

# Beyond Simple Screen Design

## Part I: Principles of information visualization

- Tufte's guidelines
- Visual variables for representing information
- The information seeking mantra

## Part II: Information visualization in practice

- Visualization in games
- Visualization research

## Part III: Metaphors

- How metaphors can be used and misused

James Tam

## Part I: Information Visualization

Principles of information visualization (Tufte)

Visual variables (Bertin)



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**


34, 34, 34

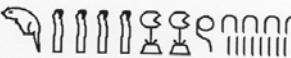
James Tam

## Egyptian Numerals

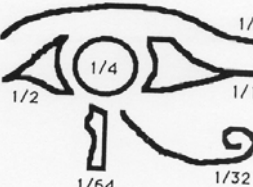
						
$10^0$	$10^1$	$10^2$	$10^3$	$10^4$	$10^5$	$10^6$
w	mg	št	ḥz	ḏb'	ḥfn	ḥḥ



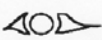
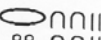
Egyptian cardinal icons.

  
 24

  
 142,149

Sample Egyptian numbers.

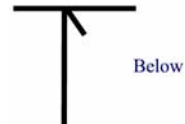
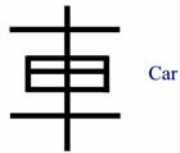
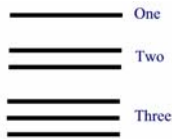


			
$1/2 + 1/14$		$1/2 + 1/4 + 1/16$	
4/7		13/16	1/244

Sample Egyptian fractions.

James Tam

## Chinese...Sort Of



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
- 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

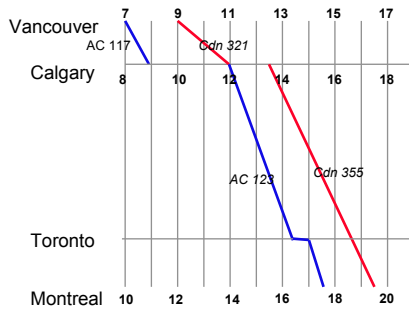
James Tam

## Which Is The Best Flight?

### Length, stop-overs, switches...

		<i>Depart</i>	<i>Arrive</i>
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

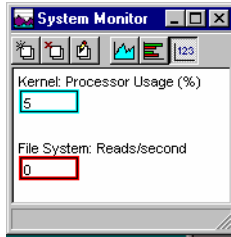
	Breakfast	Lunch	Dinner	Bedtime		Breakfast	Lunch	Dinner	Bedtime
Lanoxin	O				Lanoxin				
Inderal	O	O	O		Inderal			Inderal	
Quinag	O	O	O	O	Quinag		Quinag	Quinag	Quinag
Carafate	O	O	O	O	Carafate	Carafate	Carafate	Carafate	Carafate
Zantac		O		O	Zantac				Zantac
Couma				O	Couma				Couma

*Organized by both time of day and by drug*

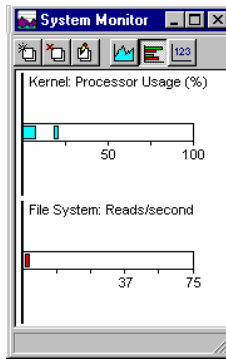
James Tam

## Which Representation Is Best?

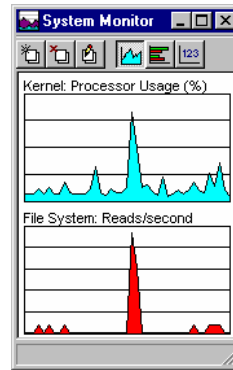
Depends heavily on task



What is the precise value?



What is the performance now compared to the peak?



How does performance change over time?

James Tam

## 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*

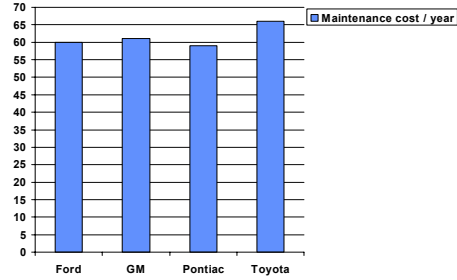
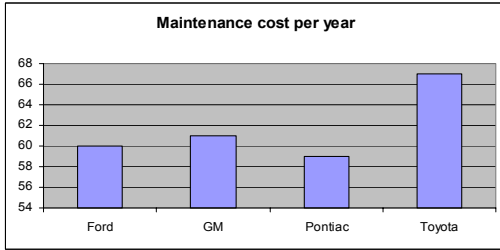
### **Note:**

*Many visual examples on the following slides are taken from Tufte's books*

James Tam



## Avoid Distortion

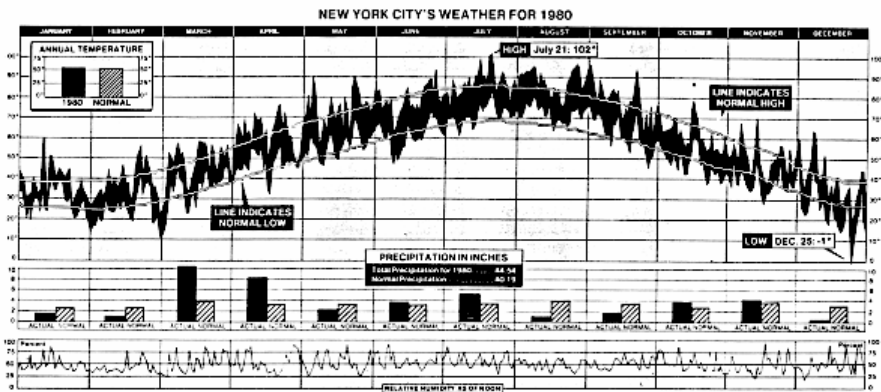


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## Present Many Numbers In A Small Space

### New York Weather History

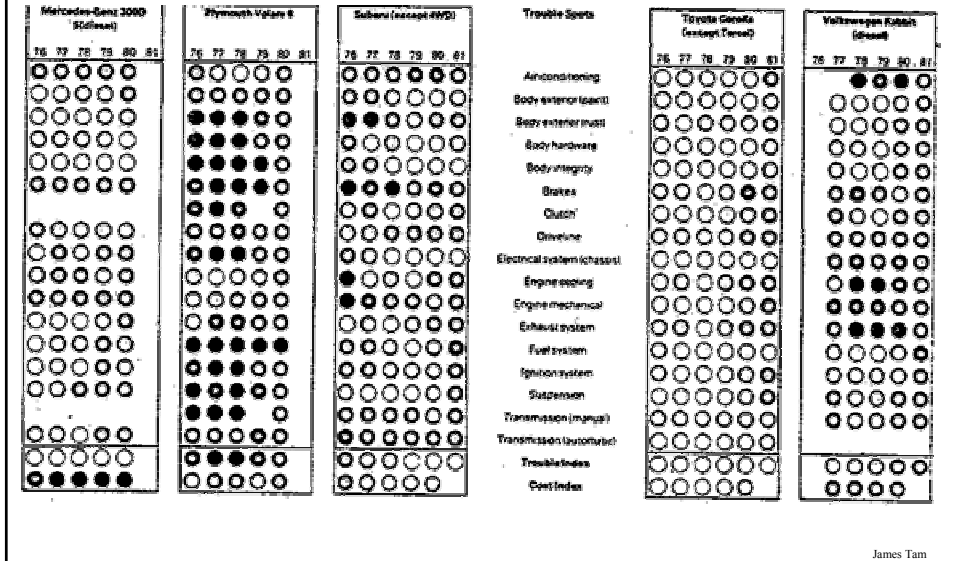
- 181 numbers/sq inch



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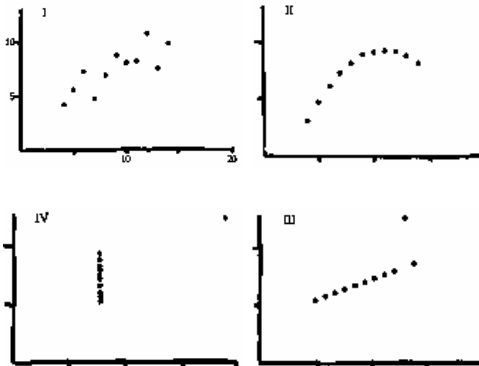


## Broad Overview And Fine Detail



## 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	9.43	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	6.80

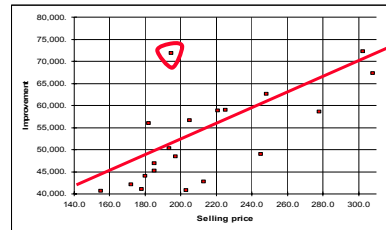
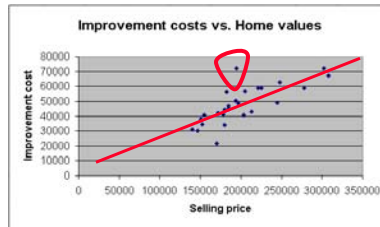


N: 11.0  
 mean X's : 9.0  
 mean Y's : 7.5  
 standard error of slope estimate: 0.1  
 sum of squares: 110.0  
 regression sum of squares: 27.5  
 residual sum of squares of Y: 13.8  
 correlation coefficient: 0.8  
 r squared: 0.7  
 regression line:  $Y=3+0.5X$

***These graphics reveal the information***

## Another Example: 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
<b>16</b>	<b>194500</b>	<b>71860</b>
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

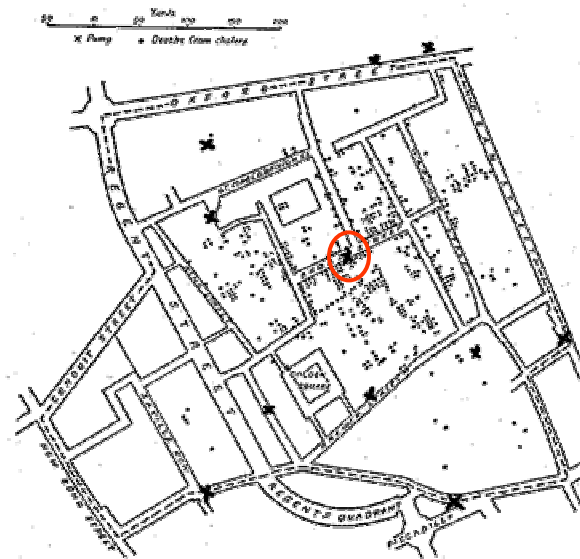


James Tam

## Interpreting Information

### Deaths by Cholera

Dr John Snow  
1854



James Tam

# Telling A Story: Napoleon's March To Moscow

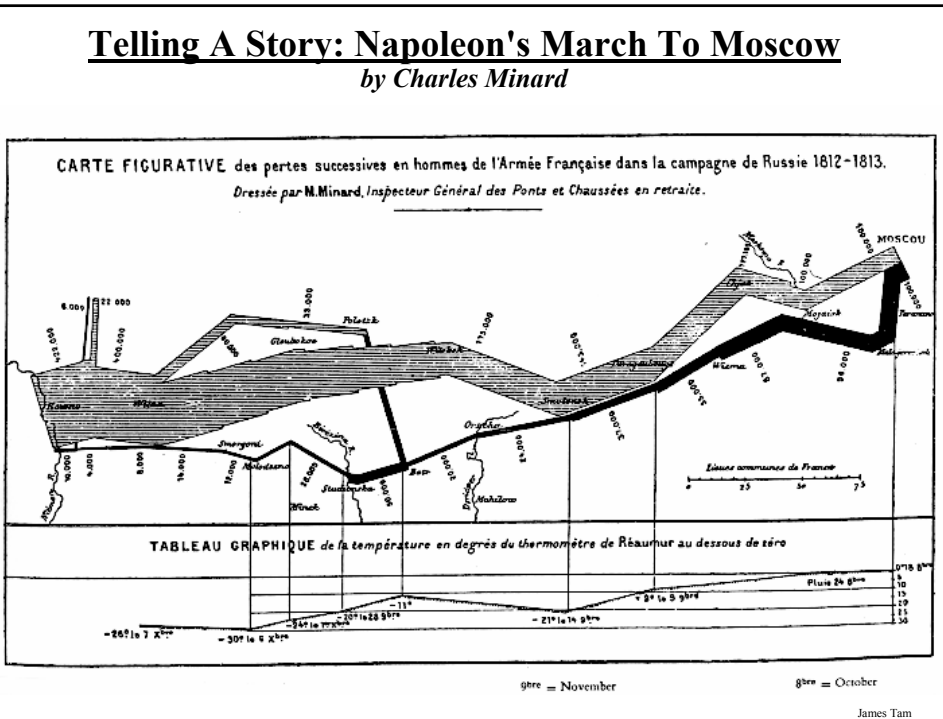
by Charles Minard



James Tam

# Telling A Story: 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



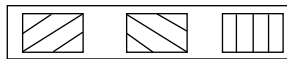
### Value

- Changes in brightness



### Orientation

- Changes in alignment



### Colour

- Changes in hue



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## Visual Variables (2)

### Texture

- Variations in pattern



### Motion



[www.st-duffer.com](http://www.st-duffer.com)

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## Visual Variables

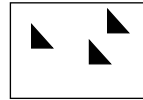
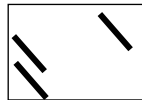
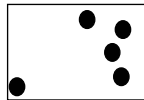
### Characteristics of visual variables

- **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?  
(think of it as variation)
- **Length**  
Across how many changes in this variable are distinctly perceptible?

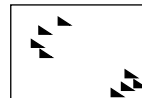
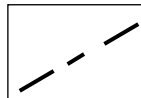
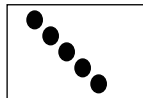
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### Visual Variable: Position

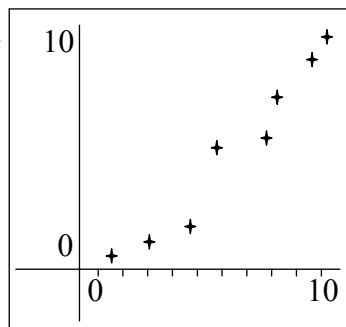
✓ Selective



✓ Associative



✓ Quantitative



✓ Order

✓ Length

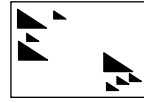
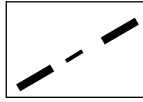
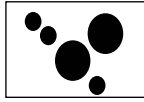
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## Visual Variable: Size

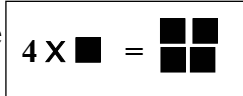
✓ Selective



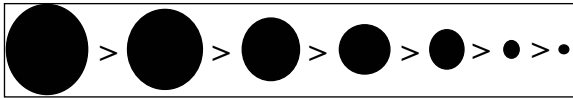
✓ Associative



≠ Quantitative



✓ Order



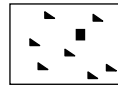
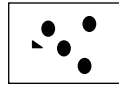
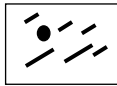
✓ Length

Theoretically infinite but practically limited

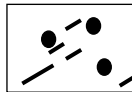
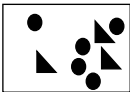
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## Visual Variable: Shape

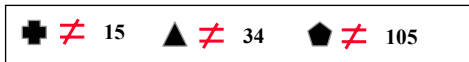
≠ Selective



≠ Associative



≠ Quantitative



≠ Order

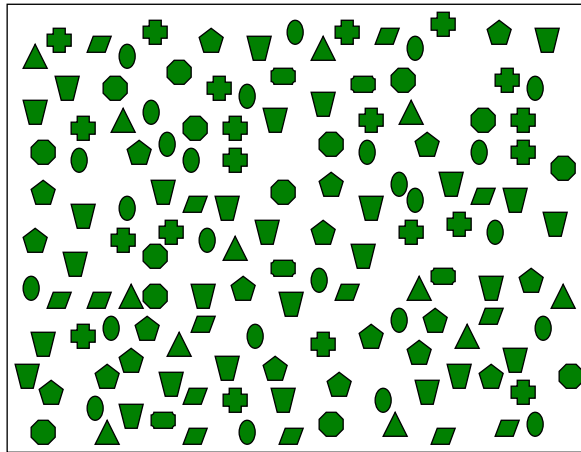


✓ Length



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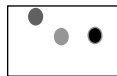
## Shape



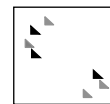
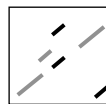
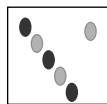
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## Visual Variable: Value

✓ Selective



✓ Associative



✗ Quantitative



✓ Order



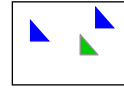
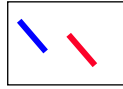
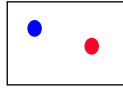
✓ Length

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

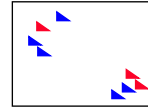
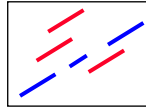
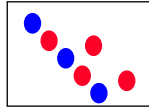
James Tam

## Visual Variable: Color

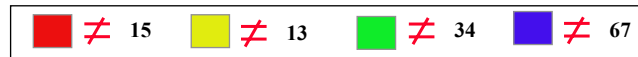
✓ **Selective**



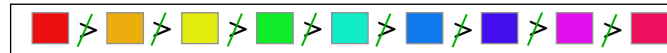
✓ **Associative**



≠ **Quantitative**



≠ **Order**

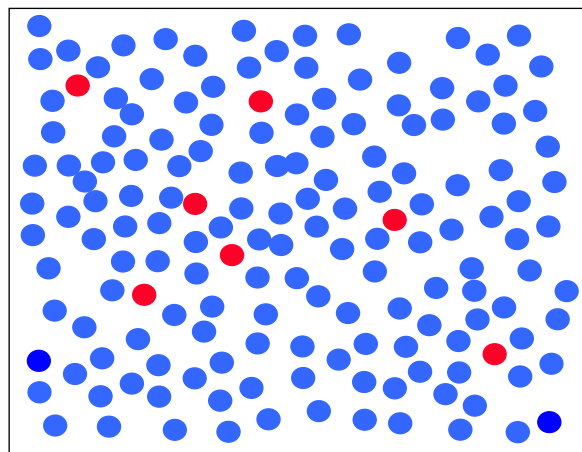


✓ **Length**

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

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## Color



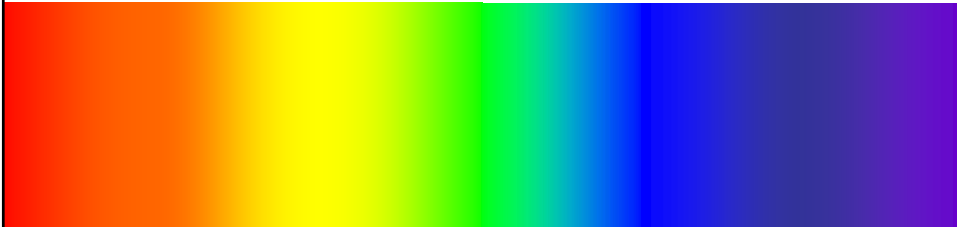
James Tam



## Color Encoding

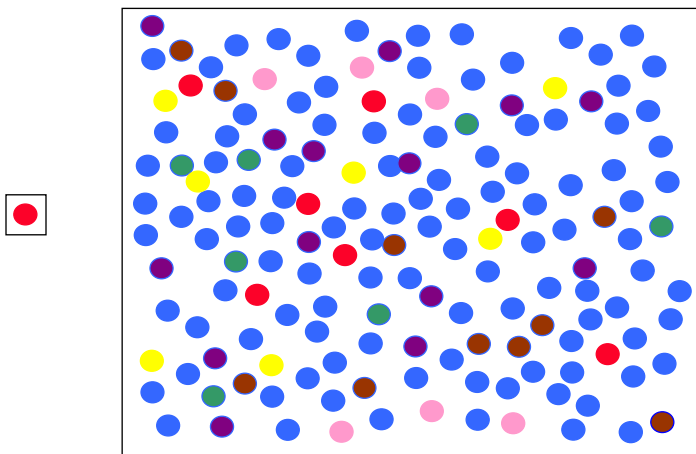
### Common advice says use a rainbow scale

- Marcus, Murch, Healey
- Problems with rainbows

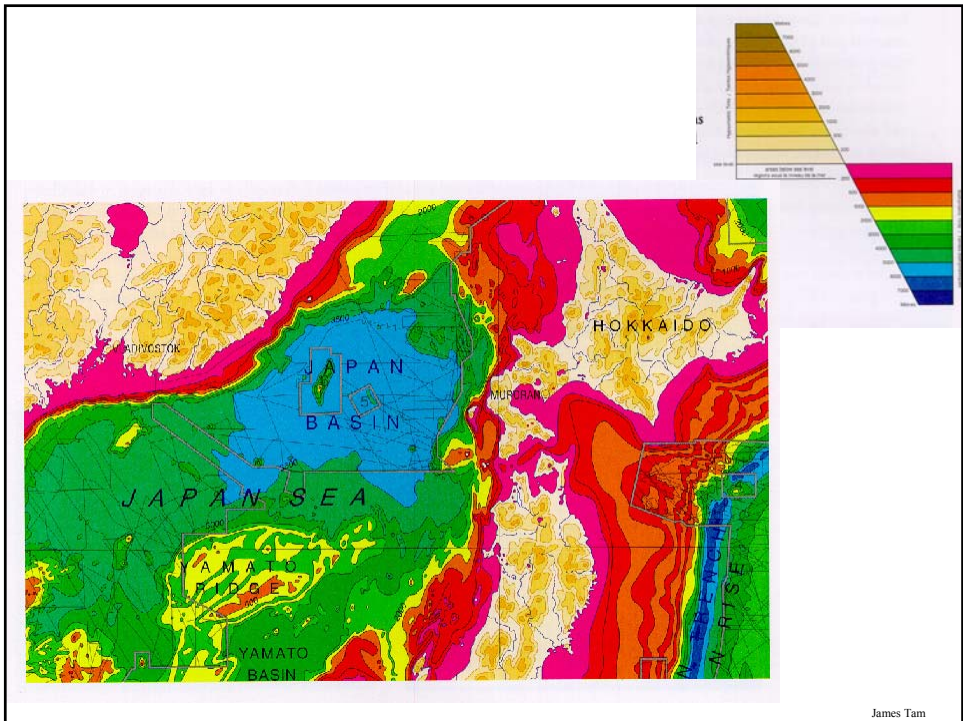
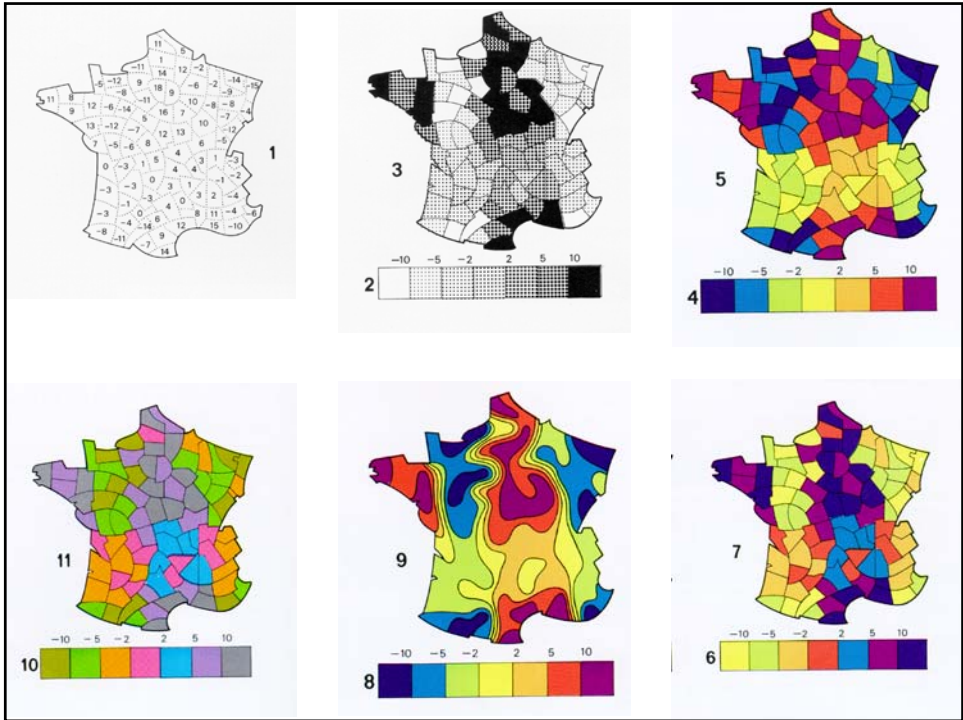


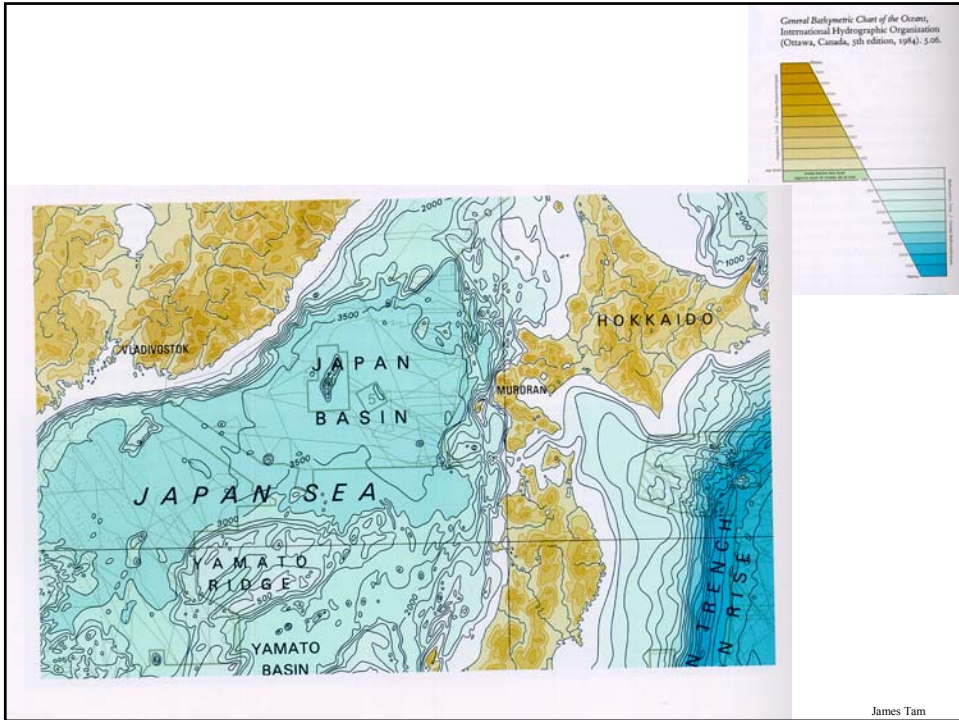
James Tam

## Color



James Tam



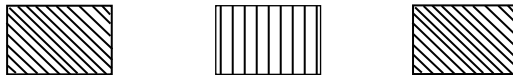


### Visual Variable: Orientation

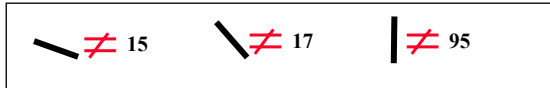
✓ Selective



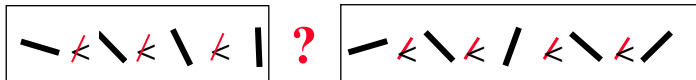
✓ Associative



≠ Quantitative



≠ Order



✓ Length

~5 in 2D

? in 3D

## 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

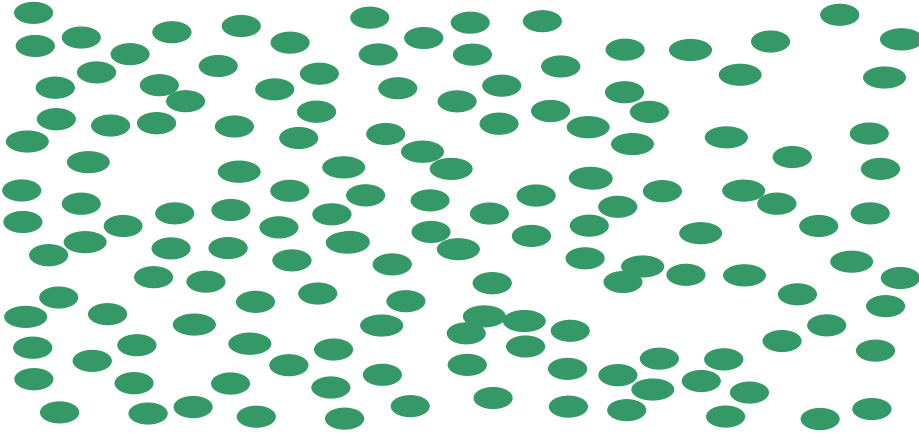
≠ **Quantitative** - subjective perception

≠ **Order**

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

James Tam

# Motion

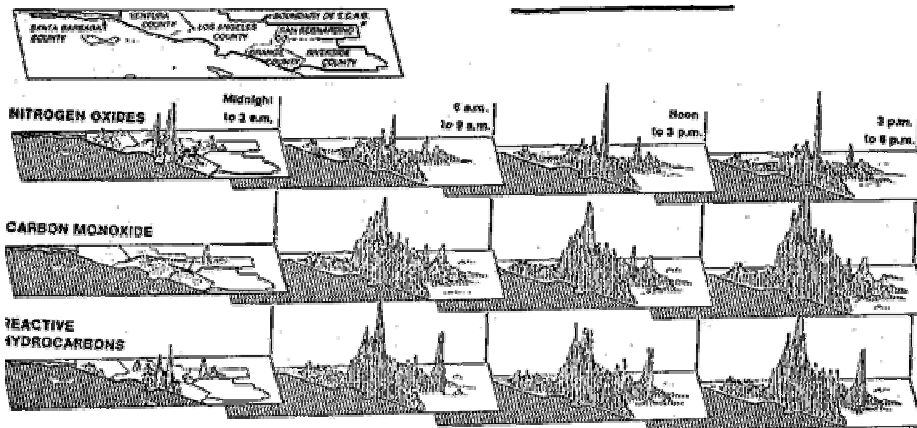


James Tam

## Small Multiples: General Principles

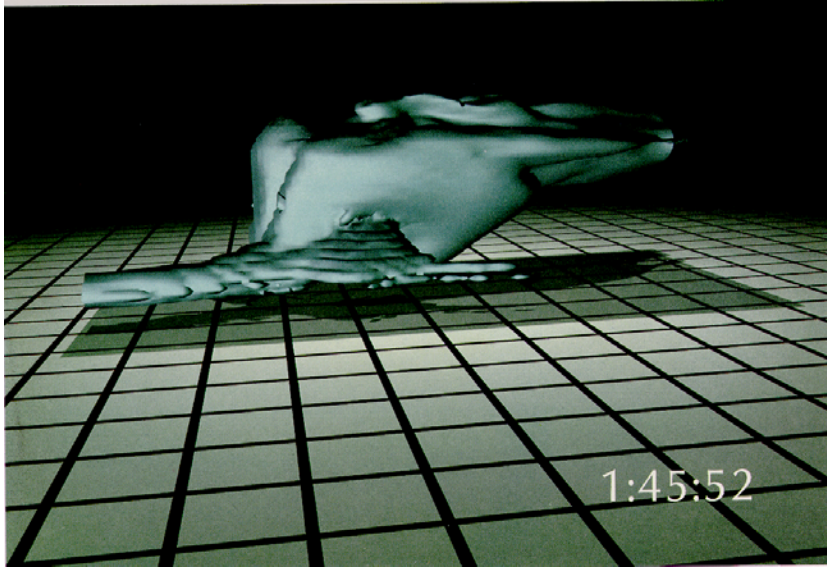
Learn once

Invite comparisons



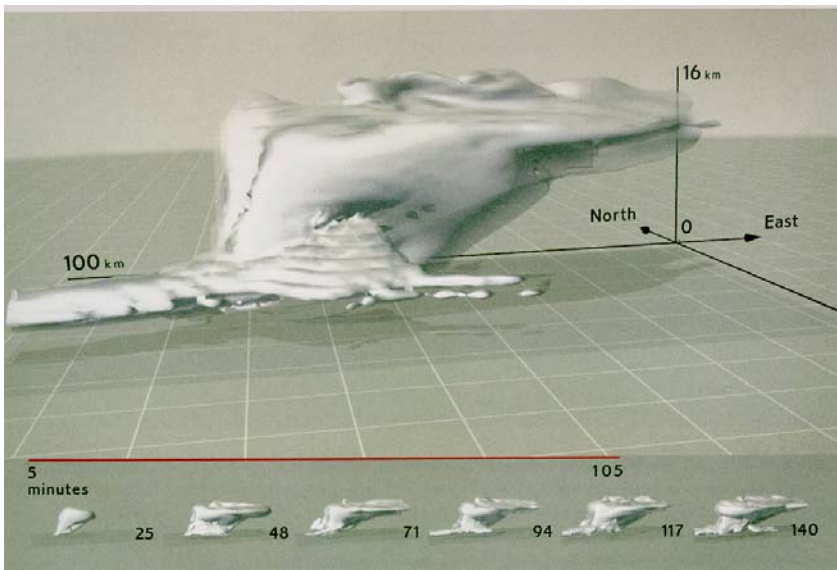
James Tam

## 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**

*Ben Shneiderman, Designing the User Interface 3<sup>rd</sup> Ed. 1997 p523*

James Tam

## **Part II: Applying Information Visualization In Actual 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 In Games



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

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 (Blizzard)

James Tam

## Table Lens

Housing Market for Santa Clara County, CA - March 2000

Bedrooms	Price	Square Foot	Status	Baths	Address	City	State	Zip	Realtor	MLS #	
5	151	389,000	3531	Sale Pending	4	6755 STEPH...	Gilroy	CA	95020	CENTURY 2...	4361
	152	389,000	2261	Sale Pending	3	3583 BAYO...	San Jose	CA	95111	BAY CITES...	10970
	153	389,000	-	Sale Pending	1.5	1781 ANGEL...	San Jose	CA	95111	ROSE GARD...	944120
4											
3											
2											

Spotlight Columns

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

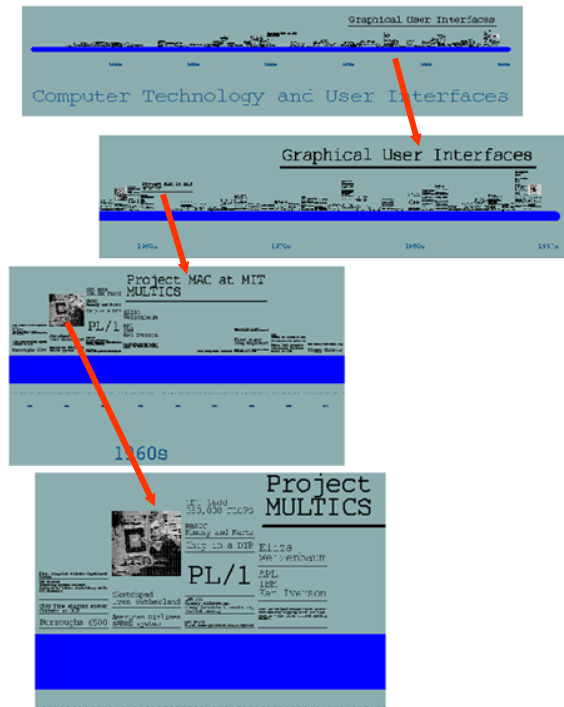


James Tam

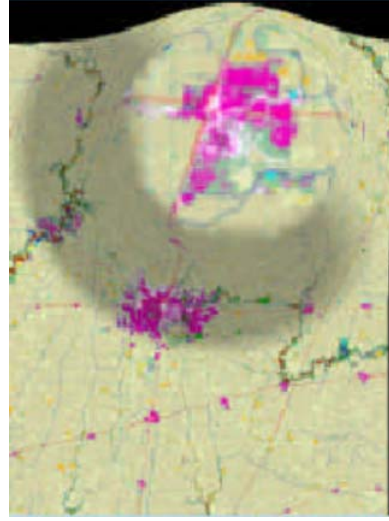
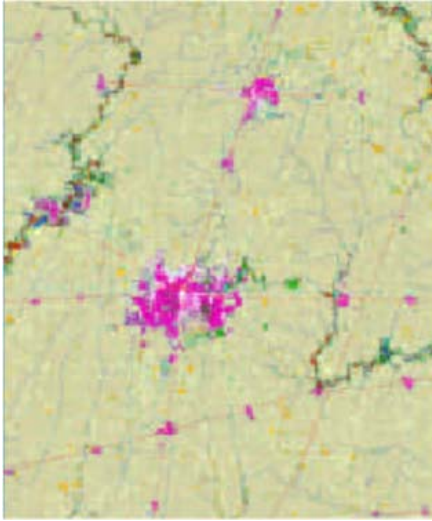
**Pad++: A Zoomable Graphical Sketchpad for Exploring Alternate Interface Physics**  
Bederson et al  
*Journal of Visual Languages and Computing* 7, 1996

## Browsing of digital images

<http://java.sun.com/features/2001/08/photomesa.html>



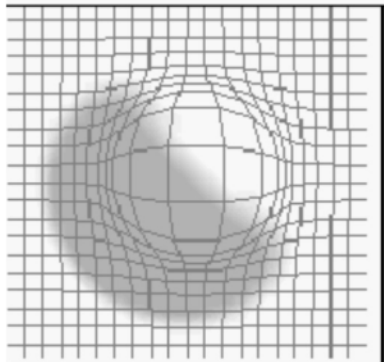
## Focus And Context



James Tam

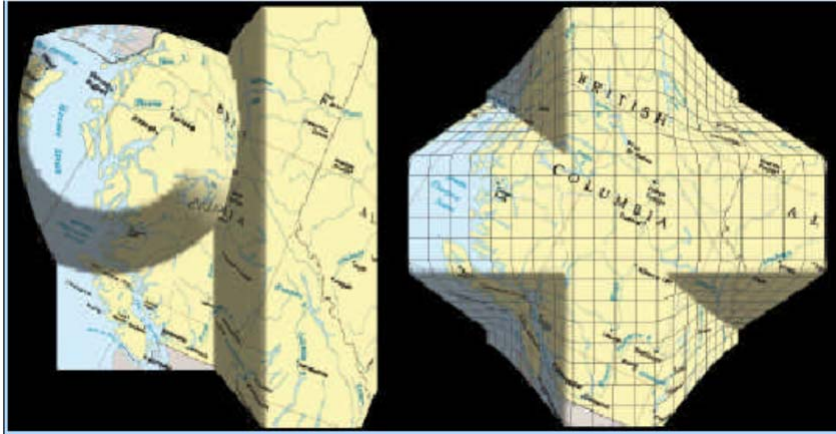
## Map – Elastic View

Distortion is understandable through the use of a grid and shading



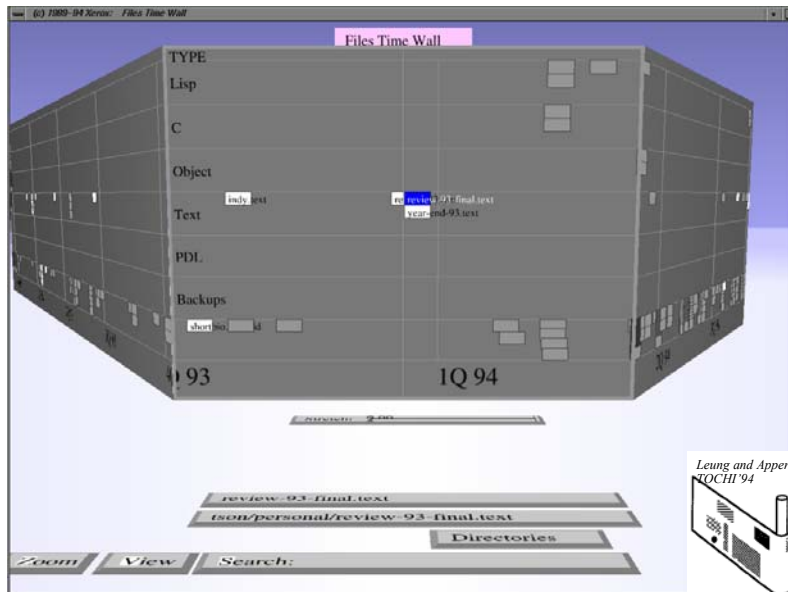
James Tam

## Alternative Distortion Algorithms



James Tam

## Perspective Wall

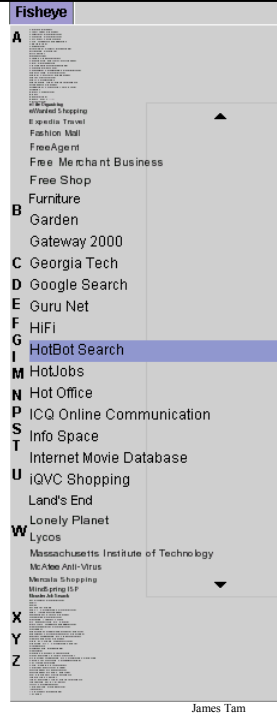


Leung and Apperly  
TOCHI'94

Mackinlay / Robertson / Card: Proc ACM CHI'91

James Tam

# Fisheye Menus



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

## 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.

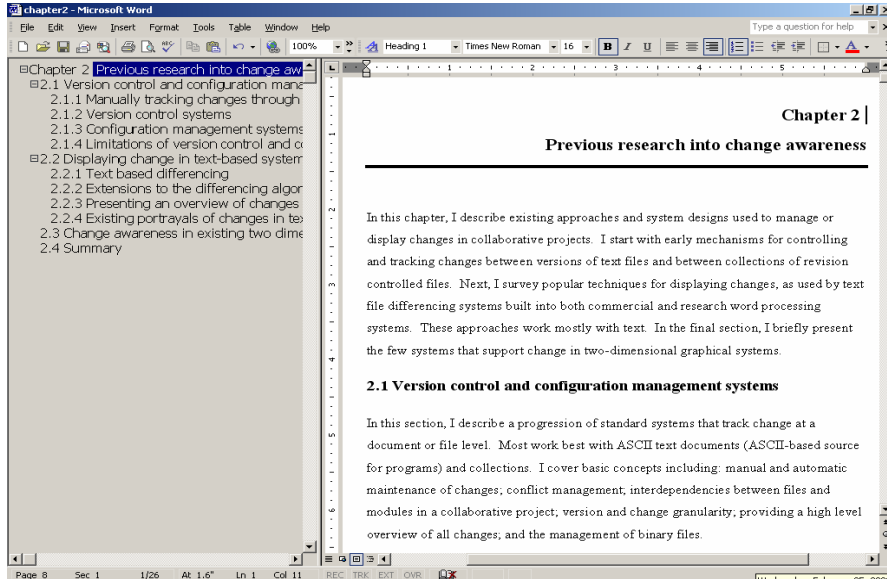
### **2.2 Displaying change in text-based systems**

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

James Tam

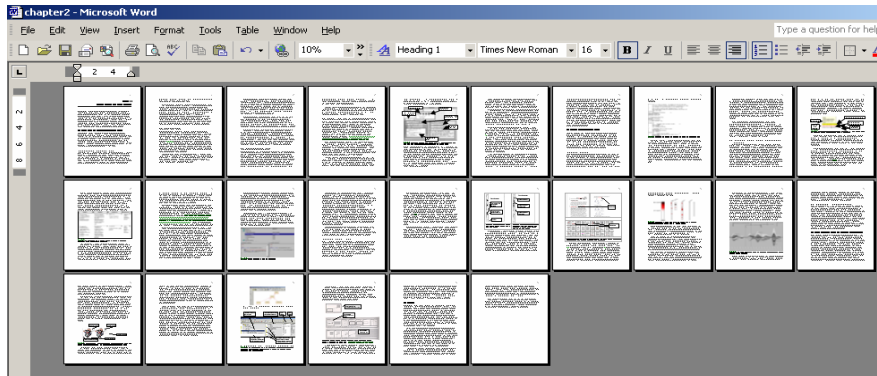


# Visualizing A Large Document (Overview)



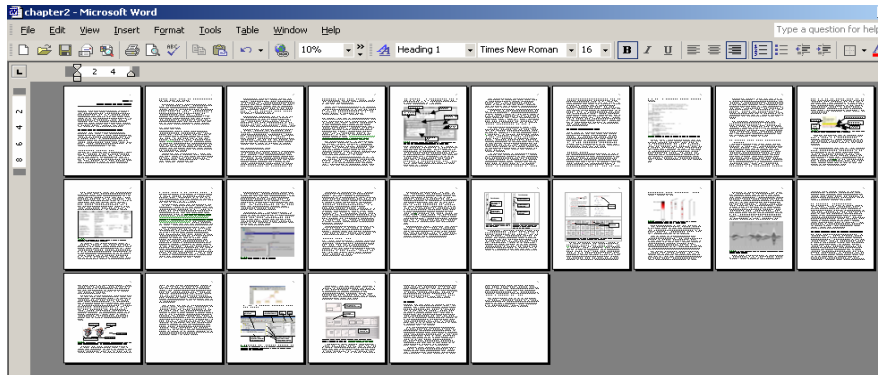
James Tam

# Visualizing A Large Document (Overview)



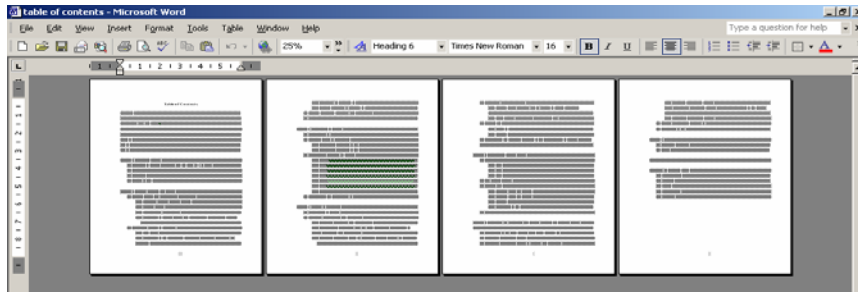
James Tam

## Visualizing A Large Document (Overview)



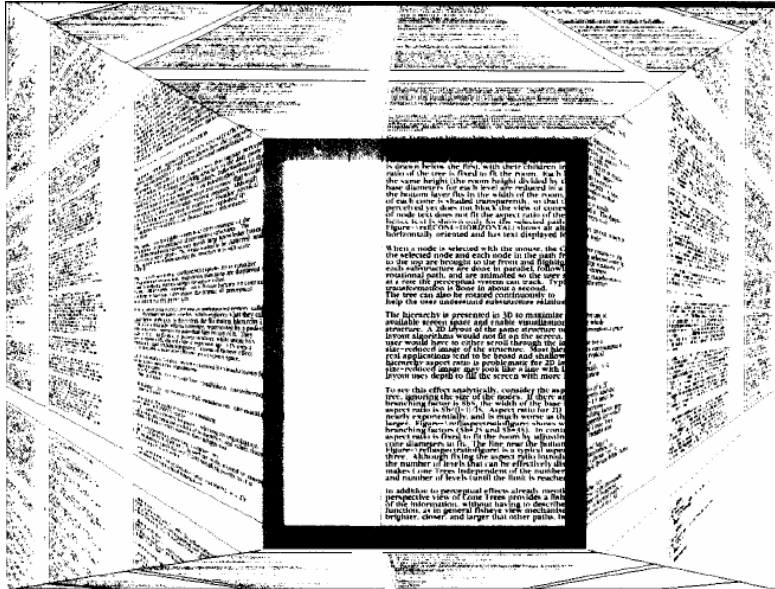
James Tam

## Visualizing A Large Document (Overview)



James Tam

# DocumentLens



Robertson / Mackinlay ACM UIST 1993

James Tam

# Data Mountain



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

James Tam

## Data Mountain



Robertson / Czerwinski / Larson / Robbins / Thiel / van Dantzig

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

James Tam

## Task Gallery



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

## Dynamic Queries (Home Finder)

The yellow dots above are homes in the DC area for sale. You may get more information on a home by selecting it. You may drag the 'A' and 'B' distance markers to your office or any other location you want to live near. Select distances, bedrooms, and cost ranges by dragging the corresponding slider boxes on the right. Select specific home types and services by pressing the labeled buttons on the right.

**Dynamic HomeFinder**

Reset Quit

Save Print

Dist to A:  
1 30

Dist to B:  
1 30

Bedrooms:  
1 7

Cost:  
\$50k \$500k

Look at:  
Hse TH Cnd

Features:  
Grq Fp1

CAC New

Shneiderman et al  
University of Maryland  
<http://www.cs.umd.edu/hcil/spotfire/>

James Tam

## Starfield Display

Popularity

9  
8  
7  
6  
5  
4  
3  
2

1960 1965 1970 1975 1980 1985 1990 1995

Year of Production

**Witches of Eastwick, The**  
Director: Miller, George Year: 1987  
Country: USA Language: English  
Actors: Nicholson, Jack Cher  
Jenkins, Richard Sarandon, Susan  
Joakum, Keith Pfeiffer, Michelle  
Struycker, Carel Cartwright, Vero

Michelle Pfeiffer

Title: ALL  
Actor: ALL  
Actress: Pfeiffer, Michelle  
Director: Miller, George

105 Length 231

0 450  
Ratings G PG PG-13 R  
Films Shown: 210

ALL Drama Mystery Comedy Music Action War Sci-Fi Western Horror

Copyright (C) 1993 HCIL

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

James Tam

# HomeBay

**Dynamic Queries**

**Radar Overview**

**Progressive details on demand**

#	Price	Area	Property Type
01	\$154,900	Marlborough Park	Bungalow
02	\$193,900	North Creechchild	Two-Story
03	\$199,900	Westgate	Bungalow
04	\$199,900	Covecreek Hills	Two-Story
05	\$199,900	Birkenwood	Bungalow
06	\$299,795	Ingleswood	Condo
07	\$299,000	Luscany	Mansion
08	\$249,900	Capital Hill	Duplex
09	\$249,900	Arbour Lake	Townhouse
10	\$249,900	Baird Trail	Bungalow
11	\$288,000	Stathcona Park	Two-Story
12	\$289,900	Patterson	Townhouse
13	\$310,000	Arbour Lake	Two-Story

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

James Tam

# PhotoFinder

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

Photo Viewer: C:\My Photos\arc\0000033.jpg

People in Library (Drag and Drop onto Photo)

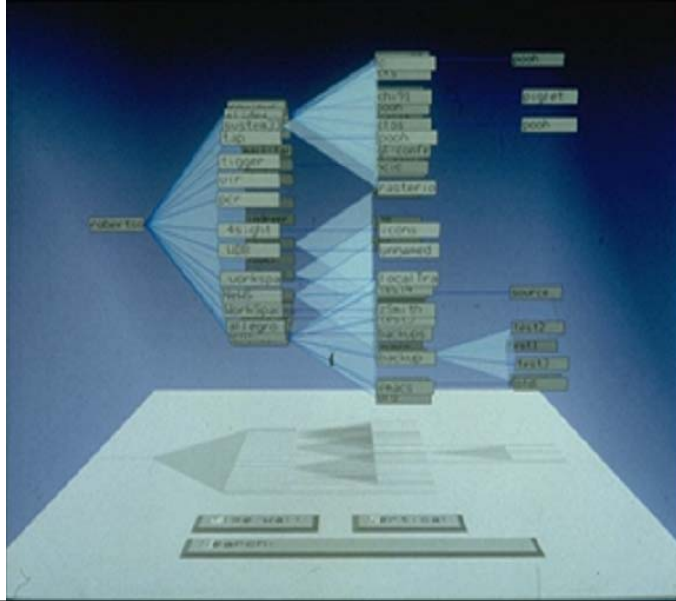
Last Name:      First Name:

People in this photo

Show Name Labels

Status: 2/21/00 12:30 PM

# Cone Trees



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

James Tam

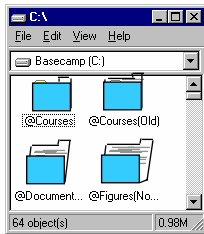
# Which Folder Has The Most Documents?

right menu + properties

Name	Size	Type	Mod
@Courses		File Folder	2/2
@Courses(Old)		File Folder	5/2
@Documents(Jan1)		File Folder	5/2
@Figures(Nov1)		File Folder	7/1

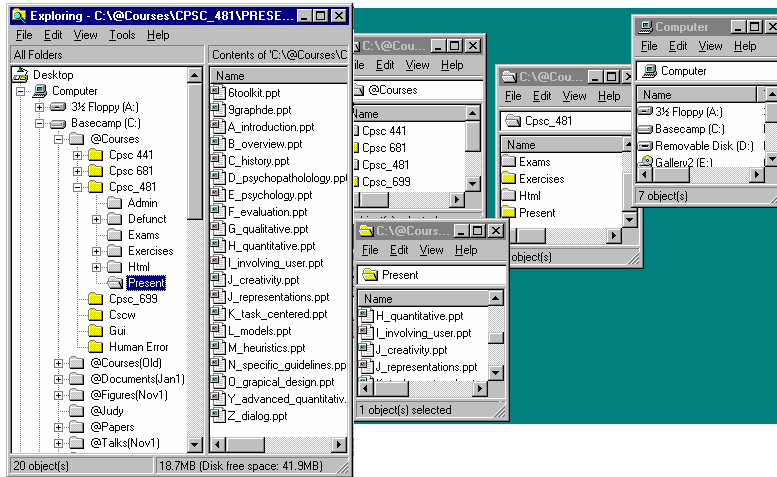
General | Sharing

Type: File Folder  
Location: C:\  
Size: 59.1MB (62,013,739 bytes)  
Contains: 1,038 Files, 176 Folders  
MS-DOS name: @COURSES  
Created: Saturday, February 22, 1997 10:27:34 AM

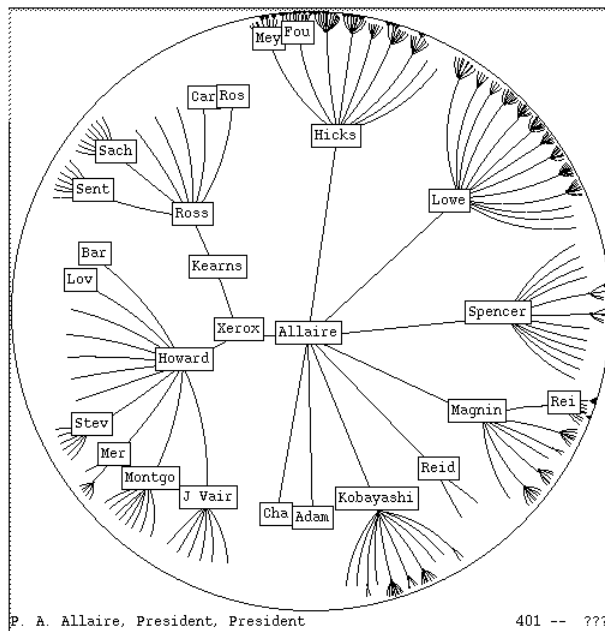


James Tam

# Where Am I? Where Was I Going?



James Tam



P. A. Allaire, President, President

401 -- ???

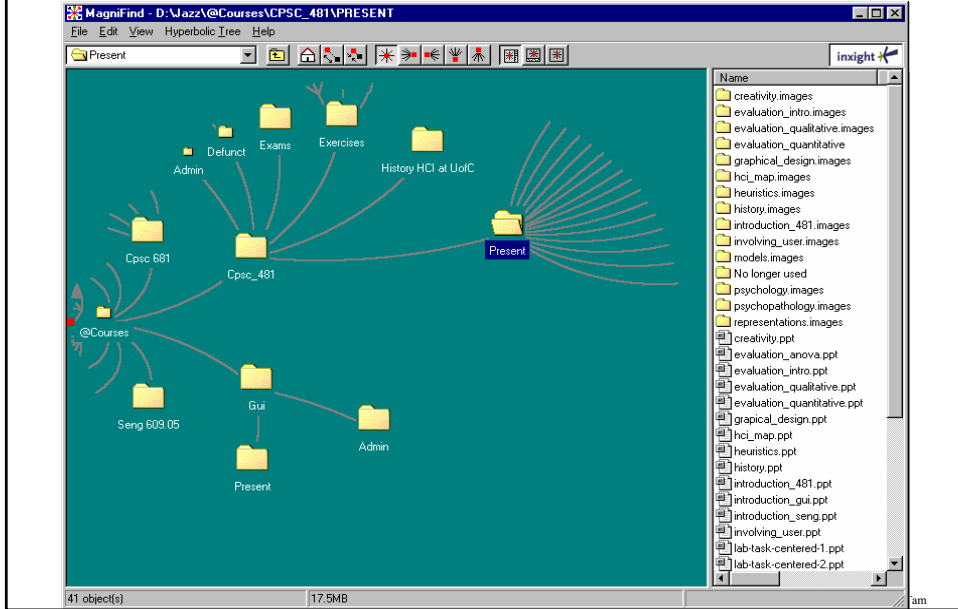
Demo: <http://startree.inxight.com/>

**Xerox Parc/Inight**

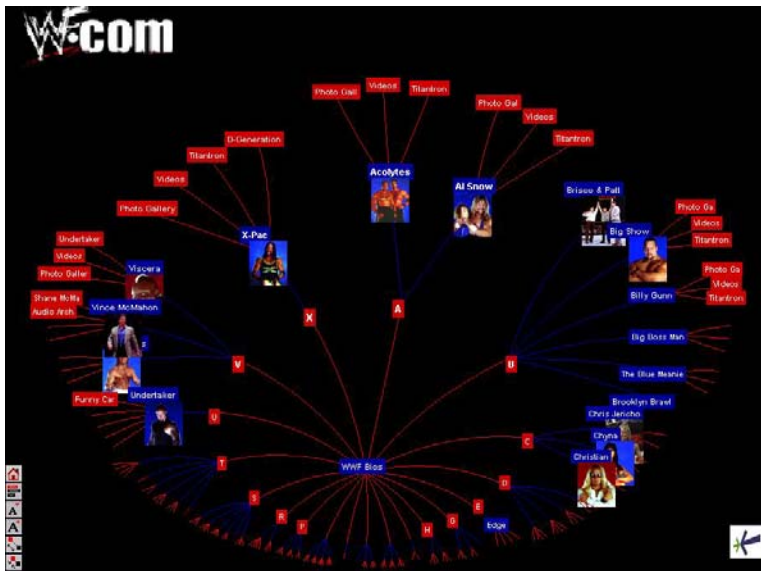
James Tam



# Hyperbolic View Of A Disk Hierarchy



# Hyperbolic View Of The Web

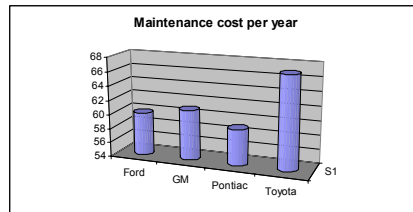
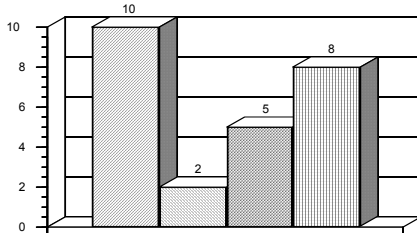


Demo: <http://startree.inxight.com/>

## 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 III: Metaphors

### **How metaphors can be used and misused**

James Tam

## Interface Metaphors

### Definition of Metaphor

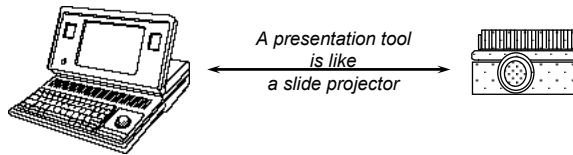
- Application of name or descriptive term to an object to which it is not literally applicable

### 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



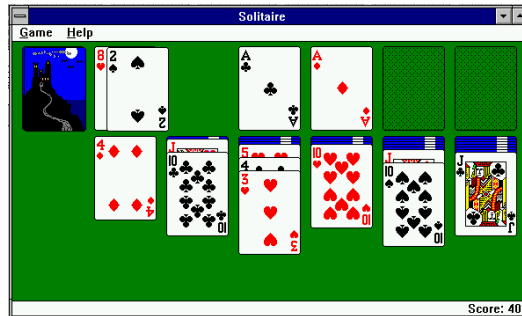
James Tam

## 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.	89,740.	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	76,850.	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.

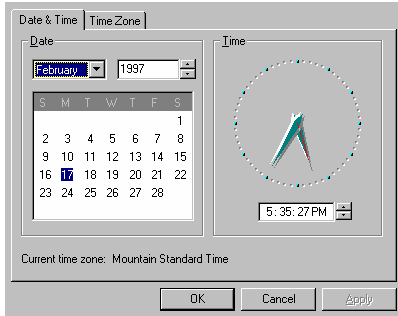
spreadsheet (actuary sheet)



games (literal world)

James Tam

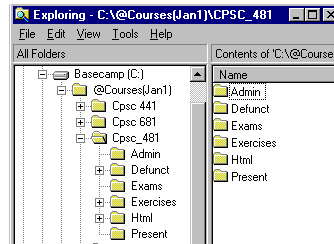
## Interface Metaphors (2)



**Control Panels with familiar controls**

Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
City: \_\_\_\_\_  
Province: \_\_\_\_\_  
Postal Code: \_\_\_\_\_

**Forms**



**Hierarchical Folders**

James Tam

## Creating Interface Metaphors

### **Generating metaphors**

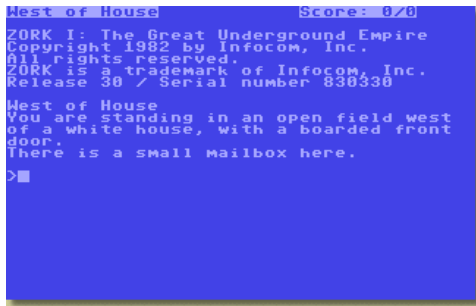
- Use metaphors that matches user's conceptual task
  - Desktop metaphor for office workers
  - Paintbrush metaphor for artists...
- Given a choice, choose the metaphor close to the way the system works
- Ensure emotional tone is appropriate to users
  - eg file deletion metaphors
    - Trashcan
   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

James Tam

## Evaluating Metaphors

### Consider the probable consequences of employing a particular metaphor

- Will the metaphor restrict how people will try to use the system?
  - e.g., Viewing the file system strictly in terms of a folder/file hierarchy vs. the ability to create links between directories.
- Will the metaphor make people believe that the system can do more than it currently can?
  - e.g., Agent-based systems, Eliza



Zork: Infocom

James Tam

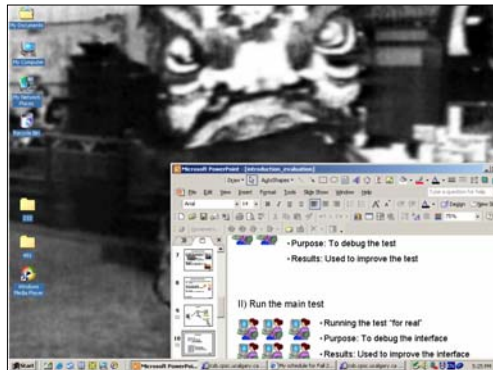
## Metaphors Should Not Be Static

### Evolve metaphors

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



Dilbert © United Features Syndicate

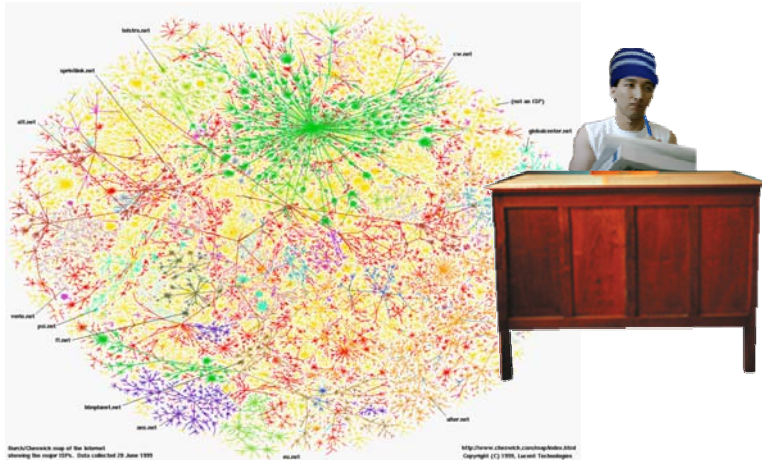


James Tam

## Metaphors Should Not Be Static (2)

### Evolve metaphors

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



James Tam

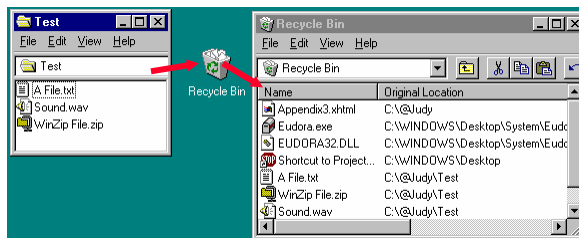
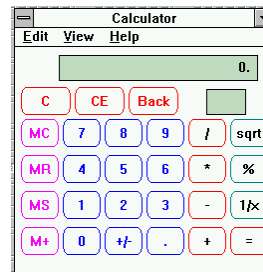
## Misuse Of Metaphors

### Caveat

- Metaphors can be overdone!

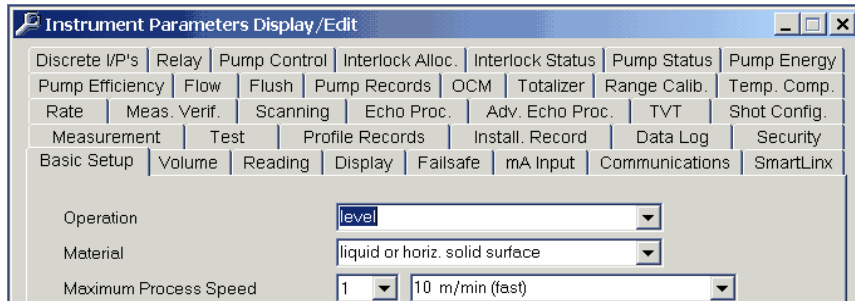
### Common pitfalls

- 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 Engagement & Direct Manipulation

### **Direct Engagement**

- The feeling of working *directly* on the task

### **Direct Manipulation**

- An interface that behaves as though the interaction was with a real-world object rather than with an abstract system



James Tam

## **Direct Engagement & Direct Manipulation (2)**

### **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 like real world)

### **Almost always based on a metaphor**

- Mapped onto some facet of the real world task semantics

James Tam

## **Direct Engagement**

### **Xerox Star: pioneered in early '80s, copied by almost everyone**

- Simulates desktop with icons
  - In and out baskets
  - File folders and documents
  - Calculators
  - Printers
  - Blank forms for letters and memos
- Small number of generic actions applicable system wide
  - Move, copy, delete, show properties, again, undo, help
    - e.g., same way to move text, documents, etc
  - Property sheets
    - pop-up form, alterable by user
- What you see is what you get (WYSIWYG)

James Tam



## Direct Engagement (2)

### Star's observers:

- Objects understood in terms of their visual characteristics
  - Affordances, Constraints
- Actions understood in terms of their effects on the screen
  - Causality
- Intuitively reasonable actions can be performed at any time
  - Conceptual model

James Tam

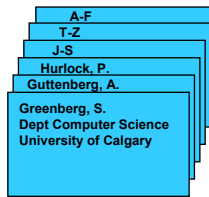
## Direct Engagement: A Telephone Database

```
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

## Metaphors In Games



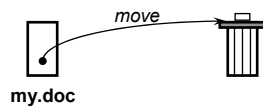
The Sims House Party  
(Maxis)

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)

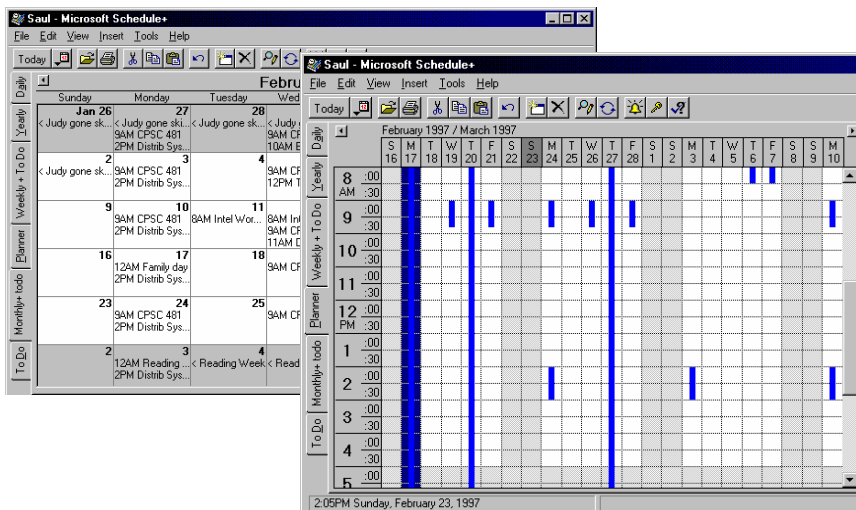
### Advantages

- 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

## Direct Manipulation

Representation directly affects what can be directly manipulated



# Is Direct Manipulation The Way To Go?

## Some Disadvantages

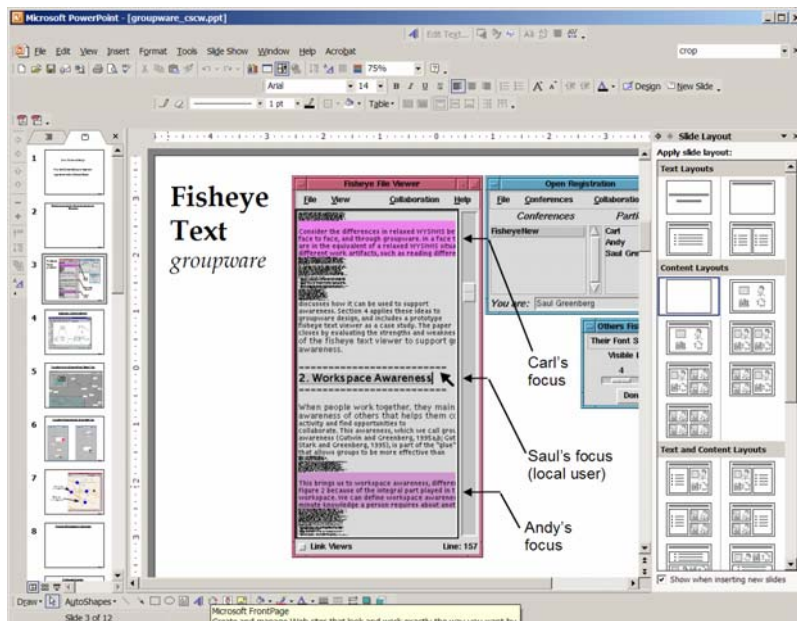
- Ill-suited for abstract operations
  - Spell-checker?
- Tedium
  - Manually search large database vs. query
- Task domain may not have adequate physical/visual metaphor
- Metaphor may be overly-restrictive

## 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”)

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# Conventional Applications: A Mix



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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

# Interface Design and Usability Engineering

