

“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

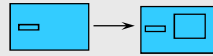
Imagery

- 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

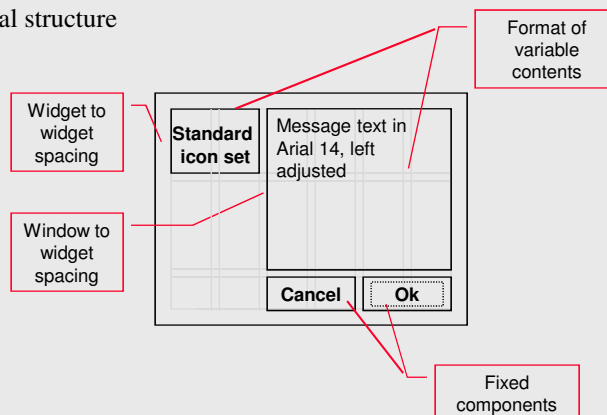
- aligns related components

Organization

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

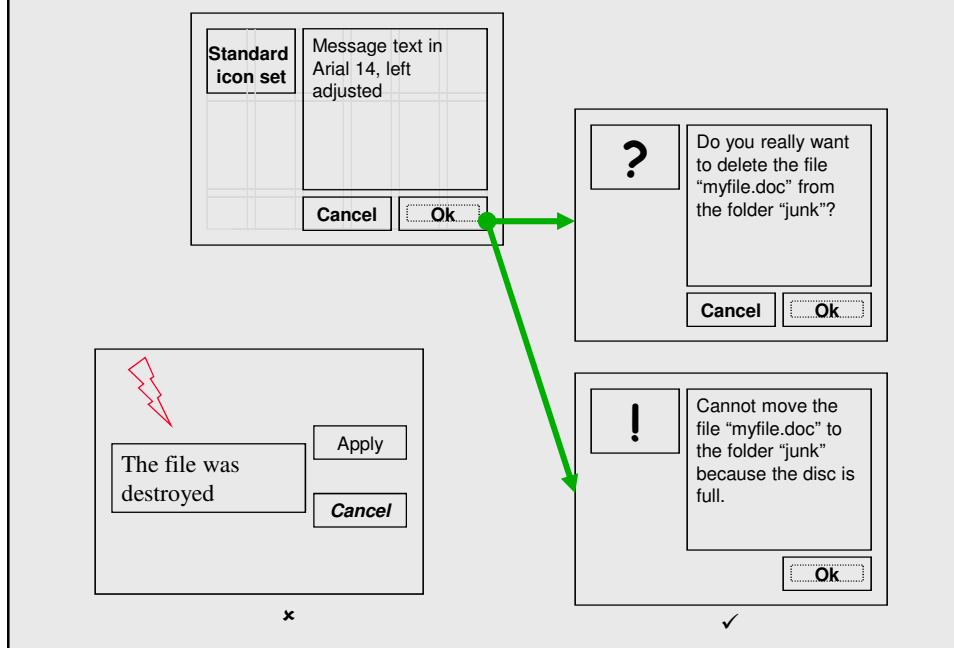
Consistency

- location
- format
- repetition
- organization

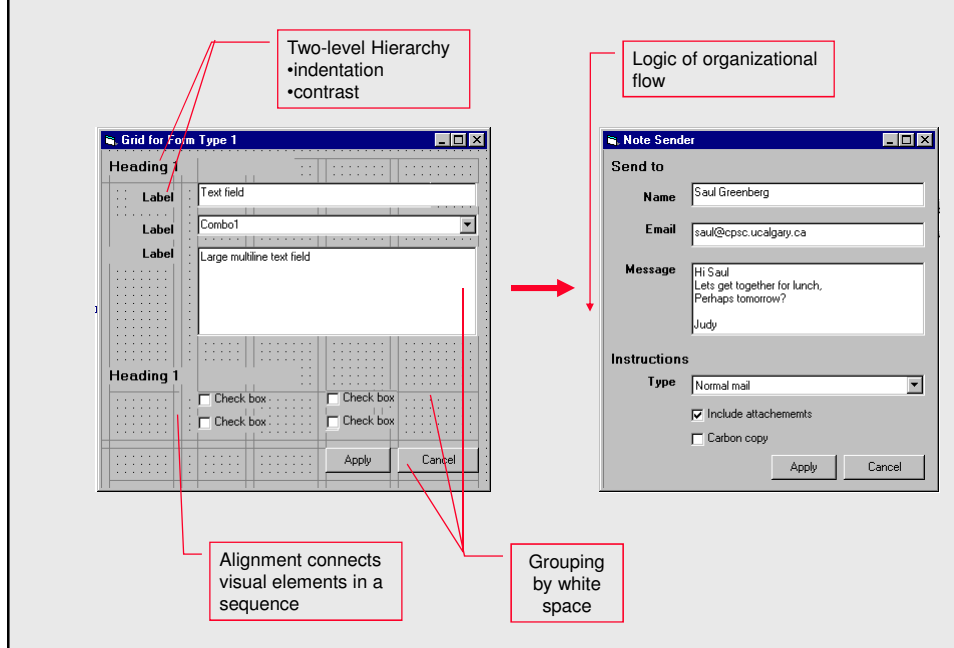


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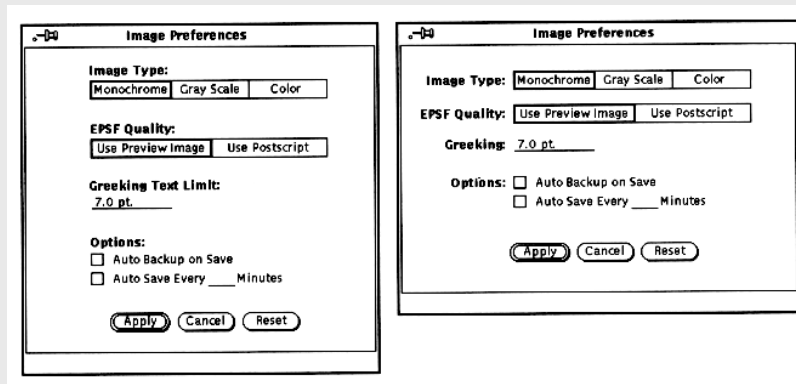
Using same Grid-Based Template across project



Generic Grid to Specific Use



Classic Mac Comparison on Negative Space



*The importance of negative space
from mullet & sano*

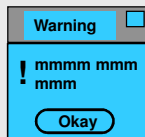
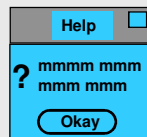
Visual Consistency

Internal consistency

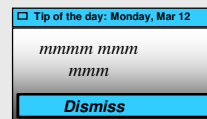
- same conventions and rules for all elements of the GUI unless strong reason
- set of application-specific grids enforce this

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: <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"/>

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Explicit Structure via Lines can get cluttered

(a)

(b)

Using explicit structure as a crutch
from Mullet & Sano

UMEG | Grades | Enter Grades - Microsoft Internet Explorer

Address: https://www.umeg.umd.edu/bin/grdEntry

UMEG

University of Maryland Eastern Shore: Grading system

[Logout](#)

[Rosters](#) [Grades](#)
[Enter Grades](#) [Review Grades](#) [Correct Grades](#) [Authorize Grader](#) [Incomplete Grades](#)

Term: Fall 2005 **Title:** INTRO INFO TECHNOLOGY
Course: CMSC102 **Instructor(s):** Golub, Evan
Section: 0101 **TA(s):** None

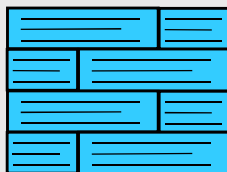
For a list of grade definitions, click [here](#).
Only getting a partial grade roster for a 300- or 400-level course?
 We ONLY monitor Early Warning Grades for first-year students and student athletes in 300- and 400-level courses.

UID	Student Name	Grade														
11	[blurred]	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
		+ A	-	+ B	-	+ C	-	+ D	-	F	S	U	Z			
11	[blurred]	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
		+ A	-	+ B	-	+ C	-	+ D	-	F	S	U	Z			
11	[blurred]	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
		+ A	-	+ B	-	+ C	-	+ D	-	F	S	U	Z			
11	[blurred]	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
		+ A	-	+ B	-	+ C	-	+ D	-	F	S	U	Z			

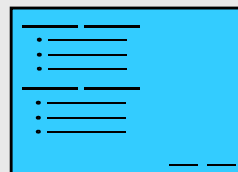
Internet

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



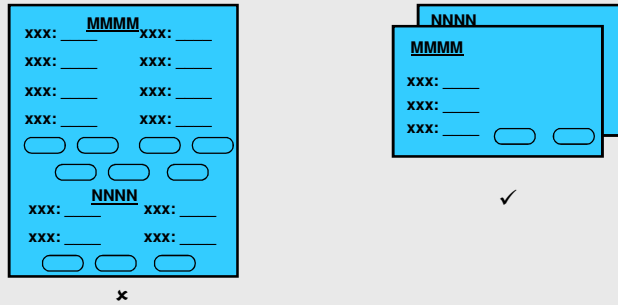
x



✓

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

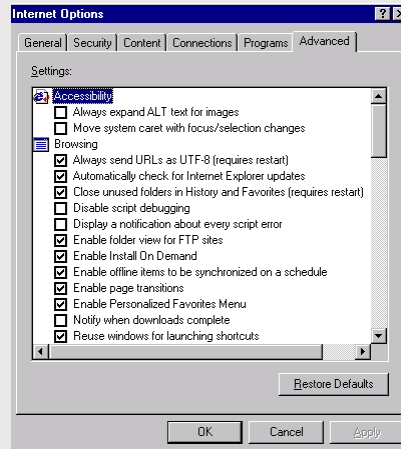
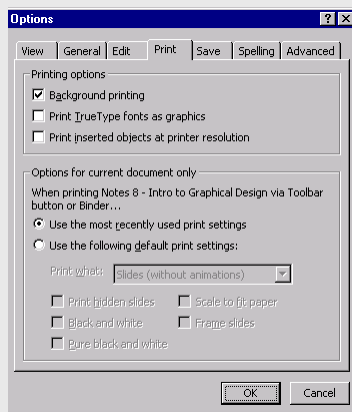


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Tabs to help Visual Economy

Excellent means for factoring/grouping related items.

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

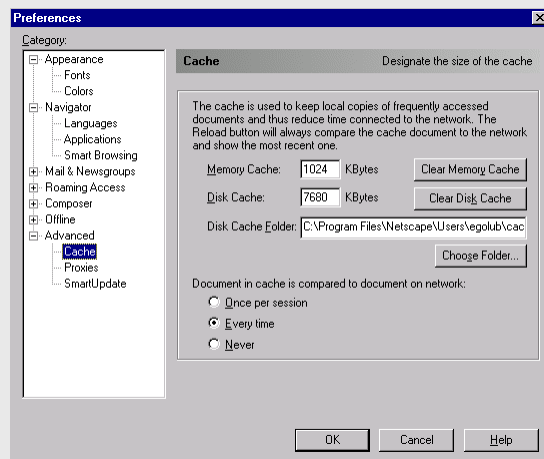


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Tree Views to help Visual Economy

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...

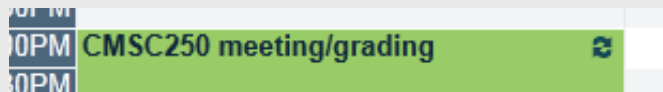


Partial icon family

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Accurate/Appropriate Imagery

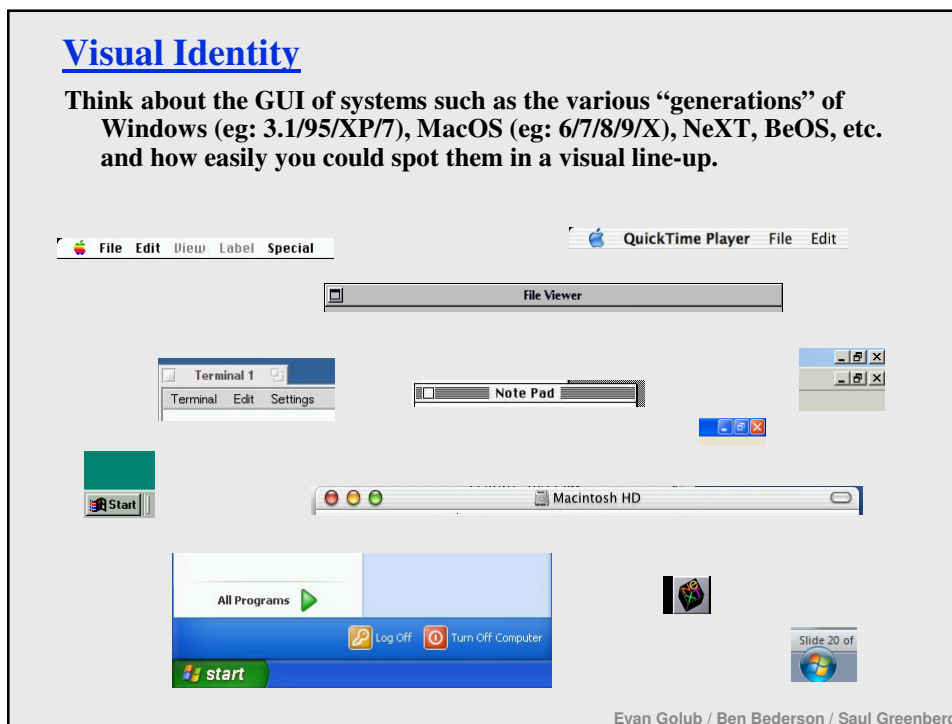
What does that icon in the upper-right corner mean on this event scheduling page?



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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/>

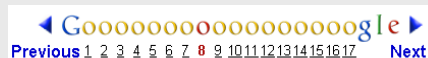
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Some Examples of Color Use

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:

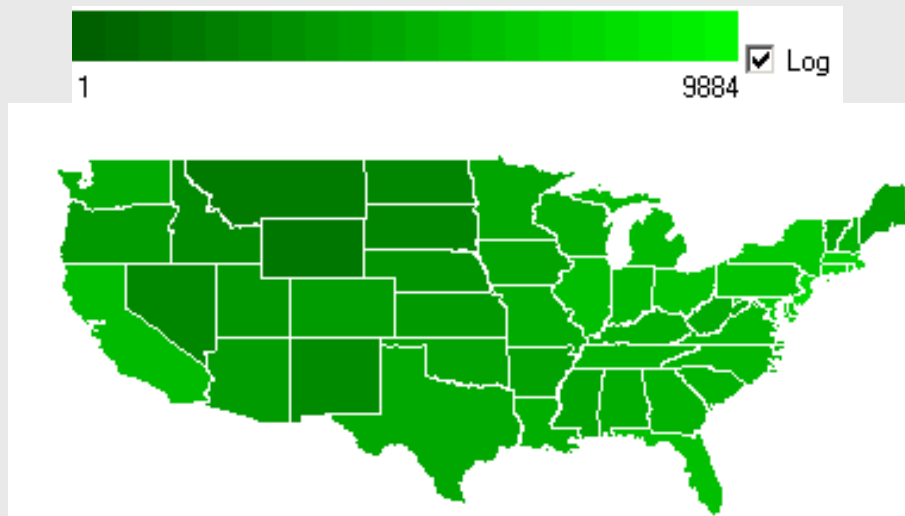
ALUMNI
BUSINESS, INDUSTRY AND GOVERNMENT
CURRENT STUDENTS
FACULTY AND STAFF
MEDIA
PARENTS, FAMILIES, FRIENDS
PROSPECTIVE STUDENTS
VISITORS

RESOURCES FOR:

ALUMNI
BUSINESS, INDUSTRY AND GOVERNMENT
CURRENT STUDENTS
FACULTY AND STAFF
MEDIA
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 ± 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 ± 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 ± 2 chunks of information, each of which being divided into 7 ± 2 chunks of information. Google's 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 ± 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

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.

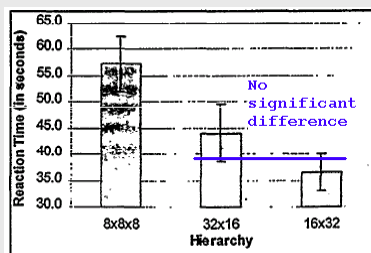


Figure 1: Average reaction time for each hierarchy.

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Navigation -vs- Content -vs- Advertising

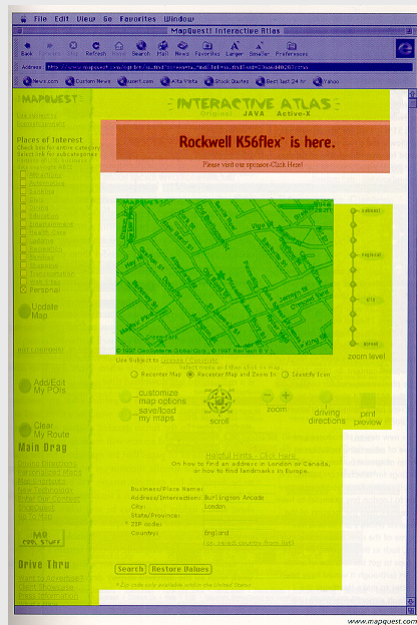
Nobody “wants” to navigate.

Navigation is a necessary evil.

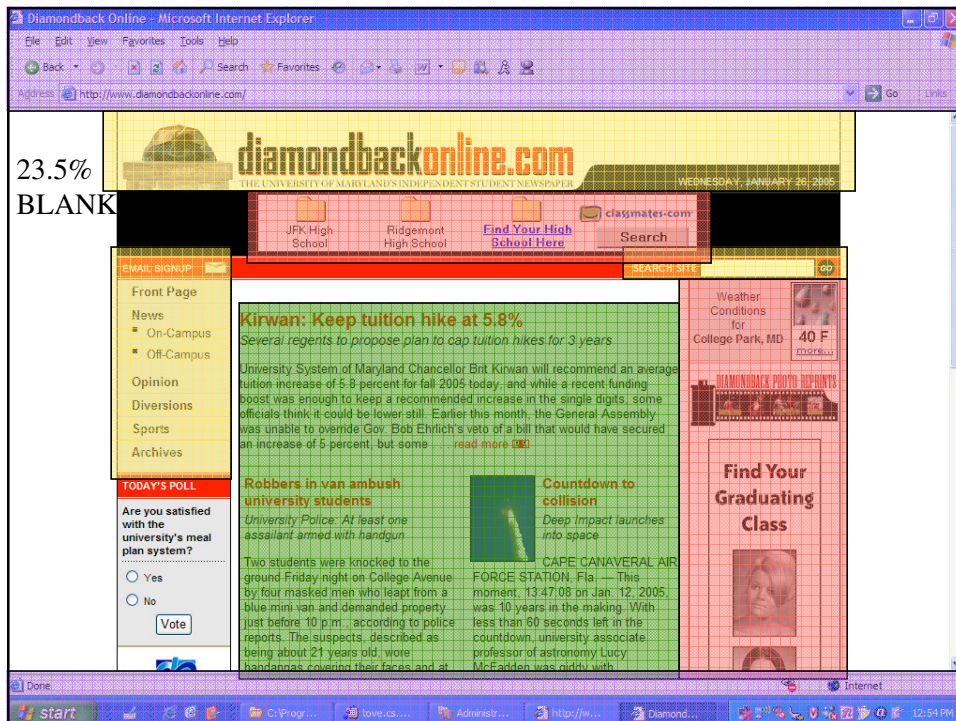
Screen space taken up with explicit navigation typically takes away from actual content.

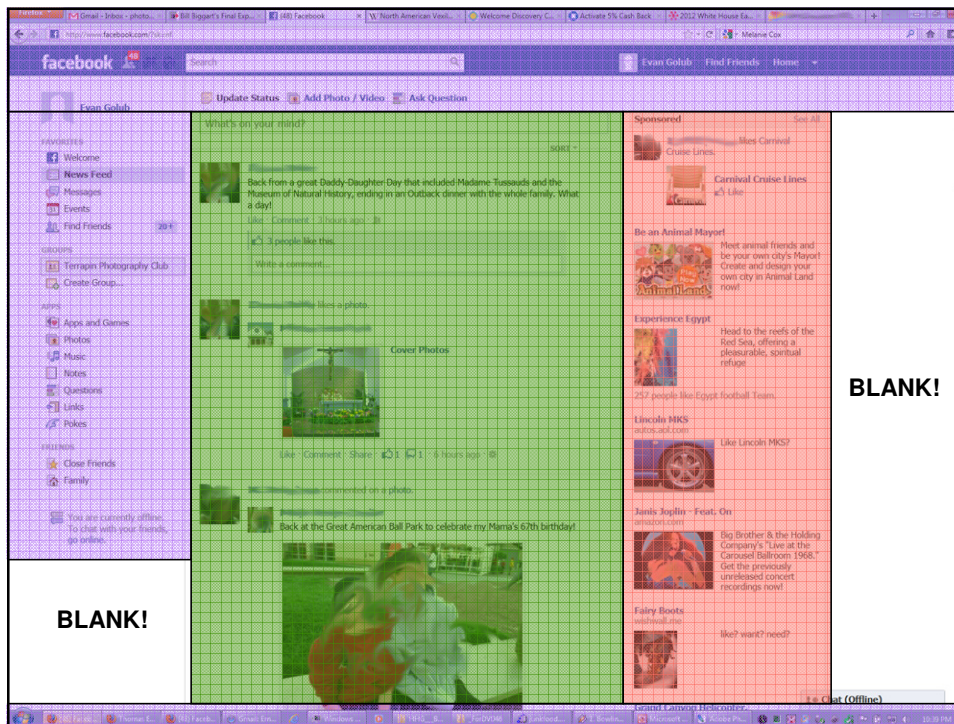
This early Mapquest example from the late 1990s shows how extreme the imbalance can be...

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



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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.

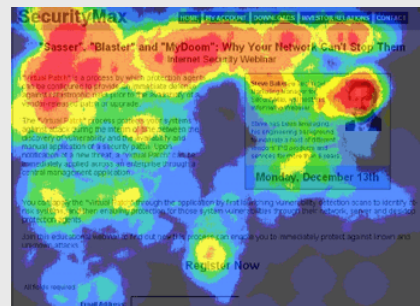
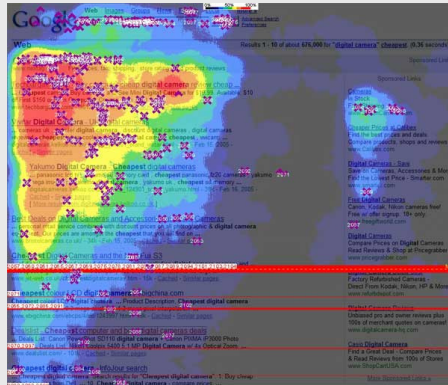
Scent: “Conveys distal target information via category labeling”

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

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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:

	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

Some historic distribution of monitor resolutions:

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%

By 2012 things were at a point where 85% of screens of those visiting W3Schools were larger than 1024x768 but as smartphone penetration has soared even if the resolution is higher, the screen size itself might be rather small.

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

We also need to consider widescreen monitors that do not have 4:3 aspect ratios 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 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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W3Schools Stats History

Date	Other high	1920x1080	1366x768	1280x1024	1280x800	1024x768	800x600	Lower
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%
January 2002	6%					34%	52%	8%
January 2001	5%					29%	55%	11%
January 2000	4%					25%	56%	15%

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Content Formats (I)

- HTML
 - Basically the web markup language (currently at HTML 5). Go to 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)

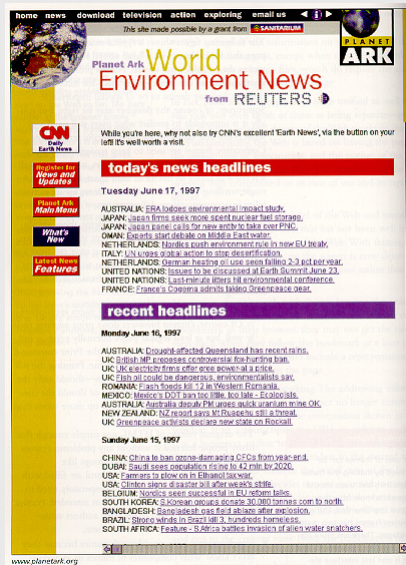
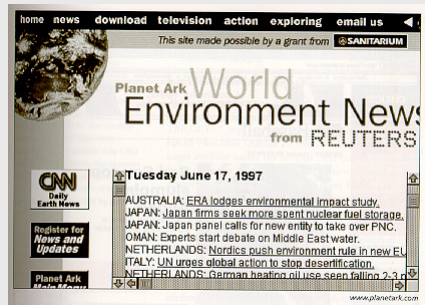
- Flash Player
 - Has become far more common but the lack of it on the iOS platform has shaken this up quite a bit, with discussion of HTML5 features as a possible replacement.
 - Seems to want to update every week or two.
 - Flash applications themselves have gotten quite large and processor-intense.
- 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” - If you use them, have a very good reason!

- Navigation gets much harder
- Can't track URLs as easily
- Gives user less control over resizing and scrolling
- Older browsers / custom browsers don't support frames well

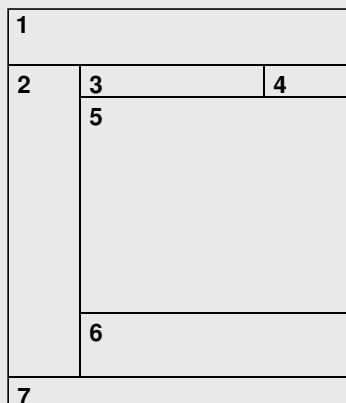


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How to Build Web Prototypes?

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

Evan Golub / Ben Bederson / Saul Greenberg

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.

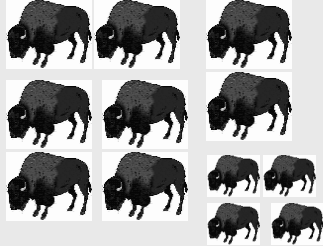
...is appropriate to the person viewing the data.

...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



Buffalo / kids

八, 四



Adults



Kids

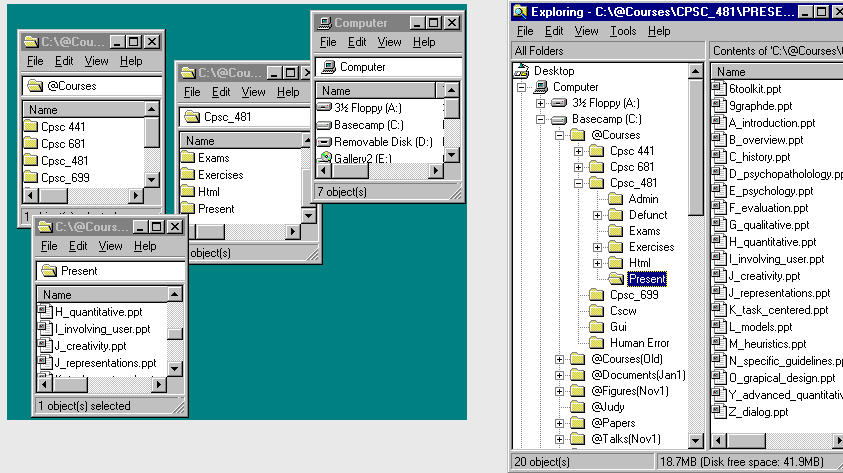
Where am I? (Geographic Navigation)

Detailed navigation
plus precision

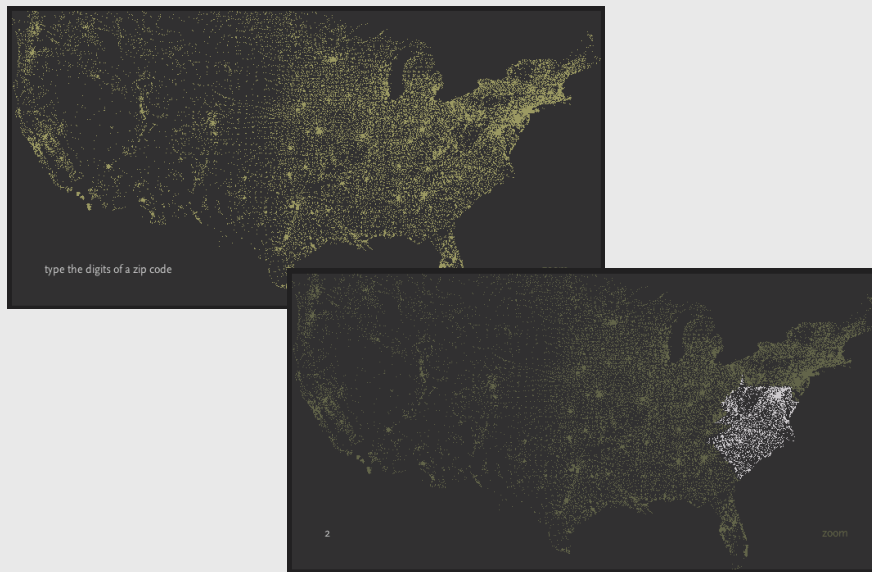


General navigation plus orientation

Where am I? (File System Navigation)

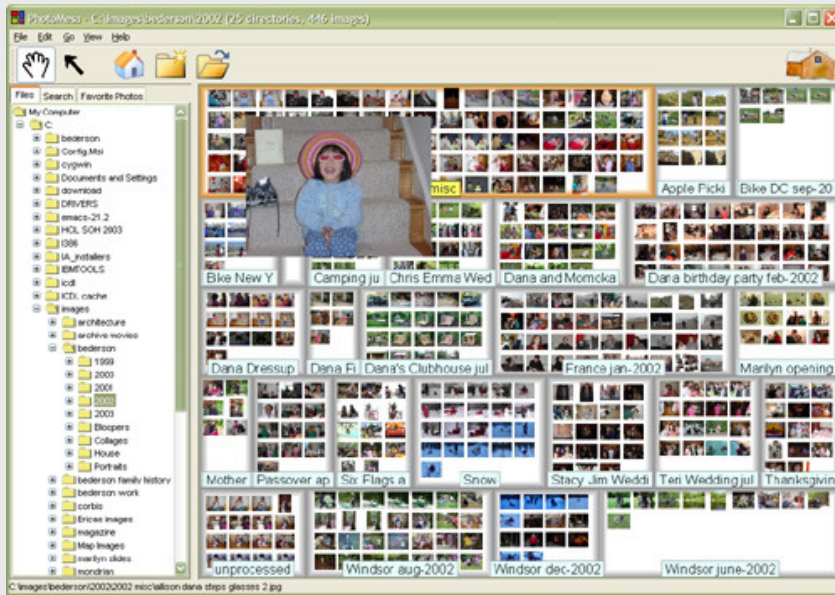


Where am I? (Revealing Patterns Interactively)

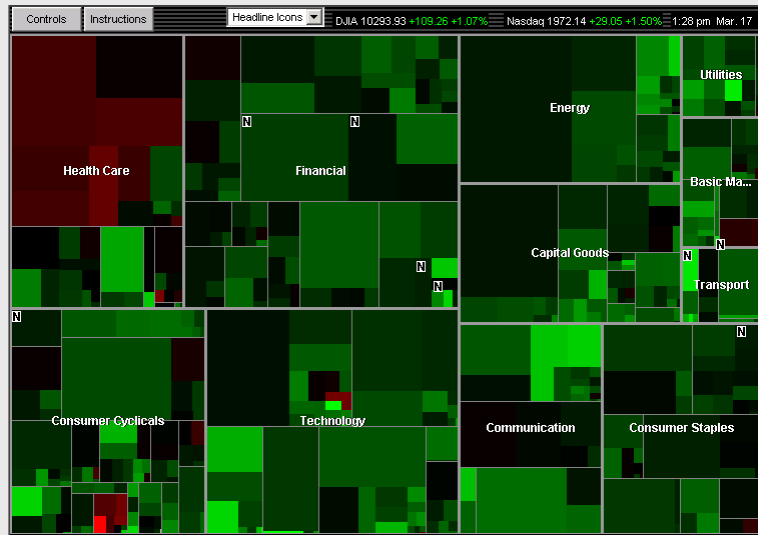


<http://acg.media.mit.edu/people/fry/zipdecode/>

Which folder has the most photos?

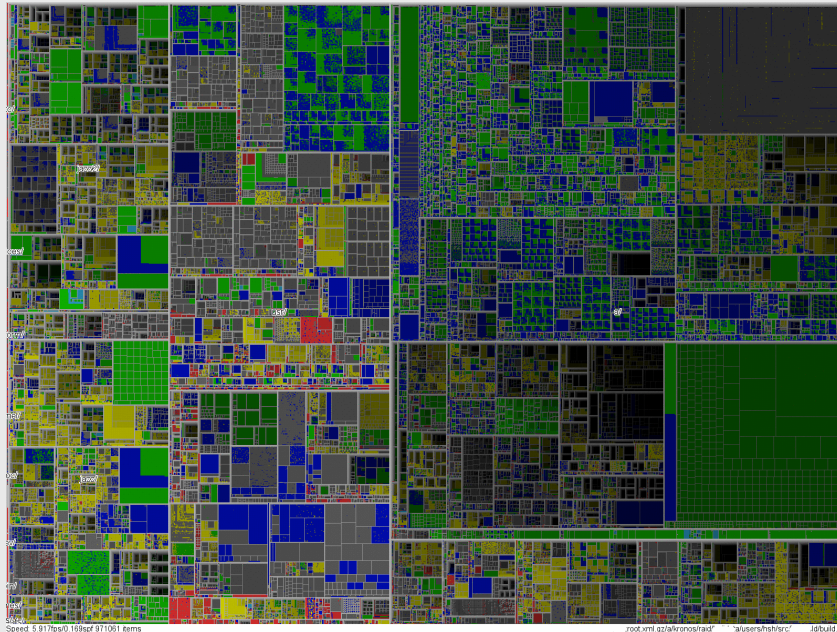


What stock is doing best?



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

Which folder is using the most drive space?



What's going on in the world?

newsmap

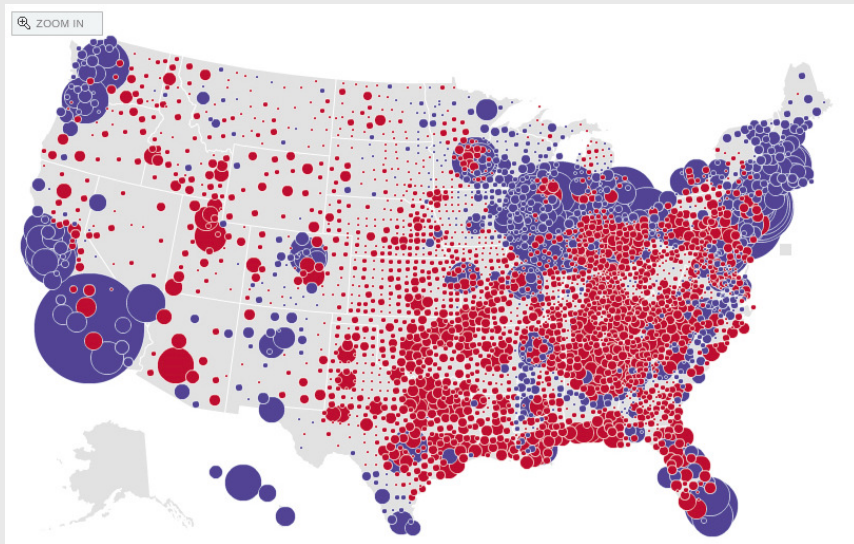
Sun March 13, 2011 16:04:04

powered by

SEARCH ALL | WORLD | HISTORICAL | BUSINESS | TECHNOLOGY | SPORTS | ENTERTAINMENT | HEALTH | LESS THAN 1 HR AGO | MORE THAN 1 HR AGO | MORE THAN 1 HOUR AGO

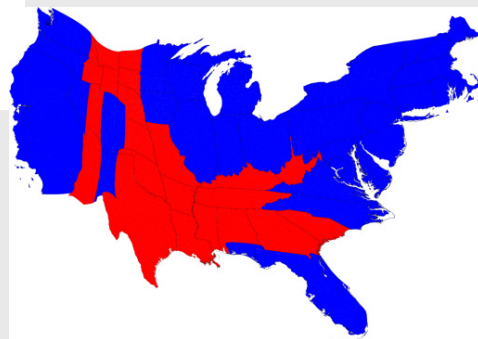
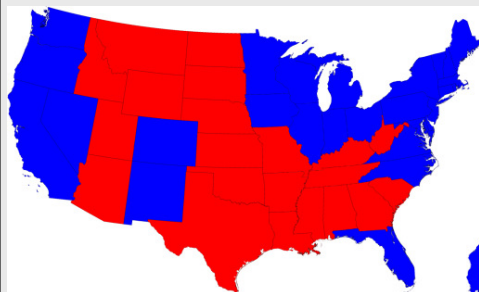
EU support for Arab rebels is shamefully late	Libyan Rebels Retreat from Oil Port Under Fire from Pro-Gadhafi Forces	Gaddafi forces rout rebels in eastern Libya	Violence undermines conciliation between Yemeni ruling party, opposition	Veering From Peaceful Models, Libya's Youth Revolt Turns Toward Chaos	Save us, beg rebels driven out of key oil city by relentless onslaught of ...
Libyan rebels flee Port Brega as Kadafi forces advance	In Libya, advance by Gaddafi forces sends rebels fleeing	Carnage on I-95 After Crash Rips Bus Apart	10000 feared dead in Japan's Miyagi prefecture alone	Israel can no longer pretend there's no Mideast conflict	Protesters Seal Off Bahrain's Financial Center
Libya: Gaddafi troops force rebels out of Brega	Arabs to urge UN to impose no-fly zone on Libya	Gbagbo Forces Attack Ouattara Stronghold	Tsunami causes ripples in Gurgaon	Japan Quake: Fears For '10000 Missing'	Japan tsunami grazes Americas but impact light
Charlie Sheen – wasn't he a film actor in the Eighties?	Japanese authorities rush to save lives, avert nuclear crisis	Bookies refund Binocular bets	Ponting - We were rusty	Italy say 'merci' to Masi after historic victory	Manchester City vs Reading Report
REVEALED Katie Price's from fantasy girl Leicester Poppins lives is calamity	Gwyneth's Choice of song in Glee was a bit off, but that's all	Duo tap way to dance victory	Hamilton: Season is wide open	Japan quake: Disaster relief efforts under way	Alarazi set for Festival show
Stars warn of cuts threat to arts	North's poor struggle on to end	City's 20th anniversary	Italy say 'merci' to Masi after historic victory	Japan quake: Disaster relief efforts under way	Alarazi set for Festival show
Stars warn of cuts threat to arts	North's poor struggle on to end	City's 20th anniversary	Scotland braced for more blizzards	Japan quake: Disaster relief efforts under way	Alarazi set for Festival show
Stars warn of cuts threat to arts	North's poor struggle on to end	City's 20th anniversary	Fears for Britons after Japan quake	Japan quake: Disaster relief efforts under way	Alarazi set for Festival show

Who won the 2008 Presidential elections, by how much?



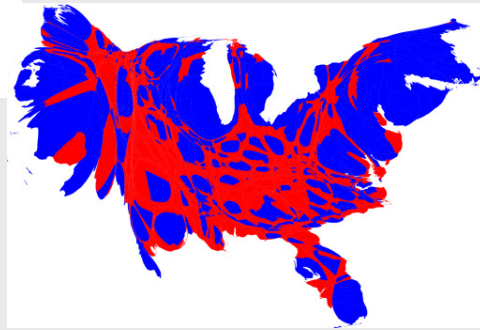
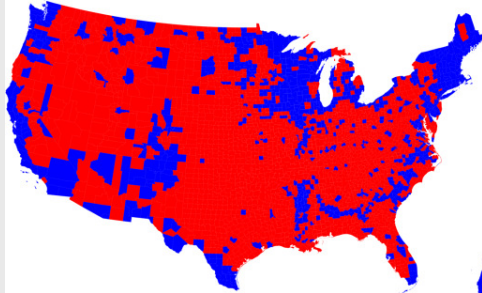
Who won the 2008 Presidential elections, by how much?

By state...



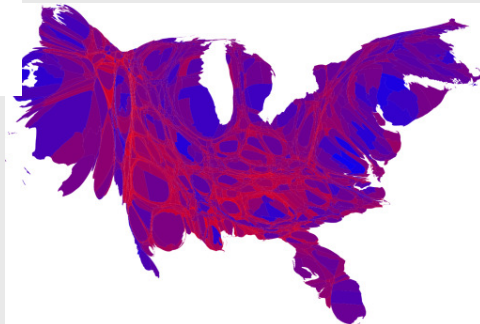
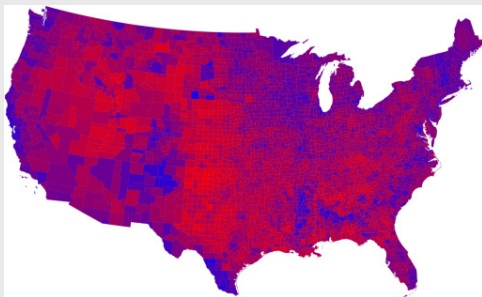
Who won the 2008 Presidential elections, by how much?

By county...



Who won the 2008 Presidential elections, by how much?

By percentage...

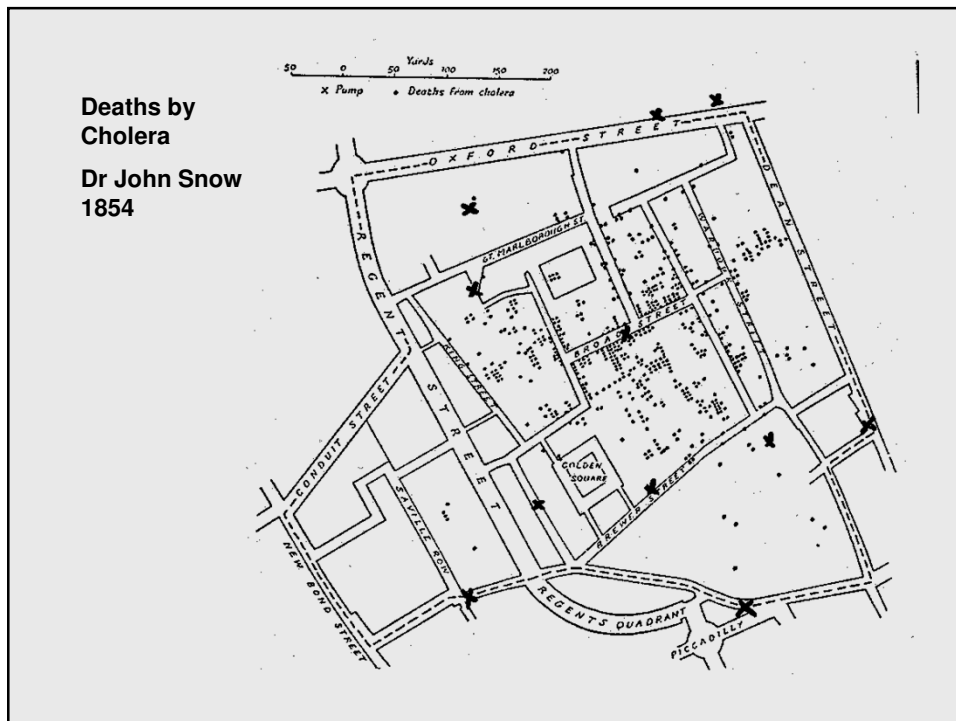


Information Visualization

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



Interaction

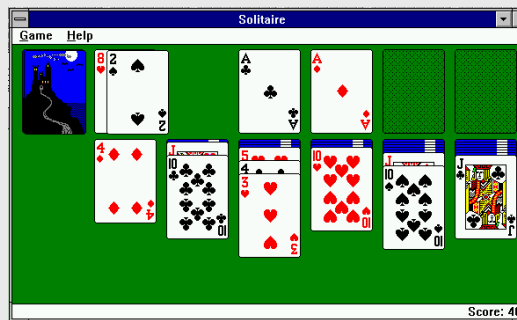
If a picture is worth a thousand words, then an interactive visualization is worth a thousand pictures.....

Metaphors (I)

Pervade excellent interfaces

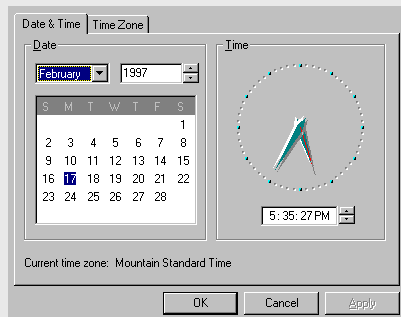
	A	B	C	D
1	Market value	Land	Improvement	Total assess
2	140.0	65,850.	73,120.	138,970.
3	147.0	77,780.	72,070.	149,850.
4	151.0	74,850.	88,740.	163,590.
5	152.0	80,110.	99,410.	179,520.
6	155.0	79,050.	109,130.	188,180.
7	170.0	94,750.	50,960.	145,710.
8	172.0	82,150.	106,250.	188,400.
9	178.0	78,560.	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.	113,500.	193,560.
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	63,100.	141,730.	224,830.

spreadsheet (actuary sheet)



games (literal world)

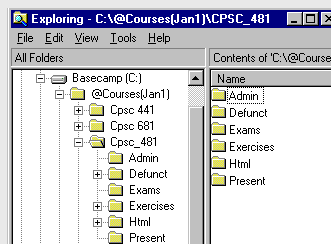
Metaphors (II)



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

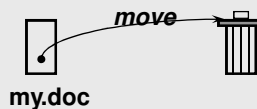
Xerox Star: pioneered in late 70's and early '80s
=copied by almost everyone=

- 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...

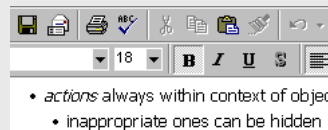
Action-Object

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.