



Information Visualization for Knowledge Discovery

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Professor, Department of Computer Science
Member, Institute for Advanced Computer Studies



UNIVERSITY OF
MARYLAND

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Interdisciplinary research community

- Computer Science & Info Studies
- Psych, Socio, Poli Sci & MITH

(www.cs.umd.edu/hcil)

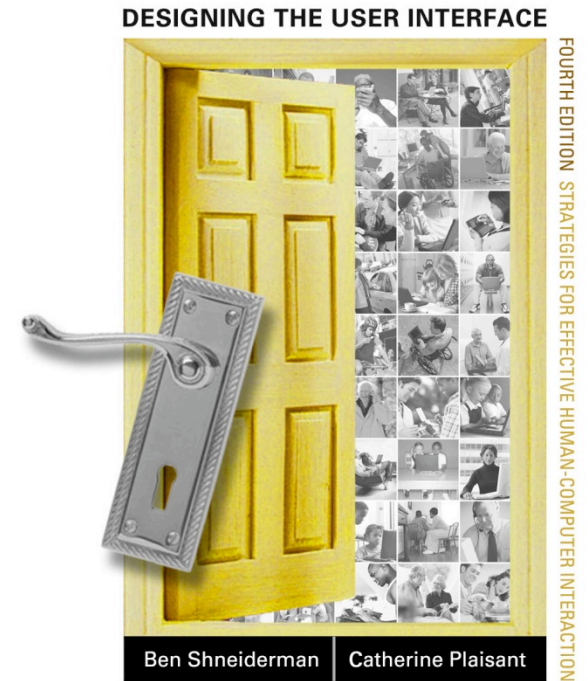


Scientific Approach (~~beyond user friendly~~)

- Specify users and tasks
- Predict and measure
 - time to learn
 - speed of performance
 - rate of human errors
 - human retention over time
- Assess subjective satisfaction
(Questionnaire for User Interface Satisfaction)
- Accommodate individual differences
- Consider social, organizational & cultural context

Design Issues

- Input devices & strategies
 - Keyboards, pointing devices, voice
 - Direct manipulation
 - Menus, forms, commands
- Output devices & formats
 - Screens, windows, color, sound
 - Text, tables, graphics
 - Instructions, messages, help
- Collaboration
- Help, tutorials, training

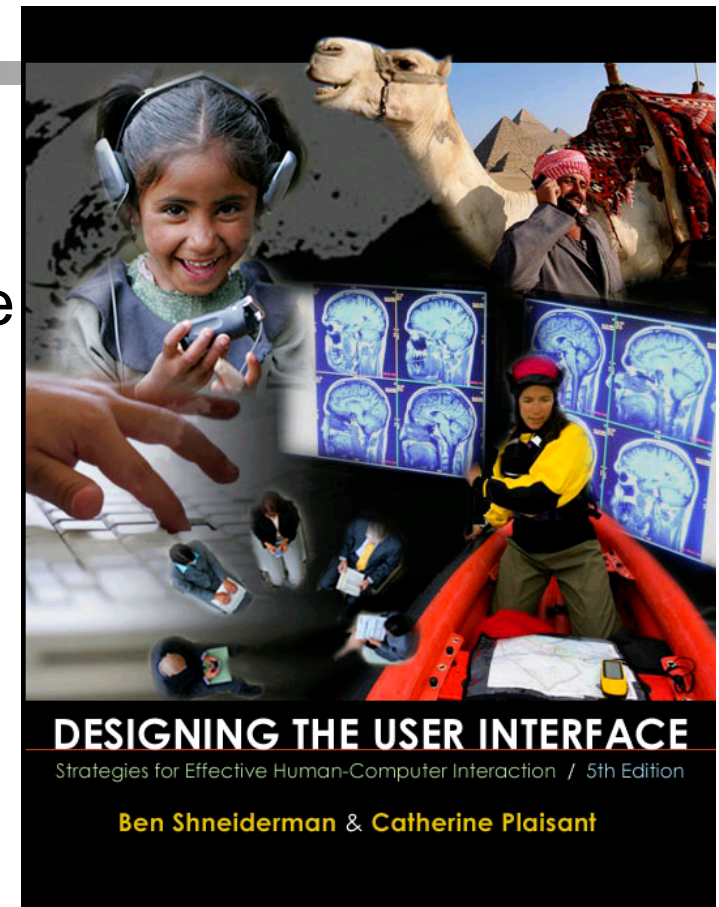


www.awl.com/DTUI



Design Issues

- Input devices & strategies
 - Keyboards, pointing devices, voice
 - Direct manipulation
 - Menus, forms, commands
- Output devices & formats
 - Screens, windows, color, sound
 - Text, tables, graphics
 - Instructions, messages, help
- Collaboration & Social Media
- Help, tutorials, training
- Search & Visualization



www.awl.com/DTUI

Fifth Edition: March 2009



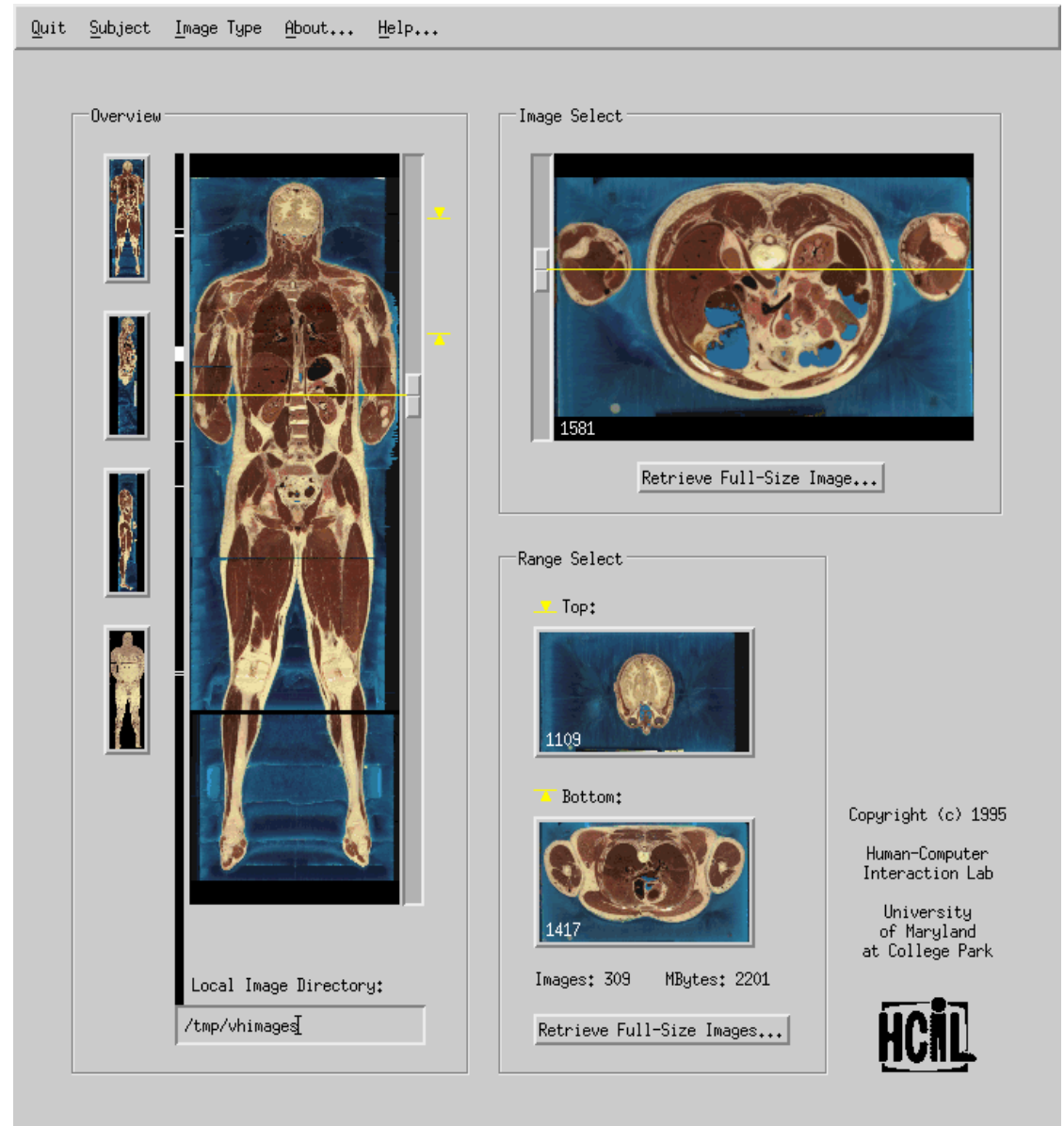
U.S. Library of Congress



- Scholars, Journalists, Citizens
- Teachers, Students


Visible Human Explorer (NLM)

- Doctors
- Surgeons
- Researchers
- Students



NASA Environmental Data

- Scientists
- Farmers
- Land planners
- Students

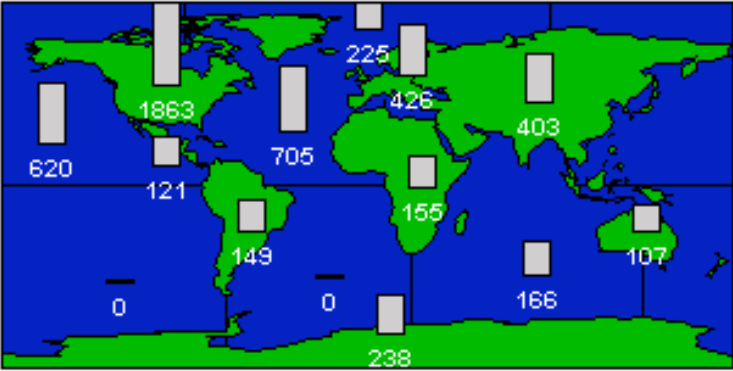


Global Change Master Directory

Global Change Master Directory

Query Preview

Area Selection:



Select attributes of interest by clicking on map area

Topic Selection:

Atmosphere	2151
Biosphere	1083
Cryosphere	313
Human Dimensions	595
Hydrosphere	643
Land Surface	802
Oceans	1321
Paleoclimate	120
Radiance Or Imagery	738
Solar Physics	113
Solid Earth	429
Not Specified	0

Year Selection:

Prehistoric	0
0001 - 1699	21
1700 - 1799	51
1800 - 1849	91
1850 - 1899	283
1900 - 1929	409
1930 - 1939	415
1940 - 1949	498
1950 - 1959	711
1960 - 1969	978
1970 - 1979	1649
1980 - 1989	2445
1990 - 1999	2391
Not Specified	644

Bureau of the Census



- Economists, Policy makers, Journalists
- Teachers, Students

American FactFinder™

NSF Digital Government Initiative



Census,
NCHS,
BLS, EIA,
NASS, SSA

- Find what you need
- Understand what you Find



www.ils.unc.edu/govstat/

FEDSTATS



International Children's Digital Library



INTERNATIONAL CHILDREN'S DIGITAL LIBRARY

A Library for the World's Children

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QUICK LINKS

[myICDL Account](#)

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- [Select language](#)

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For returning visitors

- [Recently added books](#)

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For researchers

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Our Mission

We are a library that provides free access to children's books from around the world. By ensuring access to books from many cultures and in diverse languages, we foster a love of reading, a readiness to learn, and a response to the challenges of world illiteracy.

We invite you to [explore our growing library](#) and learn how you can [contribute to our efforts](#).

FEATURED BOOKS

Colorful illustrations with Jeanette Marin

May 8, 2006 Selected by Jeanette Marin, a student at the University of Maryland. Jeanette has three daughters

Simple Search

Home > [Read books!](#) > Simple Search

Rainbow Covers
 Red Covers
 Orange Covers
 Yellow Covers
 Green Covers
 Blue Covers

French = 16 books

 Aliou and Jean French	 The amazing adventures of... French	 The baby's doll French	 Baby can read French
 A big little girl French	 Collection of 150 prints o... French	 I'll be a stuntman! French	 I'm good at French French - German

Short Books
Medium Books
Long Books
Recently Added Books
Award Winning Books
Fairy Tales

Keywords in English

www.childrenslibrary.org

Information Visualization

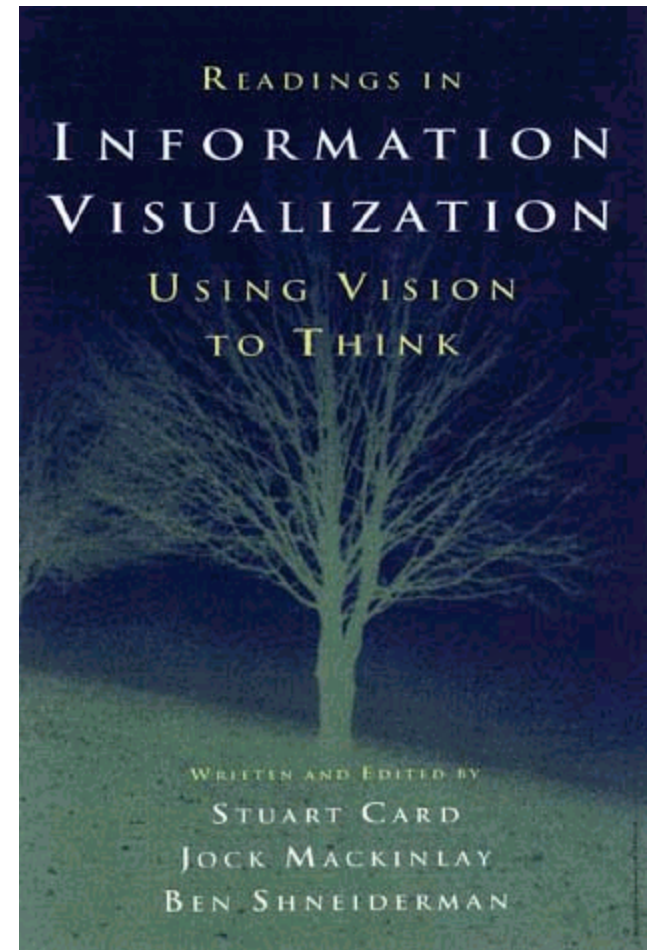


**The eye...
the window of the soul,
is the principal means
by which the central sense
can most completely and
abundantly appreciate
the infinite works of nature.**

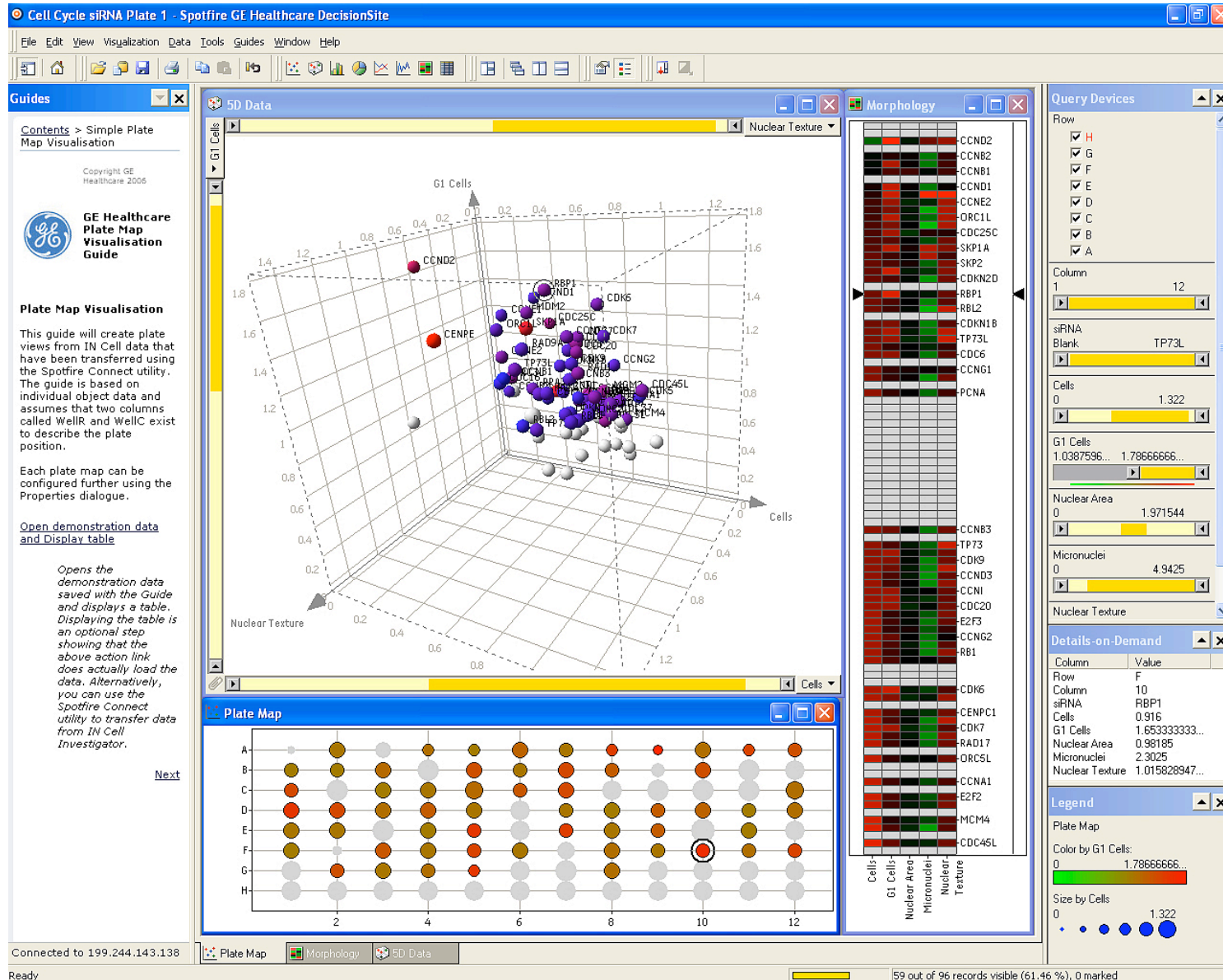
Leonardo da Vinci
(1452 - 1519)

Using Vision to Think

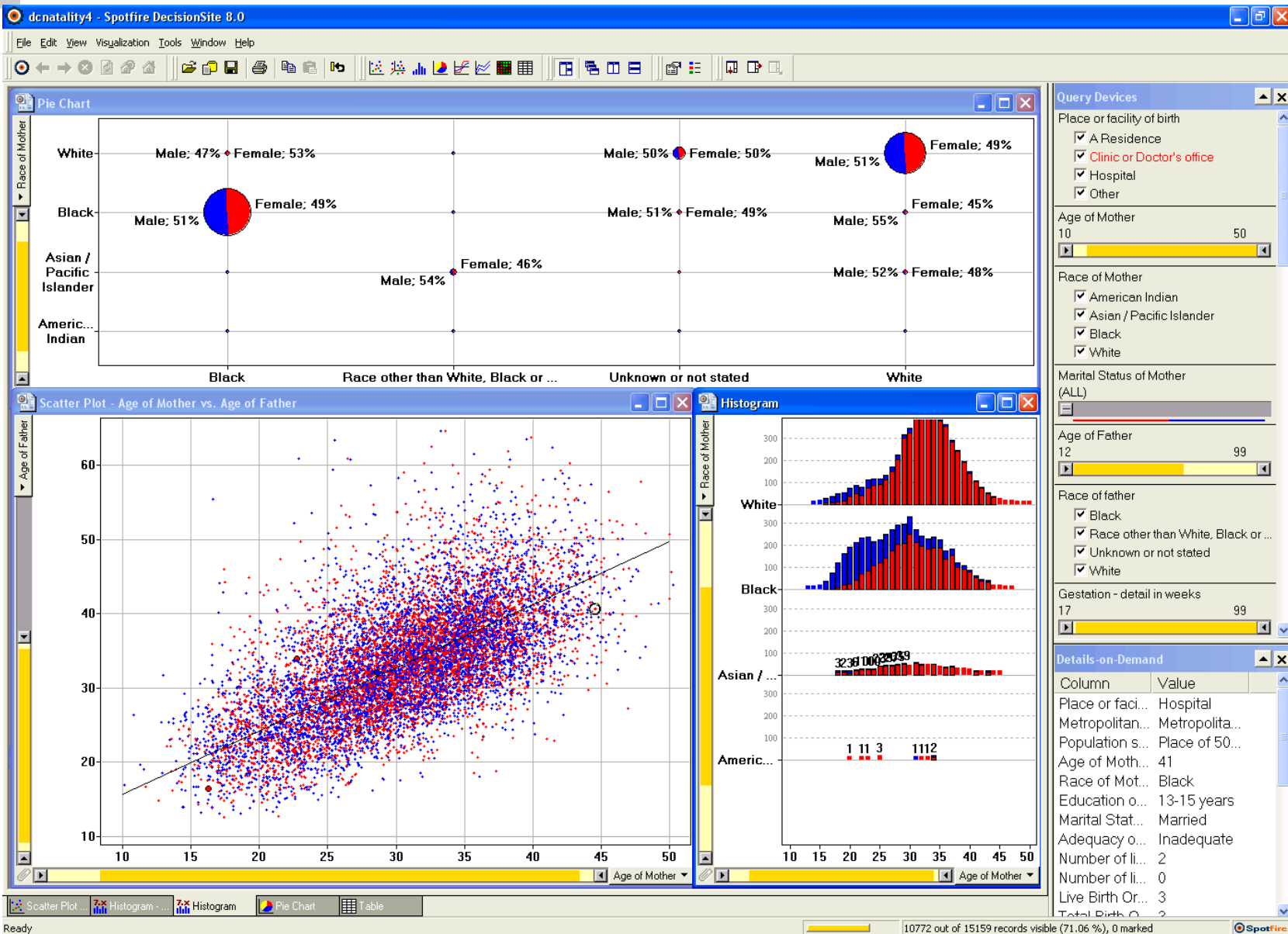
- **Visual bandwidth is enormous**
 - Human perceptual skills are remarkable
 - Trend, cluster, gap, outlier...
 - Color, size, shape, proximity...
 - Human image storage is fast and vast
- **Opportunities**
 - Spatial layouts & coordination
 - Information visualization
 - Scientific visualization & simulation
 - Telepresence & augmented reality
 - Virtual environments

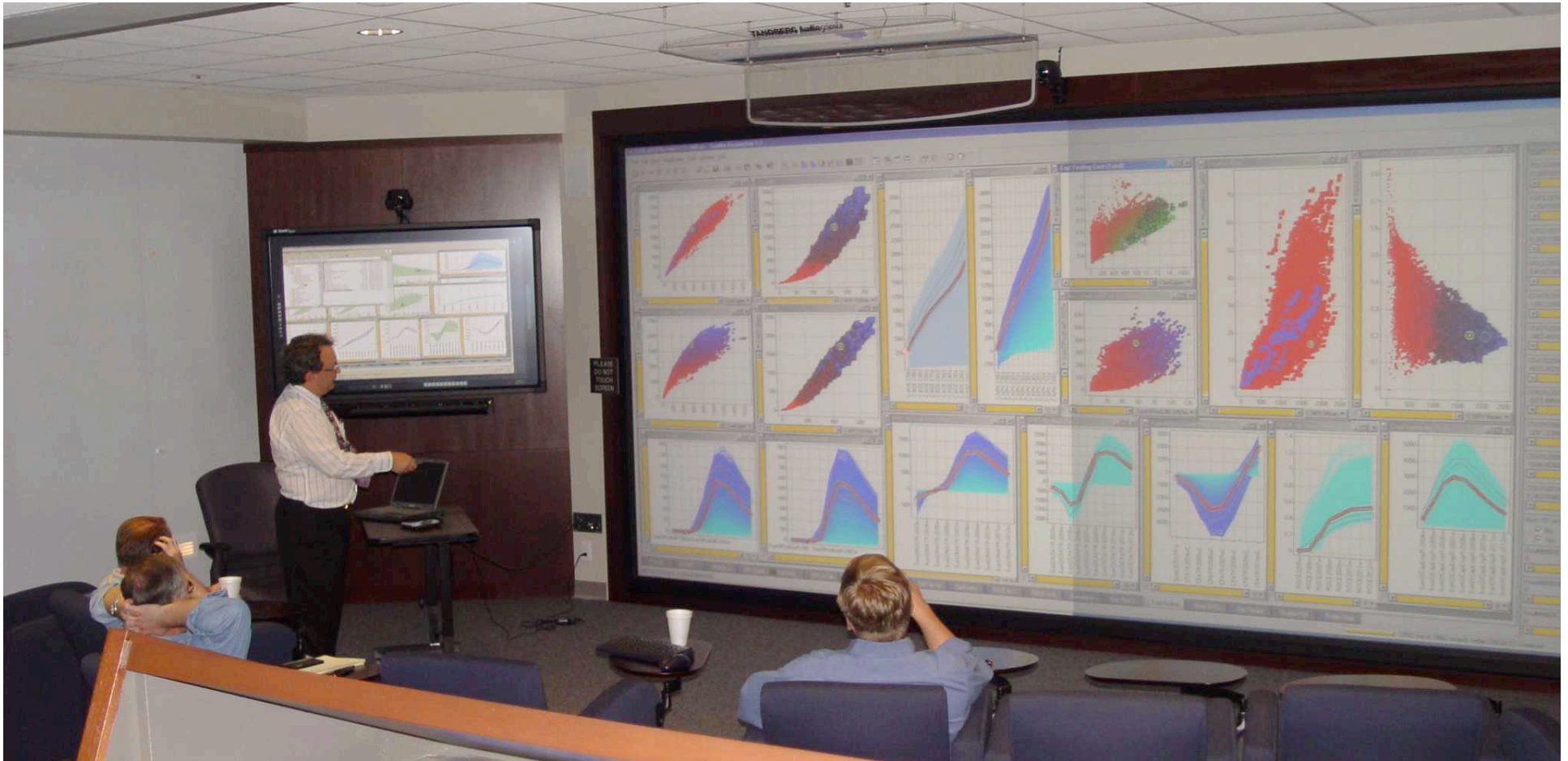


Spotfire: Retinol's role in embryos & vision



Spotfire: DC natality data

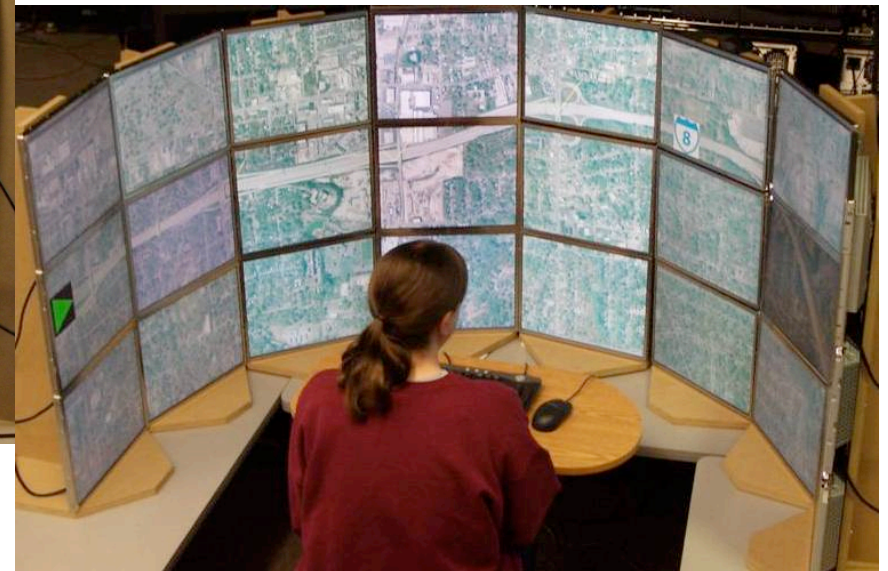




100M-pixels & more



Large displays
for single users



infovis.cs.vt.edu/gigapixel

100M-pixels & more



Information Visualization: Mantra

- Overview, zoom & filter, details-on-demand
- Overview, zoom & filter, details-on-demand
- Overview, zoom & filter, details-on-demand
- Overview, zoom & filter, details-on-demand
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Information Visualization: Data Types

SciViz

- **1-D Linear** Document Lens, SeeSoft, Info Mural
- **2-D Map** GIS, ArcView, PageMaker, Medical imagery
- **3-D World** CAD, Medical, Molecules, Architecture

InfoViz

- **Multi-Var** Spotfire, Tableau, GGobi, TableLens, ParCoords,
- **Temporal** LifeLines, TimeSearcher, Palantir,
DataMontage
- **Tree** Cone/Cam/Hyperbolic, SpaceTree, Treemap
- **Network** Pajek, JUNG, UCINet, SocialAction, NodeXL

ManyEyes: A web sharing platform



The screenshot shows the ManyEyes website interface. On the left, there are navigation links under three categories: 'explore' (visualizations, data sets, comments), 'participate' (create visualization, upload data set), and 'learn more' (gallery & tour, visualization types, data format & style, about Many Eyes, FAQ). Below these is a 'contact' section with a 'contact us' link. In the top right corner, there is a 'Sign in' link. The main content area is titled 'Try Our Featured Visualizations!' and features four columns, each with a visualization thumbnail, a title, a short description, and the author's name. The visualizations include a map of the U.S., a bar chart, a network graph, and a treemap. At the bottom of the main content area, there is an illustration of two stylized heads with speech bubbles, one containing a quote mark and the other a question mark. Below this illustration are two links: 'Check out the Many Eyes Blog' and 'Participate in the Many Eyes Forum'. The footer of the page features the 'many eyes' logo, the tagline 'for shared visualization and discovery', the IBM logo with the text 'brought to you by IBM', and the URL 'http://services.alphaworks.ibm.com/manyeyes/app'.

explore
visualizations
data sets
comments

participate
create visualization
upload data set

learn more
gallery & tour
visualization types
data format & style
about Many Eyes
FAQ

contact
contact us

Sign in

Try Our Featured Visualizations!

U.S. Overall Violent Crime Rate per 100,000 Popul...
Why Illinois?
by wesley willett

Early magazine content
At one point Cosmo was 81% fiction.
by Martin Wattenberg

Harry Potter is Freaking Popular
As much a parlor game as a visualization! Read the comments.
by Alison

World of Warcraft Top 100 Item Drops by Mob
Understanding a virtual world.
by ltc

Check out the Many Eyes Blog

Participate in the Many Eyes Forum

many eyes
for shared visualization and discovery

brought to you by IBM

<http://services.alphaworks.ibm.com/manyeyes/app>

<http://services.alphaworks.ibm.com/manyeyes/app>



Business takes action

- General Dynamics **buys** MayaViz
- Agilent **buys** GeneSpring
- Google **buys** Gapminder
- Oracle **buys** (Hyperion **buys** Xcelsius)
- Microsoft **buys** Proclarity
- InfoBuilders **buys** Advizor Solutions
- SAP **buys** (Business Objects **buys** Infomersion & Inxight & Crystal Reports)
- IBM **buys** (Cognos **buys** Celequest) & ILOG
- TIBCO **buys** Spotfire

Treemap: view large trees with node values

- + Space filling
- + Space limited
- + Color coding
- + Size coding
- Requires learning

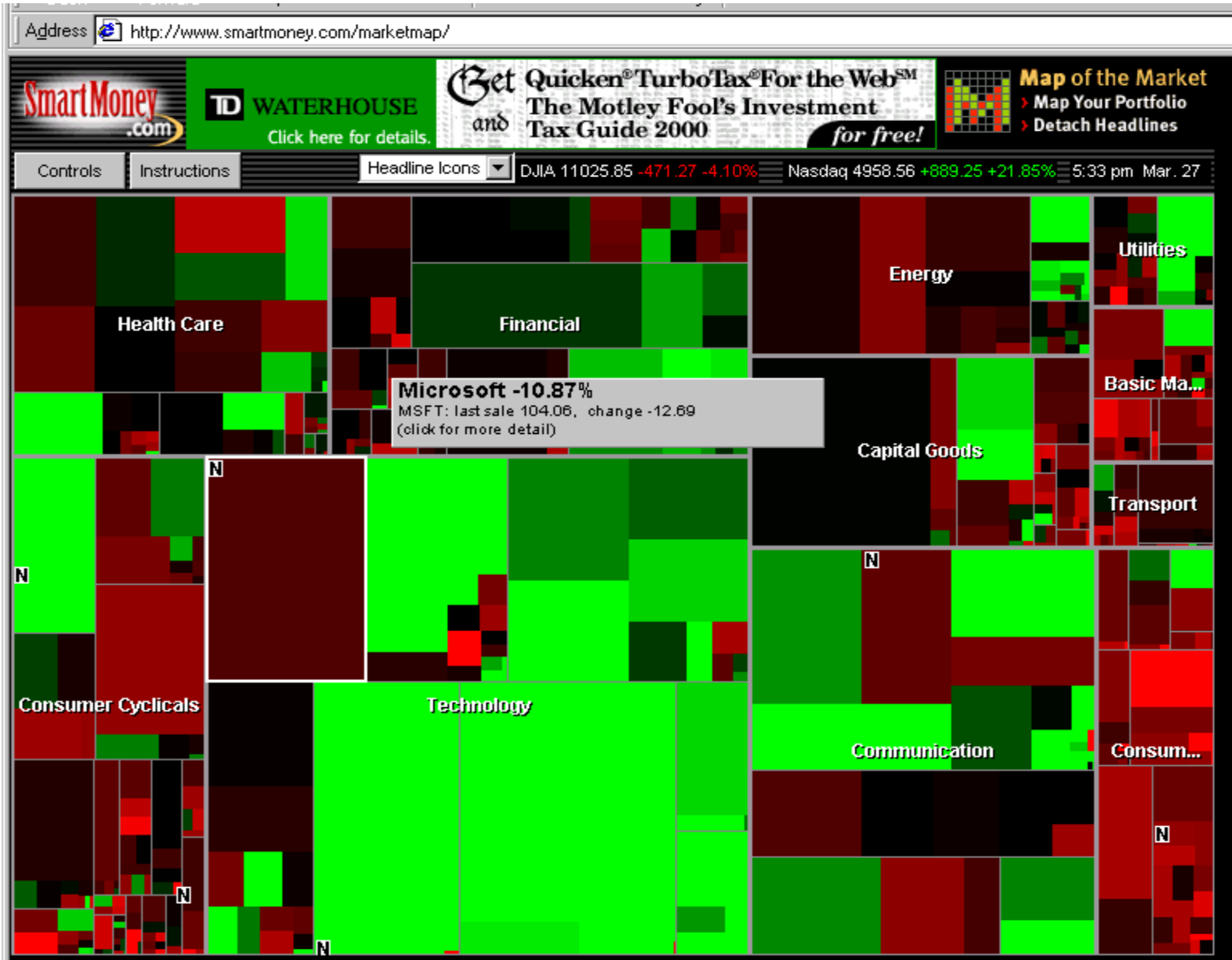
TreeViz (Mac, Johnson, 1992)
NBA-Tree(Sun, Turo, 1993)
Winsurfer (Teittinen, 1996)
Diskmapper (Windows, Micrologic)
SequoiaView, Panopticon,
HiveGroup, Solvern
Treemap4 (UMd, 2004)



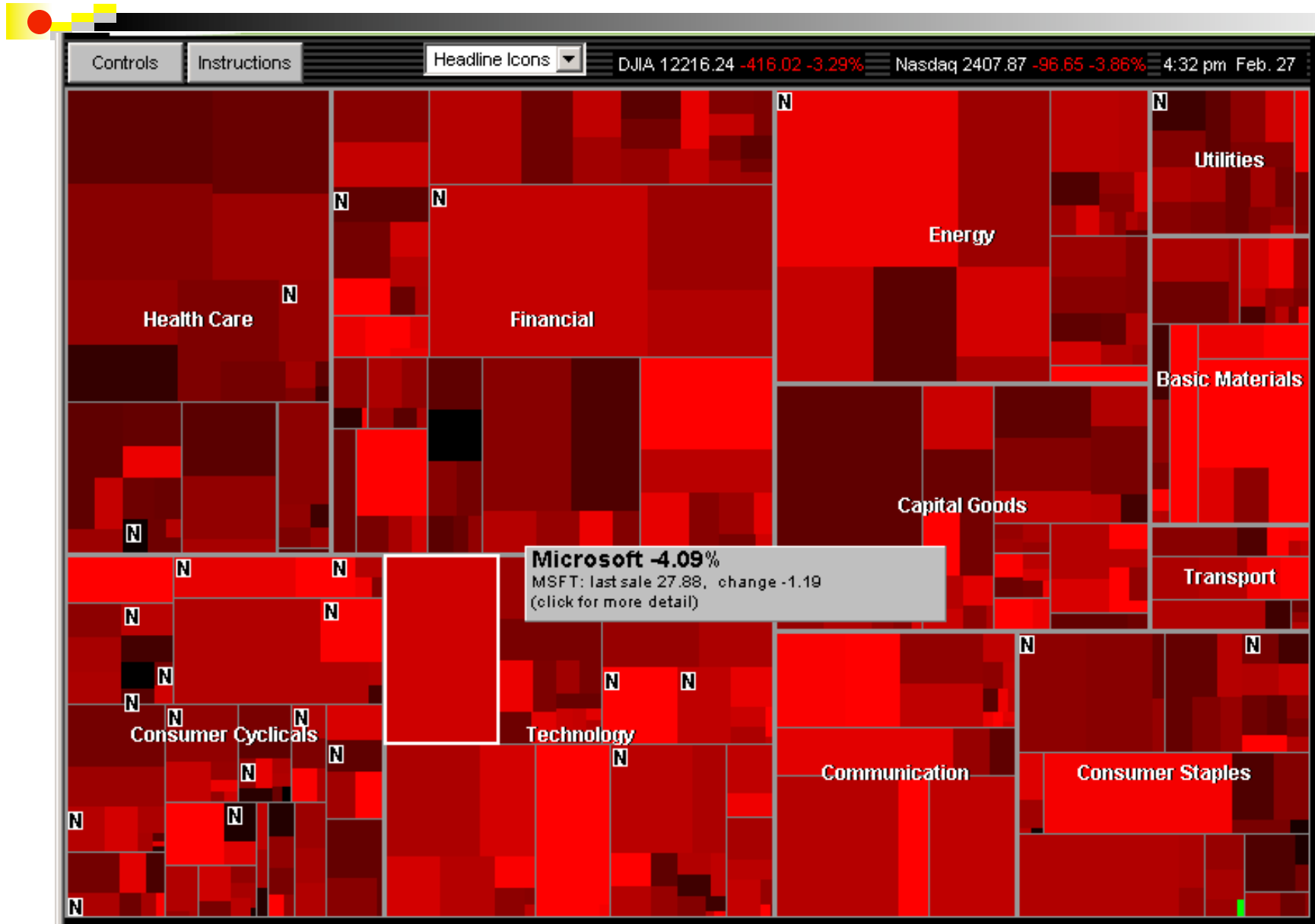
(Shneiderman, *ACM Trans. on Graphics*, 1992 & 2003)



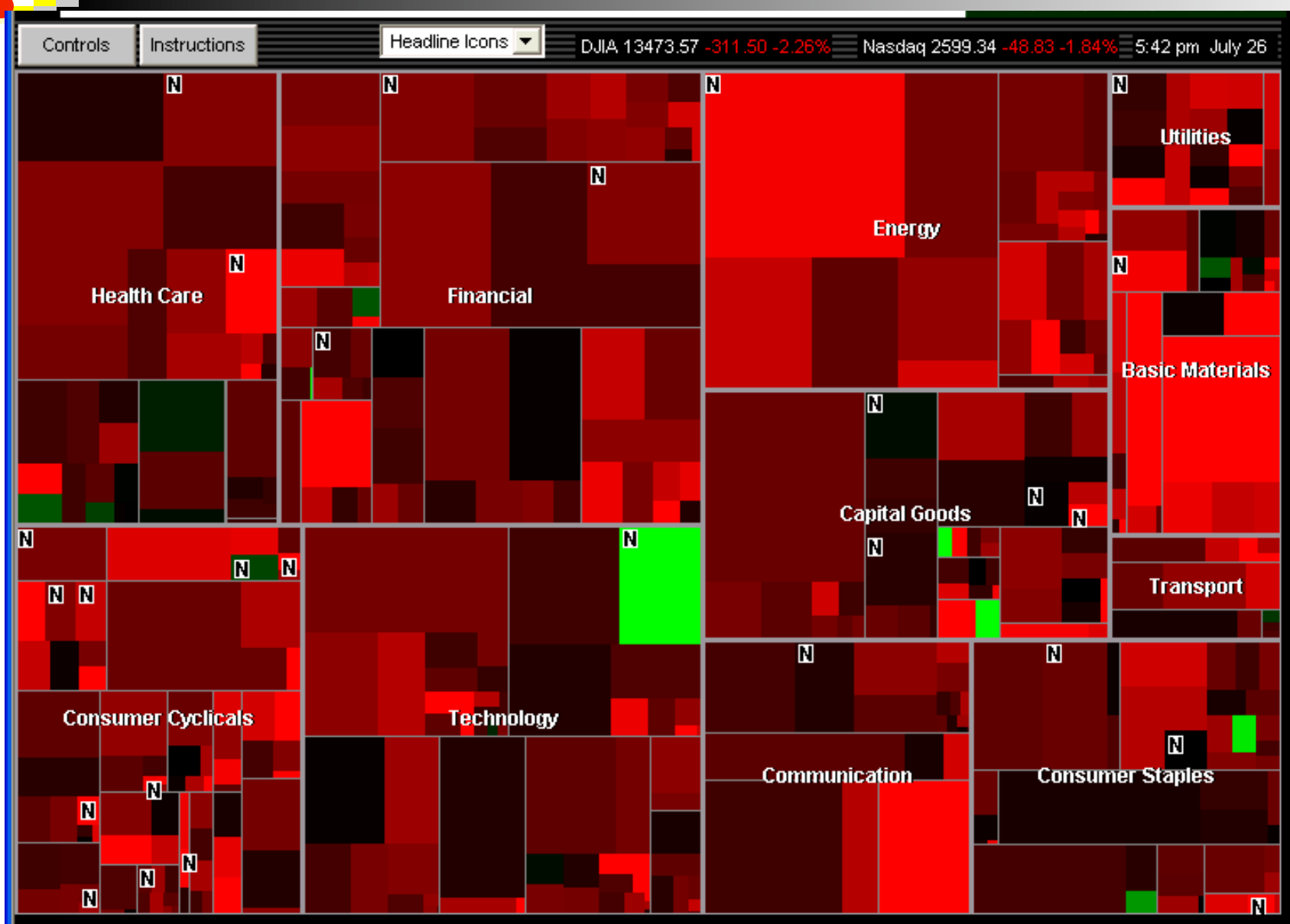
Treemap: Stock market, clustered by industry



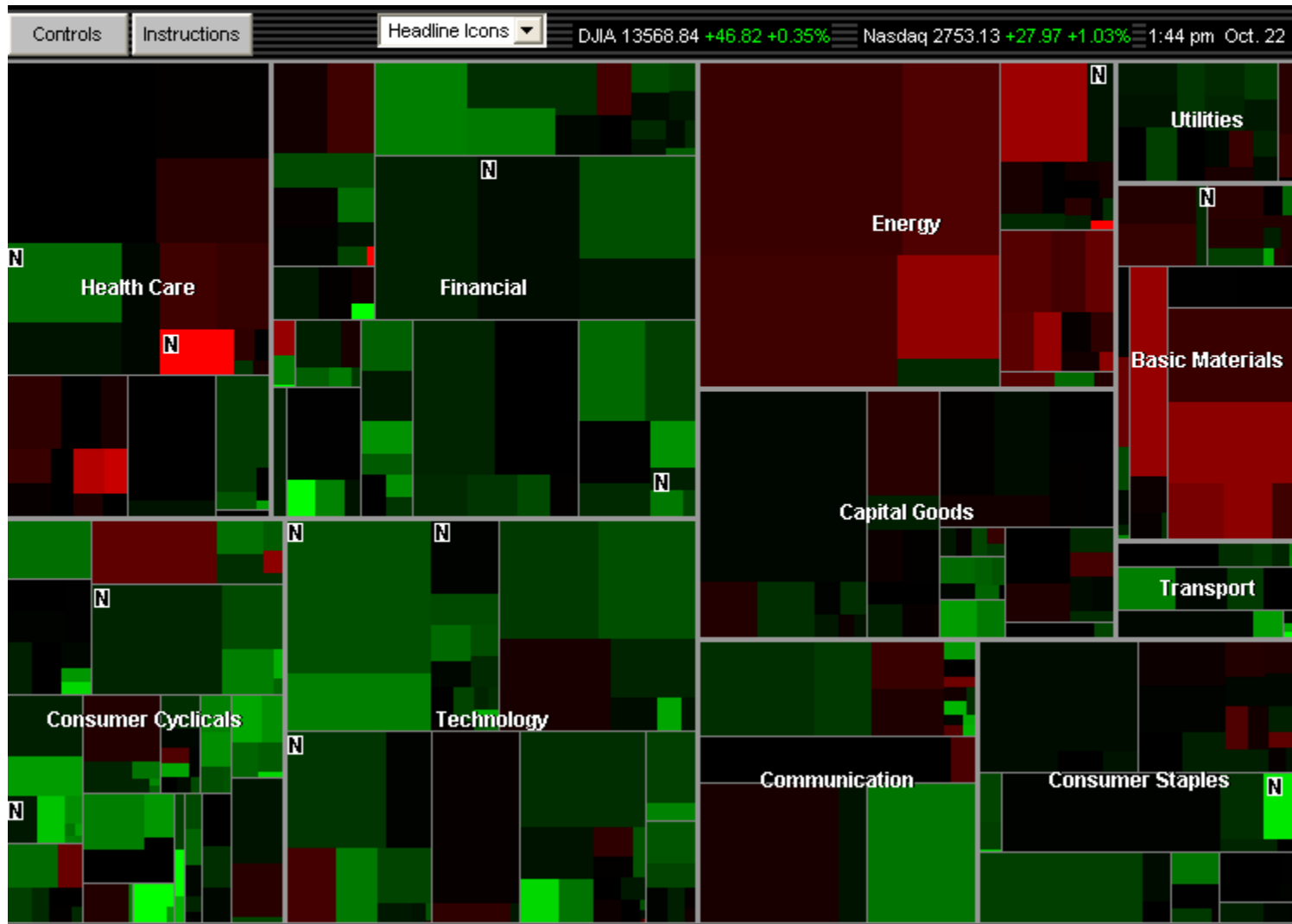
Market falls steeply Feb 27, 2007, with one exception



Market falls 311 points July 26, 2007, with a few exceptions

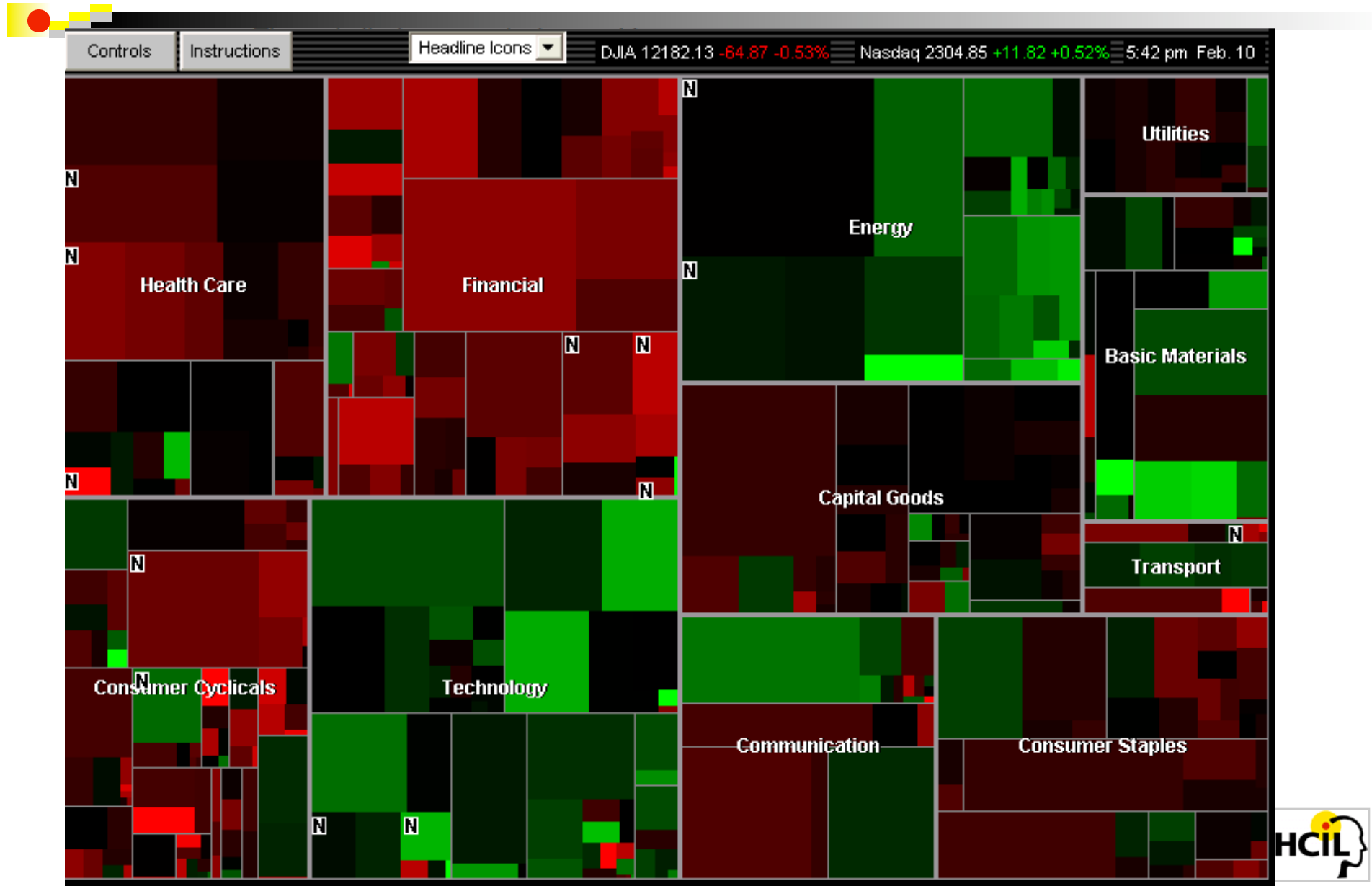


Market mixed, October 22, 2007, Energy & Basic Material are down

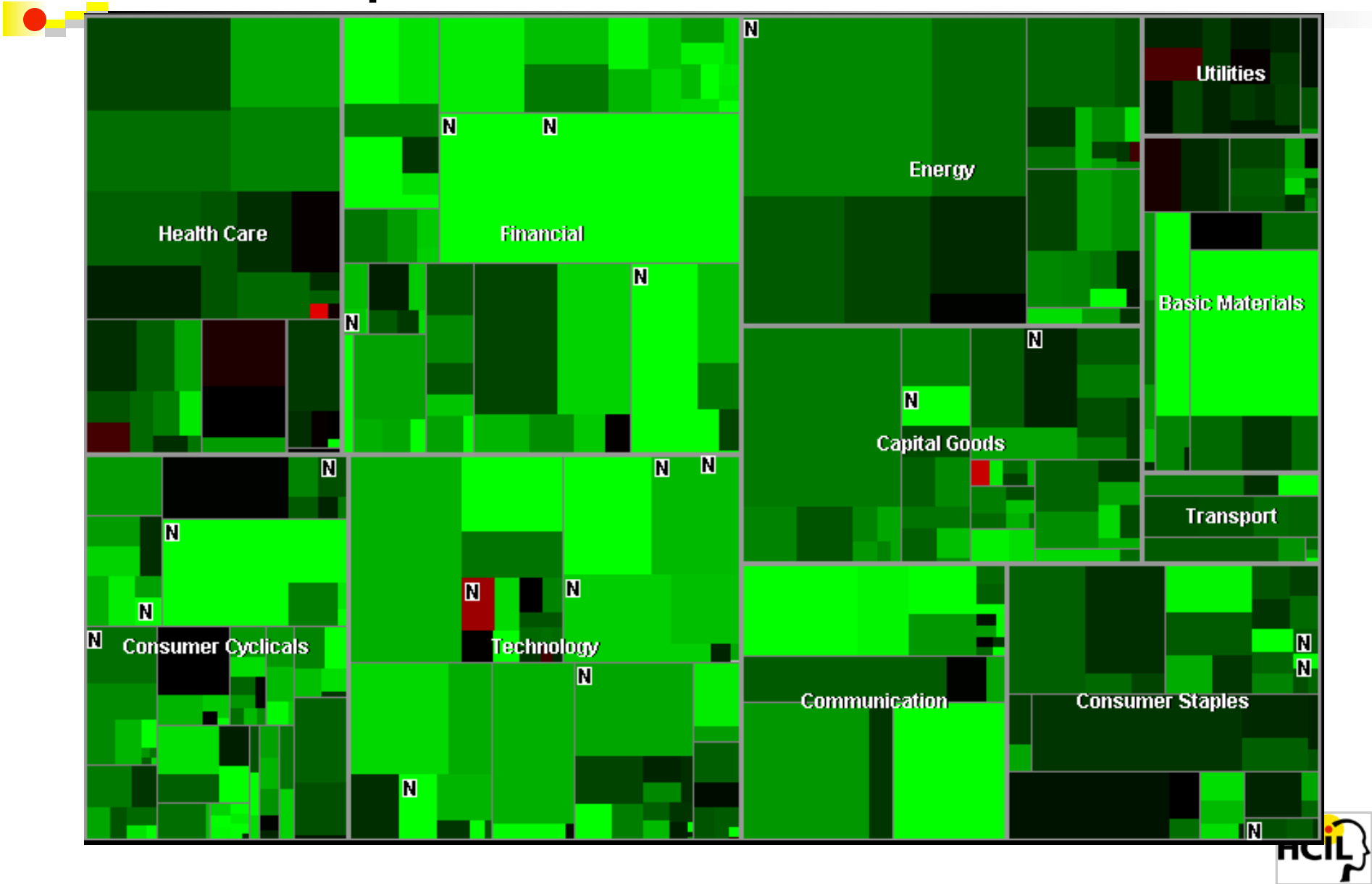


Market mixed, February 8, 2008

Energy & Technology up, Financial & Health Care down



Market rises 319 points, November 13, 2007, with 5 exceptions



Treemap: Newsmap



Treemap: Gene Ontology



<http://www.cs.umd.edu/hcil/treemap/>



Treemap: Product catalogs

www.hivegroup.com



http://www.hivegroup.com/amazon_dyn.html - Microsoft Internet Explorer

The Hive Group Close Window *Audio & Video* *Camera & Photo* *Computer Add-Ons*


Digital Cameras: All Digital Cameras Amazon.com prices subject to change. Generated: Mon Oct 6 22:24:34 2003

HONEYCOMB LAYOUT

GROUP by: SIZE represents: COLOR represents: Few Sales Bestsellers n/a

Nikon	Sony	Kodak	Panasonic
	\$1,016.95	\$799.99	\$499.99 \$282.9...
			\$399.99 \$26... \$26...
			\$399.99 \$26... \$24...
		Olympus	Fujifilm
		\$349... \$34...	\$438... \$34...
		\$216... \$16...	\$39... \$38...
		\$179.9...	\$269.94 \$226.99
		Yashica	Casio
			\$499.8...
			\$32...
		Minolta	Canon Cameras US
		\$399.99	\$429.99
		\$349.99	\$319... \$129...
		\$282.9...	\$299.9...
		\$99.88	** Other Brands (CLICK TO ZOOM IN)** 1
		Epson	RCA
		\$799.00	\$299.0...
			Argus
			\$15...

Pentax Optio 555 5MP Digital Camera w/ 5x Optical Zoom



Pentax
List Price: n/a
Our Price: \$599.99
You Save: n/a
Availability: Not yet released

Features:

- .. 5.0 MegaPixel CCD
- .. Ultra lightweight aluminum alloy body - Weighs only 7.2 oz
- .. Voice recording mode - audio capability that rivals stand alone audio recording devices
- .. Unlimited recording in Movie mode with sound

Average Customer Review: 0.00 Stars (0 Reviews)
Sales Rank: 3,670

[Click to View Options](#)

Displaying: 94 of 94 Amazon Products Cell Labels: Price SEARCH:

FILTERS

1) Show Only Available Items

2) Average Customer Review:

3) Amazon.com - You Save %:

4) Amazon.com - You Save \$:

- \$0 - \$40
- \$41 - \$82
- \$83 - \$124
- \$125 - \$166
- \$167 - \$208
- \$209 - \$250

5) Amazon.com - Our Price:

- \$36 - \$1029
- \$1030 - \$2023
- \$2024 - \$3016
- \$3017 - \$4010
- \$4011 - \$5004
- \$5005 - \$5999

6) Amazon.com - Sales Rank:

- 96 - 6892
- 6893 - 13689
- 13690 - 20486
- 20487 - 27283
- 27284 - 34081

Peet's Coffee & Tea

SHOP | ROASTING | FRESHNESS | TASTING | ABOUT US

COFFEE TASTING | COFFEE BREWING | TEA TASTING | TEA BREWING

COFFEE SELECTOR

CLICK HERE FOR HELP.

THIS FIELD REPRESENTS THE FULL SPECTRUM OF PEET'S COFFEES.

CLICK ON A COFFEE TO ADD IT TO YOUR CART OR TO LEARN MORE.

LEGEND

GROUP = COFFEE TYPE

SIZE = PRICE

COLOR = BODY

Medium Very Full

CHECK A BOX TO VIEW...

BEST SELLERS

RECOMMENDED FOR ESPRESSO

Try our Holiday Gift Finder.

Peet's Blends	Decaffeinate
Africa and Arabia	The Pacific
Dark Roast	Americas

Top Blend
 Premium coffees from Latin America and the Pacific blended to create full body, sparkling acidity, and spicy notes.
 \$10.95 / lb (Click for more)

Click here to let us know what you think of Peet's Coffee Selector.
 Powered by [Honeycomb™](#).





MARINE CORPS EQUIPMENT READINESS INFORMATION TOOL

USMC BY TAMCN | USMC By MEF | 1 MEF | 2 MEF | 3 MEF | MARFORRES | NAVAS | PREPOSITIONED | BPLS

[Home](#) | [Readiness by Commodity](#) | [Readiness by Functional Area](#) | [Feedback](#) | [Logout](#)

GROUP: Functional Area |
 SIZE: Rating - Current |
 COLOR: MR rating - Current |
 95% 90% 100% NA

FILTER BY PROBLEMS
TAMCNs with problems in every checked area will be displayed.

	Current	This Month	This Quarter	This Year
MR <85	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
S <90	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
R <95	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

FILTER BY ITEMS
Selected items will be shown.

- 00 - Unknown
- 10 - Radios
- 11 - Communications Support Equipment
- 13 - Air Command/Control Equipment
- 14 - Air Support Radar/IFF Equipment
- 15 - Electronic Equipment
- 17 - Ground Support Radar
- 18 - Tactical Remote Sensor Equipment
- 19 - Intelligence/Surveillance Equipment
- 20 - Generators
- 21 - Environmental Control Equipment
- 23 - Earthmoving Equipment
- 26 - Materials Handling Equipment
- 29 - Engineer Support
- 30 - Trucks
- 35 - Towed Motor Transport Equipment
- 40 - Tanks
- 41 - Assault Amphibious Vehicles
- 42 - Light Armored Vehicles
- 43 - Antileak
- 45 - Infantry Weapons
- 48 - Anti-Air Weapon Systems and I
- 43 - Missile Systems
- 50 - High Density/Low Deadline
- 97 - Communications Security Equipment
- 98 - Assault Craft
- 99 - Nuclear Biological Chemical Equip

View Deadlined Items for this TAMCN
 Generate Control Chart for this TAMCN
 Generate Historical View for this TAMCN
 Show Tabular data for this TAMCN

Track this TAMCN
 Zoom In on this group
 Zoom Out to view all
 Close Menu

B2469
Tractor, Full-Track, W/AngleBlade, T-5

	Last Week	This Month	This Quarter	This Year
MR:	101%	101%	100%	94%
S:	111%	113%	112%	110%
R:	91%	89%	89%	86%

Click mouse for reports and options.

Currently displaying: 184 of 184 items

Search by TAMCN # |
 Search by TAMCN Title |
 Filter by Current Excess |
 Label by Current Excess |
 Show Only Pacing Items

FILTER BY SEARCH CRITERIA
TAMCNs meeting search criteria will be shown.

EXCESS FILTER & LABEL
Isolate items w/excess equipment

FILTER BY PACING ITEM
Pacing Items will be shown.

[Manage MyMERIT Portfolio](#) |
 Filter by MyMERIT Portfolio |
 Label by MyMERIT Portfolio

COMMENTS: Feature Coming Soon



Treemap: NY Times – Car&Truck Sales

The New York Times

February 25, 2007

Truck Sales Slip, Tripping Up Chrysler

Over the past few years, Chrysler executives said they were following the lead of Toyota and Honda, focusing on vehicles that met the needs of their customers. But as American consumers turned away from large trucks and S.U.V.'s in 2006, Chrysler continued to churn out big vehicles, which are now sitting unsold at dealerships across the country.

READING THE CHART

Boxes are scaled proportionally according to number of cars sold in 2006

Change in sales from 2005 to 2006



Chrysler Group **-7.0%**
 Trucks/vans/S.U.V.'s 1.6 million
 Cars 0.5 million
 Pickups, minivans and S.U.V.'s made up 76 percent of Chrysler's sales, which left it vulnerable when consumers shifted to cars.

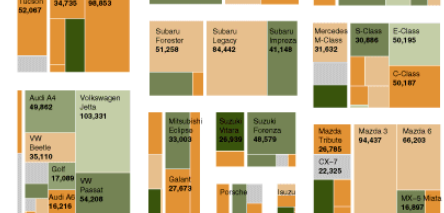
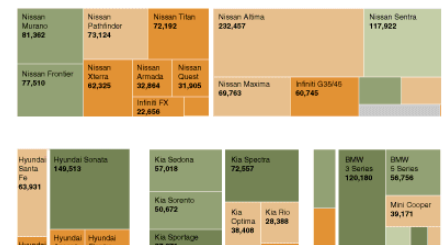
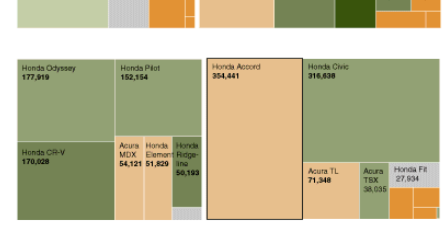
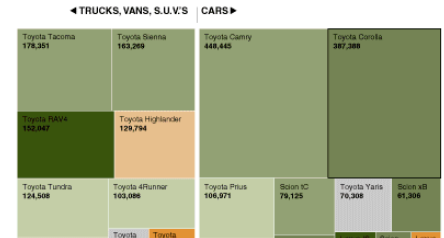
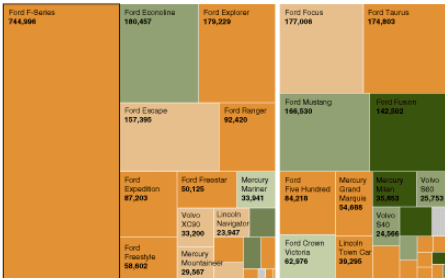
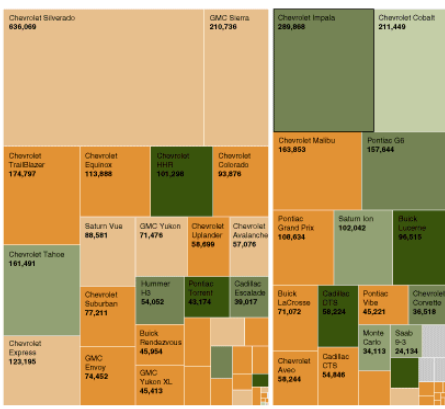
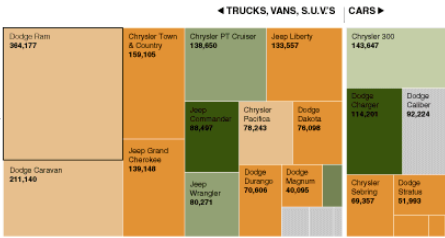


General Motors **-8.7%**
 Trucks/vans/S.U.V.'s 2.5 million
 Cars 1.6 million
 G.M. introduced new versions of its large S.U.V.'s in late 2005, hoping they would bolster sales. Instead, sales of big vehicles were hurt when gas prices climbed. One of the few standouts was the Chevrolet HHR, now in 2006.



The Chevrolet Impala, with or without flashing lights, did well in 2006, when a redesign came out.

Ford **-8.3%**
 Trucks/vans/S.U.V.'s 1.8 million
 Cars 1.1 million
 Even the country's best-selling vehicles, the F-Series, slumped in 2006, with sales dropping 13 percent. One of Ford's bright spots was the new Fusion sedan, which made its debut in late 2005 and sold well in its first full year.



Toyota **+12.5%**
 Trucks/vans/S.U.V.'s 1.1 million
 Cars 1.5 million
 Toyota rolled out a new version of the Camry, and once again it was the country's best-selling car.



Corolla sales also jumped, along with gas prices. Toyota could not escape the decline in sales of super-sized S.U.V.'s like its Sequoia.

Honda **+3.2%**
 Trucks/vans/S.U.V.'s 0.7 million
 Cars 0.8 million
 Like the Corolla, the small Honda Civic did well. But the Accord stalled. Buyers, it seems, are waiting for the new version to be released this year.



Nissan **-5.3%**
 Trucks/vans/S.U.V.'s 0.5 million
 Cars 0.6 million

BMW **+2.1%**
 Trucks/vans/S.U.V.'s 0.1 million
 Cars 0.3 million

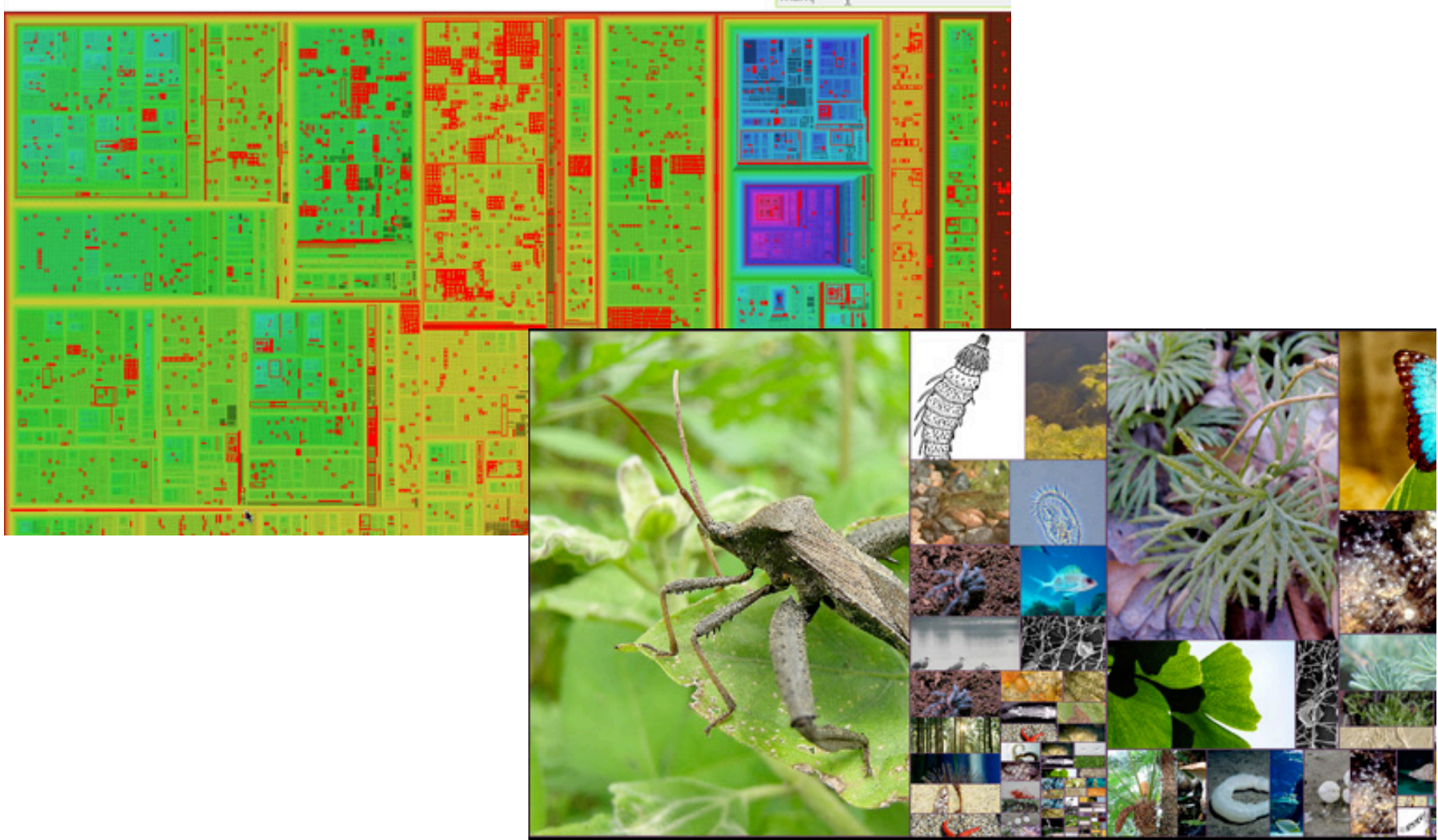
Mercedes-Benz **+10.3%**
 Trucks/vans/S.U.V.'s 0.1 million
 Cars 0.2 million
 Mercedes-Benz, owned by DaimlerChrysler, had a comeback in 2006, thanks to a new version of its flagship S-Class. BMW sales were helped by a new Truck Sales Slip, 3 Series sport sedan.

Sources: Ward's AutoIntelligence; Edmunds

Amanda Cox and Hannah Fairfield/The New York Times

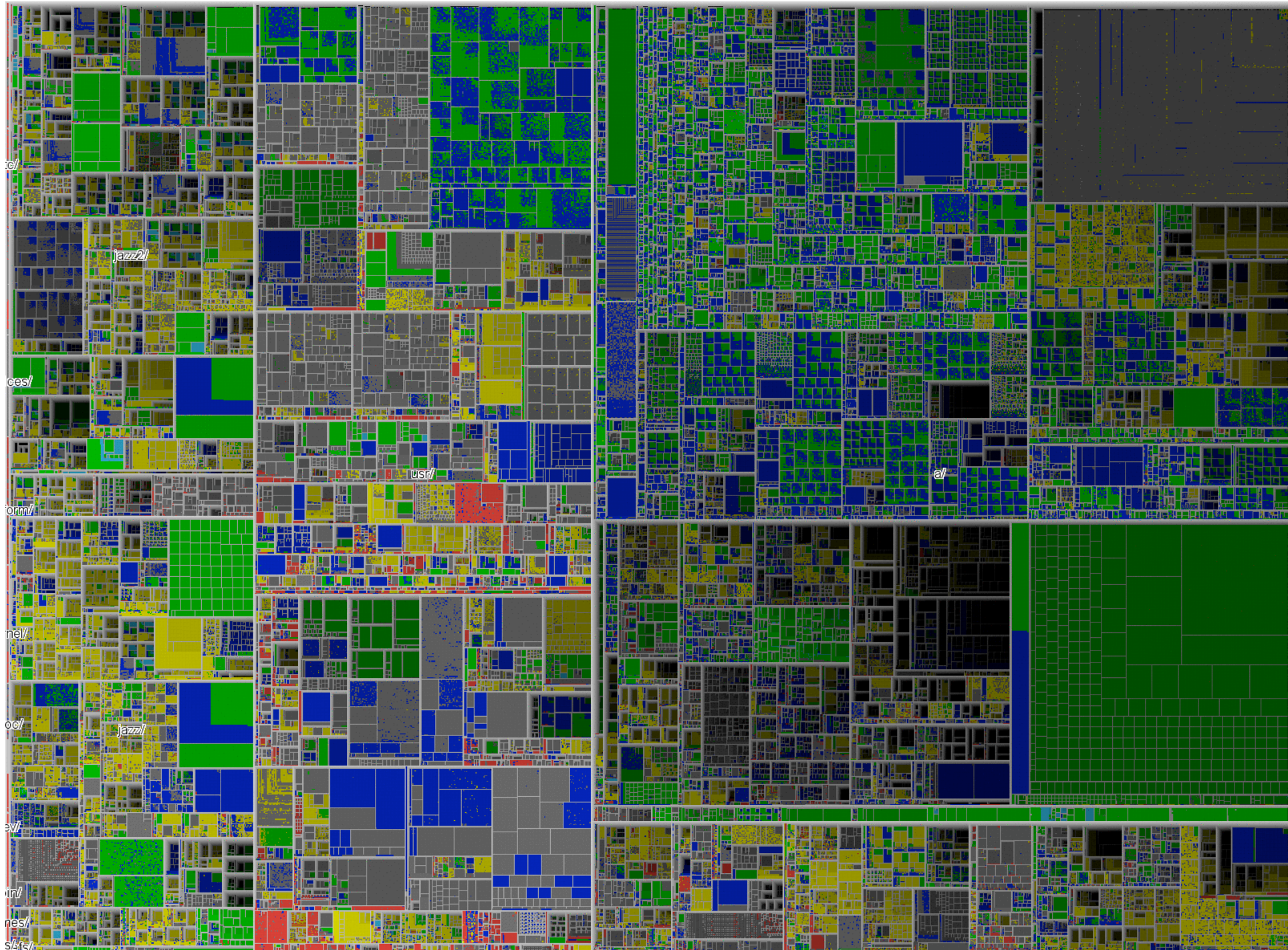


Treemap: Tree of Life (1.8M species)



<http://eol.org>



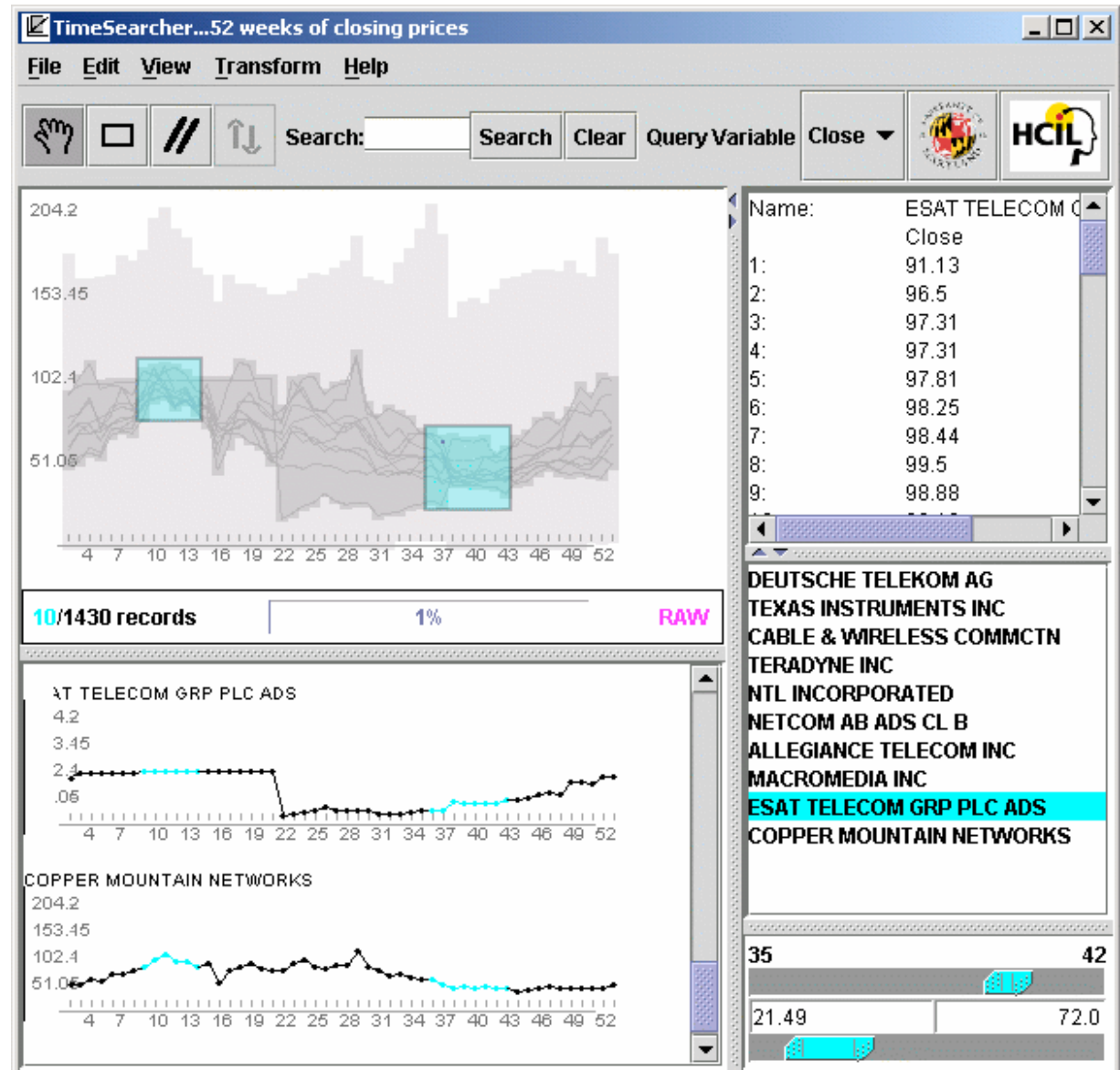


Speed: 5.917fps/0.169spf 971061 items

root.xml.gz/a/kronos/raid/ /usr/src/ /build.sh

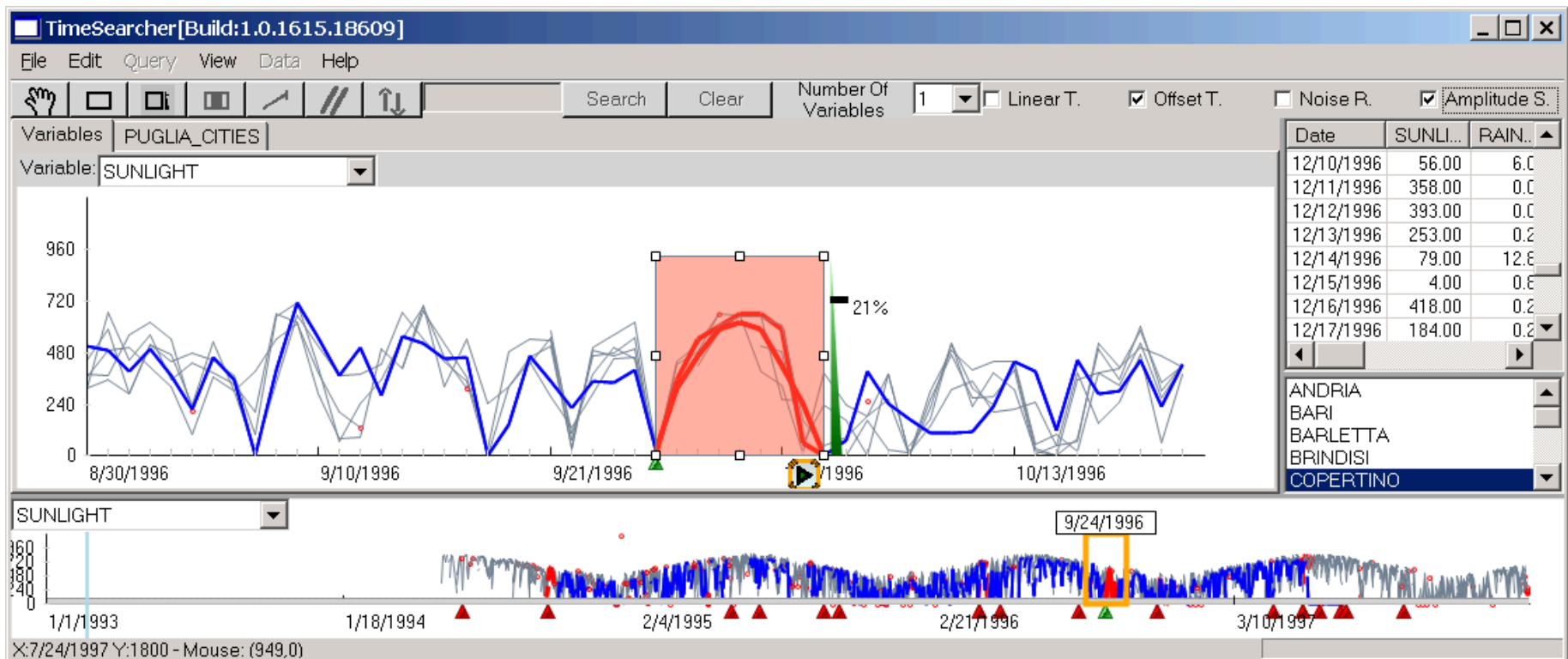
Temporal Data: TimeSearcher 1.3

- Time series
 - Stocks
 - Weather
 - Genes
- User-specified patterns
- Rapid search



Temporal Data: TimeSearcher 2.0

- Long Time series (>10,000 time points)
- Multiple variables
- Controlled precision in match
(Linear, offset, noise, amplitude)



TimeSearcher: Shape Searcher Edition

TimeSearcher: Shape Searcher Edition...52 weeks of closing prices

File Edit View Transform Help

5 Point Angular Spike Points in Shape: Search

Medarex Inc
204.2
153.15
102.1
51.05

Mitsui & Co Ltd
204.2
153.15
102.1
51.05

Icici Limited CI D
204.2
153.15
102.1
51.05

Mitsui & Co Ltd
204.2
153.15
102.1
51.05

Arrowpoint Cmmunctns
204.2
153.15
102.1
51.05

Micromuse Inc
204.2
153.15
102.1
51.05

Name:	Medarex Inc
Close	
1:	36.25
2:	50.13
3:	67.88
4:	58.0
5:	66.0
6:	81.88
7:	98.25
8:	122.75
9:	194.81
10:	143.0
11:	93.5
12:	67.88
13:	50.25
14:	72.63
15:	38.63
16:	40.75

- 100.0 Medarex Inc
- 99.60 Mitsui & Co Ltd
- 99.56 Icici Limited CI D
- 99.25 Mitsui & Co Ltd
- 99.23 Arrowpoint Cmmunctns
- 98.88 Micromuse Inc
- 98.85 Kansas City Sthrn Ind
- 98.85 Mitsui & Co Ltd
- 98.10 Imclone Systems Inc
- 98.07 Arrowpoint Cmmunctns
- 97.90 Usweb Corp
- 97.87 Foundry Networks Inc
- 97.81 Mmc Networks Inc
- 97.52 Next Level Comm Inc
- 97.49 Newport Corp
- 97.47 Applied Micro Circuits
- 97.25 Icici Limited CI D
- 96.70 Kansas City Sthrn Ind

1 Time 52

0 Metric 100

TimeSearcher: Shape Searcher Edition...52 weeks of closing prices



LifeLines: Patient Histories

The screenshot displays the LifeLines software interface, which is used for managing patient medical histories. The interface is divided into two main sections: a patient history timeline on the left and a medical image viewer on the right.

Patient History Timeline (Left Panel):


- Obesity:** A thick black horizontal bar spans the top of the timeline.
- Diagnoses:**
 - Atrial Flutter:** Indicated by a red vertical bar.
 - Flu Pneumonia:** Indicated by a blue and red horizontal bar.
 - Migraine:** Indicated by a blue horizontal bar.
 - Fatigue:** Indicated by a blue horizontal bar.
 - Diabetes:** Indicated by a red horizontal bar.
 - Knee Pain:** Indicated by a blue horizontal bar.
 - Pneumonia:** Indicated by a red vertical bar.
 - Knee Surgery:** Indicated by a blue vertical bar.
- Procedures:**
 - Blood:** Indicated by two red vertical bars.
 - EKG:** Indicated by a red vertical bar.
 - Xray:** Indicated by a red vertical bar.
 - Blood:** Indicated by three red vertical bars.
 - Blood:** Indicated by two red vertical bars.
 - Pap:** Indicated by two red vertical bars.
 - Pap:** Indicated by two red vertical bars.
 - Pap:** Indicated by two red vertical bars.
 - Pap:** Indicated by two red vertical bars.
 - Mammo:** Indicated by two red vertical bars.
 - Sonogram:** Indicated by a red vertical bar.
- Medications:**
 - Cardizem:** Indicated by a red horizontal bar.
 - Ventolyn:** Indicated by a blue horizontal bar.
 - Antib.:** Indicated by a blue horizontal bar.
 - Advil:** Indicated by a blue horizontal bar.
 - Insulin:** Indicated by a blue horizontal bar.
 - Insulin:** Indicated by a blue horizontal bar.
 - Propranolol:** Indicated by a blue horizontal bar.
 - Dispensed:** Indicated by a blue horizontal bar.
 - Batramex stop:** Indicated by a blue horizontal bar.
 - Lasilix:** Indicated by a blue horizontal bar.
 - Physical Therapy:** Indicated by a blue horizontal bar.
 - Low Salt Fat Diet:** Indicated by a green horizontal bar.
- Timeline Navigation:** A green bar at the bottom shows the current page (2/92) and a timeline with markers for years 93, 94, 95, 96, and 97.

Medical Image Viewer (Right Panel):

- Ultrasound Image:** A grayscale ultrasound image of a heart, showing the internal structure and motion.
- Scale Marks:** Located on the right side of the image, including "SCALE MARKS 1 cm" and "DIST. 80mm".
- Technical Data:** On the right side, technical parameters are listed: "ENH", "PWP", "HEAR", "FAR", "BAL", "POWER", and "672".
- Patient Information:** At the bottom of the image, it says "PATIENT ID [redacted] 17mm/3.0 ORIENTED R/L".
- LifeLines Control Panel:** A control panel is visible at the bottom of the image viewer, with tabs for "Layout", "Label", "Summary", "Search", and "Zoom". It includes settings for "Location Allowed" (Top Right, Top Right & Left, 4 Corners), "Link from Timeline to Label" (No, Yes), "Font Size" (8-20), and "Truncation" (No, Yes).



LifeLines: Customer Histories



Mrs Linda Simpson
Maryland 41
Allergic to polyester

5-26-1998 black p6 Linda BD "url" 13

LifeLine


	10/9596	97	98	99
▼ Catalogs	Fall95 Spring96	Fall96 Spring97	Fall97 Spring98	Fall98 Custom cata Summerspecial98
▼ Store		Store		
▼ WWW		Web	Web Web	Web
▼ PURCHASES				
▼ Clothes		\$101 \$194		\$127 \$150back
▼ Week-end		\$160		
▼ Accessories		\$152		\$27
▼ House		\$152		
▼ Specials				
▼ Return		too-small		
▼ Credit		Credit Refused		
▼ Birthday		Linda BD	Linda BD	Linda BD

Linda Simpson ORDER#614345 (MOST RECENT)
11-1-1997,\$150, Visa card, order by phone


[D45F224: Boots - 4 - Black](#)
----> **BACKORDER - estimated shipping 12-15**

[D45F236: Gloves - Black - M](#)
[A78156: Corduroy pants - Tan - L](#)
[157826: Hat - Grey - M](#)

Kids Backcountry hiking boots
Leather boots with super grip soles.



Black



Brown

LifeLines2: Align-Rank-Filter

LifeLines 2 - events.txt (de-identified real data)

File About

Records 7/47 Rank by [# of Acute myocardial infarction]

Align by [1st Acute myocardial infarction]

		-3 yrs	-2 yrs	-1 yr	match	1 yr	2 yrs	3 yrs	4 yrs
▼1000000045									
▽-									
Acute myocardial in	6				▲ Acute myocardial in				
Coronary atheroscl					▲ Coronary atherosclerosis~				
Hypertensive disea		▲ Hypertensive disease							
▼1000000026									
▽-									
Acute myocardial in	2				▲ Acute myocardial infarction				
Coronary atheroscl					▲ Coronary atherosclerosis~				
Hypertensive disea		▲ Hypertensive disease							
Other and unspecif					▲ Other and unspecified ang~				
Postmyocardial infa					▲ Postmyocardial infarction~				
▼1000000052									
▽-									
Acute myocardial in	2				▲ Acute myocardial infarction				
▼1000000011									
▽-									
Acute myocardial in	1				▲ Acute myocardial infarction				
Hypertensive disea		▲ Hypertensive disease							
▼1000000043									
▽-									
Acute myocardial in	1				▲ Acute myocardial infarction				
Coronary atheroscl					▲ Coronary atherosclerosis~				
Hypertensive disea					▲ Hypertensive disease				
▼1000000054									
▽-									
Acute myocardial in	1				▲ Acute myocardial infarction				
Hypertensive disea					▲ Hypertensive disease				

ARF Controls Preferences

Align by...
1st Acute myocardial infarction(7)

Rank by...
#/times Acute myocardial infarction(7)

Filter by...
nothing
#/times 1 Acute myocardial infarction(7)
sequence Acute myocardial infarction(7)
Acute myocardial infarction(7)
None

Collapse all

Legend

- ▲ Acute myocardial infarction
1 mon. 3 mon. edit
- ▲ Aneurysm of heart (wall)
edit
- ▲ Chronic Rheumatic heart disease
1 mon. 4 mon. edit
- ▲ Coronary atherosclerosis~
2 mon. 4 day edit
- ▲ Hypertensive disease
15 day 6 mon. edit

HCIL UNIVERSITY OF MARYLAND

Copyright 2007
HCIL UMD

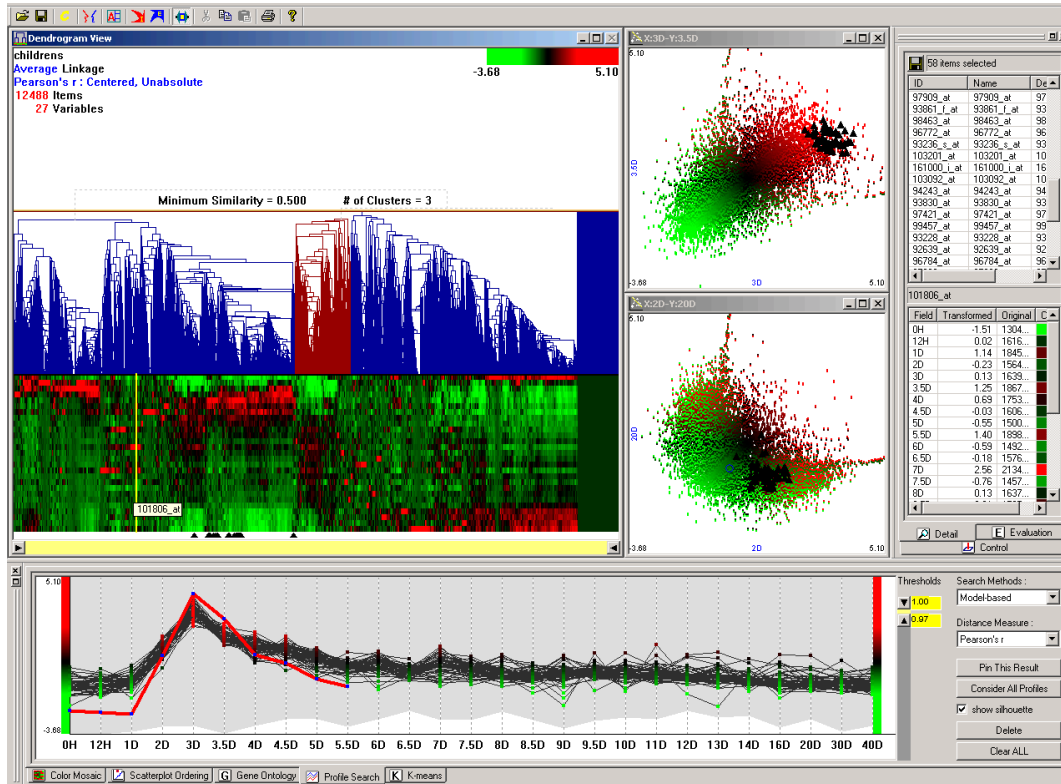
Aligned by [1st Acute myocardial infarction] Ranked by [# of Acute myocardial infarction]



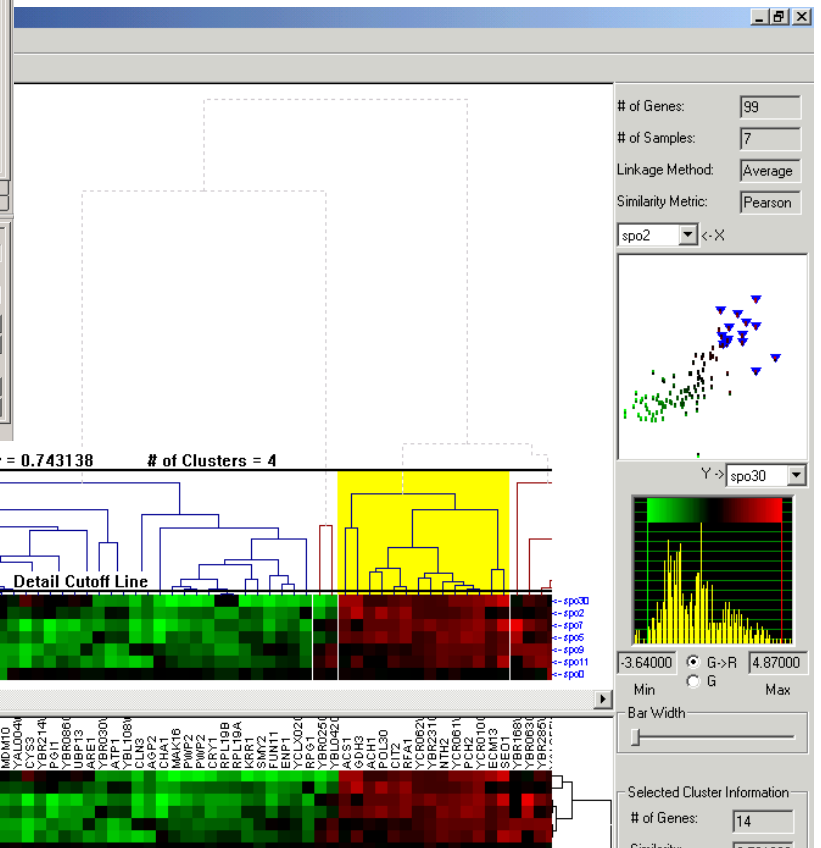
Goal: Find Features in Multi-Var Data

- Clear vision of what the data is
- Clear goal of what you are looking for
- Systematic strategy for examining all views
- Ranking of views to guide discovery
- Tools to record progress & annotate findings

Multi-V: Hierarchical Clustering Explorer



www.cs.umd.edu/hcil/hce/



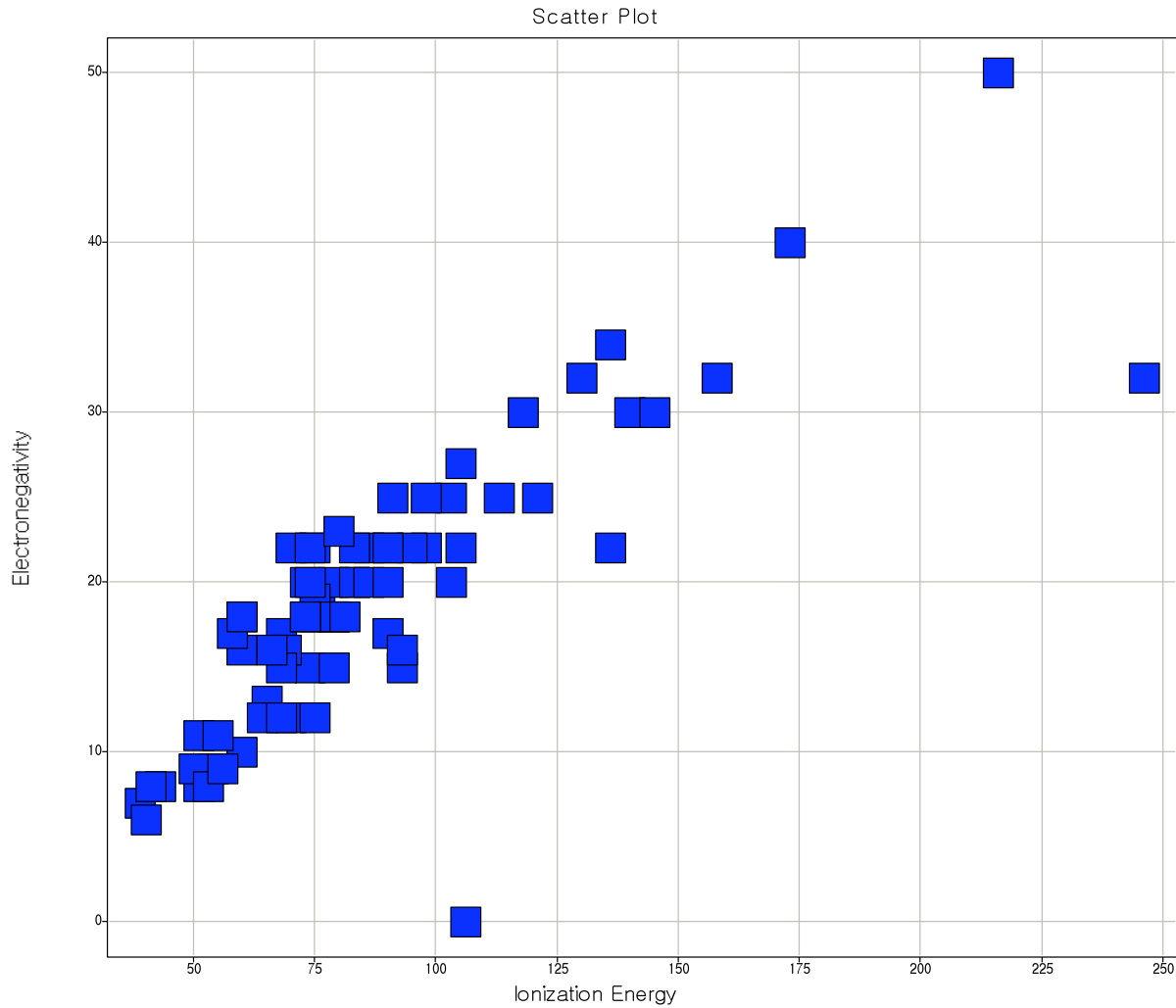
“HCE enabled us to find important clusters that we didn’t know about.”
- a user

Do you see anything interesting?

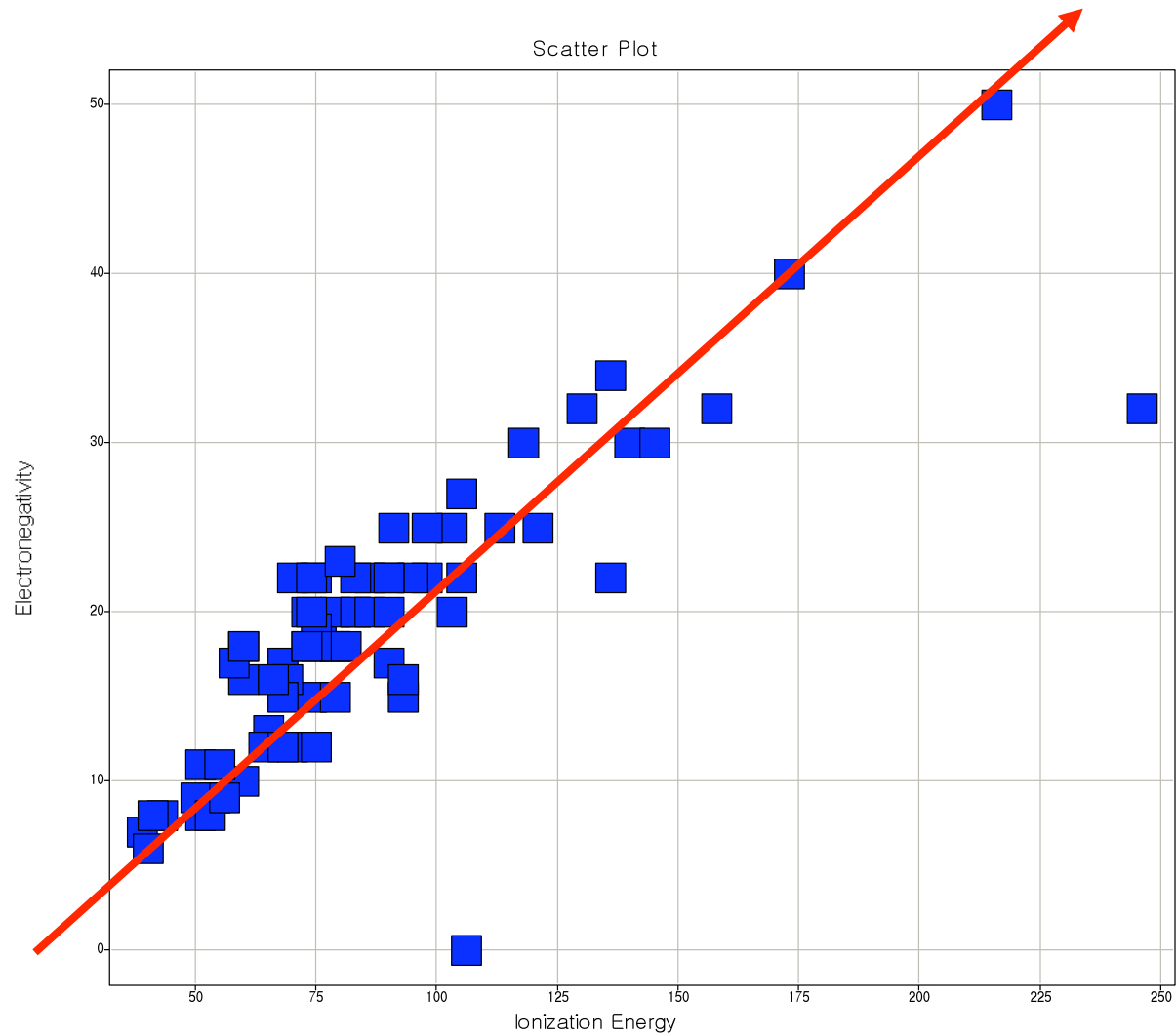


	A	B	C	D	E	F	G	H	I	J	K
1	Element	*P1	*P2	Atomic Num	Atomic Mas	Atomic Radi	Ionic Radius	Ionization E	Electronega	*C1	*C2
2	Ac	140	0	89	227	200	126	51	11	62	56
3	Ag	630	80	47	107	144	129	75	18	124	40
4	Al	750	160	13	27	143	67	60	16	28	25
5	Ar	1050	160	18	39	98	154	158	32	176	51
6	As	870	120	33	75	120	72	98	22	115	33
7	At	990	40	85	210	140	76	95	22	119	22
8	Au	630	40	79	197	144	99	91	25	131	22
9	B	750	200	5	10	85	41	83	20	101	8
10	Ba	80	40	56	137	222	149	51	8	46	56
11	Be	80	200	4	9	112	59	93	15	82	15
12	Bi	870	40	83	209	150	117	73	20	140	27
13	Br	990	120	35	79	114	182	118	30	161	44
14	C	810	200	6	12	77	30	113	25	82	1
15	Ca	80	120	20	40	197	114	60	10	70	51
16	Cd	690	80	48	112	151	109	90	17	113	43
17	Cl	990	160	17	35	100	167	130	32	173	47
18	Co	500	120	27	59	125	83	79	18	120	30
19	Cr	320	120	24	52	128	75	68	17	91	28
20	Cs	20	40	55	132	265	181	39	7	7	56
21	Cu	630	120	29	63	128	87	76	19	118	32
22	F	990	200	9	19	72	119	173	40	39	1
23	Fe	440	120	26	55	126	83	79	18	115	32
24	Fr	20	0	87	223	269	194	40	6	1	56
25	Ga	750	120	31	69	135	76	60	18	89	31
26	Ge	810	120	32	72	122	87	79	20	118	33
27	H	20	240	1	1	32	0	136	22	40	1
28	He	1050	240	2	4	31	93	246	32	1	1
29	Hf	200	40	72	178	159	85	70	12	95	44
30	Hg	690	40	80	200	151	116	103	20	147	27
31	I	990	80	53	126	133	206	105	27	153	44
32	In	750	80	49	114	167	94	58	17	93	42
33	Ir	500	40	77	192	136	82	90	22	116	25
34	K	20	120	19	39	227	152	43	8	37	56
35	Kr	1050	120	36	83	112	169	140	30	163	47

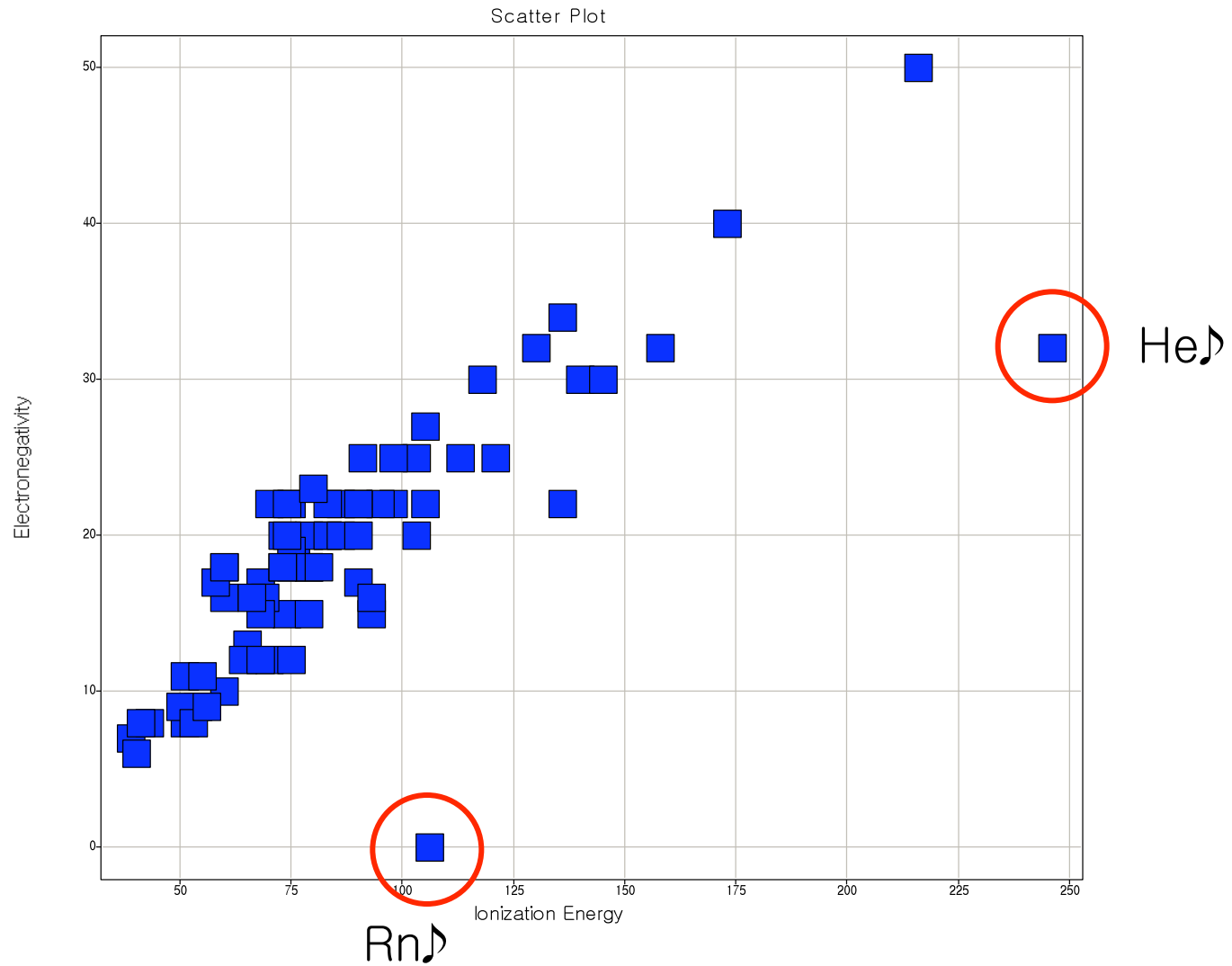
What features stand out?



Correlation...What else?



... and Outliers



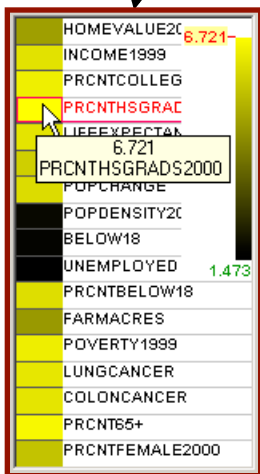
Demonstration

Demo

- US counties census data
 - 3138 counties
 - 14 dimensions : population density, poverty level, unemployment, etc.

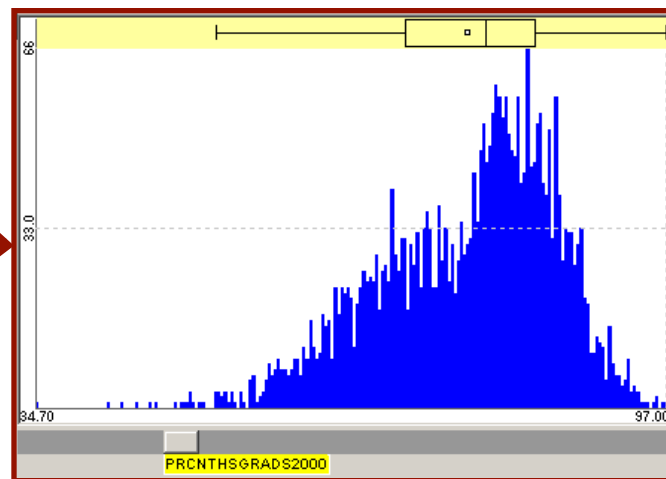
Rank-by-Feature Framework: 1D

Ranking Criterion



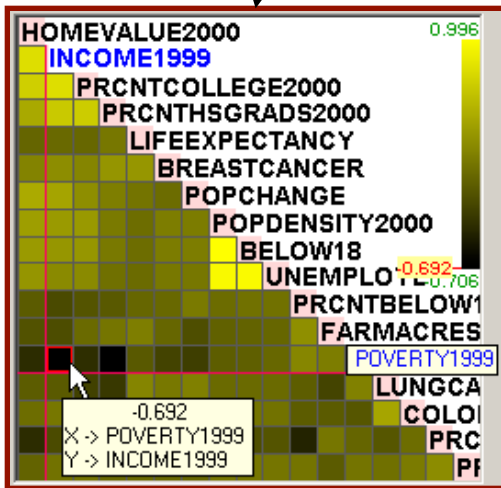
Score List

Rank	Column Name	S.	Min	Q1(25%)	Median	Q3(75%)
1	PRCNTHSG...	6.721	34,700	71,200	79,200	84,1
2	PRCNT65+	6.580	1,800	12,100	14,400	17,
3	PRCNTCOL...	6.370	4,900	11,200	14,500	19,
4	POVERTY1999	6.350	0,000	9,500	13,000	17,
5	LUNGCANC...	6.208	10,700	50,200	60,300	69,
6	COLONCAN...	6.169	7,400	19,300	22,400	25,
7	LIFEEPEC...	6.135	65,600	74,200	75,600	76,
8	INCOME1999	6.096	5213,000	15136,000	16946,000	18986,
9	PRCNTBEL...	6.019	9,600	23,700	25,300	27,
10	POPCHANGE	5.979	-10,400	-0,800	0,200	1,
11	BREASTCA...	5.710	0,000	20,579	23,713	26,
12	PRCNTFEM...	5.469	32,700	50,000	50,800	51,
13	HOMEVALU...	4.724	0,000	57900,000	75900,000	96900,
14	FARMACRES	4.607	0,000	82807,500	186881,000	367063,
15	POPDENSIT...	1.828	67,000	11223,500	24653,000	61775,
16	BELOW18	1.729	13,000	2821,500	6310,000	15510,
17	UNEMPLOY	1.473	3,000	237,000	559,000	1309,



Rank-by-Feature Framework: 2D

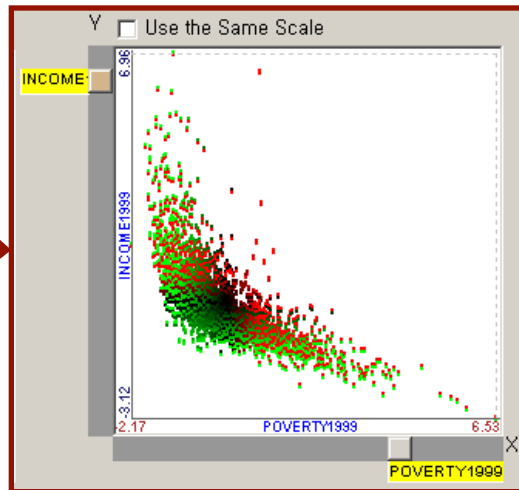
Ranking Criterion



Score List

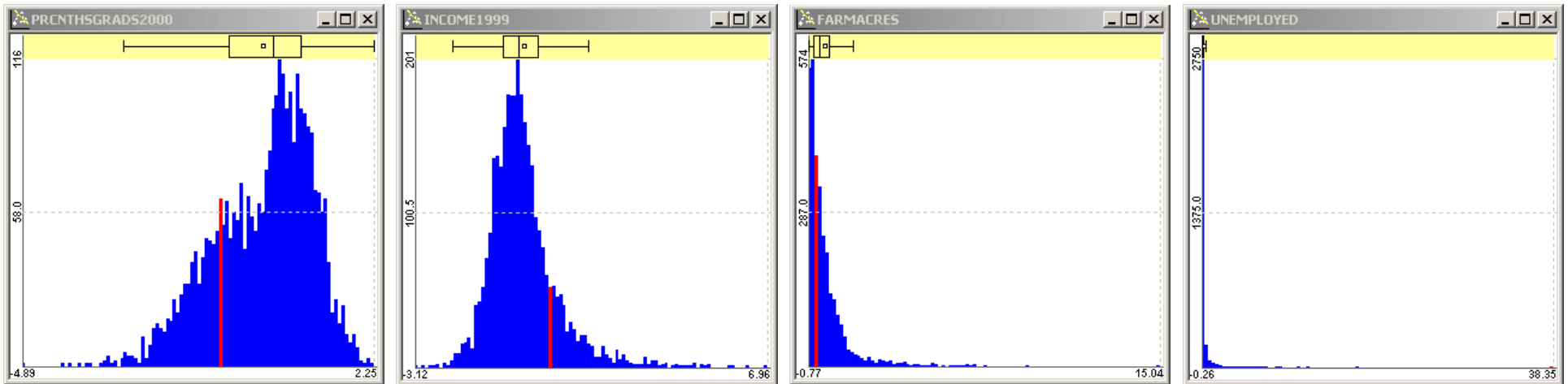
Rank	X axis	Y axis	Score
118	PRCNT65+	POPDENSITY2...	-0.169
119	PRCNT65+	BELOW18	-0.179
120	FARMACRES	POPCHANGE	-0.180
121	FARMACRES	INCOME1999	-0.184
122	PRCNT65+	INCOME1999	-0.201
123	PRCNTBELO...	INCOME1999	-0.204
124	LUNGCANCER	FARMACRES	-0.237
125	POVERTY1999	BREASTCANC...	-0.247
126	LUNGCANCER	PRCNTCOLLE...	-0.257
127	POVERTY1999	POPCHANGE	-0.276
128	PRCNT65+	PRCNTCOLLE...	-0.293
129	LUNGCANCER	PRCNTTHSGRA...	-0.310
130	POVERTY1999	PRCNTCOLLE...	-0.370
131	PRCNT65+	POPCHANGE	-0.381
132	PRCNT65+	HOMEVALUE2...	-0.385
133	POVERTY1999	HOMEVALUE2...	-0.386
134	PRCNT65+	PRCNTBELO...	-0.441
135	POVERTY1999	INCOME1999	-0.692
136	POVERTY1999	PRCNTTHSGRA...	-0.706

Manual Projection Browser

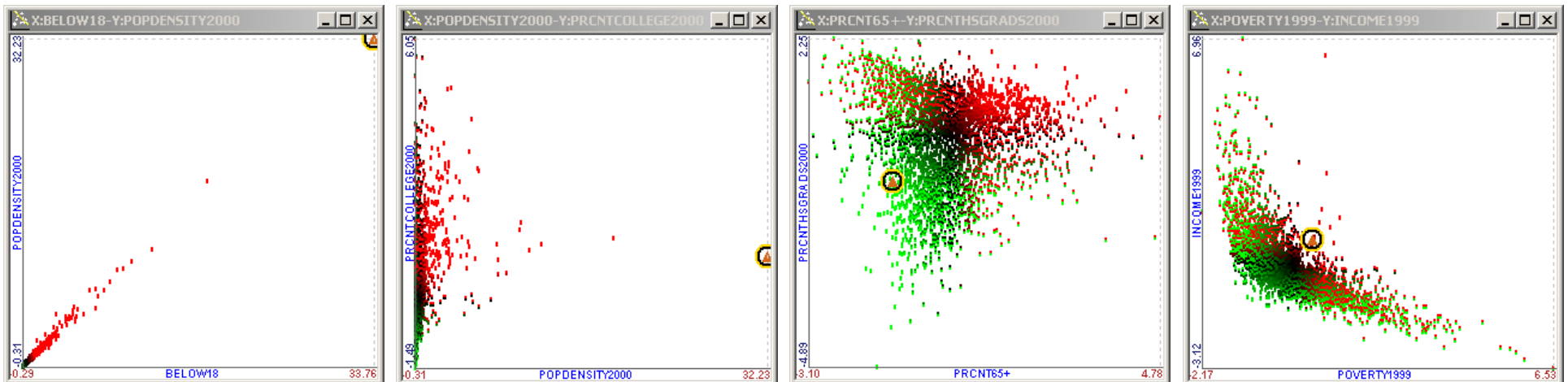


A Ranking Example

3138 U.S. counties with 17 attributes



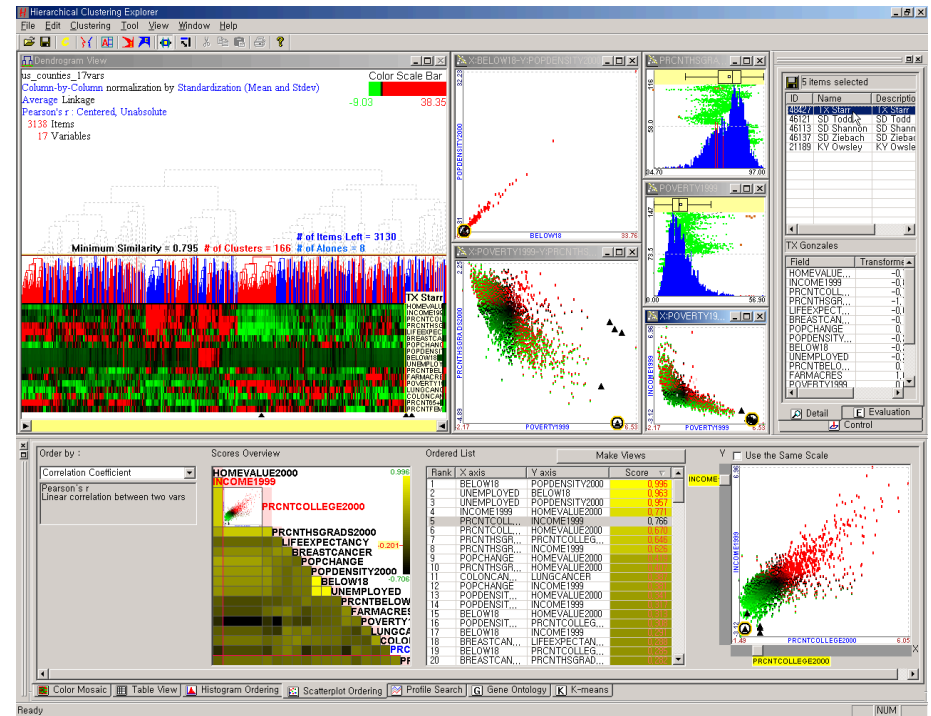
Ranking Criterion: Uniformity (entropy) (6.7, 6.1, 4.5, 1.5)



Ranking Criterion: Pearson correlation (0.996, 0.31, 0.01, -0.69)

HCE Status

- In collaboration and sponsored by Eric Hoffman: Children's National Medical Center
- Phd work of Jinwook Seo
- 72K lines of C++ codes
- 8,000+ downloads since April 2002
- www.cs.umd.edu/hcil/hce



Evaluation Methods

Ethnographic Observational Situated

- Multi-Dimensional
- In-depth
- Long-term
- Case studies

Evaluation Methods

Ethnographic Observational Situated

- Multi-Dimensional
- In-depth
- Long-term
- Case studies

Domain Experts
Doing Their Own Work
for Weeks & Months

Evaluation Methods

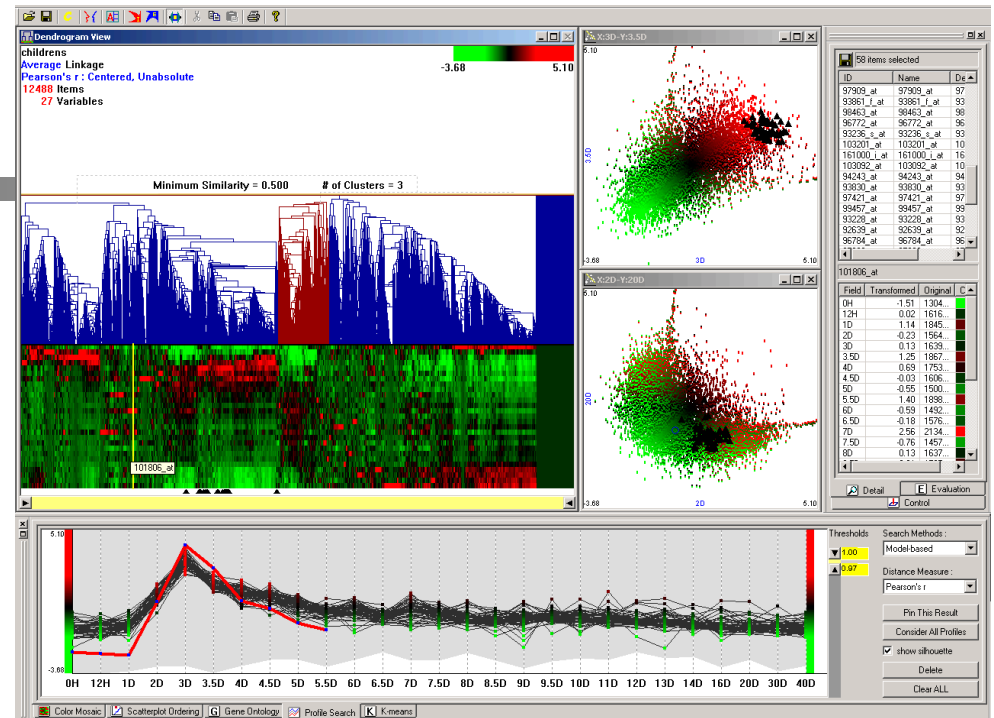
Ethnographic Observational Situated

- Multi-Dimensional
- In-depth
- Long-term
- Case studies

MILCs

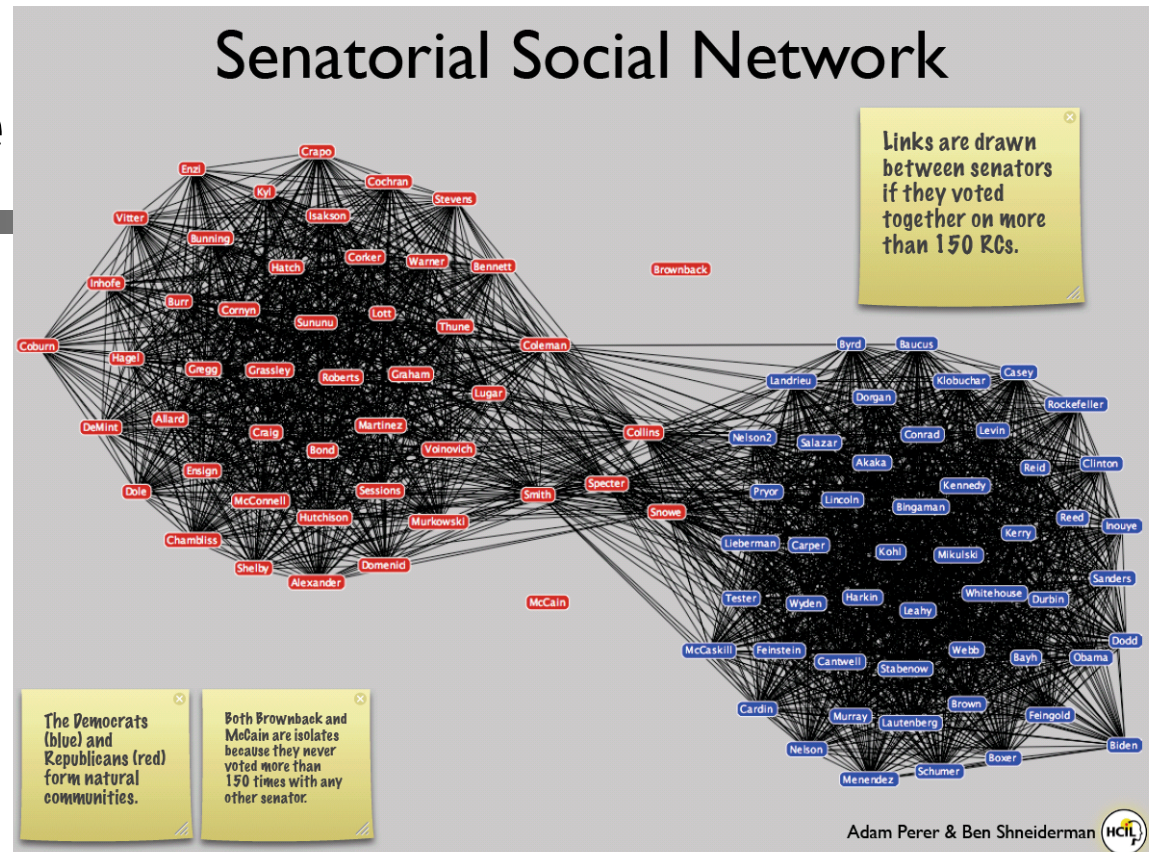
MILC example

- Evaluate Hierarchical Clustering Explorer



- Focused on rank-by-feature framework
- 3 case studies, 4-8 weeks (molecular biologist, statistician, meteorologist)
- 57 email surveys
- Identified problems early, gave strong positive feedback about benefits of rank-by-feature

MILC example



- Evaluate SocialAction

- Focused on integrating statistics & visualization
- 4 case studies, 4-8 weeks (journalist, bibliometrician, terrorist analyst, organizational analyst)
- Identified desired features, gave strong positive feedback about benefits of integration

Perer & Shneiderman, CHI2008



Case Study Methodology

- 1) Interview (1 hr)
- 2) Training (2 hr)
- 3) Early Use (2-4 weeks)
- 4) Mature Use (2-4 weeks)
- 5) Outcome (1 hr)

Take Away Message

Rank-by-Feature Framework

- Decomposition of complex problems into multiple simpler problems wins
- Ranking guides discovery
- Systematic strategies

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