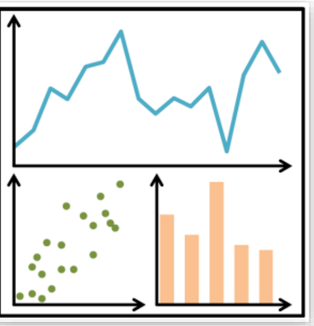
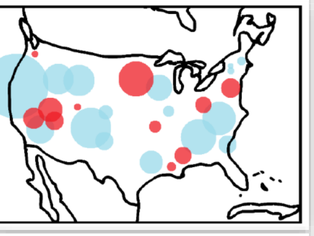
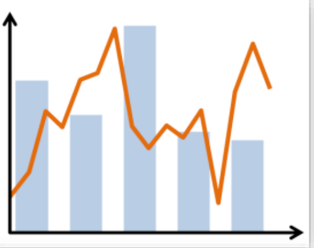
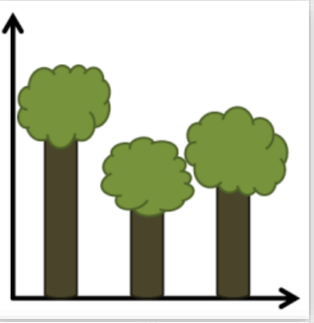
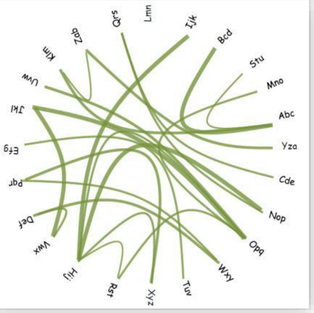






Lecture 15: Trees and Networks, continued…

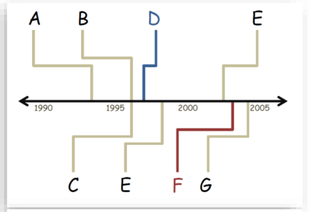
CS 7250

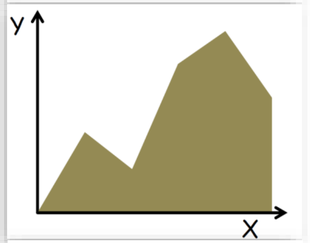
SPRING 2021

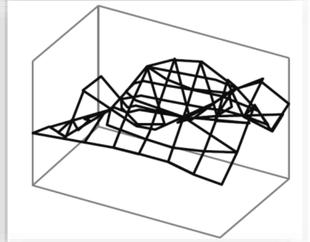
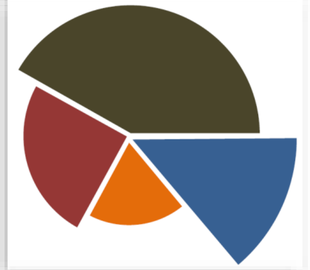
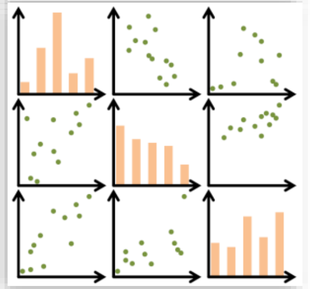
Prof. Cody Dunne

NORTHEASTERN UNIVERSITY

Slides and inspiration from Michelle Borkin, Krzysztof Gajos, Hanspeter Pfister, Miriah Meyer, Jonathan Schwabish, and David Sprague





Checking In

Trees & (Mainly) Networks, continued...

Goals for Today

- Learn common visual encoding techniques for network data (adjacency matrix) and tree data (treemaps), and the advantages of each one.

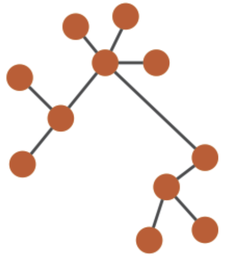
Previously, on CS 7250…

Arrange Networks and Trees

Node–Link Diagrams

Connection Marks

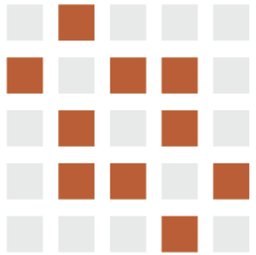
✔ NETWORKS ✔ TREES



Adjacency Matrix

Derived Table

✔ NETWORKS ✔ TREES



Enclosure

Containment Marks

✘ NETWORKS ✔ TREES

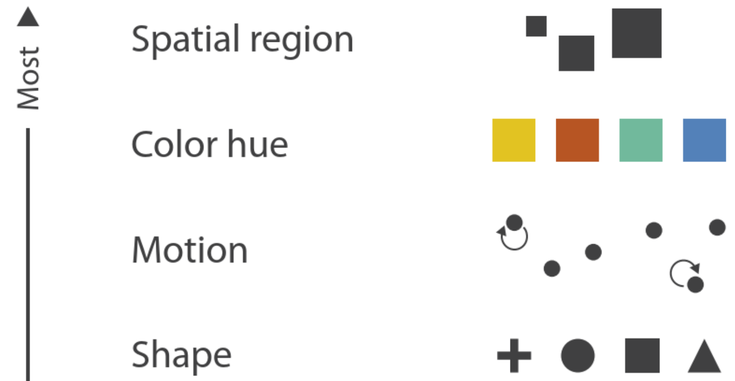
"Treemap"

Spatial Layout

Channels: Expressiveness Types and Effectiveness Ranks

Magnitude Channels: Ordered Attributes

- Position on common scale
- Position on unaligned scale
- Length (1D size)
- Tilt/angle
- Area (2D size)
- Depth (3D position)
- Color luminance
- Color saturation
- Curvature
- Volume (3D size)



Most

Effectiveness

Least

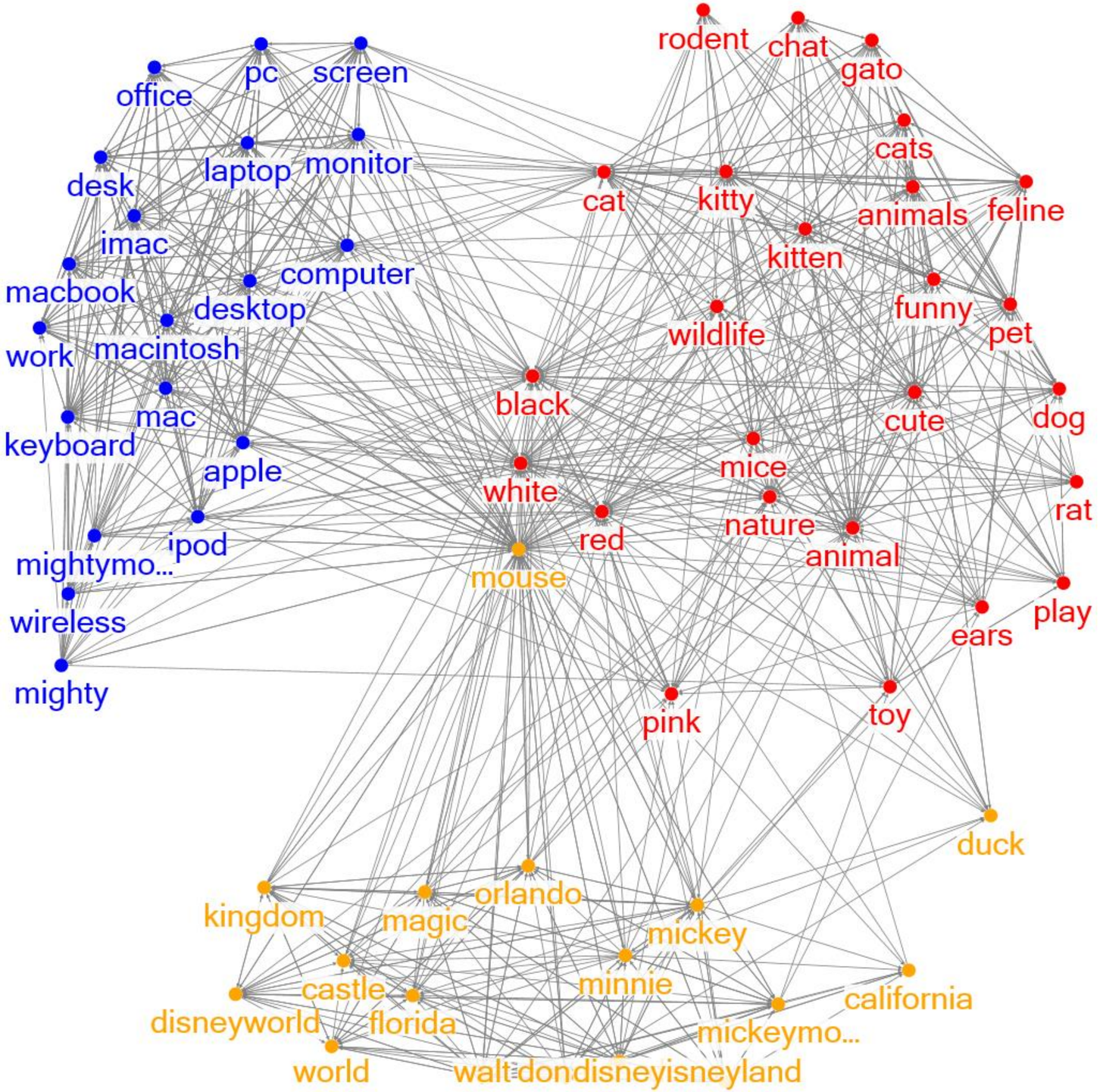
Same

Same

Identity Channels: Categorical Attributes

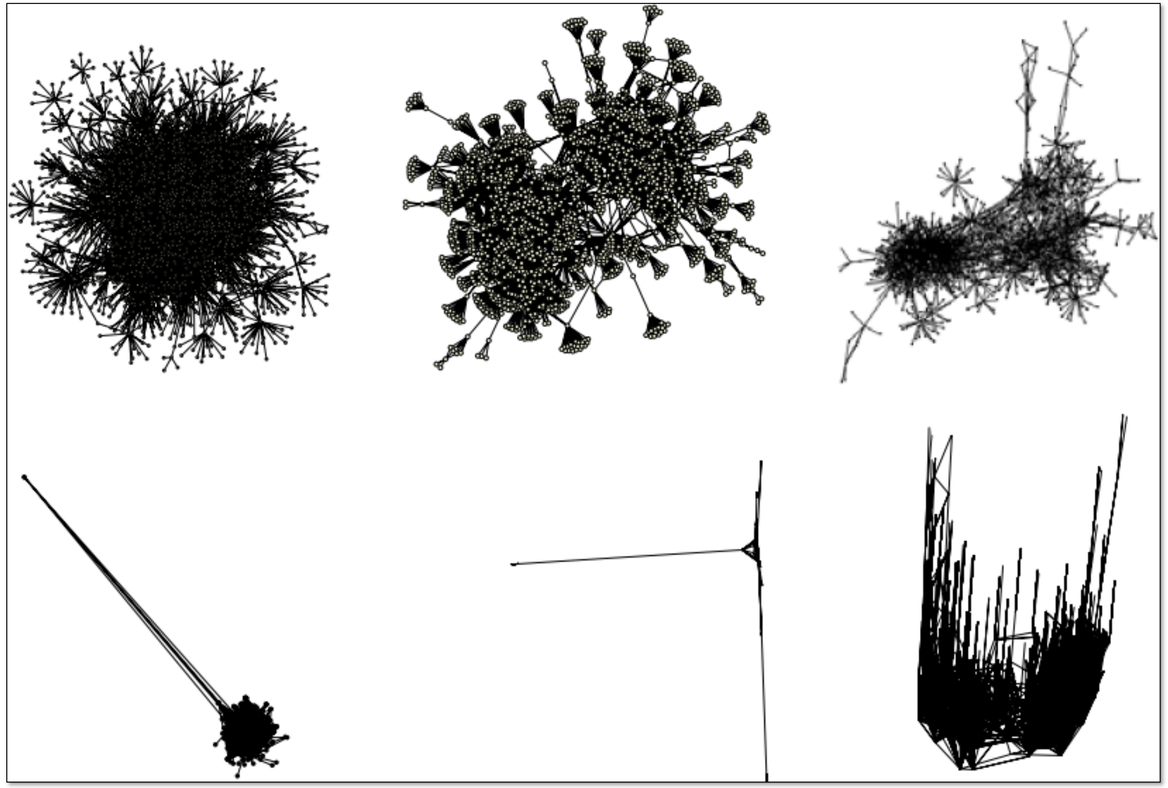
- Spatial region
- Color hue
- Motion
- Shape

Flickr Query for “Mouse”

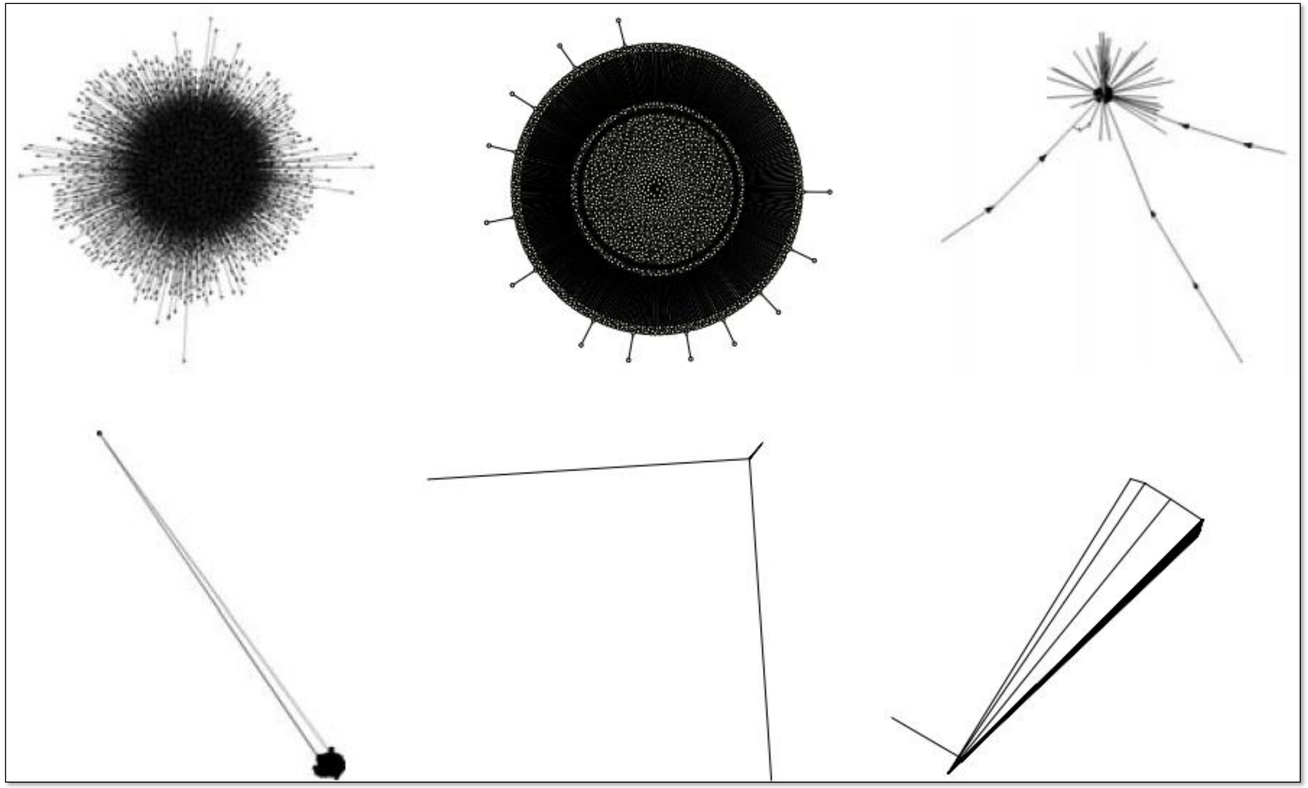


Layout Algorithm Comparisons

Graph A



Graph B



Hachul & Jünger, 2006

Now, on CS 7250…

In-Class Exercise

In-Class Algorithms — Network Planarity Party

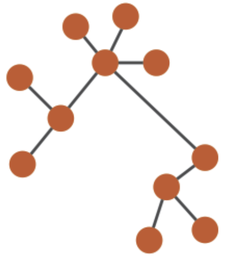
~22 min

Arrange Networks and Trees

Node–Link Diagrams

Connection Marks

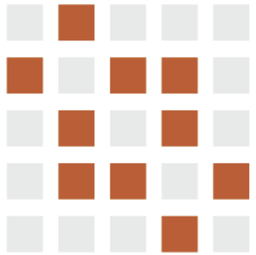
✔ NETWORKS ✔ TREES



Adjacency Matrix

Derived Table

✔ NETWORKS ✔ TREES



Enclosure

Containment Marks

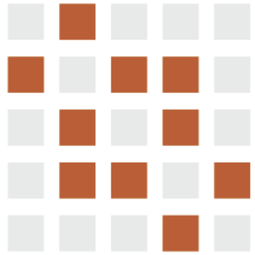
✘ NETWORKS ✔ TREES

"Treemap"

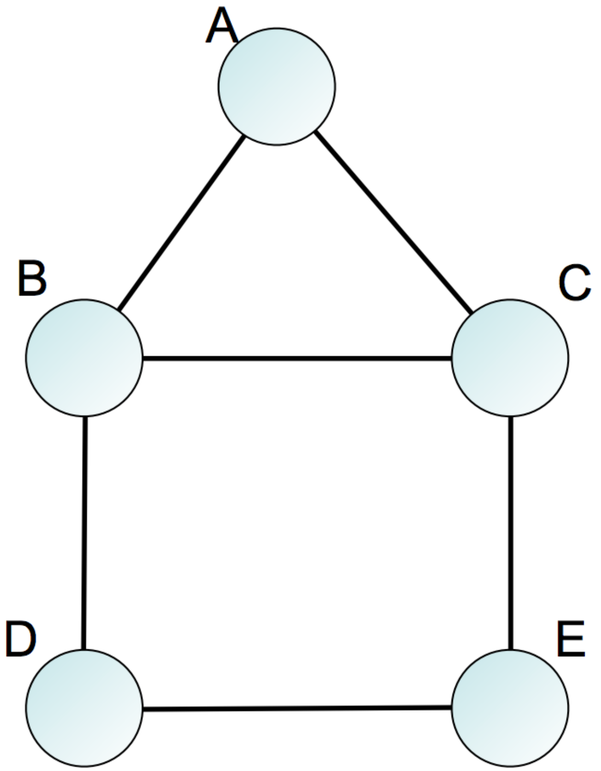
Adjacency Matrix

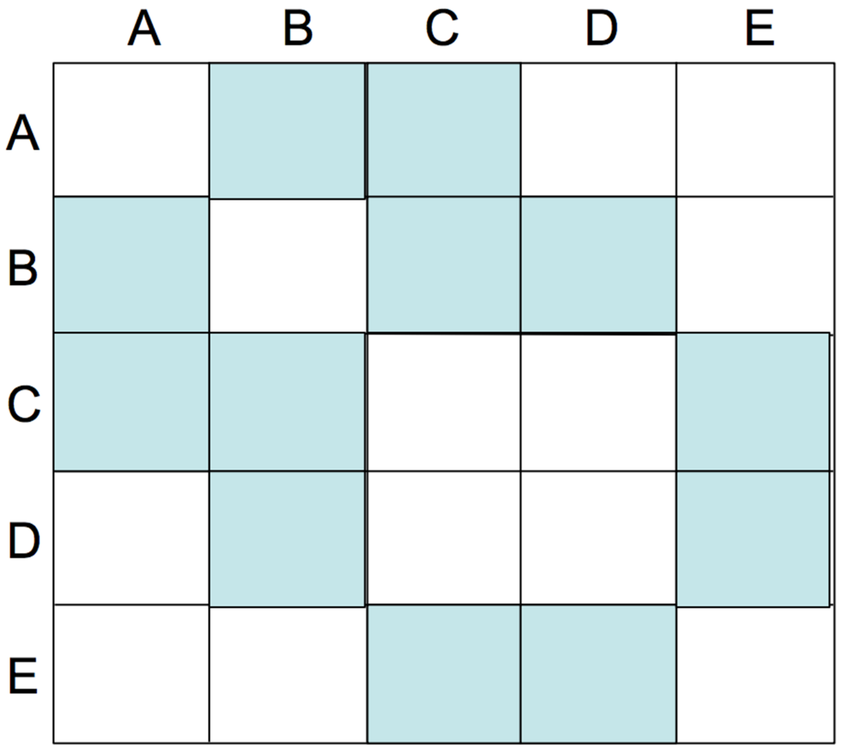
Derived Table

✔ NETWORKS ✔ TREES

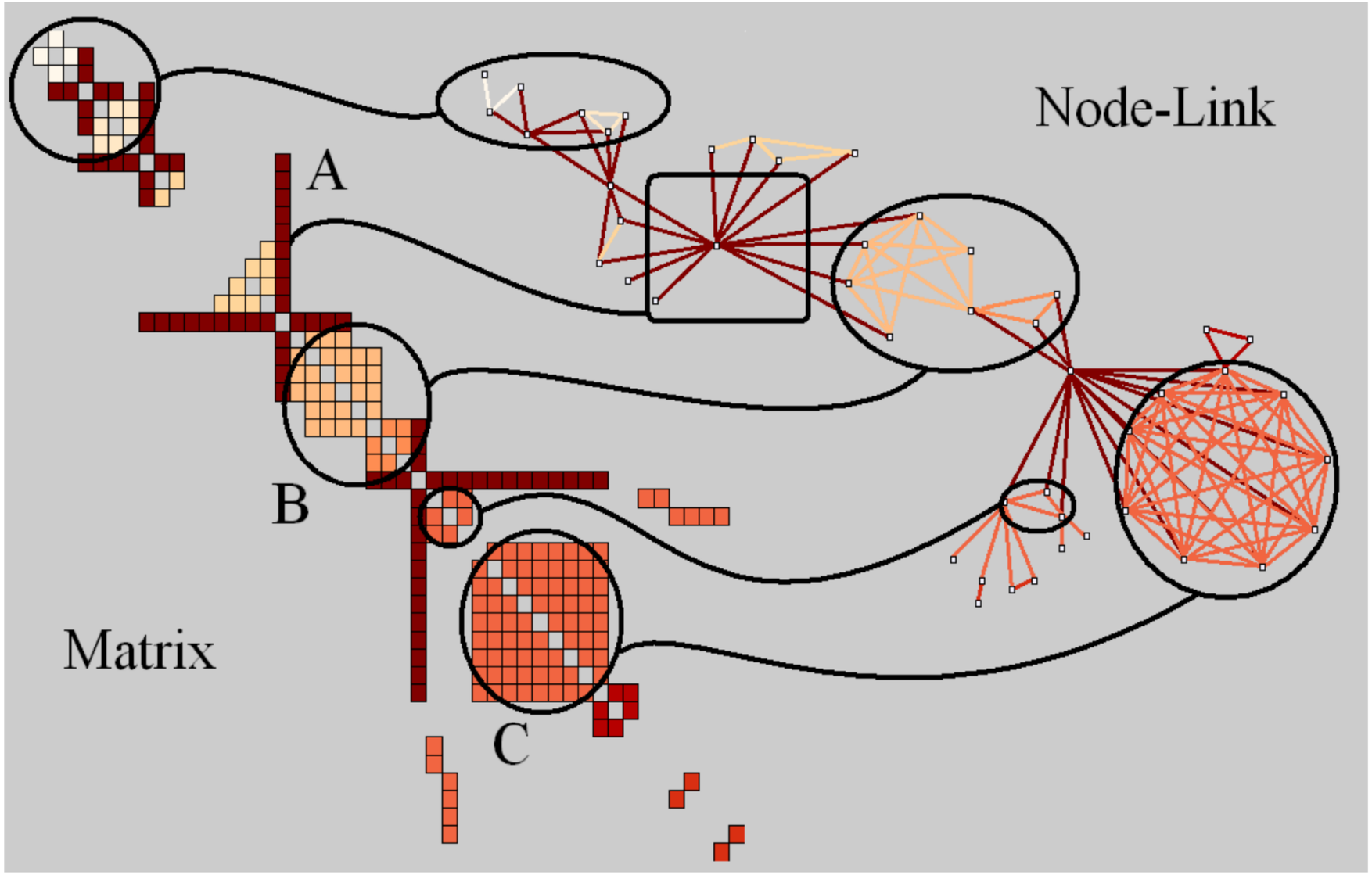


Alternate to node-link visualization for dense & weighted networks





Adjacency Matrix

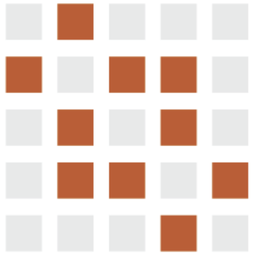


Henry & Fekete (2006)

Adjacency Matrix

Derived Table

✔ NETWORKS ✔ TREES



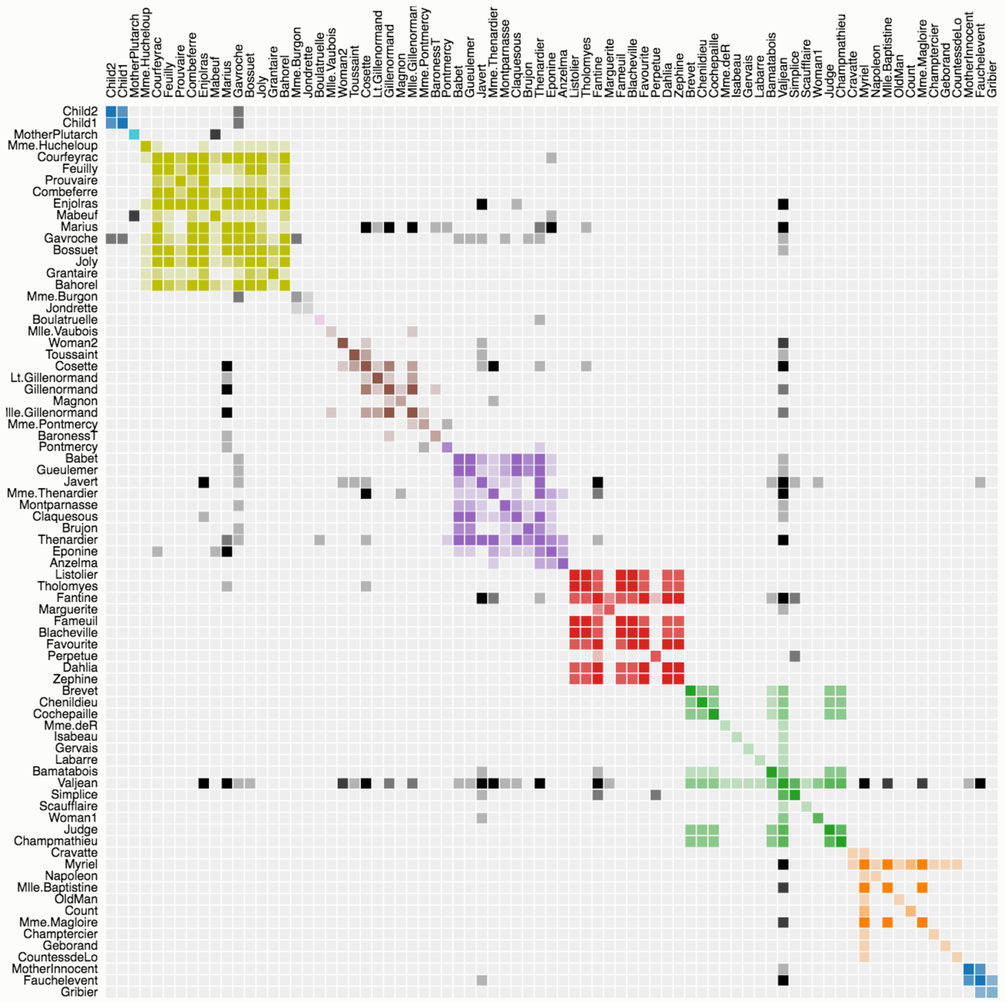
Pros:

- great for dense graphs
- visually scalable
- can spot clusters

Cons:

- **row order affects what you can see**
- abstract visualization
- hard to follow paths

Les Misérables Co-occurrence



Source: The Stanford GraphBase.

Order: by Cluster

This matrix diagram visualizes character co-occurrences in Victor Hugo's *Les Misérables*.

Each colored cell represents two characters that appeared in the same chapter; darker cells indicate characters that co-occurred more frequently.

Use the drop-down menu to reorder the matrix and explore the data.

Built with d3.js.

Previous Class

https://bost.ocks.org/mike/miserables/

WDA-LS clustered co-occurrence

Use the drop-down menu to reorder the matrix and explore the data.

When ordered by cluster, rows and columns are clustered by affinity values using hierarchical agglomerative clustering.
Distance measure: Euclidean.
Linkage technique: Single.

Rows and columns are then arranged using leaf reordering using the algorithm from: Sakai, Ryo, et al. "Dendsort: modular leaf ordering methods for dendrogram representations in R." F1000Research 3 (2014).

Cell labels show count and color shows normalized affinity.

Cody Dunne and Tim Stutts, IBM Watson Health Cognitive Visualization Lab

---

Dataset: genes/genes Medline (example) ▾ Edge List

Order: by Cluster ▾

The query was for genes related to the genes SOX9, TCF7L1, SMAD4, PIK3CA, KRAS in Medline.

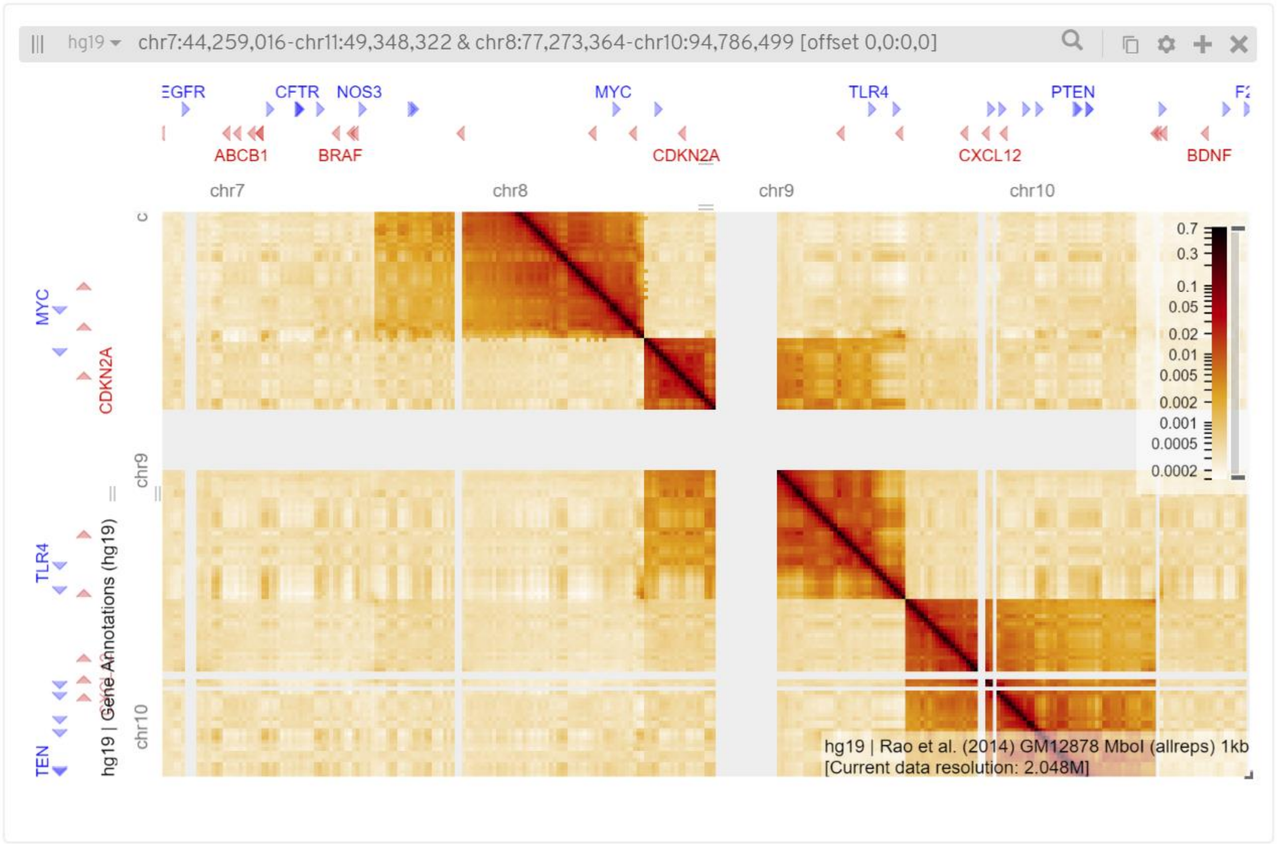
	SOX9	TCF7L1	SMAD4	KRAS	PIK3CA
tp53	33	4	406	1295	726
apc	10	1	106	255	91
kras	10	1	166	11277	926
nras	0	0	20	878	269
hras	0	0	9	659	107
f2	2	0	5	407	0
raf1	3	1	12	760	266
alk	0	0	11	339	126
ns2	0	0	0	228	0
sos1	0	0	0	286	8
hspb3	0	0	4	279	9
ptpn11	0	0	6	192	21
cd8a	4	0	7	190	25
cd4	0	0	11	152	34
ifng	0	0	14	118	12
myc	18	1	50	278	80
mlh1	0	1	34	190	50
smad4	13	1	3052	166	53
smad2	21	1	828	12	12
smad3	20	0	658	6	12
smad7	5	0	281	0	0
smad1	17	0	262	0	6
tgfb1	23	0	230	16	7
inhbe	12	0	164	0	0
tgfbr2	5	0	123	22	6
cdkn2a	13	0	222	330	150

HiGlass About Examples Docs

HiGlass is a tool for exploring genomic contact matrices and tracks. Please take a look at the examples and documentation for a description of the ways that it can be configured to explore and compare contact matrices. To load private data, HiGlass can be run locally within a Docker container. The HiC data in the examples below is from Rao et al. (2014) [2].

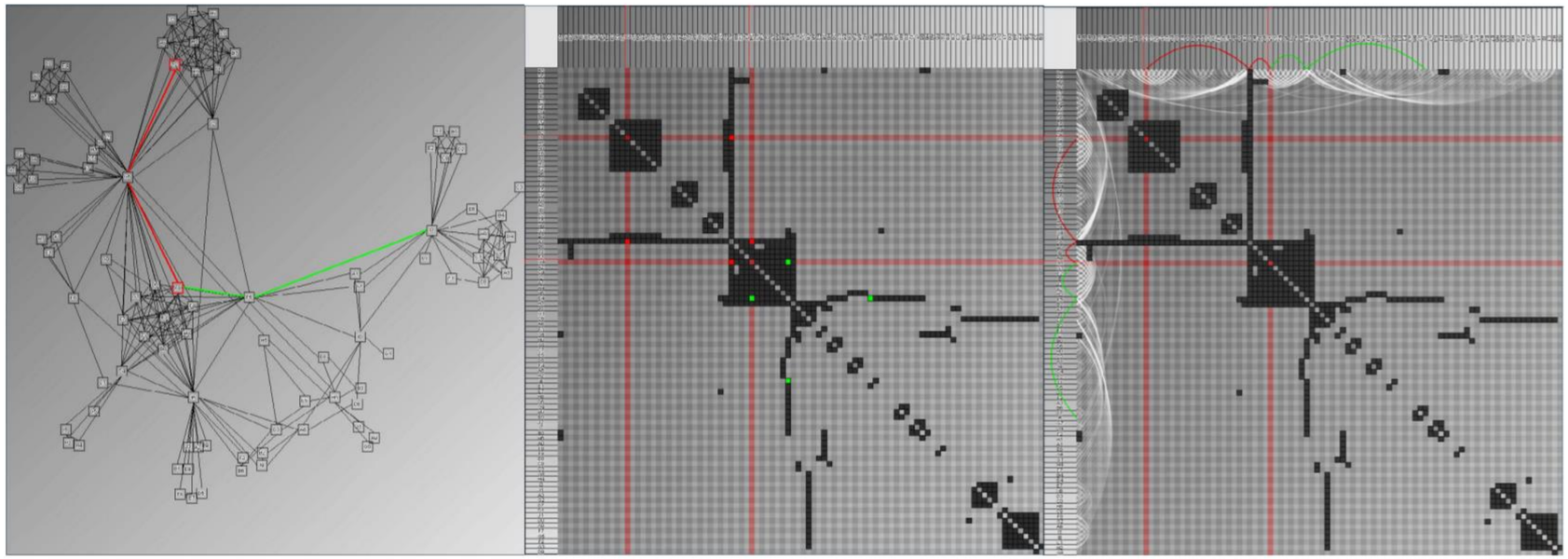
A preprint of the paper describing HiGlass is available on bioRxiv [1].

Single View

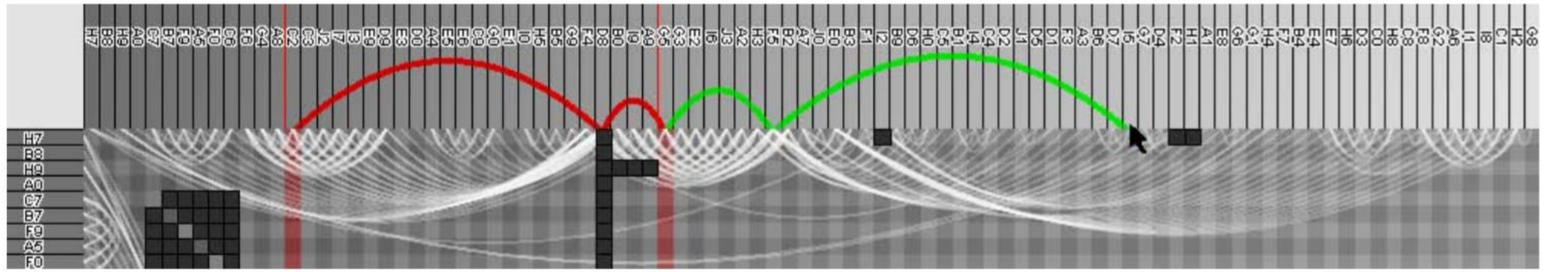


http://higlass.io/

MatLink



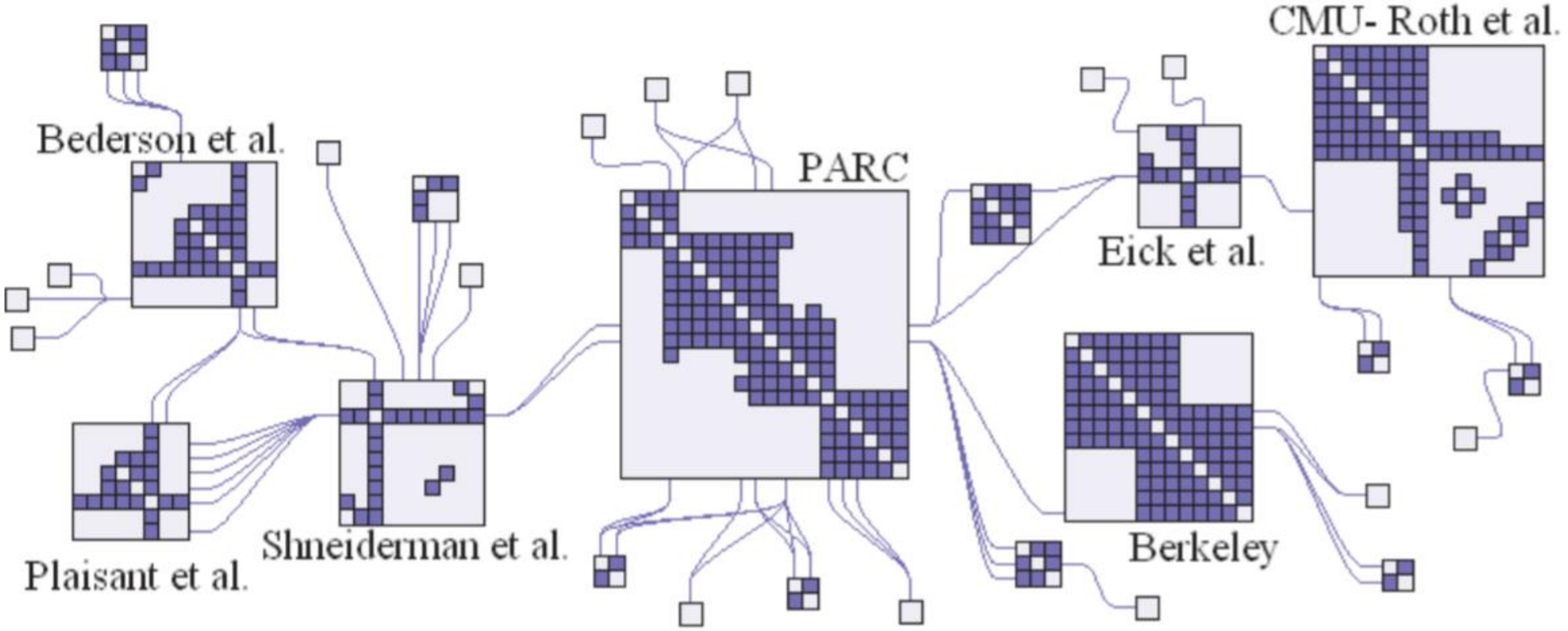
(a) Node-Link(NL) **(b)** Matrix(MAT) **(c)** MatLink



(d) Zoom on MatLink

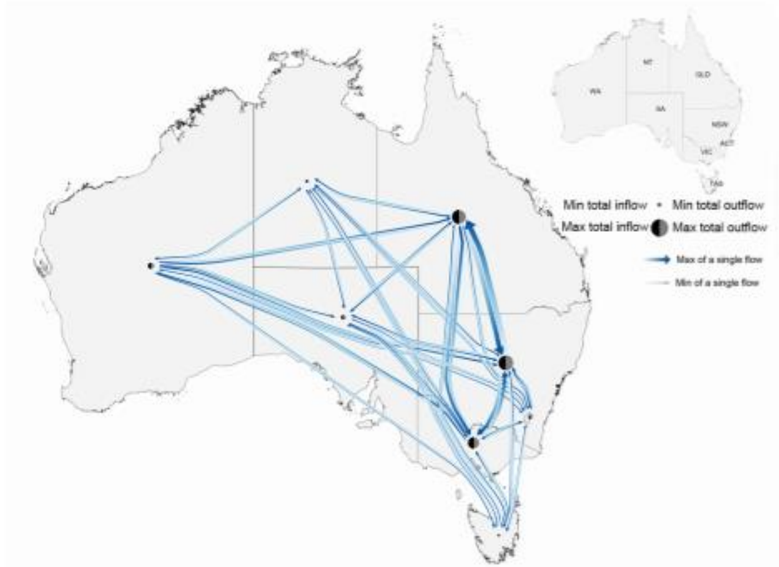
Henry & Fekete, 2007

NodeTrix

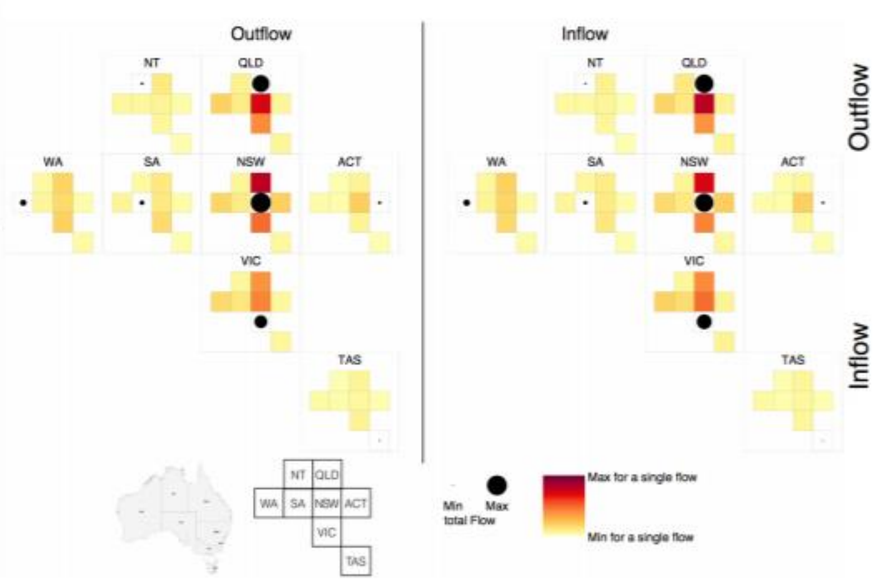


Henry et al, 2007

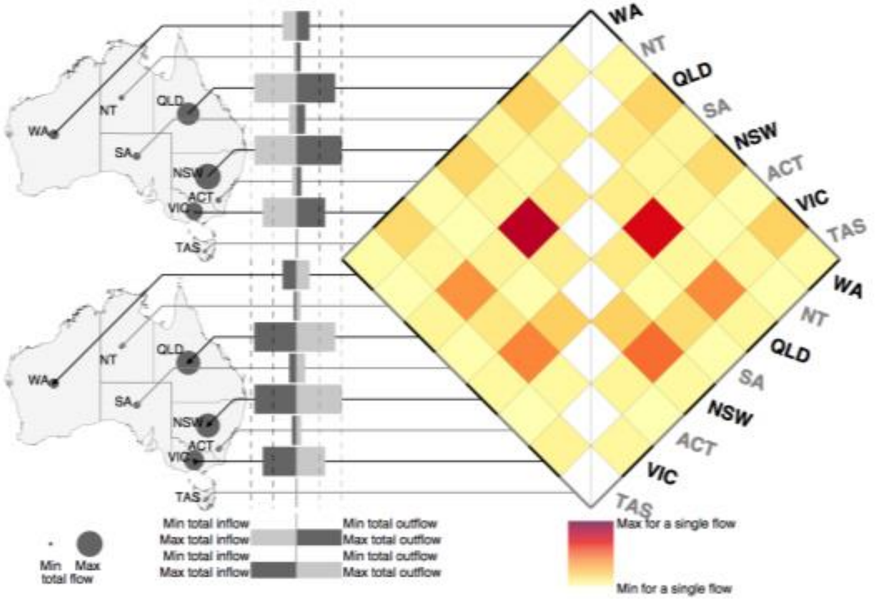
MapTrix



(a) Bundled Flow Map



(b) OD Map

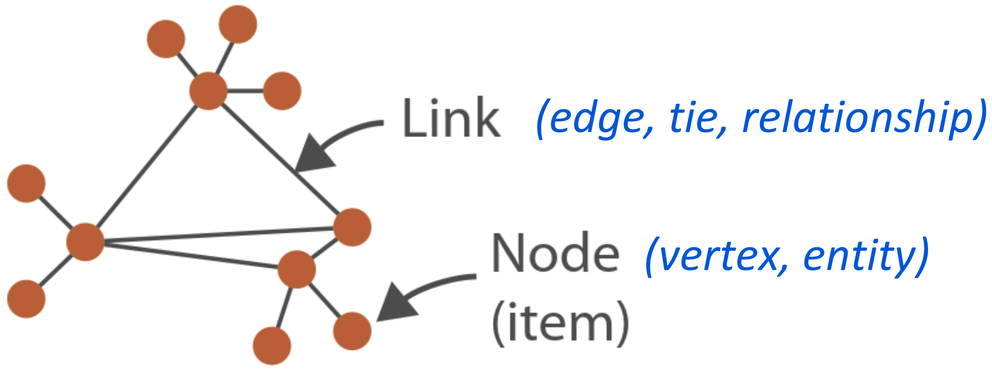


(c) MapTrix

https://vimeo.com/182970812
https://vimeo.com/278433529

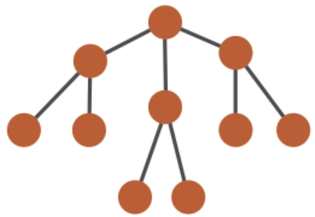
Yang et al., 2016; Demo

➔ Networks *(graphs)*



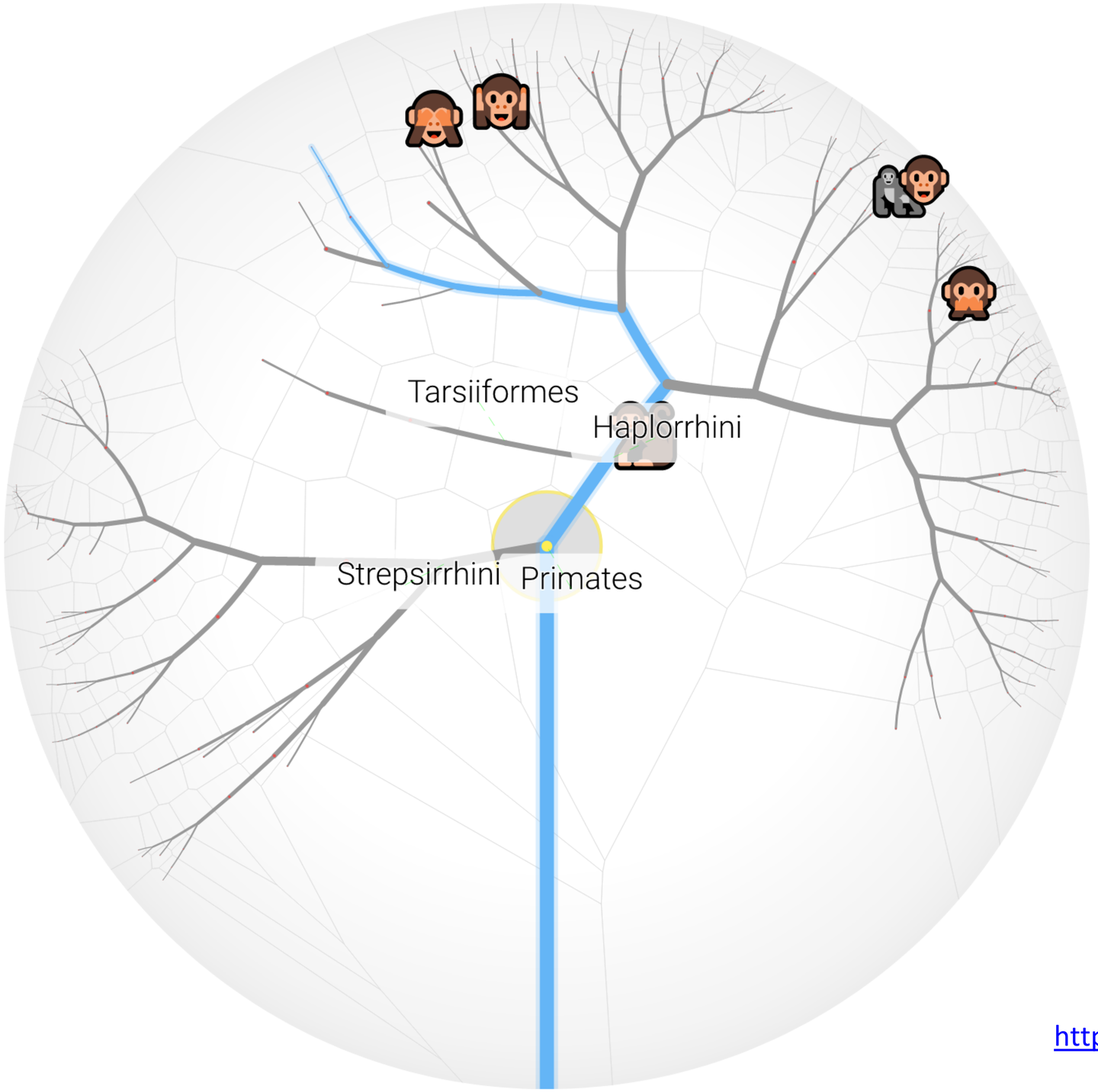
Network = entities and relationships between them

➔ *Trees*

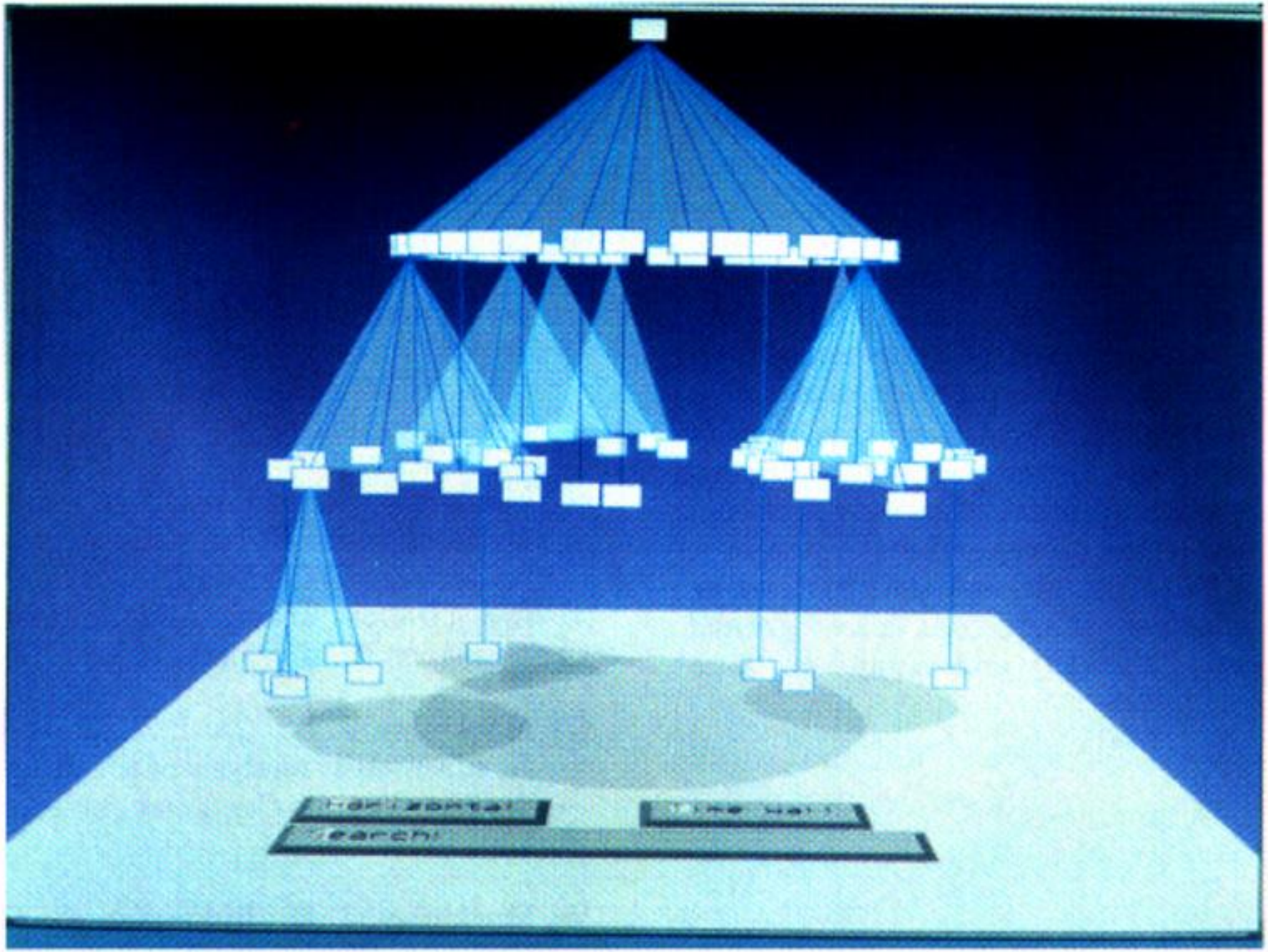


Tree = *undirected*, *connected*, *acyclic* network

Hyperbolic trees



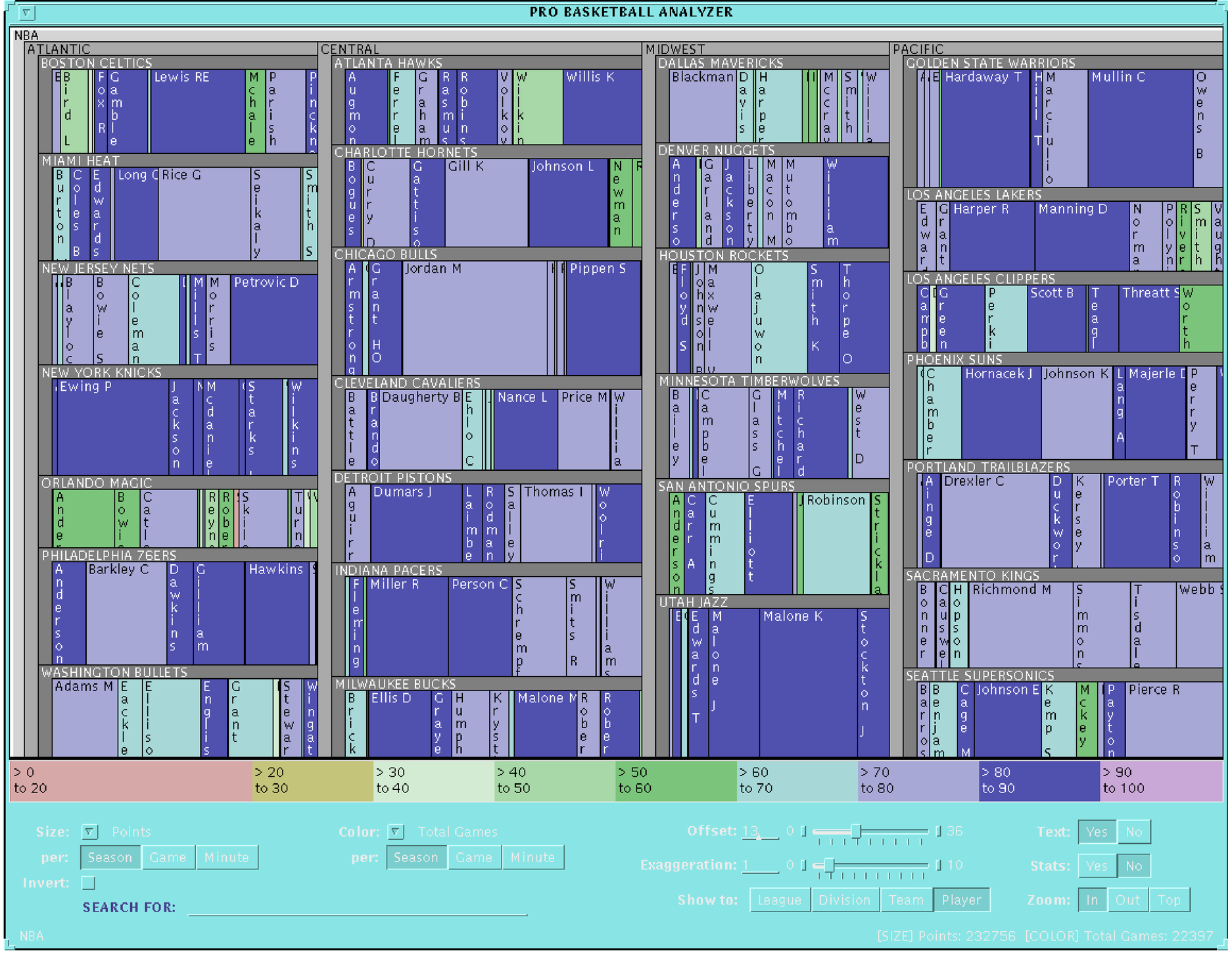
https://glouwa.github.io/d3-hypertree-examples/demo/



Cone Trees

Robertson et al., 1991

Slice and Dice Treemaps



Turo & Shneiderman, 1993

Cluster / Squarified Treemaps

[Wattenberg, 1999](); [Bruls et al., 2000](); [finviz live site](); Snapshot: [finviz, 2020]()

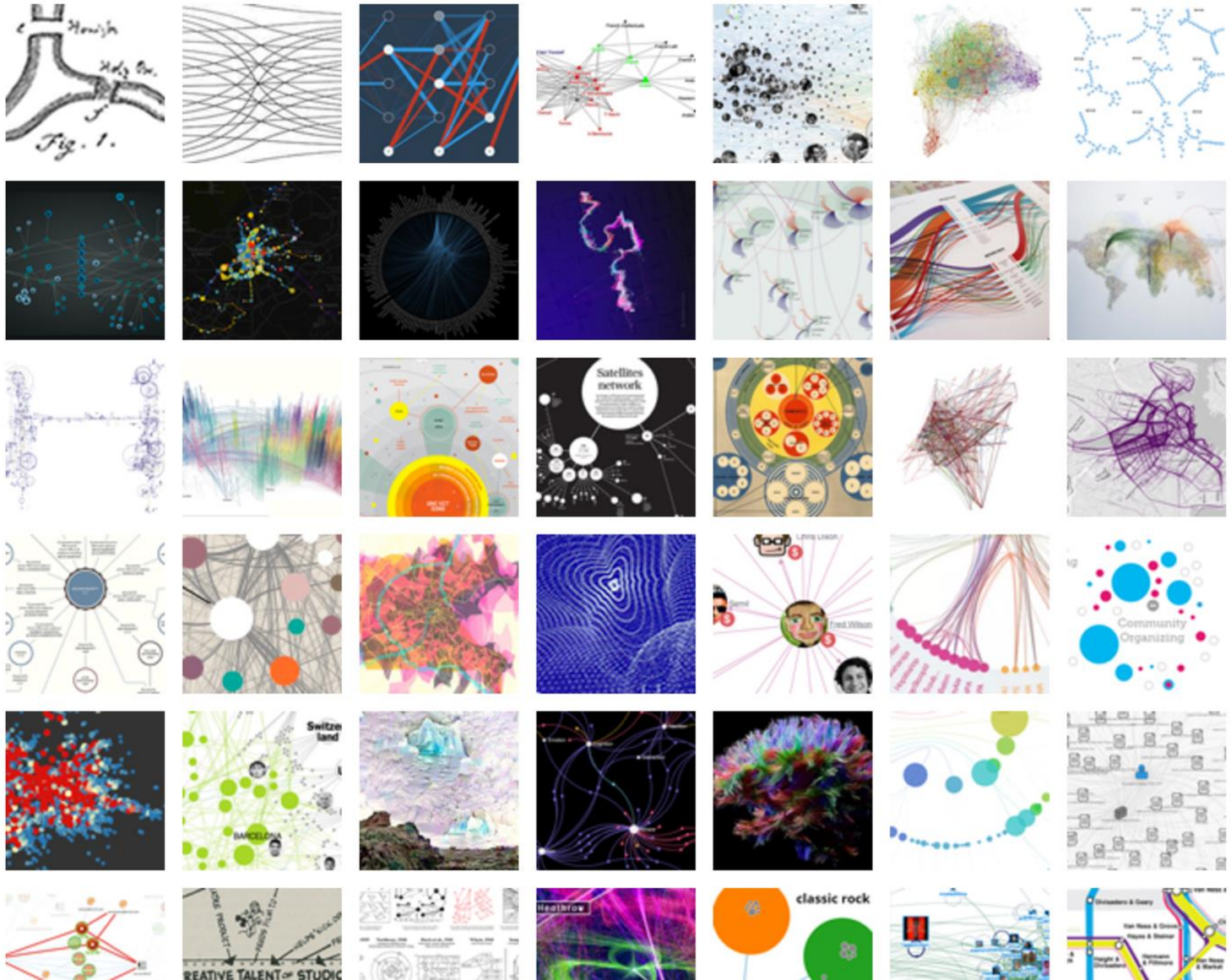
visual complexity

Search the VC database:

GO

Latest Projects:

Indexing **1000** projects

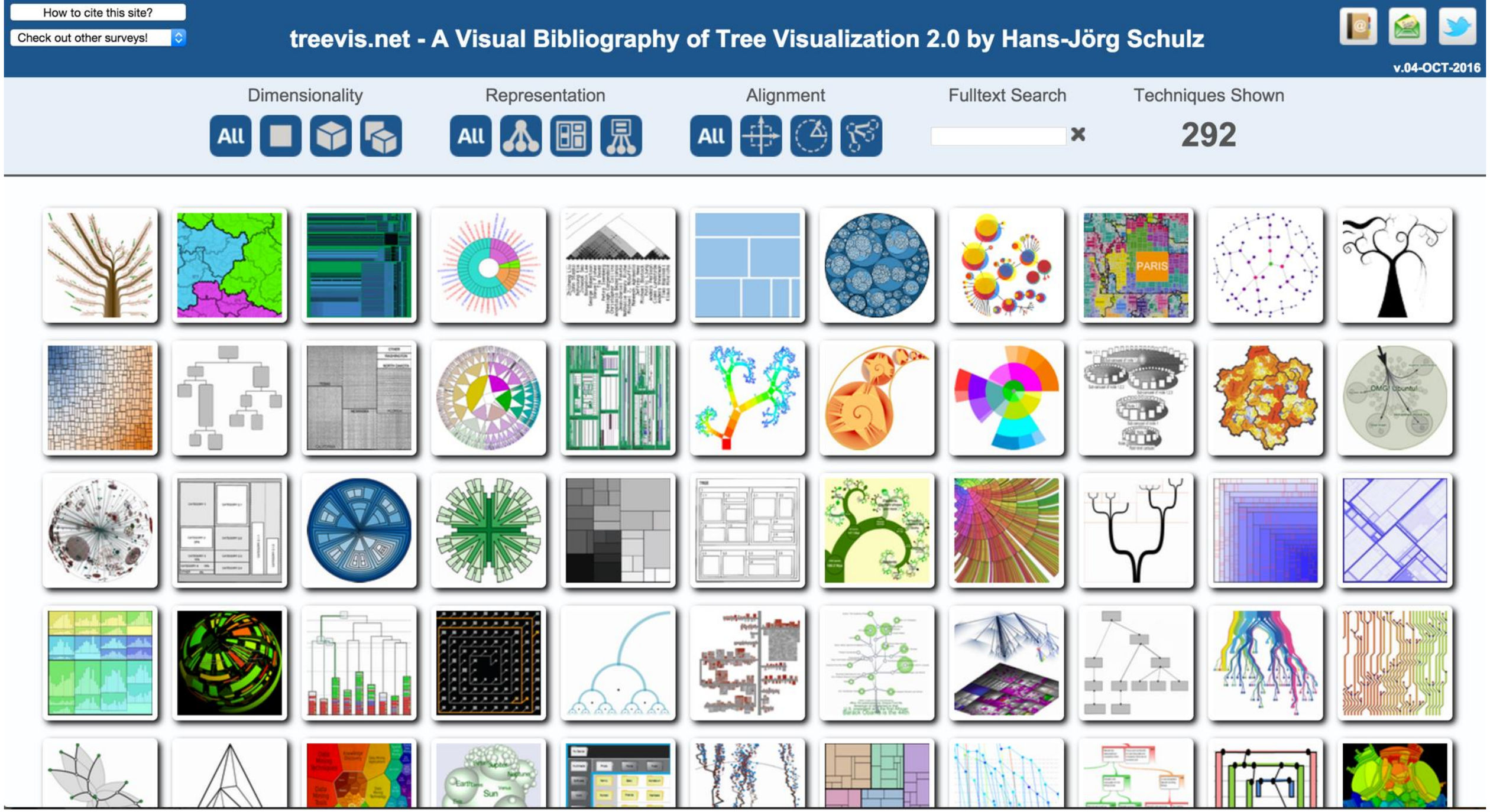


Filter by: SUBJECT

- Art (74)
- Biology (60)
- Business Networks (50)
- Computer Systems (39)
- Food Webs (16)
- Internet (35)
- Knowledge Networks (141)
- Multi-Domain Representation (70)
- Music (47)
- Others (77)
- Pattern Recognition (53)
- Political Networks (34)
- Semantic Networks (44)
- Social Networks (135)
- Transportation Networks (70)
- World Wide Web (55)

See All (1000)

Lima, 2005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treevis.net - A Visual Bibliography of Tree Visualization 2.0 by Hans-Jörg Schulz
v.04-OCT-2016
Dimensionality
All
Representation
All
Alignment
All
Fulltext Search
Techniques Shown
292
PARIS

PREVIOUSLY, ON CS 7250…

IN-CLASS EXERCISE

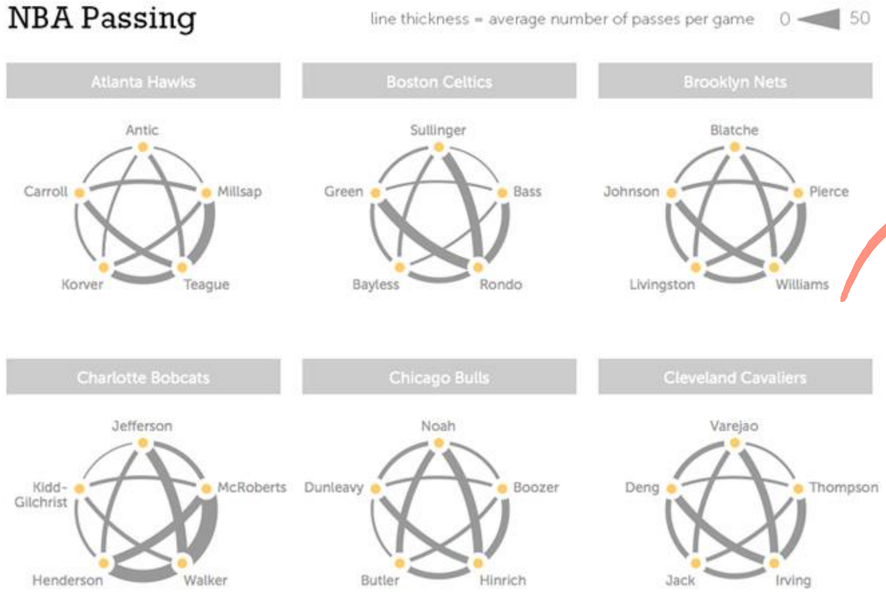
NBA Passing

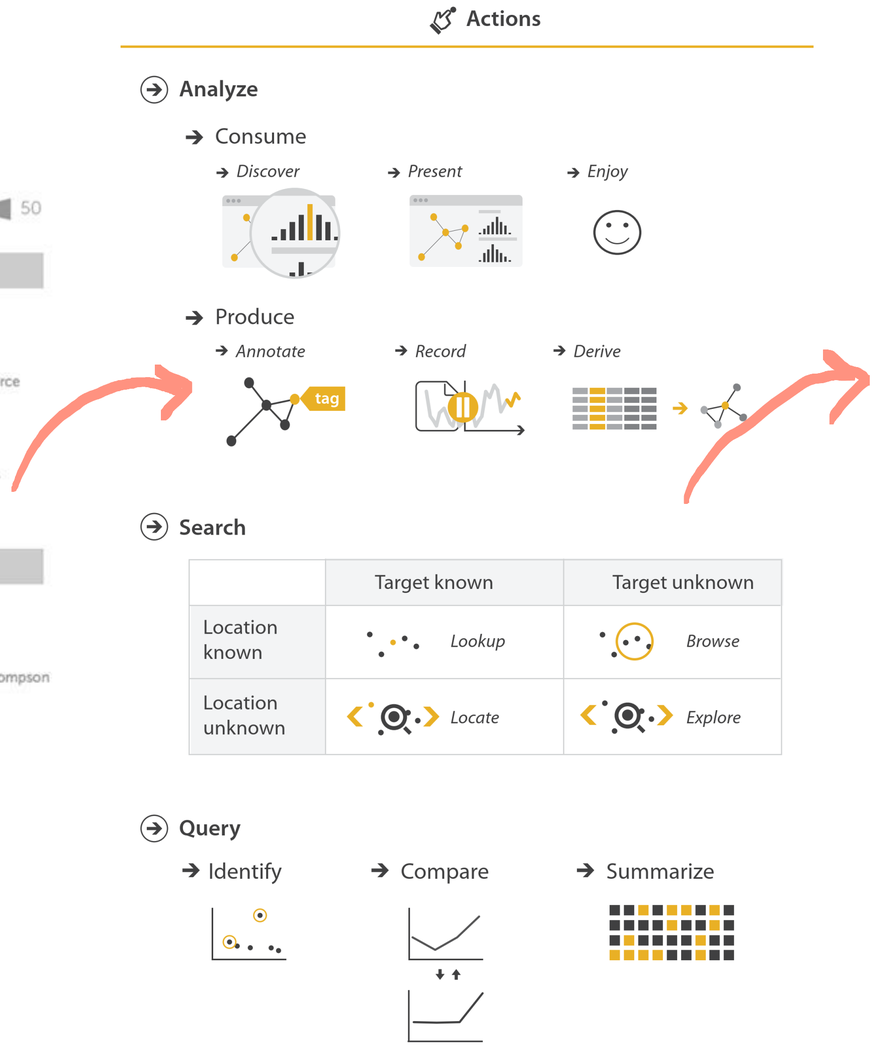
line thickness = average number of passes per game 0 50

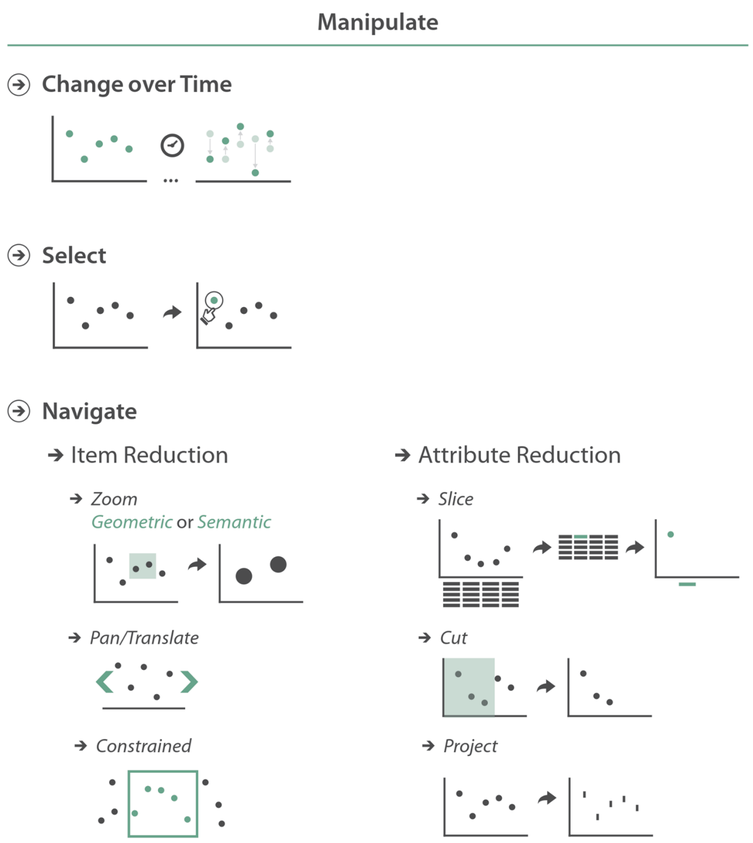
Now, on CS 7250…

In-Class Design — Interactive/Animated NBA Passing

~~38min~~ 23min remaining







Upcoming Assignments & Communication

Look at the upcoming assignments and deadlines regularly!

- Textbook, Readings, & Reading Quizzes — Variable days
- In-Class Activities — 11:59pm same day as class
  T: In-Class Project Feedback Meetings & Work, F: Lecture, T: Lecture/TBD
- Assignments & Projects— Generally due R 11:59pm
  R (6 days):
  Project 6 — Sprint 1
  Next-Next R (13 days):
  Project 7 — Sprint 2 & Paper Draft

Use Canvas Discussions for general questions, email the TAs/S-LTA/instructor for questions specific to you: codydunne-and-tas@ccs.neu.edu. Include links!

If you're emailing about a particular assignment, please **include the URL of the Submission Details page**. (Canvas documentation.)

If you have a project question, **give us your group number**. E.g., include: `Group ## — Topic` with '##' replaced by your group number and 'Topic' replaced by your topic.