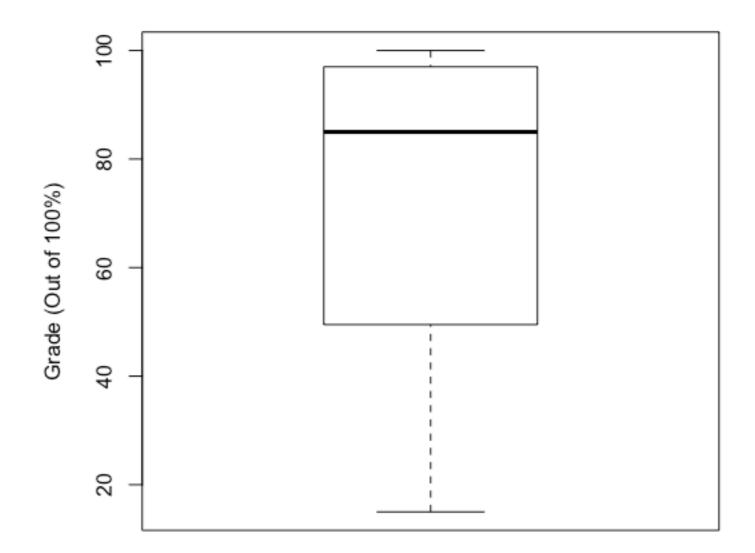
Interaction Techniques

SWE 432, Fall 2018 Web Application Development



HW4 Graded

HW4 Grades, as of Wed Nov 28 09:45:30 2018



Review: Why conduct usability studies

- Evaluate interaction design with **real** empirical data, gathering ground truth of user performance
- Identify usability issues



Review: Data collection

- Think aloud
- Screencast
- Questionnaires or interview questions to gather participant feedback

Review: Piloting study design

- Dress rehearsal for conducting actual study
- Goals
 - Ensure software / prototype won't "blow up"
 - Test tasks ensure right length & difficulty
 - Test that materials are comprehensive and comprehensible
 - Test data collection protocol and methods
- As-needed piloting
 - Use first study session as pilot only if issues arise and must be addressed

Today

- What principles guide the design of usable interaction techniques?
 - How can interaction designs help support making plans, taking action, and interpreting feedback?
 - How does a direct manipulation interface make complex tasks easier?

Interaction technique

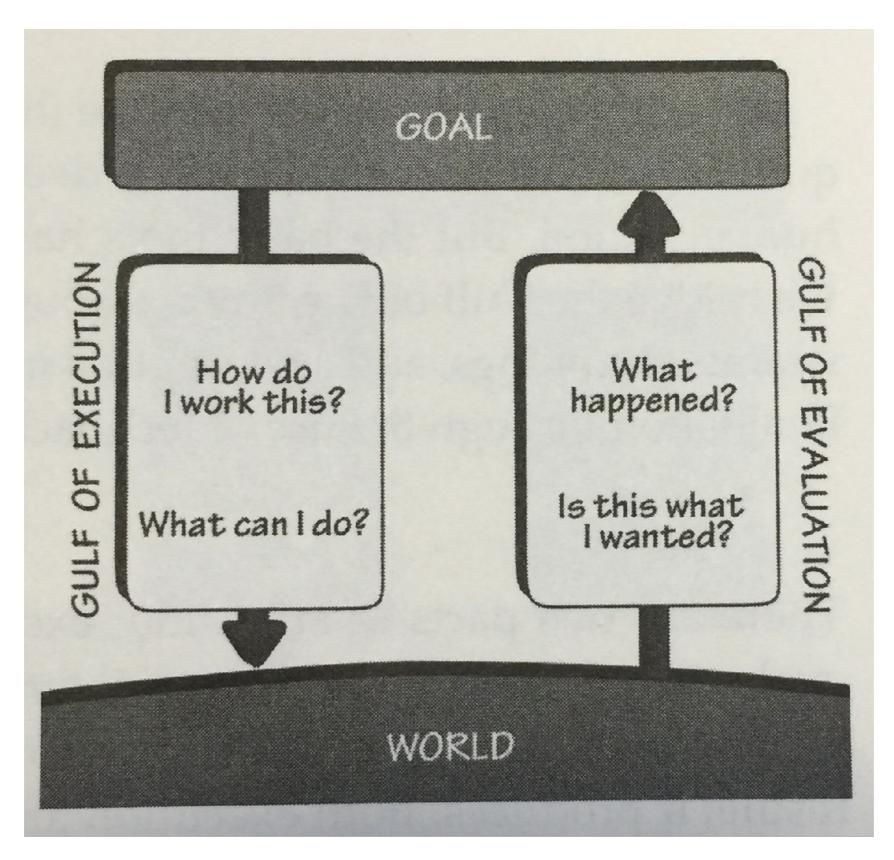
- A method by which a user can perform an action or sequence of actions with a computer.
- Might encompass software (e.g., accelerators on a menu) and/or specialized hardware (momentum scrolling on iOS)
- What makes a good interaction technique?
 - Usability: task performance, discoverability, learnability, ...

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Example: Filtering

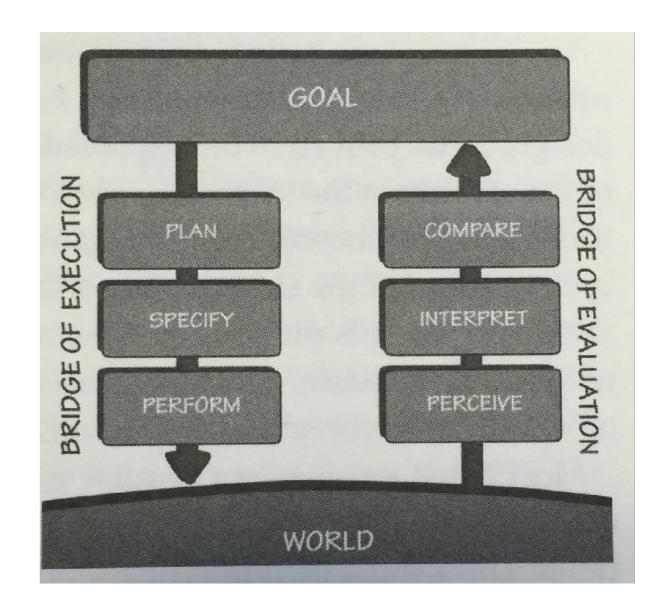
• http://www.kayak.com

Gulfs of execution and evaluation



Norman's 7 stages of action

- 1. Goal (form the goal)
- 2. Plan (the action)
- 3. Specify (action sequence)
- 4. Perform (action sequence)
- 5. Perceive (the state of the world)
- 6. Interpret (the perception)
- 7. Compare (outcome w/ goal)



Signifiers

- a.k.a "cognitive affordances" [Hartson & Pyla]
- Goals
 - Show which UI elements can be manipulated
 - Show how they can be manipulated
 - Help users get started
 - Guide data entry
 - Suggest default choices
 - Support error recovery

Hinting

- Indicate which UI elements can be interacted with
- Possible visual indicators
 - Static hinting distinctive look & feel
 - Dynamic hinting rollover highlights
 - Response hinting change visual design with click
 - Cursor hinting change cursor display

Help users predict outcome of actions

- What does this do?
- Should I click it?



Bell

Clarity of wording (Example)

Design for clarity & precision

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Clarity of wording

- Choose words carefully
- Speak the user's language
- Avoid vague, ambiguous terms
- Be as specific as possible
- Clearly represent domain concepts

Consistency

- In use of terms
 - e.g., do not use "revise" and "edit" interchangeably
- In how commands
 map to UI
 interactions

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Likely & useful defaults

- Default text, if relevant (e.g., date)
- Default cursor position
- Avoid requirements to retype & re-enter data

Avoid using modes

- Modes create inconsistent mapping
 - E.g., control S sometimes saves, sometimes sends email
 - Especially dangerous for frequent interactions that become highly automatic System 1 actions
- Avoid when possible
- Clearly distinguish if necessary

Physical actions

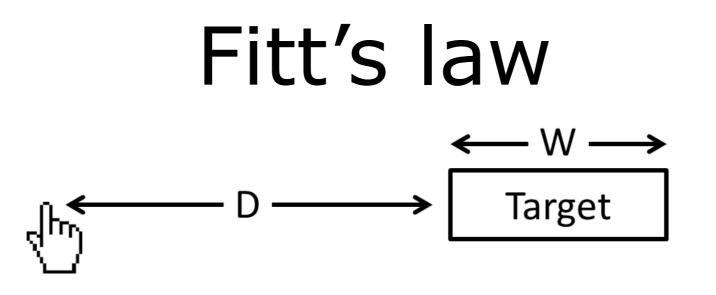
Provide intermediate feedback during interactions

- As user is interacting with objects, provide feedback on interactions
- Examples
 - While dragging object, show new position
 - As selecting text, show selection
 - While clicking on button, show button changing

Avoid physical awkwardness

- Switching between input devices takes time
- Avoid forcing user to constantly switch between input devices (e.g., keyboard & mouse)
 - e.g., Effective tab order between fields
- Avoid awkward keyboard combinations

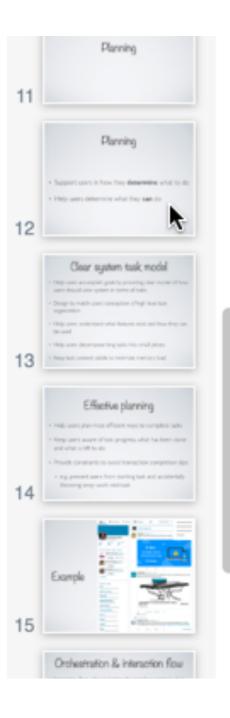
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- Time required to move to a target **decreases** with target **size** & **increases** with **distance** to the target
- Movements typical consist of
 - one large quick movement to target (ballistic movement)
 - fine-adjustment movement (homing movements)
- Homing movements generally responsible for most of movement time & errors
- Applies to rapid pointing movements, not slow continuous movements

Design implications of Fitt's law

- Constraining movement to one dimension dramatically increases speed of actions
 - e.g., scroll bars are 1D



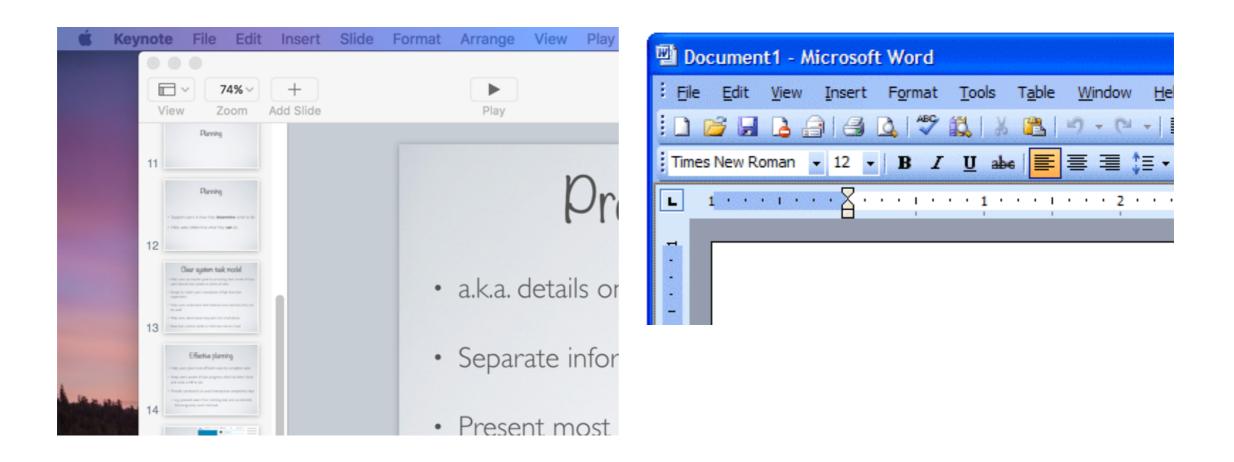
Design implications of Fitt's law

- Making controls
 Iarger reduces time to invoke actions
- Locating controls closer to user
 cursor reduces time
 - e.g., context menus

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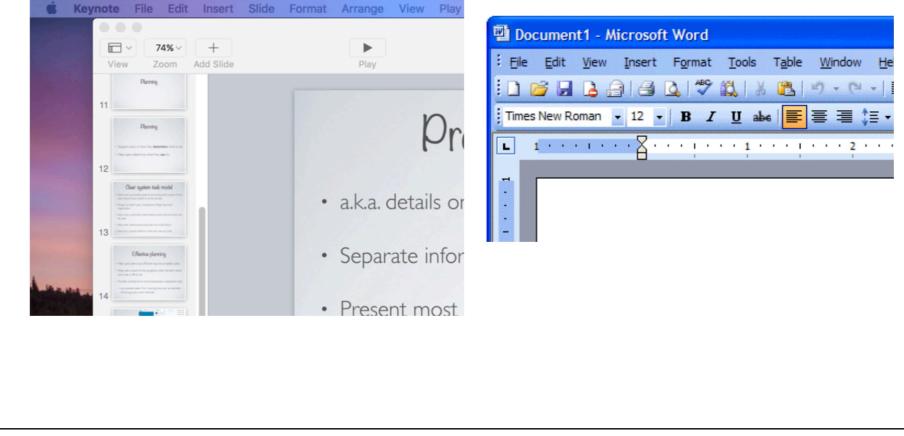
Design implications of Fitt's law

 Positioning button or control along edge of screen acts as barrier to movement, substantially reducing homing time & errors



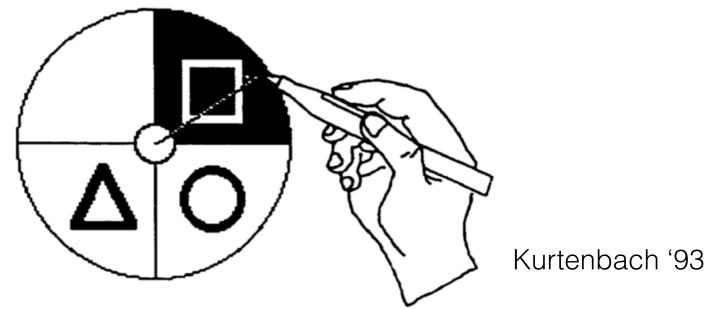
Design implications of Fitt's Law

- Problem: How to benefit from both having menu near the mouse at all times AND have the barriers?
 - Positioning button or control along edge of screen acts as barrier to movement, substantially reducing homing time & errors



Alternatives: Pie menu

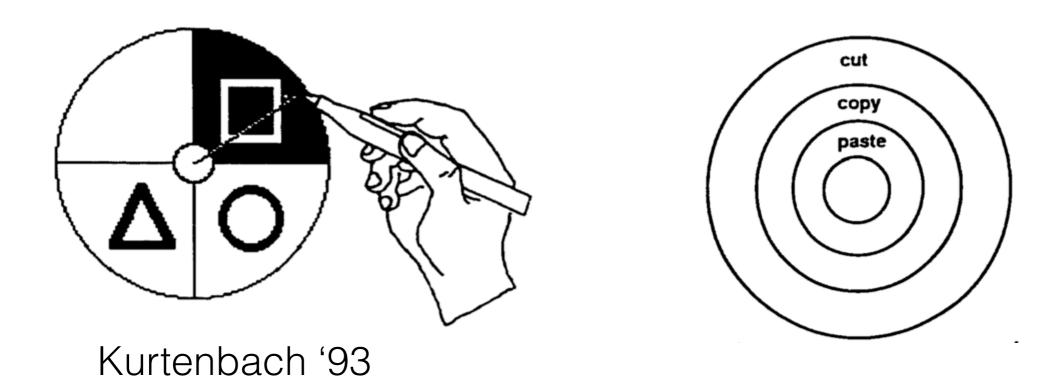
- Only angle matters, not distance
- Advantages:
 - Faster to select angle than distance
 - Fixed distance to travel
 - Scale independent
- Disadvantages:
 - Angle varies with number of items (can't always have shared items in same place)
 - Large?



More: https://medium.com/@donhopkins/the-design-and-implementation-of-pie-menus-80db1e1b5293

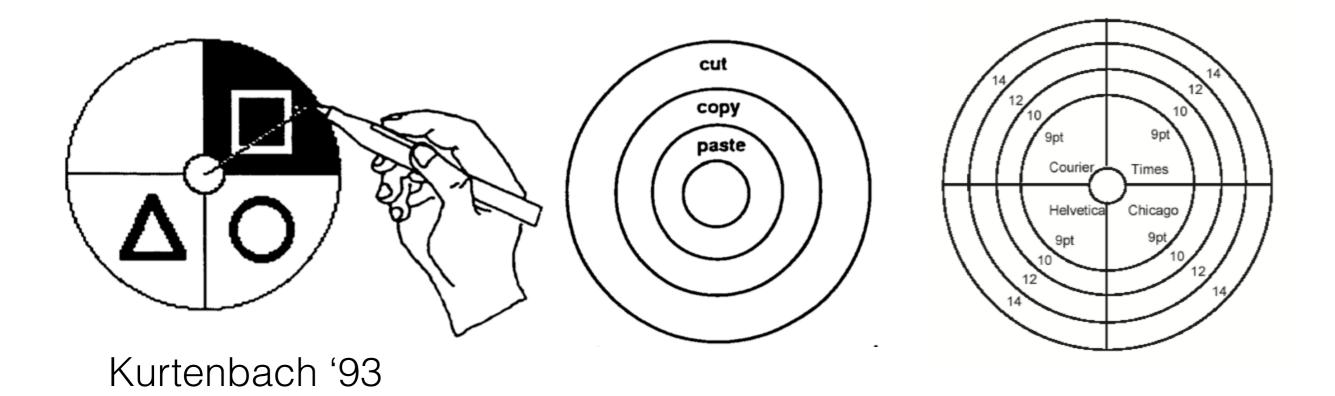
Alternatives: Bullseye

- Only distance matters, not angle
- Scale dependent



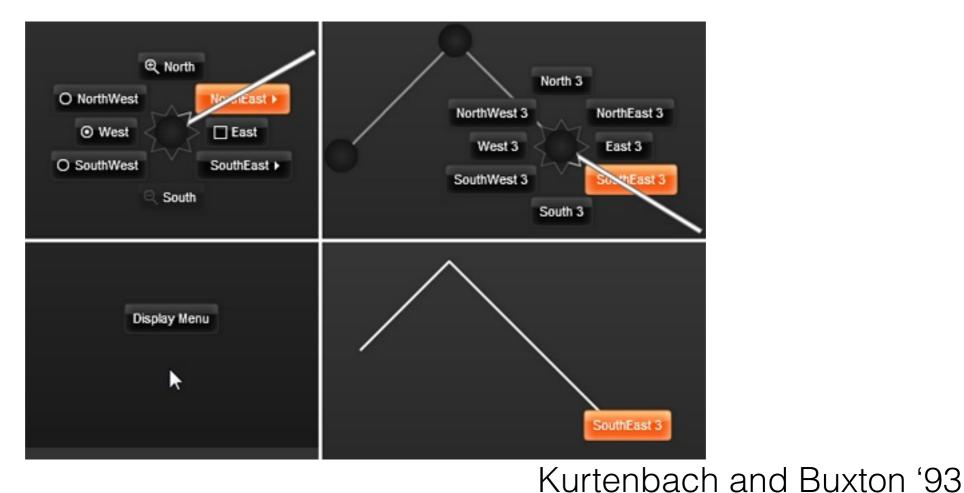
Alternatives: Dart Board

• Angle + Distance



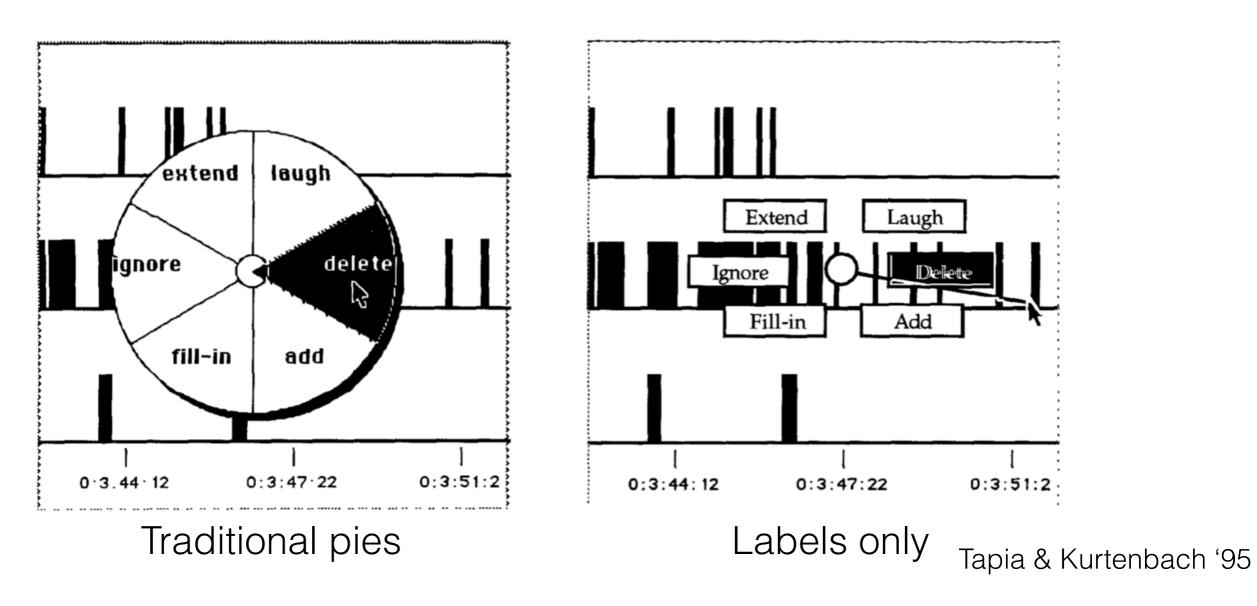
Accelerating Menus - Marking Menus

- Idea: focus on the movement and not just the visual properties
- Just like the pie, but if you hold mouse and draw, the system interprets as a gesture
- <u>https://www.youtube.com/watch?v=dtH9GdFSQaw</u>



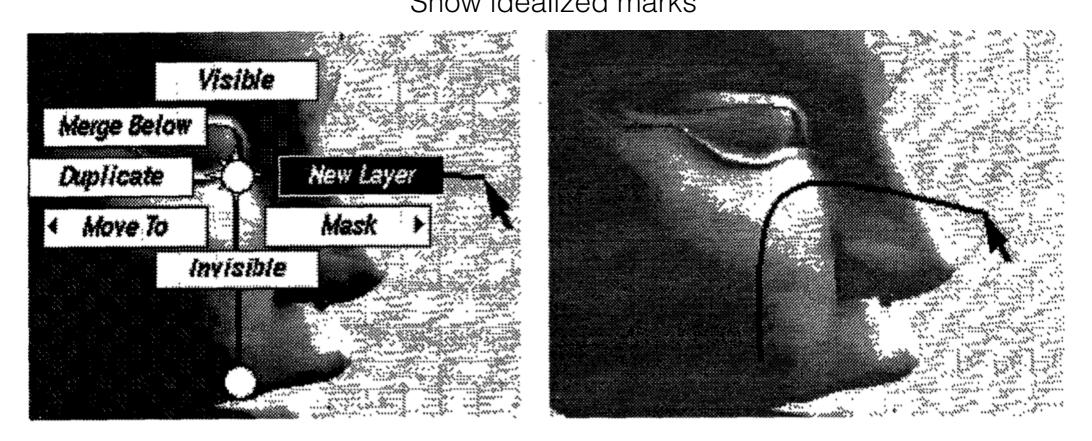
Design Details - Marking Menus

- Principle: Should help user maintain visual context
- Problem: Pies take up space
- Refinement: show only labels



Design Details - Marking Menus

Principle	Refinment
Maintain visual context	Display only labels Ignore pie wedges Make labels symmetric
Hide unnecessary information	Hide parent menus
Support skill development using graphical feedback	Use eight item menus Use compass star around menu center Show idealized marks



Tapia & Kurtenbach '95

System feedback

System response times

- 0.1second reacting instantaneously
 - requiring no special feedback except displaying result
 - limit for direct manipulation of objects in UI
- 1.0 second **freely** navigating commands
 - noticeable delay, limit for keeping user's flow of thought uninterrupted
- 10 seconds keeping users attention
 - limit for keeping user's attention focus in UI
 - longer delays create task breaks
- [Nielsen, Usability Engineering, 1993]

Automation

- Keep user in control at highest task levels
- Take control from user when need is obvious & user is busy
- Provide visibility of automation & opportunities to correct when necessary

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Provide feedback for all user actions

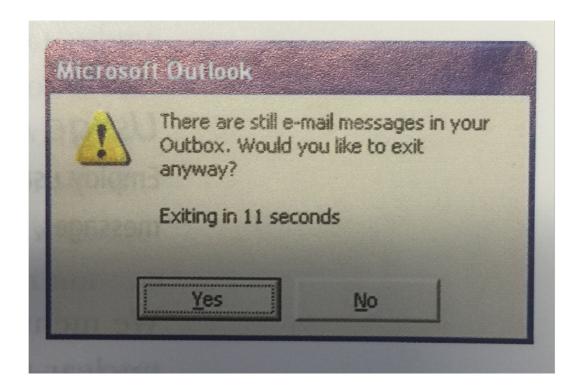
- Feedback helps keep users on track in accomplishing goals
- Request confirmation to prevent costly errors (but use sparingly)
- Make feedback visible, noticeable, legible, located w/ in users focus of attention
- Provide feedback early
- Provide feedback consistently

Tone of feedback

- Establishes relationship with user
- Important not to take user feel "stupid"
- Make the system take blame for errors
- Be positive, to encourage
- Provide helpful messages, not cute messages
- Avoid violent, negative, demeaning, threatening terms (e.g., illegal, invalid)

Crafting feedback text

- Clarity support clear understanding of outcome
- Precise wording
- Completeness include enough information to fully understand outcomes



Show users how to fix errors

- Good: detecting user errors
- Better: directly showing how errors can be fixed
- (Best: using constraints to prevent errors from ever occurring)

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🔕 The project cannot be built until build path errors are resolved	CrowdCoding
Warnings (1 item)	

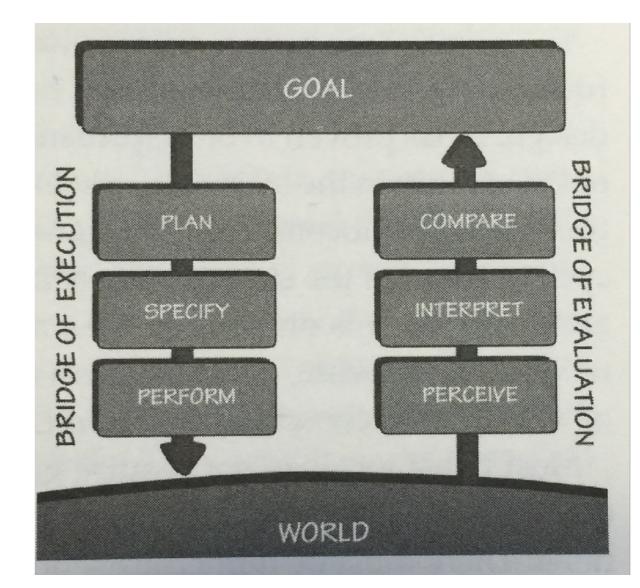
Avoid anthropomorphism (in most contexts)

- Anthropomorphism the attribution of human characteristics to non-human objects
 - e.g., "Sorry, but I cannot find the file you need"
- Provides a false mental model
 - leads to user thinking they can interact with system as person
 - can be over promising & condescending
- May work in spoken interaction settings, where system does match user's mental model

Direct manipulation

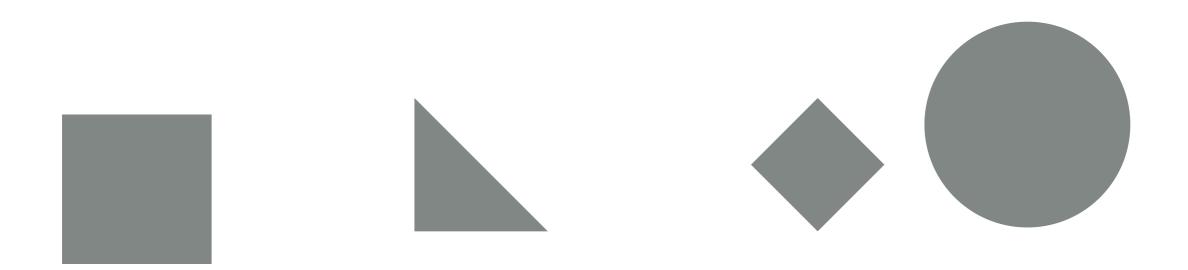
Motivation

- User is trying to do a task, manipulating some [model] of world
- Hard to plan out long sequence of actions in advance
- Gulf of execution: hard to know if took correct action
- Gulf of evaluation: hard to understand if successfully manipulated world
- Hard to compare hidden world to desired world



Direct manipulation

• "Rapid incremental reversible operations whose impact on the objects of interest is immediately visible" (Shneiderman, 1982)



Benefits

- Supports exploration
 - Don't plan long sequence of actions: pick an action, try it, can change mind if want to do something else instead
- Provides immediate feedback
 - Can quickly see what outcome of actions are in manipulating the world
 - Easy to compare desired state of the world to actual state of the world

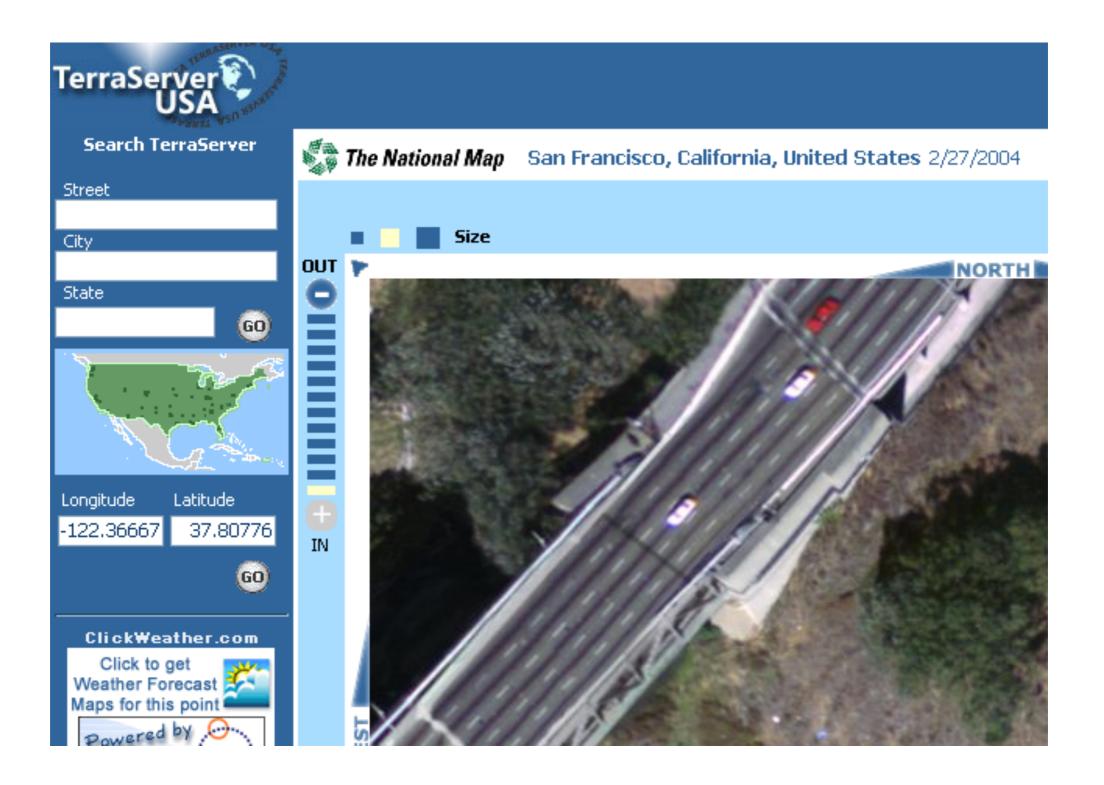
Example - GUI builder

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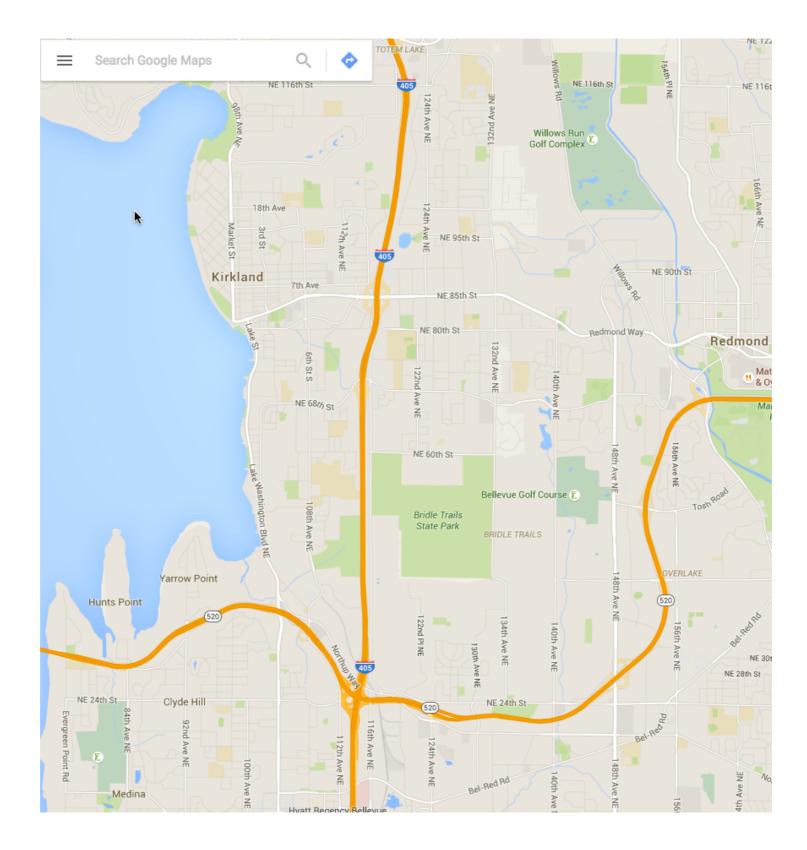
Example - Spreadsheets

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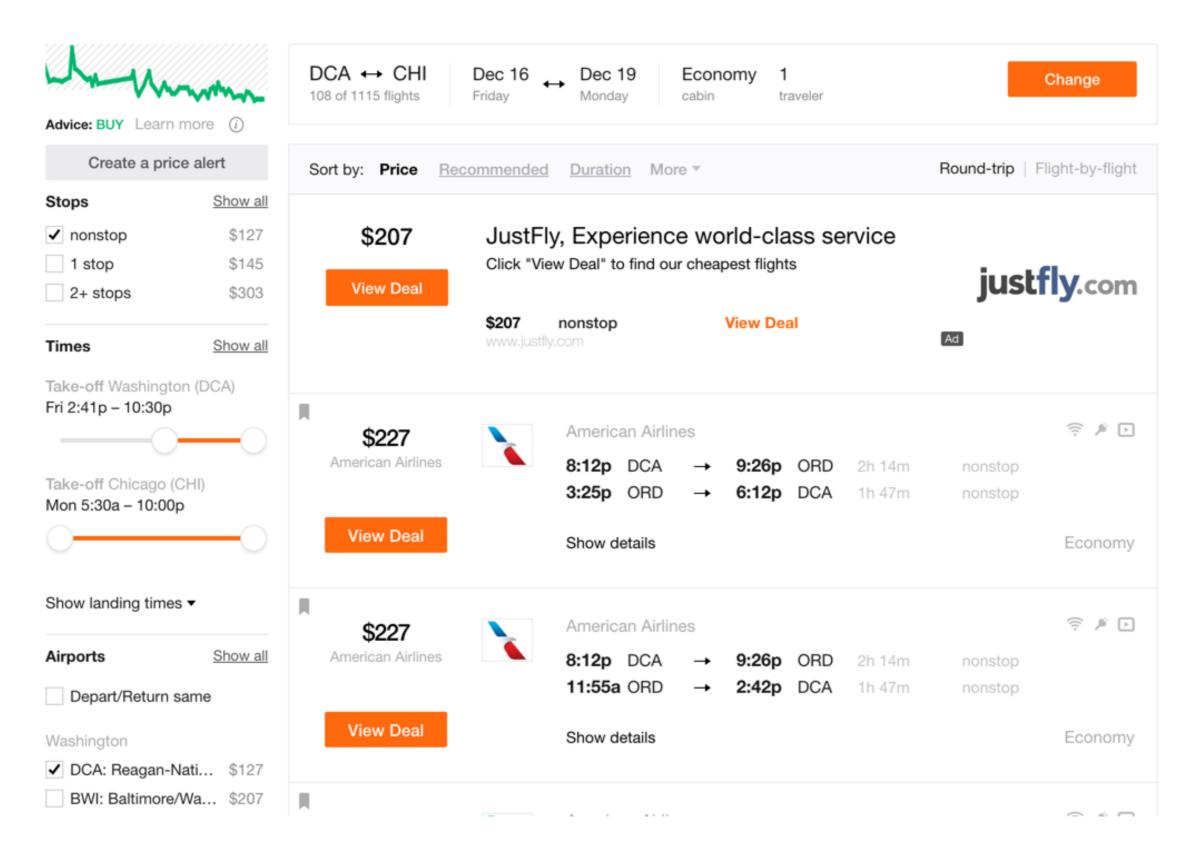
Example - Microsoft TerraServer



Example - Google Maps



Example - Kayak



In Class Activity

- In groups of 2 or 3:
 - Identify at least 3 separate usability issues of a web application that violates one of the interaction design principles in this lecture
 - For each issue, brainstorm ways that this usability issue might be addressed.

In Class Activity: Direct Manipulation Programming Interactions

- In groups of 2
 - Design a system for writing React code through direct manipulation
 - Create sketches showing key screens
 - Should support
 - Standard programming language features (variables, conditionals, loops, functions)
 - Should make it faster and easier to make code changes
 - Should make it easier to get feedback on if program works