CS160: User Interface Design

Midterm Review 3/15/2010

Berkeley
UNIVERSITY OF CALIFORNIA

Upcoming Schedule

Low-Fi Prototype Assignment & Heuristic Evaluation due Today

In-class midterm on Wednesday March 17

Interactive Prototype Assignment due April 5

First working implementation

Can include Wizard of Oz parts where justified

Interactive Prototype Presentations

April 5th, 7th

Groups randomly assigned to days

General Information

Closed book, no cheat sheets, no electronic devices

Format

Short answer and longer answer questions

Will involve some recall (We know this is bad interface design)

Test-taking strategy

Questions will not be ordered in difficulty

Go through entire test, read questions, answer simple ones first

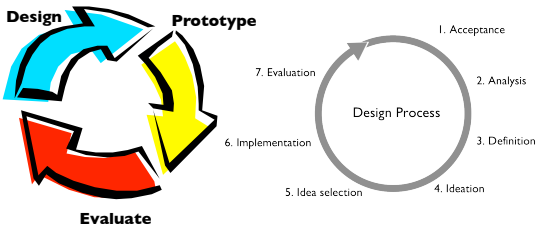
Read questions thoroughly

Covers all material in lectures, sections and readings

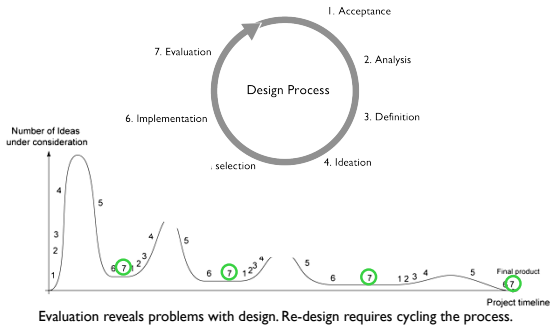
Lectures mostly go over material in readings

Use lectures as guide to most important aspects of readings

The Design Cycle



Design Cycle Over Project Lifespan

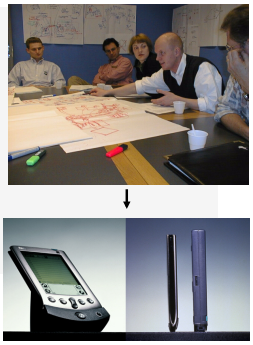


Evaluation reveals problems with design. Re-design requires cycling the process.

IDEO's Brainstorming Rules

1. Sharpen the Focus
2. Playful Rules
3. Number your Ideas
4. Build and Jump
5. The Space Remembers
6. Stretch Your Mental Muscles
7. Get Physical

Aim for quantity
Hope for quality



Observing Users

Don't just trust your intuition to make design decisions.

Observation Techniques:
Task Analysis, Contextual Inquiry

Goal: Understand user's activities in context to inform (re-)design of information technology.

Task Analysis Questions

1. Who is going to use system?
2. What tasks do they now perform?
3. What tasks are desired?
4. How are the tasks learned?
5. Where are the tasks performed?
6. What's the relationship between user & data?
7. What other tools does the user have?
8. How do users communicate with each other?
9. How often are the tasks performed?
10. What are the time constraints on the tasks?
11. What happens when things go wrong?

What is the purpose of task analysis?

Master-Apprentice Model

Allows user to teach us what they do
Master (user) works & talks
We interrupt to ask questions as they go
Each step reminds master of the next
Better than asking user to summarize work habits

What are other models?
How do other models compare?
What is a persona?

Principles of Contextual Inquiry

1. Context
2. Partnership
3. Interpretation
4. Focus

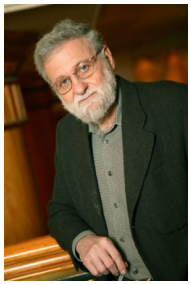
Affordances

What is an affordance?

"… the term **affordance** refers to the *perceived* and *actual* properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used.

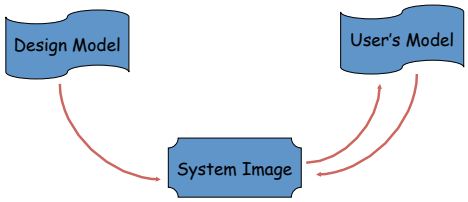
Some affordances obvious
Knobs afford turning
Buttons afford pushing
Glass can be seen through

Some affordances learned
Glass breaks easily
Floppy disk
Rectangular – can't insert sideways
Tabs prevent backwards insertion



The Design of Everyday Things. 1988. Don Norman

Conceptual Models



What is the user's conceptual model?
How does the user form the conceptual model?

What if the designers model doesn't match the user's model?

Norman's Design Principles

Make controls visible
Make sure mapping is clear
Provide feedback

Action Cycle

Metaphor

Definition

The transference of the relation between one set of objects to another set for the purpose of brief explanation

Examples?
When are they effective?
When are they not effective?

Direct Manipulation

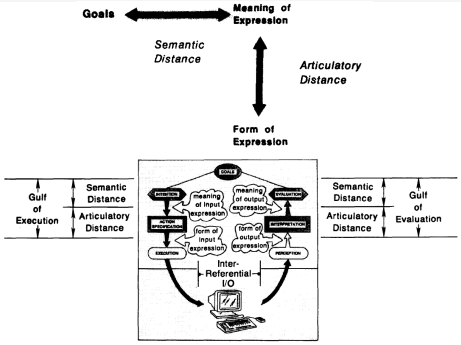
Direct Manipulation

An interface that behaves as though the interaction was with a real-world object rather than with an abstract system

Central ideas

Visibility of the objects of interest
Rapid, reversible, incremental actions
Manipulation by pointing and moving
Immediate and continuous feedback

Semantic & Articulatory Distance



Cognition

Cognetics

Ergonomics of the mind
What does that mean?

Jef Raskin

Cognitive Conscious/Unconscious

What are they?

Locus of Attention

What is it?
Why locus rather than focus?

Modes

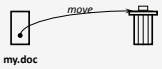
Definition

The same user actions have different effects in different situations

Noun-Verb *VS* Verb-Noun

Noun-Verb: Select object, *then* perform action
Verb-Noun: Select action, then perform it on object

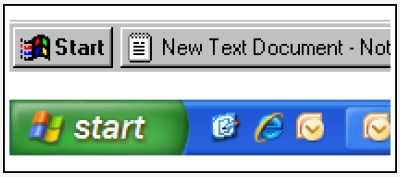
What are some examples of these two approaches?
What are the pros and cons of these two approaches?



Input Devices

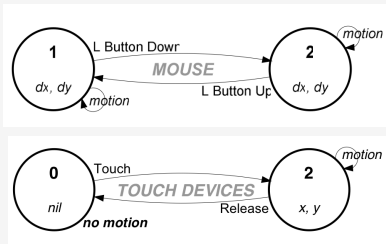
Why is the mouse a near-optimal pointing device?

How can Fitts' law guide UI design?

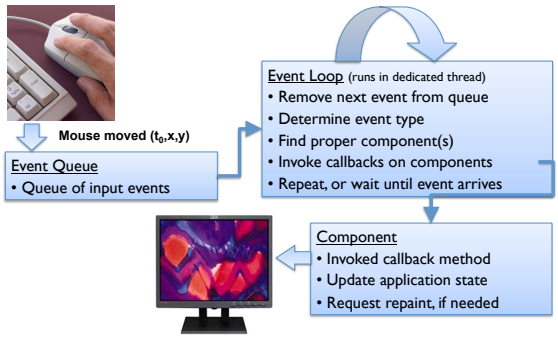


3-State Model of Input

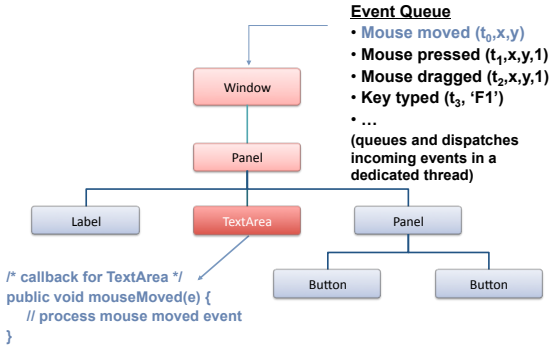
Input Devices are not equivalent –
why does this matter for UI design?



Event Dispatch Loop



Event Dispatch



Event Queue
- Mouse moved (t_0,x,y)
- **Mouse pressed (t_1,x,y,1)**
- **Mouse dragged (t_2,x,y,1)**
- **Key typed (t_3, 'F1')**
- **…**

(queues and dispatches incoming events in a dedicated thread)

Model-View-Controller

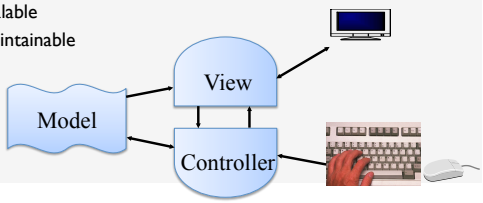
Architecture for interactive apps

introduced by Smalltalk developers at PARC

Partitions application in a way that is

scalable

maintainable

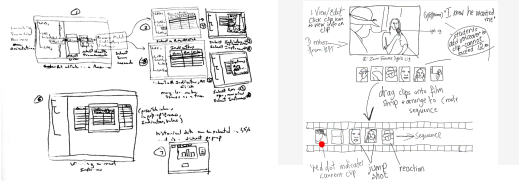


Storyboarding

Series of key frames depicting key steps in reaching a goal

Describe the interaction in context

Often useful to show user in at least 1st frame (establishing shot)



Fidelity in Prototyping

Fidelity refers to the level of detail

High fidelity

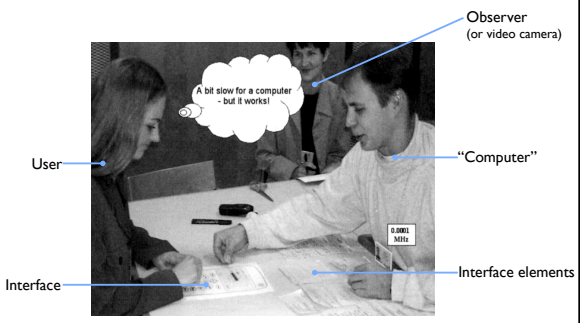
Prototypes look like the final product

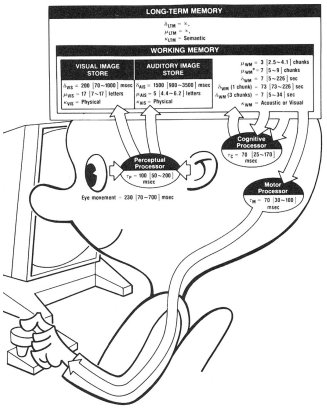
Low fidelity

Artists renditions with many details missing

Why do we prototype?

What are the disadvantages of Low- and High-fidelity prototypes?





Human Info. Processor

Perceptual
Cognitive
Motor (will discuss later)
Working memory
Long-term memory

Unified model

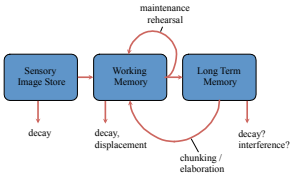
Probably inaccurate
Predicts perf. well
Very influential

Review: Memory

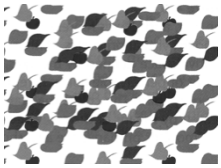
Working memory is small
Temporary storage
decay
displacement

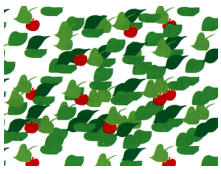
Long term memory
Rehearsal
Relate new to learned material
Link to existing knowledge
Attach meaning
Make a story

Design interface to facilitate retrieval
Recognition rather than recall

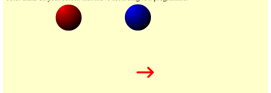


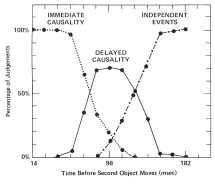
Review: Pop-Out and Causality





Michotte demonstration 1. What do you see? Most observers report that "the red ball **hit** the blue ball." The blue ball moved "**because** the red ball hit it." Thus, the red ball is perceived to "**cause**" the blue ball to move, even though the balls are nothing more than color disks on your screen that move according to a programme.





Recognition over Recall

Recall

Information reproduced from memory

Recognition

Presentation of info helps retrieve info (helps remember it was seen before)

Easier because of cues to retrieval

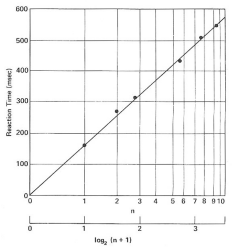
Decision Making

Hick's Law – cost of making a decision:

$$T = a + b\log_2(n+1)$$

Time depends on number of options

Choosing a movie at Blockbuster



Power Law of Practice

Task time on the nth trial follows a power law

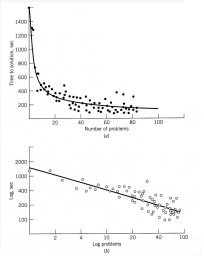
$$T_n = T_1 n^{-a} + c$$

where a = .4, c = limiting constant

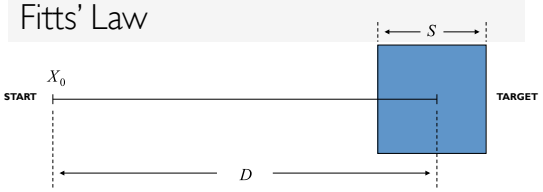
Applies to skilled behavior

Sensory

Motor



Fitts' Law



Hand movement based on series of microcorrections

X_i = remaining distance after ith move

relative movement accuracy remains constant ➔ $\frac{X_i}{X_{i-1}} = \varepsilon$

Then

$$T = I_m \log_2\left(\frac{2D}{S}\right)$$

Fitts' Law

$$T = a + b\log_2(D/S + 1)$$

a, b = constants (empirically derived)
D = distance
S = size

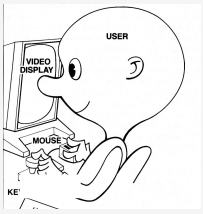
ID is Index of Difficulty = $\log_2(D/S+1)$

Models well-rehearsed selection task
T increases as the ***distance*** to the target increases
T decreases as the ***size*** of the target increases

KLM

Describe the task using the following operators:

K: pressing a key or a pressing (or releasing) a button
tK = 0.08 - 1.2s (0.2 good rule of thumb)
P: pointing
tP = 1.1s (without button press)
H: Homing (switching device)
tH = 0.4s
D(n,l): Drawing segmented lines
tD = 0.9*n + .16*l
M: Mentally prepare
tM = 1.35s
R(t): system response time
tR = t



GOMS Advantages/Disadvantages

Advantages

Gives qualitative & quantitative measures
Model explains the results
Less work than user study – no users!
Easy to modify when UI is revised

Disadvantages

Not as easy as other evaluation methods
Heuristic evaluation, guidelines, etc.
Takes lots of time, skill, & effort
Only works for goal-directed tasks
Assumes tasks expert performance without error
Does not address several UI issues,
readability, memorizability of icons, commands

Usability Heuristics

"Rules of thumb" describing features of usable systems
Can be used as design principles
Can be used to evaluate a design

Example: *Minimize users' memory load*

Pros and cons
Easy and inexpensive
Performed by experts
No users required
Catch many design flaws
More difficult than it seems
Not a simple checklist
Cannot assess how well the interface will address user goals

Phases of Heuristic Eval. (1-2)

1) Pre-evaluation training
Provide the evaluator with domain knowledge if needed

2) Evaluation
Individuals evaluate interface then aggregate results
Compare interface elements with heuristics
Work in 2 passes
First pass: get a feel for flow and scope
Second pass: focus on specific elements
Each evaluator produces list of problems
Explain why with reference to heuristic or other information
Be specific and list each problem separately

Phases of Heuristic Eval. (3-4)

3) Severity rating
Establishes a ranking between problems
Cosmetic, minor, major and catastrophic
First rate individually, then as a group

4) Debriefing
Discuss outcome with design team
Suggest potential solutions
Assess how hard things are to fix

Steps in Designing an Experiment

1. State a lucid, testable hypothesis
2. Identify variables
   (independent, dependent, control, random)
3. Design the experimental protocol
4. Choose user population
5. Apply for human subjects protocol review
6. Run pilot studies
7. Run the experiment
8. Perform statistical analysis
9. Draw conclusions

Experiment Design

Testable hypothesis

Precise statement of expected outcome

Independent variables (factors)

Attributes we manipulate/vary in each condition
Levels – values for independent variables

Dependent variables (response variables)

Outcome of experiment (measurements)
Usually measure user performance

Experiment Design

Control variables

Attributes that will be fixed throughout experiment
Confound – attribute that varied and was not accounted for
Problem: Confound rather than IV could have caused change in DVs
Confounds make it difficult/impossible to draw conclusions

Random variables

Attributes that are randomly sampled
Increases generalizability

Common Metrics in HCI

Performance metrics:

- Task success (binary or multi-level)
- Task completion time
- Errors (slips, mistakes) per task
- Efficiency (cognitive & physical effort)
- Learnability

Satisfaction metrics:

- Self-report on ease of use, frustration, etc.

Between vs. Within Subjects

Between subjects

Each participant uses one condition
+/- Participants cannot compare conditions
+ Can collect more data for a given condition
- Need more participants

Within subjects

All participants try all conditions
+ Compare one person across conditions to isolate effects of individual diffs
+ Requires fewer participants
- Fatigue effects
- Bias due to ordering/learning effects

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 that results are due to chance variation
$p < 0.05$ 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)

Explaining Psychological Statistics
Barry H. Cohen

Next Time

Midterm Exam