Representations and information visualization

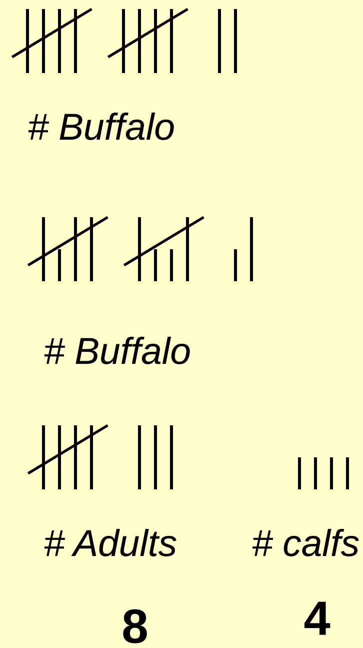
Characteristics of good representations

Information visualization

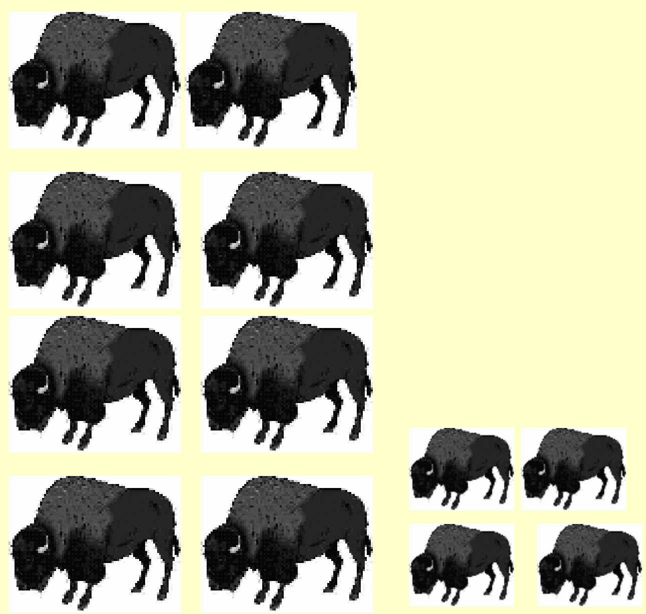
- guidelines
- visual information-seeking mantra
- techniques

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
- 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

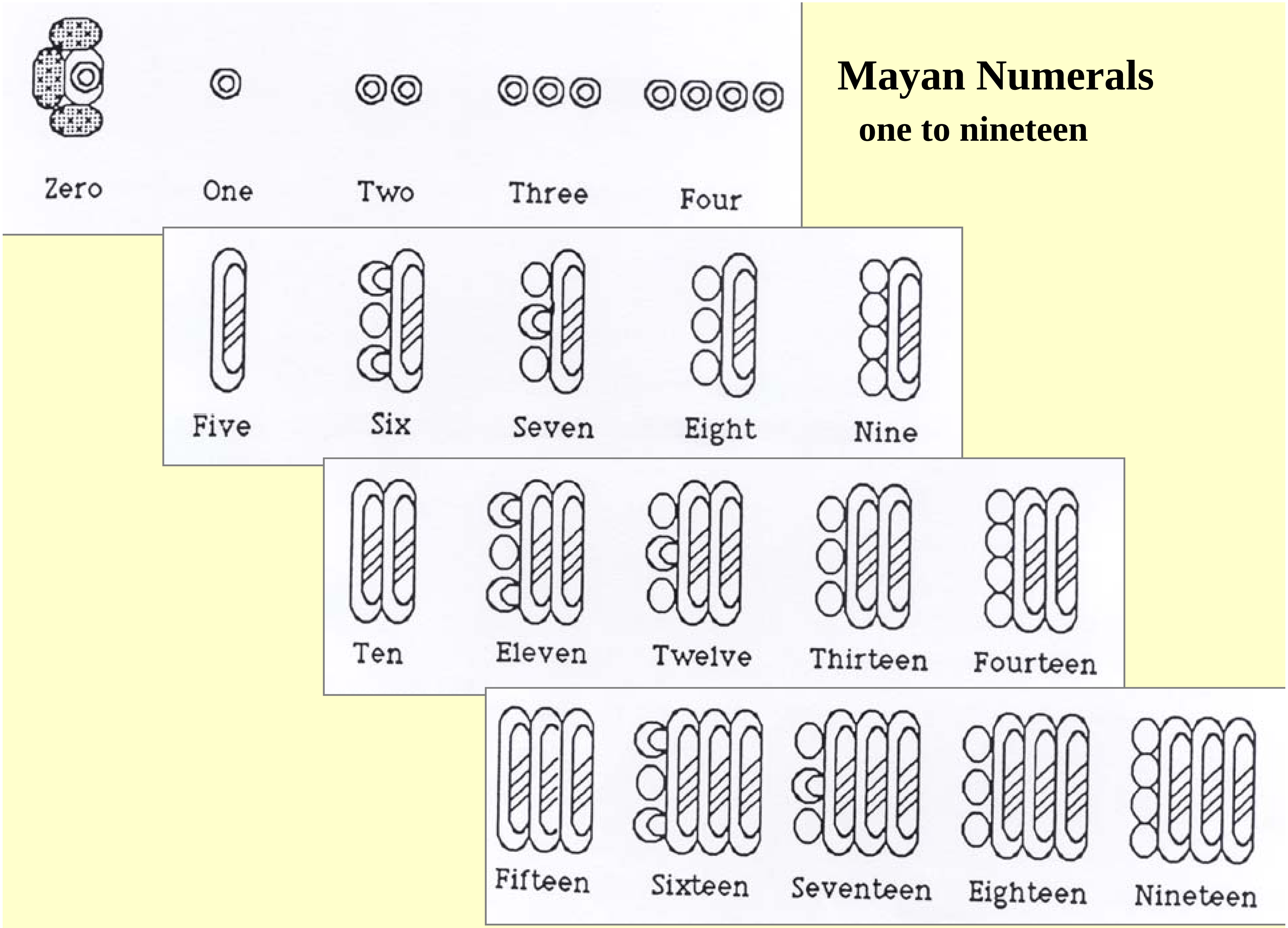
presentation

how the representation is placed or organized on the screen

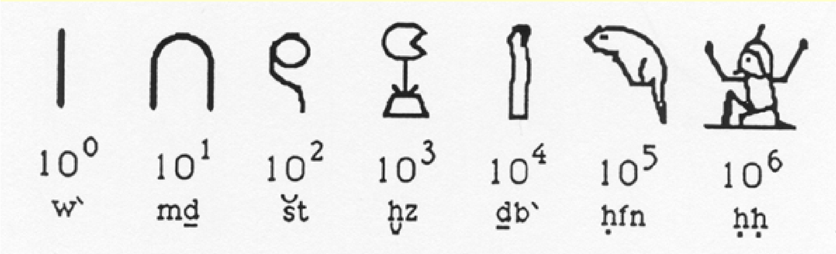
34, **34**, <u>**34**</u>

Mayan Numerals

one to nineteen

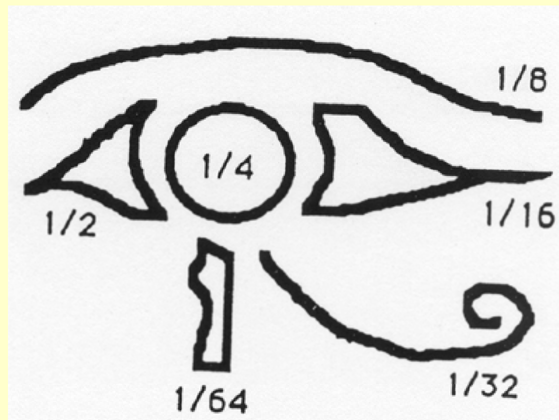


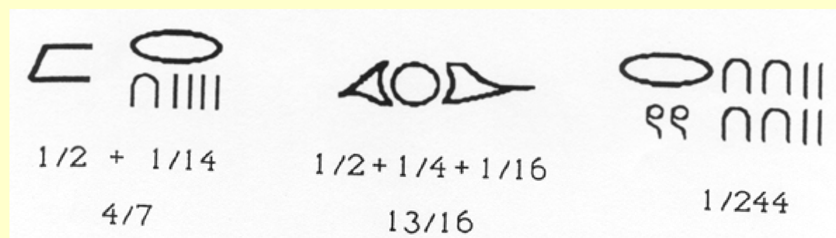
Egyptian Numerals



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

Which is the best flight?

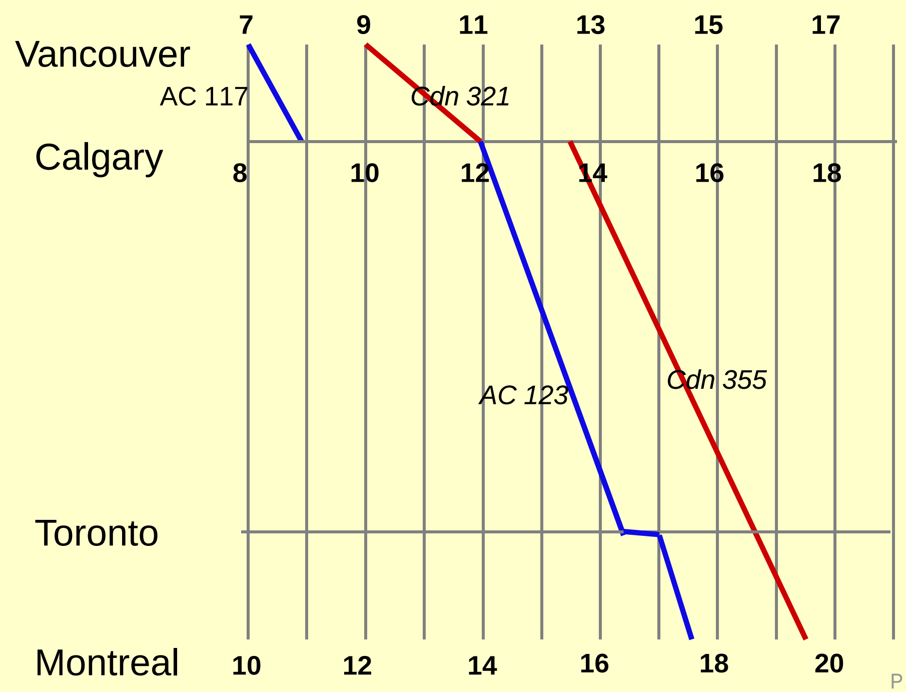
length

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

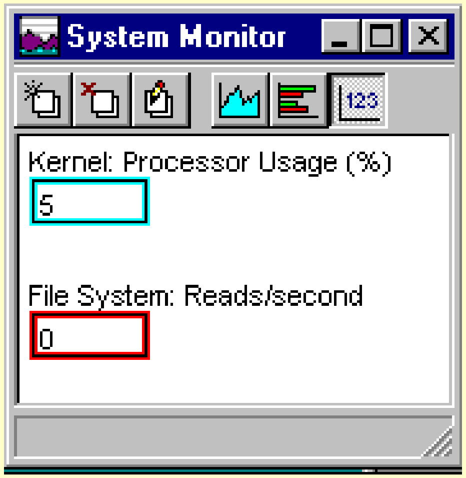
Inderal	-	1 tablet 3 times a day
Lanoxin	-	1 tablet every a.m.
Carafate	-	1 tablet before meals and at bedtime
Zantac	-	1 tablet every 12 hours (twice a day)
Quinag	-	1 tablet 4 times a day
Couma	-	1 tablet a day

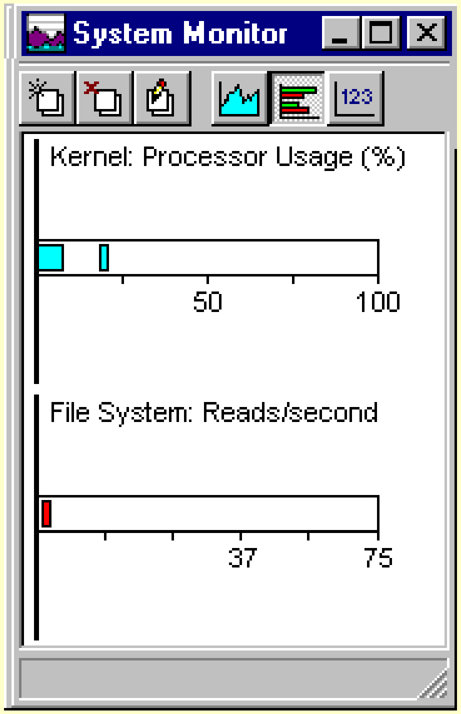
	Breakfast	Lunch	Dinner	Bedtime
Lanoxin	O			
Inderal	O	O	O	O
Quinag	O	O	O	O
Carafate	O	O	O	O
Zantac		O		O
Couma				O

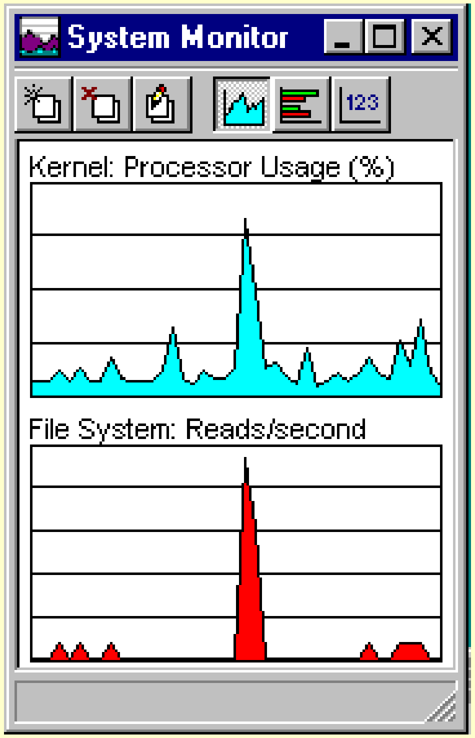
Breakfast	Lunch	Dinner	Bedtime
Lanoxin			
Inderal	Inderal	Inderal	Inderal
Quinag	Quinag	Quinag	Quinag
Carafate	Carafate	Carafate	Carafate
	Zantac		Zantac
			Couma

Which representation is best?

depends heavily on task





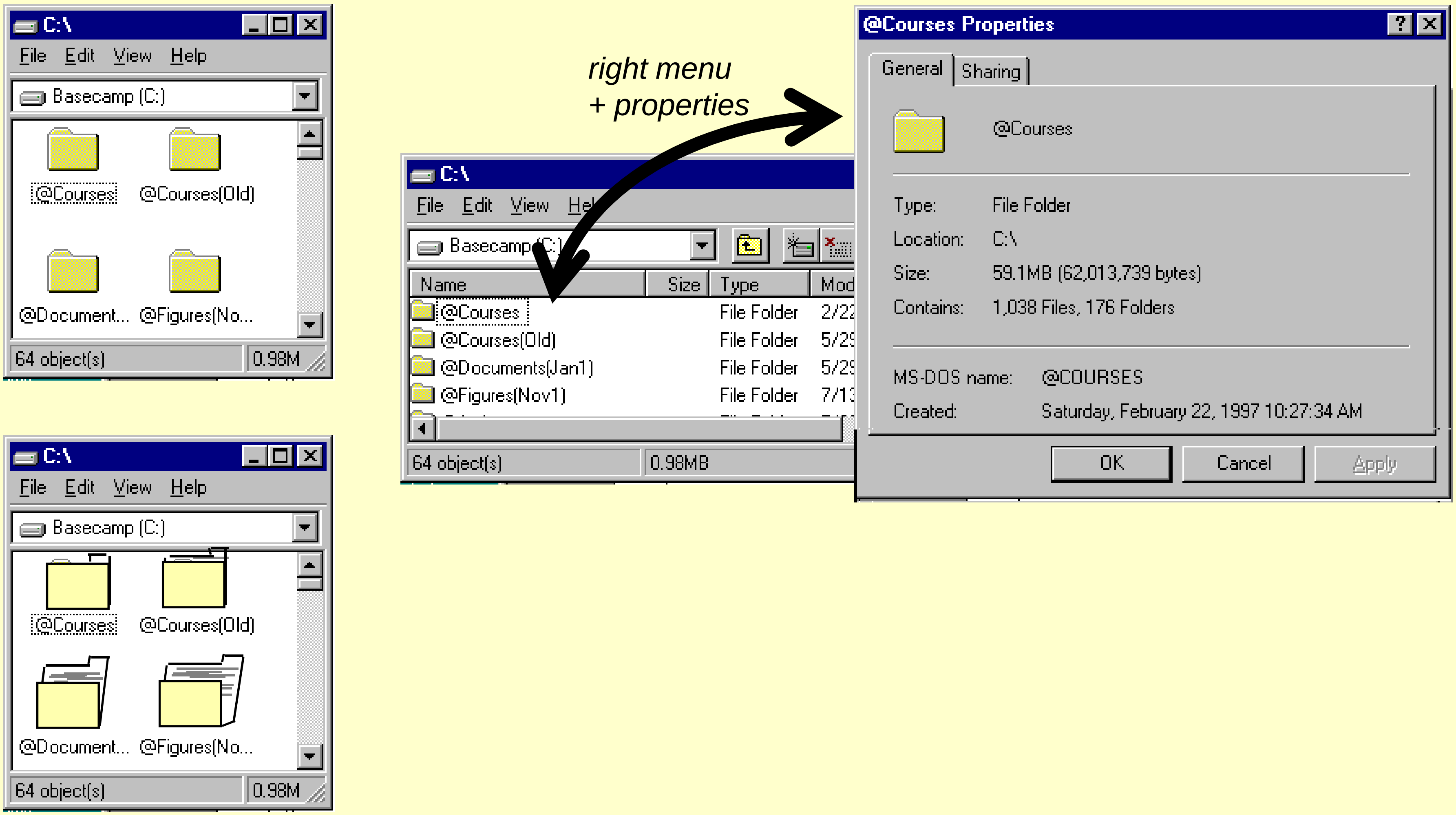


What is precise value?

How does the performance now compared to its peak?

How does performance change over time?

Which folder has the most documents?

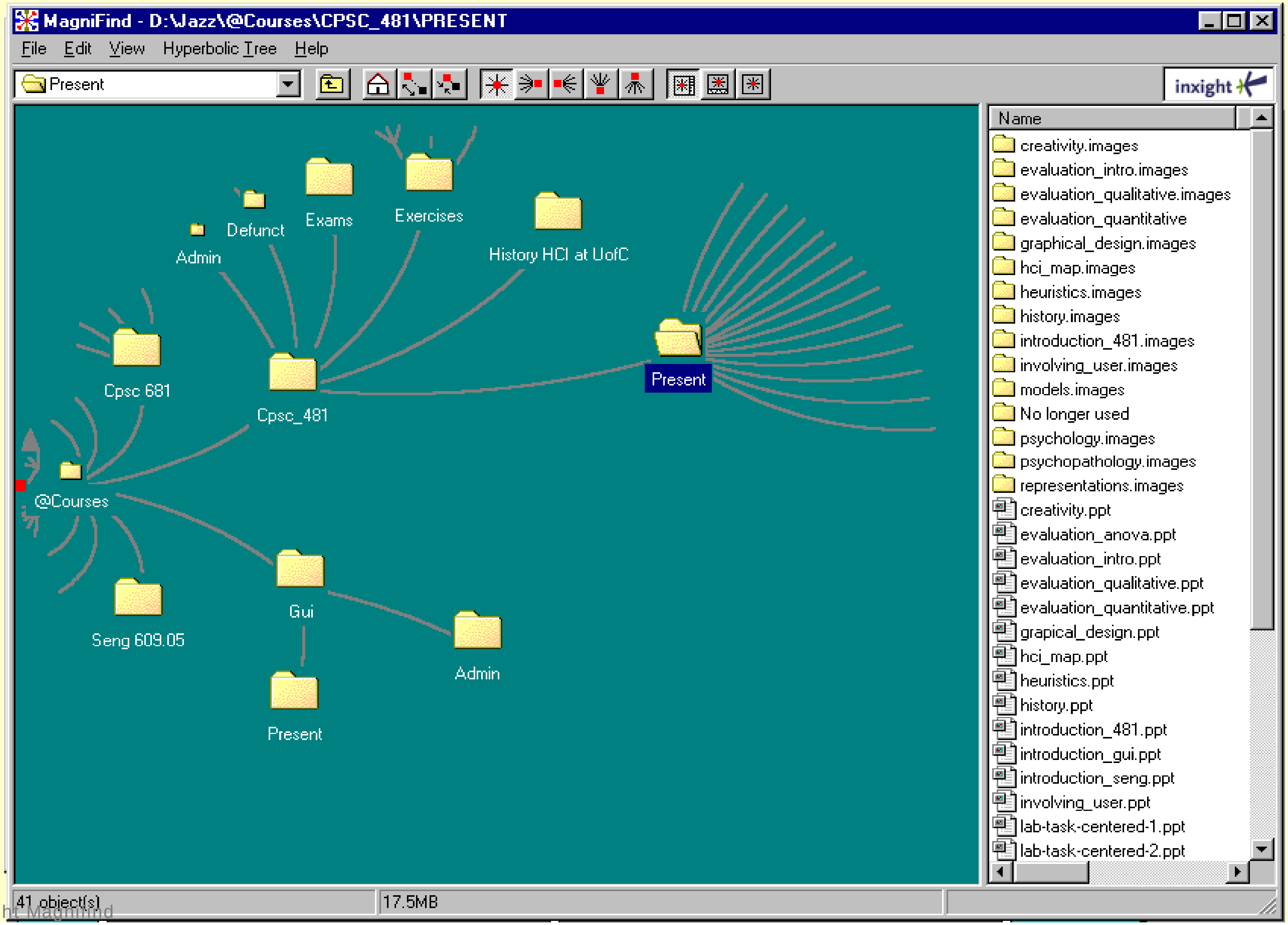


Where am I?

Detailed navigation plus precision

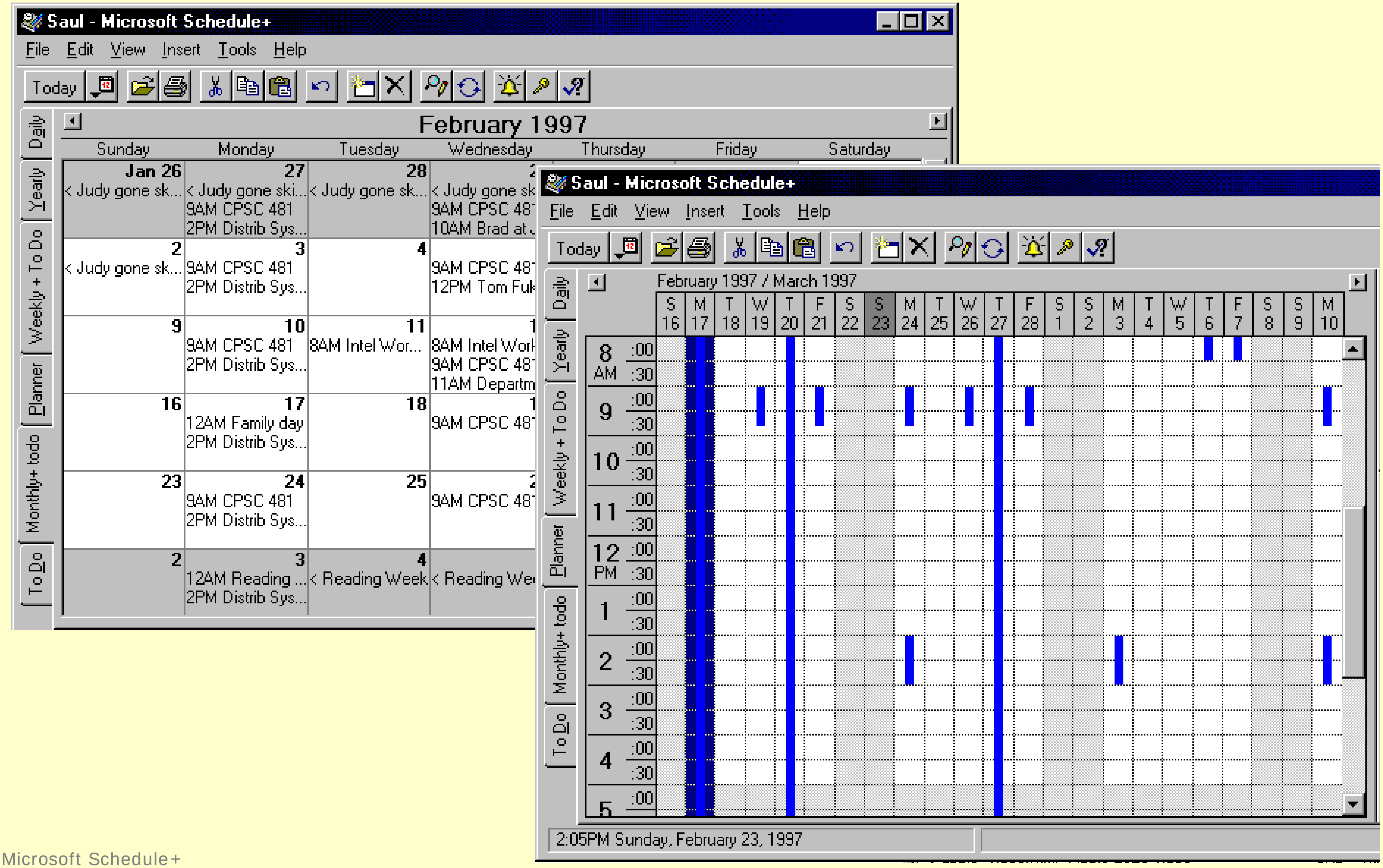
General navigation plus orientation

Where am I?



Inxight Magnifind

What do I have to do?



Microsoft Schedule+

Information Visualization

Graphics should reveal the data

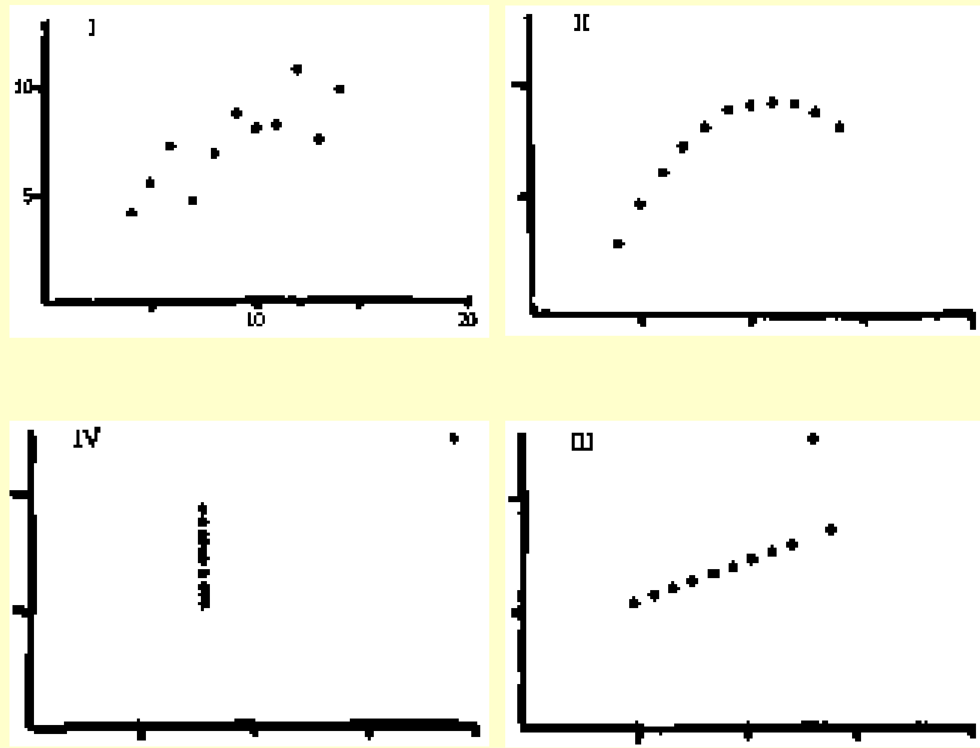
- show the data
- not get in the way of the message
- avoid distortion
- present many numbers in a small space
- make large data sets coherent
- encourage comparison between data
- supply both a broad overview and fine detail
- serve a clear purpose

E. Tufte
Visual Display of Quantitative Information

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

Anscombe's Quartet

I		II		III		IV	
X	Y	X	Y	X	Y	X	Y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	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

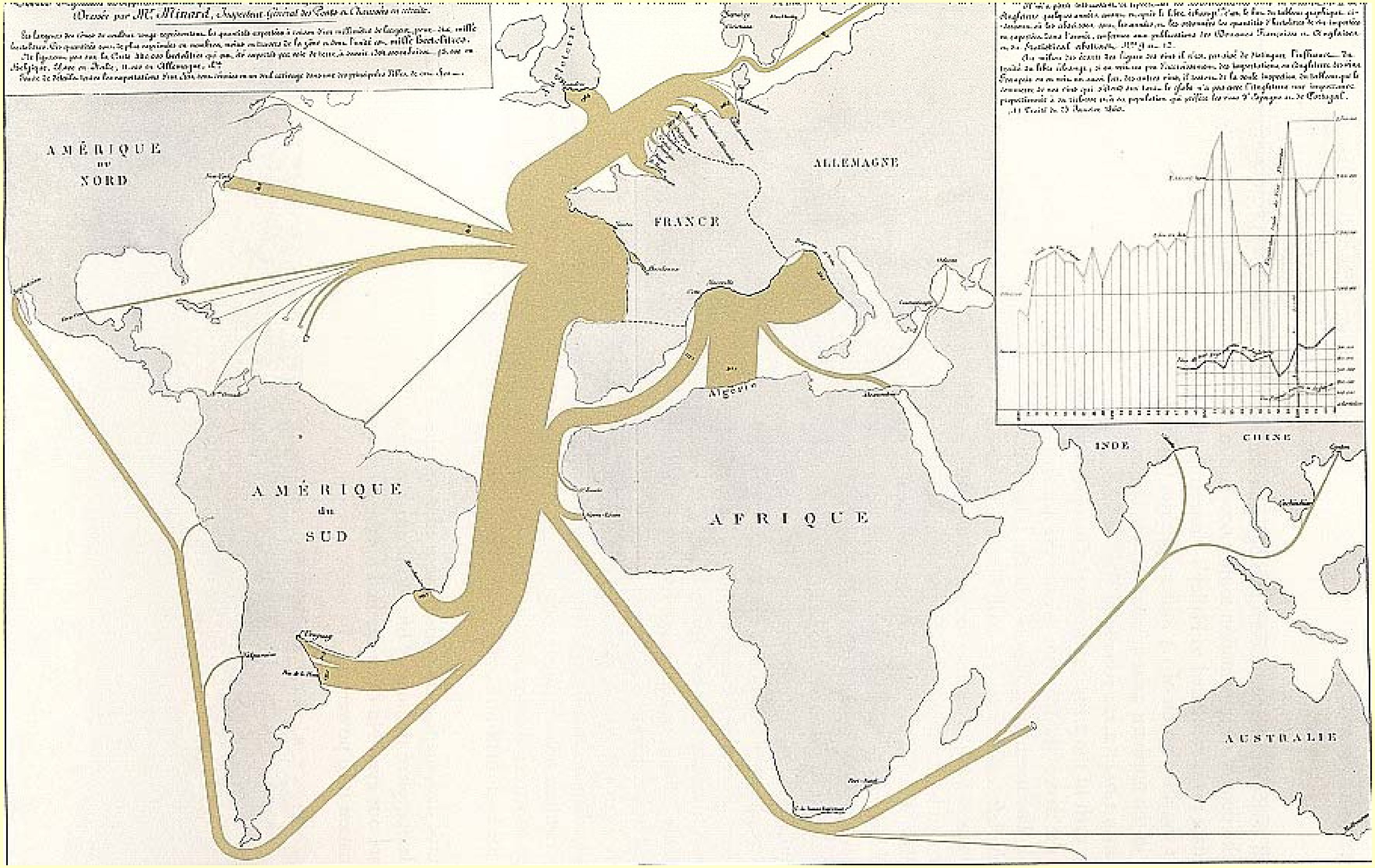
E. Tufte "Visual Display of Quantitative Information" p 25,

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.

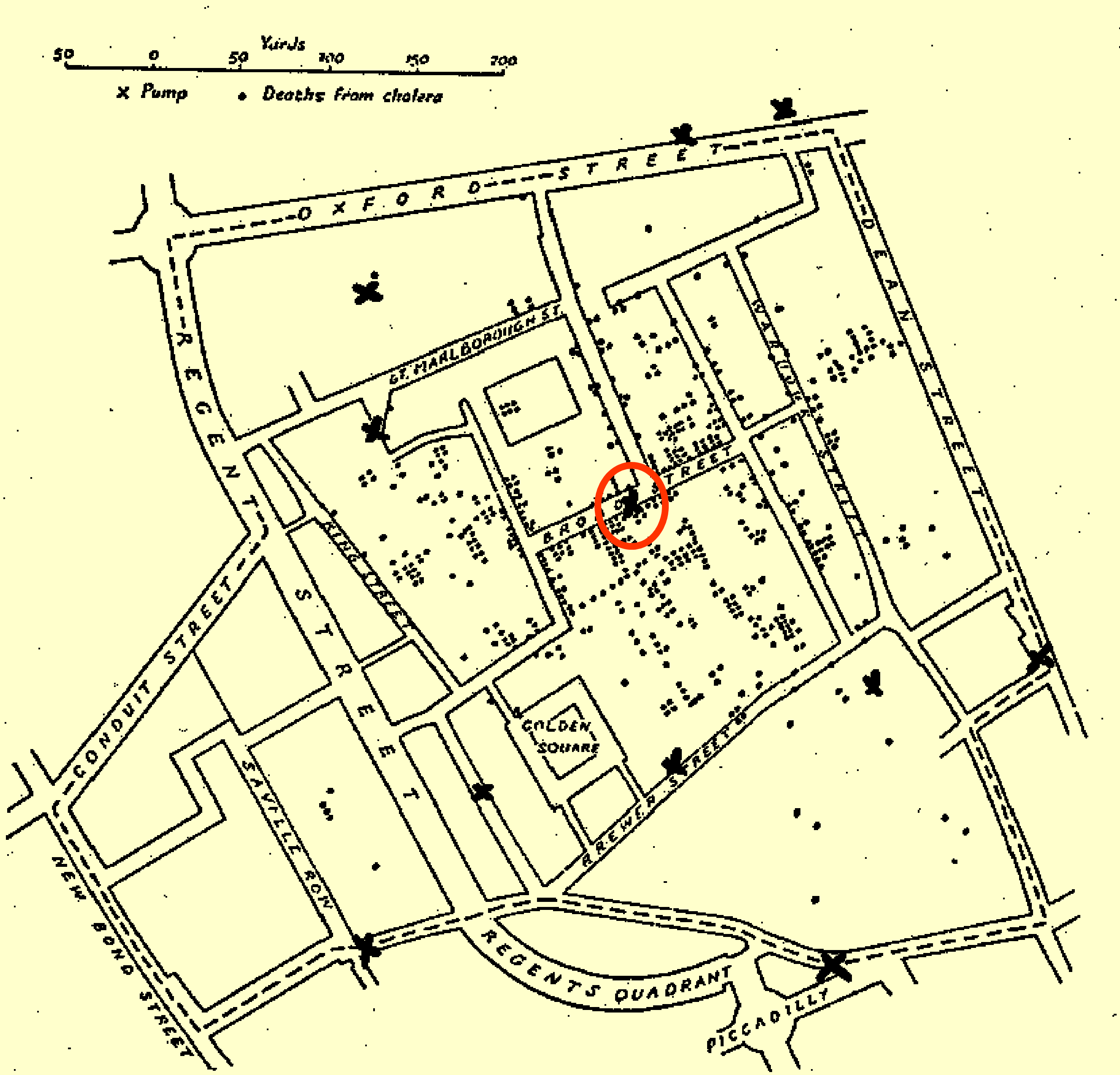
1864 Exports of French Wine



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

Deaths by Cholera

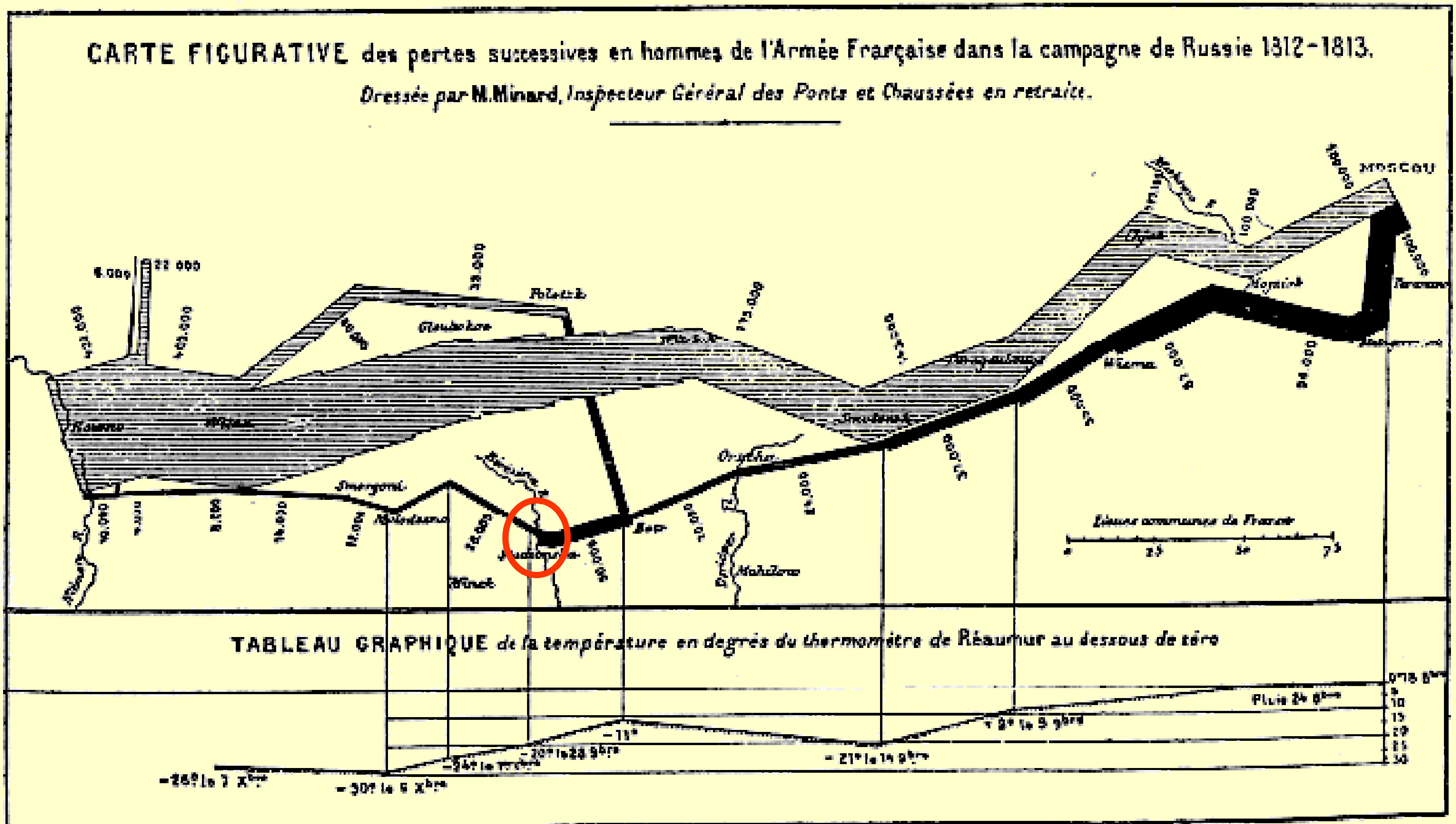
Dr John Snow
1854



E. Tufte "Visual Display of Quantitative Information"

Napolean's march to Moscow

by Charles Minard



E. Tufte "Visual Display of Quantitative Information"

9bre = November

8bre — October

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 !

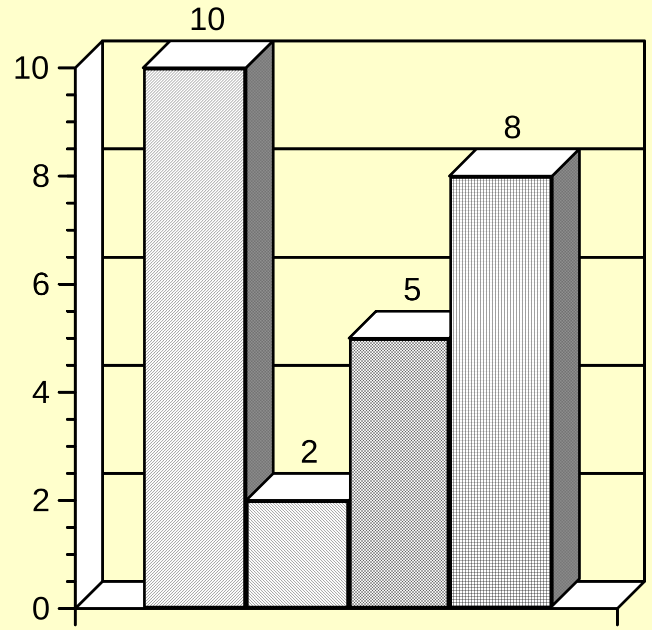


Chart Junk: Cotton production in Brazil, 1927

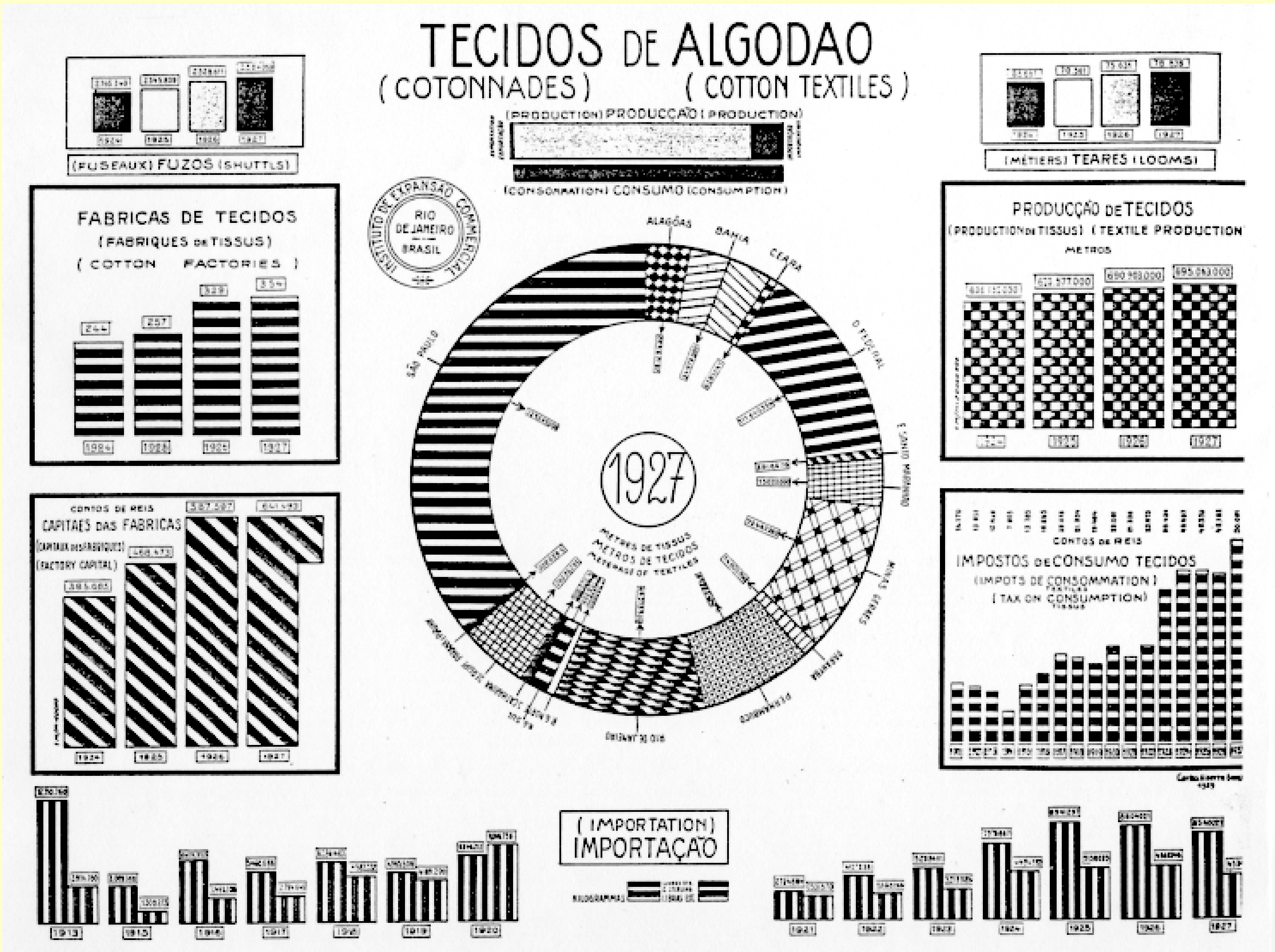
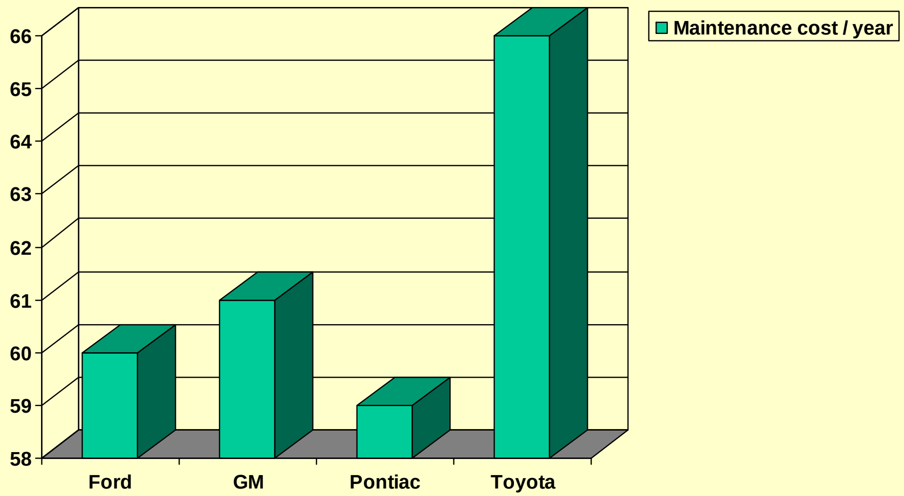
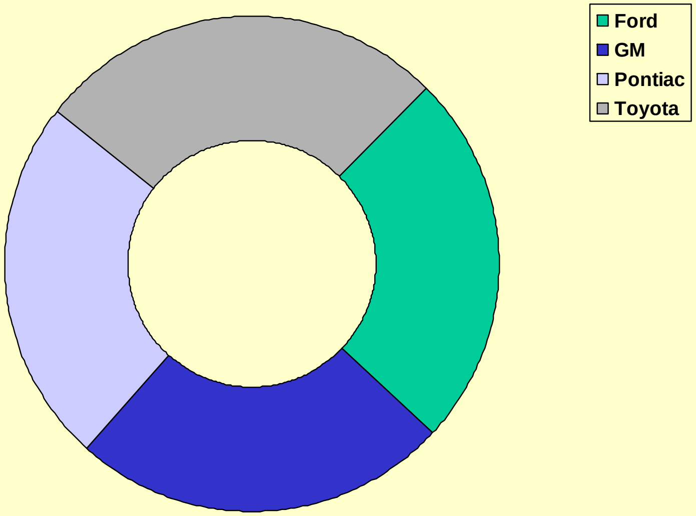
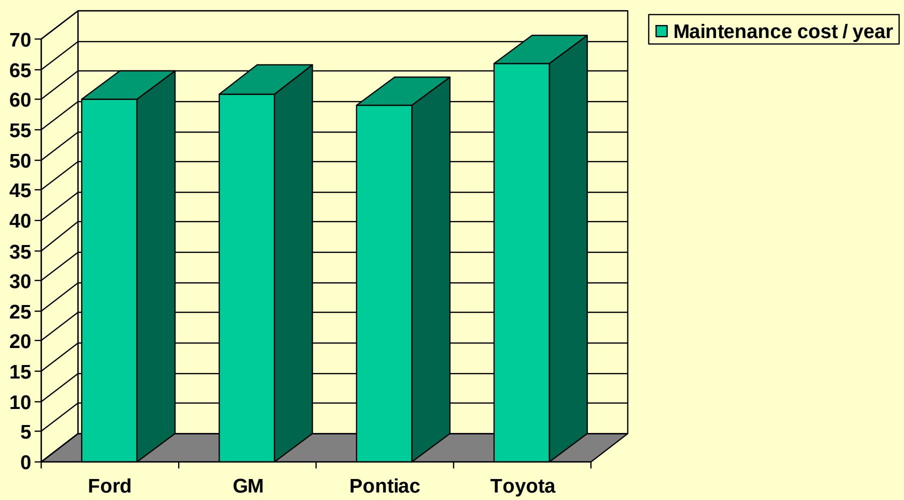
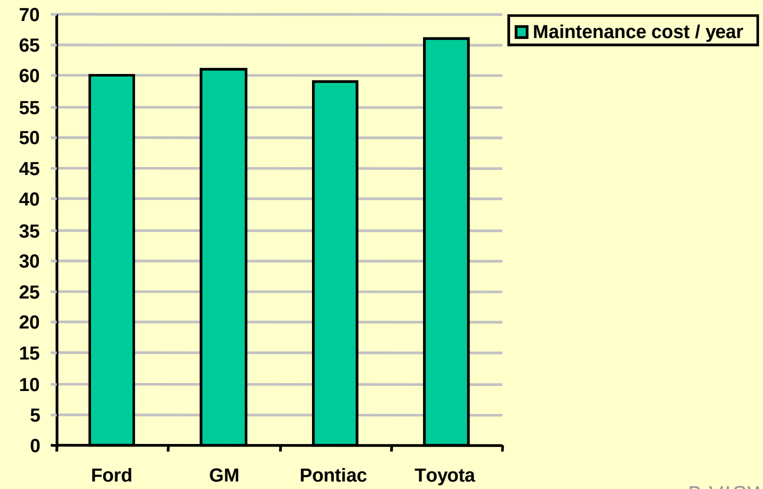


Chart Junk: Removing deception and simplification





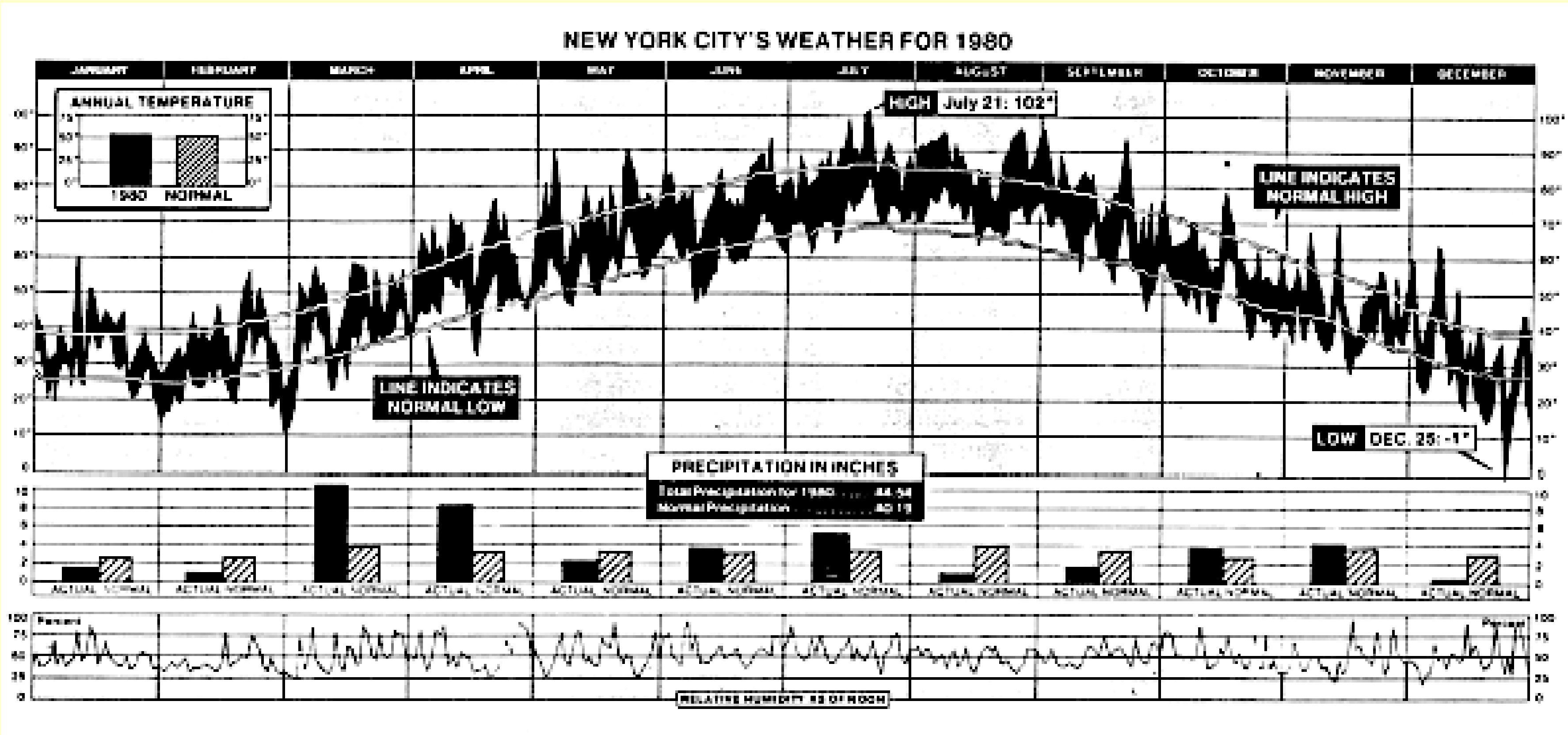




Data density

New York Weather History

- 181 numbers/sq inch

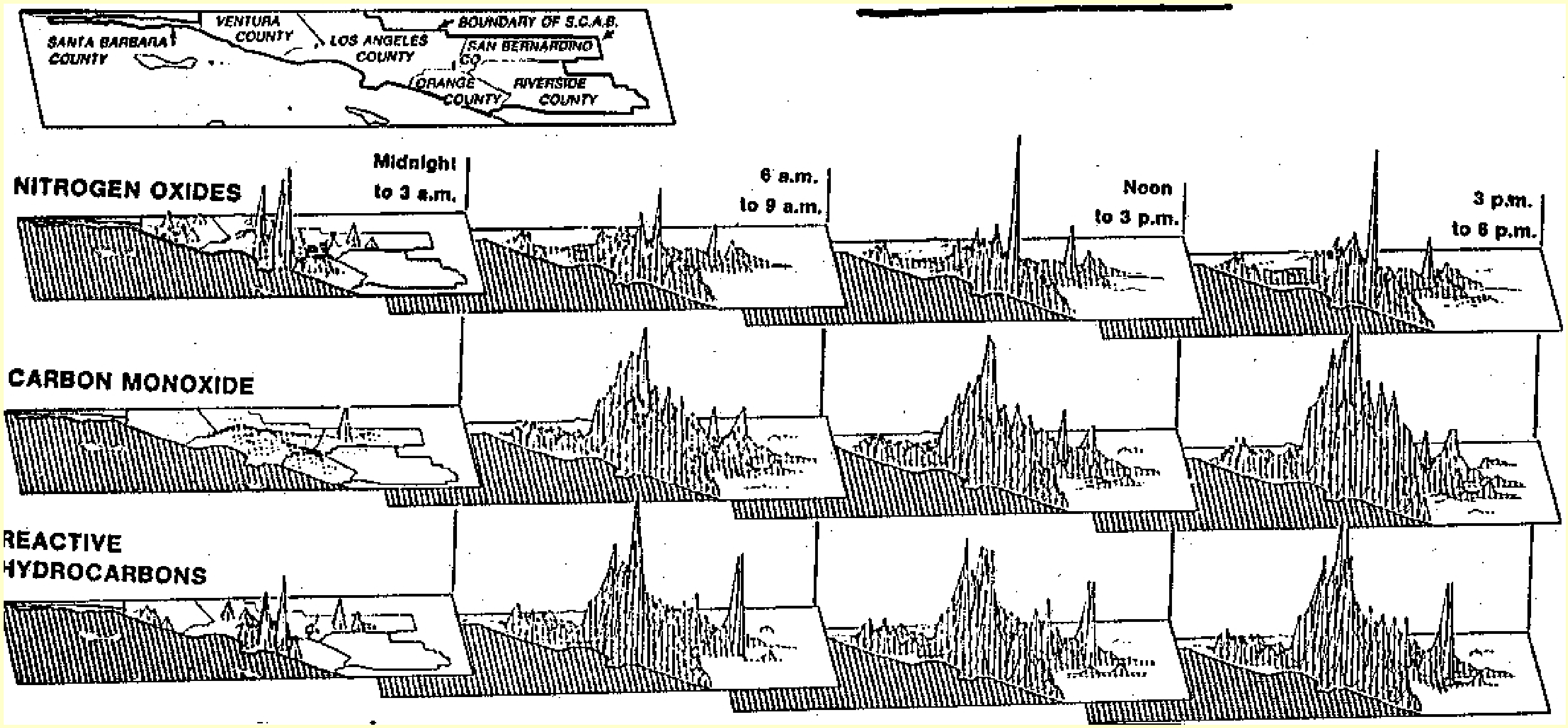


E. Tufte "Visual Display of Quantitative Information"

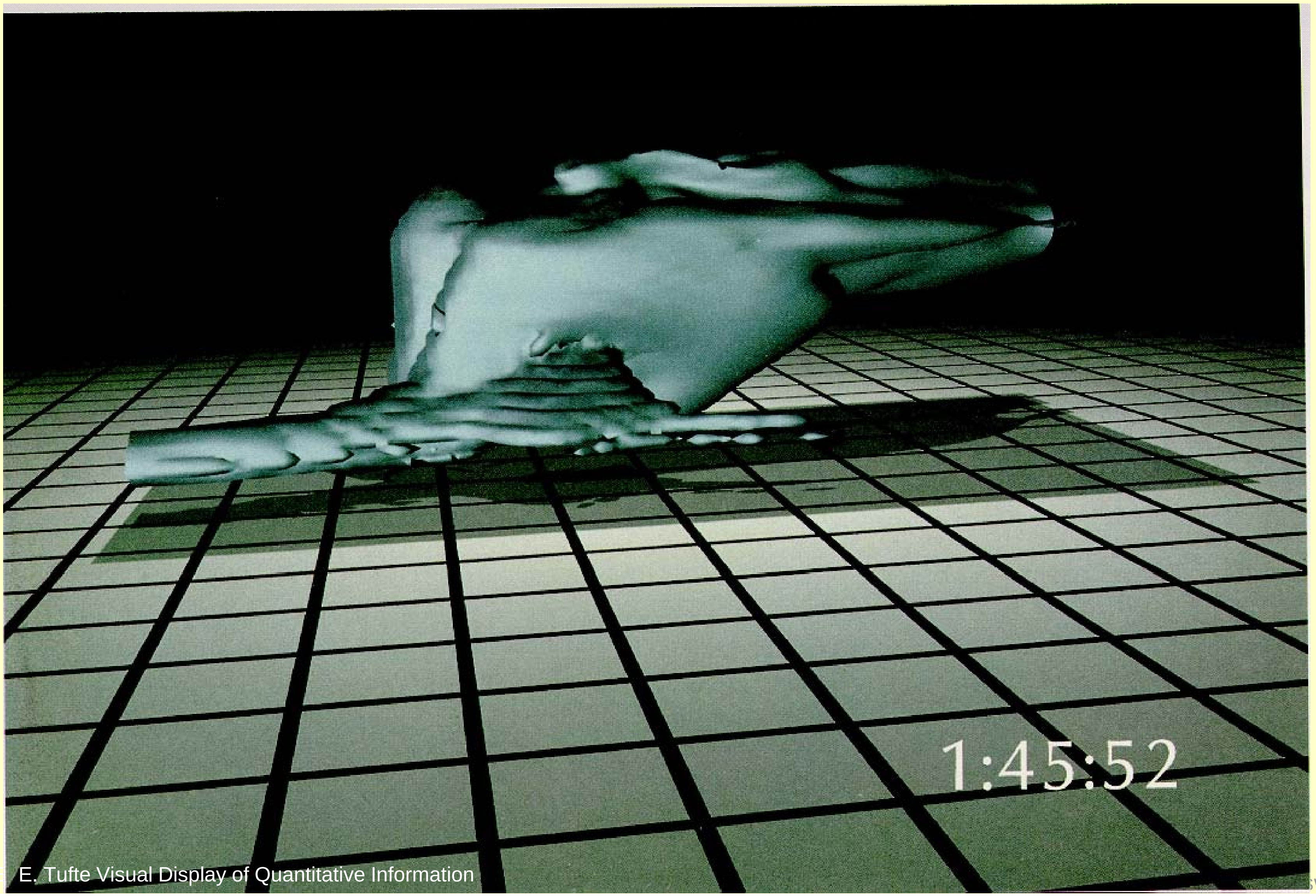
Small multiples

Learn once

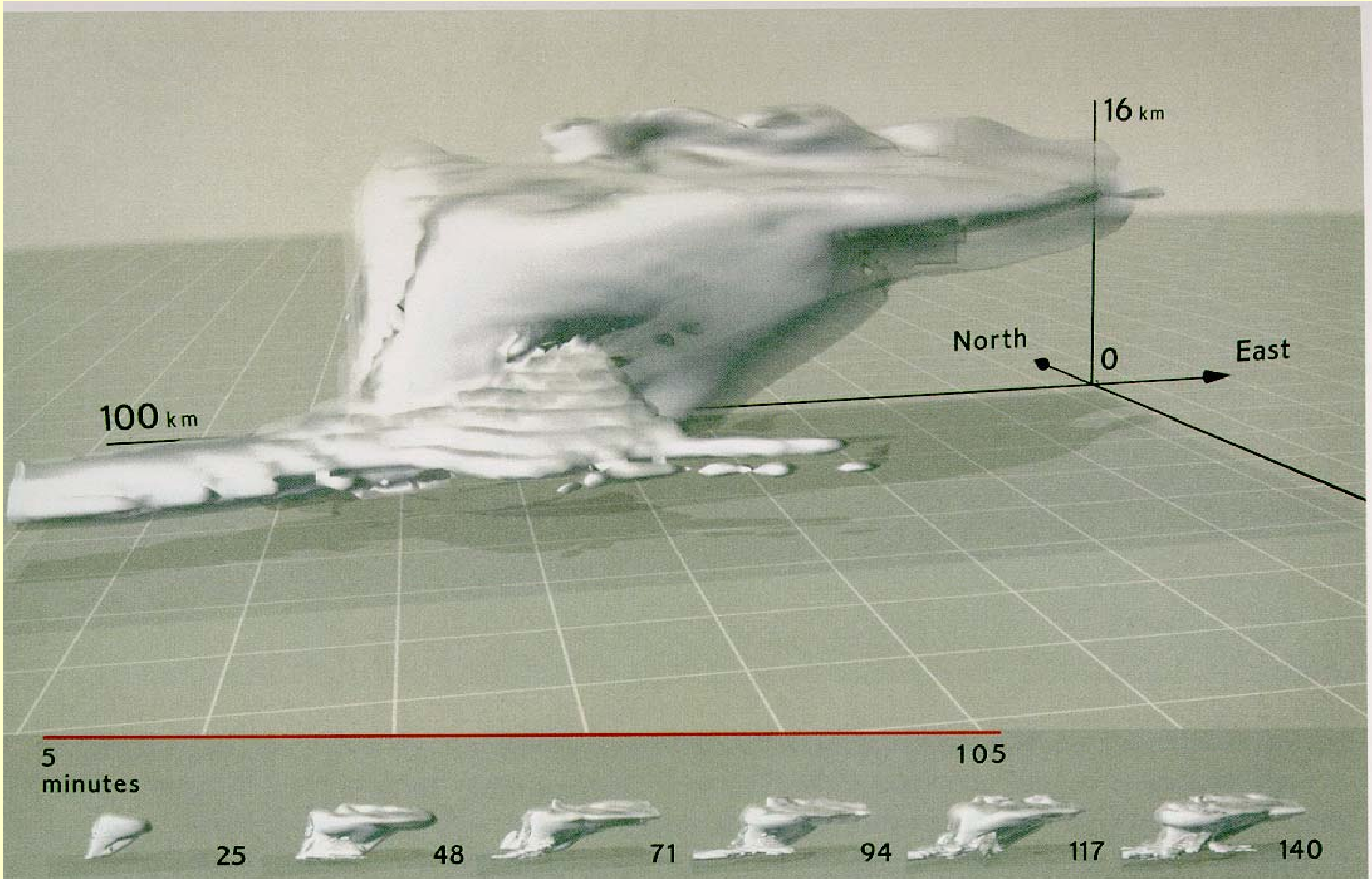
- invite comparisons



Small multiples: Showing time and change



Small multiples: Showing time and change



E. Tufte Visual Display of Quantitative Information

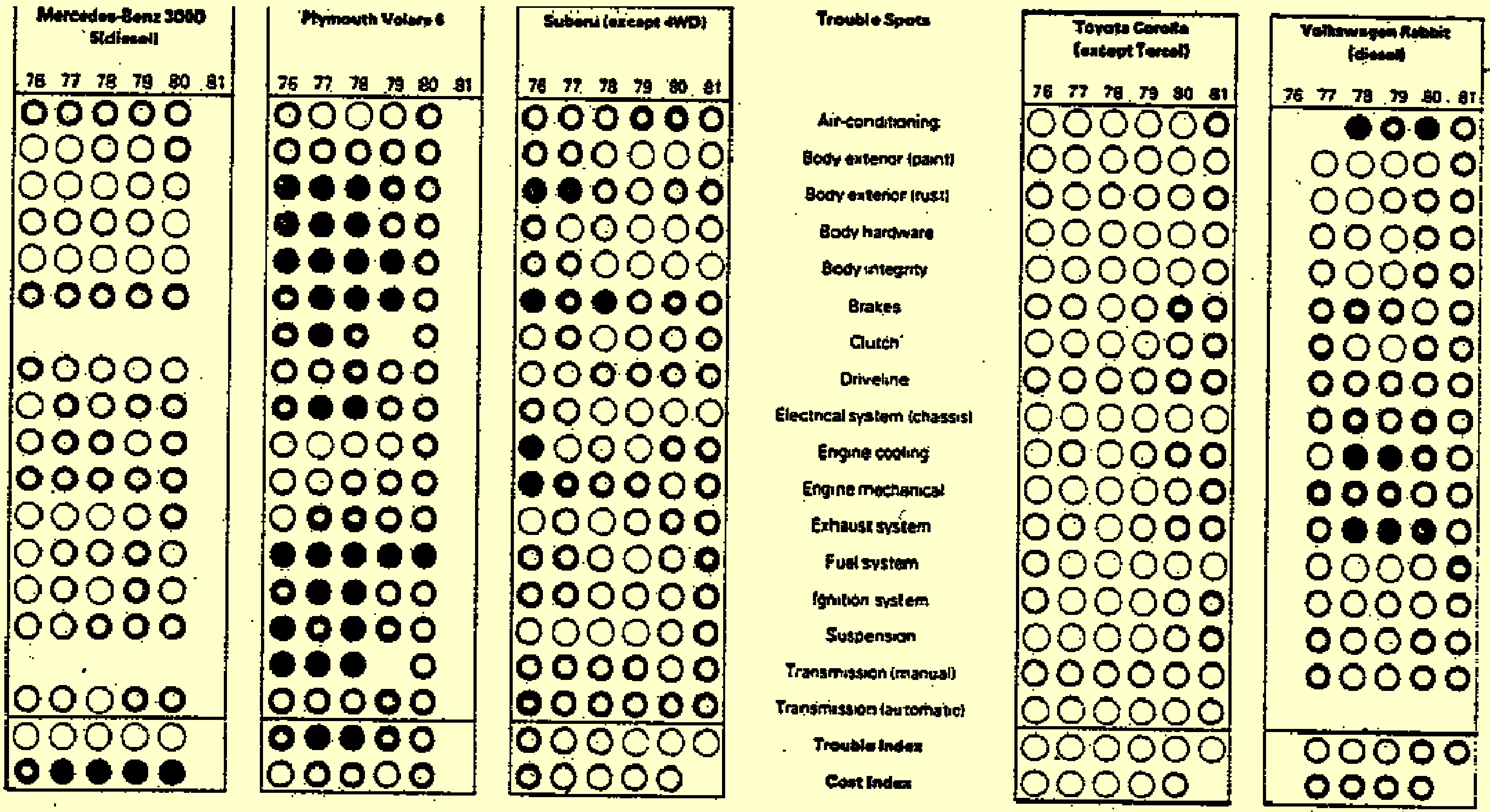
Visual information-seeking mantra

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
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

Shneiderman, Designing the User Interface 3rd Ed. 1997 p523

Overview & detail for comparisons

using small multiples and data density



PhotoFinder

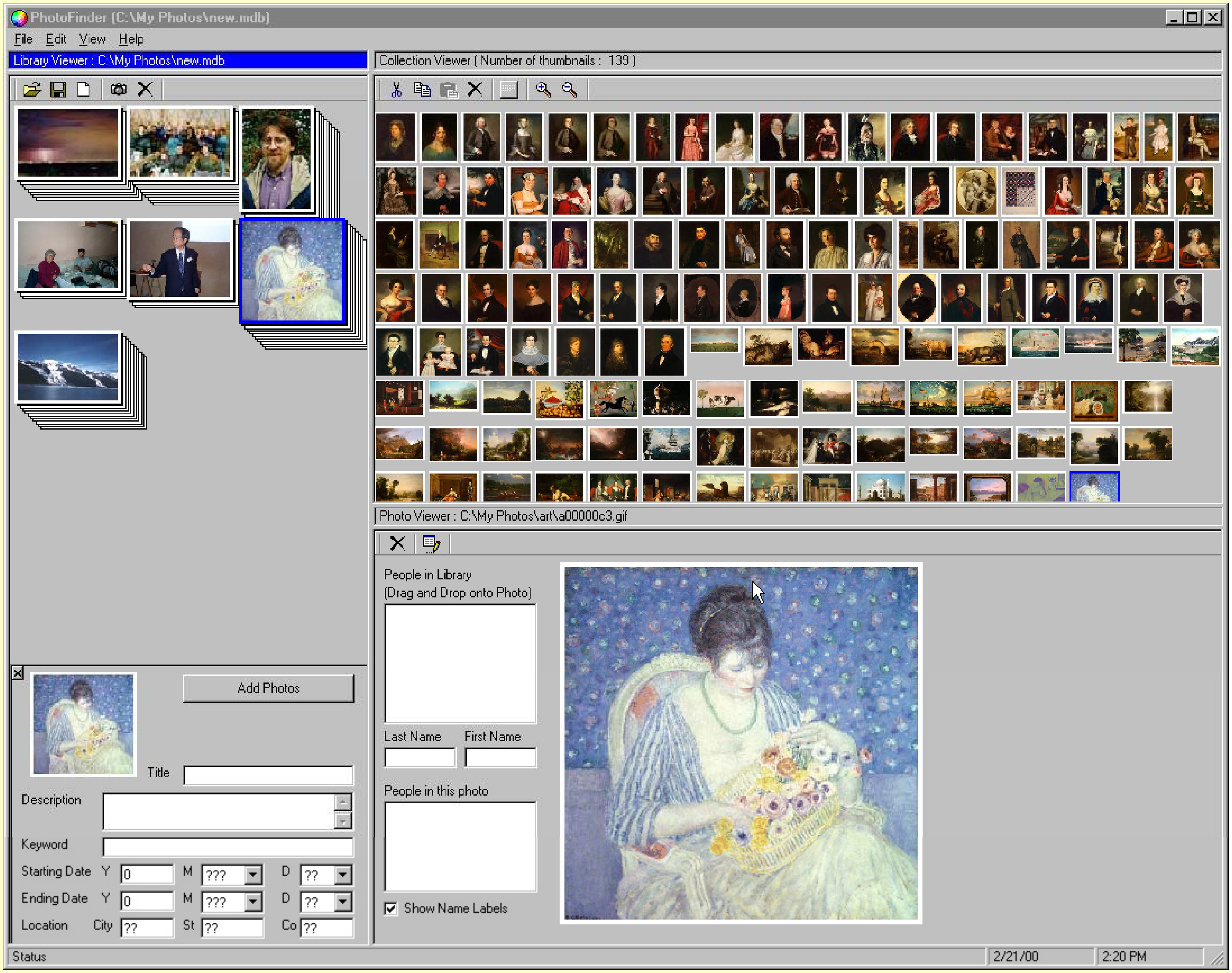
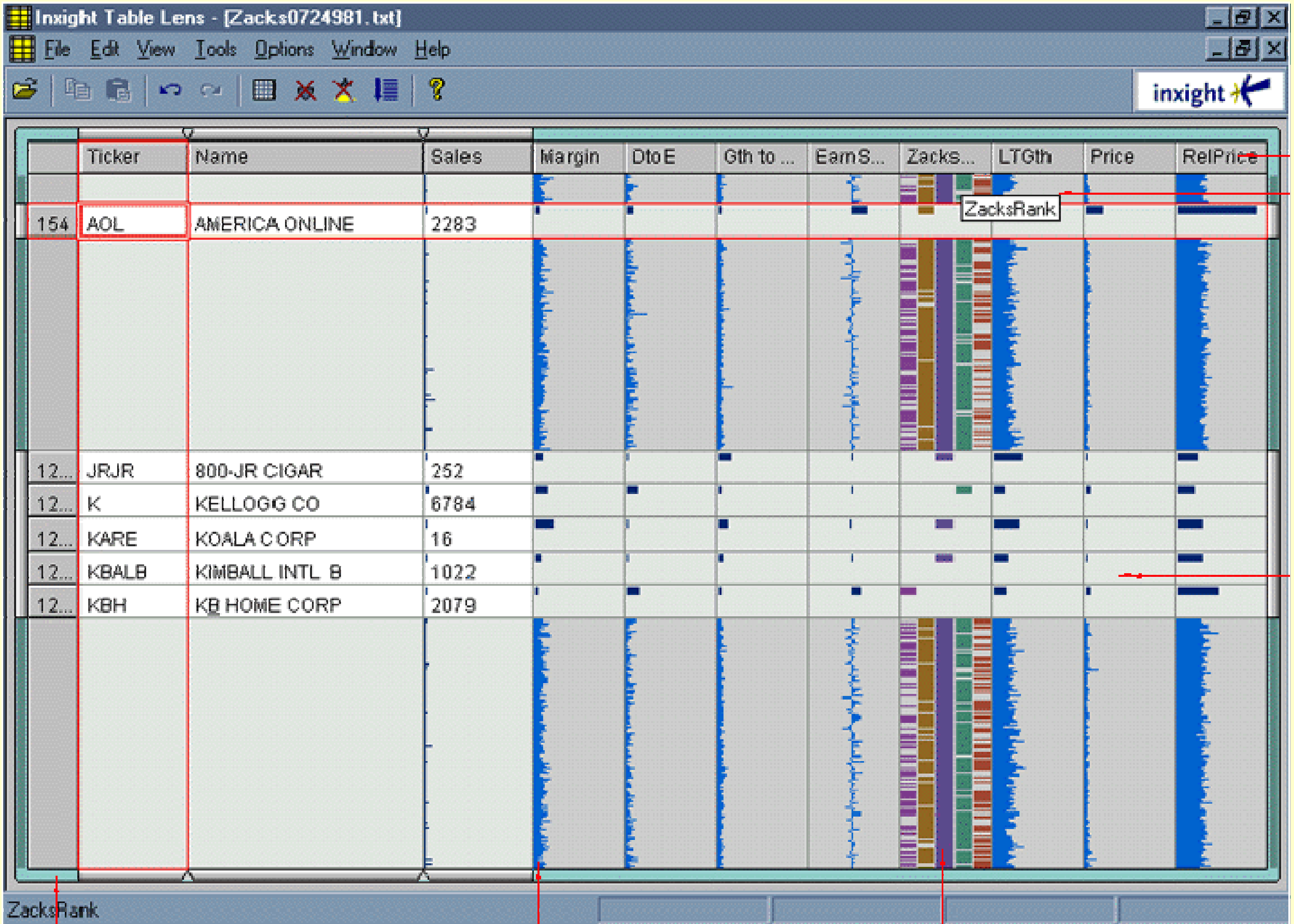
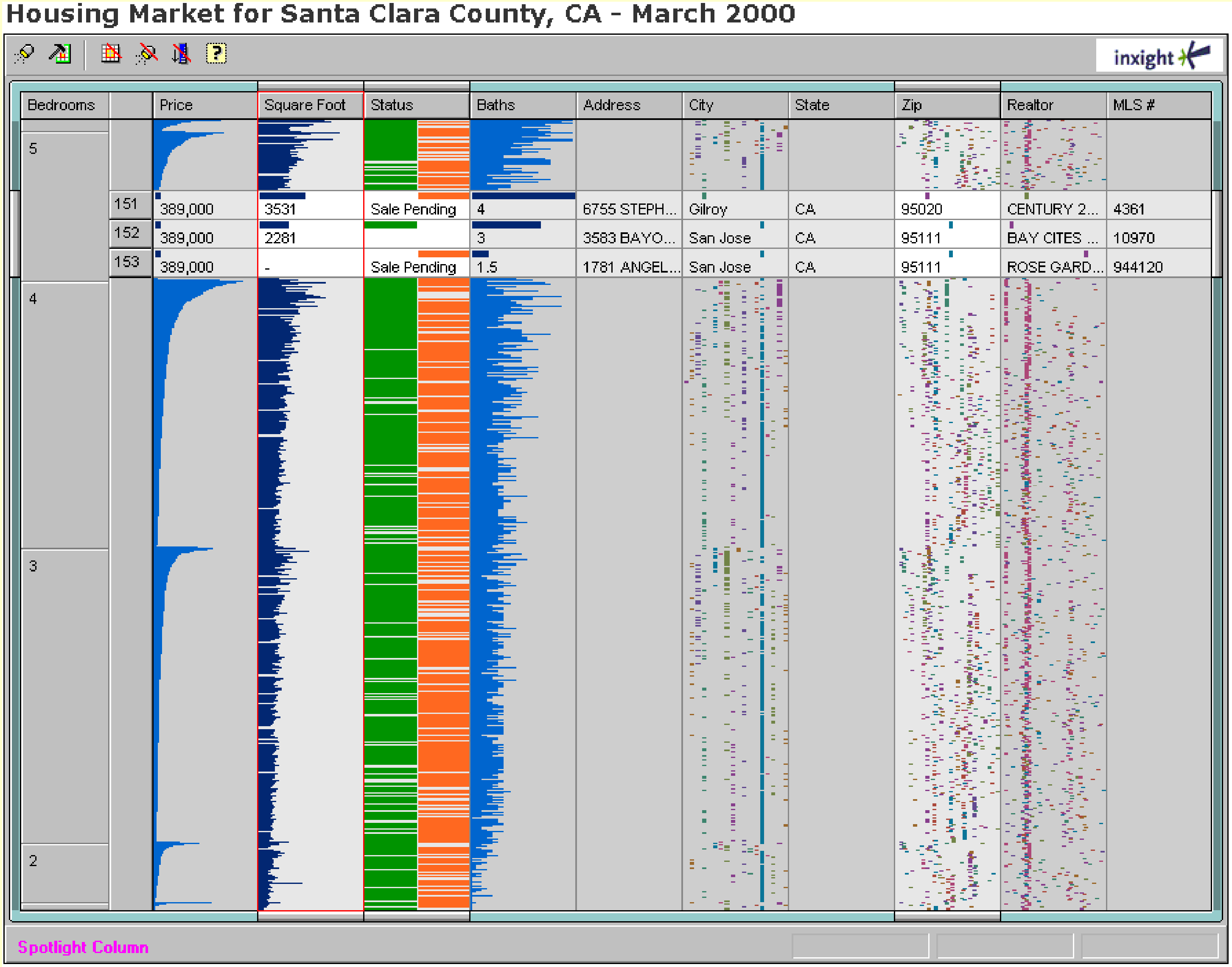


Table Lens



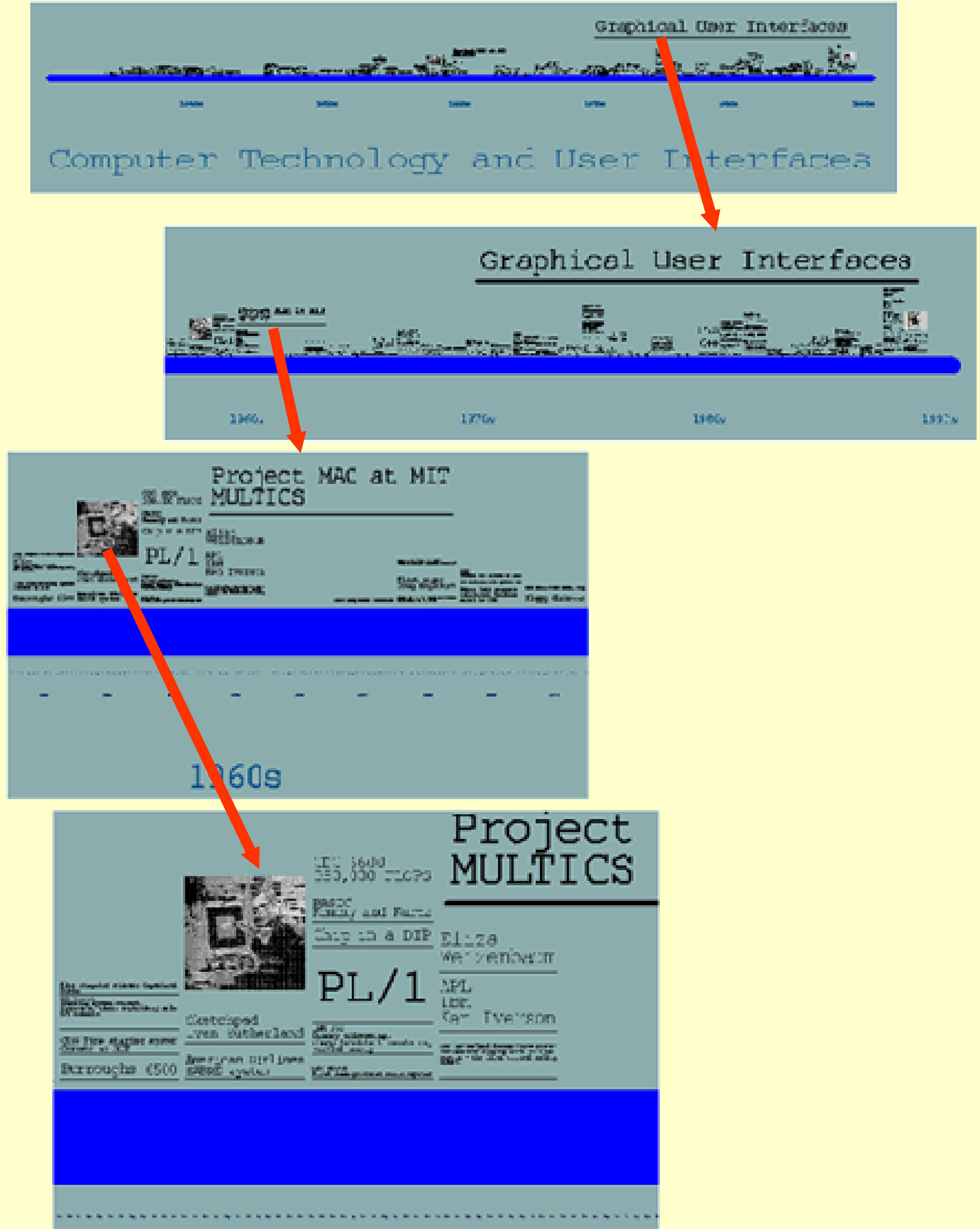
Inxight Table Lens

Table Lens



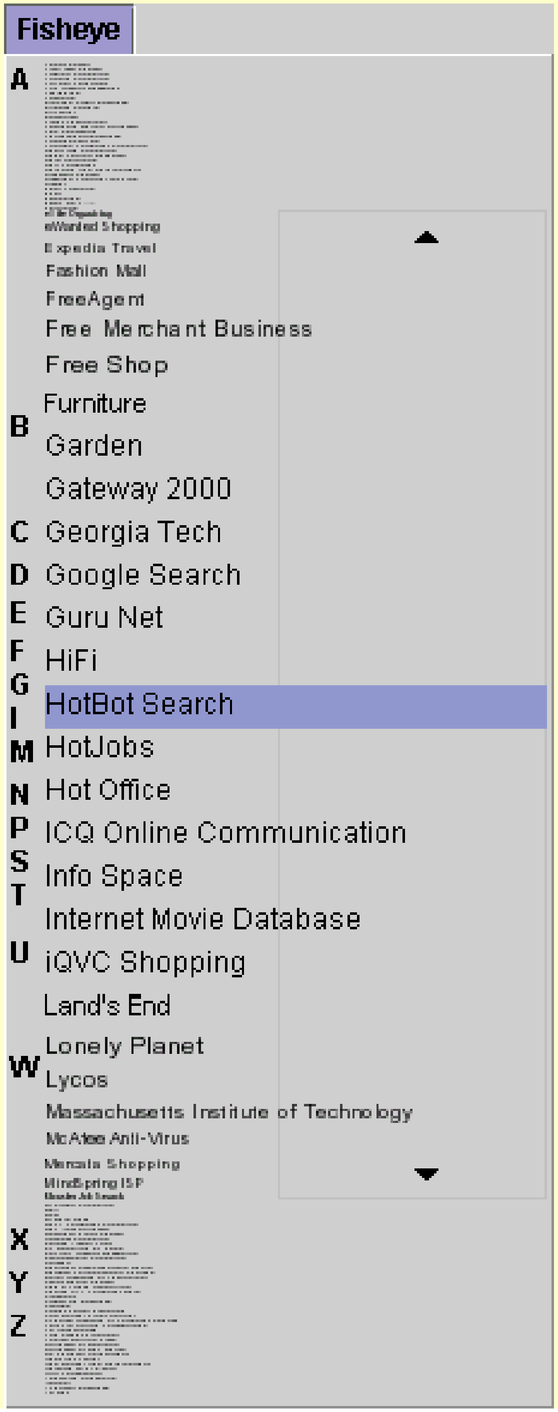
Inxight Table Lens

Infinite Zoom



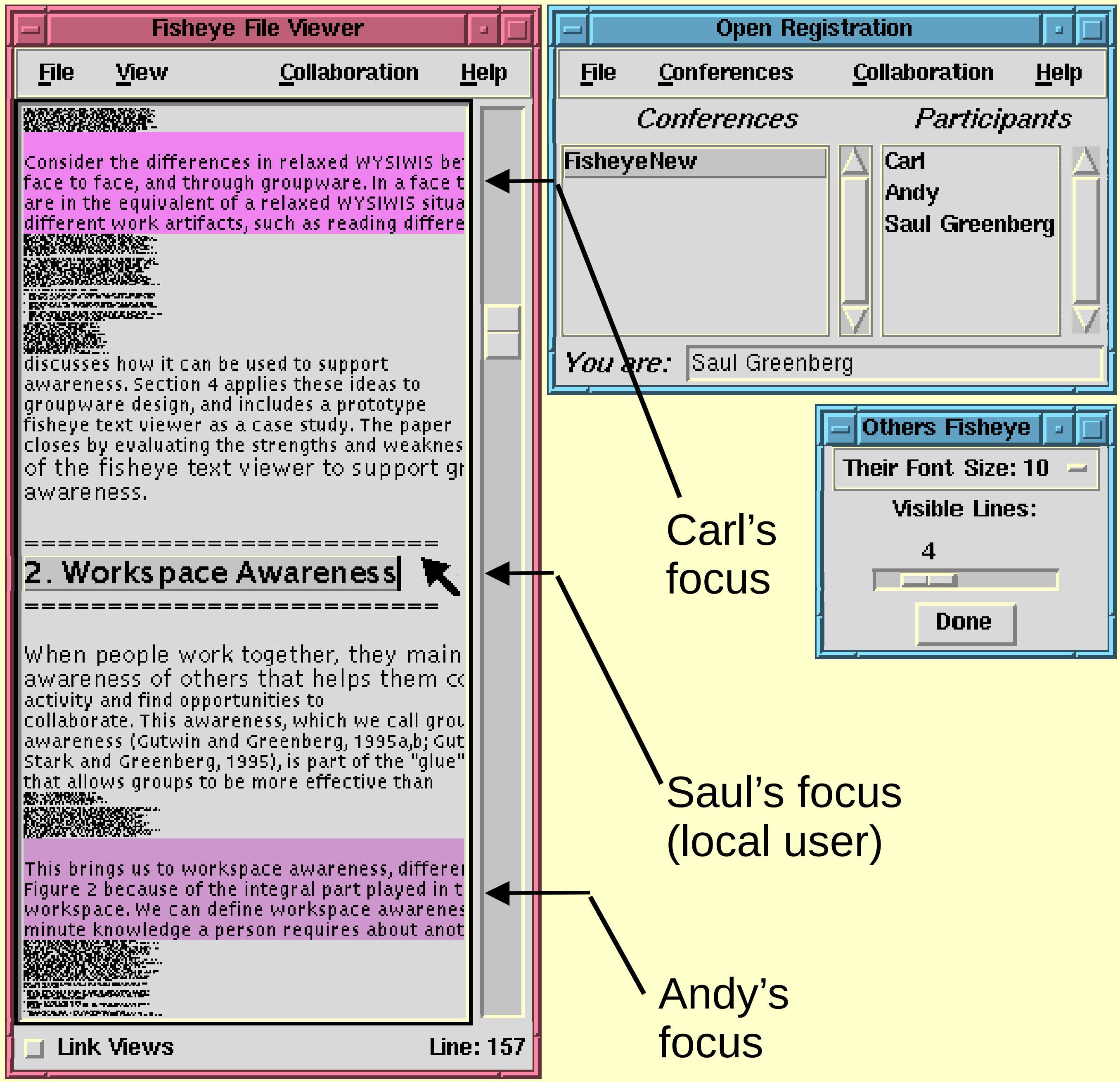
Pad++: A Zoomable Graphical Sketchpad for Exploring Alternate Interface Physics. Bederson et al Journal of Visual Languages and Computing 7, 1996

Fisheye Menus

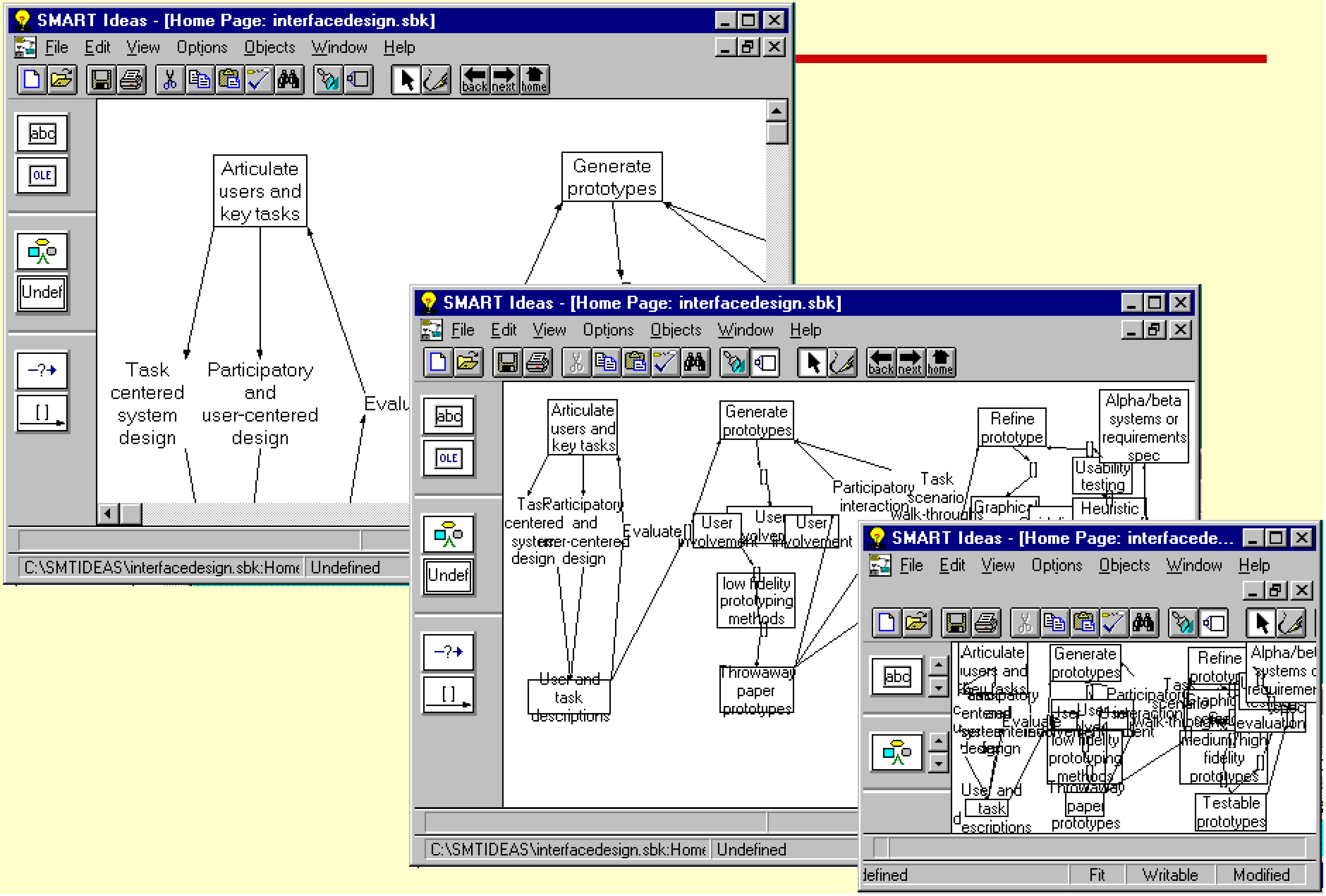


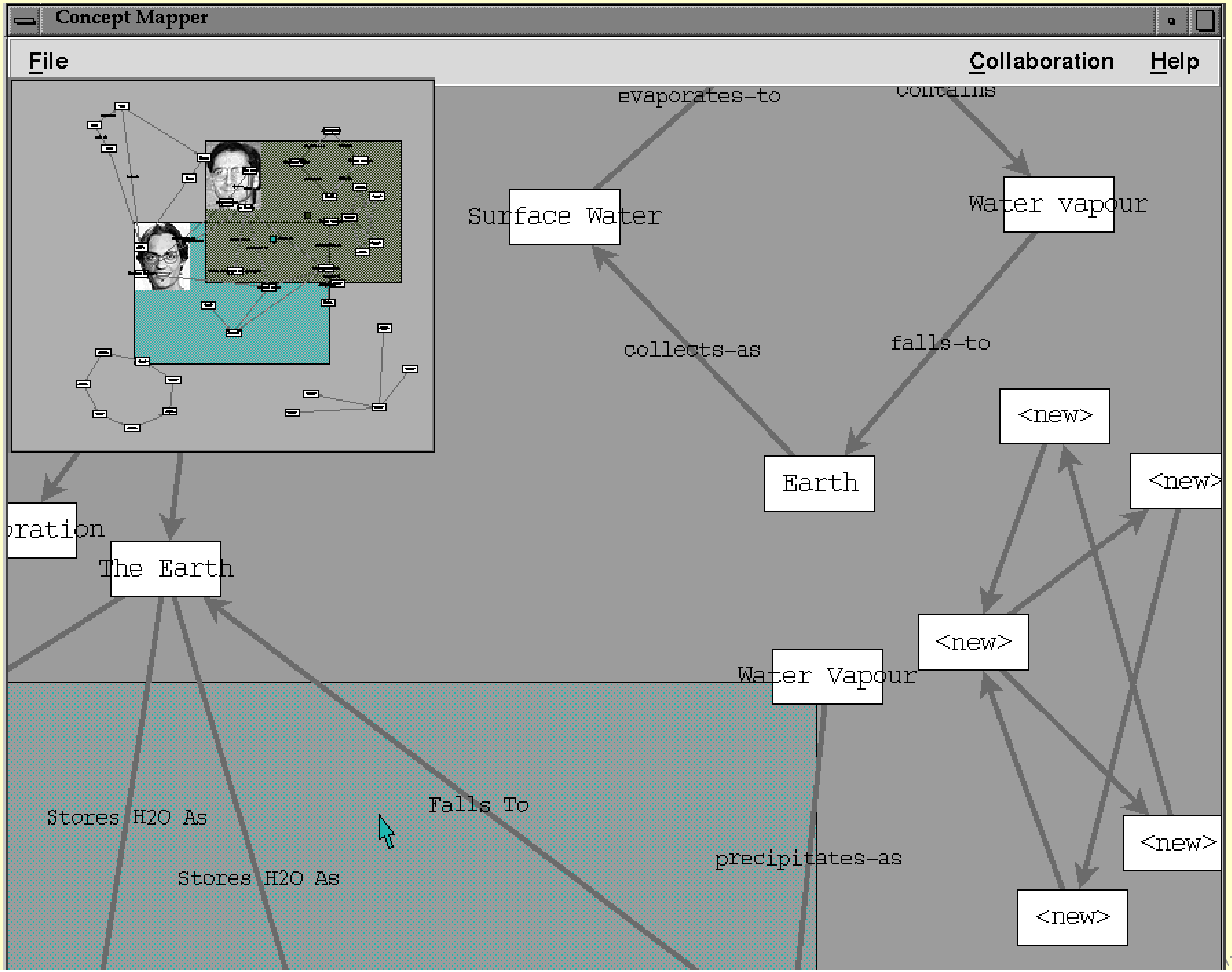
Bederson, B.B. (May 2000) University of Maryland
www.cs.umd.edu/hcil/fisheyemenu/

Fisheye Text *groupware*



Case study: Concept mapping




Concept Mapper
File
Collaboration
Help
evaporates-to
Surface Water
Water vapour
collects-as
falls-to
Earth
<new>
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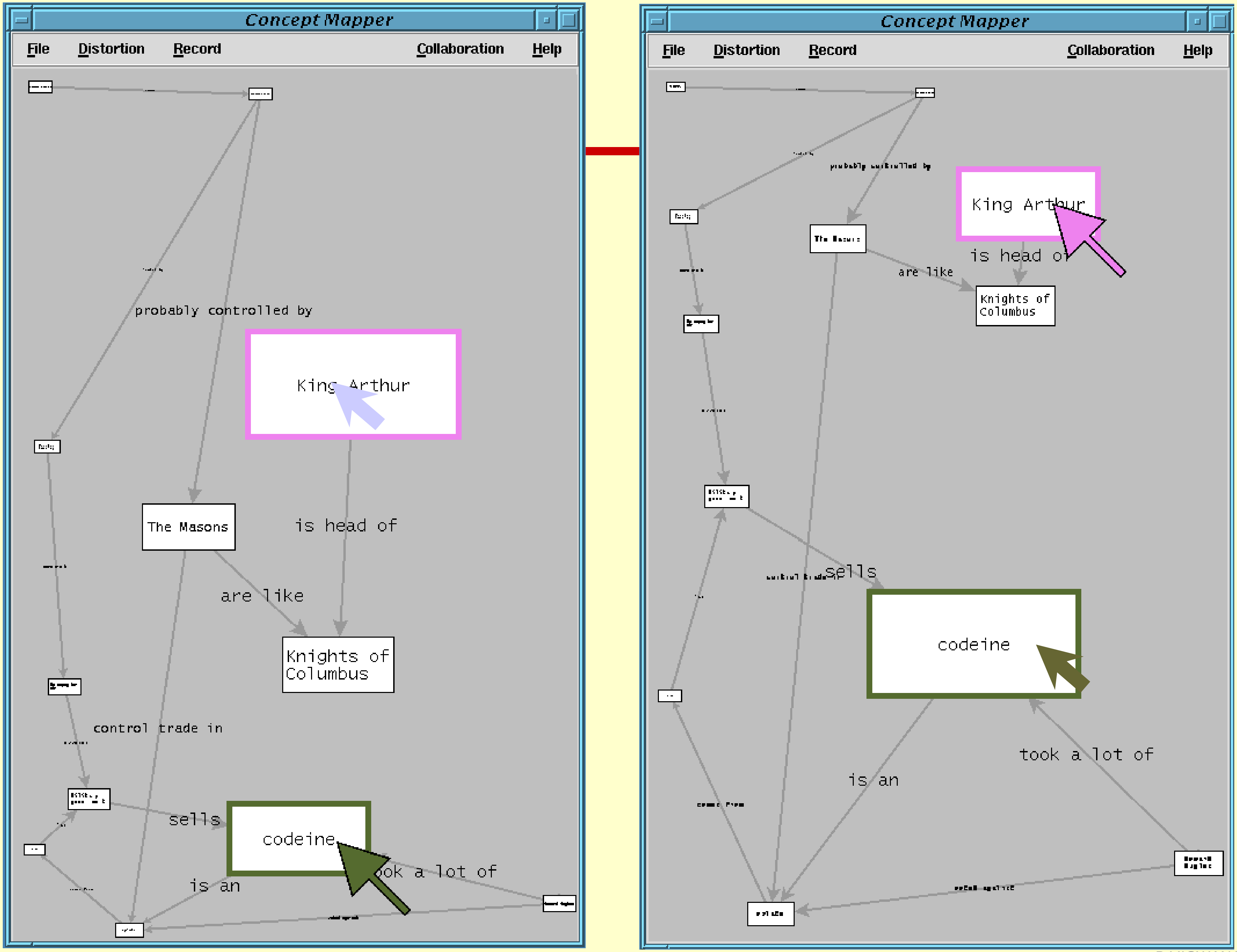
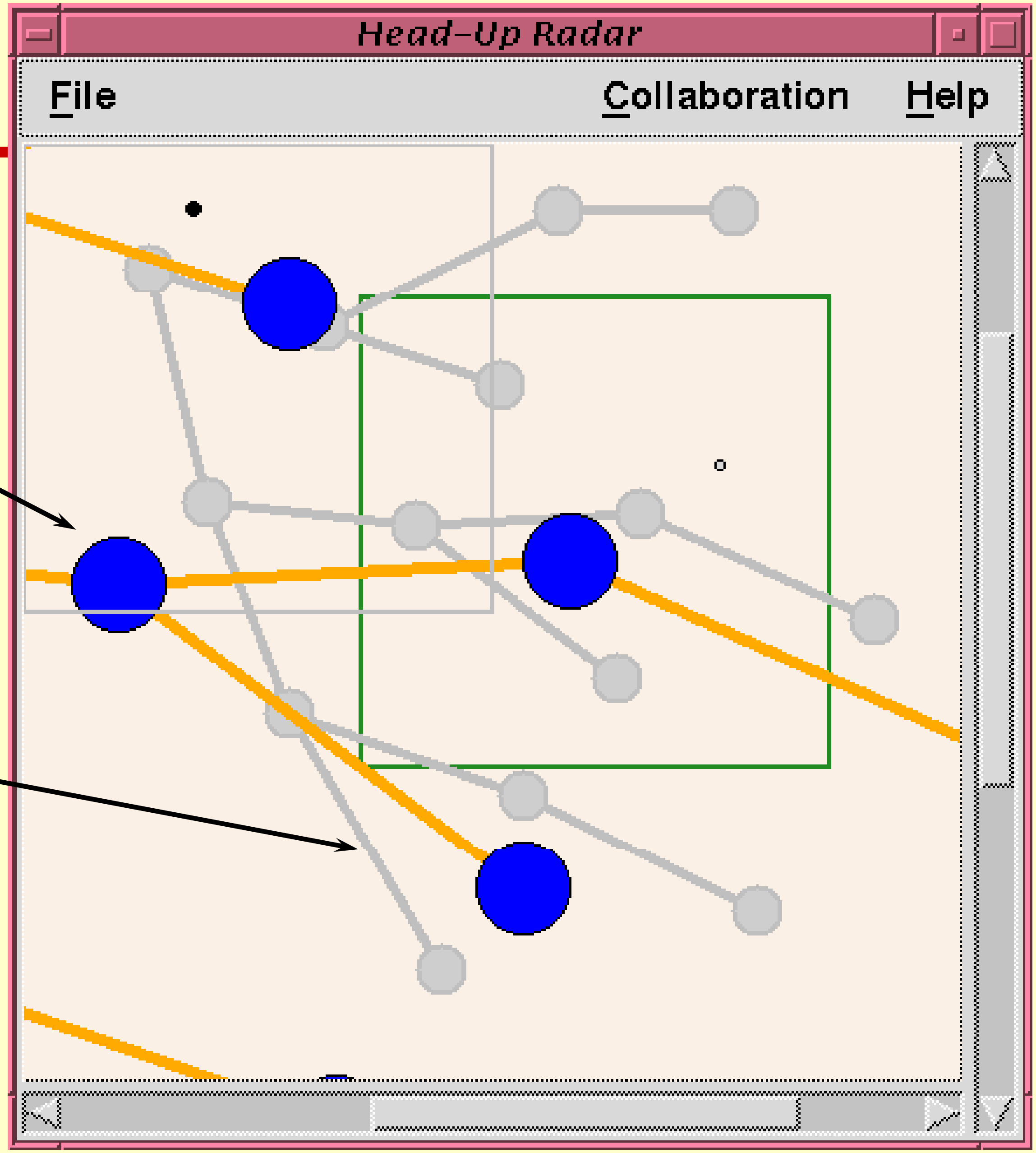
The Earth
<new>
Water Vapour
Stores H2O As
Falls To
Stores H2O As
precipitates-as
<new>
<new>



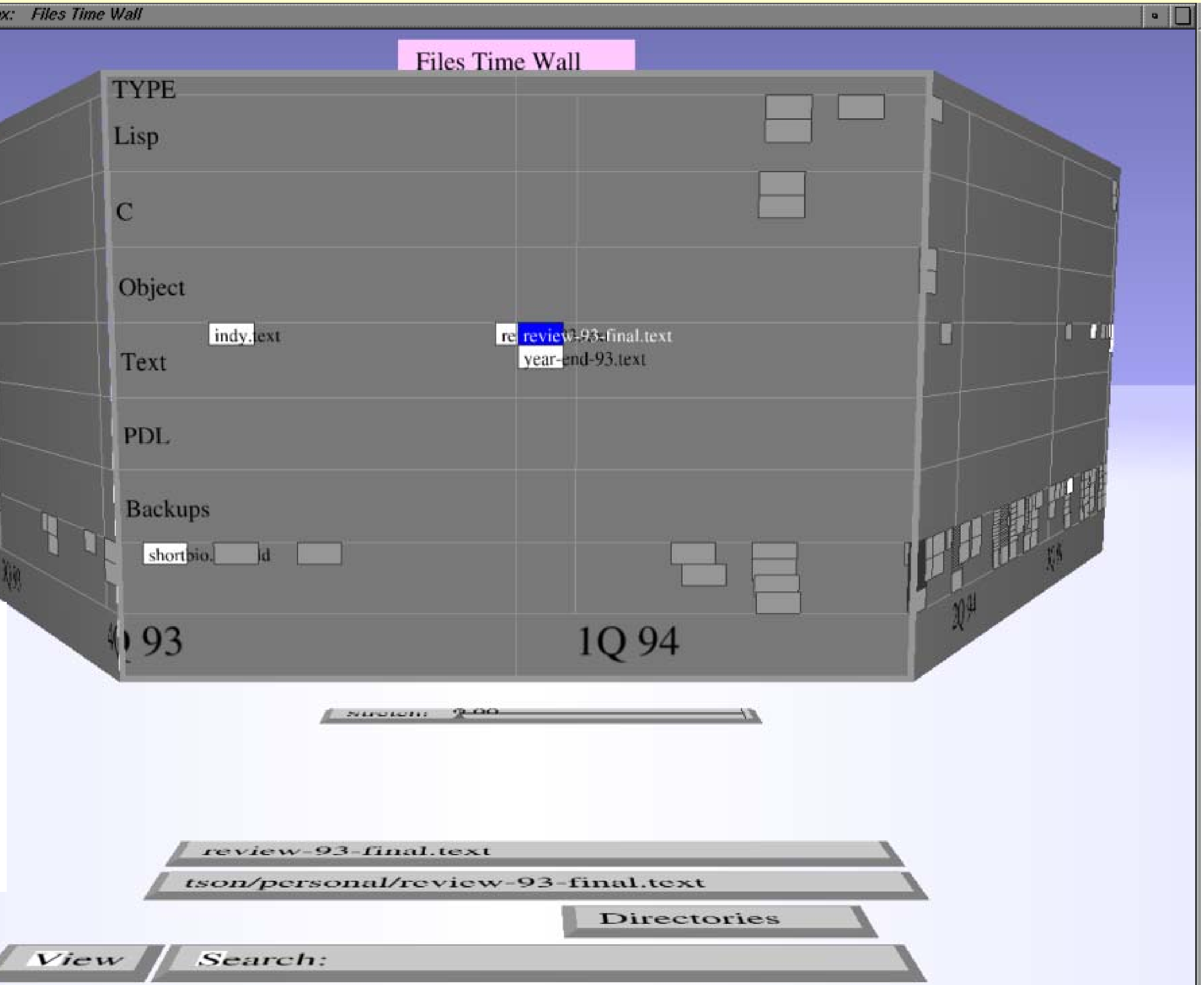
P.VISWANATHA

Main view
in foreground

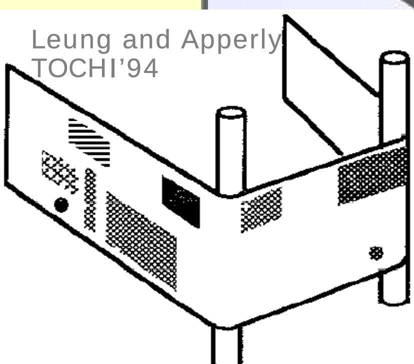
Overview
in background



Perspective Wall

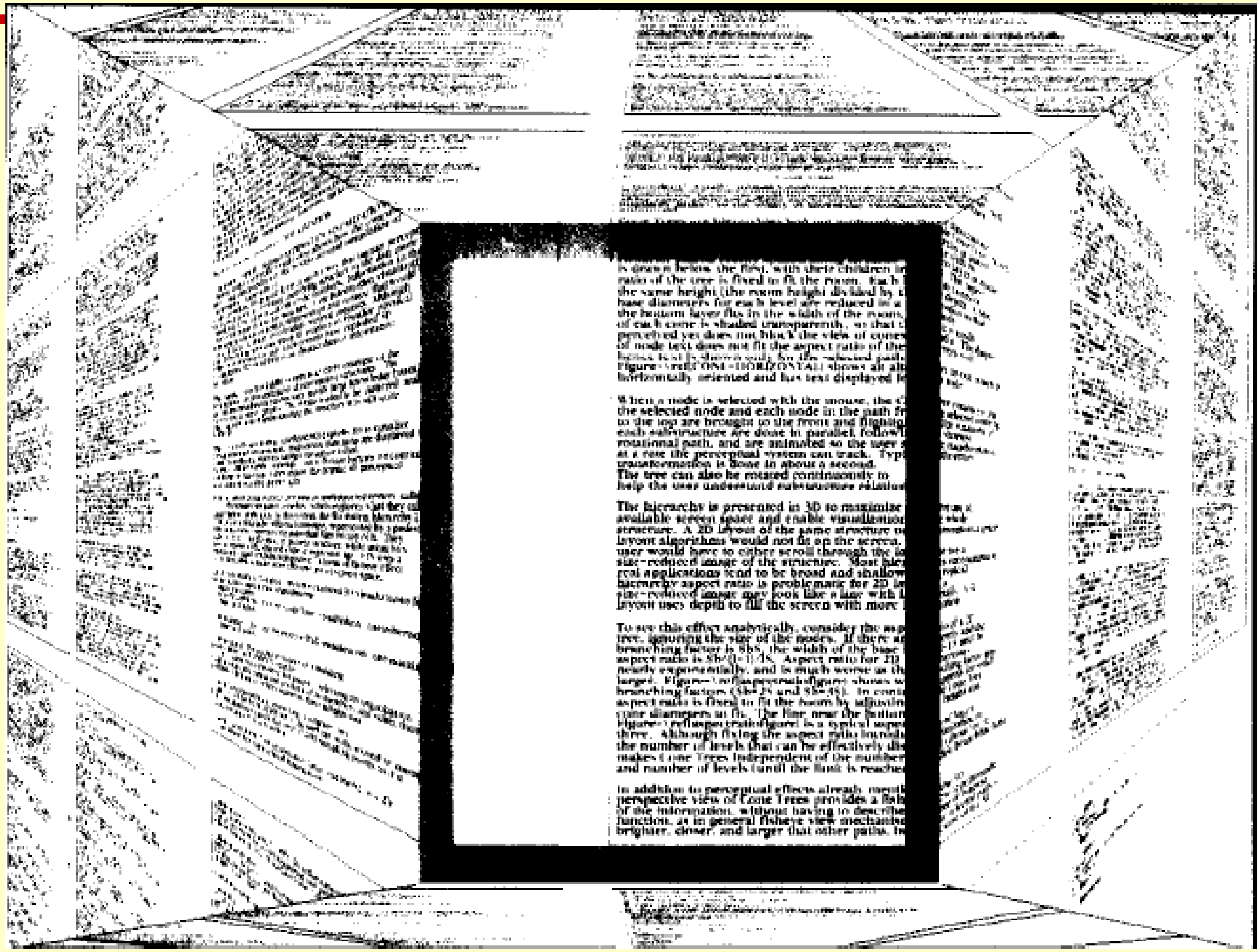


Leung and Apperly
TOCHI'94



Mackinlay / Robertson / Card: Proc ACM CHI'91

Document Lens



Robertson, Mackinlay ACM UIST 1993

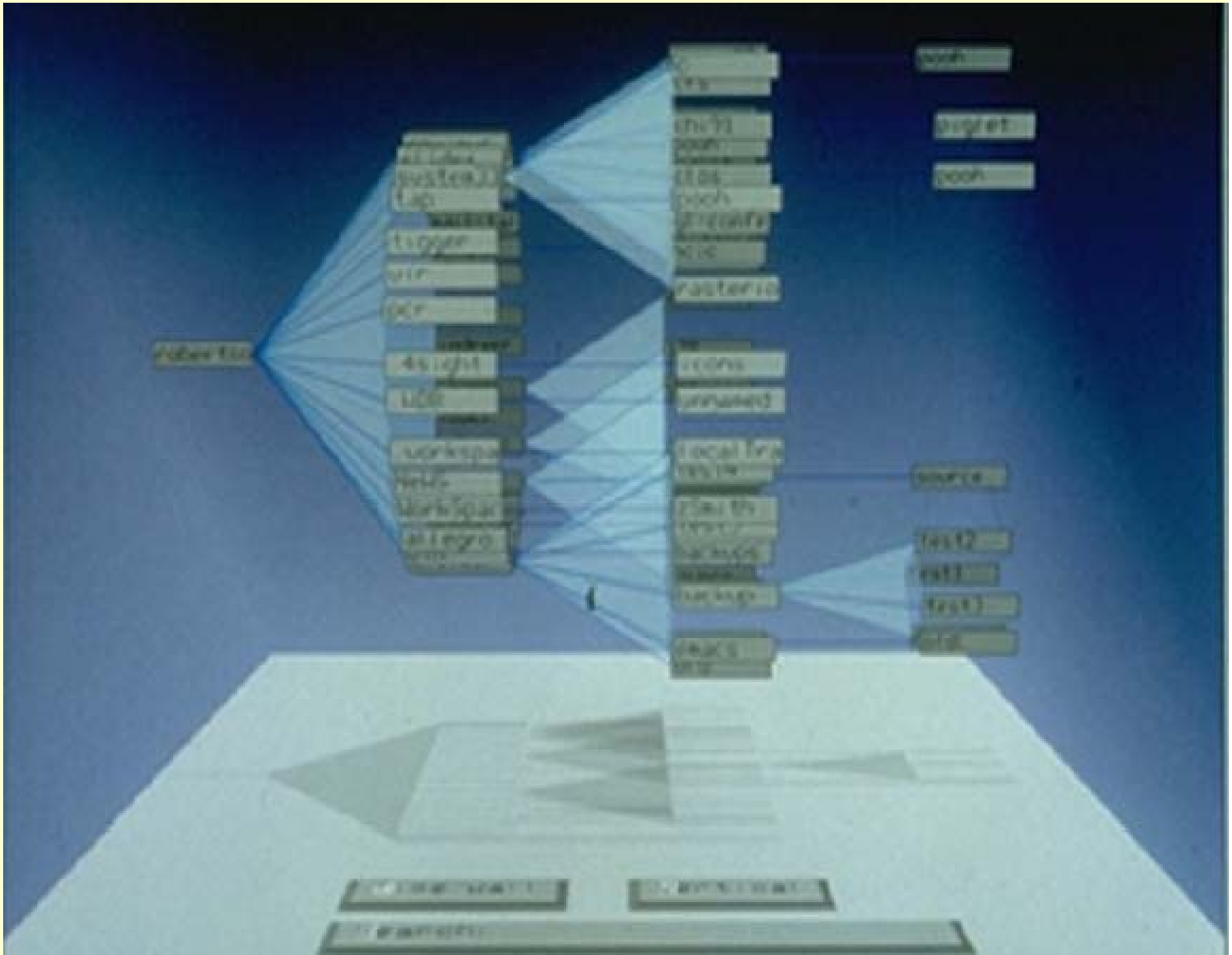
Robertson / Czerwinski / Larson / Robbins / Thiel / van Dantzich
Data Mountain: Using Spatial Memory for Document Management
Proc ACM UIST'98

Data Mountain

Task Gallery

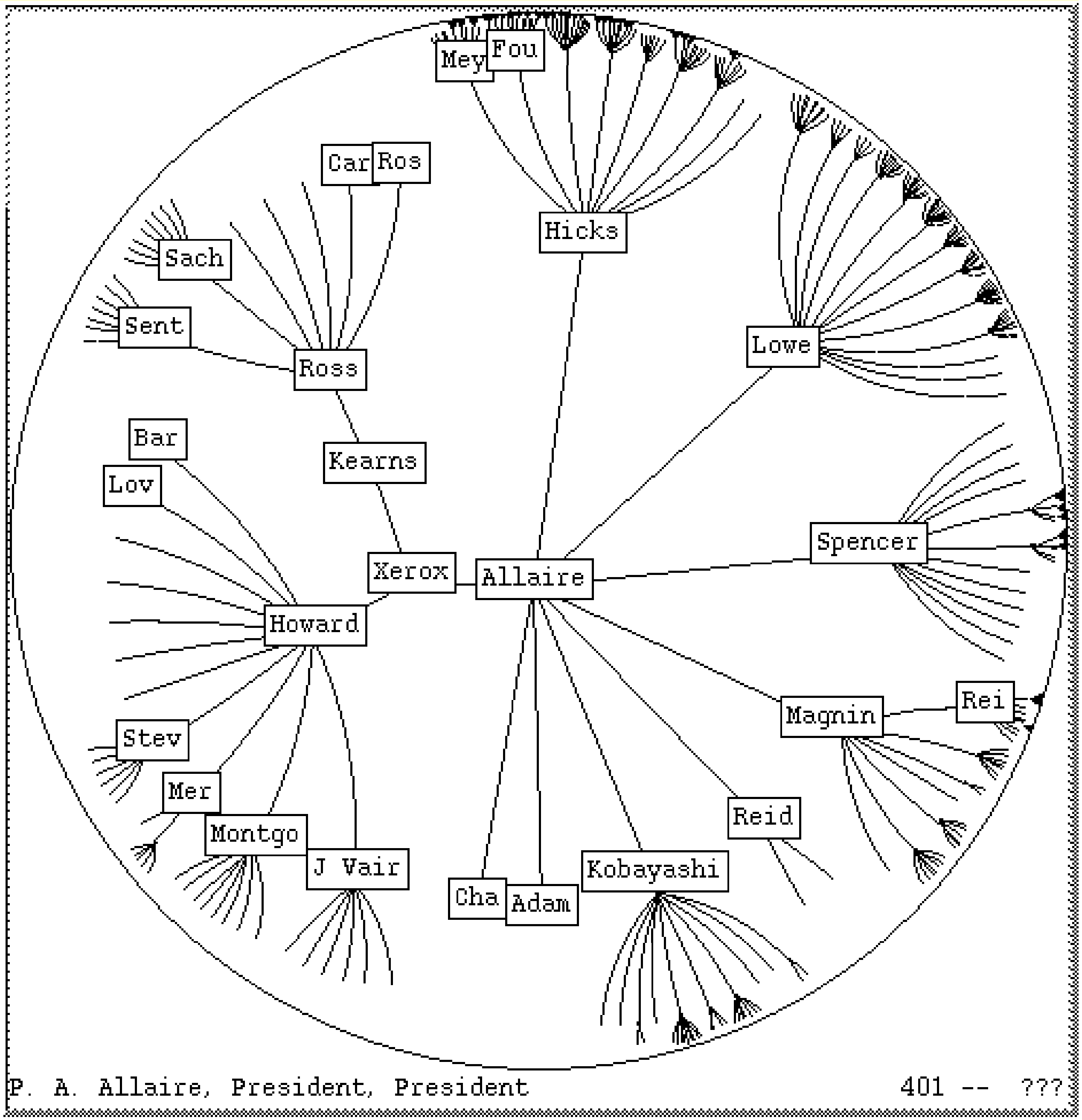
www.research.microsoft.com/ui/TaskGallery/

Cone Trees

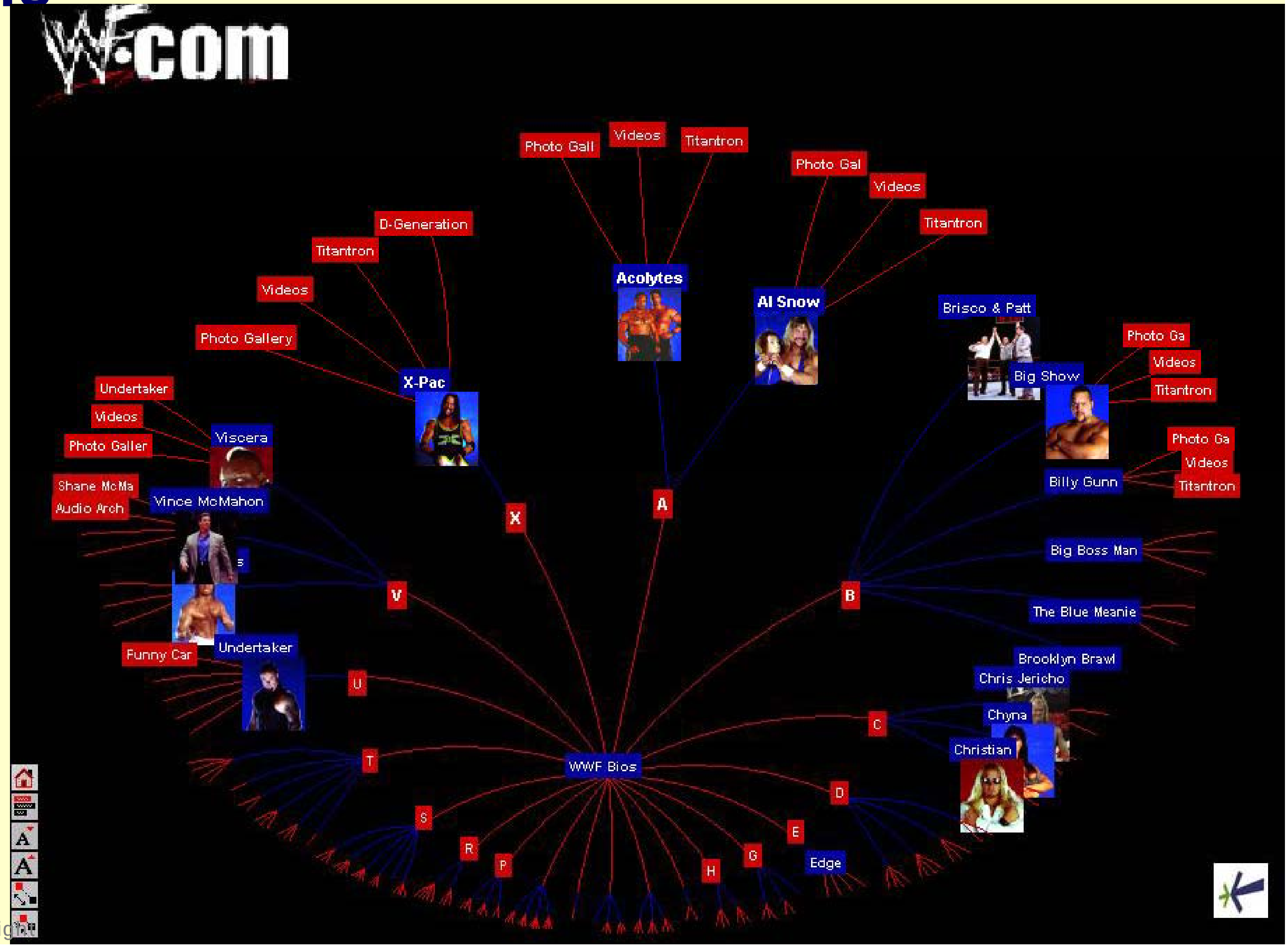


Robertson / Mackinlay / Card Cone Trees: Animated 3D Visualizations of Hierarchical Information. *Proc ACM CHI'91*

Hyperbolic Lens



Hyperbolic Lens



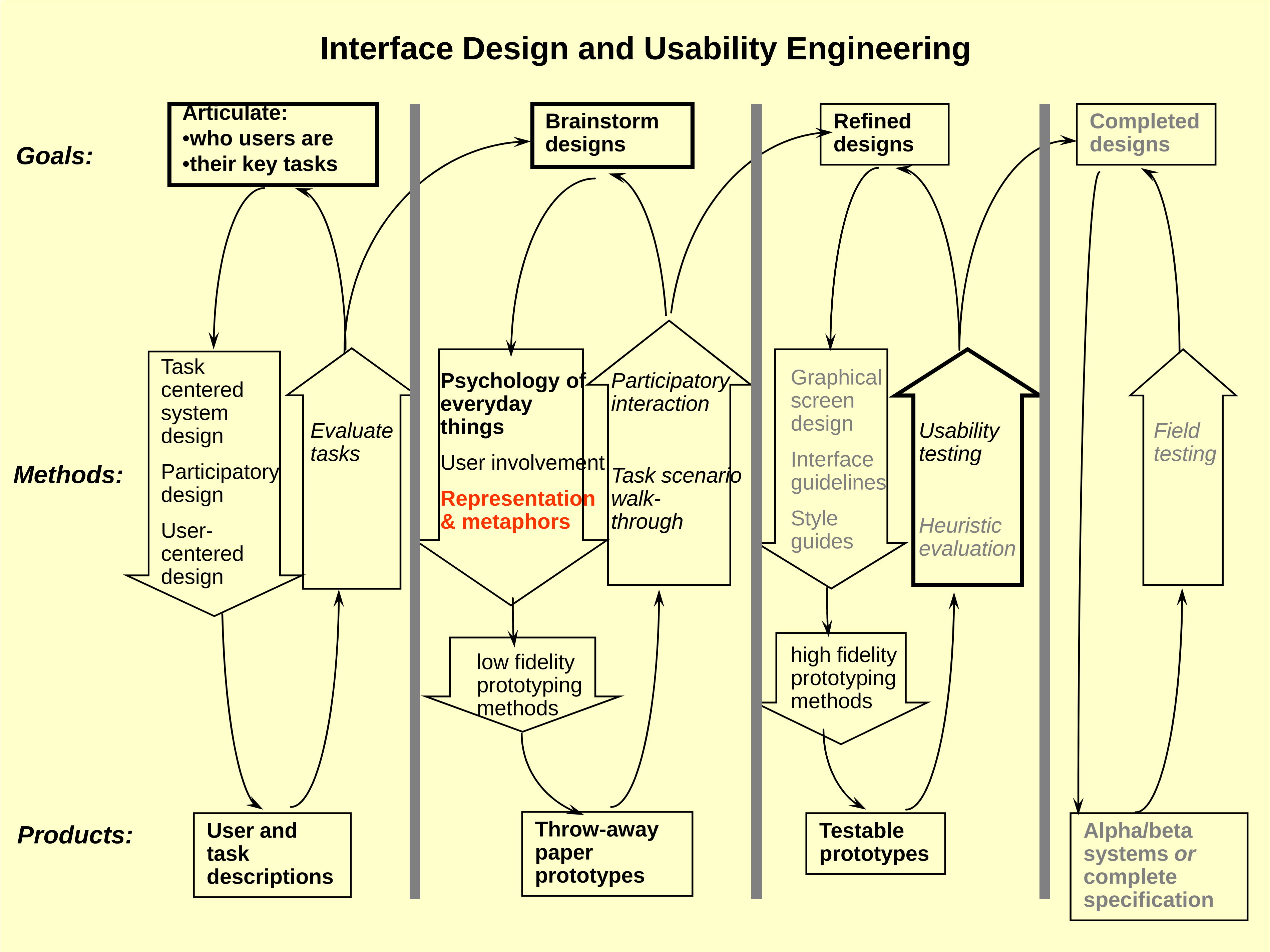
What you now know

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



Interface Design and Usability Engineering
Goals:
Articulate:
•who users are
•their key tasks
Brainstorm designs
Refined designs
Completed designs
Methods:
Task centered system design
Participatory design
User-centered design
Evaluate tasks
Psychology of everyday things
User involvement
Representation & metaphors
Participatory interaction
Task scenario walk-through
Graphical screen design
Interface guidelines
Style guides
Usability testing
Heuristic evaluation
Field testing
low fidelity prototyping methods
high fidelity prototyping methods
Products:
User and task descriptions
Throw-away paper prototypes
Testable prototypes
Alpha/beta systems or complete specification