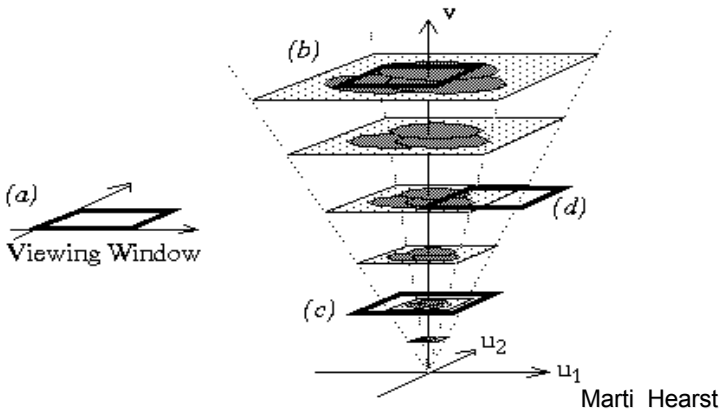
3 Information Visualization

Space-Scale Diagrams
(Furnas & Bederson 95)

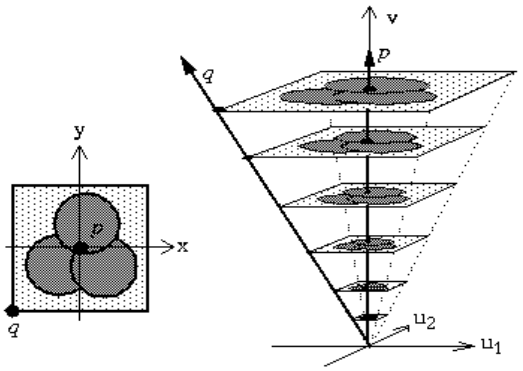
- User has a fixed-sized viewing window
- Moving it through 3D space yields all possible sequences of pan & zoom



Marti Hearst

Space-Scale Diagrams
(Furnas & Bederson 95)

- A point is transformed to a ray
- Circular regions become cones



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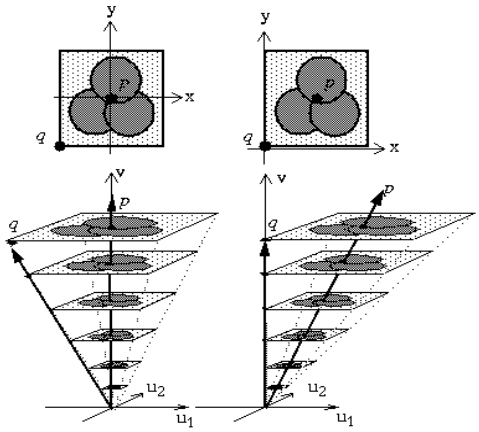
Space-Scale Diagrams
(Furnas & Bederson 95)

- If you move the origin of the 2D plane, the properties of the original 2D picture do not change
- Therefore, the absolute angles between the rays should not be assigned any meaning



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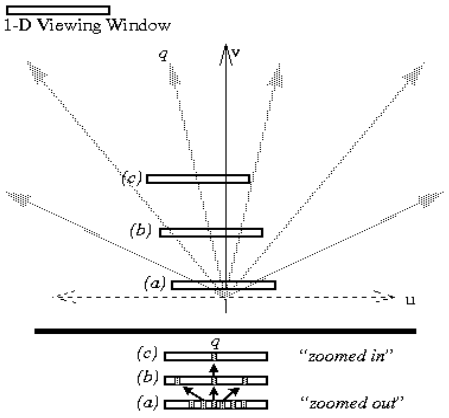
Space-Scale Diagrams
(Furnas & Bederson 95)

- We can think of this in terms of 1D too
- When zoomed out, you can see wider set of points



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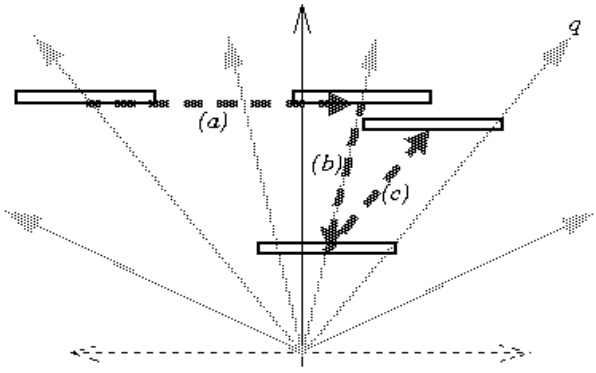
Space-Scale Diagrams
(Furnas & Bederson 95)

- Pure pan (a)
- Pure zoom (b)
- Pan and zoom keeping q in same position in the viewing window (c)



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Semantic Zooming

- Geometric (standard) zooming:
  - The view depends on the physical properties of what is being viewed
- Semantic Zooming:
  - When zooming away, instead of seeing a scaled-down version of an object, see a different representation
  - The representation shown depends on the meaning to be imparted.

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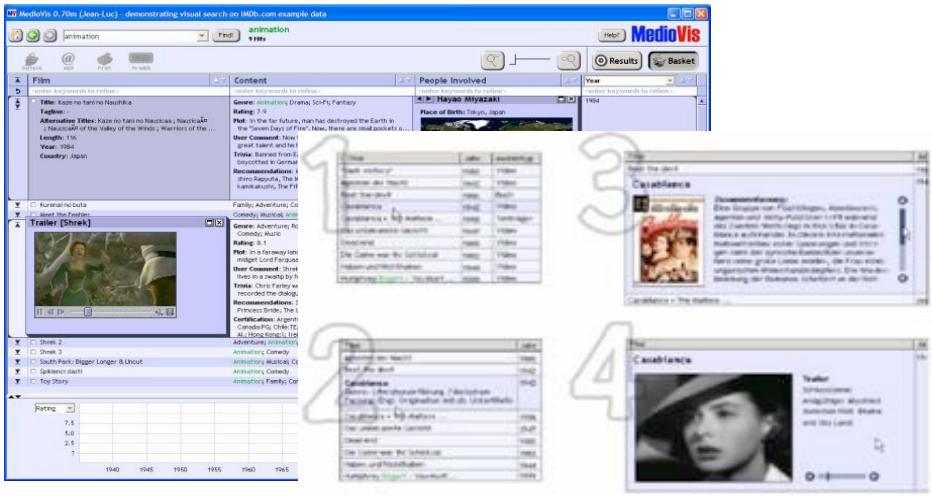
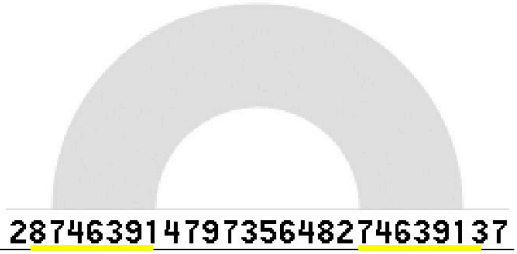
Semantic Zoom in MedioVis

http://hci.uni-konstanz.de/research/projects/mediovis

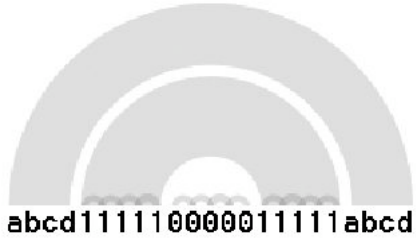


Arc Diagrams

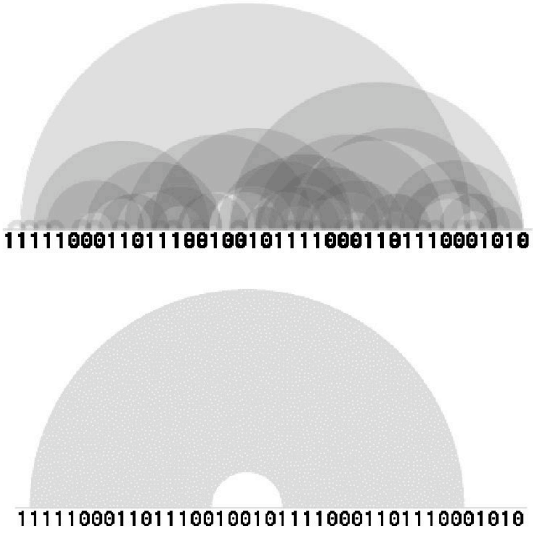
- Visualization method for representing complex patterns of repetition in string data.
  - Arc diagrams scale efficiently for strings that contain many instances of the same subsequence.
  - idea of visualizing only a subset of all possible pairs of matching substrings.
  - highlight just the subsequences essential to understanding the string's structure



Arc Diagrams - Basics

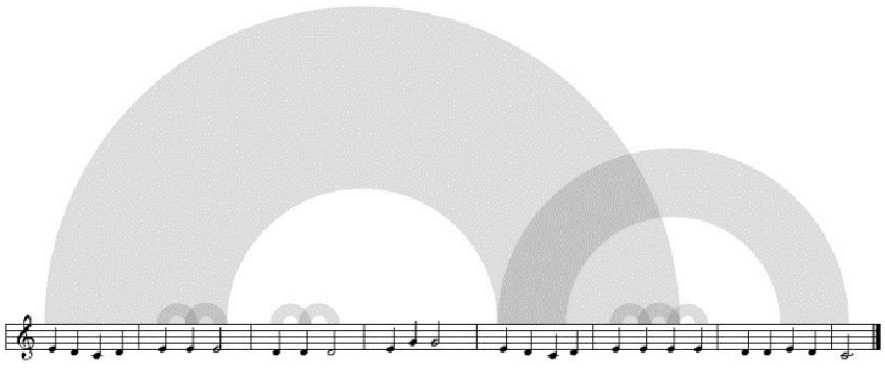


Arc Diagram – Level of Detail

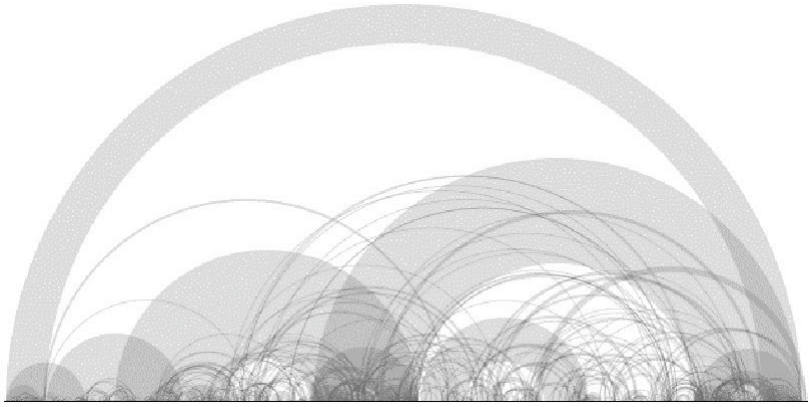


Applied to
- Music
- DNA
- Web pages
- Byte code

Arc Diagram applied to Music



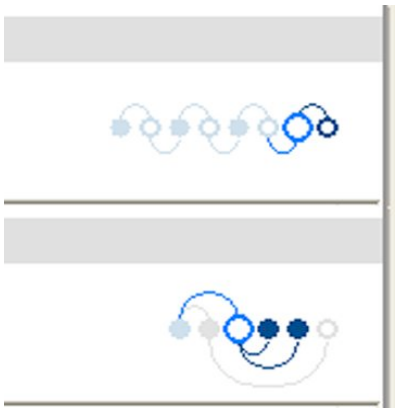
Arc Diagram applied to Music "für Elise"



- More details
  Martin Wattenberg. Arc Diagrams: Visualizing Structure in Strings
  IBM Watson Research Center, Technical report 2002-11

Thread Arcs

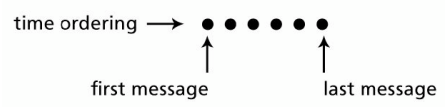
- Thread Arcs combine the chronology of messages with the branching tree structure of a conversational thread
- Benefits
  - Chronology
  - Relationships
  - Stability
  - Compactness
  - Attribute Highlighting
  - Scale
  - Interpretation/Sense

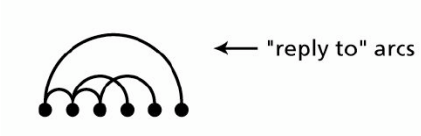


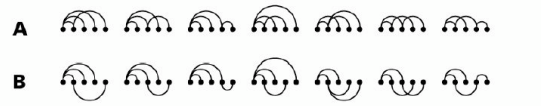
Bernard Kerr, 2003
http://www.research.ibm.com/remail/threadarcs.html

Thread Arcs for Emails

- **Visualization**
  - Linear layout of message nodes connected by relationship arcs.
  - Each circular node represents a message in the thread.
  - *Chronology* of the thread is encoded by the position
  - The width of a Thread Arc is a linear function of the size of the thread
  - *Compact visualization* if height is constrained







The relationship between messages are clearer when arcs are draw above and below nodes (B).

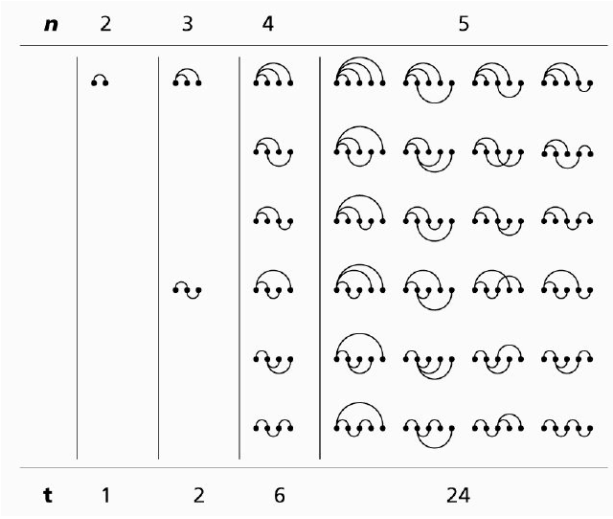
Pseudo code for drawing a thread arc

To make a Thread Arc

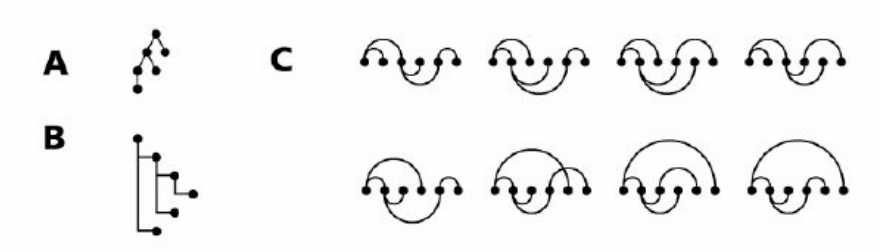
```
sort all messages chronologically
find the generation depth of each message

for each message
     if the message is the root message then
          place the node at the starting position
          don't draw an arc
     else
          place the message to the right of the last message
          if the message generation depth is odd then
               draw an arc above the line to the message's parent
          else
               draw an arc below the line to the message's parent
next message
```

Space of Possible Thread Arcs (5 Messages)



Chronological Information in the Thread Arcs



Example Email Client using Thread Arcs

Click stream Visualization

- Jeffrey Brainerd Barry Becker
  Case Study: E-Commerce Clickstream Visualization
  Proceedings of the IEEE Symposium on Information Visualization 2001 (INFOVIS'01)
- http://www.sims.berkeley.edu/courses/is247/s02/readings/brainerd.pdf

Click stream Visualization

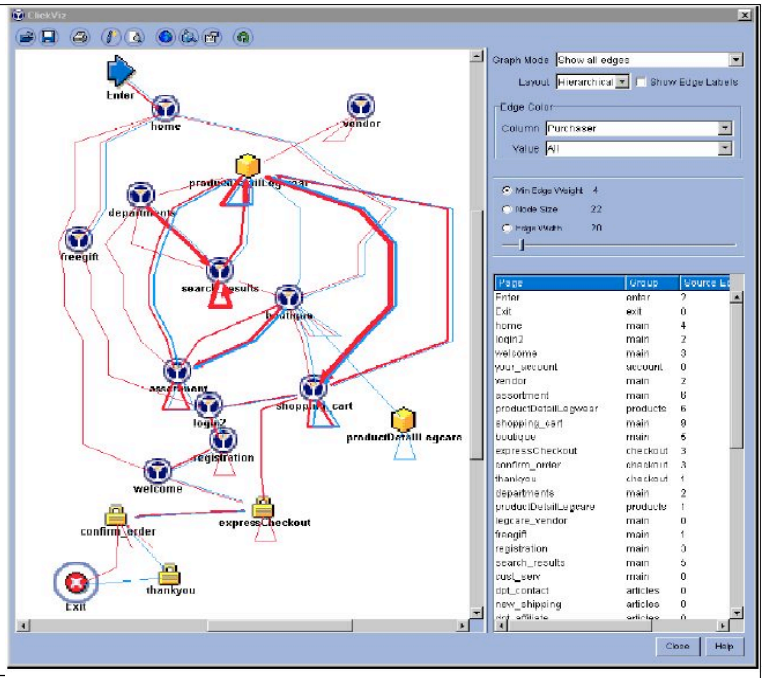


Figure 1: Main ClickViz window showing hierarchical layout

Click stream Visualization

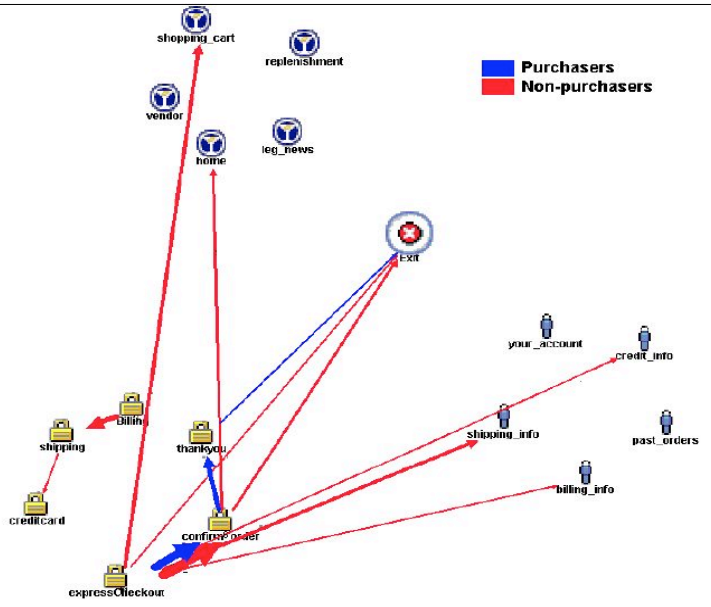
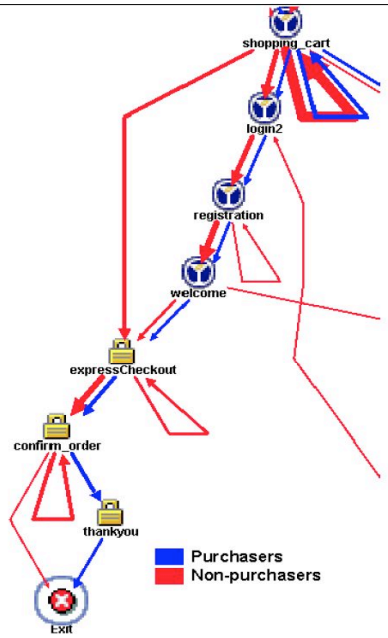


Figure 2. Circular layout. All the checkout pages are grouped (lower left). Red edges that emanate from the checkout pages to other parts of the site represent non-purchasers who are abandoning the checkout process.

Click stream Visualization



- Brainerd et al.

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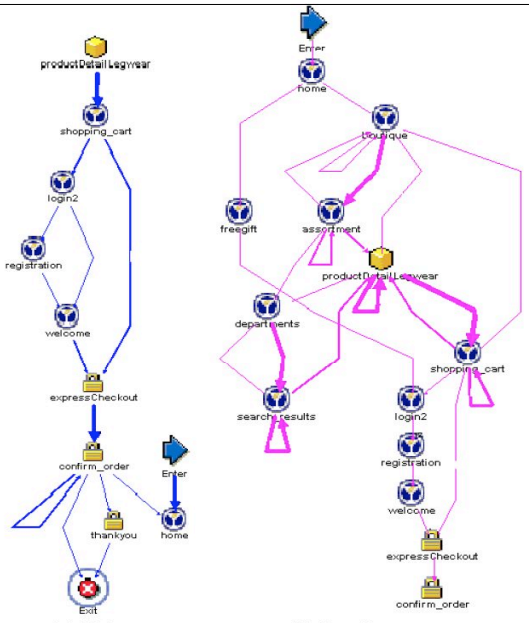
Figure 4. Checkout process. Purchasers take a direct route through the checkout process, whereas non-purchasers show a more haphazard route, including self-edges and early abandonment, possibly indicating a confusing checkout process.

Click stream Visualization



- Brainerd et al.

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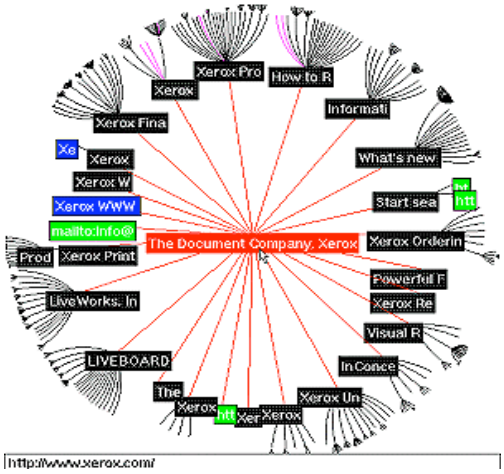
Figure 3. Gender Differences: Males tend to navigate in specific, direct patterns, whereas women's navigation patterns include much more browsing, utilizing much more of the site.

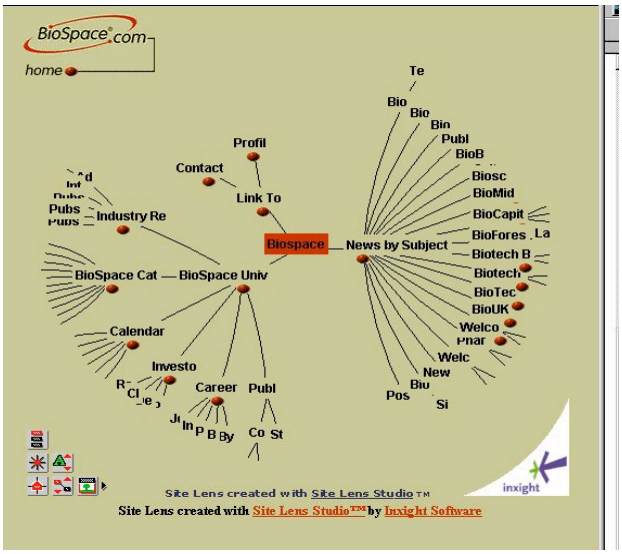
Hyperbolic Browser

- In the hyperbolic plane, the circumference and area of a circle grow exponentially with its radius
- Allocate each node a wedge of the hyperbolic plane
- The node recursively places all its children within an arc of that wedge
  - at an equal distance from itself
  - far enough out so the children are separated by at least a minimum distance
- Parallel lines diverge in hyperbolic geometry
  - each child's wedge will span about the same angle as its parent's
  - but not children's wedges will overlap

Hyperbolic Tree Browser
(Lamping et al. 95)



Inxight's Hyperbolic Browser



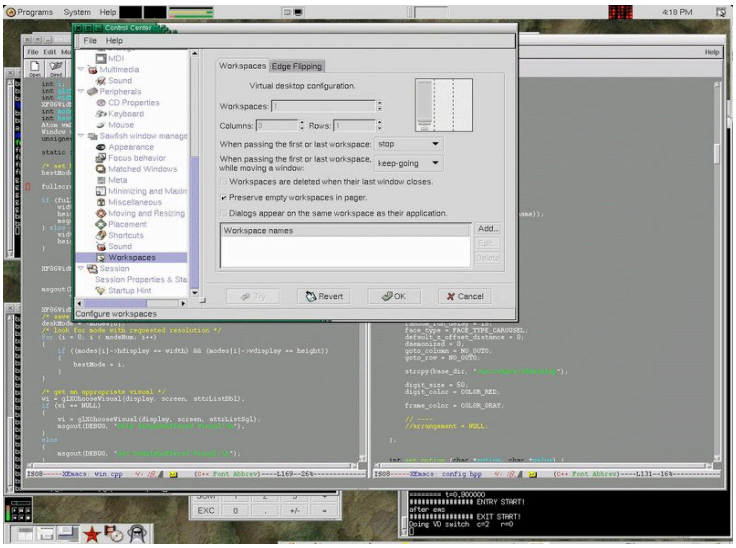
Hyperbolic Tree Views

- Nice demos on the Web
  - www.inxight.com
  - www.thebrain.com
    - » This is a variation on it that might be more interesting
    - » Decides dynamically which subsets of the data to show

TheBrain.com

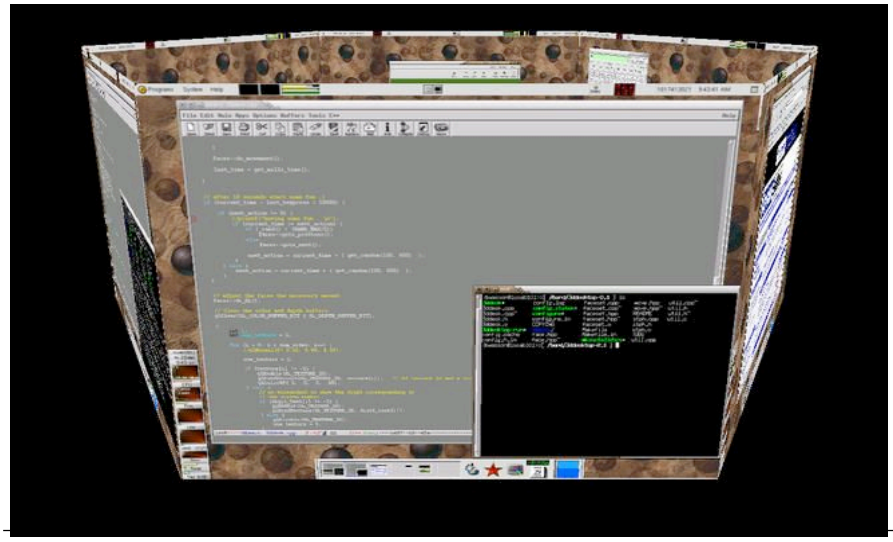
3D Desktop - http://desk3d.sourceforge.net/

switching virtual desktops in 3D



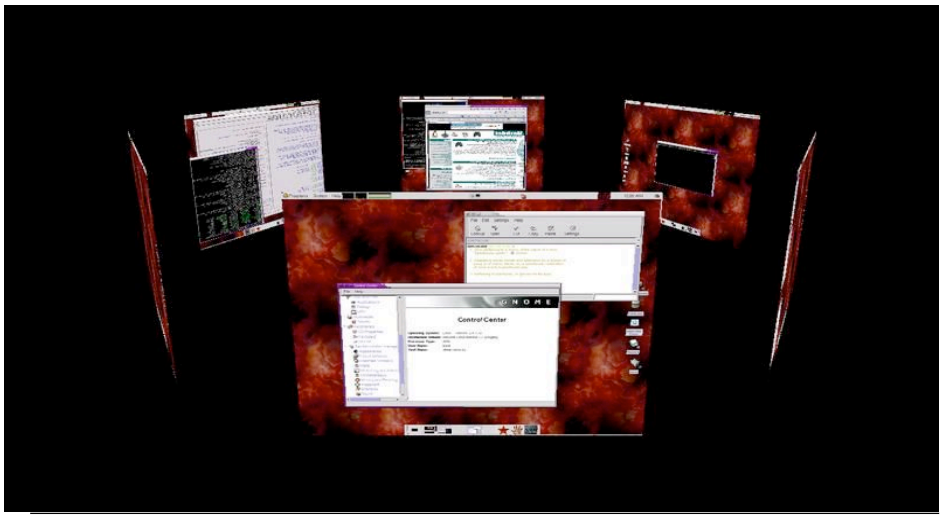
3D Desktop - http://desk3d.sourceforge.net/

switching virtual desktops in 3D



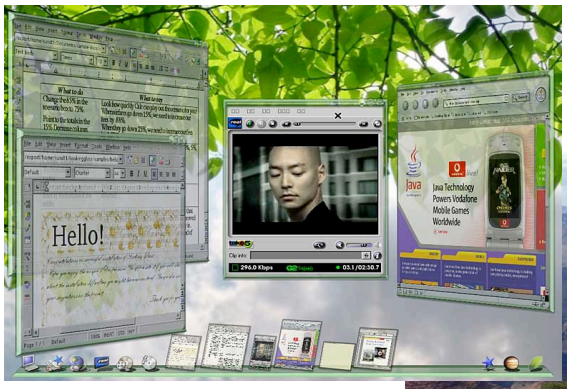
3D Desktop - http://desk3d.sourceforge.net/

switching virtual desktops in 3D



Sun: Project Looking Glass functional 3D-Desktop

Video ~ 6min

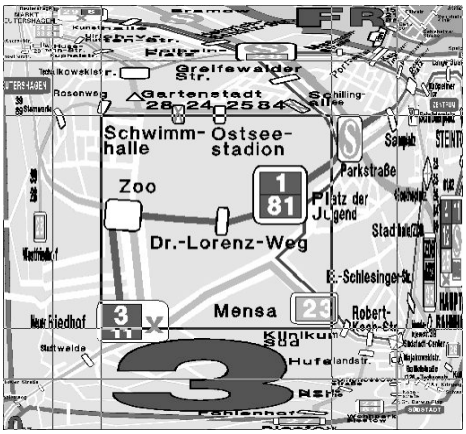


https://lg3d.dev.java.net/

Visualization on Mobile Devices

- Some common challenges
  - Small screen
  - Limited processing power
  - Limited interaction
  - Limited bandwidth to data source

Rectangular Fish Eye View
saving bandwidth in transmission



- Rauschenbach, U.: *"The Rectangular Fish Eye View as an Efficient Method for the Transmission and Display of Large Images"*, in: Proceedings of IEEE ICIP'99, Kobe, Japan, Oct. 25-28, 1999. http://wwwicg.informatik.uni-rostock.de/Projekte/MoVi/Publications/ICIP99/

Rectangular Fish Eye View
saving bandwidth in transmission

Figure 3: Rectangular fish eye view example

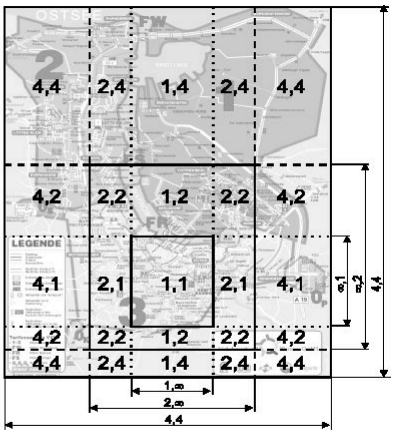


Figure 4: Generating RoI grid

Providing context for map navigation

- Baudisch, P. and Rosenholtz, R.
  Halo: A Technique for Visualizing Off-Screen Locations.
  In *Proceedings of CHI 2003*, Fort Lauderdale, FL, April 2003,pp. 481-488.

Providing context for map navigation

Providing context for map navigation