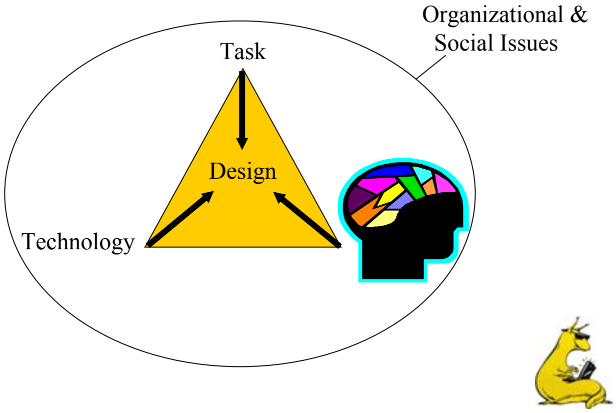
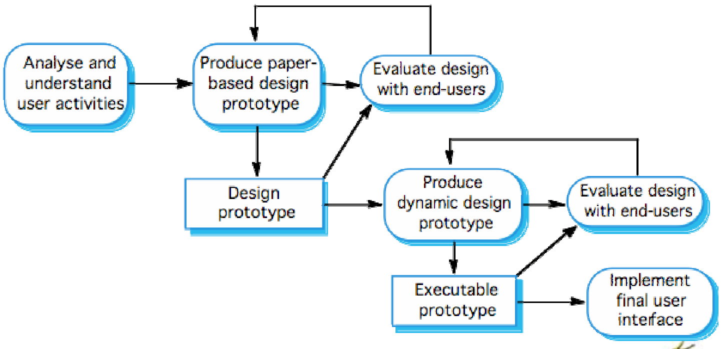
HCI Foundations: Design Process



The design process (in reality)


Analyse and understand user activities
Produce paper-based design prototype
Evaluate design with end-users
Design prototype
Produce dynamic design prototype
Evaluate design with end-users
Executable prototype
Implement final user interface

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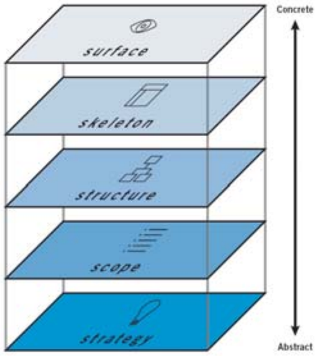
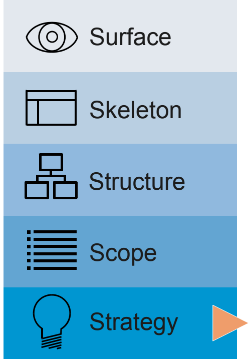
Or see it as a 5 layer development



Strategy = users, usage, goals



goals:
- spreadsheet w. embedded statistical functions
- integration w. text editor
- establish file format as default information sharing format
- …

user profiles:
- accountant
- business planner
- engineering students
- …

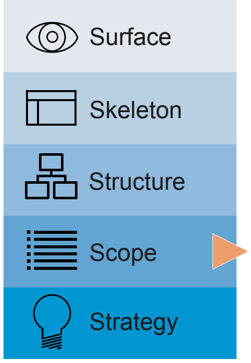
usage contexts:
- office desktop
- laptop on airplane
- in the field
- …

Requirements

Personas

Scenarios

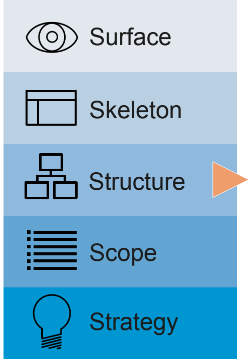
Scope = user tasks supported

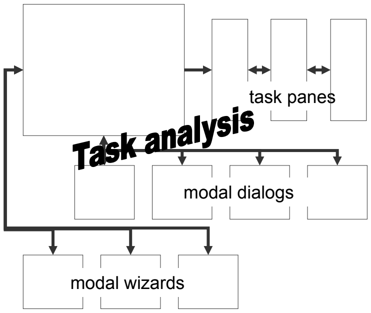


user tasks:
- enter numbers
- enter text
- enter formulas
- format cells
- sort information
- filter information
- aggregate information
- graph data
- save data
- import data
- export data
- print
- …..

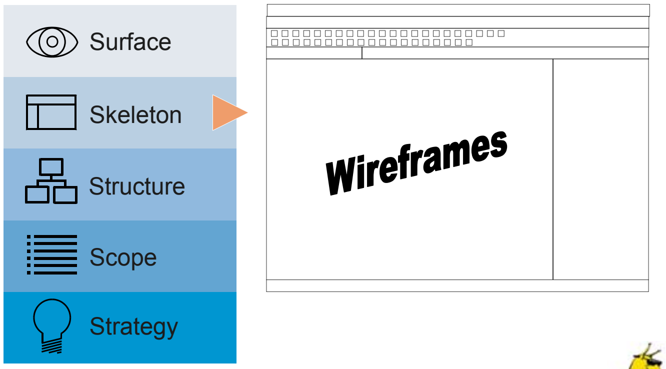
Task examples

Structure = Dialog progression





Skeleton = Screen Layout and Functional Compartments in the Screen



Surface

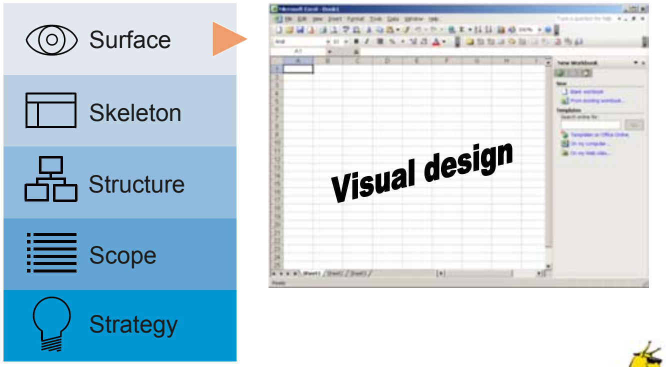
Skeleton

Structure

Scope

Strategy

Surface = Visual Design Aspects



Surface

Skeleton

Structure

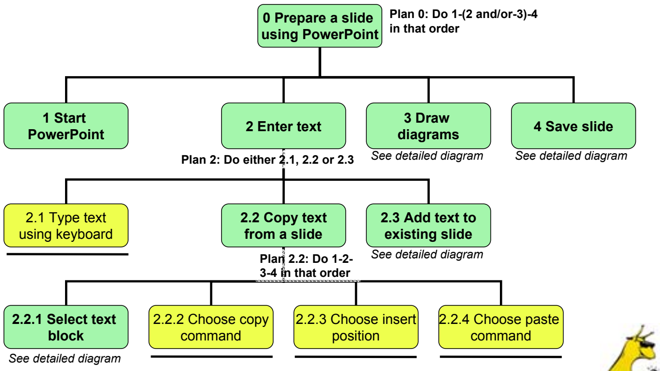
Scope

Strategy

(Hierarchical) Task Analysis

- Methods of analysing what people **can** do, what things they use and what they know.
- Description of work by hierarchical decomposition.
- Divided into *goals, tasks* and *actions*
  - Goals: The end-point of work (may be several)
  - Tasks: Reasoning about combinations of actions
  - Actions: Simple, cognitively singular operations
- Not timing, precedence, order of task performance
- Arbitrary level of elaboration by the analyst
  - Depends on scope of problem
  - Depends on likely value of elaboration

Hierarchical Task Analysis



0 Prepare a slide using PowerPoint

Plan 0: Do 1-(2 and/or-3)-4 in that order

1 Start PowerPoint

2 Enter text

3 Draw diagrams

4 Save slide

Plan 2: Do either 2.1, 2.2 or 2.3

See detailed diagram

See detailed diagram

2.1 Type text using keyboard

2.2 Copy text from a slide

2.3 Add text to existing slide

Plan 2.2: Do 1-2-3-4 in that order

See detailed diagram

2.2.1 Select text block

2.2.2 Choose copy command

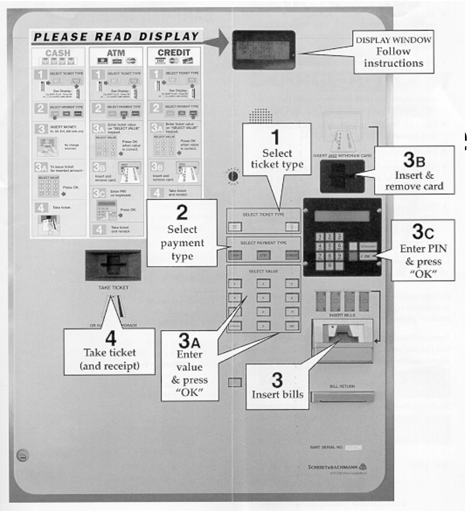
2.2.3 Choose insert position

2.2.4 Choose paste command

See detailed diagram

Task Analysis: Plans

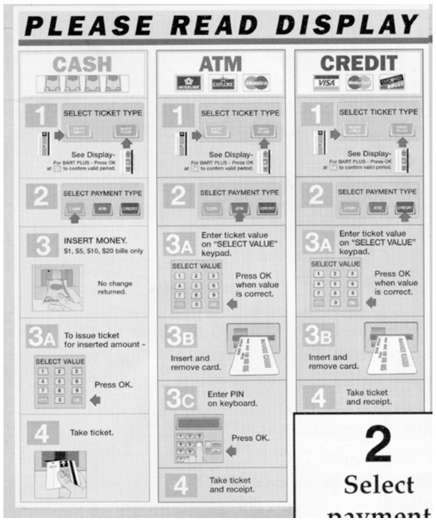
- fixed sequence - 1.1 then 1.2 then 1.3
- optional tasks - if the distance is big, do 1.2
- waiting for events - when the prescription is ready, do 1.4
- cycles - do 5.1 then 5.2 while there are still prescriptions to fill
- time-sharing - do 1 and 2 at the same time
- discretionary - do any of 3.1, 3.2 or 3.3 in any order
- mixtures - most plans involve several of the above



PLEASE READ DISPLAY
CASH
ATM
CREDIT
DISPLAY WINDOW Follow instructions
1 Select ticket type
3B Insert & remove card
3C Enter PIN & press "OK"
2 Select payment type
4 Take ticket (and receipt)
3A Enter value & press "OK"
3 Insert bills

From task analysis to rface design

From task analysis to interface design



PLEASE READ DISPLAY

CASH

1 SELECT TICKET TYPE

See Display- For BART PLUS - Press OK at 3A to confirm valid period.

2 SELECT PAYMENT TYPE

3 INSERT MONEY. $1, $5, $10, $20 bills only

No change returned.

3A To issue ticket for inserted amount -

SELECT VALUE

Press OK.

4 Take ticket.

ATM

1 SELECT TICKET TYPE

See Display- For BART PLUS - Press OK at 3A to confirm valid period.

2 SELECT PAYMENT TYPE

3A Enter ticket value on "SELECT VALUE" keypad.

SELECT VALUE

Press OK when value is correct.

3B Insert and remove card.

3C Enter PIN on keyboard.

Press OK.

4 Take ticket and receipt.

CREDIT

1 SELECT TICKET TYPE

See Display- For BART PLUS - Press OK at 3A to confirm valid period.

2 SELECT PAYMENT TYPE

3A Enter ticket value on "SELECT VALUE" keypad.

SELECT VALUE

Press OK when value is correct.

3B Insert and remove card.

4 Take ticket and receipt.

2 Select payment

Structure in a website

- ▶ Long scrollable pages vs. linked shorter pages
- ▶ Number of links (clicks) to get to a goal page - major cause of users abandoning a site.

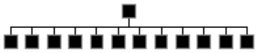
$$C_{unfam} = \left(\sum_{i=1}^{L-1} n^i\right) + 1$$

The average number of clicks to get to the target at an unfamiliar site; *n* = the number of links per page; *L* = the number of levels

- ▶ Depth and breadth also have effect on time

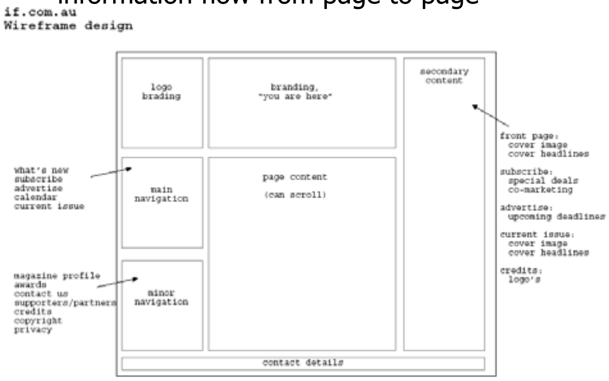
$$ST = \frac{((b+1)t/2 + k + c)}{(\ln b)} \ln n$$

Lee and MacGregor model (1985); ST = search time for self-terminating search (halfway through); depth = d, breadth = b, n = total options in the whole hierarchy, *t* = time to process one option, *k* = human response time and *c* = computer response time

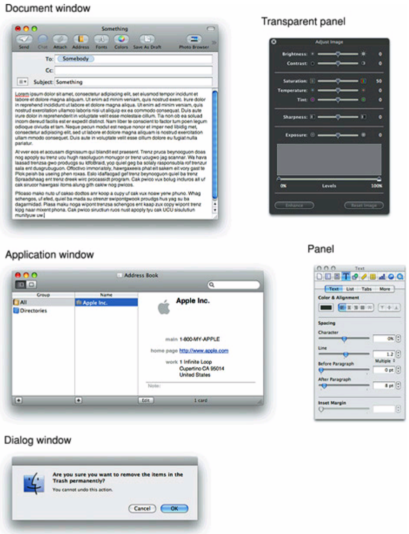


Wireframe

- ▶ Presents basic elements of a page and how information flow from page to page



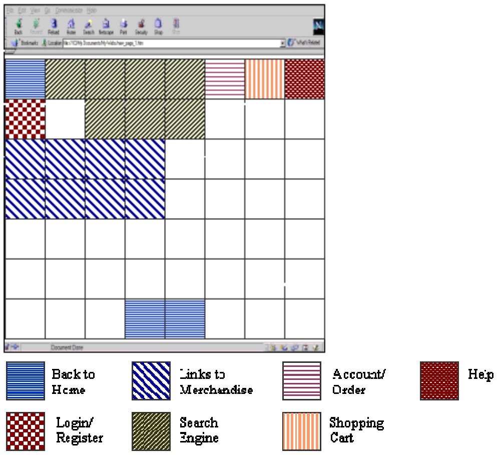
Wireframe



Are you sure you want to remove the items in the Trash permanently?

You cannot undo this action.

Wireframe: e-commerce site



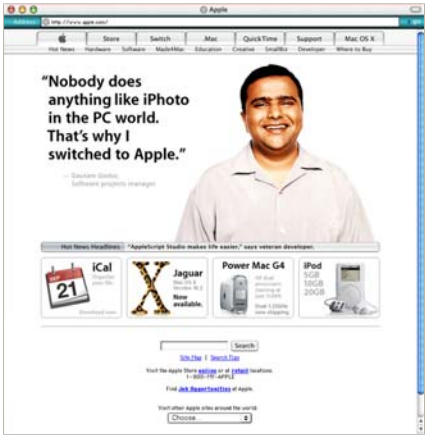
Visual Design Elements

- ▶ Clarity
- ▶ Consistency
- ▶ Alignment
- ▶ Text
- ▶ Images
- ▶ Color

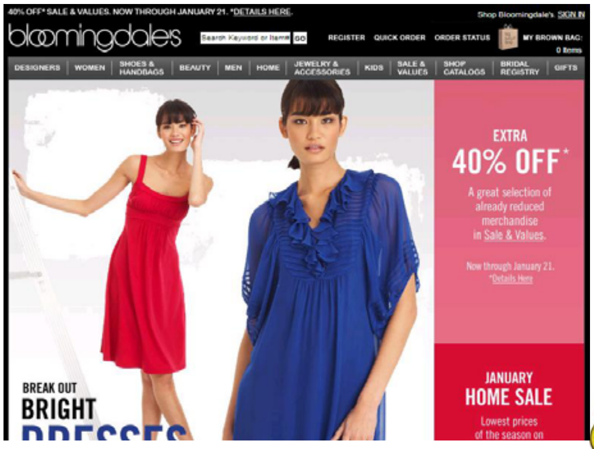
Clarity

- Every element in an interface should have a reason for being there → make it clear, too
- Less is more (economy of visual element)
- Consider overall and local density
  - Overall: how much information is on the screen
  - Local: how tightly packed the information is
- How? White space
  - Leads the eye
  - Provides symmetry and balance through its use
  - Strengthens impact of message
  - Allows eye to rest between elements of activity
  - Used to promote simplicity, elegance, class, refinement

Which is cleaner & clearer? This?



Or this?



Consistency

- Likeness in behavior and appearance between similar tasks/operations/situations/terminology
- Within screen and across screens
- Conceptual consistency is about ensuring the mappings are consistent, that the conceptual model remains clear.
  - Internal: within the system
  - External: in relation to other relevant things
- Physical consistency is ensuring consistent behaviours and consistent use of colours, names, layout and so on.

Consistency: Example

Home page

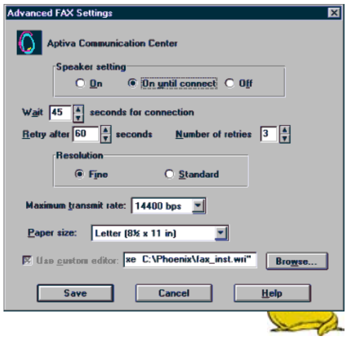
Content page 1

Content page 2

www.santafean.com

Alignment

- Cultural influence
  - West: top left, going right, then down
- Allows eye to parse display more easily
- How? Grids
  - (Hidden) horizontal and vertical lines to help place interface elements
  - Align related things
  - Group items logically
  - Aesthetically more pleasing


Advanced FAX Settings

Aptiva Communication Center

Speaker setting
○ On ● On until connect ○ Off

Wait 45 seconds for connection

Retry after 60 seconds Number of retries 3

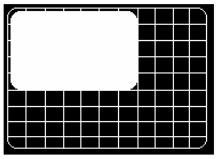
Resolution
● Fine ○ Standard

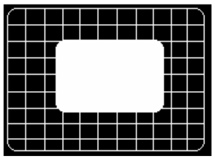
Maximum transmit rate: 14400 bps

Paper size: Letter (8½ x 11 in)

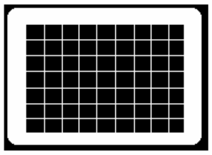
☒ Use custom editor: xe C:\Phoenix\fax_inst.wri"

Grids for user interfaces



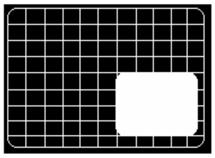


- Areas of the screen that automatically add emphasis to any material, graphic, or text placed there

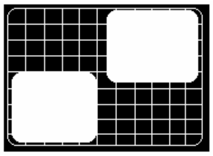


- Tend to minimize whatever is located there
- Ideal for navigational devices such as button bars, pull down menus, or status information

Grids for user interfaces

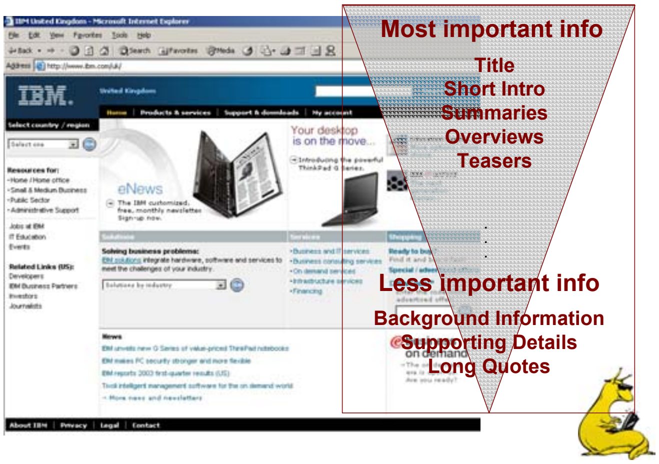


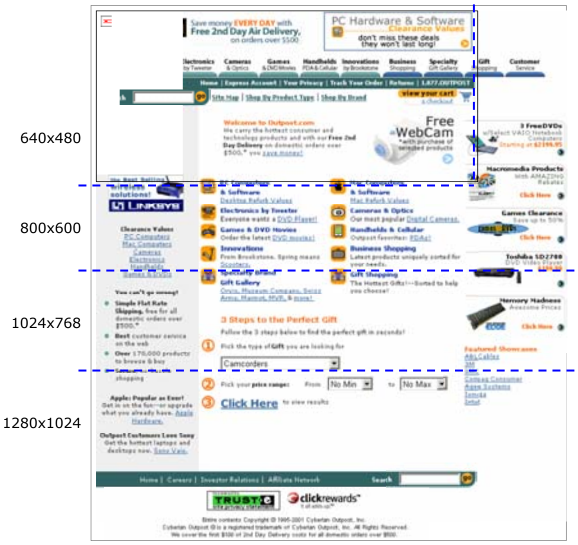
- Neutral impact on whatever is located there
- Good for summation text or summary graphics
- Minor elements may be overwhelmed



- Tend to add minimal impact to any graphics or text located there

Inverse Pyramid Writing



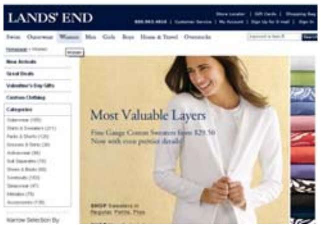


Web Screen Grids

1. Inverted 7 Grid
2. L-shaped Grid
3. Double-track Grid
4. Open Grid
5. Invisible Grid
6. Visible Grid
7. Horizontal Grid
8. Vertical Grid

1. L-shaped Grid

- vertical navigation on the left side
- additional navigation on the bottom *(less than optimal, don't use for primary navigation)*
- ideal for more text heavy sites

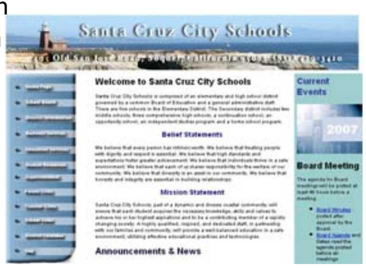


2. Inverted 7 Grid

- horizontal panel dominates the top
- vertical navigation on the left, open to the right *(left-hand navigation scheme most dominant, 30% use)*
- ideal grid for heavy use of images

3. Double-track Grid

- vertical navigation or secondary info on the left and right
- used for extensive navigation
- crowds the main information in one column

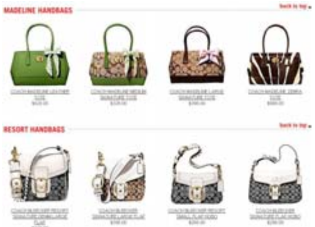


4. Open Grid

- navigation at the top *(tab navigation - 30% use, links across top of page 18%)*
- no set structure, open page
- cleanest and easiest to use
- used for sites with minimal navigation

5. Invisible Grid

- single-image screen - splash page
- page before the home page
- ideal grid for more artistic sites
- combine with other grid for main page

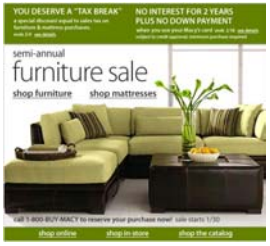


6. Visible Grid

- a highly visible grid with organized columns
- grid is preserved through every page of the site
- used in e-commerce site to present collections

7. Horizontal Grid

- all elements are aligned left to right and separated with ample white space
- creates a sense of openness from one side to the other
- difficult for large images

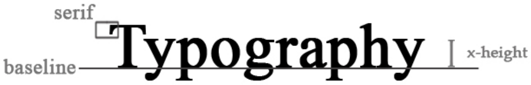

YOU DESERVE A "TAX BREAK"
NO INTEREST FOR 2 YEARS PLUS NO DOWN PAYMENT
semi-annual
furniture sale
shop furniture
shop mattresses
call 1-800-BUY-MACY to reserve your purchase now! sale starts 1/30
shop online
shop in-store
shop the catalog

8. Vertical Grid

- popular with three-dimensional sites (navigation, advertising, other elements)
- enables clear distinctions in the grid
- not ideal for text-heavy sites, used for short bits of info

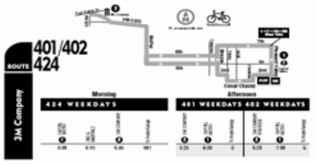
Text

- Use appropriate character size (e.g. older persons ≥12pt)
- *Poorly defined font type is harder to see*
- **BOLD is more visible** but tiring so use with caution
- The best for readability/salience trade-off is the Title Case, not ALL CAPITALS nor all small characters
- Sans Serif (Arial, Tahoma) is easier to read on screen than Serif (Times New Romans, Baskerville)
- wide kerning (horizontal space between letters) is easier to read than narrow kerning
- Also take into consideration 'leading' (the distance between 2 baselines)



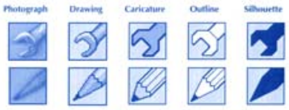
Images

- Images are the most enduring form of written communication, whether phonetic or ideographic.
- Images have been found to be:
  - Recognized faster and more accurately than text
  - Learned faster
  - Demand less from human memory
- To make effective images, we need to:
  - Know how they work
  - Understand how users perceive, recognize, remember, and use



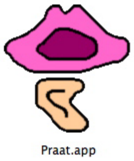
Icons

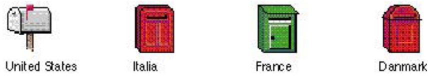
- **Icon**: a (simplified) picture on a screen that represents a specific file, directory, window, option, or program.
- Designed with a purpose, functional, and predictable
- From Apple's website on designing icons:
  - Perspective and shadows are the most important components
  - Use universal imagery that people will easily recognize
  - Simplicity - use a single object that captures the icon's action, start from basic shapes
  - Use color judiciously
  - Use icon genres to help communicate what users can do with an application before they open it



Icon Recognition

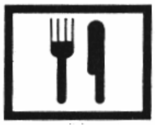
- Users must first recognize what the image is
- Recognition of images is quicker and more reliable if icons are:
  - Specific & concrete
  - Representations of real-world objects
  - Vivid and clearly depicted
  - Conceptually distinct one from another
- But unless very familiar, might be affected by users' cultural background





Icon Decoding

- The user must learn the icon's new meaning
  - What the picture represents
- Sometimes can be ambiguous. Tip: use
  - analogous image to underlying concept
  - a typical example of concept
- Mouse-over is always a good idea



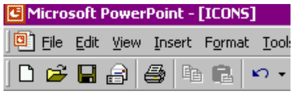
ISO 9186: Testing graphical symbol

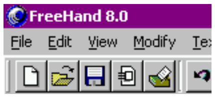
- When adapted for icon testing:

1. Comprehensibility judgment test
   - Give the function and several symbols, one of which has an opposite meaning
   - 1 = Correct understanding is certain (≥80% population)
   - 2 = Correct understanding is very probable (66-80%)
   - 3 = Correct understanding is probable (50-65%)
   - 4 = The meaning understood is opposite of intention
2. Comprehension test
   - Give one symbol at a time
   - What do you think the symbol mean?

Icon Location

- Users must be able to quickly and accurately locate the icon
- Speed and accurate location of a visual object depends on if:
  - The user has pre-established knowledge of the icon
  - The icon is distinct from all other objects in its shape and color


Microsoft PowerPoint - [ICONS]
File Edit View Insert Format Tool



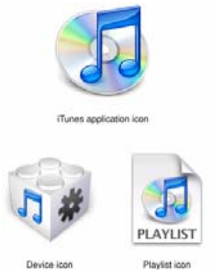
Icon Activation

- Users must know how to use the icon
  1. How it is activated: by single or double click, only mousing over (annoying), etc → through design
  2. Appearance of activation: color change, becoming non-underlined, application launch, progress indicators, etc.
  3. Activation result: sent to a new page, open a file, open a new window, etc.

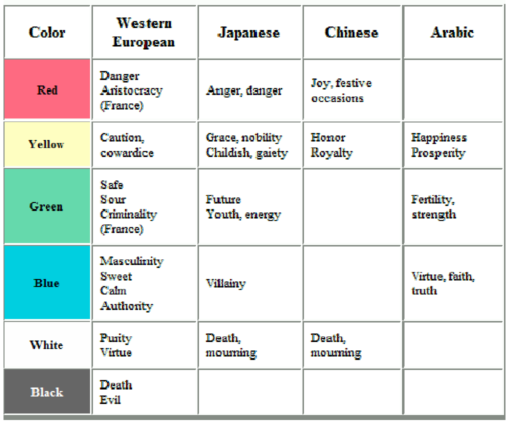
KEY: Be consistent in icon activation throughout interface (metaphor) and between applications

Icon Families

- A grouping of similarly-styled icons
- Although each icon in an icon family should be distinct, a consistent style should be present in each
- If you are creating a family or grouping of icons, do not design any icon in isolation



Color Meanings: Culturally Specific



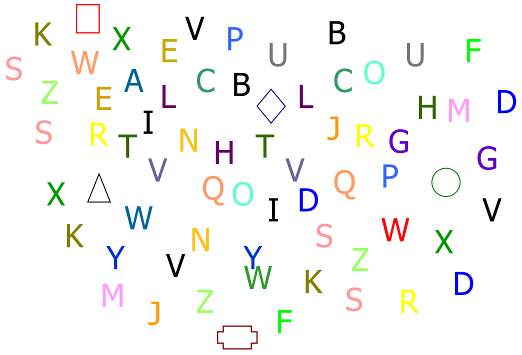
Color	Western European	Japanese	Chinese	Arabic
Red	Danger Aristocracy (France)	Anger, danger	Joy, festive occasions	
Yellow	Caution, cowardice	Grace, nobility Childish, gaiety	Honor Royalty	Happiness Prosperity
Green	Safe Sour Criminality (France)	Future Youth, energy		Fertility, strength
Blue	Masculinity Sweet Calm Authority	Villainy		Virtue, faith, truth
White	Purity Virtue	Death, mourning	Death, mourning	
Black	Death Evil			

http://www.ricklineback.com/culture2.htm

Searching and Color

- Search for a particular item on a display
- Color generally faster than character (but shapes are fastest)
  - Shapes (60%)
  - Size (40%)
  - Color (40%)
  - Alpha characters (40%) → %, >, <, ?
  - Characters (10%) → vary by character (A is faster)

Find the Red Letter; Find the 'A', Find the triangle

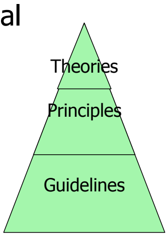


'Design'

- Conceptual design
  - Designing the system in the abstract.
  - What information and what functions are needed for the system to achieve its purpose?
  - What will someone have to know to use the system?
  - It is about helping users develop a clear mental model of the system
- Formal/physical design
  - How things are going to work
  - Detailing the look and feel of the product
  - Structuring interactions into logical sequences
  - Clarifying and presenting the allocation of functions and knowledge between people and devices.

Design Theories, Principles, Guidelines

- **Theories** – high level (includes models)
  - Describe systems, objects, actions with consistent terminology for teaching, education, and communication
  - Help predict or explain performance and behavior
- **Principles** – mid-level
  - Useful for analyzing and comparing competing designs
- **Guidelines** – specific and practical
  - Cures for design problems
  - Cautions for potential danger
  - Reminders based on experience
- Why use them?
  - Make efficient, proven decisions
  - Not to repeat mistakes of the past



Design Theories and Guidelines

- **Theories** – high level (include models)
  - Descriptive and explanatory
    - Describe and explain why certain actions or phenomena happen
  - Predictive
    - Predict human performance, satisfaction etc by interpolating previous knowledge
  - Ex: Model Human Processor, Fitts' Law
- **Guidelines** – examples
  - Ensure that embedded links are descriptive
  - Use unique and descriptive headings
  - Use radio buttons for binary choices
  - Use thumbnail images to preview larger images

Design Principles

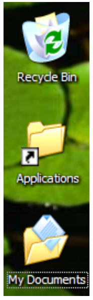
- Rules of thumb to help with the design process
- There are many of them, borrowed from computer graphics, software engineering, HCI
- No "cookbooks", no universal checklists
- Become obvious to user of poorly-designed UIs
- Are easy to ignore
- Apply at multiple levels of design
- Are neither complete nor orthogonal
  - Can all be "broken", often to satisfy another rule
- Have underpinnings in psychology or experience or common sense

Usability Principles from Dix et al.

- Learnability: Ease with which new users can begin effective interaction and achieve maximal performance
  - Predictability, Synthesizability, Familiarity, Generalizability, Consistency
- Flexibility: Support for multiple ways of doing tasks
  - Dialog Initiative, Multithreading, Task migratability, Substitutivity, Customizability
- Robustness: Supporting user in determining successful achievement and assessment of goals
  - Observability, Error Prevention, Recoverability, Responsiveness, Task Conformance

Usability principles: Learnability

- Predictability: can users predict what happens if they perform an action?
- Synthesizability: can users know what had happened looking at the current state of the system?
- Generalizability: can users generalize their knowledge from one system to another?
- Familiarity: does the system employ familiar representation of information?
- Consistency: does the system maintain consistent representation of similar concepts?

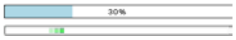


Usability principles: Flexibility

- Dialogue initiative
  - System pre-emptive: system prompts, user responds
  - User pre-emptive: user-initiated dialogue
- Multi-threading
  - Concurrent: Input goes to multiple tasks simultaneously
  - Interleaved: Many tasks, but input goes to one at a time
- Task migratability
  - Ability to move performance of task to the entity (user or system) that can do it better
- Substitutivity for Input and Output
- Customizability
  - Adaptability: Ability for users to adapt the interface
  - Adaptivity: Ability for system to adapt the interface (based on user/task model)

Usability principles: Robustness

- Observability: can user know what's happening with the system?
  - Browsability: ability to monitor without changing state → mouse-over reveals what's waiting
  - Persistence: duration of observable state
  - Feedback: an important element to support observability (let users know what to expect)
- Recoverability from task prosecution
  - Backward and forward error recovery (undo and redo)
  - Abort operation underway (only if it's slower than cognitive processing)
  - What to do if action cannot be undone?



Usability principles: Robustness

- Responsiveness: user's perception of what's acceptable speed
  - Depends on the task demand (ATC vs. ship navigation)
  - Depends on the nature of the operation (games vs. OS installation)
  - Depends on the MHP elements that are involved (drag-and-drop vs. observing google's search results)
  - Consistency is important (users remember the bad experience)
- Task conformance: Does system support all tasks user wishes to perform in expected ways?
  - Task completeness: Can system do all tasks of interest?
  - Task adequacy: Can user understand how to do tasks?
  - Extensibility: Does it allow user to define new tasks?

User Interface Design Principles*

Principle	Description
User familiarity	Use terms and concepts *familiar* to the user as it helps reasoning.
Consistency	Comparable operations should be activated in the *same way*. Commands and menus should have the same format, etc.
Minimal surprise	If a command operates in a known way, the user should be able to *predict* the operation of comparable commands.
Feedback	Update users on what's going on, maintain *two-way communication*.

* From software engineering

User Interface Design Principles

Principle	Description
Memory load	Reduce the amount of information that must be remembered between actions. *Minimize* the memory load.
Efficiency	Seek efficiency in dialogue, motion and thought. *Minimize keystrokes and movements*.
Recoverability	Allow users to *recover from their errors*. Include undo facilities, confirmation of destructive actions, 'soft' deletes, etc.
User guidance	Incorporate some form of *context-sensitive user guidance* and assistance.

Principles of Good HCI Design*

Principle	Description
Learnability	Visibility, consistency, familiarity, affordance (heard those before)
Ease of use	Navigation, control, feedback (heard those before). Navigation = providing support for users to move around the system.
Safety	Recovery from error, constraint (heard those before).
Accommodation	Flexibility, style (aesthetic design), conviviality (polite, friendly, and pleasant)

* Benyon et al., Designing Interactive Systems

Evaluation

- All of the other processes are closely linked with evaluation
- Systems must be ***verified*** and ***validated***
  - Verification is correctness within the terms of product specification
    - Designing the product right
  - Validation is the correctness of the product within the terms of its intended use
    - Designing the right product

Evaluation approaches

- Two approaches, complementary but different
- Formative → normally qualitative data (strategies, problem descriptions, comments)
  - Carried out early and throughout system development with the goal of guiding design
- Summative → more focused on quantitative data (success rates, times, errors, satisfaction)
  - Carried out at the end or at milestones during system development with the goal of assessing how well the system has met its objectives