UI design principles

Lecture 20

CS 2112 Fall 2021

Goals and non-goals

- **Goal**: Usability
  - Efficient, easy, enjoyable completion of tasks
  - Focus on user experience (UX)
- **Non-goals**:
  - Programmers first
  - Providing as many features as possible
  - Giving users what they think they want

Principle 1:
Know your user

- *“If I had asked my customers what they wanted, they would have said faster horses.”* —not Henry Ford

- *“If there is any one secret of success, it lies in the ability to get the other person’s point of view and see things from that person’s angle as well as from your own”* — Henry Ford

Requirements analysis

- First step in designing any system: what does it need to do?
- Understand needs: talk to/watch users
  - Bad: “what features do you need?”
  - Good: “what tasks do you need to perform?”

Design to your user

- Frequent or occasional?
- Novice or knowledgeable?
- Training?
- Don’t design for yourself—
  you are not the user

Know your user.

Novice users

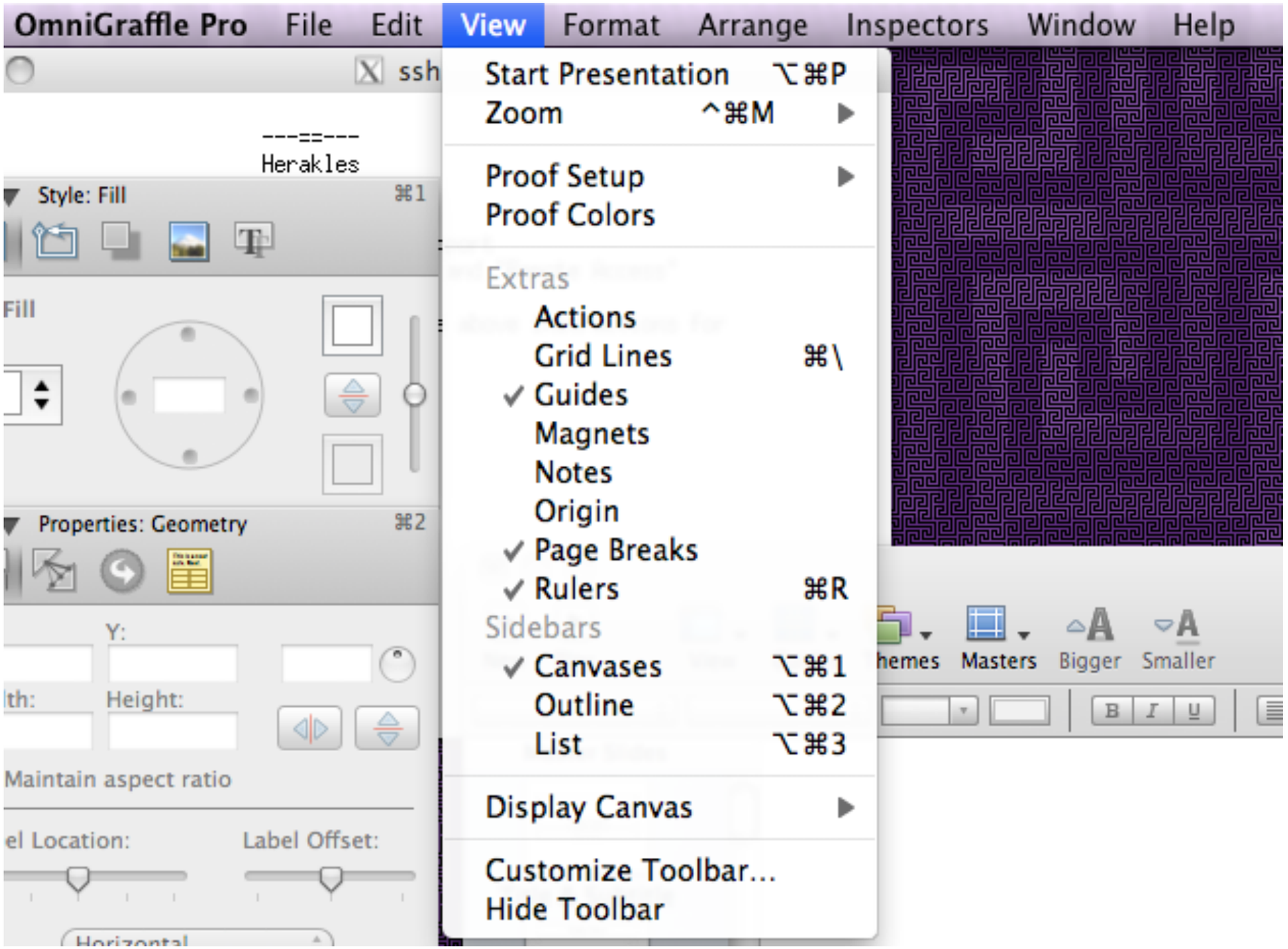
- Gentle learning curve: **discoverability**

  ⇒ User can find functionality on their own

- Protection from dangerous actions
- Clarity: simple displays, consistency with other applications and real world
  - E.g., using icons as metaphors

Know your user.

Discoverability



Know your user.

No loaded guns

Principle of Least Surprise: UI should behave as expected

Know your user.

Frequent/power users

- Goal: *efficient interaction.*
- Usability ≠ "user-friendly"
- Powerful actions, short interaction sequences (e.g., hotkeys)
- Rapid response times
- Rich controls, shortcuts for common actions
- Exploit muscle memory
- Information-rich displays
- Customization and macros

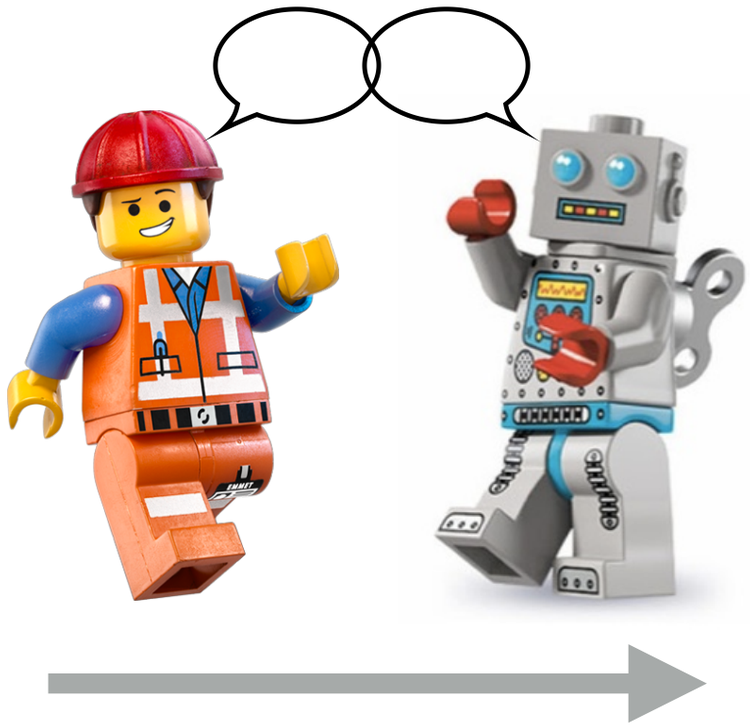
Know your user.

Power-User UI

feature-rich
information-dense

Know your user.

Principle 2:
UI is a dialogue



UI: good conversation partner?

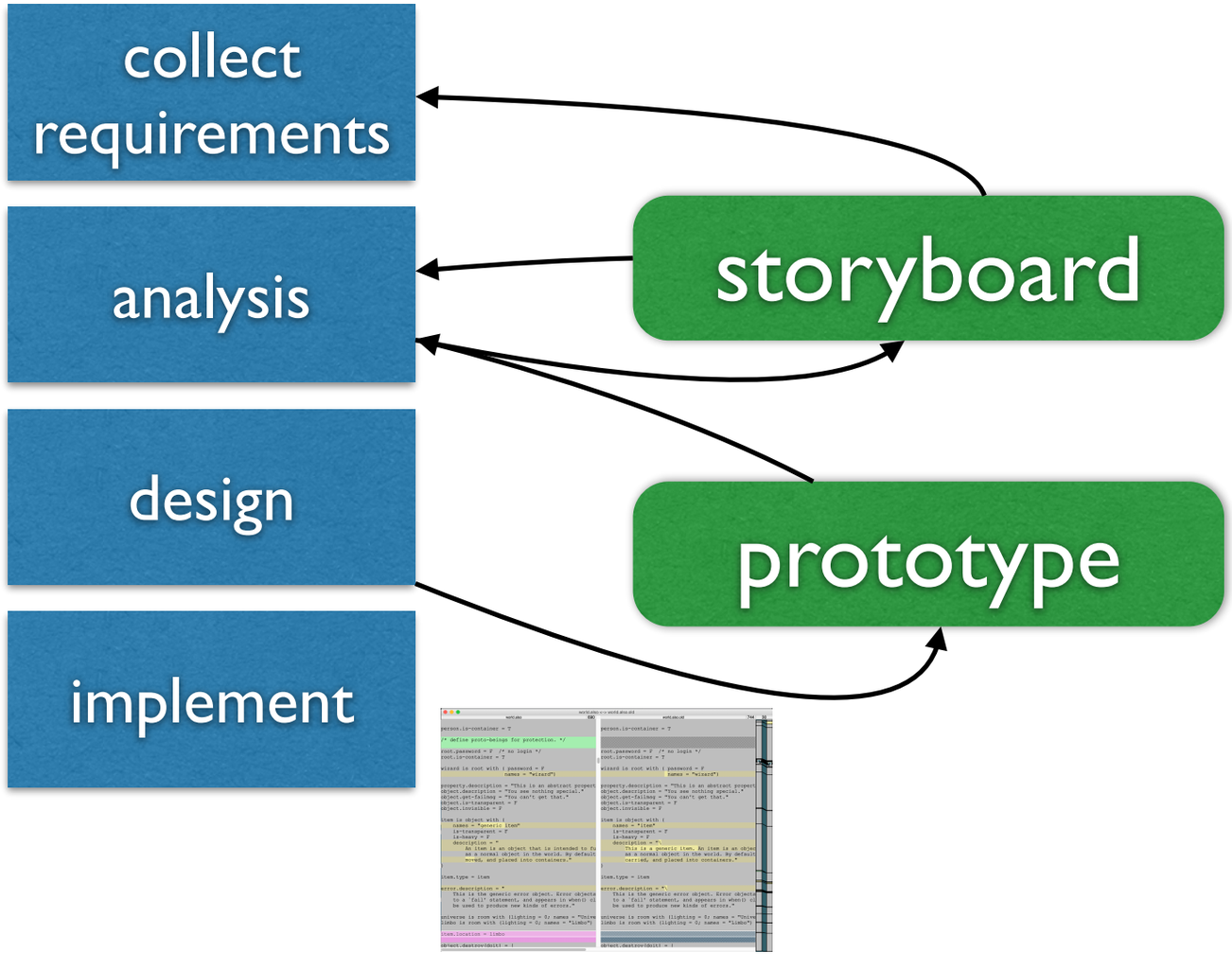
- Goal: good user experience (UX)
- Ratify actions quickly
- Be responsive
  (e.g., highlight buttons and other affordances)
- Show progress of longer actions

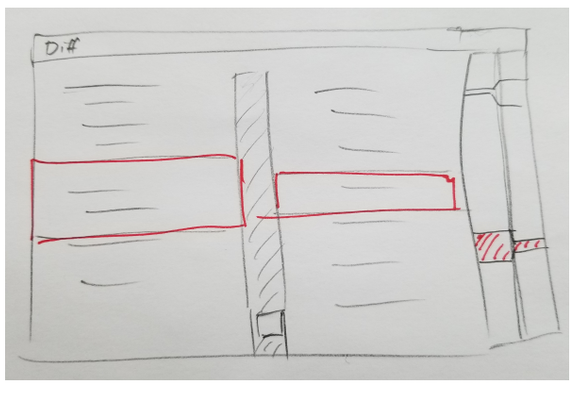
Conversations

- Identify and storyboard **use cases** to figure out what users will have to do
- Eliminate unnecessary user actions (e.g., needless confirmation dialogs)
- Short interactions with clear progress: **intermediate goal satisfaction**
- User testing to find your blind spots (as developer)
- Testing scripts help human testers to achieve coverage

Storyboarding and prototyping

- Avoiding design lock-in — early feedback loops avoid polishing a bad design.
- Design three, discard two





Interaction paradigms

- **Direct manipulation**: the UI *is* the underlying data/behavior model
  - User view: Model = View = Controller
  - Implementation: Model ≠ View ≠ Controller

- **Indirect I/O**: UI generates output when input provided (UI ≠ model)
  - e.g., menus, submitted forms, command shells

Direct manipulation vs. I/O

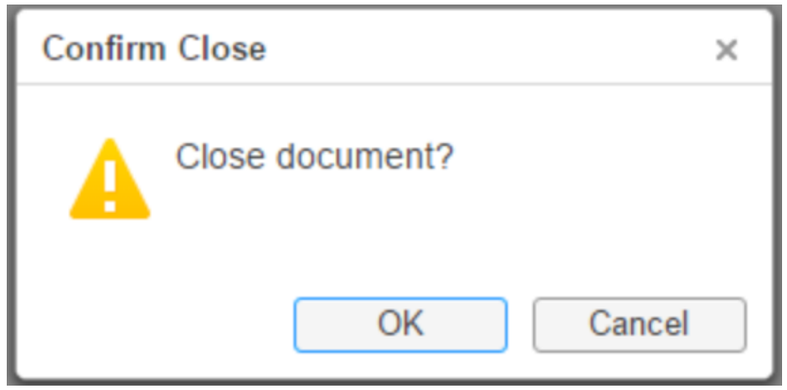
Know your user. UI is a dialogue.

Interaction time scales

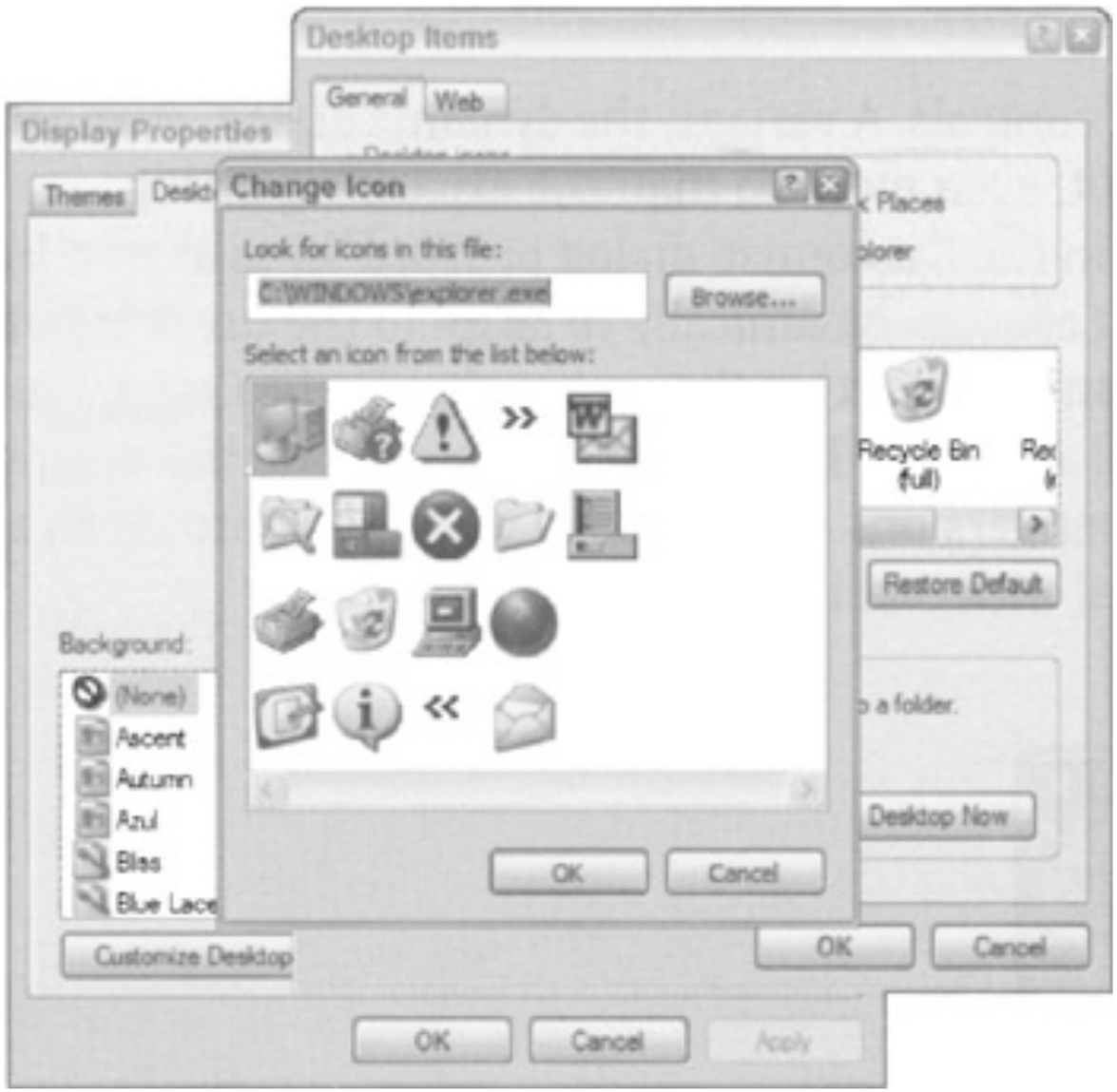
- 1/60s: biologically imperceptible: faster than neurons
- 1/30s: just fast enough for continuous-feedback tasks (e.g., mouse tracking)
- 1/10s: imperceptible delay for discrete actions, e.g. button clicks.
- 1/2s: fast but noticeable (ok for command-response interaction)
- 1/2s–5s: increasingly annoying but user stays focused
- 5s–10s: User starts to lose attention.
- 10s–1 min: User becomes distracted and productivity declines. App needs to support parallel activities.
- >1 min: Significant loss of productivity. User leaves for coffee, chats with friends.

Modes

- Modes: states of UI that limit the possible interactions.
  - Good: restricted context-sensitive vocabulary simplifies user interaction on current task
  - Bad: can be confusing and can trap users
- Moral: use judiciously

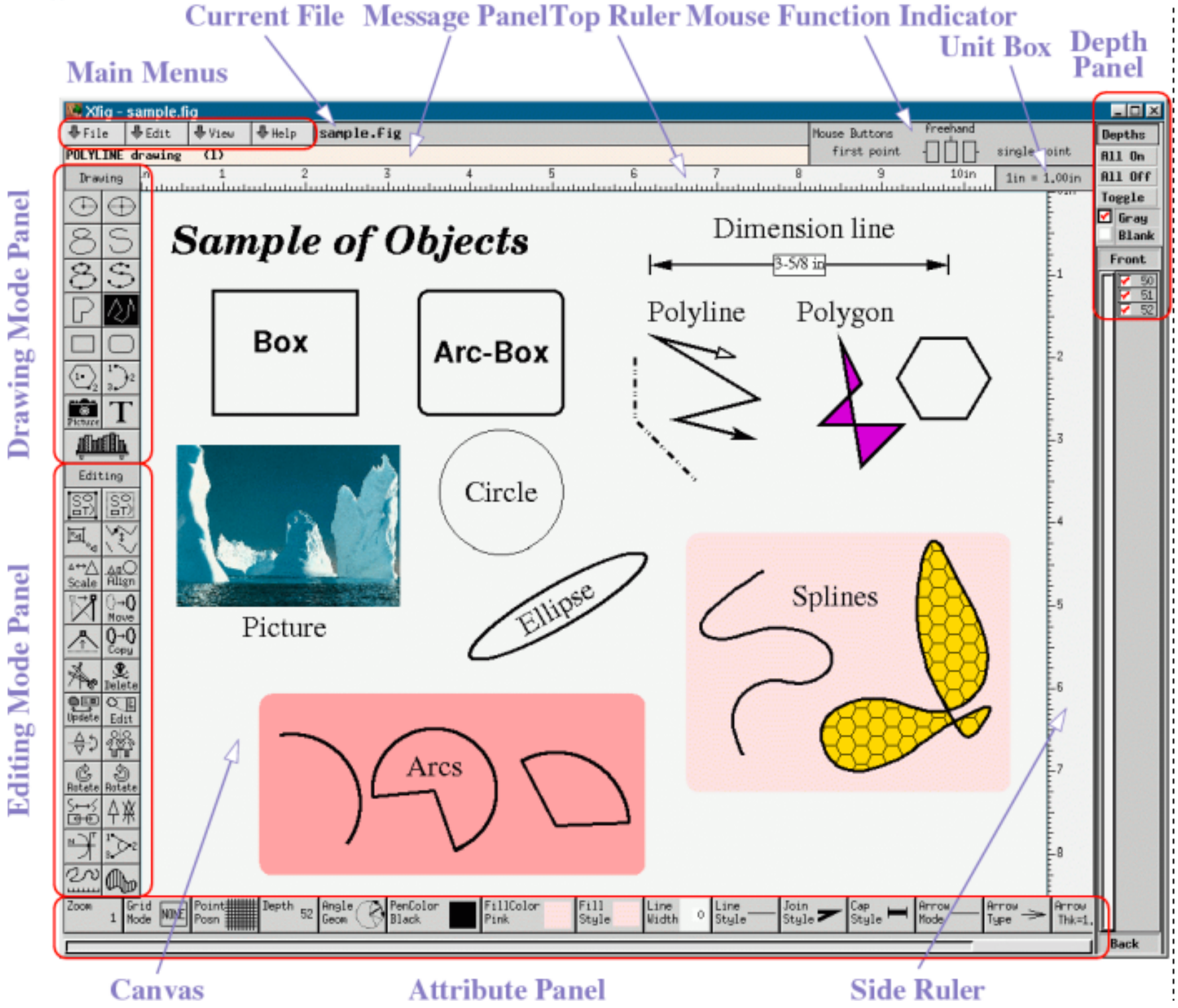


Modes gone bad: cascading dialogs



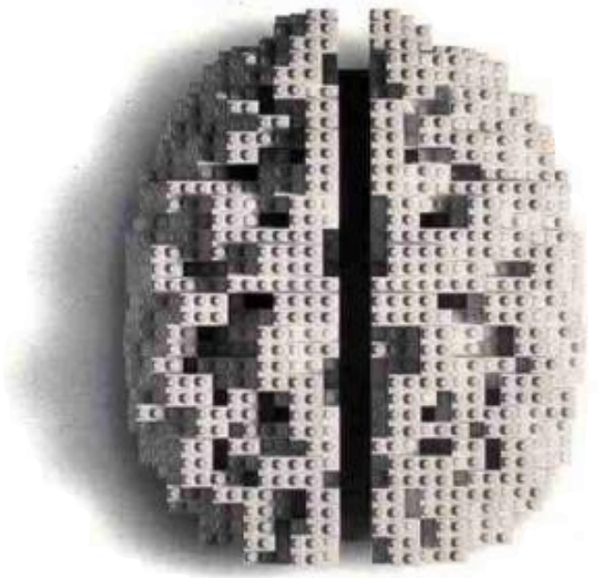
Know your user. UI is a dialogue.

xfig: the context-sensitive mouse



Know your user. UI is a dialogue.

Principle 3:
Aid Memory



"The advantage of a bad memory is that one enjoys several times the same good things for the first time."

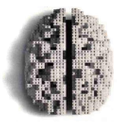
— Friedrich Nietzsche

Keep models simple

user interface

model

- Good models of data and operations are easier to learn and to remember
  - based on familiar abstractions
  - describable as narrow interface with simple spec



Trash model

```
class Trash {
    /** Move file to trash but remember where it was. */
    void discard (File f);

    /** Remove file from trash and
     *  restore it to its previous location. */
    void putBack(File f);

    /** Permanently delete all files in the trash. */
    void emptyTrash();
}
```

Simple, familiar, narrow

Rule of 7

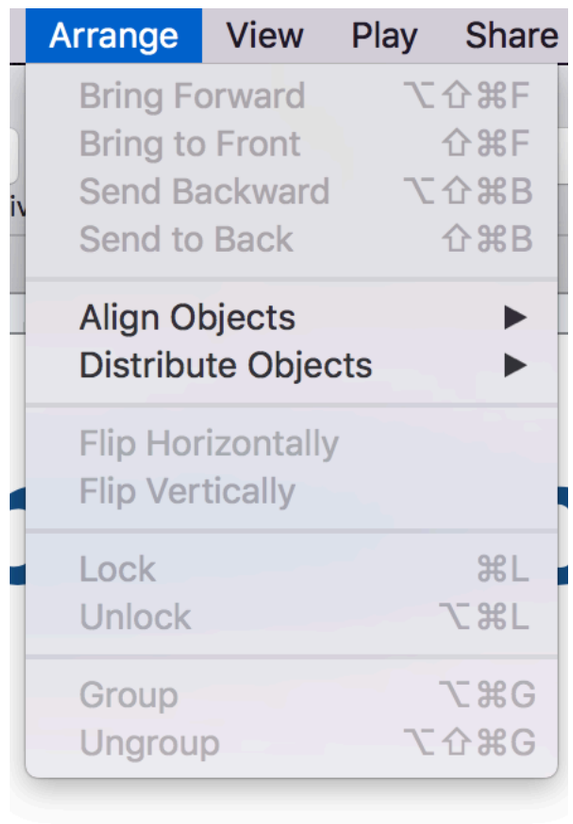
- Humans can hold at most 7 things in their head at once

⇒ Avoid long menus, arrays of buttons

⇒ Avoid complex modes

Spatial organization

- Place things that belong together close by
  - related functionality
  - used in same workflows



Spatial memory

- Human strength: spatial memory (e.g., memory palaces).
  ⇒ Good UIs exploit it

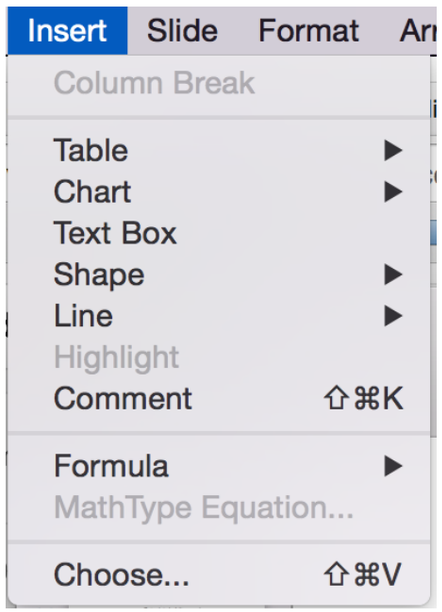
- Each window or dialogue or mode is a "place" for interaction
  - make it a nice place to be
  - avoid unnecessary places/modes
  - make navigation easy, obvious
- Big-picture views strengthen spatial sense

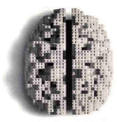
Muscle memory

- Frequent users don't need to look – UI is programmed into their muscles

$\Longrightarrow$ action needed to activate functionality should be consistent

- e.g., gray out menu items, don't remove them





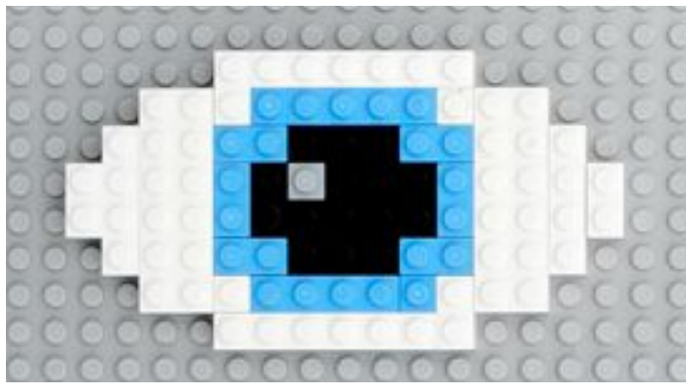
Context-sensitive help

- Help should be about what user is doing now.

$\Longrightarrow$ task-focused rather than feature-focused (unlike many modern apps!)

$\Longrightarrow$ modes provide context

Principle 4:
Visual design matters



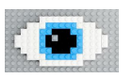
Avoid visual clutter

Tufte. Envisioning Information

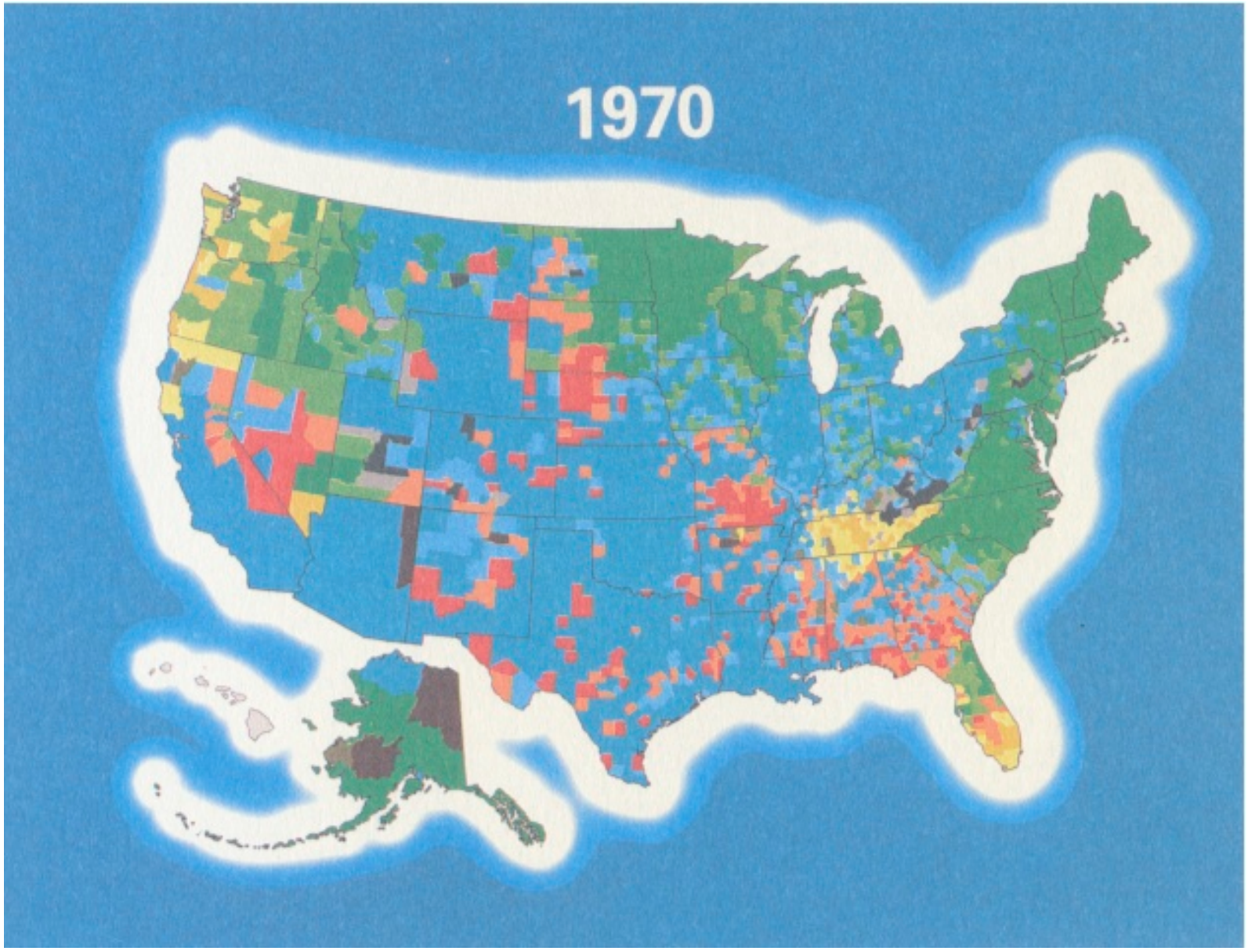
Know your user. UI is a dialogue. Aid memory. Visual design matters.

Avoid visual clutter

- Use space shading, color instead of lines to organize
- Use low-contrast separators
- Maximize information/“ink” ratio



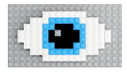
Good use of color and contrast?



Use high contrast, avoid chromatic aberration

This low-contrast text is probably not fun to read.

And it gets harder if the font size is small.



Visual consistency

- For novice users, be *externally* consistent with existing apps and real world
- For expert users, be *internally* consistent
  - e.g., buttons that navigate vs. buttons that change state vs. buttons that expose new information

- write **style guide** so developers maintain consistency.

COLORS

ON-SCREEN

Computers, televisions and other electronic displays use combinations of red, green and blue to simulate a large gamut of colors. Many displays are able to show millions of colors and can often display colors more vivid than printers.

ON-PRESS

Standard printing process, from desktop ink-jets to industrial offset lithography use combinations of cyan, magenta, yellow and black inks to simulate a large gamut of colors. This method is not able to produce the full color spectrum and lacks strongly-saturated green and orange.

CUSTOM INKS

The Pantone Matching System by Pantone, Inc. is a proprietary method of mixing inks to exacting standards. It allows highly-accurate color reproduction and is key in unifying corporate communications. PMS numbers, as listed at right, are to be used when designing and printing materials.

PRIMARY COLOR

The primary color is an off-black that screens to a subtle brownish color. It is to be used in one of the four manners shown at left.

This color allows for adequate contrast in type and photography while retaining approachability and warmth.

PMS 412 C 0 M 30 Y 66 K 98

100% 60% 15% MONOTONE IMAGERY

DO NOT

- Mix with other colors
- Screen at percentages other than sixty or fifteen

ACCENT COLOR

The bold and warm accent color provides variation to printed materials that builds hierarchy, captures attention and evokes the bold nature of GIRAFFE HEROES.

PMS 193 C 0 M 100 Y 66 K 13

100%

DO NOT

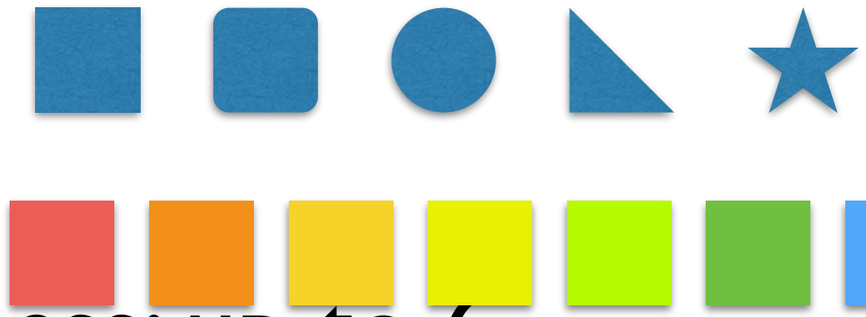
- Mix with other colors
- Use anything but 100%

giraffe project

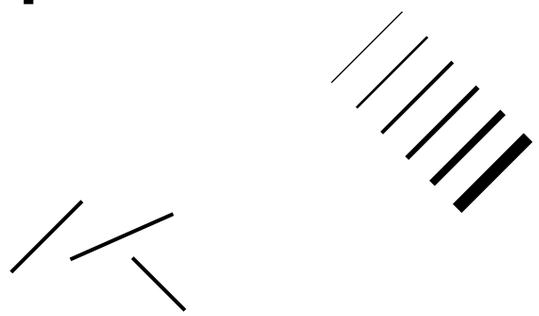
COLOR

Know your user. UI is a dialogue. Aid memory. Visual design matters.

Visual features



- Shape: up to 15
- Color: up to 24
- Size, length, thickness: up to 6
- Orientation: up to 24



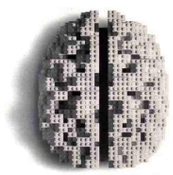
- Texture
- Color perception varies!
  - 8% M, 0.4% F have altered perception

⇒ color should only *complement* other sources of information

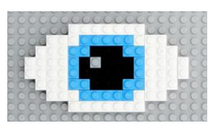
UI design principles

- Know your user

- UI is a dialogue



- Aid memory



- Visual design matters