

# Prioritizing Visual Encoding in Networks

Using the rDynamo and rNetVisor packages

Nikhil Gopal, PhD

# A Brief Story About Me

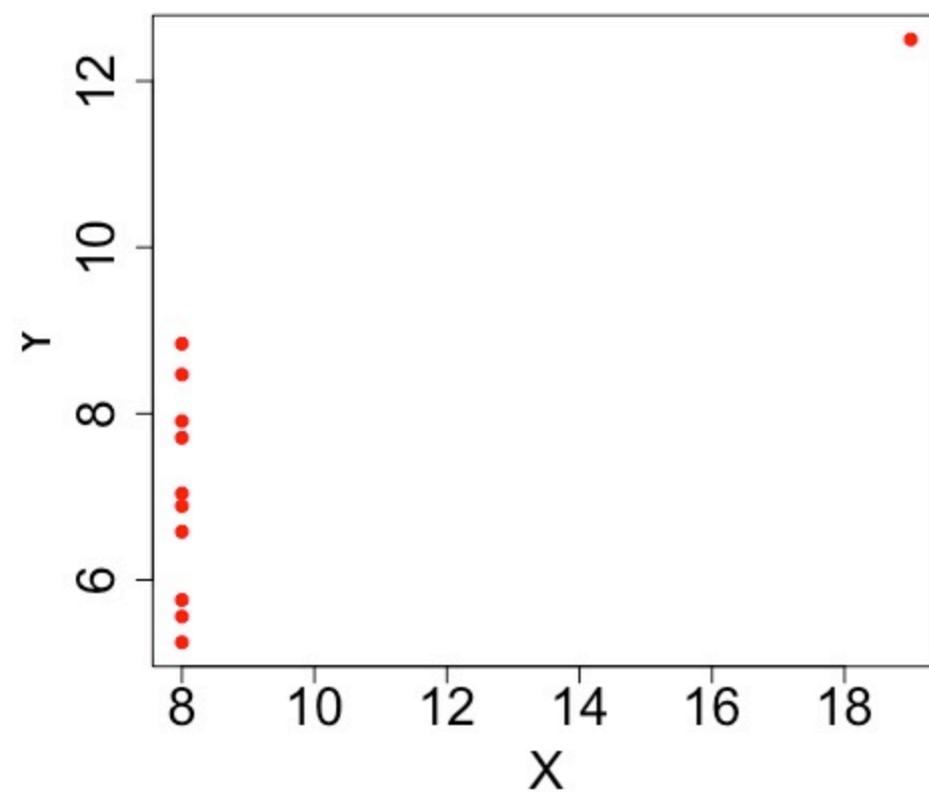
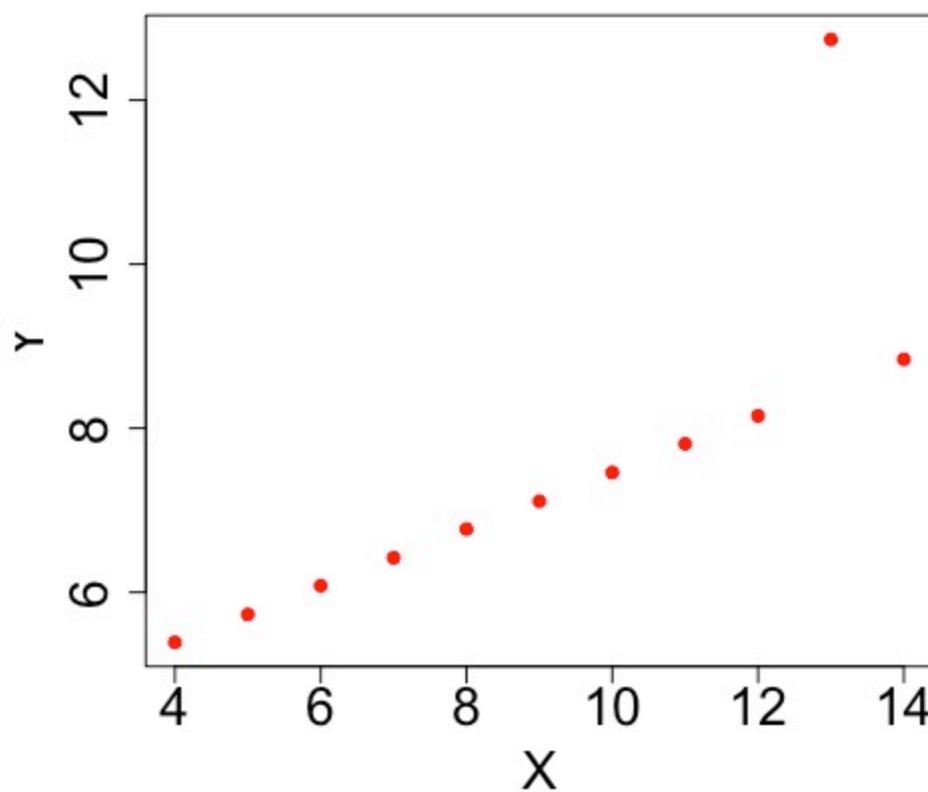
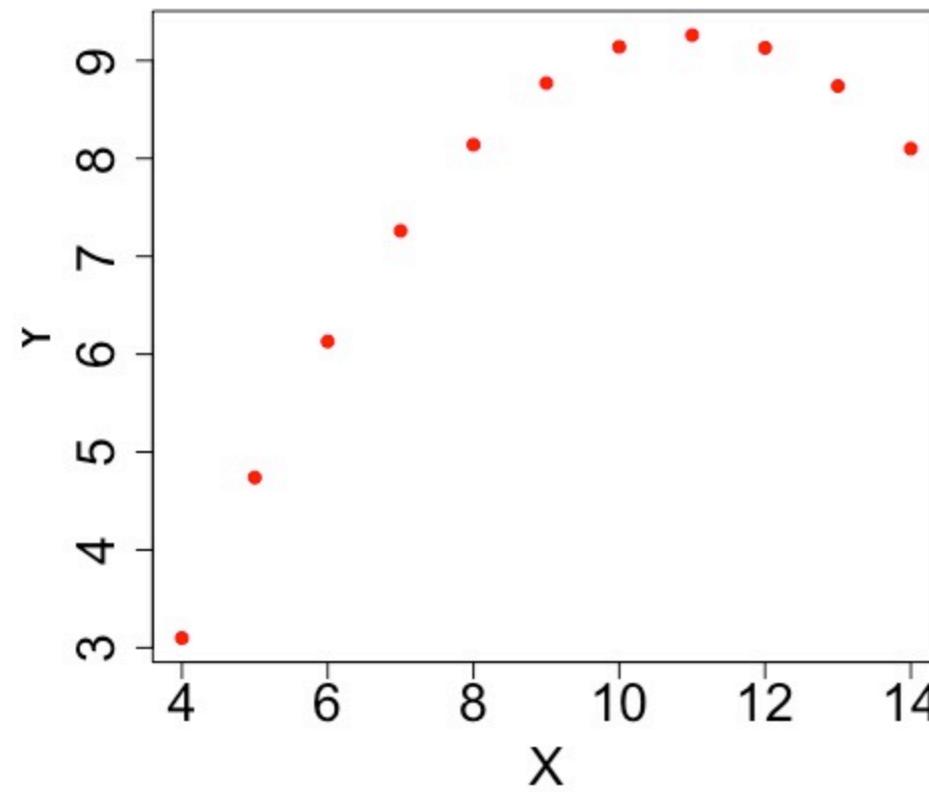
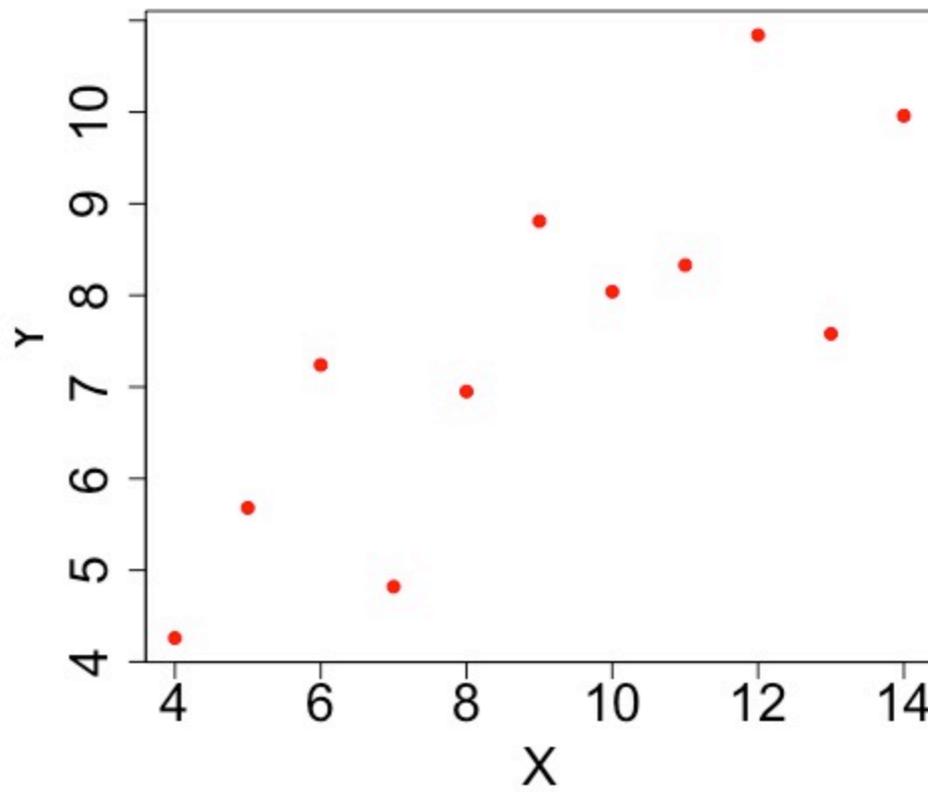
Trained in bioinformatics and  
biomedical informatics

Formerly worked at Affymetrix  
and Illumina

Found that analysis can be  
limited, we need to make sense  
of underlying complexity!



# Anscombe's Quartet



Network Visualizations  
are useful

# PANDEMIC

## OUTBREAKS

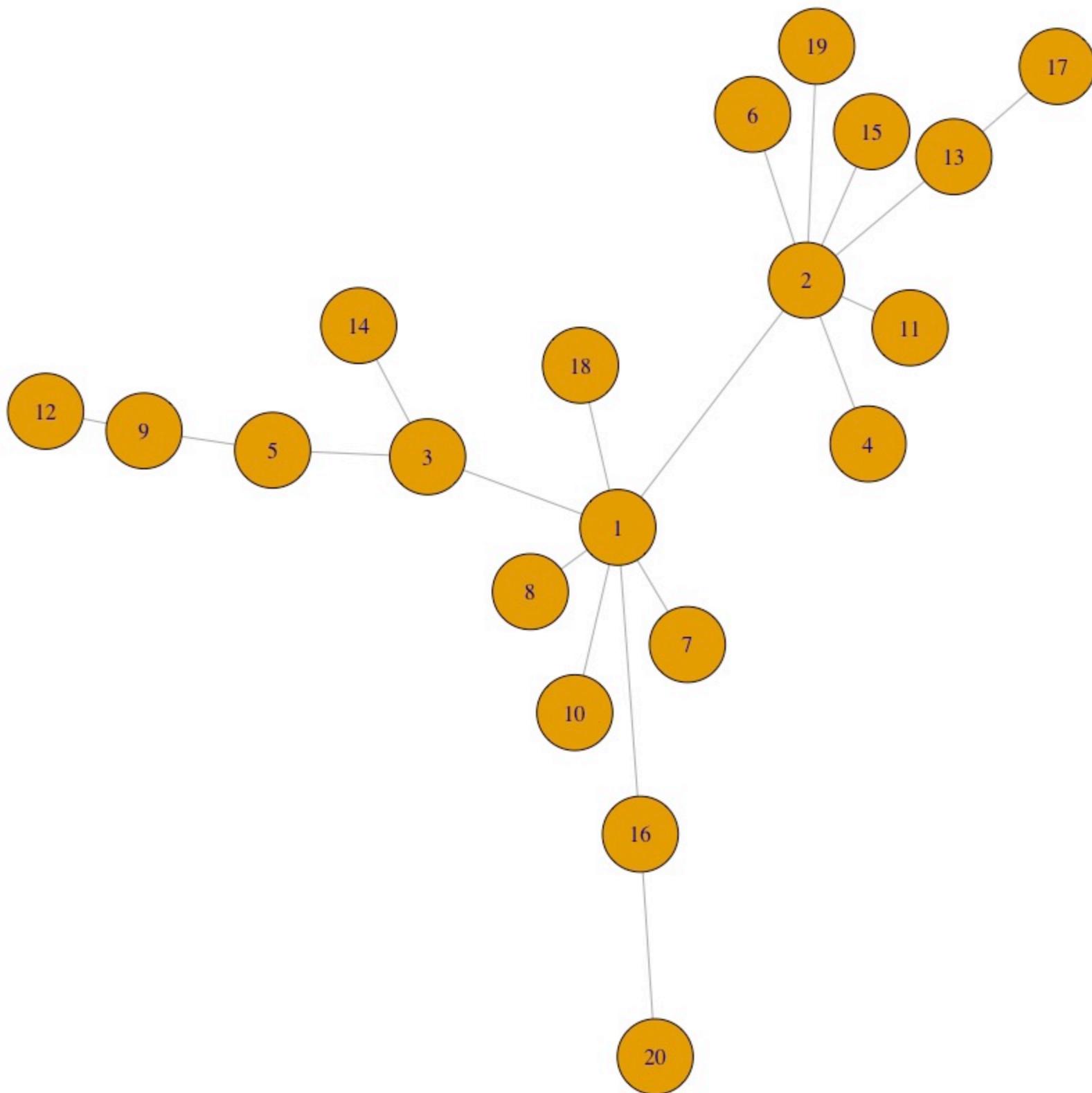


## Cures Discovered

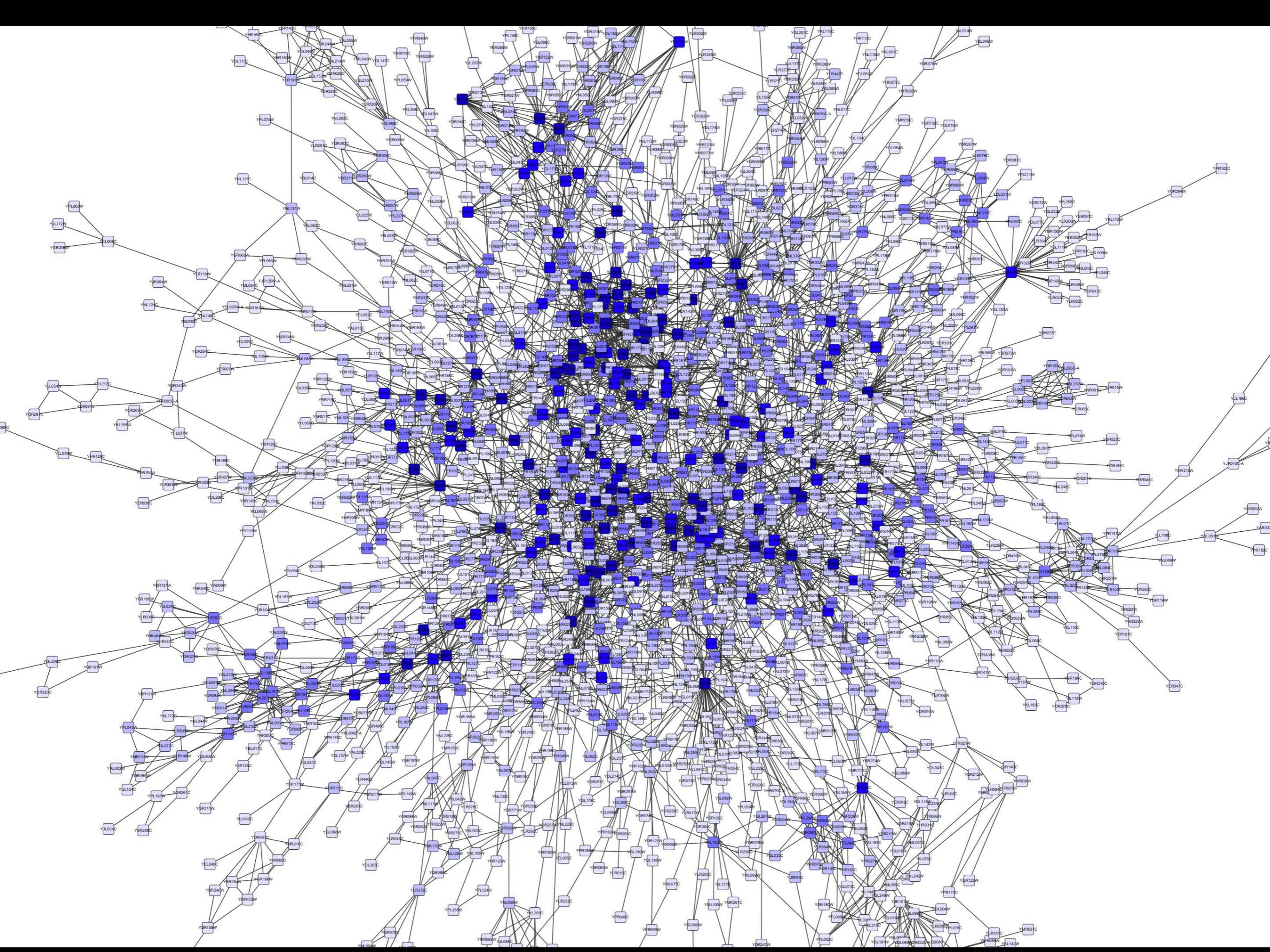
## EPIDEMIC!

1. INCREASE: Move the Infection Rate Indicator up by 1.
2. INFECT: Draw a card from the bottom of the Infection Draw Pile and infect the indicated city with 3 tokens. Discard the card.
3. INTENSIFY: Shuffle the Infection Discard Pile and place it on top of the Infection Draw Pile.





But they become  
unreadable



# A portion of my research

- Perception study to evaluate *noticeability* of visual attributes while *visually scanning* a network
- Presented networks to participants, and asked them to click on the most *noticeable* node or edge in rapid succession
- 34 controlled encoding pairs — same data presented via competing visual channels (e.g. size & shape, shape & color, etc)

# A predictive model

- Created a random forest model to explain/predict attention
  - $\text{SelectedNode} \sim \text{NodeSize} + \text{NodeShape} + \dots$
  - $\text{SelectedEdge} \sim \text{EdgeWidth} + \text{EdgePattern} + \dots$
- Performed reasonably well (AUC of 0.78, 0.86)

# So, R package?

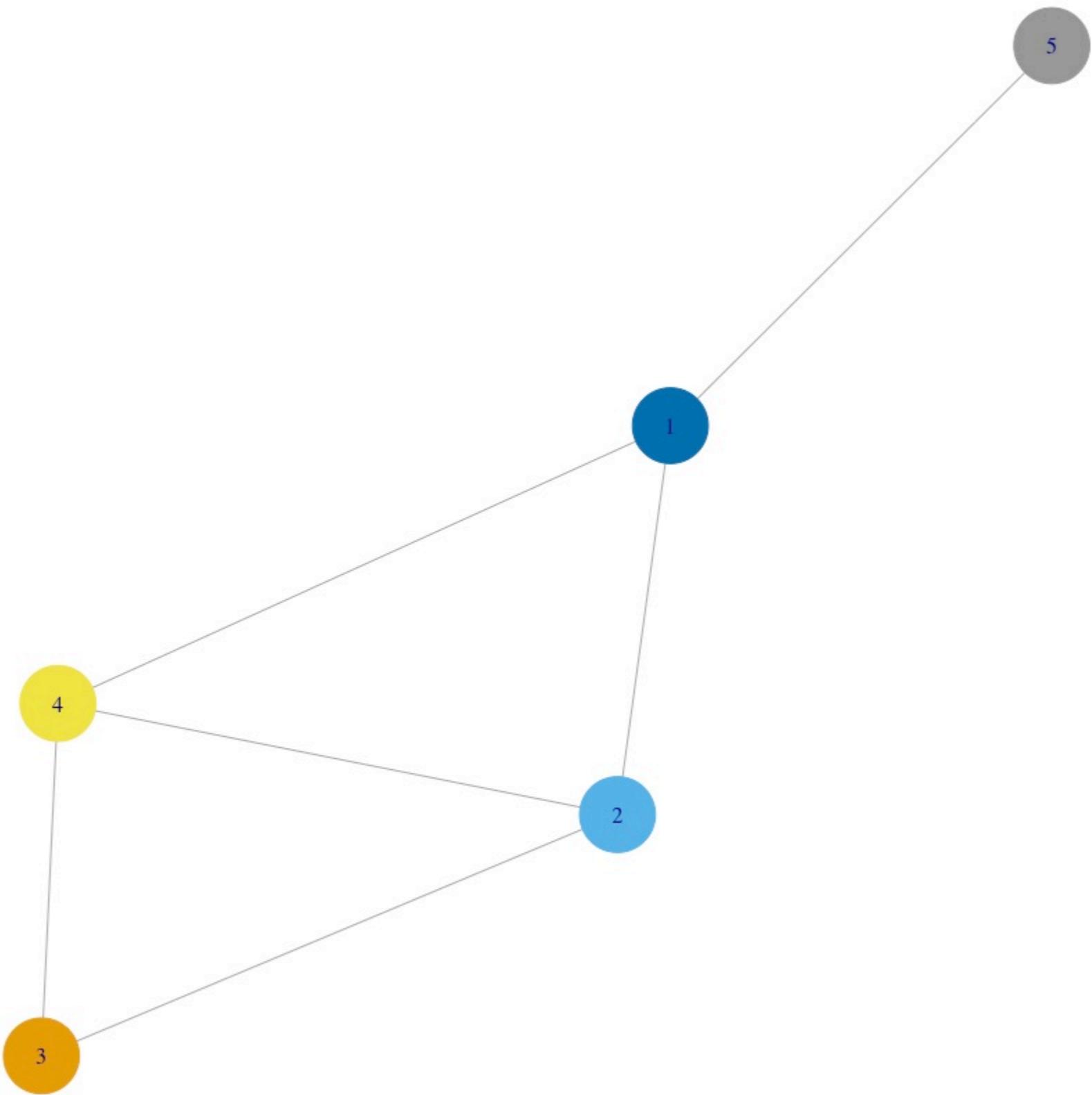
- Put the ML model into an R package to help network visualization designers “see” what a reader sees.
- rDynamo for prioritizing visual encodings (mapping of data attribute to visual attributes)
- rNetVisor for generating an attention heat map

# rDynamo Usage

- Handles prioritization of mapping between data attributes and visual attributes
- Uses linear programming to make assignments

> renderGraph(igraphObj, prioritizationMatrix)

	Data Attribute <sub>1</sub> (N)	Data Attribute <sub>2</sub> (N)	Data Attribute <sub>3</sub> (E)	Data Attribute <sub>4</sub> (E)
Visual Attribute <sub>1</sub>	10	4	1	1
Visual Attribute <sub>2</sub>	3	3	6	2
Visual Attribute <sub>3</sub>	6	9	3	3
Visual Attribute <sub>4</sub>	3	3	4	7



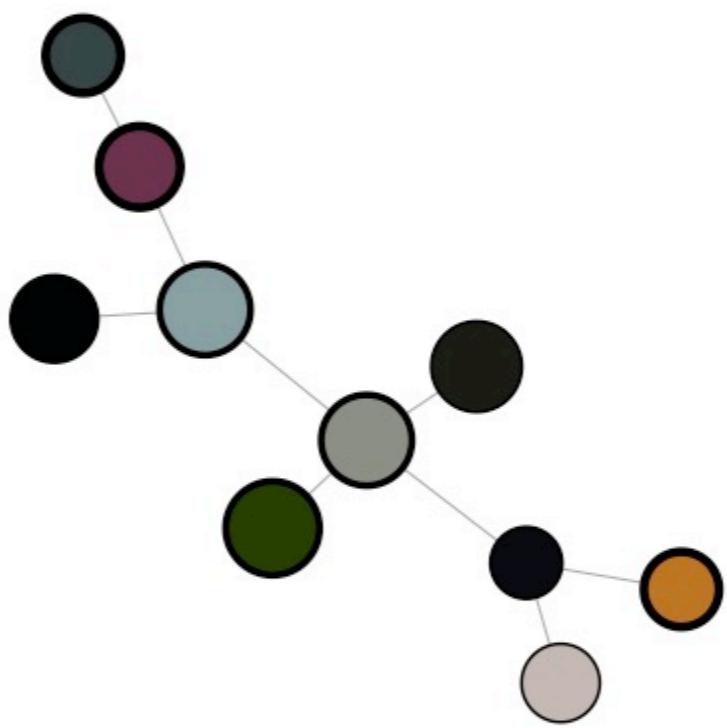
# rNetVisor Usage

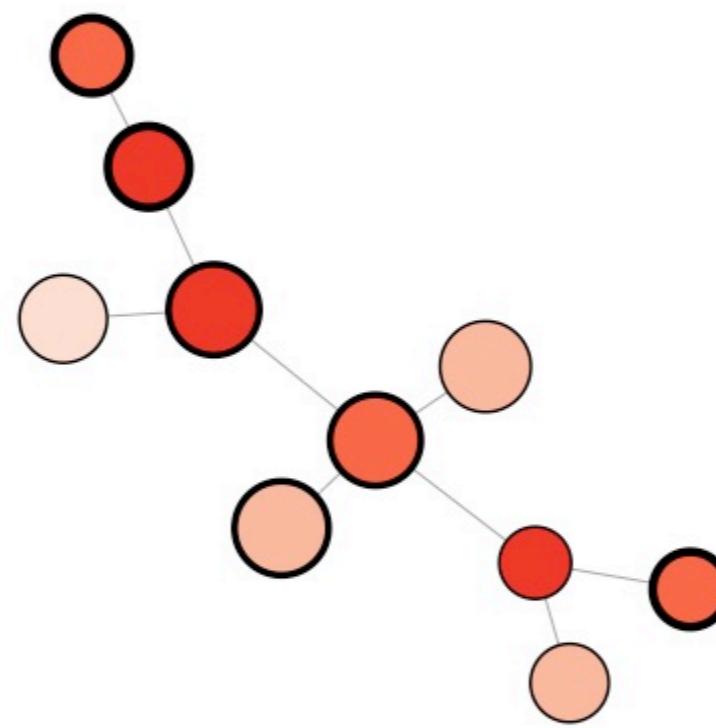
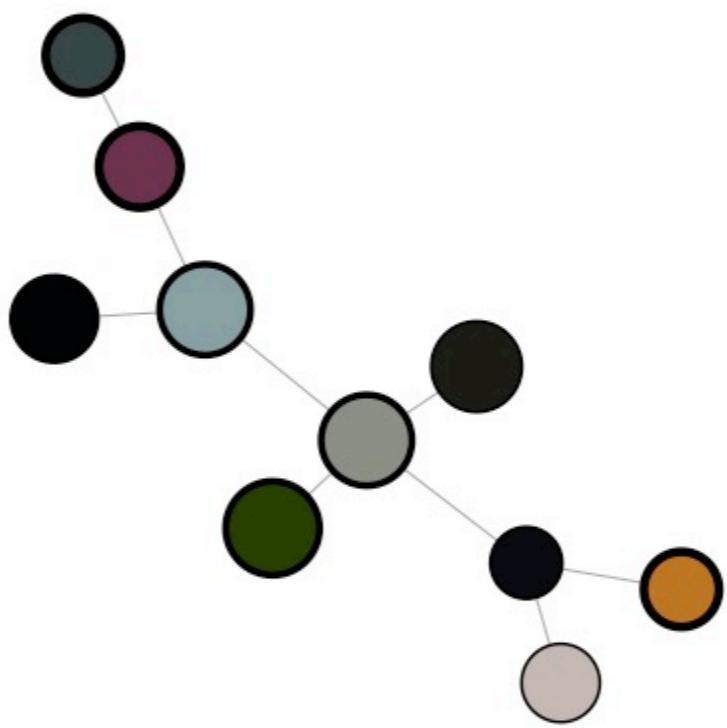
Uses the RF model to draw attention heat map

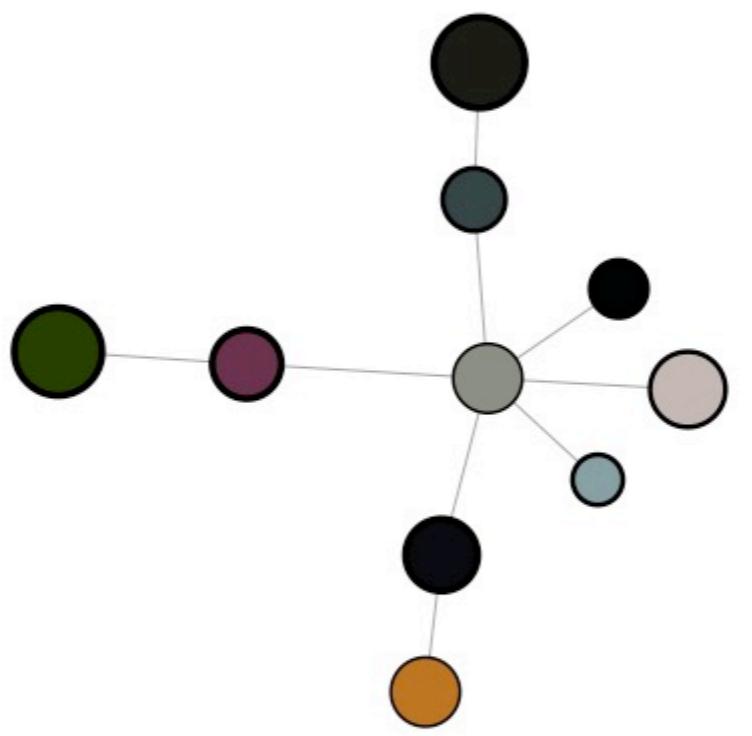
```
> generateNetValidation(igraphObj, paneled = T)
```

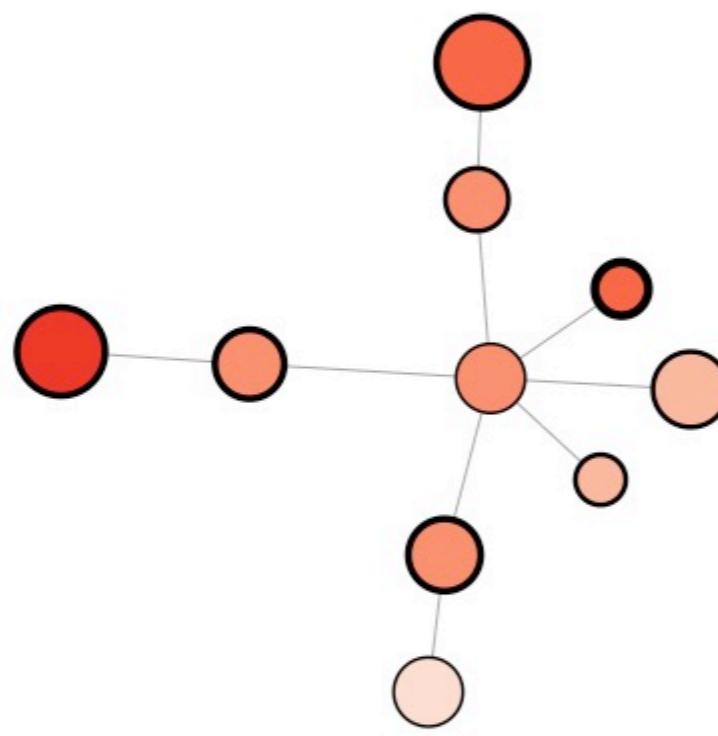
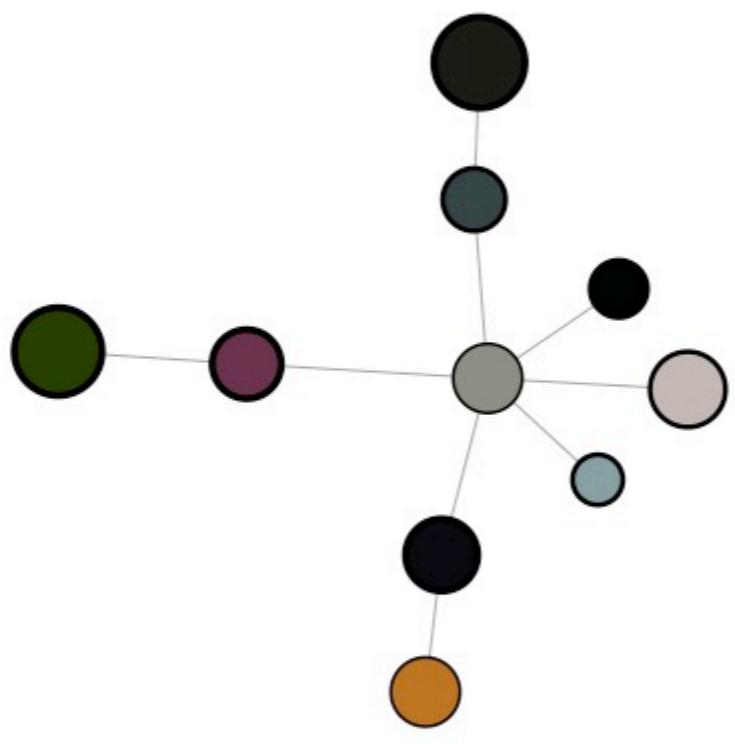
One panel has network, adjacent has attention  
heat map

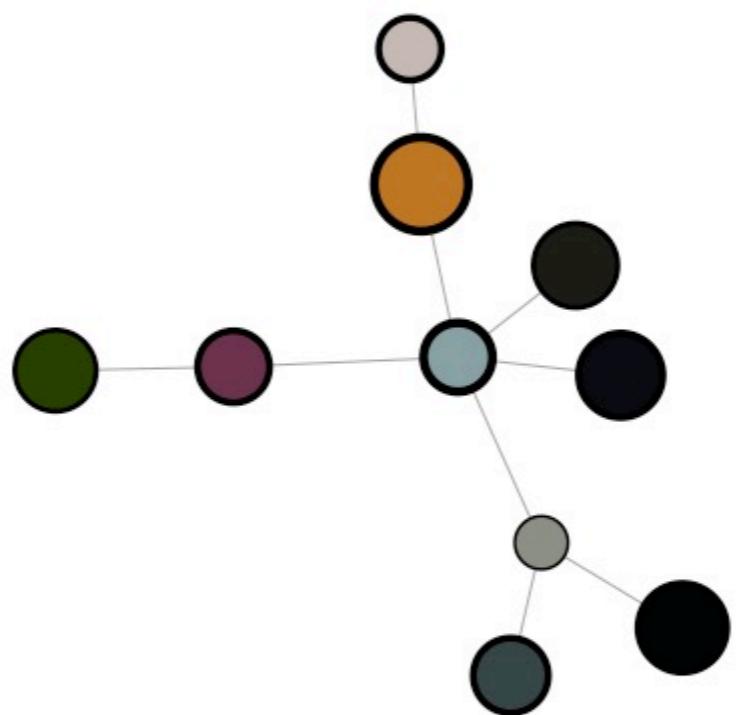
Let's see it action!

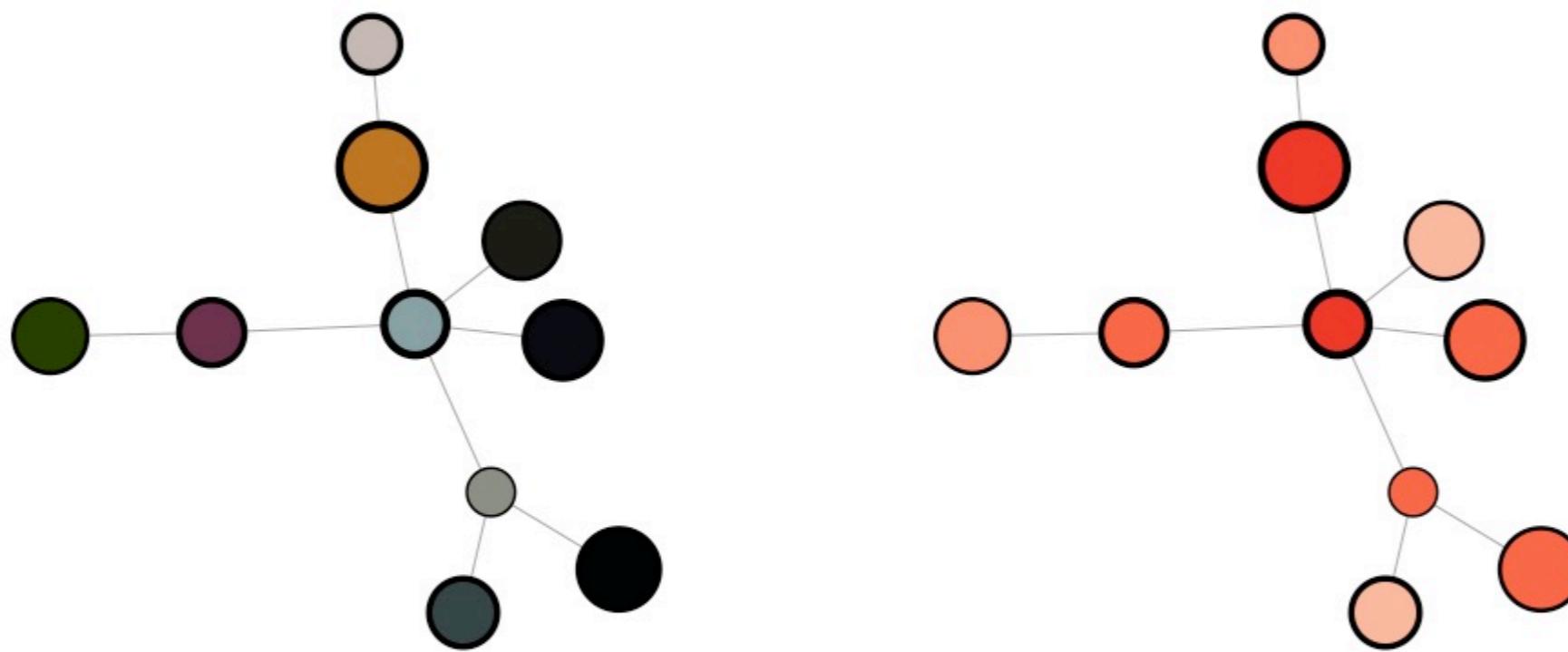


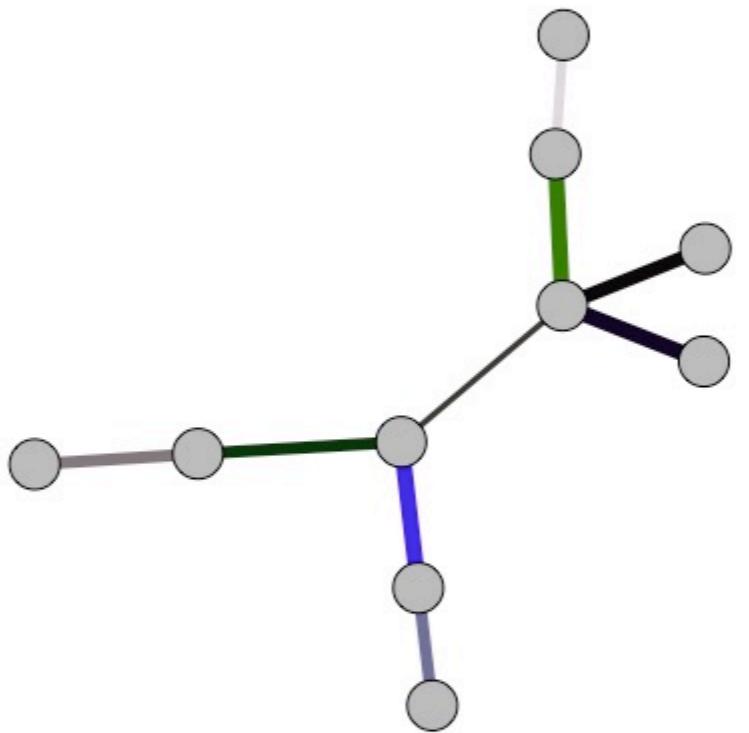


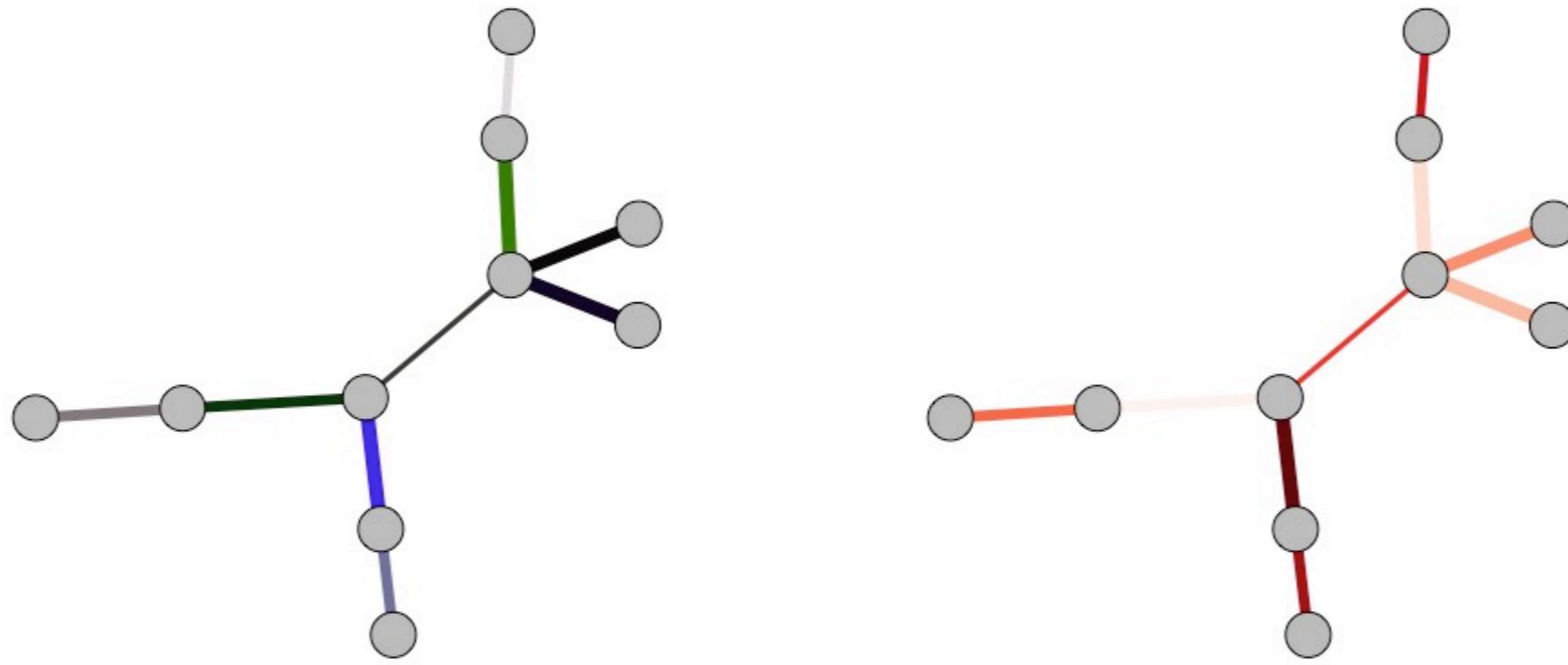


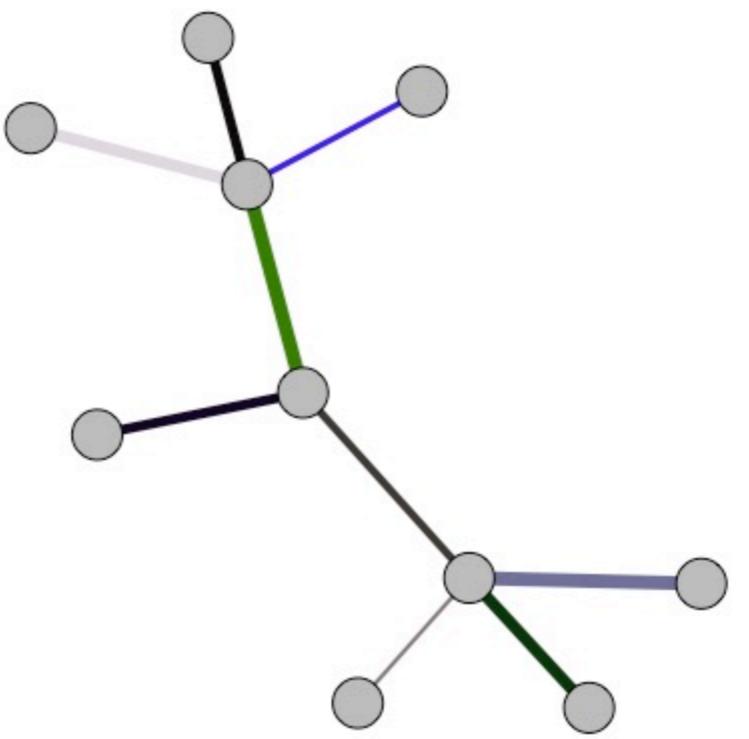


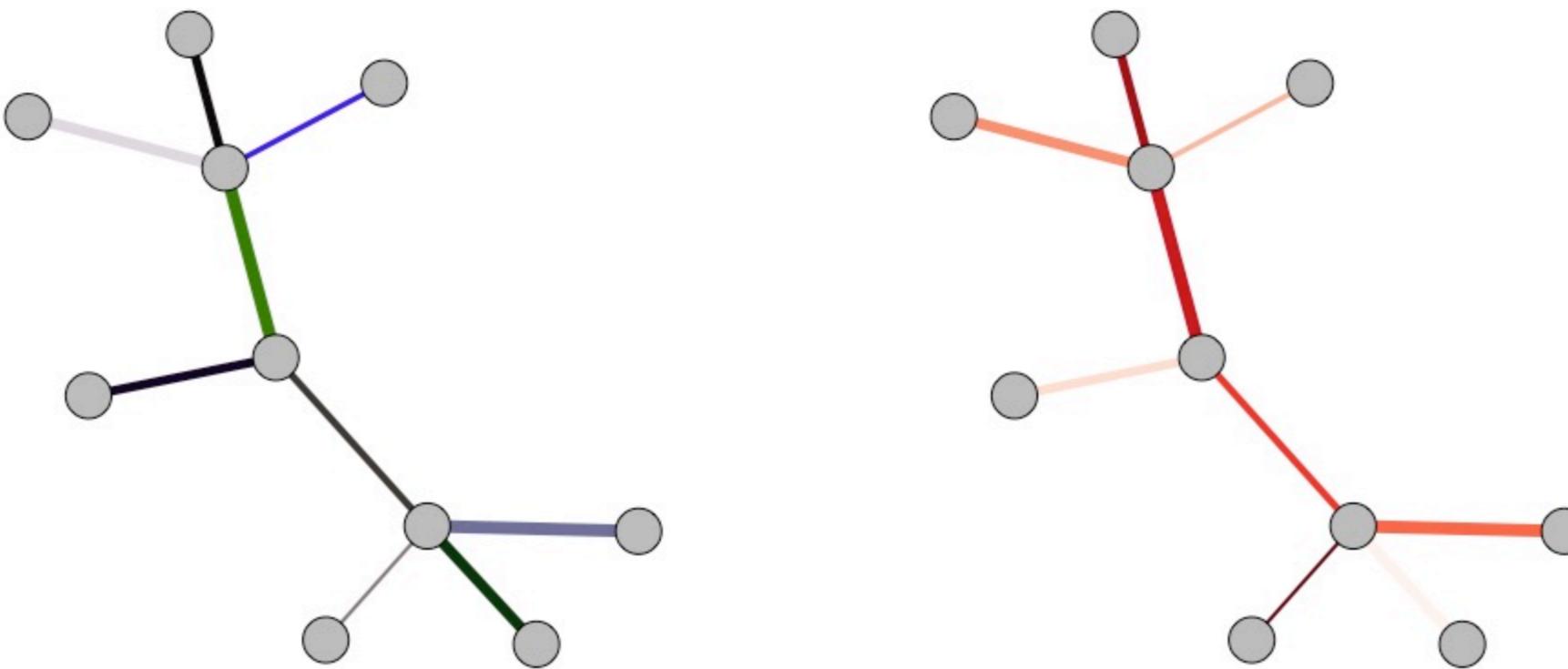


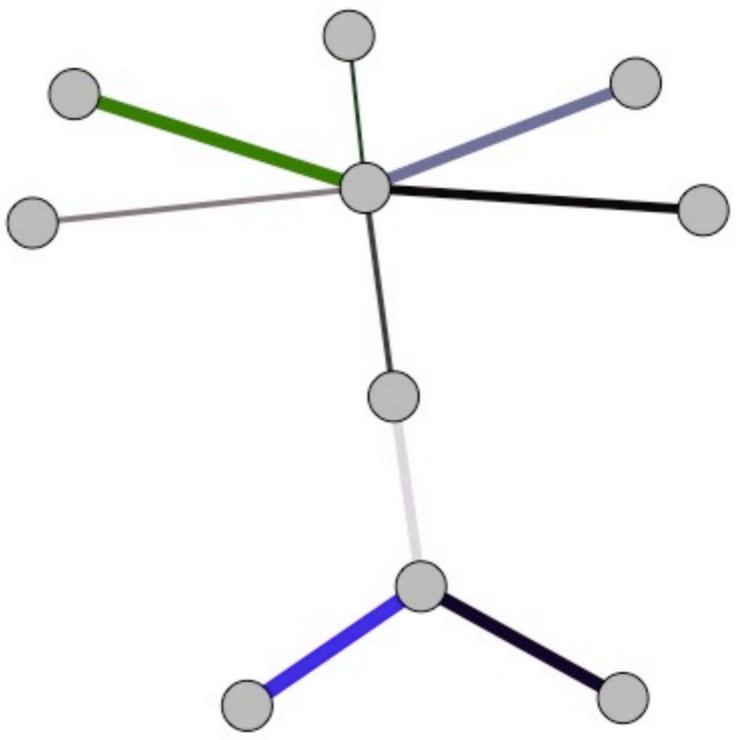


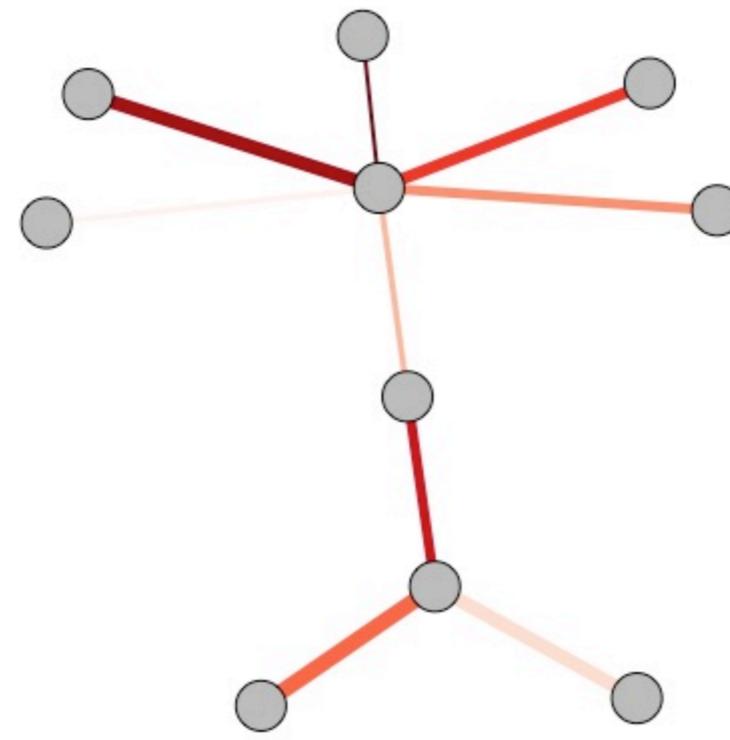
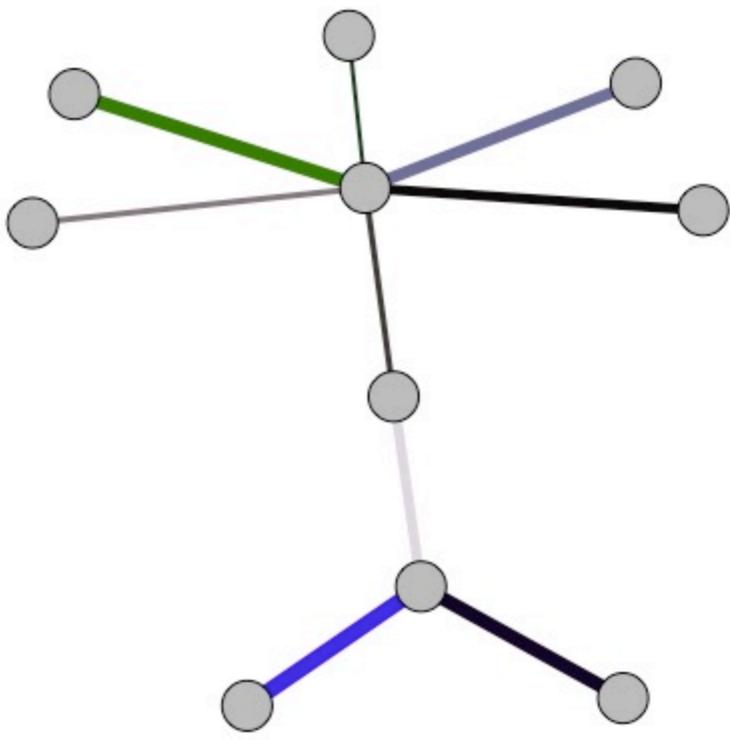












# Benefits

- Provides a prediction on how users may read a network
- Reproducible network visualization designs
- Supports transparency of design decisions
- Extensible

# Limitations and Future Work

- Designed to be used with iGraph objects
- Works best for numerical data attributes
- Underlying model assumes very small networks
- Plan to run future studies to build models for larger networks and additional tasks
- Post-hoc analysis shows linear models possible

# Where to get rNetVisor?

- GitHub link

```
install_github("ngopal/rNetVisor")
```

```
install_github("ngopal/rDynamo")
```

# Thank You

- Yay! CascadiaRConf!
- I'd love help with this!
  - Fork the repo, help identify/fix bugs
  - Send me an email! [nikhilgopal@gmail.com](mailto:nikhilgopal@gmail.com)
  - Raising funds/resources for future studies
- Thanks to Neil Abernethy, John Gennari, and Jeff Heer