

# CSC 544

# Data Visualization

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# **Lecture 26**

# **Text and Sets**

Apr. 19, 2023

# Today's Agenda

- Reminders:
  - A06 questions? (due Apr. 24)
  - P03/P04 questions? (due Apr. 26/May 3)
  - Student Course Surveys (SCSs) (due May 3)
    - Currently at 65% class completed (80% threshold unlocks extra credit!)
- Goals for today:
  - Discuss visualizing techniques for text and sets

## → Data and Dataset Types

Tables

Items

Attributes

Networks & Trees

Items (nodes)

Links

Attributes

Fields

Grids

Positions

Attributes

Geometry

Items

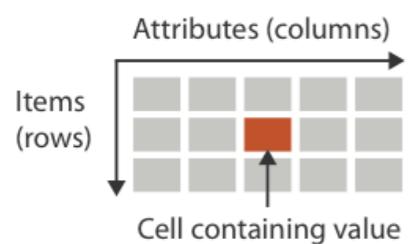
Positions

Clusters, Sets, Lists

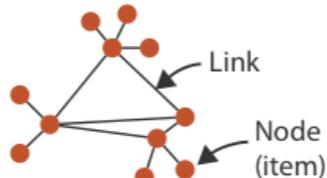
Items

## → Dataset Types

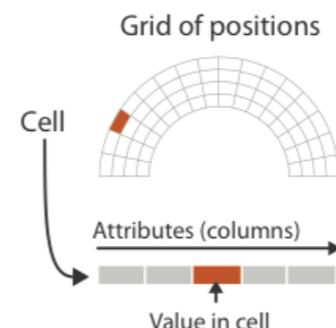
→ Tables



→ Networks



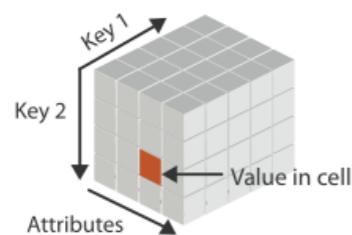
→ Fields (Continuous)



→ Geometry (Spatial)



→ Multidimensional Table



→ Trees

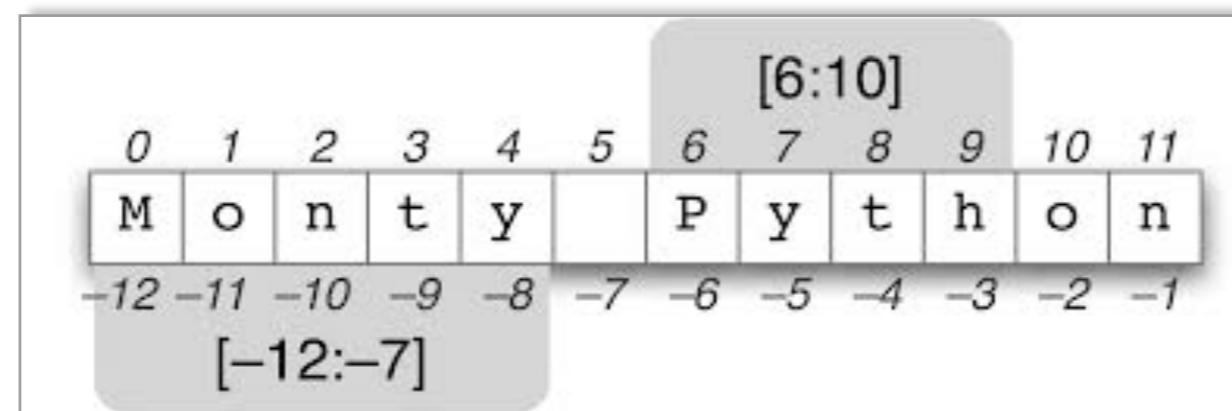


**Text**

# Text Data

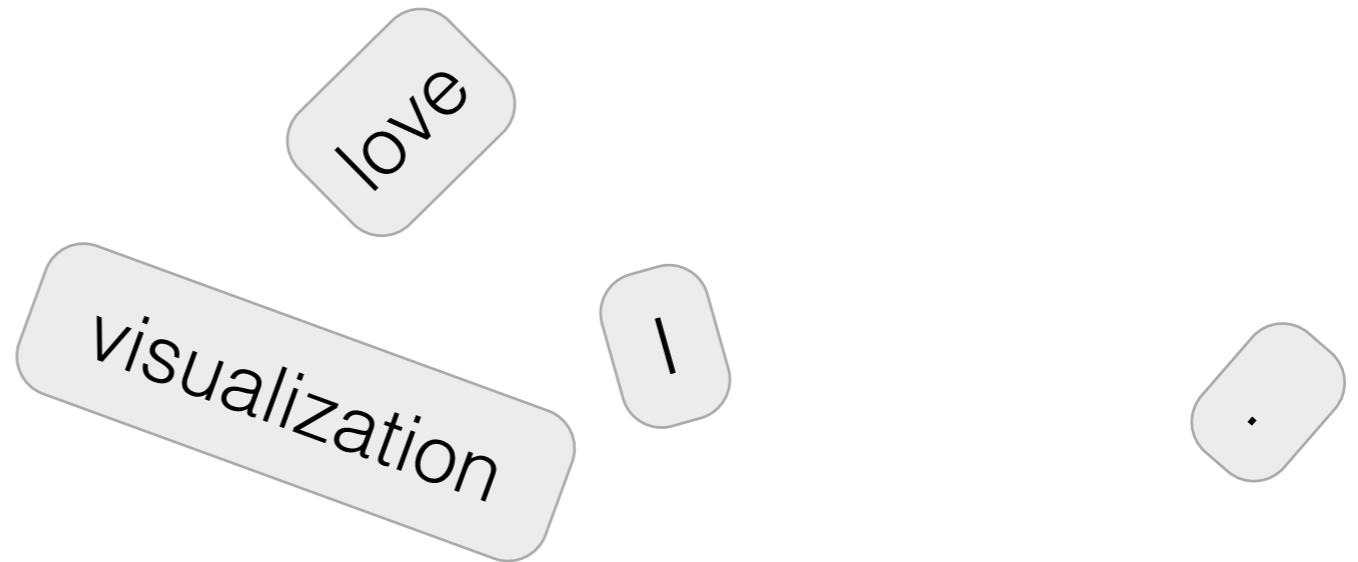
- No Numbers (implicitly)
  - Characters (ASCII)
  - Strings

b <sub>7</sub> b <sub>6</sub> b <sub>5</sub>				0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1						
B <sub>i-5</sub>				b <sub>4</sub>	b <sub>3</sub>	b <sub>2</sub>	b <sub>1</sub>	Column →	Row ↓	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	'	p					
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q					
0	0	1	0	2	STX	DC2	"	2	B	R	b	r					
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s					
0	1	0	0	4	EOT	DC4	\$	4	D	T	d	t					
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u					
0	1	1	0	6	ACK	SYN	8	6	F	V	f	v					
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w					
1	0	0	0	8	BS	CAN	(	8	H	X	h	x					
1	0	0	1	9	HT	EM	)	9	I	Y	i	y					
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z					
1	0	1	1	11	VT	ESC	+	;	K	[	k	{					
1	1	0	0	12	FF	FS	,	<	L	\	l						
1	1	0	1	13	CR	GS	-	=	M	]	m	}					
1	1	1	0	14	SO	RS	.	>	N	^	n	~					
1	1	1	1	15	SI	US	/	?	O	-	o	DEL					



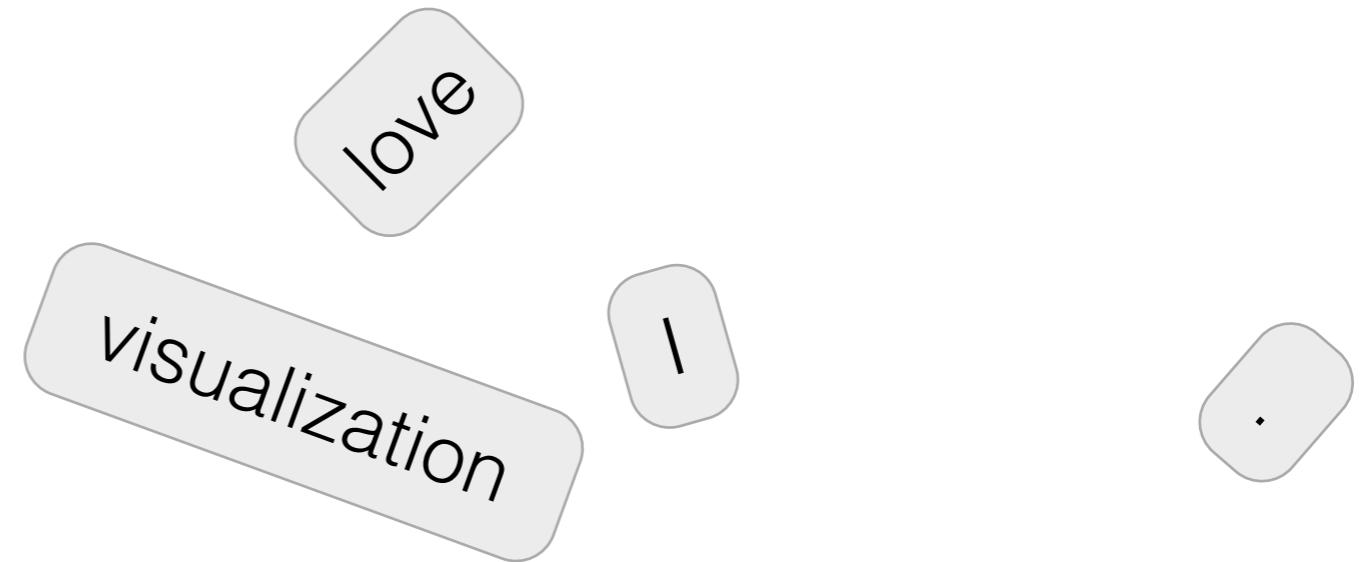
# Text Data

- Words
- Sentences
  - Paragraphs
  - Chapters
- Lines



# Text Data

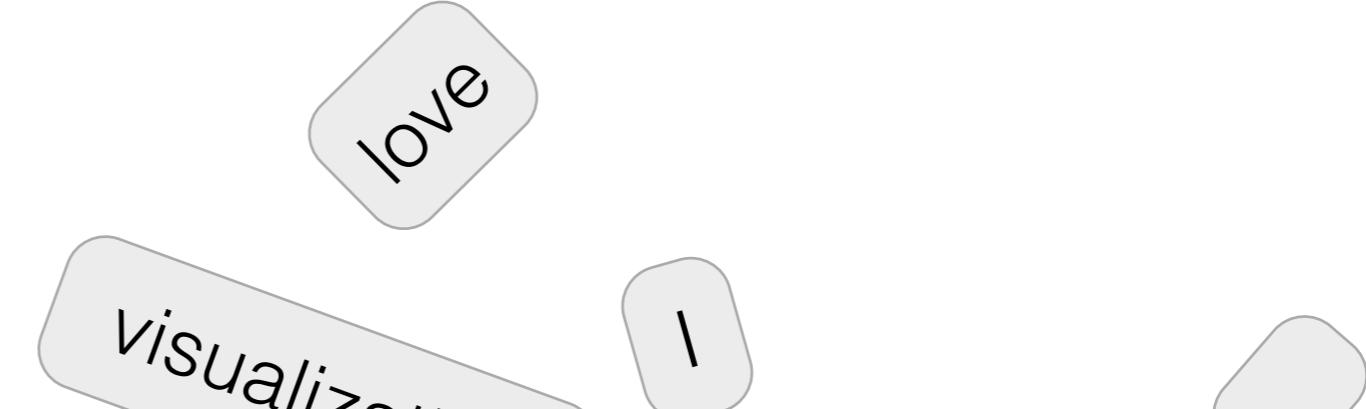
- Words
- Sentences
  - Paragraphs
  - Chapters
- Lines



I love visualization.

# Text Data

- Words
- Sentences
  - Paragraphs
  - Chapters
- Lines



```
16 // displays a data set using parallel coordinates
17
18 // dataset info
19 String dataSet = "cars";
20 String fileName = dataSet + ".csv";
21 boolean cluster = true;
22 FloatTable table;
23 float[][] data;
24
25 // row, column info
26 String[] colNames;
27 int col = 0;
28 int colTot;
29 String[] rowNames;
30 int row = 0;
31 int rowTot;
```

# Text Data

```
1 ; MB 1;SZM8.18 .MSR: ..... ;0@7 .21Ma.
2 MM .Xr28M7: a: 0W;, ..... MB@. X:MW@:X77r:
3 ZM@ .27XBM7ii Z. M7, ..... 0XM. S,BMri .rr28
4 rMM 2aiMMi,. Z r8;. .... .Mzriai2M78Z@MMWB8W
5 .MBM ;W0MMr 7 W7: .XBMMMM;,2r7MMMBWMM@MMMMW
6 W2MZ 72MMMMWWX, ia, r7220MMMMMMMM7,ra:MMMMMi WM0B
7 Z2ZM..2BMMMMMMMM 7 , MMMMMMBW0WMMMZ;:Z:MMWMMWMM MMB
8 ZaMM 72MM2X 2202M@X . MMMMM 8aZaXX2W8MM2.0rMMMBM0B,8M
9 Z2MM0iZWM: M8;Z02 MWX8: aW0BM0880M,ZrW@MXMrM,ZSzi
10 M@Wr20MM7SM8r. ,i Br;i , ,r: r20BM22XM7Xa@MMSM7iiZ2M
11 M22MWMM ;.. ,S;i, , iS27MM;@WMM Zr ;M:
12 M0@MaZ@M8 ... ,227X7: ib287BM:W0M8i0 M
13 MWM M.MWM7 ....., M27X2SX: ;2BWaSBX7MiB0MMBWMM
14 SMMr MrZBBM .... iM22aa2XXXSS22XXSSS2XXM2XBMMMMZMa
15 WMM 8 MXMM: ... XM@MW82X7rrrrr,;XXXS08ZMMi@MMMWZM
16 BM a B aZM2 .. MM0SXrr77777iXsXX2W8aMM MMM22M2M
17 MM ;rXr;.M8 .;7rrrrr7r7SSa2XZMM;aMBBZ@8M;
18 M 7 @ B WMM 20SS2aaSr7r7rX22S; ;@MMMMMrM@MMWBMM
19 M .@ @ aZMM, .::i;7S7;;MMMMMMMM,MMWB8W8M
20 ; Xi.7 XZaMM@ :i::i::;S7XMM8WMM@MMZMMW@BM0MMXr
21 S2 iarWSMM :: i2MMM22MMW20@MM0MBMW@8BWZM2
22 20 W 0;MMMi SWMMMBZ@M@0M0BWMM@MBBW0BV0;Xi
23 M W 27MMMMMMMMMMMMW@MMMB00W8BM@MMMB@8@B7rX8
24 M7 B 2S0MMM8@MMMMMMMMW822WX00M22WBBMMBWMM27XXX
25 SM B Sa8MBBMMB@80W8aS@Za2MS8SMX80B8MM@MWXr7XX
26 M 0 780M ;M8MMWMMW00MB82W7rM8W2M@MMW2;rX7777
```

```
iZ ,MM.
MM:
rBMM7
;,8MMZ
r MMM
, XMMMX
ri 8M@MM,
ix 0W00MMi
a .22228MMMX
8 r2zaa0MMM; W
8; 7SSX2WMMMi M2
X;... 72X7XBMMMZ Ma
i;.... :X7;;XBMM2 i M7
;..... r7i:i7BMMW ZM MM8
;..... ,i: .iS@MM. MM aMM
7: ..... ,,,.i;XBMM ZM2 MaMM
2i ..,..... ::;:iXX8MM .Z8MM8MM
ix .. .. rxri;rrXMBar,MW8WMI
.S :: :i ..,i 7X;;X2SXMMZ WM20M
Z,7X r .. 2S i77r72S;SMH:aM02WMS
;XiM Zi ..:Za 7Si7a27;ZMSX@8S8MM7
S,W: WB irB2X2;:72SXSM22M828MMW
i088WMWB8a27:XX0M8W8.BM; ::ZB2778M07SrW28M82a09WMI
iS2Z2i S8ZB1WMI:ZX ,WMM@.MWab0M@BM2@aZBMMMMMM
,WMMB. :M0M2MM8,0@..aM HW0ZBWZM22Za2aaaBMA
iZWM@. 2MMMMMM XMM2XMMW :WaHM8aMM2208a2Z288Za222MX
rMMS r28WMMr 7M .MM7 XB XMM@0S28@Za2Z88aa80B820S
ia: r2Z0B0MMW 8 .. M .i. MM@aMMMMMMW8Z2Z8ZaMWB2Ba
r: r28WMMMMi M, .. aM 7 , M0MM ZWMMW8002808B80S
72i72WMMMMMMMM: Mi .. W0 7X ;MM;MM . 8MBZ8B022a88MX
0MMMBBS, X Mi M7 77 HMMH7MM.7: X ; rZM228B02808Mr
MM2 @r Mi .. M. . 8, aM@MM;BMS 8Mir, i X7MB20B828Z2ZM
.aM, rM . @; rW . ,Z. MMZBMM;MM MMM 2 . ;;MMB8B0000a8Z8M
62 . MX r@ .. :S,MMZrM02 MrSMM : .r;8MM00S828a800M ,i77aMM8.
a : Mr MZ .. 7a aM2@iMB7 IBM r .:rMMMMMMMMMMMXZ2;;rrBMM8,
B2i ; MX MZ . cr WMBX:ZMS7i .. iaMr . iiii2rrXXSri isMMWI
M@ i M2 i X@ . ;X:MMM:.M2Xi ....:iM@ ,7iM2;; X8BMM
ZB ; MM X M ..:2iMM,W 8MX; .., WMS, 7,MMMMMMMMMMMM
rii: 2MM ; MB i;SZM8.i8 .MSr: ..... ;0@7 .21Ma. .;2BWB8@MMMMMM8a,
X:S, XMM 2 MM .Xr28M7: a: 0W;, ..... MB@. X:MW@:X77r: :ZMM8;
,ra;MMMMW 2M@.27XBM7ii Z. M7, ..... 0XM. S,BMri .rr28BMM
XX8:BMMM2 Mi rMM 2aiMMi,. Z r8;. .... .Mzriai2M78Z@MMWB8W
2080MM M .MBM ;W0M@r 7 W7: .XBMMMM;,2r7MMMBWMM@MMMWMM
SM@MM8 Si W2M2 72MMMMWWX, ia, r7220MMMMMM7,ra:MMMMMi WM0BBW0MM
MMB M 222M..2BMMMMMMMM 7 , MMMMMMBW0WMMMZ;:Z:MMWMMWMM MMB8aB8MM;
MMW Z 72aMM 72MM2X 2202M@X . MMMMM 8aZaXX2W8MM2.0rMMMBM0B,8MM
MM @;8ZMM0iZWM: M8;Z02 MWX8: aW0BM0880M,ZrW@MXMrM,ZSzi ZB. 0MM.
IM @ 20MW M22WMMH ;.. ,S;i, , iS27MM;@WMM Zr ;M:
M M;7B@ M0@MaZ@M8 .. ,227X7: ib287BM:W0M8i0 M
M1 M@MM MWM M.MW7 .... M27X2SX: ;2BWaSBX7MiB0MMBWMM
M2MM SMMr MrZBBM .... iM22aa2XXXSS22XXSSS2XXM2XBMMMMZMa
WZMM WMM 8 MXMM: ... XM@MW82X7rrrrr,;XXXS08ZMMi@MMMWZM
MM BM a B aZM2 .. MM0SXrr77777iXsXX2W8aMM MMM22M2M
MM7 MM ;rXr;.M8 .;7rrrrr7r7SSa2XZMM;aMBBZ@8M;
MM M 7 @ B WMM 20SS2aaSr7r7rX22S; ;@MMMMMrM@MMWBMM
XM M .@ @ aZMM, .::i;7S7;;MMMMMMMM,MMWB8W8M
MM ; Xi.7 XZaMM@ :i::i::;S7XMM8WMM@MMZMMW@BM0MMXr
M S2 iarWSMM :: i2MMM22MMW20@MM0MBMW@8BWZM2
W 20 W 0;MMMi SWMMMBZ@M@0M0BWMM@MBBW0BV0;Xi
M W 27MMMMMMMMMMW@MMMB00W8BM@MMMB@8@B7rX8
M7 B 2S0MMM8@MMMMMMMMW822WX00M22WBBMMBWMM27XXX
SM B Sa8MBBMMB@80W8aS@Za2MS8SMX80B8MM@MWXr7XX
M 0 780M ;M8MMWMMW00MB82W7rM8W2M@MMW2;rX777XXXX
ax 2 XZM MMM aXSMMBBMrX2M;7W8WMM2i;7XX77XXXX7rZM
B ai2aM M8Mr:W 8M8B0MXS2M220MM@MMB@8@B7rX8
i;SSMB MM8M7;2a W8aBM82@MMMW7,i7XXSXXXXSX7X7XX7rSM
a:82M MMBWM M,M 0@ XMWMM0i.:7XSSXXXSX7XXXX7S7X
.XMBS M8XWS.i M iMaWMMZi,.rS22SSXXS7XX777rrX7XXS0M
@MMXW0r;Si r@MMMM8r ,iirXSSr:i7SSX7777X77X2XXX: .M:
MBMWSa:S2ZMMZi .i:::7..;S7:i;r7X77XSaS; :7;i, Z
aWMia7X8WM, .. .i7..;r2r ,r7XrXX22; ,ii, ;
MM:82B@ . . . i7: S2aaa227. .rXi,..aX:,i. x
MaMM:0@7 . . .
```

# Text Data

- Documents
  - Books
  - Papers
  - Webpages
  - Emails
  - Twitter posts
- Corpus: collection of documents

The grid displays seven academic papers from the Semantic Web Conference 2008, each illustrating a different application or analysis of text corpora:

- Chapter 3: Automatic Mapping of Social Networks of Actors from Text Corpora: Time Series Analysis** by James A. Traubold and Scott Coppey. This paper discusses the automatic mapping of social networks from text corpora, specifically focusing on presidential cabinet network centrality over time.
- Semantics-Based Analysis and Navigation of Heterogeneous Text Corpora: The Purpose News and Blogs Engine** by Bernd Beetz and Daniel Trüper. It presents a system for analyzing heterogeneous text corpora, specifically news and blogs, using semantic analysis and navigation techniques.
- Automatic Analysis of Large Text Corpora – A Contribution to Structuring Web Content** by Gotz Heyer, Uwe Quasthoff, and Christian Wolff. This paper describes a system for automatically analyzing large web corpora, with a focus on extracting semantic relations from unstructured text.
- Examining the Use of Text Corpora and Online Dictionaries as Learning Tools: Pre-Service Teachers' Perspectives** by Nikiela Ebdonsson-Ogurcov, Gertulus Anagnos, and Sanna Töthöök. It explores how pre-service teachers perceive the use of text corpora and online dictionaries as learning tools in education.
- Introduction and Theoretical Background** by Factors That Influence Technological Integration in Education. This section provides an introduction and theoretical background to the factors influencing technological integration in education.
- Constructing a Large Scale Text Corpus Based on the Grid and Trustworthiness** by Peijun Li<sup>1,2</sup>, Qiaoming Zhu<sup>1</sup>, Peipei Guo<sup>1</sup>, and Geoffrey C. Bow<sup>1</sup>. It discusses the construction of a large-scale text corpus using grid computing and focuses on trustworthiness issues.
- Searching Text Corpora with gsp** by Daniel Oberle. This paper introduces a search engine called gsp designed for searching text corpora.
- AIML Knowledge Base Construction from Text Corpora** by Giovanni De Gasperis, Isabella Di Giacomo, and Nicola Paoletti. It explores the construction of an AIML knowledge base from text corpora.

Each paper includes a brief abstract, author information, and a reference section. The overall theme is the use of text corpora for various applications, from social network analysis to educational tools and search engines.

# Text Data

- Documents
  - Books
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  - Webpages
  - Emails
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- Corpus: collection of documents

Chapter 3  
Automatic Mapping of Social Networks  
of Actors from Text Corpora: Time Series  
Analysis

James A. Stanoiowski and Scott Corpe

Semantics-Based Analysis and Navigation of  
Heterogeneous Text Corpora:  
The Purpose News and Blogs Engine

Bernd Beetz and Daniel Trüper  
Department of Computer Science, K.U. Leuven, 3000 Heverlee, Belgium  
Institute for Information Systems, Pontificia Universidad Católica de Chile, Santiago, Chile

Chelsea Young @YoungChelsMarie  
@EliYoungBand can't wait to see you guys here in Buffalo,NY at the  
@1065wyrk Taste of Country in June! PS-My daddy's name is James  
Young! :)

Kat Przybyla @katprz  
Who's coming to the @1065wyrk Taste of Country? A trifecta of  
southern hotties -- @ericchurch @JoeNichols @EliYoungBand  
[buffalo.com/entertainment/...](http://buffalo.com/entertainment/)

Alica Wiedenbeck @leesh06  
@Eric\_Church at @1065wyrk Taste of Country this year.... dying.  
#Cantwait

Michele L. McDaniel @michelemcd13  
absolutely thrilled that @ericchurch will be headlining the @1065wyrk  
taste of country! Only 135 days! (but who's counting?!)

Jaime Lynn @JaimeLynn478  
@ClayModen @1065wyrk SOOOOOO excited for TOC this  
year...def bringing my 5yr old, we are HUGE Eric Church fans!!!

Jake Rosen @JRosen26  
To say @1065wyrk got taste right this year would be an  
understatement #ericchurch

Automatic Analysis of Large Text Corpora -

# **Text Visualization For Documents**

**Additional Examples:**

**[http://searchuserinterfaces.com/book/sui\\_ch11\\_text\\_analysis\\_visualization.html](http://searchuserinterfaces.com/book/sui_ch11_text_analysis_visualization.html)**

# Tag Clouds / Word Clouds

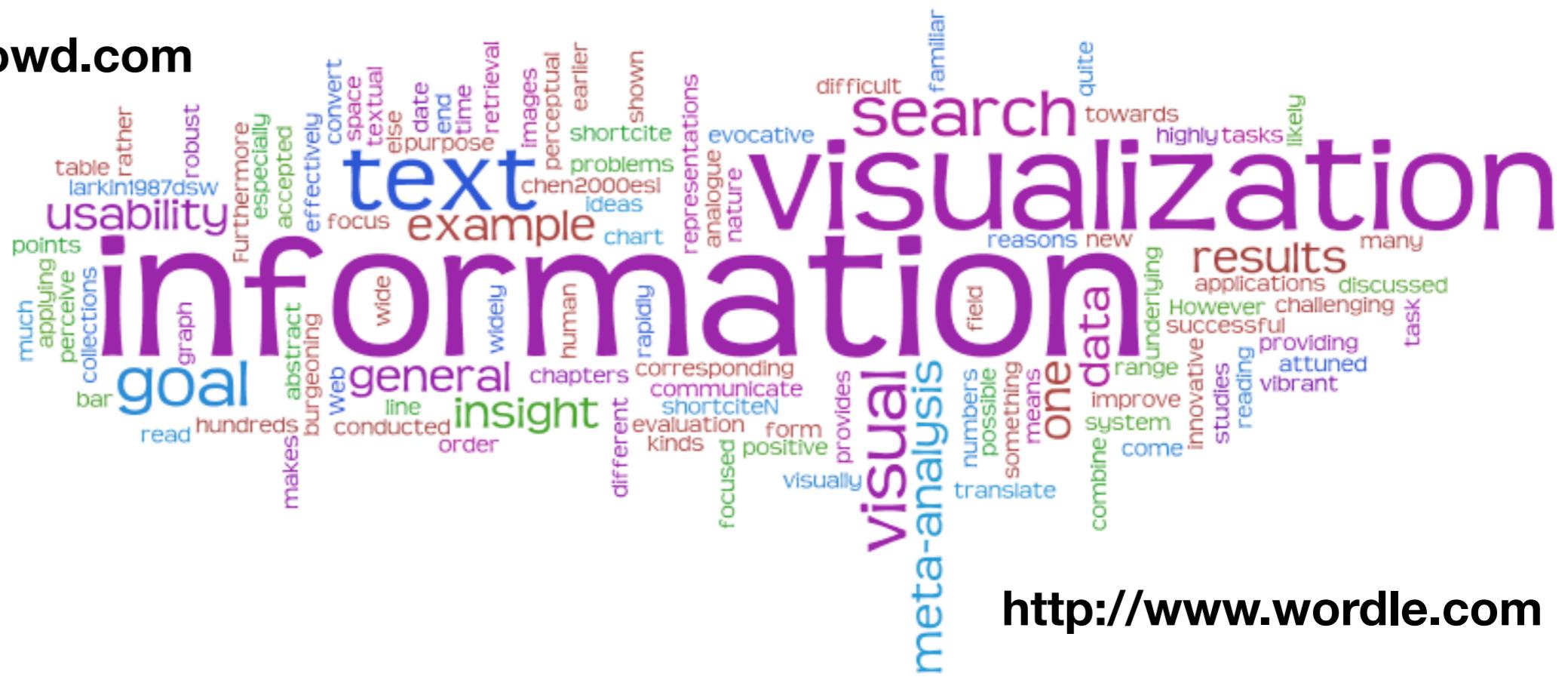
abstract accepted analogue applications applying attuned bar burgeoning challenging chapters chart collections combine communicate conducted convert **data** date difficult discussed earlier effectively end evaluation evocative familiar field focus focused form **general goal** graph highly human hundreds ideas images improve

# information innovative insight kinds line makes means

**meta-analysis** nature new numbers order ost perceive perceptual points positive problems providing purpose range rapidly read reading reasons representations **results** retrieval robust **search** shortciten{chen2000esi} shortcite{larkin1987dsw} shown space

studies successful system table task tasks **text** textual time translate underlying  
usability vibrant **visual visualization** visually web wide widely

<http://www.tagcrowd.com>



## Visualizations : definitions of visualization word tree

Uploaded by: mhalle

Created at: Wednesday May 21 2008, 11:37 PM

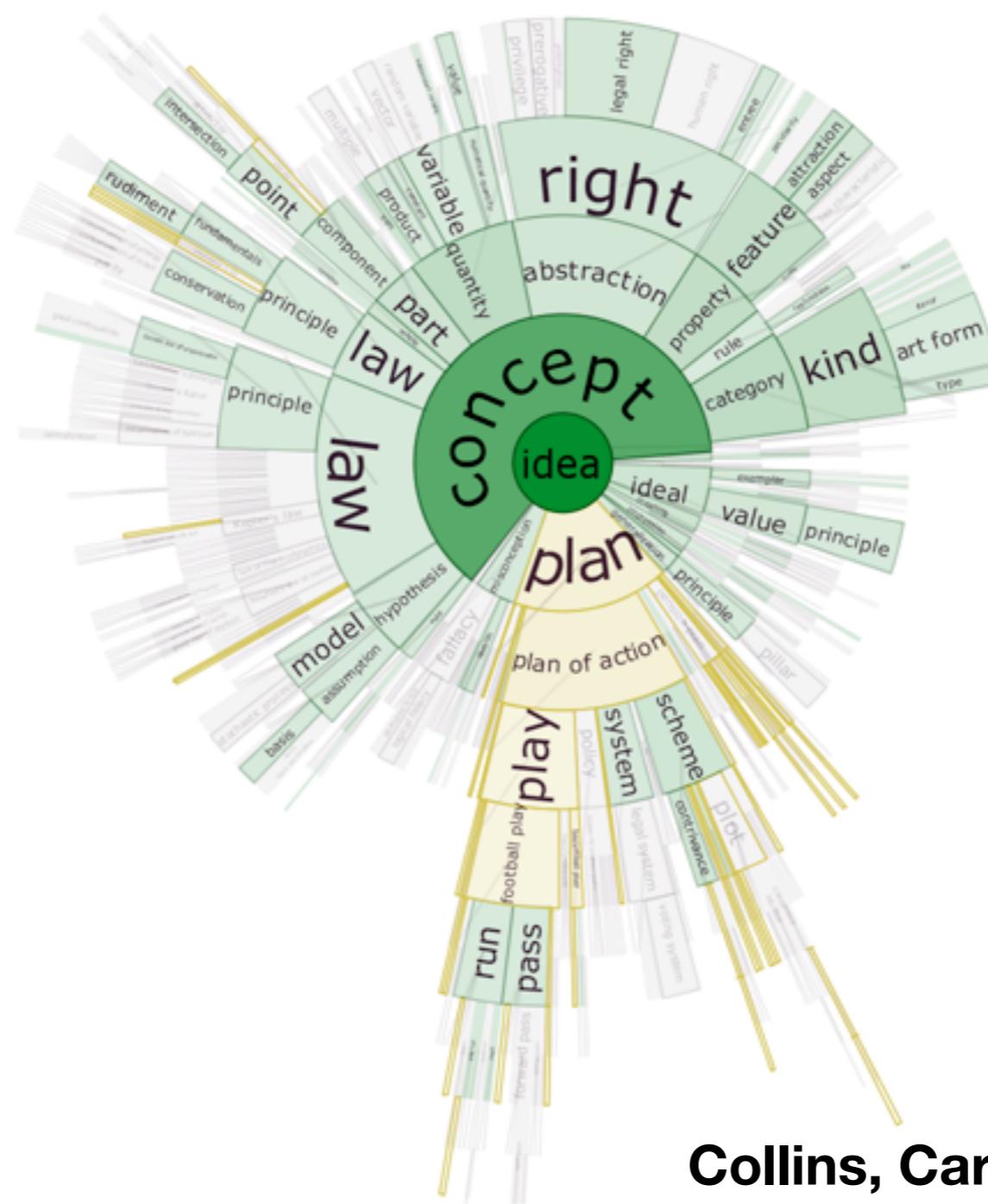
Tags: text



Wattenberg, Viegas 2008

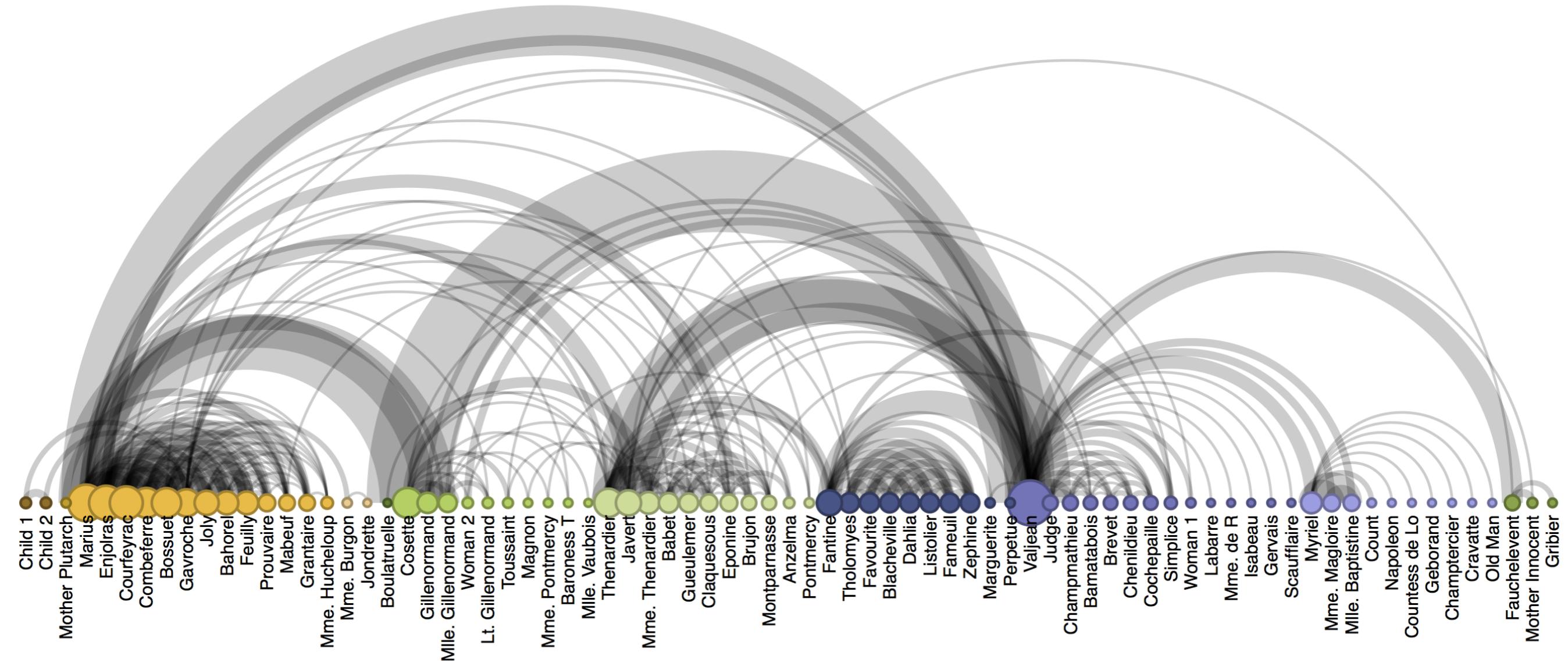
Also: <http://www.juiceanalytics.com/writing/wordtree-visual-text-exploration>

# DocuBurst: Visualizing the “is a” relationship



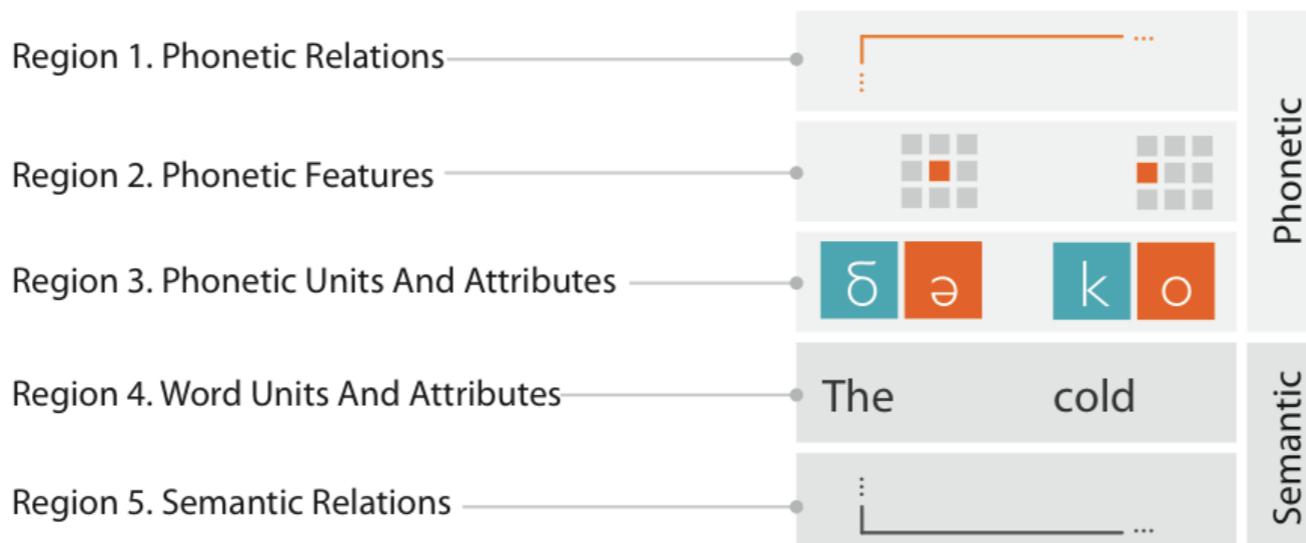
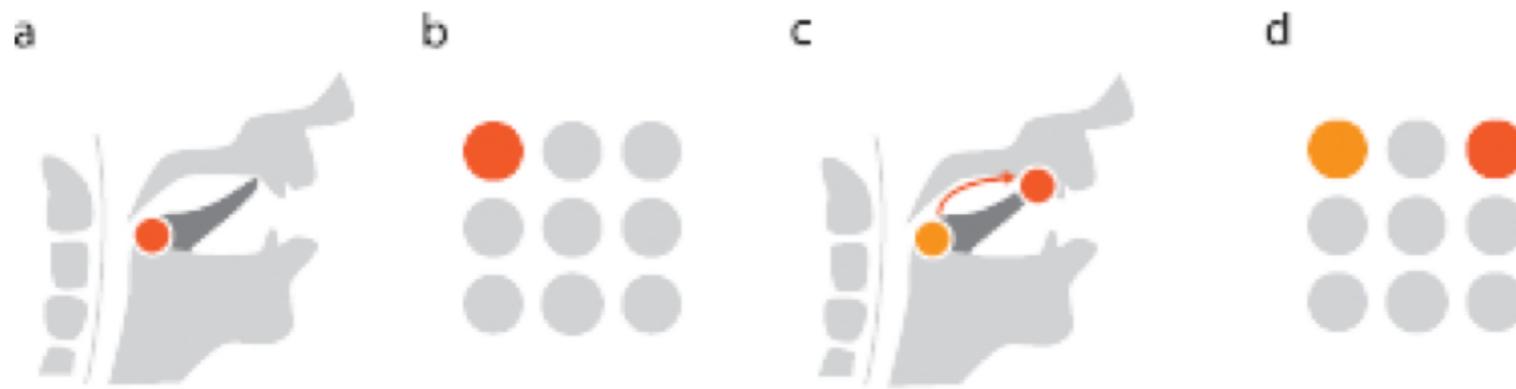
Collins, Carpendale, Penn 2008  
<http://vialab.science.uoit.ca/docuburst/index.php>

# Arc Diagrams



Analysis of the Characters from *Les Misérables*: <http://mbostock.github.io/protovis/ex/arc.html>

# Rule-Based: Poetry



# **Text Visualization For Document Collections**

# Parallel Tag Clouds to Explore and Analyze Faceted Text Corpora



## **Christopher Collins**

 [Subscribe](#)

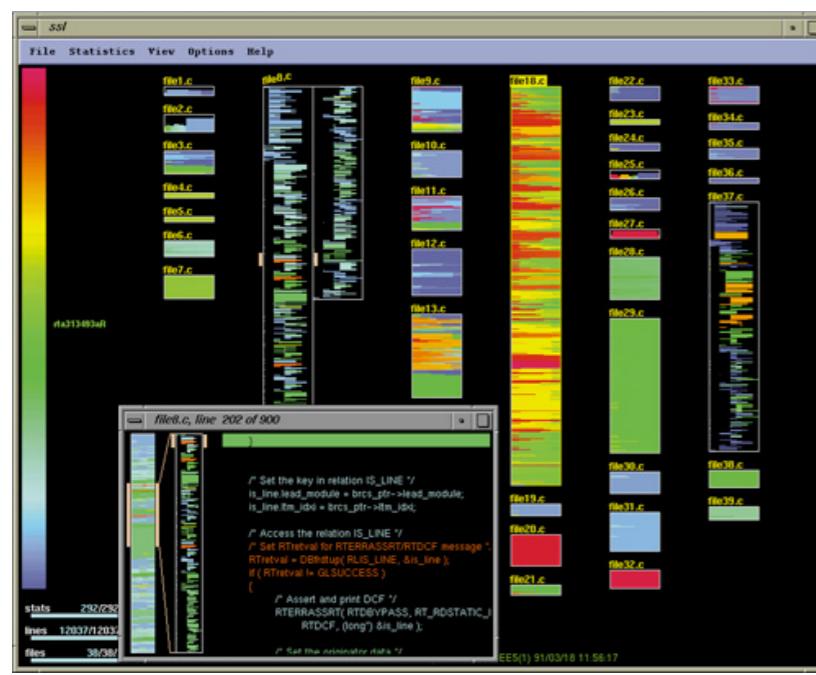
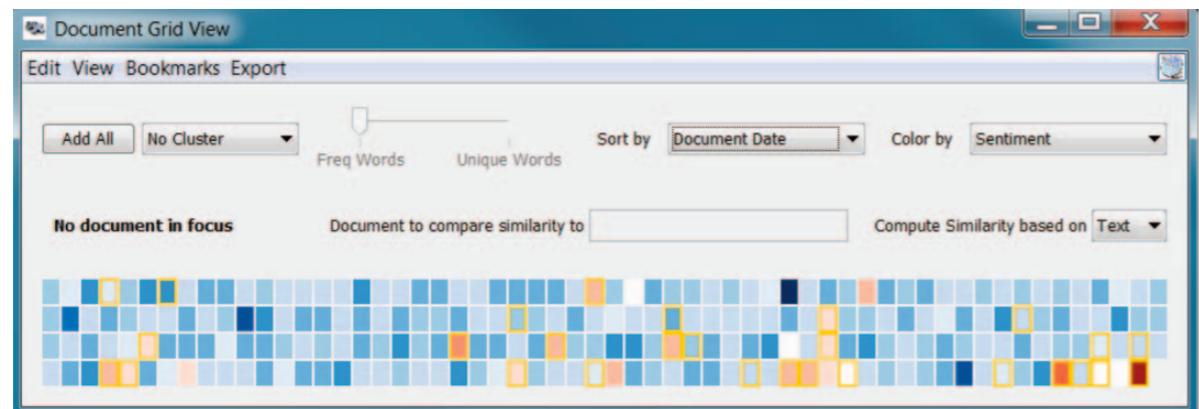
25

1

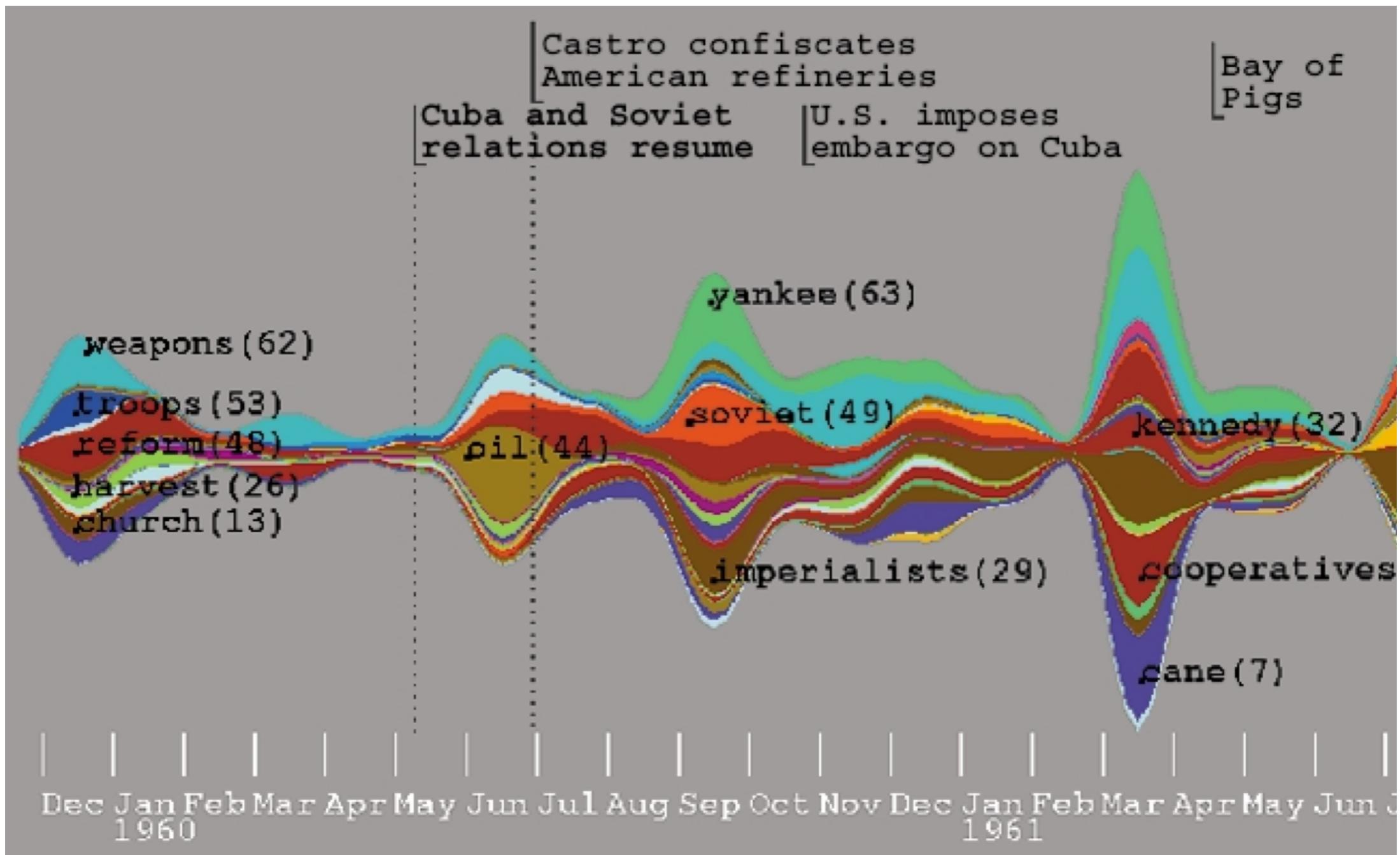
<https://www.youtube.com/watch?v=rL3Ga6xBgLw> 2.451

# Document Cards

## (small multiples)



# Showing Temporal Relationships: ThemeRiver (Stream Graph)



# Jigsaw: Many Linked Views

## Visual Analytics Support for Intelligence Analysis Case Study: The 9/11 Report

Carsten Görg  
Youn-ah Kang  
Zhicheng Liu  
John Stasko



Information Interfaces Group  
Georgia Institute of Technology

# Jigsaw: Many Linked Views

## Visual Analytics Support for Intelligence Analysis Case Study: The 9/11 Report

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# Sets

# Mental Exercise: Consider The Following Dataset



# Mental Exercise: Consider The Following Dataset

- Item: Lego



# Mental Exercise: Consider The Following Dataset

- Item: Lego
- Attributes:
  - Color
  - Height
  - Width
  - Length
  - Shape



# Dataset Could Have Other Attributes



# The Dataset in Practice

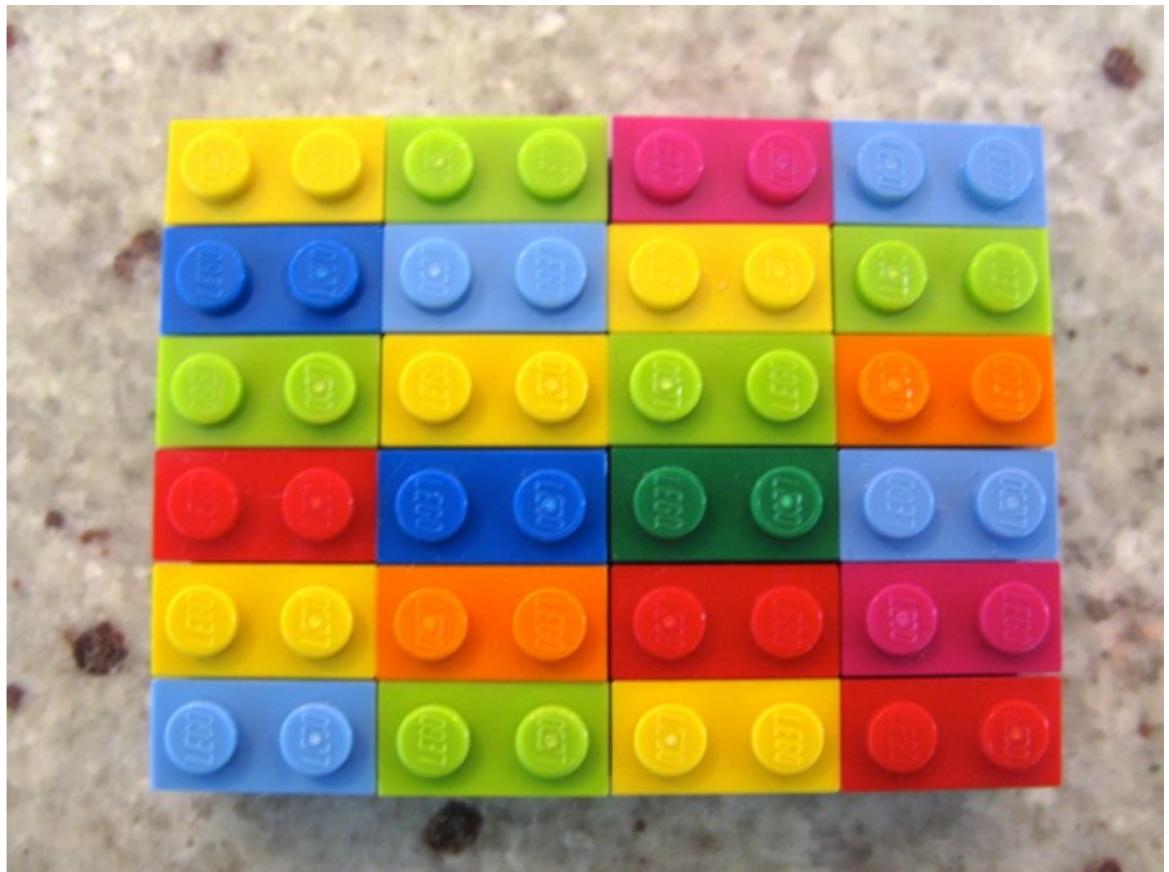
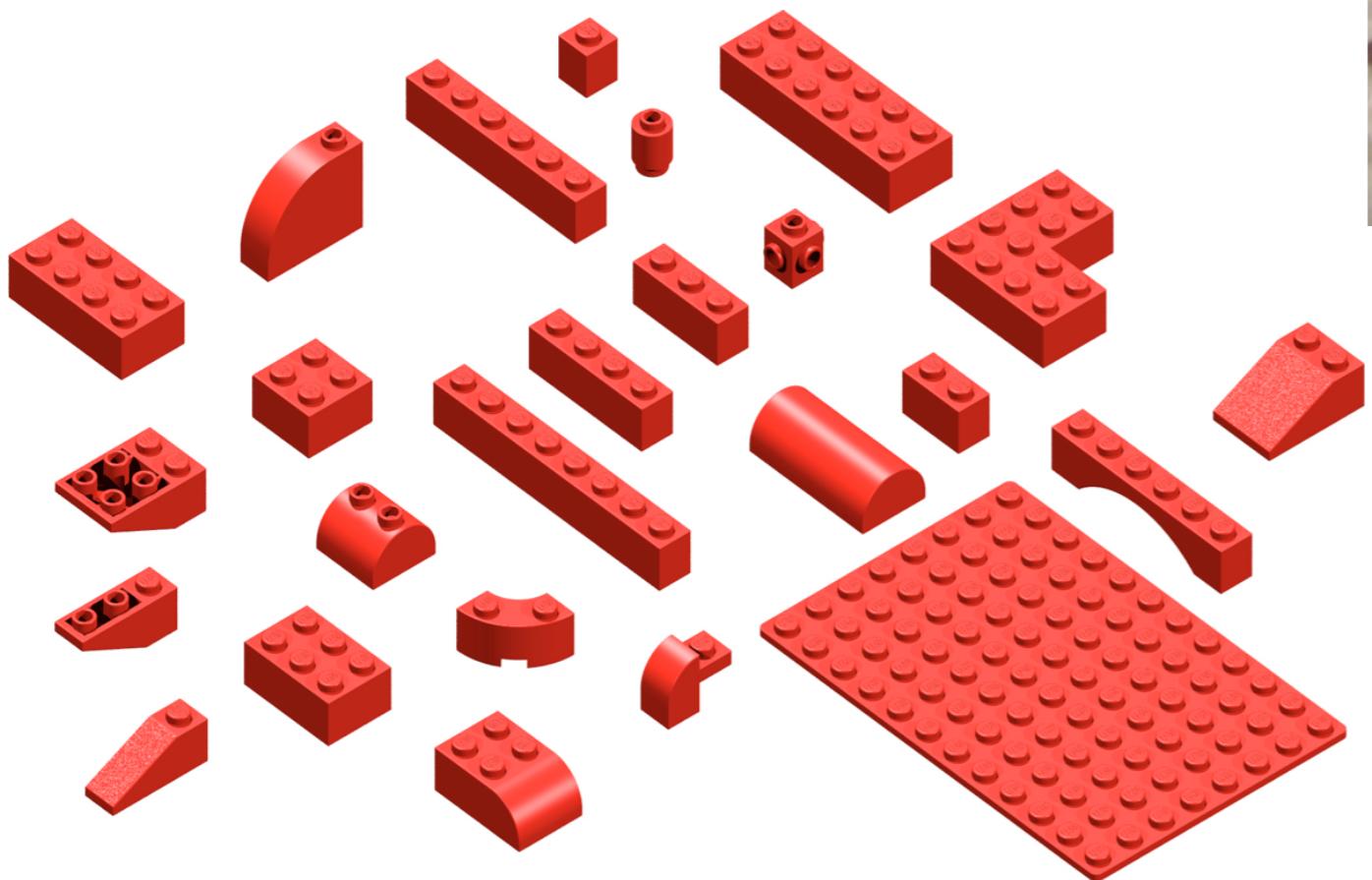


# Where Do We Start? Organization

- Sort by color



# Where Do We Start? Organization



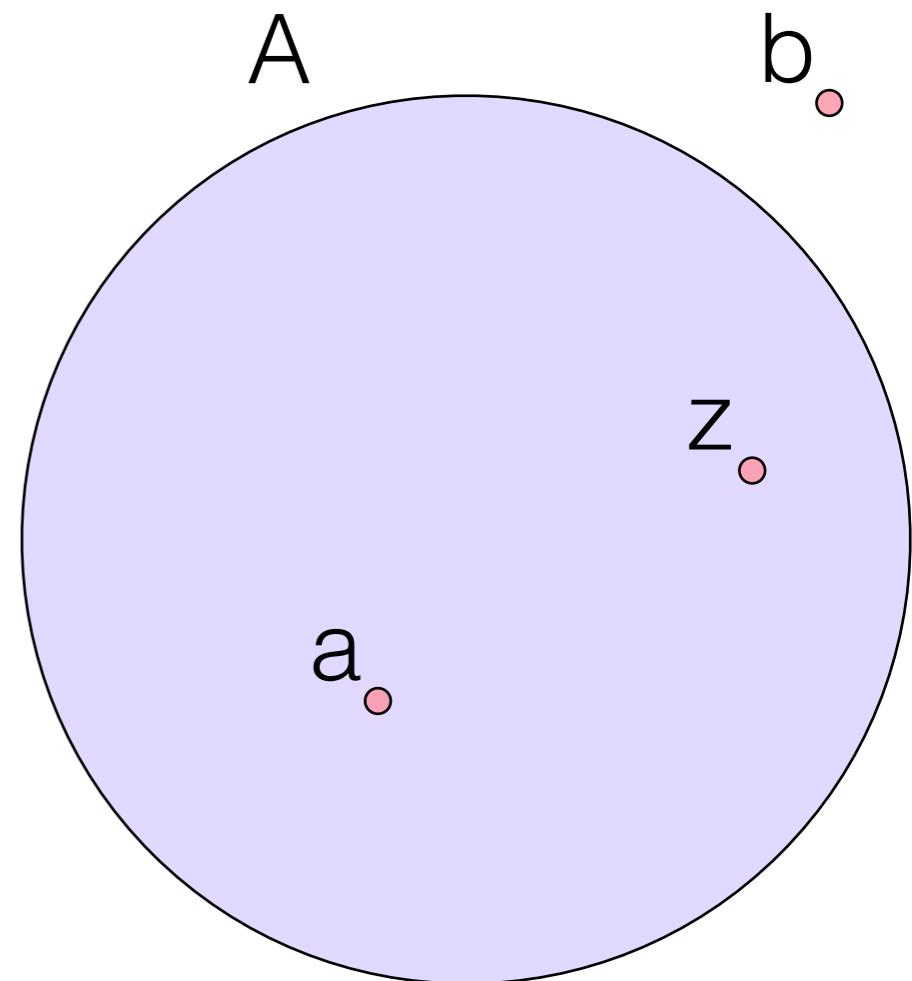
- Organization is a task where we group data into sets
- Drawbacks?



# Set Theory

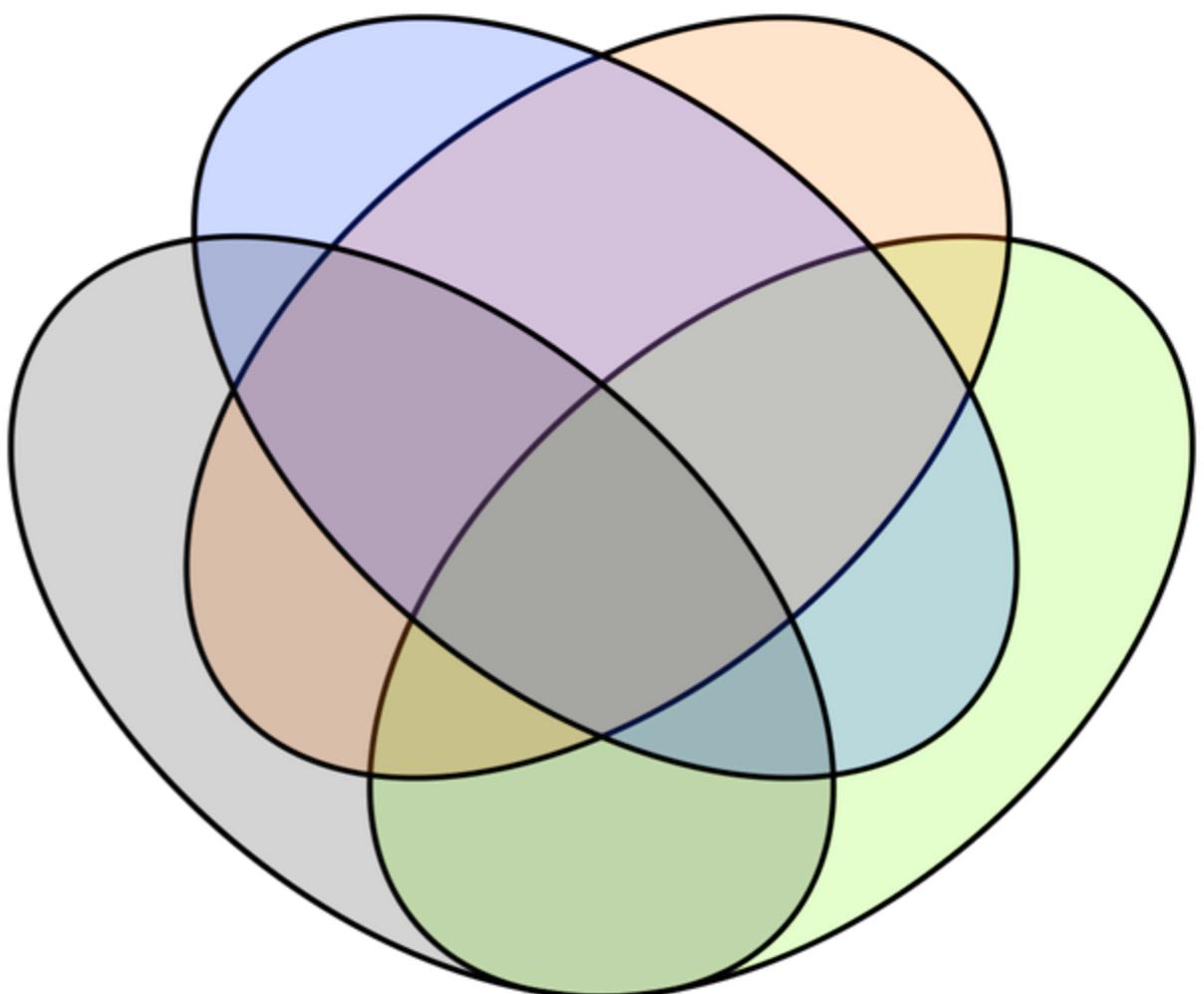
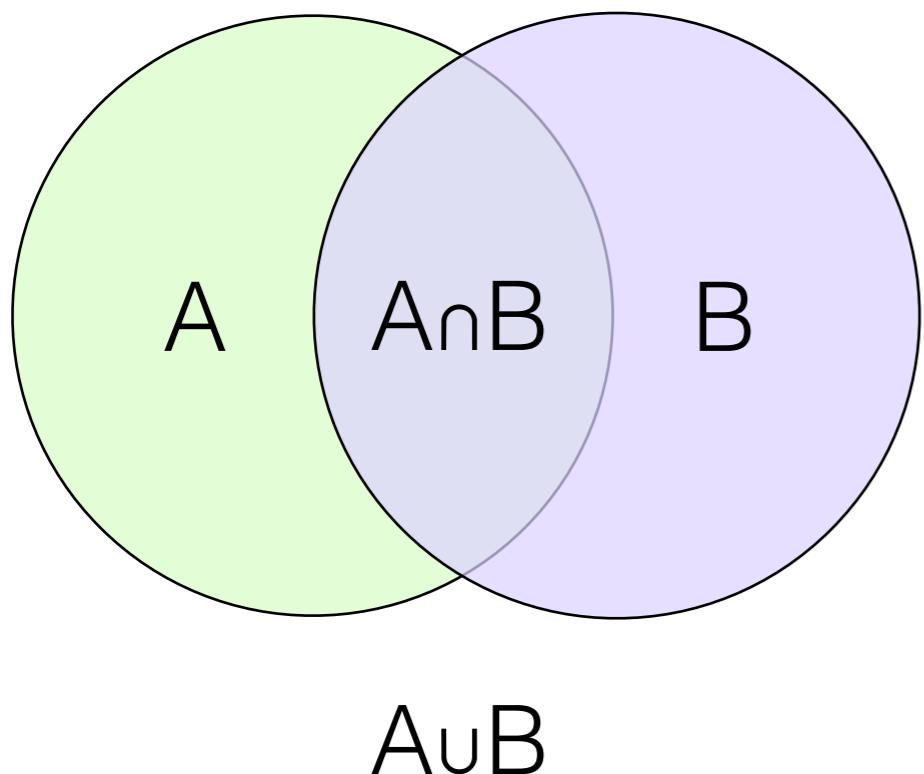
## (Cantor, Dedekind 1870s)

- A **set** is a collection of objects
  - Use capital letters: A, B, C for sets
- An **object** is anything
  - Use lower case letters: a, b, c for objects
  - Objects are contained in sets:  $a \in A$  and  $z \in A$ , but  $b \notin A$
- Discrete sets often written with {}
  - Example:  $B = \{c,d,e\}$

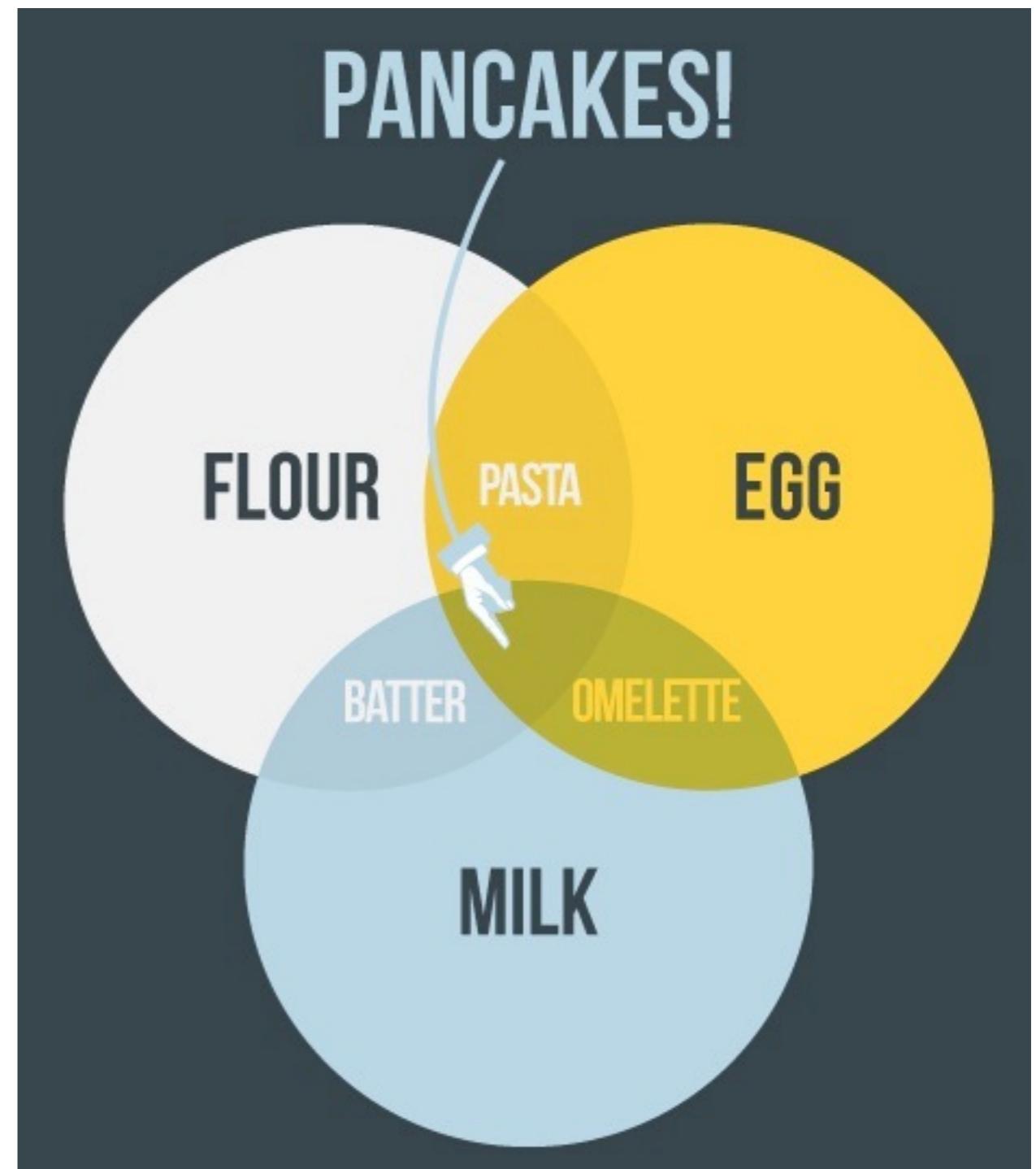


# Venn Diagrams: Showing Set Relationships

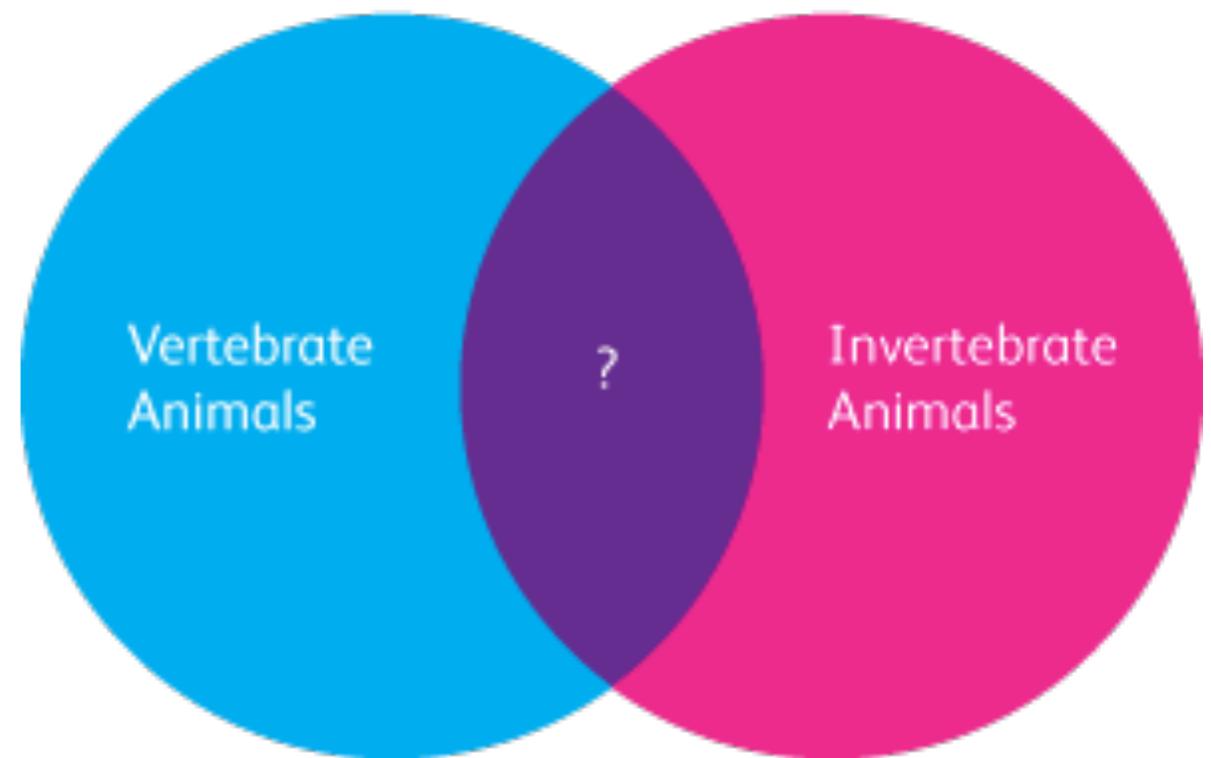
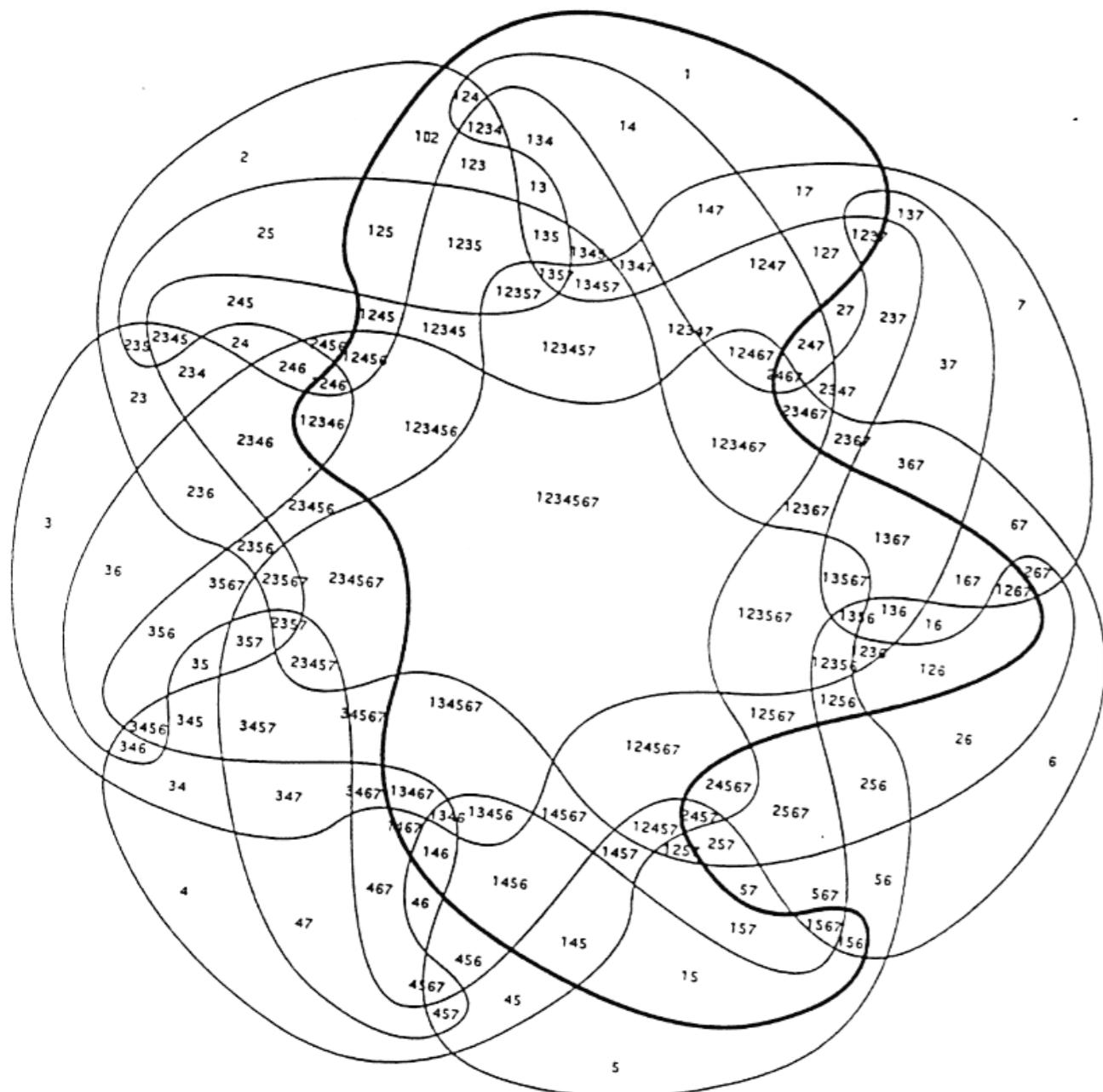
- Show intersections, unions, complements. All combinations.



# Venn Diagrams



# Venn Diagrams: Can Get Messy And Non-Sensical



# UpSet: Visualization of Intersecting Sets

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Romain Vuillemot, and Hanspeter Pfister

<http://vcglab.org/upset>



**HARVARD**  
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## UpSet: Visualization of Intersecting Sets



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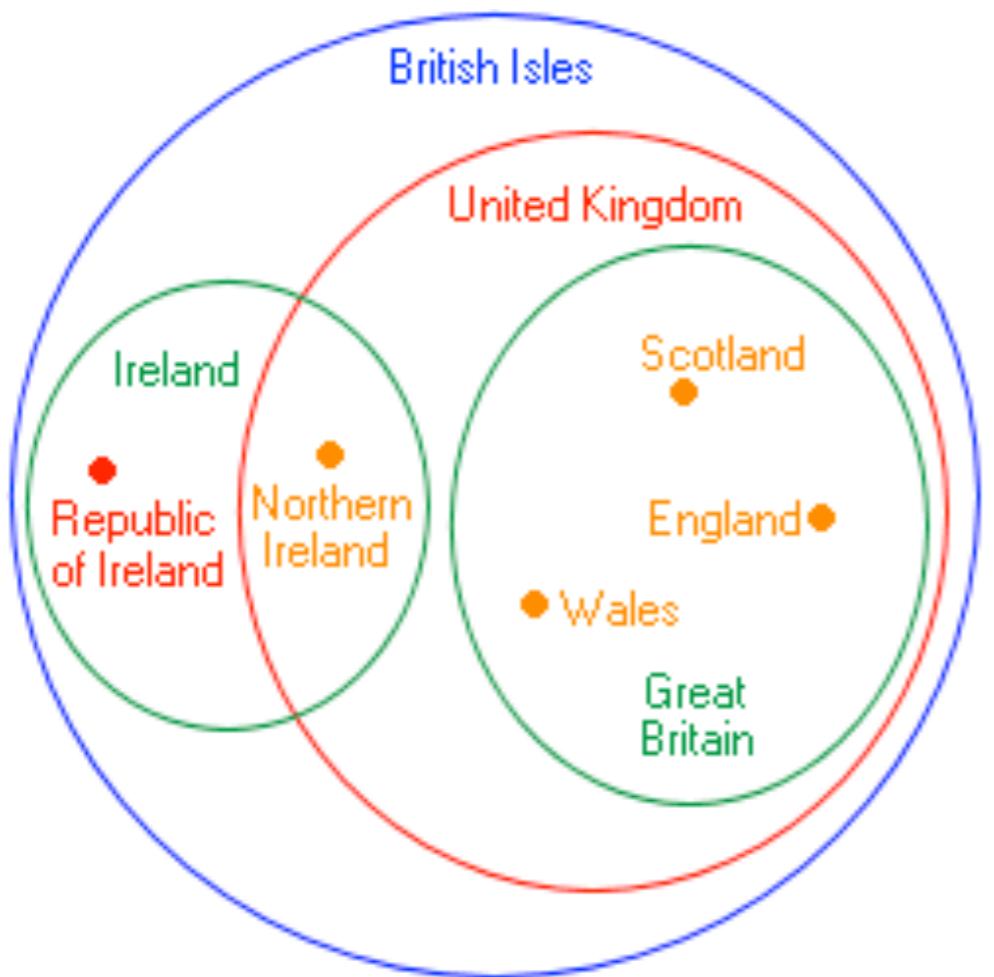
Published on Jul 21, 2014

UpSet is an interactive, web based visualization technique designed to analyze set-based data. UpSet visualizes both, set intersections and their properties, and the elements in the dataset.

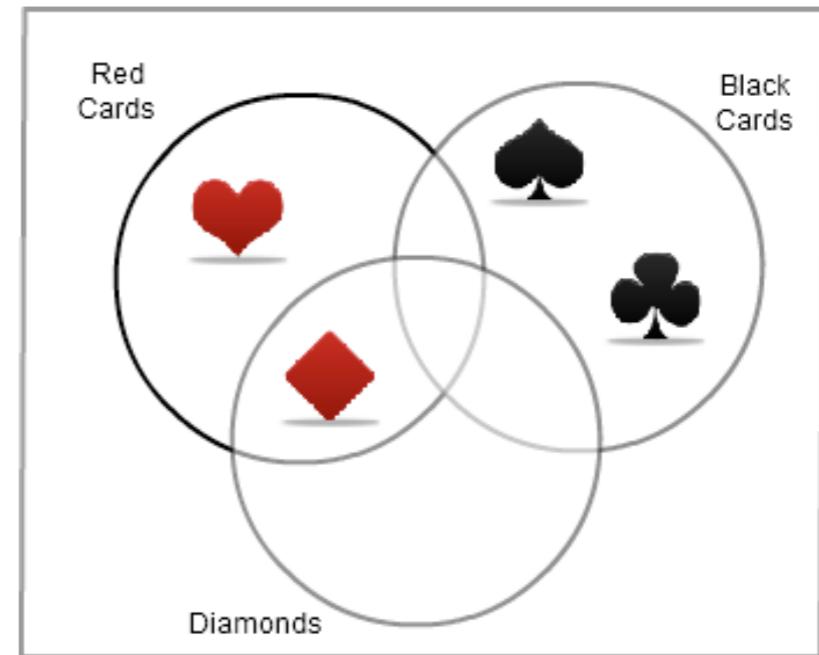
See also: <https://upset.app/>

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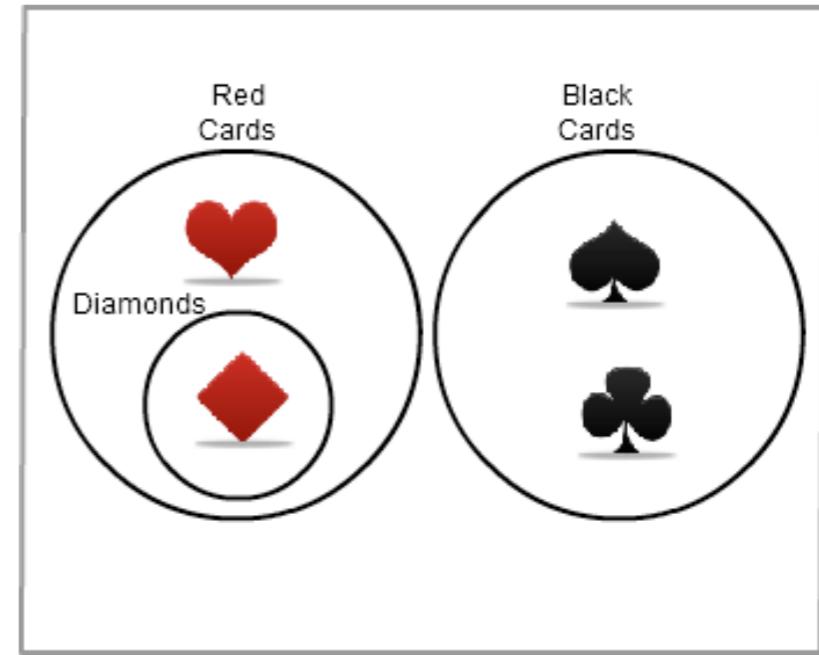
# Euler Diagrams Show Only Valid Relationships



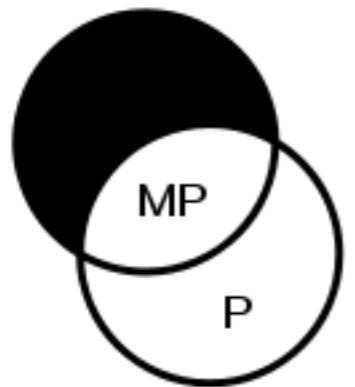
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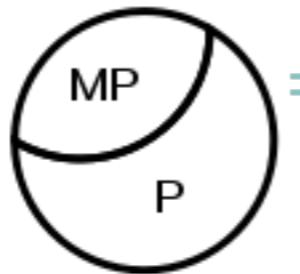
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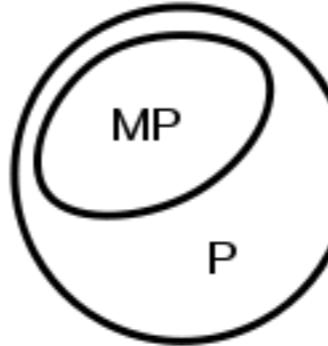
# Converting From Venn to Euler



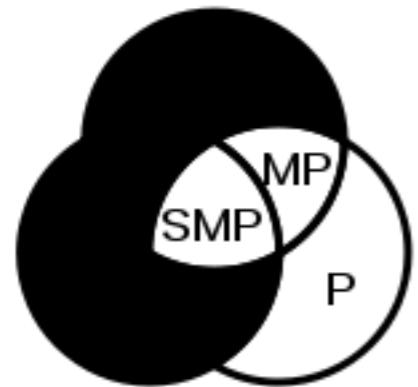
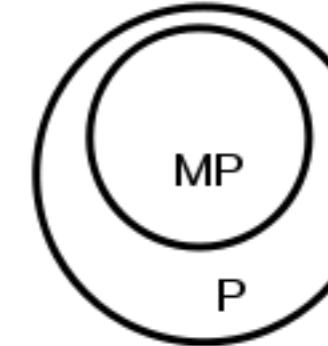
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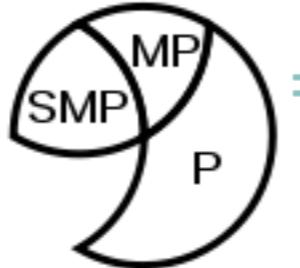
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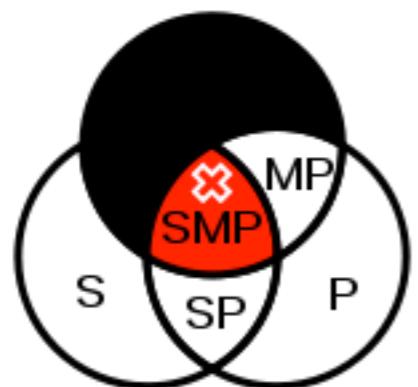
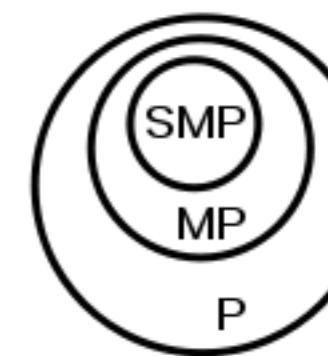
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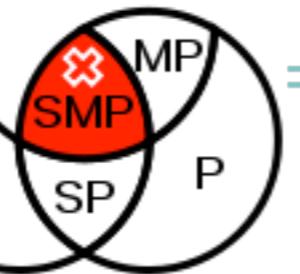
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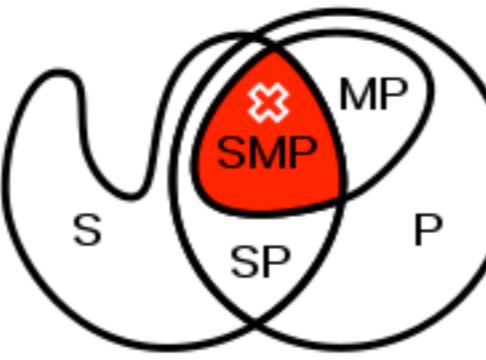
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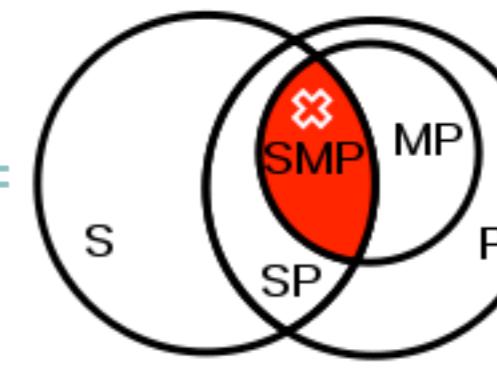
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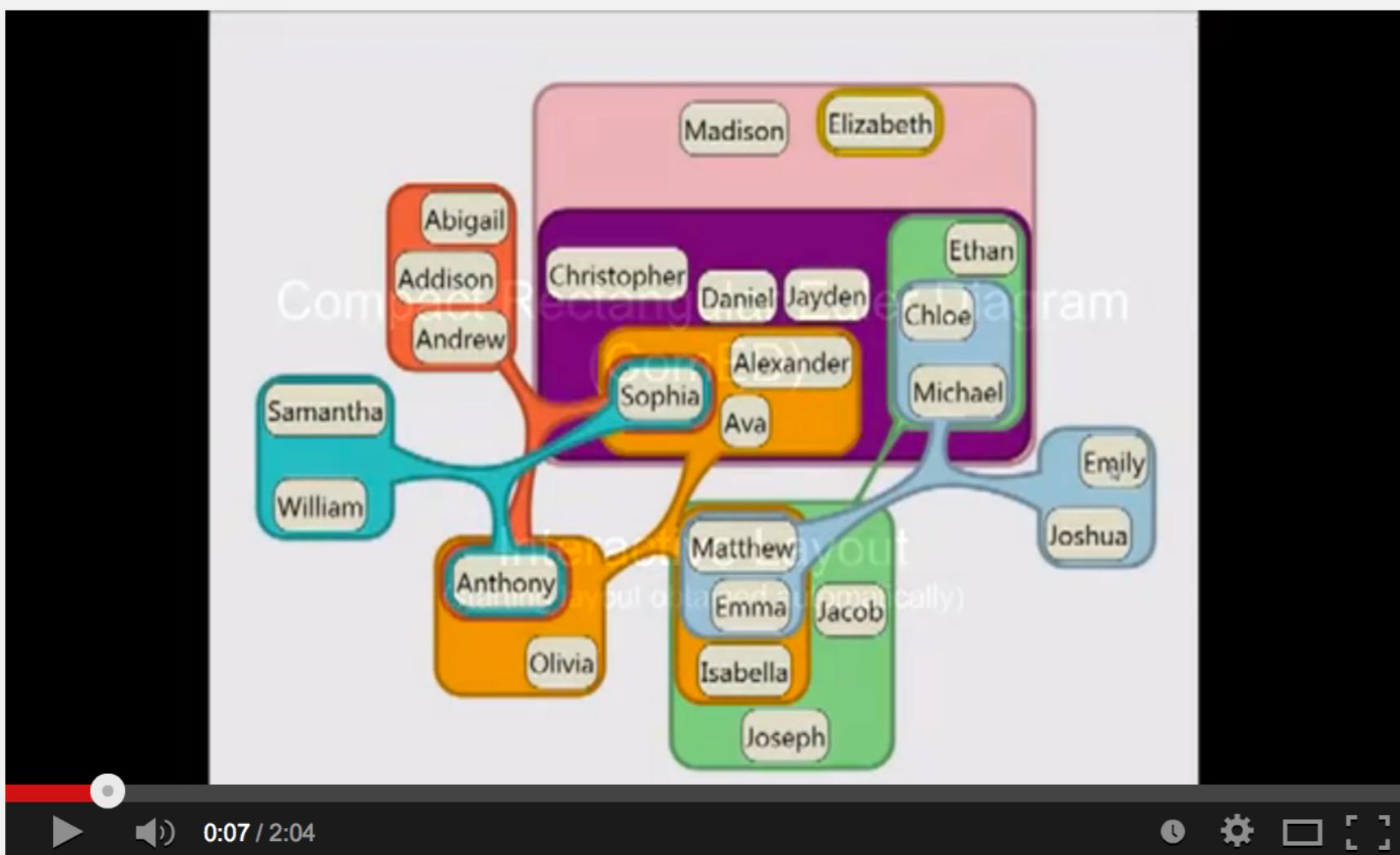


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## Untangling Euler Diagrams



Tim Dwyer

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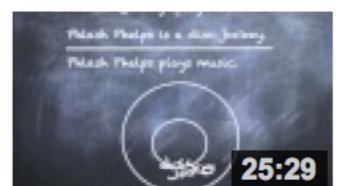
1 2 0

Published on Sep 10, 2013

Video to accompany our Infovis 2010 paper of the same name.

<https://www.youtube.com/watch?v=q2tUrqiFHBC>

<http://vis.pku.edu.cn/paper/vis2010/i...>



### 3.5 Analyzing Arguments with Diagrams

by Krista Hands  
1,947 views



### Layout with circular and other non-linear constraints using

by Tim Dwyer  
73 views



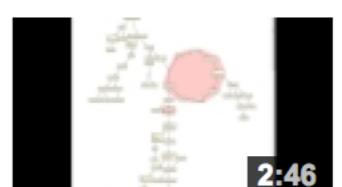
### Untangle Project

by tehb0ss  
145 views



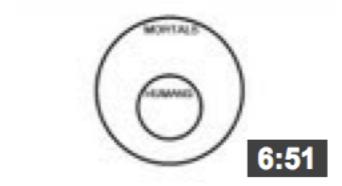
### An Evening with Leonhard Euler

by philoctetesctr  
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### Scalable, versatile and simple constrained graph layout

by Tim Dwyer  
46 views



### Euler Diagrams

by ProfessorSerna  
2,049 views



### Exploration of networks using overview+ detail with

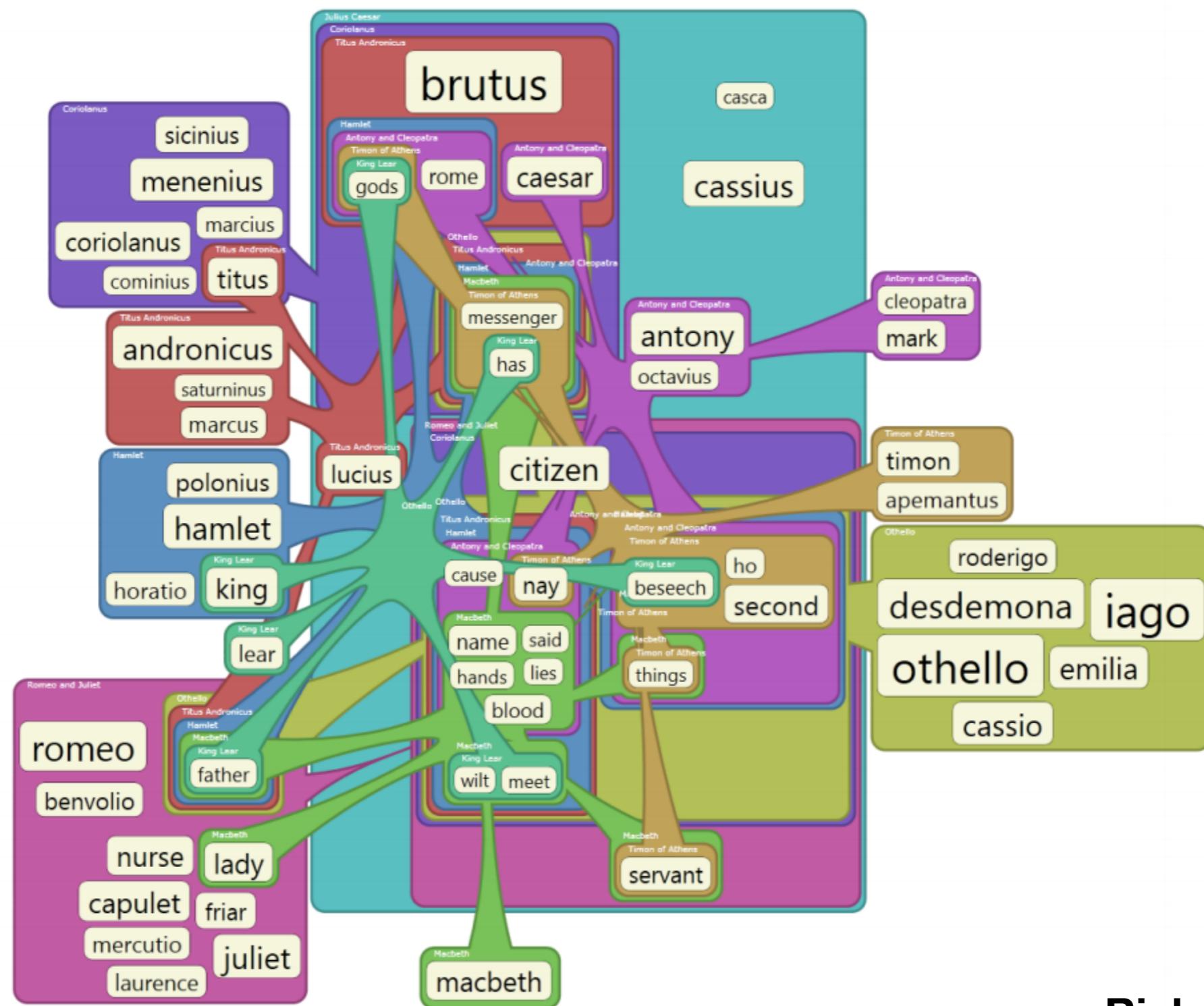
by Tim Dwyer  
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### The Difference between the United Kingdom, Great Britain and the UK

by CGP Grey  
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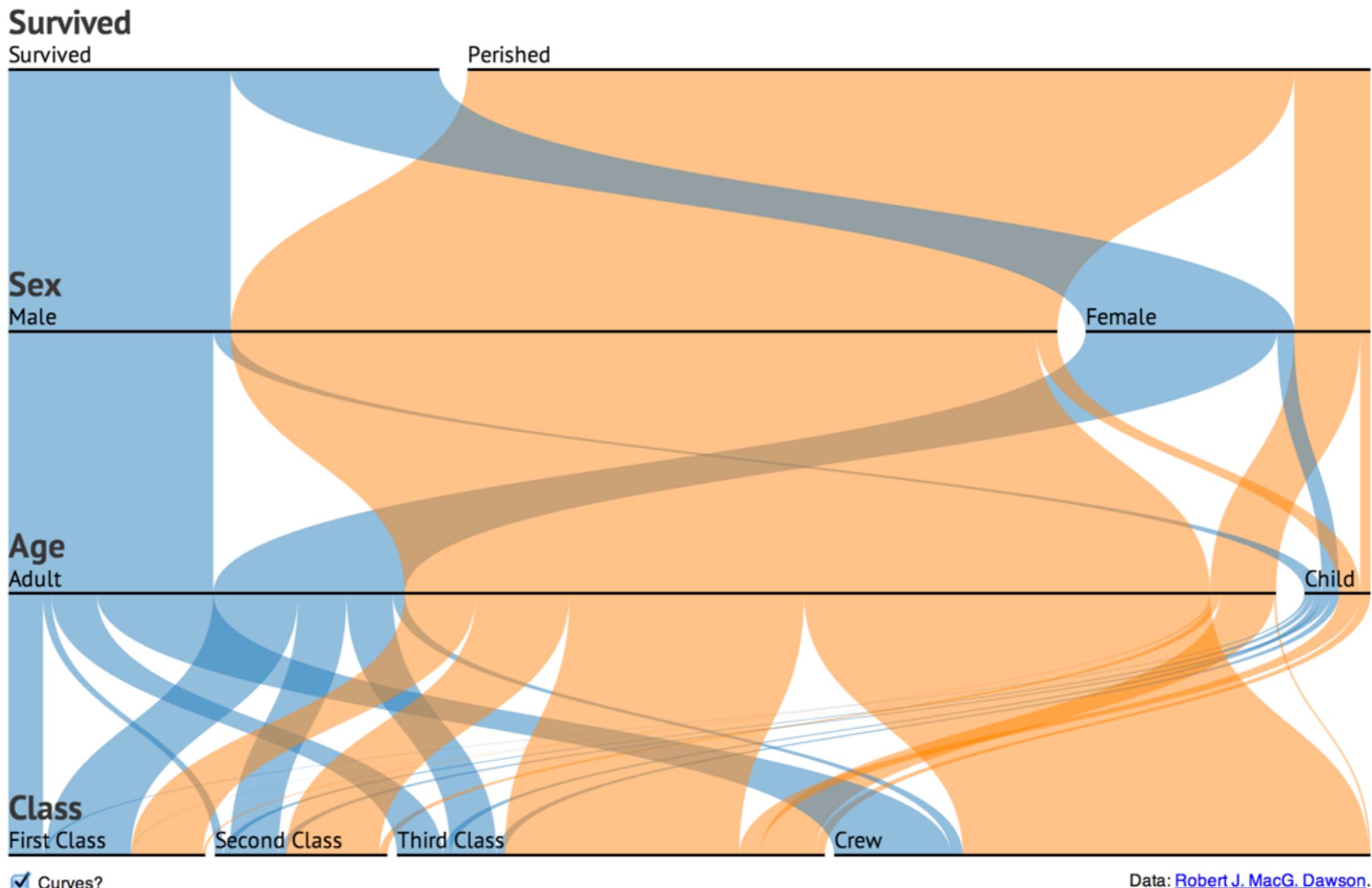
# Most Frequently Used Words in 10 of Shakespeare's Plays



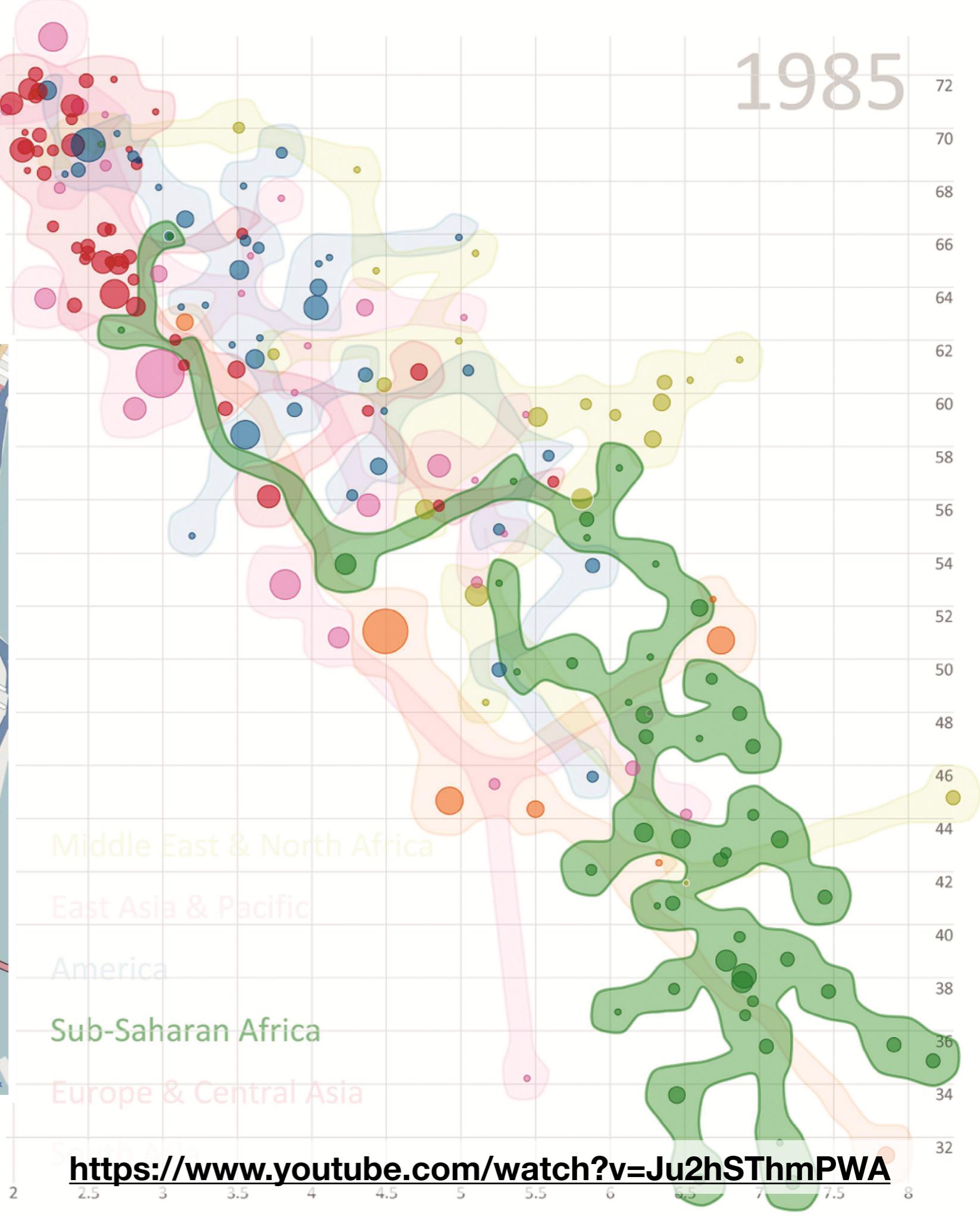
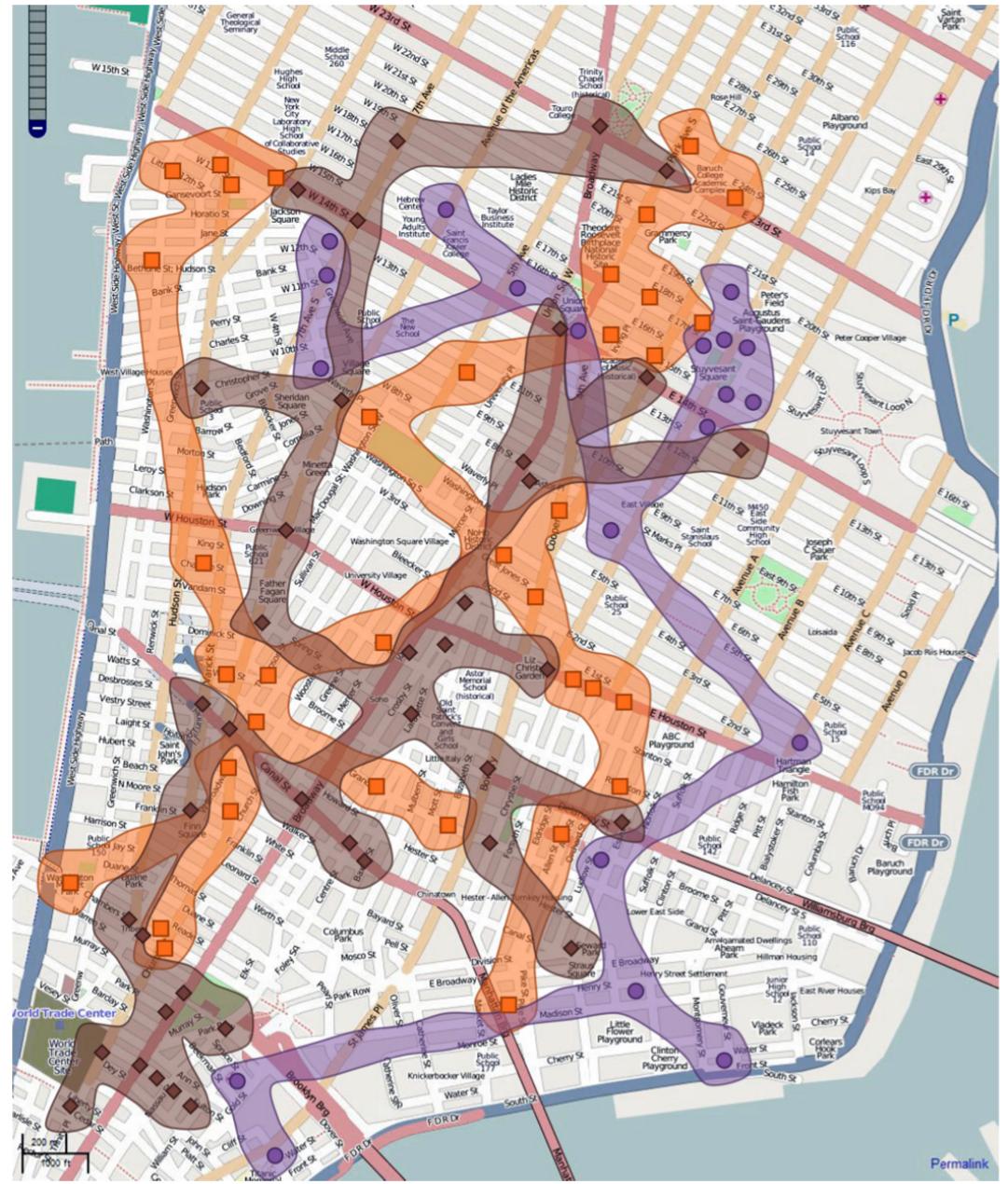
# Riche, Dwyer 2009

# Parallel Sets

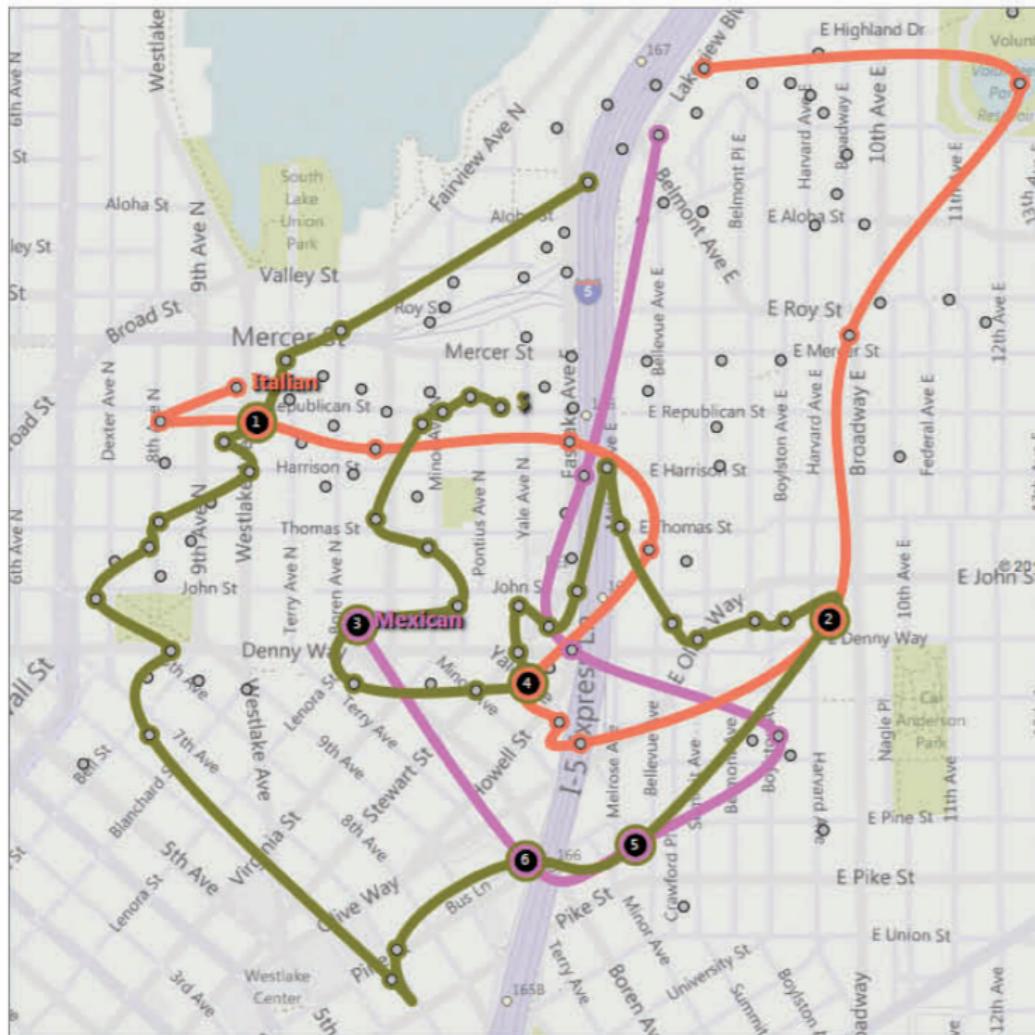
Titanic Survivors



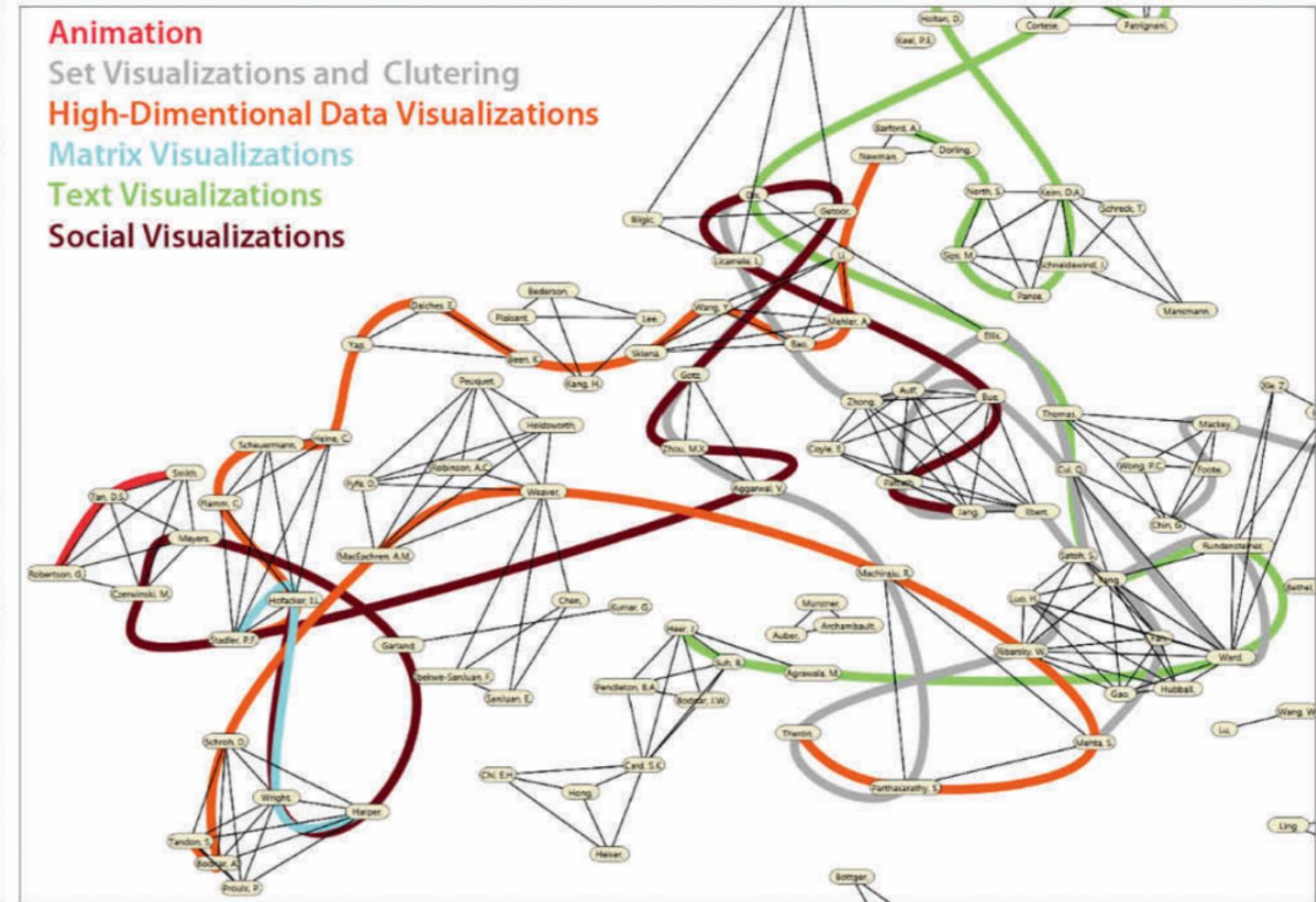
# Bubble Sets: Add Connection to Color



# Line Sets: Reduce Clutter

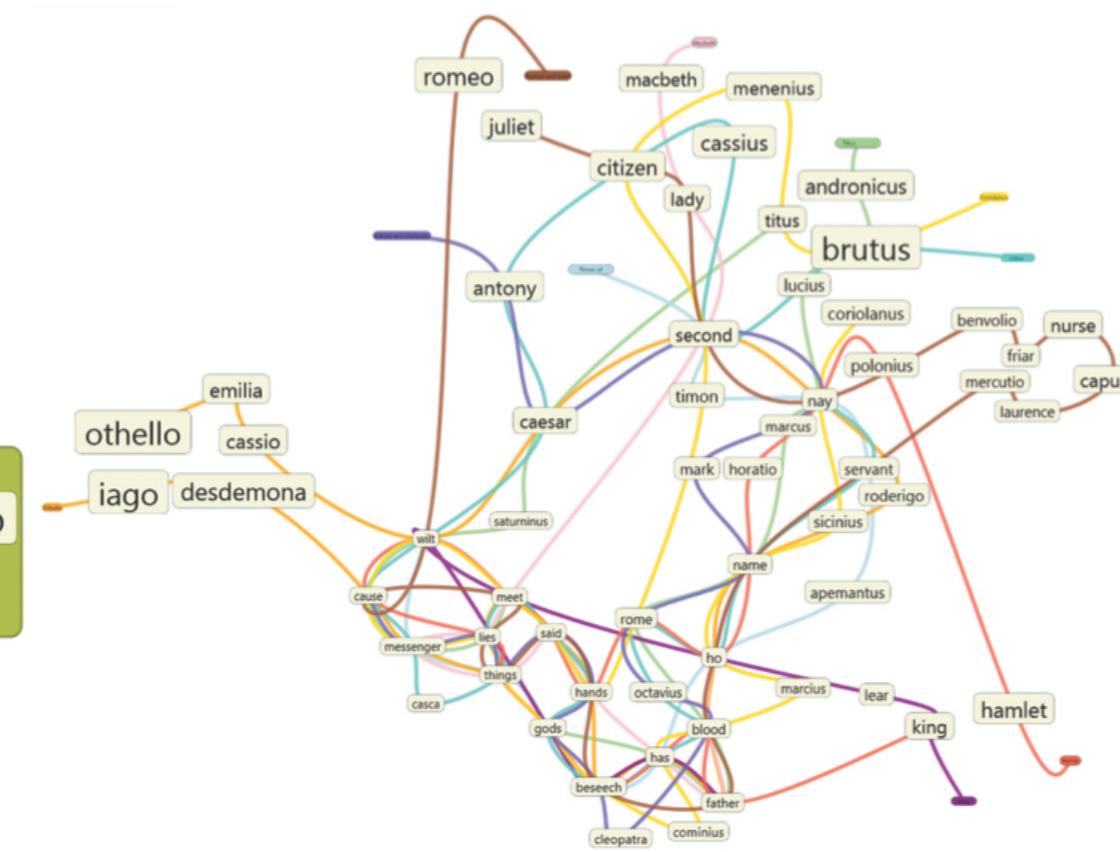
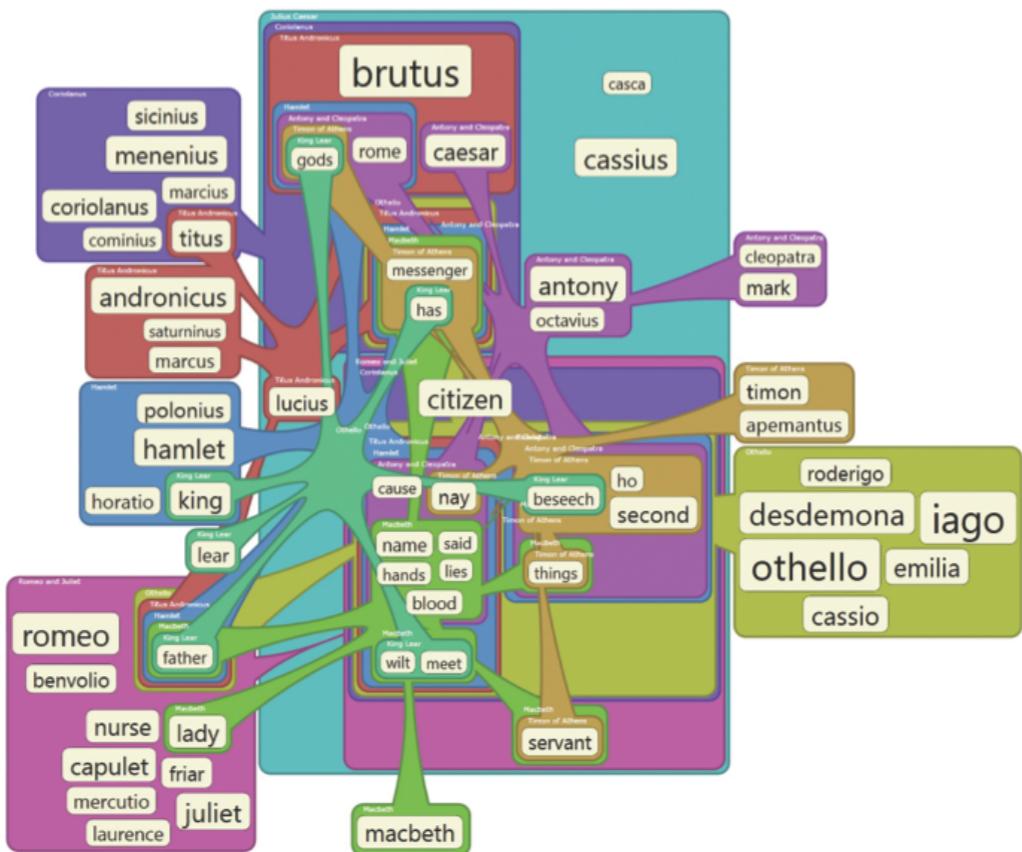
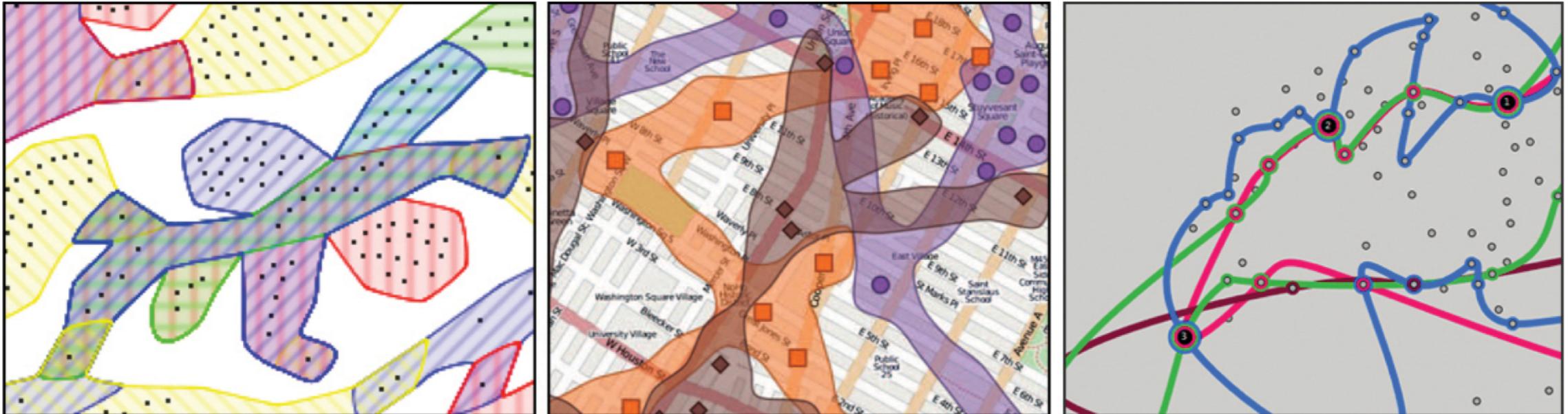


Restaurants



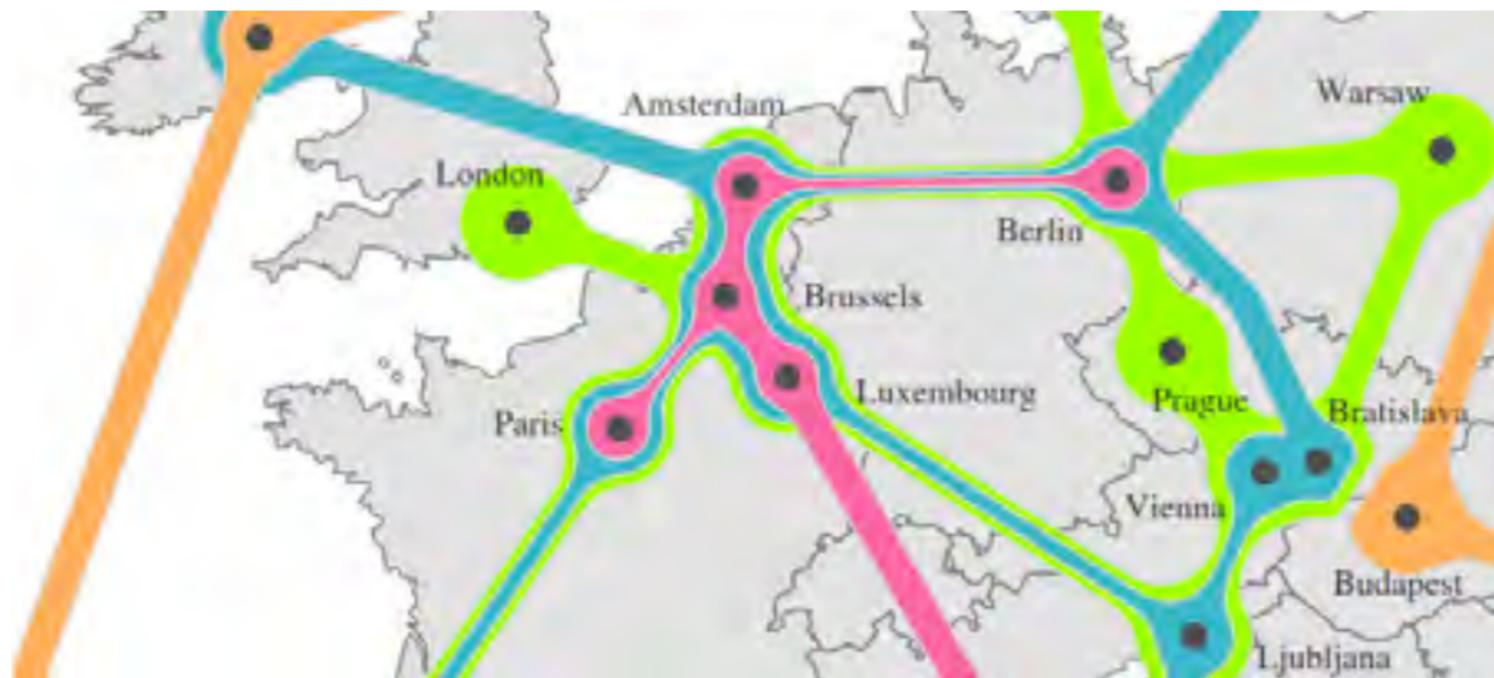
Social Communities

# Line Sets: Comparison

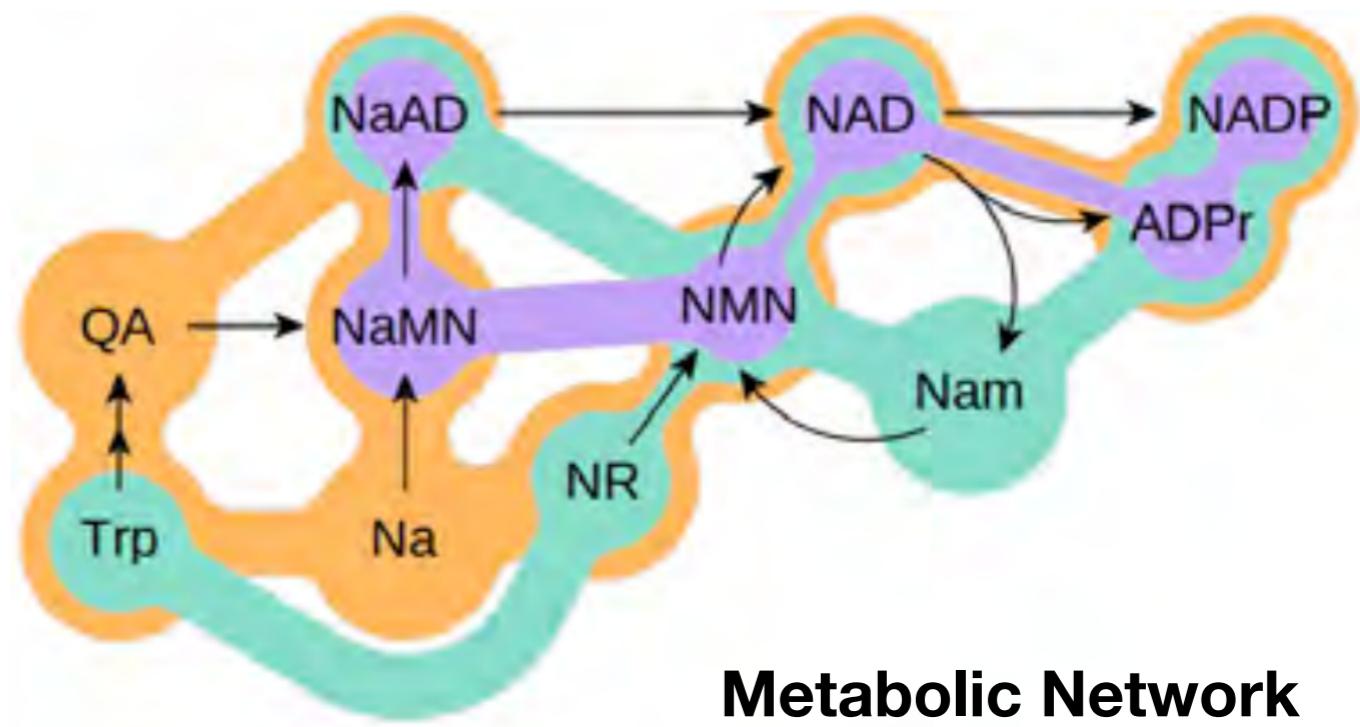


Alper, Riche, Ramos, Czerwinski 2011

# Kelp Diagrams



Cities + Routes

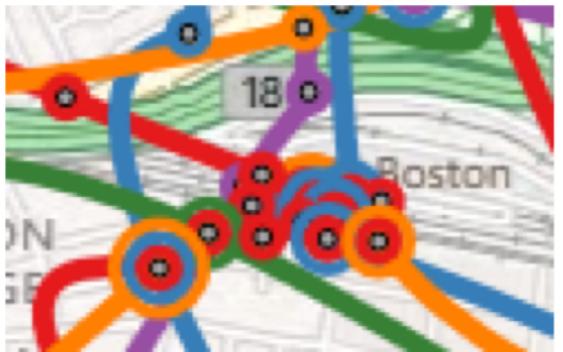


Metabolic Network

# Kelp Fusion: Combining Lines + Areas



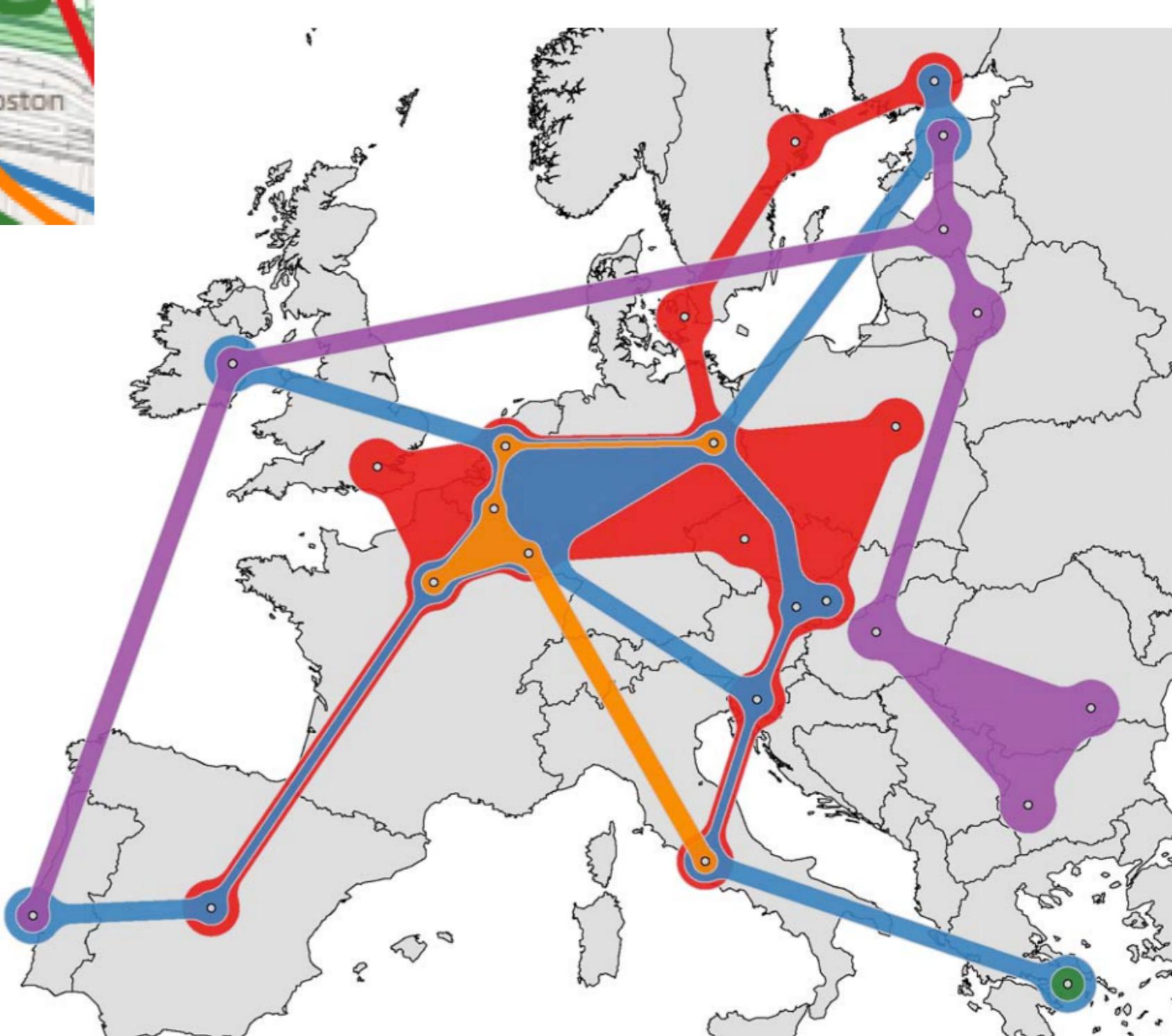
(a) Bubble Sets



(b) LineSets



(c) KelpFusion



# Lec26 Reading

- Correll, Let's Do Virtuous Data Visualization
  - Check out the optional reading for supplemental readings

# **Reminder**

# **Assignment 06**

**Assigned: Monday, April 10**

**Due: Monday, April 24, 4:59:59 pm**

# **Reminder**

# **Project Milestones 03/04**

Assigned: Wednesday, March 29

03 (Talk) Due: Wednesday, April 26, 4:59:59 pm

04 (Report) Due: Wednesday, May 3, 4:59:59 pm