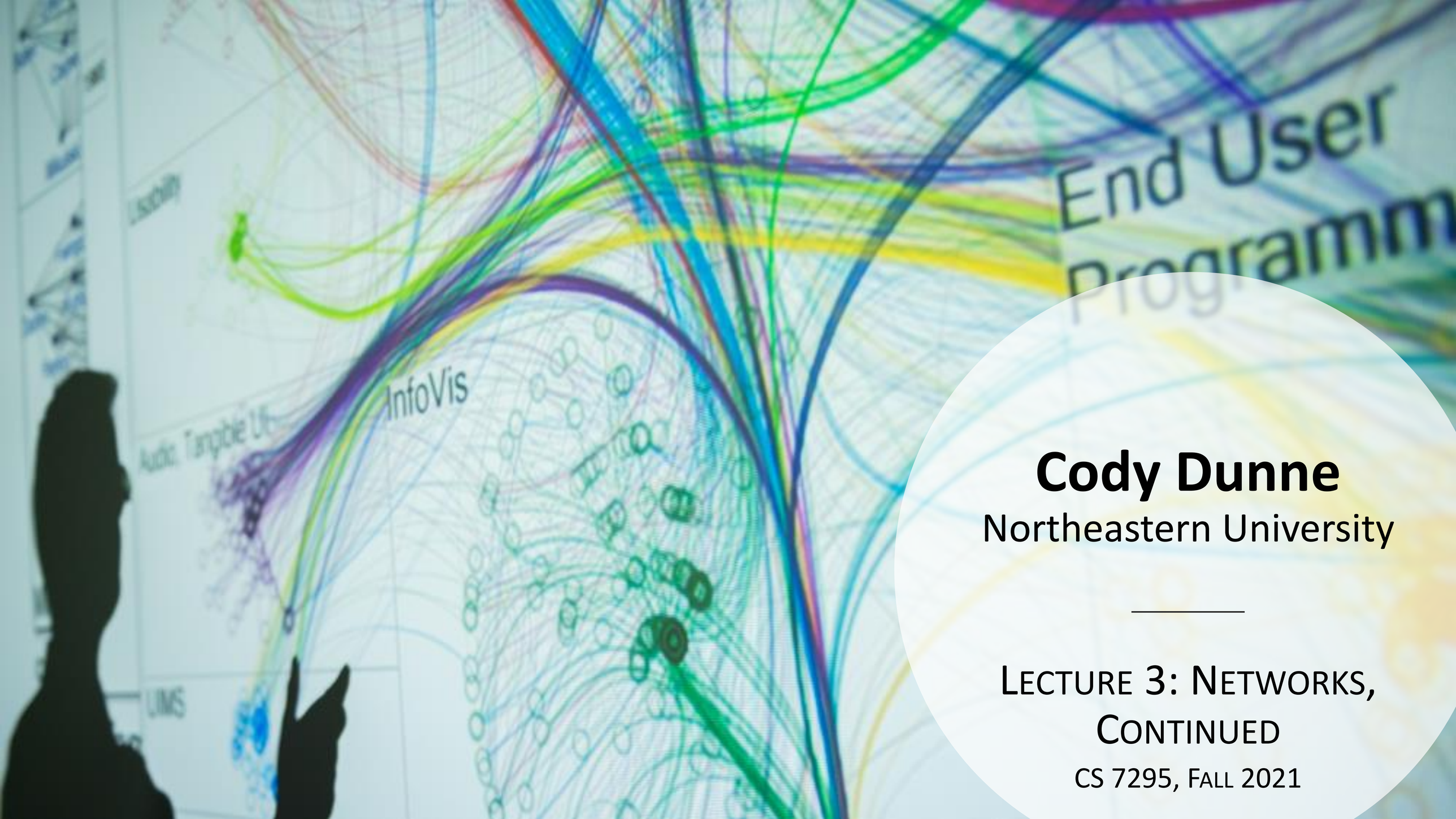


Cody Dunne
Northeastern University

Lecture 3: Networks, Continued

CS 7295, Fall 2021

Course Homepage on Canvas

https://c.dunne.dev/cs7295f21/

(project details + assignments to be added)

Feel free to interrupt with questions!

Plan for Today

Discuss:

- Marks and channels
- Node-link visualizations + encodings
- Force-directed general layouts
- Layered layouts

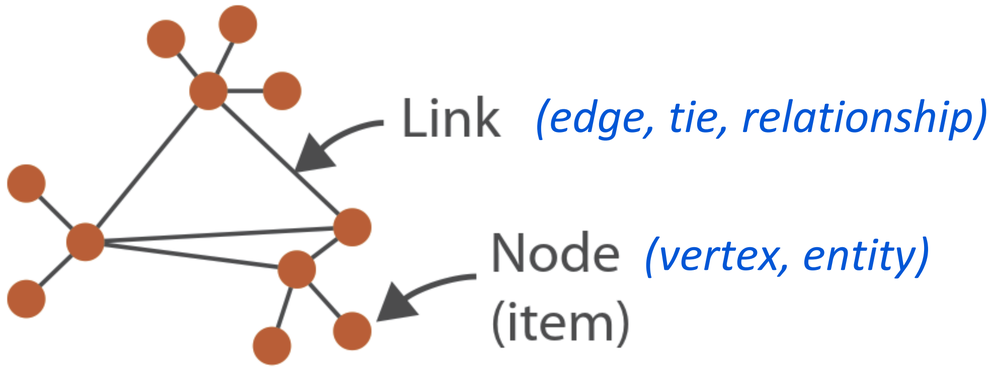
For next time:

- Discussion lead 1 — Topic Areas
- Assignment 1 — Read the Syllabus

Checking In

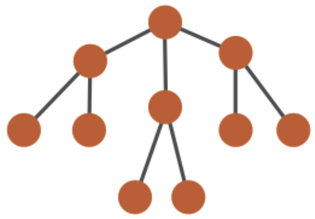
PREVIOUSLY, ON CS 7295…

➔ Networks *(graphs)*



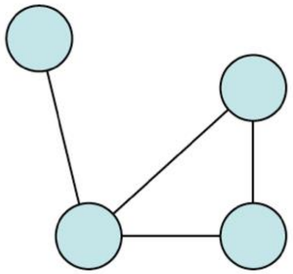
Network = entities and relationships between them

➔ *Trees*

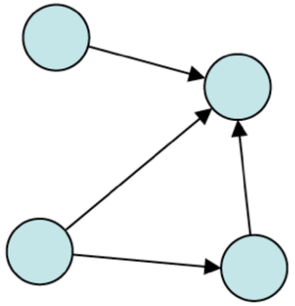


Tree = *undirected*, *connected*, *acyclic* network

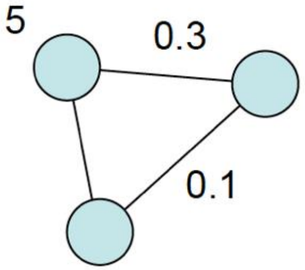
A bunch of definitions



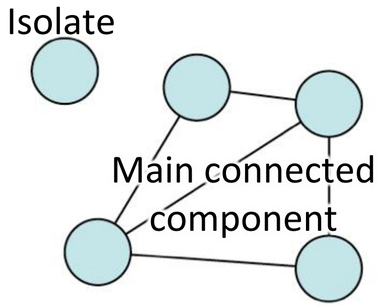
An undirected graph



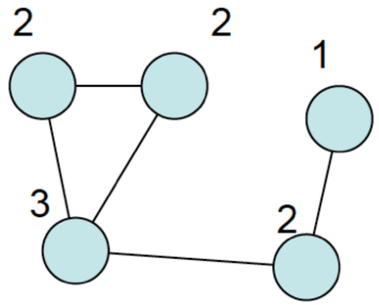
A directed graph



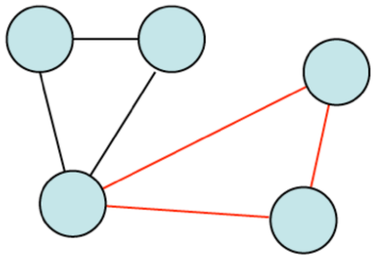
Weighted



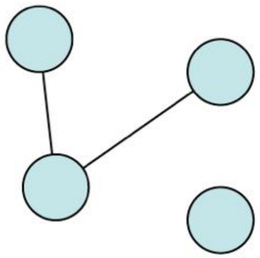
Unconnected



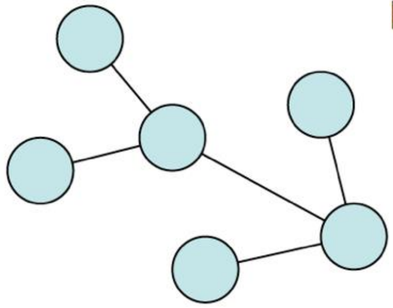
Node degrees



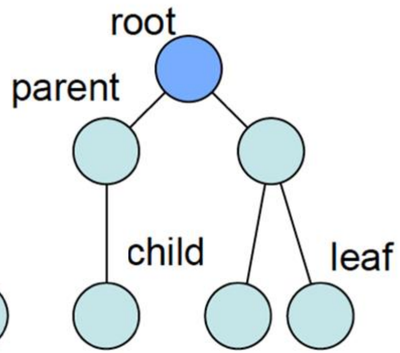
A cycle



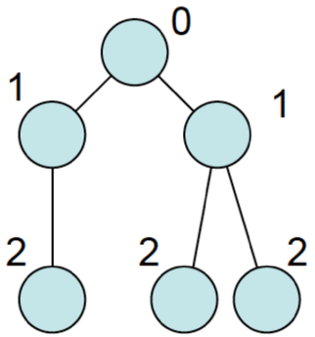
An acyclic graph



A connected acyclic graph, a.k.a. a **tree**



A rooted tree or hierarchy

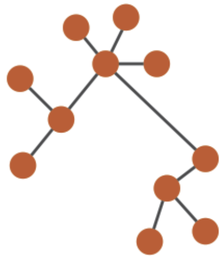


Node depths

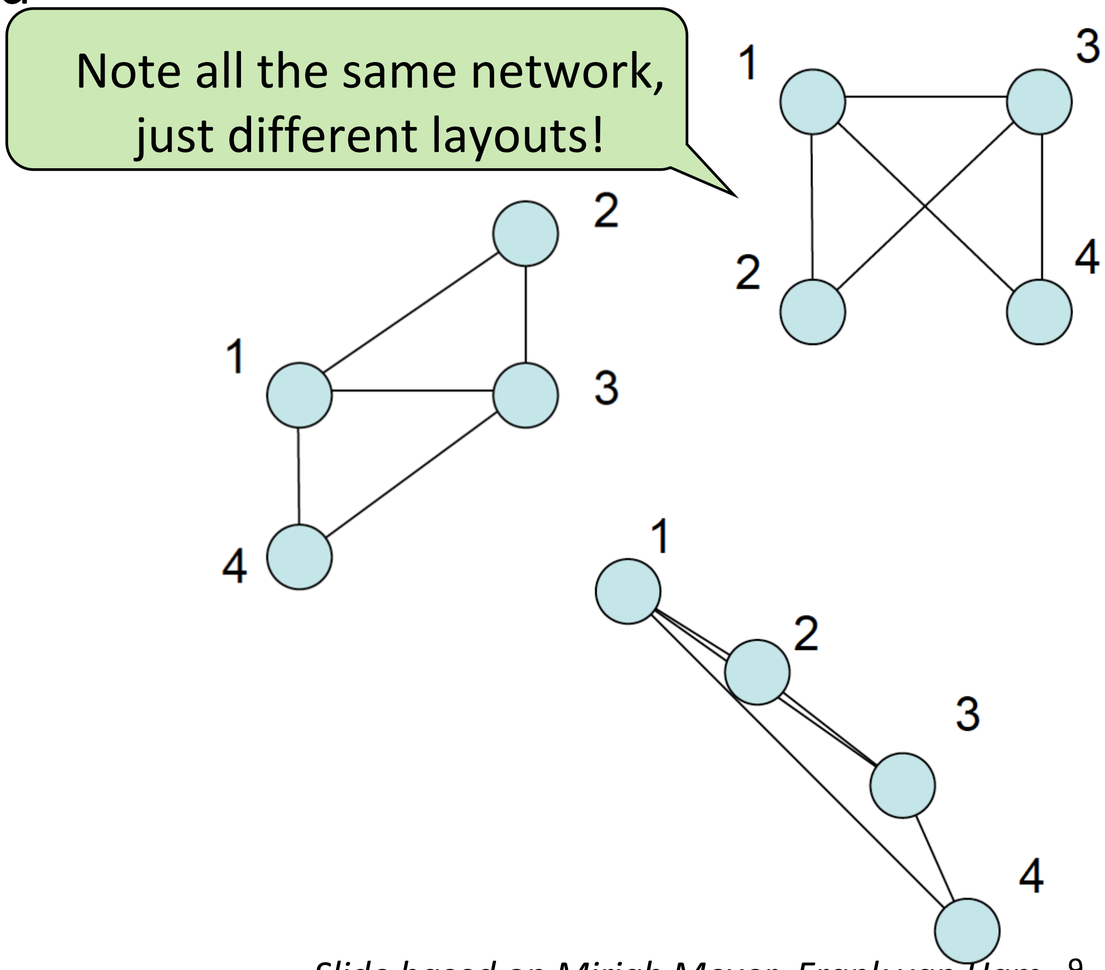
Node–Link Diagrams

Connection Marks

✔ NETWORKS ✔ TREES



- Primary concern is the *spatial layout* of nodes and edges, a.k.a. *graph drawing*
- The goal is often to effectively depict the graph structure for *topology-based tasks*:
  - connectivity, path-following
  - network distance
  - clustering
  - ordering (e.g., hierarchy level)
- But not always topology-based tasks. E.g., understanding attributes, statistics, metrics



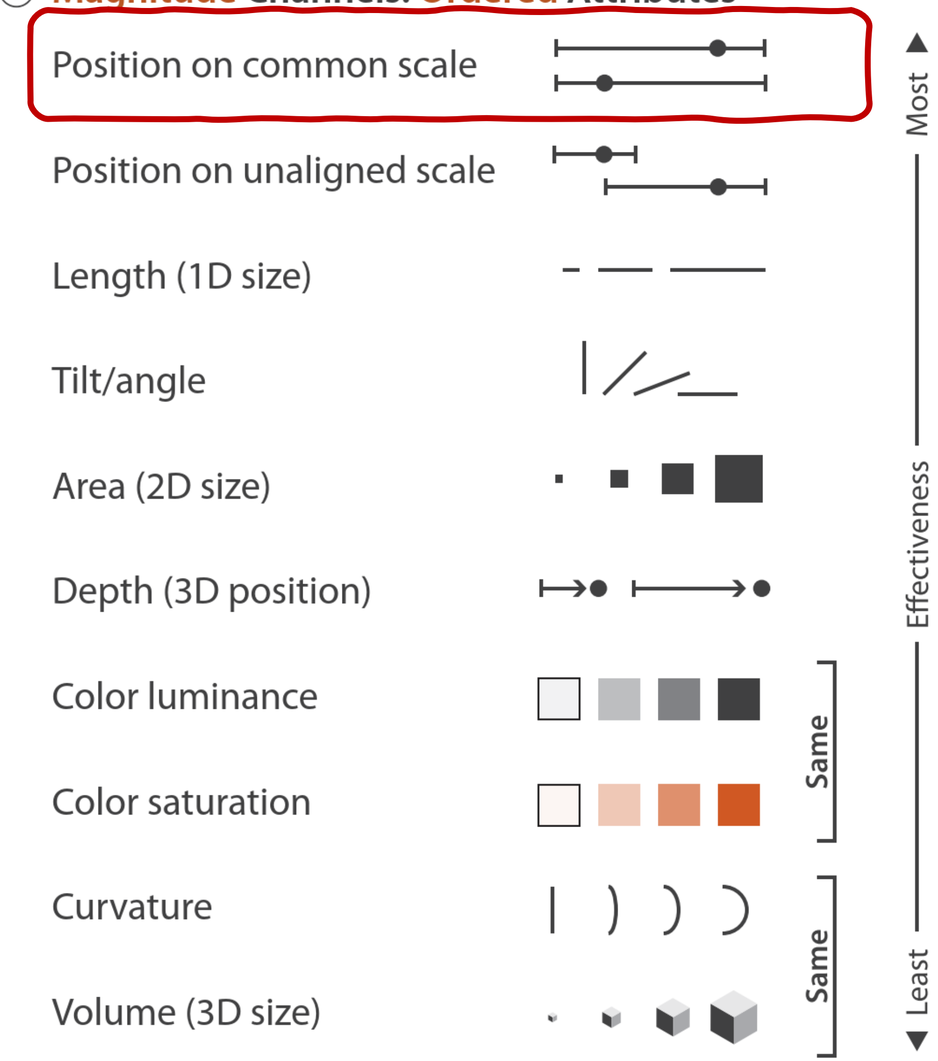
Slide based on Miriah Meyer, Frank van Ham

Now, on CS 7295…

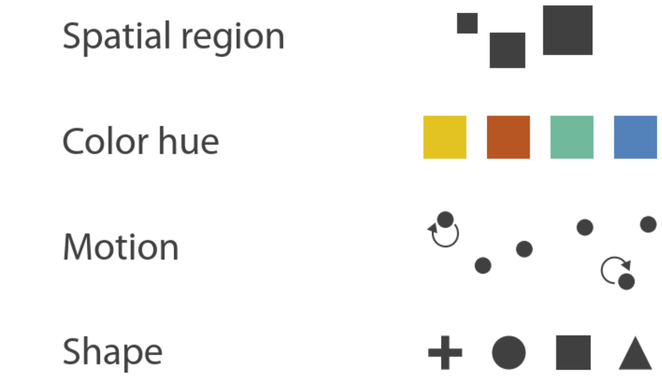
Spatial Layout

Channels: Expressiveness Types and Effectiveness Ranks

Magnitude Channels: Ordered Attributes

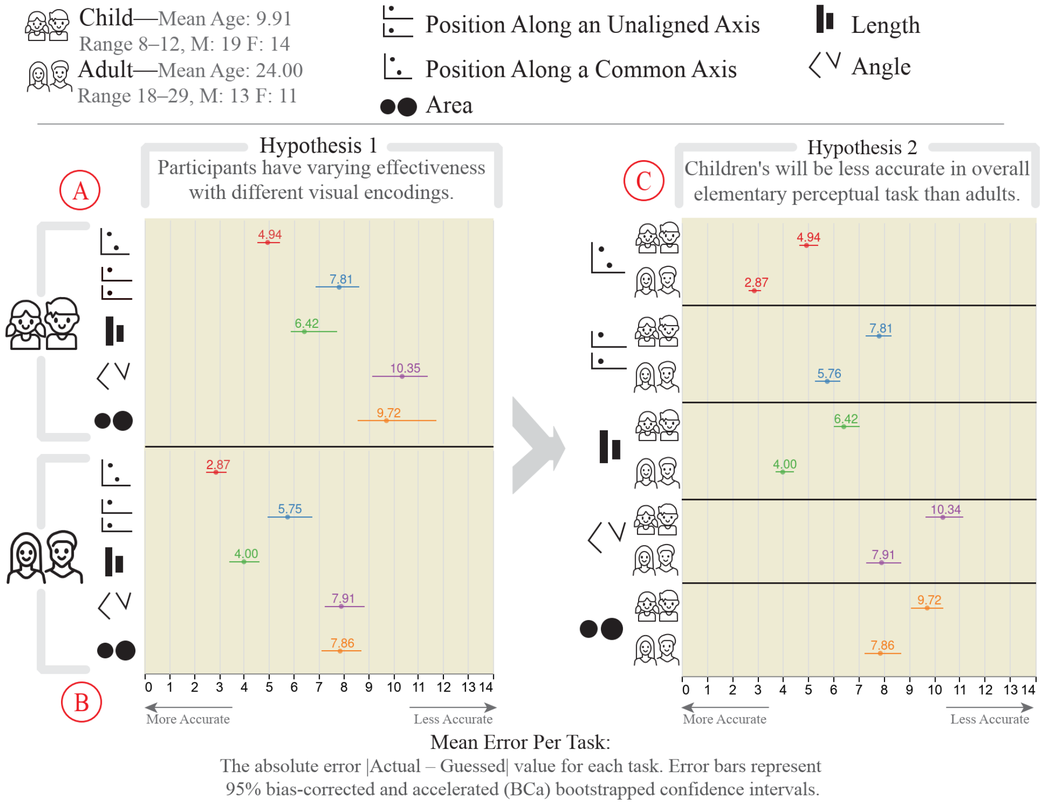


Identity Channels: Categorical Attributes



Munzer, 2014. See also:
Cleveland & McGill, 1984
Heer & Bostock, 2010
Mackinlay, 1986

Spatial Layout, Caveats



Mean Error Per Task:
The absolute error |Actual – Guessed| value for each task. Error bars represent 95% bias-corrected and accelerated (BCa) bootstrapped confidence intervals.

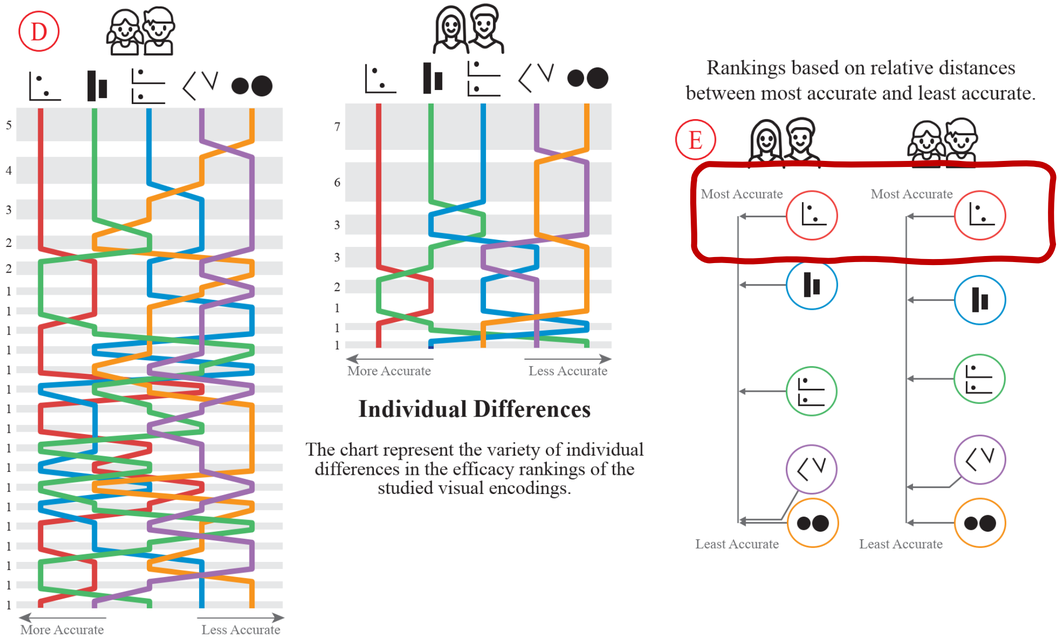


Fig. 5. Summative results for Hypothesis 1 and 2 and an exploratory analysis of individual differences in rankings. In Ⓐ, Ⓑ, and Ⓒ the error bars show 95% bias-corrected and accelerated (BCa) bootstrapped confidence intervals [23]. (A *rough* rule of thumb for reading 95% CIs is that if two intervals overlap by less than 1/4 of their average length, then the comparison will have $p < .05$ [22].) The mean absolute error for each encoding is shown in Ⓐ for children and Ⓑ for adults. In Ⓒ, the previous two charts are rearranged to compare children with adults. Children are clearly less accurate when using each of the encodings. The exploratory analysis included, Ⓓ, shows the variation in encoding rankings among individual children (left) and adults (right). Each line represents an encoding, ranked left-to-right in increasing mean absolute error for each task. The grey rows are sized to represent the count of individuals with a shared ranking. E.g,. the top row shows that 5 children ranked Position Along a Common Axis as most accurate, followed by Length, Position Along an Unaligned Axis, Angle, and lastly Area. The line-row intersections show the encoding ranking for that row. Children displayed a larger variety of individual differences in encoding rankings than adults. Finally, Ⓔ shows more simply the *overall* rankings we found for adults and children.

MARKS AND CHANNELS

Visualization Building Blocks

MARK = basic graphical element in an image

Visualization Building Blocks

CHANNEL = way to control the appearance of marks, independent of the dimensionality of the geometric primitive

Visualization Building Blocks

Marks as Items/Nodes

- Points
- Lines
- Areas

Marks as Links

- Containment
- Connection

Channels :

- Position
  - Horizontal
  - Vertical
  - Both

- Color

- Shape

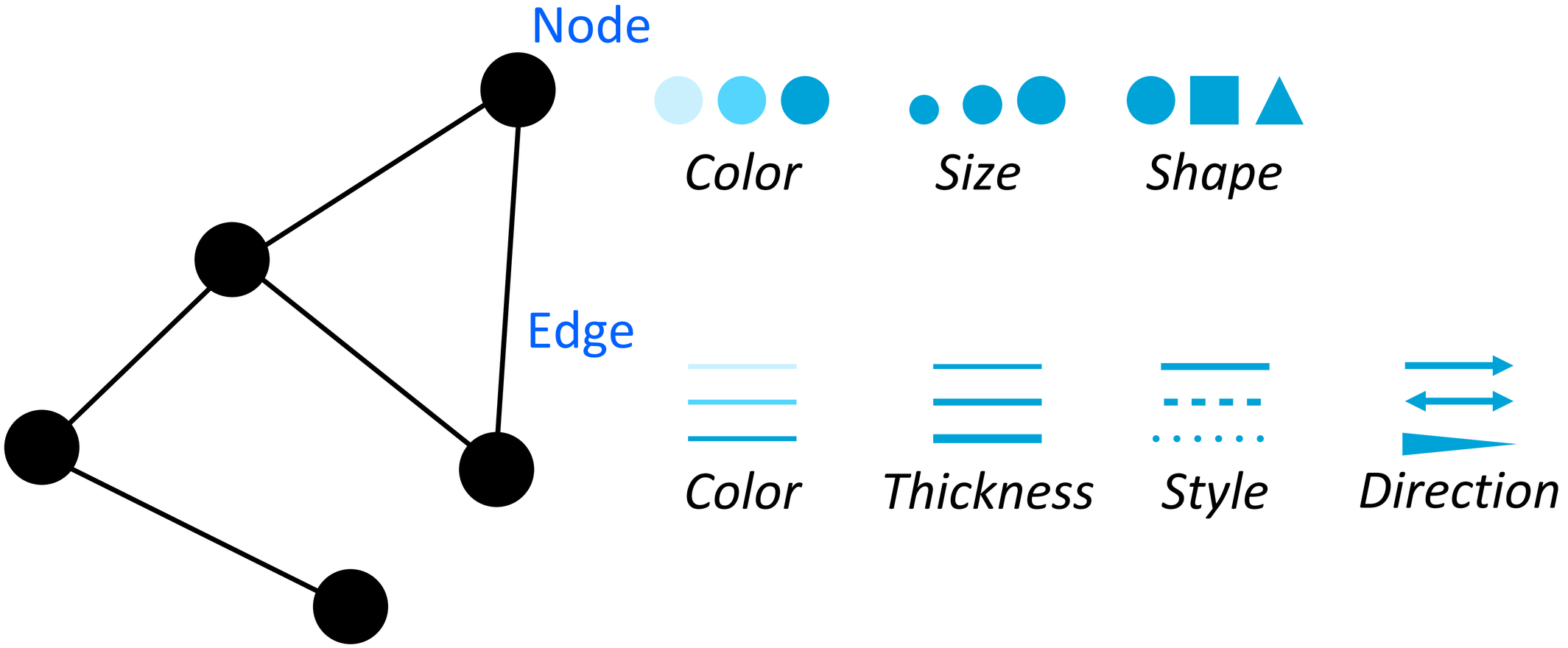
- Tilt

- Size
  - Length
  - Area
  - Volume

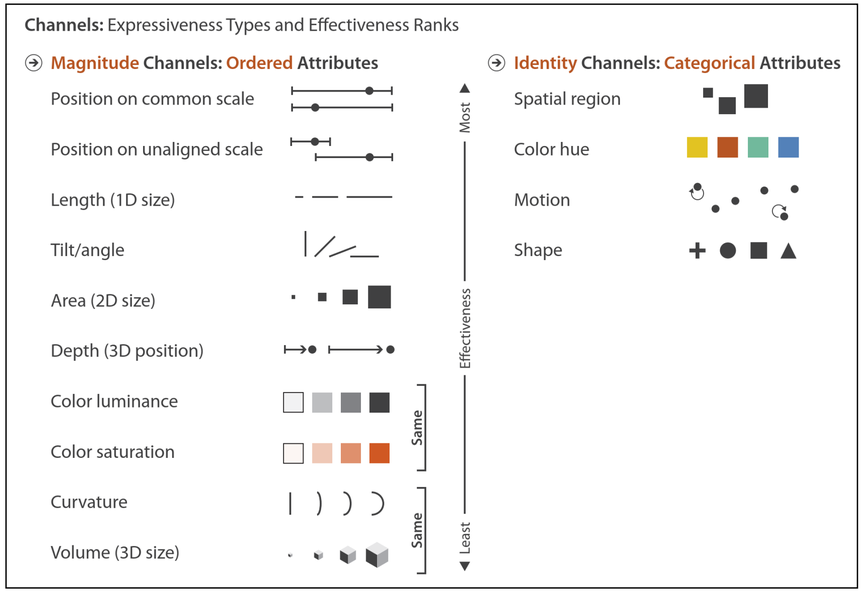
Note: these are all really important concepts when it comes time to coding your visualizations...!

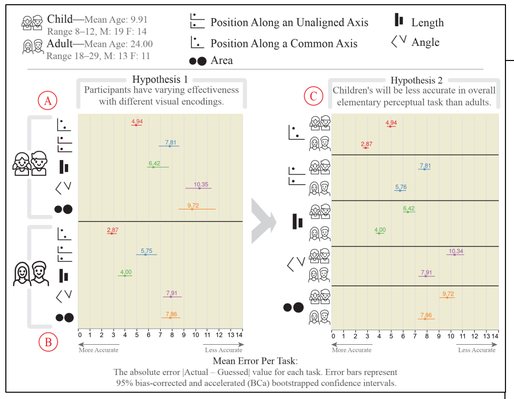
Networks

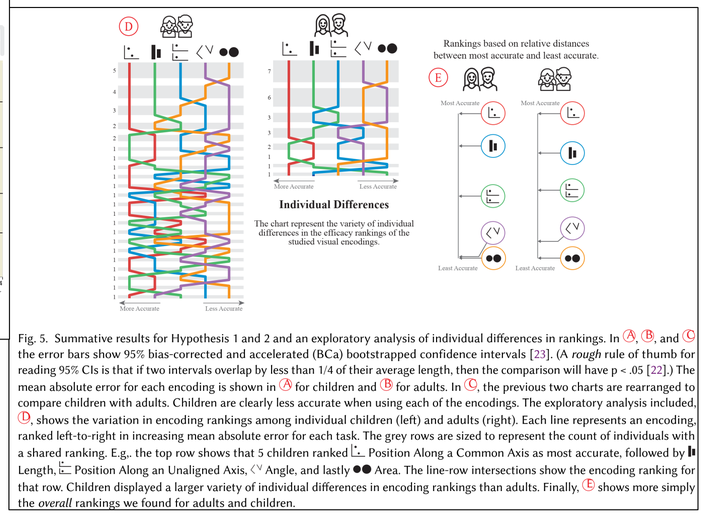
Marks & Channels



How to pick? User study results!







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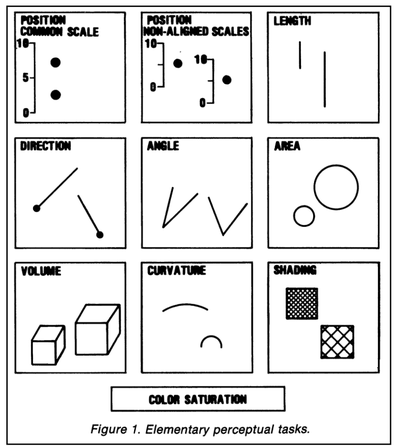


Figure 1. Elementary perceptual tasks.

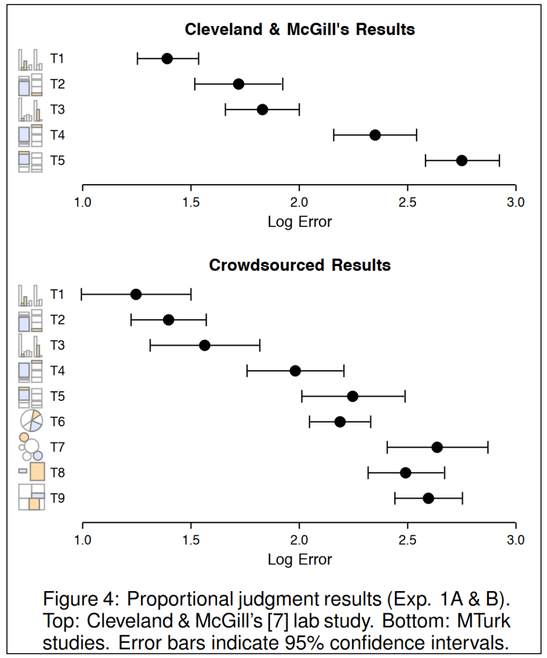


Figure 4: Proportional judgment results (Exp. 1A & B). Top: Cleveland & McGill's [7] lab study. Bottom: MTurk studies. Error bars indicate 95% confidence intervals.

[Munzer, 2014]
[Cleveland & McGill, 1984]
[Heer & Bostock, 2010]
[Mackinlay, 1986]
Panavas et al., 2021 (under submission)

An Extended Evaluation of the Readability of Tapered, Animated, and Textured Directed-Edge Representations in Node-Link Graphs

Danny Holten* Eindhoven University of Technology
Petra Isenberg† INRIA
Jarke J. van Wijk‡ Eindhoven University of Technology
Jean-Daniel Fekete§ INRIA

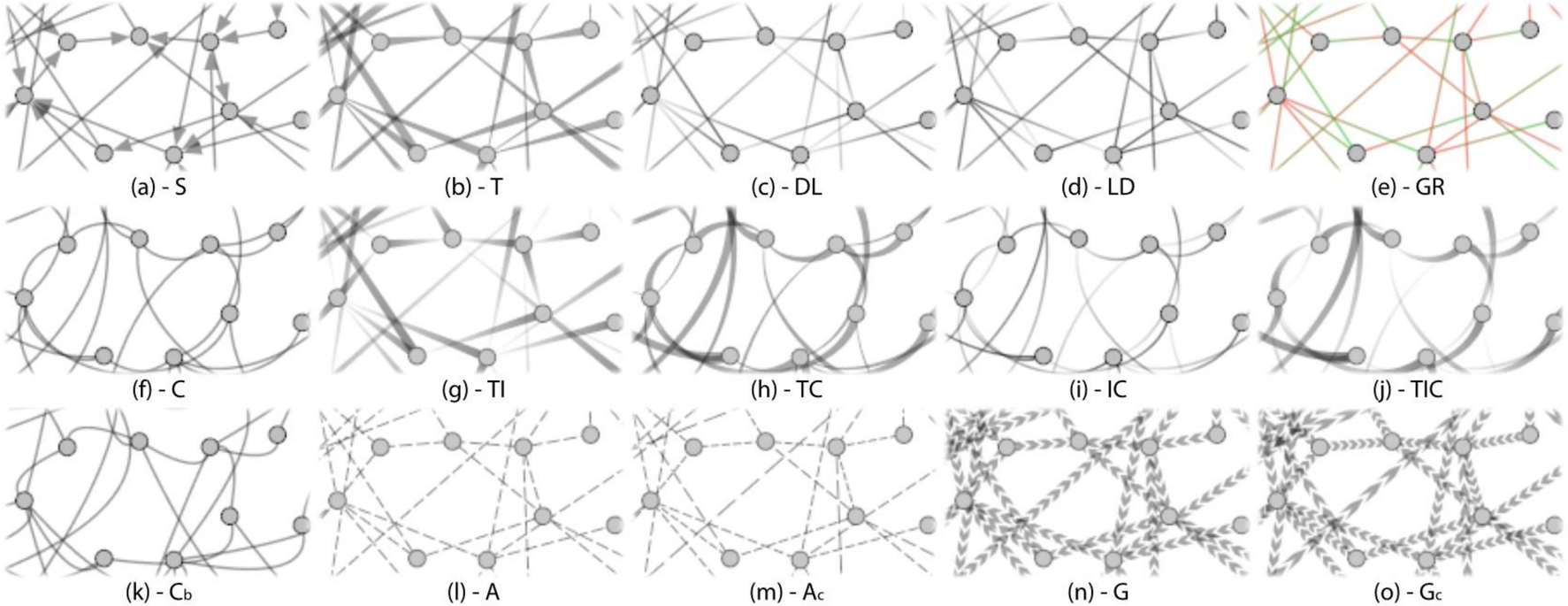


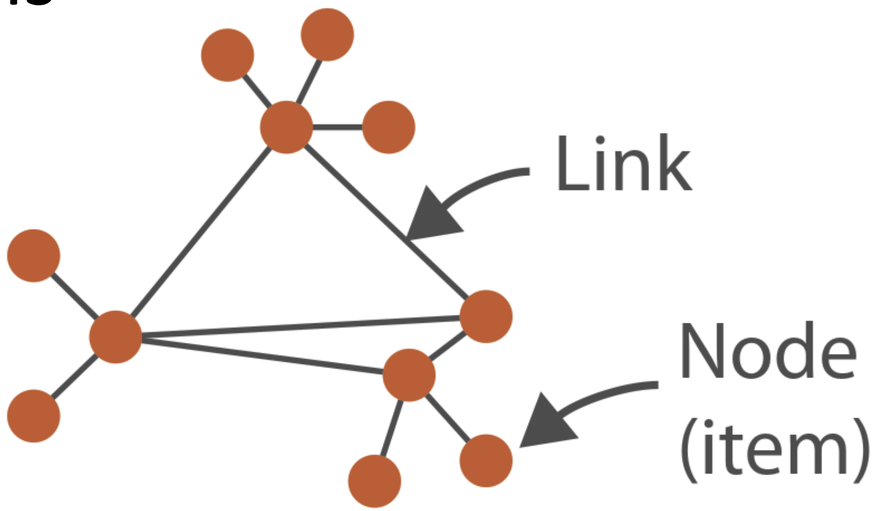
Figure 1: All directed-edge representations used in our initial (a to j), follow-up (b, k, l), and current study (b, l, m, n, o). (a) standard arrow – S, (b) tapered – T, (c) dark-to-light – DL (a.k.a intensity – I), (d) light-to-dark – LD, (e) green-to-red – GR, (f) curvature – C, (g) tapered-intensity – TI, (h) tapered-curvature – TC, (i) intensity-curvature – IC, (j) tapered-intensity-curvature – TIC, (k) biased curvature – C_b, (l) animated – A, (m) animated compressed – A_c, (n) glyph – G, and (o) glyph compressed – G_c.

Holten et al., 2011

Node-Link Visualizations

Pros:

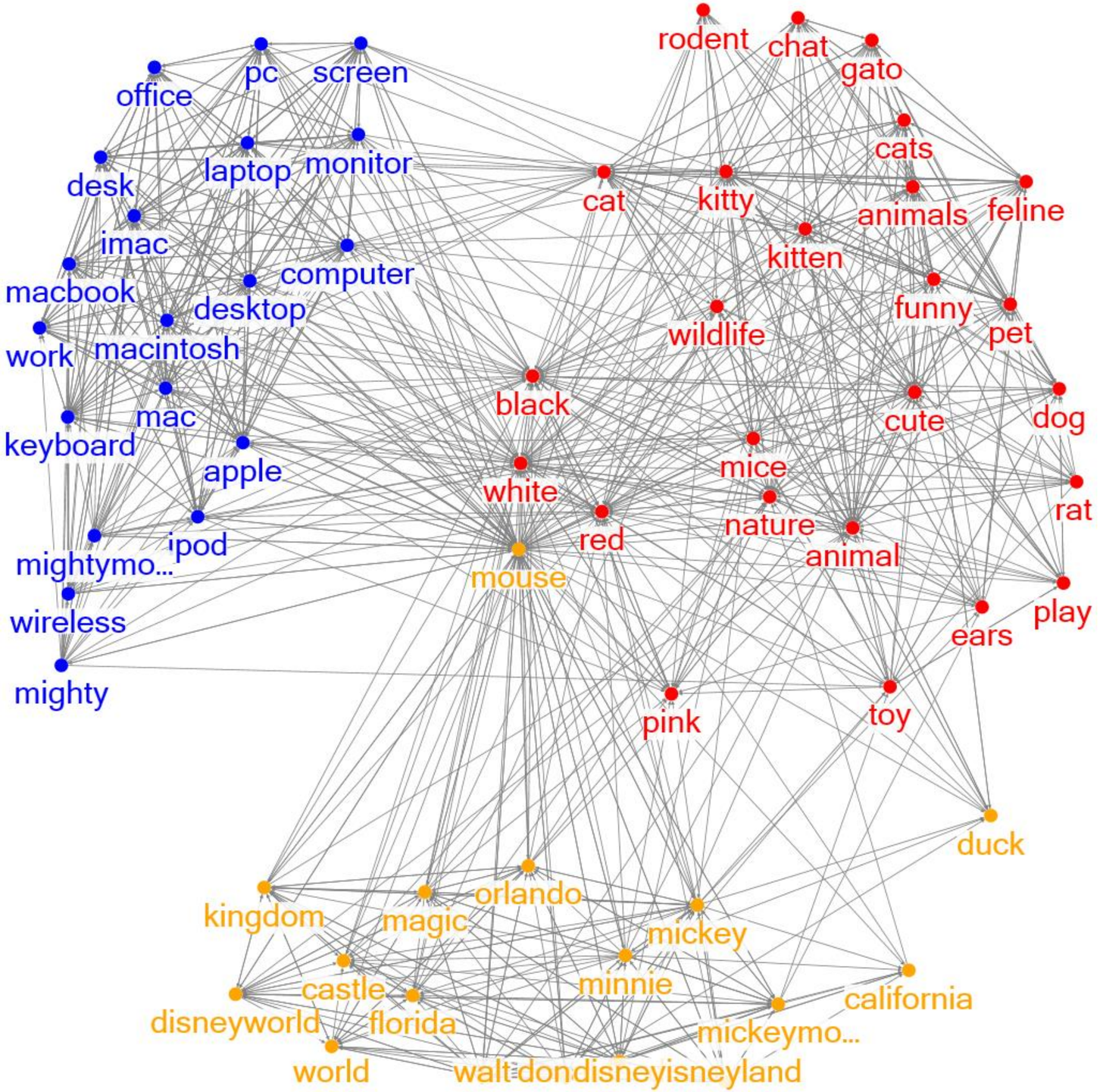
- understandable visual mapping
- can show overall structure, clusters, paths
- flexible, many variations



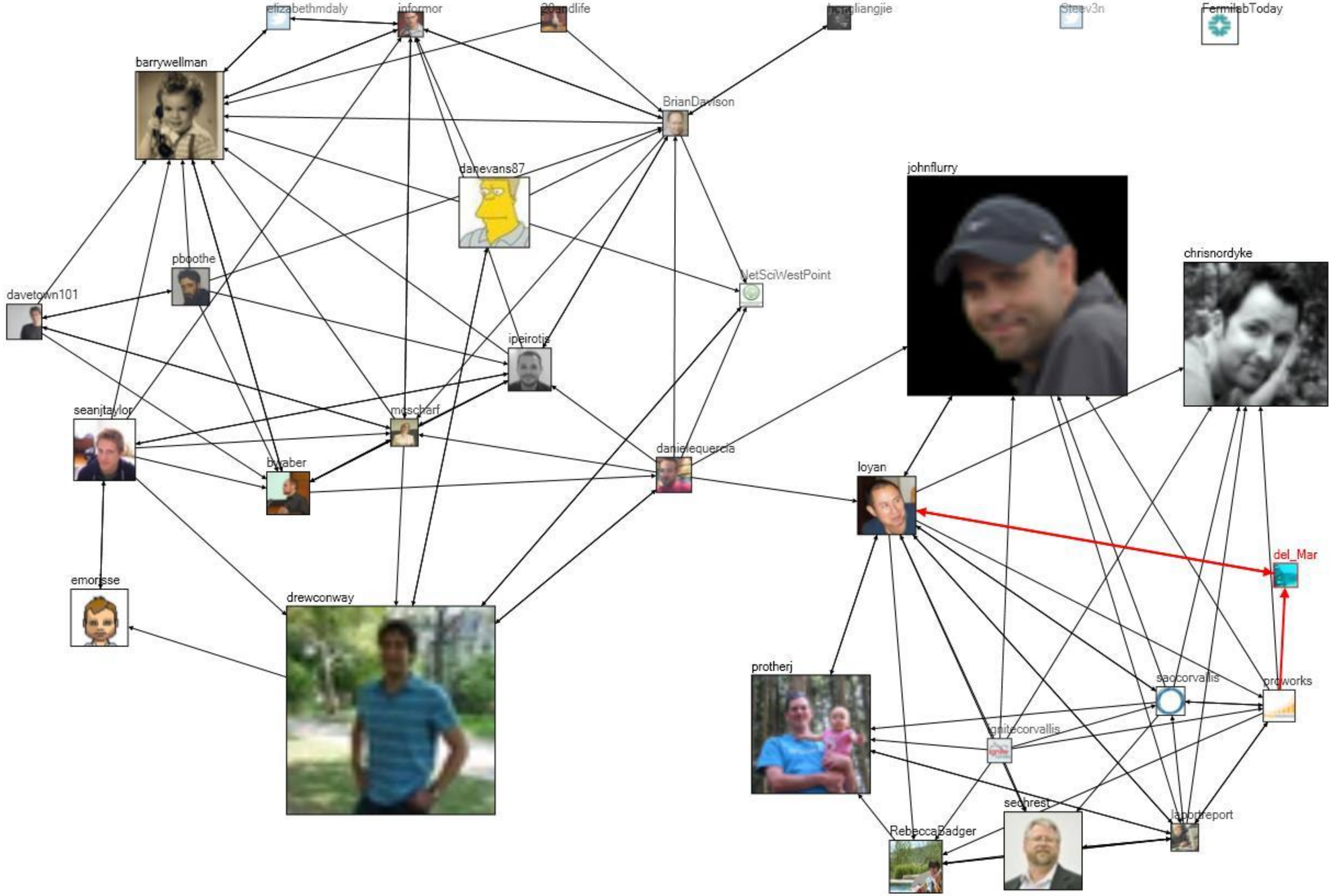
Cons:

- automatic layout algorithm deficiencies
  - -time consuming to run
  - -non-deterministic results
  - -heuristics with sometimes poor results
- not good for dense graphs - hairball problem!

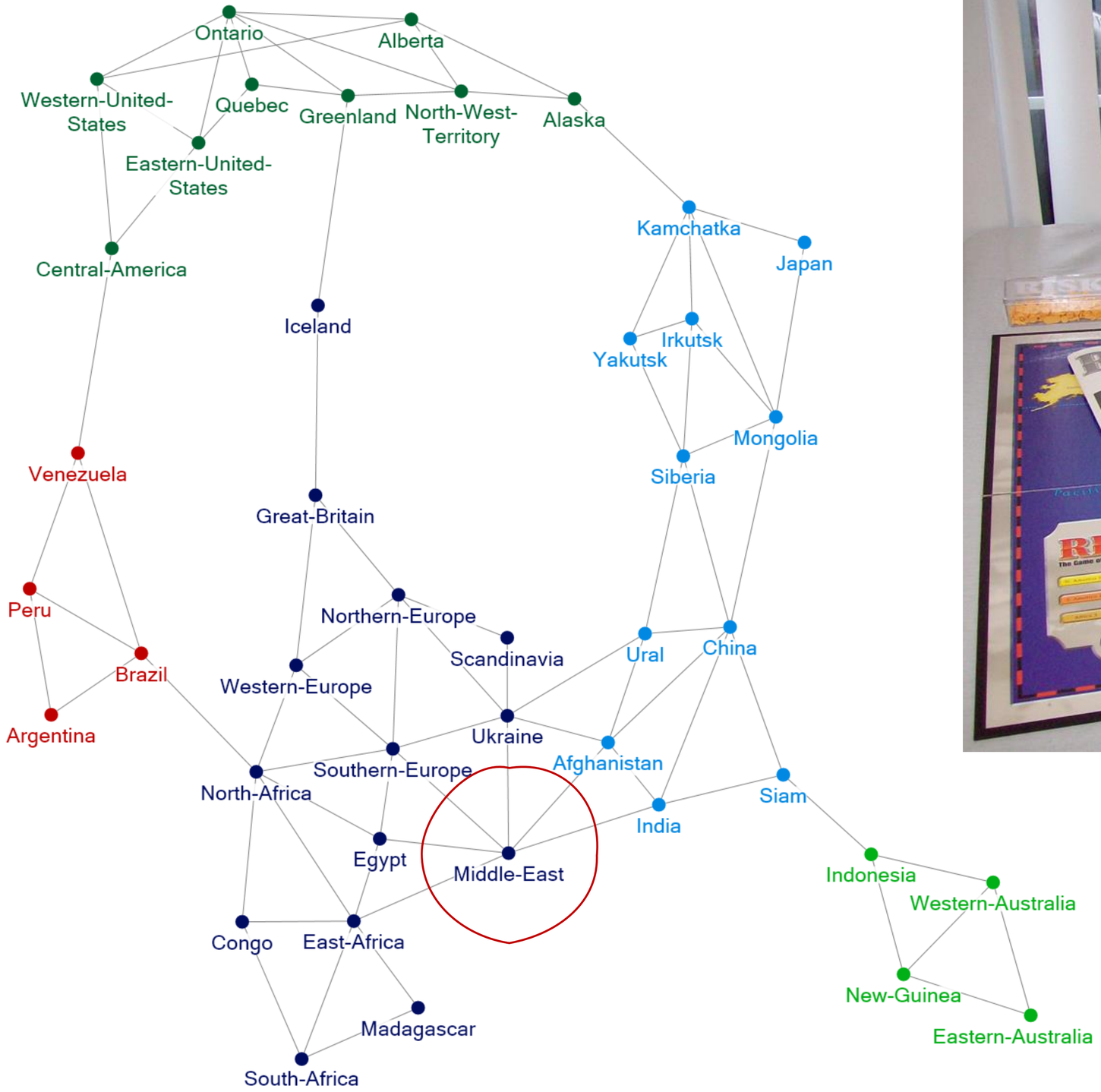
Flickr Query for “Mouse”



Tweets of the #Win09 Workshop



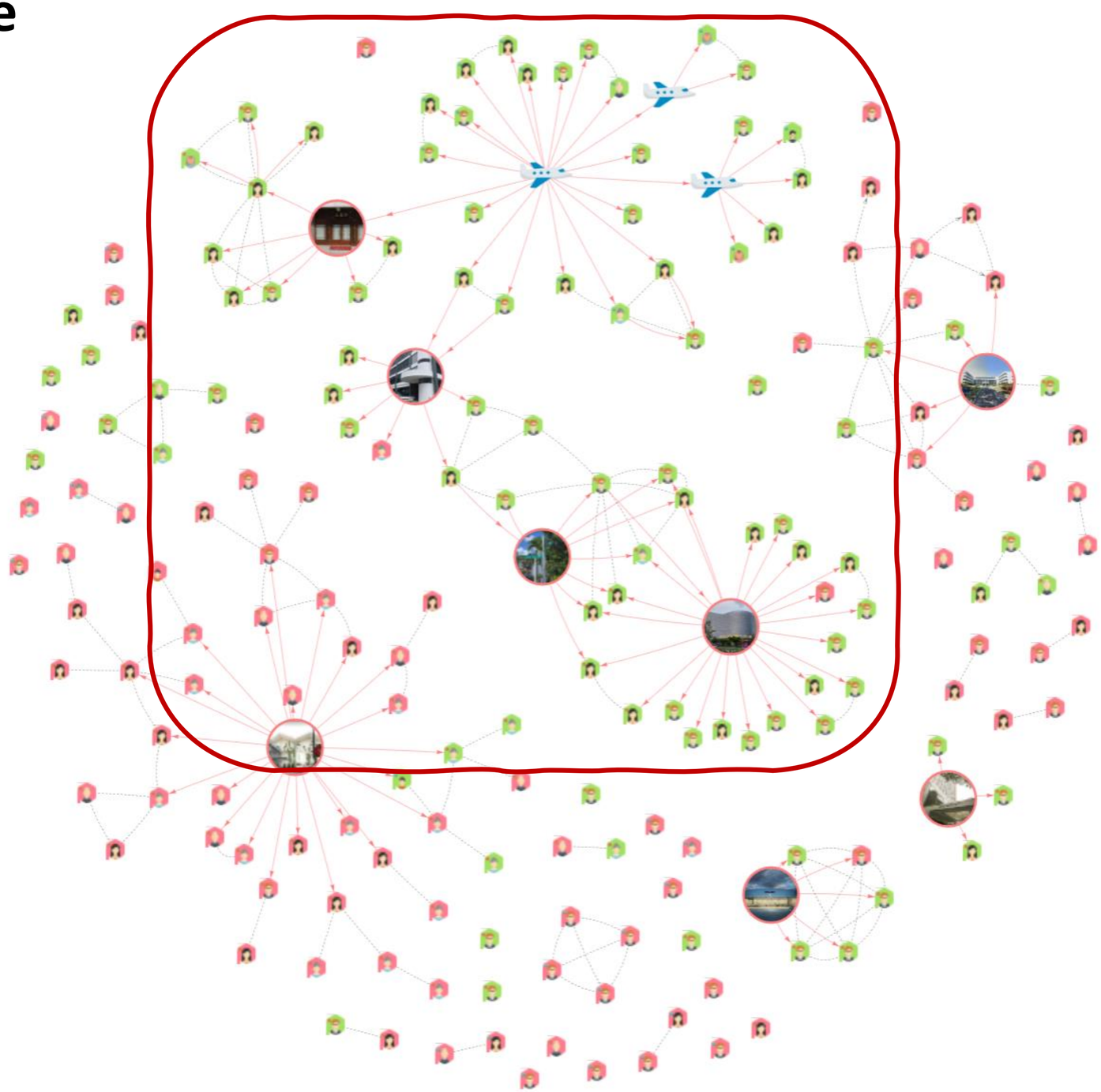

RISK
The Game of Global Domination
RISK
The Game of Global Domination
RISK


Ontario
Alberta
Western-United-States
Quebec
Greenland
North-West-Territory
Alaska
Eastern-United-States
Central-America
Kamchatka
Japan
Iceland
Irkutsk
Yakutsk
Mongolia
Siberia
Venezuela
Great-Britain
Peru
Northern-Europe
Scandinavia
Ural
China
Brazil
Western-Europe
Ukraine
Argentina
Afghanistan
Southern-Europe
North-Africa
Siam
India
Egypt
Middle-East
Indonesia
Western-Australia
Congo
East-Africa
New-Guinea
Madagascar
Eastern-Australia
South-Africa


RISK
The Game of Global Domination

Dashboard of the COVID-19 Virus Outbreak in Singapore

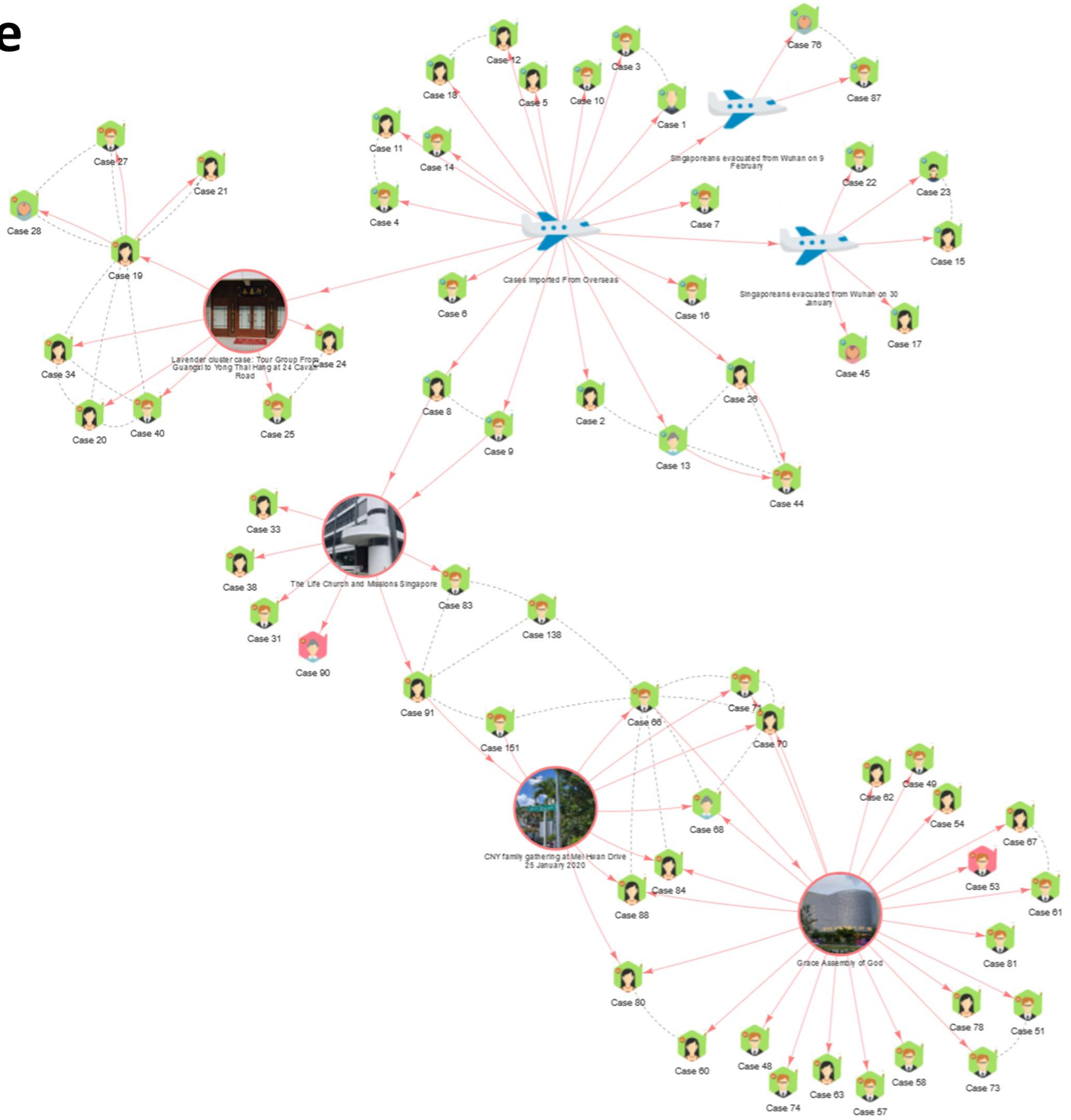
2020-01-21 – 03-12



Upcode, 2020

Dashboard of the COVID-19 Virus Outbreak in Singapore

2020-01-21 – 03-12



For Next Time & Communication

Homepage: https://c.dunne.dev/cs7295f21/
(project details + assignments to be added)

For next time:

- Discussion lead 1 — Topic Areas
- Assignment 1 — Read the Syllabus

Everyday Required Supplies:

- 5+ colors of pen/pencil
- White paper
- Laptop and charger

Use Canvas Discussions for general questions, email the instructor for questions specific to you.