

# Graphical Screen Design

## CRAP

(Contrast, repetition, alignment, proximity)

## Grids

An essential tool for graphical design

## Other important graphical screen design concepts

Visual consistency

Visual relationships

Visual organization

Legibility and readability

Appropriate imagery

Navigational cues

Familiar idioms

James Tam

## The Squint Test

Used to determine what stands out or what elements appear to belong together



James Tam

# CRAP: An Important Tool For Graphical Screen Design

## Contrast

- Make different things even more different
- Brings out dominant elements & mute lesser elements

## Repetition

- Consistency
- Repeat conventions throughout the interface to tie elements together

## Alignment

- Visually associate related elements by lining them up

## Proximity

- Group related elements
- Separate unrelated elements

James Tam

## Contrasting Contrast

**Laura Mathews**  
1951 Santa Rosa  
Santa Rosa, California 95401  
207.567.1234

**Related Skills**

Excellent working knowledge of laboratory tests and their application in oncology care through working in a clinical laboratory, analytical skills providing patient care. Assisted with laser machine layout and operation, further patient preparation, chemotherapy, and intravenous/chemotherapy administration. Promoted self-care skills and education of the client to their disease and particular treatment program.

Extensive experience with at-home care of site and cancer patients, including IV line maintenance, pain management, understanding of medicine reimbursement and social service referrals.

**Education**

1990 Associate in Science Nursing, High Honors  
Santa Rosa Junior College, Santa Rosa, California

**Experience**

1992-present Registered Nurse for Home Health Plus, Visit Division. At-home care of patients with multiple health problems, site, and cancer patients.

1990-present Registered Nurse for Memorial Hospital Oncology Unit, Santa Rosa, California. Managed the care of 4-5 oncology patients. Assisted lead nurse responsibilities. Assisted with new IV initiation. Assisted with procedures, administered chemotherapy, assessed for side effects of chemotherapy and client progress.

1985-1986 Nurse's Aide for Mendocino Coast District Hospital, Fort Bragg, California. Assisted with patient care in Med-Surg and Obstetrics settings.

1980-1984 Lab Assistant for Mendocino Coast District Hospital, Fort Bragg, California. Computer skills while inputting data, cultured lab specimens.

**Personal Statement**

Previous work experience in a fast-paced, high-stress environment has fine-tuned my organizational skills. My experiences have made me comfortable with oncology patients and their families. I appreciate value my organizational skills, superior to learn and assume responsibilities, and my dedication to my job.

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James Tam

## Repetition

### **Mickey Mouse**

- Walt Disney Studios  
Anaheim, California  
58 years old, no children

### **Employment**

- Walt Disney Studios
- Various television studios

### **Education**

- Walt Disney Studios

### **Favorite Activities**

- Driving steamboats
- Roping cattle

### **Favorite Quote**

- Everybody can't be a duck.

James Tam

## Alignment

### **Honor Form**

Heresy rheumatic starry offer former's dodder, Violate Huskings, an wart hoppings dam bounce form.

Violate lift wetter fodder, oiled Former Huskings, hoe lutter repetition for bang furry urch-an furry stretchy, Infect, simple orphan set debt Violate's fodder worse nosing button oiled mouser, Violate, honor udder hen, worsted furry gnats parson-jester putty laile form gull, sample, morticed, an unafflicted.

### **Tarred gull**

Wan moaning Former Huskings mudst haze dodder setting honor cheer, during nosing.

"Violate" sorted dole former, "Watches setting dam far? Denture nor yore canned gat retch setting darn during nosing? Germ pup offer debt cheer?"

"Am tarred, Fodder," resplendent Violate warily.

"Watches tarred far?" aster stretchy former, hoe dint häll mush symphony further gull.

### **Feeder pegs**

"Are badger dint doe mush woke dak moaning! Dächer curvy dose buckles fuller slab darn tutor peg-pan an feeder pegs?"

"Yap, Fodder. Are letter pegs."



"Dächer mail-car caws an swoop offer caw staple?" "Oll curse, Fodder. Are mukt offer caws an swapped offer staple, letter checkings, an clammed upper laeder inner checking-horse toe godder

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"Watches tarred far?" aster stretchy former, hoe dint häll mush symphony further gull.

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"Yap, Fodder. Are letter pegs."



"Dächer mail-car caws an swoop offer caw staple?" "Oll curse, Fodder. Are mukt offer caws an swapped offer staple, letter checkings, an clammed upper laeder inner checking-horse toe godder offer arches, an wen darn tutor vestibule guarding two peck offer baps

James Tam

# Proximity

CD ROMs  
 CD ROMs  
 Children's CDs  
 Educational CDs  
 Entertainment CDs  
 Laser discs  
 Educational  
 Early learning  
 Language arts  
 Science  
 Math  
 Teacher Tools  
 Books  
 Teacher tools  
 Videos  
 Hardware &  
 Accessories  
 Cables  
 Input devices  
 Mass storage  
 Memory  
 Modems  
 Printers & supplies  
 Video and sound

**CD ROMs**  
 CD ROMs  
 Children's CDs  
 Educational CDs  
 Entertainment CDs  
 Laser discs

**Educational**  
 Early learning  
 Language arts  
 Science  
 Math

**Teacher Tools**  
 Books  
 Teacher tools  
 Videos

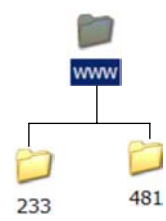
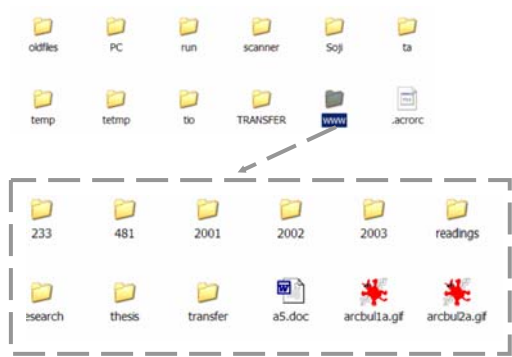
**Hardware & Accessories**  
 Cables  
 Input devices  
 Mass storage  
 Memory  
 Modems  
 Printers & supplies  
 Video and sound

James Tam

# Graphical Design

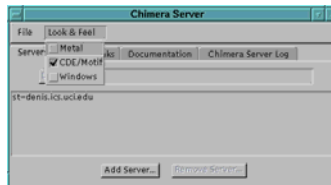
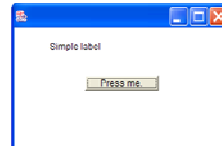
**Must account for:**

- A comprehensible mental image
  - Metaphor (known <-> unknown)
- Appropriate organization of data, functions, tasks and roles
  - Cognitive model (how do I think it works)



## Graphical Design (2)

- Quality appearance characteristics
  - The “look”
- Effective interaction sequencing
  - The “feel”



James Tam

## Components of Visible Language

### Layout

- Formats, proportions, and grids

scarves: 10.75  
hats: 5.43

### Typography

- Typefaces and typesetting

**bold** serif fixed  
*italic* sans-serif variable

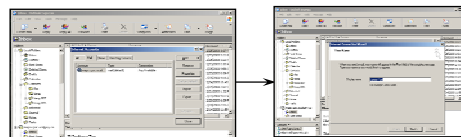
### Imagery

- Signs, icons, symbols; concrete to abstract



### Sequencing

- How the interface unfolds



James Tam

## Components Of Visible Language (2)

### Visual identity

- Unique appearance



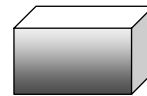
### Animation

- Dynamics of display



### Color and Texture

- Convey complex information and pictorial reality



James Tam

## Grids

### Horizontal and vertical lines to locate window components

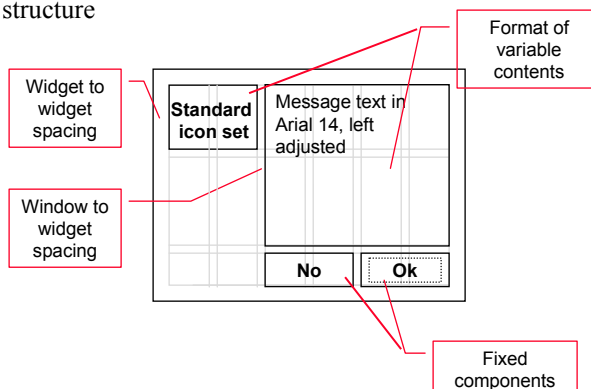
- Aligns related components

### Organization

- Contrast to bring out dominant elements
- Grouping of elements by proximity
- Show organizational structure
- Alignment

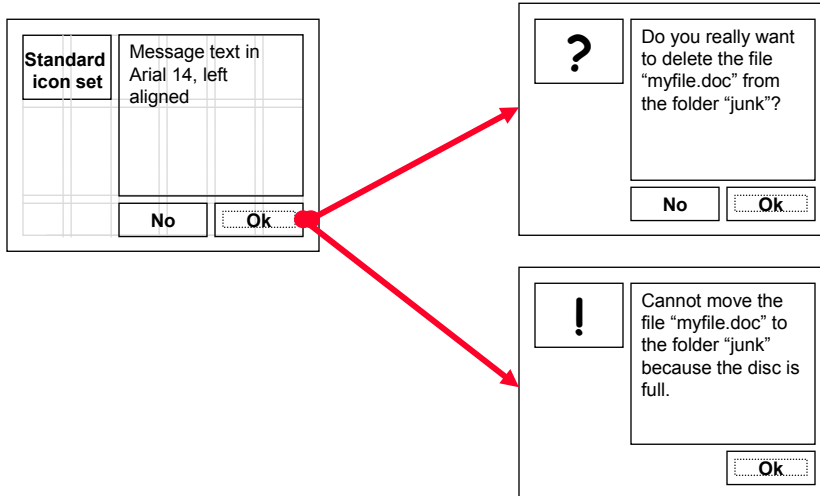
### Consistency

- Location
- Format
- Repetition
- Organization



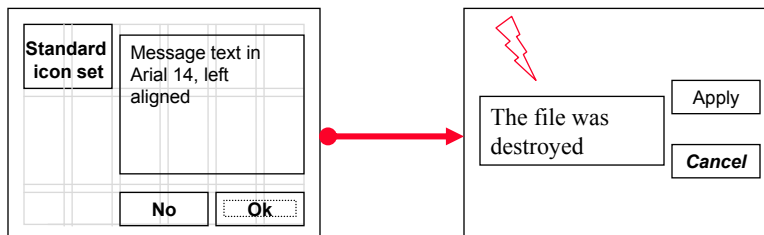
James Tam

## Uses A Grid: Consistent



James Tam

## No Grid: Inconsistent



James Tam

## Another Grid Example

Two-level Hierarchy

- indentation
- contrast

Logic of organizational flow

Alignment connects visual elements in a sequence

Grouping by white space

James Tam

## Visual Consistency: Internal Consistency

- Unless there is a compelling reason all elements of the same program follow the same rules and conventions
- Application specific grids can be used to enforce this

Doh!

Format AutoShape

Colors and Lines | Size | Position | Picture | Text Box | Web

Fill

Color: No Fill

Transparency: 0%

Line

Color: Black Style: Solid

Dashed: 0 pt Weight: 1 pt

Connector: None

Arrows

Begin style: None End style: None

Begin size: 0 pt End size: 0 pt

Default for new objects

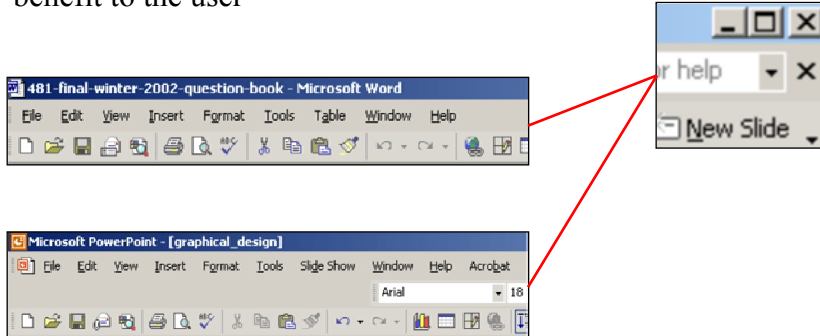
OK Cancel Preview

James Tam



## Visual Consistency: External Consistency

- Follow interface and platform style conventions
- Use grids that are platform (e.g., Windows) and widget (e.g., Java Swing) specific
- Deviate from these conventions only when there is a clear benefit to the user



James Tam

## External Consistency Violated

The image shows a web interface for 'LIGANDFIT' with several sections. The 'Primary Task Information' section includes the title 'LIGANDFIT', the subtitle 'CANCER RESEARCH PROJECT, PHASE II', a description of the project, and a progress bar showing 57% completion. The 'Member Information' section shows 'Name: JimmyT', 'Total Points: 889891', and 'Total CPU Time: 5 years: 132 days: 15 h: 25 m: 23 s'. The 'Device Information' section shows 'Overall Performance' with a score of 100 and a comparison to a 'High-end Desktop System'. The interface uses a blue and white color scheme with various buttons and progress indicators.

The UD agent © United Devices: www.ud.com

James Tam

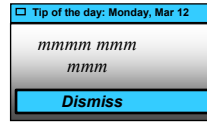
## A Tool For Ensuring Consistency: Mumble Text



✓



✓



✗

James Tam

## Structure Is Difficult To Ascertain

sometimes be more a nuisance than a benefit. This was found to be the case in my own investigation of potential change display mechanisms summarized in Chapter 5 and published as Tam, McCaffrey, Maurer, and Greenberg (2000). During this study, many test participants expressed a desire for useful abstractions that combine rudimentary change information into one higher-level conceptual change. For example, one participant noted while watching the animated replay of a class name being shown "...I don't need to see each and every character being typed just to see a name change!" Of course, care must be taken to make these abstractions understandable, e.g., by using already familiar representations or notations. This minimizes the cost of acquiring information while maximizing its benefits due to the added structure and organization.

Based upon my previous findings (to be discussed in Chapter 5), I add a third dimension, *persistence*, to Gutwin's classification. Persistence refers to how long the information is displayed (Figure 4.1 side pane). The display of information is *permanent* if it is always visible and *passing* if it only appears for a certain period. We noticed how study participants frequently complained when important information disappeared off the screen. Conversely, they also indicated that screen clutter might occur with the mechanisms that constantly displayed all changes. Thus, there's a need to classify change information according to how long it should stay visible.

With permanent persistence, the effort needed to find changes i.e., the acquisition cost is low because the information is always there. Ideally, a person merely has to shift their gaze over to see the information. Because people can become accustomed to the occurrence of workspace events, they can also ignore things that do not interest them and pay closer attention to things that are of interest (Gutwin 1997).

With passing persistence, information about changes is presented only for a limited duration. This is useful when the information applies only to a specific portion of the project (artifact or group of artifacts) being viewed, or when the change information otherwise becomes irrelevant.

The matrix in Figure 4.1 suggests that these dimensions can be combined, giving eight possibilities. For example, a literal, situated and passing display of changes is depicted in Figure 4.2a. The figure shows an animation of a changed circle (by using a 'replay' technique) where the circle literally retraces the path that it took as it was moved. It is situated because the animation occurs in the same place that the change actually happened. The persistence is 'passing' because once an animation has replayed a change, the information is gone. Figure 4.2b shows two other examples within a concept map editor. The first illustrates the symbolic, situated and permanent octant, where color value (shades of gray) is used to indicate changed 'Jim' and 'Jack' nodes. Thus, it is symbolic because changes are mapped to a gray scale value, situated because the shading is applied directly to the node that was changed, and permanent because the color values are always on. Figure 4.2b also portrays an example of the symbolic, separate, and passing octant, where a person can raise a node's change details in a pop-up as a text description by mousing-over the node. Thus it is somewhat separate as the information appears outside the changed node, it is symbolic as it uses the text to describe the changes, and passing because the pop-up disappears when the person moves the mouse off the node (not quite on the node).

In summary, these three dimensions provide the designer with a means of classifying change information. I now turn to other display issues, where we need to represent the change information in an easily understood and readily accessible fashion.

James Tam

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James Tam

## Structure Is Implied With White Space

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James Tam

## Relationships Between Screen Elements

- Using white space (negative proximity) vs. forcing an explicit onscreen structure (e.g., the use of bounding boxes)

Mmmm: <input type="text"/>	Mmmm: <input type="text"/>	Mmmm: <input type="text"/>
Mmmm: <input type="text"/>	Mmmm: <input type="text"/>	Mmmm: <input type="text"/>
Mmmm: <input type="text"/>	Mmmm: <input type="text"/>	Mmmm: <input type="text"/>
Mmmm: <input type="text"/>	Mmmm: <input type="text"/>	Mmmm: <input type="text"/>
Mmmm: <input type="text"/>	Mmmm: <input type="text"/>	Mmmm: <input type="text"/>
x	x	✓

James Tam

## Explicit Structure

The image shows two overlapping dialog boxes from Microsoft Word. The background dialog box is the 'Footnote' dialog, with the 'Numbering Style' set to 'Numeric (4)'. The foreground dialog box is the 'Sort' dialog, which is divided into three columns: 'First Sort', 'Second Sort', and 'Third Sort'. Each column has a 'Sort By' dropdown menu and radio buttons for 'Ascending' and 'Descending'. The 'First Sort' dropdown is set to 'Start Time', and the 'Ascending' radio button is selected. The 'Second Sort' and 'Third Sort' dropdowns are set to 'No Sort'. The 'Sort' dialog has 'Cancel' and 'OK' buttons. The 'Footnote' dialog has 'Set', 'Cancel', and 'Help' buttons. A red circle highlights the 'Set' button in the 'Footnote' dialog.

Using explicit structure as a crutch from Mullet & Sano page 31

James Tam

## What Are The Input Fields? What Is Output Only?

- Bad alignment
- Poor choice of colors to distinguish labels from editable fields

Form Title -- (appears above URL in most browsers and is used by WWW search)		Background Color:
Q&D Software Development Order Desk		FFFBF0
Form Heading -- (appears at top of Web page in bold type)		Text Color:
Q&D Software Development Order Desk <input checked="" type="checkbox"/> Center		000080
E-Mail responses to (will not appear on)	Alternate (for mailto forms only)	Background Graphic:
dversch@q-d.com		
Text to appear in Submit button	Text to appear in Reset button	<input type="radio"/> Mailto
Send Order	Clear Form	<input checked="" type="radio"/> CGI
Scrolling Status Bar Message (max length = 200 characters)		
****WebMania 1.5b with Image Map Wizard is here!****		
<< Prev Tab		Next Tab >>

Webforms

James Tam

## No Regard For Order And Organization

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

Save Cancel Help

IBM's Aptiva Communication Center

James Tam

## A Haphazard Layout

Haphazard layout  
from Mullet & Sano page 105

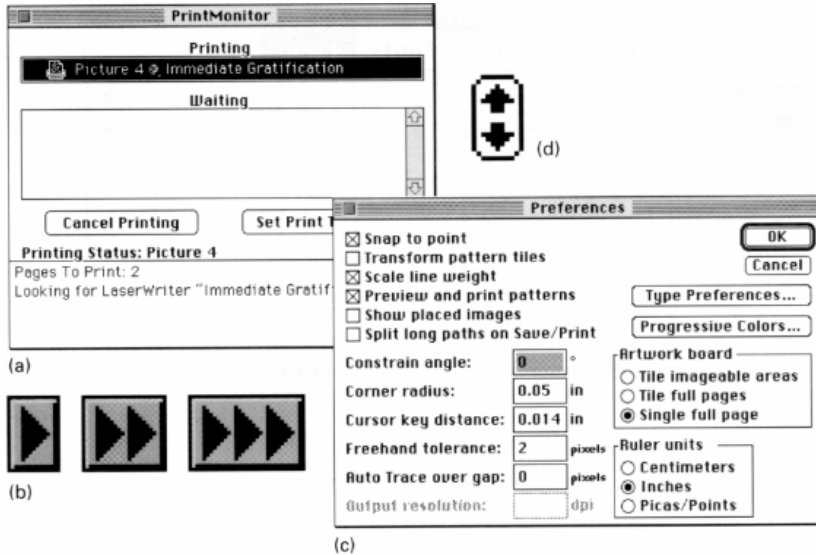
James Tam

## Repairing A Haphazard Layout

Repairing a  
haphazard layout  
from Mullet &  
Sano page 105

James Tam

## Spatial Tension



Spatial Tension from Mullet & Sano page 72

James Tam

## Overuse Of 3D Makes The Layout Look Cluttered

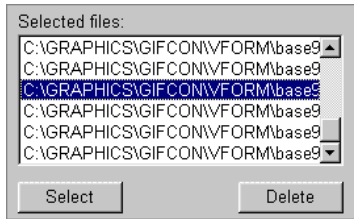


WebForms

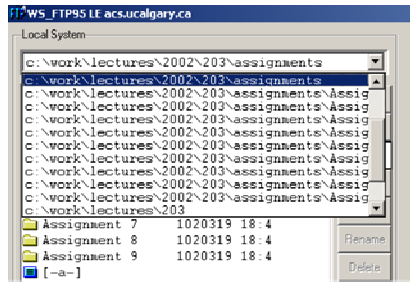
James Tam

## Relationships Between Screen Elements

- How do you choose when you cannot discriminate screen elements from each other?



GIF Construction Set

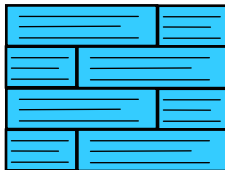


WS-FTP

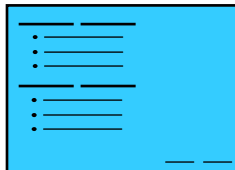
James Tam

## Navigational Cues

- Provide initial focus
- Direct attention to important, secondary, or peripheral items as appropriate
- Assist in navigation through material



x



✓

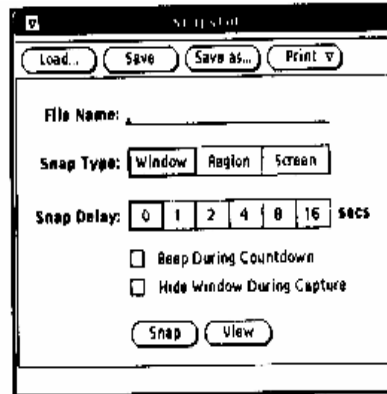
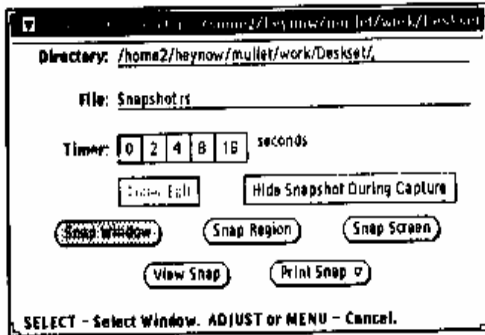


✓

James Tam



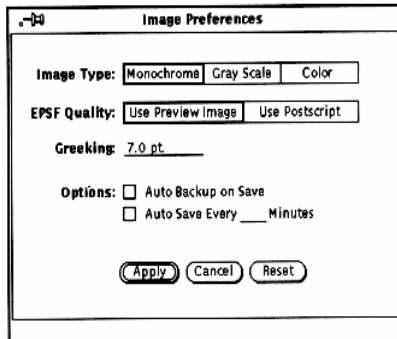
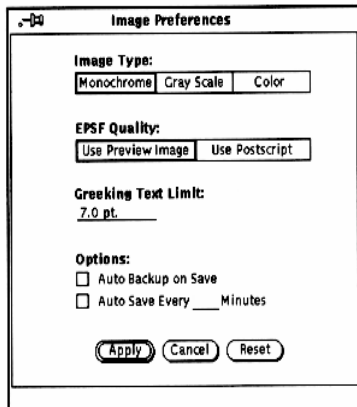
## Re-Factoring An Interface



Redesigning a layout using alignment and factoring from Mullet & Sano Page 119

James Tam

## The Importance Of Negative (White) Space

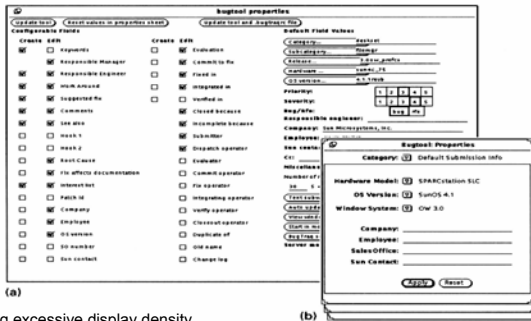


The importance of negative space from Mullet & Sano page 129

James Tam

## Economy Of Visual Elements

- Minimize number of controls
- Include only those that are necessary
  - Eliminate, or relegate others to secondary windows
- Minimize clutter
  - So information is not hidden

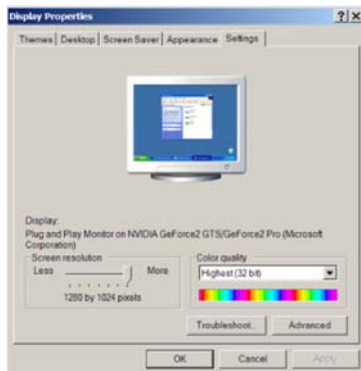


Repairing excessive display density  
from Mullet & Sano Page 111

James Tam

## Economy Of Visual Elements (Tabs)

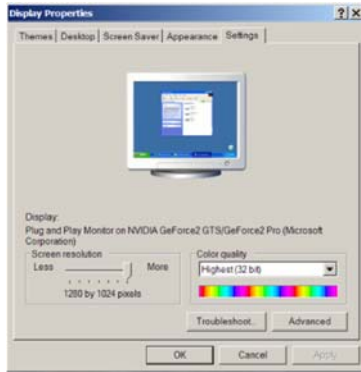
Excellent means for factoring  
related items



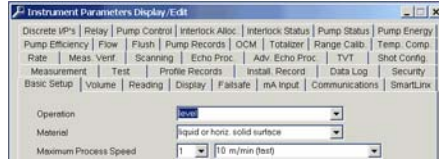
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## Economy Of Visual Elements (Tabs)

Excellent means for factoring related items



But it can be overdone



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## Legibility And Readability: Font Choice

*Whenever your local SMS Administrator sends you an actual software Package, the SMS Package Command Manager will appear (usually at network login time) displaying the available Package(s). The following screenshots display scenes similar to what you will see when you receive an actual SMS Package.*

*To start the demonstration, click the "OK" button.*

## Legibility And Readability: Capitalization

If you wish to add/change network information, please select one of the following options.

- I WANT TO CONNECT TO AN EXISTING TIME & CHAOS WORKGROUP OR MODIFY THE CONNECTION SETTINGS.
- I WANT TO BUILD A BRAND NEW WORKGROUP.

These choices must be really important, or are they?

## Legibility And Readability: Capitalization (2)

THIS IS AN EXAMPLE OF TEXT THAT IS SHOWN ALL IN CAPITAL LETTERS. AS YOU CAN PROBABLY TELL, THE LACK OF VARIATION IN HEIGHT MAKES IT SOMEWHAT MORE DIFFICULT TO READ. THIS WHOLE PARAGRAPH JUST GOES ON AND ON WITHOUT SAYING ANYTHING SIGNIFICANT. THE OTHER SIDE EFFECT OF ALL CAPITALS IS THAT SOME PEOPLE THINK THAT IT IS THE TEXT EQUIVALENT OF SHOUTING AT SOMEONE. ALSO OTHER PEOPLE MAY THINK THAT IT IS MORE SIGNIFICANT BECAUSE IT IS ALL IN CAPITALS. THAT IS PROBABLY WHY SOME PEOPLE DO IT - IN ORDER TO GIVE THE IMPRESSION THAT THEIR MESSAGE IS REALLY IMPORTANT. BUT AS YOU HAVE PROBABLY ASCERTAINED (ASSUMING THAT YOU HAVE EVEN READ THIS FAR) THAT PUTTING TEXT ALL IN CAP'S IS SIMPLY TOO PAINFUL TO READ.

## Use Capitalization Sparingly

### Proverbs On Individual Differences

You do **NOT** necessarily represent a good representative user of equipment or systems you design

Do not expect others to think and behave as you do, or as you might like them to.



People vary in thought and behaviour just as they do physically

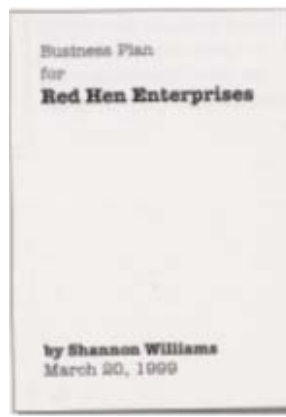
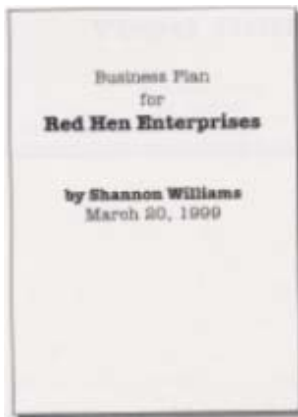


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## Center Alignment

- Some regard it as unprofessional and advocate against it's use.
- It's described as being unprofessional looking and plain.



## Center Alignment

- Overuse of centering can make it harder to determine the structure of onscreen elements.

```
while ((reRun == 'y') || (reRun == 'e'))
{
    if (reRun != 'e')
        b.scan();
        b.display();
        generation += 1;
    System.out.println("\t\t\tGeneration: " + generation);
    System.out.print("Do you wish to play another generation (y/n): ");
    reRun = (char) Console.in.readChar();
    Console.in.readLine();
    if (reRun == 'e')
        b.edit();
}
```

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## Center Alignment



- It can be useful for providing additional contrast

- e.g., titles vs. the body of the text.

Some Potential Research Topics

**HCI and expert systems: Scope -Masters or Doctorate level projects**

There has been little research conducted into determining what is usable for software used by expert users. Most of the work in the area of Human-Computer interaction is more applicable to high level interfaces such as GUI's than they are for low level interfaces such as a Unix command line. Research in this area would involve studying these types of users and their tasks in order to come up with a set of usability heuristics that can guide future designers of these systems as well be used as an evaluation tool for existing systems.

**Educational tools: Scope - undergraduate research project**

In order to help undergraduate students grasp some of the more difficult and abstract concepts being taught in class, instructors will sometimes provide visual representations in order to provide a mental model of what the code is actually doing. For example, when first teaching linked lists to students it is common to draw out a picture of a list consisting of nodes and their links. List operations are then demonstrated by redrawing some or all parts of the list manually. A useful learning aid could consist of a system that could demonstrate list operations but do so in an interactive fashion. The student could create some code and see the effects of different list operations in order to better understand the cause-effect relationship between the code and the list.

**Gaming projects**

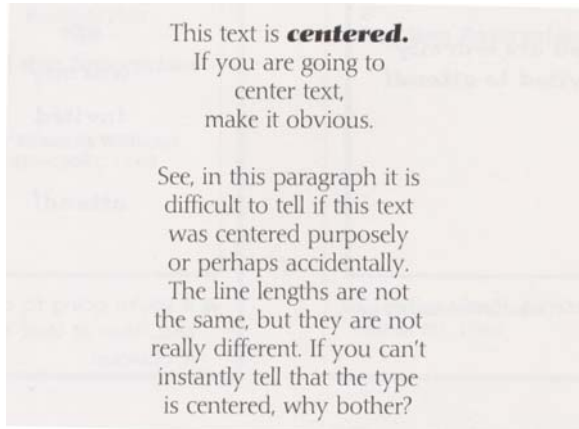
- So it should be used sparingly
- It should also be used for a reason rather than as the default

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## Center Alignment



- **If you are employing it to provide contrast then make it obvious**



## Legibility And Readability

- Characters, symbols, graphical elements should be easily noticeable and distinguishable

Text set in  
Helvetica

Text set in  
Times Roman



TEXT SET IN  
CAPITOLS

Text set in  
Braggadocio

Text set in  
Courier



## Legibility And Readability

### Proper use of typography

- 1-2 typographical effects (typeface or typography) - 3 max
  - Font types, normal, italics, bold, underline
- 1-3 fonts sizes max

Large

Medium  
Small

#### Readable

Design components to be inviting and attractive

Design components to be inviting and attractive

✓

Large

Medium  
Small

#### Unreadable

Design components to be *inviting* and attractive

Design components to be **inviting** and *attractive*

✗

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## Legibility And Readability

- Typesetting
  - Point size
  - Word and line spacing
  - Line length
  - Indentation
  - Color

#### Readable

Design components to be inviting and attractive

Design components to be inviting and attractive

✓

Unreadable: Design components to be easy to interpret and understand. Design components to be inviting and attractive

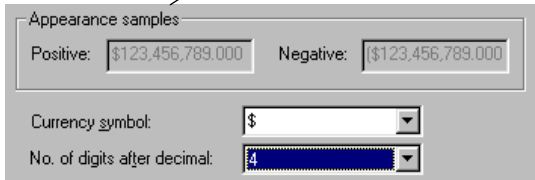
✗

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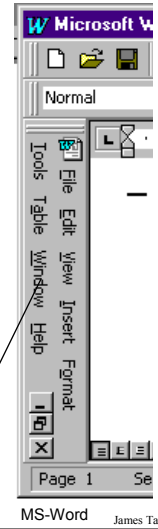
## Legibility And Readability

Grayed-out example text hard to read.  
Why not make it black?



Regional Preferences applet in Windows95

Text orientation makes it difficult to read



MS-Word James Tam

## Imagery

### Signs, icons, symbols

- Right choice within spectrum from concrete to abstract

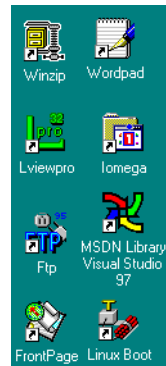


**BOOZE!**



### Icon design *very* hard

- Except for most familiar, always label them

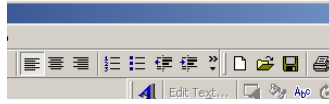


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## Imagery (Continued)

### **Image position and type should be related**

- Image “family”



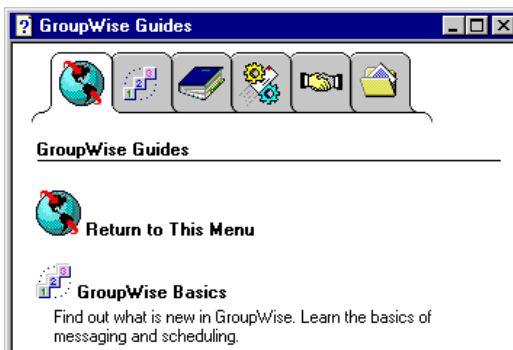
- Don't mix metaphors

### **Consistent and relevant image use**

- Not gratuitous
- Identifies situations, offerings...

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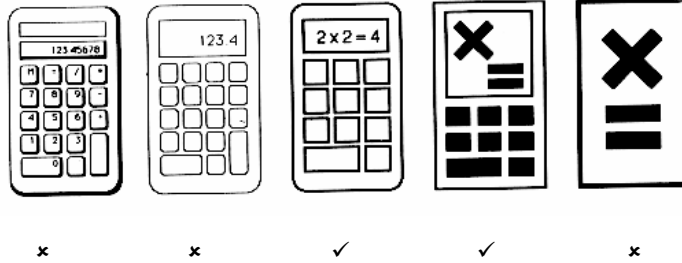
## Why Icon Design Is Hard: An Example



Novell GroupWise 5.1

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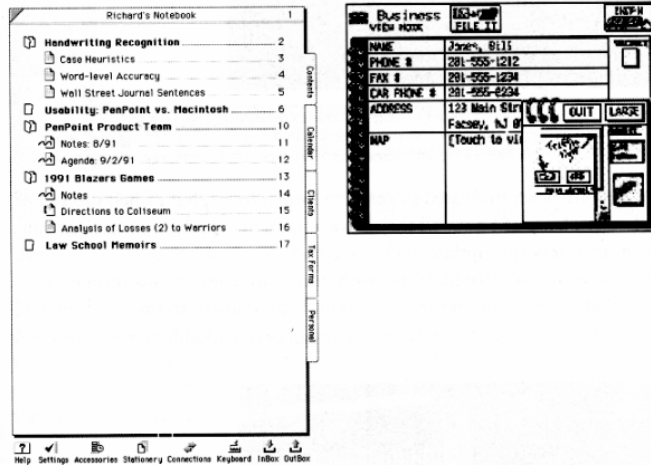
## Icon Design: Use The Appropriate Level Of Detail



Choosing levels of abstraction from Mullet & Sano Page 174

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## Interface Design: Use An Appropriate Level Of Detail



Refined vs excessive literal metaphors from Mullet & Sano page 25

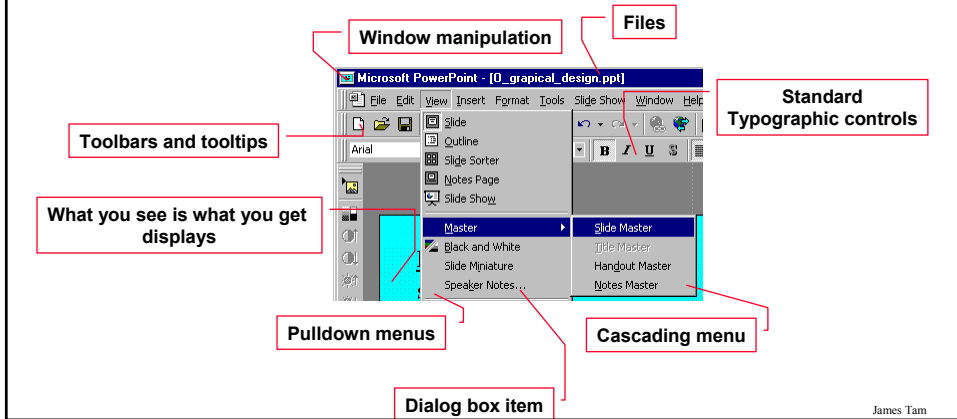
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# Idioms

## Familiar ways of using GUI components

- Appropriate for casual to expert users
- Builds upon computer literacy
- Must be applied carefully in walk up and use systems

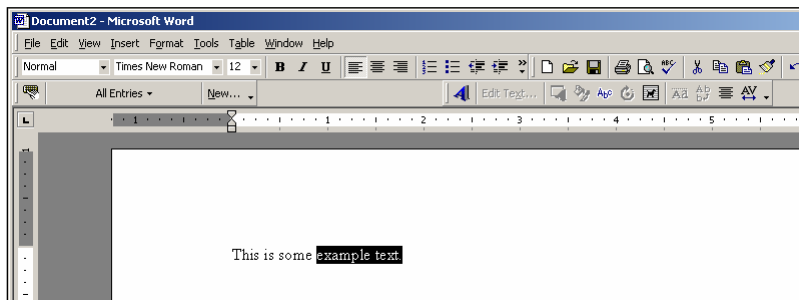
## Some examples



## How To Choose Between Widgets

### 1) What components *must* be in the display

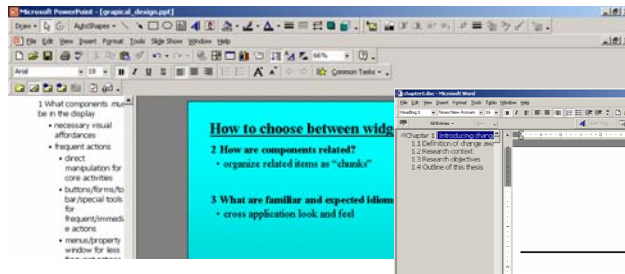
- Necessary visual affordances
- Frequent actions
  - Direct manipulation for core activities
  - Buttons/forms/toolbar/special tools for frequent/immediate actions
  - Menus/property window for less frequent actions
  - Secondary windows for rare actions



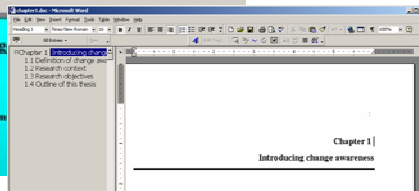
## How To Choose Between Widgets (Continued)

- 2) **How are components related?**
  - Organize related items as “chunks”
- 3) **What are familiar and expected idioms?**
  - Cross application look and feel

### MS-PowerPoint

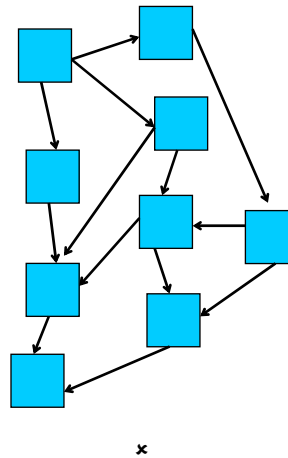
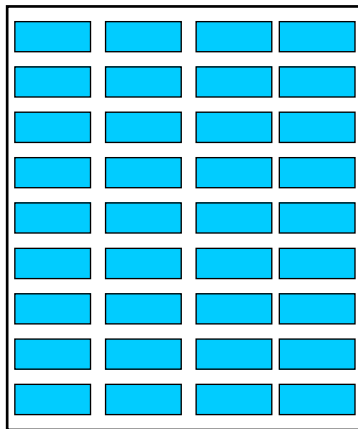


### MS-Word



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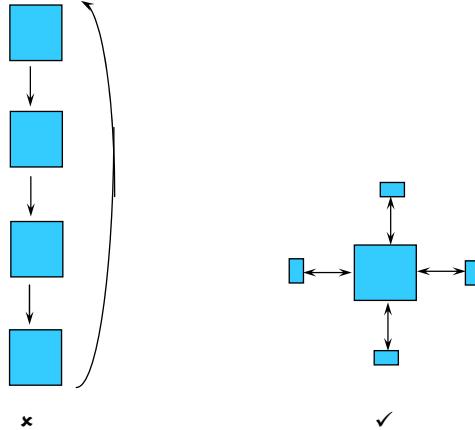
## Balance Between Too Many Controls On A Single Screen Vs. Too Many Screens



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## Widgets And Complexity

- How can window navigation and clutter be reduced?
  - Avoid long paths
  - Avoid deep hierarchies
  - Re-factor/combine functions



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## What You Now Know

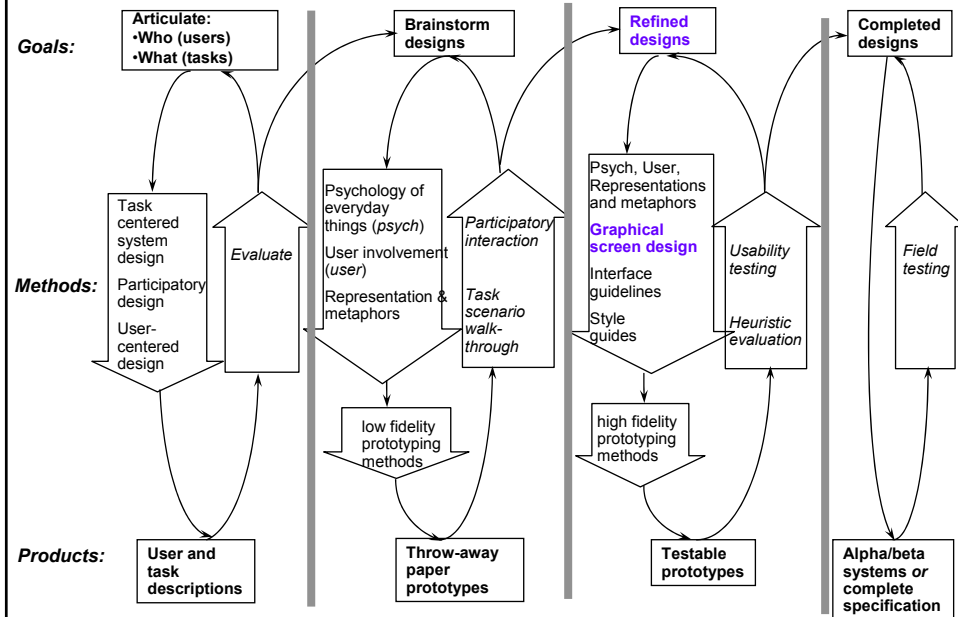
**Grids and C.R.A.P. are essential tools for graphical design**

**Important visual concepts include**

- Visual consistency
  - Repetition
- Visual organization
  - Contrast, alignment and navigational cues
- Visual relationships
  - Proximity and white space
- Familiar idioms
- Legibility and readability
  - Typography
- Appropriate imagery

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# Interface Design And Usability Engineering



This diagram is a variation of the one presented by Saul Greenberg

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