Information Visualization

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Course Goals

Information Visualization

Key Approaches and Design Principles

Information Visualization aims

To use **human perceptual capabilities**

To gain **insights** into **large and abstract data sets**

that are difficult to extract using standard query languages

Abstract and Large Data Sets

Symbolic

Tabular

Networked

Hierarchical

Textual information

Course Approach

Foundation in Human Visual Perception

How it relates to creating effective information visualizations

Understand Key Design Principles

for creating **Effective** Information Visualizations

Study Major Visualization Approaches

Data & Map Visualizations ... Visualization of Large Abstract Spaces

Use Visualization Tools

Tableau, D3.js

Design New, Innovative Visualizations

Course Approach (cont.)

1 **Key Approaches** in **Information Visualization**

Standard Data Displays – Infographics – Maps

NYTimes Visual Data Stories

Interactive Data Visualization

Augmented Reality – AI + Machine Learning

Search & Text – Social Network

Advanced Visual Data Stories – Emerging Themes + State of Art

2 **Visual DataStory Design Principles**

Develop what constitutes an effective Visual "DataStory":
its key design principles and showcase examples.

3 **Term Projects**

Review + Analyze Visualization Tools or **How to Guide**

Evaluate Visualization Tool

Design Visualization Prototype

Individual / Group DataStory Project

Gameplan

Course Website

http://comminfo.rutgers.edu/~aspoerri/Teaching/InfoVisOnline/Home.html

Assignments & Grading

- **Graded Discussions** - 15%
- **Short Reports** - 15%
- **Visualization Tasks** - 30%
- **Visual DataStory Design Principles** - 15%
- **Term Project** - 25%

Gameplan (cont.)

Schedule

http://comminfo.rutgers.edu/~aspoerri/Teaching/InfoVisOnline/Schedule.html

Lectures

http://comminfo.rutgers.edu/~aspoerri/Teaching/InfoVisOnline/Lectures.html

- **Narrated Lectures + Video Demos**
- **Related Info**: readings, videos and resources
  (will be **continuously updated** throughout semester)
- **Slides Handout** available for download & print-out
  - Open in **Powerpoint**
  - File > Print …
    - "Print what" = "Handout"
    - Select "2 slides" per page

Your Guide

Anselm Spoerri

- Computer Vision
- Filmmaker – IMAGO
  - Click on the center image to play video
- Information Visualization – InfoCrystal ➔ searchCrystal
- Media Sharing – Souvenir
  - In Action Examples: click twice on digital ink or play button
- Rutgers Website

Goal of Information Visualization

Use human perceptual capabilities
to **gain insights** into **large data sets**
that are **difficult to extract**
using standard query languages

Exploratory Visualization

- Look for structure, **patterns**, trends, anomalies, relationships
- Provide a **qualitative** overview of large, complex data sets
- Assist in **identifying region(s) of interest** and appropriate parameters for more focussed quantitative analysis

Shneiderman's 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

Information Visualization - Problem Statement

Scientific Visualization

- Show abstractions, but based on physical space

Information Visualization

- Information does not have any obvious spatial mapping

Fundamental Problem

How to map non–spatial abstractions into effective visual form?

Goal

Use of computer-supported, interactive, visual representations of abstract data to **amplify cognition**

How Information Visualization Amplifies Cognition

Increased Resources

- Parallel perceptual processing
- Offload work from cognitive to perceptual system

Reduced Search

- High data density
- Greater access speed

Enhanced Recognition of Patterns

- Recognition instead of Recall
- Abstraction and Aggregation

Perceptual Interference

Perceptual Monitoring

- Color or motion coding to create pop out effect

Interactive Medium

Information Visualization = Emerging Field

Key Principles

- Abstraction
- Overview ➔ Zoom+Filter ➔ Details-on-demand
- Direct Manipulation
- Dynamic Queries
- Immediate Feedback
- Linked Displays
- Linking + Brushing
- Provide Focus + Context
- Animate Transitions and Change of Focus
- Output is Input
- Increase Information Density

Information Visualization – "Toolbox"

Perceptual Coding

Position	
Size	
Orientation	
Texture	
Shape	
Color	
Shading	
Depth Cues	
Surface	
Motion	
Stereo	
Proximity	
Similarity	
Continuity	
Connectedness	
Closure	
Containment	

Interaction

Direct Manipulation	
Immediate Feedback	
Linked Displays	
Animate Shift of Focus	
Dynamic Sliders	
Semantic Zoom	
Focus+Context	
Details-on-Demand	
Output ➔ Input	

Information Density

Maximize Data-Ink Ratio	
Maximize Data Density	
Minimize Lie factor	

Spatial vs. Abstract Data

"Spatial" Data

- Has inherent 1-, 2- or 3-D geometry
- **MRI**: density, with 3 spatial attributes, 3-D grid connectivity
- **CAD**: 3 spatial attributes with edge/polygon connections, surface properties

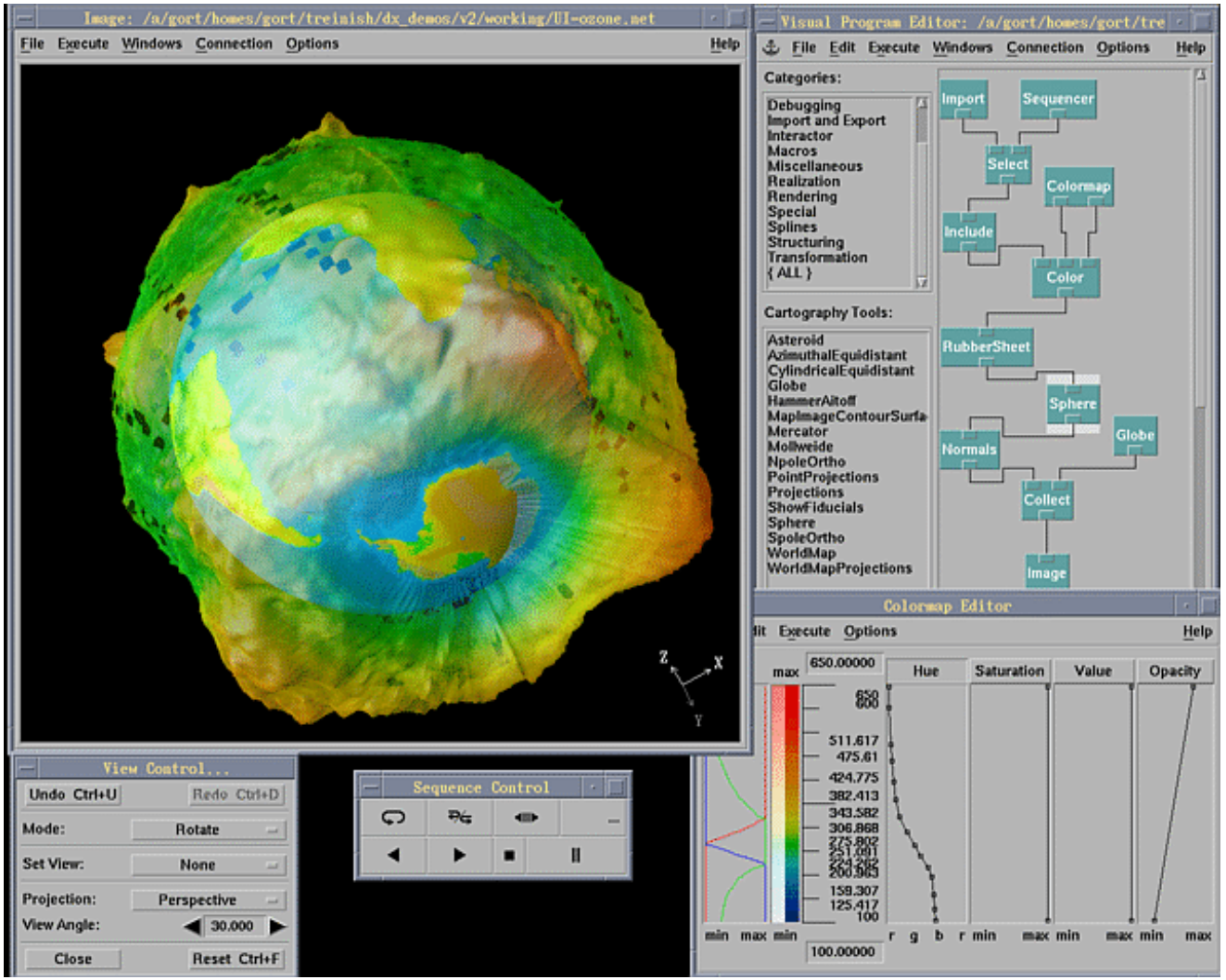
Abstract, N-dimensional Data

- Challenge of creating intuitive mapping
- **Chernoff Faces**
- **Software Visualization**: SeeSoft
- **Scatterplot** and **Dimensional Stacking**
- **Parallel Coordinates** and **Table Lens**
- **Hierarchies:** Treemaps, Brain,Hyperbolic Tree
- **Boolean Query**: Filter-Flow, InfoCrystal

"Spatial" Data Displays

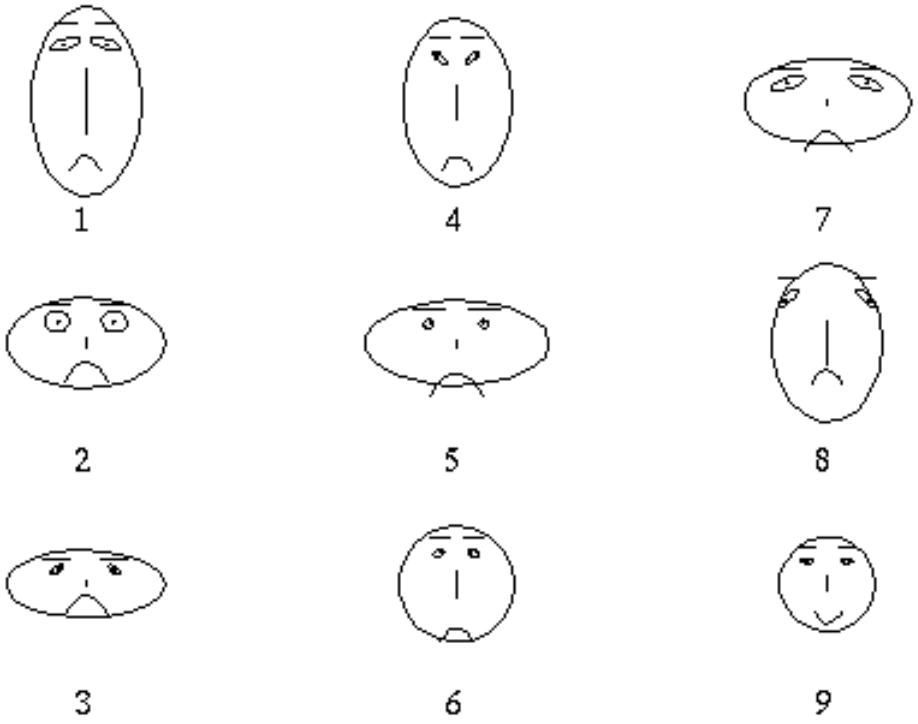
IBM Data Explorer

http://www.research.ibm.com/dx/



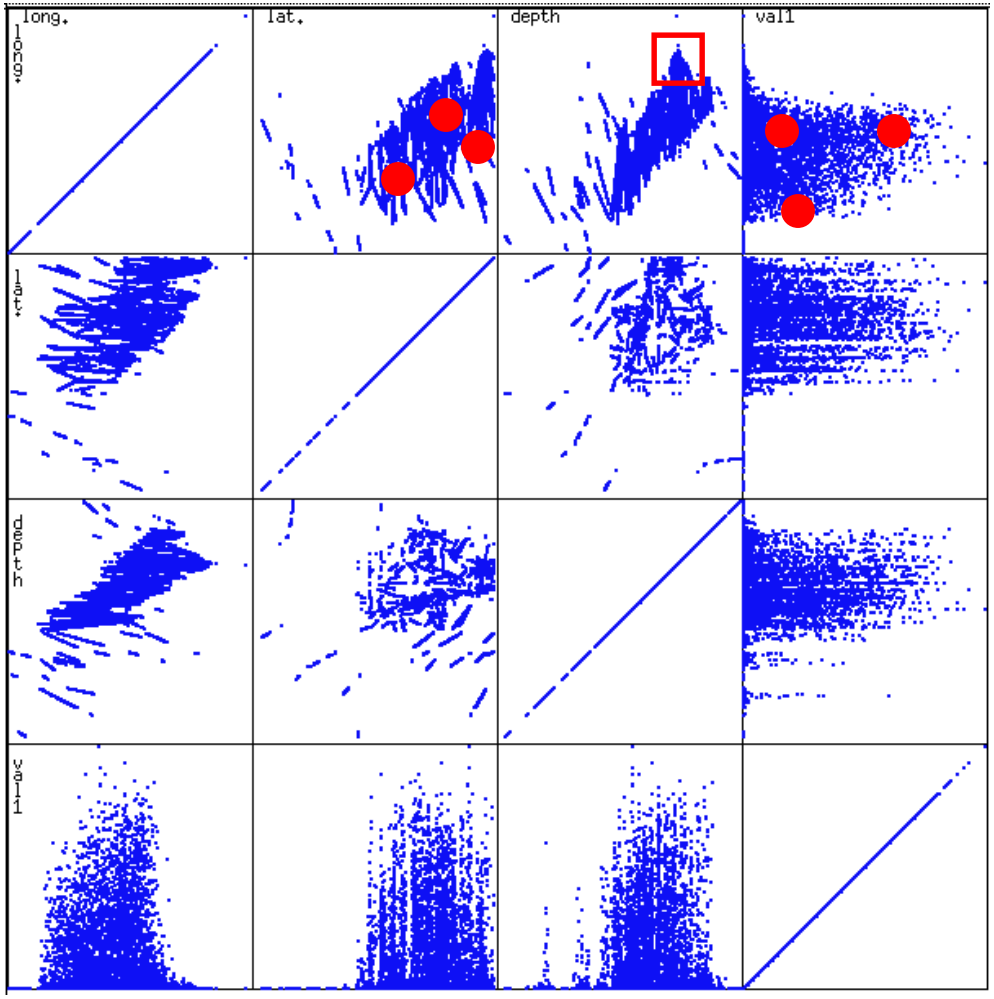
Abstract, N-Dimensional Data Displays

Chernoff Faces



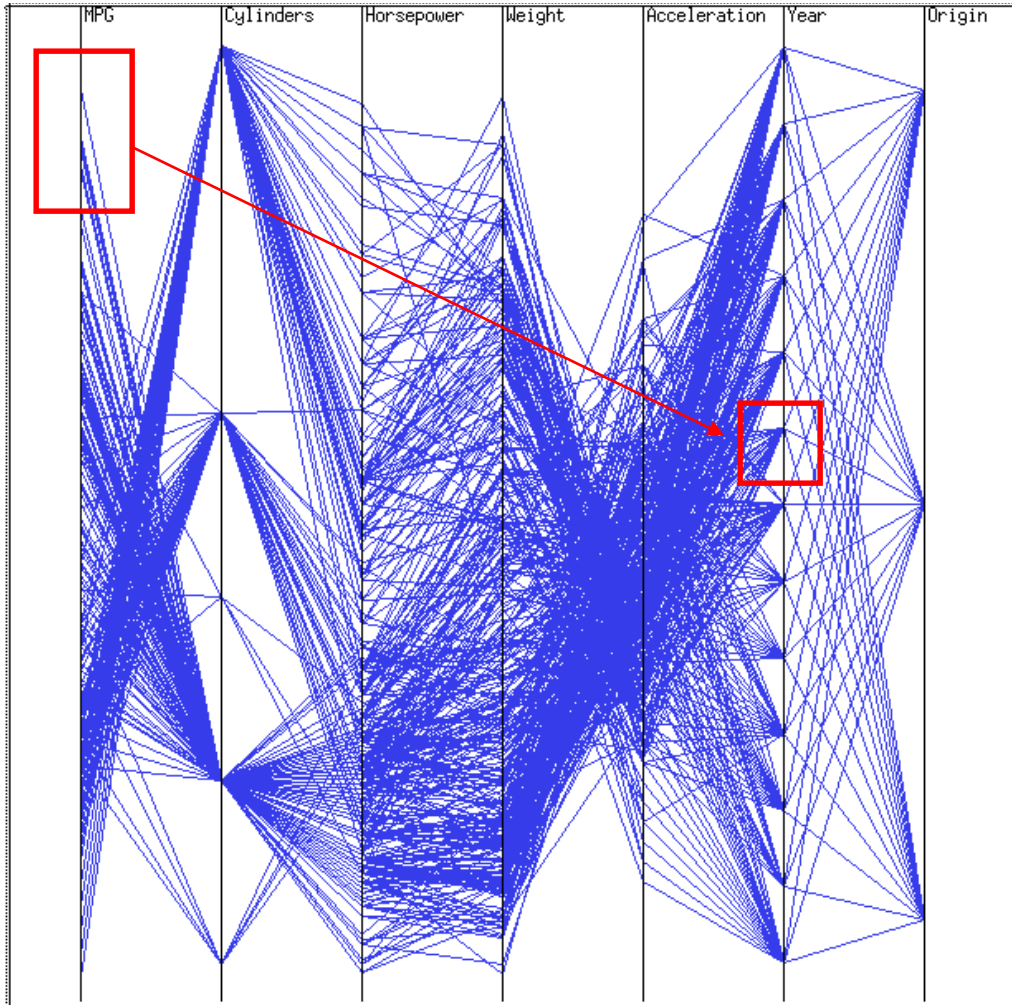
Abstract, N-Dimensional Data Displays

Scatterplot and **Dimensional Stacking**



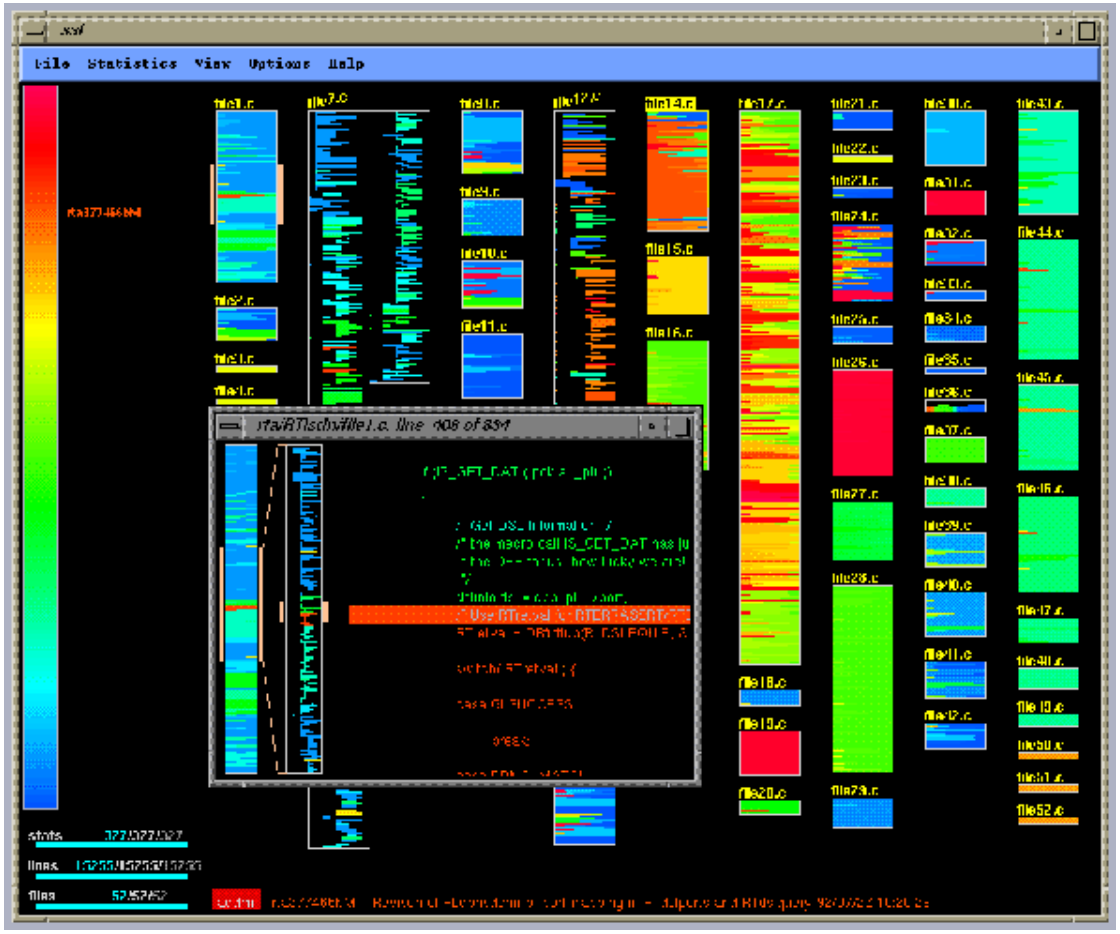
Abstract, N-Dimensional Data Displays

Parallel Coordinates by Isenberg (IBM)



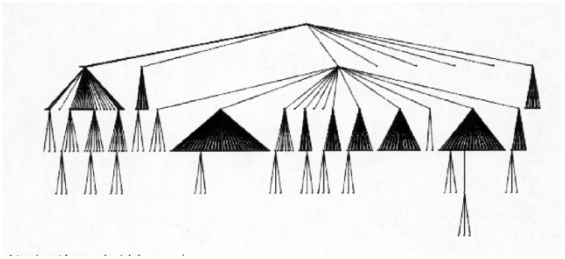
Abstract, N-Dimensional Data Displays

Software Visualization - **SeeSoft**

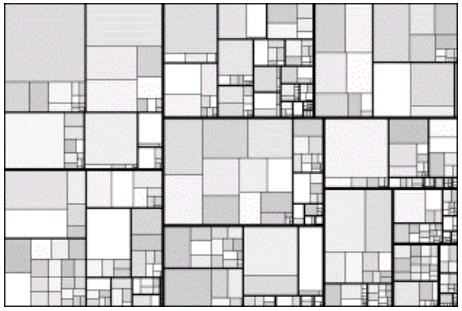


Line = single line of source code and its length **Color** = different properties

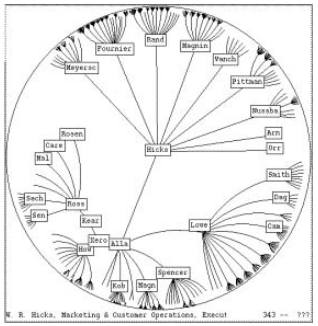
Abstract ➔ Hierarchical Information – Preview



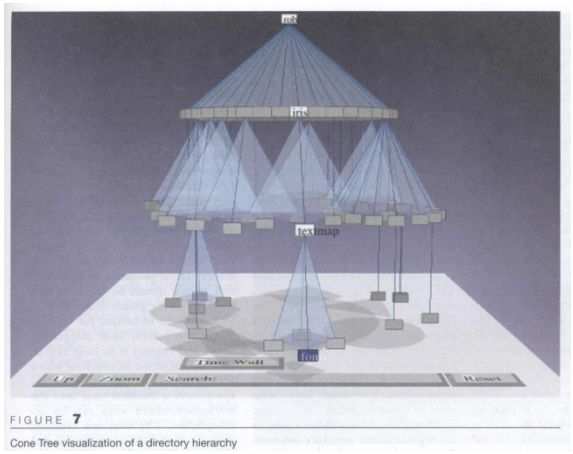
Traditional



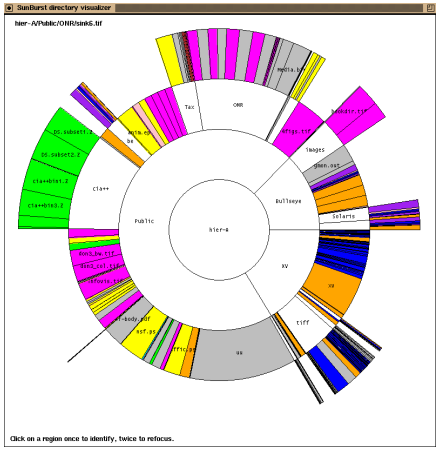
Treemap



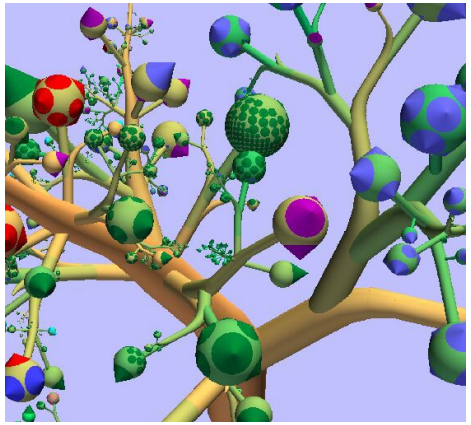
Hyperbolic Tree



ConeTree

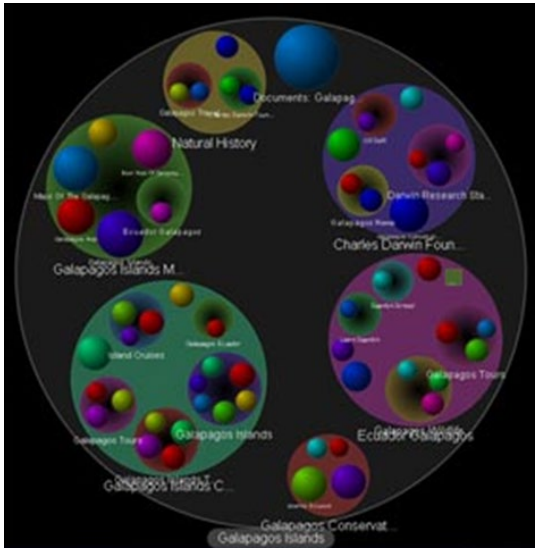


SunTree

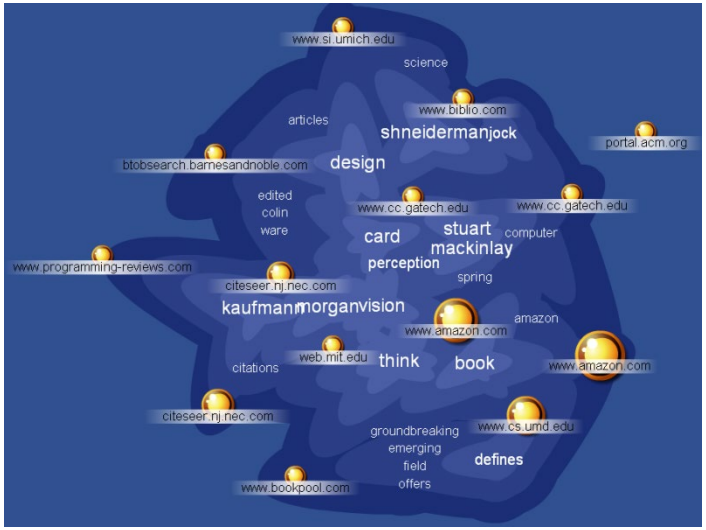


Botanical

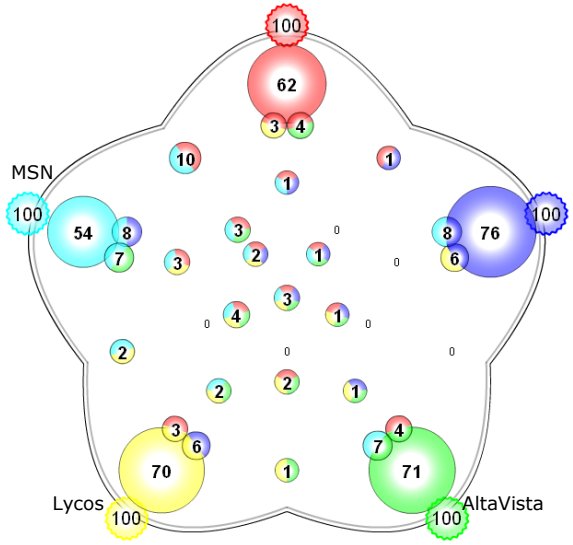
Abstract ➔ Text – **MetaSearch** Previews



Grokker



Kartoo



MetaCrystal ➔ searchCrystal

Abstract ➔ Text

Document Visualization - **ThemeView**