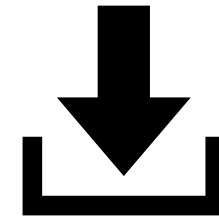


Visualizing Relationships: A Friendly Introduction to Working with Networks using Gephi... starting soon!

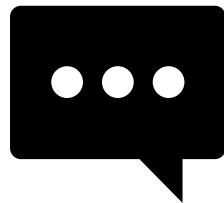
Please mute
mics and
stop sharing
video

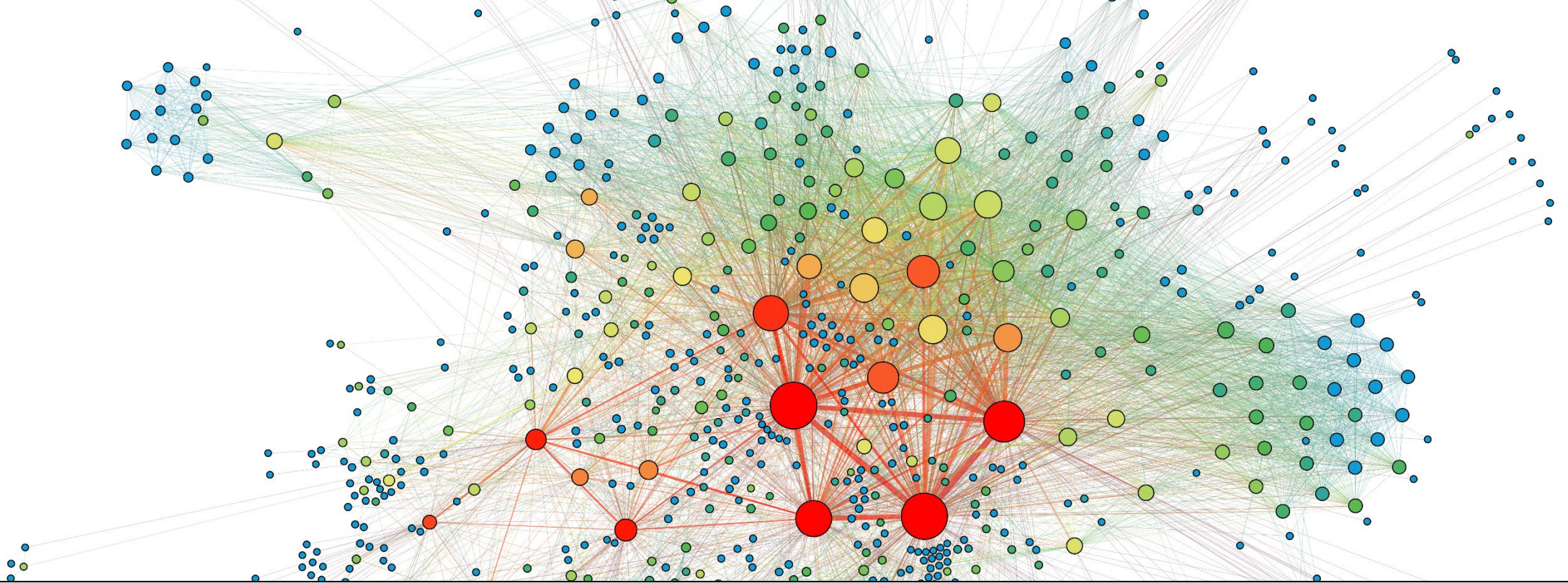


If you haven't
done so yet,
download the
workshop
files



Please use the chat
to ask questions





Visualizing Relationships: A Friendly Introduction to Working with Networks using Gephi

Kelly Schultz, Data Visualization Librarian

kelly.schultz@utoronto.ca

Slides: <https://uoft.me/gephislides>

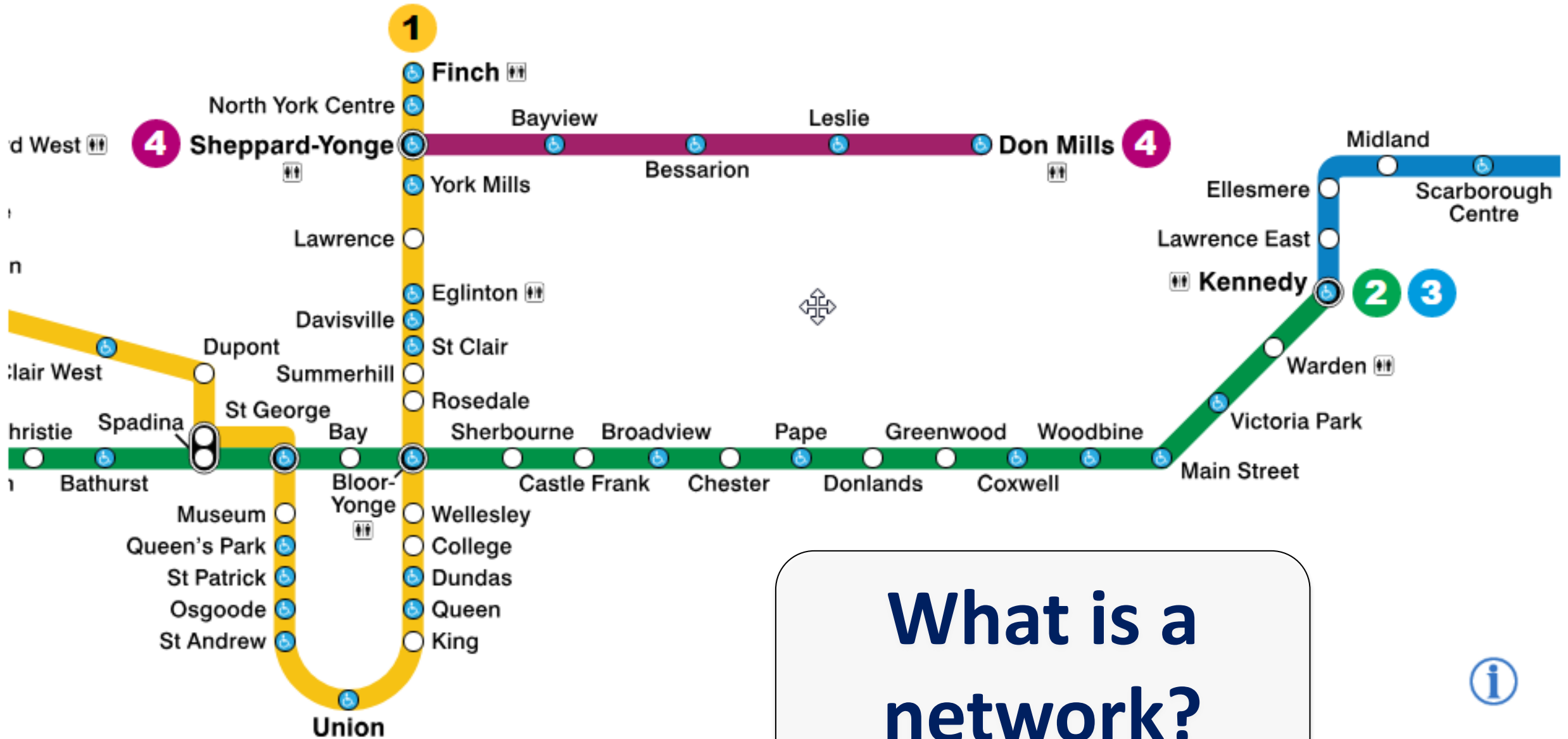
Agenda

- Learning Objectives
- Introduction to Networks
- Network Data Formats
- Break
- Introduction to Gephi
- Gephi Demonstration & Activities
- Wrap-up & Questions

Learning objectives

- Participants will be able to:
 - ✓ Recognize networks and situations that call for network visualization and analysis
 - ✓ Use appropriate terms to describe networks
 - ✓ Understand network data formats, and format data for use in Gephi
 - ✓ Use Gephi to load, visualize, analyze, and publish network graphs



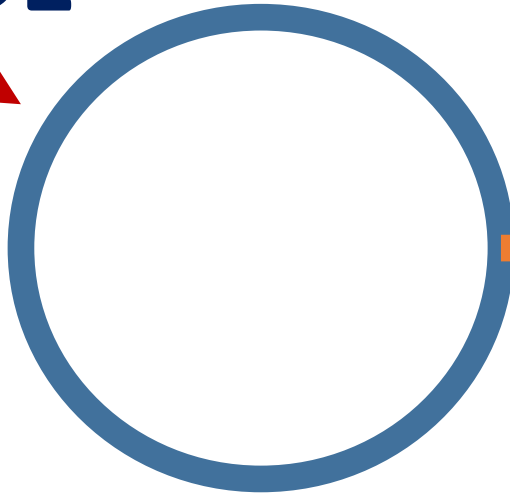


What is a network?

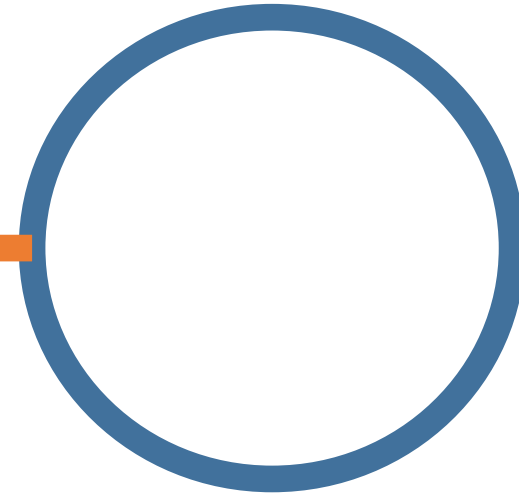


Basic Terminology: Nodes and Edges

NODE



EDGE

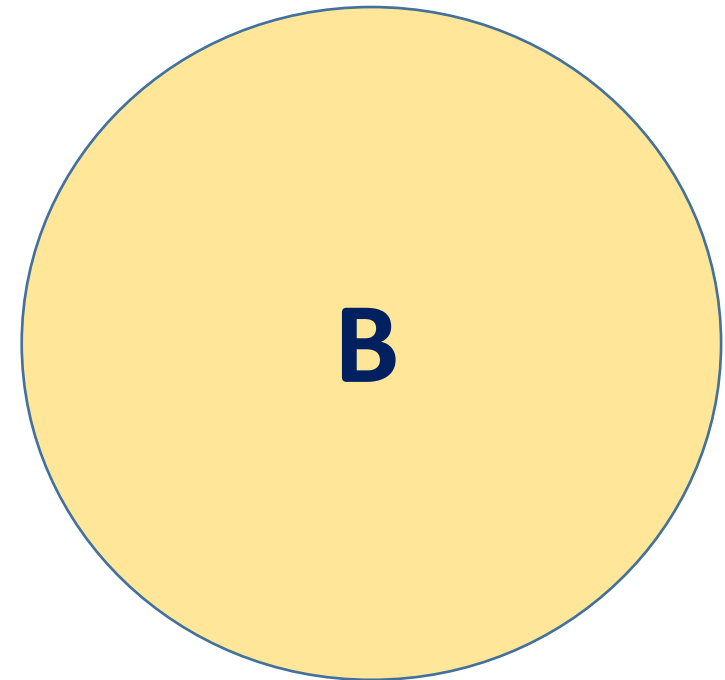
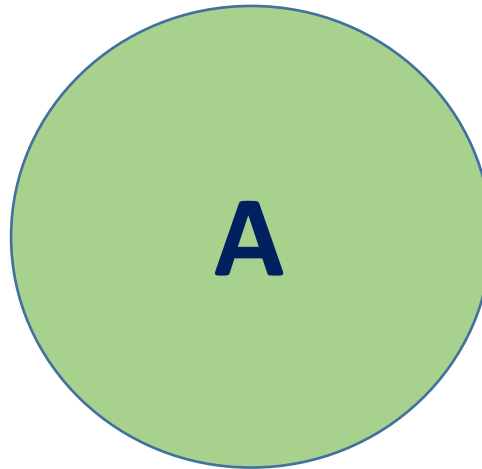


Basic Terminology: Nodes

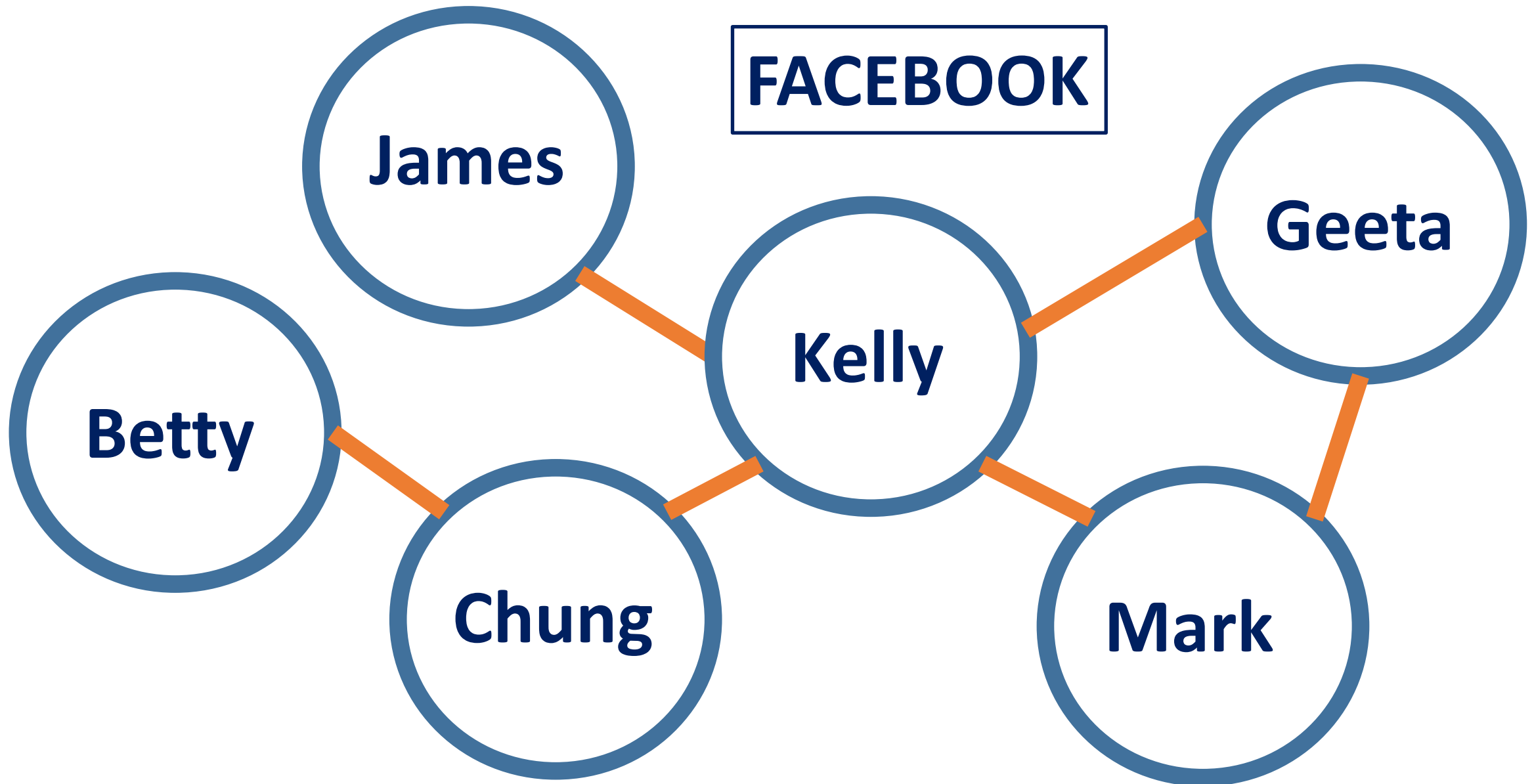
LEGEND



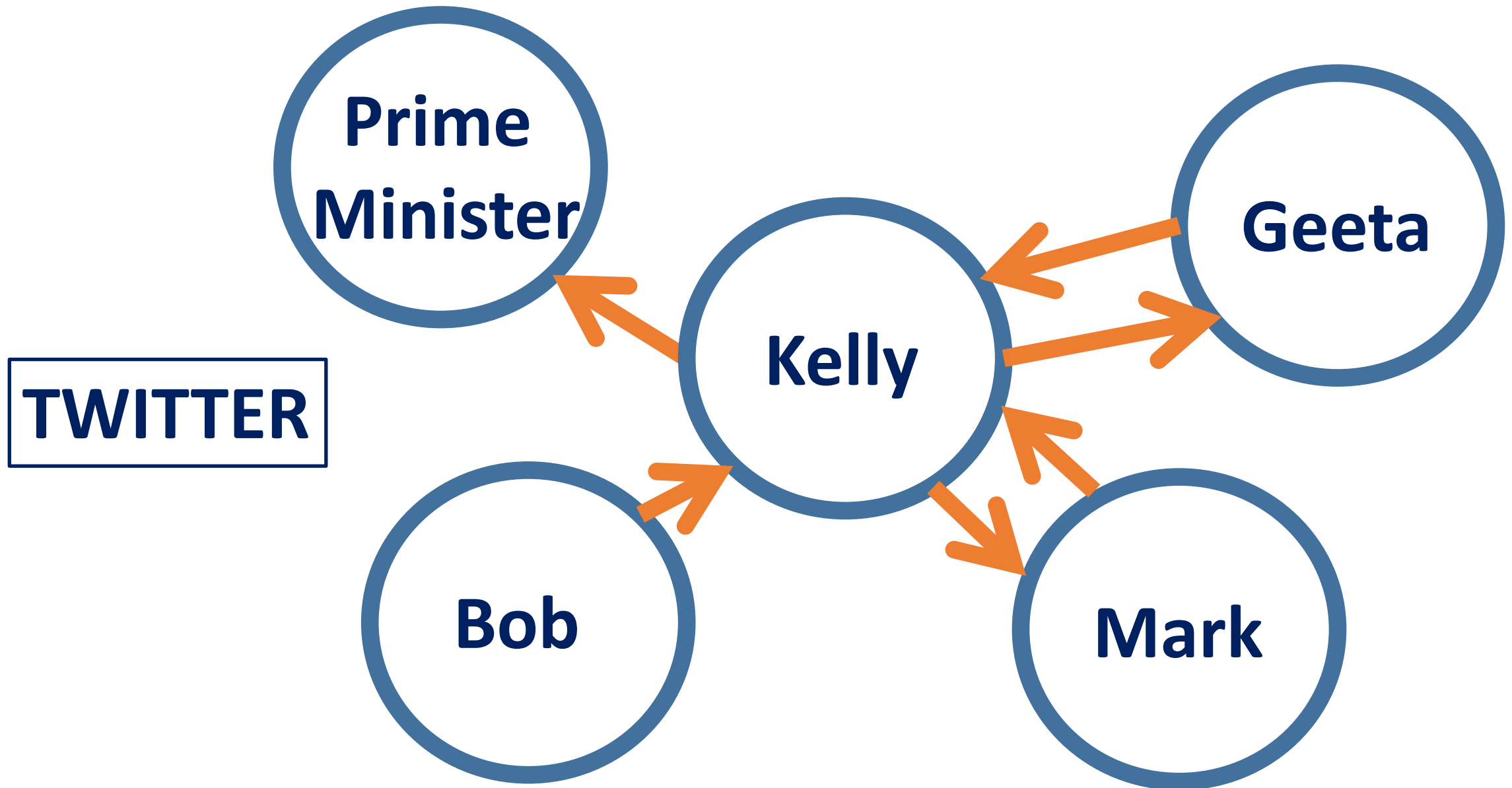
**SIZED BY
COUNT**



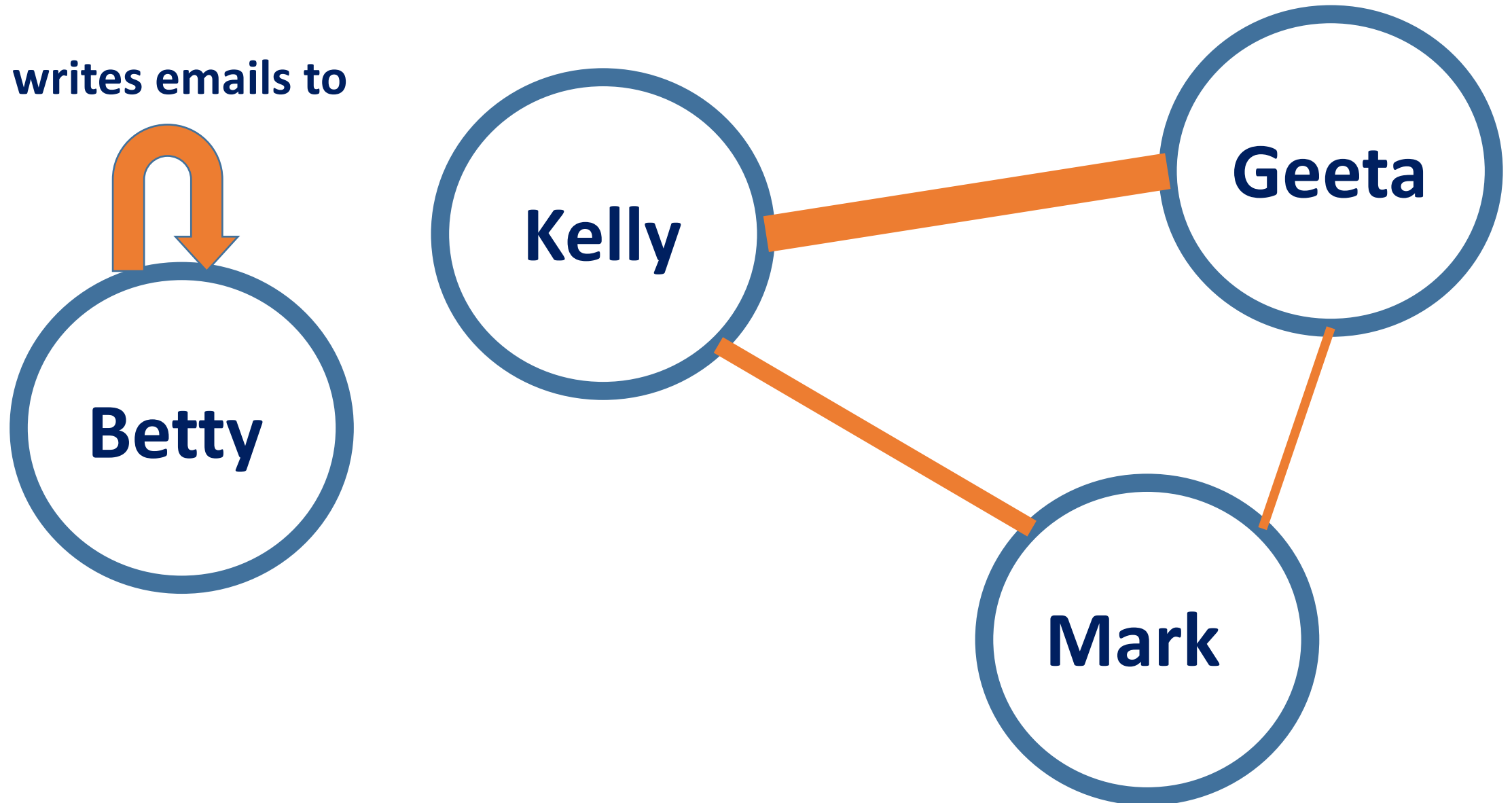
Basic Terminology: Undirected Graph



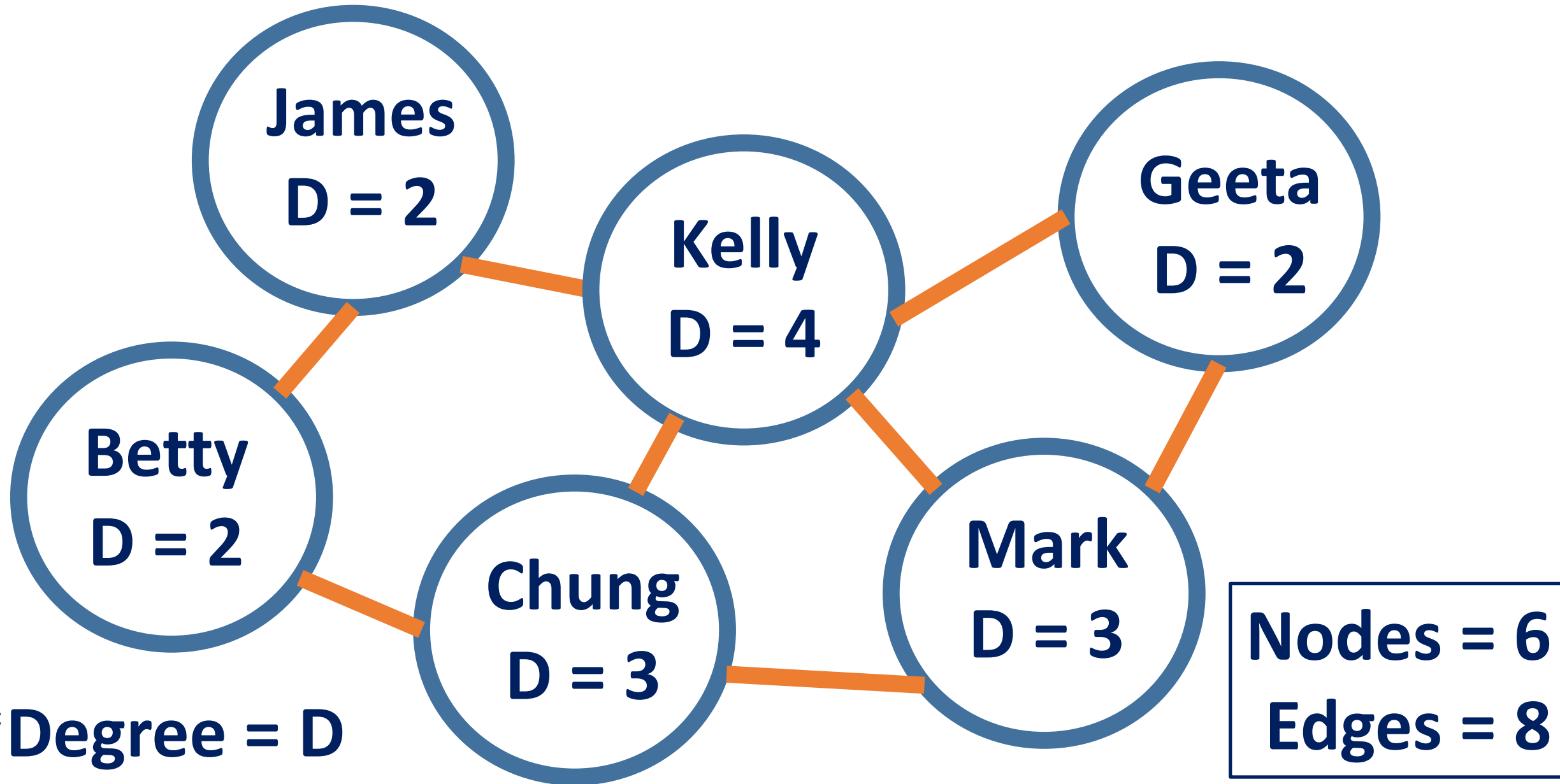
Basic Terminology: Directed Graph



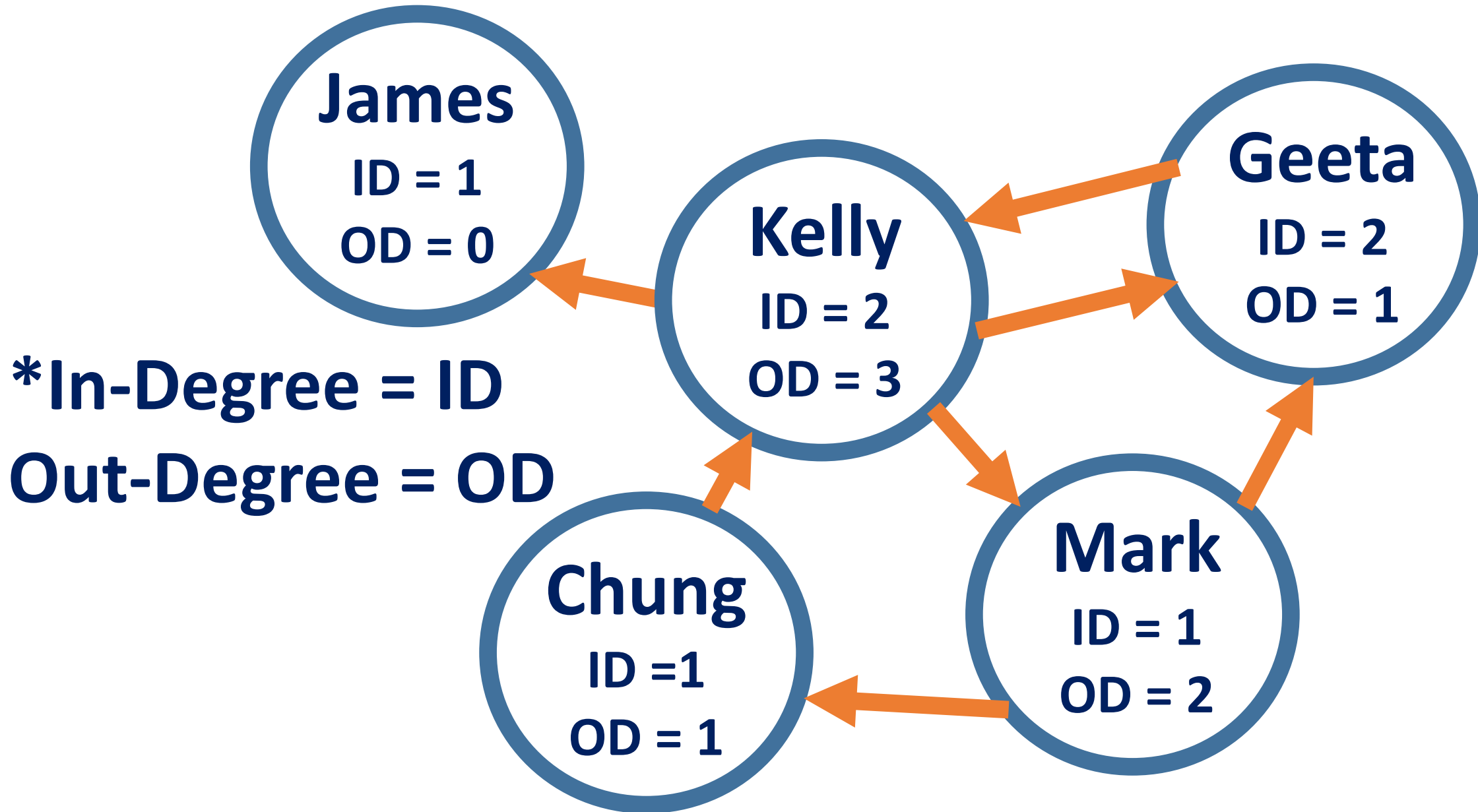
Basic Terminology: Edges



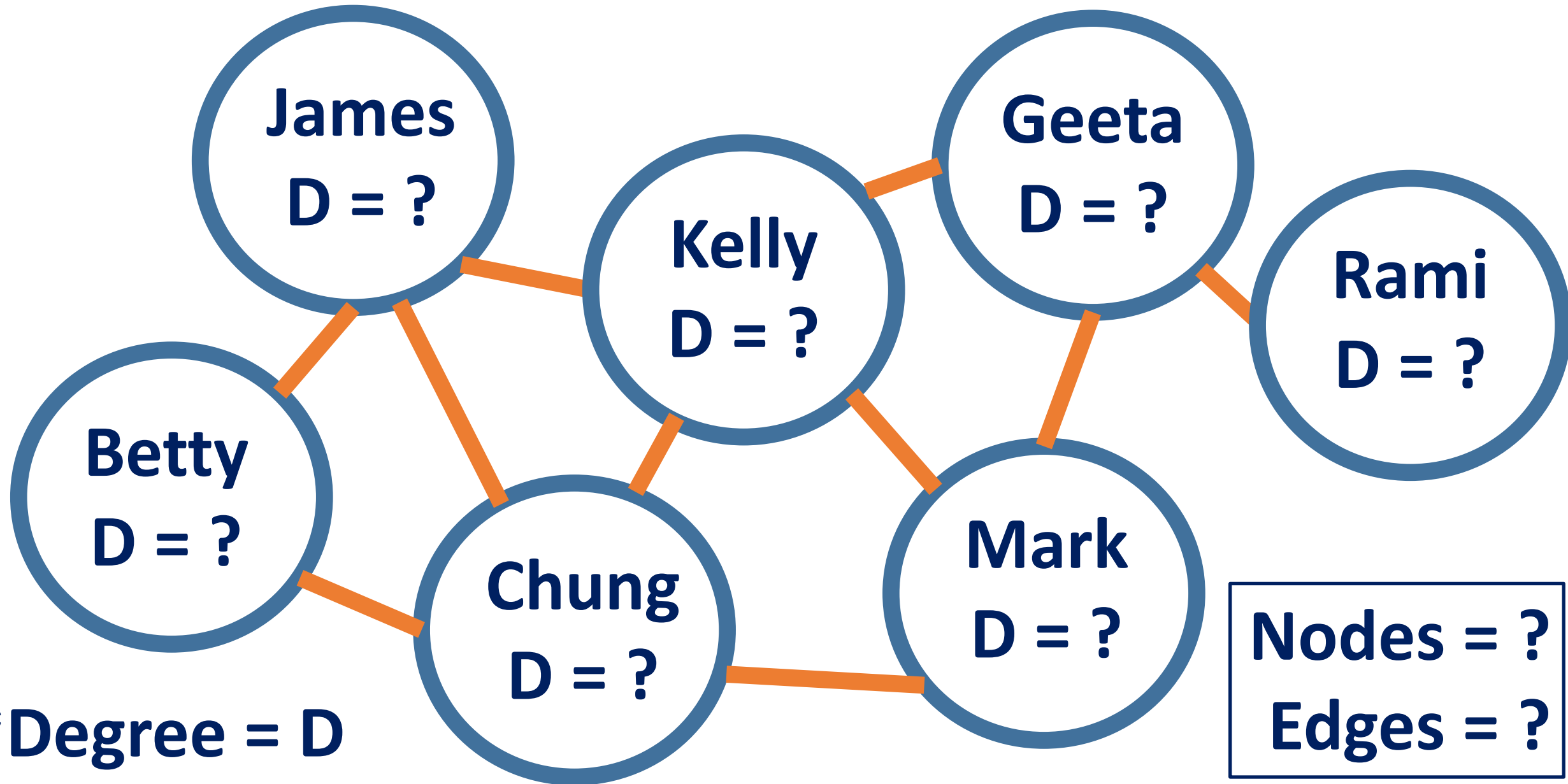
Basic Network Analysis



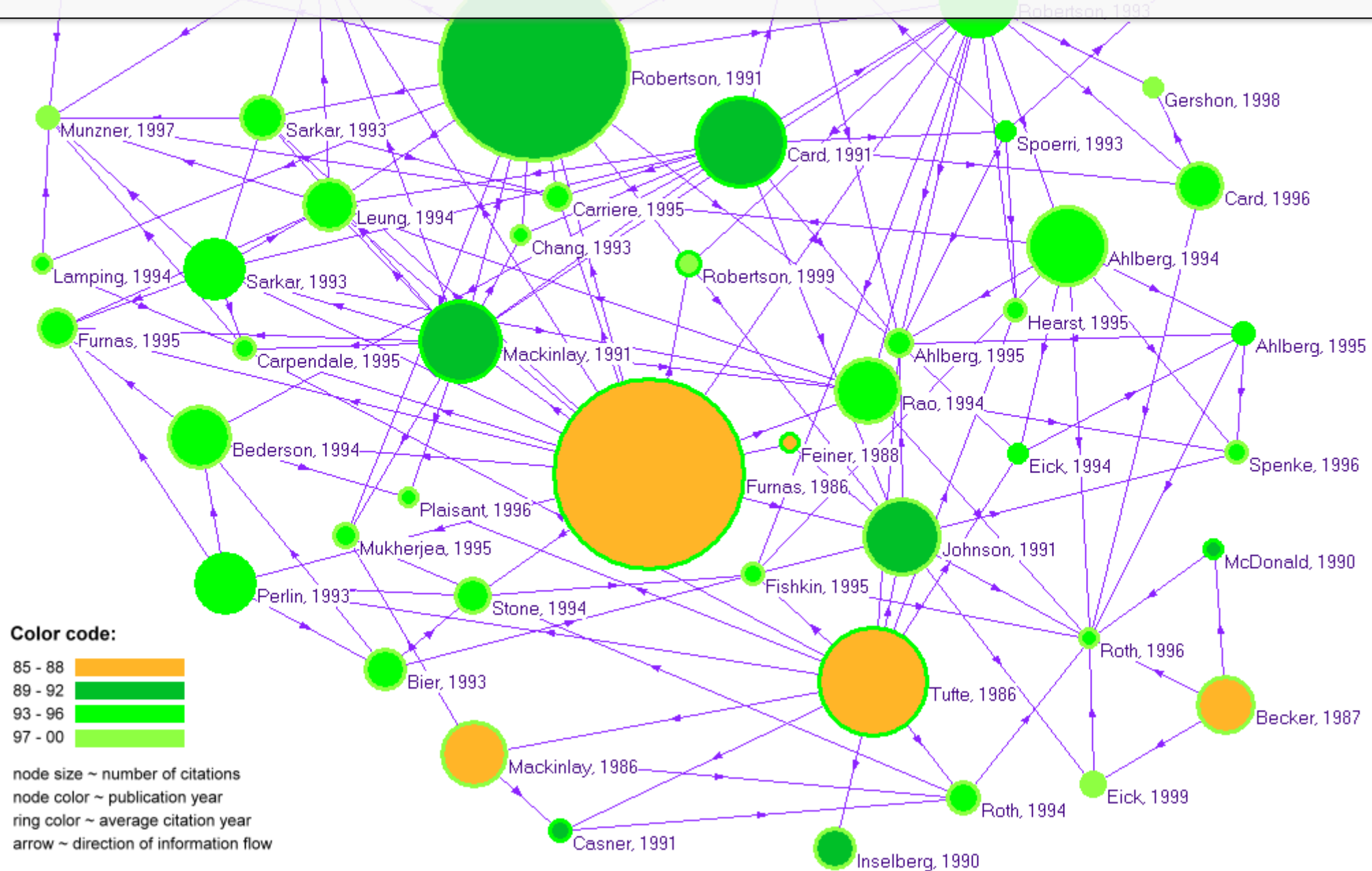
Basic Network Analysis Continued



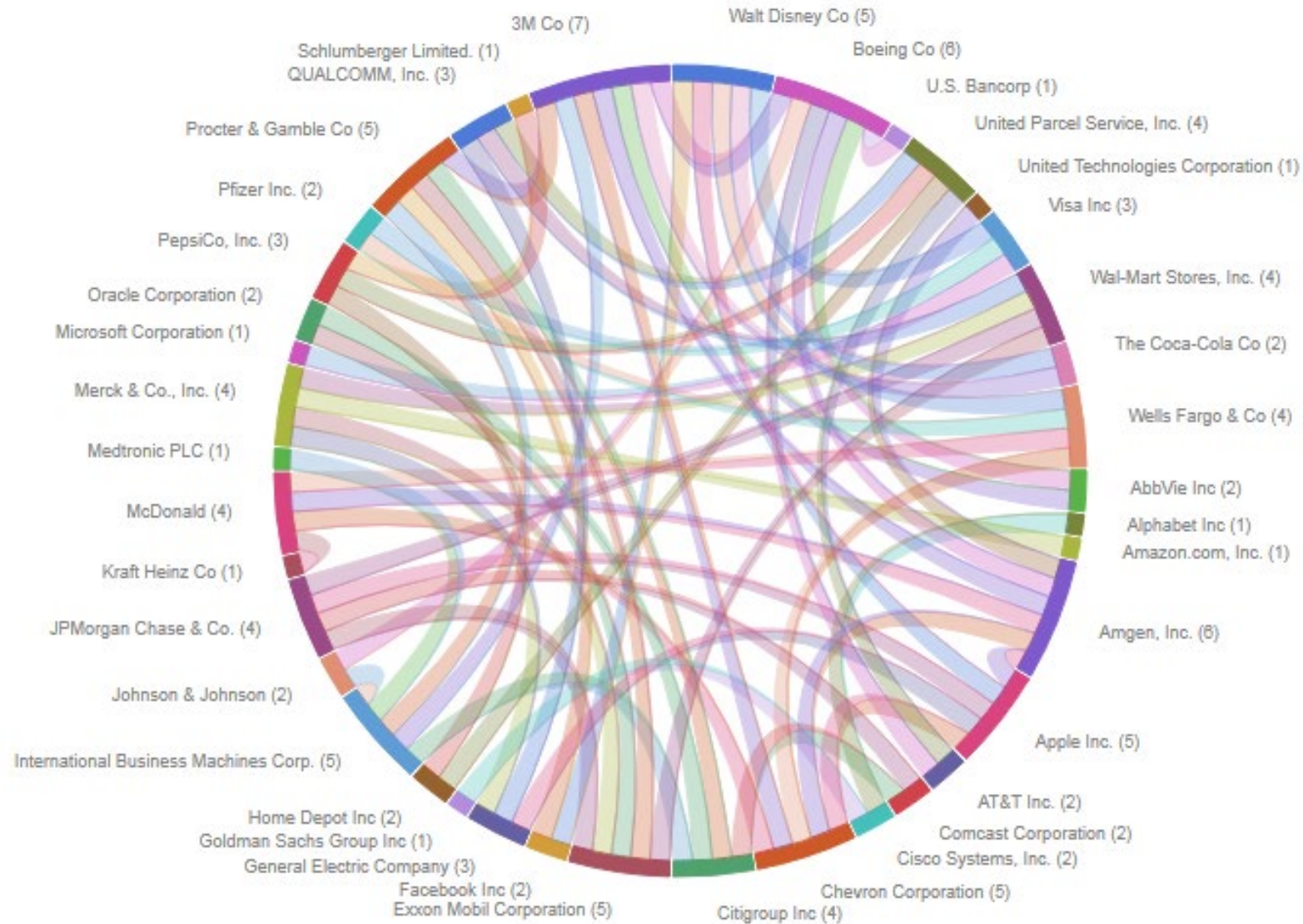
Activity: Test Your Understanding



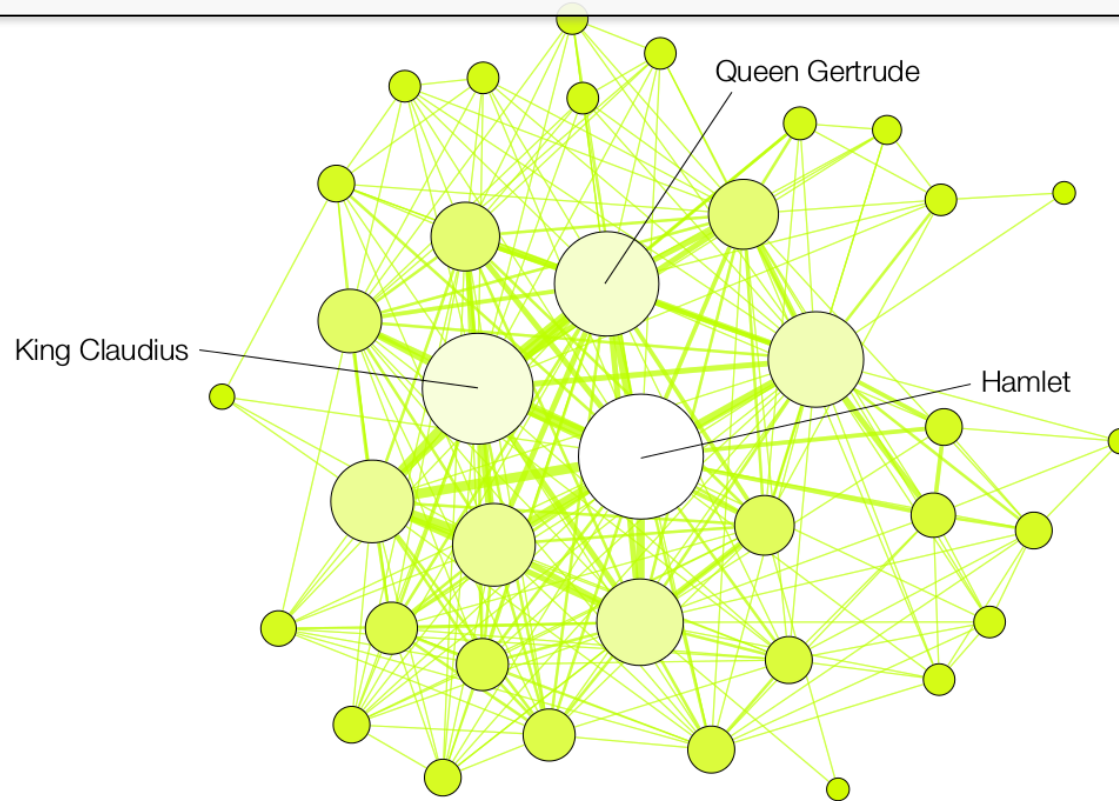
Information Networks



Social Networks



Fictional Networks



HAMLET

Number of characters 37 | 39% Network density

Transportation Networks



Network Data Formats

	Edge List/Matrix Structure	XML Structure	Edge Weight	Attributes	Visualization Attributes	Attribute Default Value	Hierarchical Graphs	Dynamics
CSV								
DL Ucinet								
DOT Graphviz								
GDF								
GEXF								
GML								
GraphML								
NET Pajek								
TLP Tulip								
VNA Netdraw								
Spreadsheet*								

Network Data Formats - Adjacency Matrix

Source/From

NEW EXAMPLE – MATRIX HAS CHANGED!

	A	B	C	D	E	F
1		Node A	Node B	Node C	Node D	
2	Node A	0	1	1	2	
3	Node B	0	0	0	1	
4	Node C	1	0	0	3	
5	Node D	2	1	3	0	
6						

Network Data Formats - Node Table

	A	B	C	
1	ID	Label	Nationality	
2		1 Mark	German	
3		2 James	English	
4		3 Betty	Swedish	
5		4 Kelly	French	
6		5 Chung	French	
7		6 Geeta	Swedish	
8				

Network Data Formats - Edge Table

NEW EXAMPLE – TABLE HAS CHANGED!

	A	B	C	D
1	Source	Target	Weight	Correspondence
2	1	4	3	Personal
3	1	5	7	Personal
4	1	6	1	Personal
5	2	3	2	Business
6	2	4	10	Personal
7	3	5	5	Business
8	4	5	4	Personal
9	4	6	4	Business
10	4	1	5	Personal

Network Data Formats - Poll

Adjacency Matrix

	A	B	C	D	E	F
1		Node A	Node B	Node C	Node D	
2	Node A	0	1	1	2	
3	Node B	0	0	0	1	
4	Node C	1	0	0	3	
5	Node D	2	1	3	0	
6						

Node and Edge Tables

	A	B	C	
1	ID	Label	Nationality	
2		1 Mark	German	
3		2 James	English	
4		3 Betty	Swedish	
5		4 Kelly	French	
6		5 Chung	French	
7		6 Geeta	Swedish	
8				

	A	B	C	D	
1	Source	Target	Weight	Correspondence	
2	1	4	3	Personal	
3	1	5	7	Personal	
4	1	6	1	Personal	
5	2	3	2	Business	
6	2	4	10	Personal	
7	3	5	5	Business	
8	4	5	4	Personal	
9	4	6	4	Business	
10	4	1	5	Personal	

Example – Romeo and Juliet

Nodes

	A	B	C
1	ID	Label	Alliance
2	1	Romeo	Montague
3	2	Juliet	Capulet
4	3	Friar Lawrence	None
5	4	Mercutio	None
6	5	The Nurse	Capulet
7	6	Tybalt	Capulet
8	7	Capulet	Capulet
9	8	Lady Capulet	Capulet
10	9	Montague	Montague
11	10	Lady Montague	Montague
12	11	Paris	Capulet
13	12	Benvolio	Montague
14	13	Prince Escalus	None
15	14	Friar John	None
16	15	Balthasar	Montague
17	16	Sampson	Capulet
18	17	Gregory	Capulet
19	18	Abram	Montague
20	20	Peter	Capulet
21			

Edges

	A	B	C
1	Source	Target	Relationship
2	1	2	Romantic partners
3	1	9	Family members
4	1	10	Family members
5	1	12	Family members
6	1	4	Friends
7	1	3	Friends
8	2	7	Family members
9	2	8	Family members
10	2	5	Friends
11	2	3	Friends
12	4	13	Family members
13	6	2	Family members
14	6	7	Family members
15	6	8	Family members
16	7	8	Family members
17	9	10	Family members
18	12	9	Family members

Example – Romeo and Juliet Cont'd

Nodes

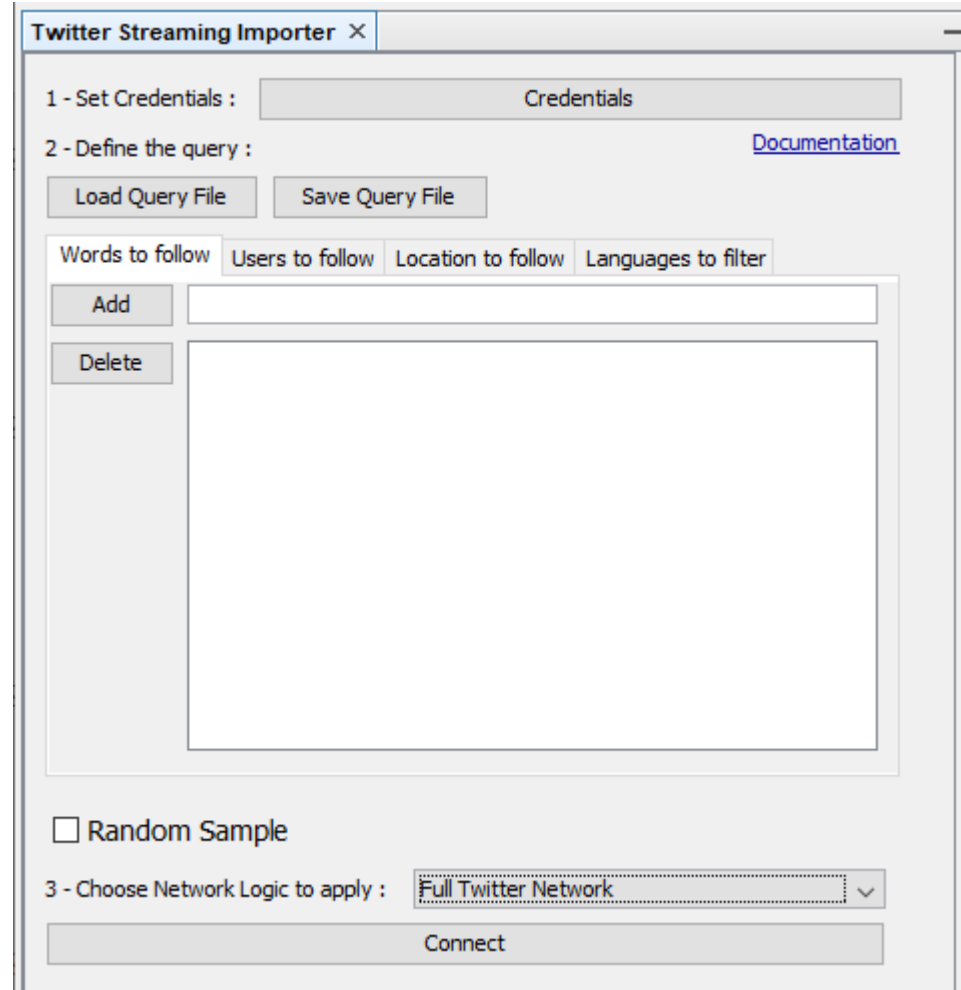
	A	B	C
1	ID	Label	Alliance
2	1	Romeo	Montague
3	2	Juliet	Capulet
4	3	Friar Lawrence	None
5	4	Mercutio	None
6	5	The Nurse	Capulet
7	6	Tybalt	Capulet
8	7	Capulet	Capulet
9	8	Lady Capulet	Capulet
10	9	Montague	Montague
11	10	Lady Montague	Montague
12	11	Paris	Capulet
13	12	Benvolio	Montague
14	13	Prince Escalus	None
15	14	Friar John	None
16	15	Balthasar	Montague
17	16	Sampson	Capulet
18	17	Gregory	Capulet
19	18	Abram	Montague
20	20	Peter	Capulet
21			

Edges

“spoke to”
→

	A	B	C	
1	Source	Target	Relationship	Weight
2	1	2	Romantic partners	12
3	2	1	Romantic partners	32
4	1	10	Family members	3
5	1	12	Family members	etc.
6	1	4	Friends	
7	1	3	Friends	
8	2	7	Family members	
9	2	8	Family members	
10	2	5	Friends	
11	2	3	Friends	
12	4	13	Family members	
13	6	2	Family members	
14	6	7	Family members	
15	6	8	Family members	
16	7	8	Family members	
17	9	10	Family members	
18	12	9	Family members	

Option 1: TwitterStreamingImporter



The screenshot shows the 'Twitter Streaming Importer' application window. It has a title bar with the text 'Twitter Streaming Importer' and a close button. The main content area is divided into several sections:

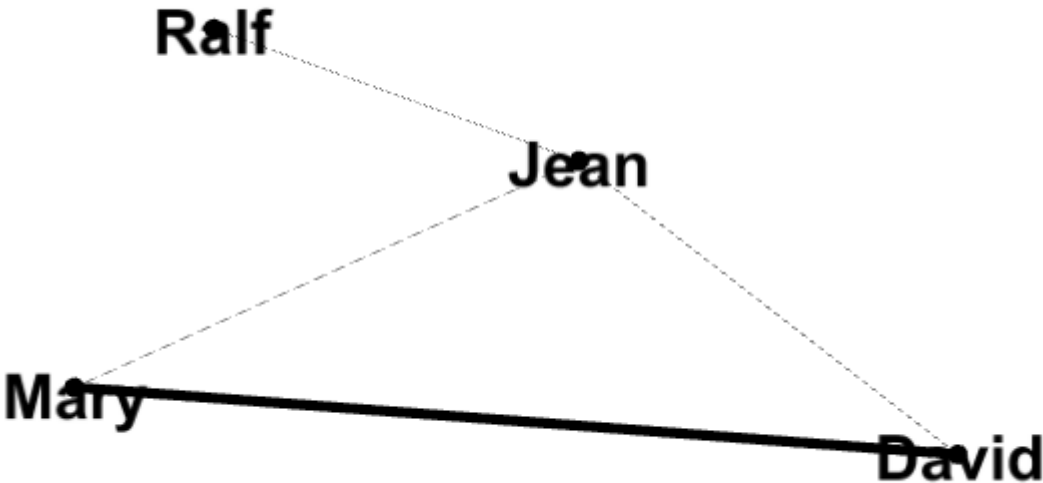
- 1 - Set Credentials :** A text input field labeled 'Credentials'.
- 2 - Define the query :** A section with a 'Documentation' link, 'Load Query File' and 'Save Query File' buttons, and four tabs: 'Words to follow', 'Users to follow', 'Location to follow', and 'Languages to filter'. The 'Words to follow' tab is active, showing an 'Add' button and a text input field. Below this is a 'Delete' button and a large empty list area.
- 3 - Choose Network Logic to apply :** A checkbox for 'Random Sample' and a dropdown menu currently set to 'Full Twitter Network'.

At the bottom of the window is a large 'Connect' button.

Automating

Option 2: Similarity Computer

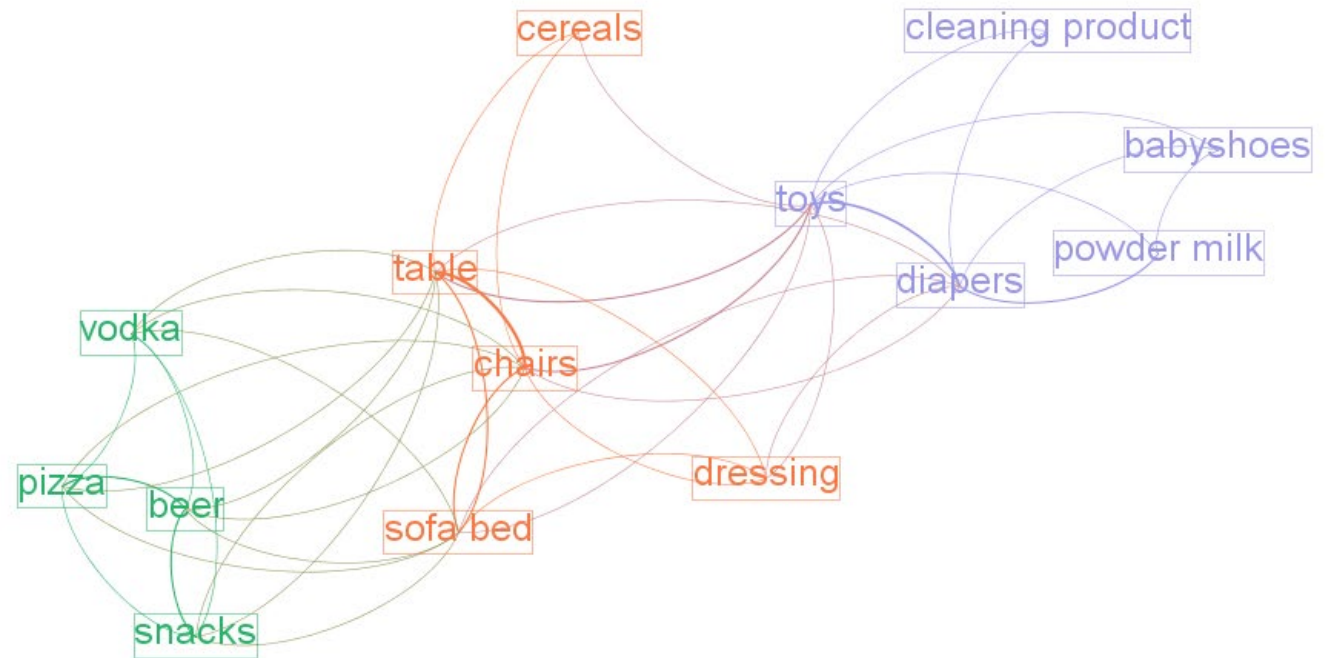
	A	B	C
1	Author	Taste in Ice creams	City preference
2	David	Strawberry	Venice
3	Mary	Strawberry	Venice
4	Jean	Vanilla	Venice
5	Ralf	Vanilla	Paris



Automating

Option 3: Convert Excel and csv files to networks

	A	B
1	Client	Purchases
2	A	sofa bed,chairs,table,dressing,toys,diapers
3	B	toys,diapers,powder milk,babys shoes
4	C	beer,snacks,vodka,pizza,sofa bed,chairs,table
5	D	cereals,toys,table,chairs
6	E	cleaning product,diapers,toys
7	F	powder milk,diapers
8	G	beer,snacks
9	H	pizza,beer
10	I	table,chair
11		



Automating

Option 4: Sci2

[Login](#)

Sci2 Tool

A Tool for Science of Science Research & Practice

[Home](#) [Download](#) [Documentation](#) [Ask An Expert](#) [Testimonials](#) [Developers](#)

This site is deprecated, please download the latest version of Sci2 on [GitHub](#).

The Science of Science (Sci2) Tool is a modular toolset specifically designed for the study of science. It supports the temporal, geospatial, topical, and network analysis and visualization of scholarly datasets at the micro (individual), meso (local), and macro (global) levels.

[Registration required.](#)



Download
Sci² Tool

News

2018

- Jan 31, The [Sci2 \(Science of Science\) Tool v1.3](#) release provides support for Java 1.9 and removes deprecated plugins.

[Release Notes](#)



Sci2 User Interface

1 / 4

Start Stop (2)



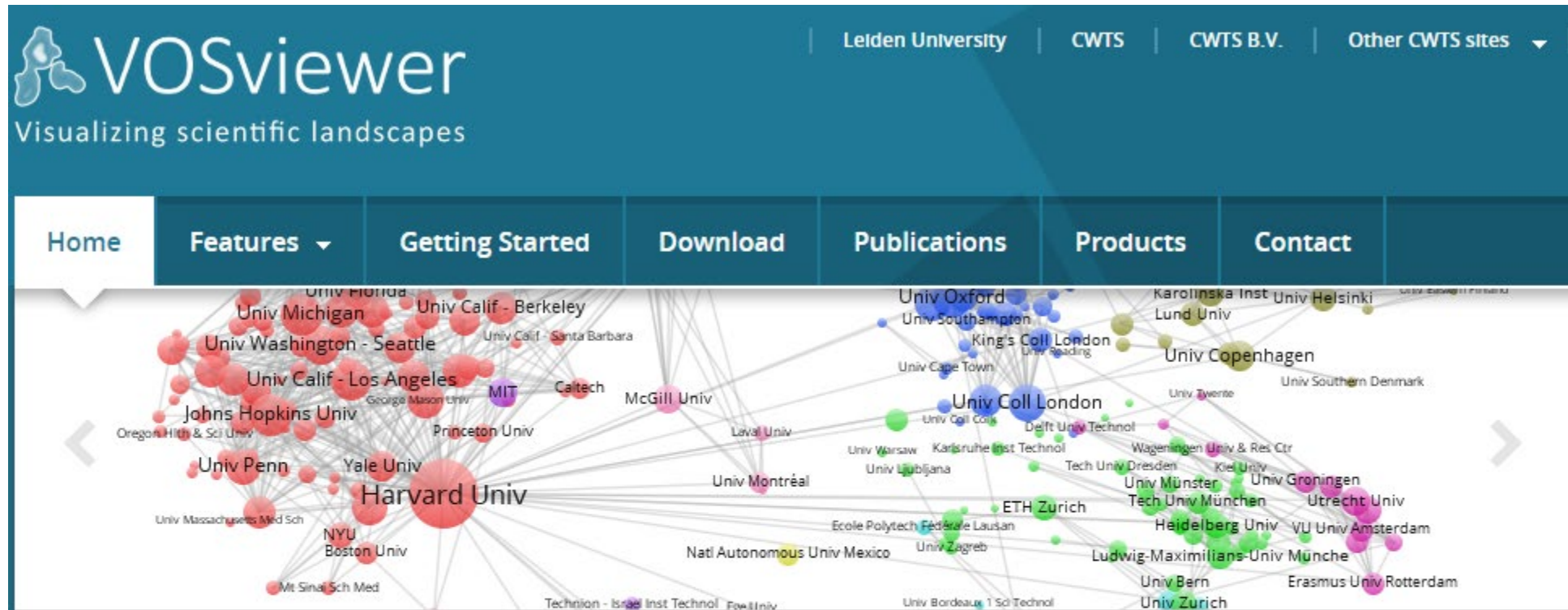
More ...

Automating



Have a question?
Ask an Expert!

Option 5: VOSviewer



Welcome to VOSviewer

VOSviewer is a software tool for constructing and visualizing bibliometric networks. These networks may for instance include journals, researchers, or individual publications, and they can be constructed based on citation, bibliographic coupling, co-citation, or co-authorship relations. VOSviewer also offers text mining

functionality that can be used to construct and visualize co-occurrence networks of important terms extracted from a body of scientific literature.

Automating



Break

What is Gephi?



[Download](#) [Blog](#) [Wiki](#) [Forum](#) [Support](#) [Bug tracker](#)

[Home](#) [Features](#) [Learn](#) [Develop](#) [Plugins](#) [Services](#) [Consortium](#)

The Open Graph Viz Platform

Gephi is the leading visualization and exploration software for all kinds of graphs and networks. Gephi is open-source and free.

Runs on Windows, Mac OS X and Linux.

[Learn More on Gephi Platform »](#)



[Release Notes](#) | [System Requirements](#)

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APPLICATIONS

PAPERS

Gephi Demo

Gephi 0.9.2 - Project 1

File Workspace View Tools Window Help

Overview Data Laboratory Preview

Workspace 1

Appearance ☒ **Graph** ☒ **Context** ☒

Nodes ☒ Edges ☐

Unique Partition Ranking

#c0c0c0

Apply

Layout ☒

Expansion

Run

properties

Scale factor	1.2
--------------	-----

Expansion

Presets... Reset

Dragging (Configure)

Context ☒

Nodes: 7
Edges: 10
Undirected Graph

Filters ☒ **Statistics** ☒

Reset

Library

- Attributes
- Dynamic
- Edges
- Operator
- Topology
- Saved queries

Queries

Drag filter here

Select Filter

Arial Bold, 32

Activity: Loading Data

Visualize the network data describing actors that work together on movies from 2006-2016. The dataset is provided in the *Movie Actors* folder.

1. Save demo project as demo.gephi
2. Create a **new project** and **load the nodes and edges** tables provided from the folder specified above. This is an **undirected graph** with no duplicate edges.
3. **Save this project** as movie.gephi

Gephi Demo Continued

Gephi 0.9.2 - Project 1

File Workspace View Tools Window Help

Overview Data Laboratory

Workspace 1

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- Attributes
- Dynamic
- Edges
- Operator
- Topology
- Saved queries

Queries

Drag filter here

Select Filter

Arial Bold, 32

Activity: Appearance

1. Save demo project as demo.gephi. **Reopen movie.gephi** project file.
2. **Colour your nodes based on the *Citizenship*** attribute (i.e., an actor's country of citizenship) and **size your nodes based on the *Age* attribute** (i.e., an actor's rough age based on year of birth compared to 2021).
3. **Colour all your edges** the default **grey** colour.
4. **Save this project**

Gephi Demo Continued



Gephi 0.9.2 - Project 1

File Workspace View Tools Window Help

Overview Data Laboratory

Workspace 1

Appearance ☒ **Graph** ☒ **Context** ☒

Nodes ☒ Edges ☐  

Unique Partition Ranking

#c0c0c0

Apply

Layout ☒

Expansion

Run

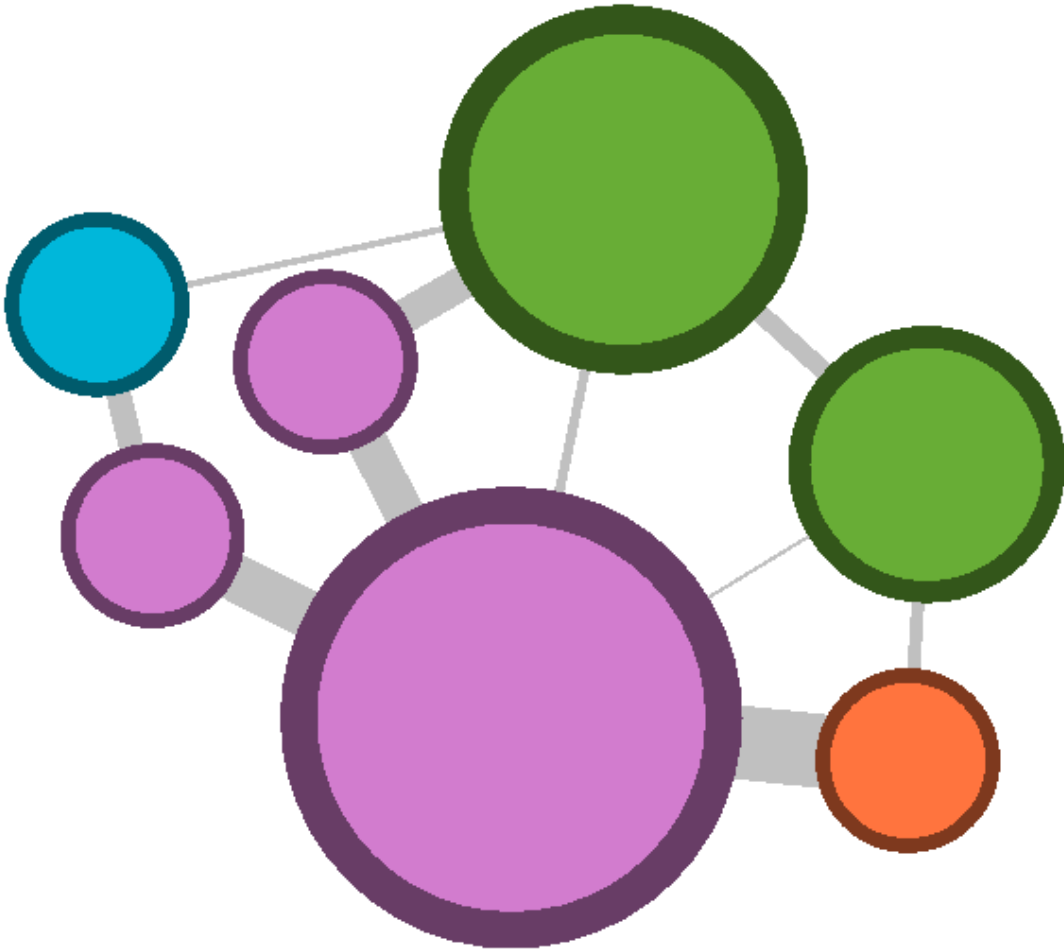
properties

Scale factor	1.2
--------------	-----

Expansion

Presets... Reset




Dragging (Configure)



Context ☒

Nodes: 7
Edges: 10
Undirected Graph

Filters ☒ **Statistics** ☐

Reset   

Library

- Attributes
- Dynamic
- Edges
- Operator
- Topology
- Saved queries

Queries

Drag filter here

Select Filter

Arial Bold, 32

Activity: Layout and Labels

1. Save demo project as demo.gephi. **Reopen movie.gephi** project file.
2. Use ***Circular Layout***, ordering nodes by the ***Label*** attribute, going ***counter-clockwise***, and select ***Prevent Node Overlap***. This will put the actors' nodes listed in a circle, in alphabetical order by actor first name.
Note: Counter-clockwise might seem unintuitive, but because nodes are ordered in descending order (Z to A), that is how to make it go in alphabetical order clockwise.
3. **Add node labels and adjust the layout** so that the graph and labels are legible. Note: Try using the *Expansion* and *Label Adjust* layouts.
4. **Hover over a node** to see its connections. In this example, that would show all the actors that have worked together with that actor in at least one movie.
5. **Save this project**

Gephi Demo Continued

Gephi 0.9.2 - Project 1

File Workspace View Tools Window Help

Overview Data Laboratory

Workspace 1

Appearance ☒ **Graph** ☒ **Context** ☒

Nodes ☒ Edges ☐

Unique Partition Ranking

#c0c0c0

Apply

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Run

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Scale factor	1.2
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Presets... Reset

Dragging (Configure)

Context ☒

Nodes: 7
Edges: 10
Undirected Graph

Filters ☒ **Statistics** ☐

Reset

Library

- Attributes
- Dynamic
- Edges
- Operator
- Topology
- Saved queries

Queries

Drag filter here

Select Filter

Arial Bold, 32

Activity: Publish

1. Save demo project as demo.gephi. **Reopen movie.gephi** project file.

2. **Take a screenshot** of the graph.

3. **Export your graph as a PDF**, adjusting it to match what you had prepared in the *Overview* tab.

Note: To retain the edge thicknesses (which represent how many movies two actors have worked together on), select *Rescale Weight* and for *Min. rescaled weight* enter *1* and *Max. rescaled weight* enter *10*. Make sure to also change the edge colour back to *original*.

4. **Save this project**

Resources

- Network Theory
 - [*Networks, Crowds, and Markets: Reasoning about a Highly Connected World*](#) by David Easley and Jon Kleinberg [Preprint on-line]
 - [*Visual Insights: A Practical Guide to Making Sense of Data*](#) by Katy Börner and David E. Polley [Print and E-Book available]
 - [*Demystifying Networks, Parts I & II*](#)
 - [*"A Gentle Introduction To Graph Theory"*](#) by Vaidehi Joshi
- Gephi Books
 - [*Mastering Gephi Network Visualization: Produce Advanced Network Graphs in Gephi and Gain Valuable Insights into your Network Datasets*](#) by Ken Cherven [Print book]
 - [*Network Graph Analysis and Visualization with Gephi: Visualize and Analyze your Data Swiftly using Dynamic Network Graphs Built with Gephi*](#) by Ken Cherven [Print book]

Resources Continued

- Gephi Tutorials
 - [Learn how to use Gephi](#)
 - [Duke University's Gephi Guide](#)
 - [Gephi tutorials](#) maintained by Clément Levallois
 - [GEPHI – Introduction to Network Analysis and Visualization](#) by Martin Grandjean
- Additional Data Preparation Tutorials (for alternative ways to prepare data)
 - [Preparing Data 1: Making an Edge List](#)
 - [Preparing Data 2: Making a Node List from an Edge List](#)
 - [Data Preparation for Gephi: Step by Step](#)
- [Gephi Supported Graph Formats Chart](#)
- [Layouts](#)
- [Filters](#)

Tools & Libraries

- [Cytoscape](#)
- [D3](#)
- [GUESS](#)
- [NodeXL](#)
- [ORA](#)
- [Pajek](#)
- [Python & NetworkX](#)
- [Python or R & igraph](#)

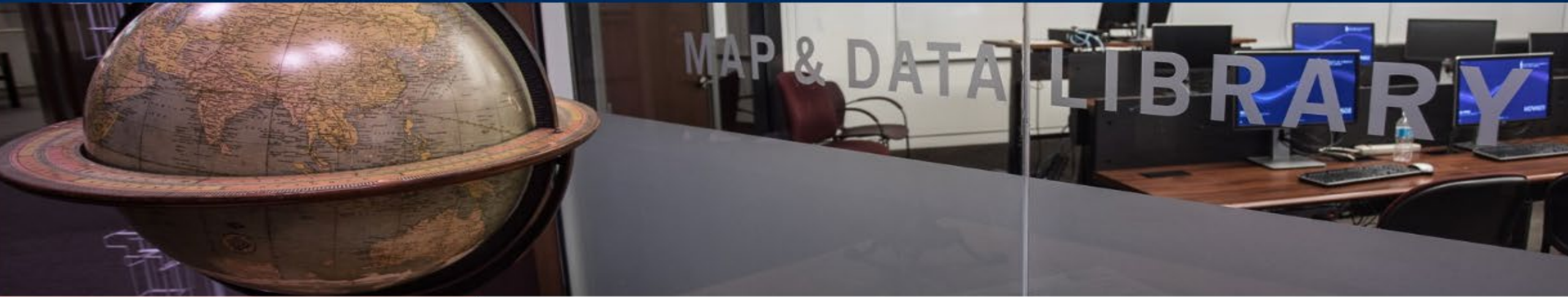
Tools & Libraries Continued

- [Sci2 & Network Workbench](#)
- [SigmaJS](#)
- [SNAP](#)
- [Social Network Visualizer](#)
- [UCINET](#)
- [VOSviewer](#)

Network Datasets

- [Index of Complex Networks](#)
- [UCIrvine Network Data Repository](#)
- [Stanford Large Network Dataset Collection](#)
- [UCINET Datasets](#)
- [Network Datasets](#)

And more can be found on the dataset list from the [Duke Network Analysis Centre](#)



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Scholars GeoPortal | Geospatial data | Remote sensing | Air photos

Numeric data

Microdata | Statistics | Census of Canada

Maps and atlases

Scanned maps | Fire insurance plans | Rare maps

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Contact: mdl@library.utoronto.ca



Questions?

Data Source

- Movie Actor Data: <https://data.world/promptcloud/imdb-data-from-2006-to-2016/workspace/file?filename=IMDB-Movie-Data.csv> (Must complete a free registration with data.world to access the data)

Image credits

- **Slide 2:** “SocialNetworkAnalysis.png”, Martin Grandjean [CC BY-SA 4.0 (<https://creativecommons.org/licenses/by-sa/4.0>), <https://commons.wikimedia.org/wiki/File:SocialNetworkAnalysis.png>]
- **Slide 3:** *Manos*, morguefile.com/xololounge, <http://mrg.bz/Yda9Is>
- **Slide 4:** *Drawing and coloring*, Freelmages.com/ Ove Tøpfer, <http://www.freeimages.com/photo/drawing-1313453>
- **Slide 5:** “Interactive Map”, Toronto Transit Commission, https://www.ttc.ca/Subway/interactive_map/interactive_map.jsp#
- **Slide 14:** “Analysis and Visualization of the IV 2004 Contest Dataset: Paper-Citation Network, Image 1.1.”, Börner, Katy, Richard Klavans, Michael Patek, Angela Zoss, Joseph R. Biberstine, Robert Light, Vincent Larivière, and Kevin W. Boyack , <https://cns.iu.edu/2004-InfoVis.html>
- **Slide 15:** “Interconnectedness of companies through shared board members”, Data Interview Questions, https://www.interviewqs.com/blog/board_members
- **Slide 16:** “Network visualization: mapping Shakespeare’s tragedies”, Martin Grandjean, <http://www.martingrandjean.ch/network-visualization-shakespeare/>

Image credits

- **Slide 17:** “Connected World: Untangling the Air Traffic Network”, Martin Grandjean, <http://www.martingrandjean.ch/connected-world-air-traffic-network/>
- **Slide 18:** “Supported Graph Formats”, Gephi, <https://gephi.org/users/supported-graph-formats/>
- **Slide 26:** “Creating a network from a table of entities and their attributes”, Clément Levallois, <https://seinecle.github.io/gephi-tutorials/generated-html/similarity-computer-en.html>
- **Slide 27:** “Creating a network from a table of cooccurring items”, Clément Levallois, <https://seinecle.github.io/gephi-tutorials/generated-html/cooccurrences-computer-en.html>
- **Slide 30:** *Coffee break*, flickr.com/Berit Watkin, <https://flic.kr/p/dzBrCi>
- **Slide 46:** *audience wave*, flickr.com/Gavin Tapp, <https://flic.kr/p/aqvnet>

Links for Workshop

- [Demonstration Tutorial](#)
- [Workshop Files](#)
- [Previous Workshop Recording](#)