Hierarchies and Trees 2 (Space-filling)

CS 4460 – Intro. to Information Visualization November 1, 2017 John Stasko

Learning Objectives

25

- Understand original treemap algorithm
- Appreciate different applications of treemaps
 Stocks, tennis, geography, elections, ...
- Explain shortcomings of original algorithm and why squarified treemaps often preferred
- Describe SunBurst layout
- Compare and contrast SunBurst to Treemap (+/-)
- Describe circle-packing approach





- Definition
 - Data repository in which cases are related to subcases
 - Can be thought of as imposing an ordering in which cases are parents or ancestors of other cases

Fall 2017

CS 4460



CS 4460





Fall 2017



Treemap Example



Quiz

Applications

- Can use Treemap idea for a variety of domains
 - File/directory structures
 - Basketball statistics
 - Software diagrams
 - Tennis matches

Fall 2017

CS 4460

Tennis Viewing Application

- Analyze, review and browse a tennis match
- Space-filling/treemap-like hierarchy representation for a competition tree
- Shows match, sets, games, points
- Uses lenses to show shot patterns
- Red/green to encode two players
- Composite colors on top of each other

Jin and Banks IEEE CG&A `97

8

7

Fall 2017



Simulated Match Results

Match view	un fannisviewer Ver. 1									
Devidence	FINAL OF GOLDEN TRIANGLE OPEN									
Bond won —	J. Bond	3 2	MI Mich	EI						
Set results	6 - 3 5 - 7 39 - 39 		3 - 6 30-50 	6 - 2 2 detices						
Lens showing ball movement on individual points				50-30 50-15						
Game results	So 15		15-50 2 deuces	50-15						
Fall 2017	CS 4460			10						



Treemap Affordances

- Good
 - Representation of two attributes beyond node-link: color and area
- Not as good
 - Representing structure
 - What happens if it's a perfectly balanced tree of items all the same size?
 - Also can get long-thin aspect ratios
 - Borders help on smaller trees, but take up too much area on large, deep ones

Aspect ratios



Variation

- What could we do to remedy those issues?
- Can rectangles be made more square?think about it.....
 - In general, a very hard problem!

Variation: "Cluster" Treemap

- SmartMoney.com Map of the Market
 - Illustrates stock movements
 - "Compromises" treemap algorithm to avoid bad aspect ratios
 - Basic algorithm (divide and conquer) with some hand tweaking
 - Takes advantage of shallow hierarchy
 - www.smartmoney.com/marketmap Defunct now

	Image on next slide		Wattenberg	
Fall 2017	-	CS 4460	CHI 99	15





More recent times

Sept. 29, 2008



Newer One (also now defunct)



A variant

https://finviz.com/map.ashx

Search ticker, company or profile		ONS Q charlessamas		STOCK	100%	FREE	Learn More
Home News Screener Maps	Groups Portfolio Inside	r Futures Forex Backtest	s Elite			Wed NOV 04 2015 9:58	SAMEST O Help Login Registe
vitiw 📕 Map 🔲 Bubbles							🕑 Share map 🛛 — 🕂
MAPPESTE S&P 500 World Full	TECHNOLOGY INTERNET INFORMATION PR GOOGL +0.70%	TELECOM SERVICES - DOME A	CRM 405% 405% 405% 405% 405% 405% 405%	S MENT-DIV HOME DRIPOVE CMCSA -0.63%	RESTAURANT BUSINESS SE MCD PCLN 10.16% YUM ORC 4358 4031 MHFF FISV MCO 405 RAUKOADS CATV SYSTE	AND	SLE OKAGASE OKAGAS SPECIAL SLE DOM MAR USS C HAL MOV SE PPG A ACRECI OKAGASE DO DEMICASE DO
Exchange Traded Funds	FB #		A COMMUNICA QCOM 407X DISCOUNT ERSIFIE SEMICO	COST WEAK	UNP CSX TWC A275 4375 TWC 4275 CALTY APPAREL DEPARTM BUX LB TIX BOARD		DOW PX ADD CONTRACTOR
	MSFT +1.03%	SEMICONDUCTOR WCC SET LAN INTC SEE LANCO ACCO BECK EX		TGT DRUGSW RES DG CAH CC INAILORD CAH ASC SPE MANORAL ASC SPE		JNJ +0.23% -22% B PFE ABBY L	MY UNH CVS 42X -23X -23X AND CI MEDICAL APPLIANCE MEDICAL
AAP Advance Auto Parts Inc. AAPL Aceile Inc.	FINANCIAL	CHENT HIR YOR	+1	.14% 🚟 📶	577	-0.94% -455% -45	-0.225 234 STD MEDICAL
ABBV Abb/eloc. ABC Anwines/cellergen ABT Abbet Lateretories ACE ACE Limited ACH Accenture (d)	WFC 84		GS CONSUL ELECTRON	MER GOODS IC EQUIPMENT PERSONAL PR	COUCT CRAMETTES	GILD CORK CELC CORK CELC CANK CELC CANK CELC CANK CELC CANK CELC	
	JPM +0.36%	ASSET MANA BUT - BELK BLK BK SPG COF 311 4012K 4012K 402K 0	CME A	APL 0.82% PROCESSED & GIS CAL CO UNIT			UTILITIES UDDRENSE PROD UTIX GD 00.45% -0225 -0.45% -0.46 -0.45% -0.45% -0.46% -0.4
	BRK-B -0.39%	NCE STI AS ART - RE ACC STI AS ART - RE STI AS ART - RE ACC STI AS ART - RE STI AS ART - RE STI AS ART - RE STI AS ART - RE L IAC UPER BAR E OR ART - RE L IAC STI AS ART - RE PRU L IAC STI AS ART - RE PRU R IAC STI AS ART - RE	AMT BEVERAGE AMT BEVERAGE BBT KCE KO AFL HST	S-SOFTDRINK PEP 0.27% -0.14% AUTOMANAR MINST DHS F -0.2%	MDL STZ ALITO PA 412 ALIT MAR ACI PA PACKAGIN S IIP 854	MMM ORB CH ARME A - Carrier - Carri	LMT 577 SO PAL DIX E 4555 420 PAL DIX E 4555 420 PAL DIX E 4555 420 PAL DIX E 4555 420 PAL DIX E 455 42
		and out. Drag roomed map to pan it. icker to see its main competitors in a		detailed information in a new wi		3% -2% -1%	0% +1% +2% +3%

SmartMoney Review

- Tufte-esque micro/macro view
- Dynamic user interface operations add to impact
- One of best applications of an InfoVis techniques that I've seen

Fall 2017

CS 4460

Squarified Problem

- On some of the algorithms, a small change in data values makes all the rectangles drastically change position (unstable layout)
- Newer variants developed to address that problem

CS 4460



Showing Structure

- Regular borderless treemap makes it challenging to discern structure of hierarchy, particularly large ones
 - Supplement Treemap view
 - Change rectangles to other forms

Variation: Cushion Treemap

Add shading and texture to help convey structure of hierarchy

Van Wijk & van de Wetering InfoVis `99



Fall 2017

CS 4460

25



www.win.tue.nl/sequoiaview/

Treemap Applications

Fall 2017

CS 4460

27

Product Sales

www.hivegroup.com/amazon.html



Fall 2017

www.marumushi.com/apps/newsmap/newsmap.cfm

200

News Stories

Marumushi

	_	_		_		_	_						
🗐 newsmap - Mi	icrosoft Inter	rnet Explorer											_ 7 🛛
Ele Edit Vew	Favorites I	ools Help											A *
G Back 🔹 🐑) - 💌 🛽	🖞 🏠 🔎 Sea	rch 🤺 Favorite	• 😁 🗯	3.7	w •	, 3						
Address 🛃 http://A	www.marumush	ii.com/apps/newsmap	/newsmap.cfm										🔁 Go Links »
🕷 absut 🛛 🕷 p	permalink [+ SELECT ALL COUNTRIES	RUSTRALIA C	anada	FRANCE	DEUTSCHLA	en Nor	ITALR		HEW ZEALA	10 E 179	NA 📕 U.C.	2 U.S.
Karami S Only Uni Governm	Says ity nent	Israeli govt helped build illegal	Congress Hearings Focus On ML Baseball Staroid	Strike 'threate ns' Paris Olympic bid	Tendul kar misses record	Champi ons League: Reds reaction	Europe beware of Liverpool	Preside praises Middle change	nt East s	Memor set for judge's mothe	rial US s slain r	Boeing stress steadi	j leader es ness
Lebanon	6 	outposts	Use	bohind Arsenal failure, says Henry	to the cutfield. (AP)	Suns join	Carlo Pario- Nice Race	Apat wins	thy s!	Bush's Securit proposi takes a	Social y al hit	Australian Shares Midday Resources & Rates Cool	Hackers Hit Lexis Nexis
Chechen rebels pio new lead	ck Ag ler ^{La}	iwan Plans assive Protest jainst China w	Barça were robbed	Bill Clinto Surgery Today	in admits to Super scalping	Spurs Garden Of Despair	Arantes Er Ritera	Scientists seek source of Mount St.	Secule parel scrubs 'Doar Skiec' plat	Probe: Leadern Dich 1 Order Prison Alune	Snowed- in hikers found in mountai ms	Market Competi BM V for Appre unfazed Sale by Retek	Database Mins Fed report al for growing out PC Unit automotion
39 Habbodies de Theoreman de Calendaria de C	aradinaj eparts for he Hague	Hong Kong leader resigns	Q&A: Micha	action ac	the fac iversity ourage	e of	Blake jurors ask to review testimony of three people	Helens blast Condoleez za Visits Mexico	Two charged in capitor of adapted con	Inference researches connected biller Transat er standen transat	Intelligence in the solid independe it pared	Kmart Is stores to	
Vatican: Pope At Extending chiral Stay sna	ider still dam tes winnst oraci pervis Durt ileast 27 high ildren e after One ack still	a into a sino pird flu bird flu bird flu bird flu bird flu bird flu mach mach er" bird sino bird flu bird flu b	Jacks on court case	Cro Qae targ Com Coat over clair	Active ada tet bio to ty suppl fsex ms	g rodoo chang Dies Leidou dies n he finne State	The factors and the factors an	Correction: Apple -Sony- Napster Story Services Revealed Revealed Revealed	Robin Hood Pirates Plea Guilty First MMS mobile phone virus discovered	LC physical physical memory arrange Patronella Patronella Patr	Mercedit news 100 Mit fard, with dard, with dard, with dard mit the dard mit dard mit the dard mit dard mit da	Plavix Nothing Out of Ordinary for LRMC	A second
Thursday March	10, 2005 8:1	8				ICT ALL CATEG	ONES	-				LAYOUT: 💌 S	ourrified 📰 Strinderd
ARCHIVED FRE SHE SUB-		TONT HOW		ss then to menut	IES AGO 🛹 WOI	10 E	Heton	BUSHESS		HILLOTY	SPORTS	ENTERTIAL	HEALTH
00:00		100 M 100 M	110	RE THREE TO PRIMUT	TES AGO								
IRON				FUR: INNE 1 H	US 107							D leter	tec
CONE DOINE											1.	ancen	HDL.
			(CS 446	50								29

Fall 2017

Fall 2017

www.nytimes.com/packages/html/newsgraphics/2011/0119-budget/



Fall 2017

CS 4460

31





http://www.treemap.com/datasets/uselections/?goback=.gde_80552_member_184123140 Fall 2017 CS 4460 33



Fig. 5. *Hierarchical Network Map* displaying all 19,731 autonomous systems (one can still zoom in twice for details) on a large display wall (5.20m × 2.15m, 8.9 Megapixels, powered by eight projectors). The query interface on the top left shows the traffic distribution over time and specifies the selected data, in this case the traffic entering the gateway of the University of Konstanz on *well-known ports (0-1023)* on 29 November 2005 using "transferred bytes" as measure with logarithmic color mapping. One recognizes a heavy traffic load from AS 3320 (red) of "Deutsche Telekom" as well as to neighboring autonomous systems in Germany. A port histogram reveals high activity on the Web ports 80 and 443. For security and privacy reasons, the data was aggregated and sanitized.

Fall 2017

CS 4460

Mansmann & Vinnik *TVCG* `06



https://carrotsearch.com/foamtree/

FoamTree





Fall 2017

CS 4460

37

www.cs.umd.edu/hcil/treemap-history/



Fall 2017

Limitation?

- What is primary shortcoming of treemap as a hierarchical data set representation?
- How could we do better?
 - Keep advantages without incurring disadvantages

Fall 2017

CS 4460

Another Technique

• What if we used a radial rather than a rectangular space-filling technique?

- We saw node-link trees with root in center and growing outward already...
- Make pie-tree with root in center and children growing outward
 - Radial angle now corresponds to a variables rather than area

CS 4460



Radial Space-Filling



Stasko, Catrambone, Guzdial & McDonald IJHCS '00

SunBurst ● Treemap I凹 Jp One Directory Top per Maximum Randon Quit director (executabl (default) Demo Fall 2017 CS 4460 43

SunBurst

- Root directory at center, each successive level drawn farther out from center
- Sweep angle of item corresponds to size
- Color maps to file type or age
- Interactive controls for moving deeper in hierarchy, changing the root, etc.
- Double-click on directory makes it new root

Empirical Study

- Compared SunBurst to Treemap (borderless) on a variety of file browsing tasks
 - SunBurst performed as well (or better) in task accuracy and time
 - Learning effect Performance improved with Treemap on second session
 - Strong subjective preference (51-9) for SunBurst
 - Participants cited more explicit depiction of structure as an important reason

		More to come on evaluation			
Fall 2017	CS 4460		45		

SunBurst Negative

• In large hierarchies, files at the periphery are usually tiny and very difficult to

distinguish



Help the Problem



SunBurst-omania



Fall 2017

Even Sand Crabs Do It



http://www.flickr.com/photos/jkr1812/2234846316/in/gallery-49563472@N07-72157624817856060/lightbox/

Fall 2017

CS 4460

49

Some Other Approaches

Zoomology

CS 7450 Spring '03 project

InfoVis '03 **Contest Winner** Best Student entry



Fall 2017



CS 4460

Video

Fall 2017

CS 4460



Summary

Node-link diagrams or space-filling techniques?

- It depends on the properties of the data
 - Node-link typically better at exposing structure of information structure
 - Space-filling good for focusing on one or two additional variables of cases



Zoomed In



Fall 2017

http://treevis.net



Learning Objectives

- Understand original treemap algorithm •
- Appreciate different applications of treemaps • Stocks, tennis, geography, elections, ...
- Explain shortcomings of original algorithm and why squarified • treemaps often preferred
- Describe SunBurst layout
- Compare and contrast SunBurst to Treemap (+/-)
- Describe circle-packing approach

HW 5

- Draw a graph
- 10-vertex abstract graph provided
- You draw a node-link representation
- Follow the directions!
 - Bring one copy
 - Name on back
- Due Monday 6th (no late submissions)

CS 4460

Don't spend a lot of time

Fall 2017

Upcoming

- Lab 7 D3 animations & transitions 1
 Prep:
- Graphs & Networks 1

CS 4460

References

- Spence and CMS texts
- All referred to papers

Fall 2017

CS 4460