# Information Visualization In Practice

**How the principles of information visualization can be used in research and commercial systems**



# Putting Information Visualization Into Practice

## A Common Problem

- There is a large set of information to represent.
- The display space is limited.
- Also:
  - Providing all the details all at once is not useful (results in overload).
  - Showing only a subset of the information may result in a lost of context.

## Too Much Information To Show All At Once



## Another Example Of The "Large Data Set – Limited Display Space Problem" : Adventure/RPG Games


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

## Too Much Information To Show All At Once

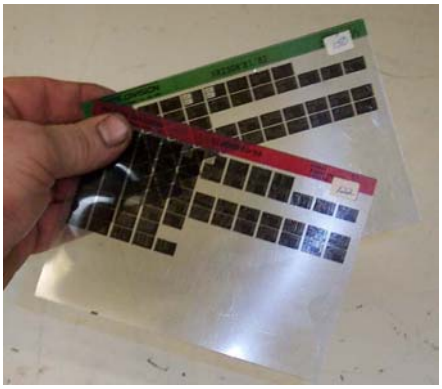
**Approaches to the problem:**

1) **Scrolling**
2) **Overview and detail**
3) **Magnification**
4) **The DragMag**
5) **Transparent overlays**
6) **Zooming**
7) **Focus and context**

James Tam

## 1) Scrolling

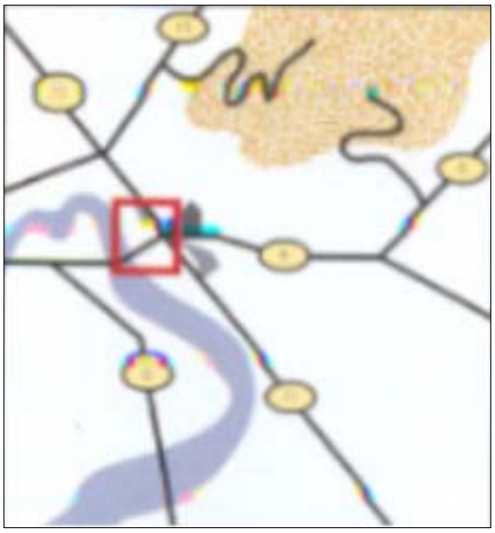
Scrolling along one dimension



Scrolling in two dimensions

James Tam

## 2) Overview And Detail: Separate



Overview

Detailed view

Images from “Information Visualization” by Robert Spence



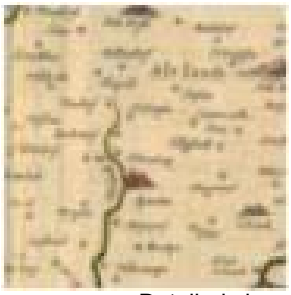
## 2) Overview And Detail: Separate

Defender © Midway Home Entertainment Ltd.

## 2. Overview And Detail: Separate

**Relating the detailed and overview can be a challenge:**

Overview



Detailed view

James Tam

## 3) Magnification: Inline

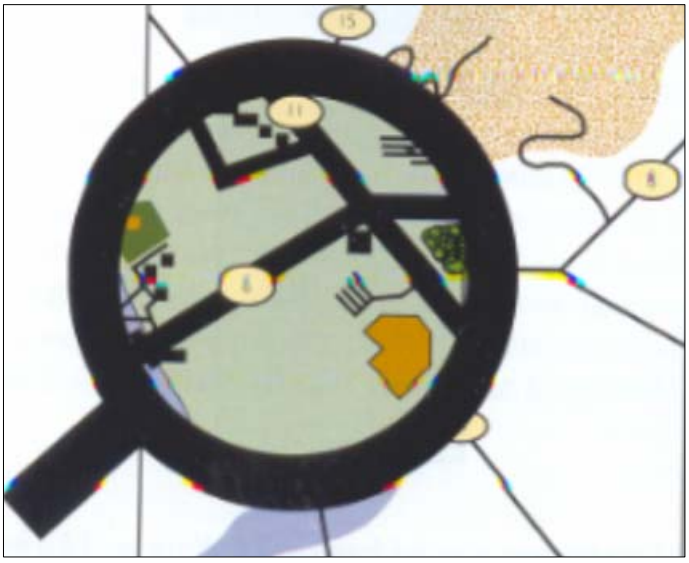


Image from “Information Visualization” by Robert Spence

James Tam

# 3) Magnification: Inline

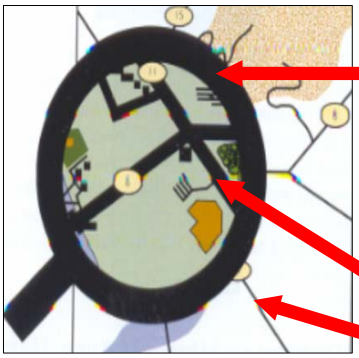


Image from “Information Visualization” by Robert Spence

**Problem 1:**
Occlusion of the area to be viewed by the viewer

**Problem 2:**

Lack of continuity between the magnified area and the surrounding context.

James Tam

# 3) Magnification: Mutually Exclusive

Icewind Dale © Interplay productions

James Tam

## 3) Magnification: Mutually Exclusive

Icewind Dale © Interplay productions

James Tam

## 4) The DragMag

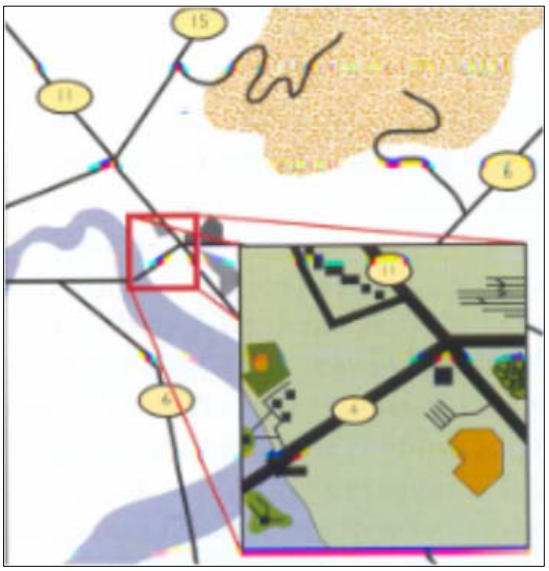


Image from “Information Visualization” by Robert Spence

James Tam

## 4) The DragMag

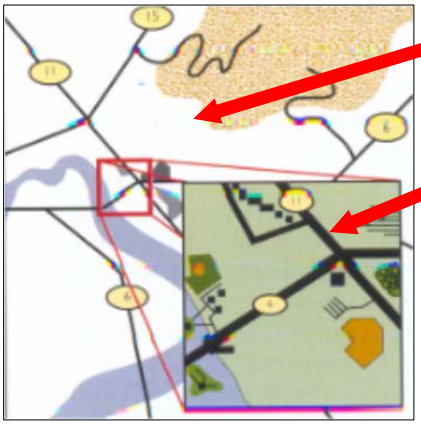
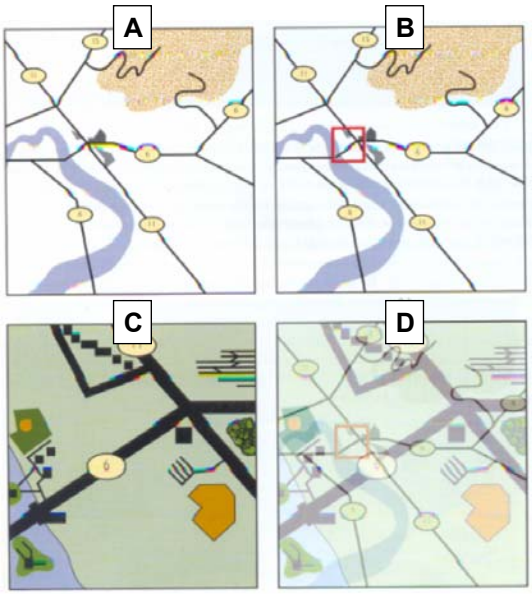



Image from "Information Visualization" by Robert Spence

James Tam

## 5) Transparent Overlays




**Key:**

A. Overview

B. Which part of the overview will be magnified

C. The magnified portion of the overview

D. The magnified view transparently overlaid on the overview

Image from "Information Visualization" by Robert Spence

James Tam

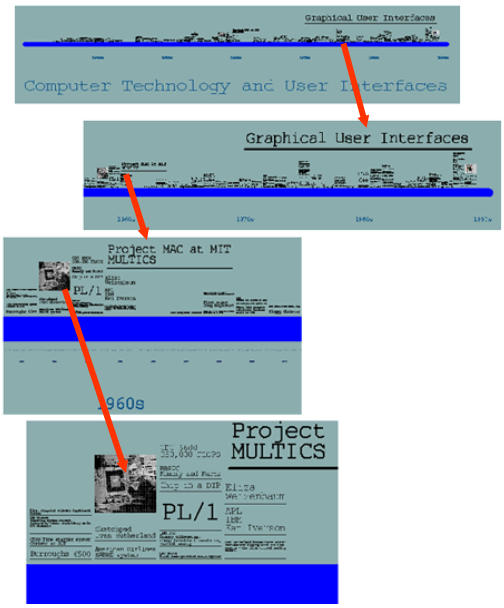
# 5) Transparent Overlays


Diablo © Blizzard

James Tam

# 6) Zooming

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

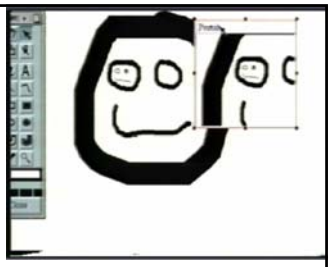



**Browsing of digital images**

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

James Tam

## Pad++: The Details



**Not a system in and of itself!**

- A proposed alternative to WIMP interfaces.
- Allows for zooming to be added to existing systems ("ZUI's")

**Characteristics**

- An infinite 2D plane
- Objects can be placed anywhere
- The plane can be scaled to any size

James Tam

## Zooming Need Not Be Just Tied To Simple Magnification/Reduction Of Size!

**Some ways that zooming can show more (or less information)**

**A. Aggregation**

**B. Filtering**

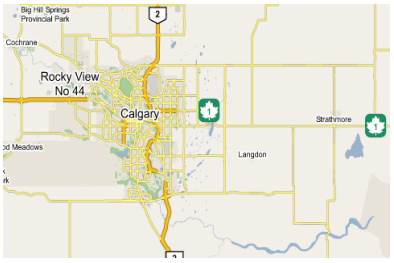
**C. Semantic zooming**

James Tam

# A. Aggregation

**Aggregation – combine information into some compact yet meaningful way**


Zoomed out



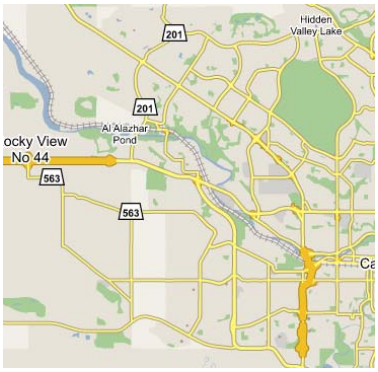

Zoomed in

Images from Google Maps: http://maps.google.com/

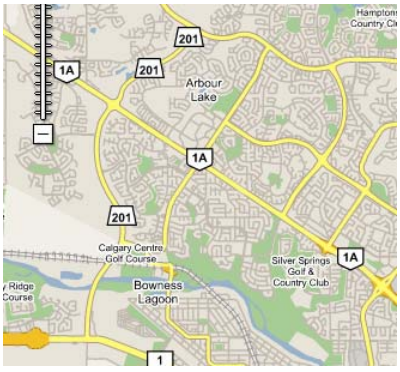
James Tam

# B. Filtering

**Block the appearance of some of the information**




Zoomed out



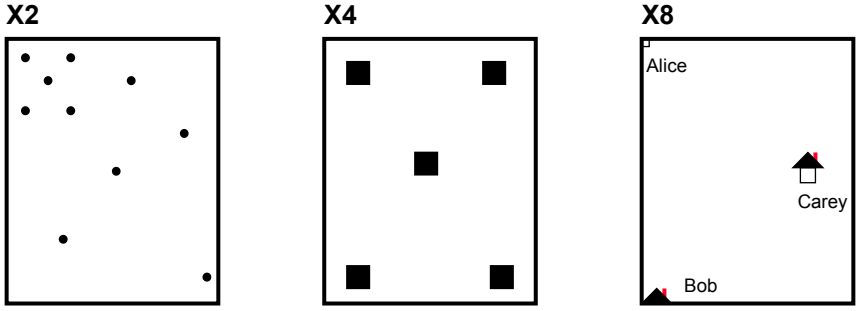

Zoomed in

Images from Google Maps: http://maps.google.com/

James Tam

## C. Semantic Zooming

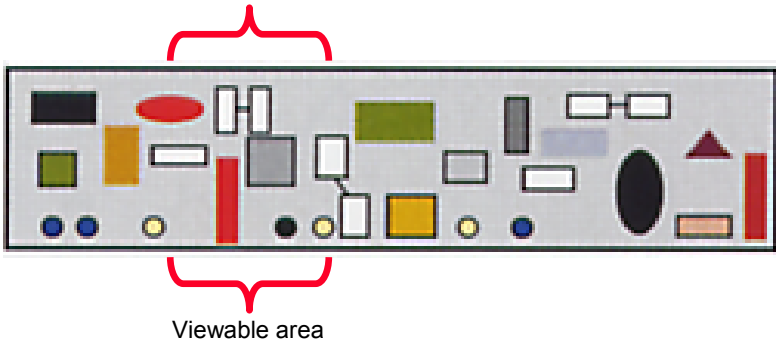
**At different zoom levels the same information may appear in the display but it is represented in a different fashion:**




James Tam

## 7. Focus And Context

- **Again the amount of the information is too large to display all at once.**

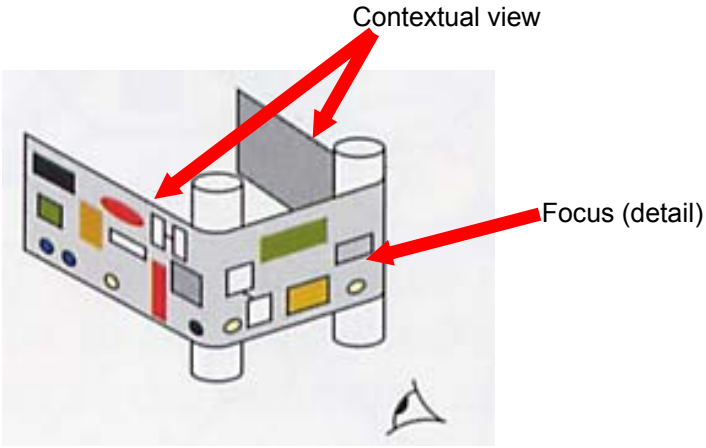



From "Information Visualization" by Robert Spence

James Tam

## 7) Focus And Context

- **With this approach detailed view can still be viewed within its surrounding context.**




From "Information Visualization" by Robert Spence

James Tam

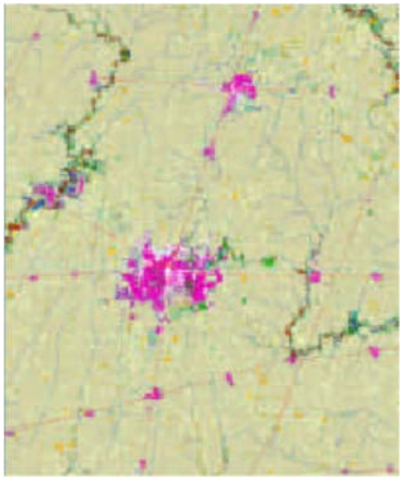
## The Fisheye Lens: Photography

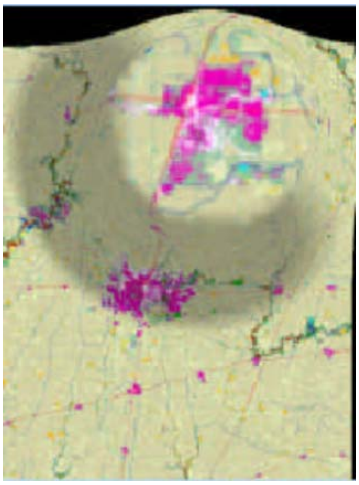
Image from: http://rick_oleson.tripod.com/

James Tam

## Fisheye View: Information Visualization

**An application of the focus and context approach**

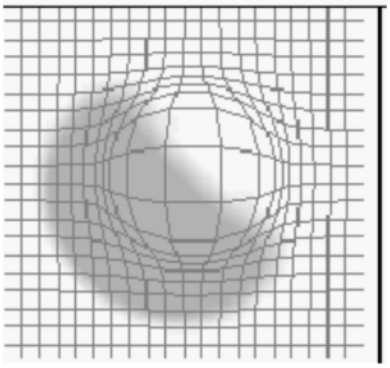




James Tam

## Fisheye View: Visual Cues For The Distortion

**Distortion is understandable through the use of a grid and shading**



James Tam

# Table Lens


James Tam

# Table Lens

**Overview:**

- Show all the information in an abstracted graphical form

**Focus:**

- Show all the details of only a subset of the data.


James Tam

## Table Lens : The Details

- **Abstracts a large volume of data into a small space.**
- **The overview may allow the user to spot:**
  - Trends
  - Patterns
  - Outliers
- **Details are provided on demand**
- **The data can be manipulated**




## Focus And Context: Distortion In One Dimension

- **Distortion in the X-dimension**

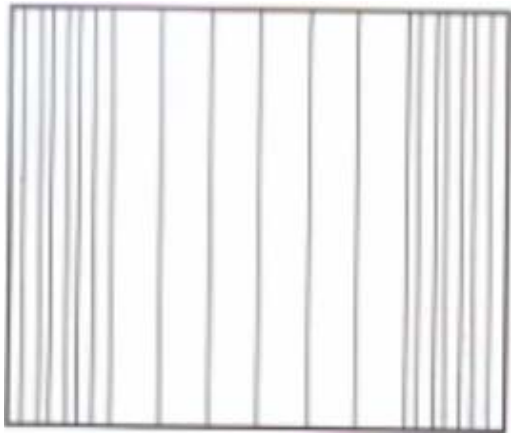
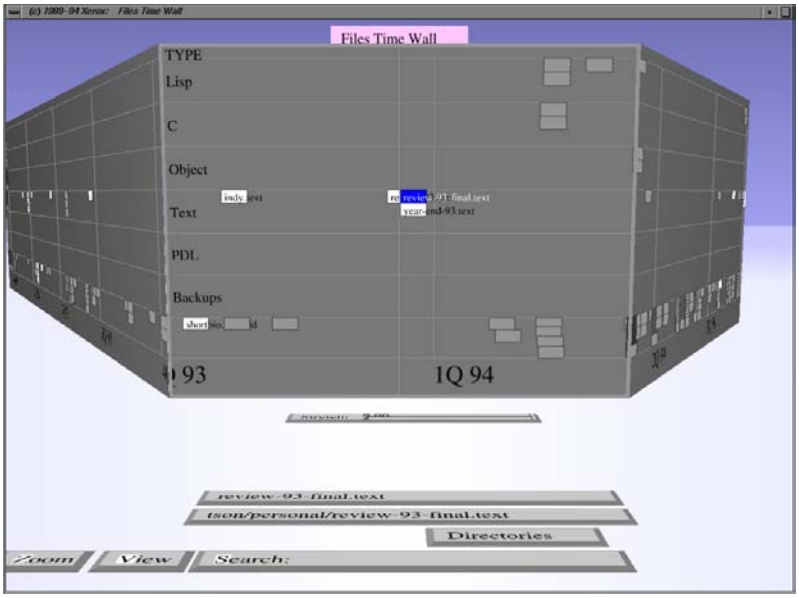


Image from “Information Visualization” by Robert Spence

# The Perspective Wall




Mackinlay / Robertson / Card: Proc ACM CHI'91

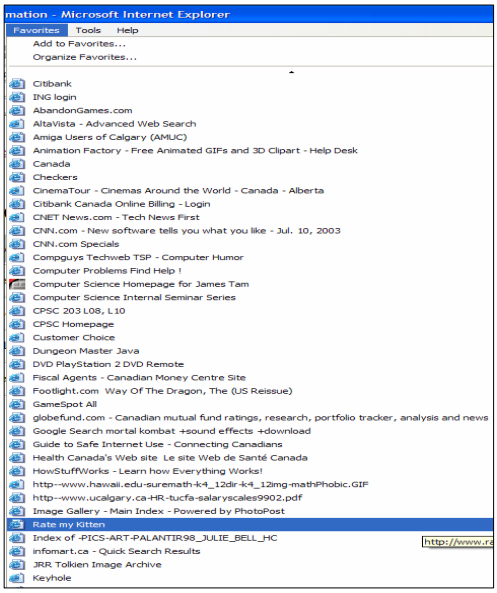


# Another Example Of The "Large Data Set – Limited Display Space Problem" : Lists

**Approaches to mitigating the problem:**

- Scrolling
- Setting up hierarchies
- Fisheye

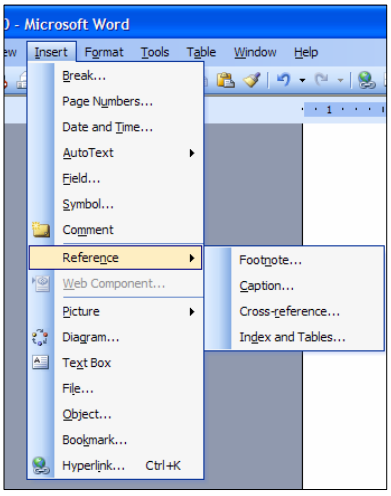
# Scrolling Menus





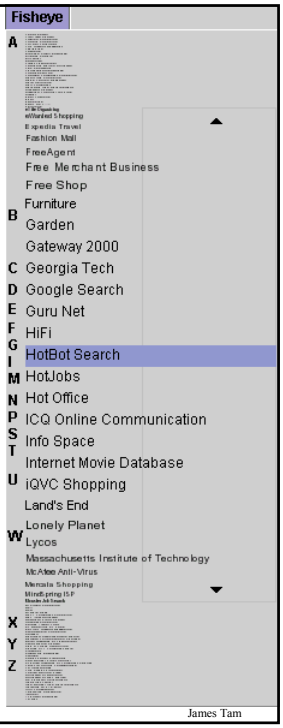

# Hierarchical Menus

**Works well for goal directed tasks (e.g., selecting from a menu of functions that are familiar).**




Word © Microsoft

# Fisheye Menus

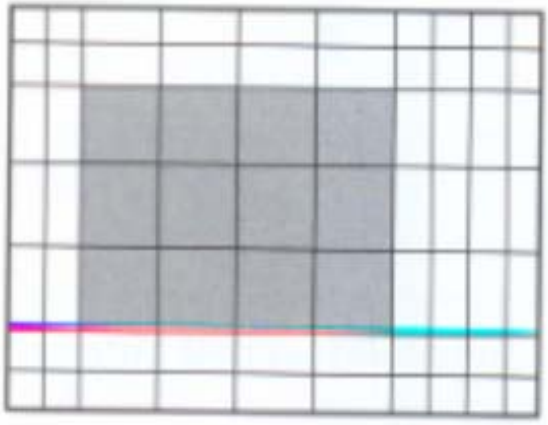



Bederson, B.B. (May 2000)
University of Maryland
www.cs.umd.edu/hcil/fisheyemenu/

James Tam

# Focus And Context: Distortion In Two Dimensions

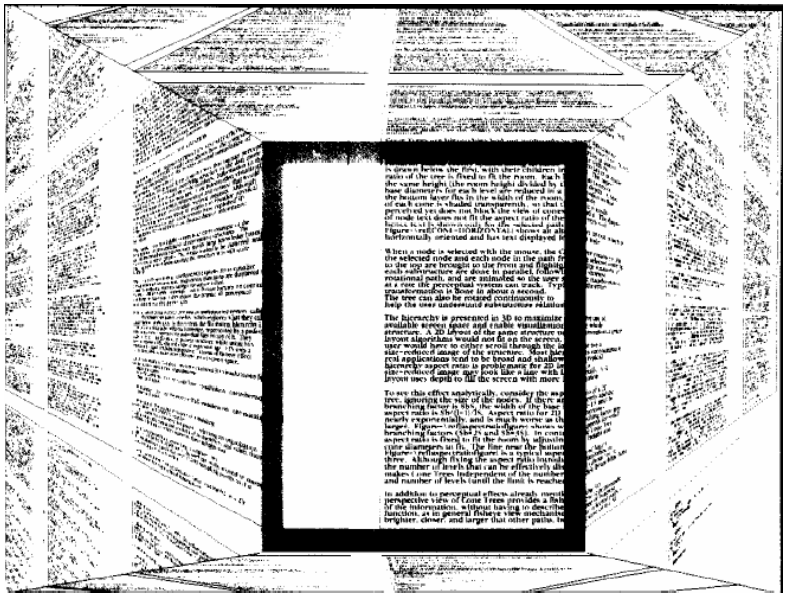
- **Distortion in both the X and Y dimensions**



Images from “Information Visualization” by Robert Spence

James Tam

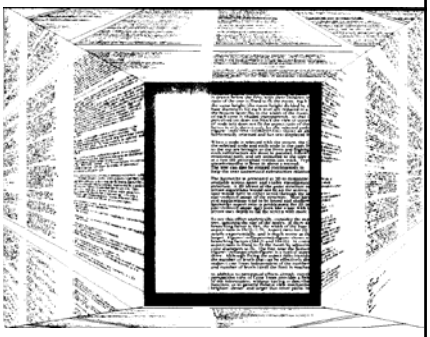
# DocumentLens



*Robertson / Mackinlay ACM UIST 1993*



# DocumentLens: The Details



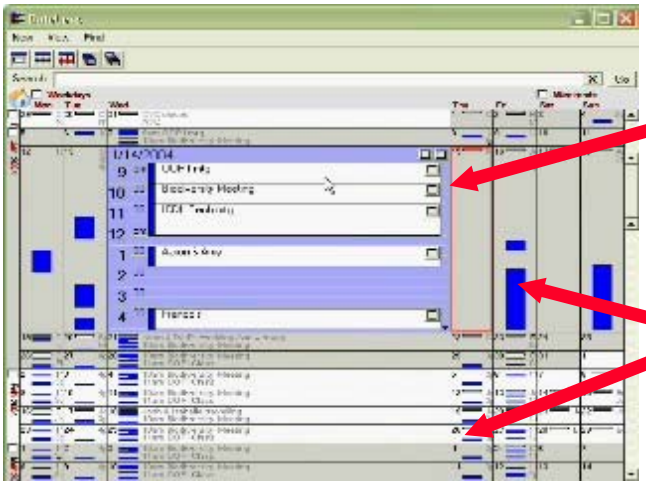
**Recall:**

- The Perspective Wall can only be used when the data is structured into different categories.
- Laying out a complete overview of a large dataset is not feasible.

**DocumentLens:**

- Can be used when the data is not organized.
- Portions of the data can viewed in greater detail while the surrounding context can still be seen.

# The DateLens



Detailed calendar view of one day (focus)

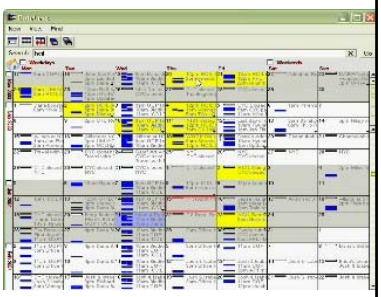
Abstracted calendar information of other days and times (context)

The DateLens: HCIL (University of Maryland) and Microsoft Research

James Tam

# The DateLens: The Details

- **Combines a fisheye view of calendar information with zooming (zui's)**
- **The fisheye view can be distorted to increase the 'weight' of particular information.**
- **Integrated searching**
  - Results show up in greater detailed in the area of focus
  - Results also show up in an abstracted form in the contextual view
- **Zooming**
  - Double headed scrollbar can be used to zoom in or out of the calendar
  - Automatic rescaling of the detailed view



James Tam

# Fisheye vs. Separate (Overhead And Detail) Views

**Separate**

**Fisheye**

James Tam

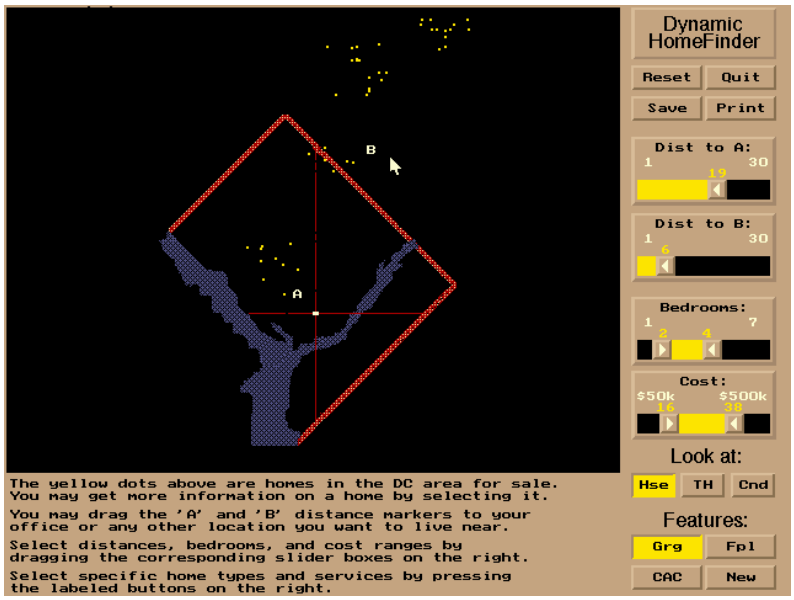
# Visual Information-Seeking Mantra

- **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 3rd Ed. 1997 p523

James Tam

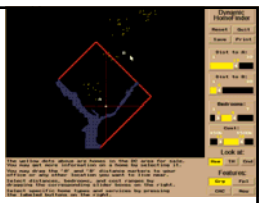
# Dynamic Queries: HomeFinder




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

James Tam

# HomeFinder: The Details



## Start with an overview of the data

- All query results may all appear in an abstracted form

## Dynamic queries (rapid, incremental, reversible actions to filter the data)

- All query results are displayed instantly
- No "search button"
- Prevents errors

## Direct manipulation of

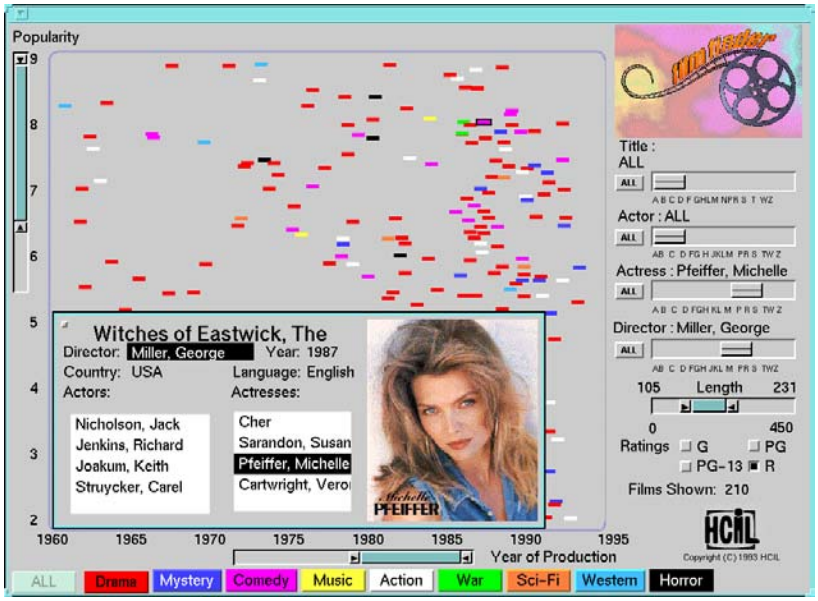
- Queries
- Query results
- Can be interacted with like real-world objects

## Details on Demand

- Additional information can be provided about each query result

James Tam

# Starfield Display: FilmFinder




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

James Tam

# FilmFinder: The Details

**Filmfinder employs many of the principles employed in the HomeFinder:**

- Overview of the data
- Filtering query results through
  - Dynamic queries
  - Direct manipulation
- Details on demand

**But with FilmFinder system there are additional concepts:**

- Zooming in on the data set.
  - When the number of query results is small additional details are provided about each result (thumbnails and text)
- Starfield display
  - The entire data base can be viewed and manipulated on one screen with meaning attached to each dimensions.
- Tight coupling of interface components (to the state of the system)

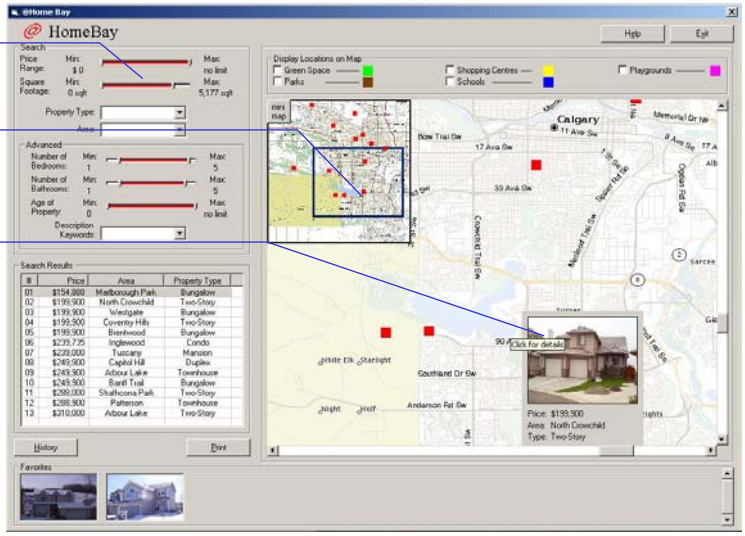
James Tam

# A Student Project: HomeBay

**Dynamic Queries**

**Radar Overview**

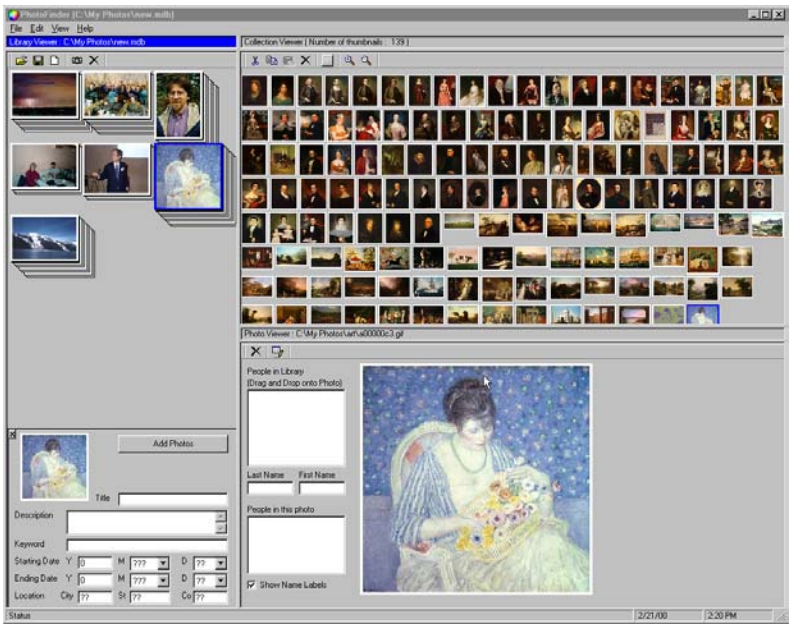
**Progressive details on demand**




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

James Tam

# PhotoFinder



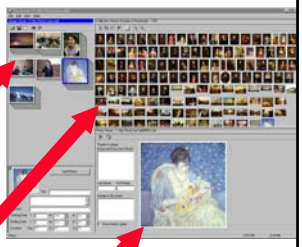

University of Maryland Human Computer Interaction Laboratory http://www.cs.umd.edu/hcil/

James Tam

# PhotoFinder: The Details

**Multiple Views Of A Large Data Set:**

- 3 levels of detail



Library view

Collection view

Photo view

James Tam

# PhotoFinder: The Details (2)

**Allows for the annotation of each photo with pertinent information ("tagging")**


James Tam

## Representing Connectivity

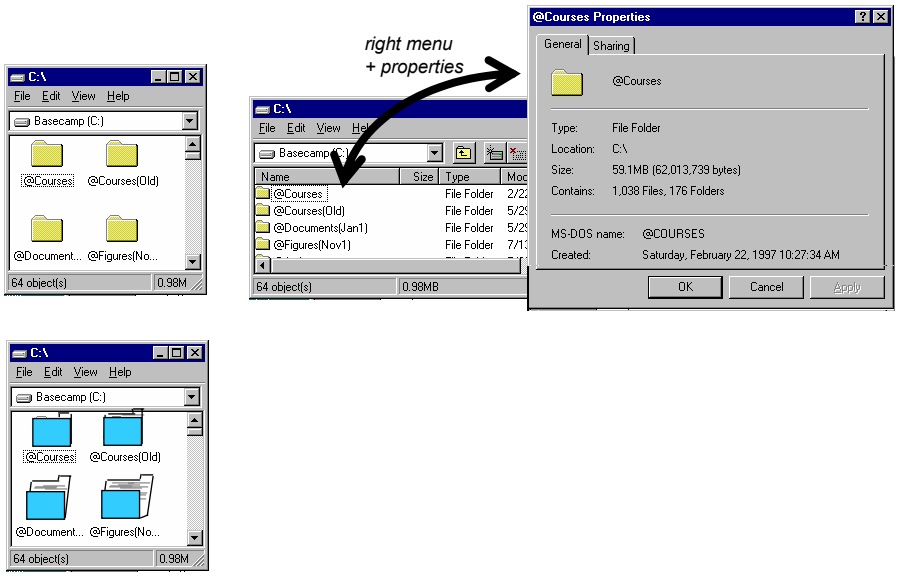
- **The problem of having large data set – but limited display space must still be dealt with**
- **Also there is the additional problem of showing how things in a large data set relate**
  - e.g., How do we show Internet connections between servers?
- **Some issues:**
  - Occlusion of information
  - Edge crossing
  - Overwhelming quantity of edges



## Representing Phone Network Connections

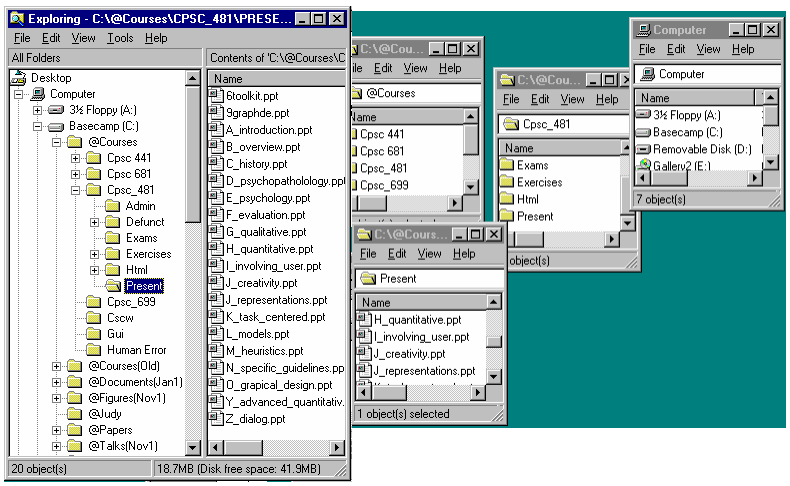
Images from "Information Visualization" by Robert Spence

# Which Folder Has The Most Documents?

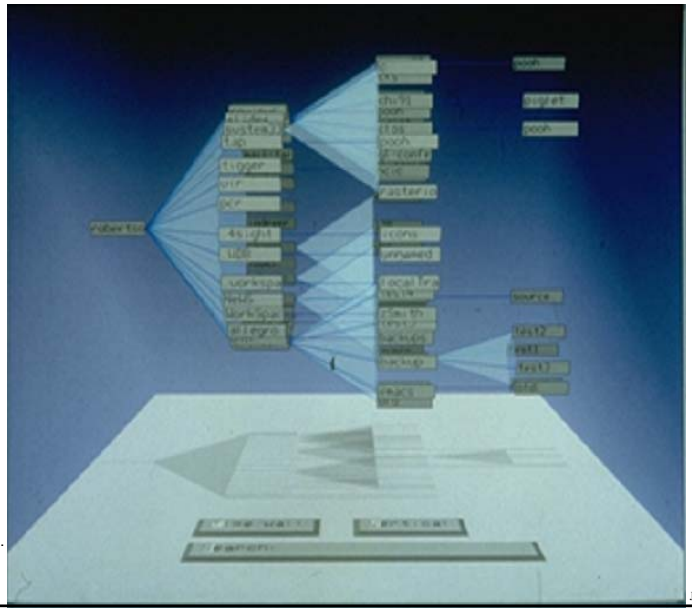





# Where Am I? Where Was I Going?



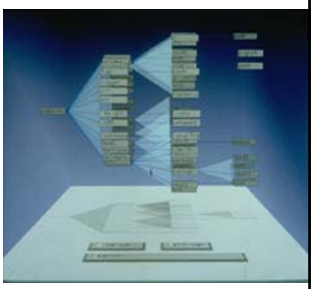
# Cone Trees



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

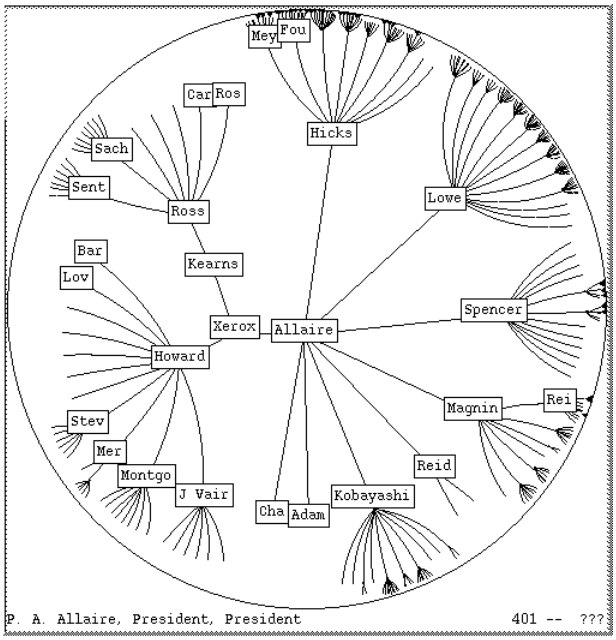
James Tam

# Cone Trees: The Details



- **Employs 3D in order to more efficiently represent the data and their relationships.**
  - Used to represent complex hierarchies
  - To mitigate the effect of occlusion transparency is employed
- **Fisheye effects are used to highlight nodes.**
- **Dynamic filtering of the tree.**
- **Animates the display to help the user to interpret results.**

James Tam

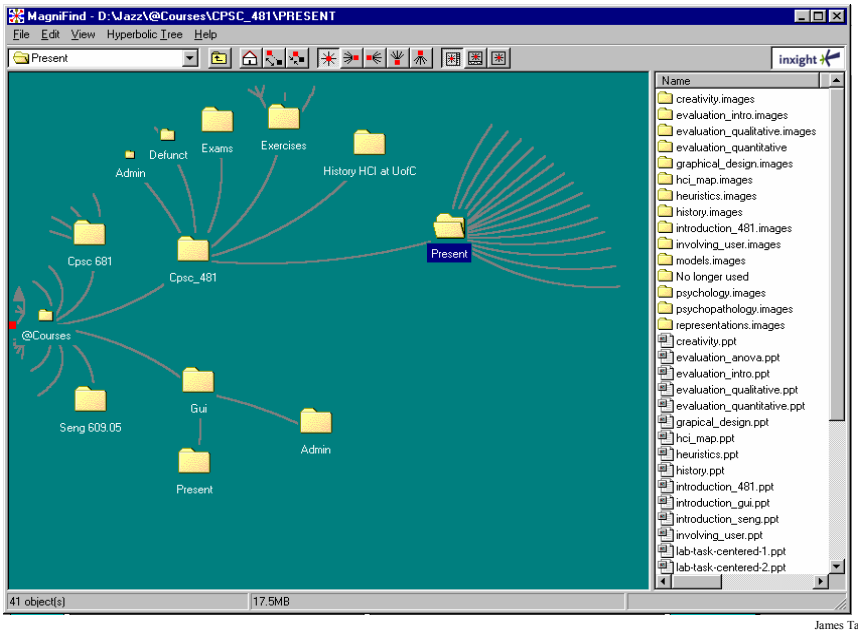



# Xerox Parc/Inxight

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

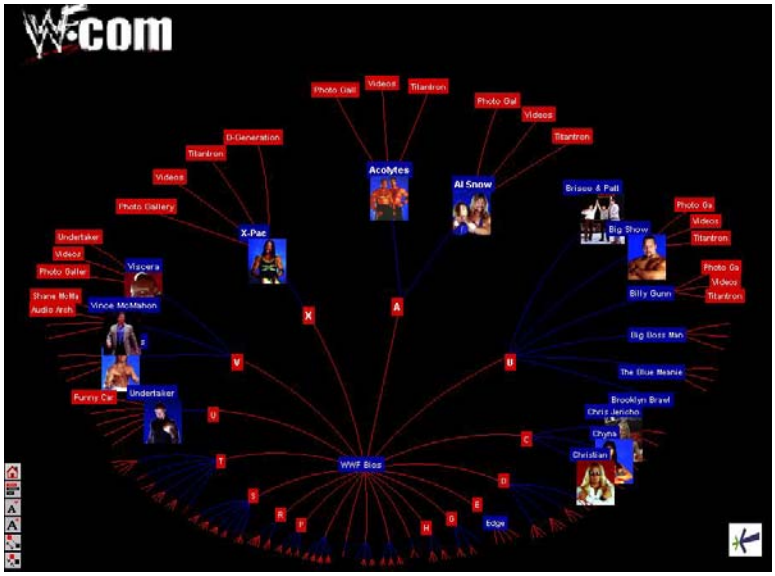
James Tam

# Hyperbolic View Of A Disk Hierarchy




James Tam

# Hyperbolic View Of The Web




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



# What You Now Know

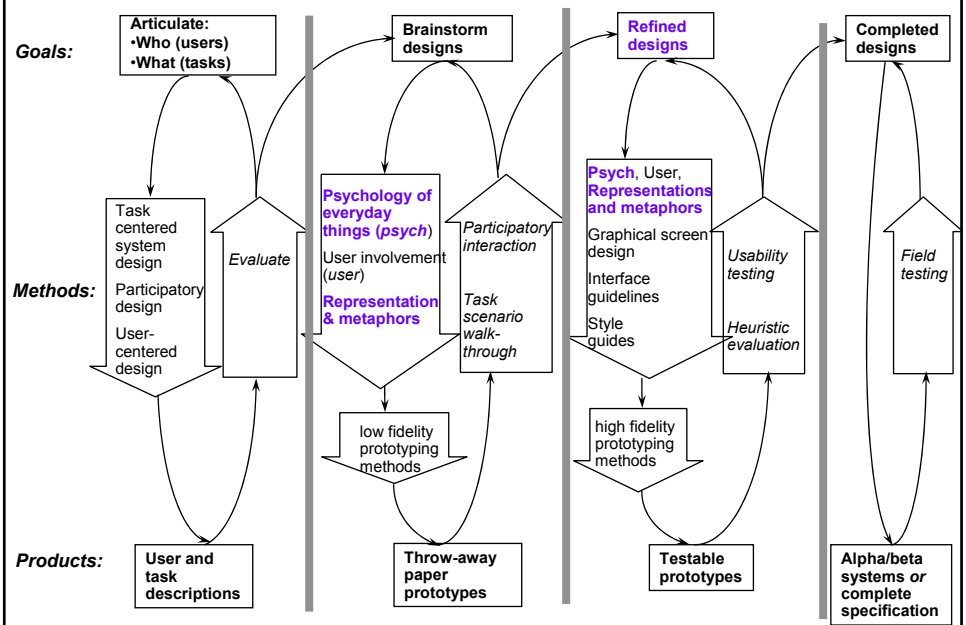
**Ways of dealing with the "large data set but limited display space" problem**

- Scrolling
- Magnification
- The DragMag
- Transparent overlays
- Overview and detail
- Focus and context
- Zooming

**The information seeking mantra and how it has been applied in the HomeFinder and FilmFinder systems**

**Problems and some solutions when representing connectivity in large data sets**

# Interface Design And Usability Engineering




This diagram is a variation of the one presented by Saul Greenberg

James Tam