A Lightning Tour of Varied Vis
IAT351

Week 1 Lecture 12
7.01.2009
Lyn Bartram
lyn@sfu.ca

These slides are shamelessly borrowed from Marti Hearst, Edward Tufte, and others

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Administrivia

The website will be up tomorrow:
www.sfu.ca/siatclass/IAT814/Spring2009.

The wiki is now operational:
https://wiki.sfu.ca/spring09/iat814g100/

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Assignment 1: Vis critiques

- Find two examples of visualization used in **practice**
  - One good, one bad
  - Example sources
    - Journal (Journal of Applied Optics, ...)
    - Science magazine (Nature, Science, Scientific American, ...)
    - News Magazine or newspaper (Newsweek, The Economist, NY Times, USA Today, ...
  - **Not** from a vis paper, design textbook, design blog etc.
- Make a wiki page with with critique, 5-8 min presentation
- Due in class Jan. 21
- This week: schedule presentations

Assignment 1: Vis critiques

- Each critique should have 2 parts (paragraph)

1. the first paragraph should tell the story behind the picture: what does this picture show?
2. The second paragraph should critique the visualization, explaining why you think it is good or bad

- Be specific
  - include criteria such as accessibility, clarity, accuracy, or any other criterion about the design of the visualization that you feel is important.

What is data Visualization?

The depiction of information using spatial and graphical representations;

Bringing information to life, visually.

Information Visualization? Scientific Visualization?

- Scientific
  - Relates to and represents physical “things” – has a physical analog
  - Ocean currents, surface of mars, human body
- Information
  - Represents data in abstract forms

- This is becoming a bit of a false differentiation
- But still used in the community to categorise approaches
- “vis for the masses” construed to mean infovis (is it really so?)

What is (Information) Visualization?

"Transformation of the symbolic into the geometric"
(McCormick et al., 1987)

"... finding the artificial memory that best supports our natural means of perception."
(Bertin, 1983)

Visual Aids for Thinking

- We build tools to amplify cognition.
- Example: multiplication (Card, Moran, & Shneiderman.)
  - In your head, multiply 35 x 95
  - Now do it on paper
  - People are 5 times faster with the visual aid

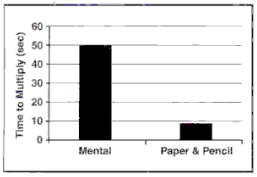
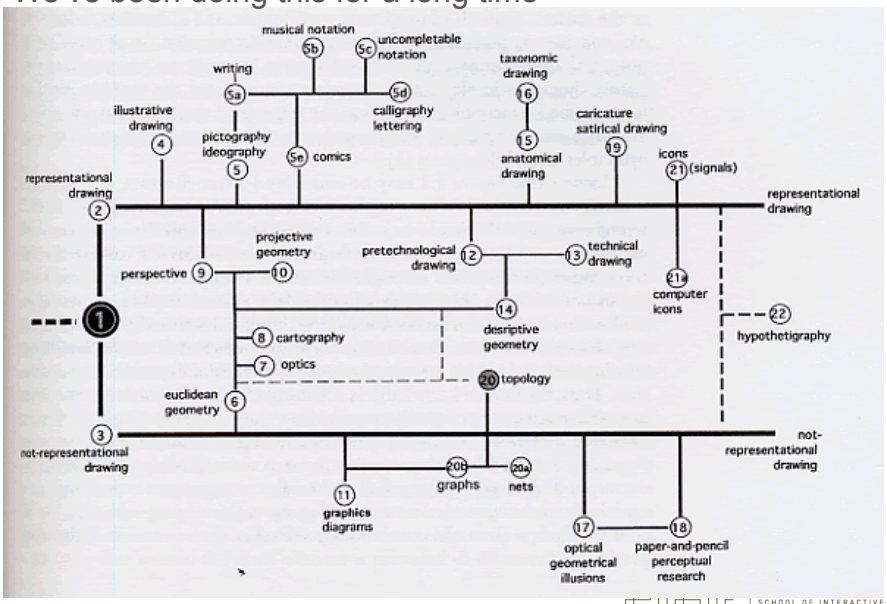
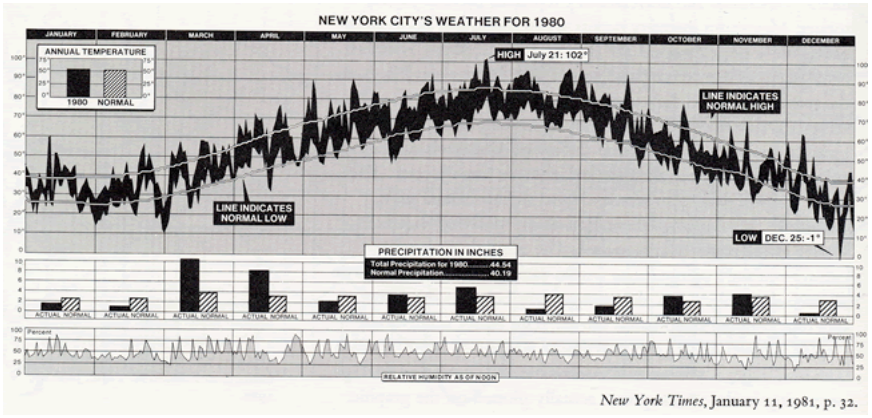


FIGURE 1.1
Use of external aids amplifies ability to do multiplication.

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

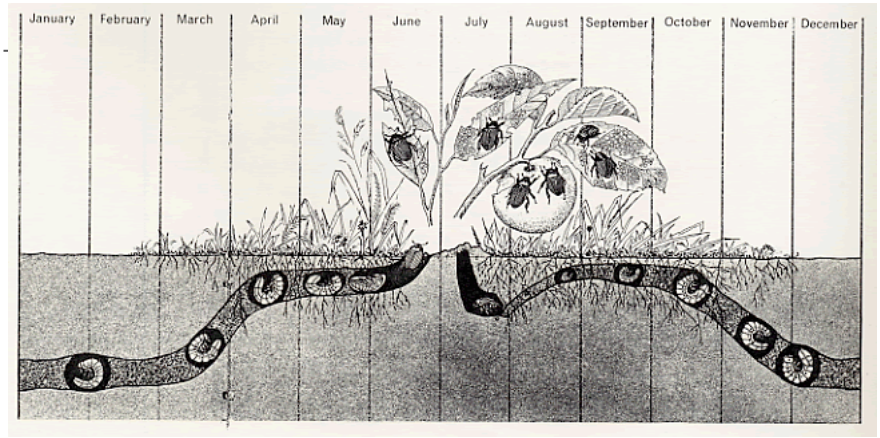
We've been doing this for a long time

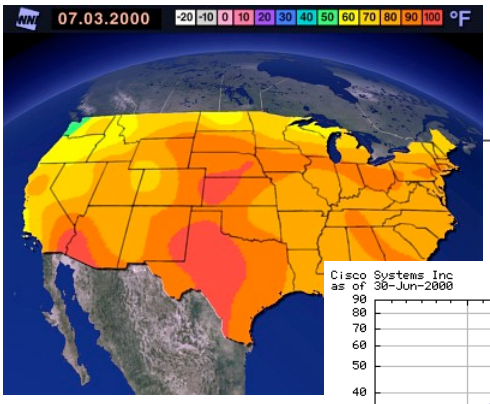




New York Times, January 11, 1981, p. 32.

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY


January
February
March
April
May
June
July
August
September
October
November
December



The Power of Info. Visualization

Images from yahoo.com

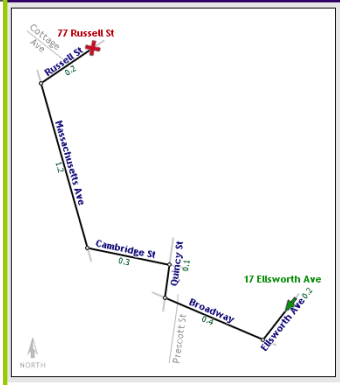
The Power of Visualization

1. **Start out going Southwest on ELLSWORTH AVE Towards BROADWAY by turning right.**
2. **Turn RIGHT onto BROADWAY.**
3. **Turn RIGHT onto QUINCY ST.**
4. **Turn LEFT onto CAMBRIDGE ST.**
5. **Turn SLIGHT RIGHT onto MASSACHUSETTS AVE.**
6. **Turn RIGHT onto RUSSELL ST.**

Image from mapquest.com

The Power of Visualization

The estimated travel time is 5 minutes for 2.16 miles of travel, total of 6 steps.



	Directions	Elapsed Distance
1	Begin at **17 Ellsworth Ave** on **Ellsworth Ave** and go Southwest for 500 feet	0.1
2	Turn right on **Broadway** and go Northwest for 0.4 miles	0.5
3	Turn right on **Quincy St** and go North for 200 feet	0.5
4	Turn left on **Cambridge St** and go West for 0.3 miles	0.8
5	Bear right on **Massachusetts Ave,Mass Ave,RT-2A** and go North for 1.2 miles	2.0
6	Turn right on **Russell St** and go Northeast for 1000 feet to **77 Russell St**	2.2

Line drawing tool by Maneesh Agrawala http://graphics.stanford.edu/~maneesh/

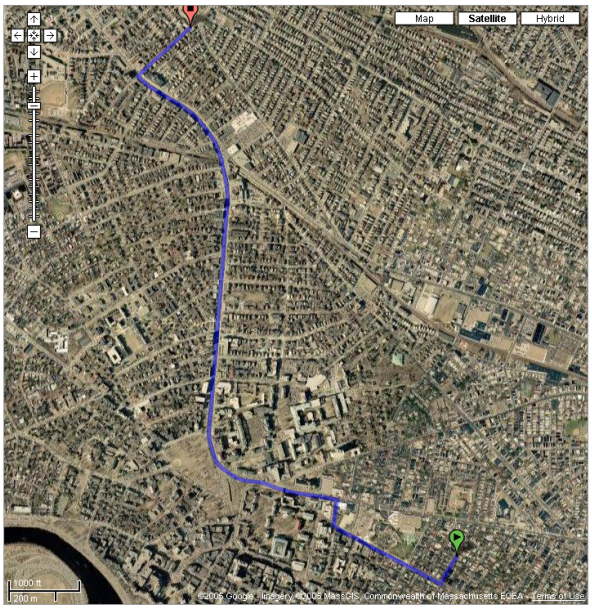
SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Google Maps BETA

Maps Local Search Directions

17 Ellsworth Ave, Cambridge, MA 02139 (Start address) ⇄ 77 Russell St, Somerville, MA 02144 (End address) Search Help

Maps



Print Email Link to this page

Start address:	17 Ellsworth Ave Cambridge, MA 02139
End address:	77 Russell St Somerville, MA 02144
Distance:	2.2 mi (about 3 mins)

Reverse directions

1. Head **southwest** from **Ellsworth Ave** - go **0.1 mi**
2. Turn **right** at **Broadway** - go **0.3 mi**
3. Turn **right** at **Prescott St** - go **0.1 mi**
4. Turn **left** at **Cambridge St** - go **0.3 mi**
5. Bear **right** at **Massachusetts Ave** - go **1.2 mi**
6. Turn **right** at **Russell St** - go **0.2 mi**

These directions are for planning purposes only. You may find that construction projects, traffic, or other events may cause road conditions to differ from the map results.

Map data ©2005 NAVTEQ™, Tele Atlas

NTERACTIVE
NOLOGY

Visualization for Problem Solving

Mystery: what is causing a cholera epidemic in London in 1854?

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Visualization for Problem Solving

Illustration of John Snow's deduction that a cholera epidemic was caused by a bad water pump, circa 1854.

Horizontal lines indicate location of deaths.

From Visual Explanations by Edward Tufte, Graphics Press, 1997

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Visualization for Problem Solving

Illustration of John Snow's deduction that a cholera epidemic was caused by a bad water pump, circa 1854.

Horizontal lines indicate location of deaths.

From Visual Explanations by Edward Tufte, Graphics Press, 1997

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Visualization for Eliciting Knowledge from Data

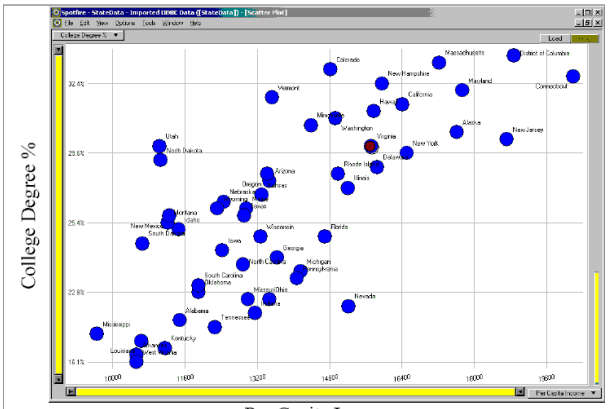
- Which state has highest Income?
- Relationship between Income and Education?
- Outliers?

Table - StateData ()

State	College Degree %	Per Capita Income
Alabama	20.6%	11486
Alaska	30.3%	17610
Arizona	27.1%	13461
Arkansas	17.0%	10520
California	31.3%	16409
Colorado	33.9%	14821
Connecticut	33.8%	20189
Delaware	27.9%	15854
District of Columbia	36.4%	18881
Florida	24.9%	14698
Georgia	24.3%	13631
Hawaii	31.2%	15770
Idaho	25.2%	11457
Illinois	26.8%	15201
Indiana	20.9%	13149
Iowa	24.5%	12422
Kansas	26.5%	13300
Kentucky	17.7%	11153
Louisiana	19.4%	10635
Maine	25.7%	12957
Maryland	31.7%	17730
Massachusetts	34.5%	17224
Michigan	24.1%	14154
Minnesota	30.4%	14389
Mississippi	19.9%	9648
Missouri	22.3%	12989
Montana	25.4%	11213
Nebraska	26.0%	12452
Nevada	21.5%	15214
New Hampshire	32.4%	15959
New Jersey	30.1%	18714
New Mexico	25.5%	11246
New York	29.6%	16501
North Carolina	24.2%	12885
North Dakota	26.1%	11051
Ohio	22.3%	13461
Oklahoma	22.8%	11893
Oregon	27.5%	13418
Pennsylvania	23.2%	14868
Rhode Island	27.5%	14901
South Carolina	23.0%	11897
South Dakota	24.6%	10661
Tennessee	20.1%	12255
Texas	25.5%	12304
Utah	30.0%	11829
Vermont	31.5%	13527
Virginia	30.0%	15713
Washington	30.9%	14923
West Virginia	16.1%	10520
Wisconsin	24.9%	13276
Wyoming	25.7%	12311

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Visualization for Eliciting Knowledge from Data

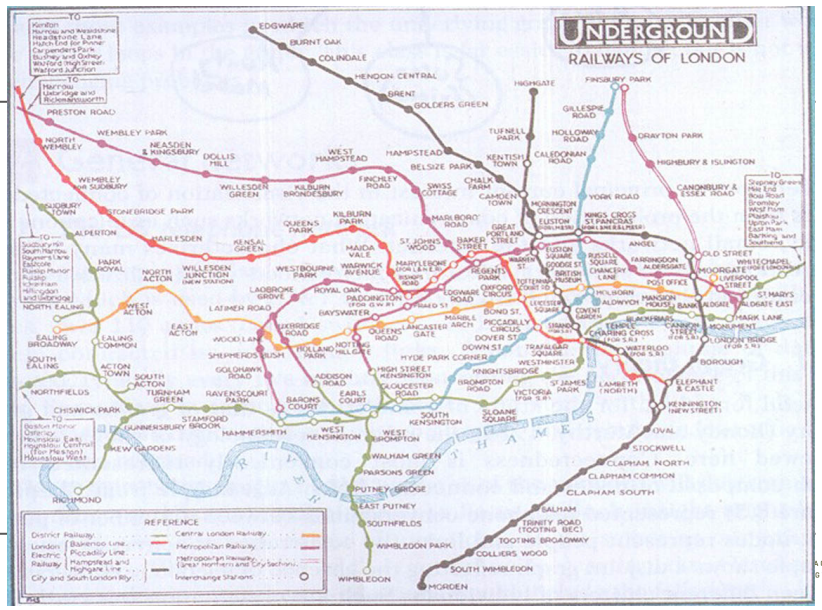


SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Visualization for Clarification

- London Subway Map Example
- Abstract away details for easier understanding
- Harry Beck's schematic

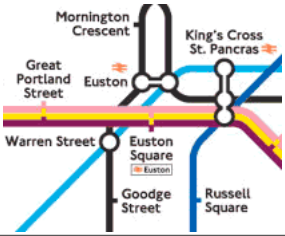
London Underground Map 1927

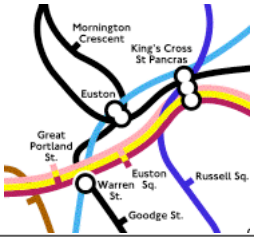


London Underground Map 1990s

Visualization for Clarification

- Horizontal, vertical and 45° segments
- Key insight: topology and relative location of stations





SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

From http://www.ideography.co.uk/

Visualization: Two Primary Goals

Analyze, Explore, Discover

Explain, Illustrate, Communicate

Case Study:
The Journey of the TreeMap

- The TreeMap **(Johnson & Shneiderman '91)**
- Idea:
  - Show a hierarchy as a 2D layout
  - Fill up the space with rectangles representing objects
  - Nested rectangles indicated levels of hierarchy
  - Size on screen indicates relative size of underlying objects.

Case Study:
The Journey of the TreeMap

(Johnson & Shneiderman '91)

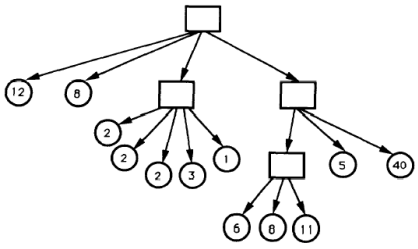


Fig. 1. Typical 3-level tree structure with numbers indicating size of each leaf node.

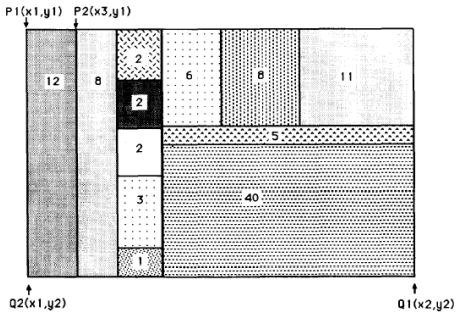


Fig. 2. Tree-map of Figure 1.

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

(Johnson & Shneiderman '91)

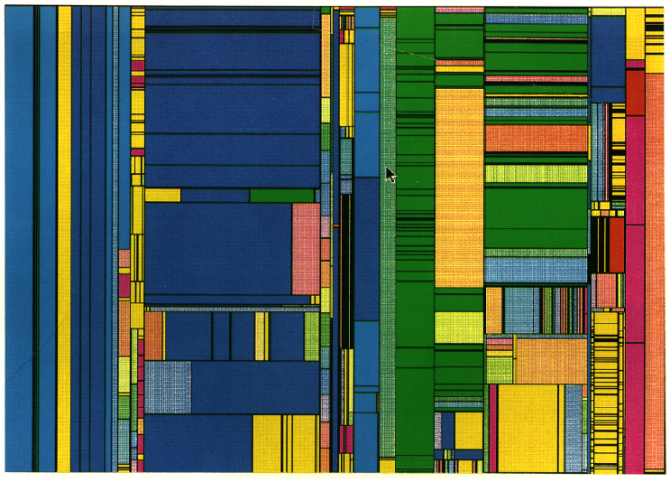


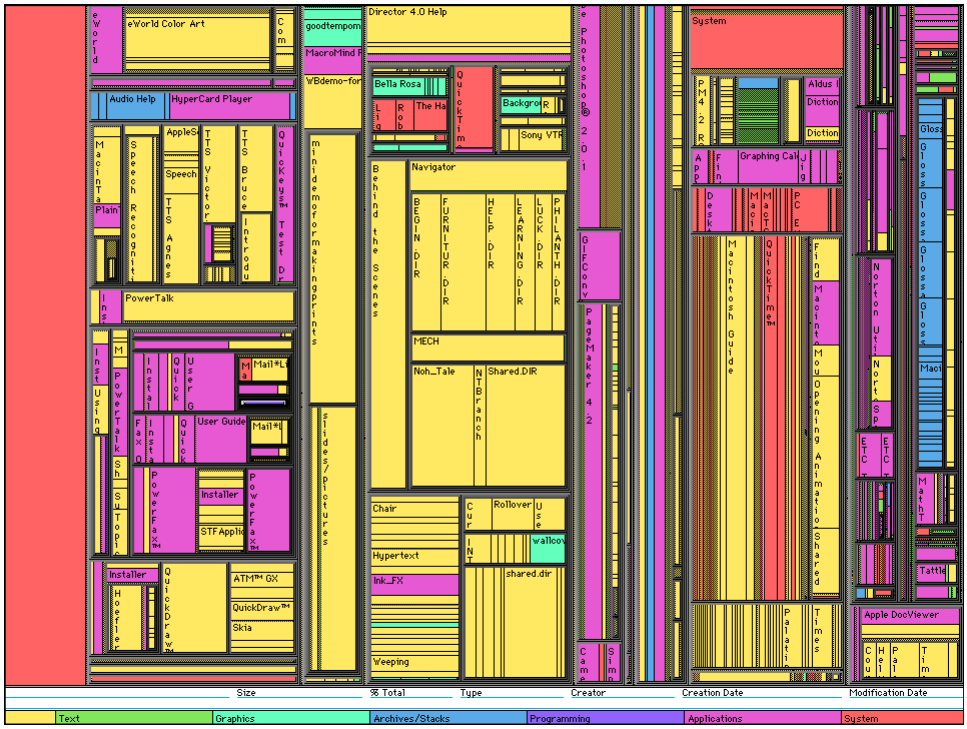
Fig. 4. 850 files at four levels with color coding by tile type. File name pops up when cursor rests on a file.

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Case Study: The Journey of the TreeMap

- The TreeMap **(Johnson & Shneiderman '91)**
- Idea:
  - Show a hierarchy as a 2D layout
  - Fill up the space with rectangles representing objects
  - Nested rectangles indicated levels of hierarchy
  - Size on screen indicates relative size of underlying objects.

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY



Treemap Problems

- Too disorderly
  - What does adjacency mean?
  - Aspect ratios uncontrolled leads to lots of skinny boxes that clutter
- Hard to understand
  - Must mentally convert nesting to hierarchy descent
- Color not used appropriately
  - In fact, is meaningless here
- Wrong application
  - Don't need all this to just see the largest files in the OS

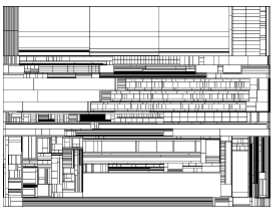
Successful Application of Treemaps

- Think more about the use
  - Break into meaningful groups
- Make appearance more usable
  - Fix these into a useful aspect ratio
  - Do not use nesting recursively
- Use visual properties properly
  - Use color to distinguish meaningfully
    - Use only two colors:
      - Can then distinguish one thing from another
    - When exact numbers aren't very important
- Provide excellent interactivity
  - Access to the real data
  - Makes it into a useful tool

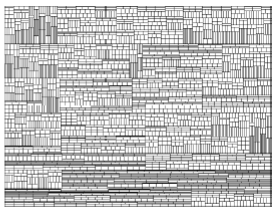
SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Squarified Treemaps

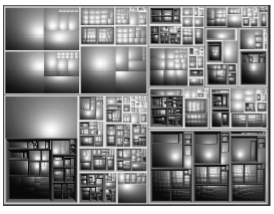
Bruls, Huizing, van Wijk, 1999



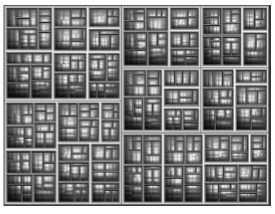
(a) File system



(b) Organization



(a) File system

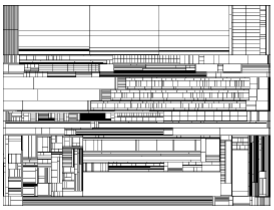


(b) Organization

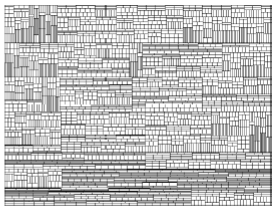
SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Squarified Treemaps

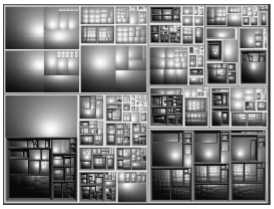
Bruls, Huizing, van Wijk, 1999



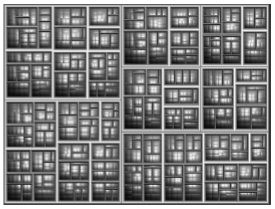
(a) File system



(b) Organization



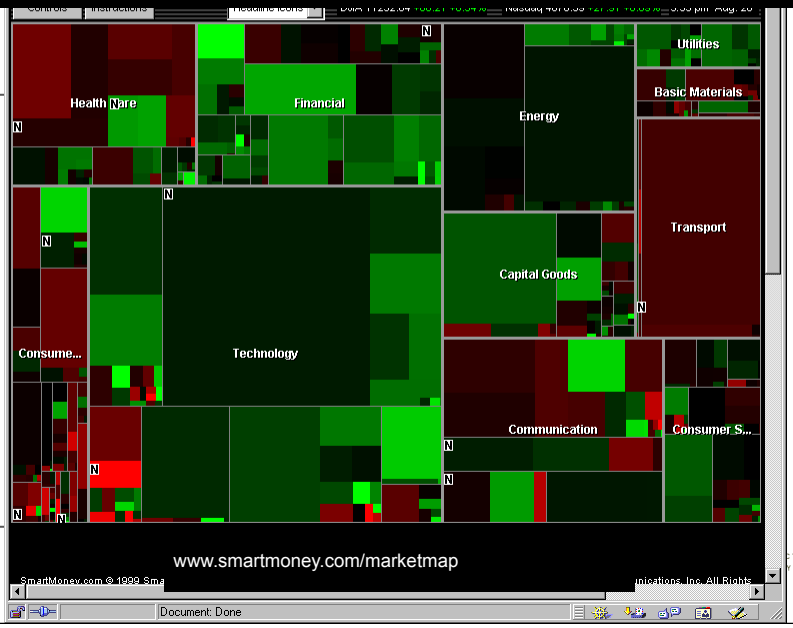
(a) File system



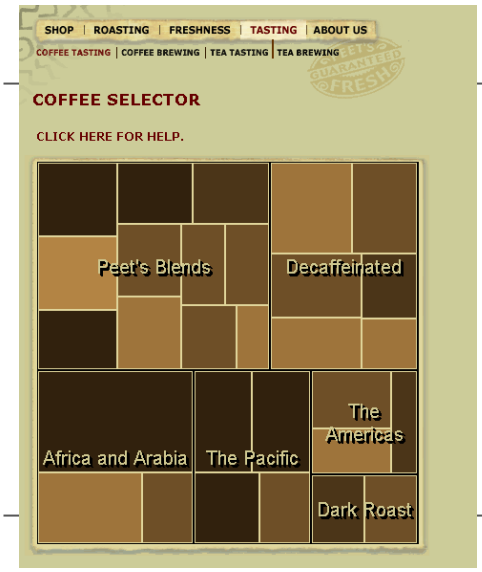
(b) Organization

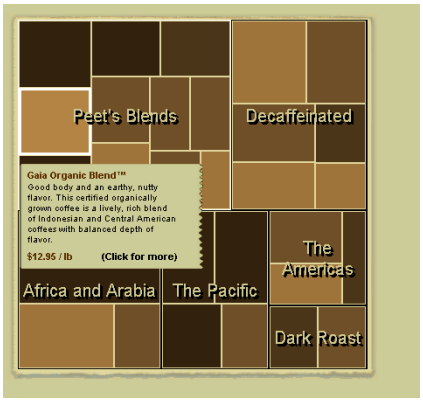
SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

A Good Use of TreeMaps and Interactivity
www.smartmoney.com/marketmap



Treemaps in Peets site



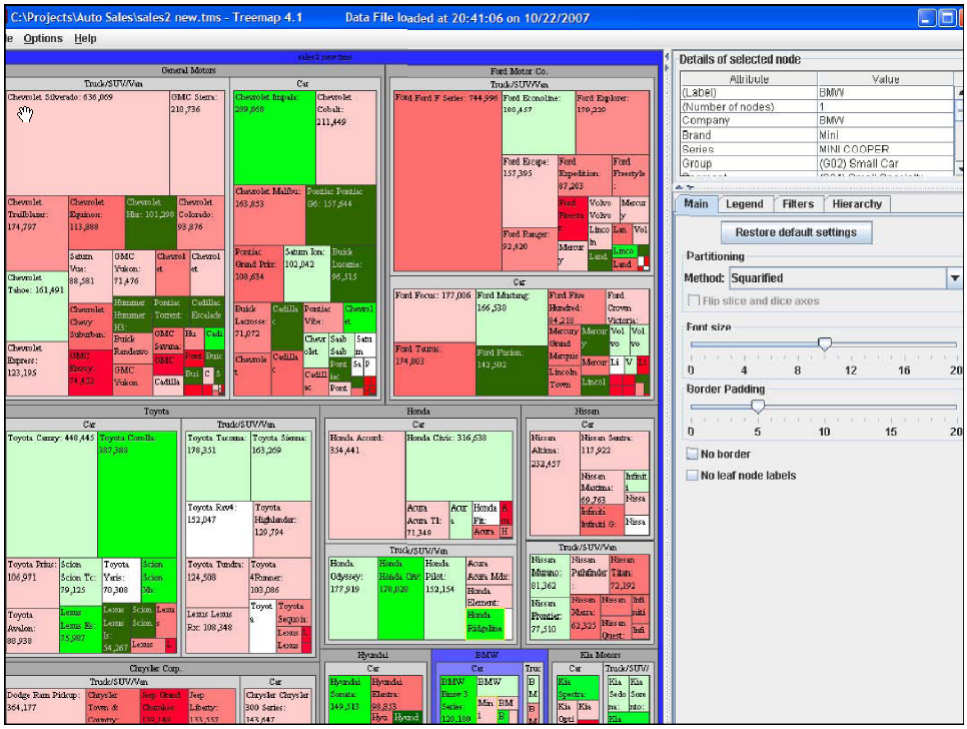


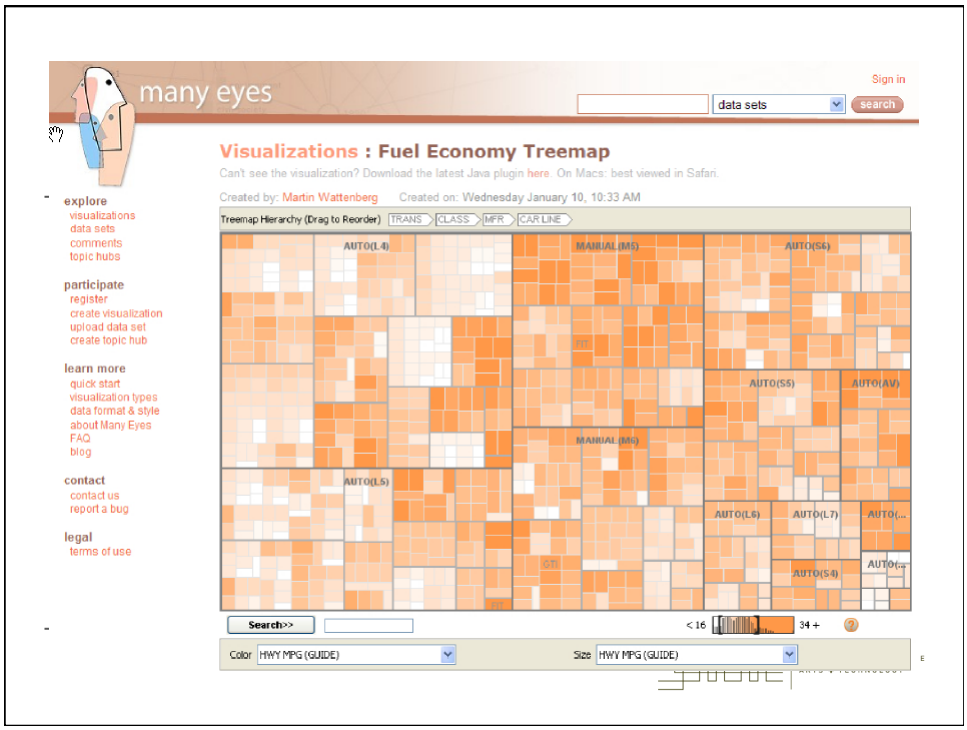
SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

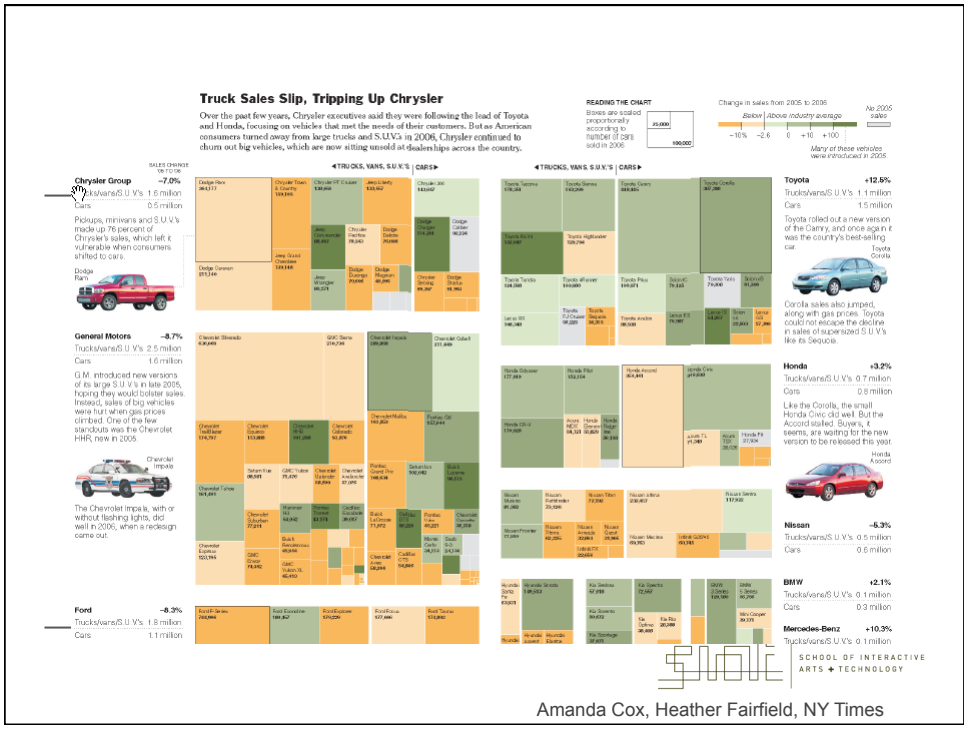
Analysis vs. Communication

- MarketMap's use of TreeMaps allows for sophisticated analysis
- Peets' use of TreeMaps is more for presentation and communication
- This is a key contrast

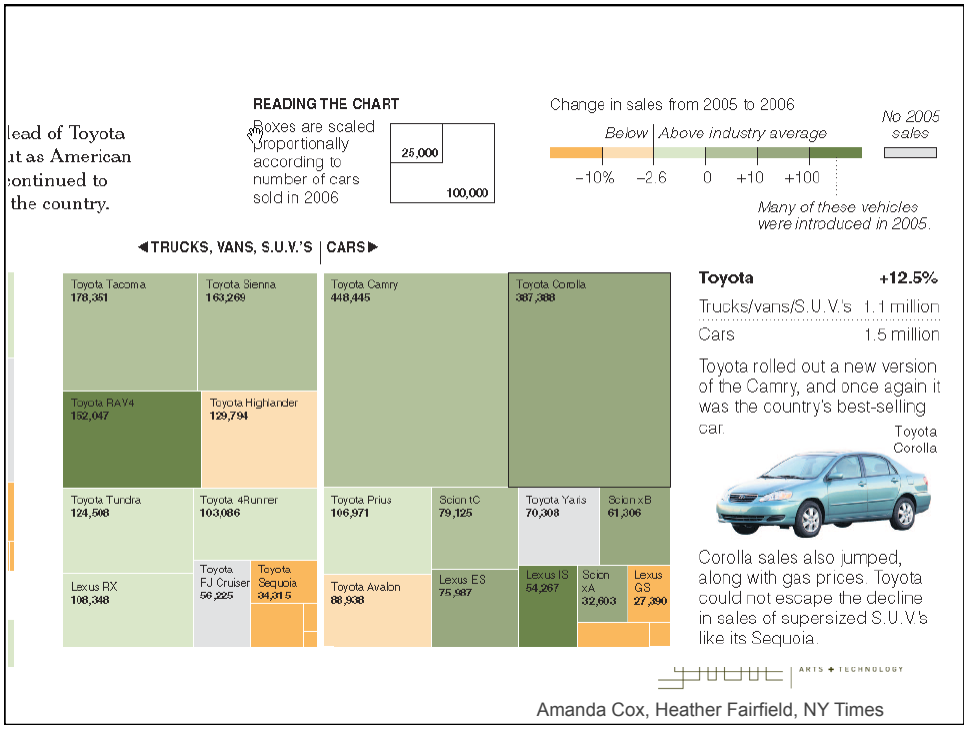
SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY


C:\Projects\Auto Sales\sales2 new.tms - Treemap 4.1
Data File loaded at 20:41:06 on 10/22/2007
File Options Help
Details of selected node
Attribute
Value
(Label)
BMW
(Number of nodes)
1
Company
BMW
Brand
Mini
Series
MINI COOPER
Group
(G02) Small Car
Main
Legend
Filters
Hierarchy
Restore default settings
Partitioning
Method:
Squarified
Flip slice and dice axes
Font size
Border Padding
No border
No leaf node labels


many eyes
Sign in
data sets
search
Visualizations : Fuel Economy Treemap
Can't see the visualization? Download the latest Java plugin here. On Macs: best viewed in Safari.
Created by: Martin Wattenberg
Created on: Wednesday January 10, 10:33 AM
explore
visualizations
data sets
comments
topic hubs
participate
register
create visualization
upload data set
create topic hub
learn more
quick start
visualization types
data format & style
about Many Eyes
FAQ
blog
contact
contact us
report a bug
legal
terms of use
Treemap Hierarchy (Drag to Reorder)
TRANS
CLASS
MFR
CAR LINE
AUTO(L4)
MANUAL(M5)
AUTO(S6)
AUTO(S5)
AUTO(AV)
MANUAL(M6)
AUTO(L5)
AUTO(L6)
AUTO(L7)
AUTO(S4)
Search>>
< 16
34 +
Color
HWY MPG (GUIDE)
Size
HWY MPG (GUIDE)



Amanda Cox, Heather Fairfield, NY Times



Amanda Cox, Heather Fairfield, NY Times

Other Taxonomies of Goals

- Others:
  - Analysis
  - Monitoring
  - Planning
  - Communication
- Tufte:
  - Description
  - Exploration
  - Tabulation
  - Decoration

- Others:
  - Aid to thinking
  - Problem solving/Decision making
  - Insight
  - Clarifying
  - Entertainment / Art

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Ideas from this slide from Stone & Zellweger

Another way to think about it

- Answer this question: Do you know the answer?
  - If yes,
    - Presentation, communication, education
  - If no,
    - Exploration, analysis
    - Problem solving, planning,
    - Aid to thinking, reasoning
- Answer this question: Are you the creator or the viewer of the information?
  - Often there is a loop between analysis and presentation

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY

Ideas from this slide from Stone & Zellweger

Goals of Information Visualization

In more detail, visualization should:

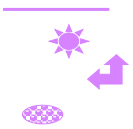
- Make large datasets coherent
  (Present huge amounts of information compactly)
- Present information from various viewpoints
- Present information at several levels of detail
  (from overviews to fine structure)
- Support visual comparisons
- Tell stories about the data

Human Perceptual Facilities

Use the eye for pattern recognition; people are good at
scanning
recognizing
remembering images

Human Perceptual Facilities

Graphical elements facilitate comparisons via
- length
- shape
- orientation
- texture



Animation shows changes across time
Color helps make distinctions
Aesthetics make the process appealing (??? BIG questions)

The Need for Critical Analysis

- We see many creative ideas, but they often fail in practice
- The hard part: how to apply it judiciously
  - Inventors usually do not accurately predict how their invention will be used
- The “coolness” factor vs. pragmatics
- Explicit (focused) vs. implicit (diffuse) communications
  - Information vs. experience
  - Synergy and the the relationship of the parts to the whole

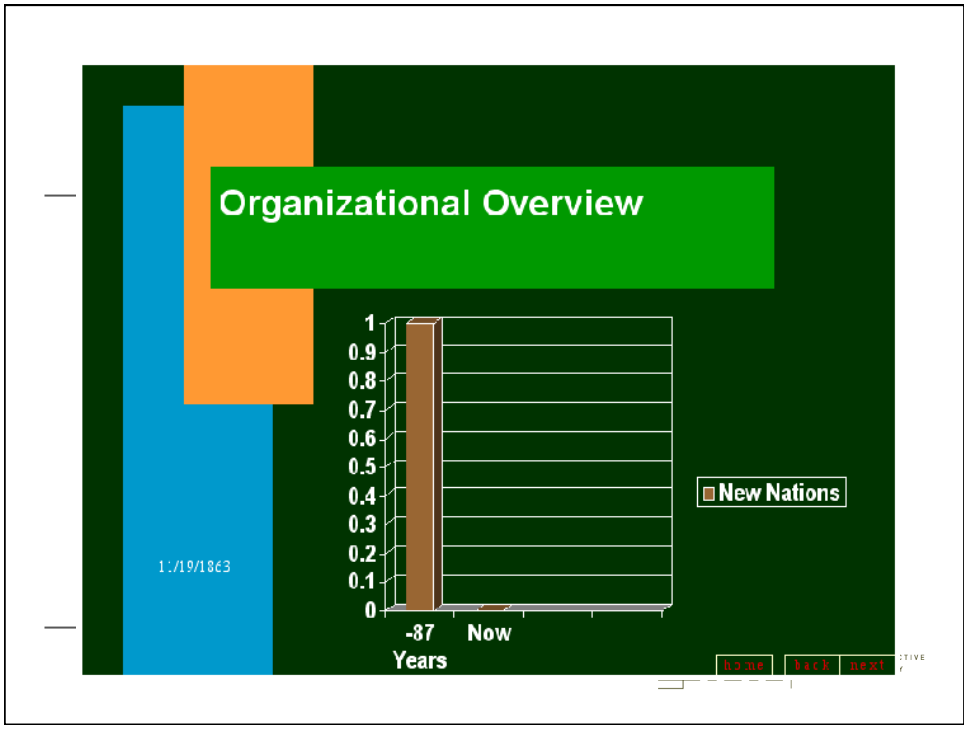
Open Issues

- Does visualization help?
  - The jury is still out
  - Still supplemental at best for text collections
    - A correlation with spatial ability
    - Learning effects: with practice ability on visual display begins to equal that of text
- Does visualization sell?
  - Jury is still out on this one too! But there are some success stories.
- This is a *hot* area! More ideas will appear!

Utility

- Have we made advances in communication with computer assisted visualization?
  - Two of my favourite examples

SCHOOL OF INTERACTIVE ARTS + TECHNOLOGY


Organizational Overview
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-87
Now
Years
New Nations
1/19/1863
home
back
next