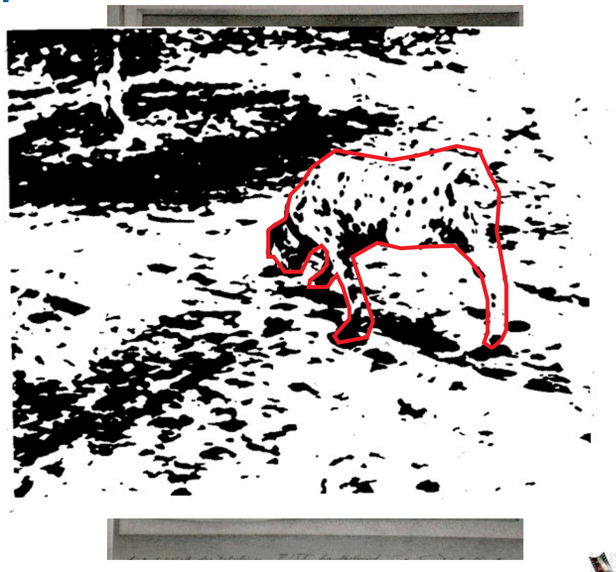
Review

- What are the differences between mistakes and slips?
- What are the different types of slips?
- How do we tend to correct slips?
- What are forcing functions?
- How can UI design help to avoid errors?
- What are Norman's Seven Principles of Design?

Design Principles

Perception

Our brains are wired to make sense of what we perceive.

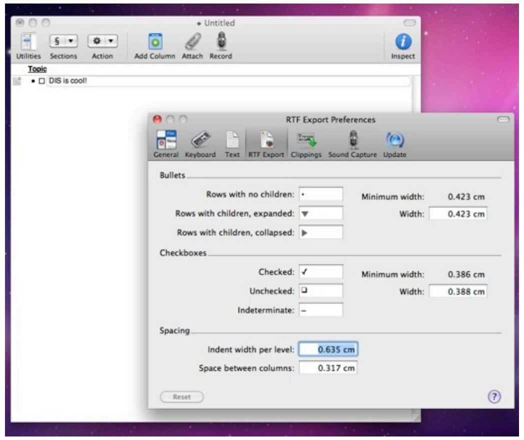


Gestalt Theory

- Köhler, Koffka, Wertheimer (Berliner Schule): *"Gestaltpsychologie", 1912*
- What do humans perceive as belonging together spatially or temporally?
- Basis of order in perception, movement, memory, thinking, learning, and acting
- Overall 100+ Gestalt laws

Why Should I Care?

- Simple rules for visual (and auditory) UI design
- Hints how users will react to spatial and temporal order
- Good UIs respect and use Gestalt laws for understandability and intuitiveness



DIS is cool!

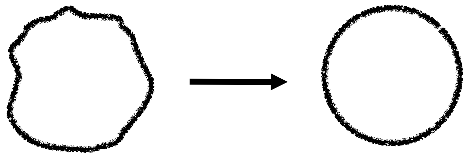
Bullets
Rows with no children: •
Rows with children, expanded: ▼
Rows with children, collapsed: ▶
Minimum width: 0.423 cm
Width: 0.423 cm

Checkboxes
Checked: ✓
Unchecked: ❑
Indeterminate: –
Minimum width: 0.386 cm
Width: 0.388 cm

Spacing
Indent width per level: 0.635 cm
Space between columns: 0.317 cm

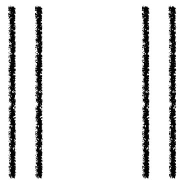
In-class Experiment

Law 1: Good Shape



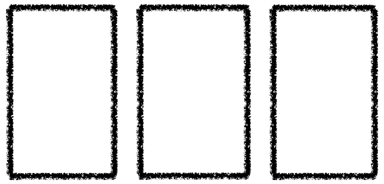
- Perception has tendency towards remembering things as "good" / clear / simple shapes
- "Cognitive compression algorithm"!
- Easier shape ⇒ easier to remember

Law 2: Proximity

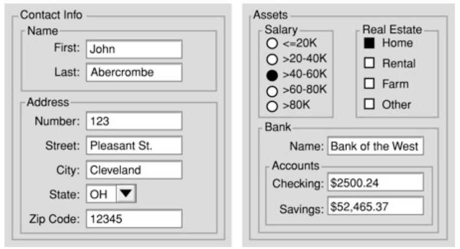


- Spatially (or temporally!) close objects (events) are perceived as belonging together.
- Advantage: allows for order by position only, without other aides
- Helps to keep the interface simple

Law 3: Closure



- Closed shapes appear as belonging together
  - Temporally?
- Foundation of window metaphor
- But: Don't Overdo It.

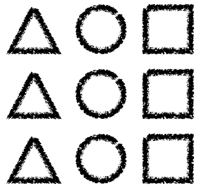


Contact Info
Name
First: John
Last: Abercrombe
Address
Number: 123
Street: Pleasant St.
City: Cleveland
State: OH
Zip Code: 12345

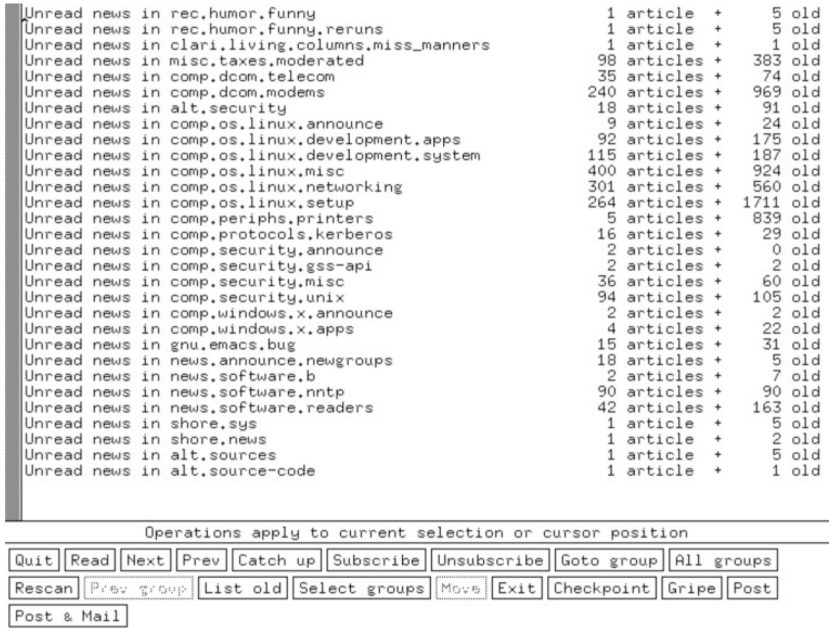
Assets
Salary
○ <=20K
○ >20-40K
● >40-60K
○ >60-80K
○ >80K
Real Estate
■ Home
□ Rental
□ Farm
□ Other
Bank
Name: Bank of the West
Accounts
Checking: $2500.24
Savings: $52,465.37

Too many boxes. (From Johnson: *GUI Bloopers*)

Law 4: Similarity



- Similar shapes appear as belonging together
  - Temporally?
- Different objects have higher information content (i.e., cognitive effort)
  - This can be A Good Thing or A Bad Thing
- Similar is not necessarily constant
  - Linearity, "elegant curve",…

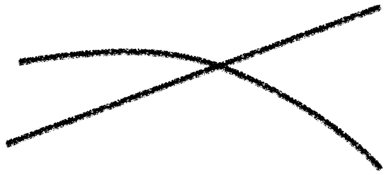


```
Unread news in rec.humor.funny                          1 article  +     5 old
Unread news in rec.humor.funny.reruns                   1 article  +     5 old
Unread news in clari.living.columns.miss_manners        1 article  +     1 old
Unread news in misc.taxes.moderated                    98 articles +   383 old
Unread news in comp.dcom.telecom                       35 articles +    74 old
Unread news in comp.dcom.modems                       240 articles +   969 old
Unread news in alt.security                            18 articles +    91 old
Unread news in comp.os.linux.announce                   9 articles +    24 old
Unread news in comp.os.linux.development.apps          92 articles +   175 old
Unread news in comp.os.linux.development.system       115 articles +   187 old
Unread news in comp.os.linux.misc                     400 articles +   924 old
Unread news in comp.os.linux.networking               301 articles +   560 old
Unread news in comp.os.linux.setup                    264 articles +  1711 old
Unread news in comp.periphs.printers                    5 articles +   839 old
Unread news in comp.protocols.kerberos                 16 articles +    29 old
Unread news in comp.security.announce                   2 articles +     0 old
Unread news in comp.security.gss-api                    2 articles +     2 old
Unread news in comp.security.misc                      36 articles +    60 old
Unread news in comp.security.unix                      94 articles +   105 old
Unread news in comp.windows.x.announce                  2 articles +     2 old
Unread news in comp.windows.x.apps                      4 articles +    22 old
Unread news in gnu.emacs.bug                           15 articles +    31 old
Unread news in news.announce.newgroups                 18 articles +     5 old
Unread news in news.software.b                          2 articles +     7 old
Unread news in news.software.nntp                      90 articles +    90 old
Unread news in news.software.readers                   42 articles +   163 old
Unread news in shore.sys                                1 article  +     5 old
Unread news in shore.news                               1 article  +     2 old
Unread news in alt.sources                              1 article  +     5 old
Unread news in alt.source-code                          1 article  +     1 old

              Operations apply to current selection or cursor position
```

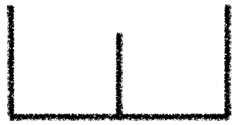
Bad button design in xrn

Law 5: Continuity



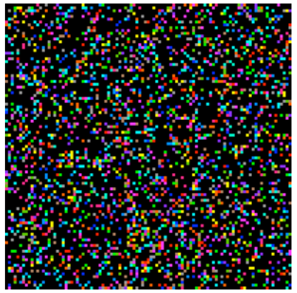
- A.k.a. "Law of the Good Curve"
- Continuous shapes appear as belonging together
  - Temporally?
- Example: music

Law 6: Experience

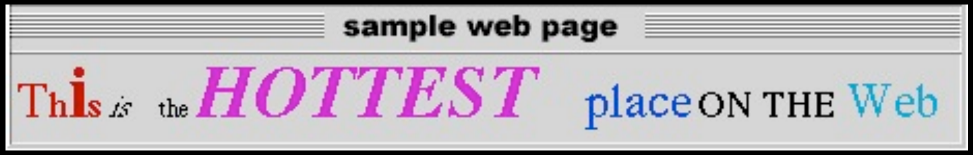


- We tend to "file" new things into categories we already know
- Uses existing knowledge, thereby saving learning effort and memory
- Foundation for the success of metaphors in UI design
  - Analog to real-world models
  - E.g., desktop metaphor

Law 7: Common Fate



- A.k.a. "Law of Common Movement"
- Animated objects within a static environment appear as a group
- By-Law: Animation has a very strong effect in UI design
  - Here: Blinking in sync groups the items



Blinking text is perceived as a group

Information Content in UIs

- Basic unit of information: bit
- Toggle button:
  - 2 states: ☐ ☑ → $\log_2(2) = 1\,\text{bit}$
- Single digit
  - 10 states: 0…9 → $\log_2(10) = 3.3\,\text{bits}$
- Single letter, upper- and lowercase, U.S.:
  - 52 states: a…z | A…Z → $\log_2(52) = 5.7\,\text{bits}$

Information Content in UIs

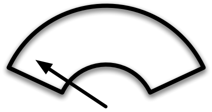
- Analog scales (reading = estimate)
  - Unmarked scale (experiment)

    3 bits (8 different positions differentiable)
  - Audio pitch, volume, salt content

    Pitch 2.5 bits (But: with perfect pitch 5–6 bits)

    Volume 2 bits

    Saltiness 1.8 bits



Analog or Digital?

- Example: speedometer in the car
- Analog displays (scales, …)
  - Quick estimate possible, range limits visible
  - Easy to detect trends
  - But: reading time increases linearly with number of significant digits
- Digital displays (digits, …)
  - Reading time ~ constant up to 3 – 4 digits
  - But: hard to estimate quickly, trends hard to detect, limits invisible without external labeling

Theory

✓ Models of interaction

✓ Affordances, mappings, constraints, types of knowledge, errors

⇒ Design principles

- Human cognition and performance
- History and vision of HCI

Practice

✓ Sketching

✓ User observation

✓ Iterative design

⇒ Prototyping

⇒ Ideation

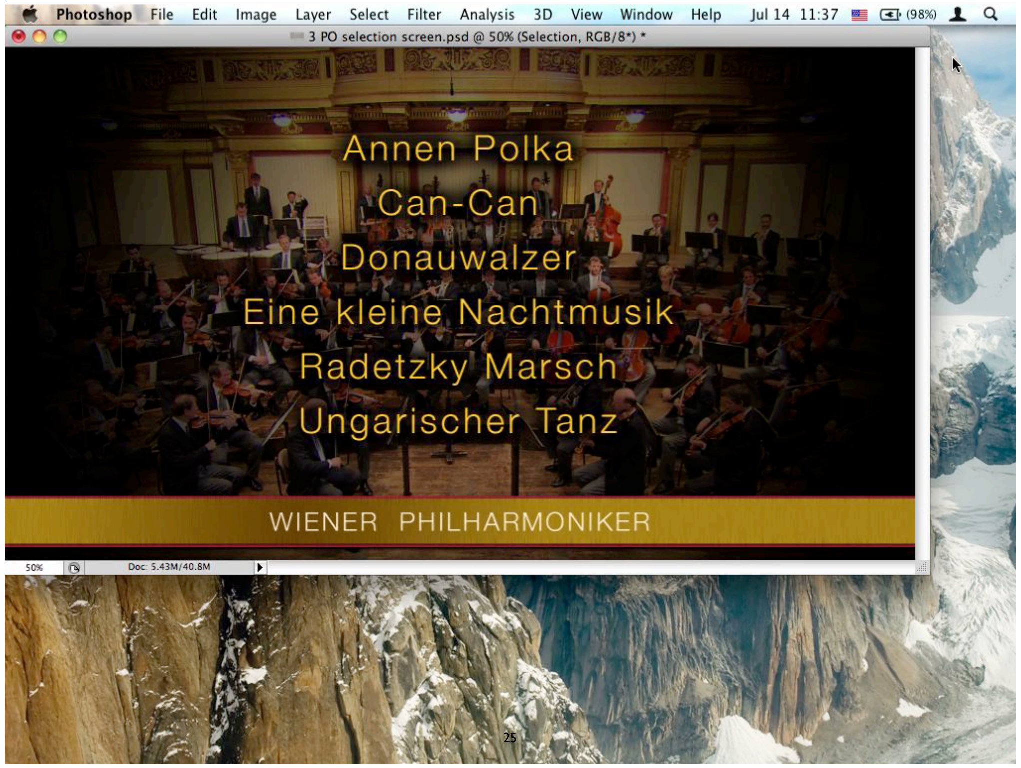
- User study and evaluation

Software Prototyping: On-Screen Storyboards

- Scripted simulations
- Using media tools such as PowerPoint or Photoshop layers
- More potential for interactivity:
  - Scene transition by simple input, timing, animation
- Prototype with slightly more vertical depth
- Use as click-through prototype or for pitching
- Pro: looks real, good for non-standard UIs, no programming
- Con: simulation fails when script is not followed

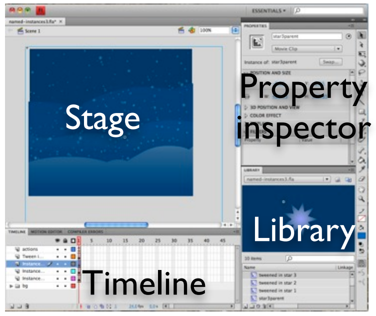
In-Class Demonstration: Personal Orchestra Prototype

- Alternative to sequential interaction scripts
- Using Photoshop layers to simulate
  - Highlighting menu options
  - Moving to different screens
- Photoshop layers can do some magic
- Normally your Screenshot Prototype will look less polished
  - This example turned out to also become our final graphical layout


Photoshop File Edit Image Layer Select Filter Analysis 3D View Window Help Jul 14 11:37 (98%)
3 PO selection screen.psd @ 50% (Selection, RGB/8*) *
Annen Polka
Can-Can
Donauwalzer
Eine kleine Nachtmusik
Radetzky Marsch
Ungarischer Tanz
WIENER PHILHARMONIKER
50%
Doc: 5.43M/40.8M

Prototyping Tools: Animation Apps

- Usually implement timeline metaphor
- Good for intricate animations
  - Pixel-based (Adobe Director)
    Maximum control over appearance
  - Vector-based (Flash)
    Smaller files, editable objects
- Powerful when extended with scripts
  - But: Scripting languages are clumsy by CS standards
- May allow for integration of non-standard hardware and other OS features (Director Xtras,...)
  - Example: Virtual Vienna



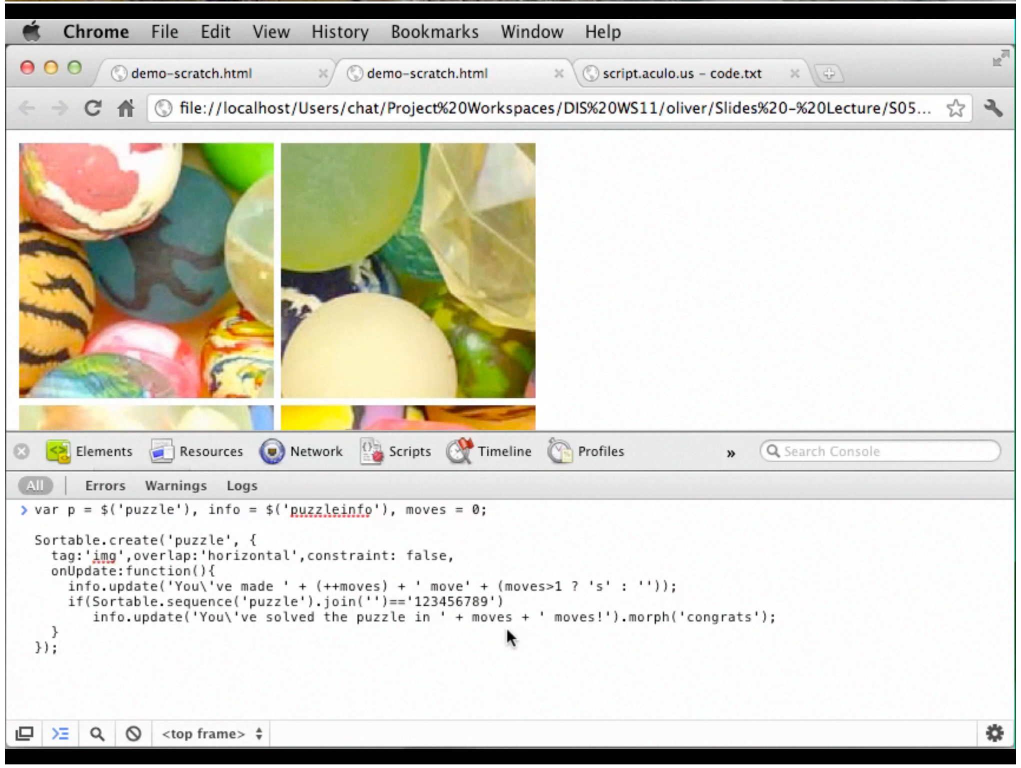
Prototyping Tools: Animation Apps

- Can even become final product
  - Virtual Vienna, Flash web content,...
- Distribution usually fairly easy
  - Free player apps
- But: Large designs become hard to manage
  - Virtual Vienna example

Prototyping Tools: Web

- DHTML = HTML + JavaScript, etc.
- Natural choice for web interface design
  - Can become final product
- Ubiquitous
  - Many tools (Dreamweaver, FrontPage, …)
  - Cleartext format
  - Viewable in any browser (in theory…), over the net
  - But: No precise look & feel (nature of the web)

Safari File Edit View History Bookmarks Develop Window Help
The Media Computing Group : The Media Computing Group at RWTH Aachen University
http://hci.rwth-aachen.de/tiki-index.php
Google
Fly
LumiNet
Multitouch
Personal Orchestra
SLAP
Snowboard
TWEND
Publications
Books
Papers
Diploma & Master's Theses
Upcoming Conferences
Upcoming Journals
Cooperations
Apple Training Center
CocoaHeads
DorkBot
hcipatterns.org
Humtec
Mac-Beratung (de)
RUFAE
UMIC
Login
Login as…
User:
Password:
Federal President Horst Köhler at the Silhouettes Interactive Experi


Chrome File Edit View History Bookmarks Window Help
demo-scratch.html
demo-scratch.html
script.aculo.us – code.txt
file:///localhost/Users/chat/Project%20Workspaces/DIS%20WS11/oliver/Slides%20-%20Lecture/S05…
Elements
Resources
Network
Scripts
Timeline
Profiles
Search Console
All
Errors
Warnings
Logs
<top frame>

```
> var p = $('puzzle'), info = $('puzzleinfo'), moves = 0;

  Sortable.create('puzzle', {
    tag:'img',overlap:'horizontal',constraint: false,
    onUpdate:function(){
      info.update('You\'ve made ' + (++moves) + ' move' + (moves>1 ? 's' : ''));
      if(Sortable.sequence('puzzle').join('')=='123456789')
         info.update('You\'ve solved the puzzle in ' + moves + ' moves!').morph('congrats');
    }
  });
```

Demo: Prototyping Interaction with Javascript

- Modern Javascript library allows prototyping the user interaction quickly
- script.aculo.us
  - Implementation of common animations and user interactions
  - Convenience $() function to access DOM elements (Prototype framework)
- Use your web browser as the IDE

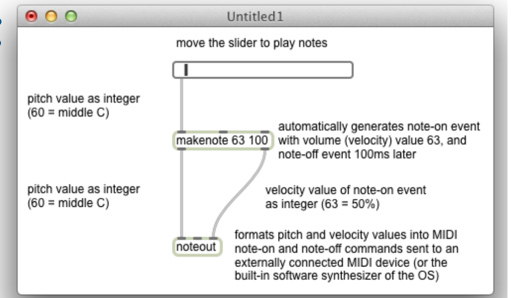
Prototyping Tools: Rapid Development Environments

- VisualBasic, Tcl/Tk, etc.
- Good for standard GUIs (create standard look & feel)
- Often become final product
- Partly interpreted
  - Quick development cycle, but potential performance issues

Prototyping Tools: Rapid Development Environments

- Distribution: OK
  - Not always cross-platform
  - May require specific runtime environment
- "Programming for the rest of us"
  - End-user programming
  - Empowers users
  - E.g., Automator in Mac OS X

Prototyping Tools: Special-Purpose


Untitled1
move the slider to play notes
pitch value as integer (60 = middle C)
makenote 63 100
automatically generates note-on event with volume (velocity) value 63, and note-off event 100ms later
pitch value as integer (60 = middle C)
velocity value of note-on event as integer (63 = 50%)
noteout
formats pitch and velocity values into MIDI note-on and note-off commands sent to an externally connected MIDI device (or the built-in software synthesizer of the OS)

- Example: MAX/MSP
  - Multimedia development environment
  - Originally for MIDI applications
  - Extended to handle graphics, audio, and video
  - Build applications by connecting "patches" that process incoming data
  - Very helpful for specific type of applications
    - MIDI/audio/video processing, interactive music systems
  - Can be used for end products (WorldBeat)
  - Distribution: Mac and Windows, free player
    - pd for Linux

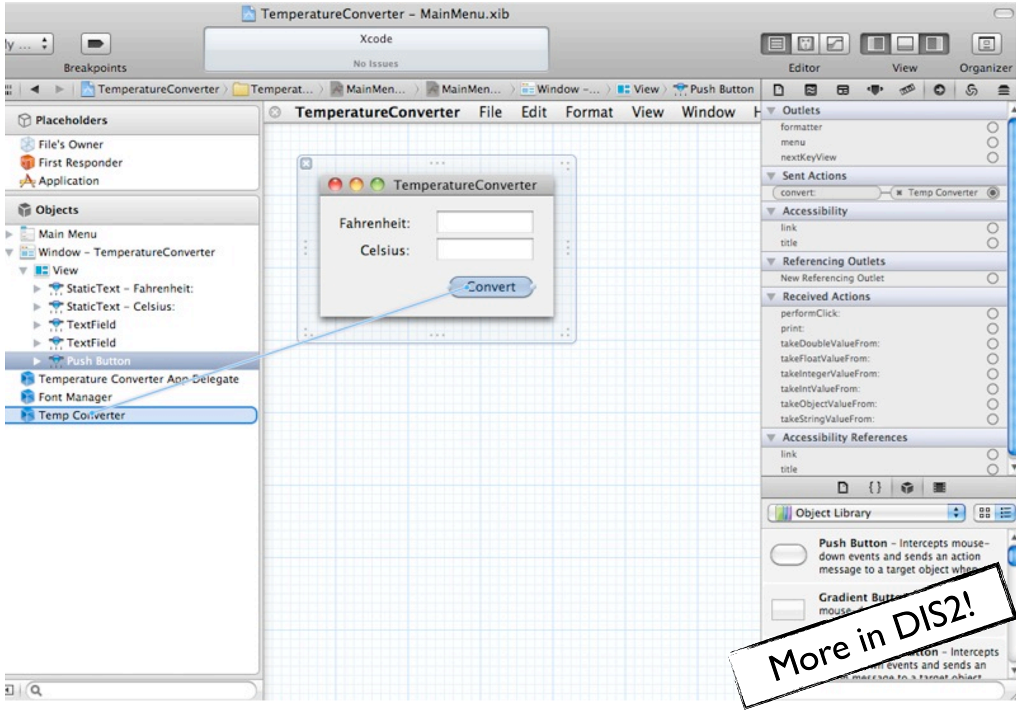
More in DIS2!

User Interface Builders

- Graphical/textual tools to define UI of real software application
- Usually part of integrated development environment (IDE)
- Pro:
  - Finished design can be used for final implementation
  - Real look & feel
  - Vertical functionality can be added easily
- Con:
  - Limited to 1 window system and its toolkit (windows, buttons, …)

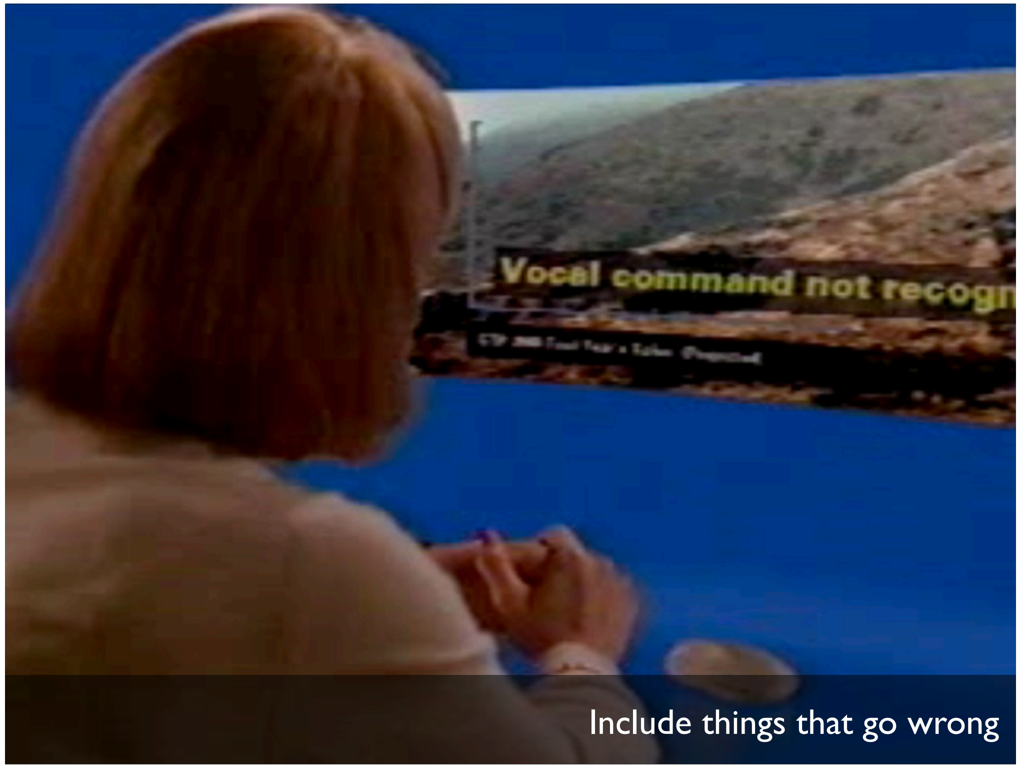
Example: Interface Builder in Xcode

- Create UIs for Mac OS X and iOS applications
  - Design static layout, e.g., position of a button in a window
  - Connect dynamic behavior, e.g., connect a button to an action method in a class
- UI can be tested without compiling or writing any code
- Suggests a more user-centered implementation process
  - Start with the UI, not the application functionality
  - IB generates source code skeleton that can then be filled in
  - IB uses special constants to include hints about outlets and actions in the source code

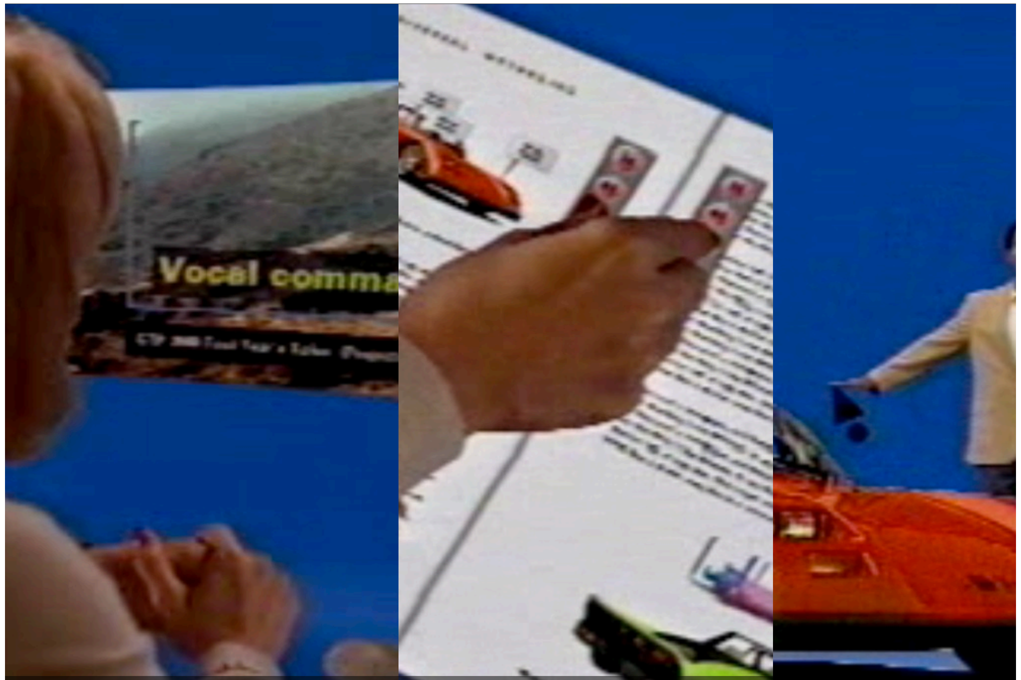


Video Prototyping

- Visualize the behavior of a system
- Videotape short scenes of the user interacting with the system
- Cut together to tell the story
- Great for envisioning futuristic system
- Example: Sun's Starfire, Apple's Knowledge Navigator



Use camera angle instead of implementing difficult interaction



Different input devices

Discovering social issues during prototyping

Starfire Prototyping Guideline

- Continuously question if assumptions are realistic within 10-year timeframe
- Iterative nature, like any other prototype
- Include things that go wrong
- Avoid impossible hardware designs
- Design interface first, then decide film scenes based on budget
  - E.g., Mouse, voice, reverse angle much cheaper than gesture and pen

Ideation

Styles of Thinking

- When thinking about a problem, we try to do too much at once
  - Emotion, information, logic, hope, creativity,...

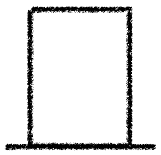
⇒ Instead: Think in *one* style at a time!
  - Maximizes sensitivity of the brain in that direction

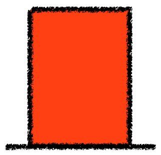
- Everybody has their own preferred styles of thinking
  - Correlated with personality, training, professional background, role, situation,...

- When people think in different styles, they argue

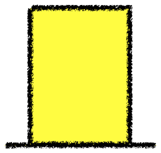
⇒ *Parallel thinking*:
  - Let everybody think in the same style for a while
  - Then move to the next style of thinking, to cover all styles

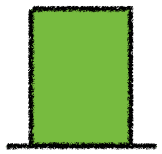
Six Thinking "Hats" (Styles)

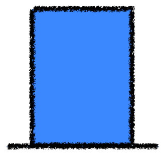

Paper
Objective, facts and figure


Blood
Intuition, gut feeling, emotion

Serious
Cautious, critical


Sun
Hope, benefits, positive thinking


Growing Grass
Creativity, new ideas


The Sky Above
Organize other hats

[de Bono, 2001]

Six Thinking Hats

- Use hats to refer to thinking styles instead of people
  - ✔ "That was good black hat thinking; now let's put the yellow hat on."
  - ✗ "You are too critical. You should see the benefits of this."
  - ✗ "You are a black hat!"
- When to use which hat?
  - Preset: Determine hat sequence before meeting
  - Evolving: Determine next hat on-the-fly (not for beginners)

Six Thinking Hats Guideline

- Only moderator can trigger hat changes
- Short time per hat (1 min per participant)
  - Extend when new things come up — do not limit creativity
  - Red hat: Keep time short. Make statements as definite as possible.
- Example sequence
  - Blue: organize the meeting and hats
  - Red (if there is a strong preexisting feeling): let people lay down emotional burden
  - White: bring everyone up-to-date with information
  - First Yellow, then Green, and then Black (benefits motivate people to overcome difficulties, get the ideas, criticize the ideas)
  - White: assess the idea against existing information
  - Blue: conclude and summarize
  - Red: reflect on thinking performance

Your DIS1 Project

- Theme: "You make me want to be a better person"
  - Interactive system ⇒ persuades users ⇒ behavior change ⇒ improve quality of life
- Three directions
  - Go green
  - Go healthy
  - Go social
- Challenge: target users must not be university students between 20–30 years age group
  - Maximum grade without accepting the challenge: 2.0
  - Maximum grade with the challenge: 1.0
  - Groups of 4–6

Go green: use sustainable energy source

Image: http://www.flickr.com/photos/30588268@N03/3576840442/

Go green: use public transport

Image: http://www.flickr.com/photos/mescon/3893805827

Go green: use energy-efficient lightbulbs
Image: http://www.flickr.com/photos/antonfomkin/5243218781

Go healthy: exercise
Image: http://www.flickr.com/photos/sbh/5127834263

Go healthy: regular health checks
Image: http://www.flickr.com/photos/seattlemunicipalarchives/4058808950/

Go healthy: eat veggies
Image: http://www.flickr.com/photos/vinothchandar/5612099123

Go social: help others

Image: http://www.flickr.com/photos/yourdon/2906764434

Go social: be physically together

Image: http://www.flickr.com/photos/pocketwiley/2910495143

Go social: bridge age gap

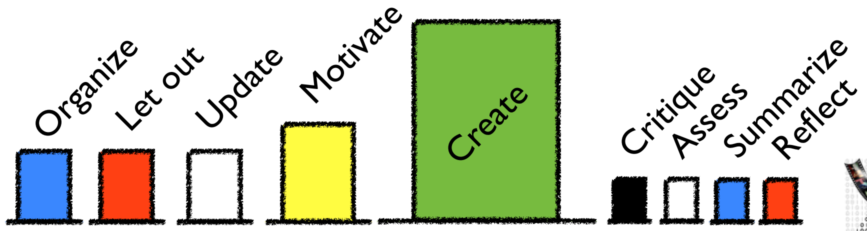
Image:http://www.flickr.com/photos/sashapo/5547805558

Brainstorming
An Initial Design Technique

- Goal: Collect as many ideas on a given topic as possible
  - Quantity, not quality; include crazy ideas
  - Go for a certain number of ideas, say, 100
- Defer judgment, don't criticize or argue (no black hat)
  - Instead, leapfrog on each other's ideas (green hat)
- Limit to 5–10 minutes
- Relax, have fun, invite good brainstormers
- Scribe collects ideas visible for all
- Trick: Cross-pollination who–what–where

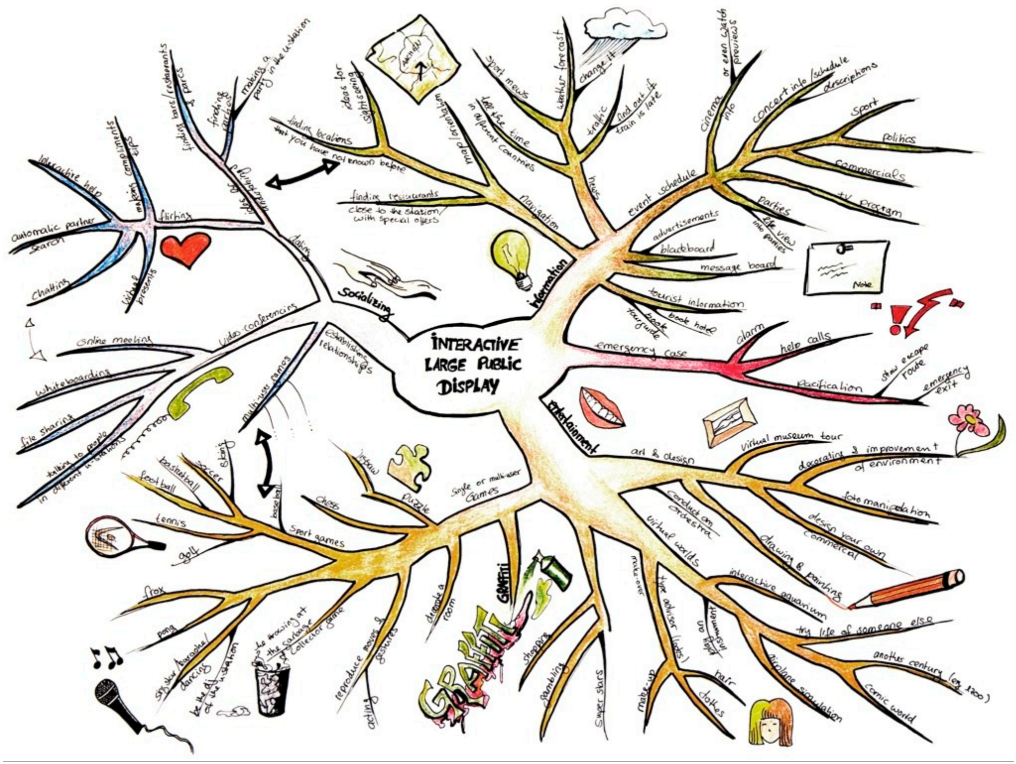
In-Class Exercise: Brainstorming

- Project Theme: "You make me want to be a better person"
- Brainstorm on
  - What behaviors could change to improve quality of life?
  - How to persuade users to change?



Structuring Brainstorms: Concept Mapping

- Used since 1500s by Spanish monks
  - Mind Mapping trademarked by Tony Buzan in 70's
- Uses both brain sides, structures note-taking for overview, planning, learning… with a visual "gestalt"
  - Use A3 landscape, subject in middle, aspects on branches, subtopics on subbranches (software?)
  - Connect additional relationships with arrows
  - Use images/icons for keywords where they work
  - Use color for branches & connections (after pencil version becomes stable)
- Grows over time, combine individual maps



Summary

- Gestalt laws allow us to leverage human perception in visual layout design
- Different software prototyping tools support different purpose of prototyping
- Six Thinking Hats and brainstorming allow early design ideas to be explored effectively