

Beyond Simple Screen Design

Part I: Principles of information visualization

- Tufte's guidelines
- Visual variables for representing information
- The information seeking mantra
- How metaphors can be used and misused
- Direct manipulation and direct engagement

Part II: Information visualization in practice

- How the principles of information visualization can be used in actual systems

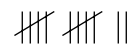
James Tam

Representations

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?



Buffalo



Buffalo

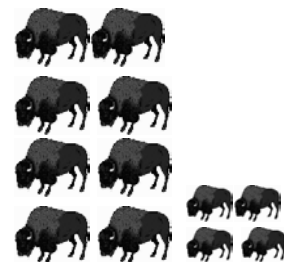


Adults

calves

8

4



James Tam

Representation

A representation is

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

For example: the number thirty-four *or* the buffalo 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

James Tam

Presentation

Not the same as representation!

The presentation of information deals with how the representation is placed or organized on the screen

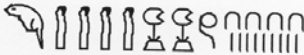
5, 5,
IV, IV

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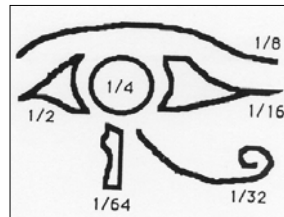
Egyptian Numerals

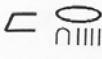
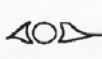
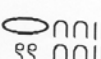
						
10^0 w	10^1 md	10^2 št	10^3 ḥz	10^4 db	10^5 ḥfn	10^6 ḥḥ

Egyptian cardinal icons.

	
24	142,149

Sample Egyptian numbers.



		
$1/2 + 1/14$ 4/7	$1/2 + 1/4 + 1/16$ 13/16	$1/244$

Sample Egyptian fractions.

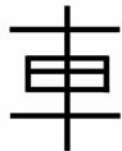
James Tam

Chinese...Sort Of

— One

== Two

=== Three

 Car

 Mouth

 Below

James Tam

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
 - In contrast the information may be present but hard to find

Q1-01	Q2-01	Q3-01	Q4-01	Q1-02	Q2-02	Q3-02	Q4-02	Q1-03	Q2-03	Q3-03	Q4-03	Q1-04	Q2-04
Revenue	6,550	6,403	6,577	6,126	7,741	7,245	7,253	7,746	8,541	7,835	8,065	8,215	10,153
Operating expenses:													
Cost of revenue	864	899	867	978	1,691	1,567	1,463	1,344	2,137	1,274	1,304	1,480	2,344
Research and development	990	1,069	1,364	1,398	1,595	1,474	1,832	1,707	1,515	1,692	1,681	1,611	2,971
Acquired in-process technology													
Sales and marketing	1,290	1,198	1,359	1,457	1,676	1,449	1,670	1,415	2,159	1,700	2,288	1,505	2,467
General and administrative	212	239	236	286	885	343	329	252	497	425	1,252	471	895
Other expenses													
Total operating expenses	3,356	3,405	3,826	4,119	5,847	4,833	5,294	4,718	6,308	5,091	6,525	5,067	8,678
Operating income	3,194	2,998	2,751	2,007	1,894	2,412	1,959	3,028	2,233	2,744	1,540	3,148	1,475
Losses on equity investments and other	(28)	(46)	(33)	(30)	(37)	(11)	(14)	(22)	(12)	(19)	(15)	(10)	(5)
Investment income	751	706	(2,620)	(980)	553	739	(617)	41	375	472	689	763	842
Nonrecurring items													
Income before income taxes	3,917	3,658	98	997	2,410	3,140	1,328	3,047	2,596	3,197	2,214	3,901	2,312
Provision for income taxes	1,293	1,207	33	319	771	1,605	425	1,006	731	1,055	731	1,287	768
Income before accounting change	2,624	2,451	65	678	1,639	2,135	903	2,041	1,865	2,142	1,483	2,614	1,544
Cumulative effect of accounting change													
Net income	\$ 2,624	\$ 2,451	\$ 65	\$ 678	\$ 1,639	\$ 2,135	\$ 903	\$ 2,041	\$ 1,865	\$ 2,142	\$ 1,483	\$ 2,614	\$ 1,544
Preferred stock dividends													
Net income available for common shareholders	\$ 2,624	\$ 2,451	\$ 65	\$ 678	\$ 1,639	\$ 2,135	\$ 903	\$ 2,041	\$ 1,865	\$ 2,142	\$ 1,483	\$ 2,614	\$ 1,544
Basic EPS before accounting change	\$0.25	\$0.23	\$0.01	\$0.06	\$0.15	\$0.20	\$0.08	\$0.19	\$0.17	\$0.20	\$0.14	\$0.24	\$0.14
Weighted average shares outstanding	10,496	10,652	10,496	10,496	10,652	10,652	10,652	10,652	10,652	10,652	10,652	10,652	10,652

James Tam

Representations (2)

- Allow people to *compute* desired conclusions
 - Trying to make use of the information may be a difficult process or “for free” depending on the representation chosen

Quarterly Income Statements in millions, except earnings per share	Q1-01*	Q2-01*	Q3-01*	Q4-01*	Q1-02	Q2-02	Q3-02	Q4-02	Q1-03	Q2-03	Q3-03	Q4-03	Q1-04	Q2-04
Revenue	\$ 6,550	\$ 6,403	\$ 6,577	\$ 6,126	\$ 7,741	\$ 7,245	\$ 7,253	\$ 7,746	\$ 8,541	\$ 7,835	\$ 8,065	\$ 8,215	\$ 10,153	
Operating expenses:														
Cost of revenue	864	899	867	978	1,691	1,567	1,463	1,344	2,137	1,274	1,304	1,480	2,344	
Research and development	990	1,069	1,364	1,398	1,595	1,474	1,832	1,707	1,515	1,692	1,681	1,611	2,971	
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Investment income	751	706	(2,620)	(980)	553	739	(617)	41	375	472	689	763	842	
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Basic EPS before accounting change	\$0.25	\$0.23	\$0.01	\$0.06	\$0.15	\$0.20	\$0.08	\$0.19	\$0.17	\$0.20	\$0.14	\$0.24	\$0.14	
Weighted average shares outstanding	10,496	10,652	10,496	10,496	10,652	10,652	10,652	10,652	10,652	10,652	10,652	10,652	10,652	

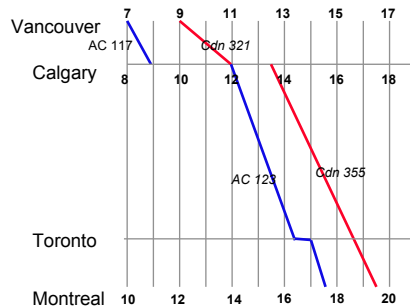
James Tam

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



James Tam

When Do I Take My Drugs?

Note: 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

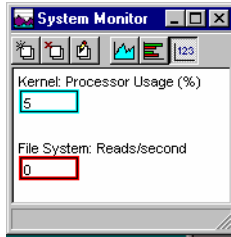
	Breakfast	Lunch	Dinner	Bedtime		Breakfast	Lunch	Dinner	Bedtime
Lanoxin	O				Lanoxin				
Inderal	O	O	O		Inderal		Inderal		
Quinag	O	O	O	O	Quinag		Quinag	Quinag	Quinag
Carafate	O	O	O	O	Carafate		Carafate	Carafate	Carafate
Zantac		O		O	Zantac				Zantac
Couma				O	Couma				Couma

Organized by both time of day and by drug

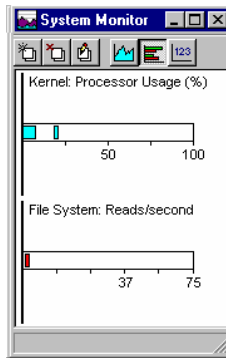
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Which Representation Is Best?

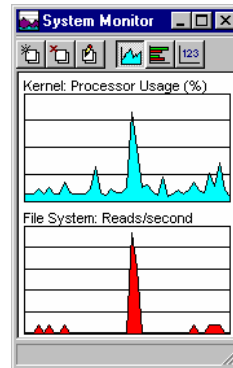
Depends heavily on task



What is the precise value?



What is the performance now compared to the peak?



How does performance change over time?

James Tam

Visualization

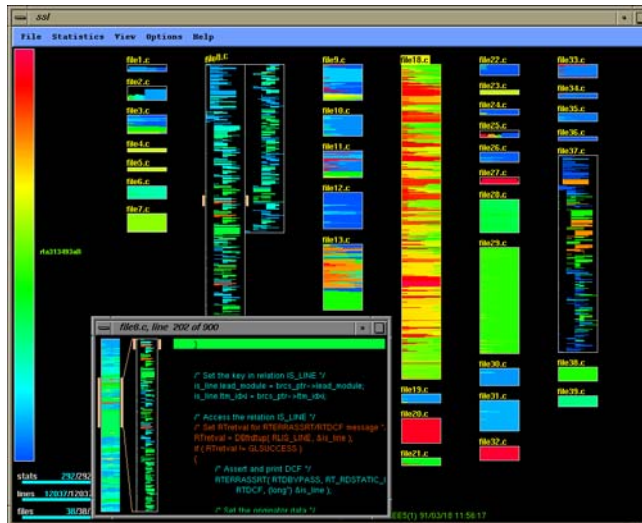
- **Representing data in a way that amplifies cognition (acquiring and using knowledge).**

- **Related to representations:**

- Representation are methods of encoding information.
- Visualizations are good representations

James Tam

Visualization Of The Change History Of Software: SeeSoft¹



1) "Seesoft—A Tool for Visualizing Line Oriented Software Statistics", Eick S.G., Steffen J.L. and Sumner E.E

James Tam

Tufte's Principles Of 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

Note:

Some of the visual examples on the following slides are taken from Tufte's books

James Tam

Show The Data



||||| |||

Buffalo

||||| |||

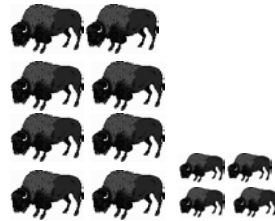
Buffalo

|||||

Adults

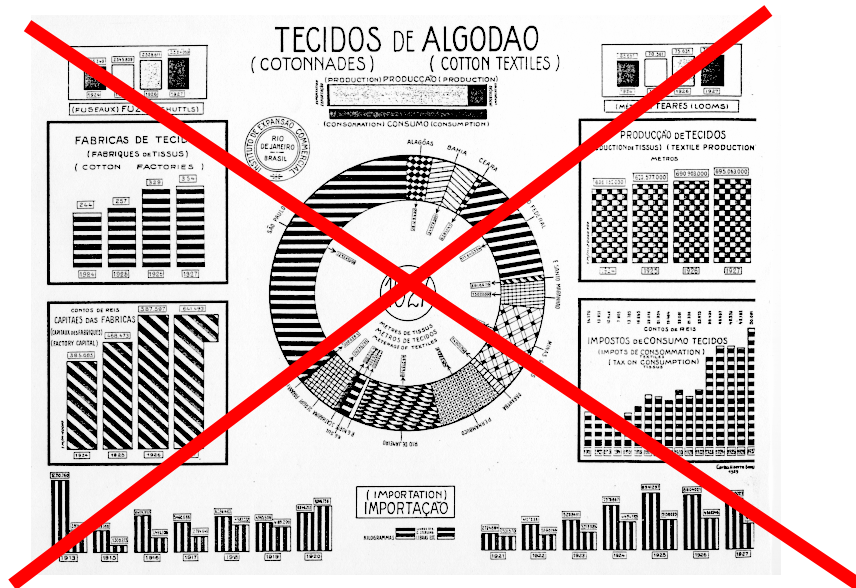
|||||

calves



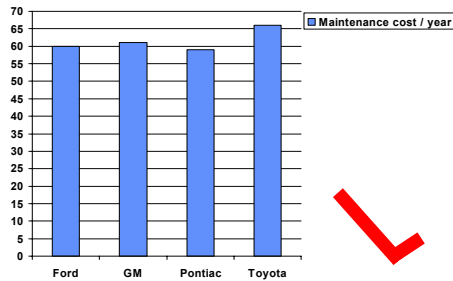
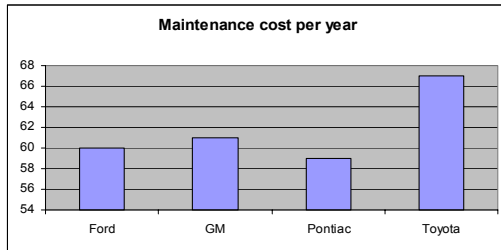
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Not Get In The Way Of The Message



James Tam

Avoid Distortion

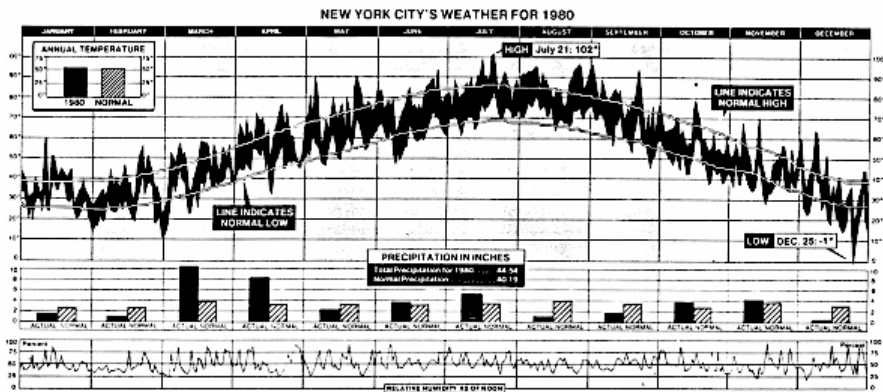


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Present Many Numbers In A Small Space, Make Large Data Sets Coherent

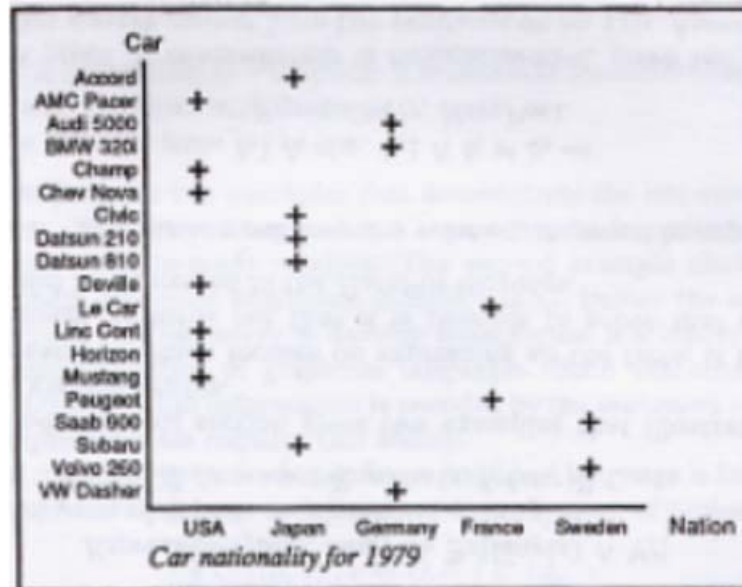
New York Weather History

- 181 numbers/sq inch



James Tam

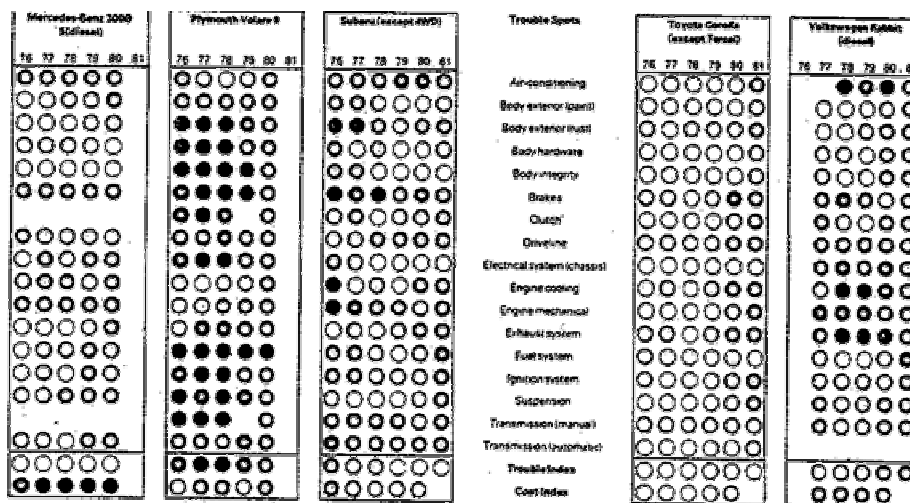
Encourage Comparison Between The Data



MacKinlay J.D. (1986) Automatic Design of Graphical Presentations.

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Broad Overview And Fine Detail

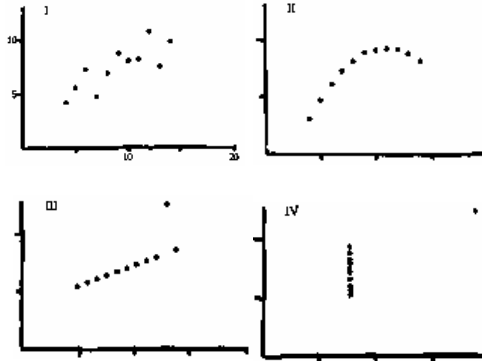


James Tam

An Illustrative Example: 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

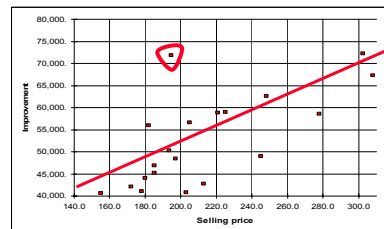
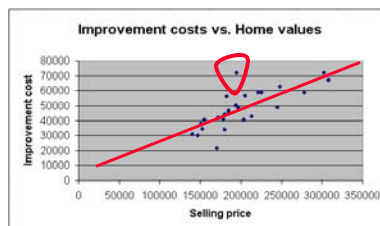
N: 11.0
 mean X's : 9.0
 mean Y's : 7.5
 standard error of slope estimate: 0.1
 sum of squares: 110.0
 regression sum of squares: 27.5
 residual sum of squares of Y: 13.8
 correlation coefficient: 0.8
 r squared: 0.7
 regression line: $Y=3+0.5X$



James Tam

Example Two: Do I Deserve A Tax Break

	A	B
1	Market value (\$)	Improvement cost (\$)
2	140000	31120
3	147000	29980
4	151000	38120
5	152000	34360
6	155000	40710
7	170000	21620
8	172000	42100
9	178000	41070
10	180000	34210
11	180000	44090
12	182000	55960
13	185000	45170
14	185000	46820
15	193400	50200
16	194500	71860
17	197000	48460
18	203000	40720
19	205000	56600
20	213000	42780
21	221000	58770
22	225000	58960
23	245000	48910
24	248000	62620
25	278000	58580
26	302500	72200
27	308000	67320

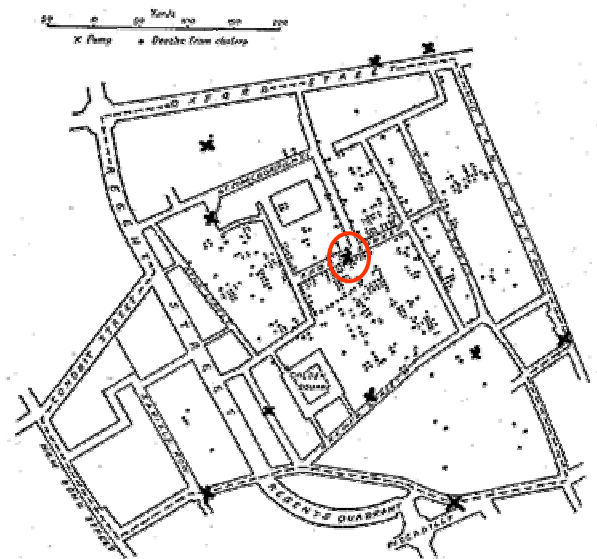


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Example Three: Interpreting Information

Deaths by Cholera

Dr John Snow
1854



James Tam

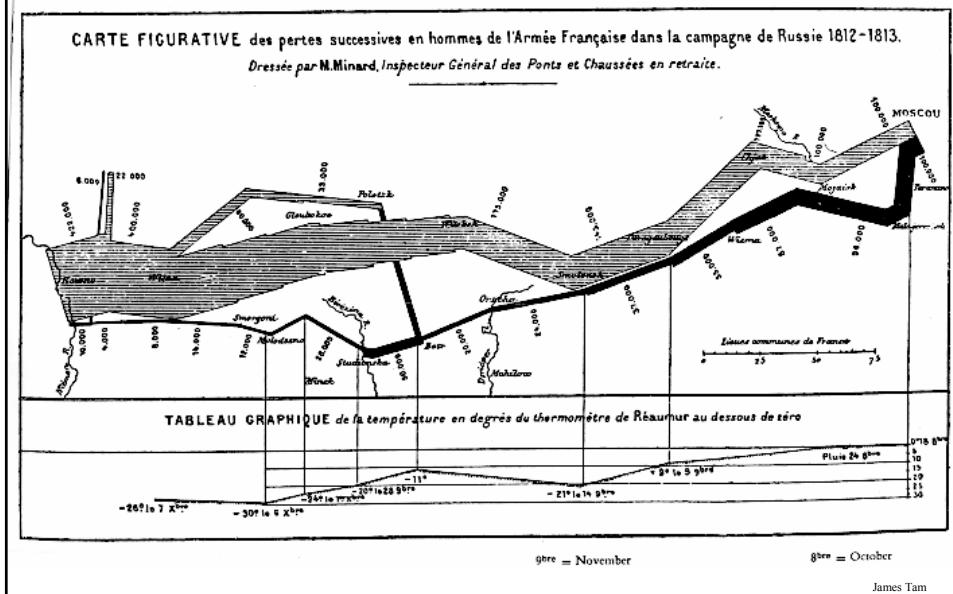
Example Four: Napoleon's March To Moscow

by Charles Minard



James Tam

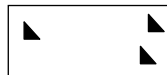
Example Four: Napoleon's March To Moscow by Charles Minard



Visual Variables

Position

- Changes in the x, y, z location



Size

- Changes in length, area or repetition



Shape

- Changes in form



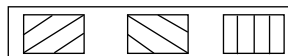
Value

- Changes in brightness



Orientation

- Changes in alignment



Colour

- Changes in hue



Visual Variables (2)

Texture

- Variations in pattern



Motion



www.st-duffer.com

James Tam

Visual Variables

Characteristics of visual variables

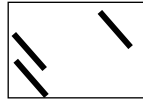
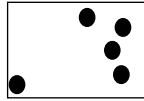
- **Selective**
Is a change in this variable enough to allow us to select it *from a group*?
- **Associative**
Is a change in this variable enough to allow us to perceive them *as a group*?
- **Quantitative**
Is there a numerical reading obtainable from changes in this variable?
- **Order**
Do changes in the visual variable indicate some sort of ranking?
- **Length¹**
Across how many changes in this variable are distinctly perceptible?

¹ Think of it as variation

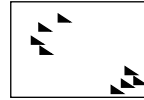
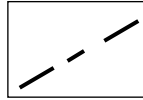
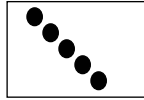
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Visual Variable: Position

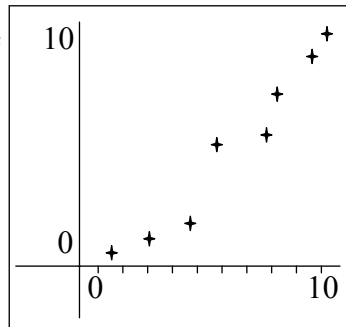
✓ Selective



✓ Associative



✓ Quantitative



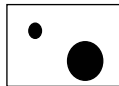
✓ Order

✓ Length

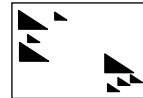
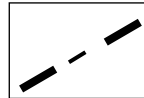
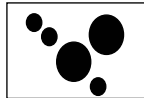
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Visual Variable: Size

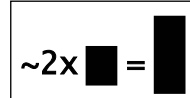
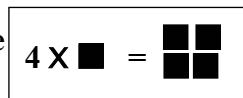
✓ Selective



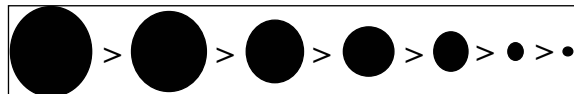
✓ Associative



≈ Quantitative



✓ Order



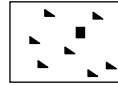
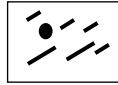
✓ Length

Theoretically infinite but practically limited

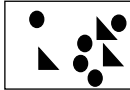
James Tam

Visual Variable: Shape

 Selective



 Associative



 Quantitative



 Order

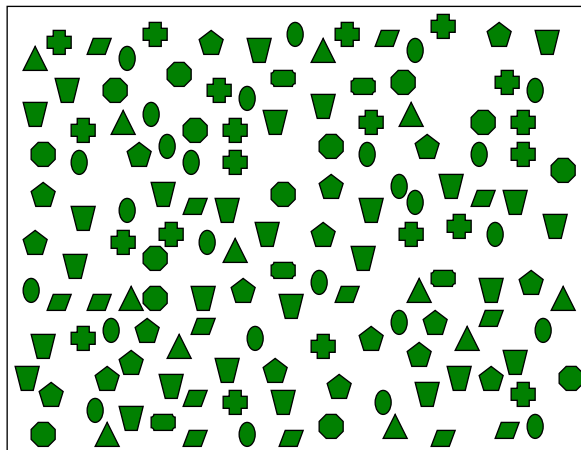


 Length



James Tam

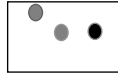
Shape



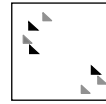
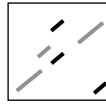
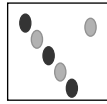
James Tam

Visual Variable: Value

✓ Selective



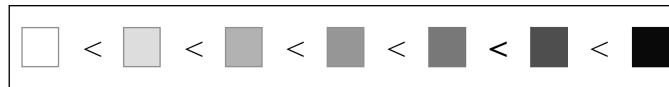
✓ Associative



≠ Quantitative



✓ Order



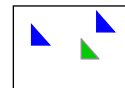
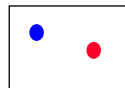
✓ Length

- Theoretically infinite but practically limited
- Association ~ < 7 and selection ~ 10

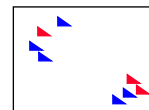
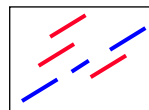
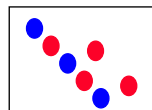
James Tam

Visual Variable: Color

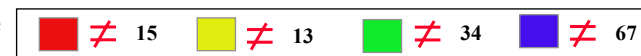
✓ Selective



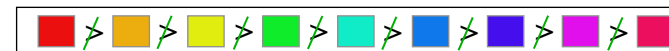
✓ Associative



≠ Quantitative



≠ Order

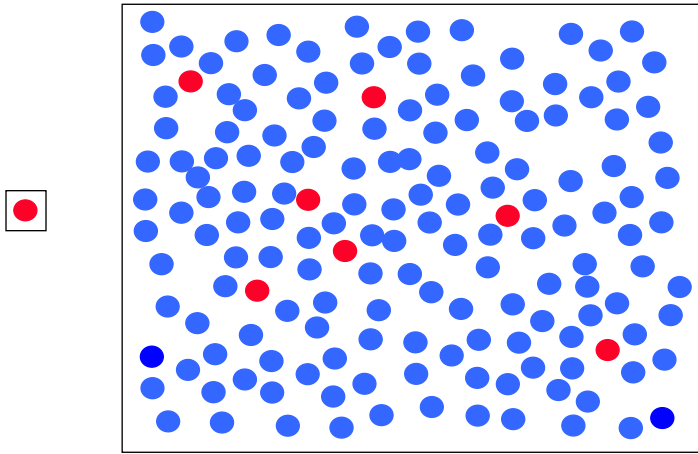


✓ Length

- Theoretically infinite but practically limited
- Association ~ < 7 and selection ~ 20

James Tam

Color

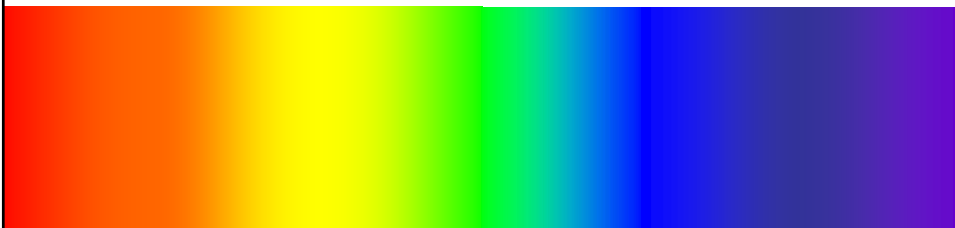


James Tam

Color Encoding

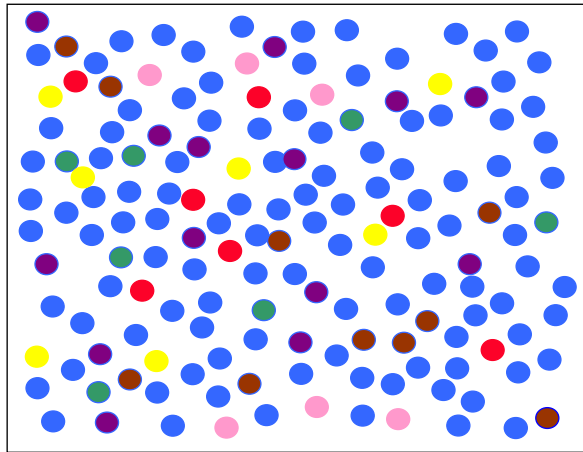
Common advice says use a rainbow scale

- Marcus, Murch, Healey
- Problems with rainbows



James Tam

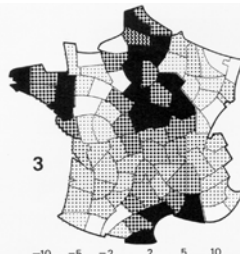
Color



James Tam



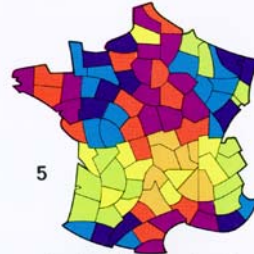
1



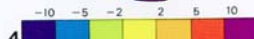
3



2



5



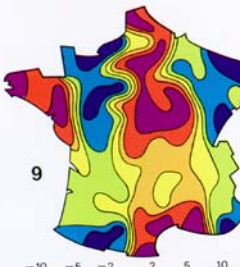
4



11



10



9



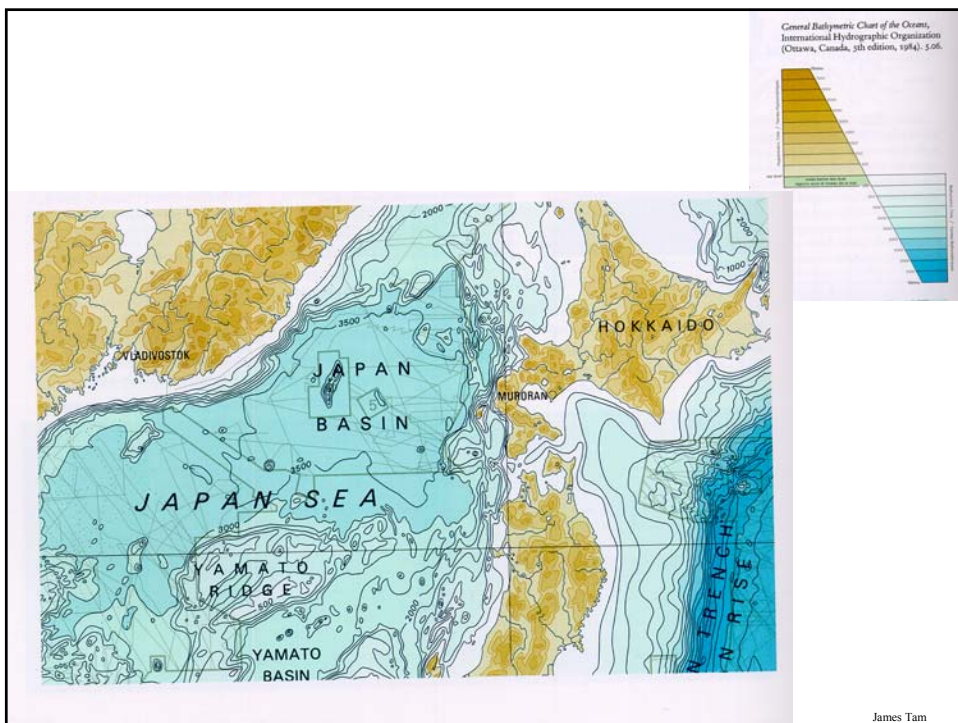
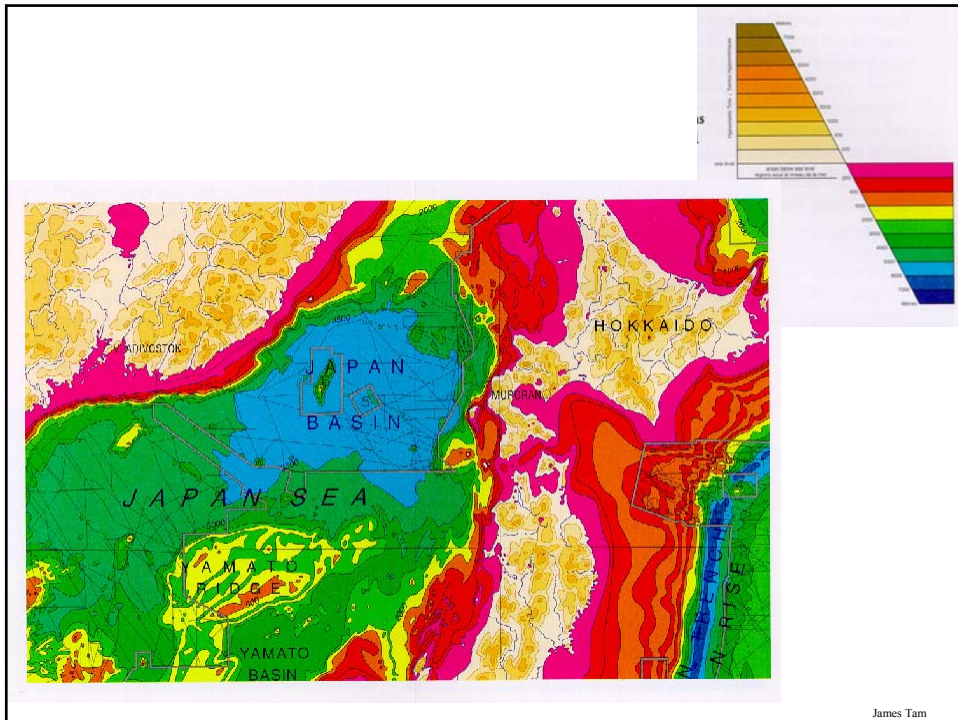
8



7



6

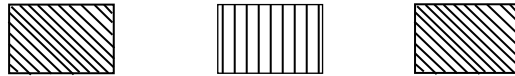


Visual Variable: Orientation

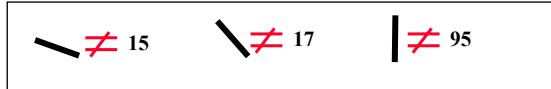
✓ Selective



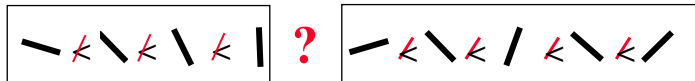
✓ Associative



≠ Quantitative



≠ Order



✓ Length

~5 in 2D

? in 3D

James Tam

Visual Variable: Texture

✓ Selective



✓ Associative



≠ Quantitative



≠ Order



✓ Length

• Theoretically infinite

James Tam

Visual Variable: Motion

✓ **Selective** - motion is one of our most powerful attention grabbers



✓ **Associative** – objects moving in unison groups them effectively

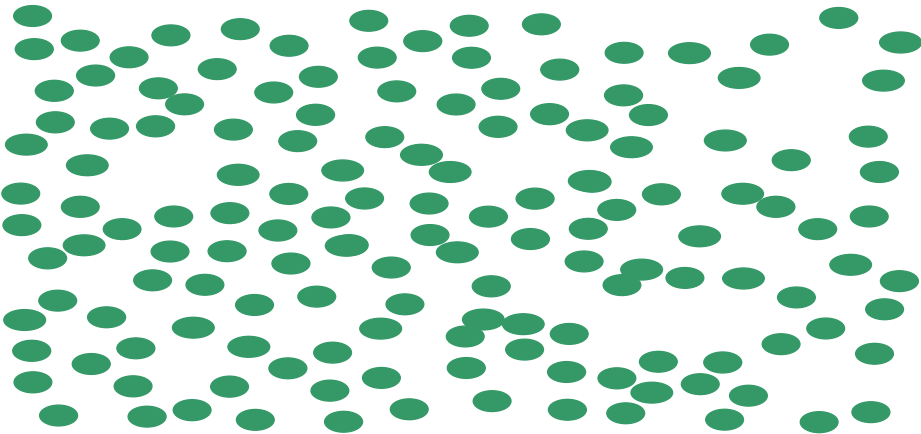
≠ **Quantitative** - subjective perception

≠ **Order**

? **Length** - distinguishable types of motion?

James Tam

Motion

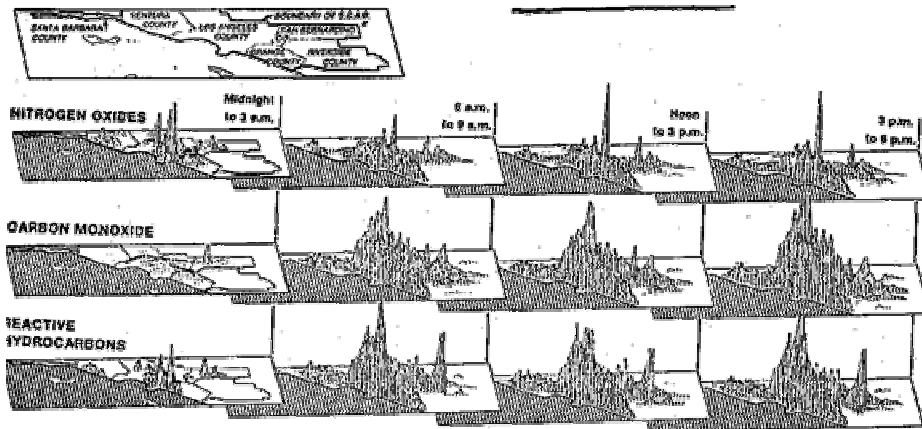


James Tam

Small Multiples: General Principles

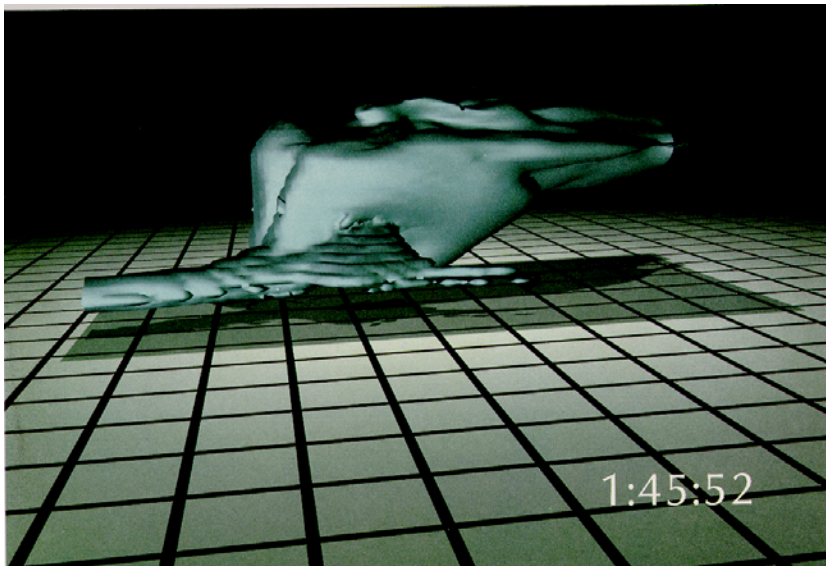
Learn once

Invite comparisons



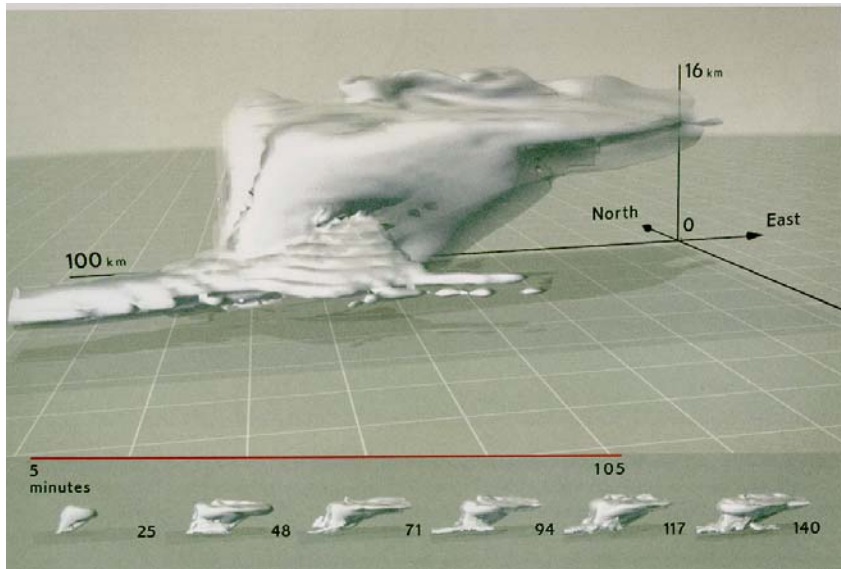
James Tam

Small Multiples: Showing Time And Change



James Tam

Small Multiples: Showing Time And Change



James Tam

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

Interface Metaphors

Definition of Metaphor

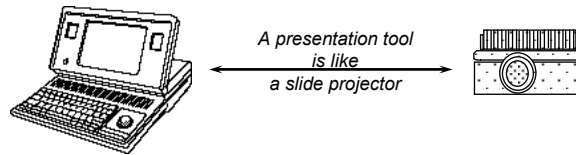
- Application of name or descriptive term to an object to which it is not literally applicable

Purpose

- Function as natural models
- Leverages our knowledge of familiar, concrete objects/experiences to understand abstract computer and task concepts

Problem

- Metaphor may portray inaccurate or naive conceptual model of the system



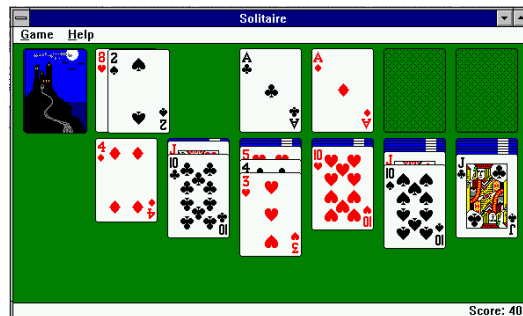
James Tam

Interface Metaphors

Pervade excellent interfaces

	A	B	C	D
1	Market value	Land	Improvement	Total assess
2	140.0	65,850.	73,120.	138,970.
3	147.0	77,780.	72,070.	149,850.
4	151.0	74,850.	88,740.	163,590.
5	152.0	80,110.	99,410.	179,520.
6	155.0	79,050.	109,130.	188,180.
7	170.0	94,750.	50,960.	145,710.
8	172.0	82,150.	106,250.	188,400.
9	178.0	78,560.	132,660.	211,220.
10	180.0	92,840.	105,670.	198,510.
11	180.0	80,090.	103,130.	183,220.
12	182.0	76,650.	115,210.	191,860.
13	185.0	75,590.	152,710.	228,300.
14	185.0	85,870.	105,330.	191,200.
15	185.0	80,060.	113,600.	193,660.
16	193.4	80,140.	131,340.	211,480.
17	194.5	73,400.	176,210.	249,610.
18	197.0	84,960.	129,800.	214,760.
19	203.0	91,600.	119,170.	210,770.
20	205.0	79,460.	137,250.	216,710.
21	213.0	87,060.	124,350.	211,410.
22	221.0	97,330.	167,500.	264,830.
23	225.0	87,160.	157,290.	244,450.
24	245.0	79,520.	144,840.	224,360.
25	248.0	89,470.	183,500.	272,970.
26	278.0	82,150.	168,720.	250,870.
27	302.5	118,500.	109,800.	228,300.
28	308.0	83,100.	141,730.	224,830.

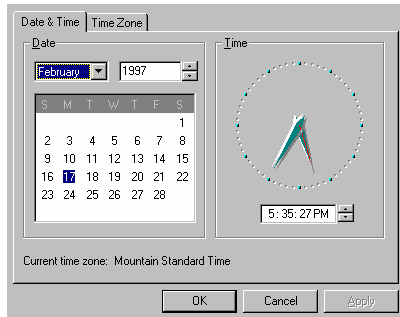
spreadsheet (actuary sheet)



games (literal world)

James Tam

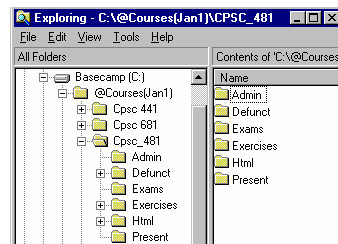
Interface Metaphors (2)



Control Panels with familiar controls

Name: _____
Address: _____
City: _____
Province: _____
Postal Code: _____

Forms



Hierarchical Folders

James Tam

A Real Life Metaphor: Life!



The Sims House Party © Maxis

James Tam

Creating Interface Metaphors

Generating metaphors

- Use metaphors that matches user's conceptual task
 - Desktop metaphor for office workers
 - Paintbrush metaphor for artists...
- Given a choice, choose the metaphor close to the way the system works
- Ensure emotional tone is appropriate to users
 - e.g., file deletion metaphors
 - Trashcan
 - Black hole
 - Paper shredder
 - Pit bull terrier
 - Nuclear disposal unit...

James Tam

Evaluating Metaphors

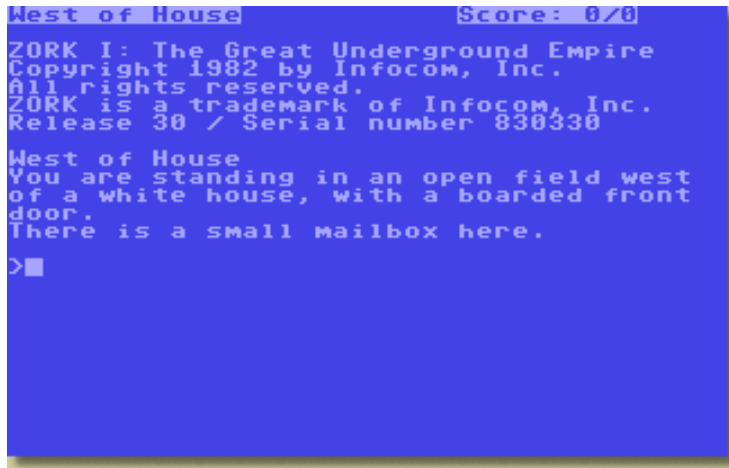
Potential problems:

- 1) The metaphor has attributes that the system doesn't.**
- 2) The system has attributes that are not suggested by the metaphor.**
- 3) An attribute exists both in the metaphor and in the system but works differently in each.**

James Tam

The Metaphor Is More Powerful Than The System

Will the metaphor make people believe that the system can do more than it currently can?



Zork © Infocom

James Tam

The System Is More Powerful Than The Metaphor Implies

Will the metaphor restrict how people will try to use the system?

- e.g., file folders



James Tam

An Attribute Differs Between The Metaphor And The System

e.g., The trash can



Real trashcan



Desk top trashcan

James Tam

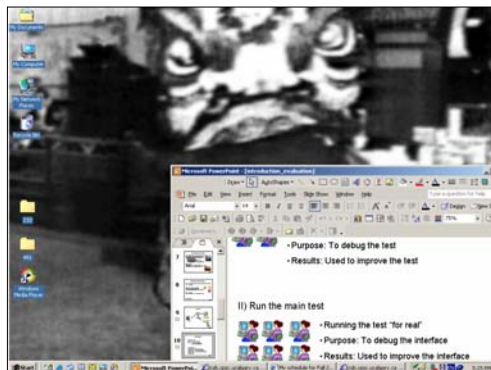
Metaphors Should Not Be Static

Evolve metaphors

- Is metaphor extensible to new features?
- When is the metaphor no longer useful?



Dilbert © United Features Syndicate

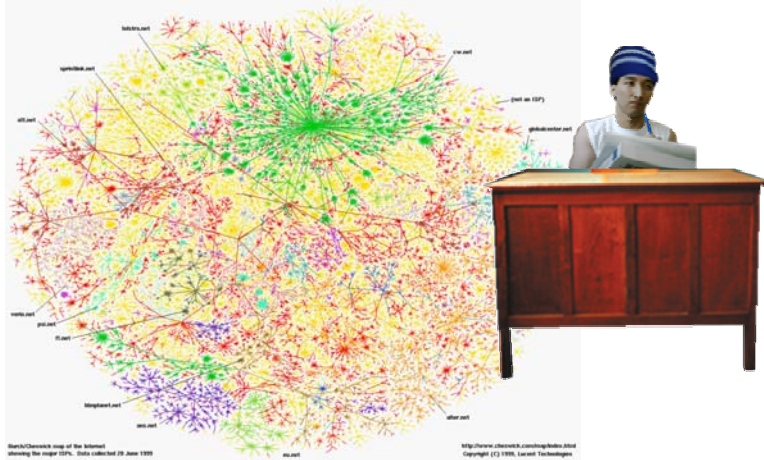


James Tam

Metaphors Should Not Be Static (2)

Evolve metaphors

- Is metaphor extensible to new features?
- When is the metaphor no longer useful?



James Tam

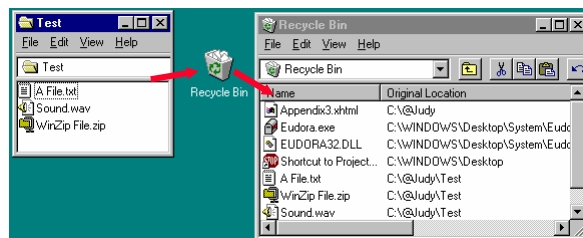
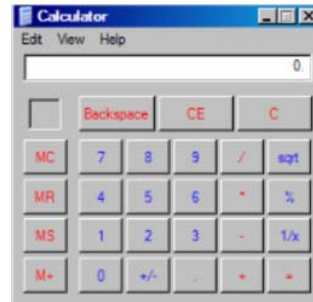
Misuse Of Metaphors

Caveat

- Metaphors can be overdone!

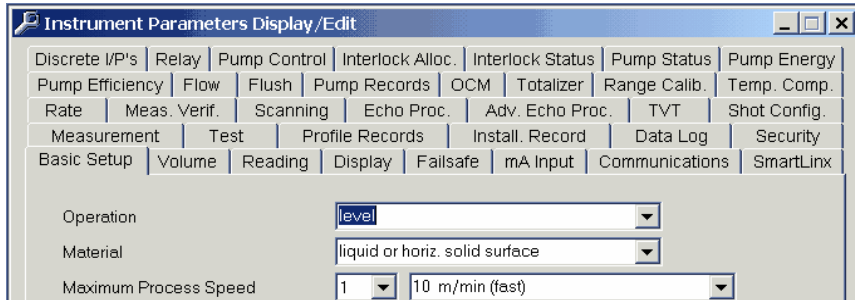
Common pitfalls

- Overly literal
 - Unnecessary fidelity
 - Excessive interactions
- Overly cute
 - Novelty quickly wears off
- Overly restrictive
 - Cannot move beyond
- Mismatched
 - Does not match user's task and/or thinking



James Tam

Misuse Of Metaphors (2)

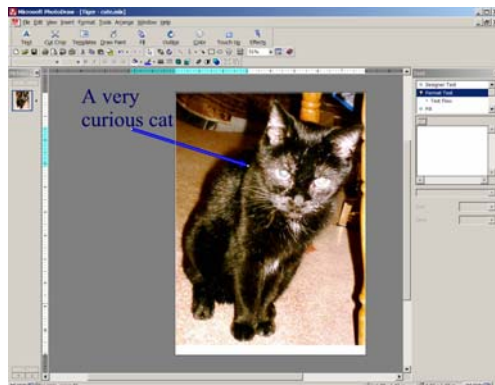


Milltronics' *Dolphin Plus* a configuration package for industrial level and flow sensors

James Tam

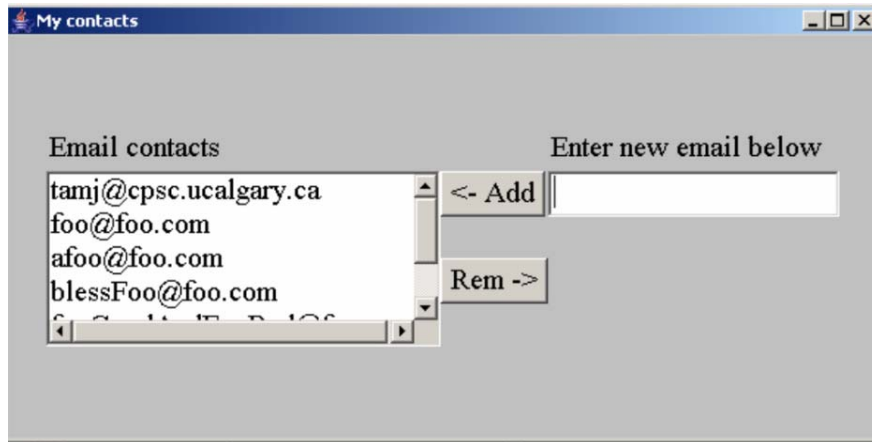
Direct Manipulation

- An interface that behaves as though the interaction was with a real-world object rather than with an abstract system
- Almost always based on a metaphor
 - Mapped onto some facet of the real world task semantics



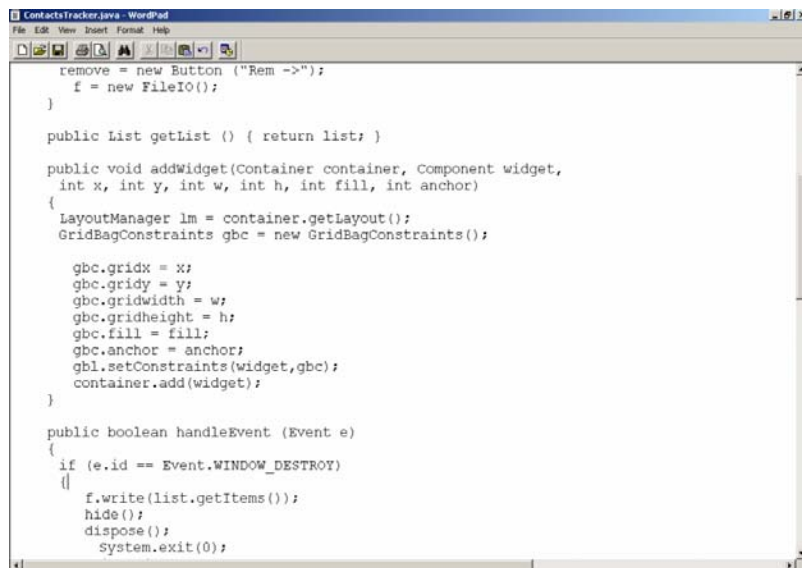
James Tam

Indirect Interaction: Writing Java GUI's



James Tam

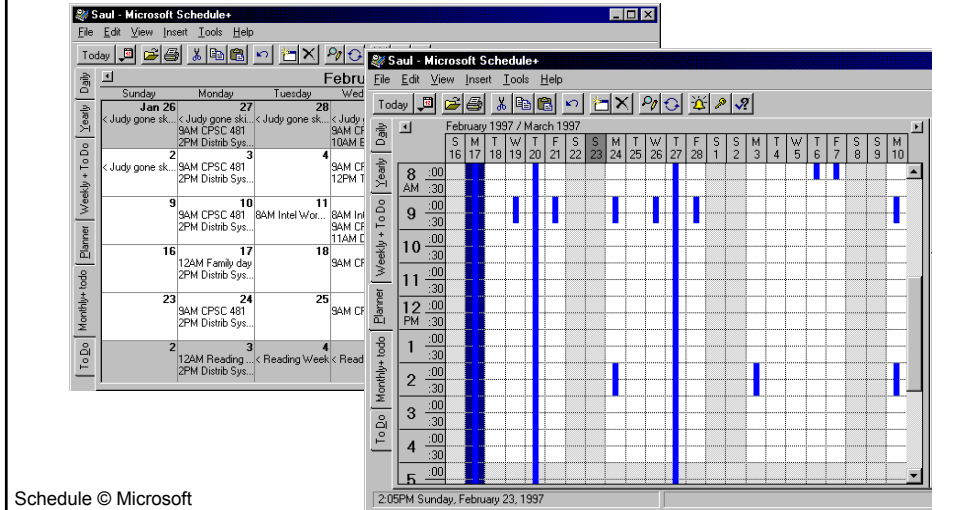
Indirect Interaction: Changing The Java Code



James Tam

Direct Manipulation

Representation directly affects what can be directly manipulated



Is Direct Manipulation The Way To Go?

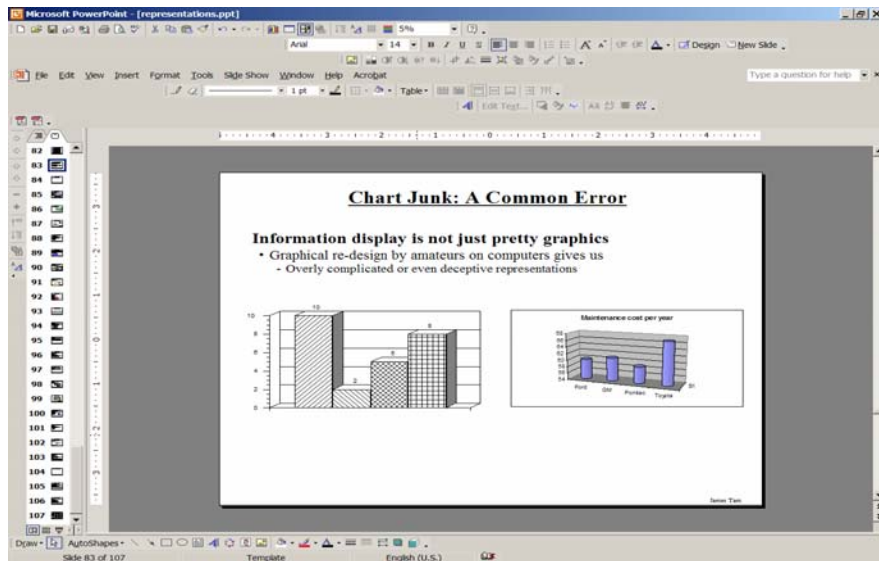
Some Disadvantages

- 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



PowerPoint © Microsoft

James Tam

Direct Engagement

- The feeling of working directly on the task.
- Need to consider the user of the system and the tasks that he or she engages in.
- Often direct manipulation is an important requirement for direct engagement.
 - e.g., A drawing program provides tools that are familiar to artists (brushes, palettes etc.)

James Tam

Direct Engagement: A Telephone Database

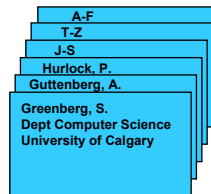
Find "Green"
>S. Greenberg
>Dept Computer Science
>University of Calgary

Command system
no direct manipulation

Search for: Green

Result: S. Greenberg
Dept Computer Science
University of Calgary

Form metaphor:
syntactic direct
manipulation



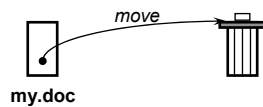
Rolodex metaphor:
full direct manipulation

James Tam

Object-Action vs. Action-Object

Select object, *then* do action

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



The Sims House Party © Maxis

James Tam

Object-Action Vs. Action-Object (2)

Advantages

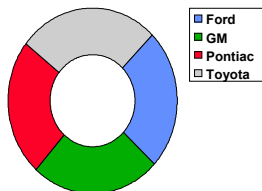
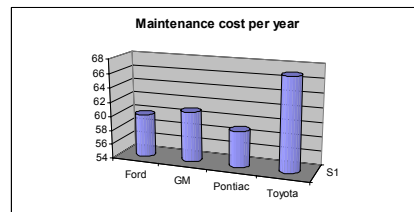
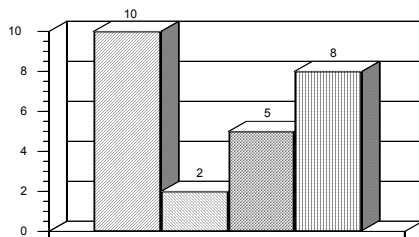
- Closer to real world
- Modeless interaction
- *Actions* always within context of object
 - Inappropriate ones can be hidden
- *Generic commands*
 - The same type of action can be performed on the object
 - e.g., drag 'n drop:
 - folders
 - files
 - paragraphs
 - text
 - numbers...

James Tam

Chart Junk: A Common Error

Information display is not just pretty graphics

- Graphical re-design by amateurs on computers gives us
 - Overly complicated or even deceptive representations



James Tam

Part II: Putting Information Visualization Into Practice

A Common Problem

- There is too much information to represent all at once
- Providing all the details all at once is not useful (overload)
- Context is lost when the details of a only subset of the information is shown.

James Tam

The Need For Visualizations: Games



Dungeon Master (Java version) <http://www.cs.pitt.edu/~alandale/dmjava/>

James Tam

Detail And Overview (Mutually Exclusive)



Icewind Dale © Interplay productions

James Tam

Detail And Overview (Mutually Exclusive)



Icewind Dale © Interplay productions

James Tam

Detail And Overview (Separate)



Defender © Midway Home Entertainment Ltd.

James Tam

Details And Overview (Situating Overlay)

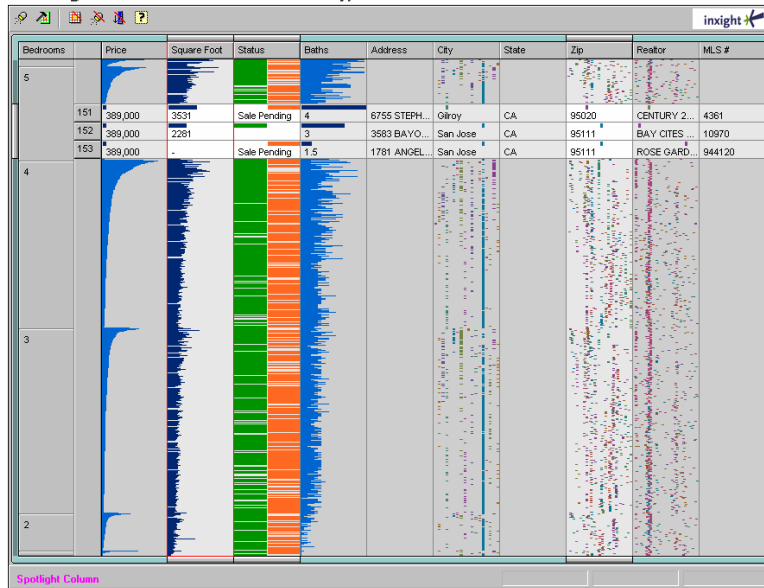


Diablo II © Blizzard

James Tam

Table Lens

Housing Market for Santa Clara County, CA - March 2000



James Tam

Zoomed Out Map

Global overview, poor detail (where's my Nome?)



James Tam

Zoomed In Map

Detail but no context (where am I?)



James Tam

Map With Inset lens

Details that occlude (block) the global context



James Tam

Map – Separate View (Detail And Global Context)

Can see both views but hard to relate together



James Tam

Map – Separate View (Detail And Global Context)

Can see both views but hard to relate together



James Tam

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

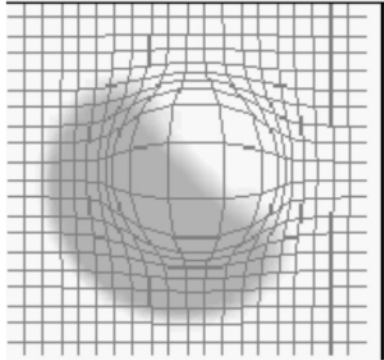
Browsing of digital images
<http://java.sun.com/features/2001/08/photomesa.html>

Fisheye View

James Tam

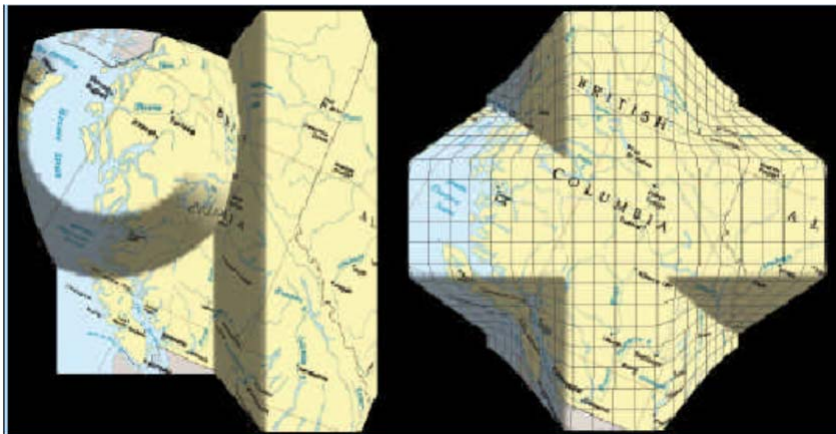
Fisheye View: Visual Cues For The Distortion

Distortion is understandable through the use of a grid and shading



James Tam

Fisheye View: Alternative Distortion Algorithms



James Tam

James Tam

[illegible]

James Tam

Visualizing A Large Document (Details)

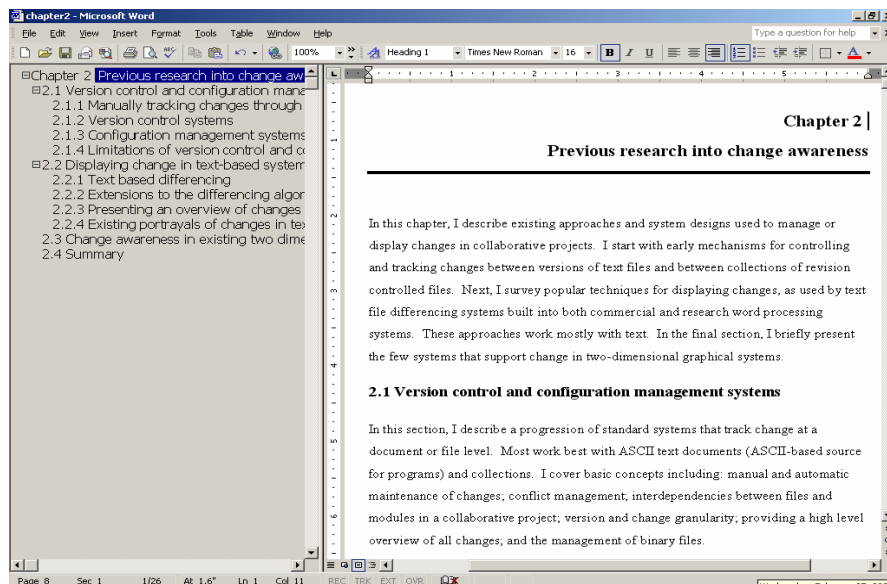
14

systems cannot compute or display the actual differences between two binary files. Most use a text-based differencing algorithm that cannot make sense of binary data whose meaning depends largely upon the application and even the hardware that is used to create it. Thus they can only report that the versions differ, which provides little useful information. To display differences between binary files in a meaningful way, the version control system would need to know the structure of the binary files it handles. Given the prolific use of binary files, often with proprietary or undocumented internal structures, it is simply impossible for a version control system to handle all binary files in a robust and generic way. Consequently, people now rely on explicit documentation of changes made by the author to fully understand the differences between versions of a binary file, or they must hope a particular application knows enough about the binary file to meaningfully present information about changes.

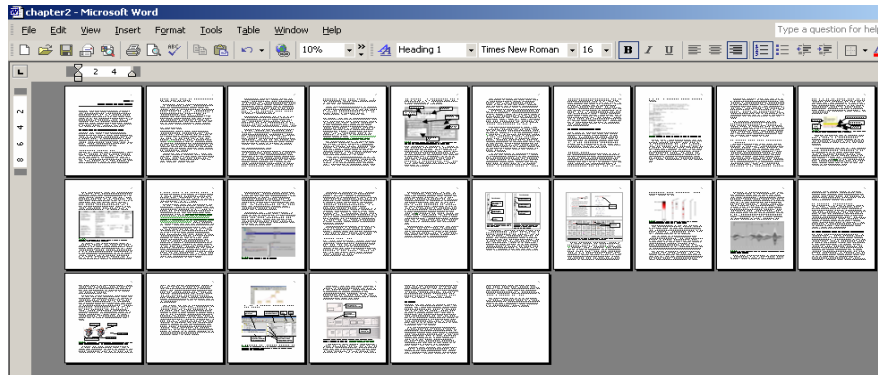
2.2 Displaying change in text-based systems

In the first subsection below I describe the early systems for tracking and managing changes such as Diff. As mentioned in the previous section, many of these systems would represent changes separately from the changed documents, which often made change tracking difficult. In the next subsection I describe some of the later systems, such as Word (Microsoft 1983), which would imbed information about changes right in

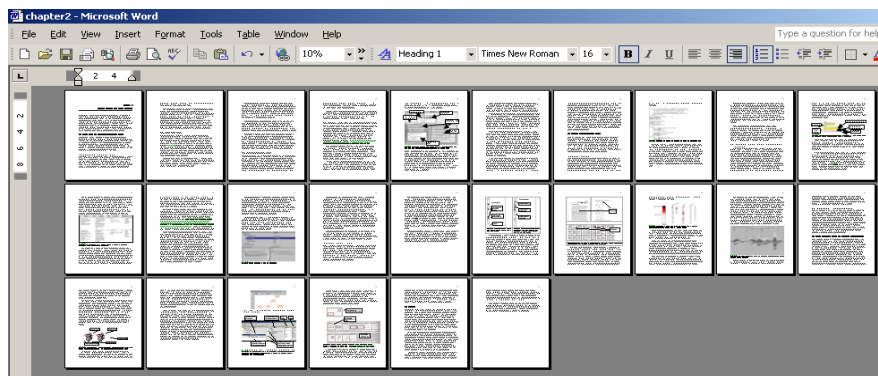
Visualizing A Large Document (Overview)



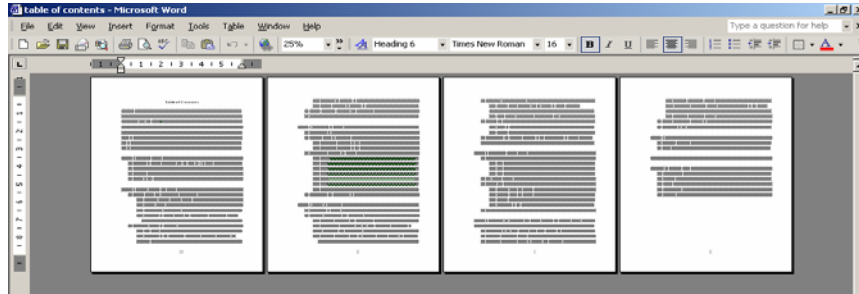
Visualizing A Large Document (Overview)



Visualizing A Large Document (Overview)



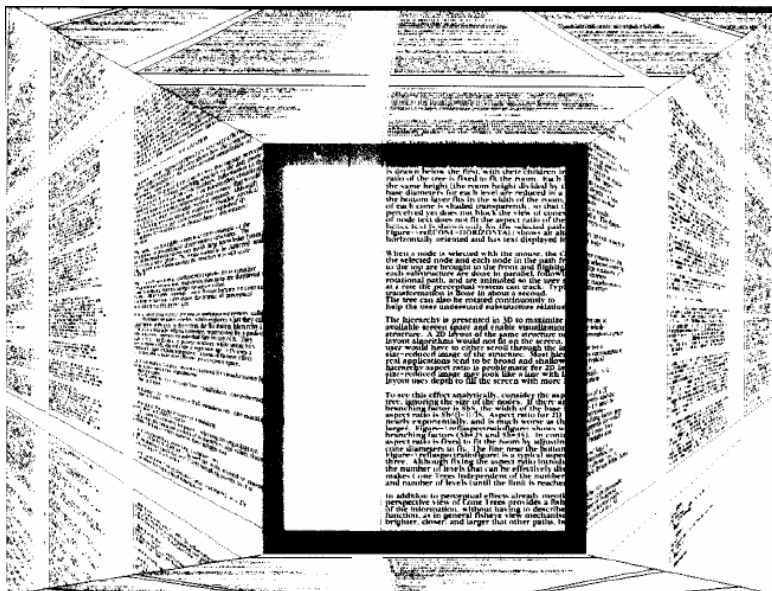
Visualizing A Large Document (Overview)



Word © Microsoft

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DocumentLens



Robertson / Mackinlay ACM UIST 1993

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Data Mountain



Robertson / Czerwinski / Larson / Robbins / Thiel / van Dantzich

Data Mountain: Using Spatial Memory for Document Management Proc ACM UIST'98

James Tam

Data Mountain



Robertson / Czerwinski / Larson / Robbins / Thiel / van Dantzich

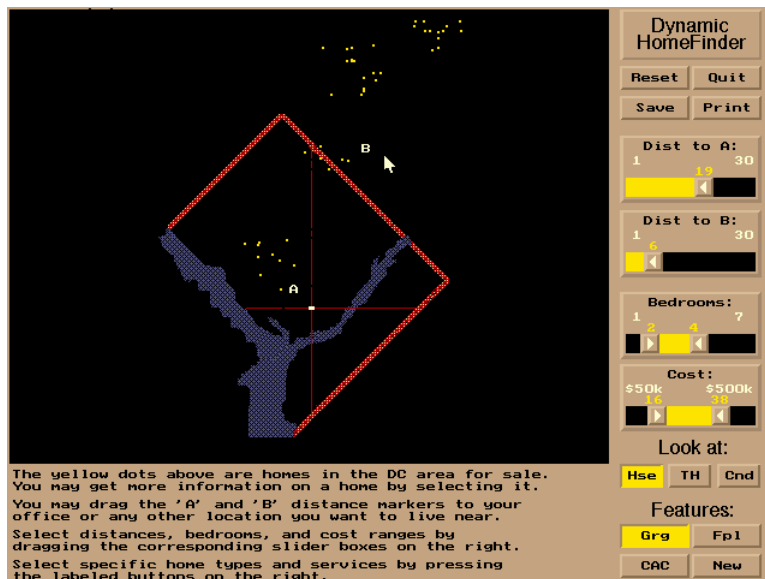
Data Mountain: Using Spatial Memory for Document Management Proc ACM UIST'98

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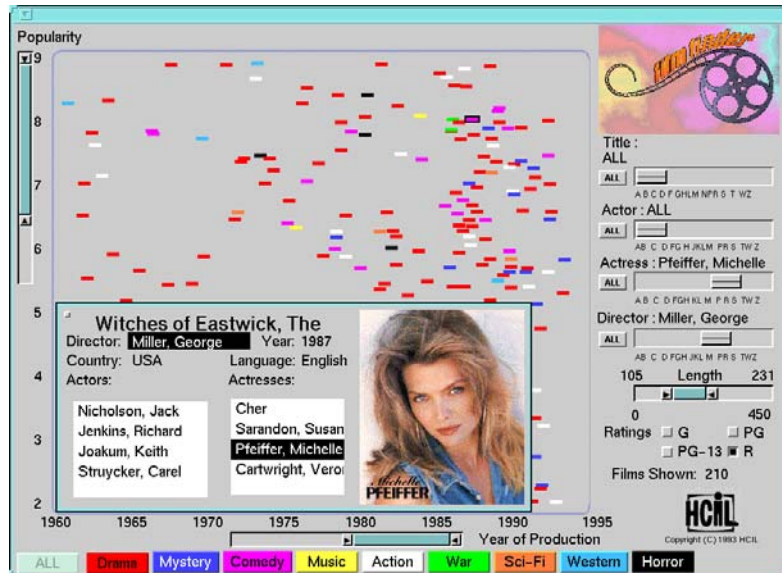
Task Gallery



Dynamic Queries (Home Finder)



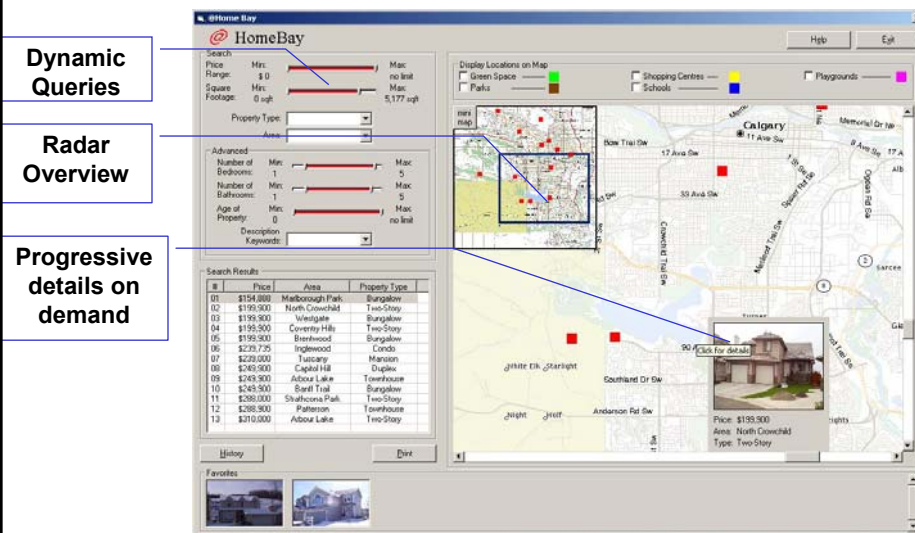
Starfield Display



Ahlberg, University of Maryland <http://www.cs.umd.edu/hcil/spotfire/>

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HomeBay



481 Student Project (April, 2000) Rob Pearson, Kashama Willms and James Chisan

James Tam

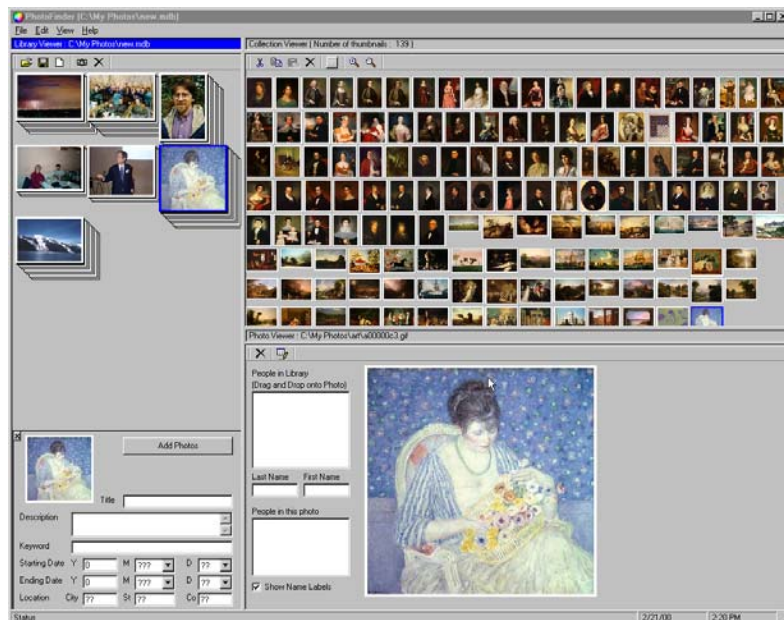
Direct Manipulation In The Previous Systems

Central ideas

- Visibility of the objects of interest (star field display)
- Rapid, reversible, incremental actions (slider)
- Manipulation by pointing and moving (like real world objects)
- Immediate and continuous display of results (no delay)

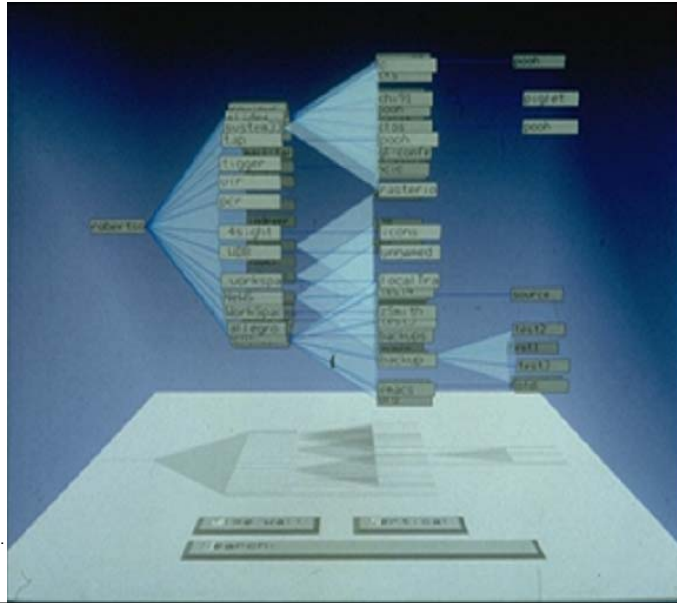
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PhotoFinder



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

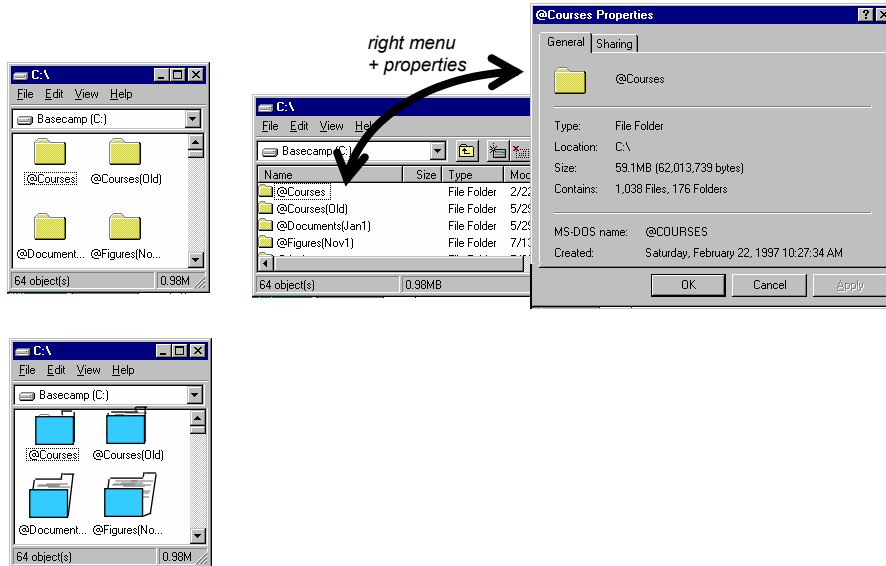
Cone Trees



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

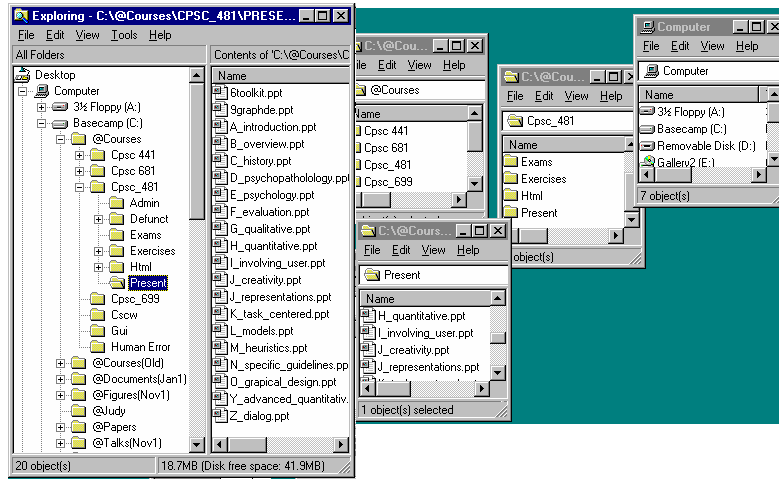
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Which Folder Has The Most Documents?

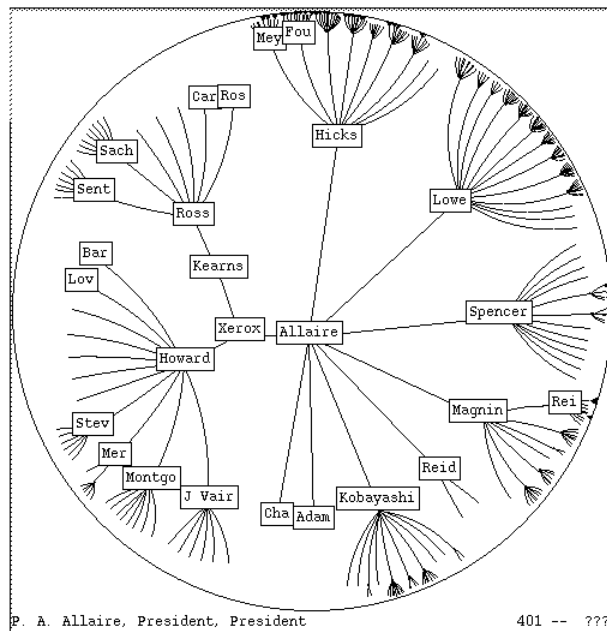


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Where Am I? Where Was I Going?



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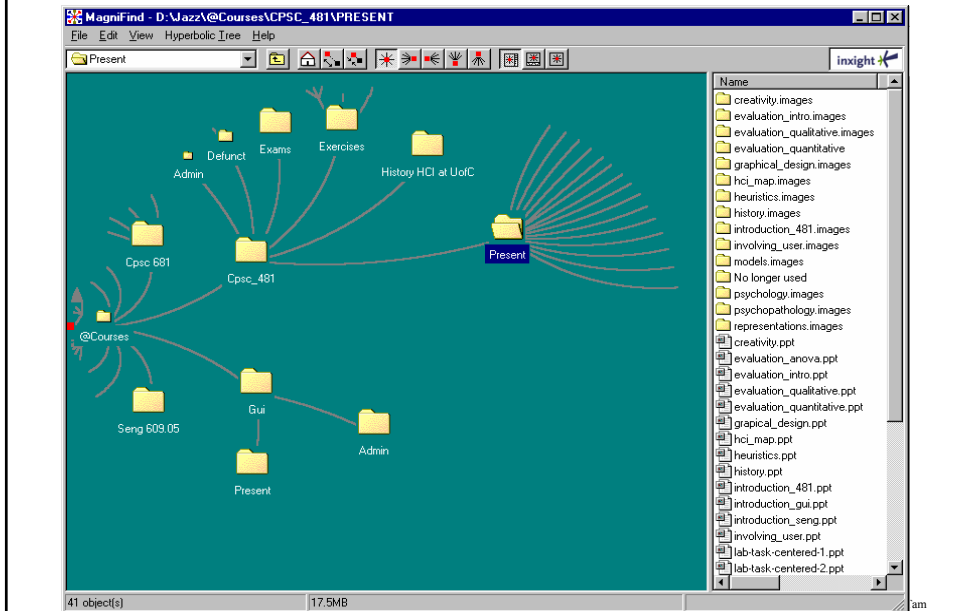


Xerox Parc/Inight

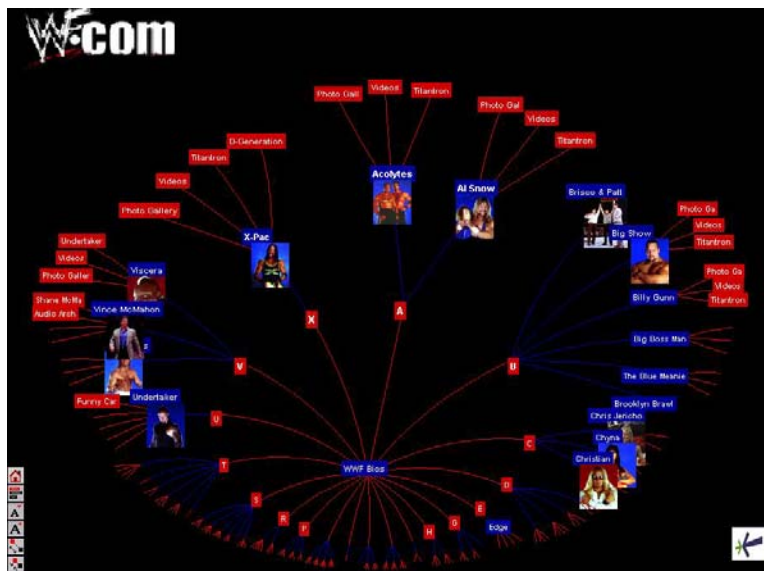
Demo: <http://starttree.inxight.com/>

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Hyperbolic View Of A Disk Hierarchy



Hyperbolic View Of The Web



Demo: <http://starttree.inxight.com/>

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What You Now Know

Good Representations

- Captures essential elements of the event / world
- Deliberately leaves out / mutes the irrelevant
- Appropriate for the person, their task, and their interpretation

Information Visualization

- Tufte's principles
- Exploits our knowledge of visual variables
- Information seeking mantra: Overview first, zoom and filter, then details on demand
- Many techniques now available (illustrated with research systems and games)

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What You Now Know (2)

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

These four components are the foundation of a true Visual Interface

James Tam

