Presentation

Presentation Problem

- Scale - many data sets are too large to visualize on one screen
  - May simply be too many cases
  - May be too many variables
  - May only be able to highlight particular cases or particular variables, but viewer's focus may change from time to time

Devices with even smaller screens are becoming more popular

- Displaying London underground map in sufficient detail requires very large screen

Solutions to Presentation Problem

- Overview and Detailed view
- Focus+Context distortion
- Panning and Zooming

Overview and Details

Overview or Details or Both

- Providing an overview of the data set can be valuable
  - Helps user present overall patterns
  - Assists user with navigation and search
  - Generally start with overview

- Providing details
  - Examining individual cases and variables
  - Generally provide details on demand

- Providing both: Overview + detail displays can be combined via either time or space
  - Time - Alternate between overview and details sequentially in same place
  - Space - Use different portions of screen to show overview and details
  - Develop interface techniques to show viewers both overview + detail, and allow flexible alternation between each

Common Solution

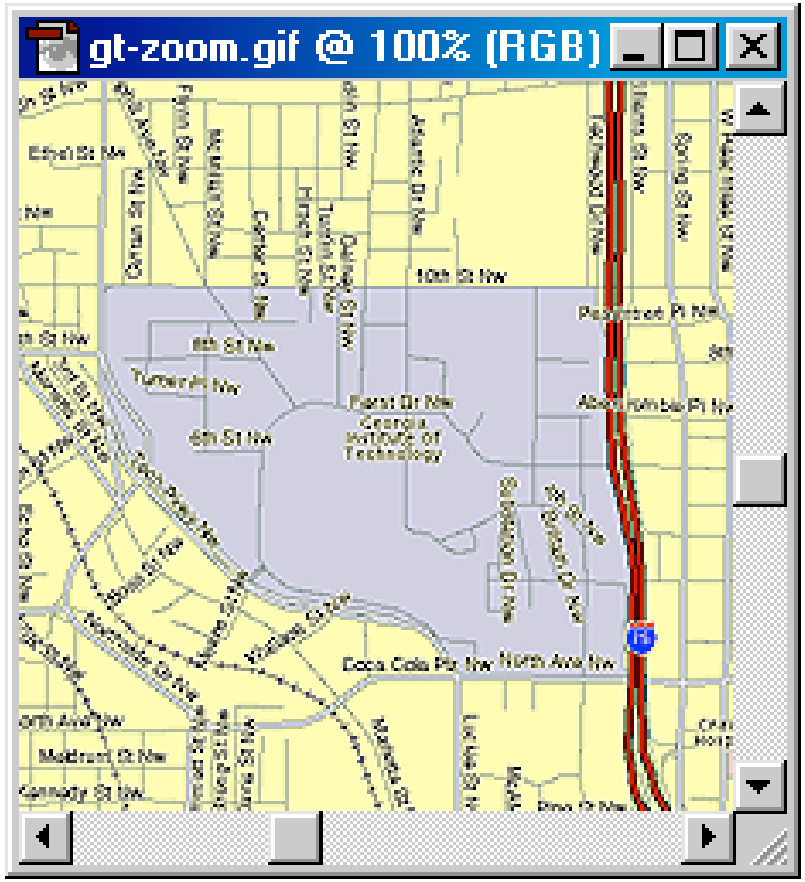
- Scroll
  - Provide a larger, virtual screen by allowing user to move to different areas

- Allow viewer to examine cases and/or variables in detail while still maintaining context of those details in the larger whole

- Navigation & interaction are important.

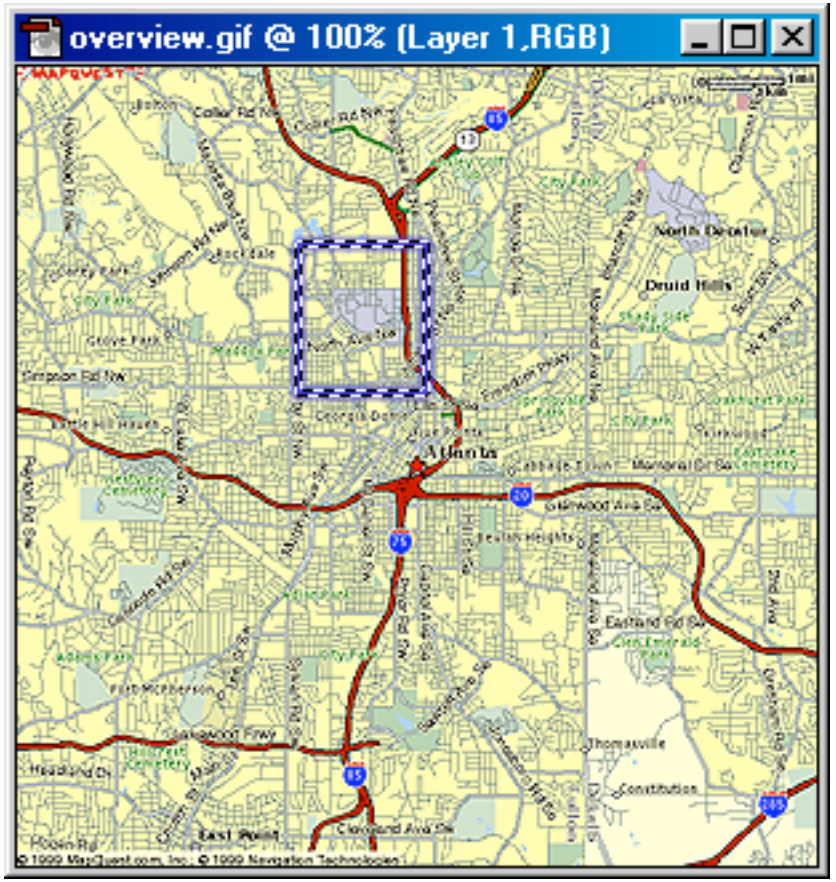
Detail-Only

- Single window with horizontal and vertical panning
- Works only when zoom factor is relatively small
- Example: Windows



Single Window with Zoom and Replace

- Global view with selectable zoom area which then becomes entire view
- Variations can let users pan and adjust zoomed area and adjust levels of magnification
- Context switch can be disorienting

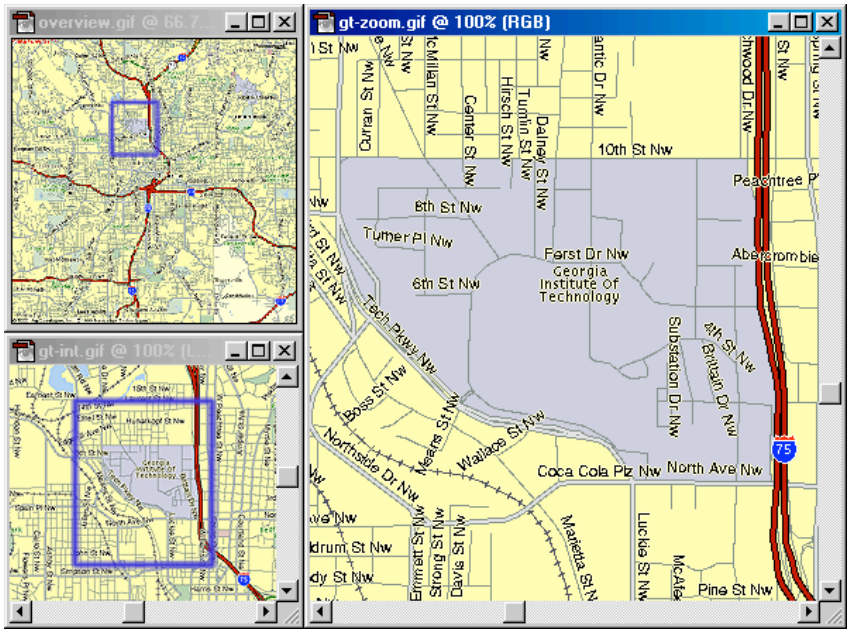


Single Coordinated Pair

- Combined display of the overview and local magnified view (separate views)
- Some implementations reserve large space for overview; others for detail
- Issue: How big are different views and where do they go?

Tiled Multilevel Browser

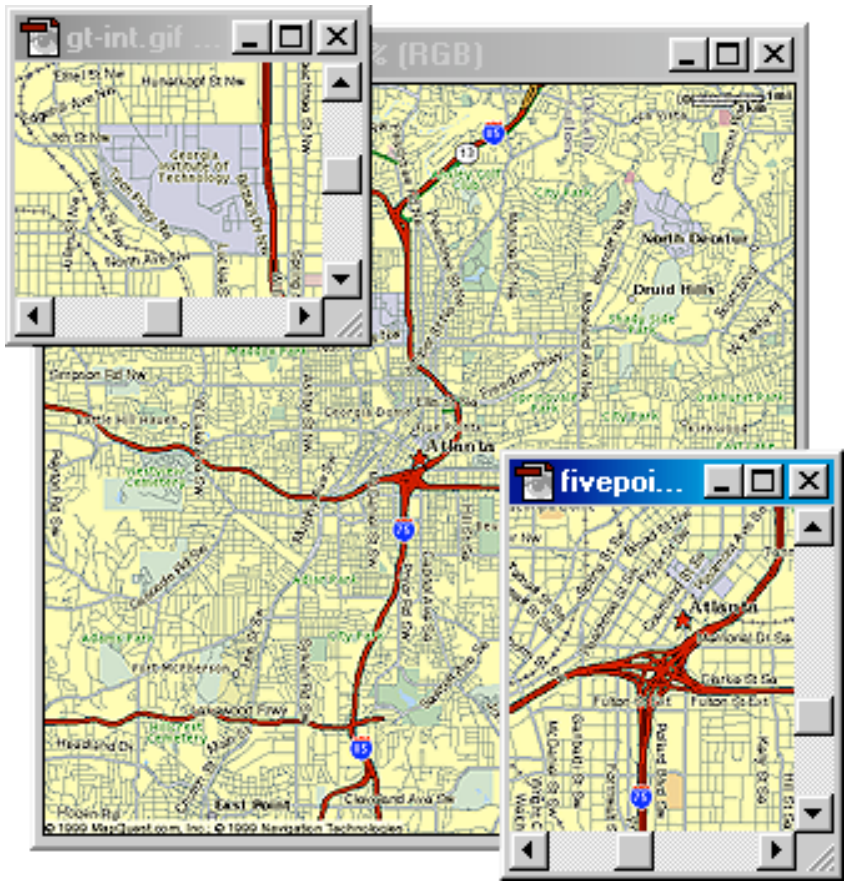
- Combined global, intermediate, and detail views
- Views do not overlap
- Good implementations closely relate the views, allowing panning in one view to affect others



Free Zoom and Multiple Overlap

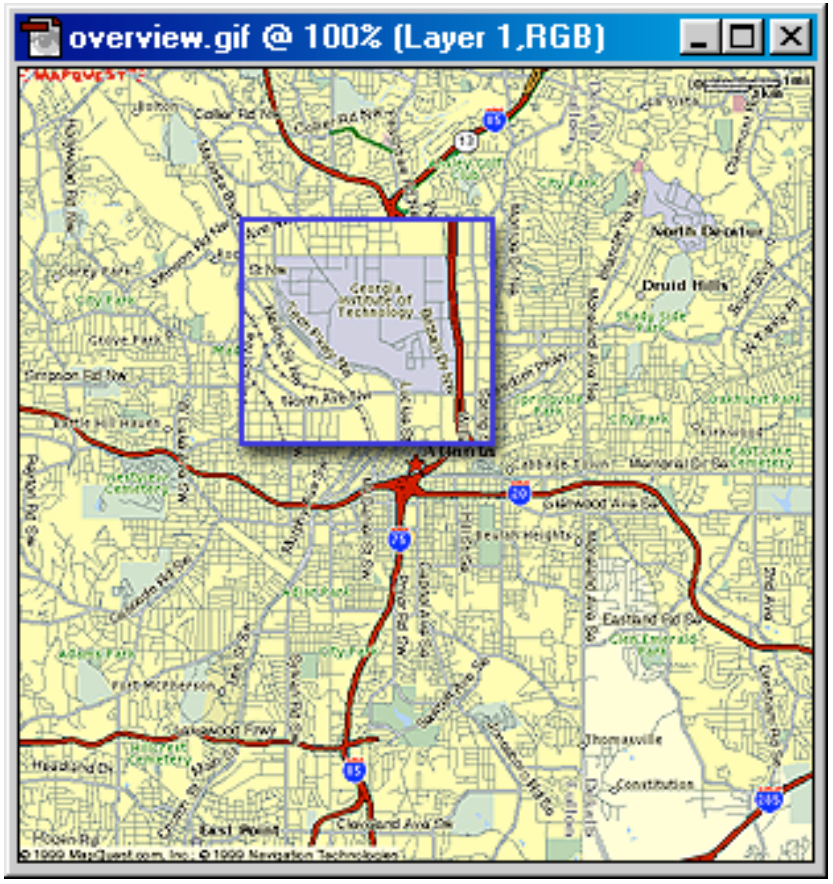
- Overview presented first; user selects area to zoom and area in which to create detailed view

- Flexible layout, but users must perform manual window management



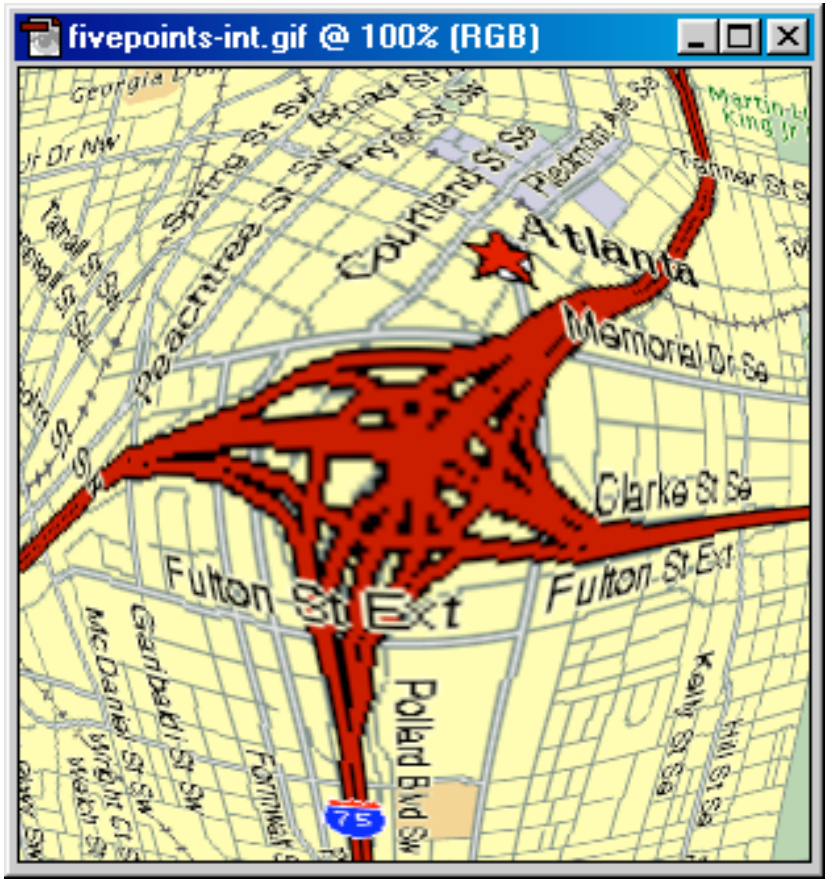
Bifocal Magnified

- "Magnifying glass" zoomed image floats over overview image
- Neighboring objects are obscured by the zoomed window



Fish-Eye View

- Magnified image is distorted so that focus is at high magnification, periphery at low
- All in one view
- Distortion can be disorienting



Important Issue

- The “overview” display may need to present huge number of data elements
- What if there simply isn’t enough room?
  - The number of data elements is larger than the number of pixels
- Reduce the visual representation
  - Smart ways to draw large numbers of data elements
  - Information Mural

Mural Algorithm

Information Mural is a two-dimensional, reduced representation of an entire information space that fits entirely within a display window or screen

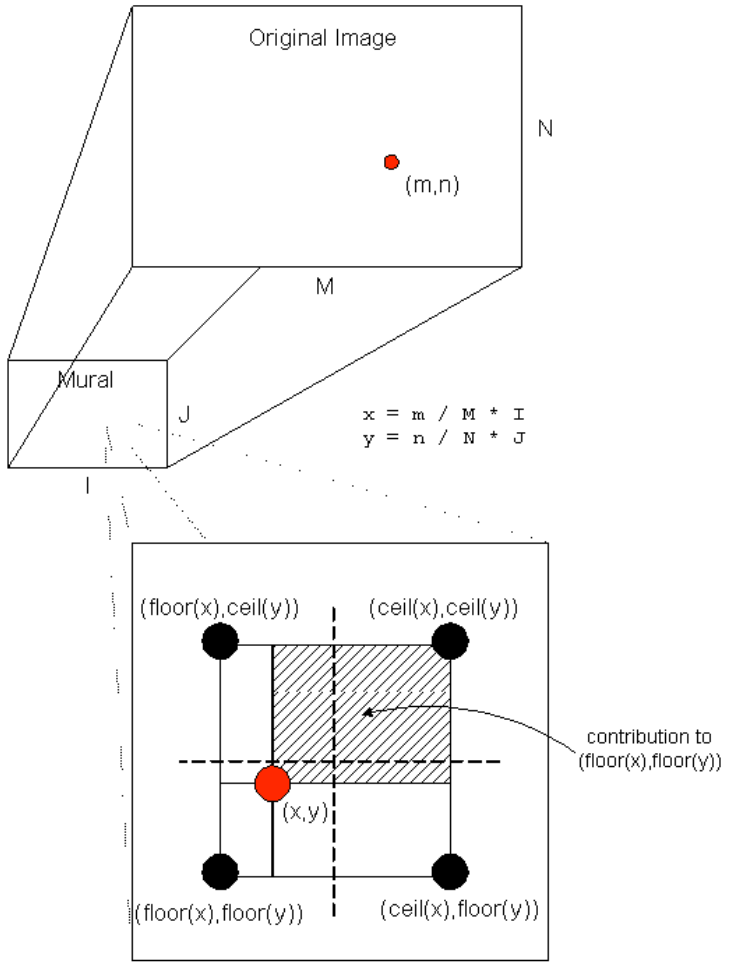
Algorithm scales an image of M x N elements into a mural of I x J pixels

Think of each data point as ink and each screen pixel as a bin

Data points (ink) don't fit cleanly into one bin, some ink may go into neighboring bins

Can map density to gray or color scale

Example, intensity of pixel is proportional to number of points that have fallen in it



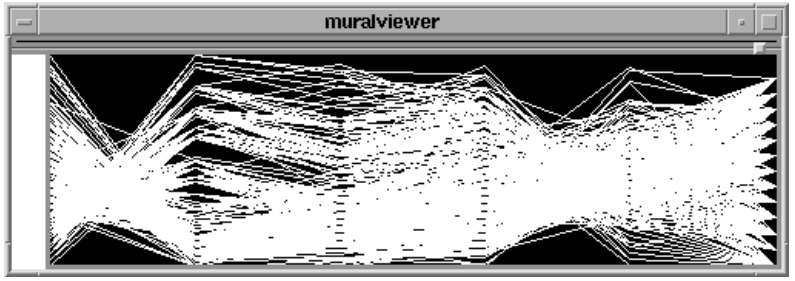
www.cc.gatech.edu/gvu/softviz/infviz/information_mural.html

Mural Example

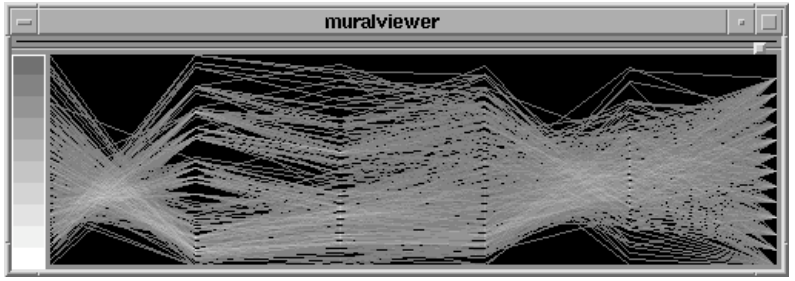
Mural of a parallel coordinate view of automobile data showing MPG, engine displacement, horsepower, weight, acceleration, and model year (1970-1982).

Standard parallel coordinate view of the data.

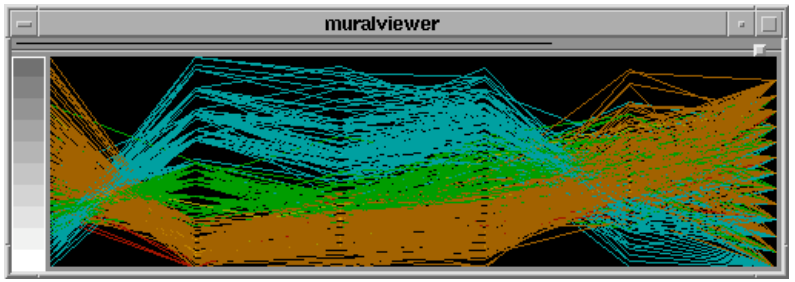
Color overlaid for number of cylinders (3 = red, 4 = orange, 5 = yellow, 6 = green, 8 = cyan)



normal



muralized

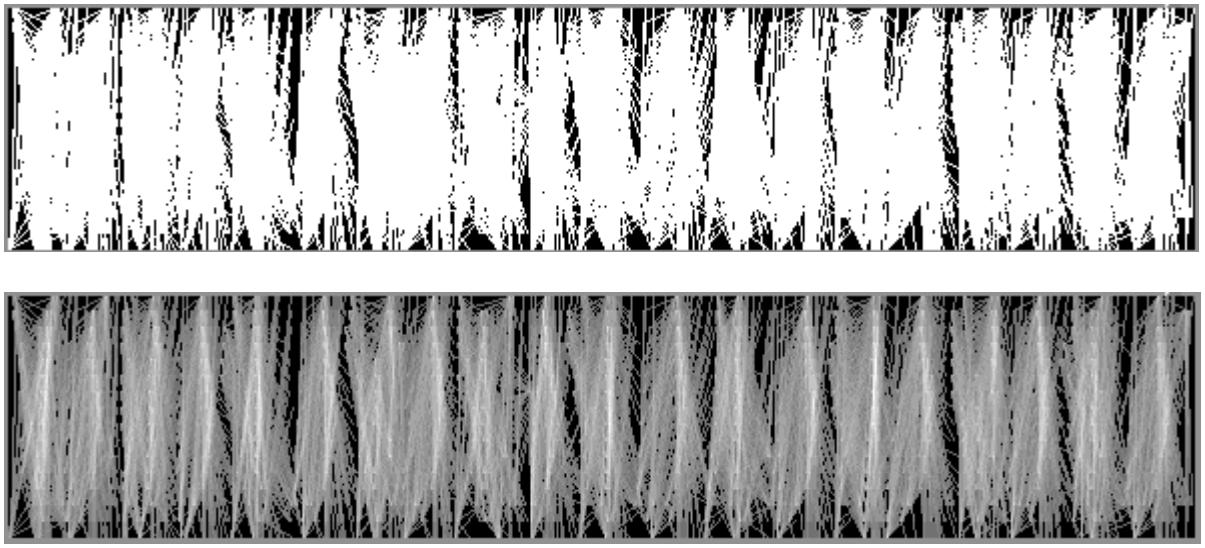


colorized

Mural Example

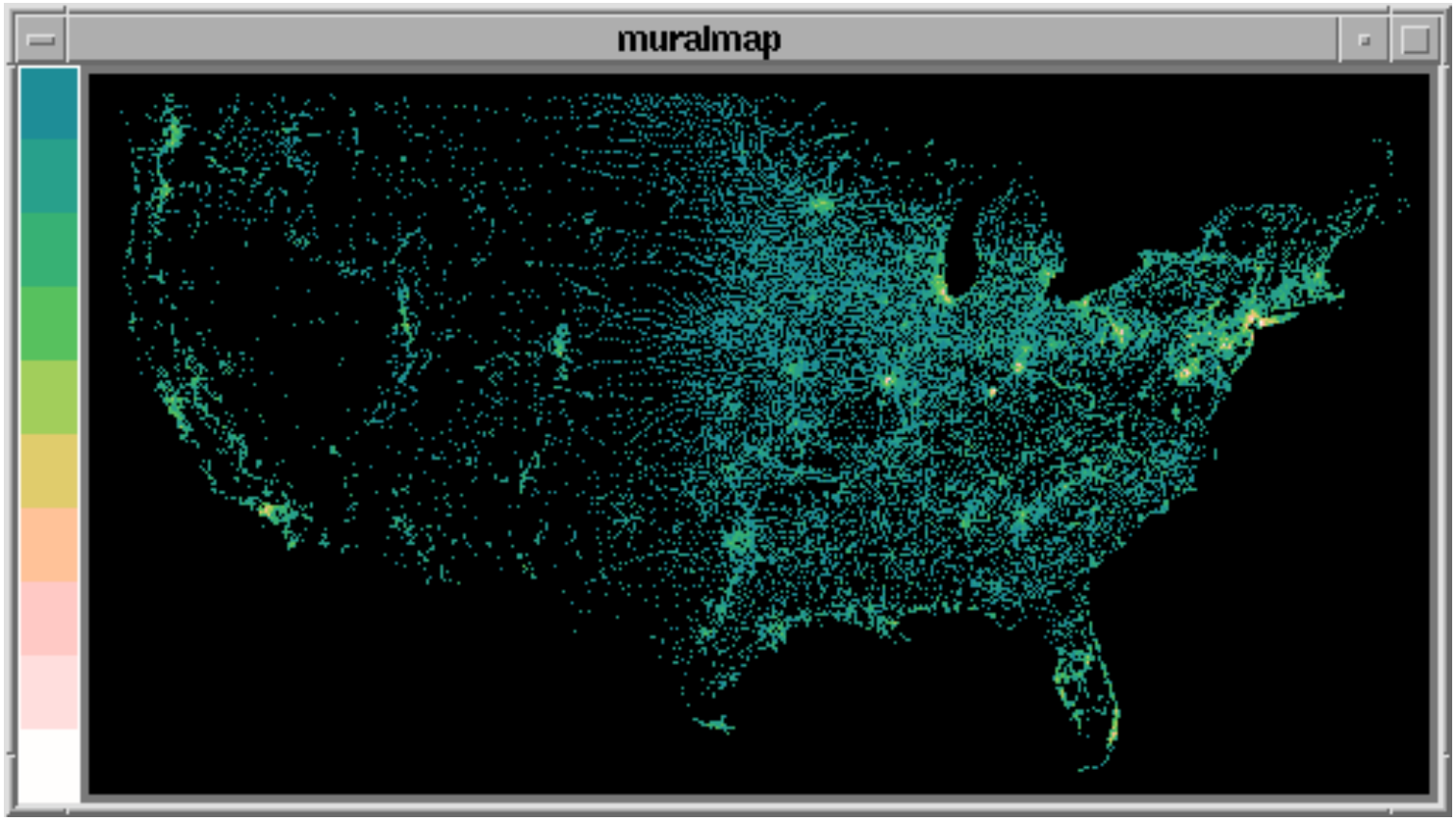
Message passing in parallel program on 16 Processors:

Each processor is assigned a row on the vertical axis, and a message is drawn as a line from one processor to another at the appropriate time coordinates



Mural Example

Mural of population density distribution, using data from the 1990 census



Focus + Context

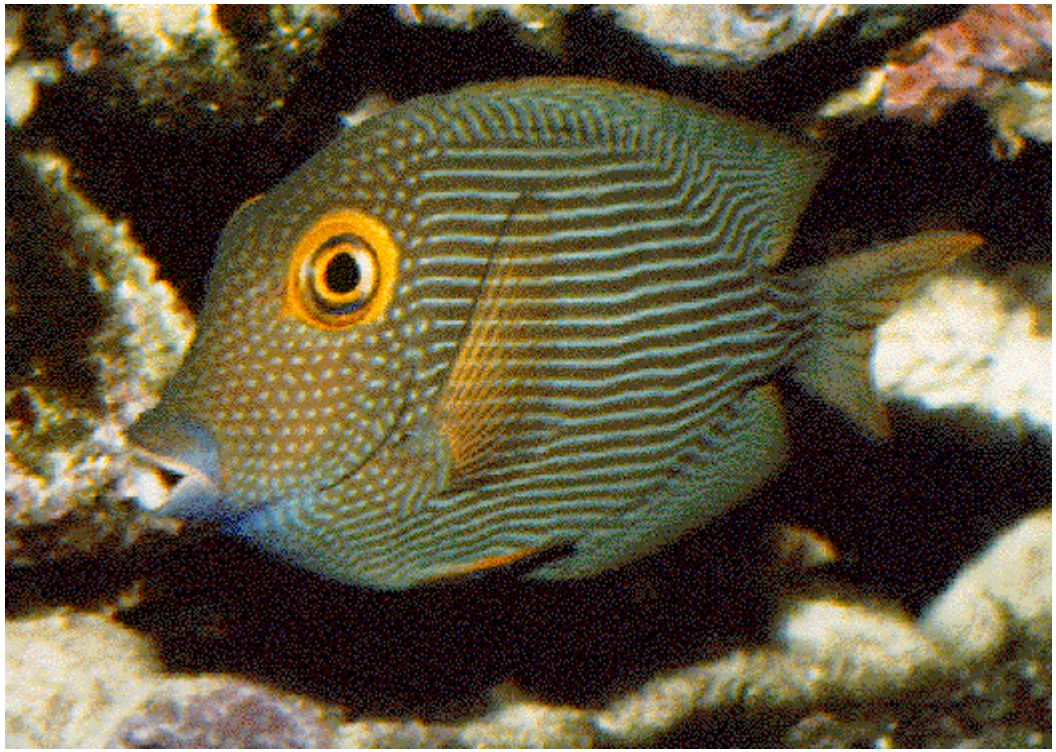
Focus + Context Views

- Same idea as overview and detail, with one key difference:
  - Typically, the overview and the detail are combined into a single display window
  - The display uses some form of distortion to combine them
  - Mimics our natural vision systems more closely

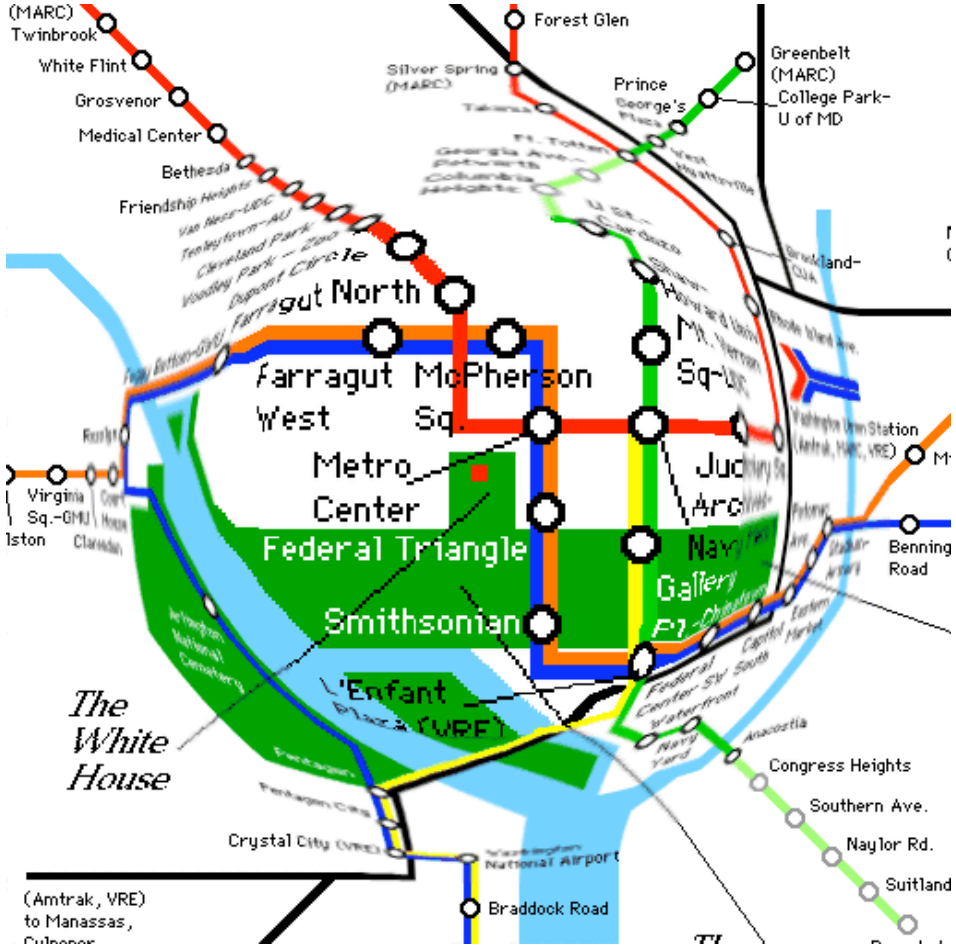
Fisheye View

- When people think about focus+context views, they typically think of the *Fisheye View* (distortion)

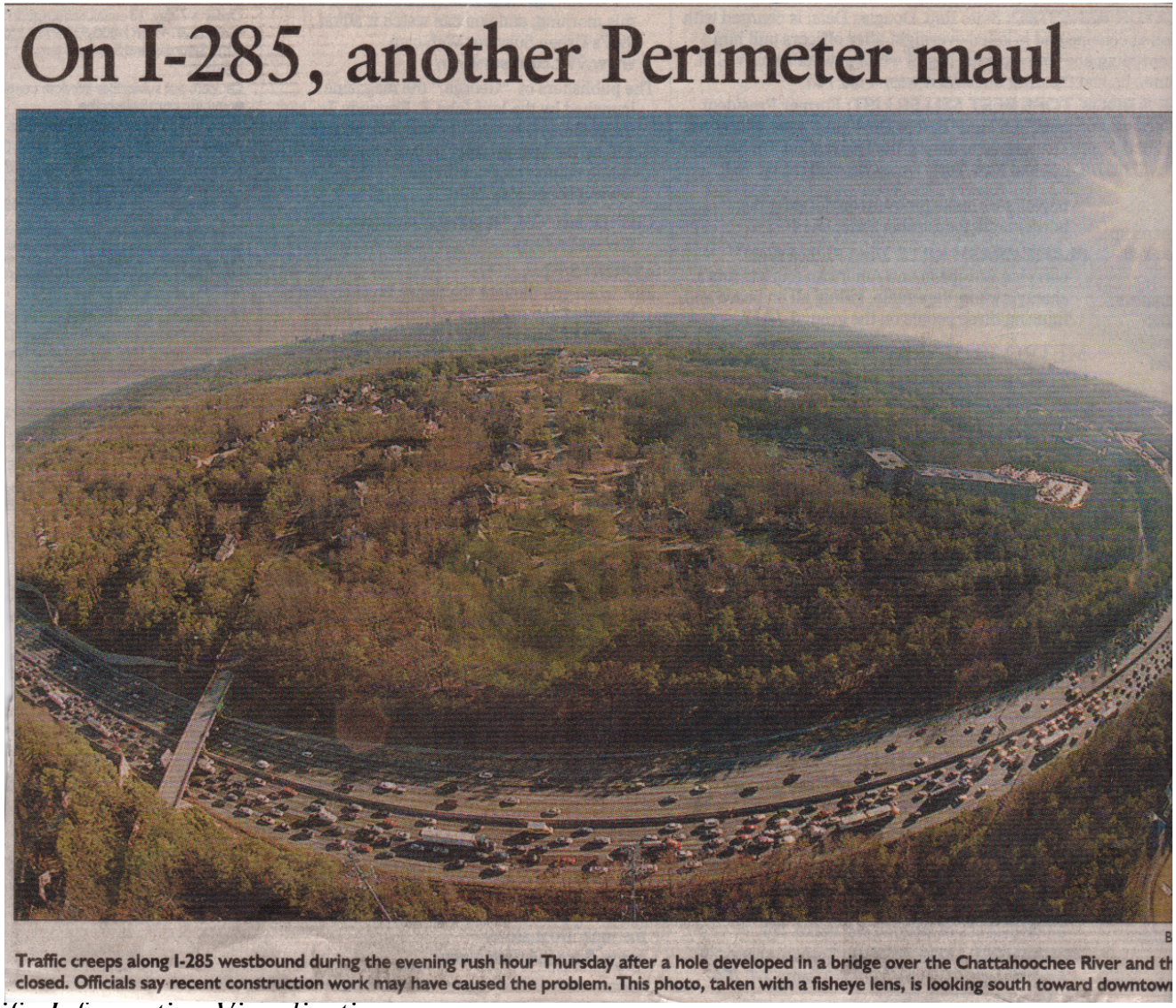
- Fisheye View (G. Furnas, 1981, 1986]
  - ➢ Provides detailed views (focus) and overviews (context) without obscuring anything…The focus area (or areas) is magnified to show detail, while preserving the context, all in a single display
- Fisheye camera lens



Example

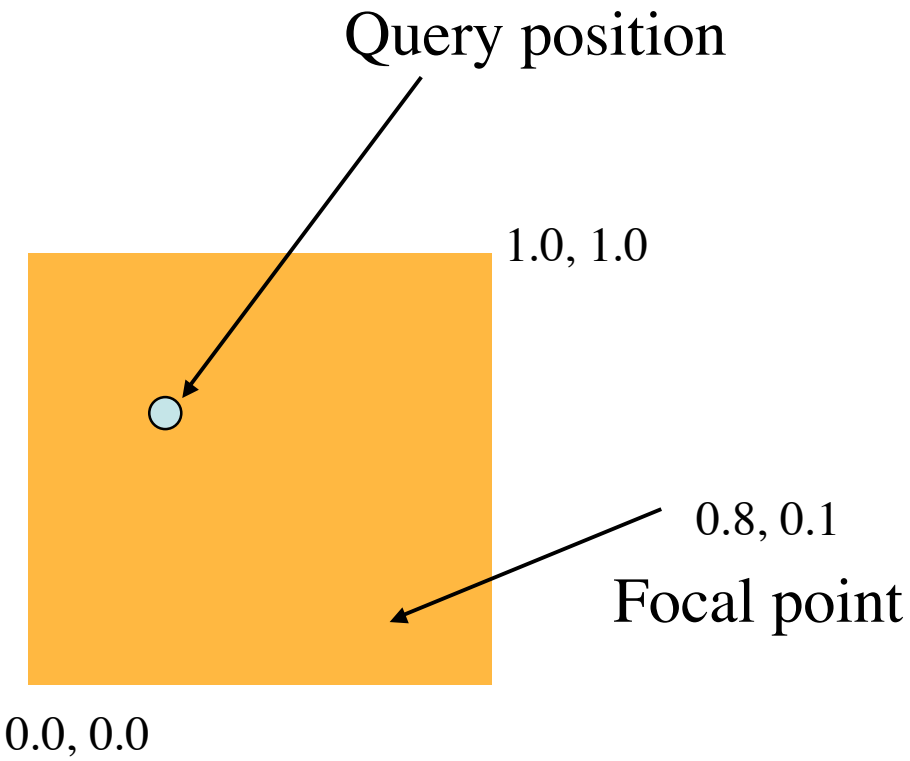

(MARC)
Twinbrook
White Flint
Grosvenor
Medical Center
Bethesda
Forest Glen
Silver Spring
(MARC)
Greenbelt
(MARC)
College Park-
U of MD
Prince
George's
Farragut North
Farragut
West
McPherson
Sq.
Metro
Center
Federal Triangle
Smithsonian
L'Enfant
Virginia
Sq.-GMU
Benning
Road
The
White
House
Crystal City
National Airport
(Amtrak, VRE)
to Manassas,
Braddock Road
Congress Heights
Southern Ave.
Naylor Rd.
Suitland

View from a Fisheye Camera Lens



Fisheye Terminology

- Focal Point
- Level of Detail
  - Some intrinsic value on each data to specify its importance
- Distance from Focus
- Degree of Interest function
  - Determines how items in display are rendered
  - Can take on various forms
    - Continuous - Smooth interpolation away from focus
    - Filtering - Past a certain point, objects disappear
    - Step - Levels or regions dictating rendering 0<x<.3 all same, .3<x<.6 all same
    - Semantic changes - Objects change rendering at different levels

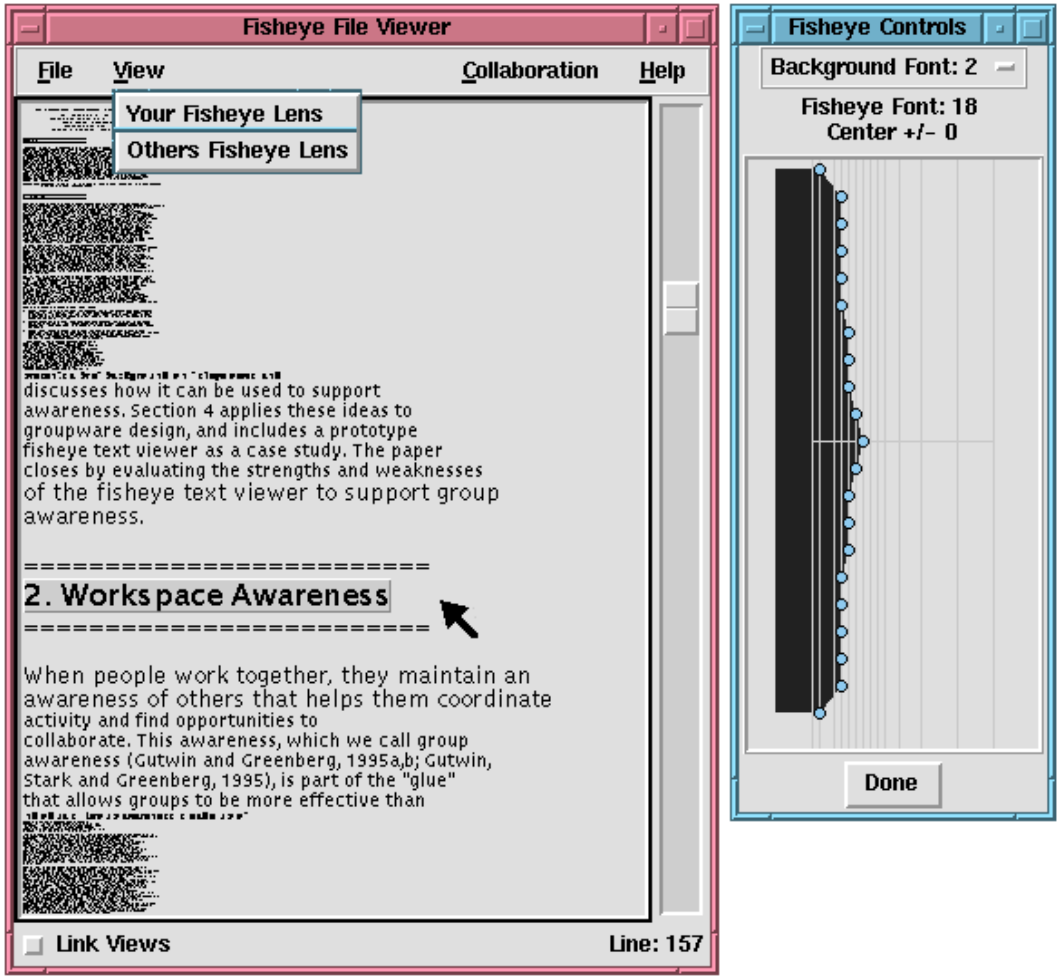


Fisheye File Viewer

Text/program viewing

Furnas' original example

Step function

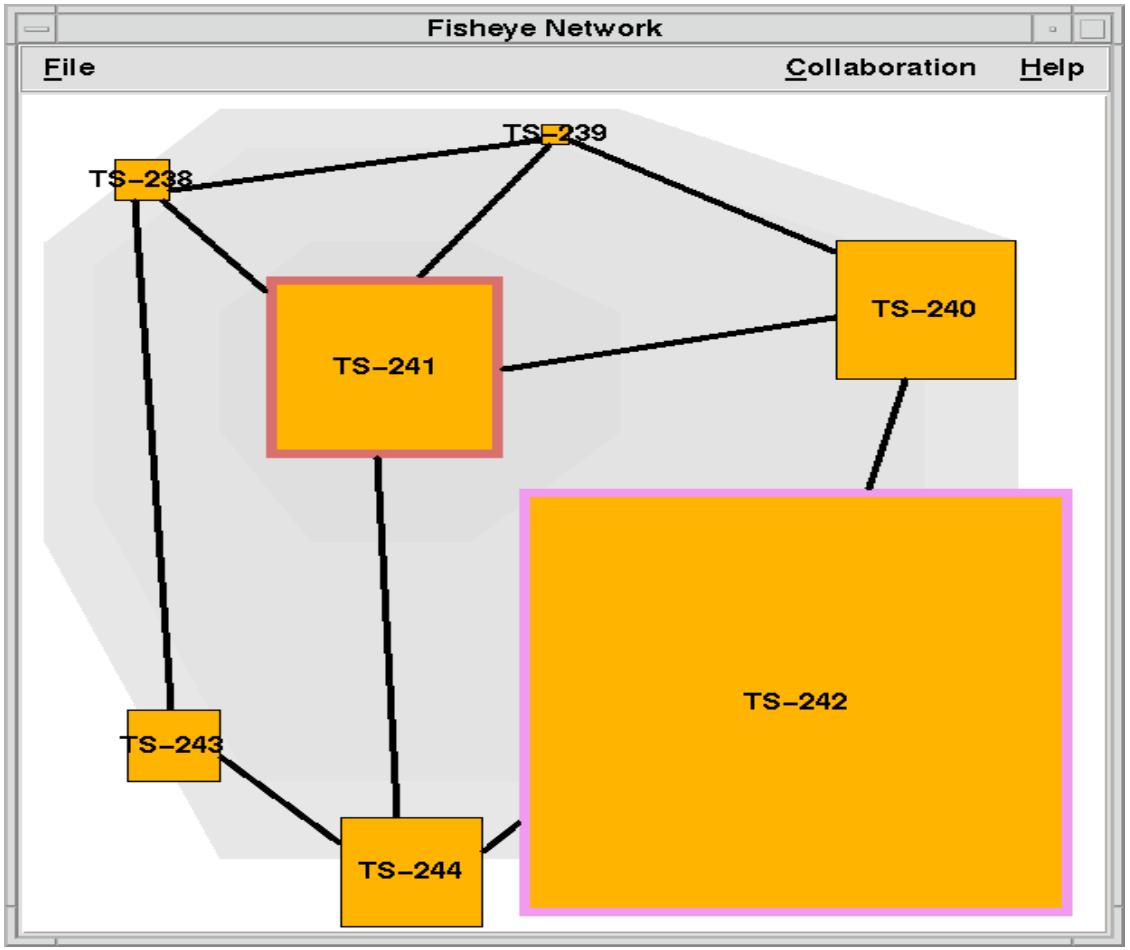


Gutwin and Greenberg, 1996

Fisheye Network

Viewing nodes in networks

Gutwin and Greenberg, 1996



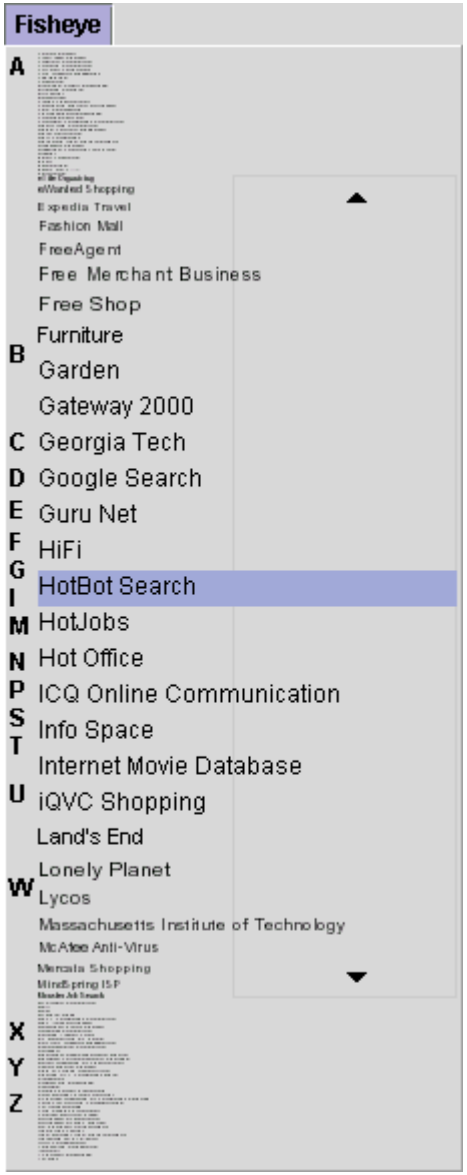
Fisheye Menu

To support selection of an item from a long linear list

Uses a focus-lock mode which lets you select items near the focus area more closely

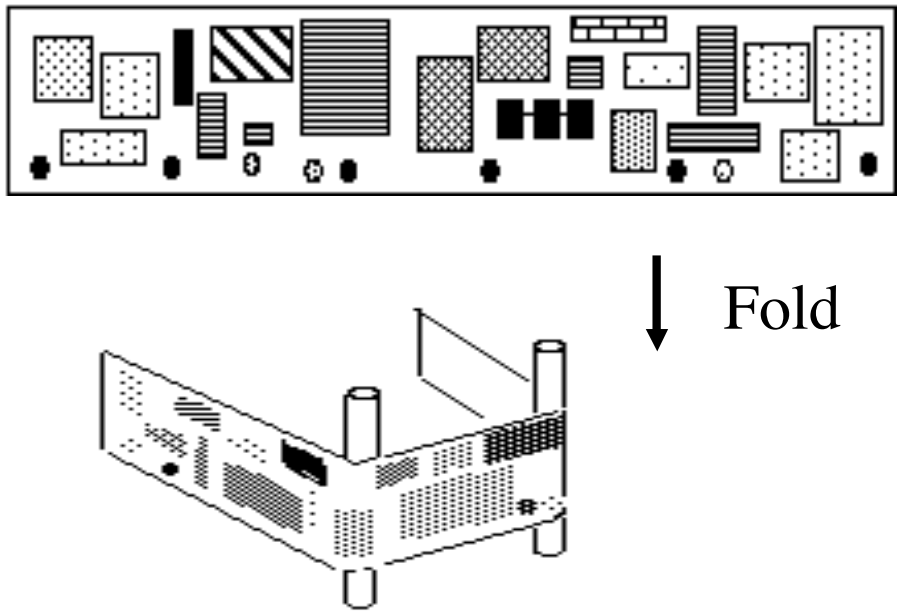
Smooth transition

[Bederson, 2000]
www.cs.umd.edu/hcil/fisheyemenu



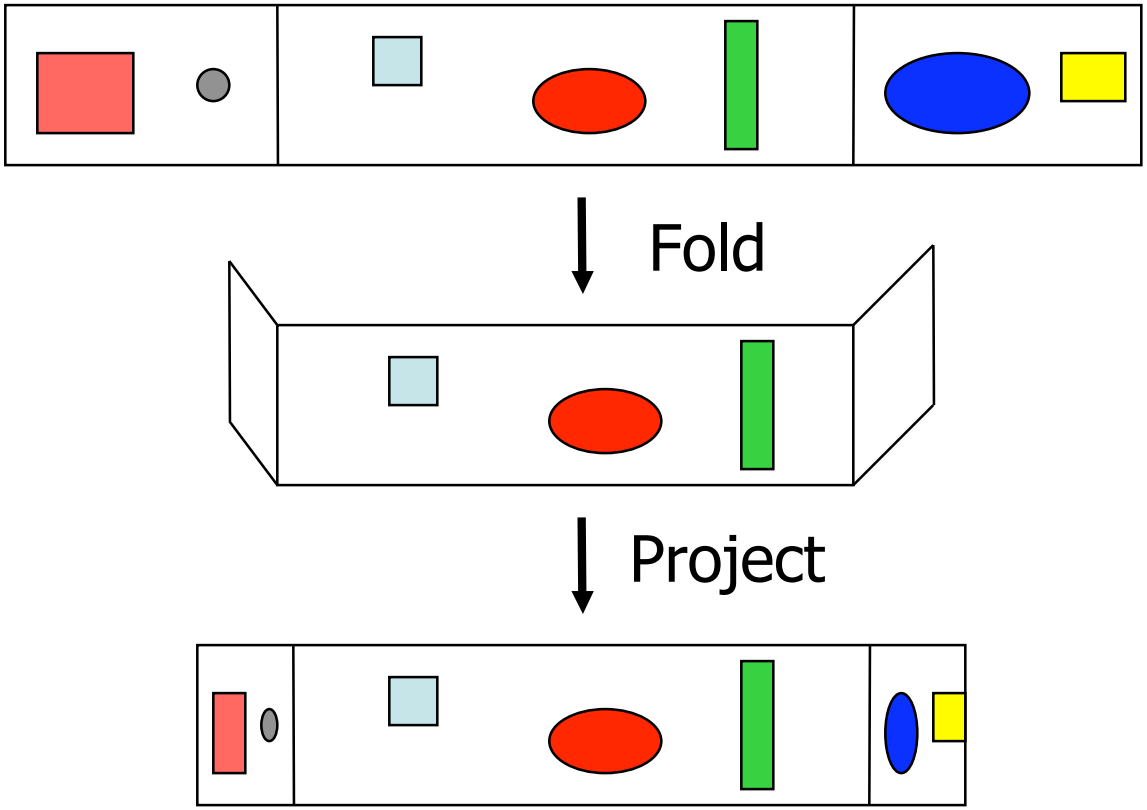
Bifocal Display

- Imagine a strip of paper (showing different items) to be pulled back across two posts , but in such a way that all of it is still in view
  - Items that will appear in the center are clear
  - Still aware of the presence of all other items (albeit distorted)
- Take items in periphery and fold back in 3-space
- Project onto front viewing screen



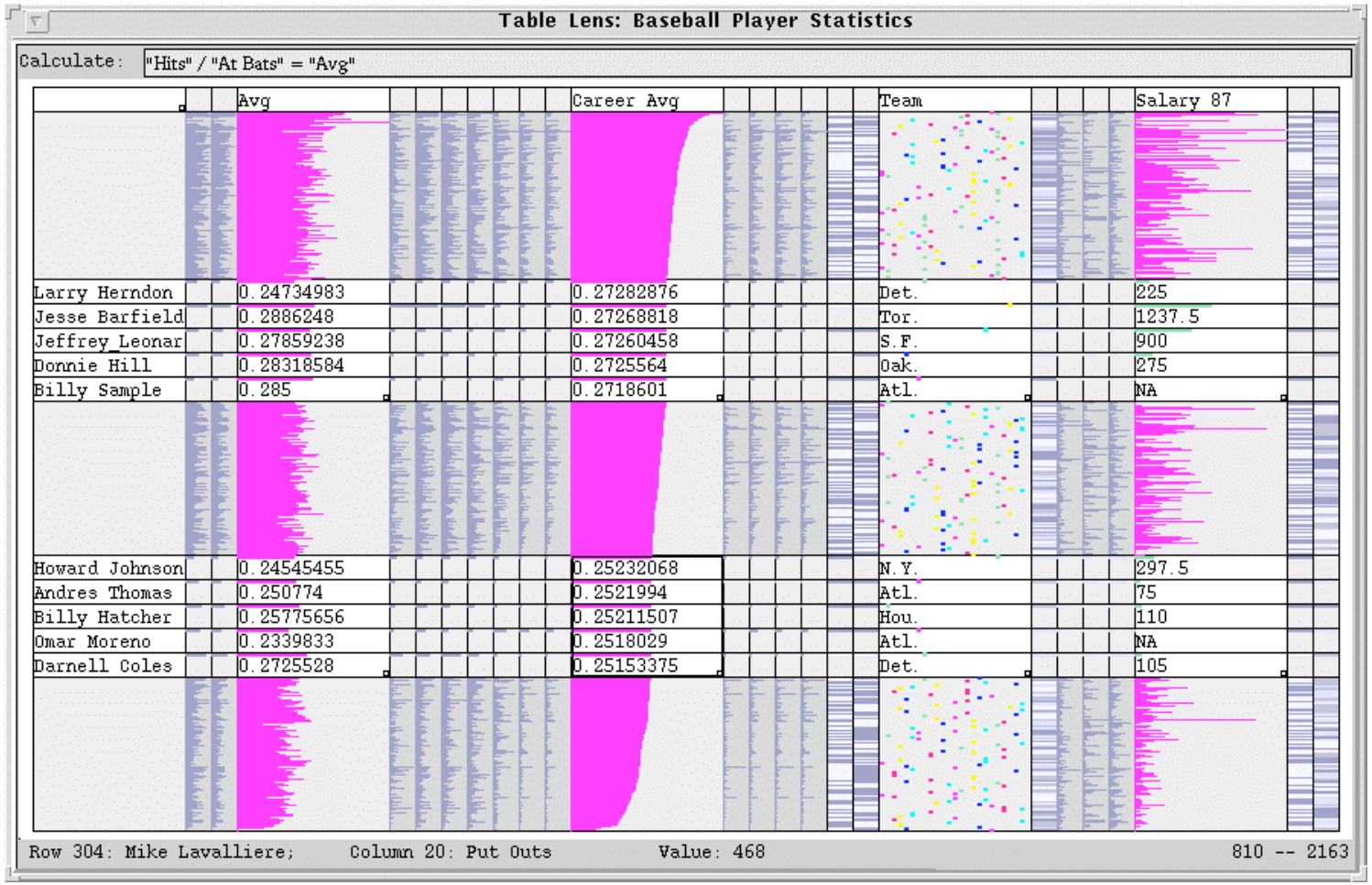
Spence and Apperly, 1982

Bifocal Display



Involves distortion in x-dimension

Table Lens

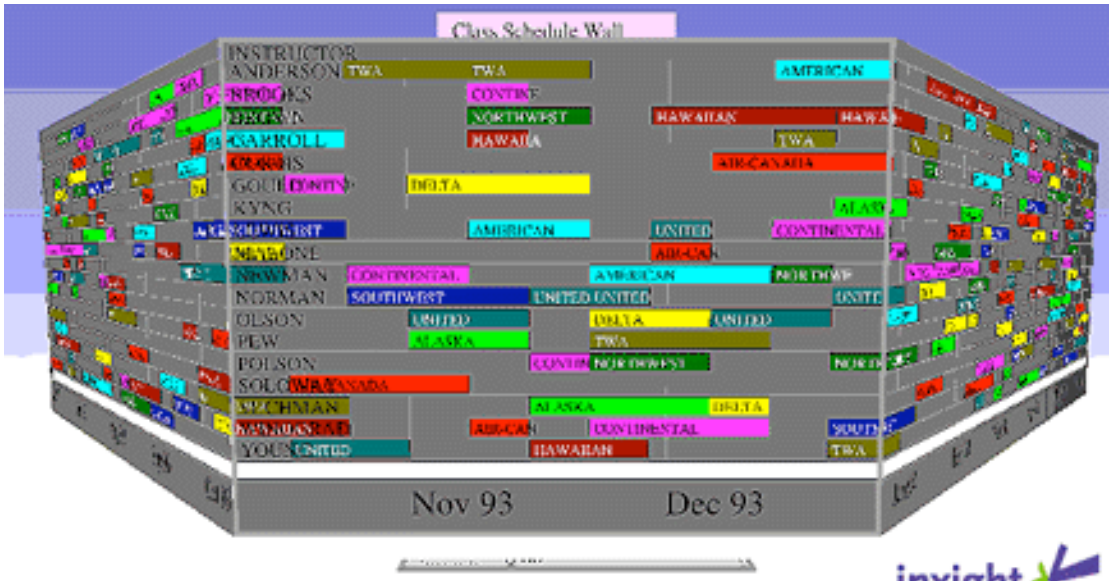


From Xerox PARC and Inxight

Table Lens exploiting distortion principle

Perspective Wall

- Simulate a 3D effect, but is essentially demonstrating the same beneficial distortion effects as the Bifocal Display
- Map work charts onto diagram, x-axis is time, y-axis is project



inxight

Mackinlay et al., 1991

Panning and Zooming

Panning and Zooming

- How about one view in which changing focus is fast and smooth?
  - Panning and Zooming
- Panning
  - Smooth movement of camera across scene (or scene moves and camera stays still)
- Zooming
  - Increasing or decreasing the magnification of the objects in a scene

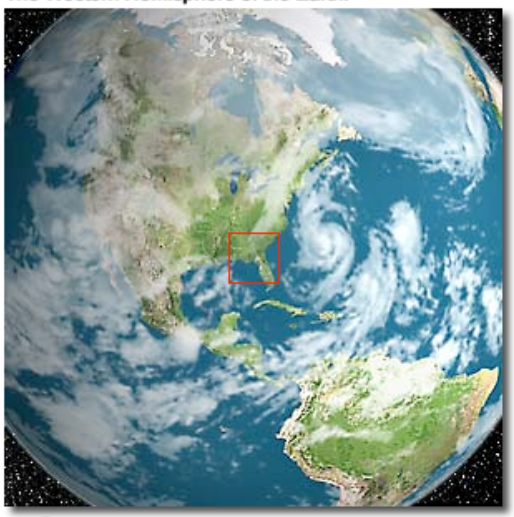
Zooming (Powers of 10)

http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/index.html

Our galaxy, the Milky Way.

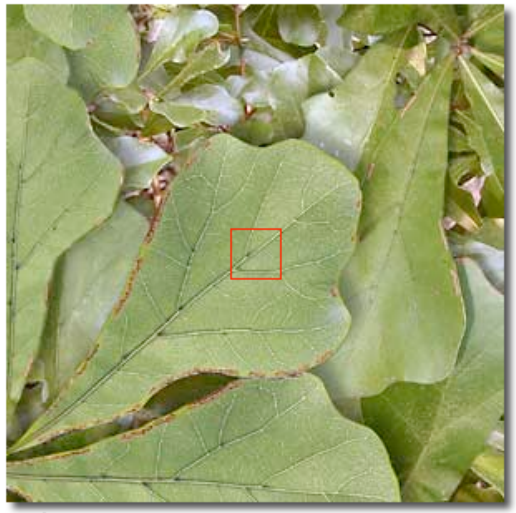
10^{+21} meters — 100,000 light years

The Western Hemisphere of the Earth.



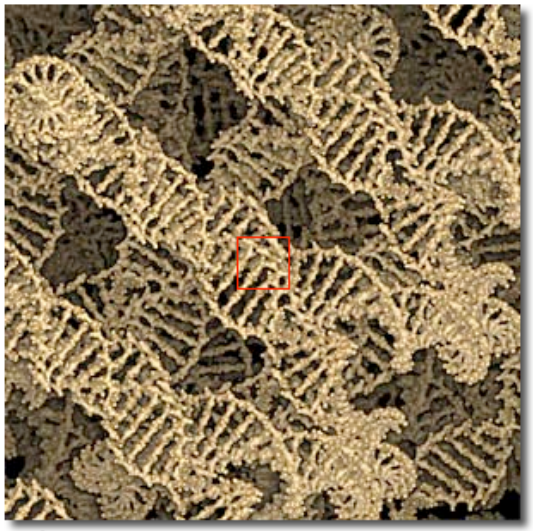
10^{+7} meters — 10,000 kilometers

Oak tree leaves at actual size.



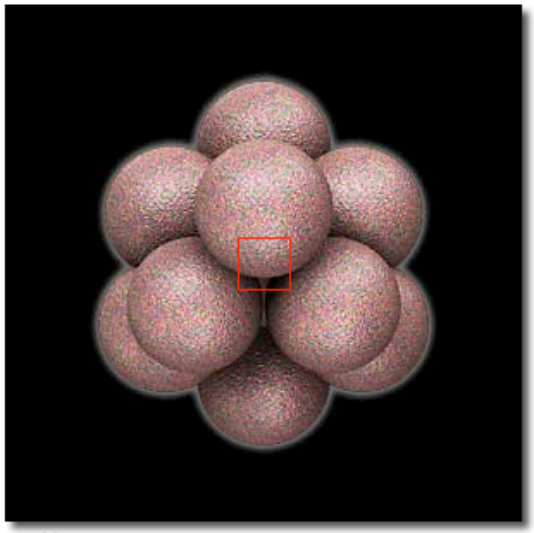
10^{-1} meters — 10 centimeters

Individual DNA strands.



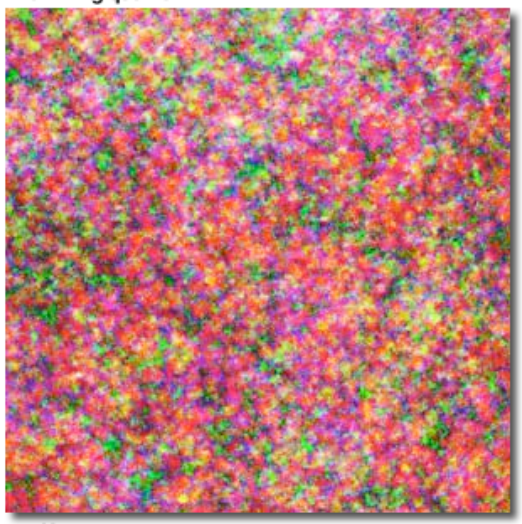
10^{-8} meters — 10 nanometers

Nucleus of the carbon atom.



10^{-14} meters — 10 femtometers

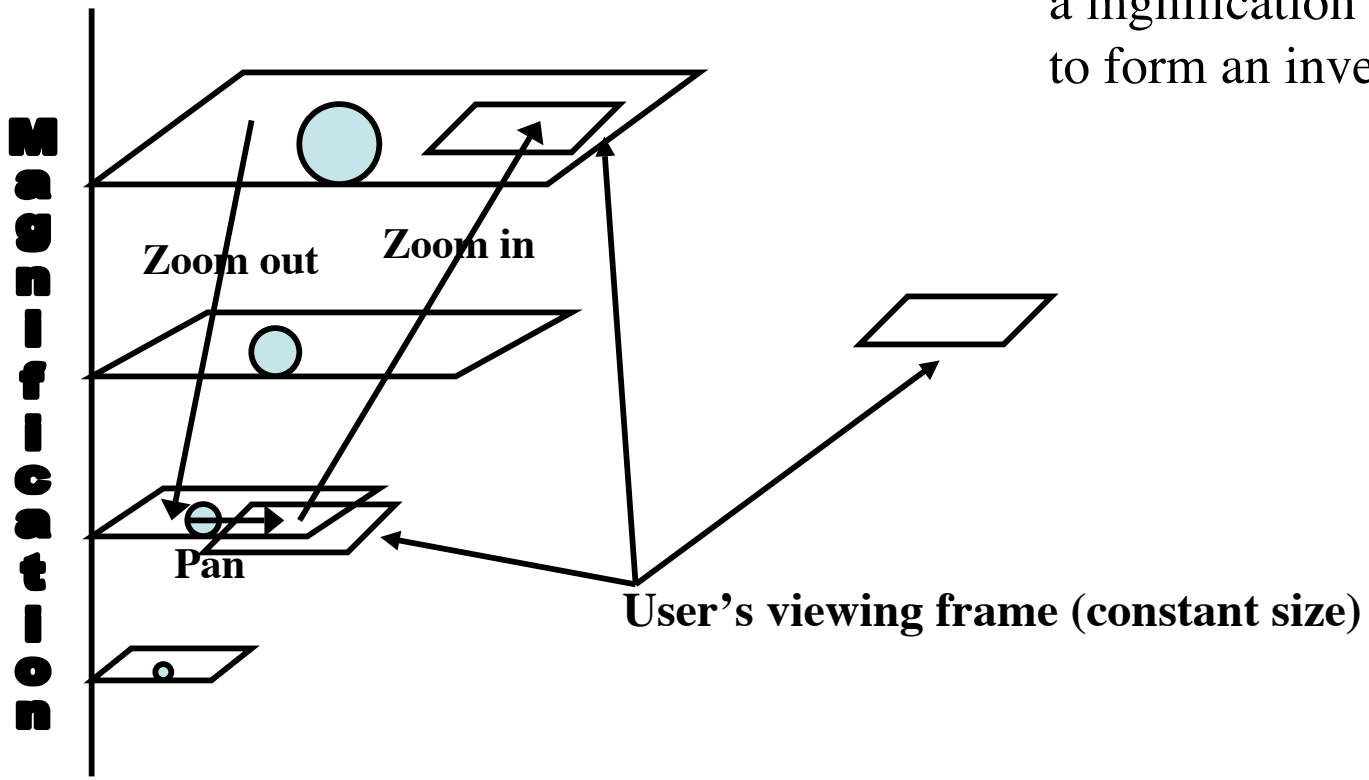
Examining quarks.



10^{-16} meters — 100 attometers

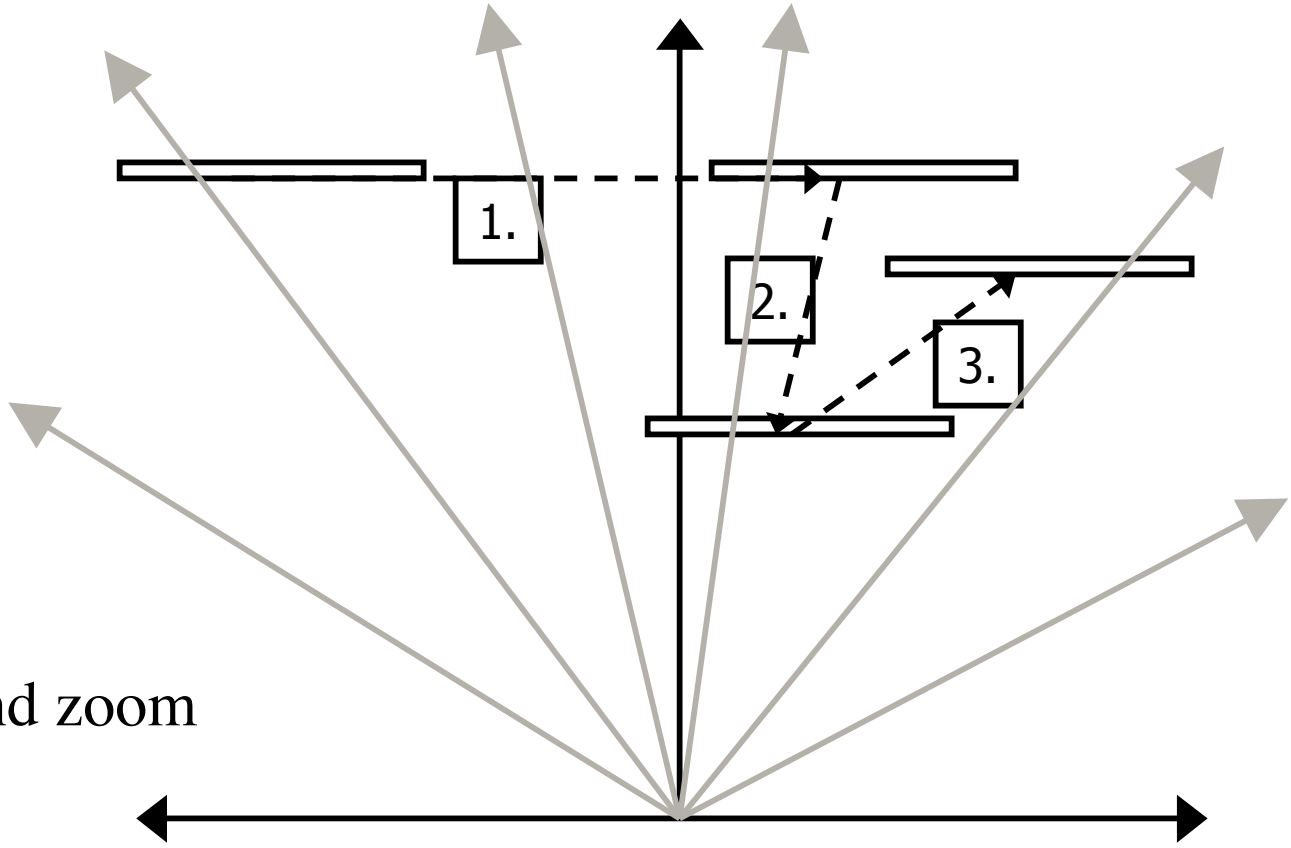
Space-Scale Diagram

A space-scale diagram contains a number of copies of a rectangular 2D image arranged vertically along a mgnification scale, and stacked to form an inverted pyramid



Furnas and Bederson, 1995

Space-Scale Diagram



1. Pan
2. Zoom
3. Pan and zoom

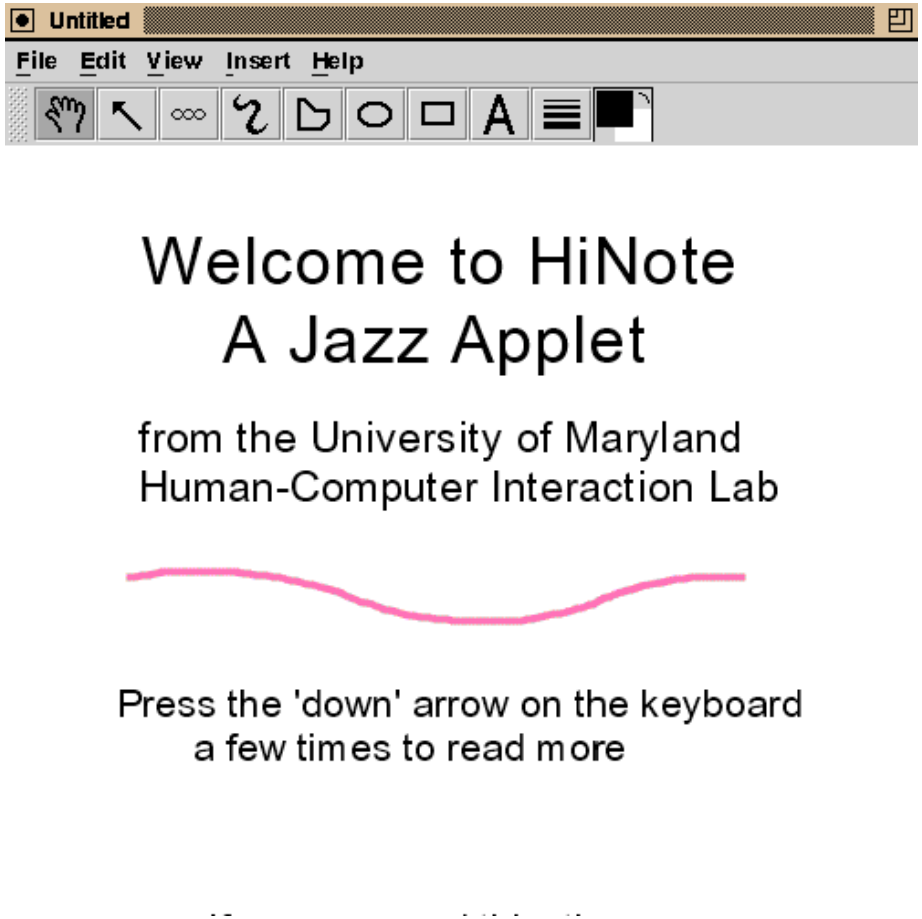
Horizontal movement of the viewing frame represents panning whereas vertical movement describes zooming

Semantic Zooming

- Objects not only change their size
- But they also change appearance/presence at different zoom levels
- More details can be shown on zooming
- Incorporated in the Pad++ Zooming Graphical Interface [Bederson and Hollan, 1994]

Supporting Software

- Pad ++
  - Support library for building applications
  - Infinite plane, panning in x-y, zooming in-out
  - Built on top of C++, Tcl/Tk and X Window System



- Jazz
  - All the stuff from Pad++
  - Implemented in java and swing
  - HiNote application is simple drawing editor

- www.cs.umd.edu/hcil/