Course Summary

CS160: User Interfaces
Maneesh Agrawala

Final Prototype, Report & Poster

Impressive

- Mean: 95.76
- Stdev: 1.92

Consider submitting a CHI work in Progress
- 6 page paper submission
- Due Jan 12
- If accepted you will get
  • A trip to San Jose
  • Companies recruiting HCI experts (Google, Microsoft, Apple etc.)
  • To meet HCI researchers
Current Grades

- Individual grade report handed out
- Consider your score vs. mean and stdev.
  - Mean is roughly a B+

- Four main categories so far
  - Class Participation 15%
  - Individual Assignments 15%
  - Group Project 40%
  - Midterm Exam 15%
  - Final Exam 15%

Class Participation

20 possible points – comments on wiki and in class

Mean 17.45, Stdev 4.22
Individual Assignments

30 points + 10 more for final assessment due today

Mean 27.96, Stdev 2.18

Group Project

420 points possible

Mean 382.41, Stdev 17.33
**Midterm**

125 points possible

Mean 99.54, Stdev 15.36

---

**Final Exam**

Friday Dec 15 (5-8pm) in 277 Cory

**Coverage**

- Covers all lectures, section and readings in class
  - 1/3 on material before midterm
  - 2/3 on material after midterm
- Closed book, no cheatsheets, no electronic devices
Optional Final Exam

Current weighting scheme

- Class Participation 15%
- Individual Assignments 15%
- Group Project 40%
- Midterm Exam 15%
- Final Exam 15%

An offer

- You can choose whether or not to take the final
- If you do not take it the weighting scheme will be
  - Class Participation 15%
  - Individual Assignments 15%
  - Group Project 47.5%
  - Midterm Exam 22.5%

Optional Final Exam

You must tell us by this Friday Dec 8 whether you plan to take the exam or not (email: cs160@imail.eecs.berkeley.edu)

If we do not hear from you we will assume you are taking it. If you say you will take it (or do not send us any email) and do not show up you will get a 0 on the final.
Course Review
(since Midterm)

In the beginning...

http://www.cryptonomicon.com/beginning.html
The Xerox Alto

Events

User input is modeled as “events” that must be handled by the system.

Examples?
- Mouse input
  - Mouse entered, exited, moved, clicked, dragged
  - Inferred events: double-clicks, gestures
- Keyboard (key down, key up)
- Window movement, resizing
**Event Queue**
- Queue of input events

**Event Loop** (runs in dedicated thread)
- Remove next event from queue
- Determine event type
- Find proper component(s)
- Invoke callbacks on components
- Repeat, or wait until event arrives

**Component**
- Invoked callback method
- Update application state
- Request repaint, if needed

**Why is an event dispatch loop useful for interactive apps?**

---

**Model View Controller**

- Model – Information application manipulates
- View – Visual display of the model
- Controller – Receives and handles input from user
Discount Usability Engineering

• Walkthroughs
  – Put yourself in the shoes of a user
  – Like a code walkthrough

• Action analysis
  – GOMS (add times to formal action analysis)

• Heuristic evaluation

Heuristic Evaluation

Developed by Jakob Nielsen (1994)

Can be performed on working UI or sketches

Small set (3-5) of evaluators (experts) examine UI
  – Check compliance with usability heuristics
  – Different evaluators will find different problems
  – Evaluators only communicate afterwards to aggregate findings
  – Use violations to redesign/fix problems
Revised Heuristics

H2-1: Visibility of system status
H2-2: Match system and real world
H2-3: User control and freedom
H2-4: Consistency and standards
H2-5: Error prevention
H2-6: Recognition rather than recall
H2-7: Flexibility and efficiency of use
H2-8: Aesthetic and minimalist design
H2-9: Help users recognize, diagnose and recover from errors
H2-10: Help and documentation

Heuristic: Visibility (Feedback)

H2-1: Visibility of system status
  – Keep users informed about what is going on
  – Example: pay attention to response time
    • 0.1 sec: no special indicators needed
    • 1.0 sec: user tends to lose track of data
    • 10 sec: max. duration if user to stay focused on action
  – Short delays: Hourglass
  – Long delays: Use percent-done progress bars
    • Overestimate usually better

Time Left: 00:00:19 searching database for matches

Progress: 46%
Severity Ratings Example

0 - don't think that this is a usability problem
1 - cosmetic problem
2 - minor usability problem
3 - major usability problem; important to fix
4 - usability catastrophe; imperative to fix

1. [H2-4 Consistency] [Severity 3][Fix 0]

The interface used the string "Save" on the first screen for saving the user's file, but used the string "Write file" on the second screen. Users may be confused by this different terminology for the same function.

Severity Rating

Used to allocate resources to fix problems

Estimates of need for more usability efforts

Combination of

– Frequency
– Impact
– Persistence (one time or repeating across design iterations)

Should be calculated after all evaluations are in

Should be done independently by all judges
Number of Evaluators

Single evaluator achieves poor results
- Only finds 35% of usability problems
- 5 evaluators find ~ 75% of usability problems
- Why not more evaluators???? 10? 20?
  - Adding evaluators costs more
  - Many evaluators won’t find many more problems

---

Treat Subjects with Respect

Testing is a distressing experience
- Pressure to perform
- Feeling of inadequacy
- Looking like a fool in front of your peers, your boss,…

(from “Paper Prototyping” by Snyder)
Quantitative Studies

Repeatable, reliable evaluation of interface elements

To control properly, usually limited to low-level issues
– Menu selection method A faster than method B

Pros/Cons
– Objective measurements \(\rightarrow\) scientific method
  • Good internal validity \(\rightarrow\) repeatability
– But, real-world implications may be difficult to foresee
  • External validity?
– Significant results doesn’t imply real-world importance
  • 3.05s versus 3.00s for menu selection

Variables

Independent variables
– Menu type (4 choices)
– Device type (2 choices) ?

Dependent variables
– Time
– Error rate
– User satisfaction

Control variables
– Location/environment …
– Device type ?

Random variables
– Attributes of subjects
  • Age, sex, …
Goals

Internal validity
- Manipulation of IV is cause of change in DV
  - Requires eliminating confounding variables (turn them into IVs, CVs or RVs)
  - Requires that experiment is replicable

External validity
- Results are generalizable to other experimental settings
  - Ecological validity – results generalizable to real-world settings

Confidence in results
- Statistics

Between Subjects Design

Wilma and Betty use one interface
Dino and Fred use the other
Within Subjects Design

Everyone uses both interfaces

Results: Statistical Analysis

Compute central tendencies (descriptive summary statistics) for each DV across each IV
- Mean
- Standard deviation

![Graph showing total completion time (s) and error rate (%) for different interfaces, including tool palette, Toolglass, FlowMenu, and control menu, with a density function chart.]
Are the Results Meaningful?

Hypothesis testing
- **Hypothesis**: Manipulation of IV effects DV in some way
- **Null hypothesis**: Manipulation of IV has no effect on DV
- Null hypothesis assumed true unless statistics allow us to reject it

Statistical significance (p value)
- Likelihood results due to chance variation (i.e. null hyp. is true)
- $p < 0.05$ usually considered significant (Sometimes $p < 0.01$)
  - Means that < 5% chance that null hypothesis is true

Statistical tests
- T-test (1 factor, 2 levels)
- Correlation
- ANOVA (1 factor, > 2 levels, multiple factors)
- MANOVA ( > 1 dependent variable)

Interactions

Multiple IVs effect DV non-additively
Effects of IVs are not independent of one another

![Graphs showing Problem Solving Time vs Group Size with and without a leader, illustrating interacting and not-interacting cases.](image)
Three Principles of Design

- Form follows function
- Economy of form
- Integrity of materials

Color

- Use a small palette (6 color Java look and feel)
- Don’t use all fully saturated colors
- Ensure good color contrast for text
Gestalt Principles

- figure/ground
- proximity
- similarity
- symmetry
- connectedness
- continuity
- closure
- common fate
- transparency

Why Create Visualizations?

Record information
- Photographs, blueprints, …

Support reasoning about information (analyze)
- Process and calculate
- Reason about data
- Feedback and interaction

Convey information to others (present)
- Share and persuade
- Collaborate and revise
- Emphasize important aspects of data
Data and Image

N - Nominal (labels)
  – Fruits: Apples, oranges, …

O - Ordered
  – Quality of meat: Grade A, AA, AAA

Q - Quantitative
  – Ordered, with measurable distances, or amounts
  – Physical measurement: Length, Mass, Temp, …

Visual Variables
  – Position
  – Size
  – Value
  – Texture
  – Color
  – Orientation
  – Shape

Magnitude Estimation

Most accurate
  – Position (common) scale
  – Position (non-aligned) scale
  – Length
  – Slope
  – Angle
  – Area
  – Volume

Least accurate
  – Color hue-saturation-density
ENIAC (1943)
World’s first numerical integrator and computer

Vannevar Bush
• Name rhymes with "Beaver"
• Faculty member MIT
• Coordinated WWII effort with 6000 US scientists
• Social contract for science
  – Federal government funds universities
  – Universities do basic research
  – Research helps economy & national defense

1890 - 1974
As We May Think: Memex

- Store all personal books, records, communications
- Items retrieved through indexing, keywords, cross references,...
- Can annotate text with margin notes, comments...
- Can construct a trail through the material and save it
- Acts as an external memory

Sketchpad (1963)

- Ivan E Sutherland’s PhD thesis
- Modern pen-based system supporting
  - CAD design
  - 3D modeling
- Key: Interactivity (real-time computing was non-existent)
NLS: oNLine System (1968)

- 1968 Fall Joint Computer Conference (SF)
- Demonstrated NLS to 1000 computer scientists
  - Video screen, chording keyboard, mouse, videoconferencing, hyperlinking, word processing, email,
  - User testing
  - Extremely influential

Xerox Star (1982)

Bitmapped display, windows, icons, menus, pointer, desktop, direct manipulation, WYSIWYG …
Ubiquitous Computing (1991)

Marc Weiser’s vision
- 100s of computers work together
- Will disappear (invisible)

Current Research in HCI

Scott Klemmer: dTools and mashups

Ryan Aipperspach: Activity Monitoring in the Home

Jingtao Wang: Mobile Interfaces
Takeaways: Why UI is Important

Major part of work for “real” programs
- Approximately 50%

You will work on “real” software
- Intended for people other than yourself

Bad user interfaces cost
- Money (5%↑ satisfaction → up to 85%↑ profits)
- Lives

User interfaces hard to get right
- People are unpredictable

Takeaways: Iterative Design

Design
- Brainstorming
- Task analysis
- Contextual inquiry

Prototype
- Low-fi, paper

Evaluate
- Low-fi testing,
- Qualitative eval
- Quantitative eval