

Representations and information visualization

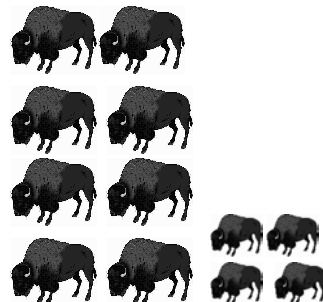
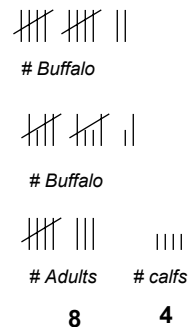
Characteristics of good representations
Information visualization
guidelines
visual information-seeking mantra
techniques

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Good representations

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

How many buffalo?



Representation

Representations

- formal system or mapping by which information can be specified (D. Marr)
- a sign system in that it stands for something other than its self.

for example:

decimal: 34,
binary: 100010,
roman: XXXIV

different representations reveal different aspects of the information

decimal: counting & information about powers of 10,
binary: counting & information about powers of 2,
roman: counting

presentation

how the representation is placed or organized on the screen

34, 34, 34

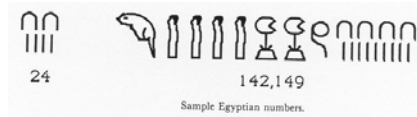
Saul Greenberg

					Mayan Numerals one to nineteen	
Zero	One	Two	Three	Four		
						
	Five	Six	Seven	Eight	Nine	
						
	Ten	Eleven	Twelve	Thirteen	Fourteen	
						
	Fifteen	Sixteen	Seventeen	Eighteen	Nineteen	

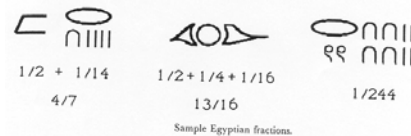
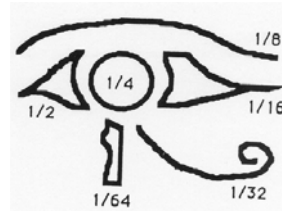
Egyptian Numerals

10^0	10^1	10^2	10^3	10^4	10^5	10^6
w	md	st	hz	db	hfn	hh

Egyptian cardinal icons.



Sample Egyptian numbers.



Sample Egyptian fractions.

Representations

Solving a problem simply means representing it so as to make the solution transparent

(Simon, 1981)

Good representations

- allow people to find relevant information
 - information may be present but hard to find
- allow people to compute desired conclusions
 - computations may be difficult or "for free" depending on representations

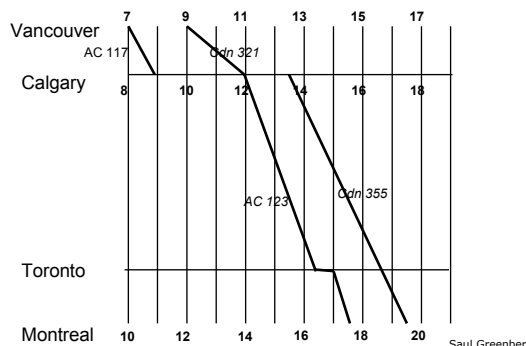
Saul Greenberg

Which is the best flight?

length
stop-overs
switches...

		depart	arrive
AC 117	Vancouver - Calgary	7:00	9:00
Cdn 321	Vancouver - Calgary	9:00	12:00
Cdn 355	Calgary - Montreal	13:30	19:30
AC 123	Calgary - Toronto	12:30	16:30
AC 123	Toronto - Montreal	16:45	17:30

*time zone: +1 van-cal, +2 cal-tor, mtl



When do I take my drugs?

10 - 30% error rate in taking pills, same for pillbox organizers

Inderal	-	1 tablet 3 times a day
Lanoxin	-	1 tablet every a.m.
Carafate	-	1 tablet before meals and at bedtime
Zantac	-	1 tablet every 12 hours (twice a day)
Quinag	-	1 tablet 4 times a day
Couma	-	1 tablet a day

	Breakfast	Lunch	Dinner	Bedtime
Lanoxin	O			
Inderal	O	O	O	O
Quinag	O	O	O	O
Carafate	O	O	O	O
Zantac		O		O
Couma				O

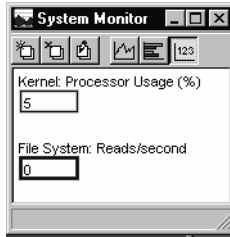
Breakfast	Lunch	Dinner	Bedtime
Lanoxin			
Inderal	Inderal	Inderal	Inderal
Quinag	Quinag	Quinag	Quinag
Carafate	Carafate	Carafate	Carafate
	Zantac		Zantac
			Couma

Adapted from Donald Norman

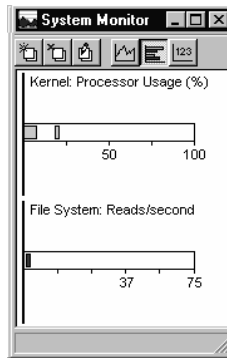
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Which representation is best?

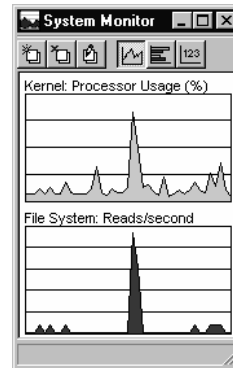
depends heavily on task



What is precise value?



How does the performance now compared to its peak?

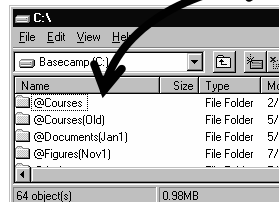
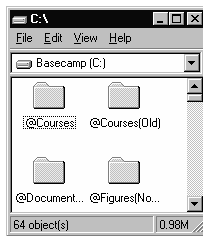


How does performance change over time?

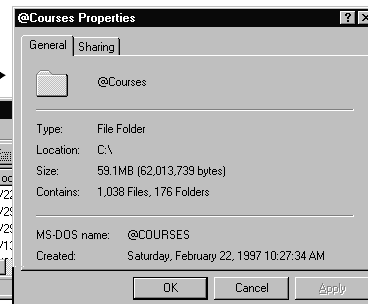
Windows 95 System Monitor

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Which folder has the most documents?



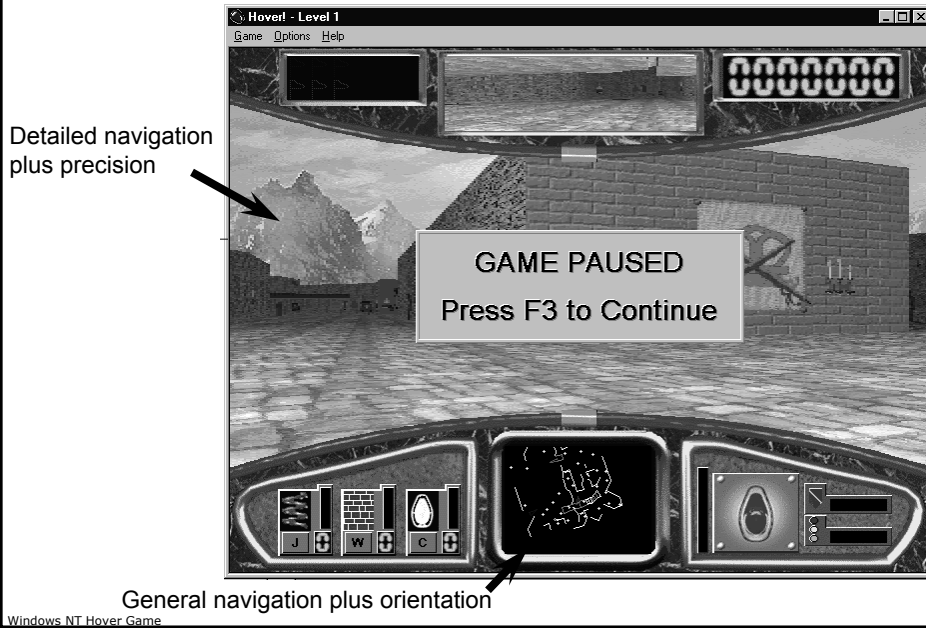
right menu
+ properties



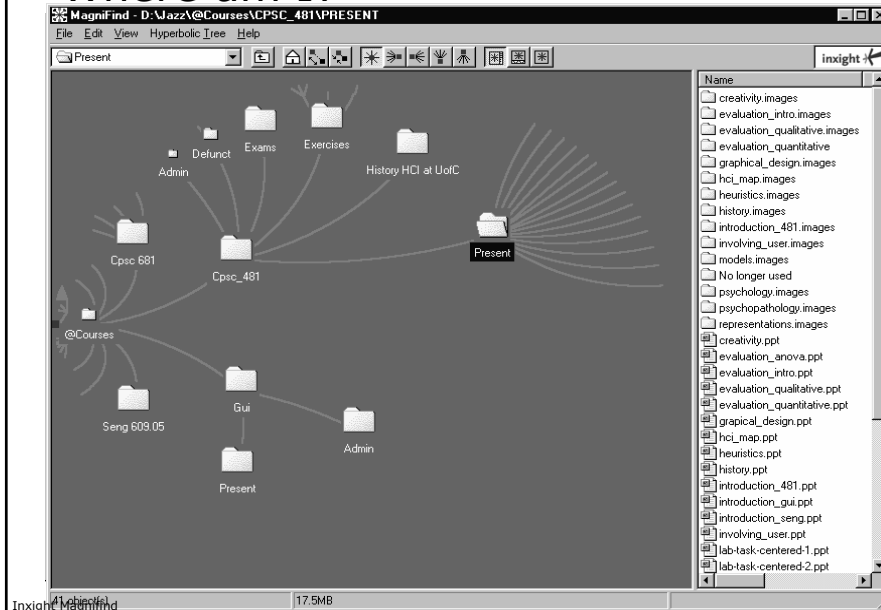
Windows 95 File Viewer

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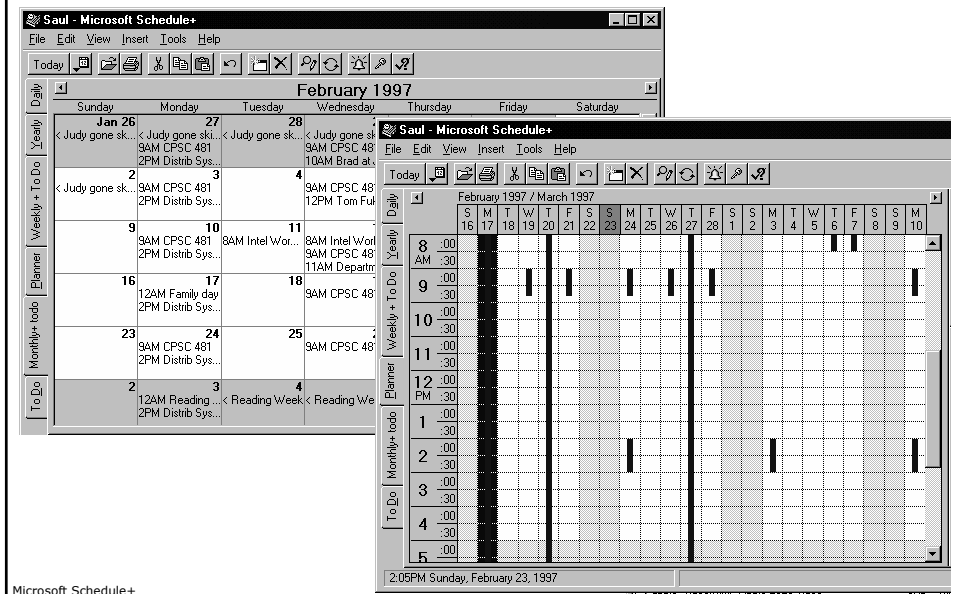
Where am I?



Where am I?



What do I have to do?



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

E. Tufte

Visual Display of Quantitative Information

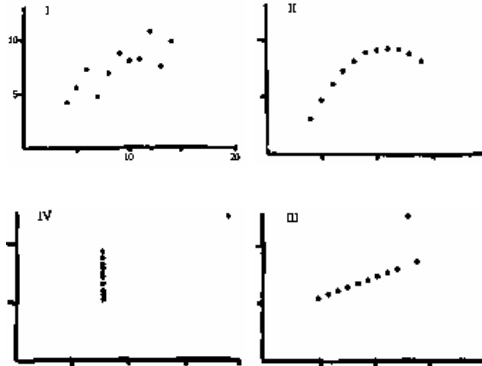
many examples on the following slides are taken from Tufte's books

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Anscombe's Quartet

I	II	III	IV
X	X	X	X
Y	Y	Y	Y
10.0	8.04	10.0	9.14
8.0	6.95	8.0	7.46
13.0	7.58	8.0	6.77
9.0	8.81	13.0	12.74
11.0	8.33	9.0	8.77
14.0	9.96	11.0	7.11
6.0	7.24	14.0	7.81
4.0	4.26	14.0	8.84
12.0	10.84	6.0	6.08
7.0	4.82	4.0	5.39
5.0	5.68	12.0	8.15
		7.0	6.42
		5.0	5.73
		8.0	7.91
		8.0	6.89

N: 11.0
 mean X's : 9.0
 mean Y's : 7.5
 standard error of slope estimate: 0.1
 sum of squares: 110.0
 regression sum of squares: 27.5
 residual sum of squares of Y: 13.8
 correlation coefficient: 0.8
 r squared: 0.7
 regression line: $Y=3+0.5X$

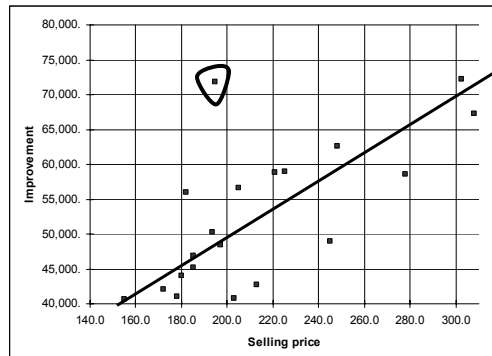


Graphics Reveal the Data

E. Tufte "Visual Display of Quantitative Information" p 25,

Do I deserve a tax break?

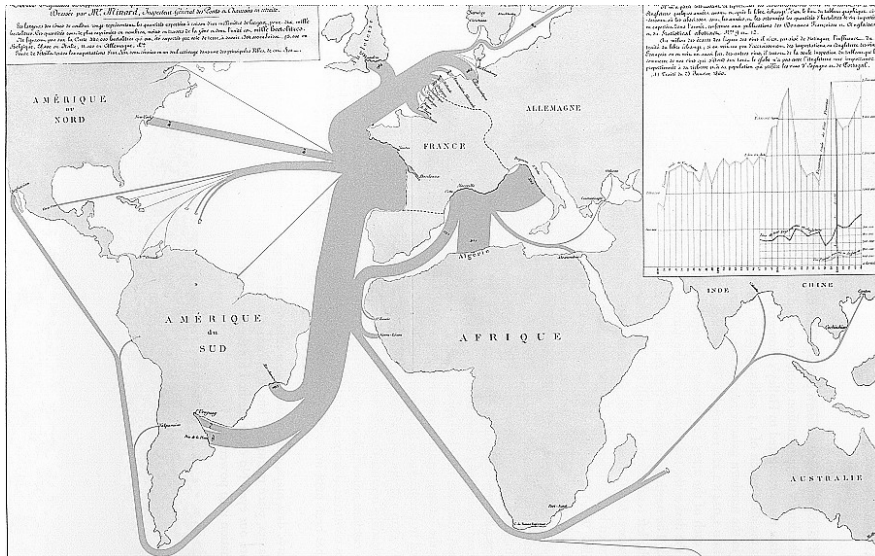
Taxcomp.xls		
	A	C
1	Market value (*\$1000)	Improvement
2	140.0	31,120.
3	147.0	29,980.
4	151.0	38,120.
5	152.0	34,360.
6	155.0	40,710.
7	170.0	21,620.
8	172.0	42,100.
9	178.0	41,070.
10	180.0	34,210.
11	180.0	44,090.
12	182.0	55,960.
13	185.0	45,170.
14	185.0	46,820.
16	193.4	50,200.
17	194.5	71,860.
18	197.0	48,460.
19	203.0	40,720.
20	205.0	56,600.
21	213.0	42,780.
22	221.0	58,770.
23	225.0	58,960.
24	245.0	48,910.
25	248.0	62,620.
26	278.0	58,580.
27	302.5	72,200.
28	308.0	67,320.



Example by Saul Greenberg

Saul Greenberg

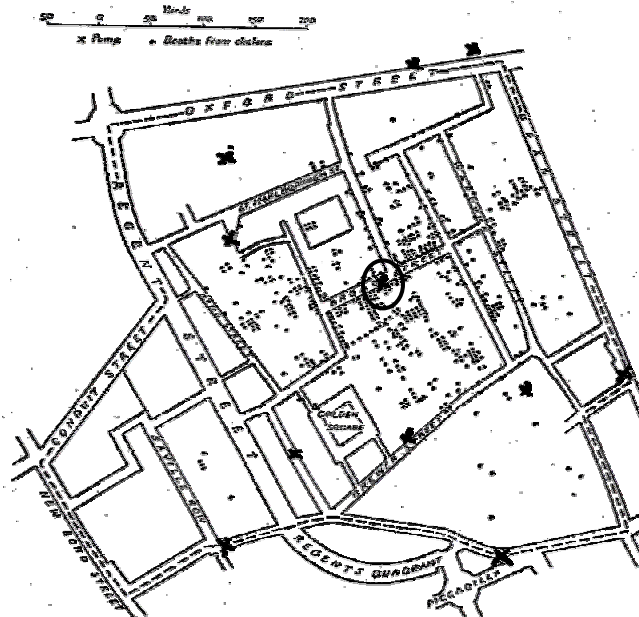
1864 Exports of French Wine



E. Tufte "Visual Display of Quantitative Information" p 25.

Deaths by Cholera

Dr John Snow
1854



E. Tufte "Visual Display of Quantitative Information"

Napoleon's march to Moscow

by Charles Minard

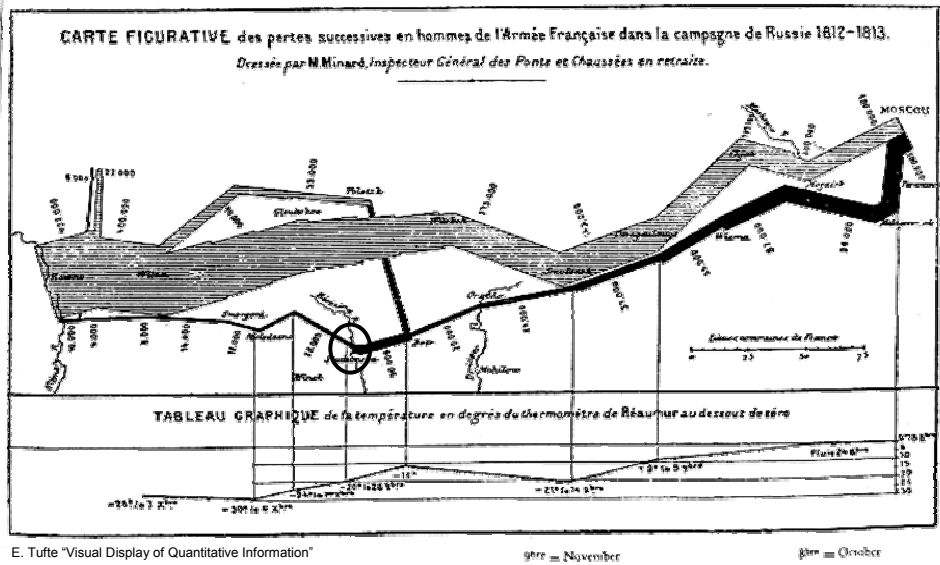
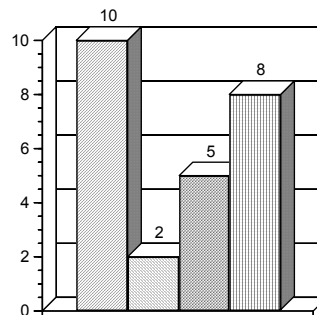


Chart Junk: A common error

Information display is not just pretty graphics

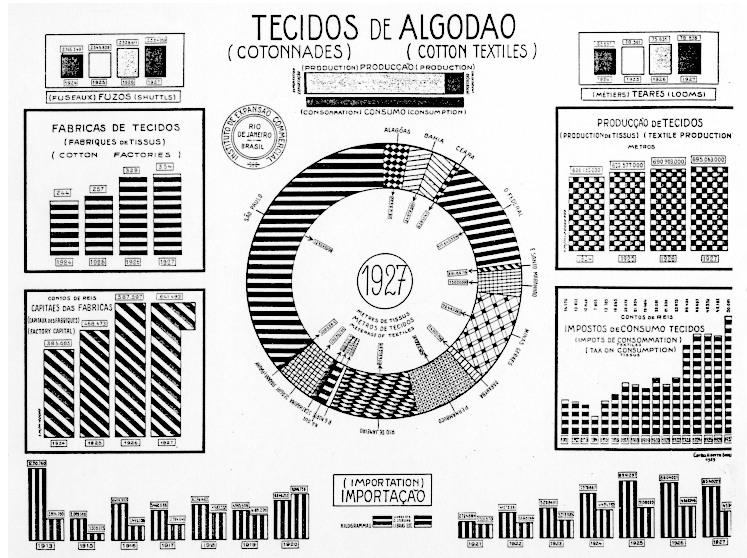
- graphical re-design by amateurs on computers gives us "fontitis," "chart-junk," etc.

Dear Sir,
This is a really exciting opportunity! Take advantage of it !



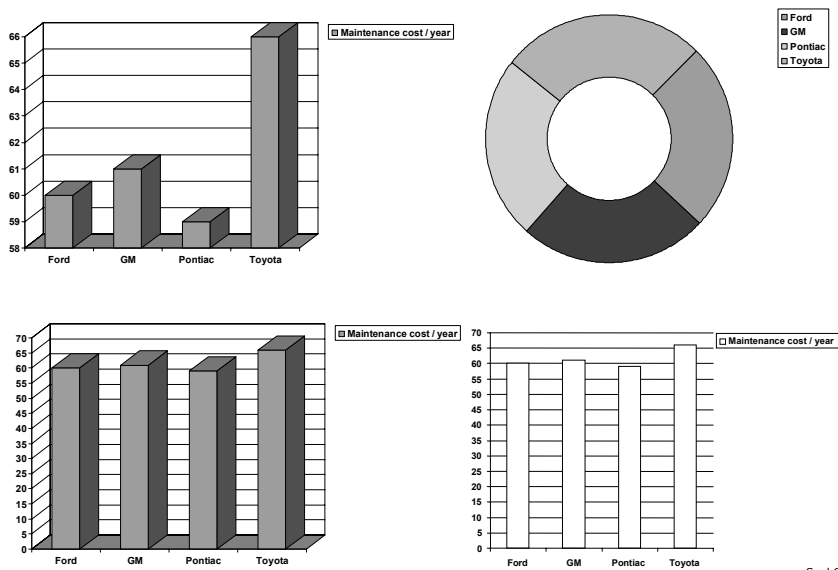
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Chart Junk: Cotton production in Brazil, 1927



E. Tufte Visual Display of Quantitative Information

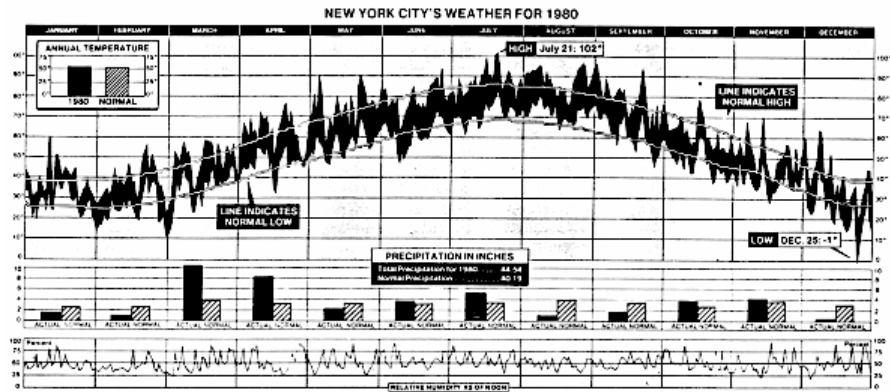
Chart Junk: Removing deception and simplification



Data density

New York Weather History

- 181 numbers/sq inch



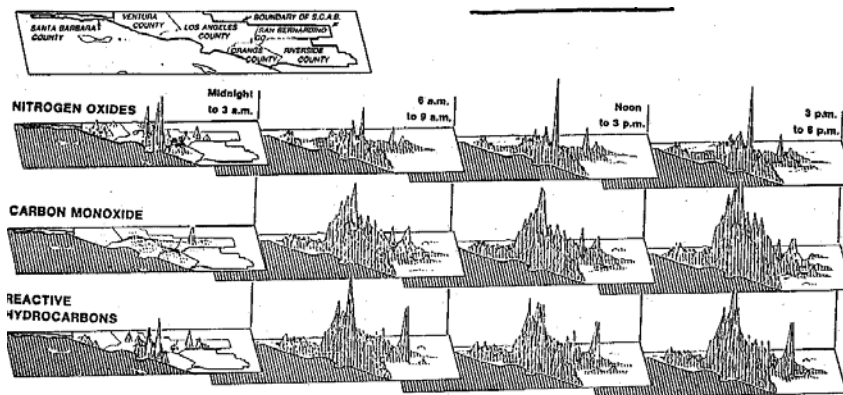
E. Tufte "Visual Display of Quantitative Information"

Saul Greenberg

Small multiples

Learn once

- invite comparisons



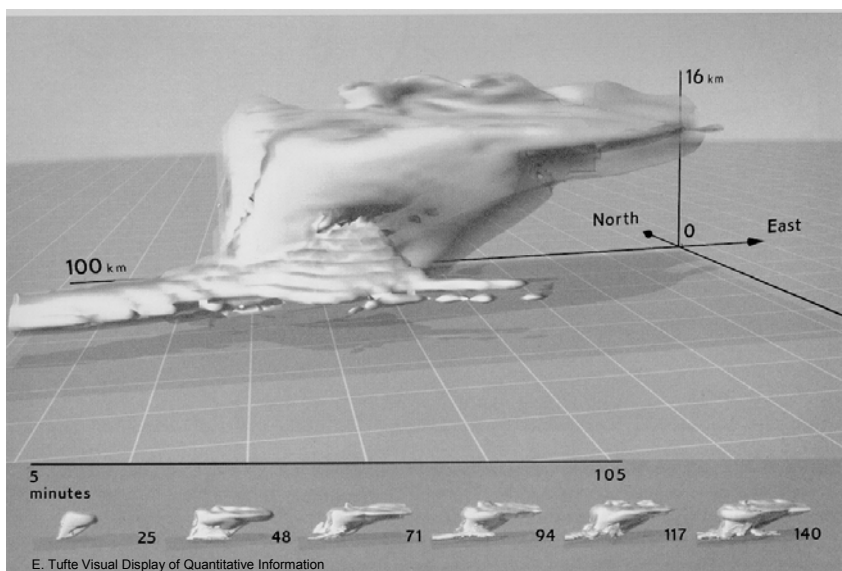
E. Tufte Visual Display of Quantitative Information

Saul Greenberg

Small multiples: showing time and change



Small multiples: showing time and change



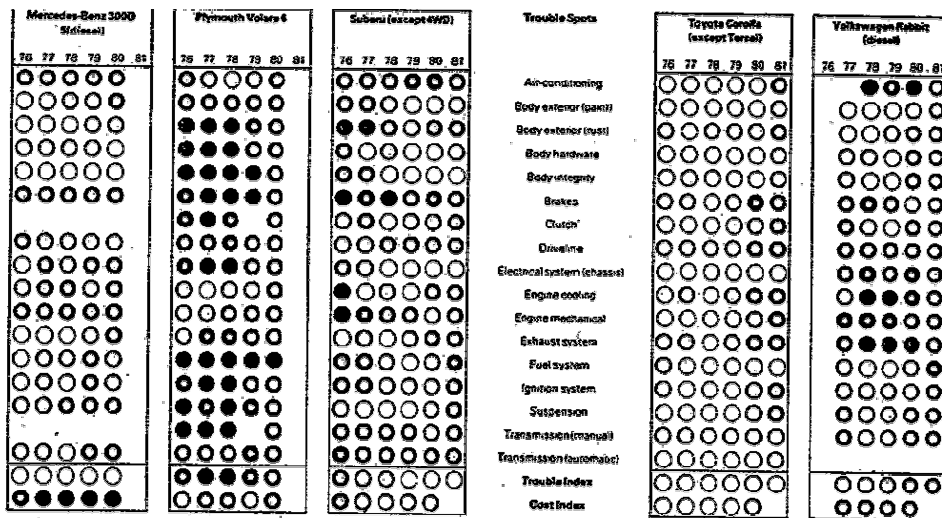
Visual information-seeking mantra

Overview first, zoom and filter, then details on demand
 Overview first, zoom and filter, then details on demand
 Overview first, zoom and filter, then details on demand
 Overview first, zoom and filter, then details on demand
 Overview first, zoom and filter, then details on demand
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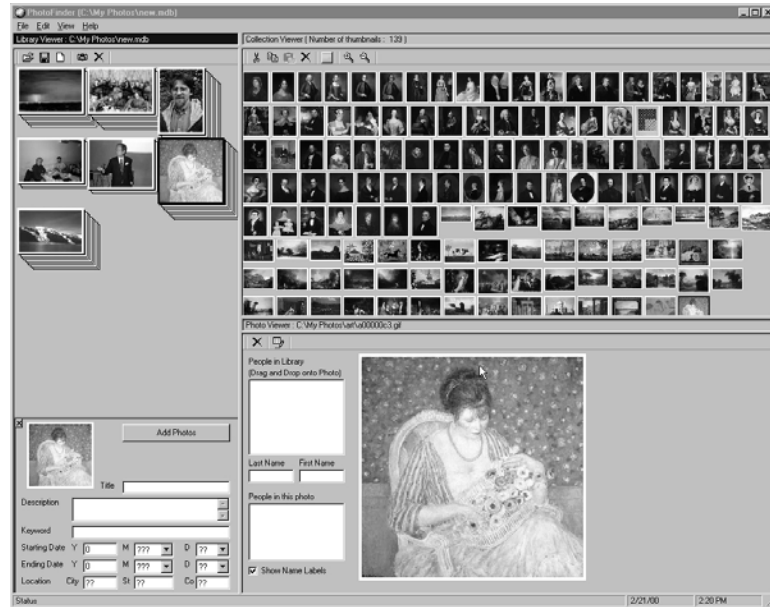
Shneiderman, Designing the User Interface 3rd Ed. 1997 p523

Saul Greenberg

Overview & detail for comparisons using small multiples and data density



PhotoFinder



University of Maryland Human Computer Interaction Laboratory <http://www.cs.umd.edu/hcil/>

Table Lens

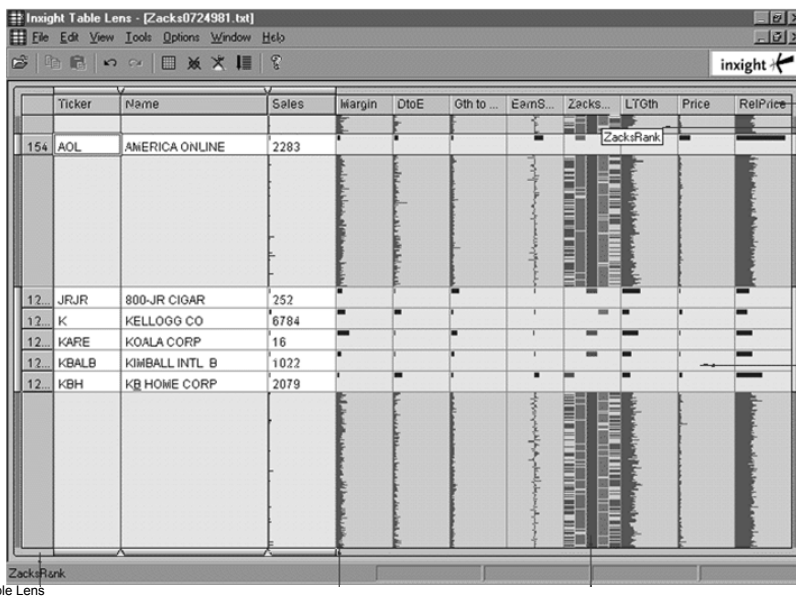


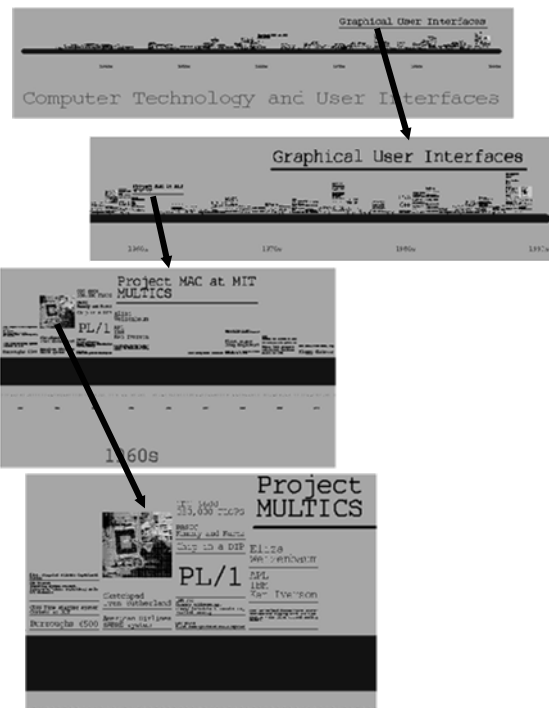
Table Lens

Housing Market for Santa Clara County, CA - March 2000

Bedrooms	Price	Square Foot	Status	Baths	Address	City	State	Zip	Realtor	M.S.#
5	388,000	3531	Sale Pending	4	6755 STEPH...	Obroy	CA	95000	CENTURY 2	4361
151	389,000	2201		3	3583 BAYO...	San Jose	CA	95111	BAY CITES	10970
152	389,000				1781 ANOEL	San Jose	CA	95111	ROSE GARD	944120
4			Sale Pending	1.5						
3										
2										

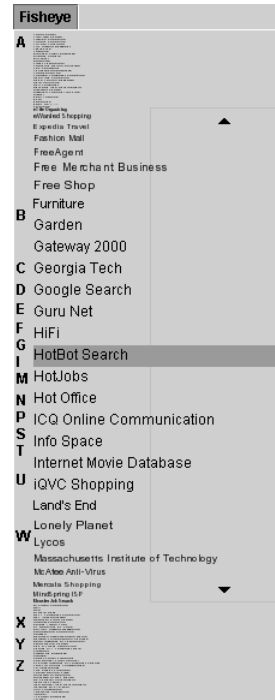
Inlight Table Lens

Infinite Zoom



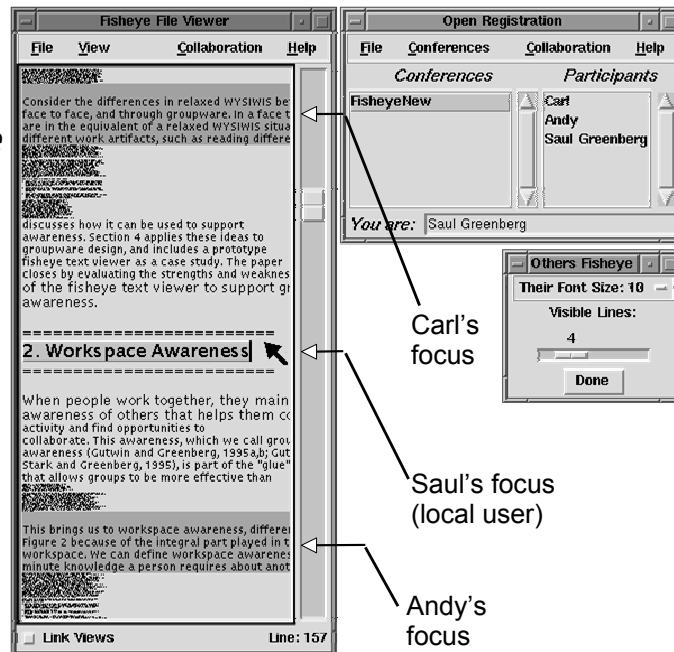
Pad++: A Zoomable Graphical Sketchpad for Exploring Alternate Interface Physics. Bederson et al Journal of Visual Languages and Computing 7, 1996

Fisheye Menus

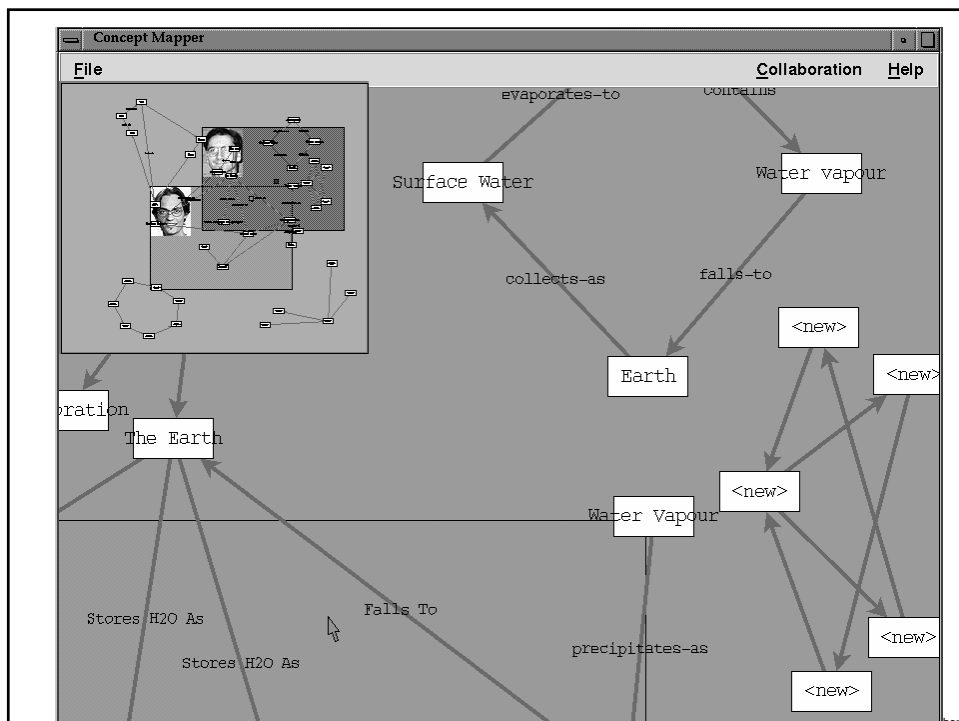
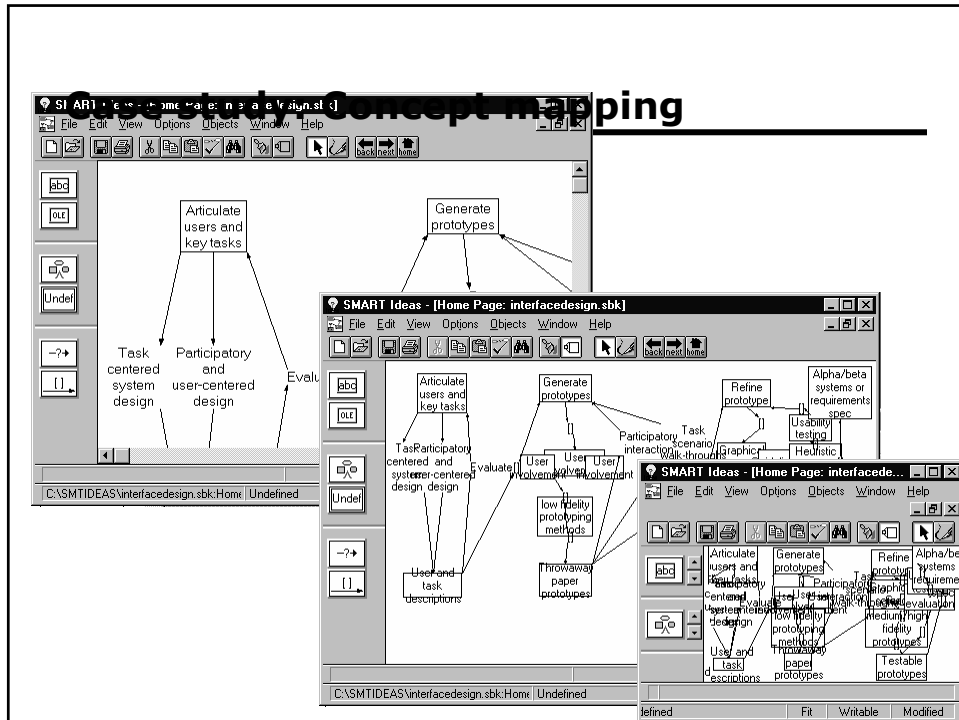


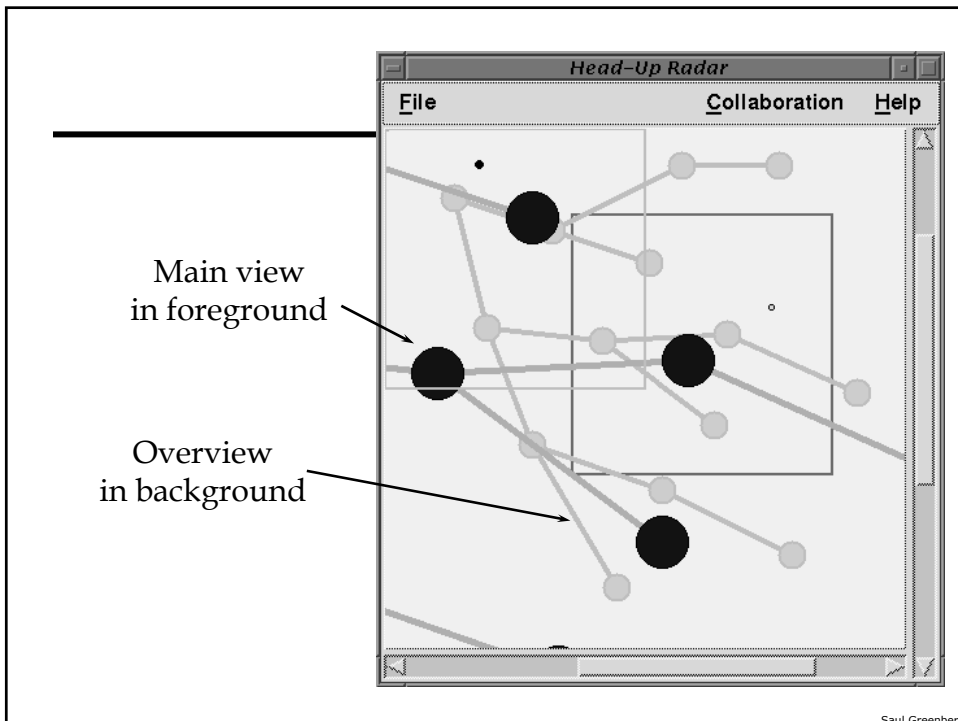
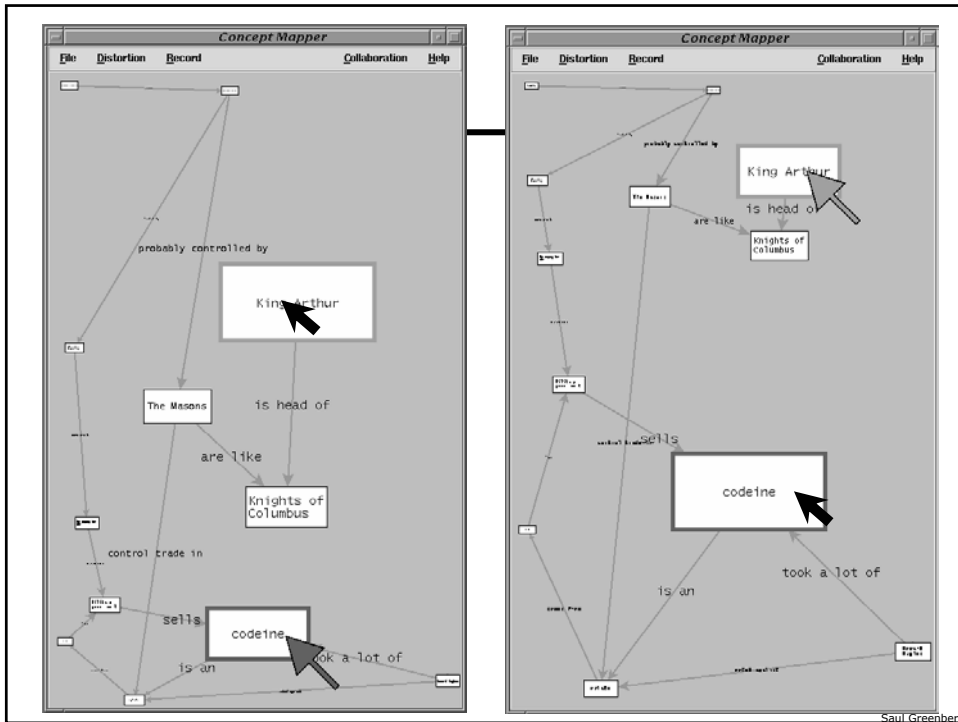
Bederson, B.B. (May 2000) University of Maryland
www.cs.umd.edu/hcil/fisheymenu/

Fisheye Text groupware

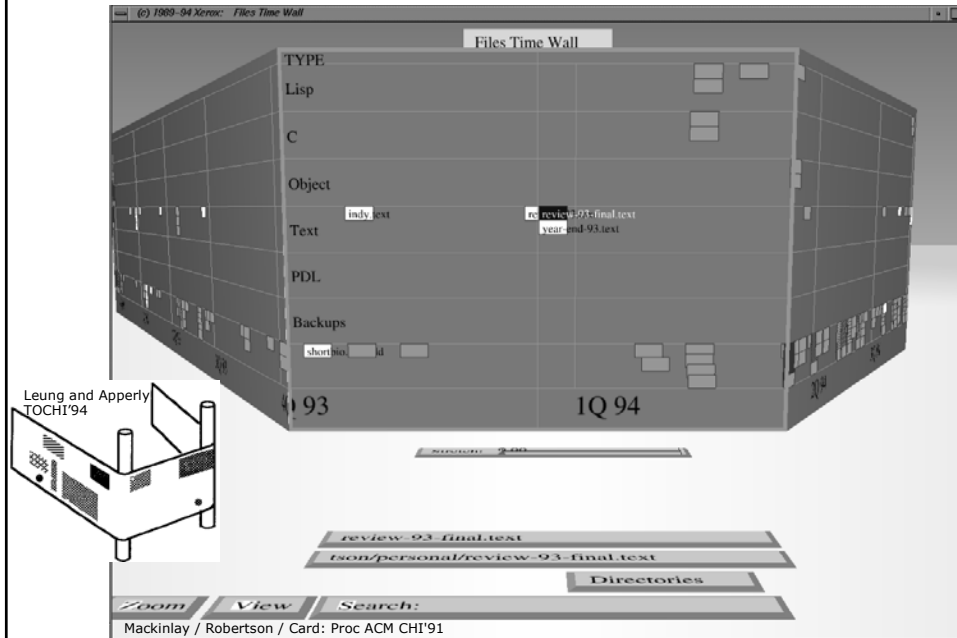


Greenberg, Graphics Interface

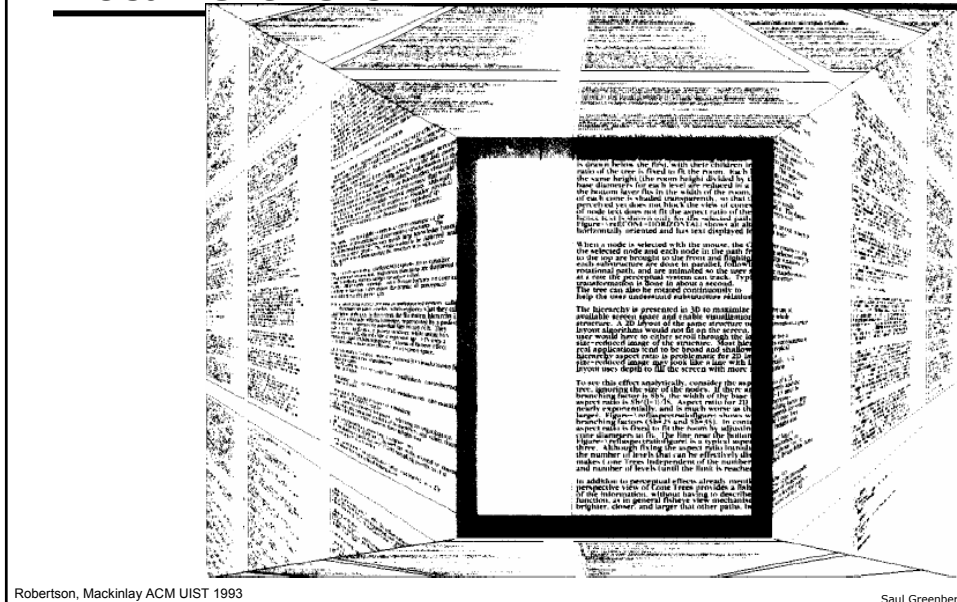




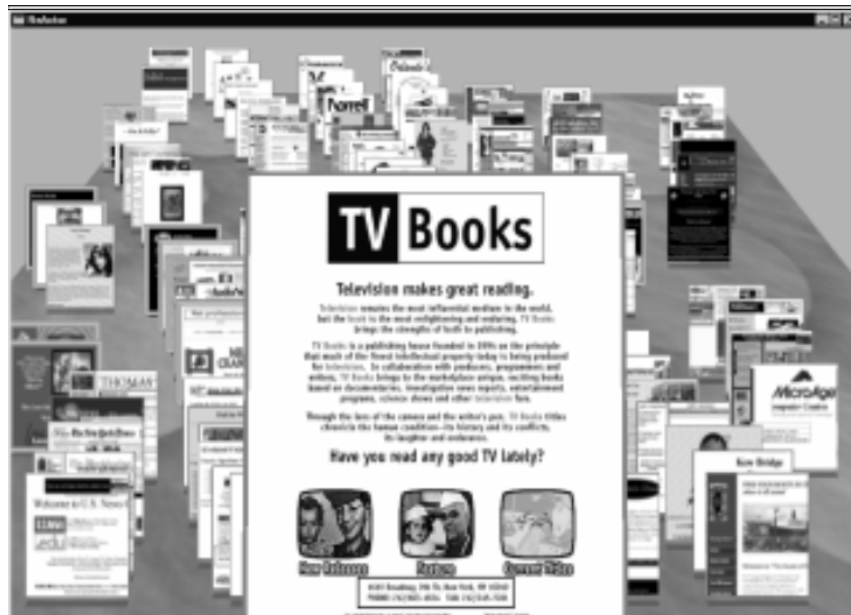
Perspective Wall



Document Lens



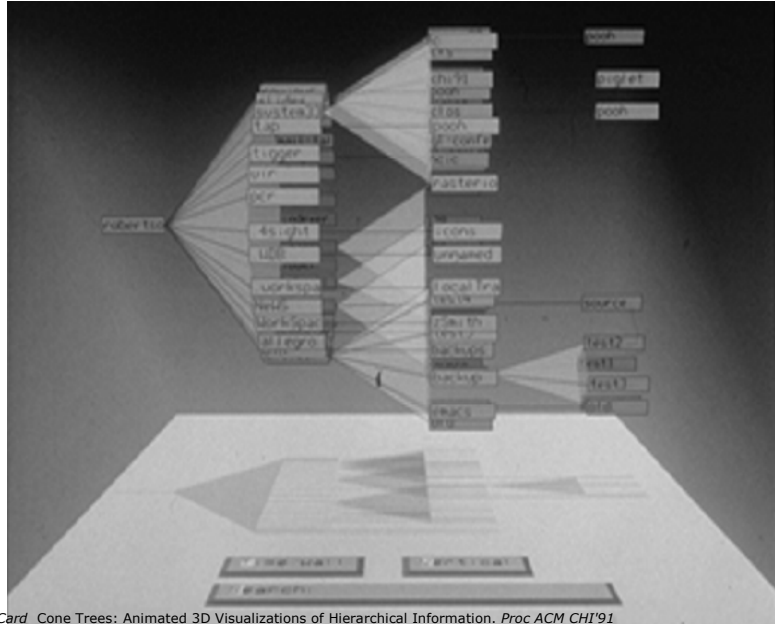
Data Mountain



Task Gallery

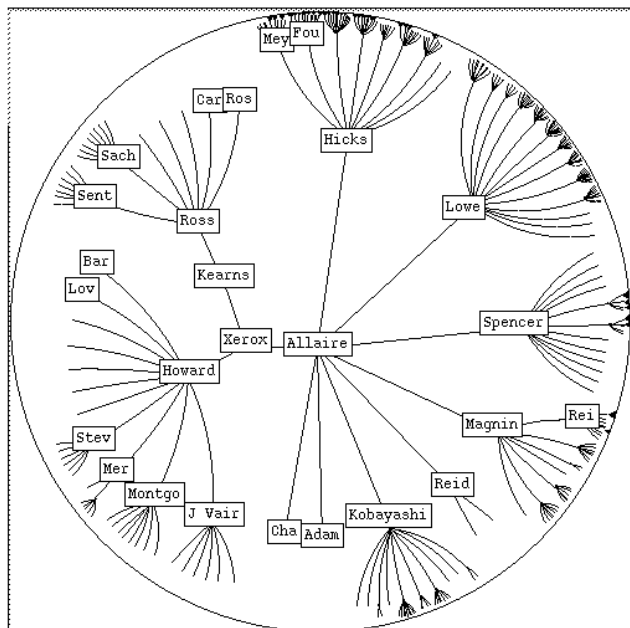


Cone Trees



Robertson / Mackinlay / Card Cone Trees: Animated 3D Visualizations of Hierarchical Information. *Proc ACM CHI'91*

Hyperbolic Lens

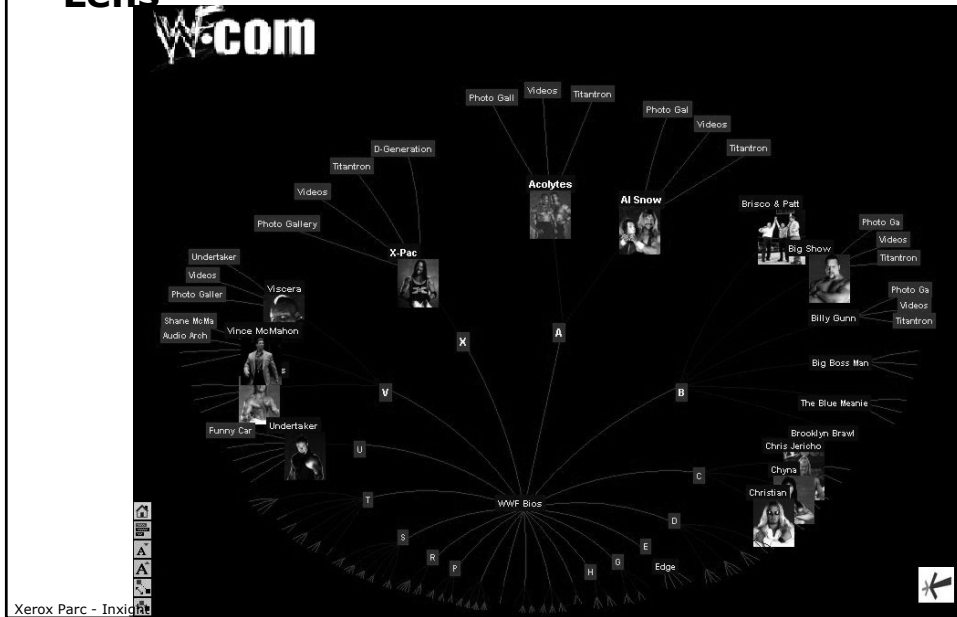


Xerox Parc - Inxight

P. A. Allaire, President, President

401 -- ???

Hyperbolic Lens



What you now know

Good representations

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

Information visualization

- Tufte's principles
- overview first, zoom and filter, then details on demand
- many techniques now available

Saul Greenberg

