal of Actions
- Predictable and Consistent User Interfaces will increase User productivity
- Allowing Users to Reverse undesired Actions will encourage Exploration and relieve Anxiety

Rule 7:Internal Locus of Control

- Software should support Internal Locus of Control
- Experienced Users strongly desire maximum Control of a System
- Systems should Respond to User Actions
- Systems that allow the User a high-level of Control will increase User Confidence

Rule 8:Memory Load

- Systems should be designed to Reduce Short-Term Memory Load
- Design Screens with Simple Information Structures
- Excessive use of Short-Term Memory results in:
  - Knowledge Gaps
  - False Starts
  - Erroneous Results
- To Reduce Short-Term Memory load:
  - Design simple Screen Displays
  - Consolidate Multiple Page Displays

Shneiderman: HCI Design Principles: III

- Prevent Errors
  - Informative error message.
  - Error Accomodation (search engine, similar words)
  - Error Prevention
    - Correct matching pairs
    - Complete sequence
    - Correct command

Interactive Heuristic Evaluation Toolkit

Suggested heuristics for Interactive toys, Young people and Entertainment applications.

- *Visibility of system status*
  Is status feedback provided continuously (eg progress indicators or messages)?
  Are warning messages displayed for long enough?
- *Match between system and real world*
  Are the words, phrases and concepts used familiar to the user?
  Is the use of metaphors easily understandable by the user?
- *Consistency and standards*
  Is there a consistent look and feel to the system interface?
- *Recognition rather than recall*
  Is the relationship between controls and their actions obvious?
- *Aesthetic and minimalist design*
  Is the design simple, intuitive, easy to learn and pleasing?
  Is the toy free from irrelevant, unnecessary and distracting information?
  Is the toy easy to remember how to use?
  Etc…

Resource: Please try http://www.id-book.com/firstedition/catherb/index.htm

Research papers

- Barrel menu: a new mobile phone menu for feature rich devices http://dl.acm.org/citation.cfm?id=2072233
- A Meta-Analytical Review of Empirical Mobile Usability Studies http://dl.acm.org/citation.cfm?id=2007456.2007459&coll=DL&dl=ACM&CFID=109364999&CFTOKEN=42328201

Summary

- Usability
- Usability Goals
- User Experience Goals
- Design Principles
- Usability Principles
- Shneiderman: HCI Design Principles

Sources

- http://www.id-book.com/

Individual Work II

- Design a new application or device
- Examine how it has been designed, paying attention to how the user is meant to interact with it?
  - Write down:
    1. Its main user groups
    2. Its functionality
    3. Explain what are the most important usability and user experience measurement for your web/application
       - Select 2 from each goals and principles and discuss the reason in detail
    4. Use them to assess how well? Describe the possibility of how would you measure those goals from users during evaluation process.
       - Eg. user experience goals :Is it fun to use? > Measure heart beat per min

         Usability goals: What specific mechanisms have been used to ensure safety? > Count files lost in 1 day
  - Repeat 3 for Design principles and Usability principles