

# **“Screen” Design and Visualization**

## **Graphical Design**

### **Good GUI design must account for:**

- comprehensible mental images
  - eg: good use of metaphors
- appropriate organization of data, functions, tasks and roles
  - eg: support a reasonable cognitive model
- quality appearance characteristics
  - sometimes called the “look” of a UI
- effective interaction sequencing
  - sometimes called the “feel” of a UI

### **These ideas are not new...**

- “Principle of Effective Visual Communication for GUI design”  
Marcus article in “*Human-computer interaction: toward the year 2000*” by Baecker, Grudin, Buxton and Greenberg
- “Designing Visual Interfaces” (1994) - Mullet & Sano, Prentice Hall

## 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

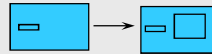
### Imagery

- signs, icons, symbols; concrete to abstract



### Sequencing

- how the interface unfolds



### Visual identity

- unique appearance



### Animation

- dynamics of display



### Color and Texture

- convey complex information and pictorial reality



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## Use of Grids

### Horizontal and vertical lines to locate window components

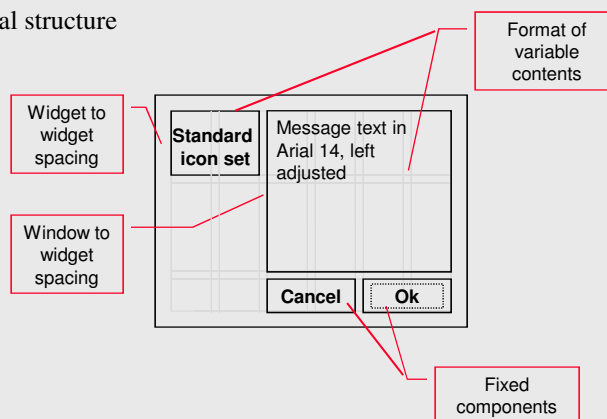
- aligns related components

### Organization

- contrast to bring out dominant elements
- grouping of elements by proximity
- show organizational structure
- alignment

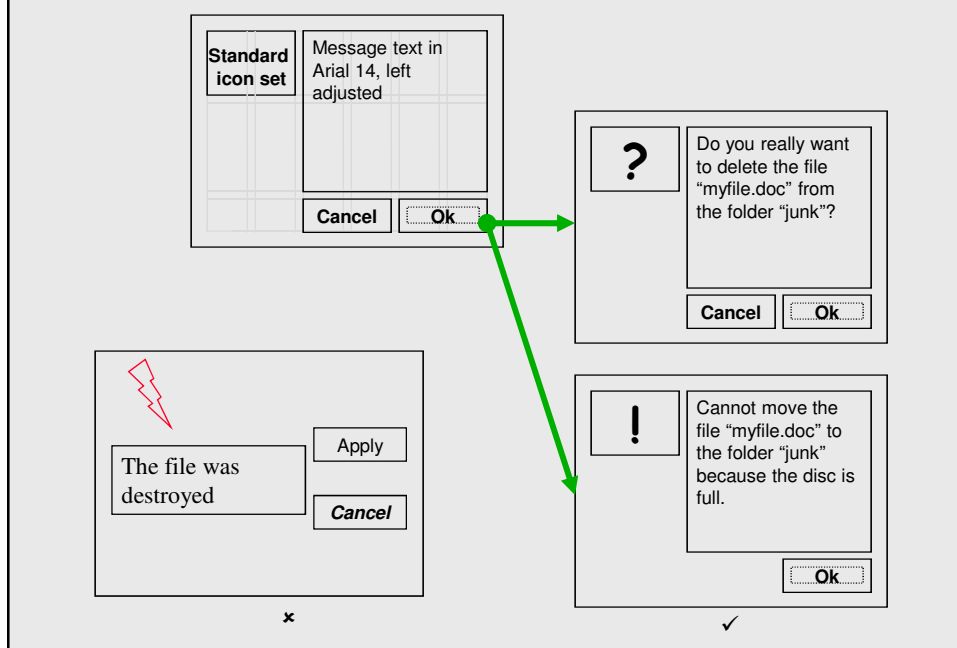
### Consistency

- location
- format
- repetition
- organization

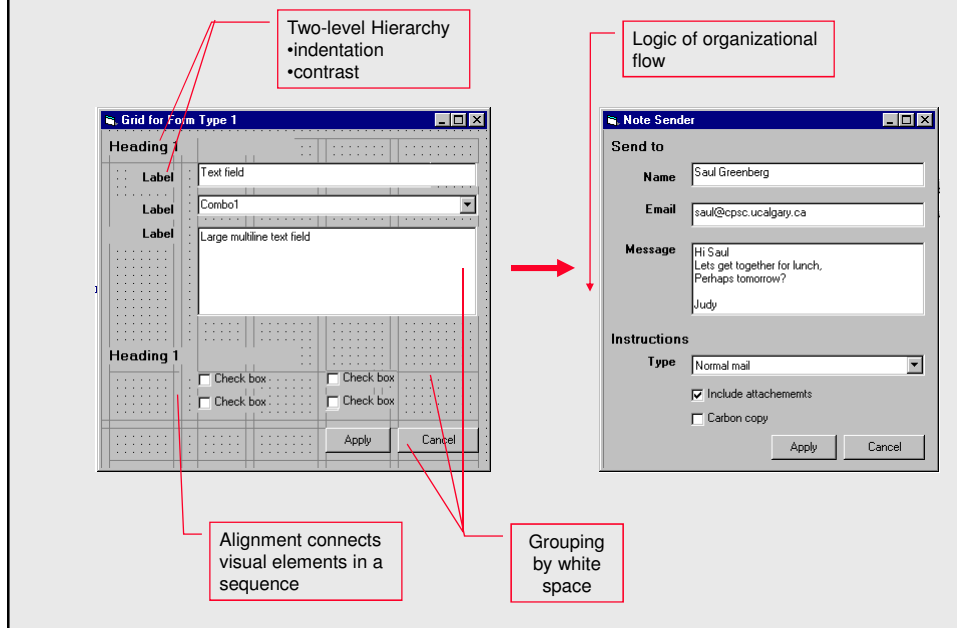


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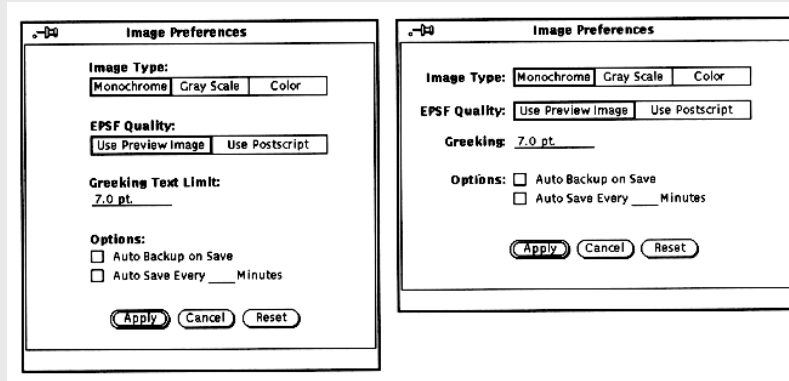
## Using same Grid-Based Template across project



## Generic Grid to Specific Use



## Classic Mac Comparison on Negative Space



*The importance of negative space  
from mullet & sano*

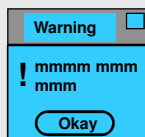
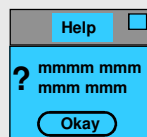
## Visual Consistency

### Internal consistency

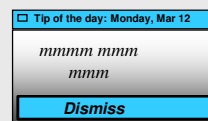
- same conventions and rules for all elements of the GUI unless strong reason
- set of application-specific grids enforce this

### External consistency

- follow platform and interface style conventions
- use platform and widget-specific grids
- deviate from conventions only when it provides a clear benefit to user



✓



✗

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## Relationships between screen elements (Grouping)

Link related elements, disassociate unrelated elements

- proxemic clusters
- white (negative) space
- alignment
- explicit structure

Mmmm:

Mmmm:

Mmmm:

Mmmm:

Mmmm:

☹

Mmmm:

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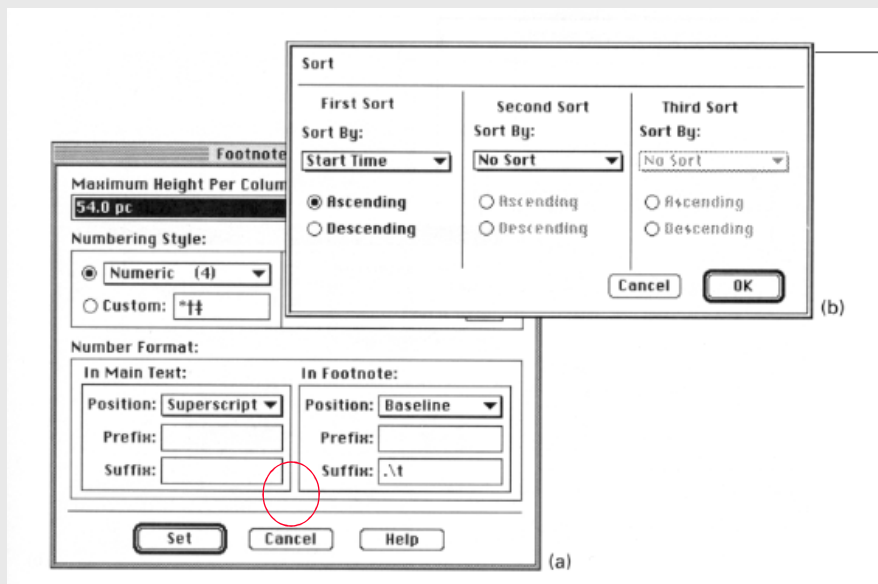
Mmmm:

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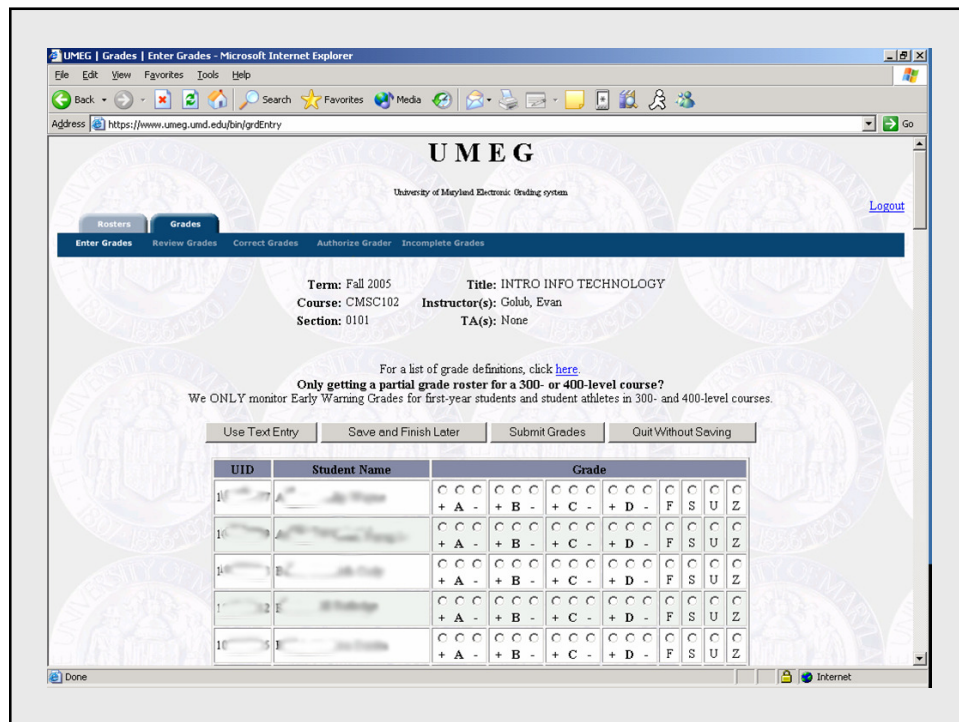
☺

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## Explicit Structure via Lines can get cluttered



Using explicit structure as a crutch  
from Mullet & Sano

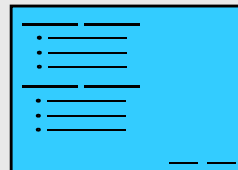


## Navigational cues are good because they...

- provide initial focus
- direct attention to important, secondary, or peripheral items as appropriate
- assist in navigation through material
- order should follow a user's conceptual model of sequences



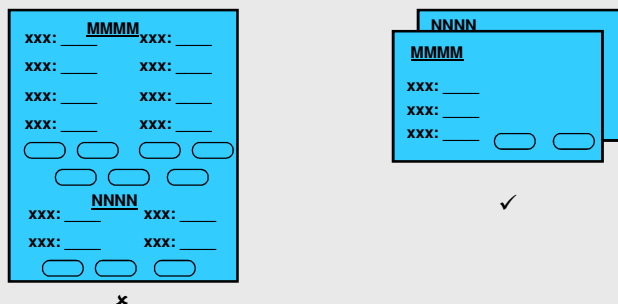
x



✓

## Economy of visual elements

- General philosophy sometimes expressed as “Make simple things simple, and hard things hard.”
- Try to minimize number of controls
- Include only those controls that are necessary
  - eliminate, or relegate others to secondary windows
- Minimize clutter/overload (don't fear multiple windows)
  - so information is not hidden/obscured

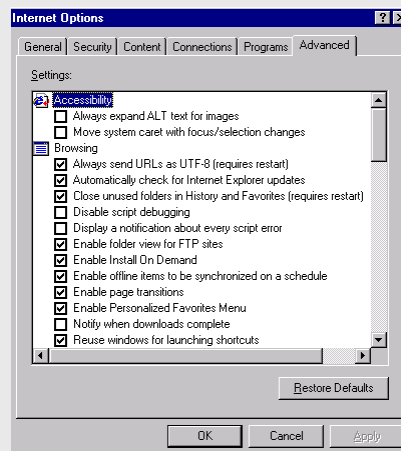
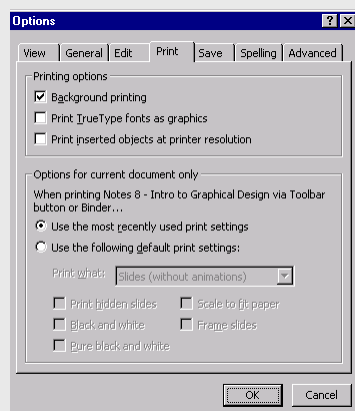


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## Tabs to help Visual Economy

Excellent means for factoring/grouping related items.

However, can be overdone or not taken far enough, so think it out!

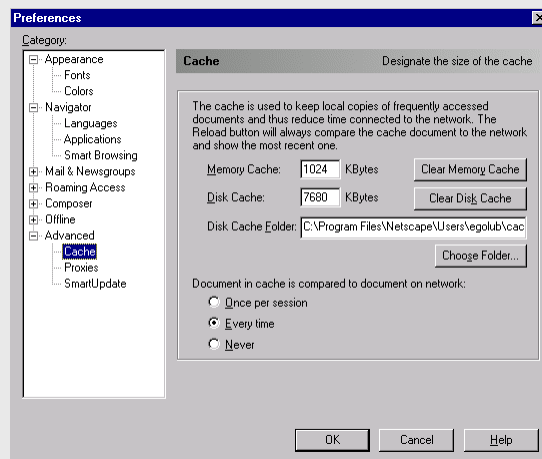


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## Tree Views to help Visual Economy

Another excellent means for factoring/grouping/clustering related items.

However, these can be difficult for some users to know how to use them.



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## Legibility and readability (I)

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

Text set in  
Helvetica

Text set in  
Times Roman

✓

TEXT SET IN  
CAPITALS

**Text set in  
Braggadocio**

Text set in  
Courier

✗

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## Legibility and readability (II)

### Proper use of typography

- 1-2 typefaces (3 max)
- normal, italics, bold
- 1-3 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 (III)

### Typesetting

- point size
- word and line spacing
- line length
- indentation

#### **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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## Imagery

### Signs, icons, symbols

- right choice within spectrum from concrete to abstract



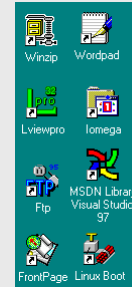
### Icon design *very* hard

- except for most familiar, always label them



### Image position and type should be related

- image “family”
- don’t mix metaphors



### Consistent and relevant image use

- not gratuitous
- identifies situations, offerings...

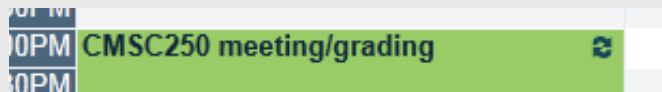


Partial icon family

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## Accurate/Appropriate Imagery

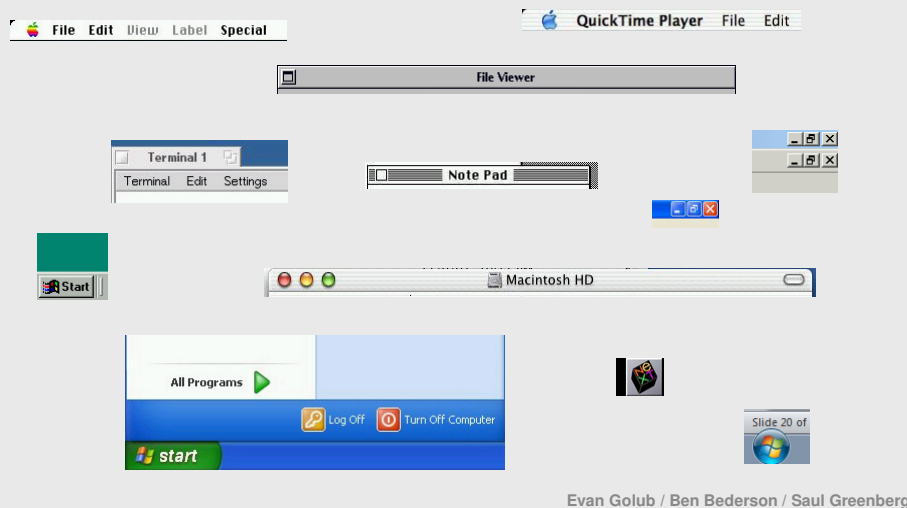
What does that icon in the upper-right corner mean on this event scheduling page?



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## Visual Identity

Think about the GUI of systems such as the various “generations” of Windows (eg: 3.1/95/XP/7), MacOS (eg: 6/7/8/9/X), NeXT, BeOS, etc. and how easily you could spot them in a visual line-up.



## Animation

Animation can take many forms. Some examples are fading transitions such as the Start Menu animation as sub-menus open, directional effects such as minimizing in OS X using the genie effect, fisheye effects such as the magnification option on the MacOS X docking bar, zooming such as in CounterPoint or KidPad, and “traditional” animation such as Microsoft’s Clippy (to name a few).

There can be both good and bad consequences. Here are some examples:

- Pro: Could provide more visual cues about a transition
- Pro: Could give sense of locality and/or relationships within data or documents
- Con: Could make the process slower overall
- Con: Could become “annoying” to the user

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## Color

The selection of the “right” color scheme can be important in design.

Some things to consider include:

- metaphor issues: red=**bad**, green=**good**
- psychological issues: light blue-green=tranquil, red=take a risk
- conflicting colors: **dark blue on black** -vs- **blue on yellow**

Some Examples of Web resources (there are far many more):

<http://www.colorschemer.com/online.html>

<http://www.colormatch.dk/>

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## Some Examples of Color Use

What do these colors mean here?



Visual Cue for Current Position



This is a poorly designed menu. Everything looks inactive, but they are live links. There are no actual visual cues until mouse-over.

### RESOURCES FOR:

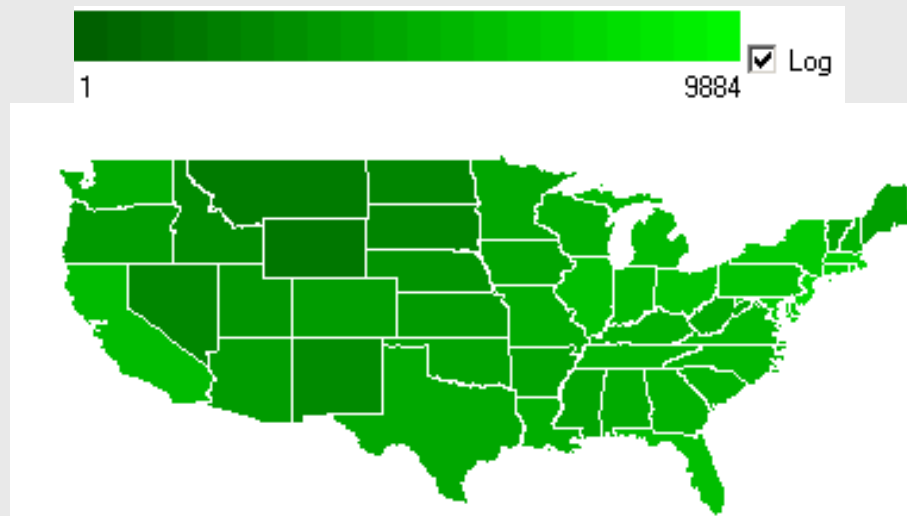
ALUMNI  
BUSINESS, INDUSTRY AND GOVERNMENT  
CURRENT STUDENTS  
FACULTY AND STAFF  
MEDIA  
PARENTS, FAMILIES, FRIENDS  
PROSPECTIVE STUDENTS  
VISITORS

### RESOURCES FOR:

ALUMNI  
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PARENTS, FAMILIES, FRIENDS  
PROSPECTIVE STUDENTS  
VISITORS

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### An example of using gradation



Can you see relative levels for the states at a glance?

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### Some Web Design Issues

- Breadth vs. Depth
- Navigation vs. Content
- Seller vs. Buyer (i.e., Designer vs. User)
- Colors and Images

Several images in this presentation are from “Designing Web Usability”  
by Jakob Nielsen [New Riders 1999]

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## Breadth vs. Depth

Numerous studies starting in the 1980s showed that when designing menu structures, you should aim for breadth over depth, but not too broad.

Miller's famous  $7 \pm 2$  study shows that people's short term memory consistently was limited to about 7 things. The good news is that he also observed that people could "chunk" things, and thus remember more.

Miller, G. A. (1956). The magical number seven plus or minus two: Some limits on our capacity for processing information. *Psychology Review*.

Sure enough, optimal menu design typically has about 7 chunks of related items.

**It is typically different when navigating on the web!**

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## Breadth vs. Depth on the Web (I)

It is possible to create a page that follows the  $7 \pm 2$  model:

<http://www.cs.umd.edu/~egolub/real.index.html>

Although this is not commonly done because there is not enough information being presented, you can still see the idea in places.

The CS dept main page and Undergraduate page each still make use of this idea in their navigation design.

Google's "black bar" sticks close to this as well.

Maryland's old student information web site was close in that it had  $7 \pm 2$  chunks of information, each of which being divided into  $7 \pm 2$  chunks of information. Google's [news.google.com](http://news.google.com) and a number of other news sites take this approach.

In practice, many sites and pages have gone to far broader designs to make it easier to be found by searches and also to support on-page search by users.

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## Breadth vs. Depth on the Web (II)

If you look at desktop software, you'll also see the  $7 \pm 2$  model appear in things like menu design.

So, what is different on the web?

- Data -vs- Operation/Navigation Links
- Slow download (ie: exploration) times that installed software doesn't have
  - this is a minor issue if you have broadband and “lightweight” pages
  - this is a more major issue if you have “heavy” pages
  - this is often a major issue on mobile devices working on EDGE/3G or even on 4G networks depending on a variety of factors
- A sense of more flexibility in layout
- Search tools for information within a page (if people know about them)
- The web has seen the growth of the concept of a “portal” in many ways

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## Breadth vs. Depth on the Web (III)

The following study attempted to examine this question carefully:

**Web Page Design: Implications of Memory, Structure and Scent for Information Retrieval** *Web Page Design* / Kevin Larson / Mary Czerwinski, *CHI 98*, p.25-32.

[www.acm.org/pubs/articles/proceedings/chi/274644/p25-larson/p25-larson.pdf](http://www.acm.org/pubs/articles/proceedings/chi/274644/p25-larson/p25-larson.pdf)

They compared 512 items from Encarta encyclopedia in structures of size:

8x8x8    16x32    32x16

Note: They did not have the “slow link” factor so this experiment might not apply to the “mobile web” in general right now.

- Short term memory is only one factor.
- Limiting depth is more important than increasing breadth.
- Chunking of information is a likely important factor.

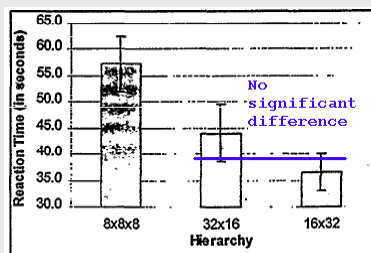


Figure 1: Average reaction time for each hierarchy.

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## Navigation -vs- Content -vs- Advertising

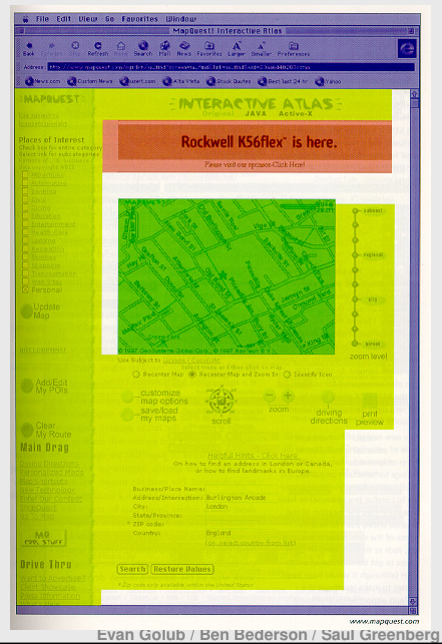
Nobody “wants” to navigate.

Navigation is a necessary evil.

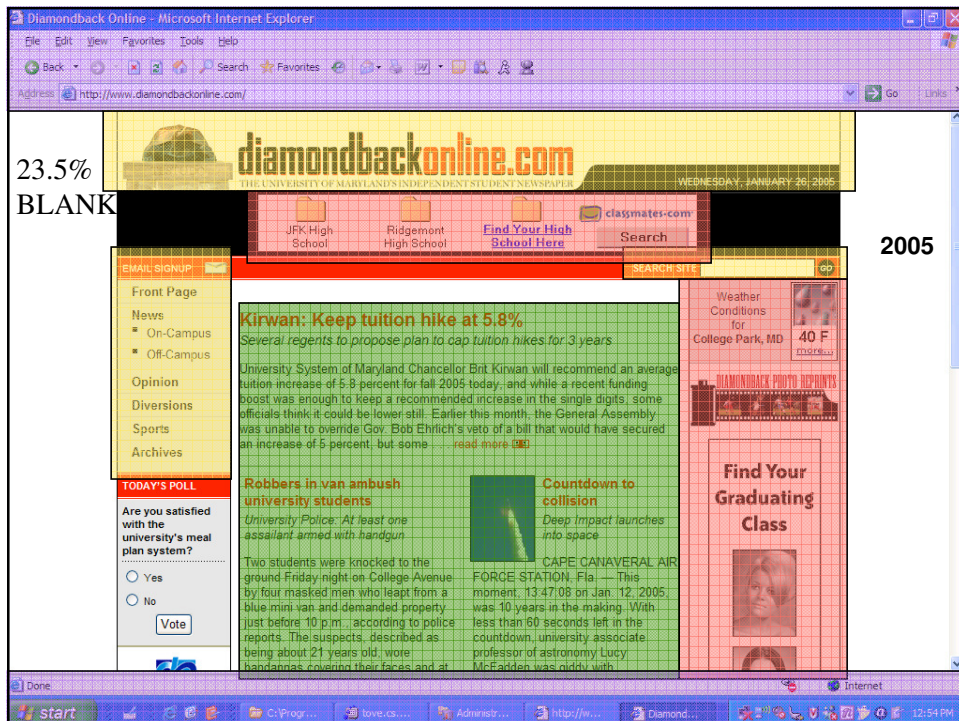
Screen space taken up with explicit navigation typically takes away from actual content.

This early Mapquest example from the late 1990s shows how extreme the imbalance can be...

Let's see how the 2005 Diamondback site or modern Facebook look...

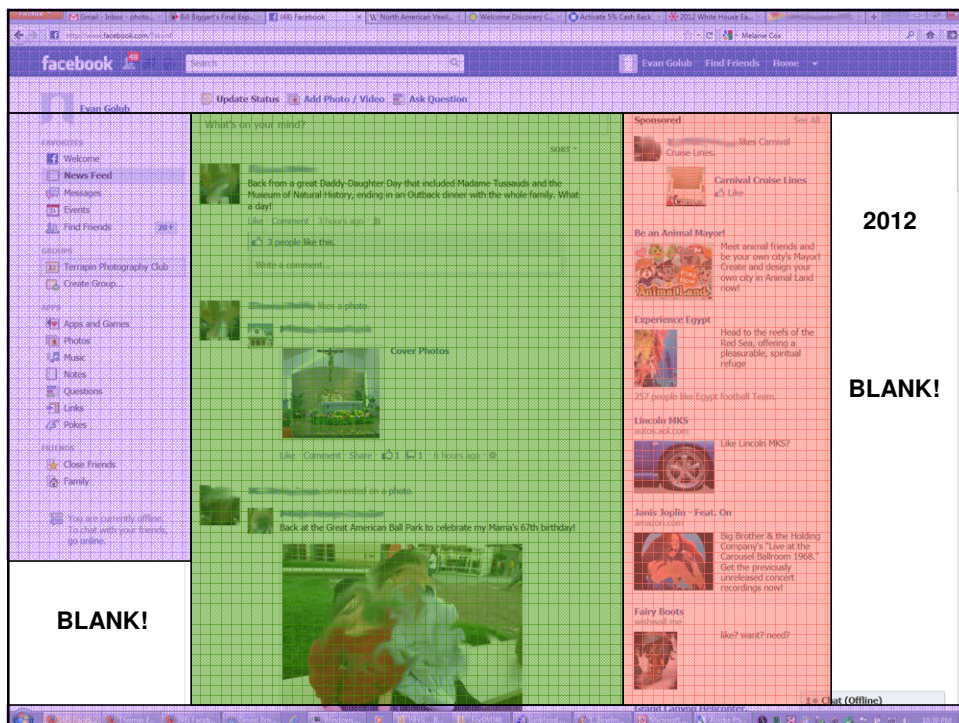
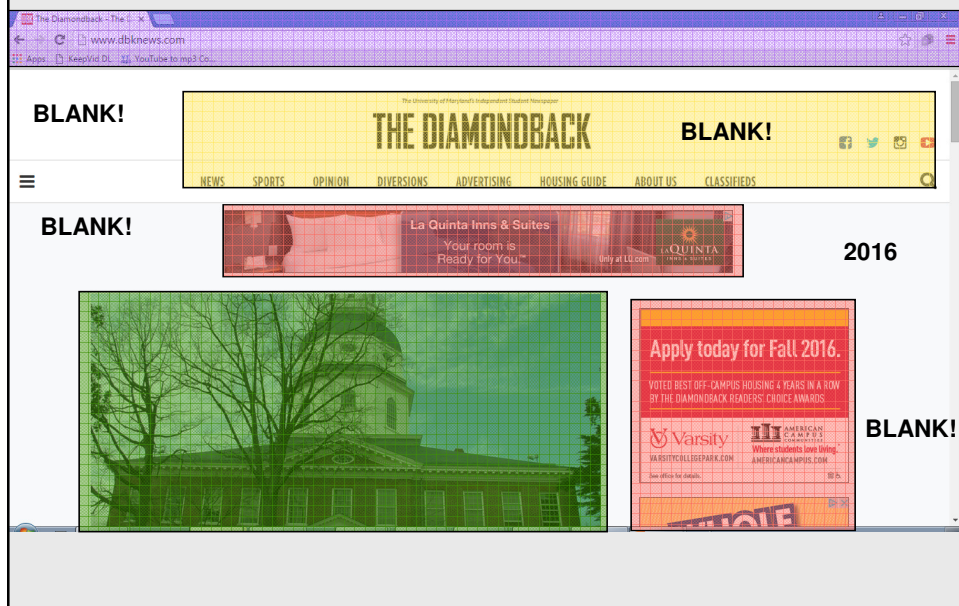


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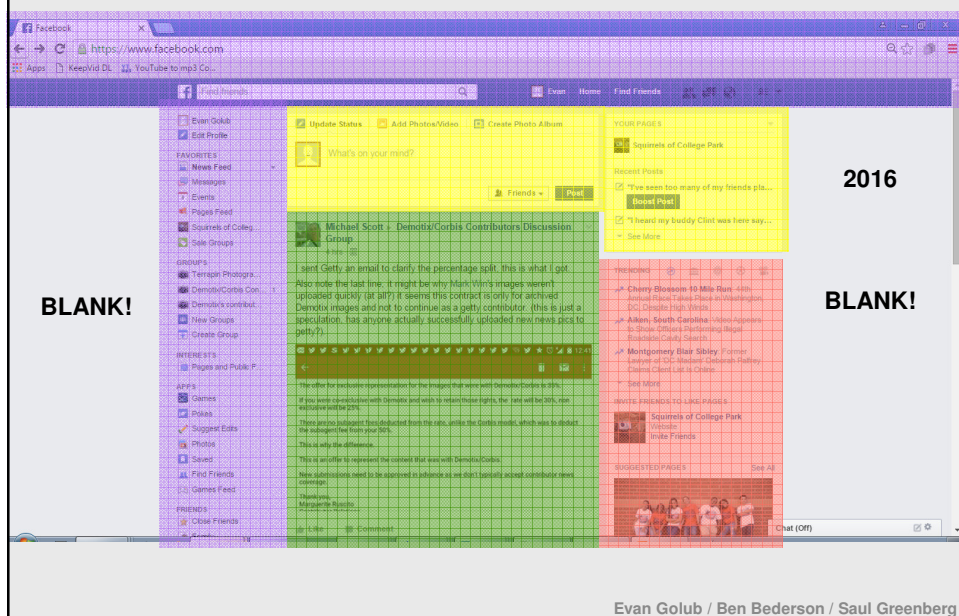




It's gotten WORSE since then! Here's my new laptop...



## Facebook's space usage on my new laptop...



## Seller vs. Buyer (Designer vs. User)

We're talking about user's needs, but designers don't always have the user's best interests in mind.

More true for web sites than other software where something is typically being sold (a product, a university, a brand, advertising, etc.)

Banner ads are the prototypical example. Users **hate** them, marketers require them. Designers often are on the user's side.

The best thing you can do is probably to be aware of these tradeoffs, and be able to make informed decisions.

However, consider the following question – how is Instagram with no profits and no profit model worth A BILLION DOLLARS to Facebook? Is the whole value in the users there?

## Colors and Images

If you change background colors, make sure you change the [link](#), [vlink](#) and [alink](#) attributes of your document to avoid “invisible” or annoying color combinations.

If you use a background image, make sure you can still read the text that is going to be on top of it. Test how that image will tile and how the text will move as the browser window is resized.

If you have many images, think about load time and whether the image will be understood at the display size.

A good way to do this is to use a machine with high resolution and test window sizes such as **800x600**, **1024x768**, **1152x864**, **1400x1050** and even extremes such as small sizes like **240x320**, **640x480** and larger sizes such as **1600x1200** to see how things appear. Also, consider that a 15” monitor at 1400x1050 is different than a 21” monitor at 1400x1050.

If you have images that **look like** they can be clicked make sure the user can **click on them!**

Don’t do this: <http://www.cs.umd.edu/~egolub/butterfly.html>

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## Give the users some hints

Describe your links well. People will very often just read the [link text](#).

Not good...

Better but could be improved...

Good!

**If you want more information, [click here](#).**

**Click here for [more information](#).**

**[More information](#).**

Researchers call this “information scent” – users hunt for information based on the tiny fragments that they think will lead them in the right direction. This kind of “greedy” algorithm is known to be unreliable, but it’s how many users work. The third example above shows a good use of information scent.

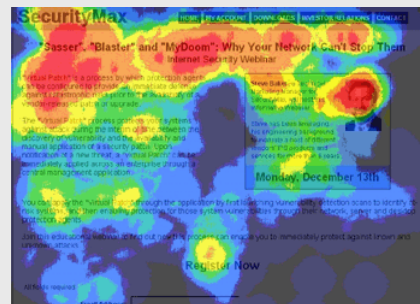
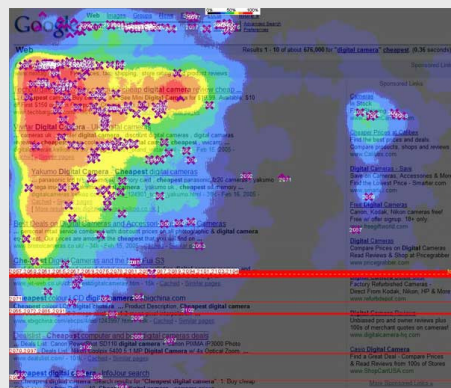
Scent: “Conveys distal target information via category labeling”

Link coloration is a major tool that users take advantage of to help them understand their own history. Change colors with care. If you do change from the default colors, do not make them counter-intuitive.

Support search on your page and site. If you do use images that contain words, make sure you have text descriptions (possibly in the **alt** description).

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## Study Where People Look



[http://www.eyetools.com/inpage/research\\_google\\_eyetracking\\_heatmap.htm](http://www.eyetools.com/inpage/research_google_eyetracking_heatmap.htm)

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## Technical Issues

- Download time
- Browser compatibility
- Screen size and resolution
- Separation of meaning from presentation

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## **Download Time**

**People have different resources at home versus at work versus when mobile.**

**Access rates are a moving target. As recently as 2007 you still had 20% of users who had Internet in the US still having “narrowband” access at home and around 10% of users had that at work.**

**Broadband has risen a great deal, but individual bandwidth might be throttled or congested. This is a major issue in the wireless world.**

**Keep these in mind as you place images, videos, applets, etc. on your Web page since the more you place there the longer it will take to load!**

**One study from 2011 said that the size of videos on web pages (on average) had tripled since 2003!**

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## **Browsers and Versions**

**People historically had tended to upgrade browsers slower with each successive version, and it would often take an operating system upgrade to get a browser upgrade.**

**However, the current trend of supporting (or even forcing) automatic upgrades and of sites seriously restricting users of old browsers has changed that trend.**

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## **Browsers and Versions**

Figuring out which the most-used browsers are can be challenging.

User agent spoofing and sampling bias are just two of the challenges.

Consider the following stats all from the same month in 2011:

	Chrome	Internet Explorer	Firefox	Safari	Opera	Other
StatCounter	48.7%	23.0%	19.6%	4.9%	1.4%	2.3%
W3Counter	38.0%	19.0%	16.8%	16.0%	3.2%	6.0%
Wikimedia	45.9%	11.7%	16.9%	7.1%	1.6%	16.8%
NetApplications	19.3%	58.3%	15.5%	5.2%	1.0%	0.4%

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## **Dealing with Browser Versions**

**Firefox saw high initial penetration, though it leveled off and then Chrome came on strong.**

**Usage in academic settings appears to differ greatly from the national trends as new browsers enter the market.**

**Ideally, you should collect browser versions and software platforms to test your site. While some software/platforms do not make this easy, if you design pages as a career, it is worth your time to set up a machine with multiple “virtual” machines, and have a different version of each browser on each “machine”.**

**Also, consider that some devices might have non-standard, possibly custom-written, embedded, browsers.**

**Finally, different sites draw different browser audiences, so you should learn about your current audience.**

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## Screen Resolution: Historic and Modern Data

Some historic distribution of monitor resolutions against the 1024x768 mark:

netmechanic.com:

Screen Resolution	1997	1999	2001
≤ 640x480	22%	13%	5%
800x600	47%	55%	53%
≥ 1024x768	31%	27%	41%

statmarket.com:

Screen Resolution	2000	2003
≤ 800x600	66%	42%
≥ 1024x768	34%	58%

steampowered.com (2016, ones with more than 1% popularity among their users)

1024 x 768	1.91%
1280 x 720	1.40%
1280 x 800	1.85%
1280 x 1024	4.73%
1360 x 768	2.89%
1366 x 768	26.04%
1440 x 900	4.80%
1536 x 864	3.11%
1600 x 900	6.80%
1680 x 1050	4.19%
1920 x 1080	36.33%
1920 x 1200	1.39%
2560 x 1440	1.47%

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## W3Schools Stats History (note differences for 2016 from previous slide)

Date	Other high	1920x1080	1366x768	1280x1024	1280x800	1024x768	800x600	Lower
January 2016	30.7%	18%	35%	6%	4%	3%	0.3%	3%
January 2015	32.7%	16%	33%	7%	5%	4%	0.3%	2%
January 2014	34%	13%	31%	8%	7%	6%	0.5%	0.5%
January 2013	36%	11%	25%	10%	8%	9%	0.5%	0.5%
January 2012	35%	8%	19%	12%	11%	13%	1%	1%
January 2011	50%	6%		15%	14%	14%	0%	1%
January 2010	39%	2%		18%	17%	20%	1%	3%
January 2009	57%					36%	4%	3%
January 2008	38%					48%	8%	6%
January 2007	26%					54%	14%	6%
January 2006	17%					57%	20%	6%
January 2005	12%					53%	30%	5%
January 2004	10%					47%	37%	6%
January 2003	6%					40%	47%	7%



## Screen Resolution: Discussion

By 2012 things were at a point where 85% of screens of those visiting W3Schools were larger than 1024x768 but as smartphone and other mobile device penetration soared and even when the resolution is higher, the screen size itself is often rather small.

When the iPhone was first competing with Android phones, one of the “sales pitches” of developing for the iPhone was a standard resolution across all models. Those days are gone...

Google created an interesting tool  
<http://analytics.blogspot.com/2012/06/new-feature-conduct-browser-size.html>

We also need to consider widescreen versus 4:3 aspect ratio monitors as well as (again) smartphones and tablets that typically have smaller screen sizes.

We might also consider who might be the “typical visitor” for a particular site and attempt to determine their stereotypical screen resolution. We should also consider whether or not users are using their full screen resolution for the browser.

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## Content Formats (I)

- HTML
  - Basically the web markup language (currently at HTML 5). Go to [www.w3c.org](http://www.w3c.org) for current “official” specifications, but realize that browsers don’t always follow them...
  - As a designer, you can choose between general font specifications (H1) or possibly specific ones (Arial 16 point bold). Use general as much as possible.
    - Fonts might not be available.
    - Text browsers and reader programs and search engines use structural information.
    - Allows for users to be able to control their experience more.
- CSS
  - Offers possibility of centralized design styles and potential savings in bandwidth.
  - Very tied into the HTML5 world.
  - Different styles for different readers possible (eg: “Standard” PC versus smartphone versus tablet, etc.).

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## Content Formats (II)

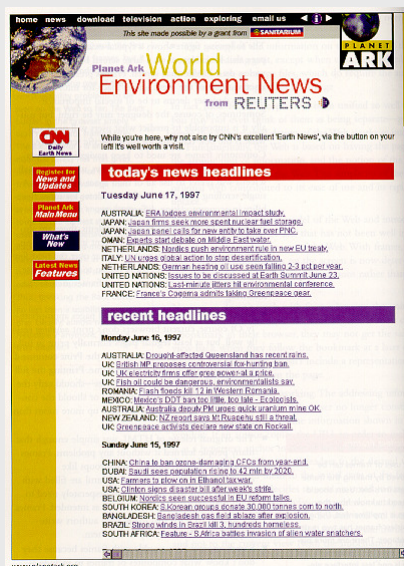
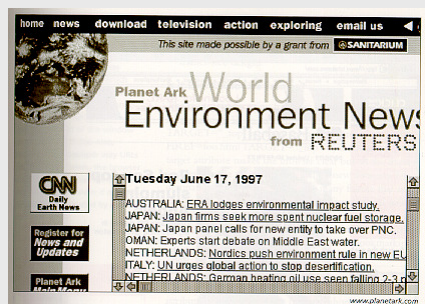
- Flash Player
  - Has become far more common but the lack of it on the iOS platform has shaken this up quite a bit, with discussion of HTML5 features as a possible replacement.
  - Seems to want to update every week or two.
  - Flash applications themselves have gotten quite large and processor-intensive.
- Javascript, ActiveX
  - Widely supported, but some users still turn it off for security reasons.
  - Multiple versions (eg: Jscript -vs- Javascript -vs- ECMAScript)
- Java
  - Newer versions are large downloads and keep getting larger...
  - Even when installed, there is a startup time for using it.
  - Users might turn it off for security or speed issues.
- The other THOUSANDS of plug-ins ☺
  - Specialized users only

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## Frames

**“Just Say No” common advice - if you use them, have a very good reason and test them in different browsers and sizes.**

- Navigation can get much harder
- Users can't track URLs as easily
- Gives user less control over resizing and scrolling
- Some browsers don't seem to support frames well

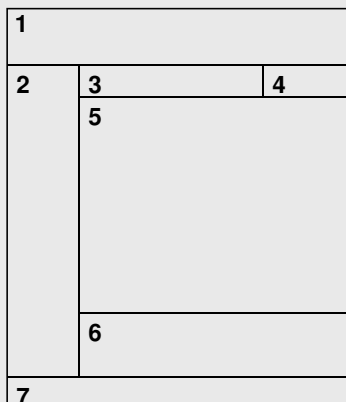


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## How to Build Web Prototypes?

Use a drawing program – not the web!

Build “wireframes” – the rest is the same as with other software



### Example Layout Model

- (1) Logo
- (2) Local or Site Index w/Links
- (3) Search Dialog
- (4) Current date
- (5) Primary Content
- (6) Secondary links
- (7) Last update, copyright info, etc.

Each item should have more information for each item with explanations and justifications.

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## Universal Accessibility

It is very important to consider users with low connection speeds, small screens, different browsers and the like, but it is also important to consider different types of users such as:

- elderly users
- child users
- novice users
- visually impaired users
- hearing impaired users
- users with poor motor control / precision
- users with poor short-term memory

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## [The Potential Value of Good Data Visualization](#)

<http://vimeo.com/29684853>

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## [Beyond Simple Screen Design](#)

**What are the characteristics of good representations?**

**What are the characteristics of good information visualization?**

**What role do metaphors play?**

**How can the use of direct manipulation help us?**

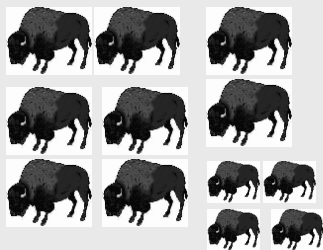
### Good information visualization...

- ...supports making discoveries.
- ...supports making decisions.
- ...supports discovering patterns.
- ...supports finding relevant information.
- ...capture essential elements of events.
- ...deliberately leaves out (or at least mutes) irrelevant data.
- ...is appropriate to the person viewing the data.
- ...is appropriate to the task being performed.

With good visualizations people can see trends, clusters, gaps, and outliers.

Use of colors, sizes, shapes, and locations all help with this.

### How to represent quantity?



||||| ||||| ||  
# Buffalo

||||| |||||  
# Adults    # Kids

||||| ||||| ||  
# Buffalo / kids

八, 四

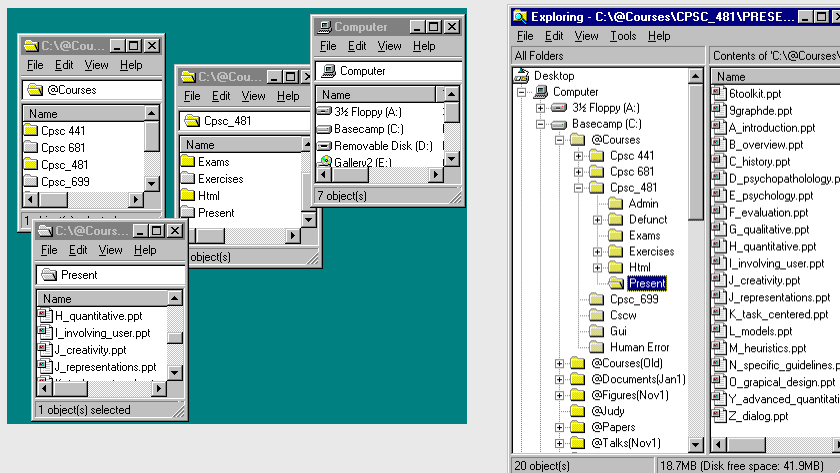
## Where am I? (Geographic Navigation)

Detailed navigation  
plus precision



General navigation plus orientation

## Where am I? (File System Navigation)

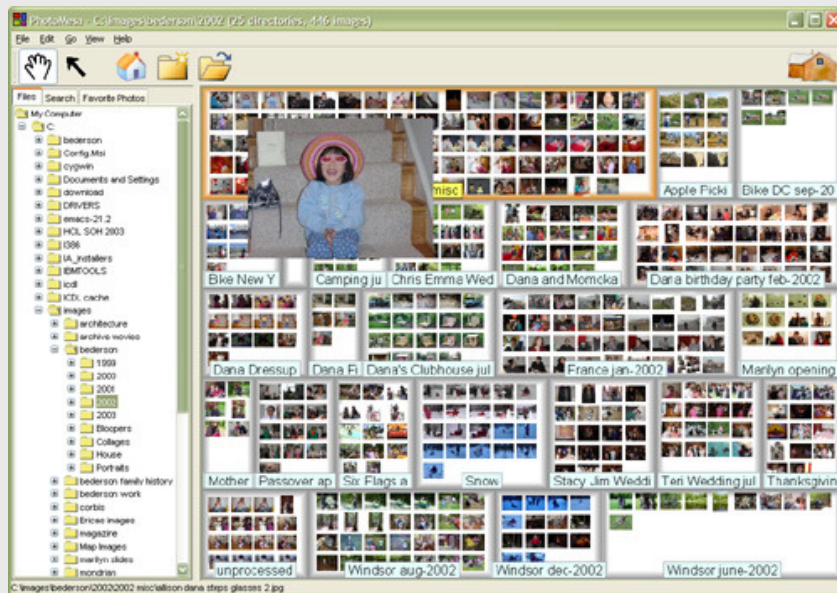


## Where am I? (Revealing Patterns Interactively)



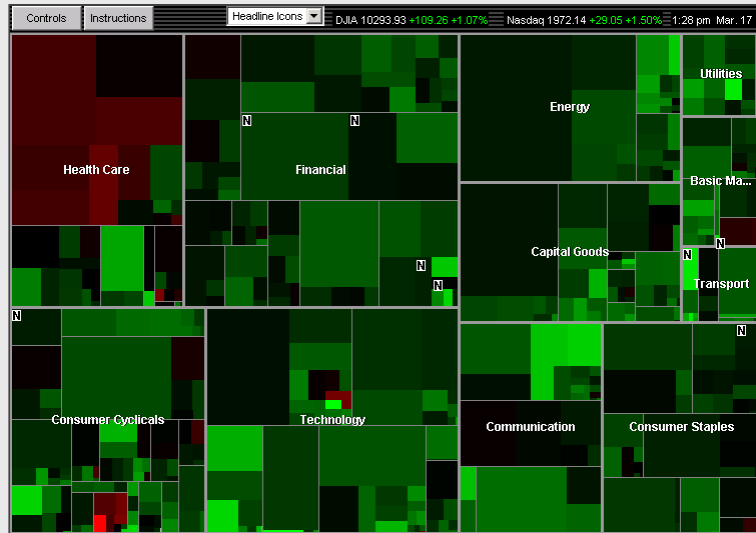
<http://acg.media.mit.edu/people/fry/zipdecode/>

## Which folder has the most photos?



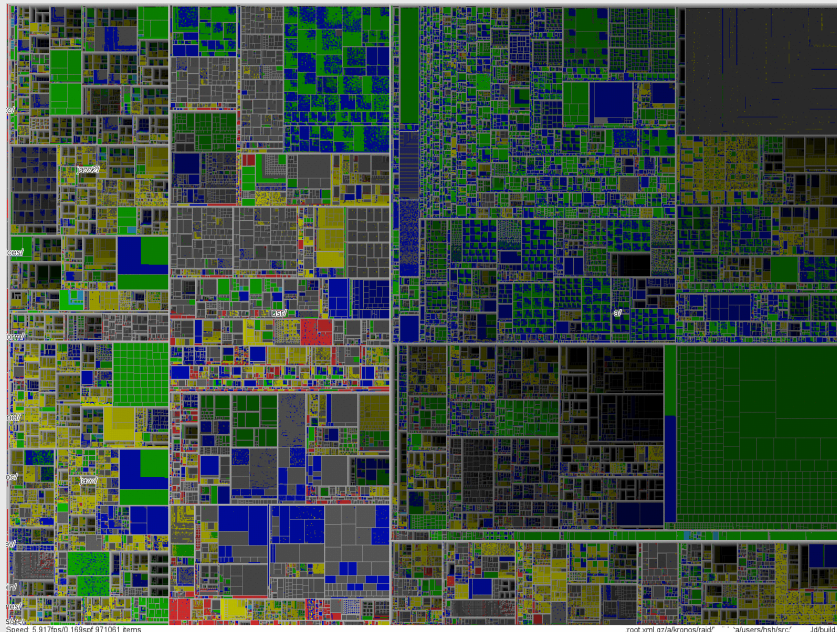


## What stock is doing best?



<http://www.smartmoney.com/marketmap/>

## Which folder is using the most drive space?



## What's going on in the world? (US Edition)

[REGISTER](#)
[LOGIN](#)
[CONTACT](#)
[SELECT ALL](#)
[FINANCIAL](#)
[TECHNOLOGY](#)
[BUSINESS](#)
[HEALTH](#)
[ENTERTAINMENT](#)
[SPORTS](#)
[LIFE](#)
[WORLD](#)
[MORE](#)

# Duke Defeats Wisconsin to Win NCAA Men's Basketball Championship

## Preview: Rangers at Athletics

Kuechel pitches Astros to shutout win over Indians

Japan's Senda outlasts Howell

## Taking Aim at 'Washington Machine,' Rand Paul Begins 2016 Presidential ...

Asian shares mostly higher following Wall Street gain

FedEx to buy TNT to expand Europe deliveries

British Services Growth Hits Seven-Month High in March

Tesla surges as vehicle sales rise

YouTube Kids app criticized as deceiving

## Aussie Strengthens as RBA's Stevens Defies Calls for Rate Cut

Vivendi confirms interest in buying Orange's DailyMotion

New Haven man pleads guilty to tax fraud

Oil prices fall; Iran, China to discuss supplies

Fed can be both late and slow to raise rates: Kocherhorkota

## Malaysia accused of rights assault as terrorism law passes

Australian police hail 'miracle' of autistic boy's outbreak survival

Man accused of killing 3 Muslims ruled eligible to face death penalty

Court appearances continue in Sharper sex-assault case

Battle for 'future of Chicago' decided in mayoral runoff Tuesday

## Election 2015: Tony Blair: public can't be trusted to make 'sensible choice' on EU

Turkey, Iran agree on trade but steer clear of Yemen disagreements

Rain, snow head across California, but little drought help

The National experiment for starting new universities in the UK

McGowan says he will back Labour

## Greek minister: Shunning extradition for German war reparations

Election 2015: Tony Blair insists he backs Ed Miliband

Upstart in Tamil Nadu after Andhra Pradesh Police hit 23 riot workers' arrests

'Selfies are bad,' Prince Harry tells Australian

McGowan says he will back Labour

Ferguson warns of council members' votes

## Elisabeth Moss jokes around with Mad Men co-star John Slattery in bed... as ...

Star Wars: The Digital Movie Collection comes April 10

American Pie 6: crazy conspiracy theories

Sesame Street Parodies 'Game of Thrones' and Humorous Fashion

Tidal takes on Spotify, Apple to follow

Inside the New NCAA Game at NBC News

Anne Hathaway transforms into Miley Cyrus in Lip Sync Battle

Maya Angelou's memoir quite isn't hers?

Dallas Buyers Club plays host in landmark piracy case

LG Display claims Apple will debut the Mac OS 10.11

Avian flu strikes Kandyohi County

World Health Day 2015: Food Safety Tips

Hander, Longford to launch 'Landscape' academy to help way to longevity

## Walmart pulls Blue Bell as precaution

Study: Breast Milk Bought on the Internet Might Not Be Legit

[SELECT ALL](#)
[WORLD](#)
[FINANCIAL](#)
[BUSINESS](#)
[TECHNOLOGY](#)
[SPORTS](#)
[ENTERTAINMENT](#)
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[TODAY](#)
[TUE APR 7, 2015 10:44:30](#)
[WEDNESDAY](#)
[THURSDAY](#)
[FRIDAY](#)
[SATURDAY](#)
[SUNDAY](#)

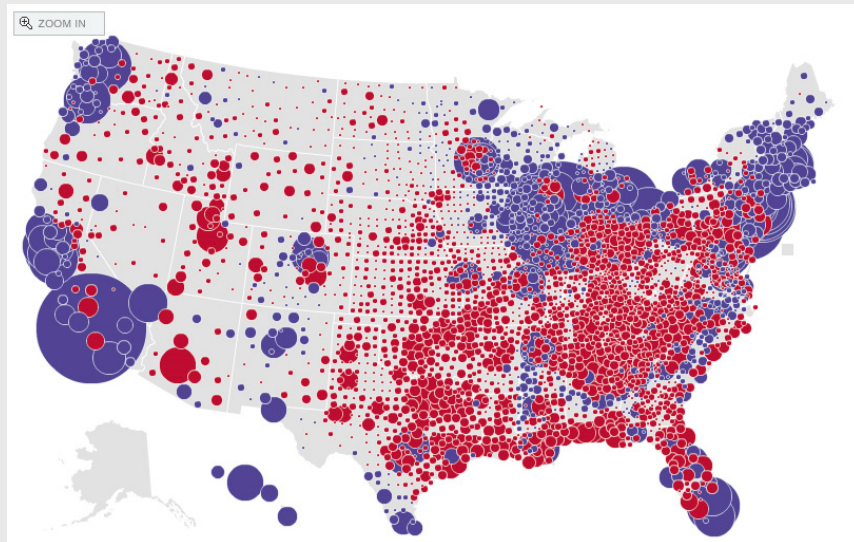
[HOME](#)
[ABOUT](#)
[CONTACT](#)
[SITEMAP](#)

## What's going on in the world? (UK Edition)

[illegible]

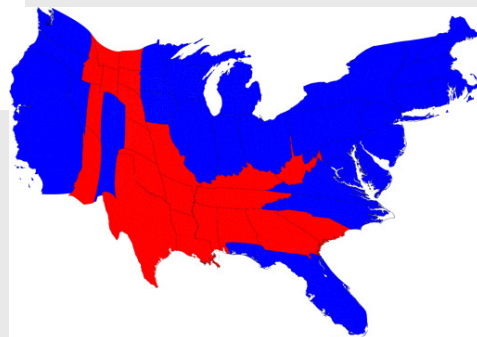
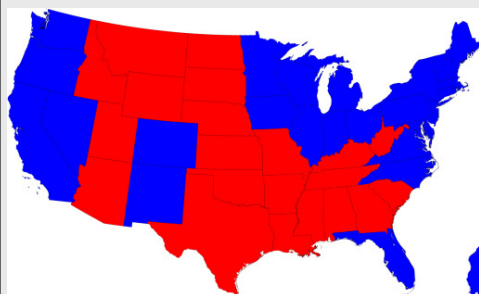


## Who won the 2008 Presidential elections, by how much?



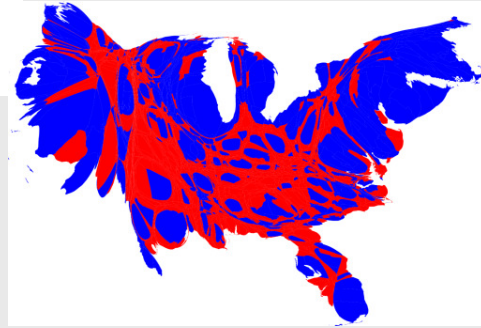
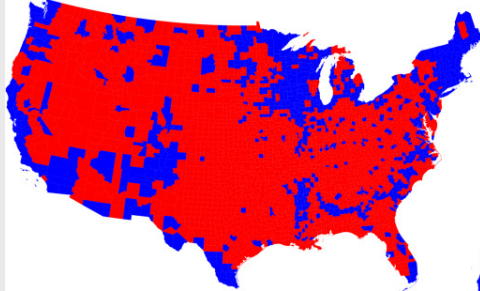
## Who won the 2008 Presidential elections, by how much?

By state...



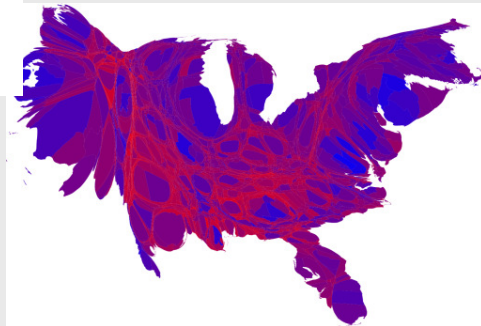
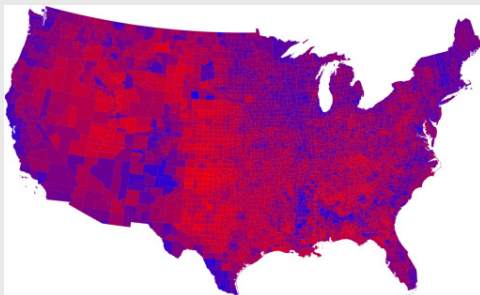
## Who won the 2008 Presidential elections, by how much?

By county...

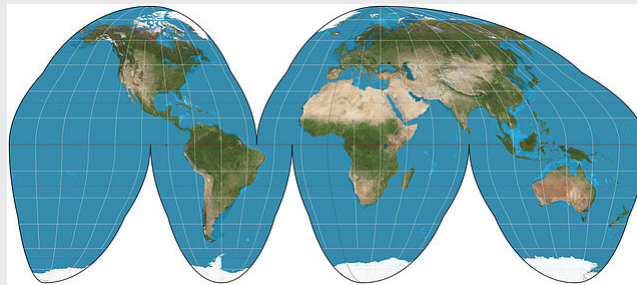
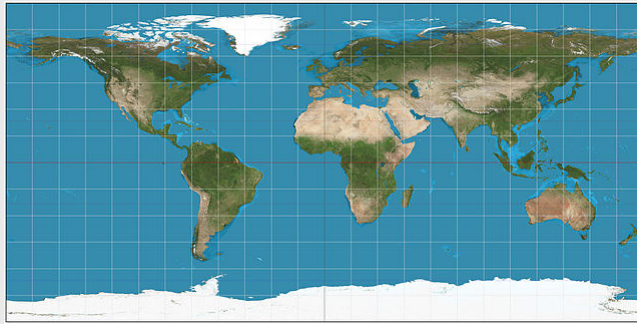


## Who won the 2008 Presidential elections, by how much?

By percentage...

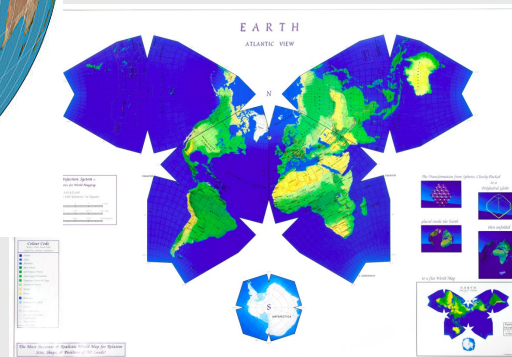
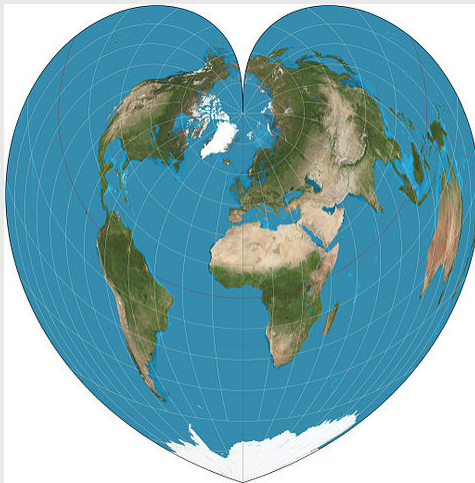


## What does the Earth look like?



Evan Golub / Ben Bederson / Saul Greenberg

## What does the Earth look like?



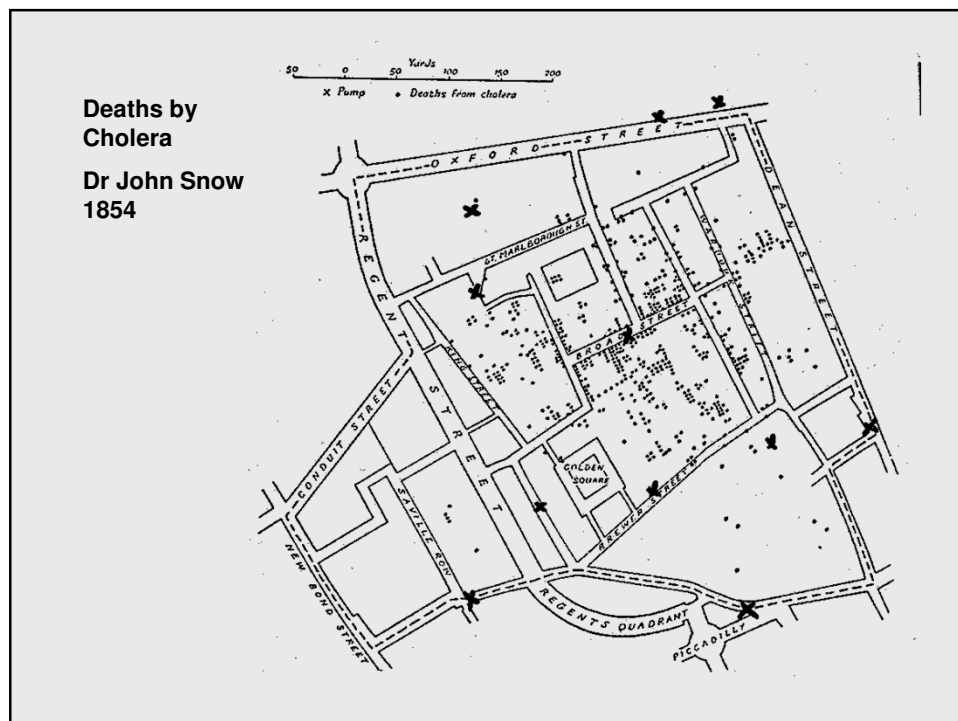
Evan Golub / Ben Bederson / Saul Greenberg

## Information Visualization

### Graphics should reveal the data

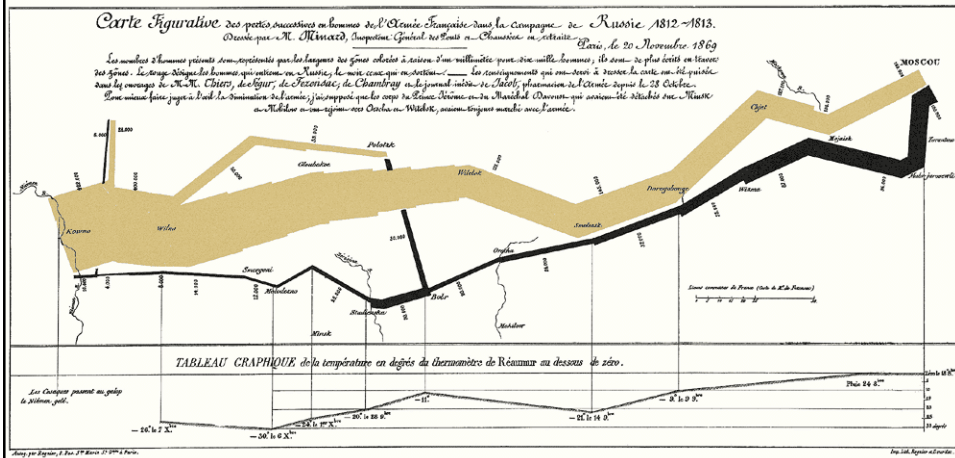
- show the data
- not get in the way of the message
- avoid distortion
- present many numbers in a small space
- make large data sets coherent
- encourage comparison between data
- supply both a broad overview and fine detail
- serve a clear purpose

*Note: many visual examples on the following slides are taken from Tufte's books such as Visual Display of Quantitative Information*



## Telling a story: Napoleon's march to Moscow

by Charles Minard (1885)



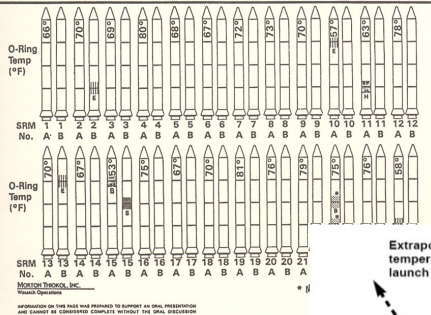
Six Variables Shown:

[1] Size of army, [2,3] Position (long/lat), [4] Direction of movement, [5] Temperature, [6] Time

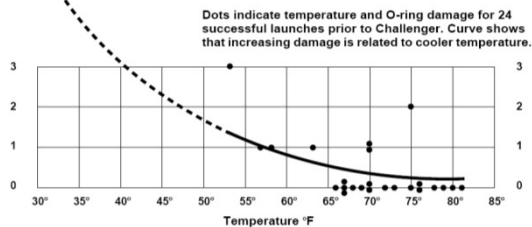
Not Shown but COULD have been: Mood of the troops with shading? Others? How?

## Challenger: Showing the right data? The right way?

History of O-Ring Damage in Field Joints (Cont)



Extrapolation of damage curve to the 31° F temperature forecast for Challenger's launch on January 28, 1986.



Interaction

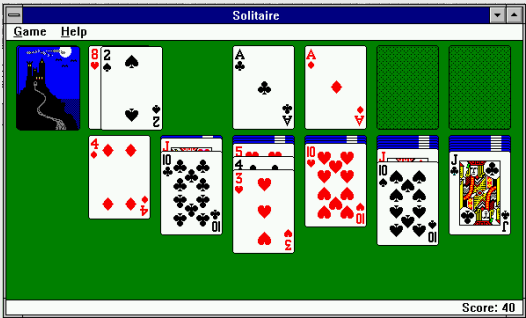
If a picture is worth a thousand words, then an interactive visualization is worth a thousand pictures.....

Metaphors (I)

Pervade excellent interfaces

	A	B	C	D
1	Market value	Land	Improvement	Total assess
2	140.0	65,850.	73,120.	138,970.
3	147.0	77,780.	72,070.	149,850.
4	151.0	74,850.	88,740.	163,590.
5	152.0	80,110.	99,410.	179,520.
6	155.0	79,050.	109,130.	188,180.
7	170.0	94,750.	50,960.	145,710.
8	172.0	82,150.	106,250.	188,400.
9	178.0	78,560.	132,660.	211,220.
10	180.0	92,840.	105,670.	198,510.
11	180.0	80,090.	103,130.	183,220.
12	182.0	76,650.	115,210.	191,860.
13	185.0	75,590.	152,710.	228,300.
14	185.0	85,870.	105,330.	191,200.
15	185.0	80,060.	113,600.	193,660.
16	193.4	80,140.	131,340.	211,480.
17	194.5	73,400.	176,210.	249,610.
18	197.0	84,960.	129,800.	214,760.
19	203.0	91,600.	119,170.	210,770.
20	205.0	79,460.	137,250.	216,710.
21	213.0	87,060.	124,350.	211,410.
22	221.0	97,330.	167,500.	264,830.
23	225.0	87,160.	157,290.	244,450.
24	245.0	79,520.	144,840.	224,360.
25	248.0	89,470.	183,500.	272,970.
26	278.0	82,150.	168,720.	250,870.
27	302.5	118,500.	109,800.	228,300.
28	308.0	65,100.	141,730.	224,830.

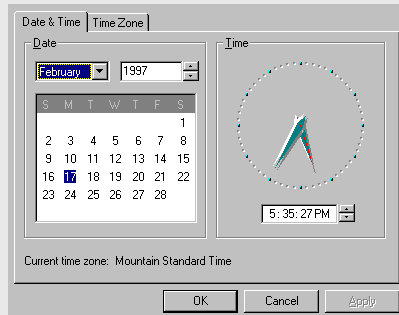
spreadsheet (actuary sheet)



games (literal world)



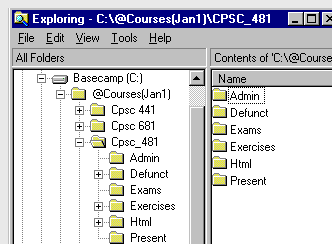
## Metaphors (II)



**Control Panels with familiar controls**

Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
City: \_\_\_\_\_  
Province: \_\_\_\_\_  
Postal Code: \_\_\_\_\_

**Forms**



**Hierarchical Folders**

## Direct Engagement & Direct Manipulation

### **Direct Engagement**

- the feeling of working *directly* on the task

### **Direct Manipulation**

- An interface that behaves as though the interaction was with a real-world object rather than with an abstract system

### **Central ideas**

- visibility of the objects of interest
- rapid, reversible, incremental actions
- manipulation by pointing and moving
- immediate and continuous display of results

### **Almost always based on a metaphor**

- mapped onto some facet of the real world task semantics

## Direct Engagement

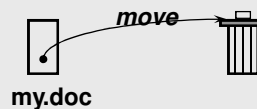
**Xerox Star: pioneered in late 70's and early '80s**  
**=copied by almost everyone=**

- simulates desktop with icons
  - in and out baskets
  - file folders and documents
  - calculators
  - printers
  - blank forms for letters and memos
- small number of generic actions applicable system wide
  - move, copy, delete, show properties, again, undo, help
    - eg same way to move text, documents, etc
  - property sheets
    - pop-up form, alterable by user
- What you see is what you get (WYSIWYG)

## Object-Action

**Select object, *then* do action**

- interface emphasizes 'nouns' (visible objects) rather than 'verbs' (actions)



### **Advantages**

- closer to real world
- modeless interaction
- *actions* always within context of object
  - inappropriate ones can be hidden
- *generic commands*
  - the same type of action can be performed on the object
  - eg drag 'n drop:
    - folders
    - files
    - paragraphs
    - text
    - numbers...



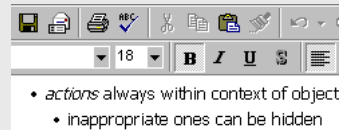
## Action-Object

### Select action, then, pick object

- interface emphasizes 'verbs' (actions) rather than 'nouns' (visible objects)

### Advantages

- Pick a setting and reuse it
- Often more efficient



## Is direct manipulation the way to go?

### Some Disadvantages

- Ill-suited for abstract operations
  - spell-checker?
- Tedium
  - manually search large database vs query
- Task domain may not have adequate physical/visual metaphor
- Metaphor may be overly-restrictive

### Solution

- Most systems combine direct manipulation and abstractions
  - word processor:
    - WYSIWYG document (direct manipulation)
    - buttons, menus, dialog boxes (abstractions, but direct manipulation “in the small”)

## Conventional Applications: A Mix



## Quick Recap (not exhaustive)

**Grids are an essential tool 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

**The use of color and animation needs to be considered carefully**

## **Quick Recap (not exhaustive)**

### **Good Representations**

- captures essential elements of the event / world
- deliberately leaves out / mutes the irrelevant
- appropriate for the person, their task, and their interpretation

### **Metaphors**

- uses our knowledge of the familiar and concrete to represent abstract concepts
- need not be literal
- has limitations that must be understood

### **Direct manipulation**

- visibility of the objects of interest
- rapid, reversible, incremental actions
- manipulation by pointing and moving
- immediate and continuous display of results
- action-object **-versus-** object-action

*These three components are the foundation of a true Visual Interface*

## **Closing Thoughts...**

**"If a picture is worth 1000 words, then an interface is worth 1000 pictures."**

**Keep user tasks and goals in mind.**

**Encourage exploration but don't overwhelm the users.**

**Overview, zoom, filter, details on demand.**

**What happens as we move forward and start to think about audible design? How many words is a song worth?**