

JUNIPER: A TREE + TABLE APPROACH TO MULTIVARIATE GRAPH VISUALIZATION

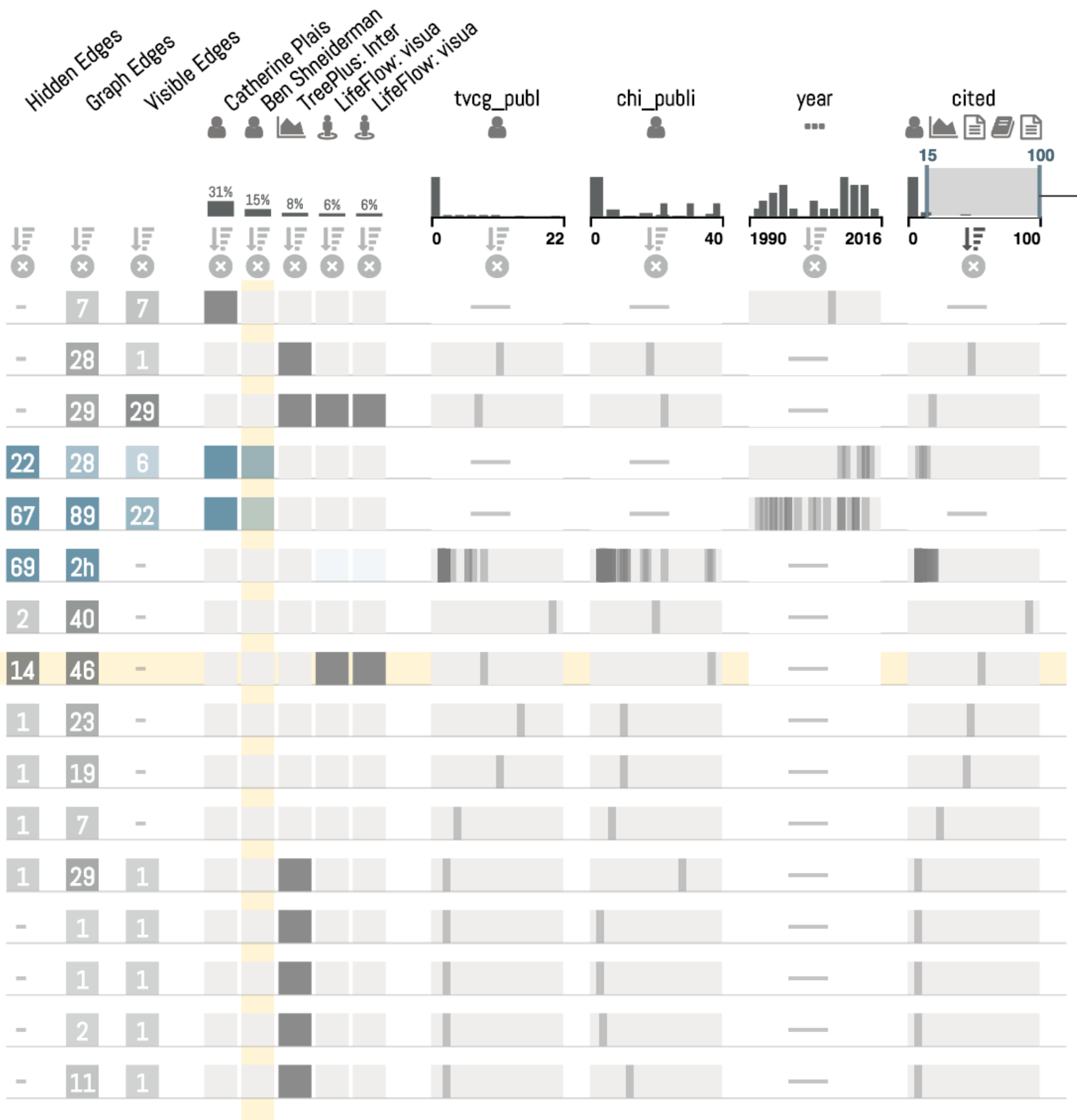
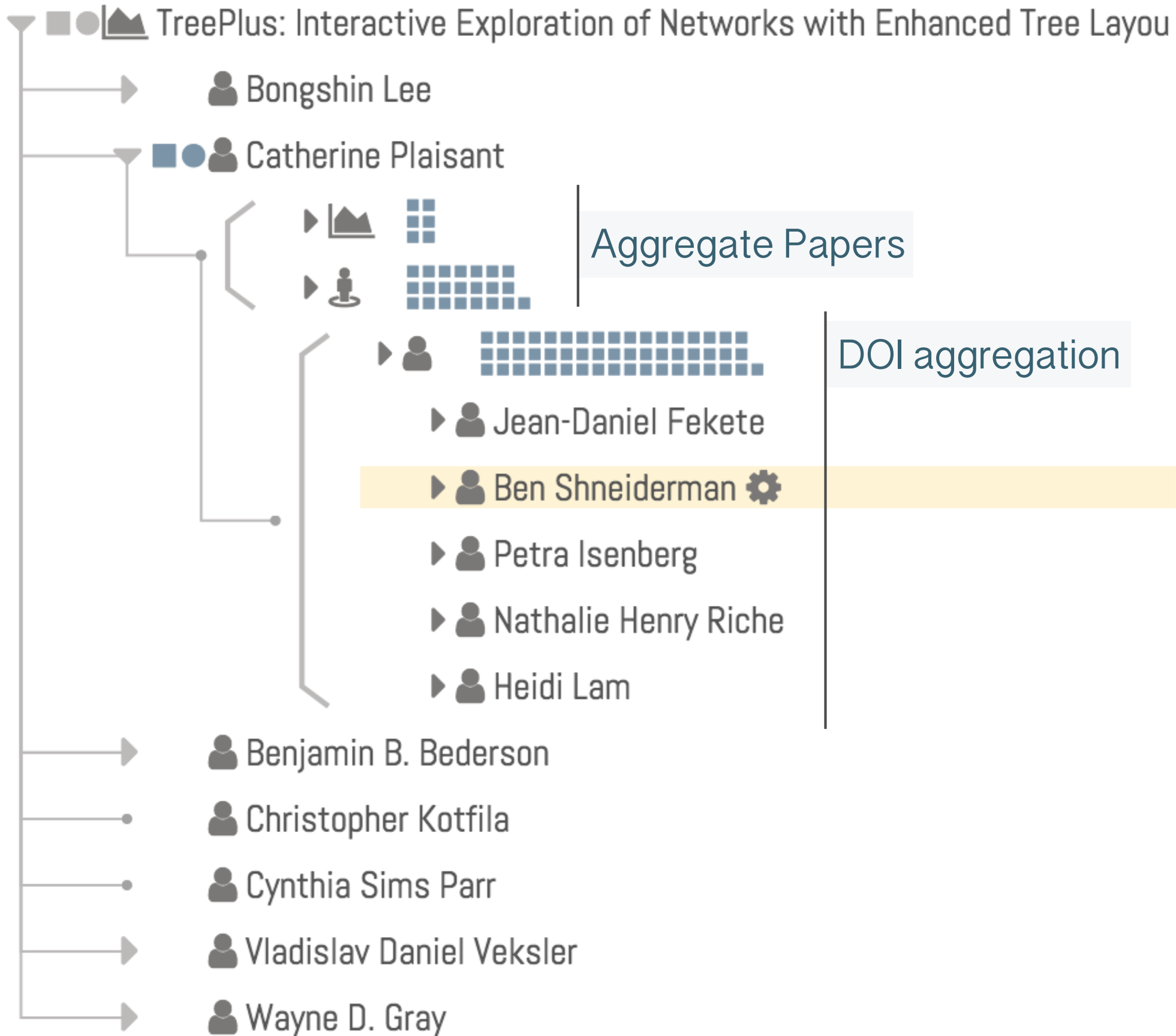
CAROLINA NOBRE, MARC STREIT, ALEXANDER LEX



visualization
design lab



Juniper
juniper.sci.utah.edu





dblp

computer science bibliography



EVERY PERSON
IN THIS ROOM

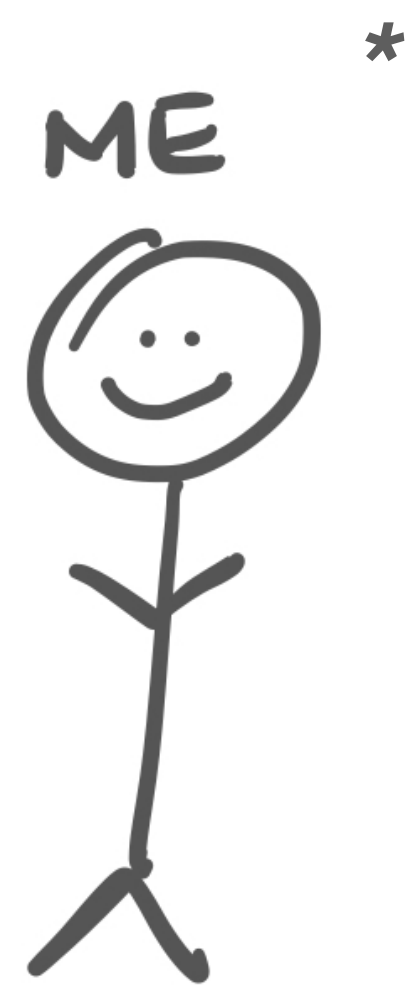
**HAS CO-AUTHORED A
PAPER WITH 2 OTHER
PEOPLE HERE**



SÃO PAULO

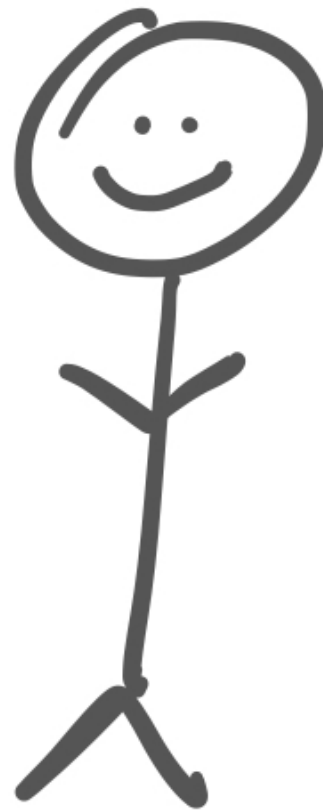
BRAZIL

**THE VIS COMMUNITY IS
A HIGHLY CONNECTED
MULTIVARIATE GRAPH**

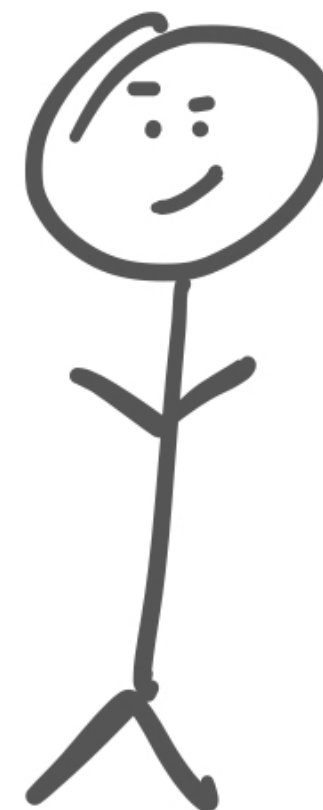


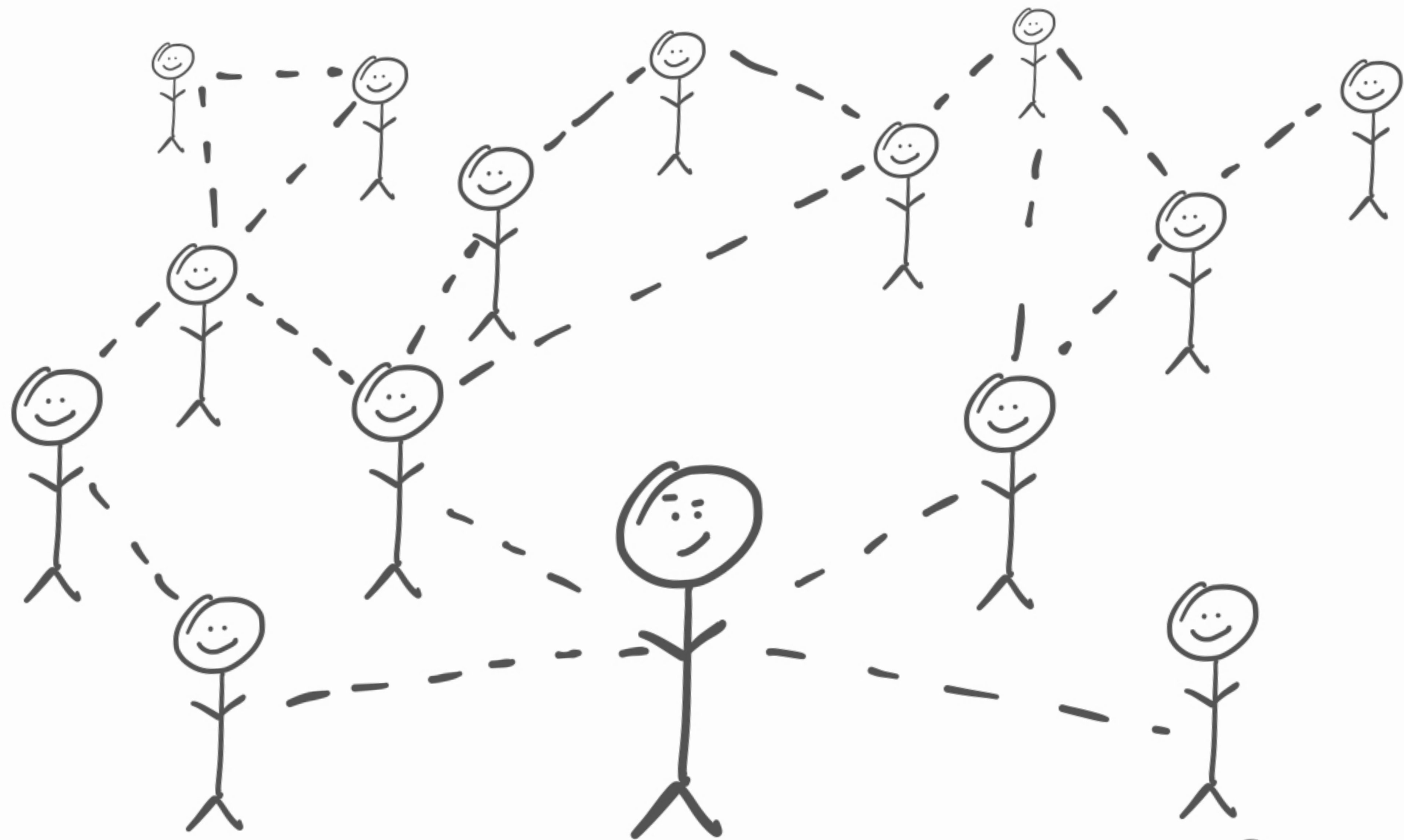
****not drawn to scale***

ME



MY ADVISOR





MY ADVISOR

ME

GRAPH TASKS

- ▶ Finding a node of interest
- ▶ Finding connected nodes
- ▶ Finding nodes with specific attribute values

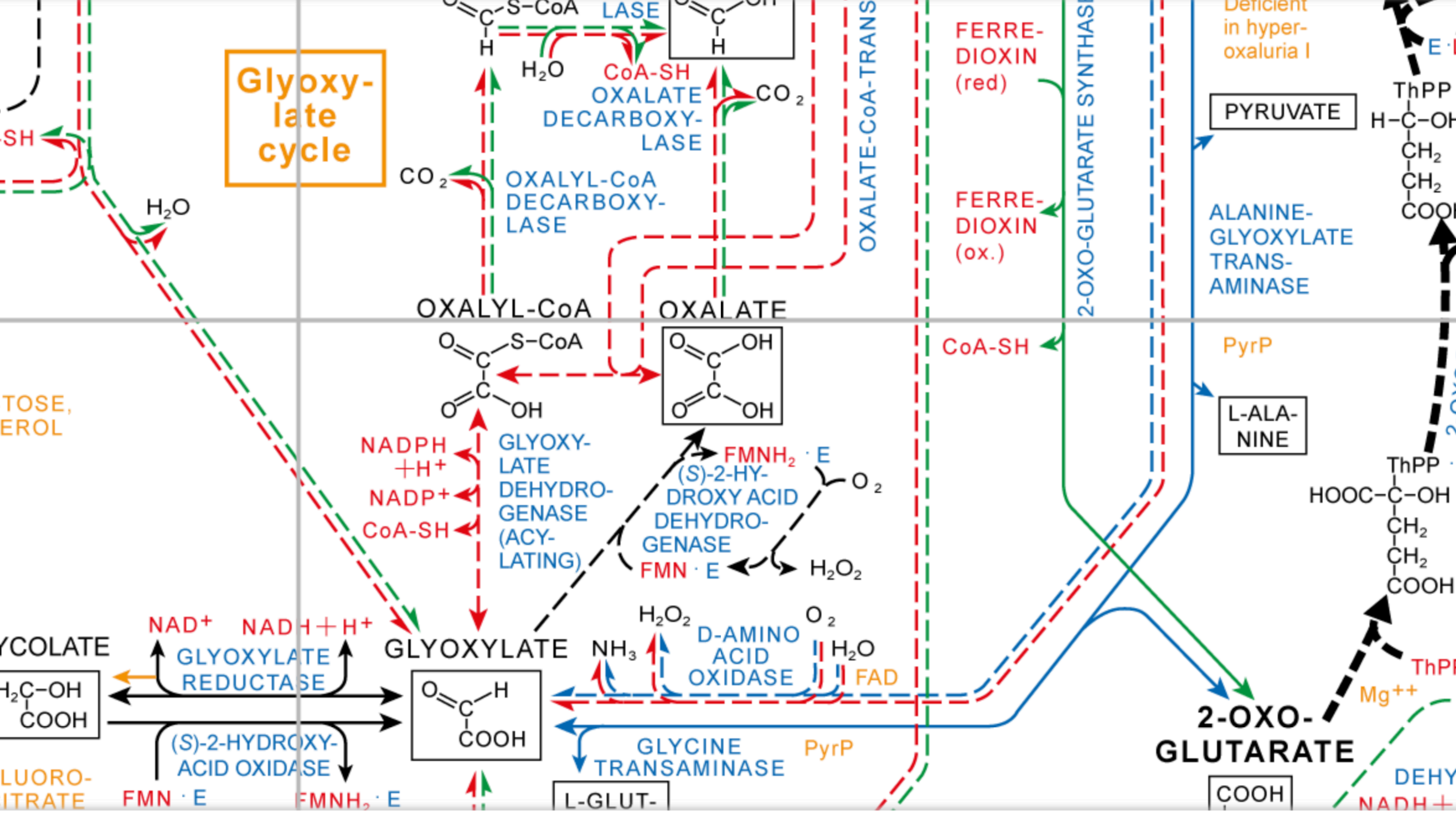
QUERY BASED

TOPOLOGY BASED

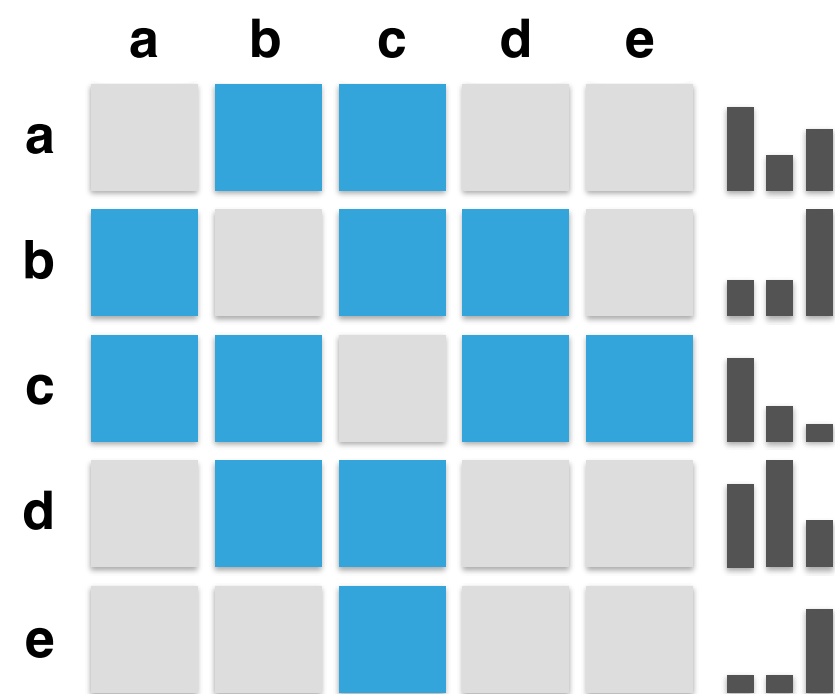
ATTRIBUTE BASED

THE CHALLENGE

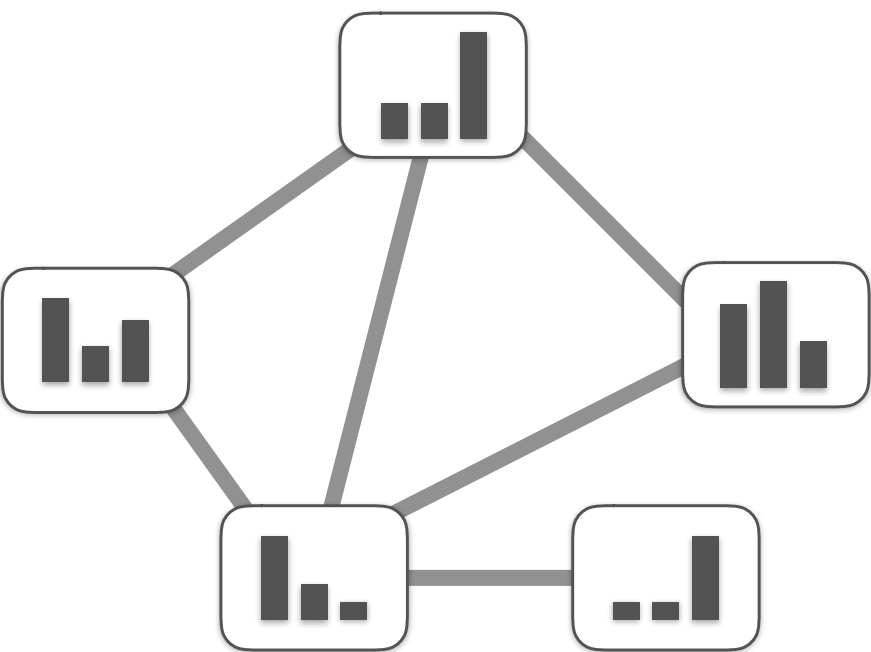
**SUPPORTING TOPOLOGY AND ATTRIBUTE
BASED TASKS EQUALLY WELL**



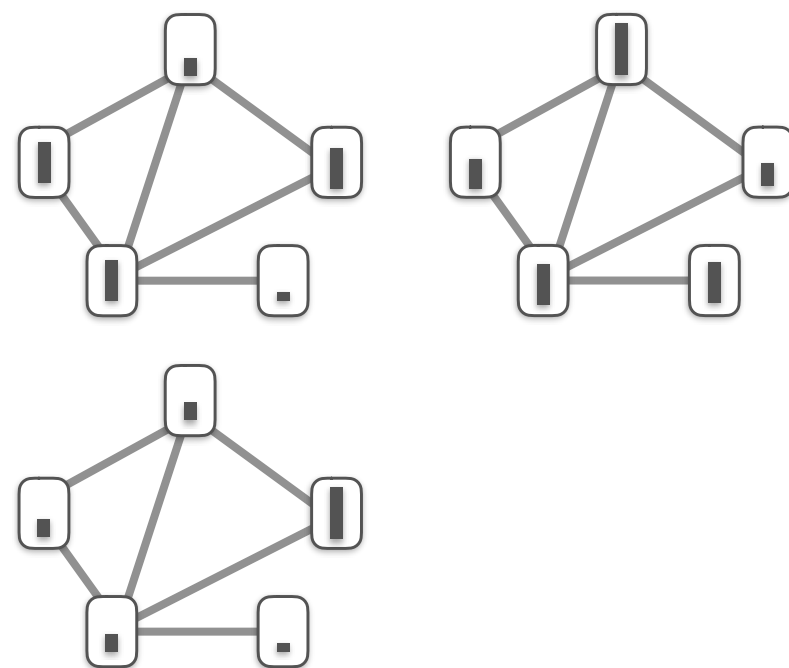
EXISTING MULTIVARIATE GRAPH VISUALIZATION TECHNIQUES



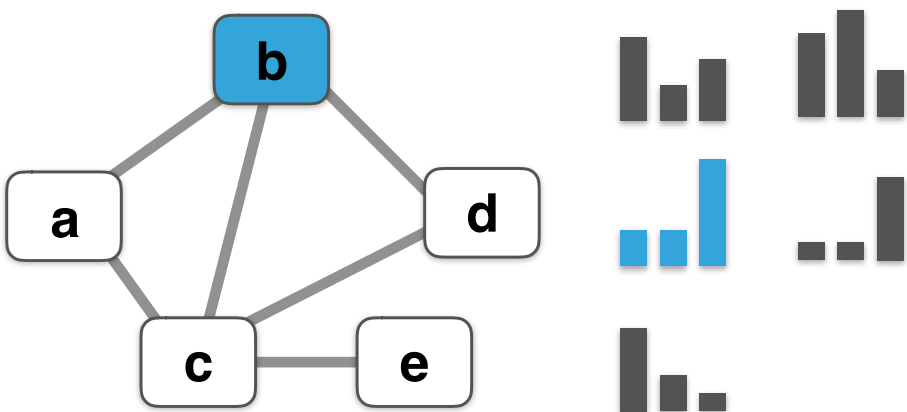
Matrices



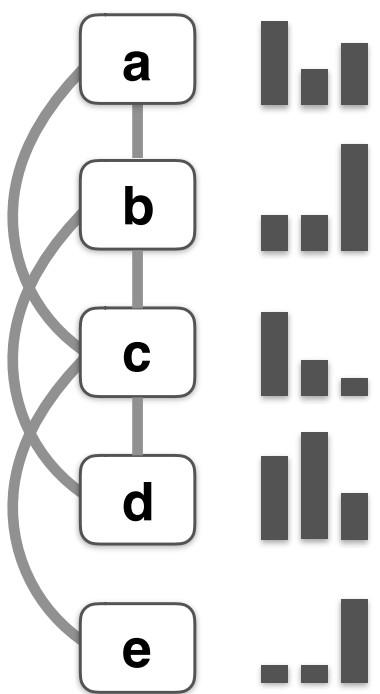
On-Node
Encoding



Small Multiples

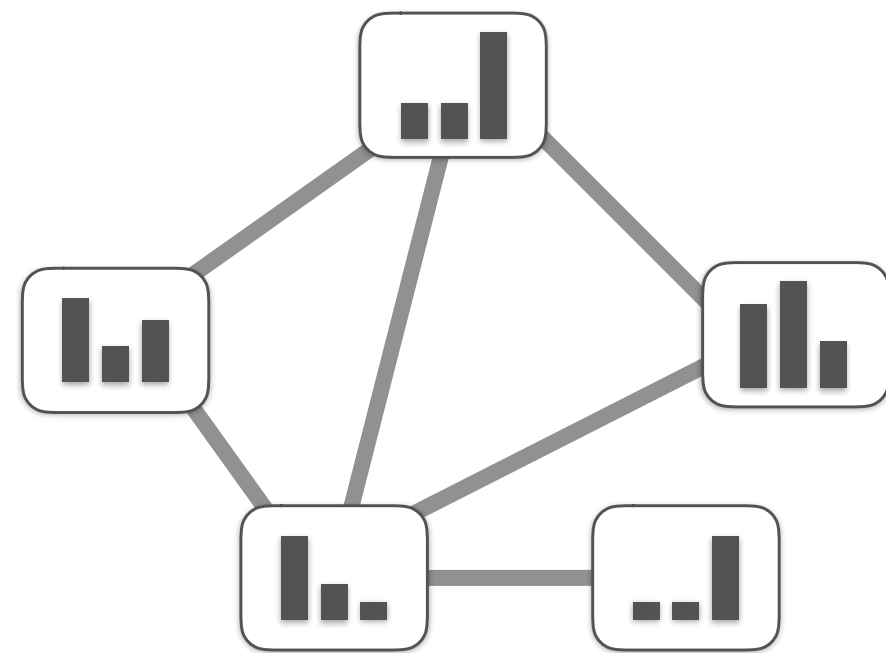


Multiple
Coordinated
Views

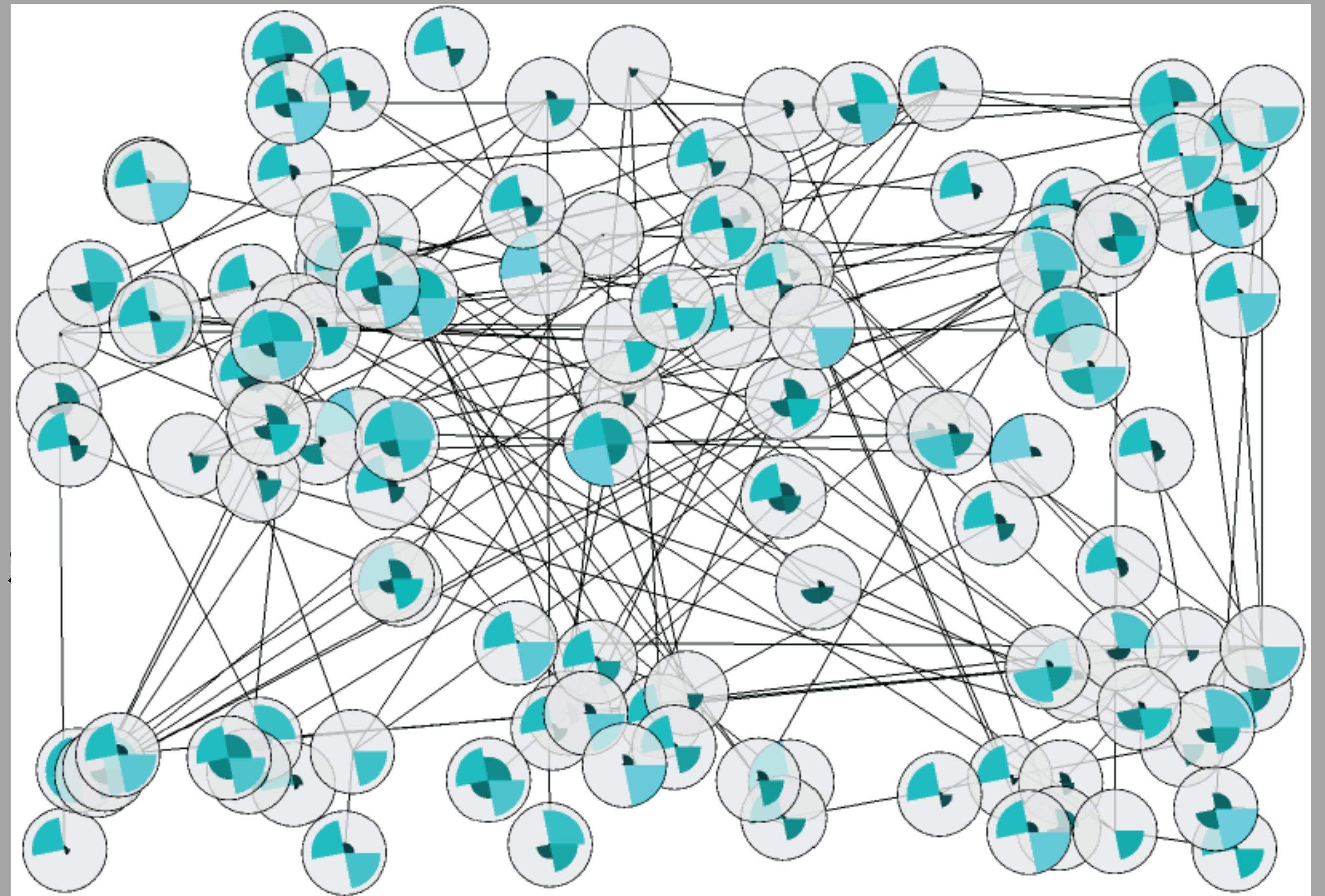


Layout
Adaption

EXISTING MULTIVARIATE GRAPH VISUALIZATION TECHNIQUES

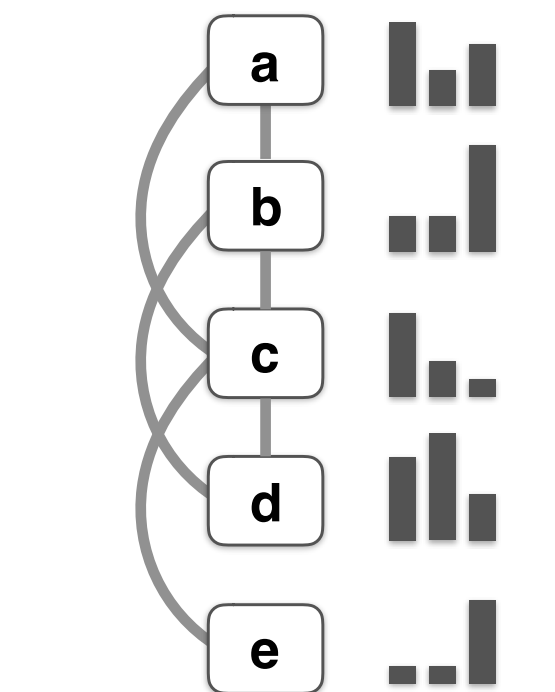
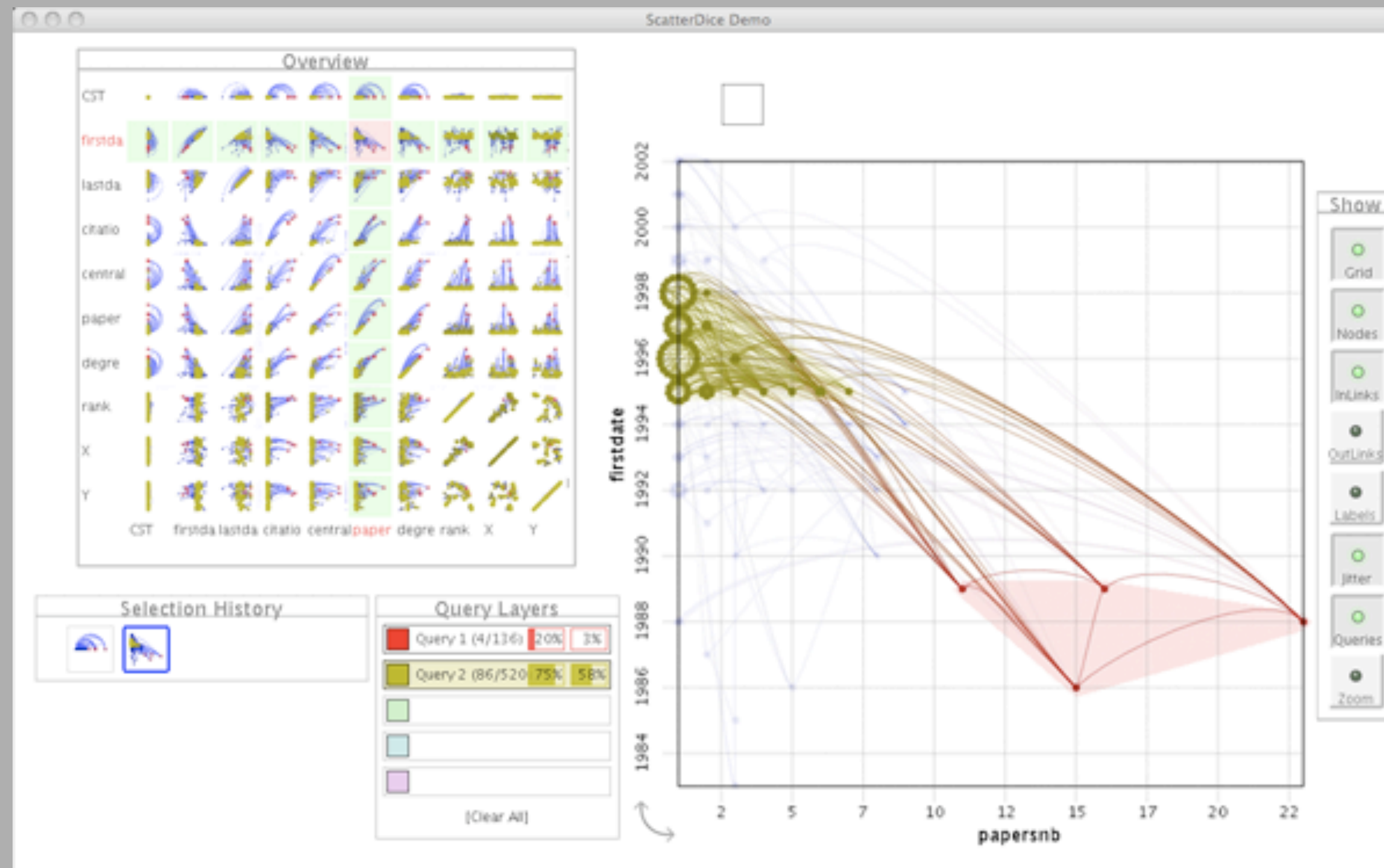


**On-Node
Encoding**



B. McDonnel, N. Elmqvist. Towards Utilizing GPUs in Information Visualization: A Model and Implementation of Image-Space Operations. *IEEE Transactions on Visualization and Computer Graphics (Proc. InfoVis 2009)*, 15(6):1105-1112, 2009.

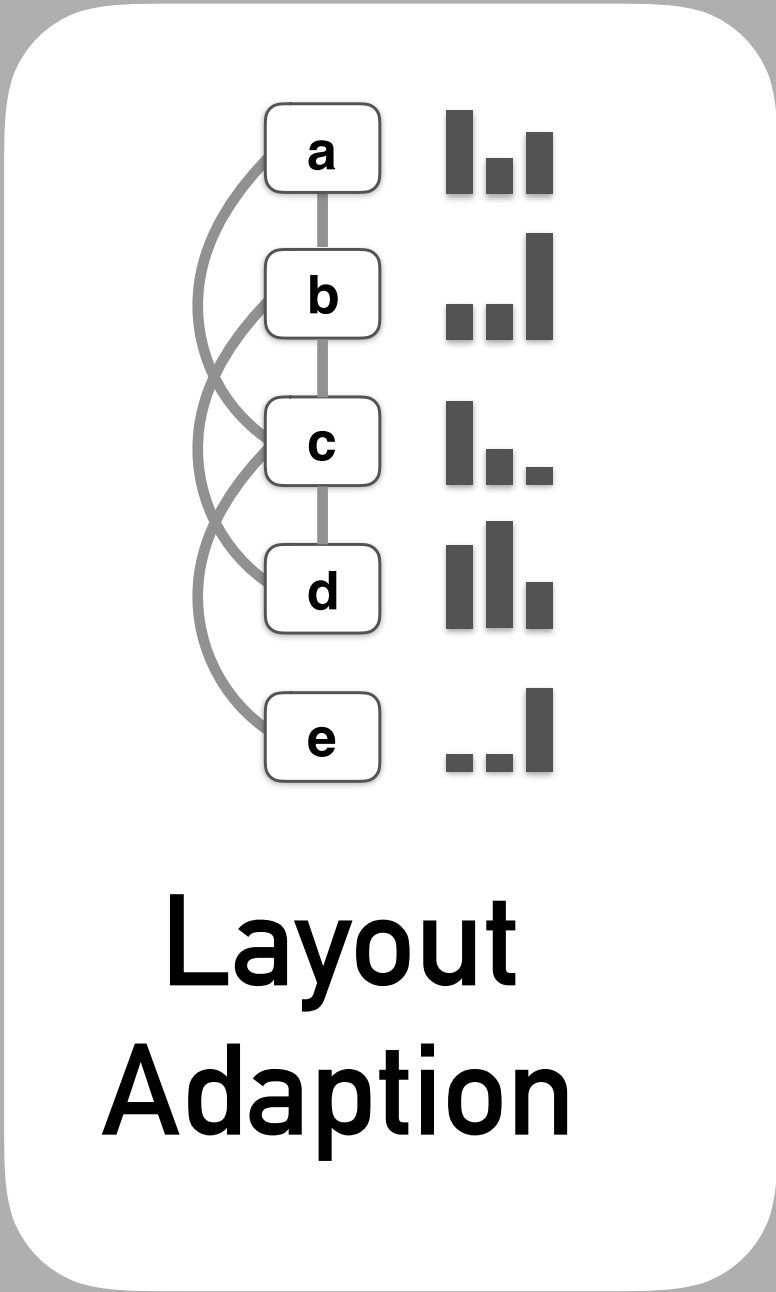
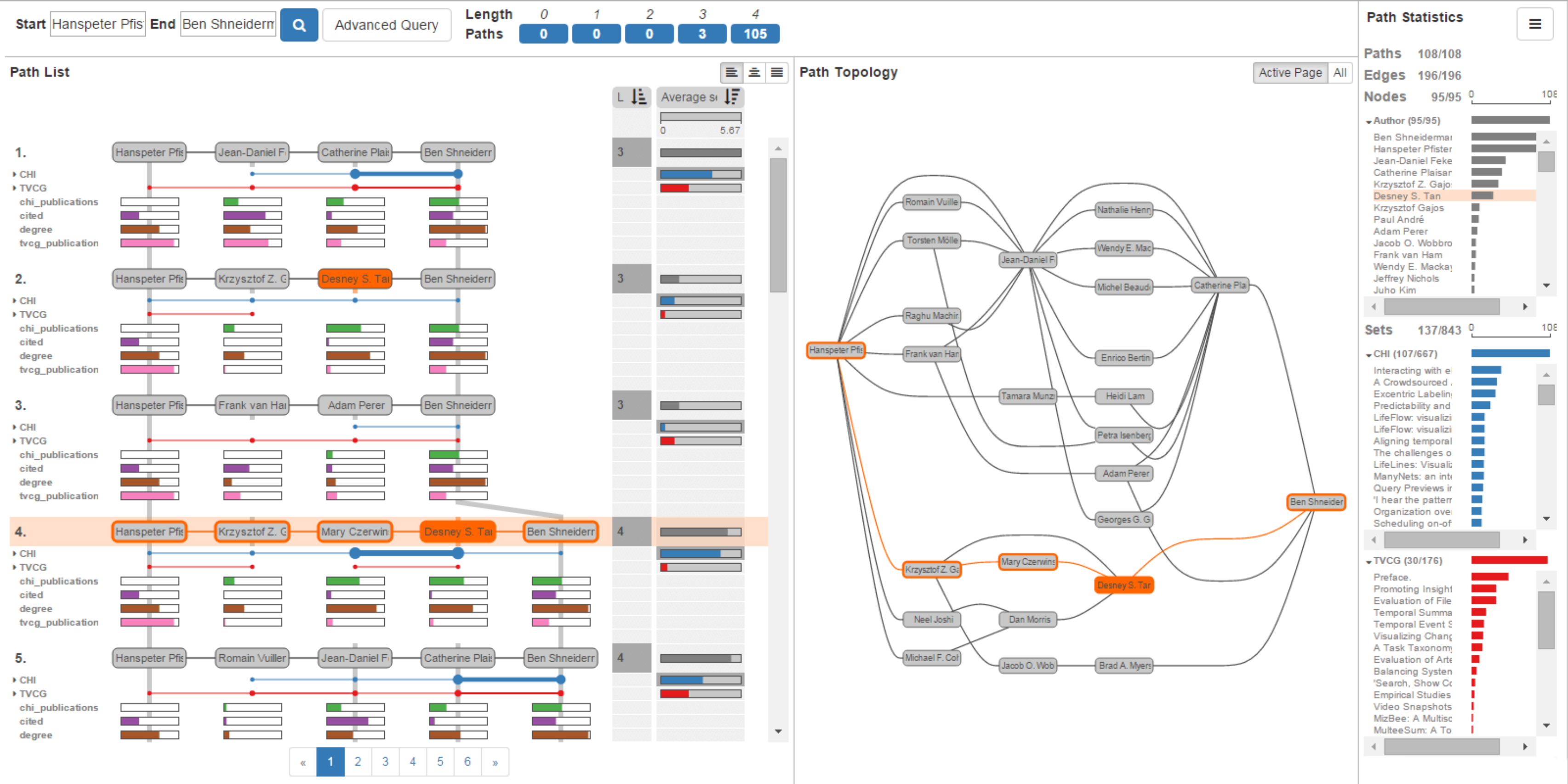
EXISTING MULTIVARIATE GRAPH VISUALIZATION TECHNIQUES



Layout
Adaption

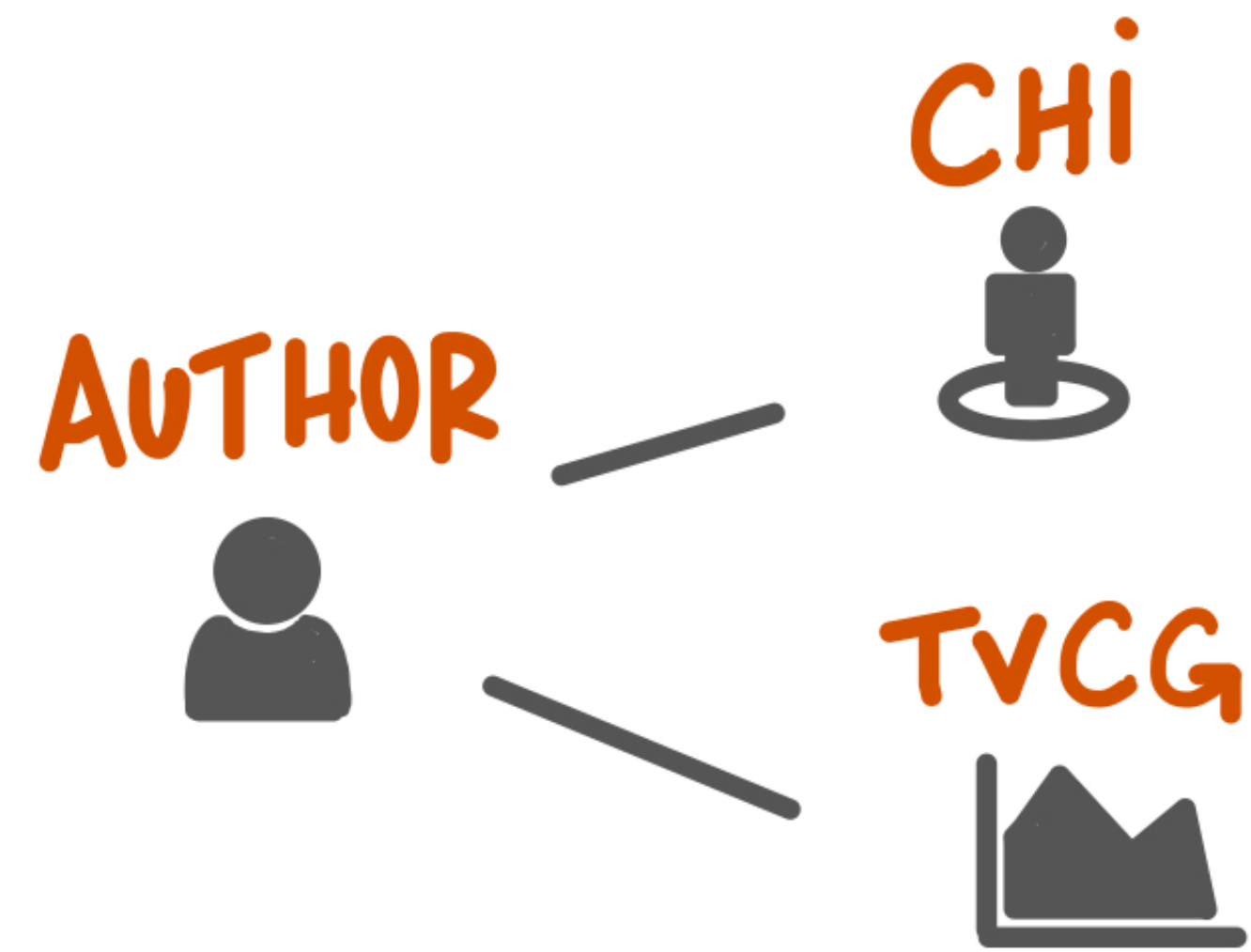
Bezerianos, Anastasia, et al. "Graphdice: A system for exploring multivariate social networks." Computer Graphics Forum. Vol. 29. No. 3. Oxford, UK: Blackwell Publishing Ltd, 2010.

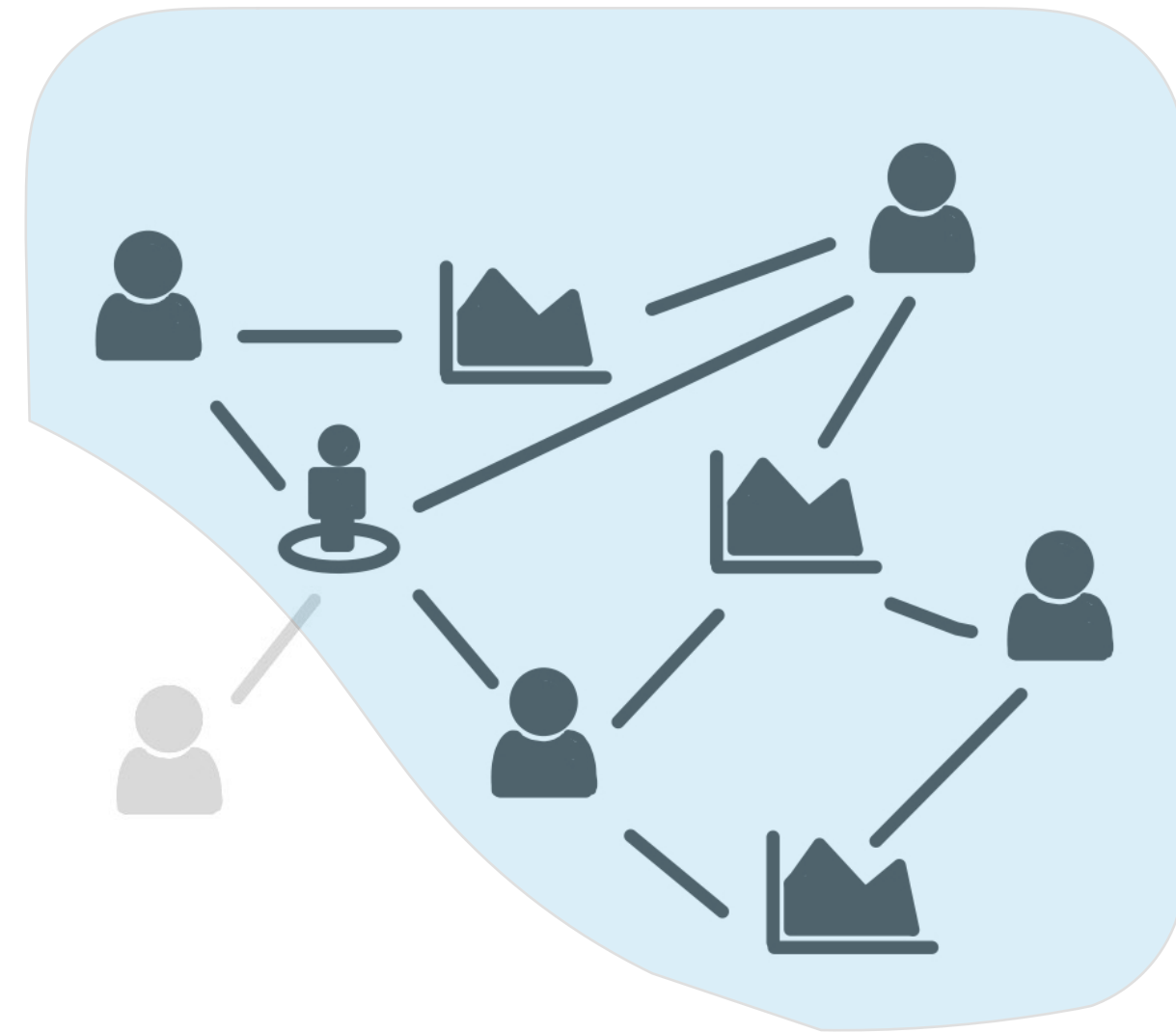
EXISTING MULTIVARIATE GRAPH VISUALIZATION TECHNIQUES



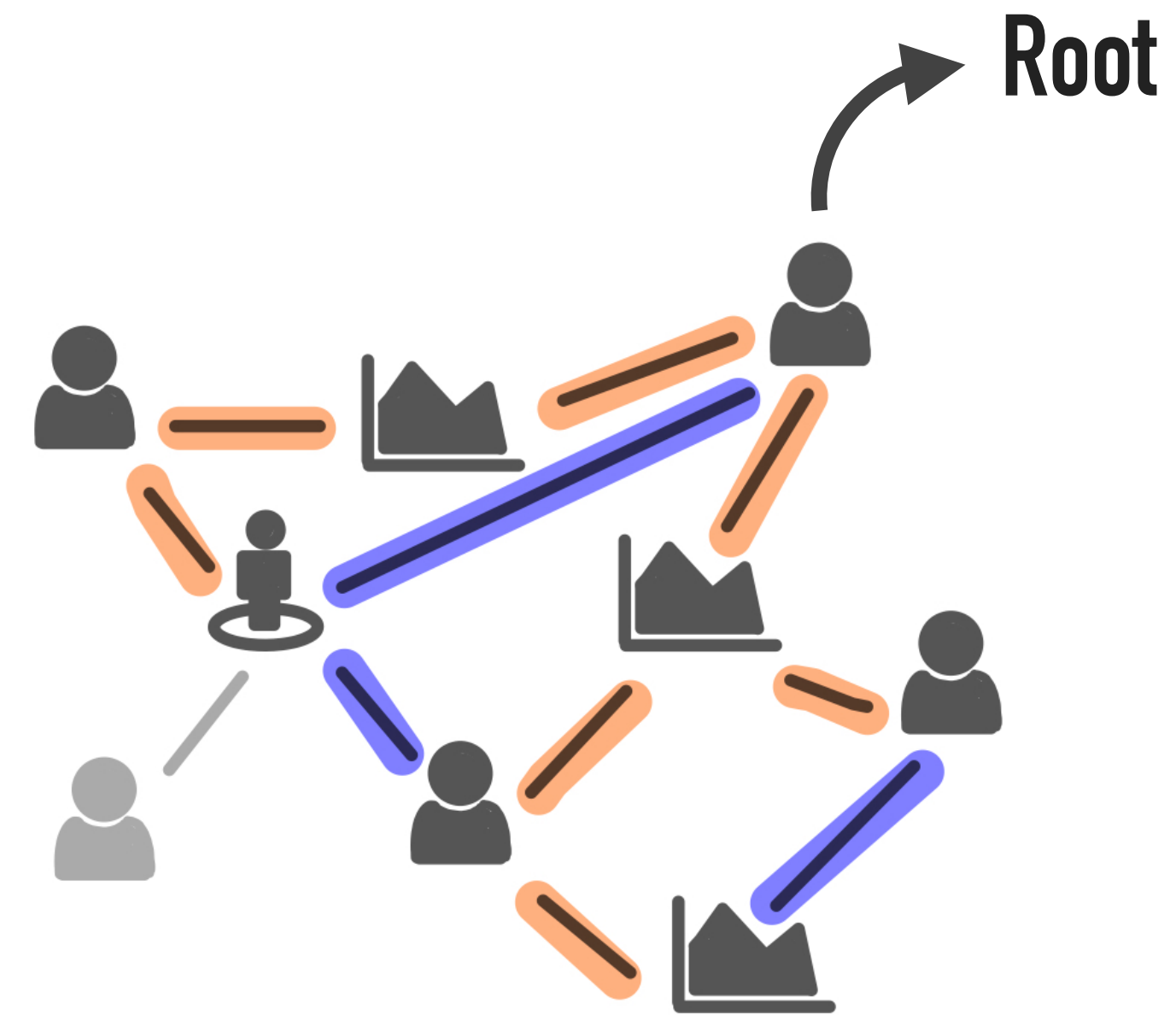
Layout
Adaption

Christian Partl, Samuel Gratzl, Marc Streit, Anne Mai Wassermann, Hanspeter Pfister, Dieter Schmalstieg, Alexander Lex. Pathfinder: Visual Analysis of Paths in Graphs Computer Graphics Forum (EuroVis '16), 35(3): 71--80, doi:10.1111/cgf.12883, 2016.



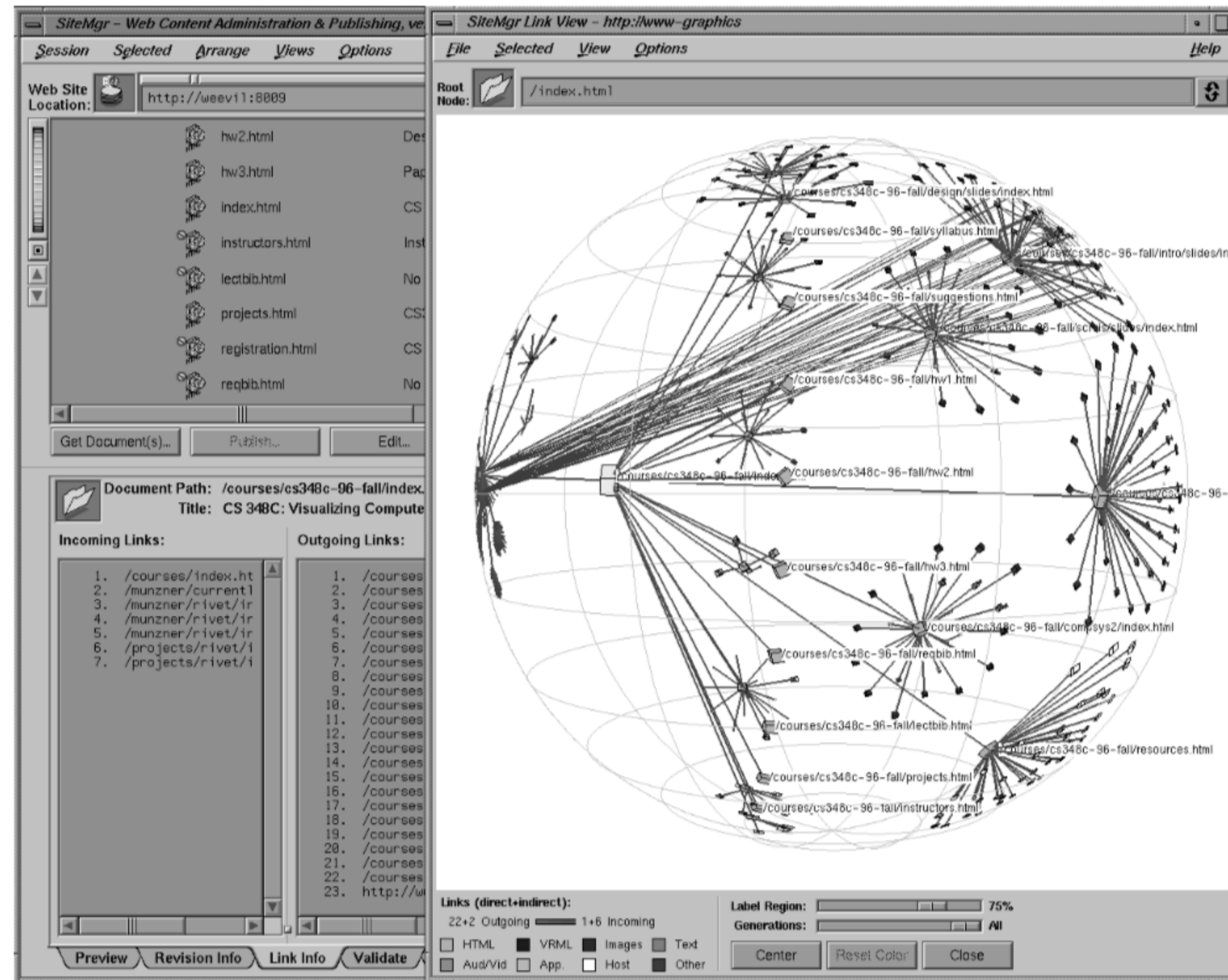


Select Subgraph

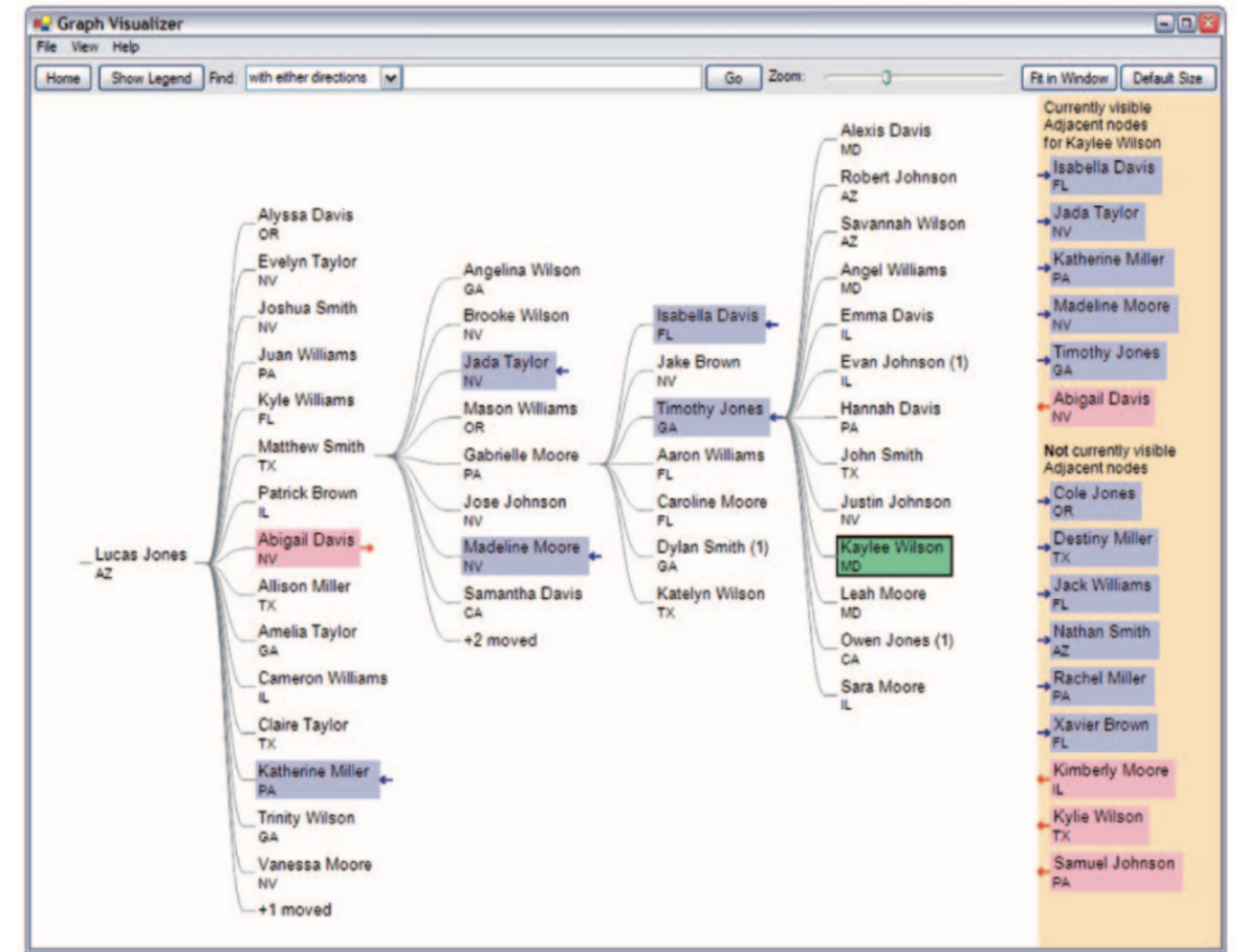


Extract a spanning tree

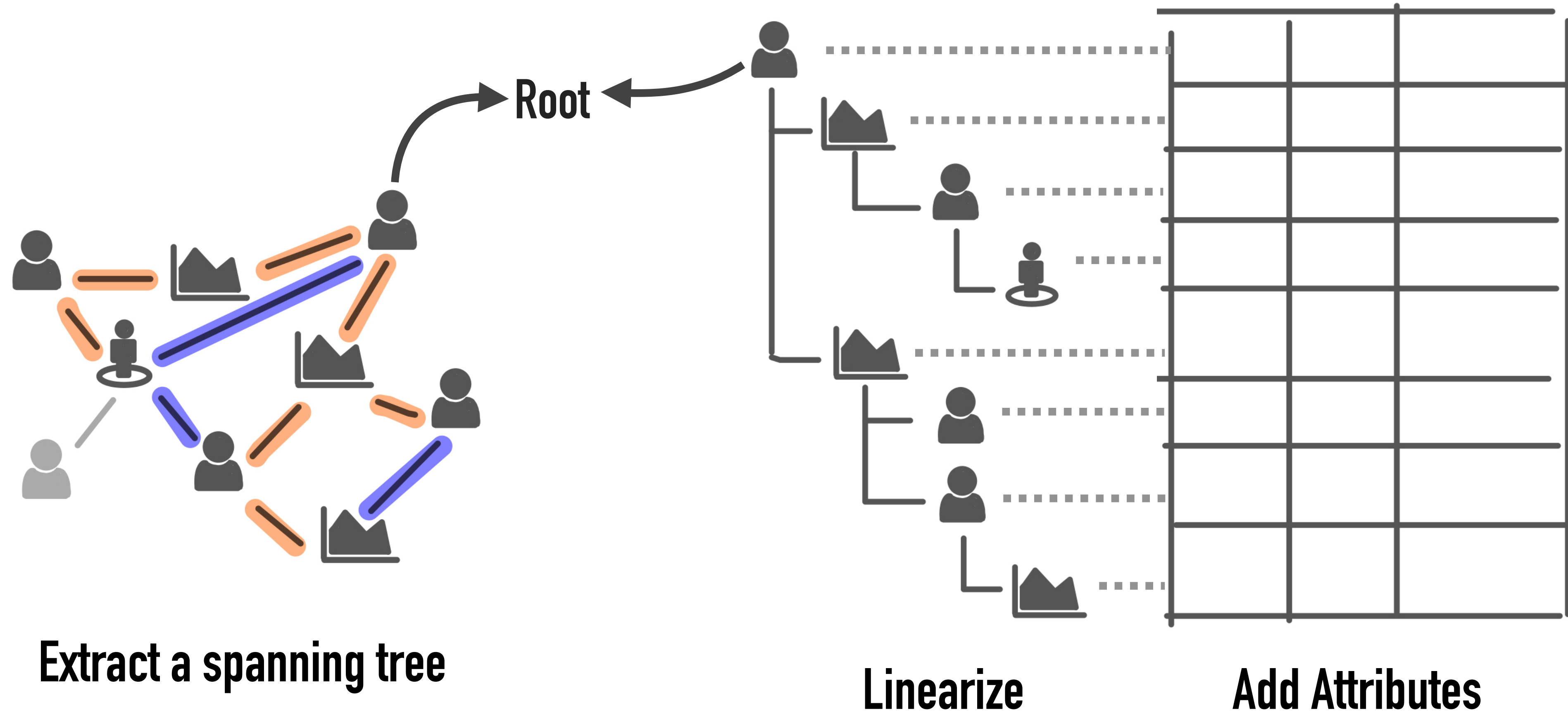
Previous Spanning Tree based Approaches



[Munzner, H3Viewer, 1998]



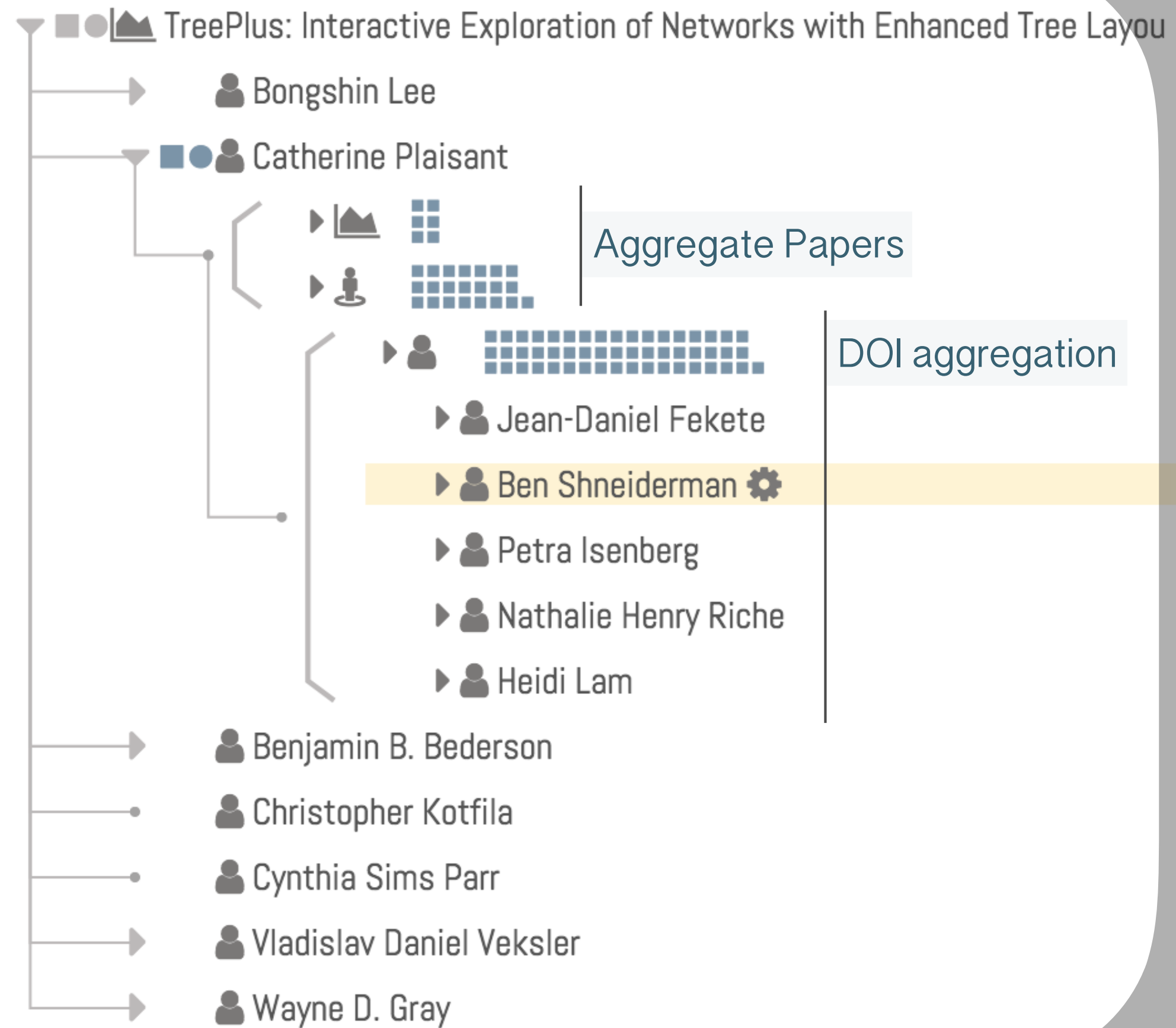
[Lee et al., TreePlus, 2006]



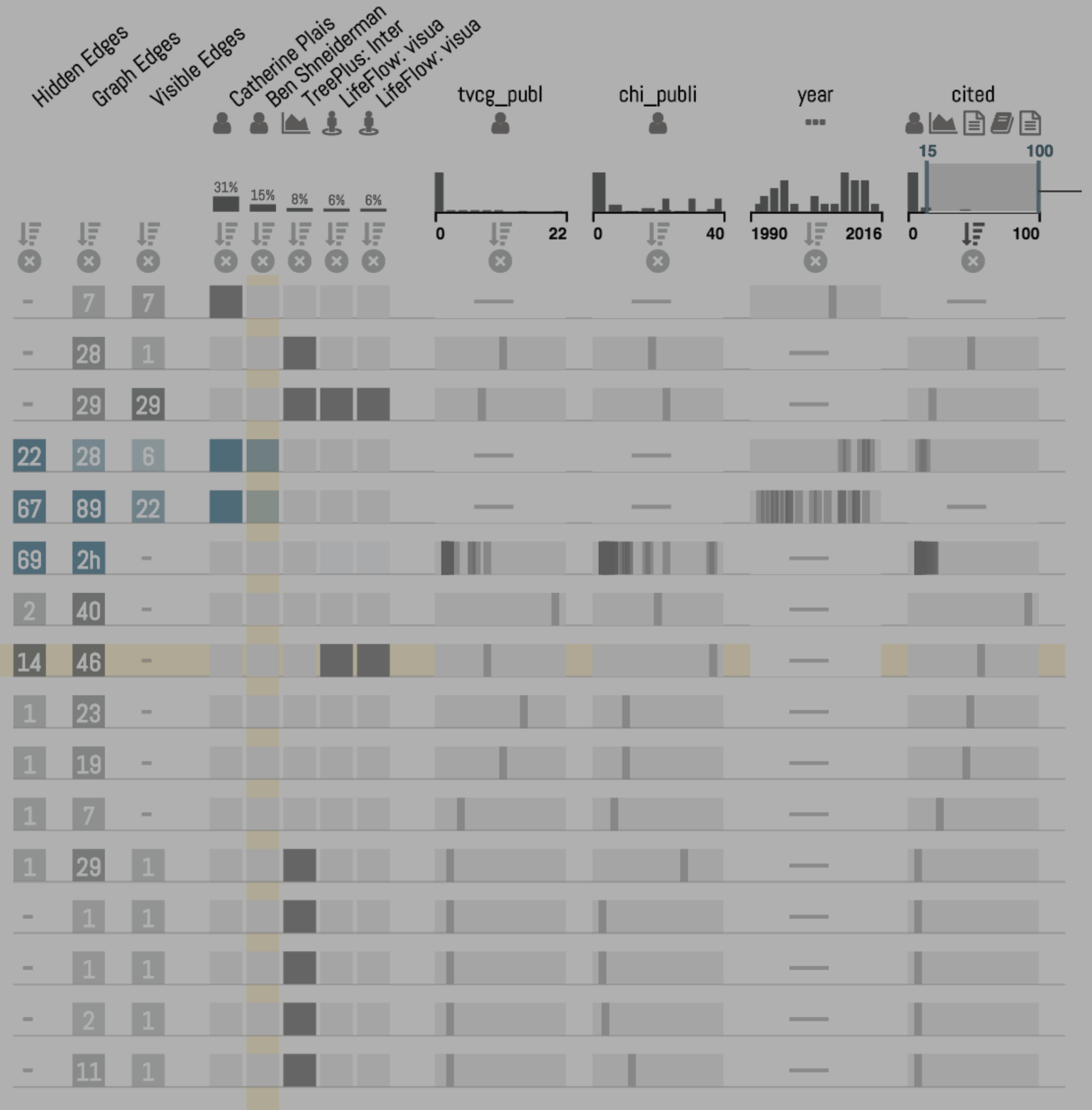
APPLYING THE SPANNING TREE AND LINEARIZATION TECHNIQUES TO A MULTIVARIATE GRAPH

SUPPORT TOPOLOGY AND ATTRIBUTE TASKS

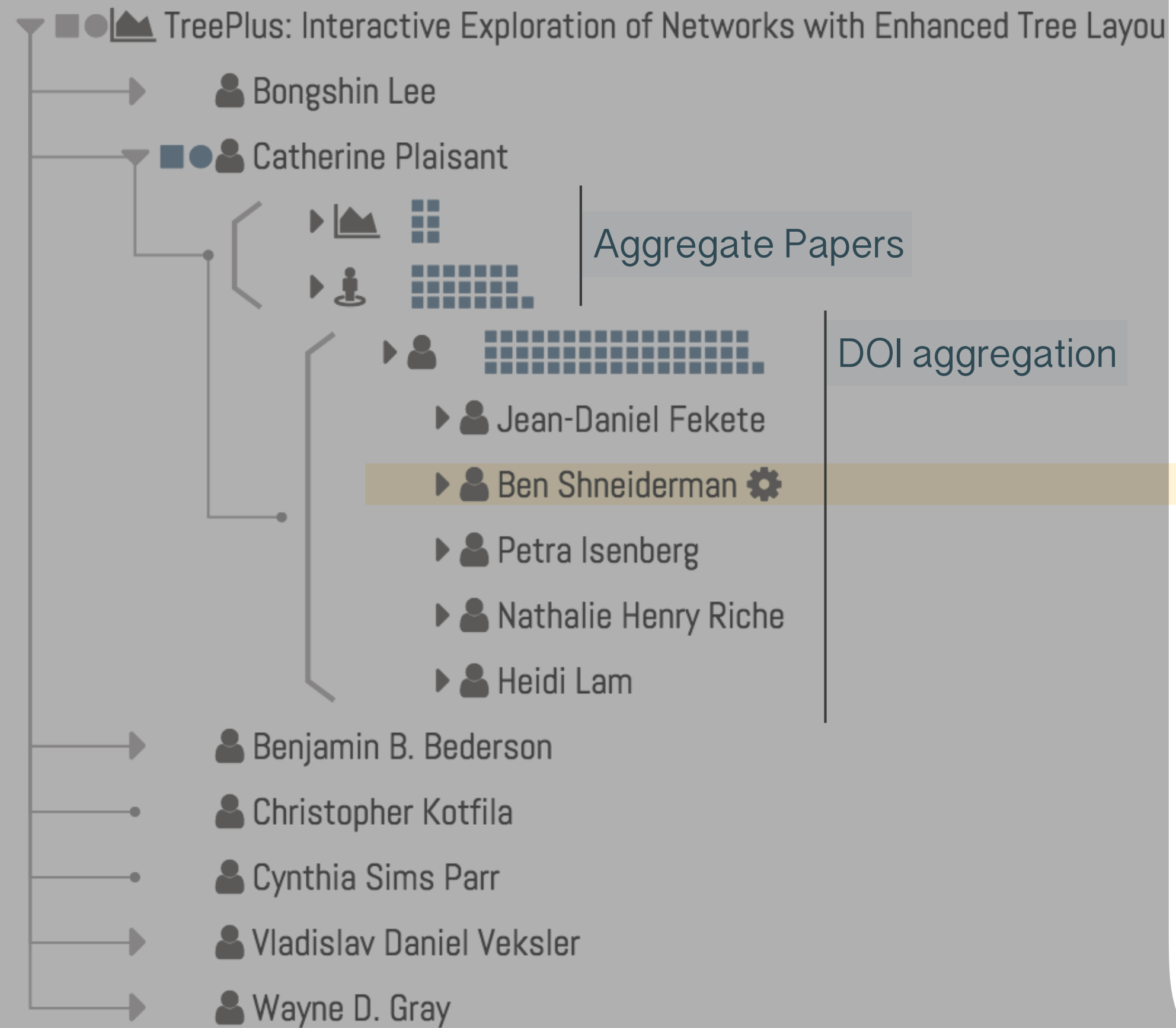
Juniper



SPANNING TREE



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[illegible]

EDGE COUNT TABLE

Juniper

TreePlus: Interactive Exploration of Networks with Enhanced Tree Layout

Bongshin Lee

Catherine Plaisant

Aggregate Papers

DOI aggregation

Jean-Daniel Fekete

Ben Shneiderman

Petra Isenberg

Nathalie Henry Riche

Heidi Lam

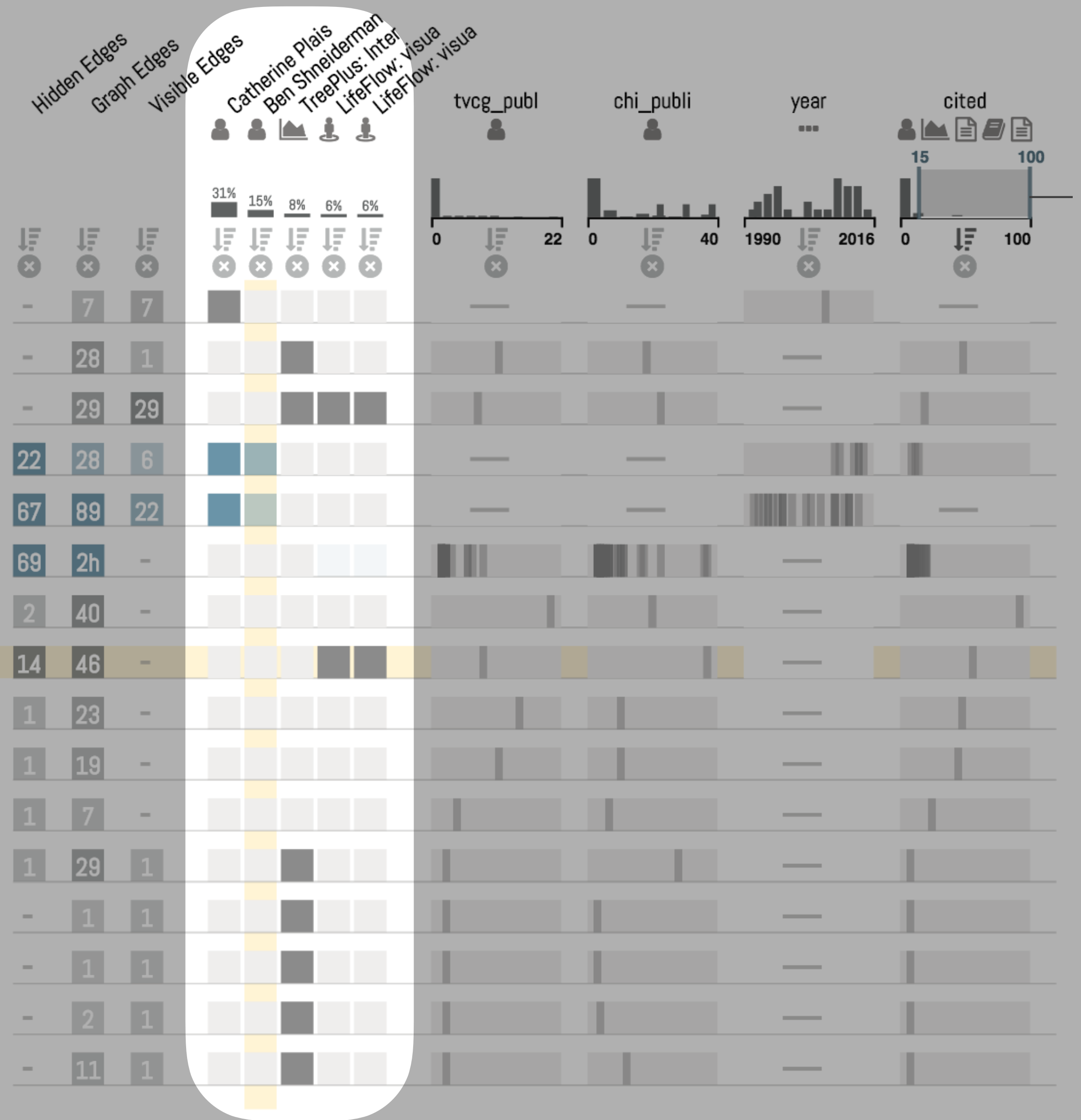
Benjamin B. Bederson

Christopher Kotfila

Cynthia Sims Parr

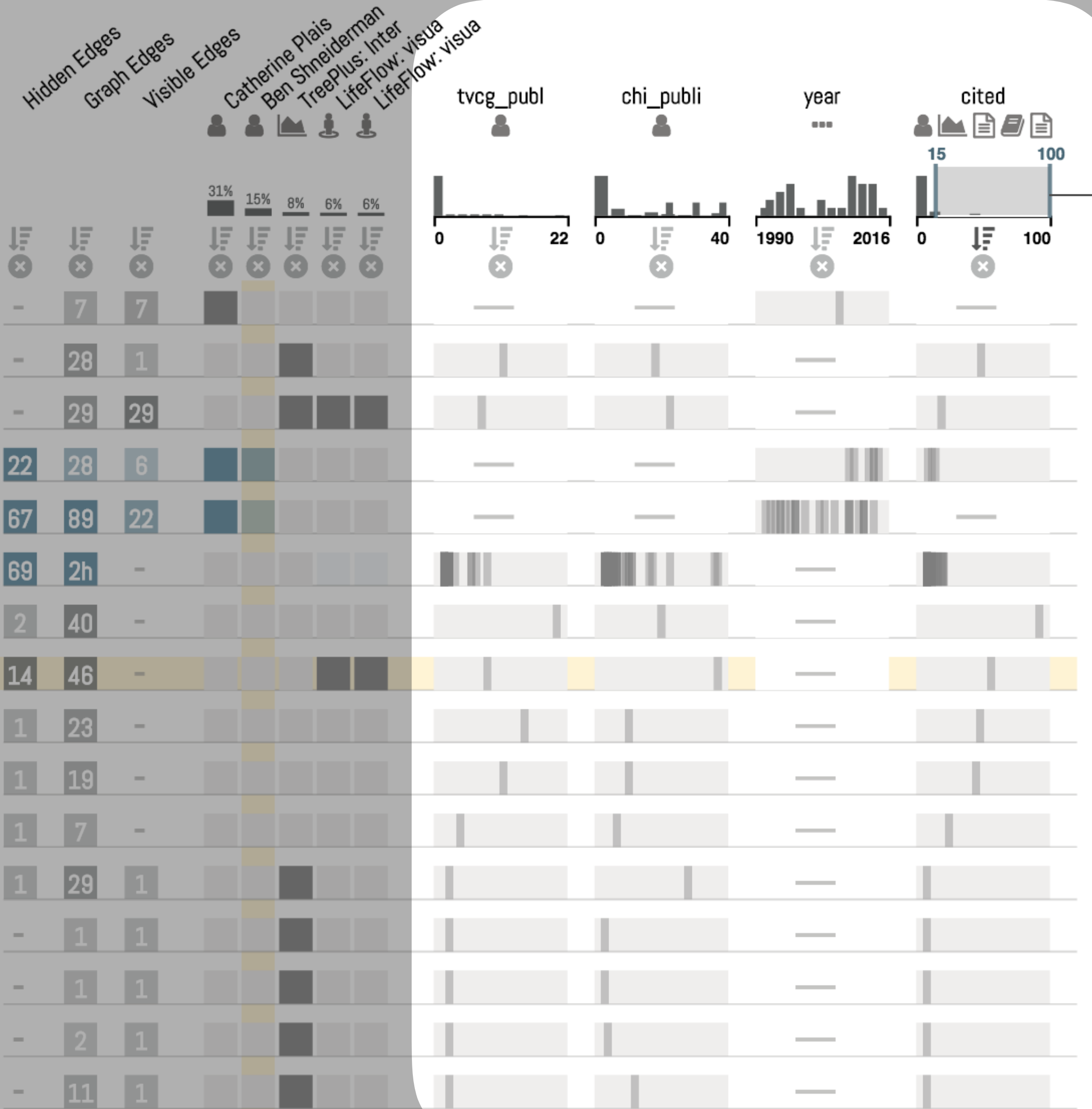
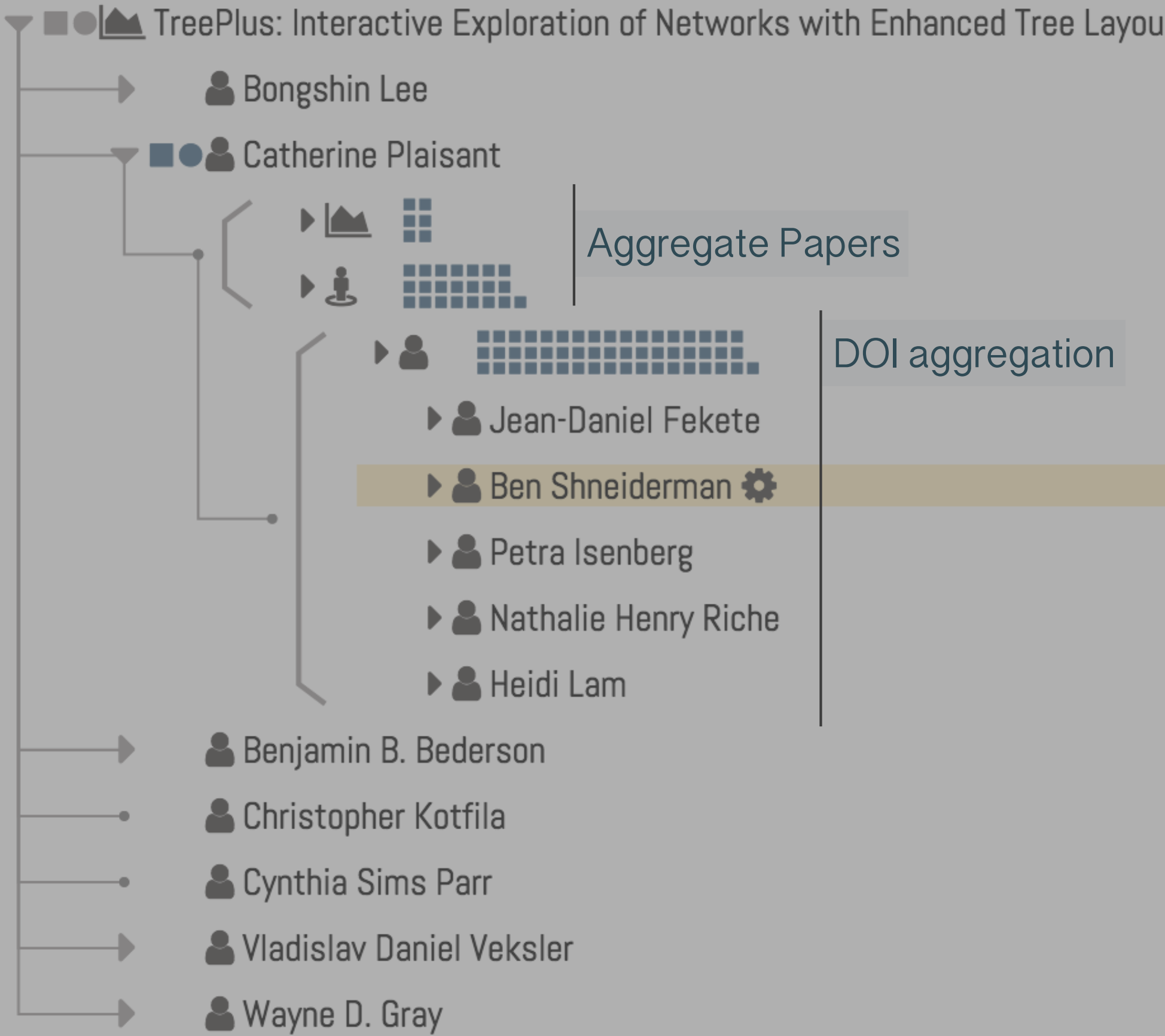
Vladislav Daniel Veksler

Wayne D. Gray

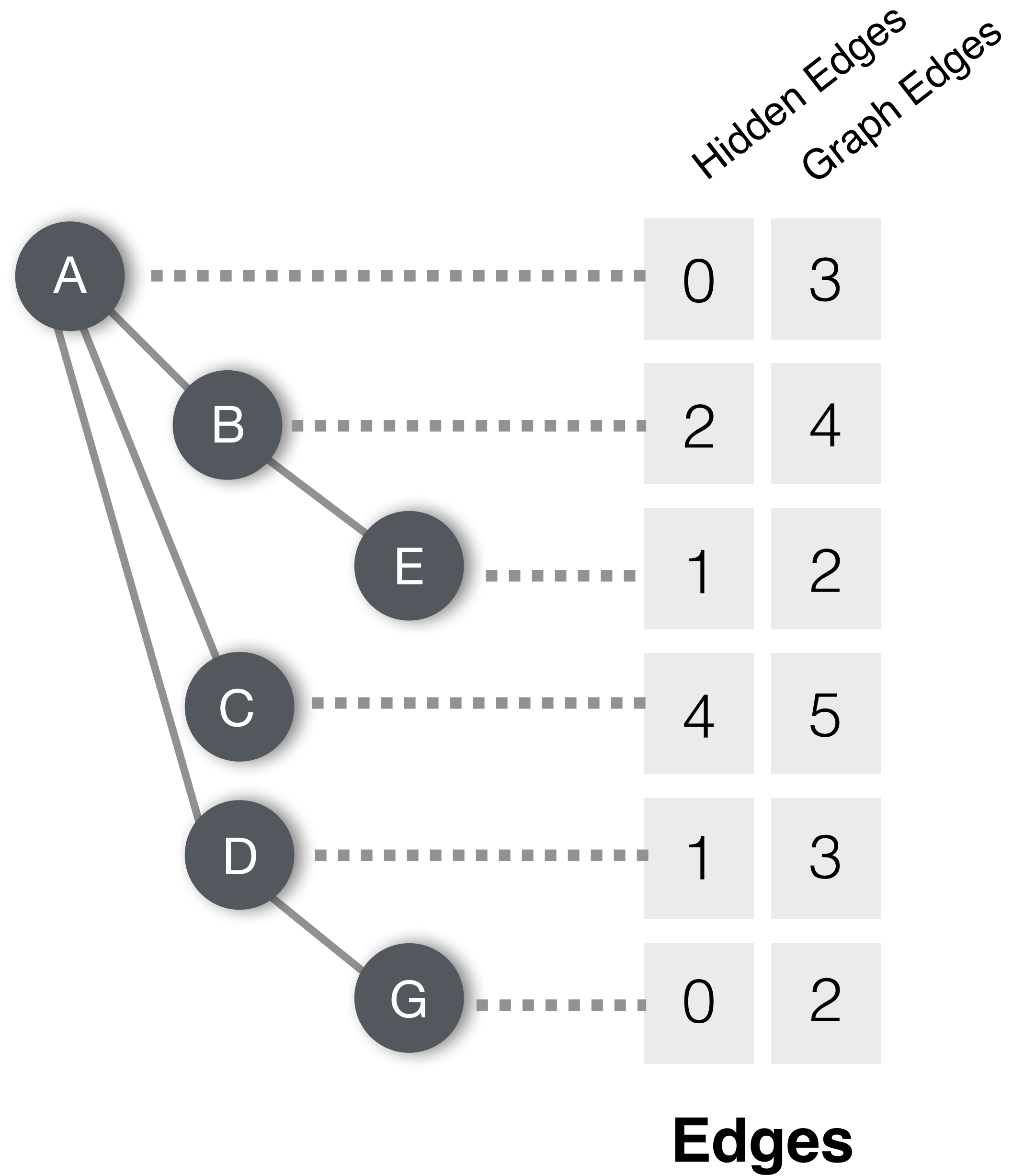


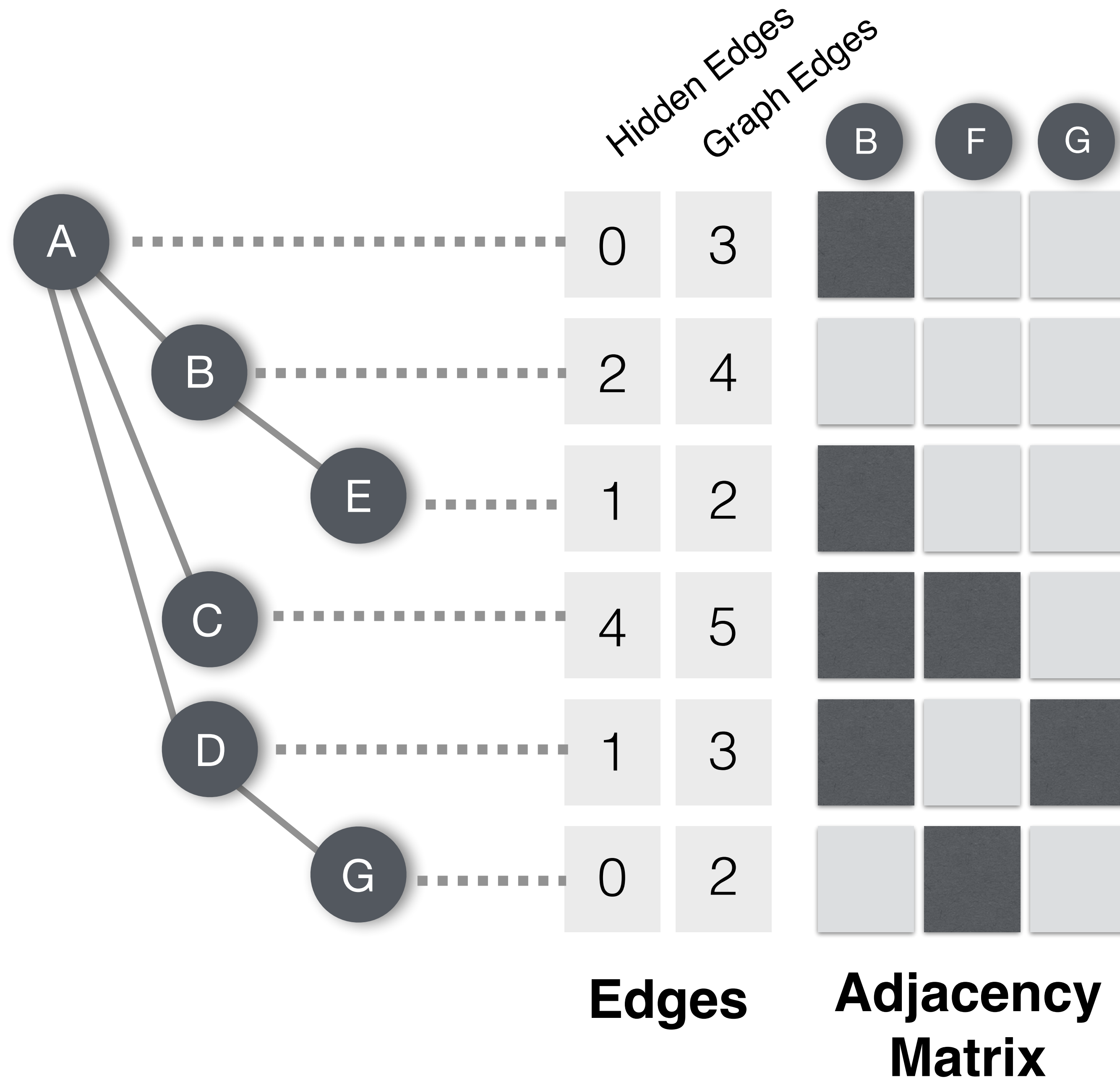
ADJACENCY MATRIX

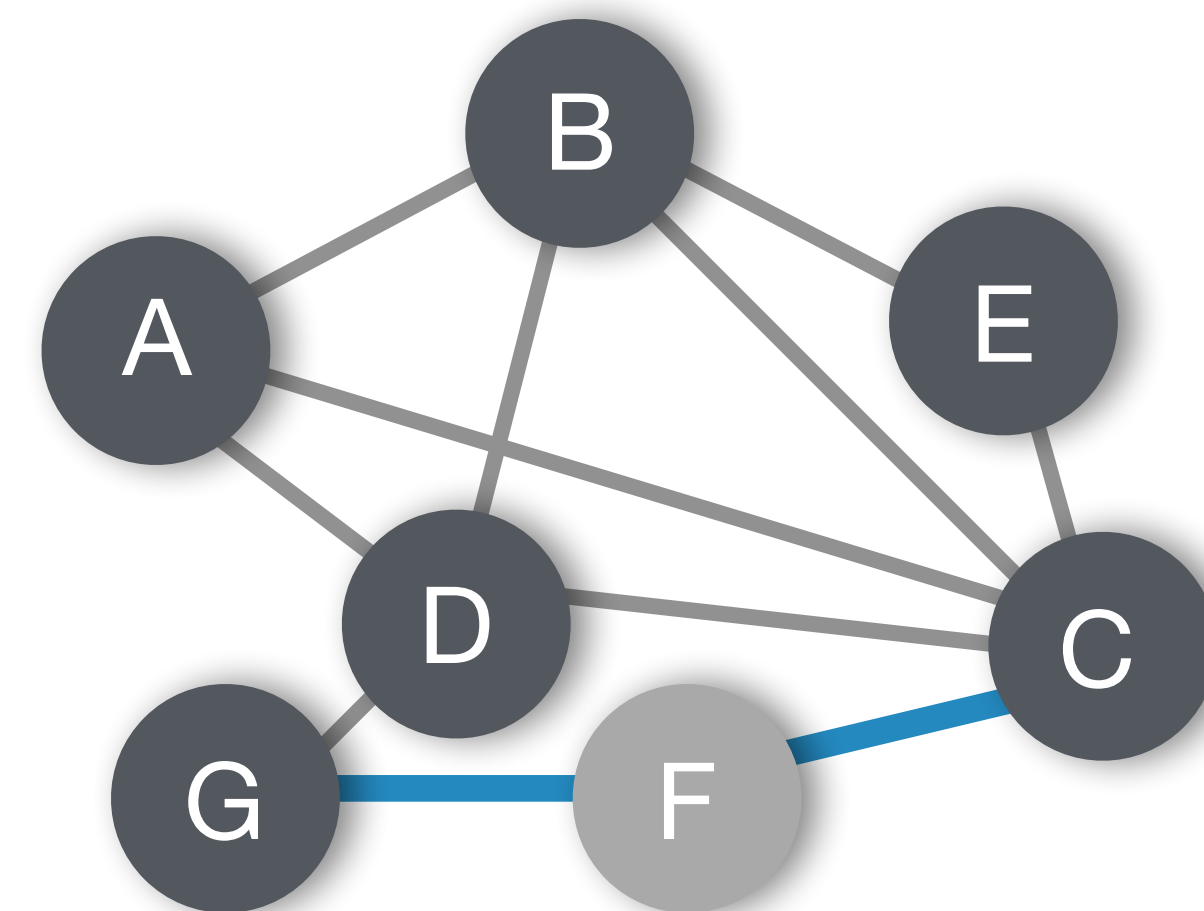
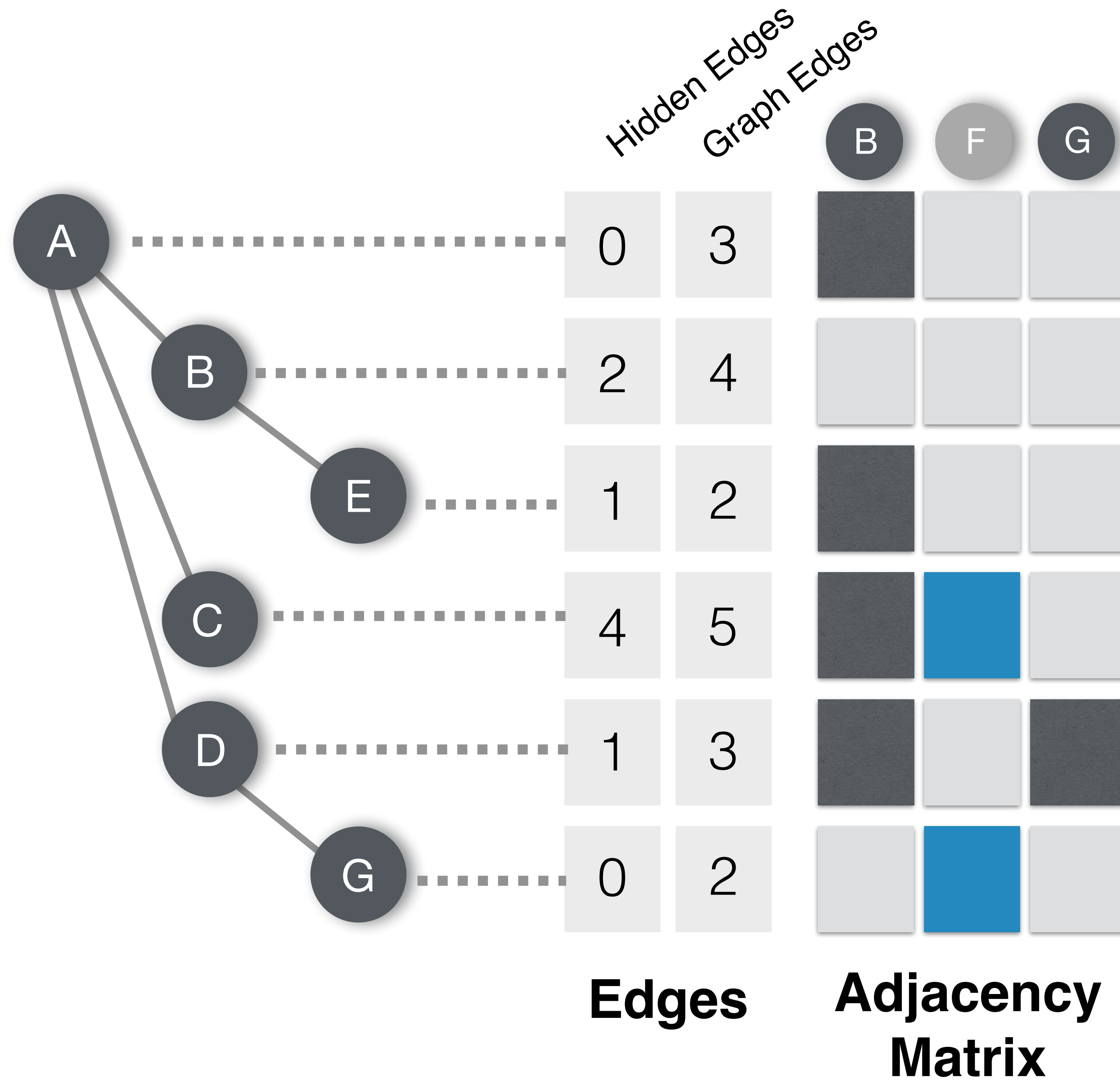
Juniper

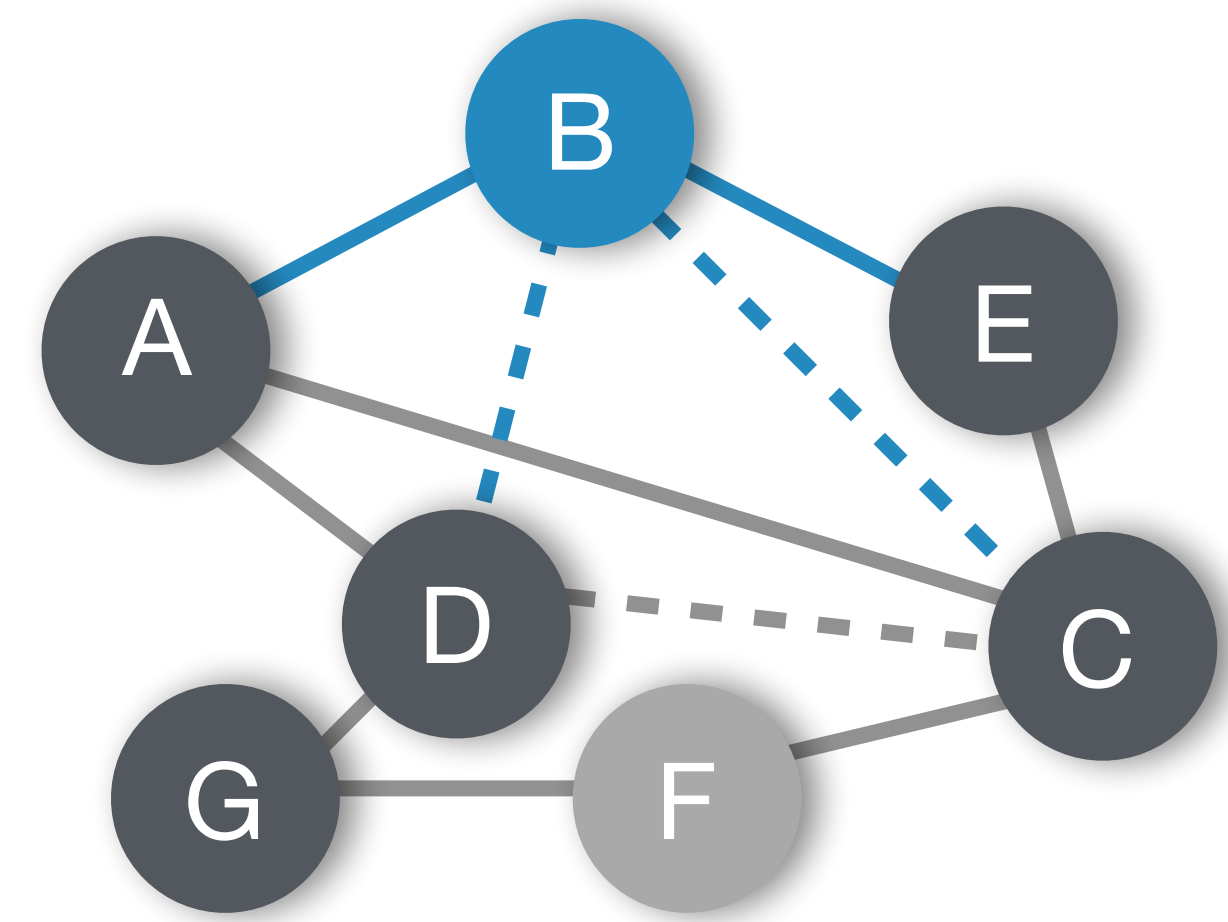
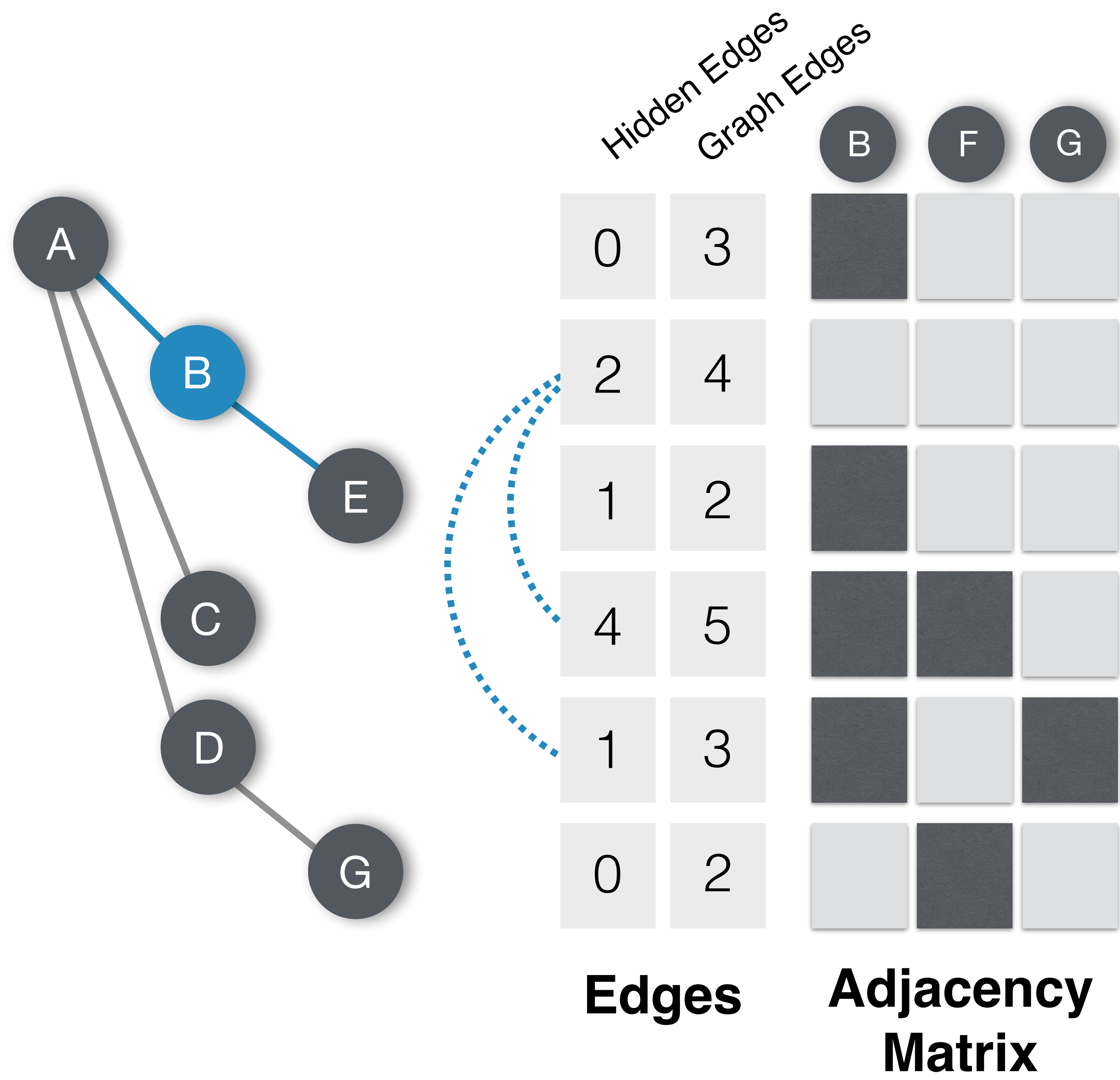


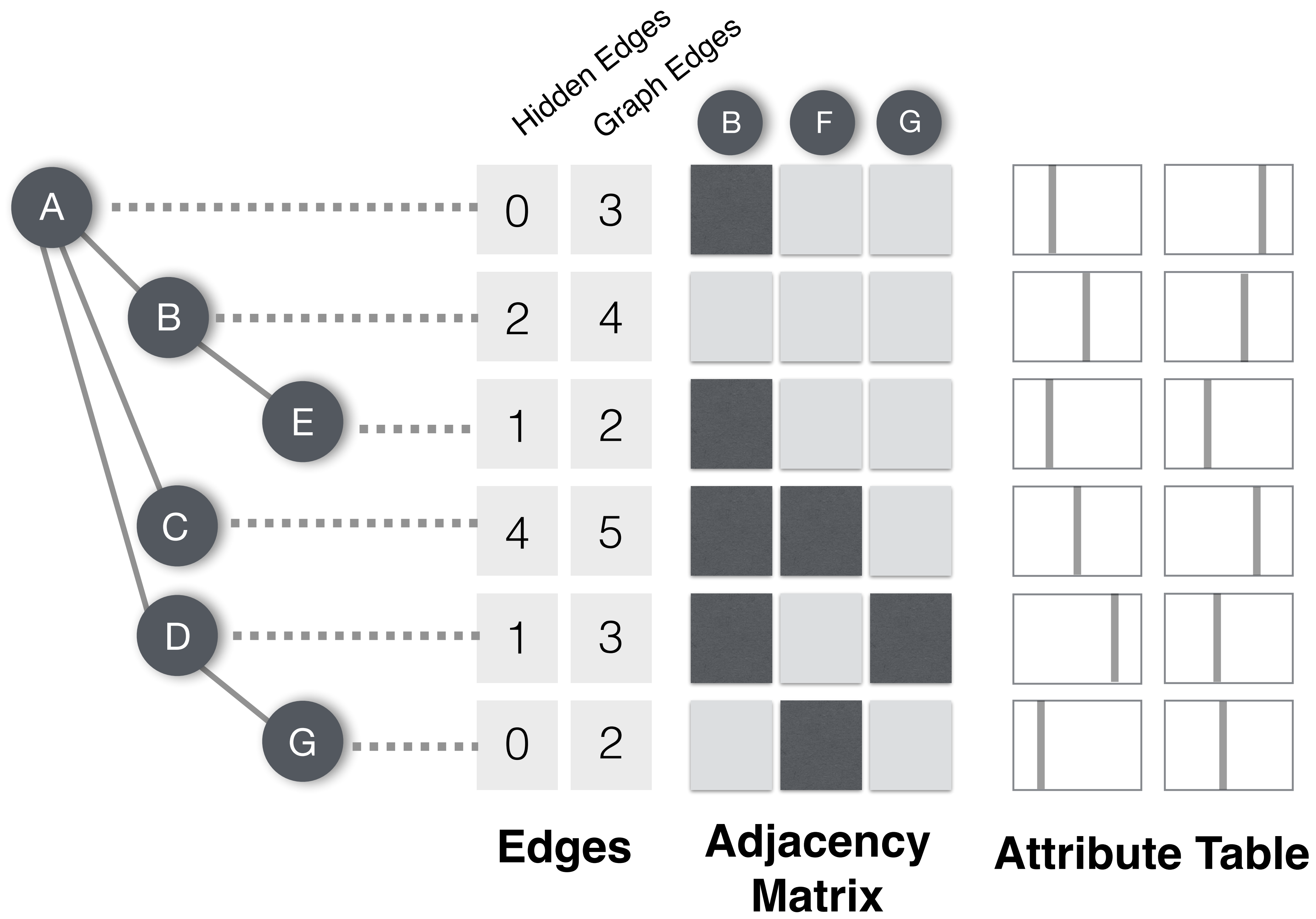
ATTRIBUTE TABLE



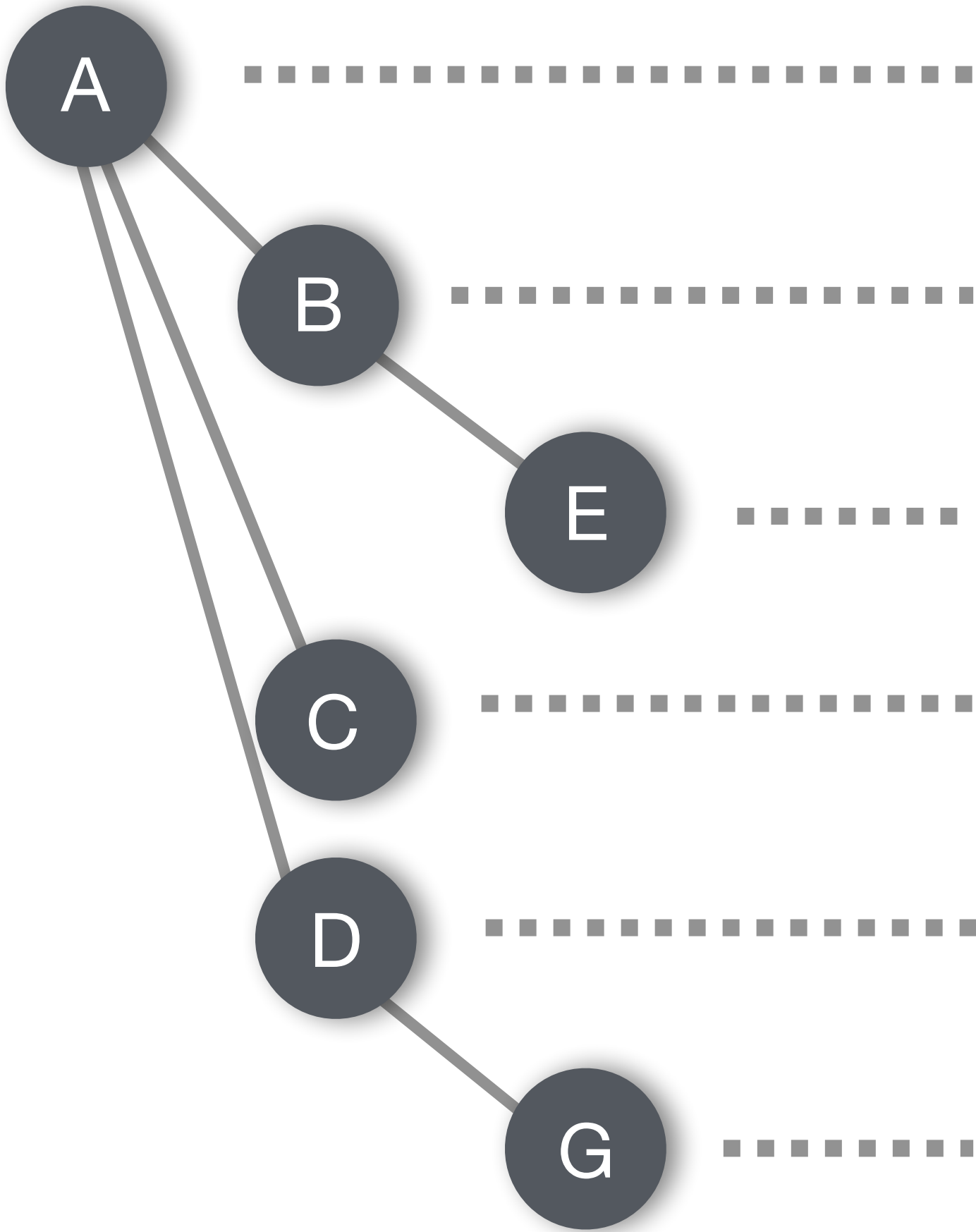




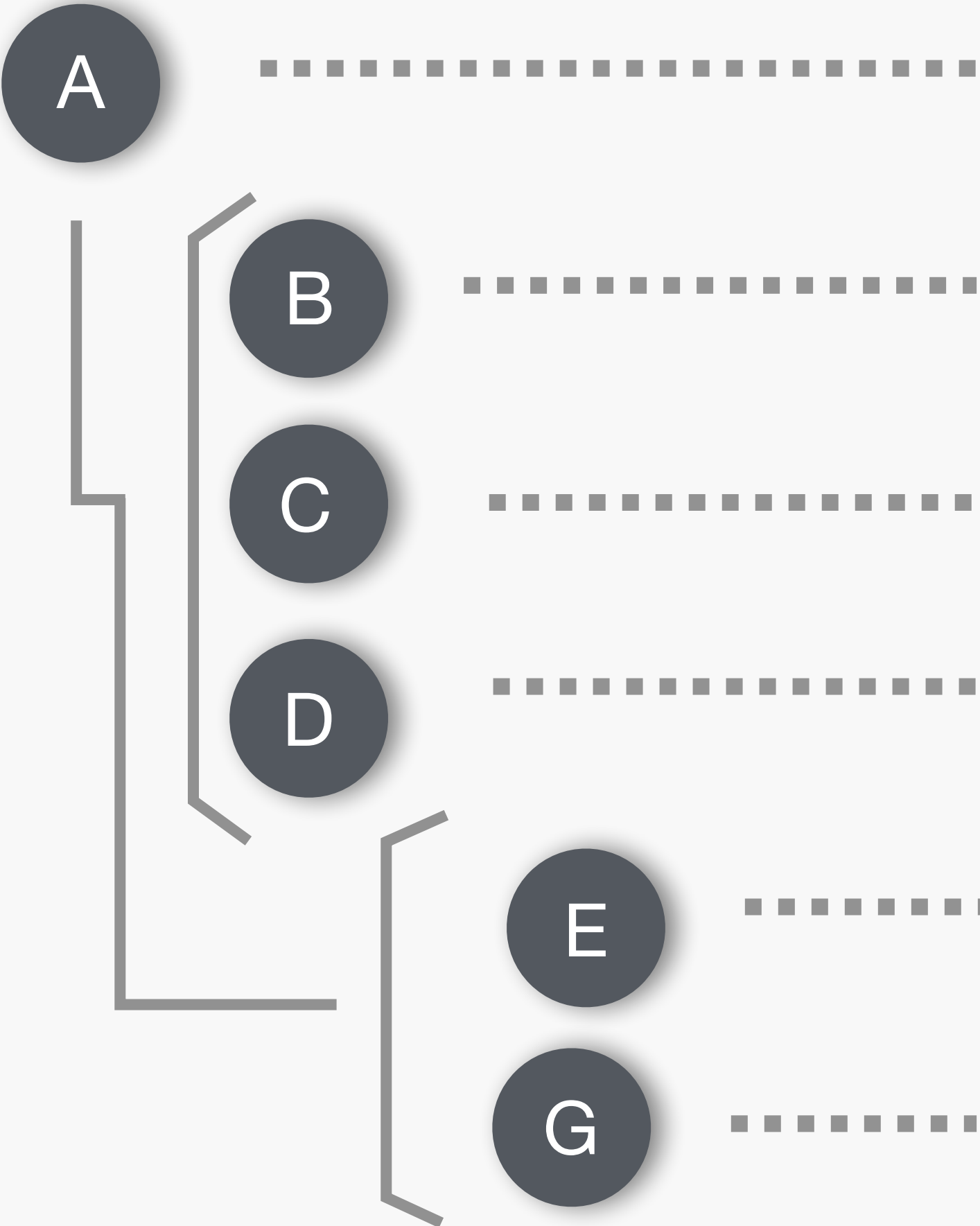




TREE MODE



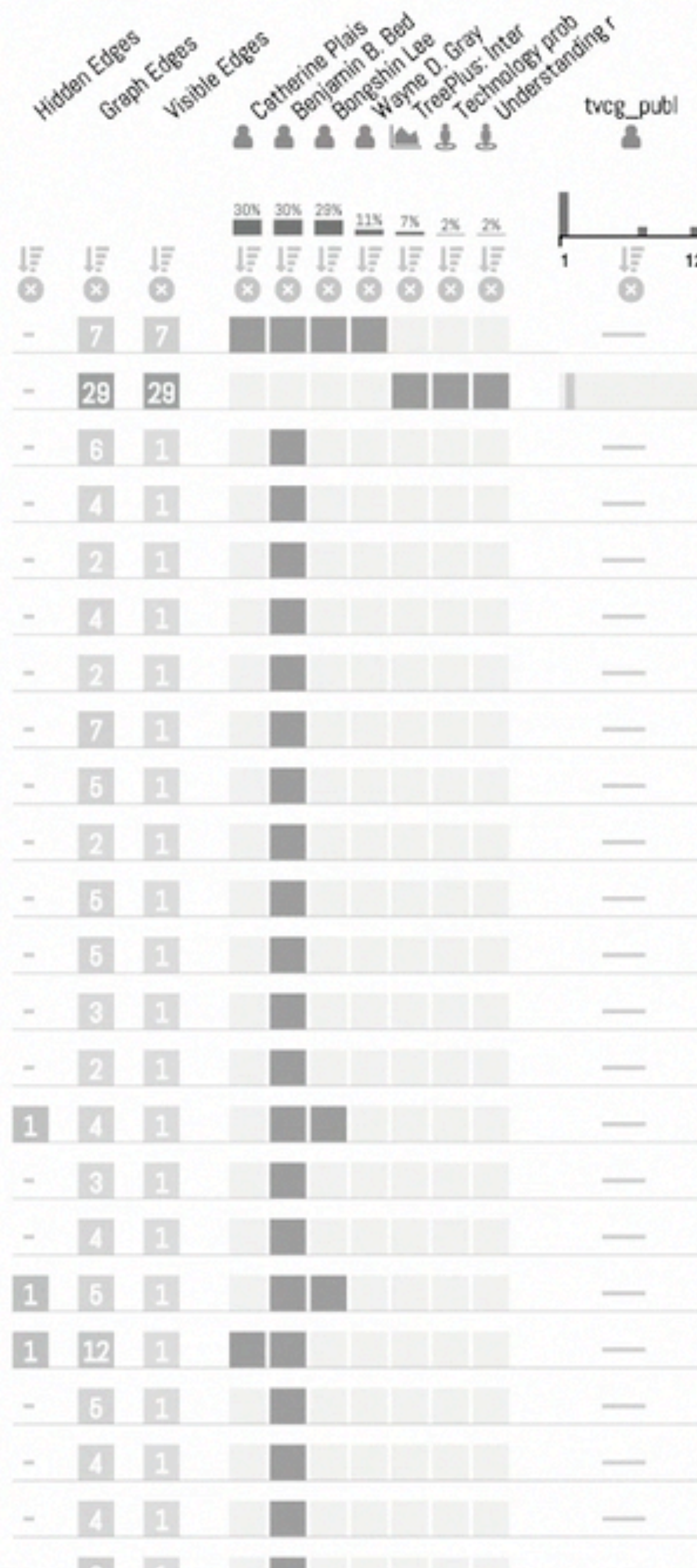
LEVEL MODE



TreePlus: Interactive Exploration of Networks with Enhanced Tree Layout

Benjamin B. Bederson

- CTArcade: learning computational thinking while tr
- Deploying monotrans widgets in the wild.
- Human computation: a survey and taxonomy of a grow
- MonoTrans2: a new human computation system to supp
- Web workers unite! addressing challenges of online
- Mobile technologies for the world's children.
- CHI policy issues around the world.
- One-handed touchscreen input for legacy applicatio
- Readability of scanned books in digital libraries.
- Workshop on SIGCHI public policy.
- AppLens and launchTile: two designs for one-handed
- Benefits of animated scrolling.
- Understanding research trends in conferences using
- Preschool children's use of mouse buttons.
- A fisheye calendar interface for PDAs: providing o
- Electronic voting system usability issues.
- Technology probes: inspiring design for and with f
- Voting: user experience, technology and practice.
- Automatic text reduction for changing size constra
- KidPad: collaborative storytelling for children.
- Smart Kids: digital library interface for young



JUNIPER IN ACTION

Shortest Path

Search for node name



(20) CHI

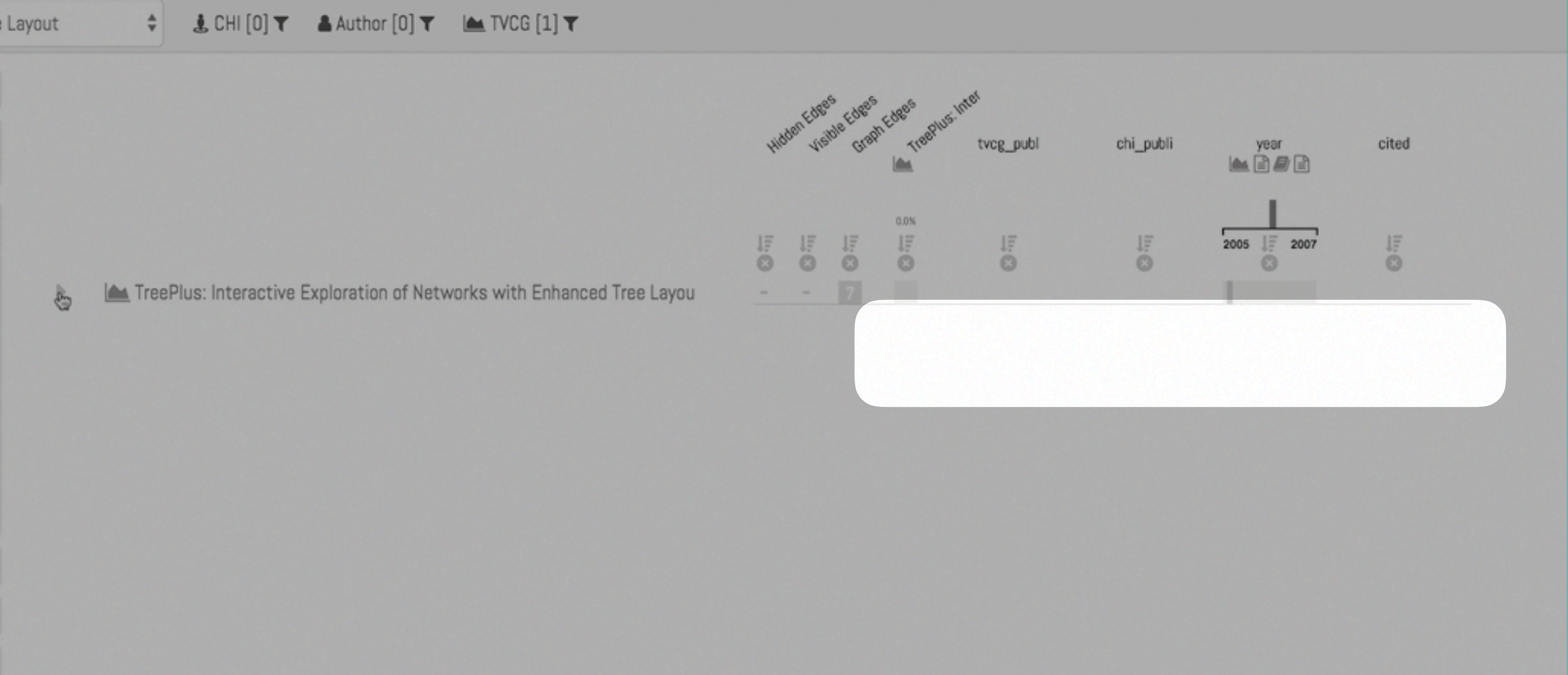
A resource s...	2	+
ADEPT: a vis...	3	+
Behaviour ch...	3	+
Creativity i...	1	+
Designing bo...	1	+
Evaluation o...	3	+

(20) Author

(20) TVCG

Query for Node

QUERY TASK

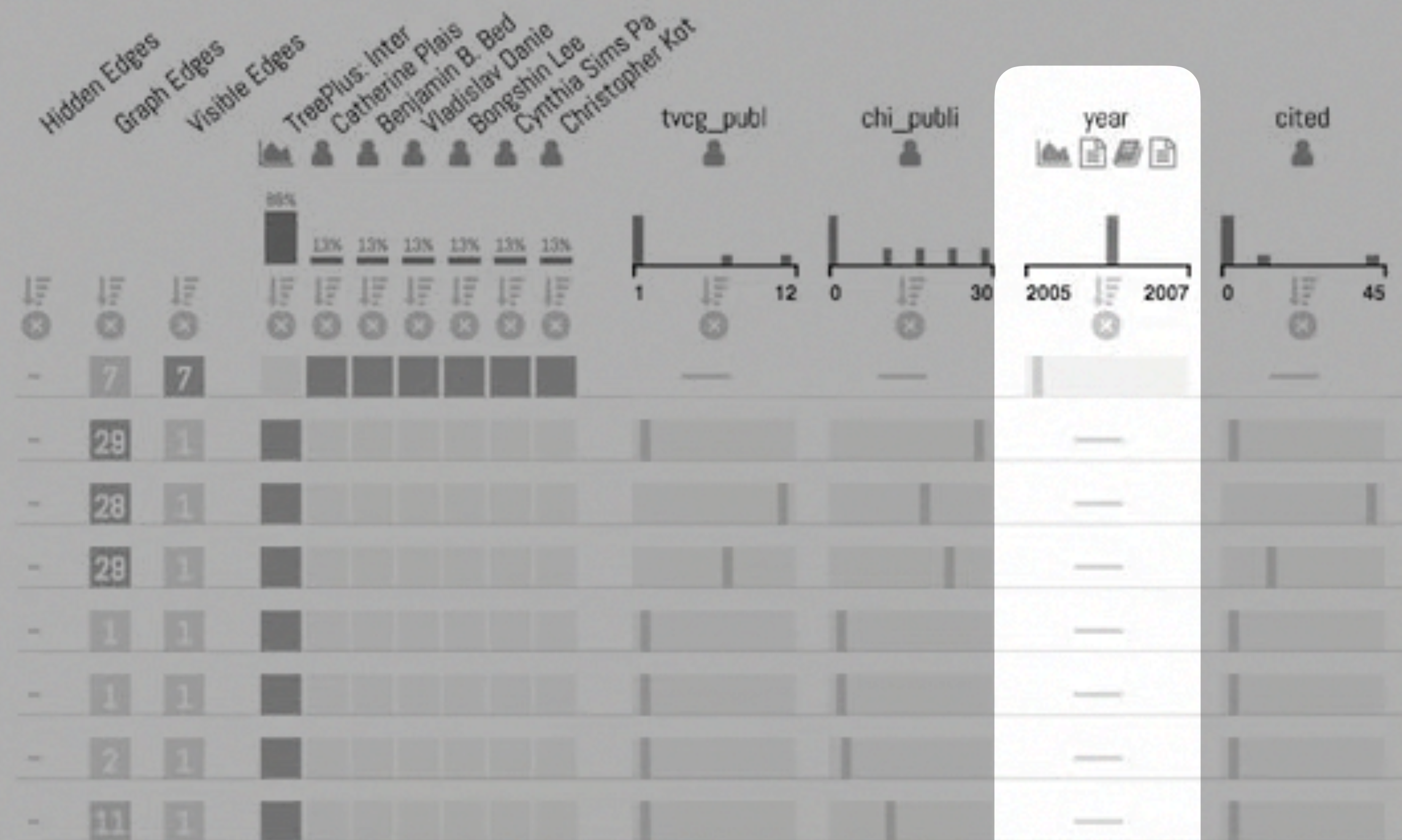


Find Neighbors

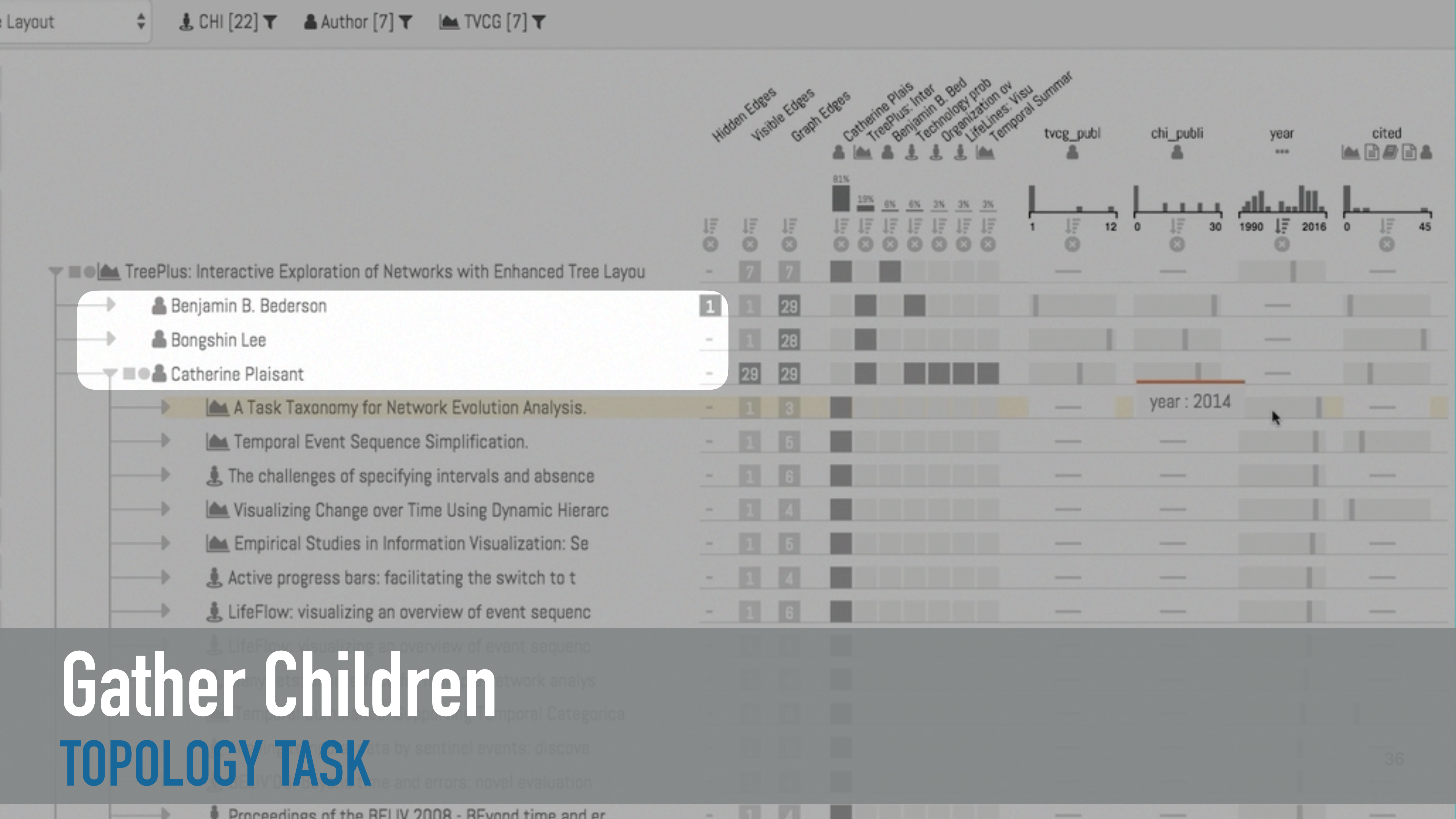
TOPOLOGY TASK

TreePlus: Interactive Exploration of Networks with Enhanced Tree Layout

- Benjamin B. Bederson
- Bongshin Lee
- Catherine Plaisant
- Christopher Kotfila
- Cynthia Sims Parr
- Vladislav Daniel Veksler
- Wayne D. Gray



Sort by Attribute
ATTRIBUTE TASK



Gather Children

TOPOLOGY TASK

TreePlus: Interactive Exploration of Networks with Enhanced Tree Layout

Benjamin B. Bederson

 Technology probes: inspiring design for and with f

27 Bongshin Lee

■● Catherine Plaisant

 A Task Taxonomy for Network Evolution Analysis. Temporal Event Sequence Simplification.

 The challenges of specifying intervals and absence

Visualizing Change over Time Using Dynamic Hierarc

Empirical Studies in Information Visualization: Se

Active progress bars: facilitating the switch to t

LifeFlow: visualizing an overview of event sequence

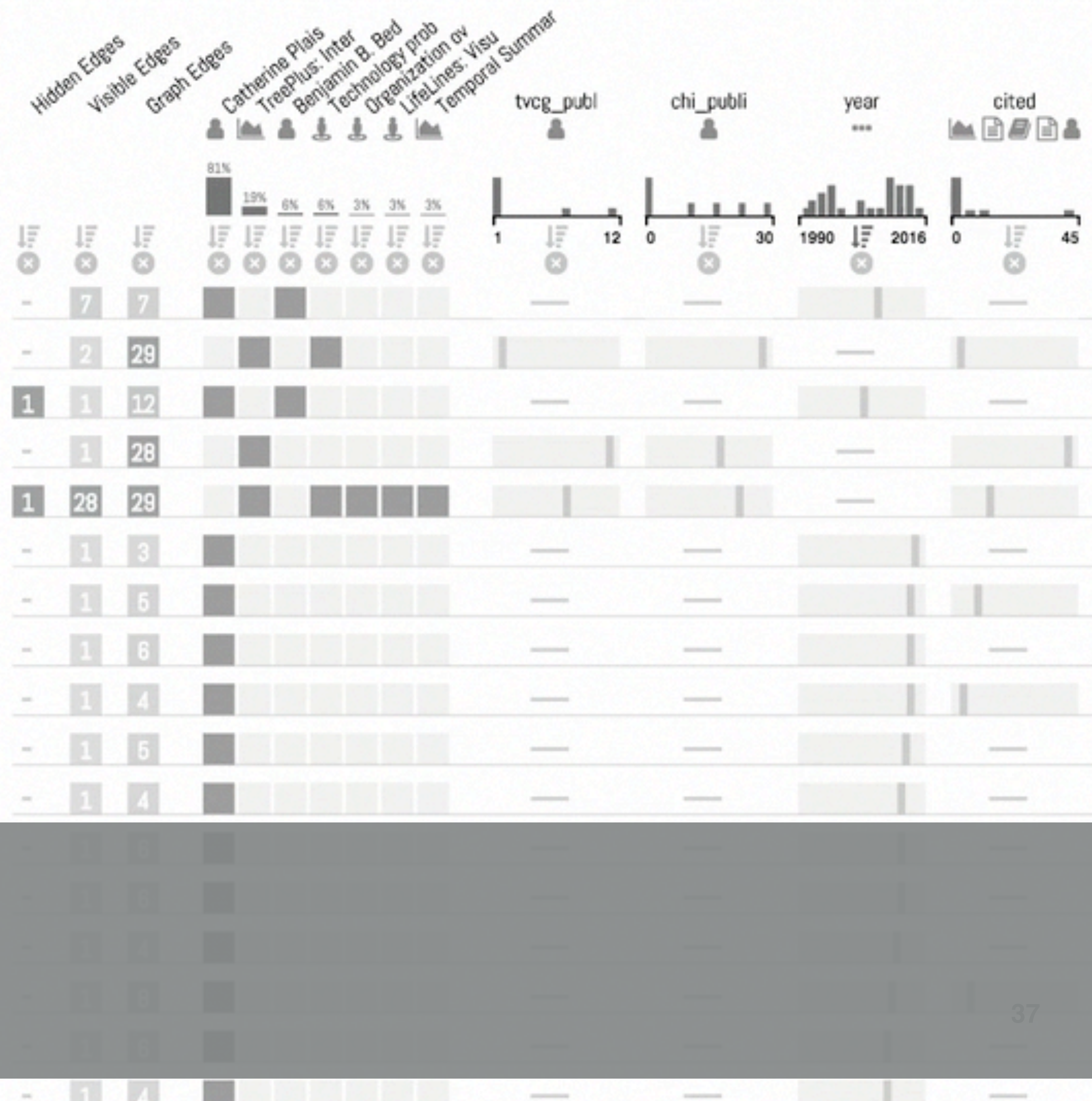
nd all children

And all children

NEW TACK

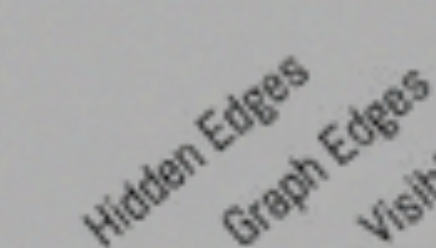
DATA TASK

BEI IV'08: Beyond time and errors: novel evaluation



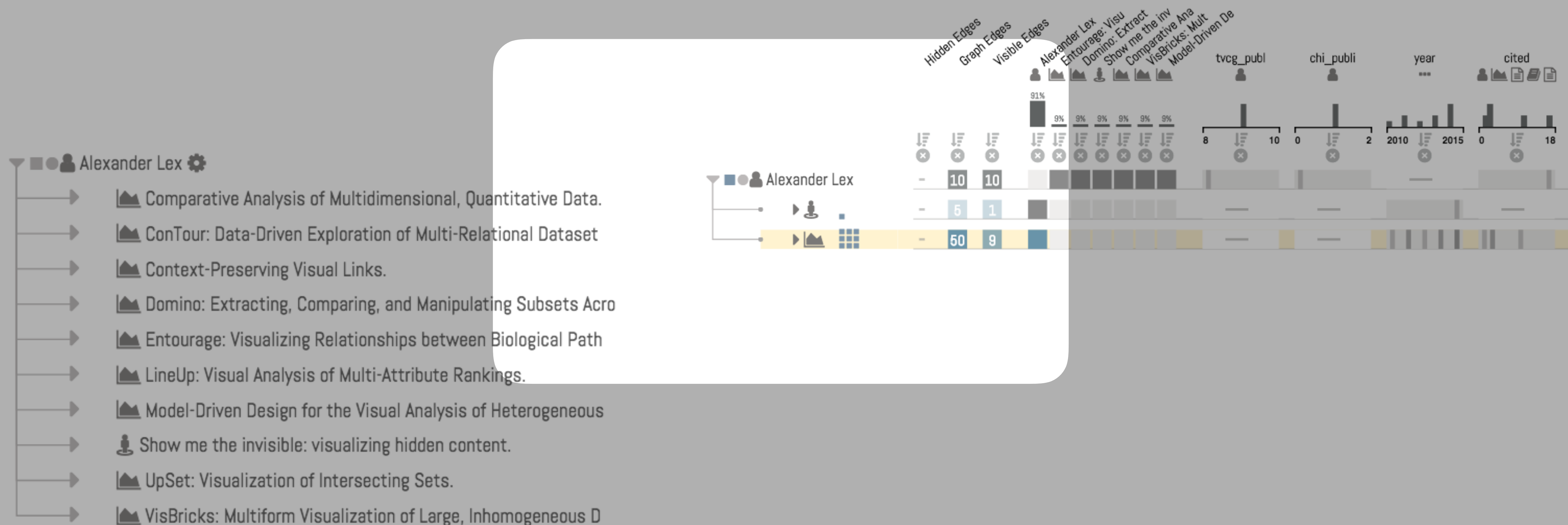
TreePl

-



Group by Distance to Root

TOPOLOGY TASK

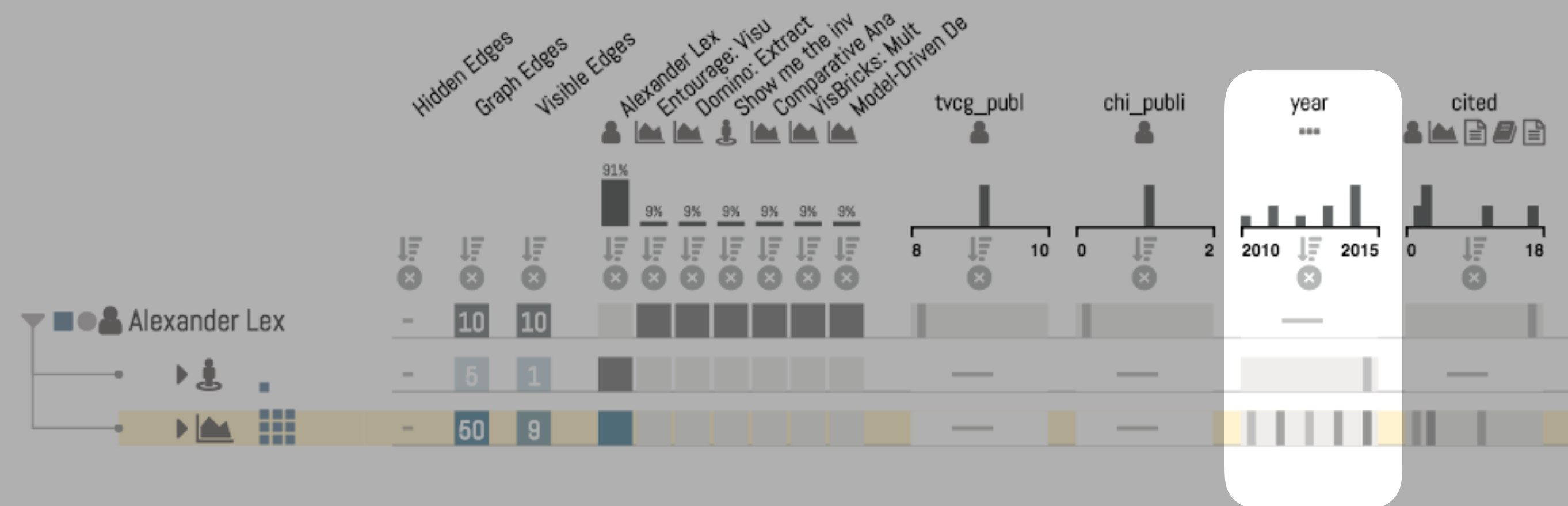


Aggregate by Type

ATTRIBUTE + TOPOLOGY TASK

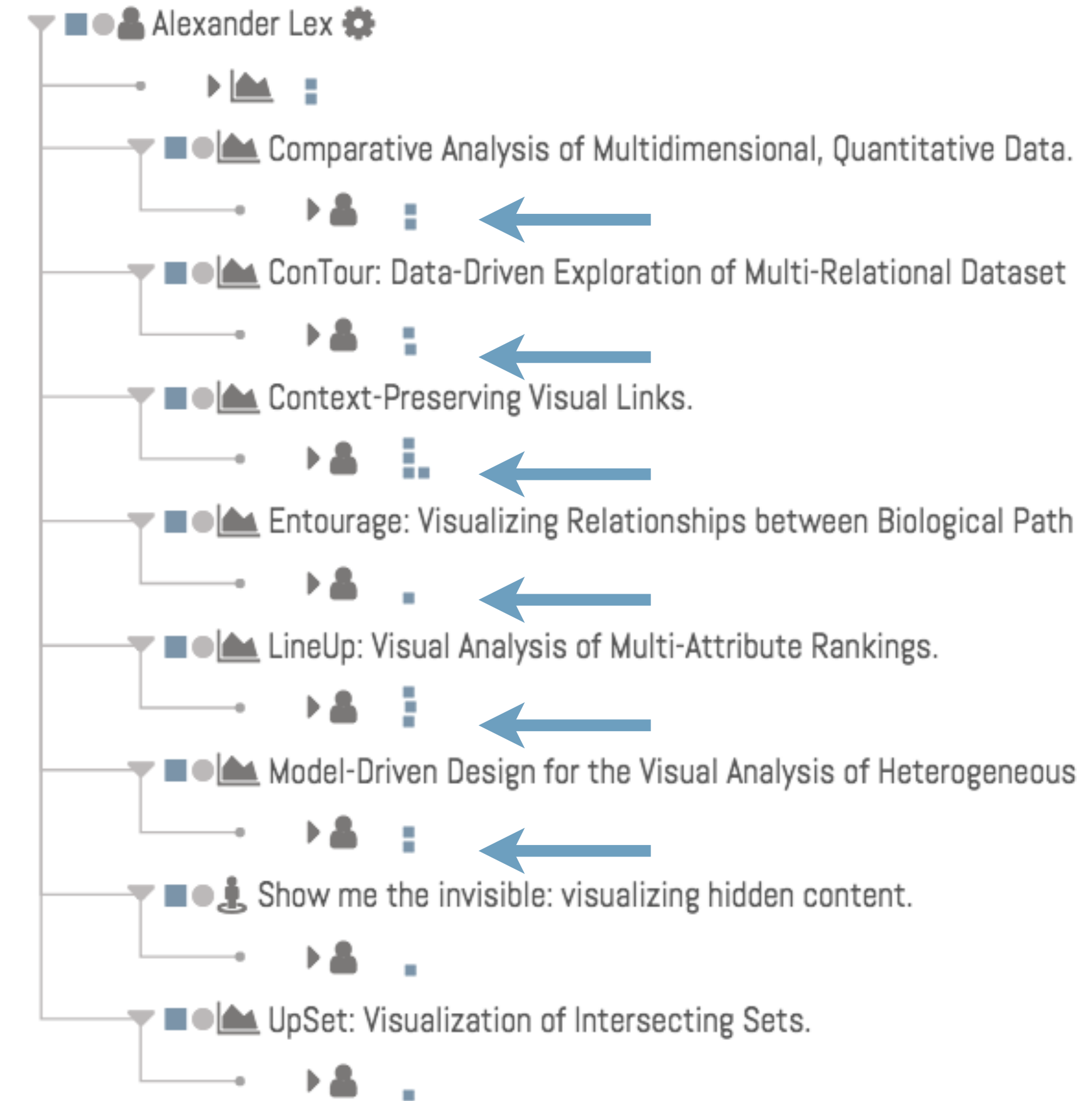
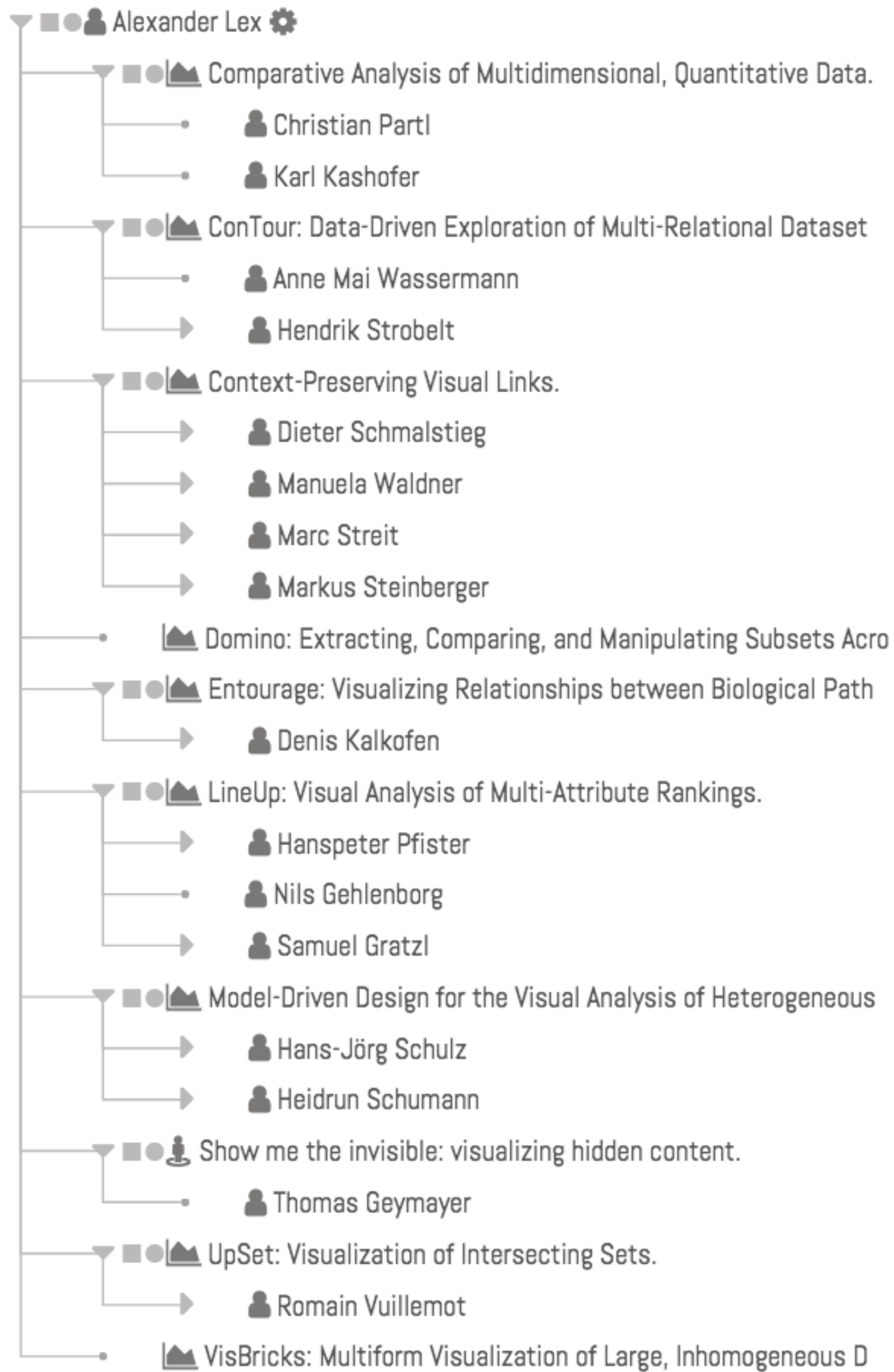
Alexander Lex

- Comparative Analysis of Multidimensional, Quantitative Data.
- ConTour: Data-Driven Exploration of Multi-Relational Dataset
- Context-Preserving Visual Links.
- Domino: Extracting, Comparing, and Manipulating Subsets Across
- Entourage: Visualizing Relationships between Biological Pathways
- LineUp: Visual Analysis of Multi-Attribute Rankings.
- Model-Driven Design for the Visual Analysis of Heterogeneous Data
- Show me the invisible: visualizing hidden content.
- UpSet: Visualization of Intersecting Sets.
- VisBricks: Multiform Visualization of Large, Inhomogeneous Datasets



Aggregate by Type

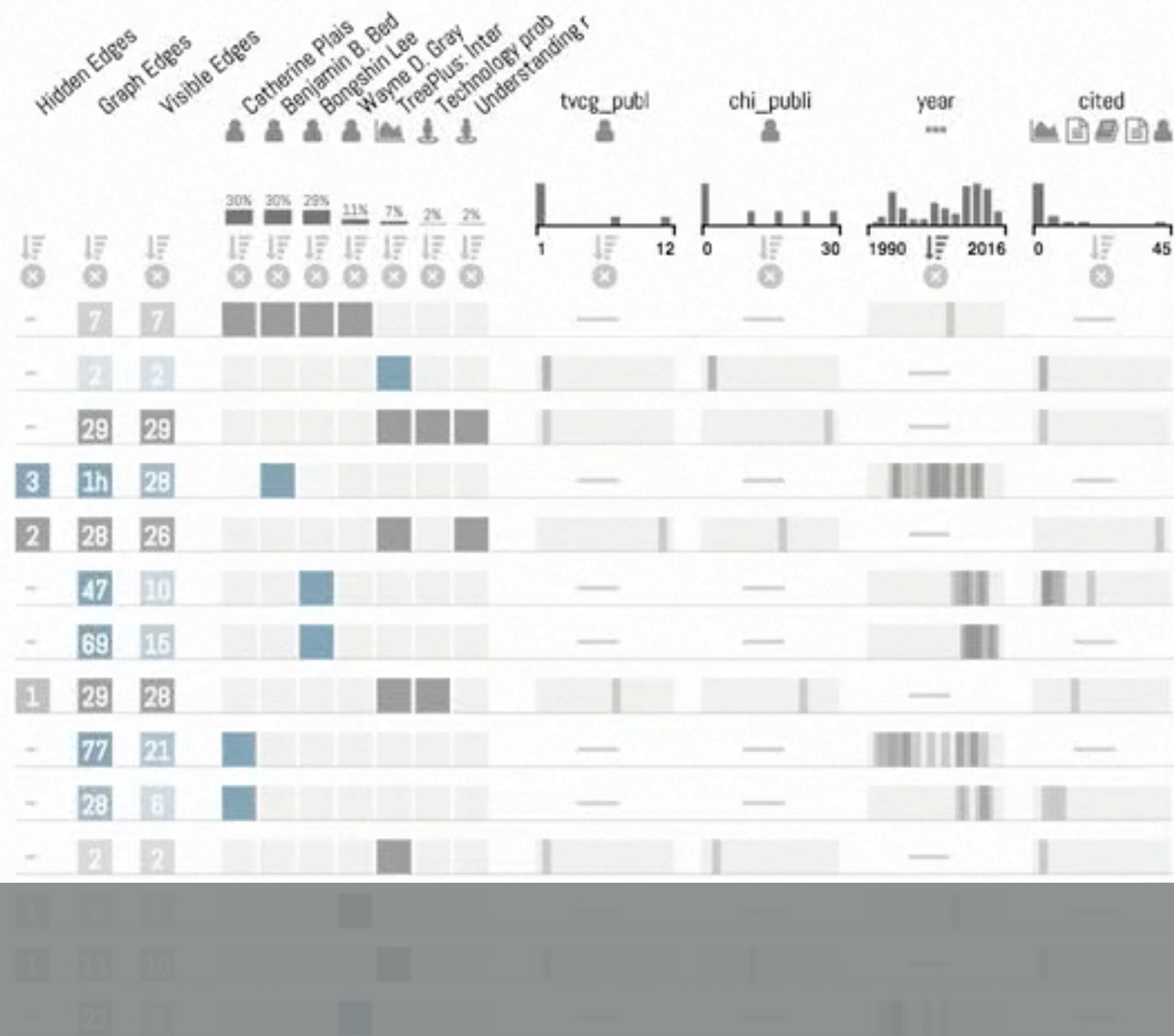
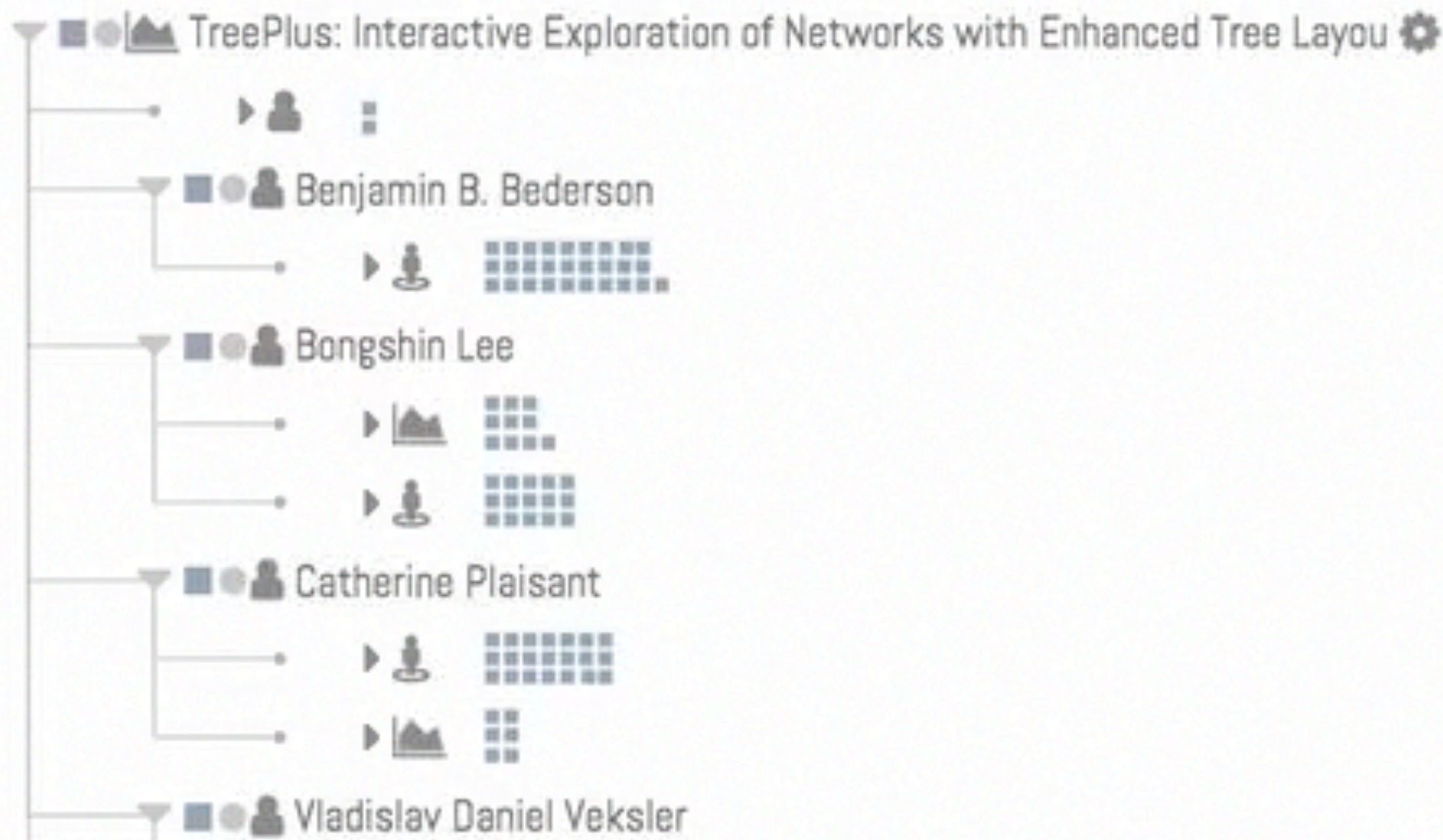
ATTRIBUTE + TOPOLOGY TASK







Aggregate by Type
ATTRIBUTE + TOPOLOGY TASK



Re-Root Tree

TOPOLOGY TASK



Degree of Interest based Aggregation

ATTRIBUTE + TOPOLOGY TASK

Shortest Path

nodetrix

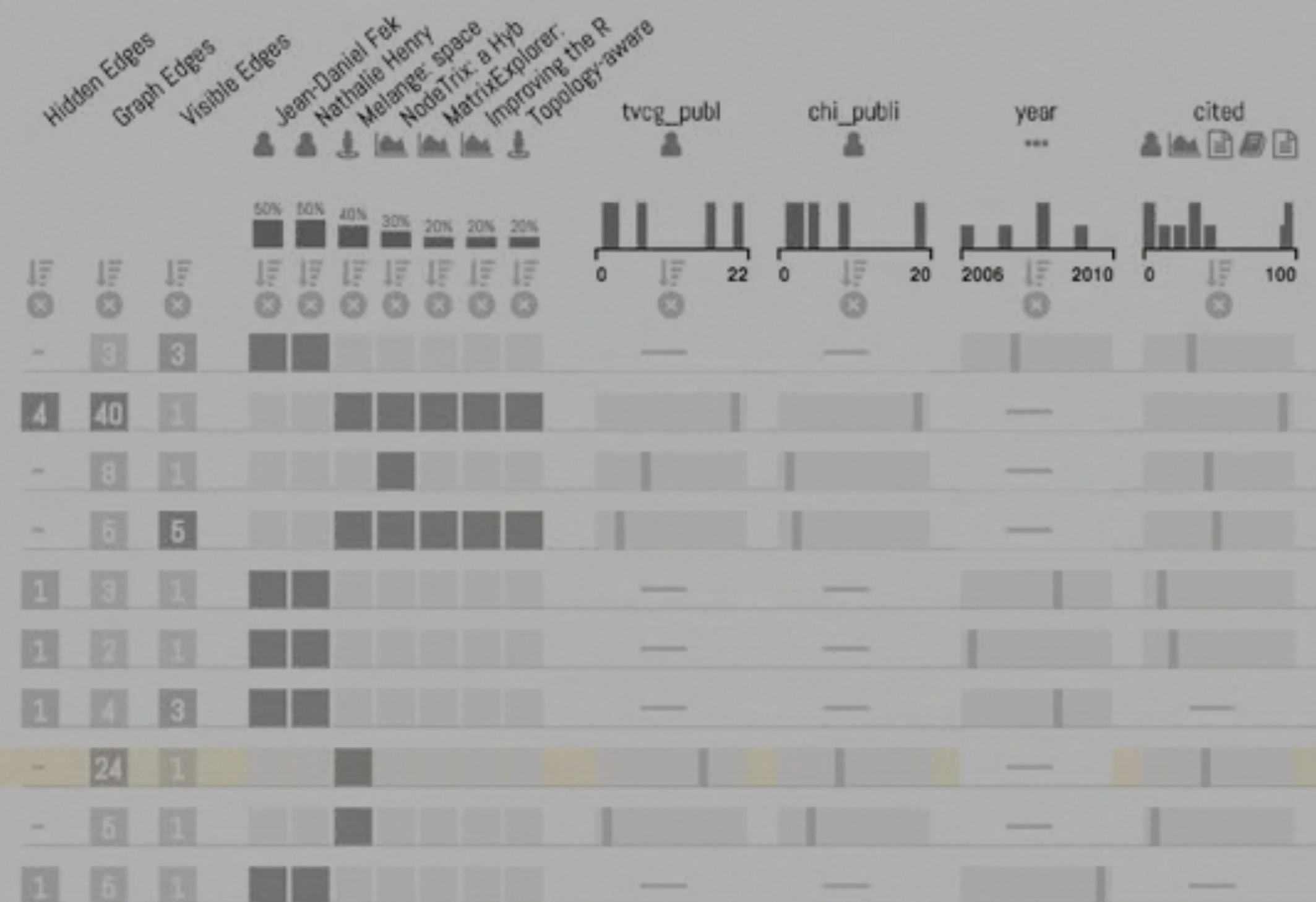
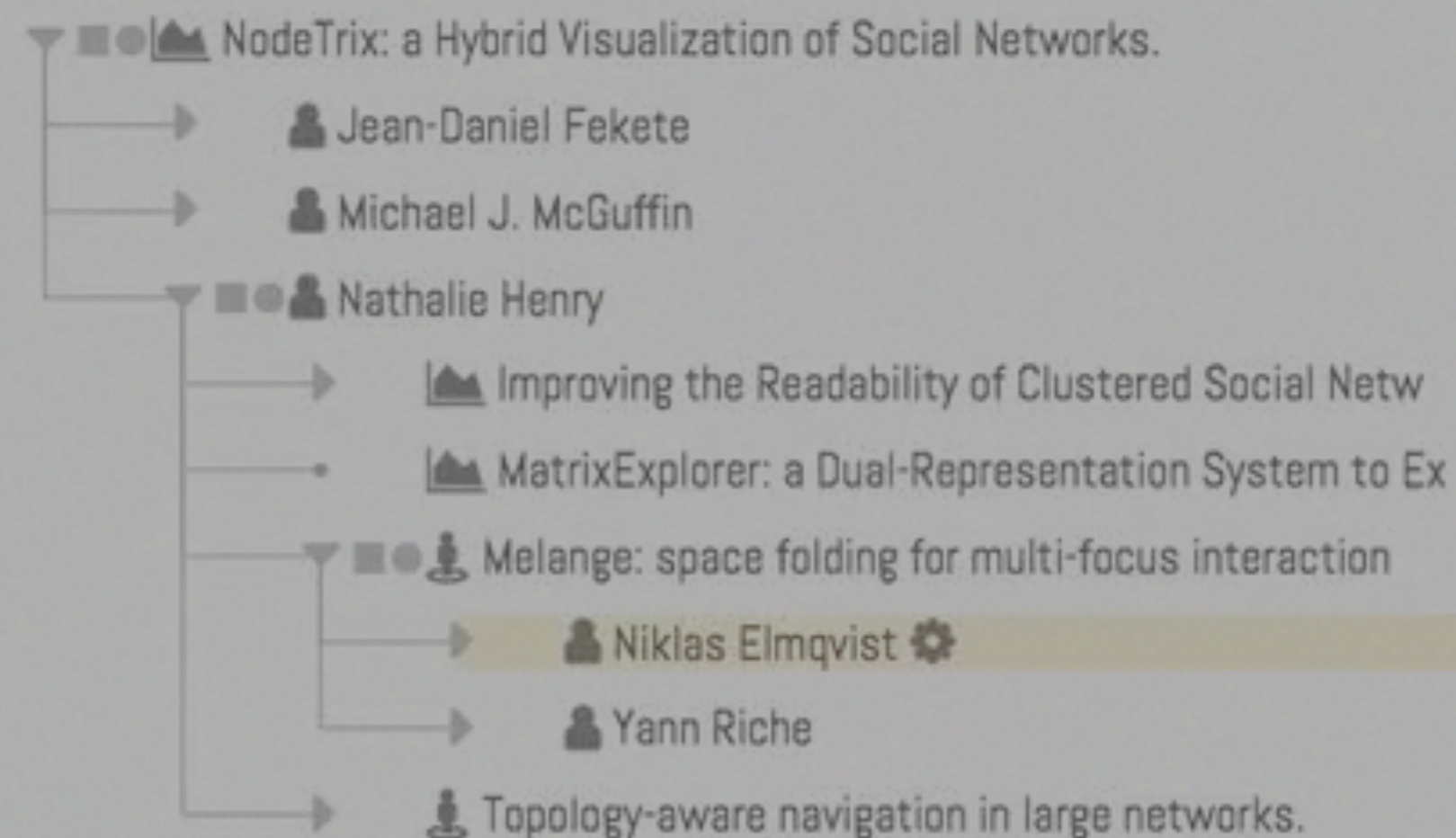
(1) Journal

NodeTrix: a ... 3 +

(1) _Set_Node

(1) TVCG

(1) Article



Shortest Path

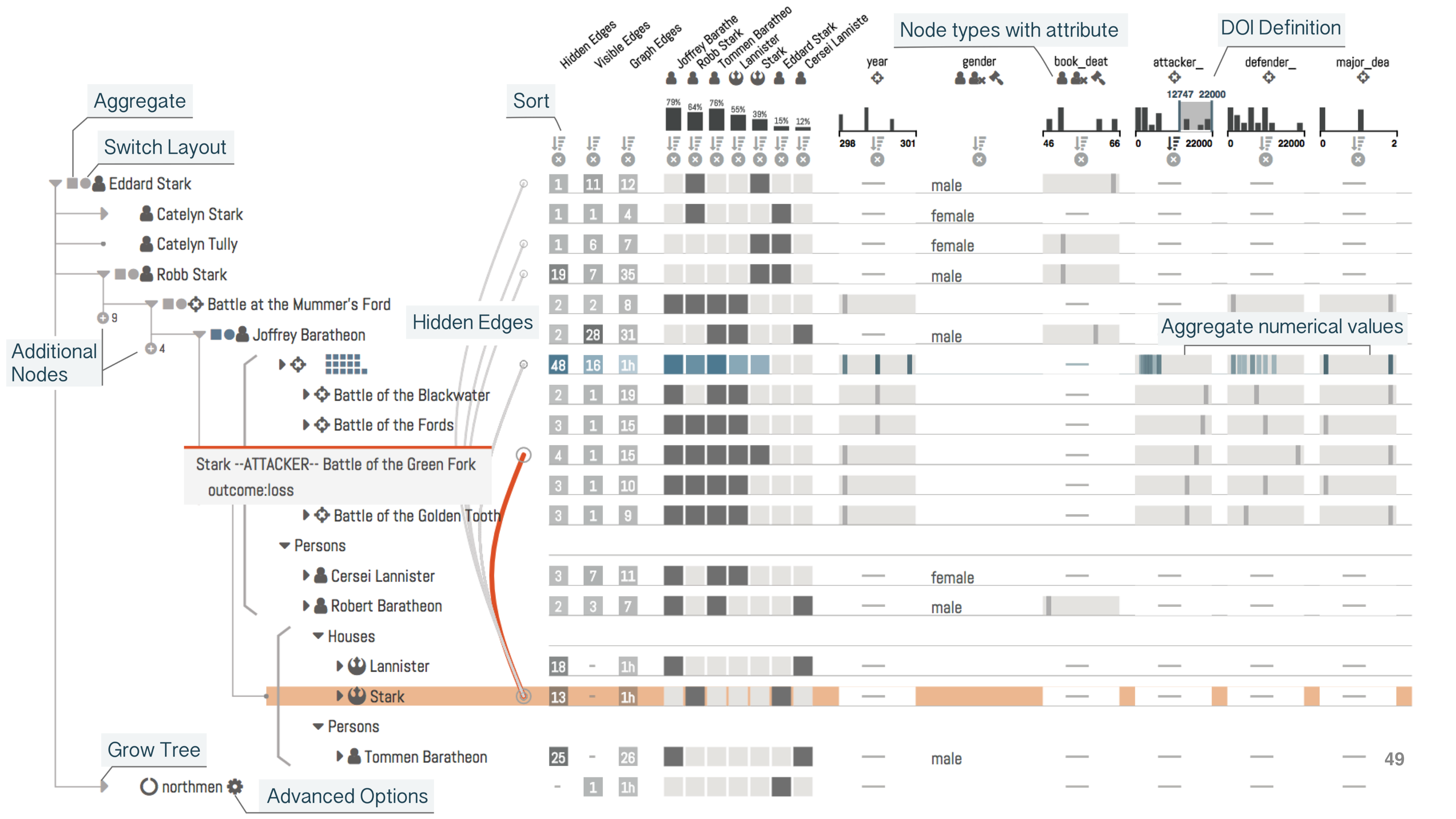
TOPOLOGY TASK

THE CHALLENGE

**SUPPORTING TOPOLOGY AND ATTRIBUTE
BASED TASKS EQUALLY WELL**

APPLYING THE SPANNING TREE AND LINEARIZATION TECHNIQUES TO A MULTIVARIATE GRAPH

SUPPORT TOPOLOGY AND ATTRIBUTE TASKS



FUTURE WORK

- ▶ Techniques for connecting to off-screen nodes
- ▶ Support for rich edge attributes
- ▶ Potential for interleaving cells in attribute table for graphs with different node types



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juniper.sci.utah.edu



visualization
design lab

