GLO-STIX

Graph-Level Operations for Specifying Techniques and Interactive eXploration

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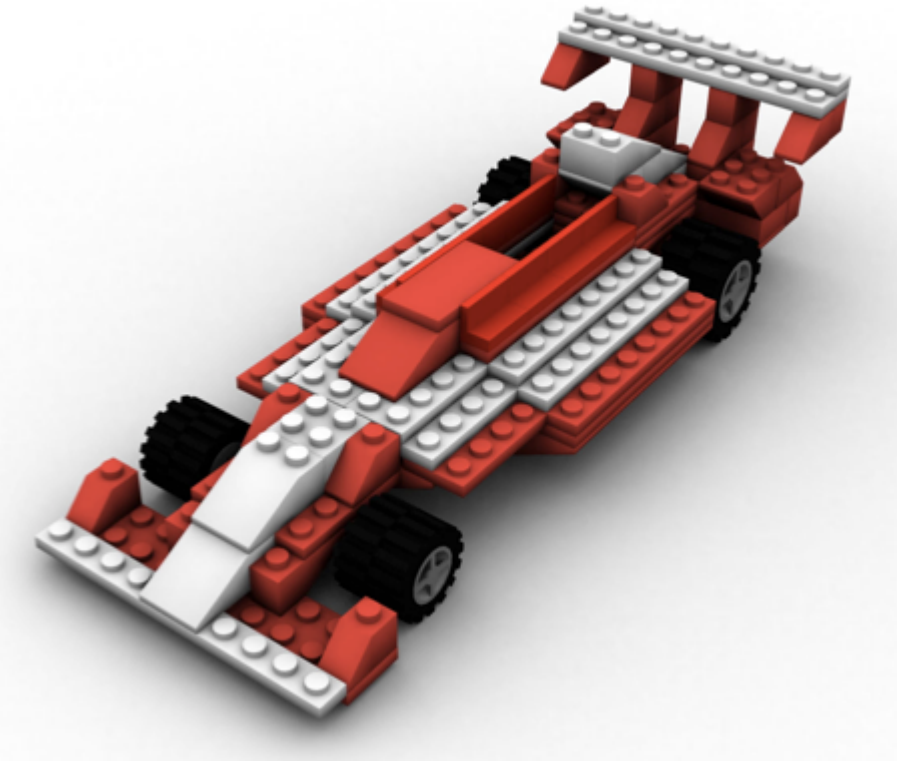
http://thetrendguys.com/wp-content/uploads/2014/02/lego-bricks.jpg



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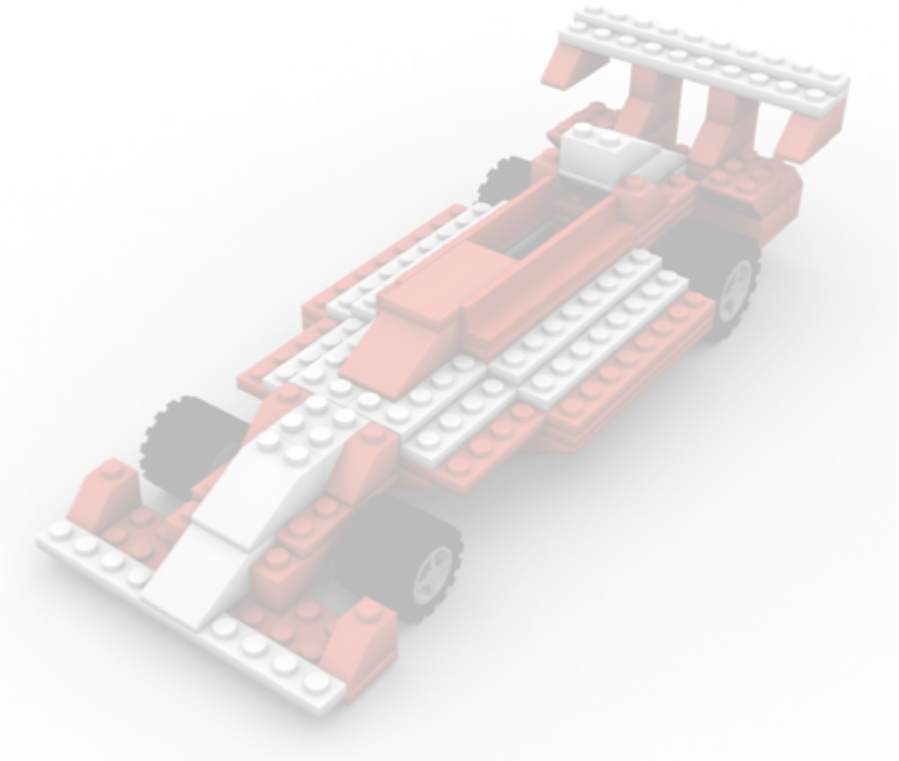

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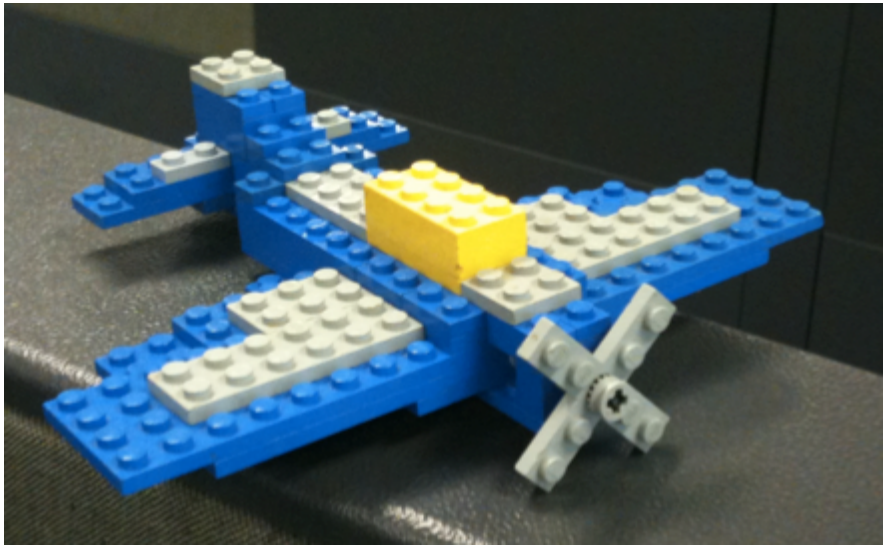

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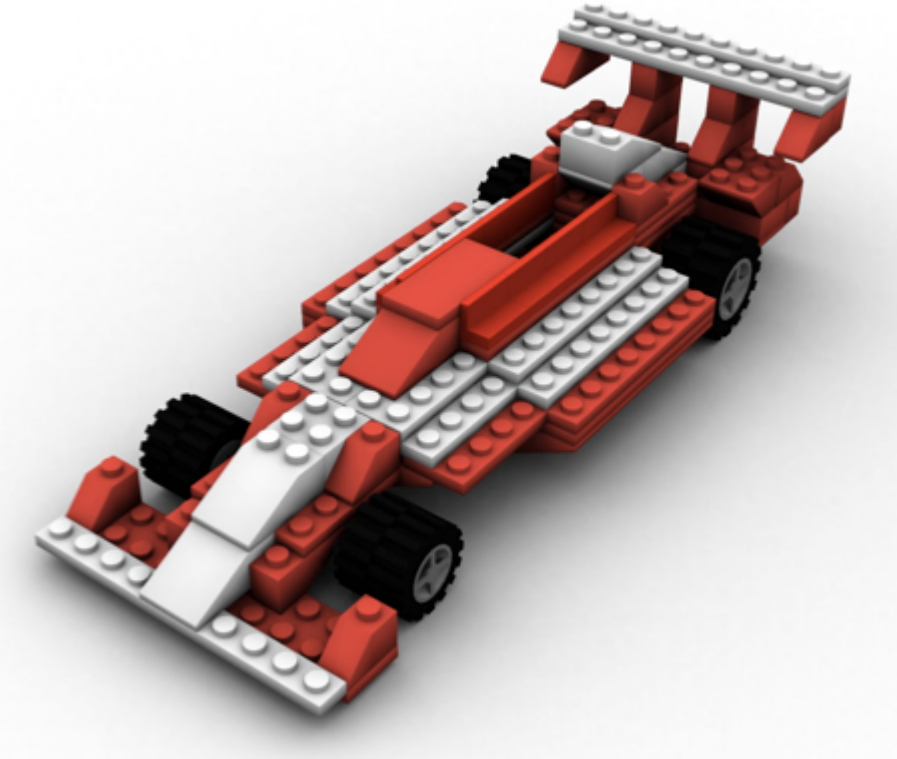

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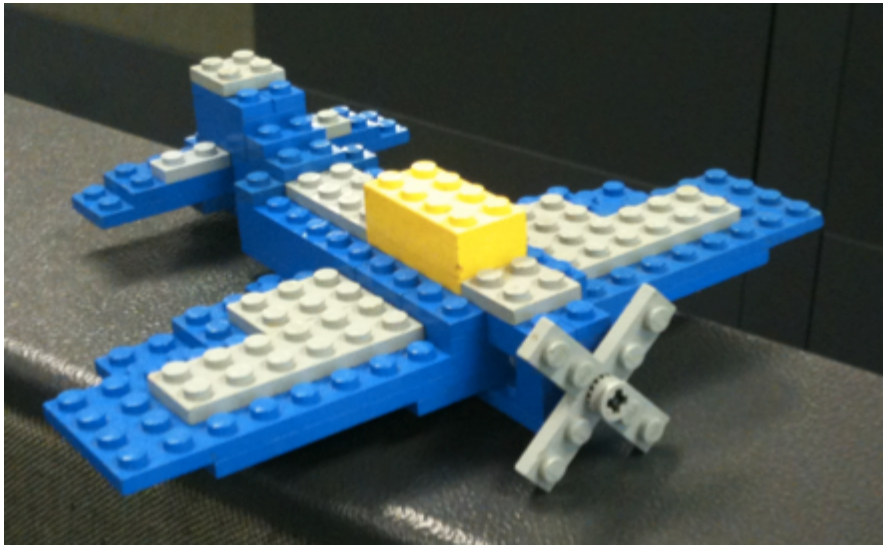

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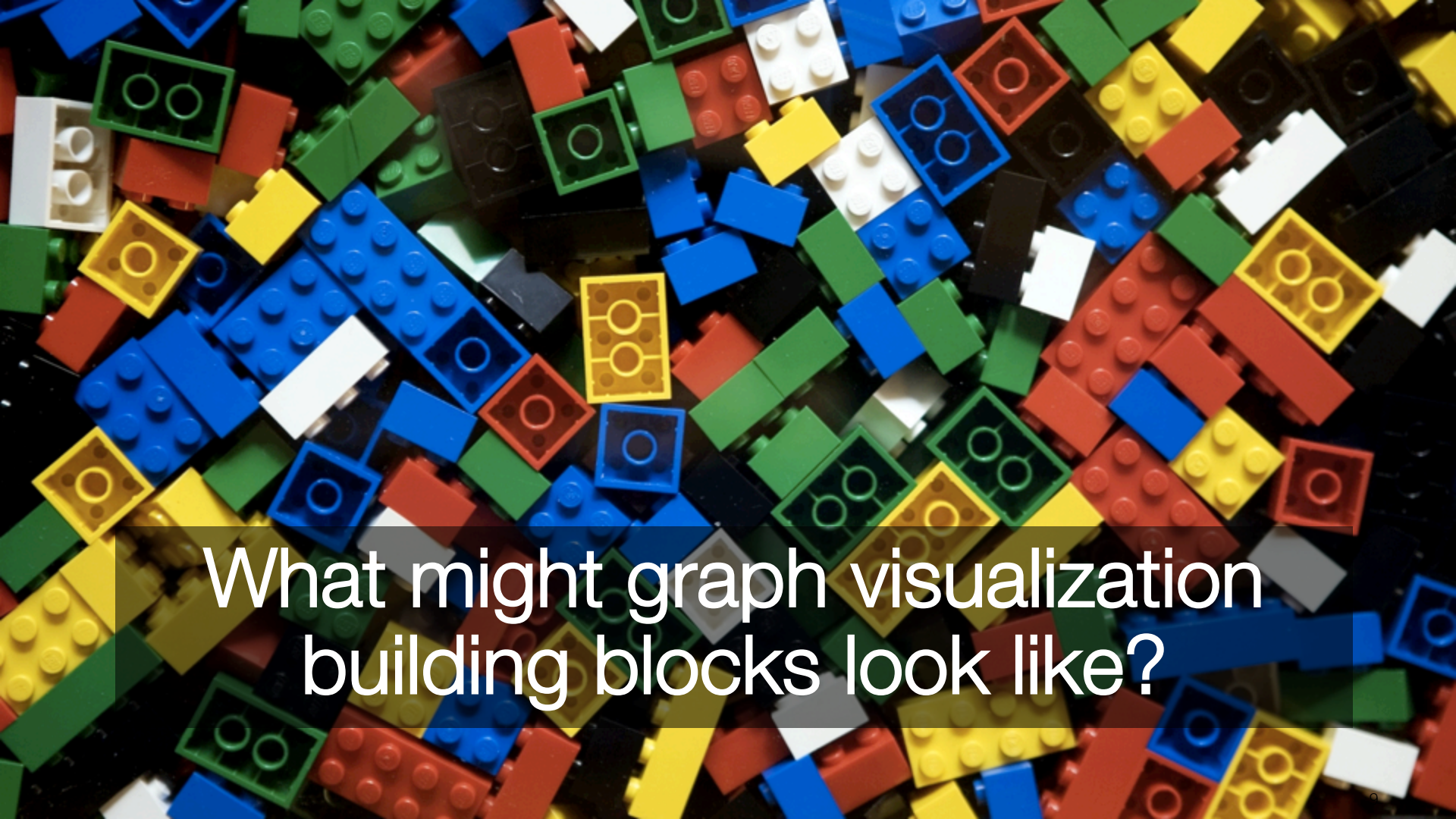
Low Level

JUNG

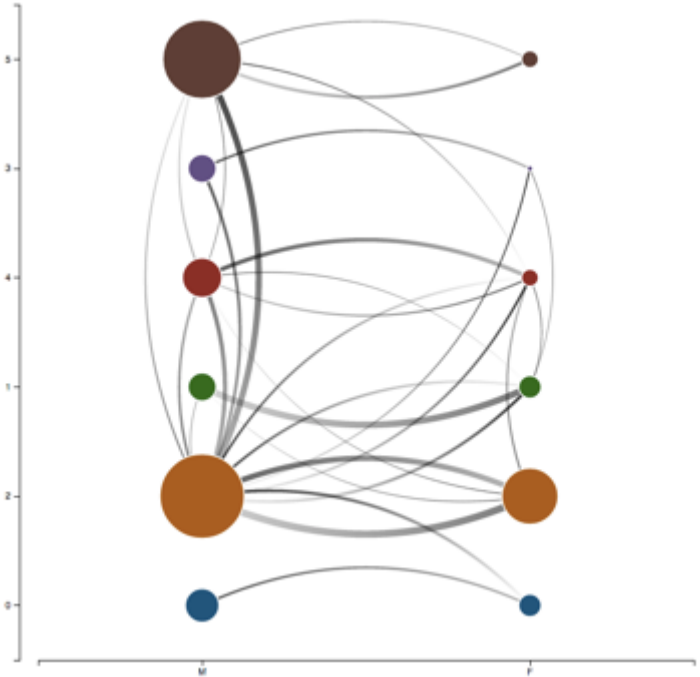
High Level


What might graph visualization
building blocks look like?

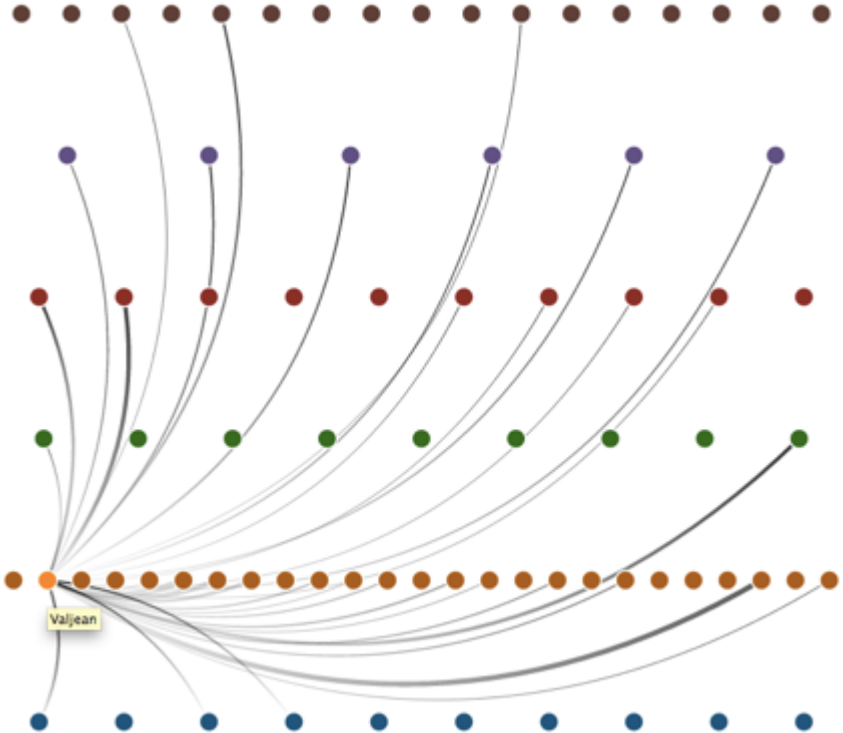
Semantic Substrates

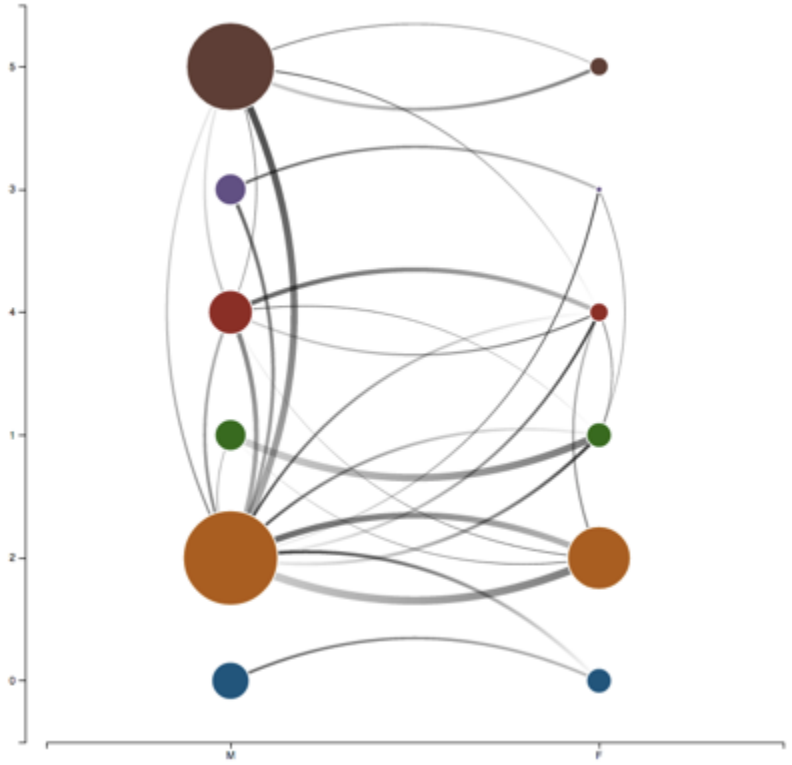
B. Shneiderman and A. Aris, “Network Visualization by Semantic Substrates,” IEEE Transactions on Visualization and Computer Graphics, vol. 12, no. 5, pp. 733 –740, 2006.

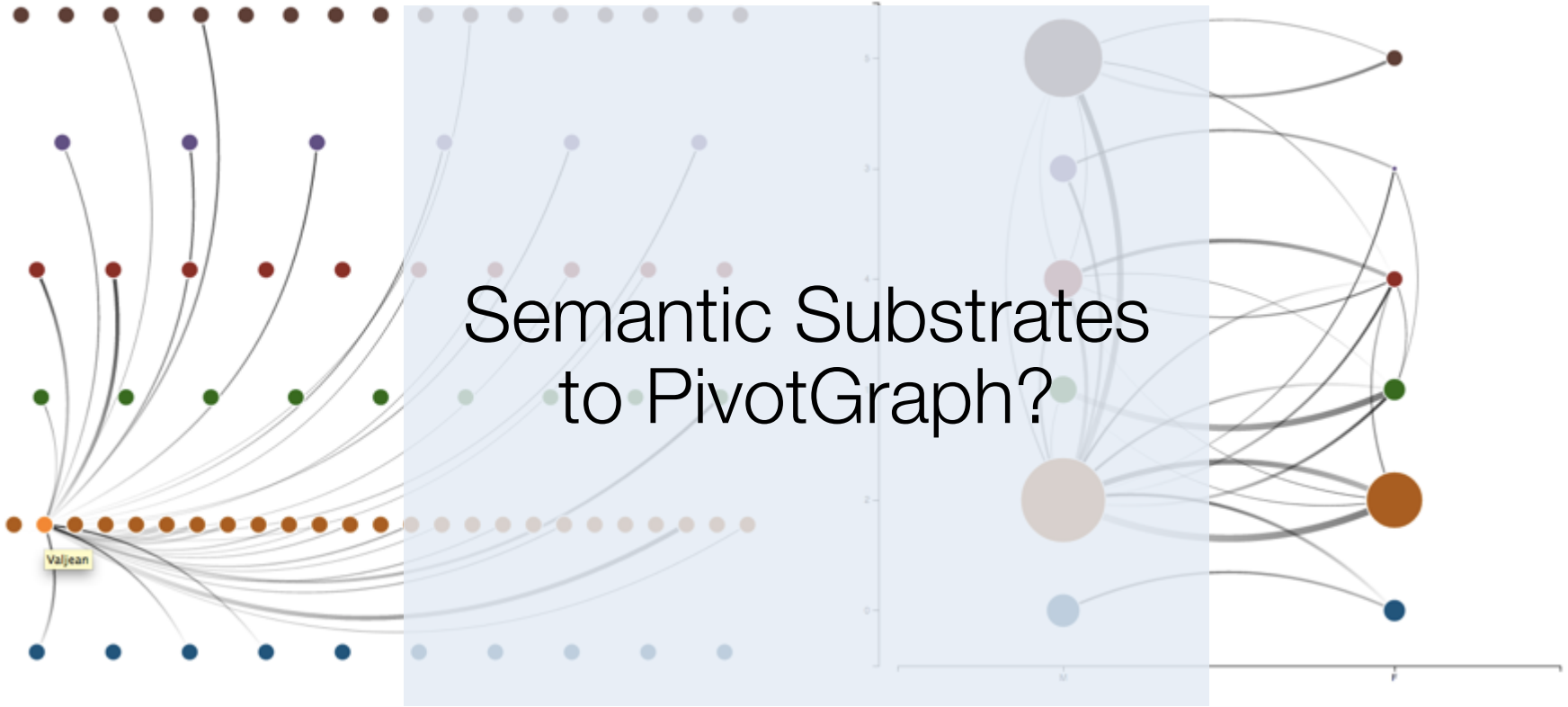
PivotGraph



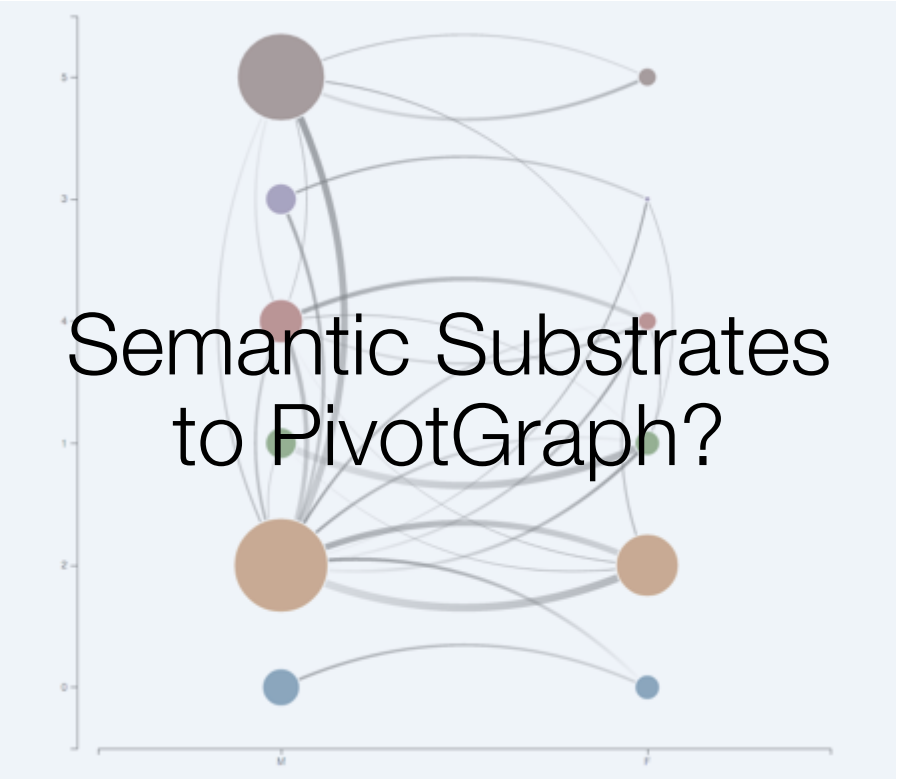
M. Wattenberg, “Visual Exploration of Multivariate Graphs,” in Proc. of the ACM SIGCHI Conference on Human Factors in Computing Systems, (CHI 2006), New York, NY, USA, 2006, pp. 811 –819.


Valjean


5
3
4
1
2
0
M
F



Semantic Substrates to PivotGraph?

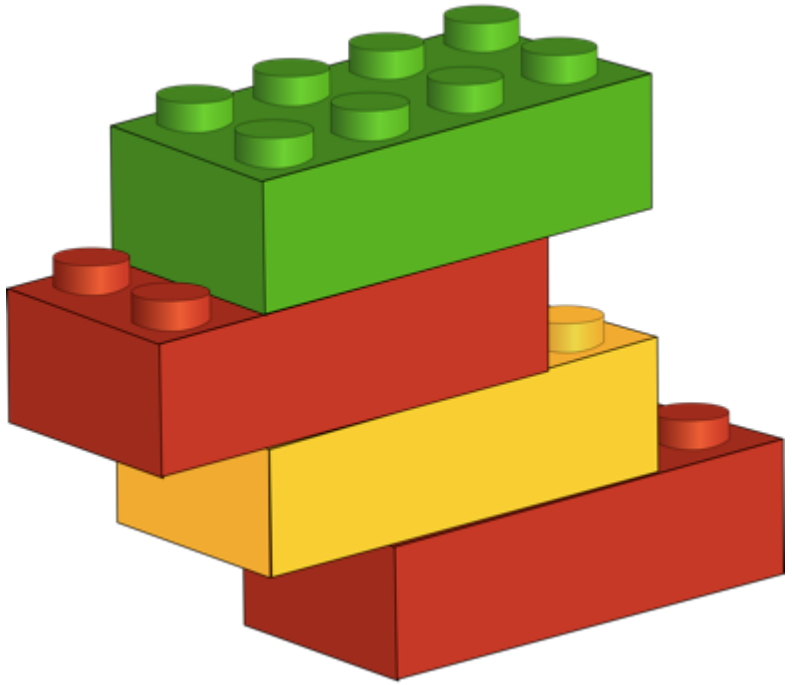


- Substrate on X
- Aggregate
- (Size Nodes by Count)
- Display All Links
- Show X Axis
- Show Y Axis

Graph-Level Operations

Graph-Level Operations (GLOs)

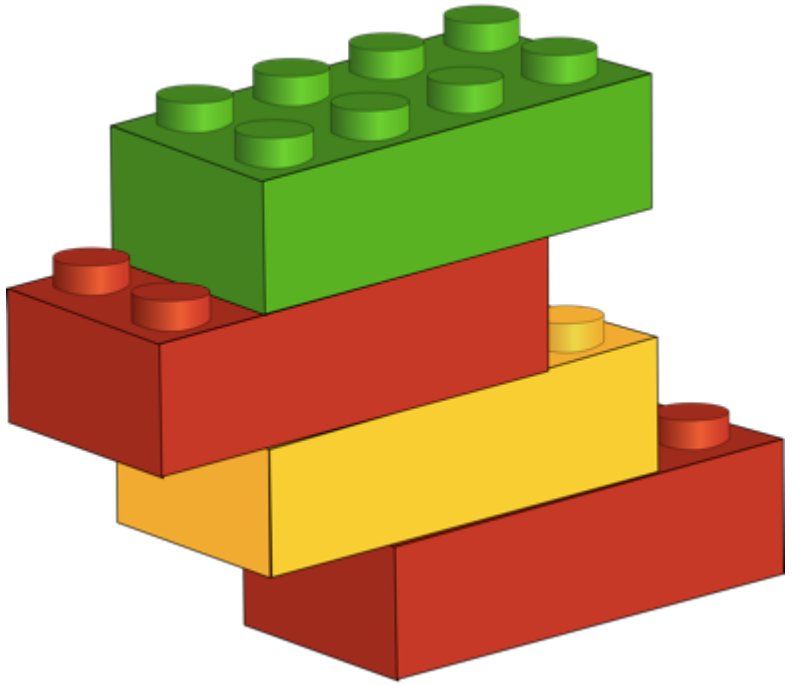
Graph-Level Operations



https://openclipart.org/detail/184889/lego-blocks-by-eggib-184889

Graph-Level Operations

Encapsulated
Manipulations
of Graph Visualizations



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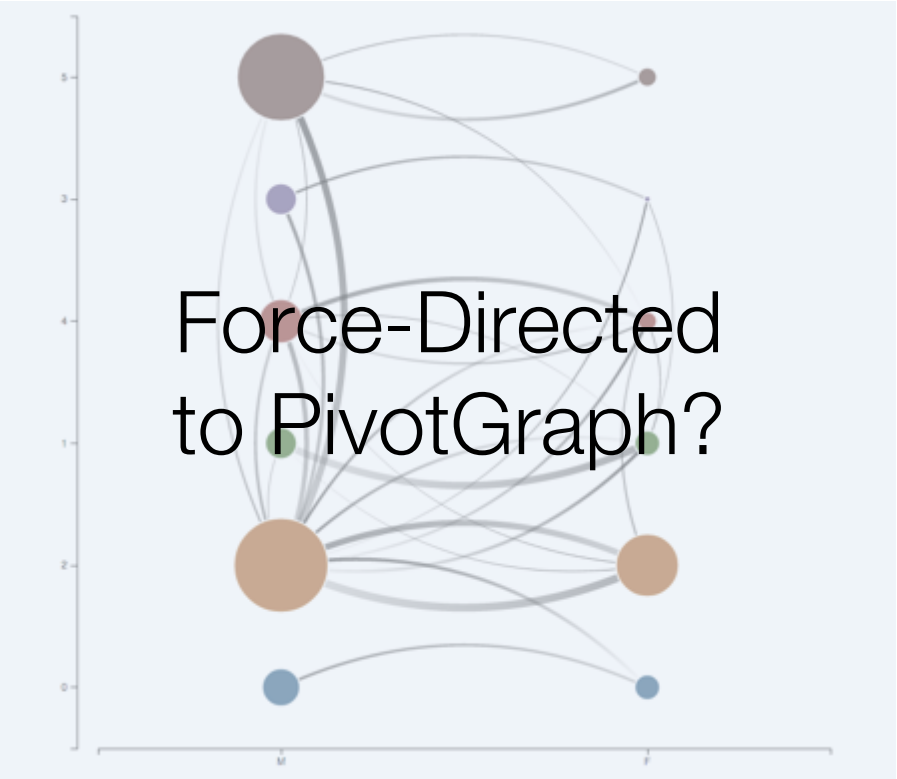
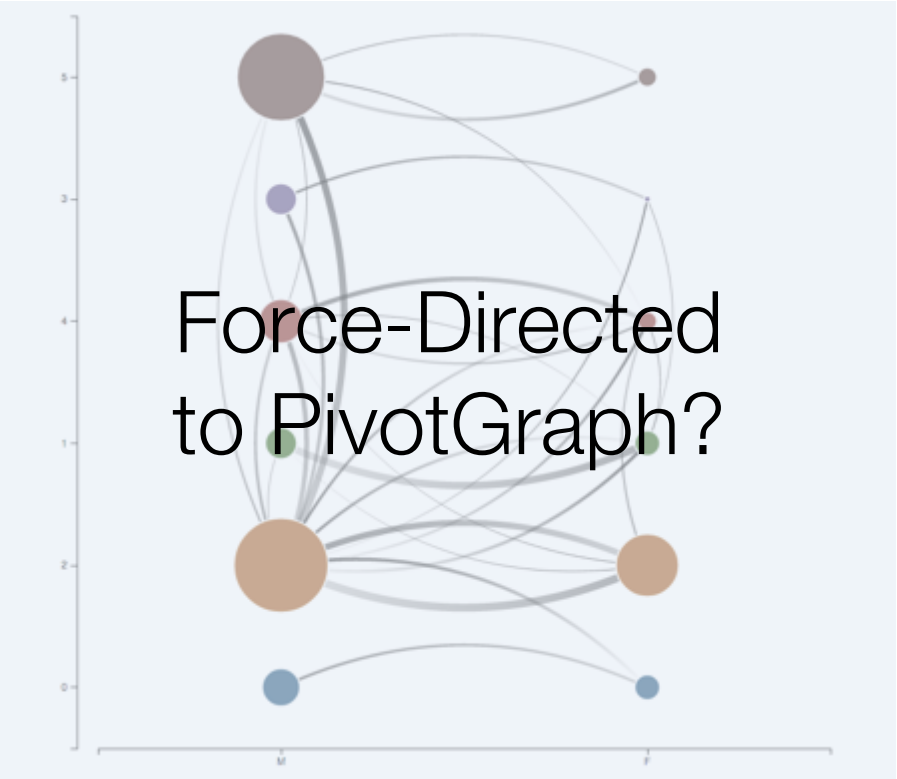
Force-Directed
to PivotGraph?

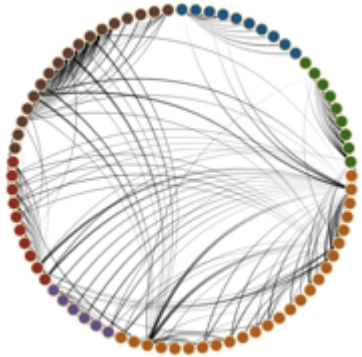


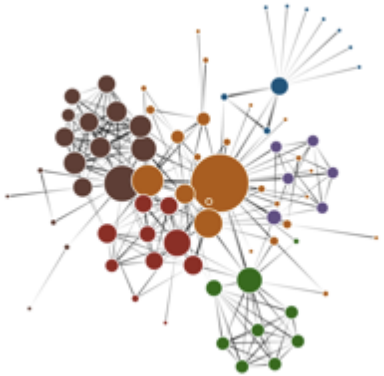
- Substrate on X
- Substrate on Y
- Show Links as Curved
- Aggregate
- (Size Nodes by Count)
- Show X Axis
- Show Y Axis

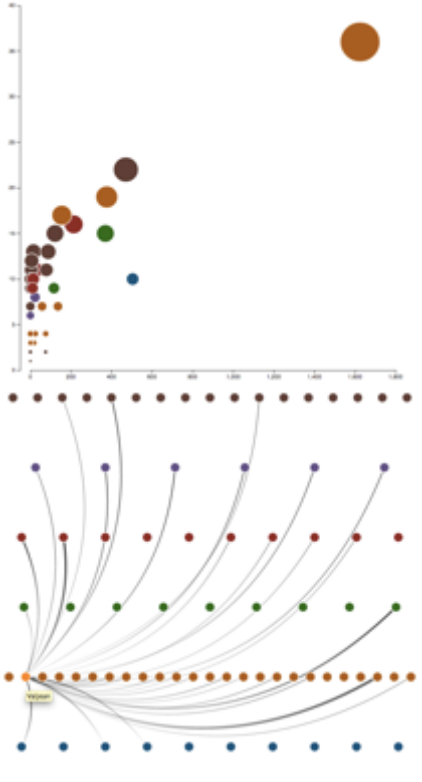


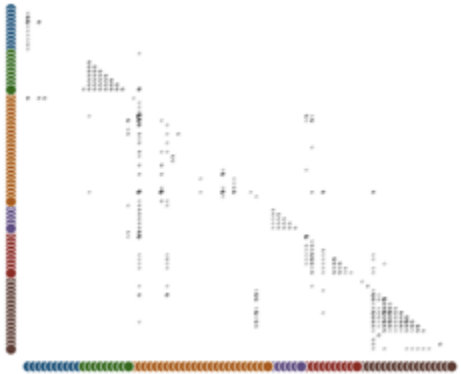
- Substrate on X
- Substrate on Y
- Show Links as Curved
- Aggregate
- (Size Nodes by Count)
- Show X Axis
- Show Y Axis

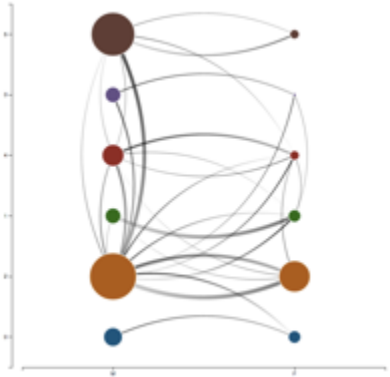
Identifying GLOs



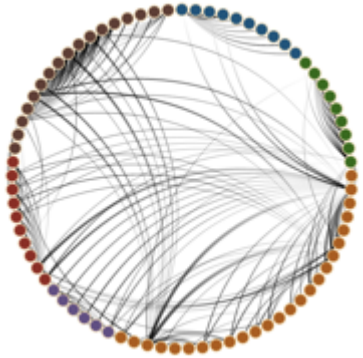






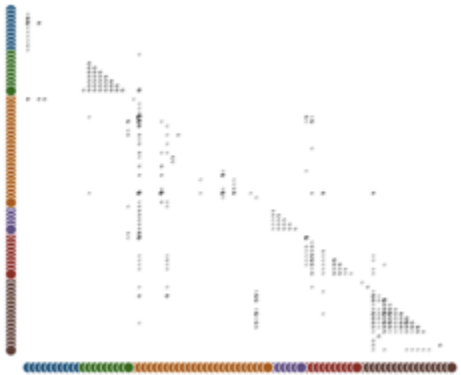


Identifying GLOs



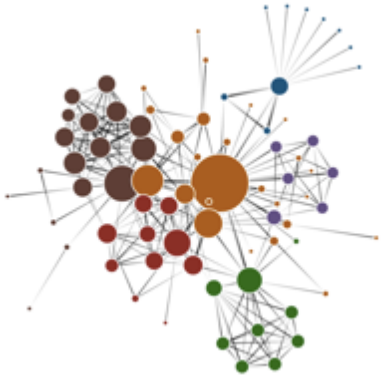
Circle Plot

Identifying GLOs



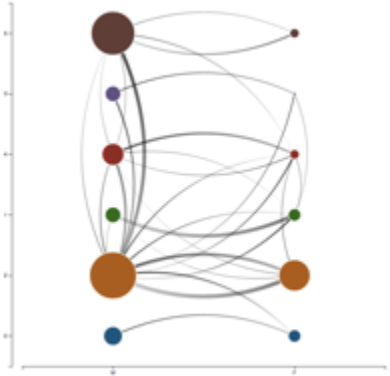
Matrix

Identifying GLOs



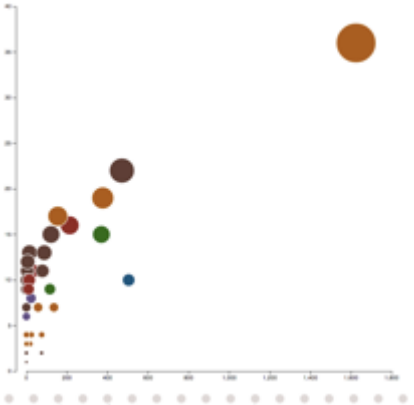
Force-Directed

Identifying GLOs



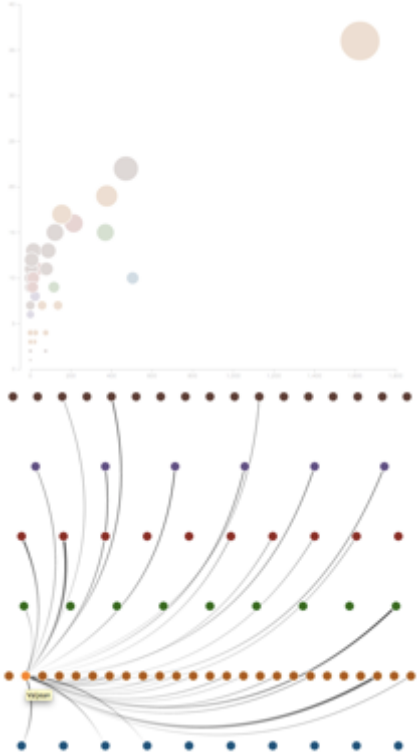
PivotGraph

Identifying GLOs



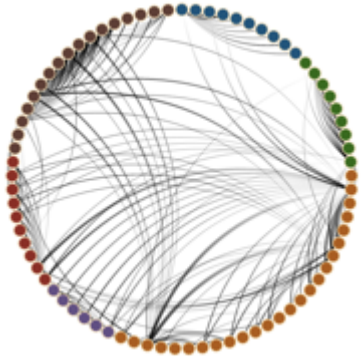
Scatterplot

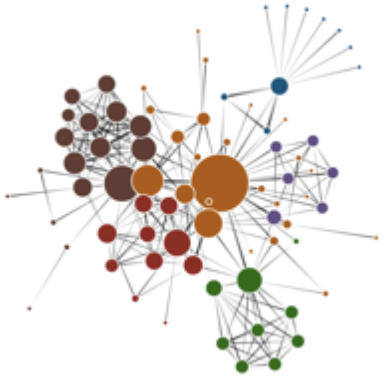
Identifying GLOs

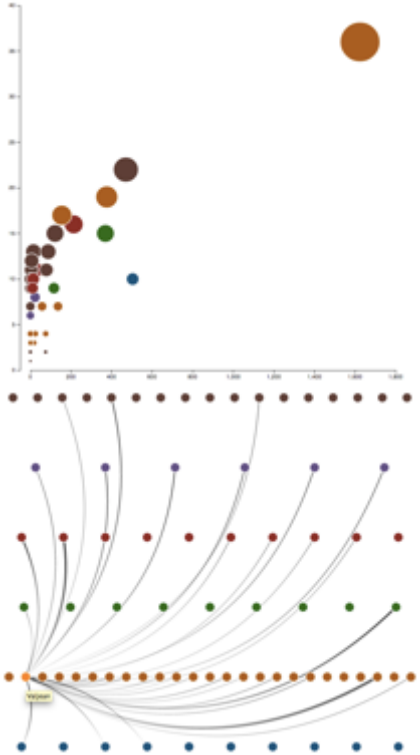


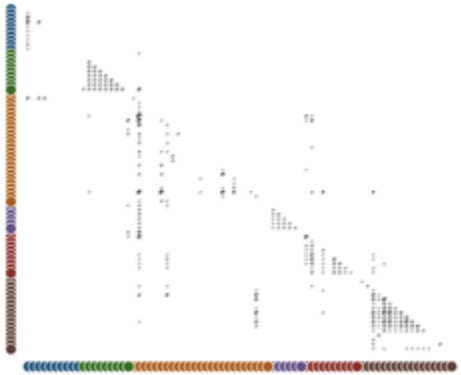
Semantic Substrates

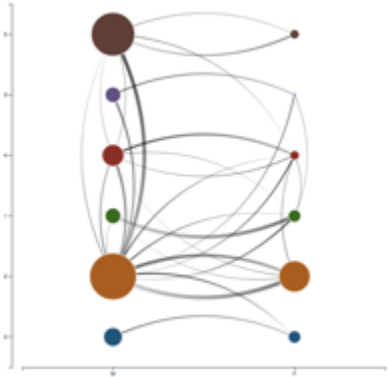
Identifying GLOs











Identifying GLOs

1. Align Nodes
2. Evenly Distribute Nodes
3. Evenly Distribute Nodes by Attribute
4. Substrate Nodes by Attribute
5. Evenly Distribute Nodes within Substrates
6. Position Nodes Relatively
7. Evenly Distribute Nodes Radially by Attribute
8. Evenly Distribute Nodes Radially
9. Position Nodes Radially by Attribute
10. Substrate Nodes Radially by Attribute
11. Evenly Distribute Nodes Along Plot Radius
12. Evenly Distribute Nodes Along Plot Radius
13. Position Nodes Along Plot Radius by Attribute
14. Substrate Nodes Along Plot Radius
15. Position Nodes Along Plot Radius by Constant
16. Apply an Algorithm to the Nodes
17. Size Nodes by a Constant
18. Size Nodes Relatively by a Continuous Attribute
19. Display All Links
20. Display Selected Links
21. Hide Links
22. Display Links as Straight
23. Display Links as Curved
24. Display Links as Circles
25. Clone Active Generation
26. Select Generation k
27. Set Source Generation k
28. Set Target Generation k
29. Remove Generation k
30. Aggregate by Attribute
31. Aggregate by Attribute and Attribute
32. Deaggregate Generation k
33. Show Axis
34. Hide Axis

Identifying GLOs

1. Align Nodes
2. Evenly Distribute Nodes
3. Evenly Distribute Nodes by Attribute
4. Substrate Nodes by Attribute
5. Evenly Distribute Nodes within Substrates
6. Position Nodes Relatively
7. Evenly Distribute Nodes Radially by Attribute
8. Evenly Distribute Nodes Radially
9. Position Nodes Radially by Attribute
10. Substrate Nodes Radially by Attribute
11. Evenly Distribute Nodes Along Plot Radius
12. Evenly Distribute Nodes Along Plot Radius
13. Position Nodes Along Plot Radius by Attribute
14. Substrate Nodes Along Plot Radius
15. Position Nodes Relatively by a Constant
16. Apply an Algorithm to the Nodes
17. Size Nodes by a Constant
18. Size Nodes Relatively by a Continuous Attribute
19. Display All Links
20. Display Selected Links
21. Hide Links
22. Display Links as Straight
23. Display Links as Curved
24. Display Links as Circles
25. Clone Active Generation
26. Select Generation k
27. Set Source Generation k
28. Set Target Generation k
29. Remove Generation k
30. Aggregate by Attribute
31. Aggregate by Attribute and Attribute
32. Deaggregate Generation k
33. Show Axis
34. Hide Axis

34 Operations

Identifying GLOs

1. Align Nodes
2. Evenly Distribute Nodes
3. Evenly Distribute Nodes by Attribute
4. Substrate Nodes by Attribute
5. Evenly Distribute Nodes within Substrates
6. Position Nodes Relatively
7. Evenly Distribute Nodes Radially by Attribute
8. Evenly Distribute Nodes Radially
9. Position Nodes Radially by Attribute
10. Substrate Nodes Radially by Attribute
11. Evenly Distribute Nodes Along Plot Radius
12. Evenly Distribute Nodes Along Plot Radius
13. Position Nodes Along Plot Radius by Attribute
14. Substrate Nodes Along Plot Radius
15. Position Nodes by a Constant
16. Apply an Algorithm to the Nodes
17. Size Nodes by a Constant
18. Size Nodes by Attribute
19. Display All Links
20. Display Selected Links
21. Hide Links
22. Display Links as Straight
23. Display Links as Curved
24. Display Links as Circles
25. Clone Active Generation
26. Select Generation k
27. Set Source Generation k
28. Set Target Generation k
29. Remove Generation k
30. Aggregate by Attribute
31. Aggregate by Attribute and Attribute
32. Deaggregate Generation k
33. Show Axis
34. Hide Axis

34 Operations

Card-Sorting

Identifying GLOs

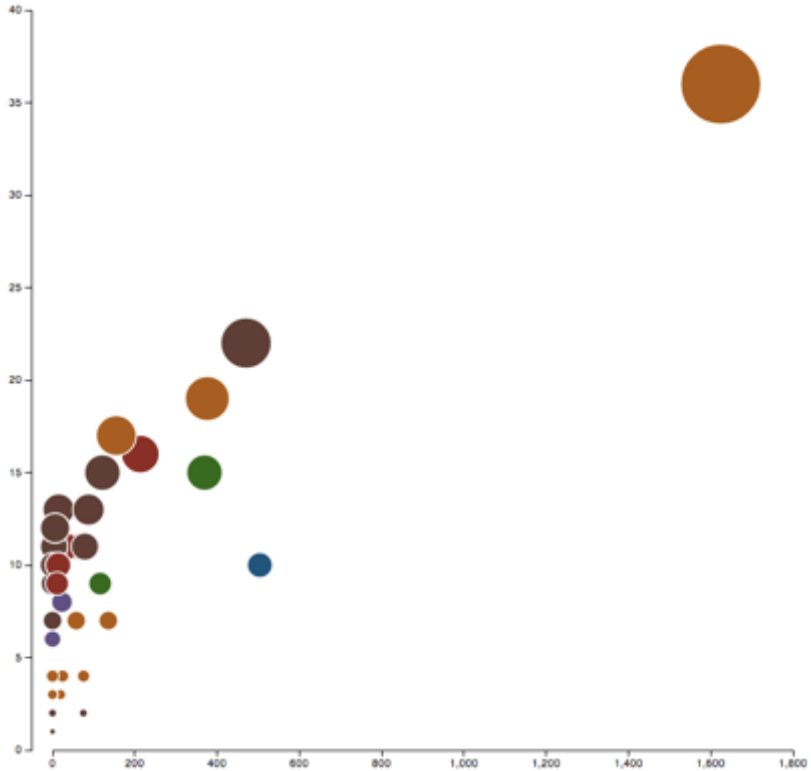
1. Align Nodes
2. Evenly Distribute Nodes
3. Evenly Distribute Nodes by Attribute
4. Substrate Nodes by Attribute
5. Evenly Distribute Nodes within Substrates
6. Position Nodes Relatively
7. Evenly Distribute Nodes Radially by Attribute
8. Evenly Distribute Nodes Radially
9. Position Nodes Radially by Attribute
10. Substrate Nodes Radially by Attribute
11. Evenly Distribute Nodes Along Plot Radius
12. Evenly Distribute Nodes Along Plot Radius
13. Position Nodes Along Plot Radius by Attribute
14. Substrate Nodes Along Plot Radius
15. Position Nodes Along Plot Radius by Constant
16. Apply an Algorithm to the Nodes
17. Resize Nodes by a Constant
18. Resize Nodes by an Attribute
19. Display All Links
20. Display Selected Links
21. Hide Links
22. Display Links as Straight
23. Display Links as Curved
24. Display Links as Circles
25. Clone Active Generation
26. Select Generation k
27. Set Source Generation k
28. Set Target Generation k
29. Remove Generation k
30. Aggregate by Attribute
31. Aggregate by Attribute and Attribute
32. Deaggregate Generation k
33. Show Axis
34. Hide Axis

34 Operations

5 Categories

Categories: Modifying Display Properties

Categories: Modifying Display Properties



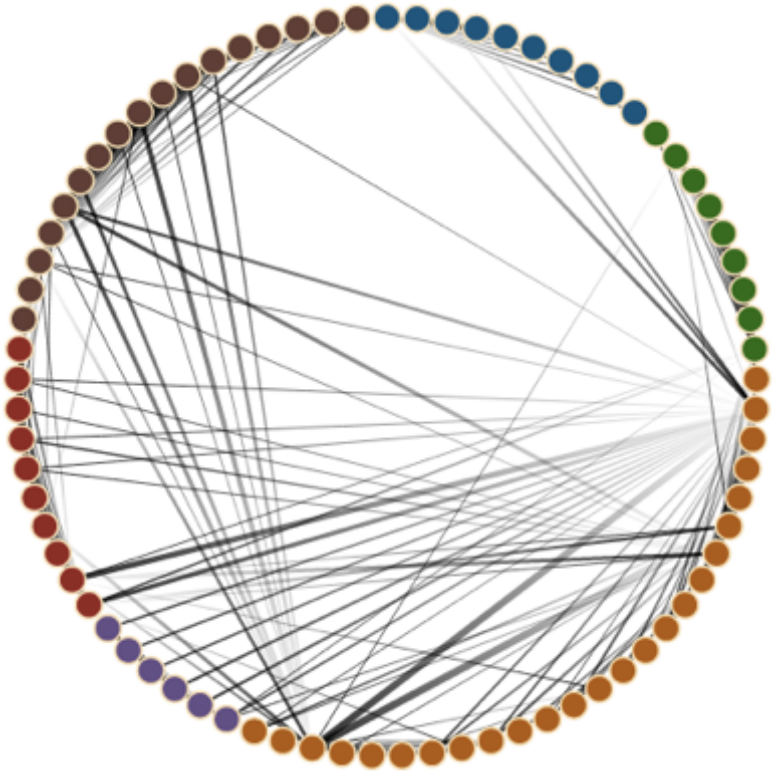
Show Axis

Hide Axis

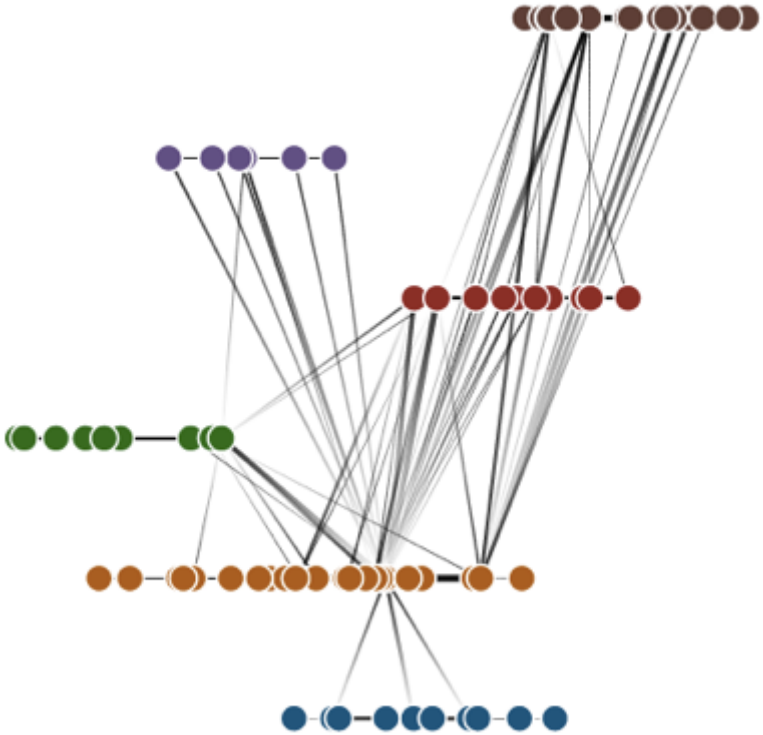
Categories: Positioning Nodes

Categories: Positioning Nodes

Evenly Distribute Nodes Radially by Attribute

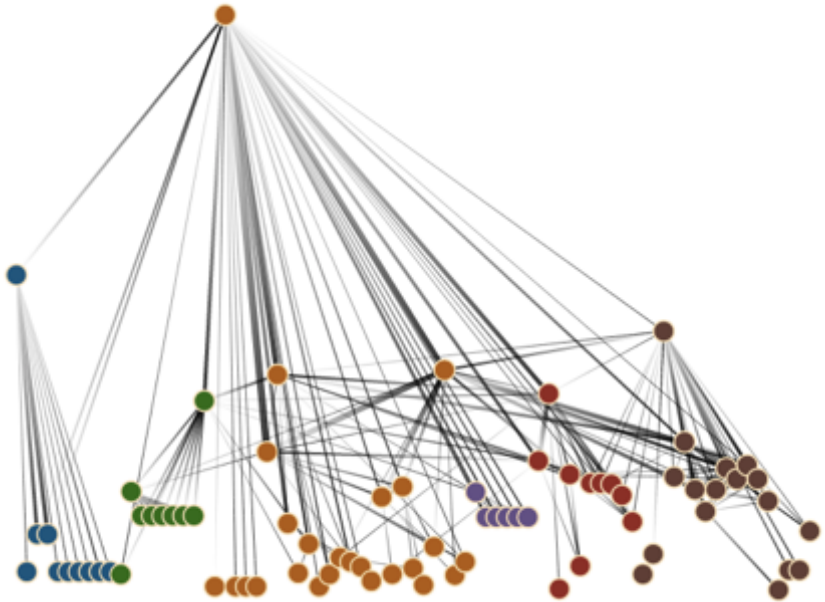


Categories: Positioning Nodes



Substrate Nodes by Categorical Attribute

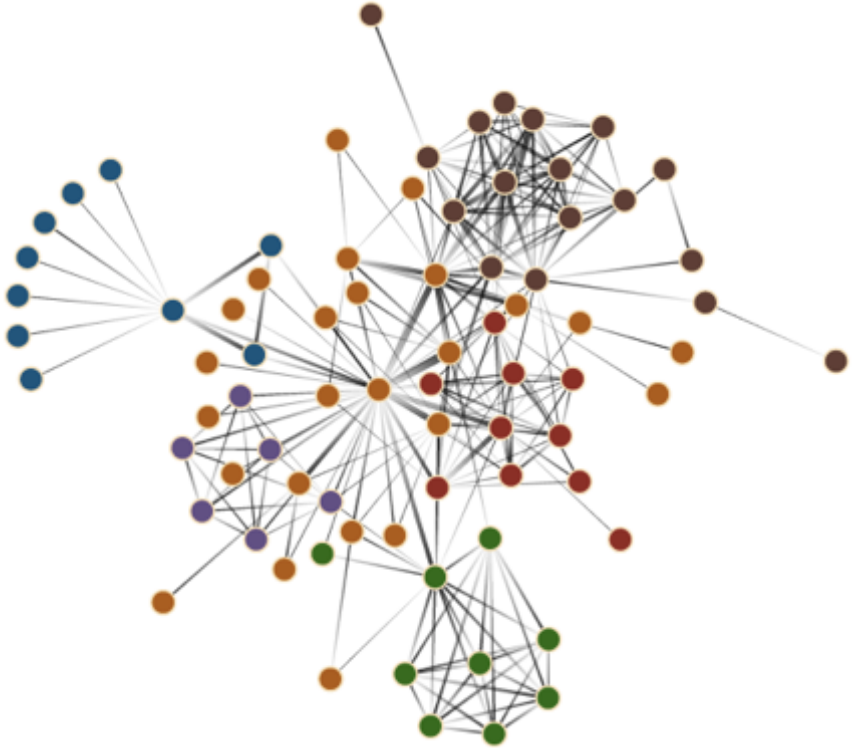
Categories: Positioning Nodes



Position Nodes Relatively by Continuous Attribute

Categories: Modifying Element Properties

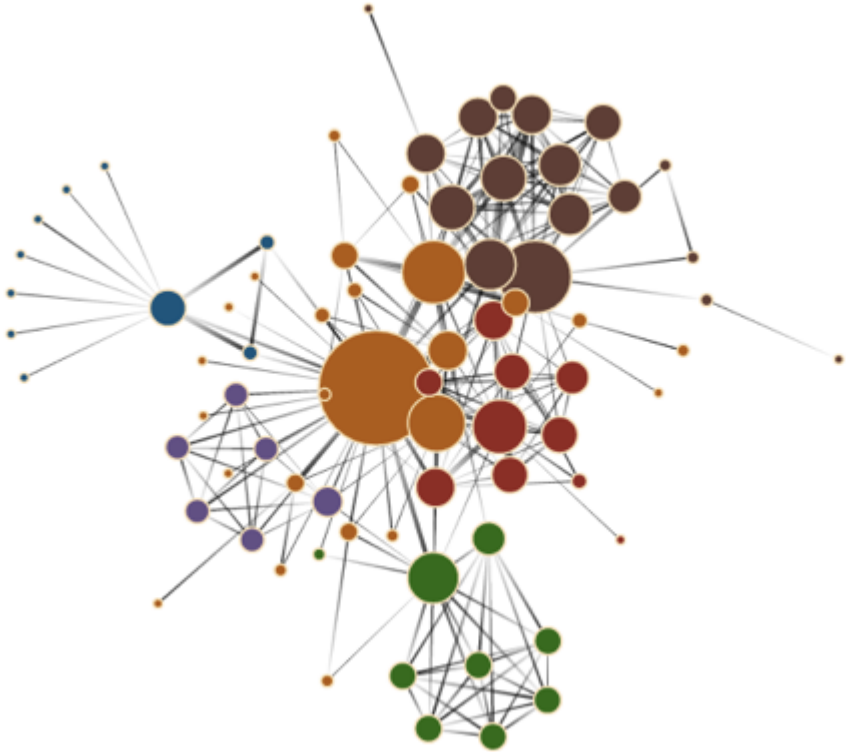
Categories: Modifying Element Properties



Size Nodes by Constant

Categories: Modifying Element Properties

Size Nodes by Attribute



Categories: Modifying Element Properties

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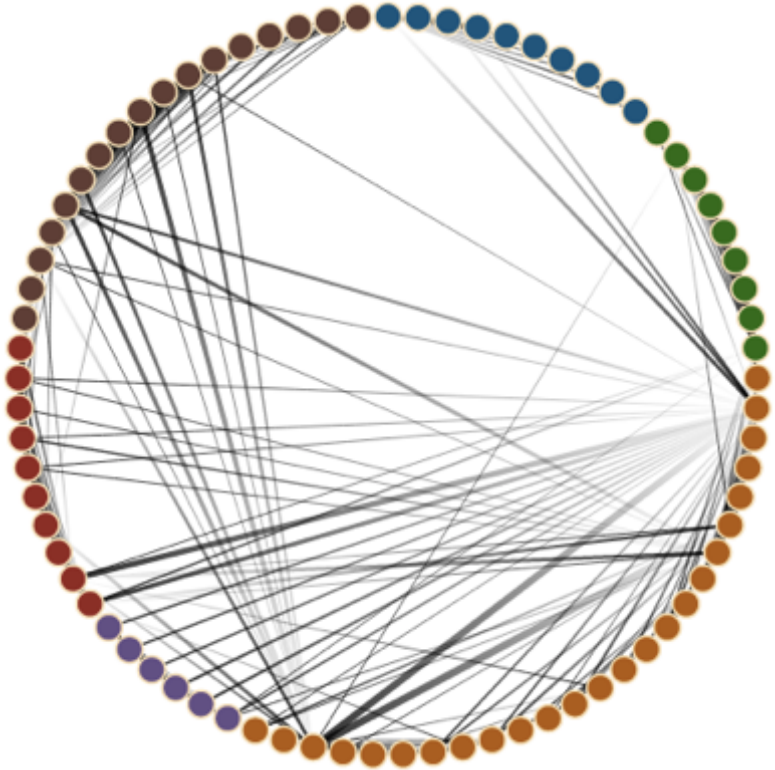
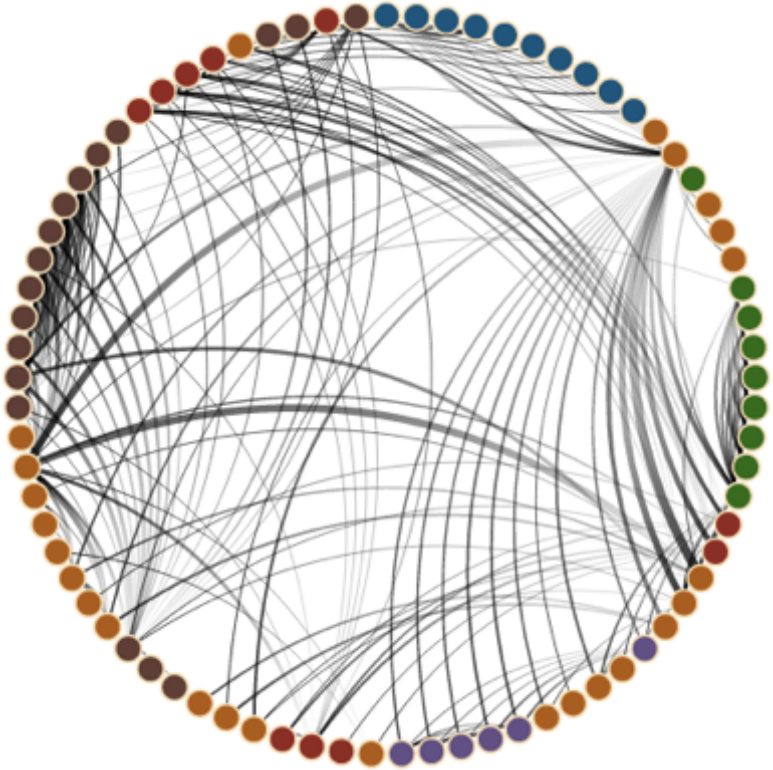


Display Links as Straight

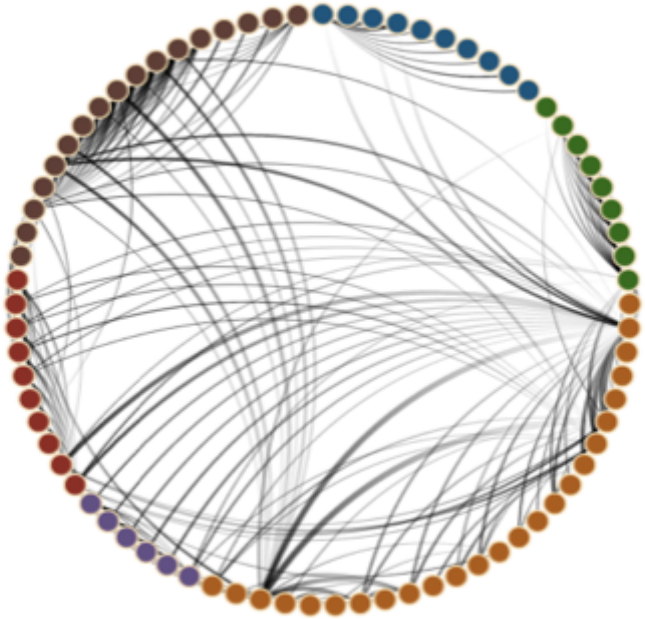
Categories: Modifying Element Properties

Display Links as Curved

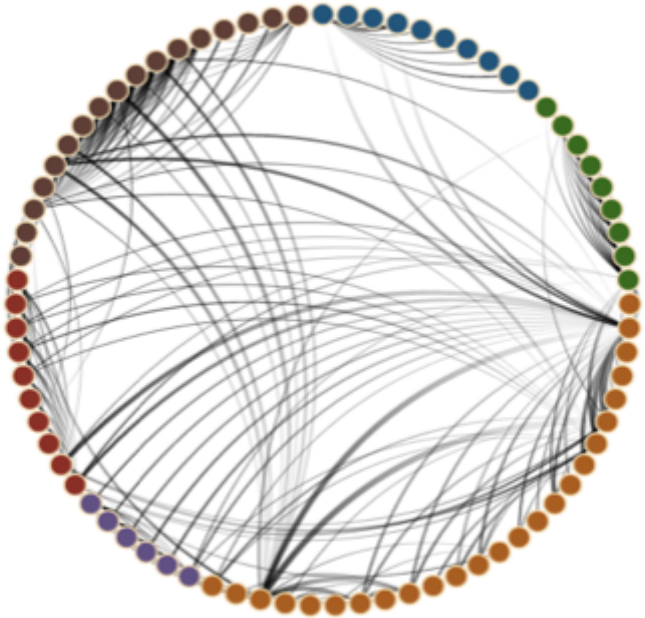


Categories: Cloning Nodes

Categories: Aggregating Nodes and Edges



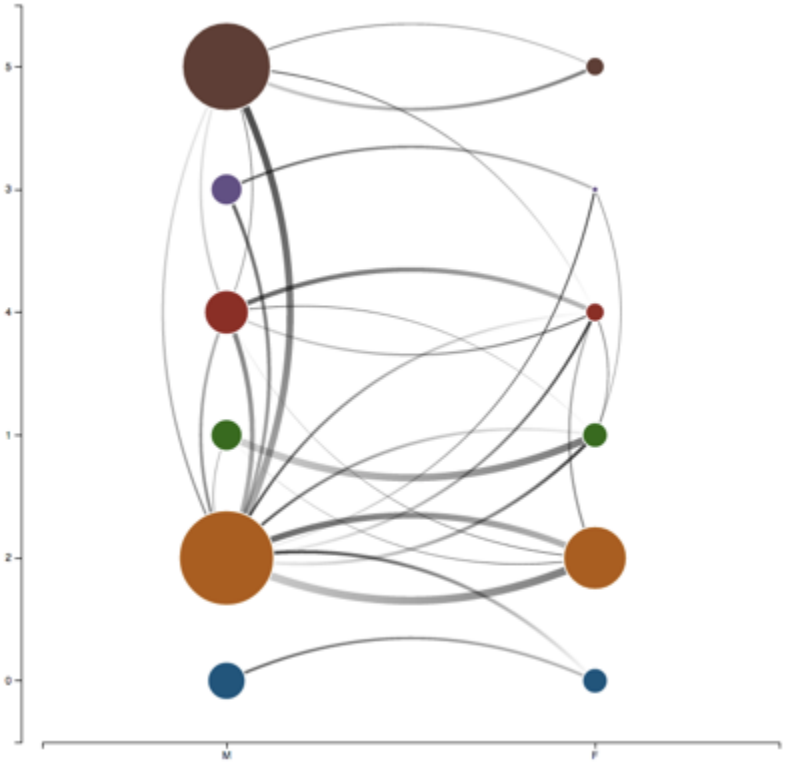
Categories: Aggregating Nodes and Edges



So why do this?

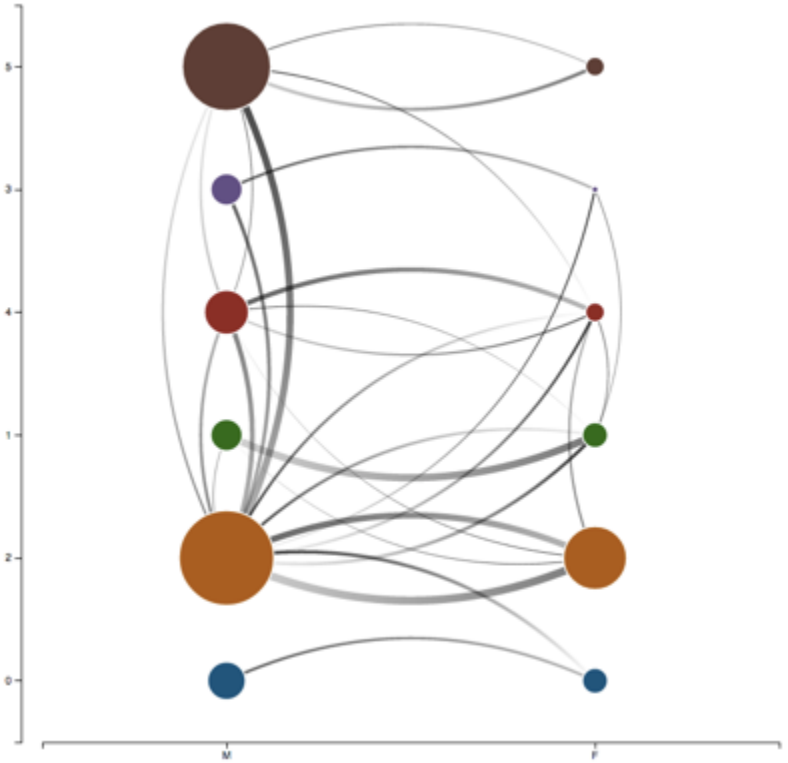
Benefits: Specifying Techniques

Benefits: Specifying Techniques

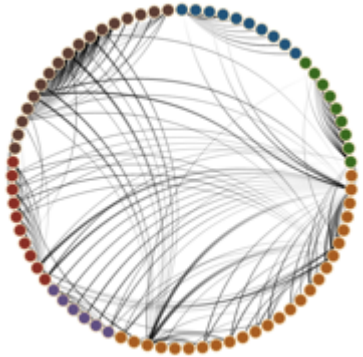


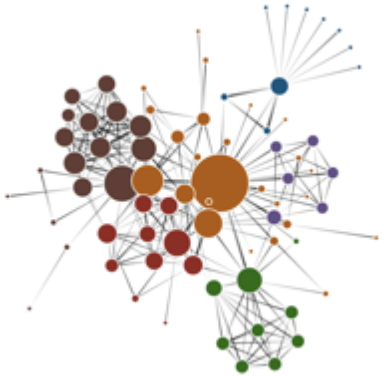
Benefits: Specifying Techniques

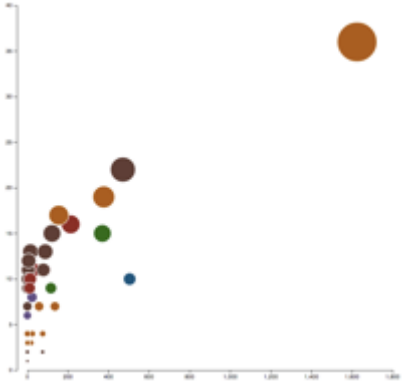
How did we get here?

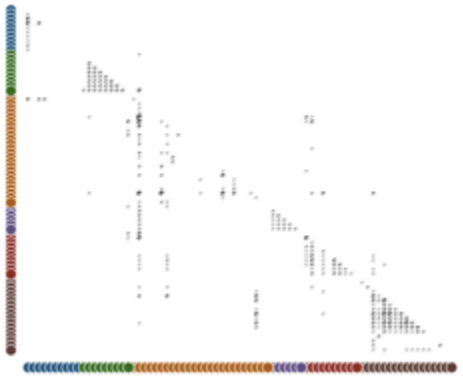


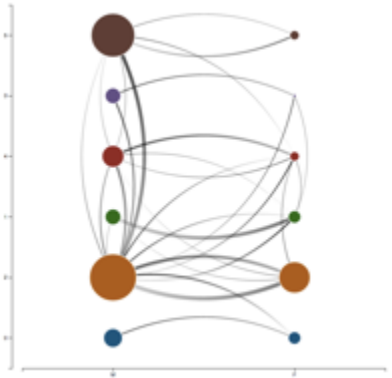
Benefits: Specifying Techniques

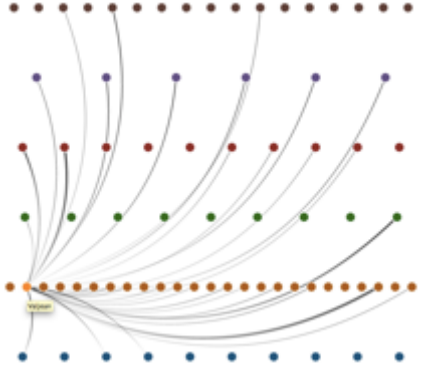












Benefits: Specifying Techniques

Substrate Nodes on *x* by *attribute0*

Substrate Nodes on *y* by *attribute1*

Aggregate Nodes
(by *attribute0* and *attribute1)*

Size Nodes by Count

Show x Axis

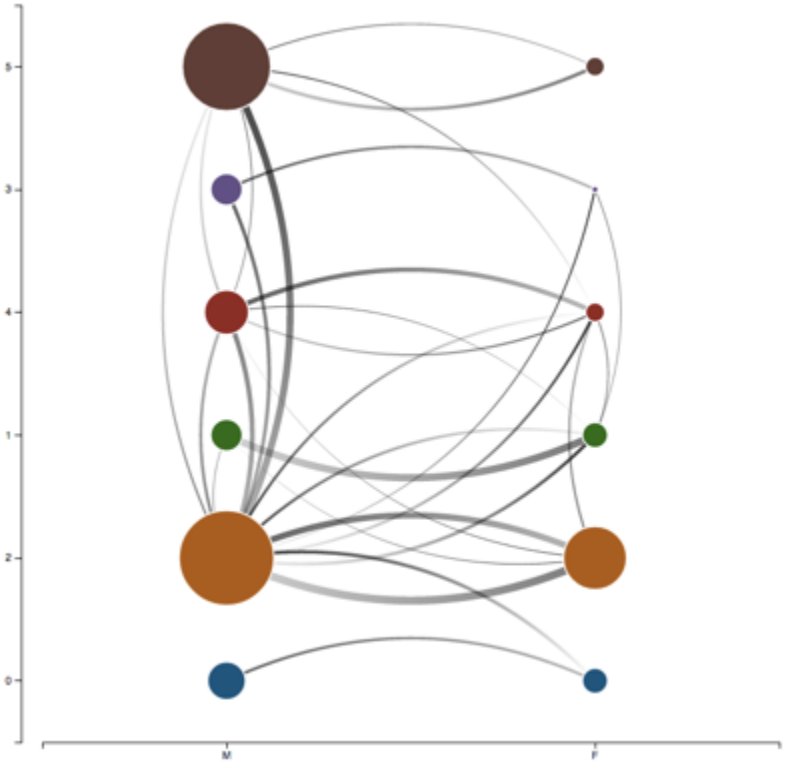
Show y Axis

Display Links as Curved

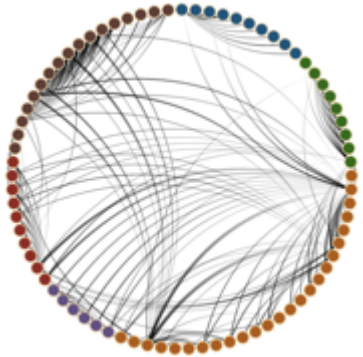
Display All Links

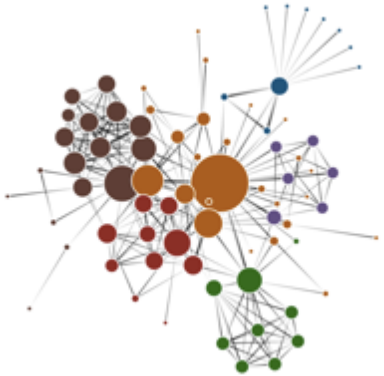
Set Target Generation 1

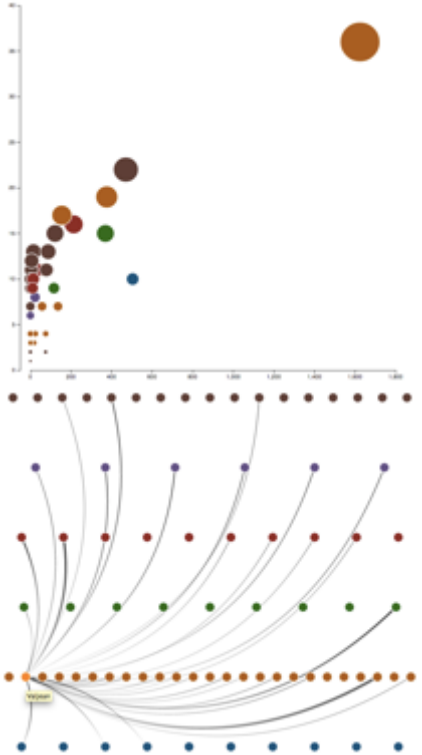
Set Source Generation 1

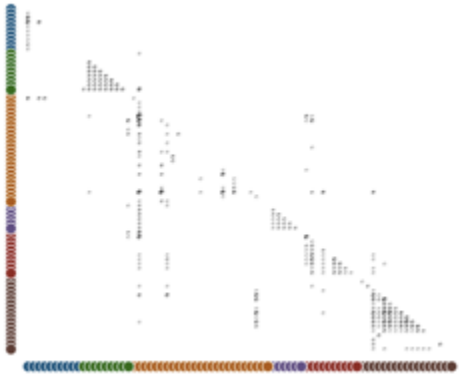


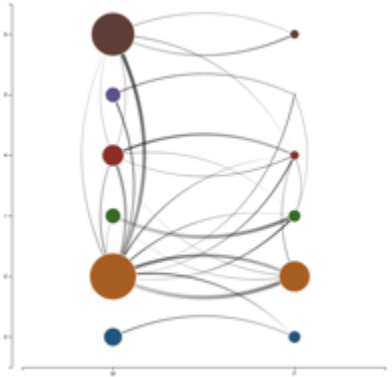
Benefits: Specifying Techniques



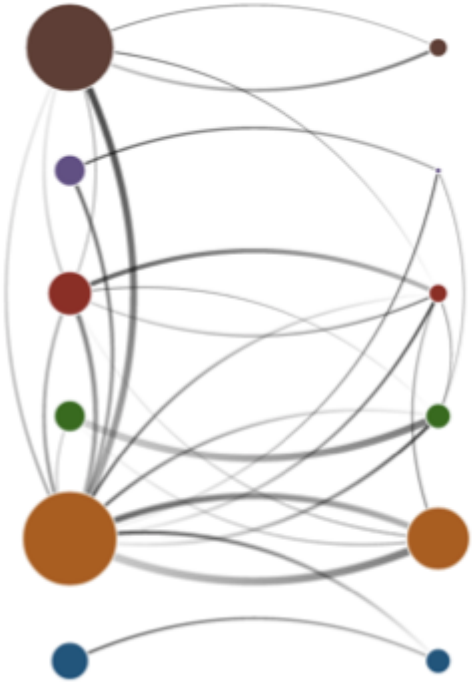




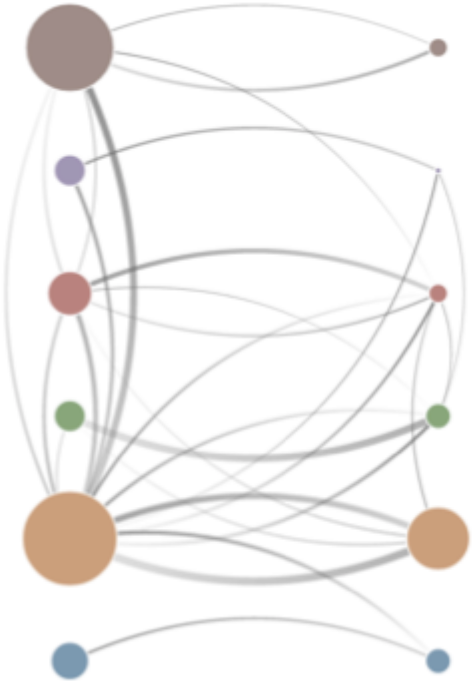


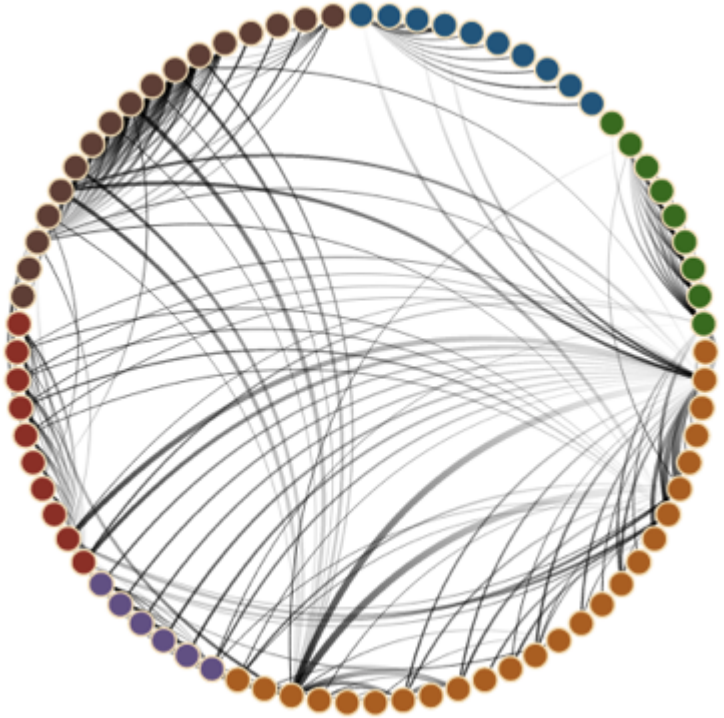


Benefits: Specifying Techniques

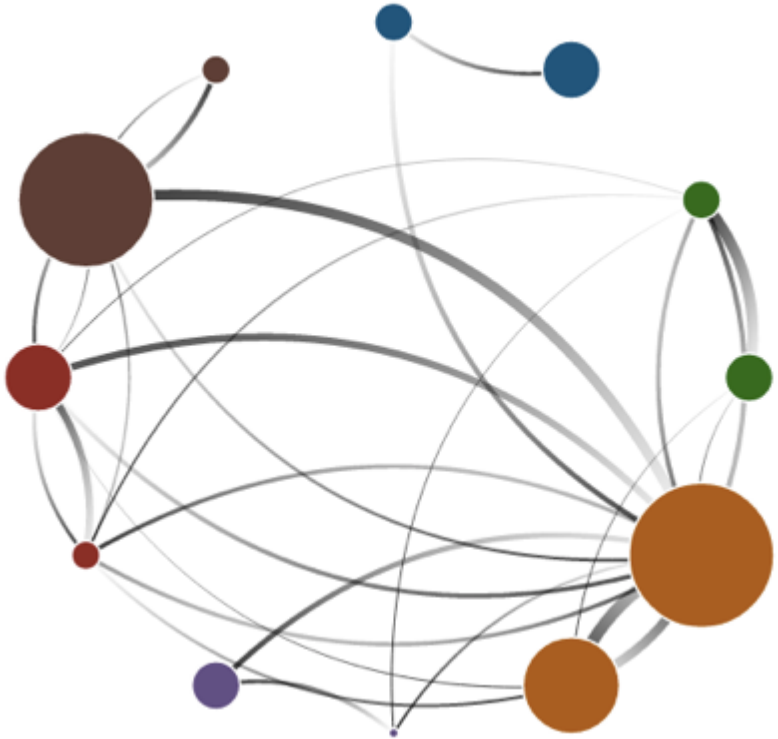


Benefits: Specifying Techniques

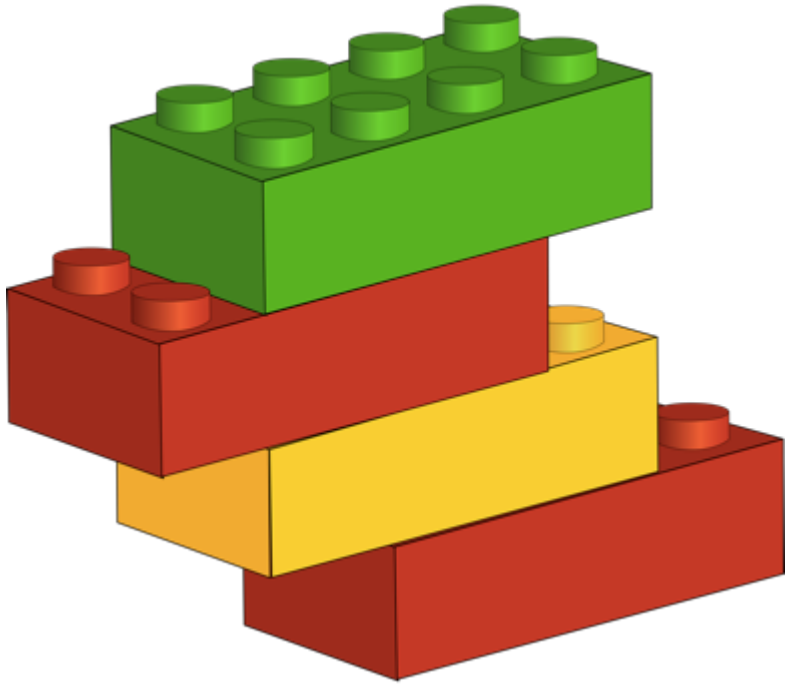




Benefits: Specifying Techniques



Benefits: For Engineers…

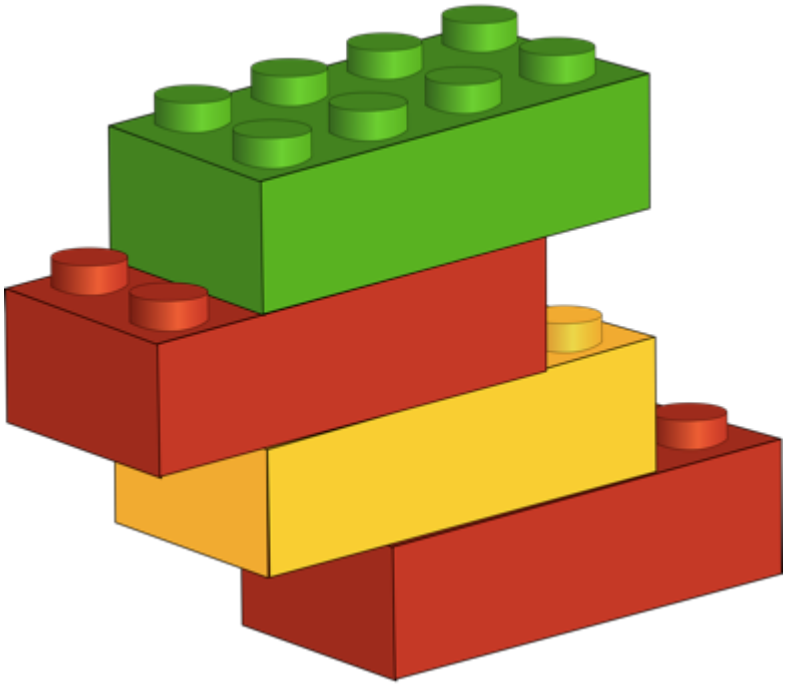


https://openclipart.org/detail/184889/lego-blocks-by-eggib-184889

Benefits: For Engineers…

Fixed Implementation Target

Get the Techniques “For Free”



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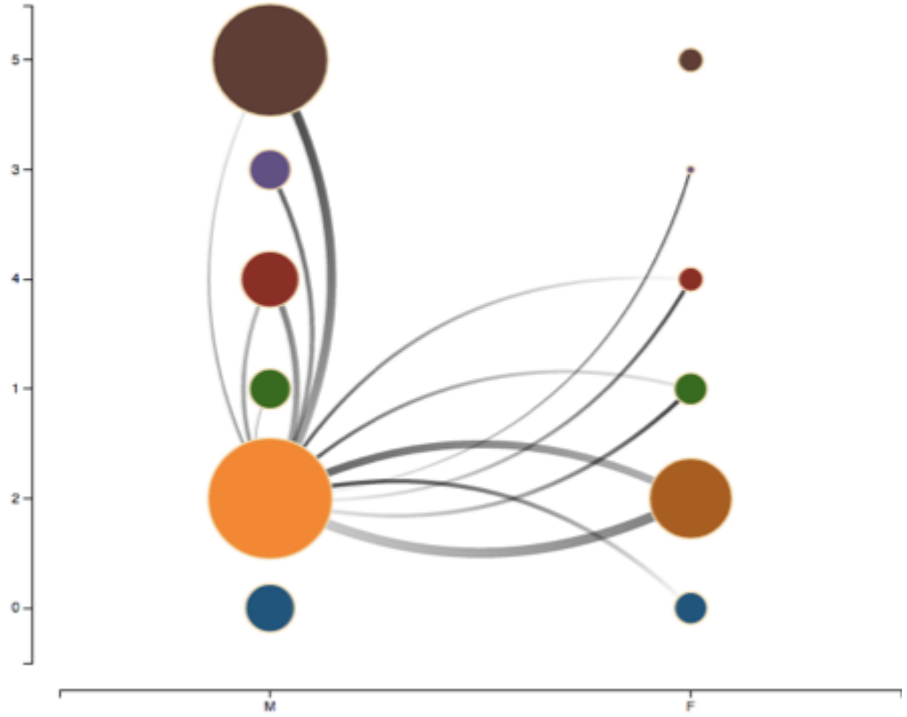
Benefits: For Analysts…

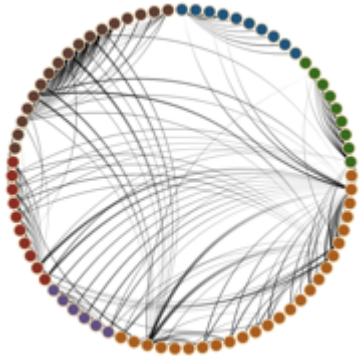


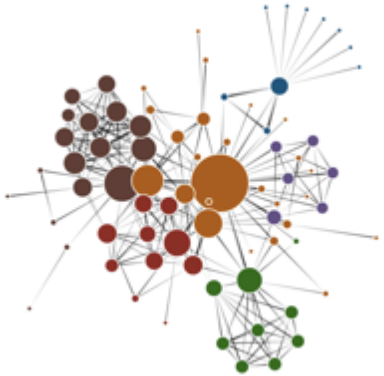
Benefits: For Analysts…

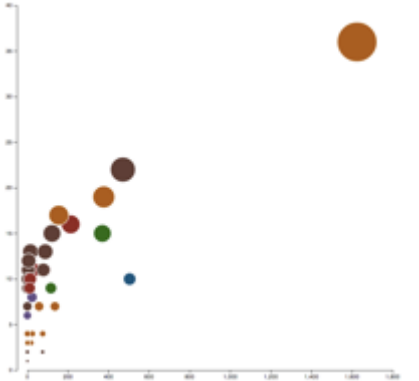
New Method of Graph Exploration

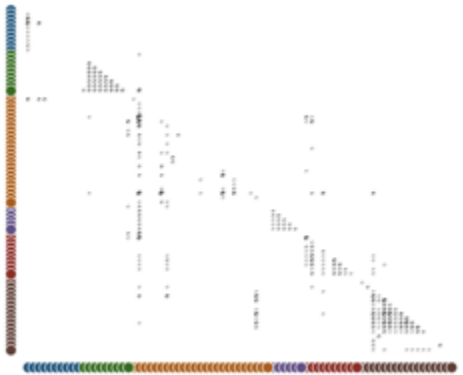
“Between Techniques”

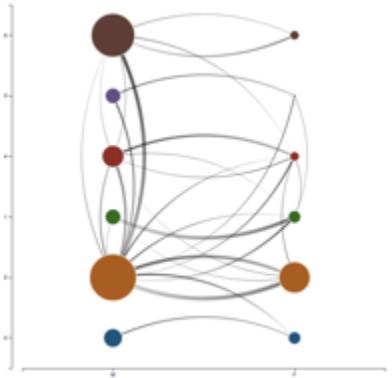
Benefits: For the Visualization Community…

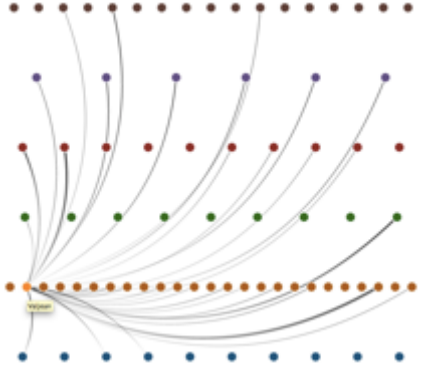












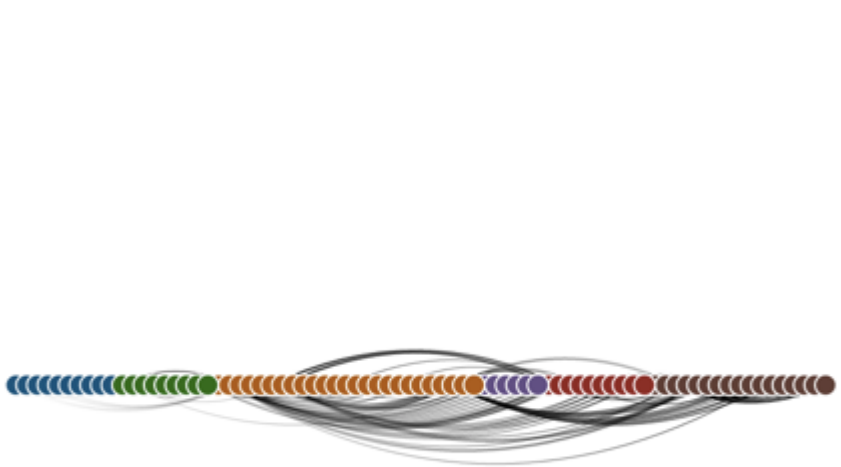
Benefits: For the Visualization Community…

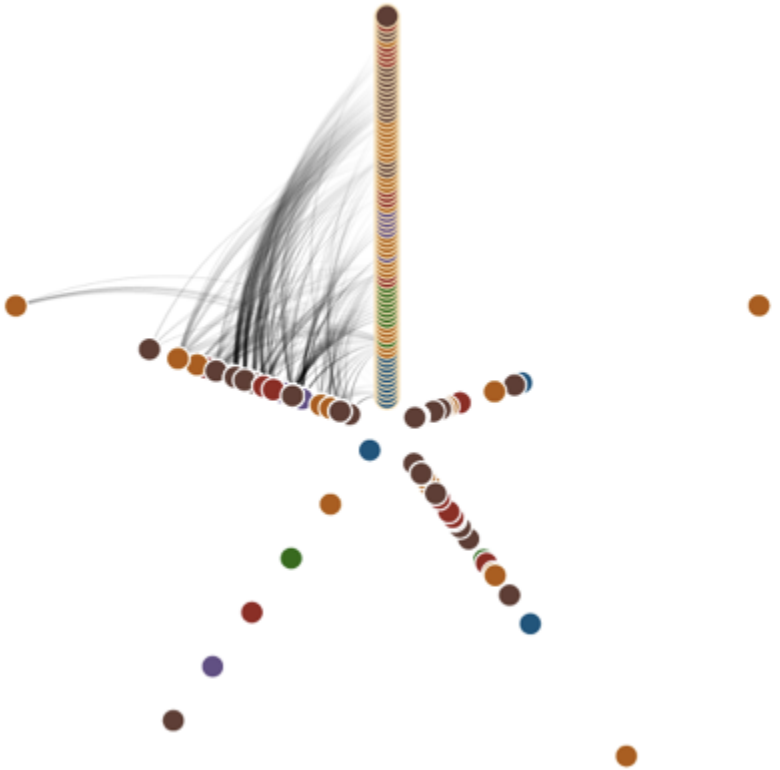
Identify New, Effective Techniques?

Benefits: For the Visualization Community…

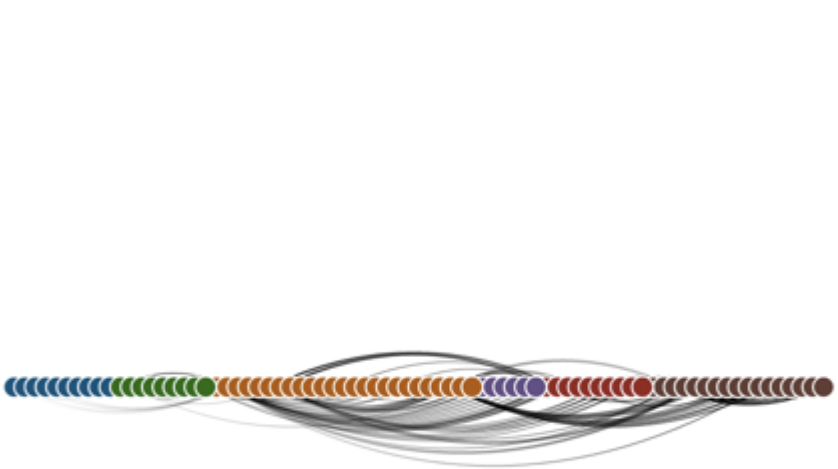
Identify New, Effective Techniques?

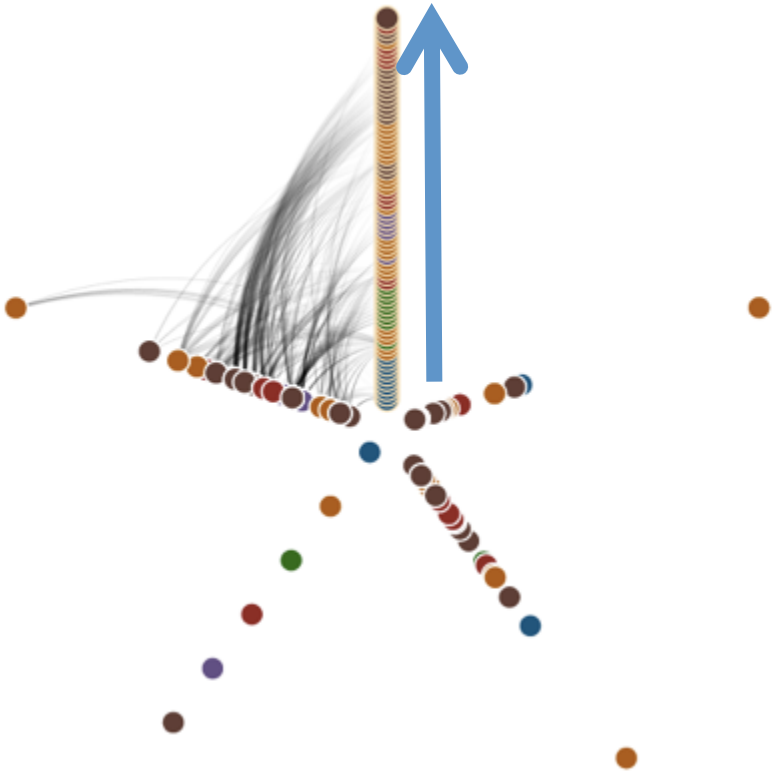
Benefits: For the Visualization Community…



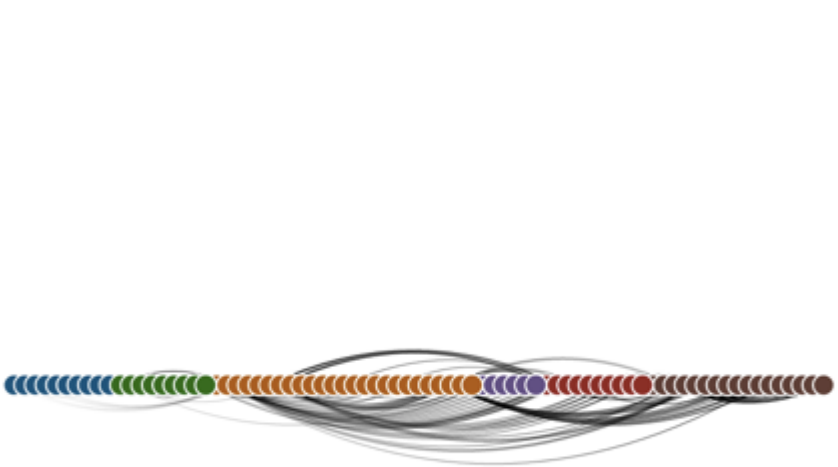


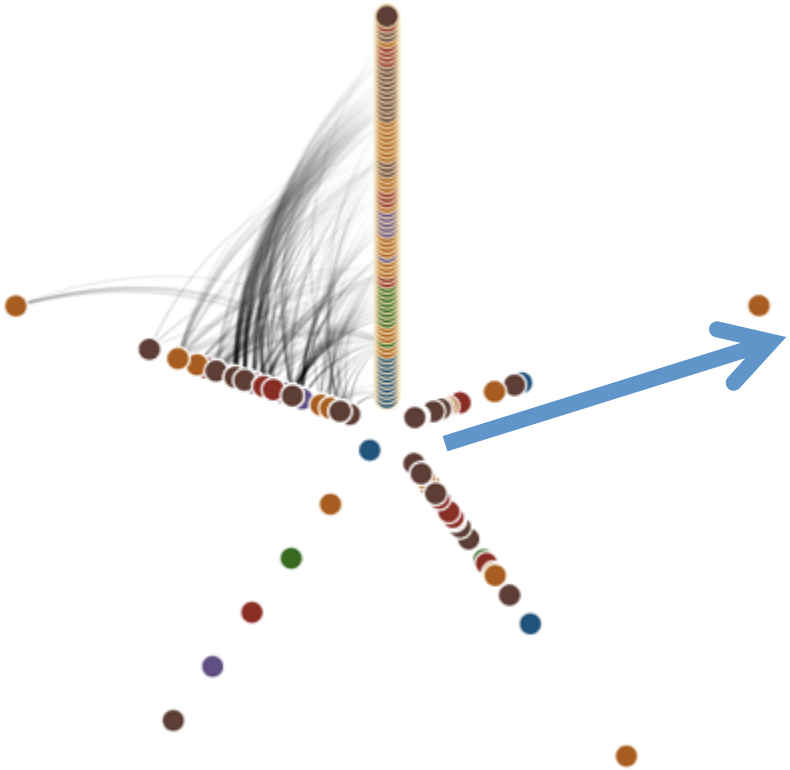
Benefits: For the Visualization Community…



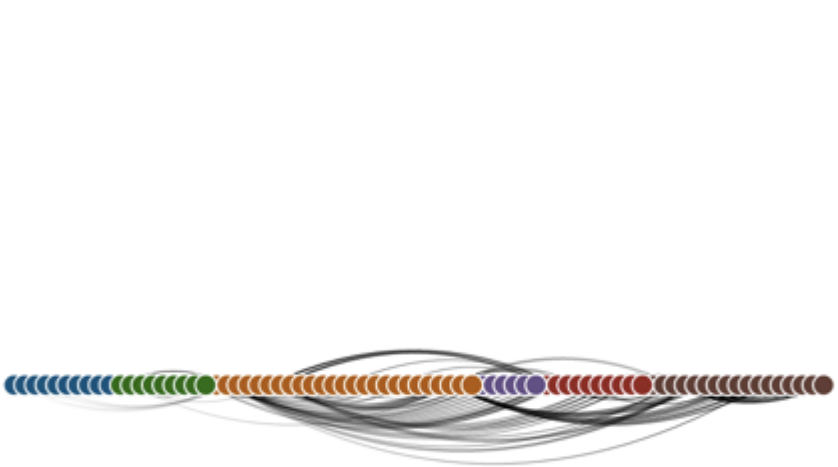


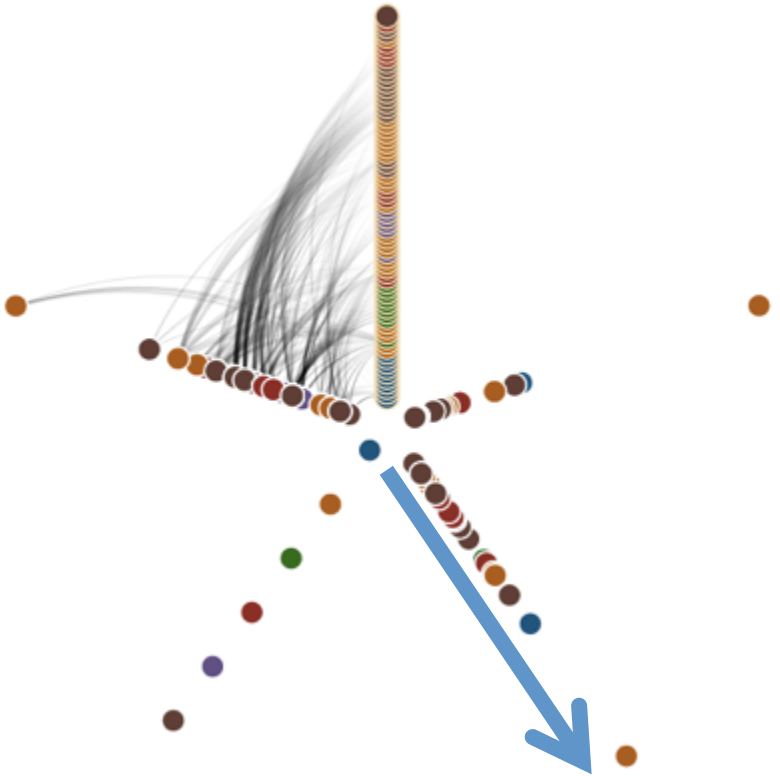
Benefits: For the Visualization Community…



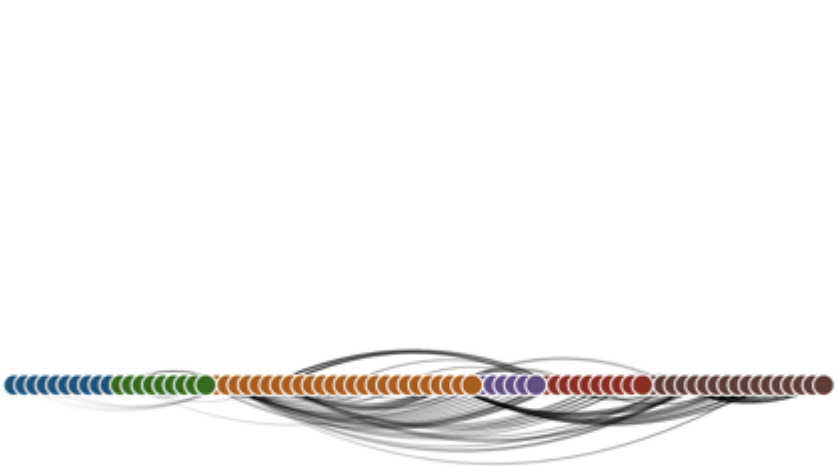


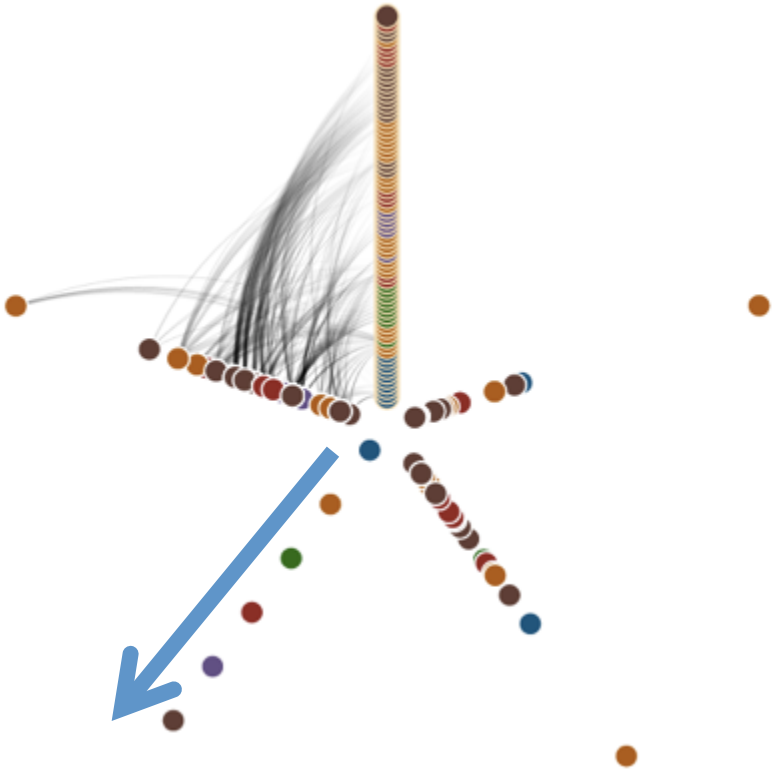
Benefits: For the Visualization Community…



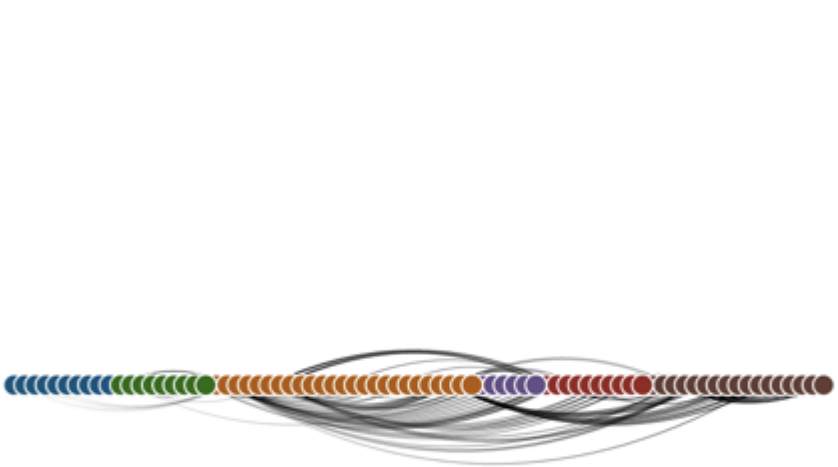


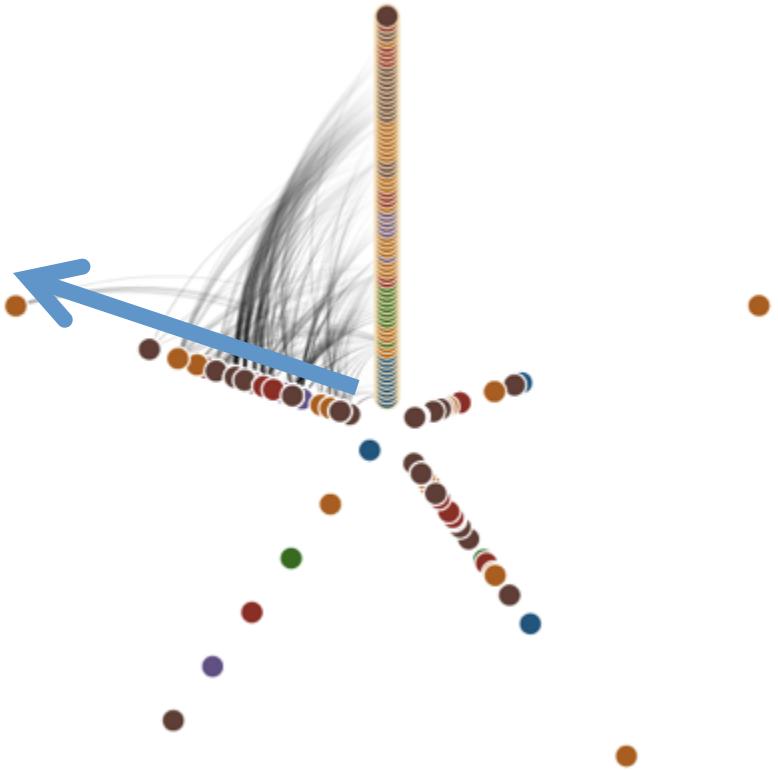
Benefits: For the Visualization Community…



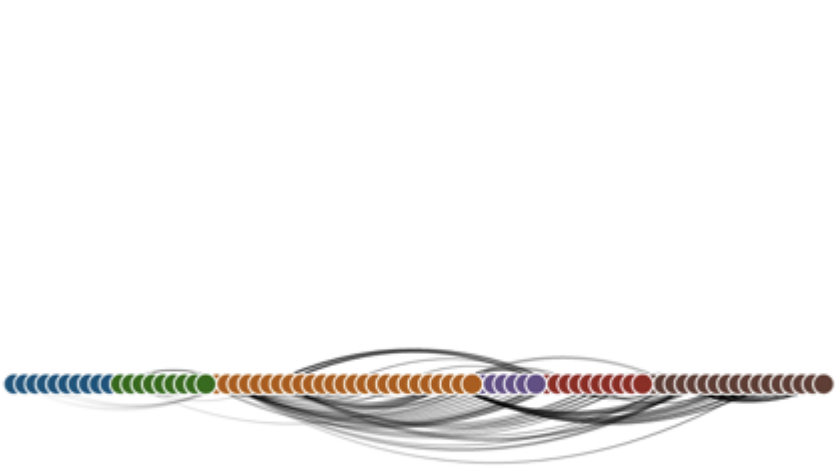


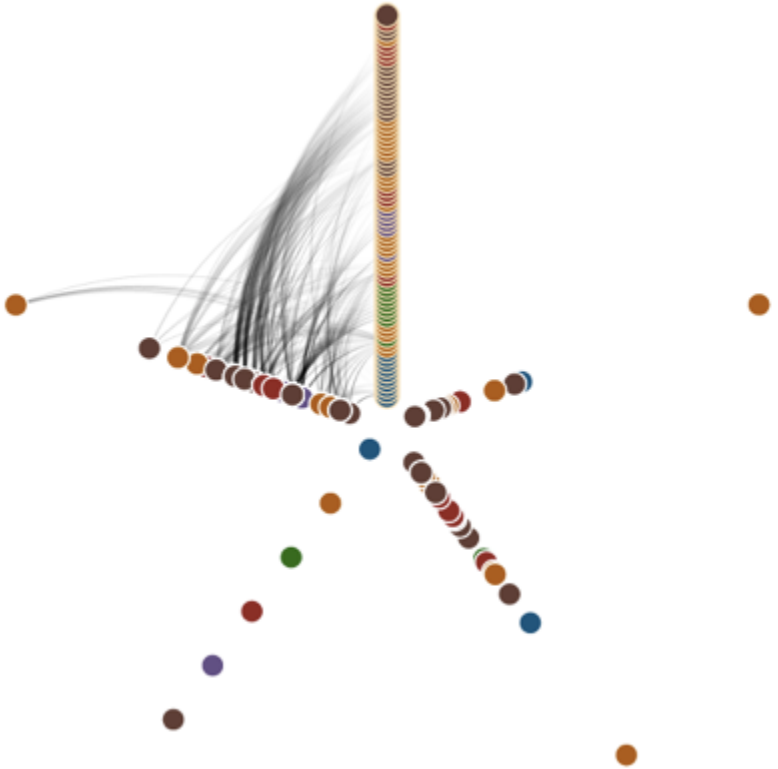
Benefits: For the Visualization Community…





Benefits: For the Visualization Community…





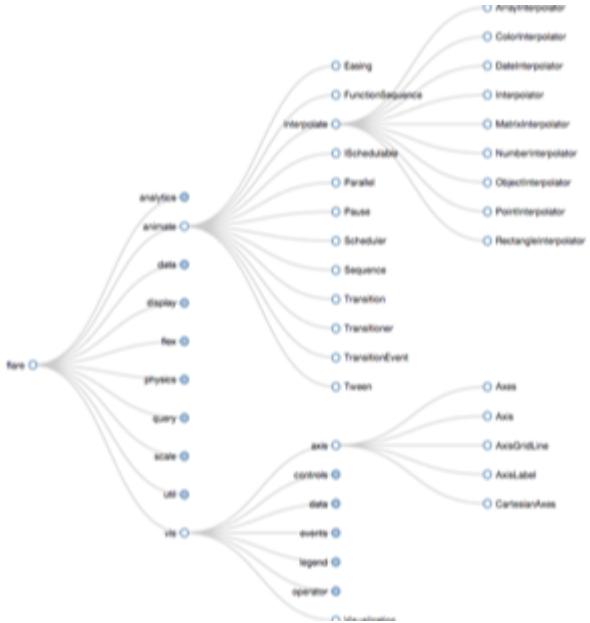
Where to go from here…

Future Work: Data

Future Work: Data

Distance from Root

Future Work: Data

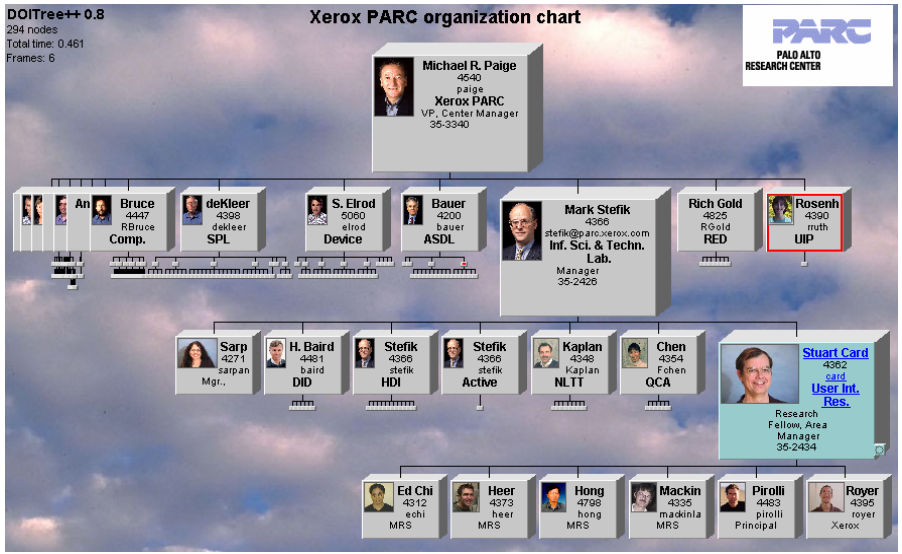


http://mbostock.github.io/d3/talk/20111018/tree.html

Distance from Root

Future Work: Data

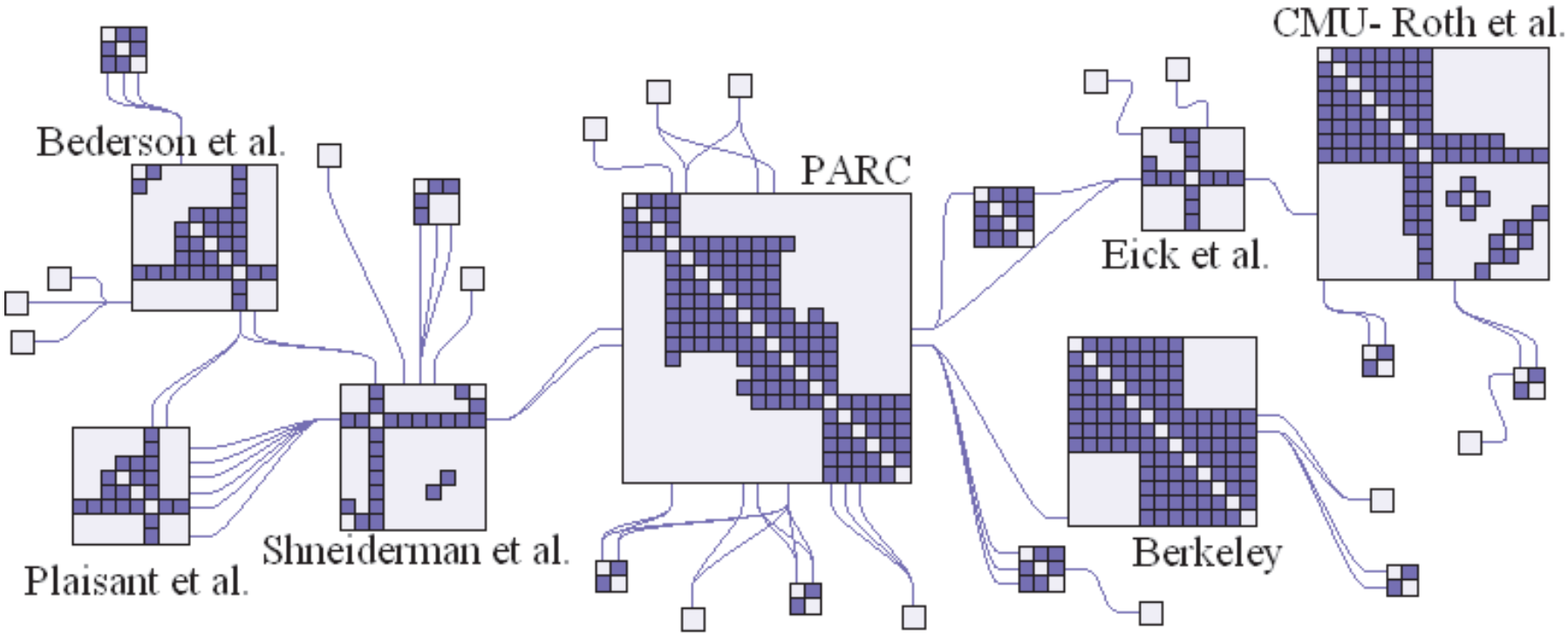
Degree of Interest



Card, Stuart K., and David Nation. "Degree-of-interest trees: A component of an attention-reactive user interface." Proceedings of the Working Conference on Advanced Visual Interfaces. ACM, 2002.

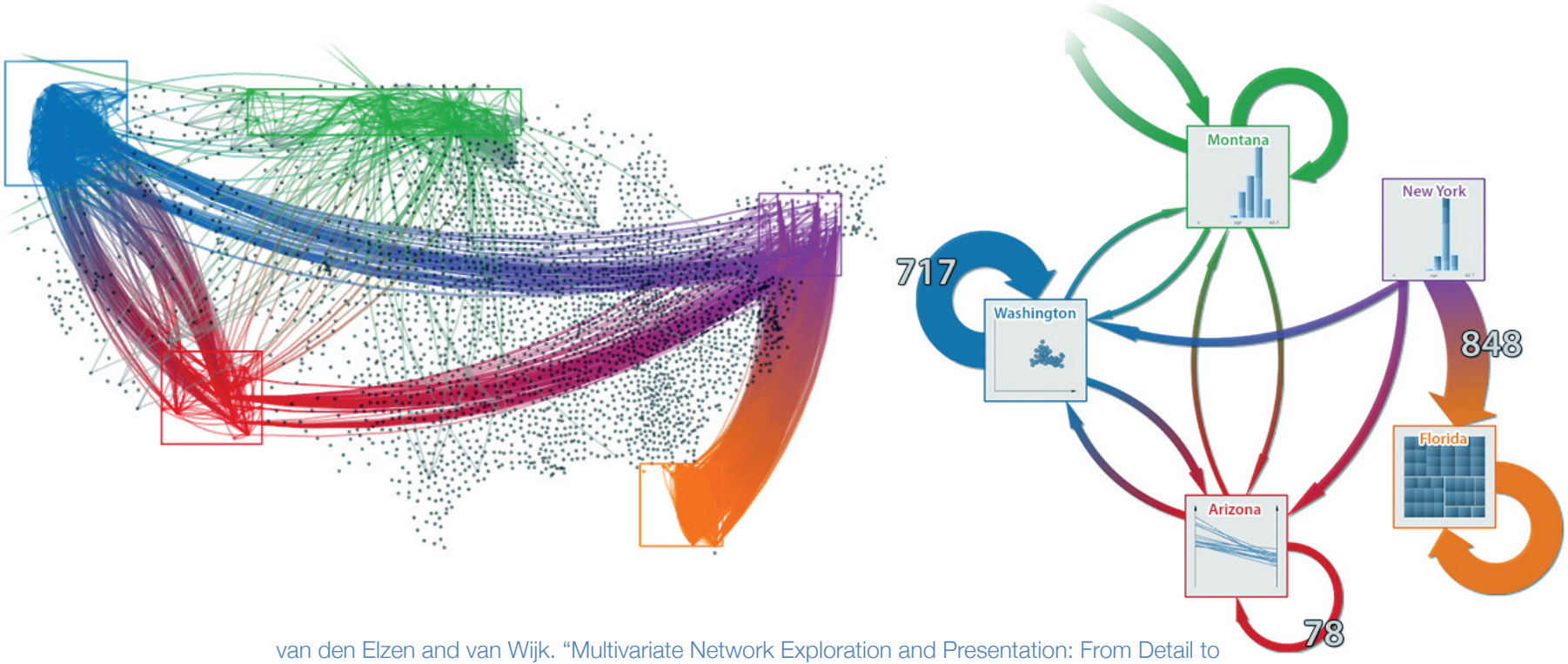
Future Work: Subgraphs

Future Work: Subgraphs



N. Henry, J.-D. Fekete, and M. J. McGuffin, "NodeTrix: a Hybrid Visualization of Social Networks," IEEE Transactions on Visualization and Computer Graphics, vol. 13, no. 6, pp. 1302 –1309, 2007.

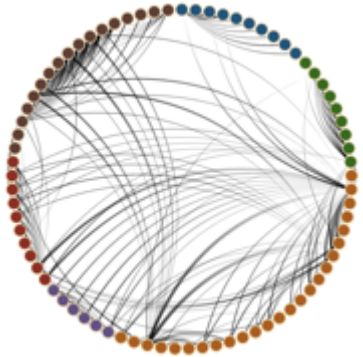
Future Work: Subgraphs

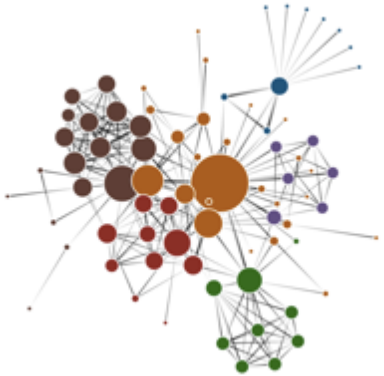


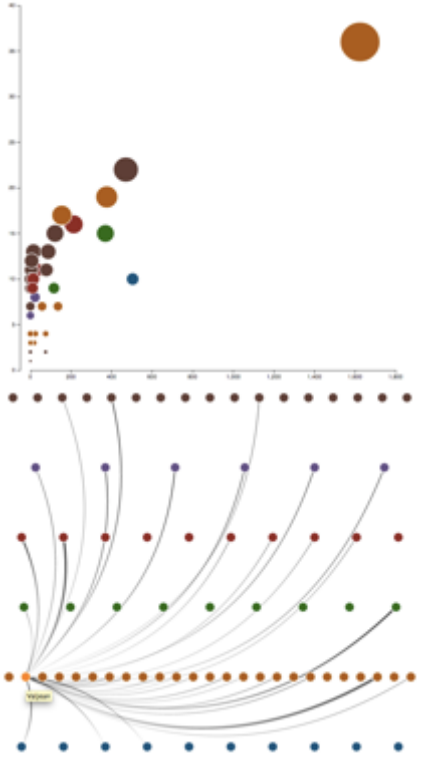
van den Elzen and van Wijk. “Multivariate Network Exploration and Presentation: From Detail to Overview via Selections and Aggregations”. Infovis 2014. (Or, *right before* this talk).

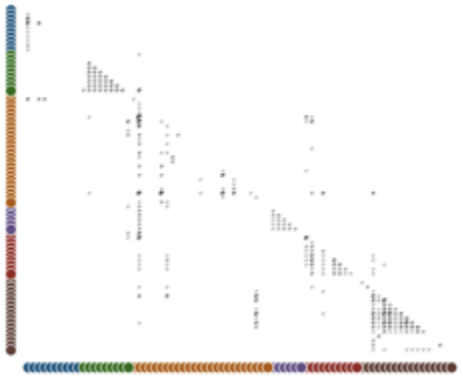
Future Work: Interaction

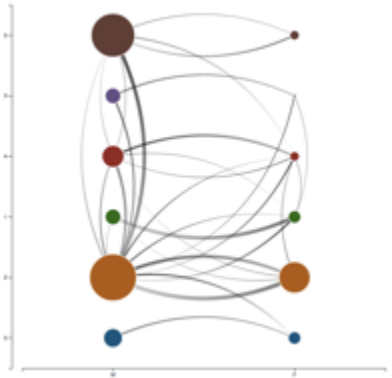
Wrapping Up…





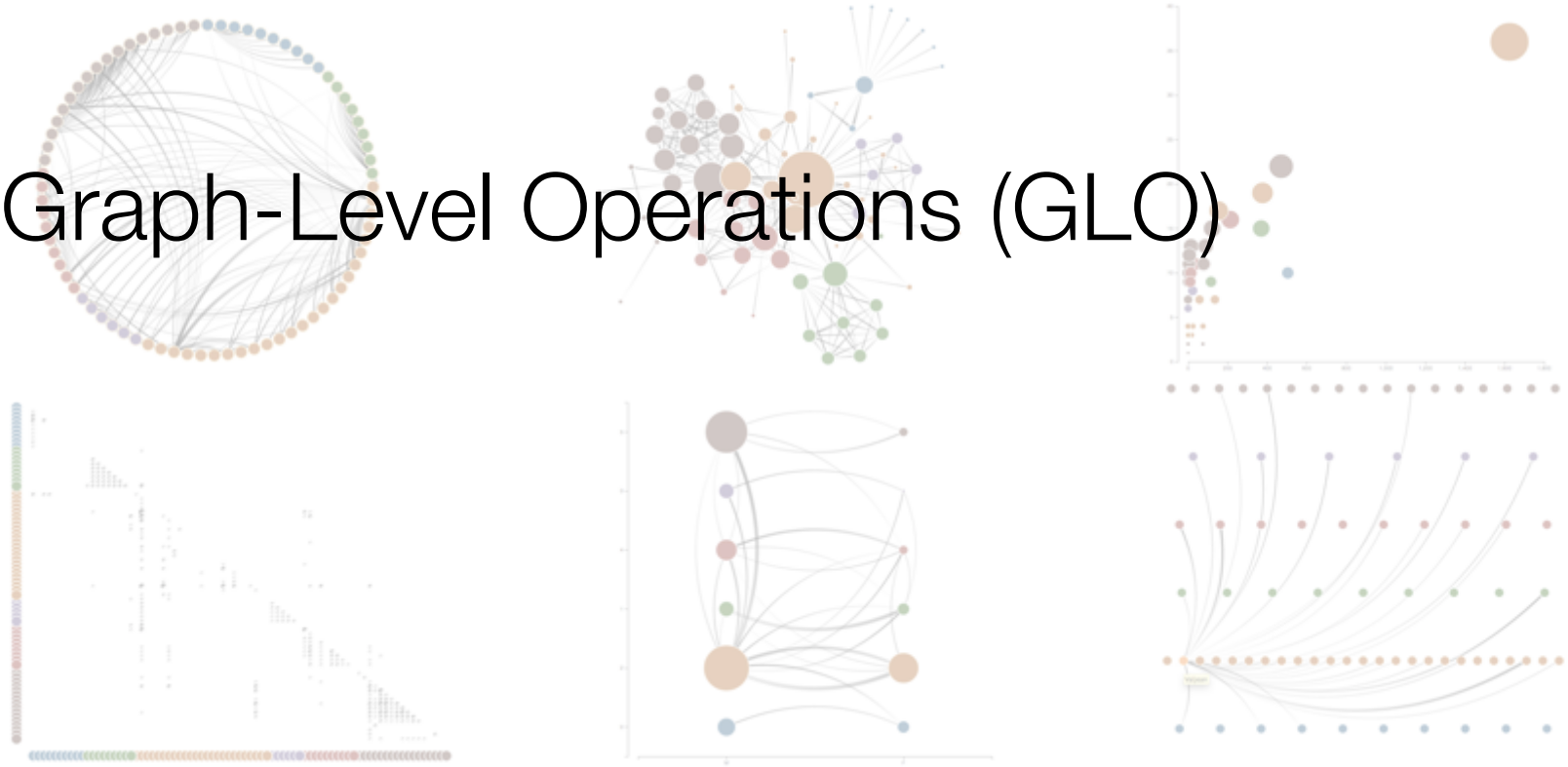






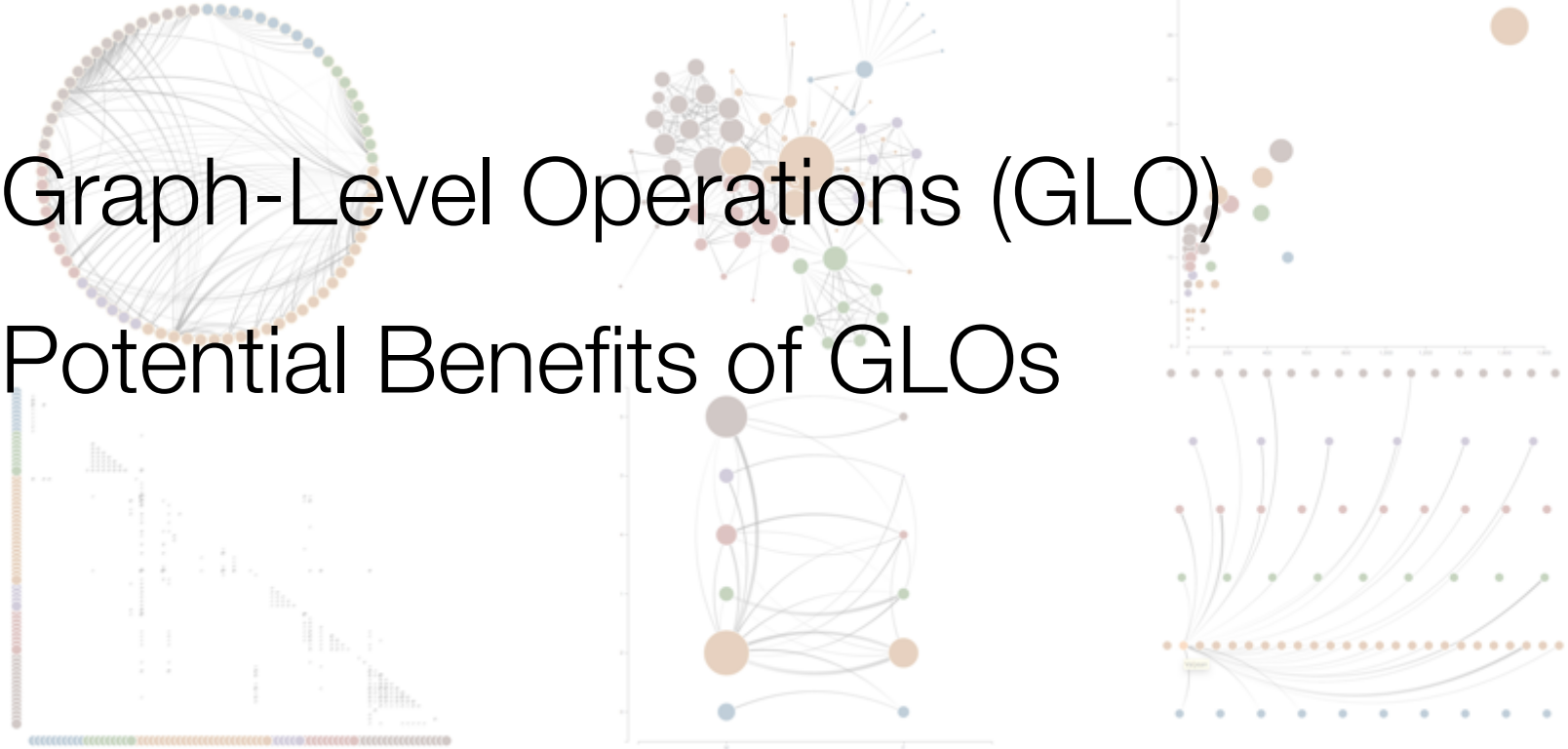
Wrapping Up…

- Graph-Level Operations (GLO)



Wrapping Up…

- Graph-Level Operations (GLO)
- Potential Benefits of GLOs



Wrapping Up…

- Graph-Level Operations (GLO)
- Potential Benefits of GLOs
- GLO-STIX Application

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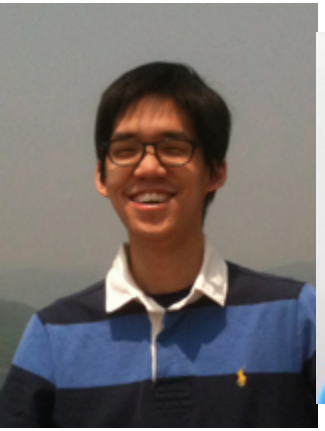
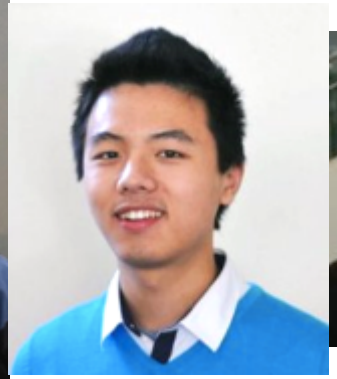

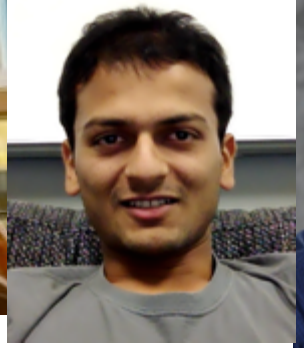

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Thank You!

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