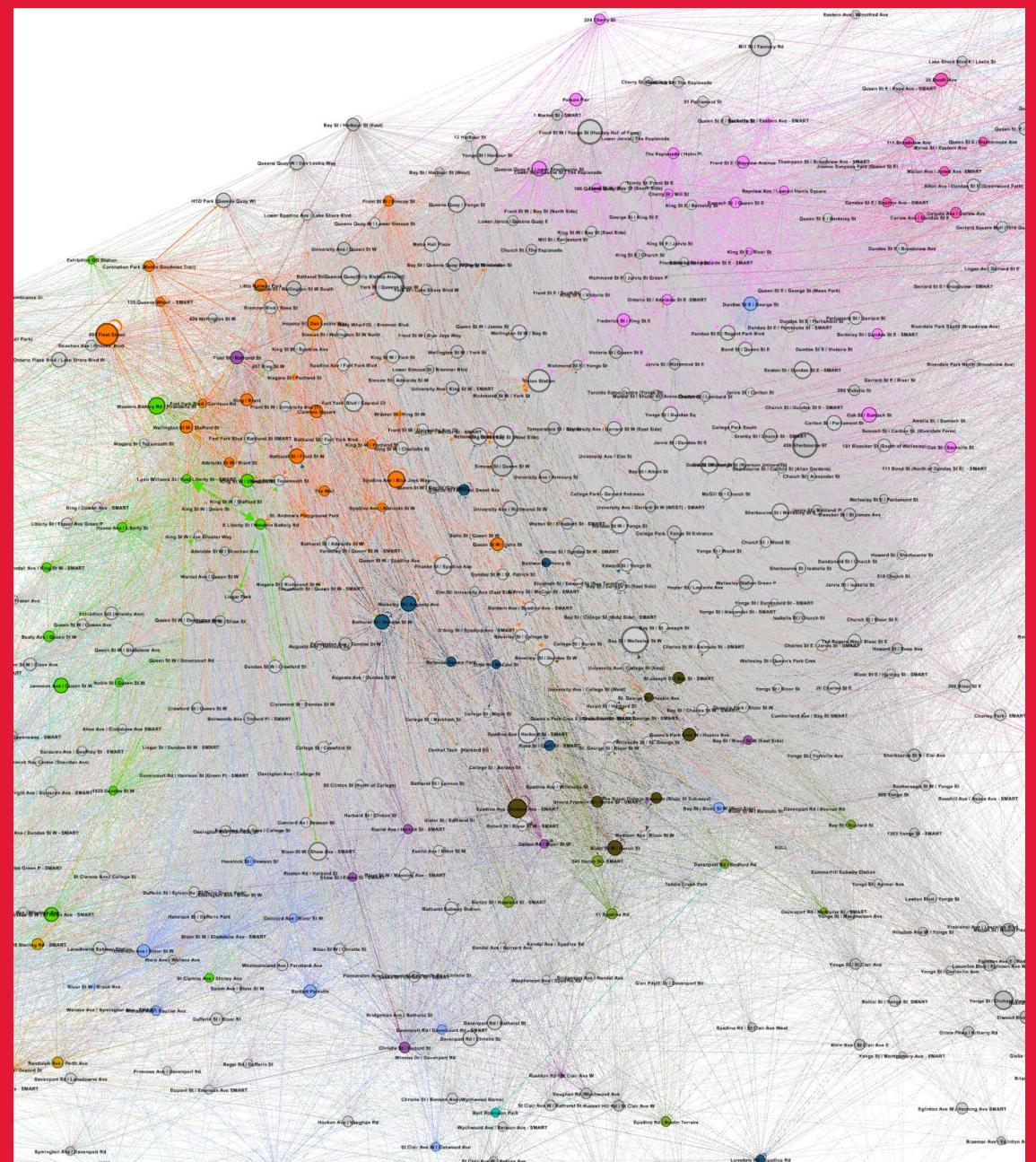


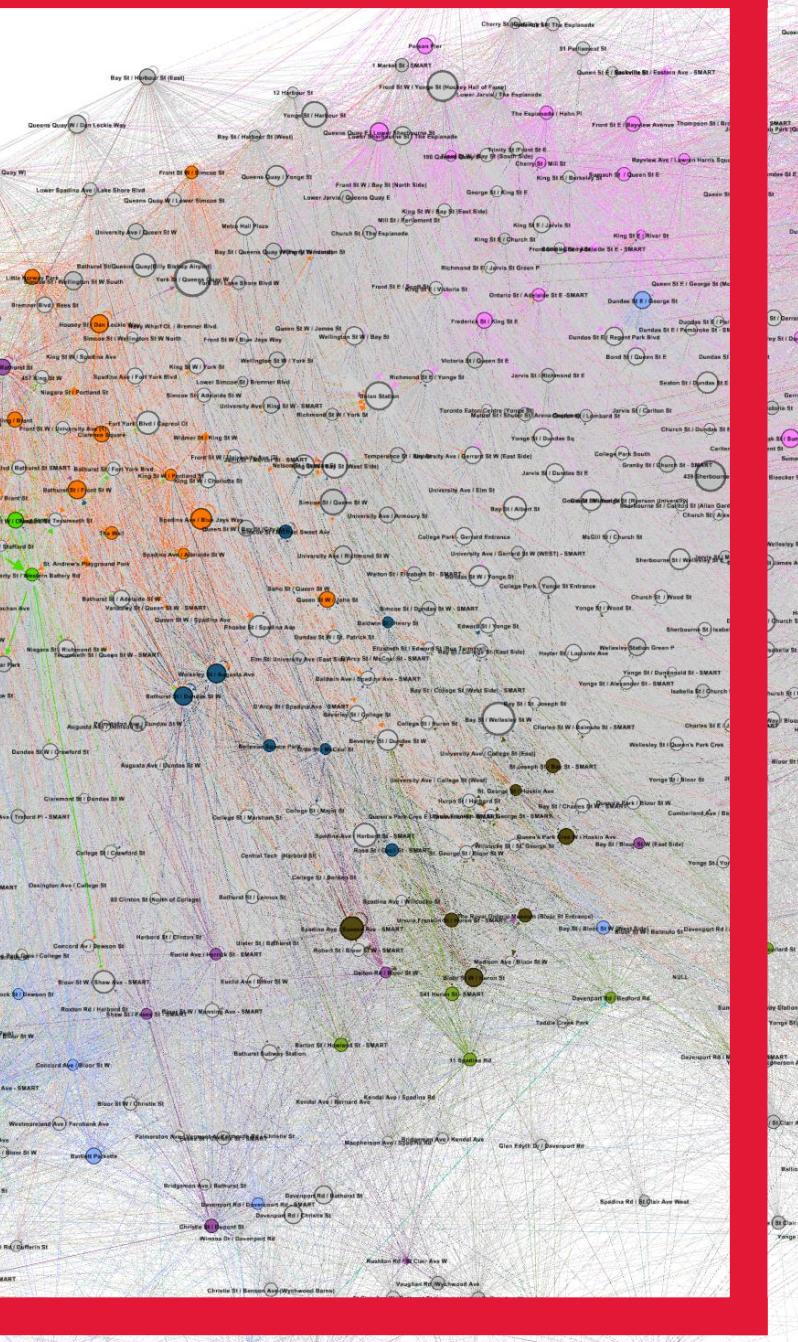
Network visualization in Gephi

York University Libraries workshop

ALEXANDRA WONG (SHE/HER)
DATA VISUALIZATION AND ANALYTICS LIBRARIAN

YORK 





Agenda

Introduction the network visualization concepts

Data set-up and requirements

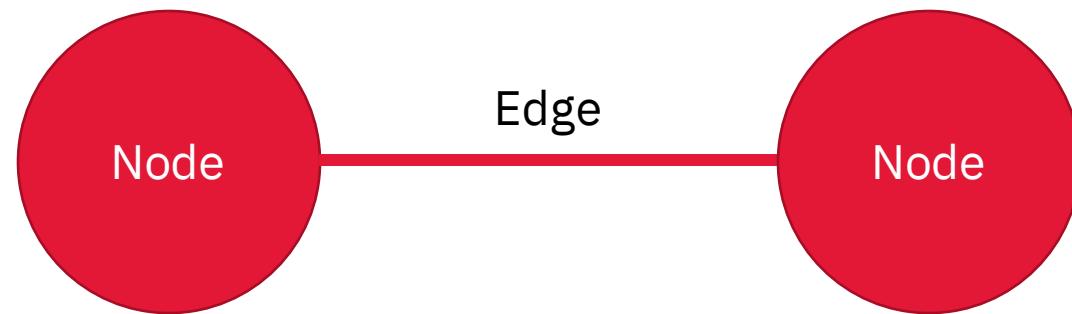
Gephi demonstration: Importing data

Gephi demonstration: Editing a network visualization

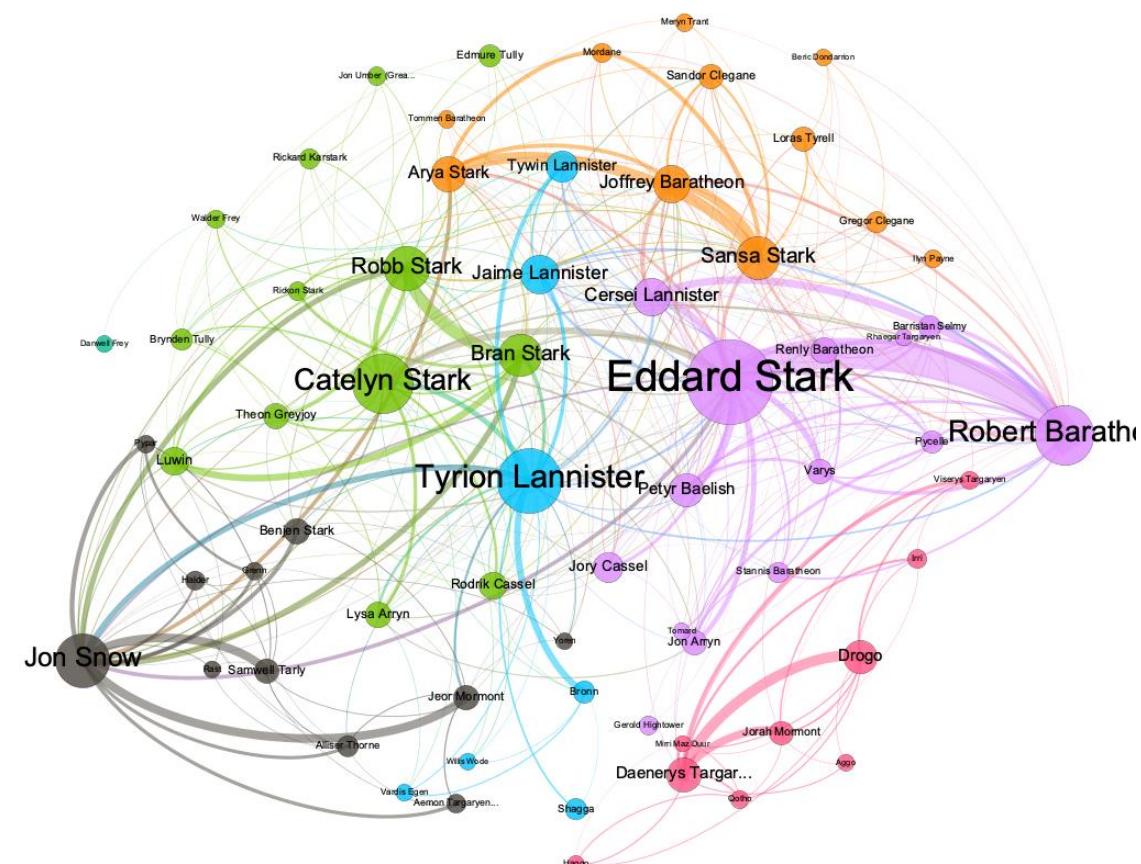
Gephi demonstration: Introduction to network analysis

Network visualization concepts: Nodes and edges

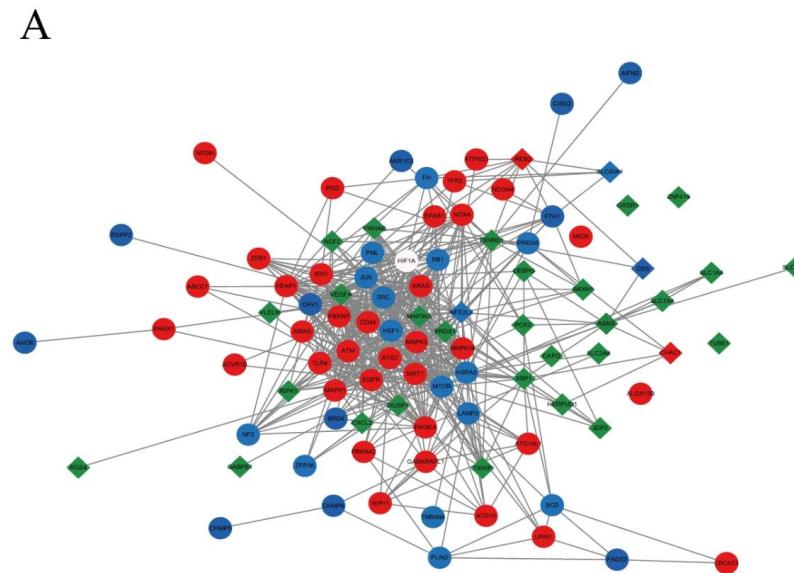
- › Network visualizations are comprised of 2 basic building blocks: Nodes and edges
- › **Node:** the entity in the network (Ex. Human, character, journal article, protein, organization)
- › **Edge:** the relationship connecting entities



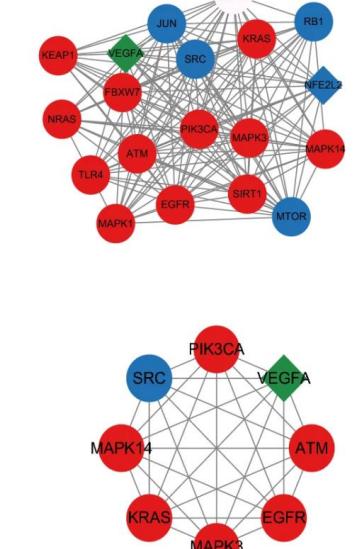
Network visualizations are everywhere!



A



B



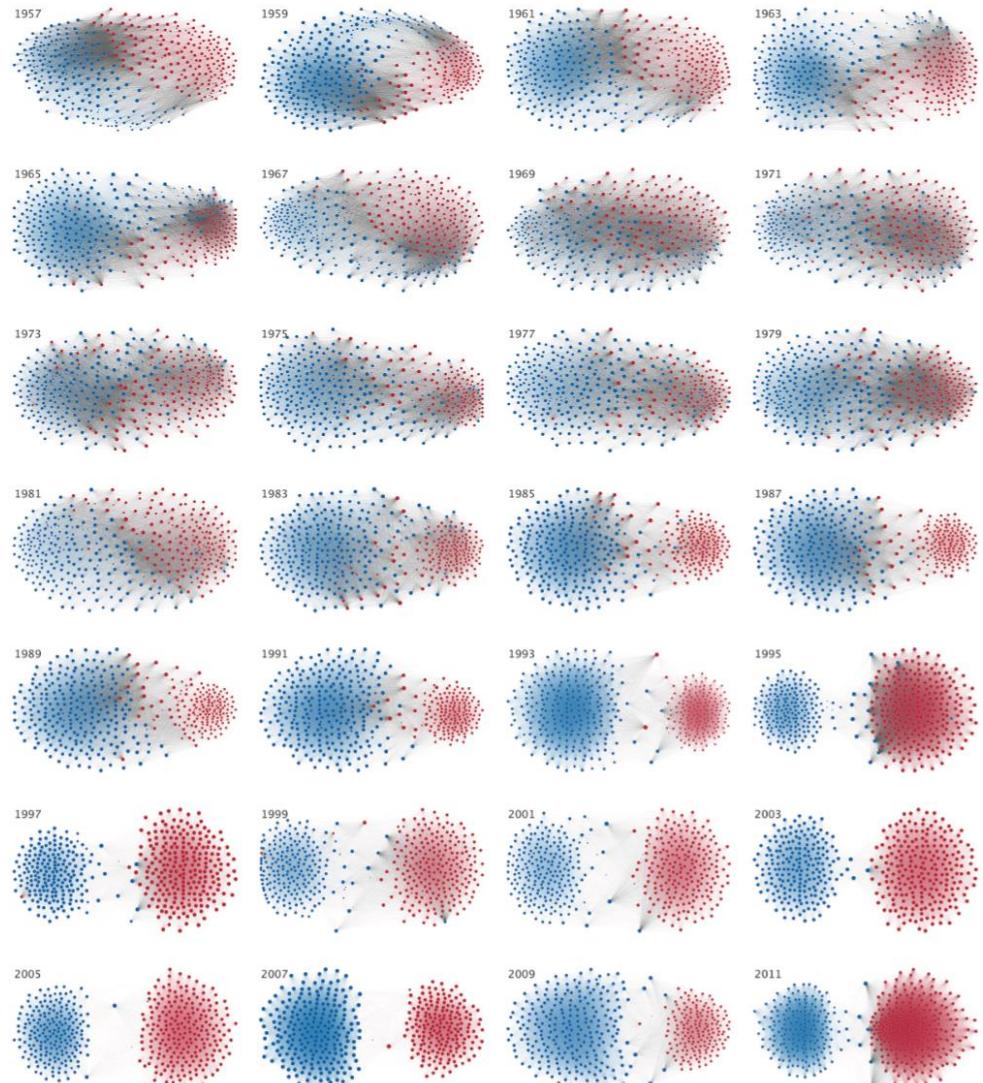
C

PPI network construction and module analysis. (A) PPI network of DE-FRGs (96 nodes and 511 edges). (B) Cytoscape-based identification of the densest connected regions (19 nodes and 146 edges) in the PPI network. (C) Hub LN-FRGs identified by 6 algorithms of cytoscape plugin cytoHubba. Red circle indicates the driver of ferroptosis, blue circle represents the suppressor of ferroptosis, green diamond indicates the marker of ferroptosis, red diamond represents both driver and marker of ferroptosis, blue diamond indicates both suppressor and marker of ferroptosis, white circle indicates the both driver and suppressor of ferroptosis.

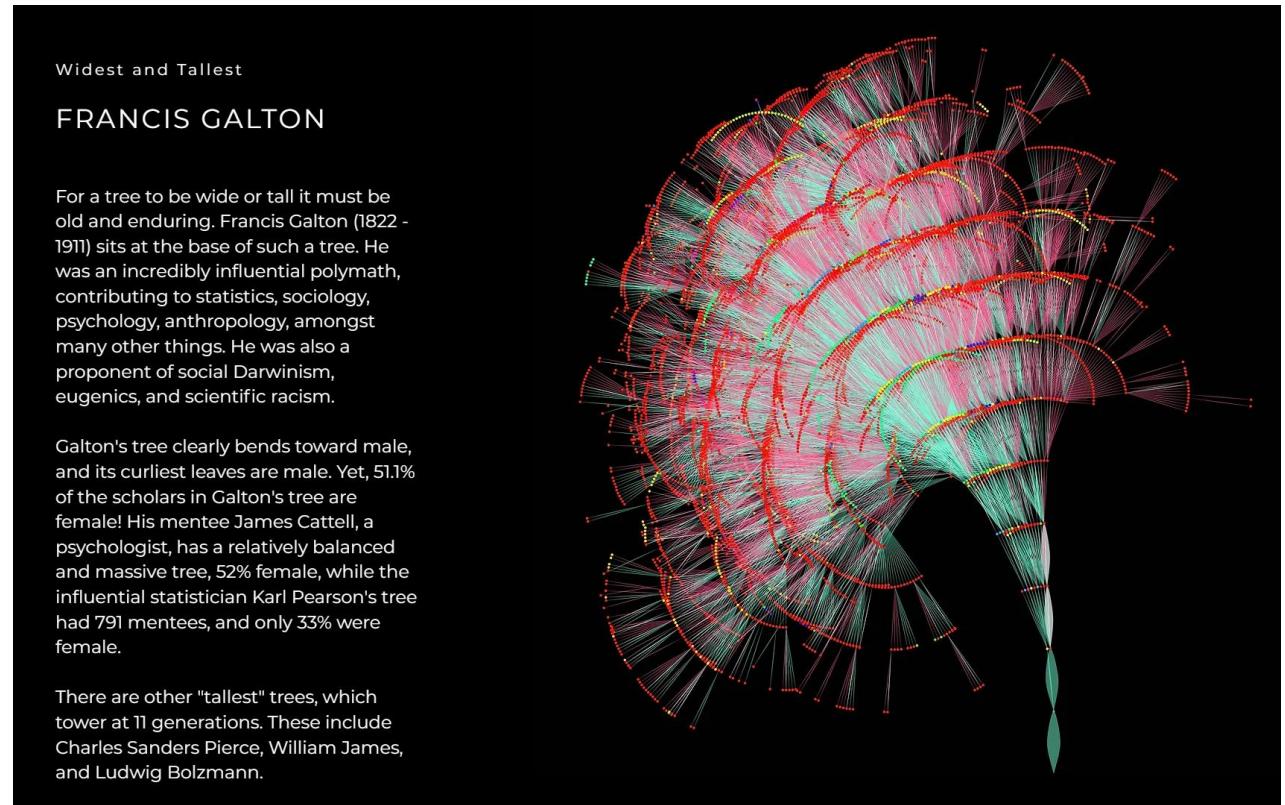
Source: Hu, W., Chen, X. Identification of hub ferroptosis-related genes and immune infiltration in lupus nephritis using bioinformatics. Sci Rep 12, 18826 (2022). <https://doi.org/10.1038/s41598-022-23730-8>

Source: Network analysis made simple. Eric Ma. <https://ericmjl.github.io/Network-Analysis-Made-Simple/>

Network visualizations are everywhere!



Source: The Rise of Partisanship and Super-cooperators in the U.S. House of Representatives. Visualisation by Mauro Martino, authored by Clio Andris, David Lee, Marcus J. Hamilton, Mauro Martino, Christian E. Gunning, and John Armistead Selde. <https://doi.org/10.1371/journal.pone.0123507>

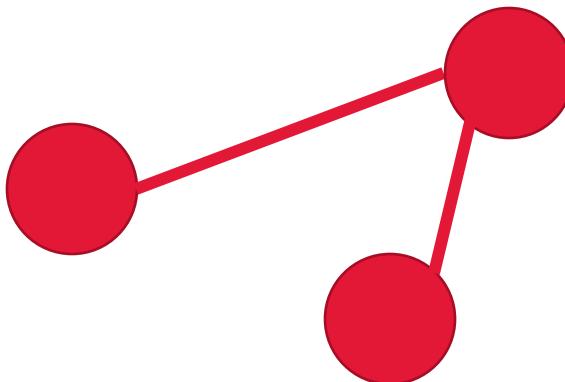


Source: Shifting Winds: Gendered Structures of Academic Mentorship. Visualization by Jiabao Li, Houjiang Liu, Jilie Zeng, Di Wu, Ying Ding, Alec McGail. <https://www.mentortrees.com/>.

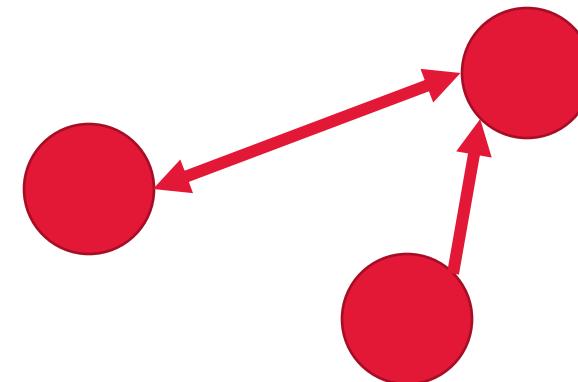
Network visualization concepts: Network attributes

- › **Single-mode:** All nodes belong to the same category
 - Ex. All nodes in a social network graph are humans
- › **Multi-mode:** All nodes are not in the same category
 - Ex. Graphs with buyers and sellers
- › **Undirected network:** relationship goes in both directions
 - Ex. Facebook friends
- › **Directed network:** relationship may not go both directions
 - Ex. Twitter following

Undirected network



Directed network



Network visualization concepts: Edge attributes

- › **Undirected edge:** Indicates a two-way relationship
- › **Directed edge:** Indicates a one-way relationship

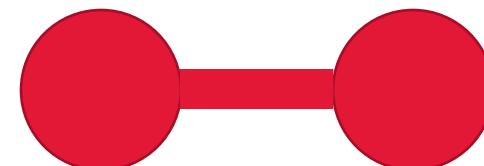
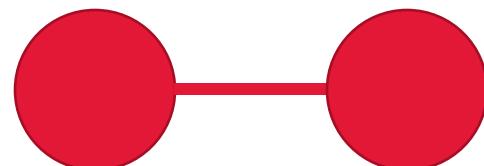
Undirected relationship



Directed relationship



- › **Weights:** Edge thickness representing the strength of the relationship

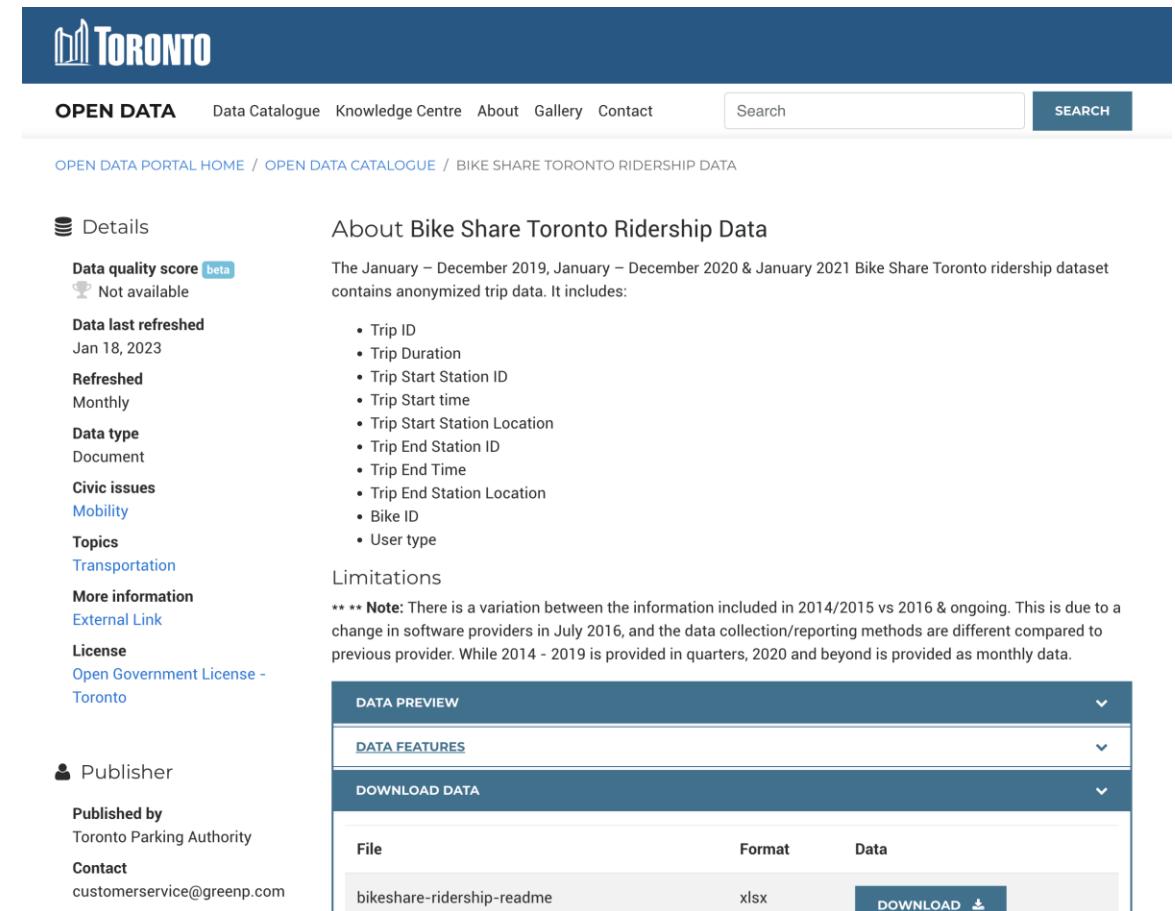


Network visualization concepts: Node attributes

- **Degree:** Number of edges connected to a node
 - **In-degree:** Number of incoming edges for a node
 - **Out-degree:** Number of outgoing edges for a node
 - Note: If applicable, degrees are affected by weights
- **Centrality:** a node's importance
 - **Degree centrality:** the more interactions, the higher the degree centrality and the more important the node
 - **Eigenvector centrality:** an important node is connected to other important nodes
 - **Betweenness centrality:** an important node is one that has involved in a high number of the shortest paths between other nodes (a “communication controller”)
 - **Closeness centrality:** an important node is one with a short average distance to other nodes in the network

Example: Data source

- Data from the City of Toronto Open Data Portal
- Bike Share Toronto Ridership Data:
<https://open.toronto.ca/dataset/bike-share-toronto-ridership-data/>
- Bike Share Toronto [Station Data]:
<https://open.toronto.ca/dataset/bike-share-toronto/>



The screenshot shows the City of Toronto Open Data Portal. The top navigation bar includes links for OPEN DATA, Data Catalogue, Knowledge Centre, About, Gallery, Contact, a search bar, and a 'SEARCH' button. The main page header features the 'TORONTO' logo. Below the header, the breadcrumb navigation shows OPEN DATA PORTAL HOME / OPEN DATA CATALOGUE / BIKE SHARE TORONTO RIDERSHIP DATA. The left sidebar contains a 'Details' section with various metadata fields: Data quality score (beta, Not available), Data last refreshed (Jan 18, 2023), Refreshed (Monthly), Data type (Document), Civic issues (Mobility), Topics (Transportation), More information (External Link), and License (Open Government License - Toronto). The right sidebar contains sections for About Bike Share Toronto Ridership Data, Limitations, and a note about data variations between 2014/2015 and ongoing. At the bottom, there are sections for DATA PREVIEW, DATA FEATURES, DOWNLOAD DATA, File (bikeshare-ridership-readme), Format (xlsx), and Data (with a 'DOWNLOAD' button).

Ridership data: Raw vs. cleaned edges

Raw data

A	B	C	D	E	F	G	H	I	J
Trip Id	Trip Duration	Start Station Id	Start Time	Start Station Name	End Station Id	End Time	End Station Name	Bike Id	User Type
19936555	502	7281	12/01/2022	Charles St W / Balmuto St - SMART	7004	12/01/2022	University Ave / Elm St	4374	Casual Member
19936556	1104	7324	12/01/2022	King St W / Charlotte St (West Side)	7176	12/01/2022	Bathurst St / Fort York Blvd	1884	Casual Member
19936557	512	7469	12/01/2022	Wellington St W / York St	7720	12/01/2022	NULL	2733	Casual Member
19936558	481	7713	12/01/2022	NULL	7028	12/01/2022	Gould St / Mutual St	158	Casual Member
19936559	496	7713	12/01/2022	NULL	7028	12/01/2022	Gould St / Mutual St	6029	Casual Member
19936560	523	7217	12/01/2022	Soho St / Queen St W	7475	12/01/2022	Jarvis St / Richmond St E	Member	Member
19936561	659	7333	12/01/2022	King St E / Victoria St	7245	12/01/2022	Tecumseth St / Queen St W - SMART	Member	Member
19936563	270	7467	12/01/2022	Lower Simcoe St / Bremner Blvd	7000	12/01/2022	Fort York Blvd / Capreol Ct	Member	Member
19936564	831	7191	12/01/2022	Central Tech (Harbord St)	7720	12/01/2022	NULL	6266	Annual Member
19936565	613	7155	12/01/2022	Bathurst St / Lennox St	7281	12/01/2022	Charles St W / Balmuto St - SMART	3851	Casual Member
19936566	707	7148	12/01/2022	King St W / Joe Shuster Way	7711	12/01/2022	NULL	413	Casual Member
19936567	300	7713	12/01/2022	NULL	7016	12/01/2022	Bay St / Queens Quay W (Ferry Terminal)	5701	Casual Member
19936568	1114	7171	12/01/2022	Ontario Place Blvd / Lake Shore Blvd W (East)	7430	12/01/2022	Marilyn Bell Park Tennis Court		
19936569	1525	7026	12/01/2022	Bay St / St. Joseph St	7203	12/01/2022	Bathurst St/Queens Quay(Billy Bishop Airport)		

Fix NULLs

Remove unneeded columns

Cleaned data

A	B	C	D	E	F	G
Source	Target	Type	StartStationId	StartStationName	EndStationId	EndStationName
Charles St W / Balmuto St - SMART	University Ave / Elm St	Directed	7281	Charles St W / Balmuto St - SMART	7004	University Ave / Elm St
King St W / Charlotte St	Bathurst St / Fort York Blvd	Directed	7324	King St W / Charlotte St (West Side)	7176	Bathurst St / Fort York Blvd
Wellington St W / York St	King St W / Portland St	Directed	7469	Wellington St W / York St	7720	NULL
Temperance St / Bay St	Gould St / Mutual St	Directed	7713	NULL	7028	Gould St / Mutual St
Temperance St / Bay St	Gould St / Mutual St	Directed	7713	NULL	7028	Gould St / Mutual St
Soho St / Queen St W	Jarvis St / Richmond St E	Directed	7217	Soho St / Queen St W	7475	Jarvis St / Richmond St E
King St E / Victoria St	Tecumseth St / Queen St W - SMART	Directed	7333	King St E / Victoria St	7245	Tecumseth St / Queen St W - SMART
Lower Simcoe St / Bremner Blvd	Fort York Blvd / Capreol Ct	Directed	7467	Lower Simcoe St / Bremner Blvd	7000	Fort York Blvd / Capreol Ct
Central Tech (Harbord St)	King St W / Portland St	Directed	7191	Central Tech (Harbord St)	7720	NULL
Bathurst St / Lennox St	Charles St W / Balmuto St - SMART	Directed	7155	Bathurst St / Lennox St	7281	Charles St W / Balmuto St - SMART
King St W / Joe Shuster Way	Havelock St / Dewson St	Directed	7148	King St W / Joe Shuster Way	7711	NULL
Temperance St / Bay St	Bay St / Queens Quay W (Ferry Terminal)	Directed	7713	NULL	7016	Bay St / Queens Quay W (Ferry Terminal)
Ontario Place Blvd / Lake Shore Blvd W	Marilyn Bell Park Tennis Court	Directed	7171	Ontario Place Blvd / Lake Shore Blvd W	7430	Marilyn Bell Park Tennis Court
Bay St / St. Joseph St	Bathurst St/Queens Quay(Billy Bishop Airport)	Directed	7026	Bay St / St. Joseph St	7203	Bathurst St/Queens Quay(Billy Bishop Air

Important data to import into network graph

Station data: Nodes and node attributes

While not *strictly* necessary to import Node data (Gephi can create nodes from the edges table), use a Node table to import any additional node data

A	B	C	D	E	F	G	H	I	
1	Id	Label	Station Id	Latitude	Longitude	Capacity	PhysicalConfiguration	PostalCode	PostalCodeArea*
2	Charles St W / Balmuto St - SMART	Charles St W / Balmuto St - SMART	7281	43.668427	-79.38725	20	SMARTMAPFRAME	NULL	NULL
3	King St W / Charlotte St	King St W / Charlotte St	7324	43.645572	-79.39399	23	REGULAR	NULL	NULL
4	Wellington St W / York St	Wellington St W / York St	7469	43.646734	-79.38301	23	REGULAR	M5J 2R2	M5J
5	Temperance St / Bay St	Temperance St / Bay St	7713	43.6506	-79.381285	22	REGULAR	M5H 2V6	M5H
6	Soho St / Queen St W	Soho St / Queen St W	7217	43.6494896	-79.393535	7	REGULAR	NULL	NULL
7	King St E / Victoria St	King St E / Victoria St	7333	43.6495789	-79.37621	19	REGULAR	NULL	NULL
8	Lower Simcoe St / Bremner Blvd	Lower Simcoe St / Bremner Blvd	7467	43.64283	-79.38409	14	REGULAR	M5J 3A6	M5J
9	Central Tech (Harbord St)	Central Tech (Harbord St)	7191	43.661975	-79.407896	11	REGULAR	NULL	NULL
10	Bathurst St / Lennox St	Bathurst St / Lennox St	7155	43.663808	-79.410491	19	REGULAR	NULL	NULL
11	King St W / Joe Shuster Way	King St W / Joe Shuster Way	7148	43.639444	-79.423611	15	REGULAR	NULL	NULL
12	Ontario Place Blvd / Lake Shore Blvd W	Ontario Place Blvd / Lake Shore Blvd W	7171	43.6322445	-79.410811	27	REGULAR	NULL	NULL
13	Bay St / St. Joseph St	Bay St / St. Joseph St	7026	43.665527	-79.387499	15	REGULAR	NULL	NULL
14	Edward St / Yonge St	Edward St / Yonge St	7041	43.656729	-79.382736	23	REGULAR	NULL	NULL
15	University Ave / Richmond St W	University Ave / Richmond St W	7646	43.6503935	-79.386021	27	REGULAR	M5H 4G1	M5H
16	Yonge St / St Clair Ave	Yonge St / St Clair Ave	7642	43.6885046	-79.394005	19	REGULAR	M4T 1Z2	M4T
17	College Park - Yonge St Entrance	College Park - Yonge St Entrance	7418	43.65988	-79.38279	25	REGULAR	M5B 2H4	M5B
18	King St W / Portland St	King St W / Portland St	7720	43.644395	-79.400654	16	SMARTMAPFRAME	M5V 1M6	M5V
19	Baldwin St / Henry St	Baldwin St / Henry St	7545	43.6560758	-79.393259	15	REGULAR	M5T 1L2	M5T
20	Front St E / Scott St	Front St E / Scott St	7375	43.6476616	-79.37549	10	REGULAR	NULL	NULL
21	Euclid Ave / Bloor St W	Euclid Ave / Bloor St W	7040	43.664467	-79.414783	19	REGULAR	NULL	NULL
22	King St W / Stafford St	King St W / Stafford St	7158	43.6422222	-79.411111	15	REGULAR	NULL	NULL
23	Bathurst St / Fort York Blvd	Bathurst St / Fort York Blvd	7176	43.639179	-79.399595	19	REGULAR	NULL	NULL
24	Bathurst St / Adelaide St W	Bathurst St / Adelaide St W	7298	43.645324	-79.40345	25	REGULAR	NULL	NULL
25	11 Spadina Rd	11 Spadina Rd	7710	43.6677246	-79.404137	18	ELECTRICBIKESTATION	M5R2S9	M5R

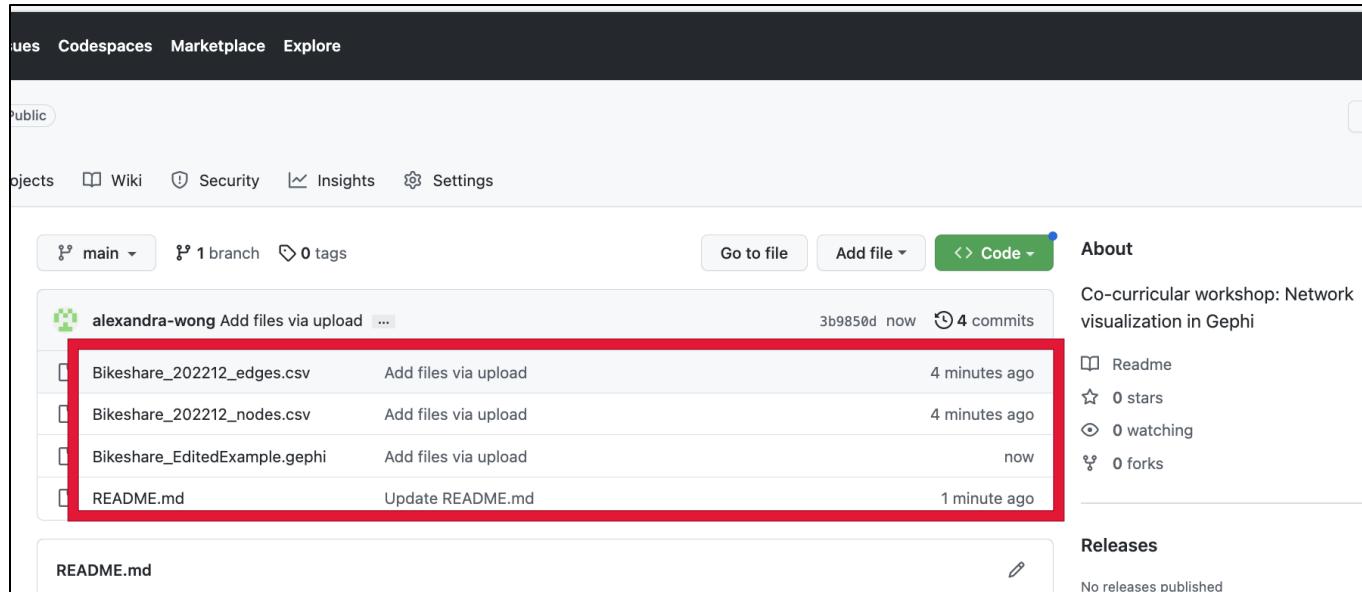
Important data to import into network graph

Additional attributes to import

*new column
added after
downloading
raw data

Download the cleaned data

- Download from GitHub: https://github.com/yorkulibraries-ds/networkvisualization_gephi



The screenshot shows a GitHub repository page for "networkvisualization_gephi". The main repository page displays a list of files in the "main" branch. A red box highlights the first four files: "Bikeshare_202212_edges.csv", "Bikeshare_202212_nodes.csv", "Bikeshare_EditedExample.gephi", and "README.md". The "About" section on the right describes the repository as a "Co-curricular workshop: Network visualization in Gephi".

README.md

Co-curricular workshop: Network visualization in Gephi

Edge dataset is derived from Bike Share Toronto Ridership dataset in the City of Toronto. <https://open.toronto.ca/dataset/bike-share-toronto-ridership-data/>

Node dataset is derived from the Bike Share Toronto dataset in the City of Toronto. <https://open.toronto.ca/dataset/bike-share-toronto/>



The screenshot shows the details for the "Bikeshare_202212_edges.csv" file. The file was uploaded by alexandra-wong. It has 1 contributor and is 21.8 MB in size. A red box highlights the "Download" button at the bottom right of the page.

Bikeshare_202212_edges.csv

alexandra-wong Add files via upload ...

Latest commit 8c8389e 5 minutes ago History

1 contributor

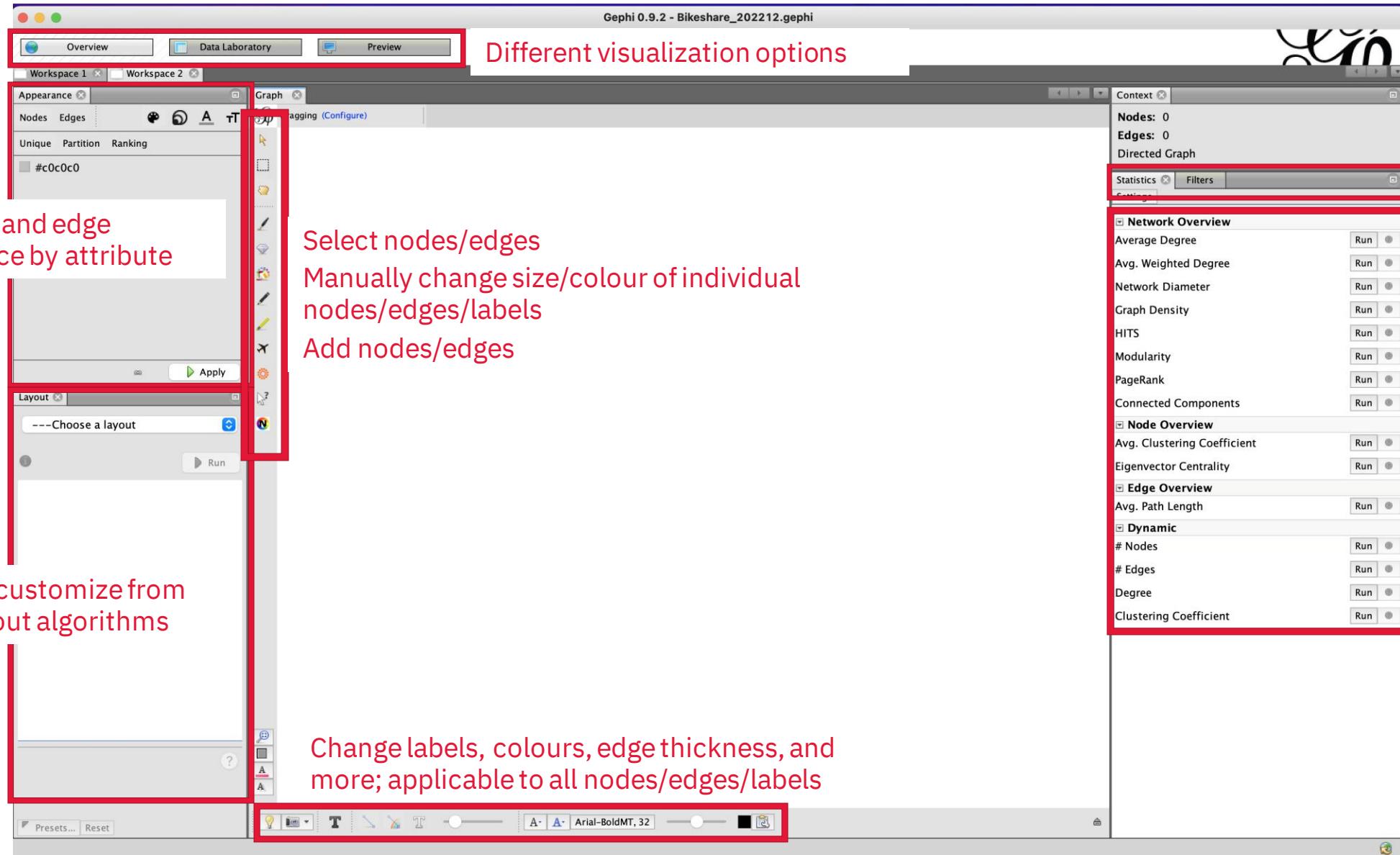
21.8 MB

Download

[View raw](#)

(Sorry about that, but we can't show files that are this big right now.)

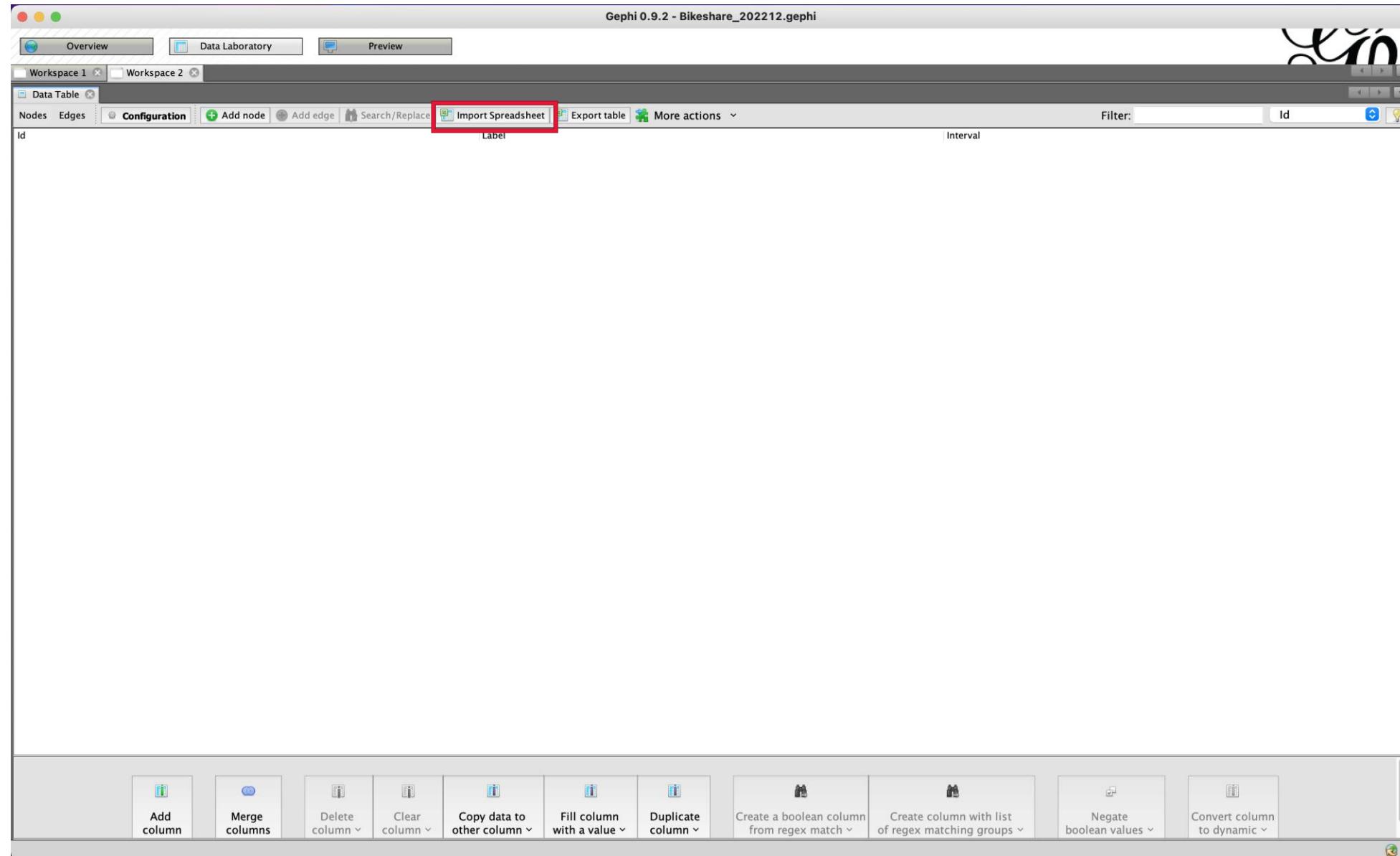
Gephi interface: Overview



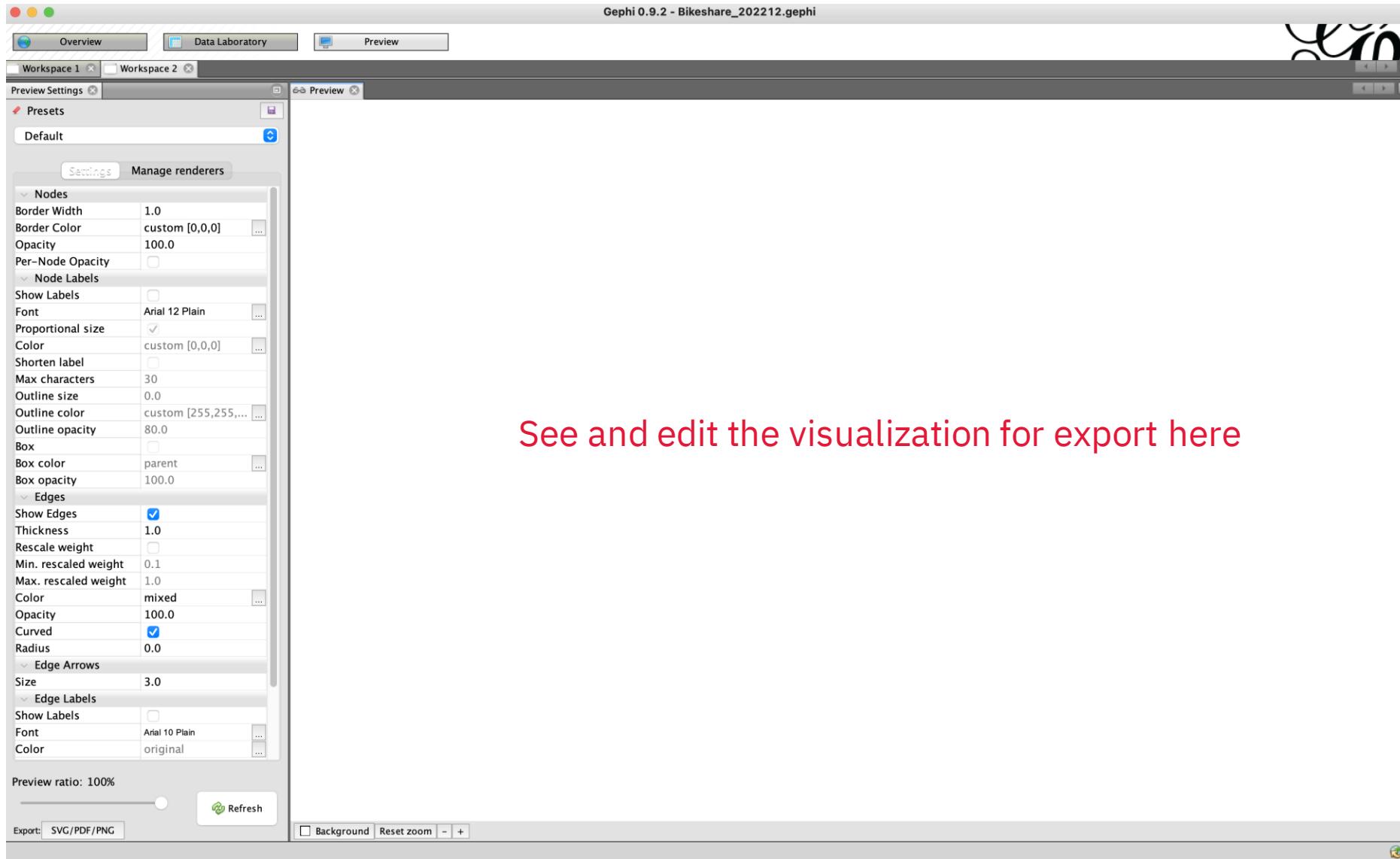
Switch to add filters for nodes

Conduct network analysis

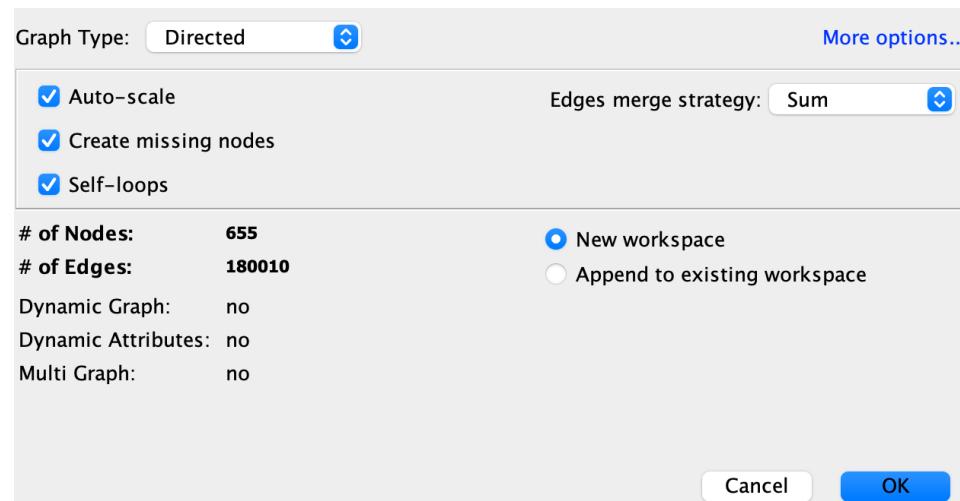
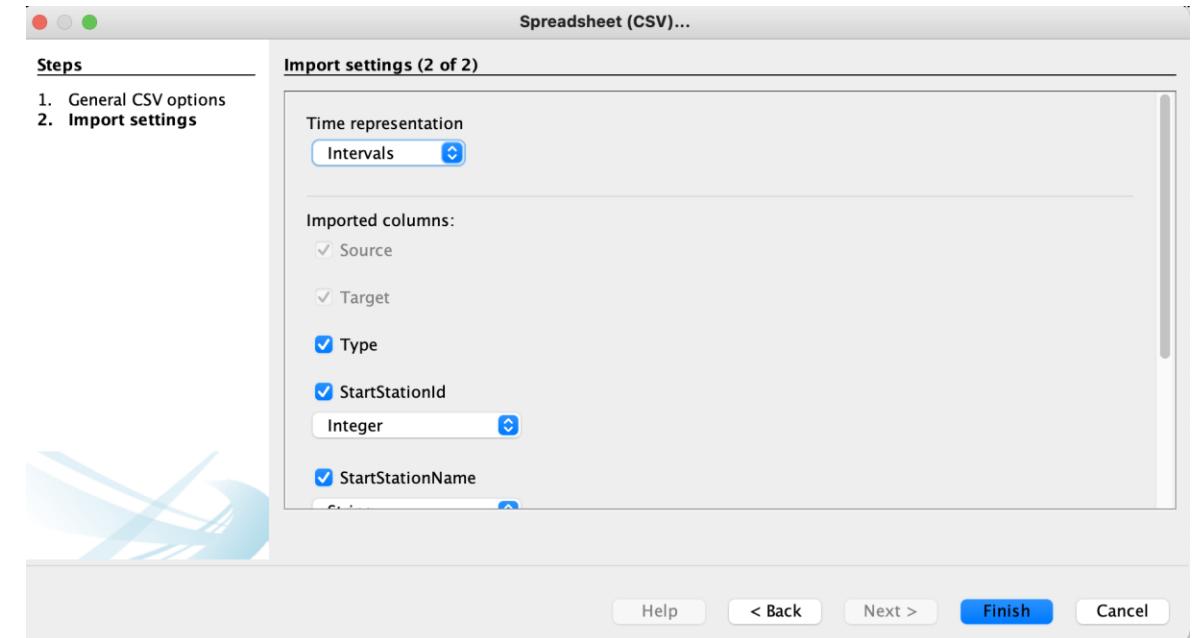
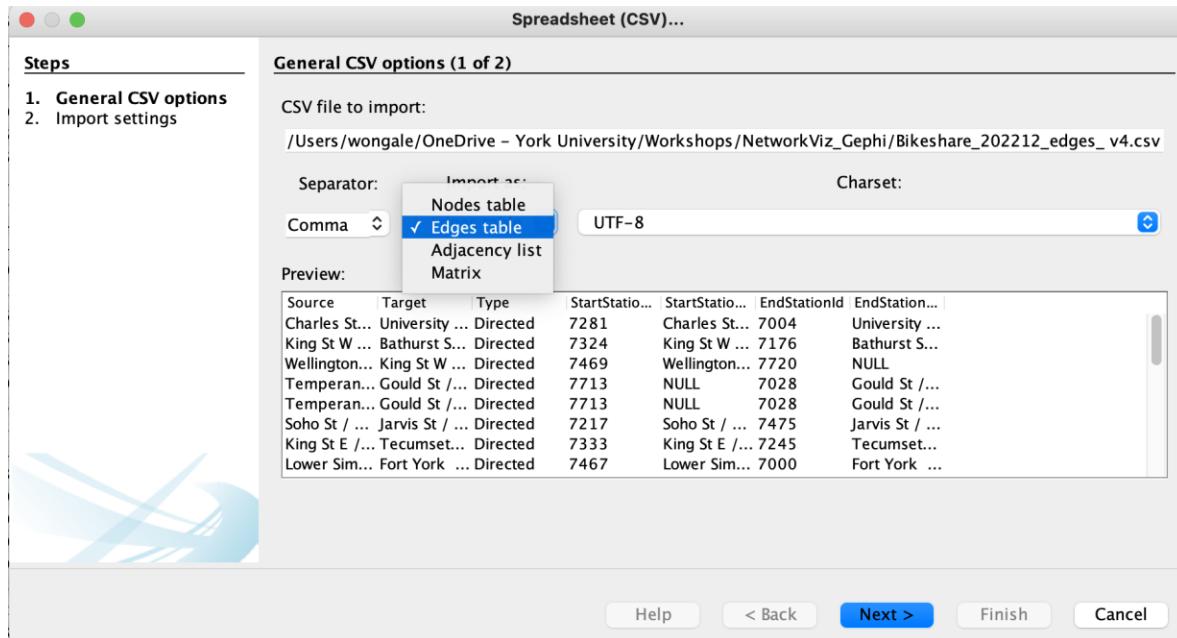
Gephi interface: Data Laboratory



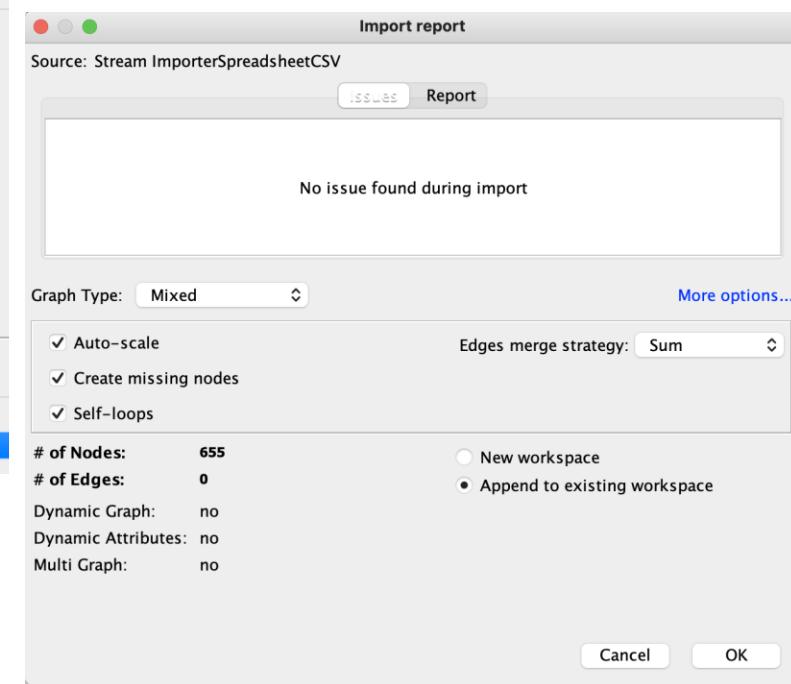
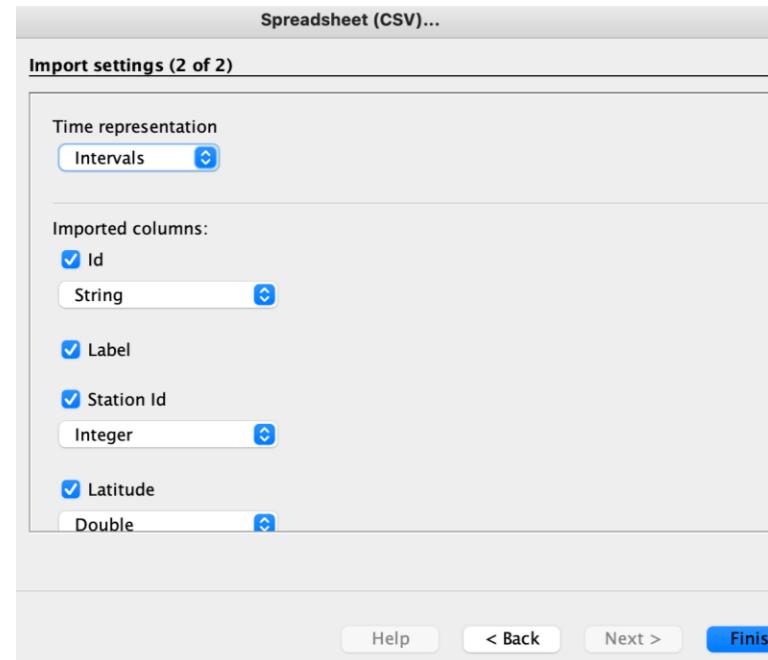
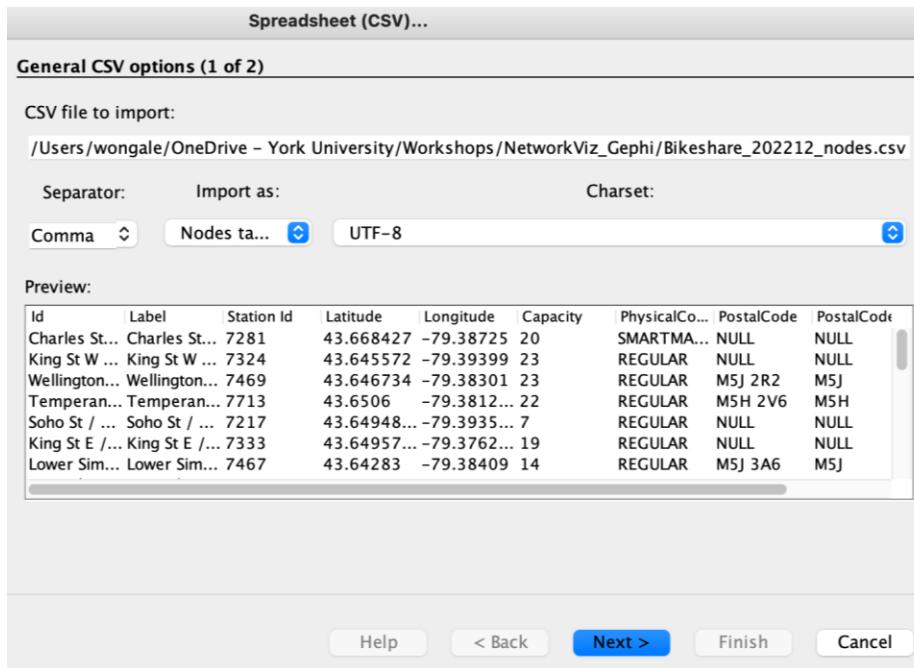
Gephi interface: Preview



Importing Edge data into Gephi



Importing Node data into Gephi



Nodes after importing

Gephi 0.9.2 - Bikeshare_202212.gephi

Overview Data Laboratory Preview

Workspace 1

Data Table

Nodes Edges Configuration Add node Add edge Search/Replace Import Spreadsheet Export table More actions Filter: Id

Id	Label	Interval	station id	latitude	longitude	capacity	physicalconfiguration	postalcode	postalcodearea	name
Charles St W / Balmut...	Charles St W / Balmut...		7281	43.668427	-79.38725	20	SMARTMAPFRAME			Charles St W / Balmut...
University Ave / Elm St	University Ave / Elm St		7004	43.656518	-79.389099	11	REGULAR			University Ave / Elm St
King St W / Charlotte St	King St W / Charlotte St		7324	43.645572	-79.39399	23	REGULAR			King St W / Charlotte S...
Bathurst St / Fort York...	Bathurst St / Fort York...		7176	43.639179	-79.399595	19	REGULAR			Bathurst St / Fort York...
Wellington St W / York St	Wellington St W / York St		7469	43.646734	-79.38301	23	REGULAR	M5J 2R2	M5J	Wellington St W / York St
King St W / Portland St	King St W / Portland St		7720	43.644395	-79.400654	16	SMARTMAPFRAME	M5V 1M6	M5V	Wellington St W / York St
Temperance St / Bay St	Temperance St / Bay St		7713	43.6506	-79.381285	22	REGULAR	M5H 2V6	M5H	Temperance St / Bay St
Gould St / Mutual St	Gould St / Mutual St		7028	43.6582	-79.3768	31	REGULAR			Gould St / Mutual St
Soho St / Queen St W	Soho St / Queen St W		7217	43.64949	-79.393535	7	REGULAR			Soho St / Queen St W
Jarvis St / Richmond St	Jarvis St / Richmond St		7475	43.652777	-79.372637	19	REGULAR	M5C 2H6	M5C	Jarvis St / Richmond St E
King St E / Victoria St	King St E / Victoria St		7333	43.649579	-79.37621	19	REGULAR			King St E / Victoria St
Tecumseh St / Queen...	Tecumseh St / Queen...		7245	43.646552	-79.406468	9	SMARTMAPFRAME			Tecumseh St / Queen...
Lower Simcoe St / Bre...	Lower Simcoe St / Bre...		7467	43.64283	-79.38409	14	REGULAR	M5J 3A6	M5J	Lower Simcoe St / Bre...
Fort York Blvd / Capr...	Fort York Blvd / Capr...		7000	43.639832	-79.395954	35	REGULAR			Fort York Blvd / Capr...
Central Tech (Harbor...	Central Tech (Harbor...		7191	43.661975	-79.407896	11	REGULAR			Central Tech (Harbor...
Bathurst St / Lennox St	Bathurst St / Lennox St		7155	43.663808	-79.410491	19	REGULAR			Bathurst St / Lennox St
King St W / Joe Shust...	King St W / Joe Shust...		7148	43.639444	-79.423611	15	REGULAR			King St W / Joe Shust...
Havelock St / Dewson St	Havelock St / Dewson St		7711	43.655479	-79.430246	15	REGULAR	M6H 3B3	M6H	Havelock St / Dewson St
Bay St / Queens Quay ...	Bay St / Queens Quay ...		7016	43.640978	-79.376785	23	REGULAR	M5J	M5J	Bay St / Queens Quay ...
Ontario Place Blvd / L...	Ontario Place Blvd / L...		7171	43.632244	-79.41081	27	REGULAR			Ontario Place Blvd / L...
Marilyn Bell Park Tenn...	Marilyn Bell Park Tenn...		7430	43.633537	-79.437461	27	REGULAR	M6K 3C1	M6K	Marilyn Bell Park Tenn...
Bay St / St. Joseph St	Bay St / St. Joseph St		7026	43.665527	-79.387499	15	REGULAR			Bay St / St. Joseph St
Bathurst St/Queens Qu...	Bathurst St/Queens Qu...		7203	43.635492	-79.398253	35	REGULAR			Bathurst St/Queens Qu...
D'Arcy St / McCaul St ...	D'Arcy St / McCaul St ...		7386	43.655227	-79.39201	15	SMARTMAPFRAME			D'Arcy St / McCaul St ...
Edward St / Yonge St	Edward St / Yonge St		7041	43.656729	-79.382736	23	REGULAR			Edward St / Yonge St
University Ave / Richm...	University Ave / Richm...		7646	43.650393	-79.386021	27	REGULAR	M5H 4G1	M5H	University Ave / Richm...
King / Brant	King / Brant		7685	43.645102	-79.39745	22	REGULAR	M5V 1L7	M5V	King / Brant
Yonge St / St Clair Ave	Yonge St / St Clair Ave		7642	43.688505	-79.394005	19	REGULAR	M4T 1Z2	M4T	Yonge St / St Clair Ave
Vaughan Rd /Wychwo...	Vaughan Rd /Wychwo...		7538	43.688282	-79.425386	19	REGULAR	M6C 2N5	M6C	Vaughan Rd /Wychwo...
College Park - Yonge ...	College Park - Yonge ...		7418	43.65988	-79.38279	25	REGULAR	M5B 2H4	M5B	College Park - Yonge ...
Baldwin Ave / Spadina...	Baldwin Ave / Spadina...		7248	43.654905	-79.398448	20	SMARTMAPFRAME			Baldwin Ave / Spadina...
King St W / Stafford St	King St W / Stafford St		7158	43.642222	-79.411111	15	REGULAR			King St W / Stafford St
Baldwin St / Henry St	Baldwin St / Henry St		7545	43.656076	-79.393259	15	REGULAR	M5T 1L2	M5T	Baldwin St / Henry St
Little Norway Park	Little Norway Park		7411	43.635023	-79.399505	22	REGULAR	M5V 2Y9	M5V	Little Norway Park
John St / Mercer St - ...	John St / Mercer St - ...		7253	43.6461	-79.3895	12	SMARTMAPFRAME			John St / Mercer St - ...
Front St E / Scott St	Front St E / Scott St		7375	43.647662	-79.37549	10	REGULAR			Front St E / Scott St
Front St E / Cherry St	Front St E / Cherry St		7108	43.652686	-79.358395	15	REGULAR			Front St E / Cherry St
Euclid Ave / Bloor St W	Euclid Ave / Bloor St W		7040	43.664467	-79.414783	19	REGULAR			Euclid Ave / Bloor St W
Dalton Rd / Bloor St W	Dalton Rd / Bloor St W		7061	43.666294	-79.406643	15	REGULAR	M6G1A1	M6G	Dalton Rd / Bloor St W
King St W / Spadina Ave	King St W / Spadina Ave		7010	43.645323	-79.395003	19	REGULAR			King St W / Spadina Ave
Bathurst St / Adelaide ...	Bathurst St / Adelaide ...		7298	43.645324	-79.40345	25	REGULAR			Bathurst St / Adelaide ...

Add column Merge columns Delete column ▾ Copy data to other column ▾ Fill column with a value ▾ Duplicate column ▾ Create a boolean column from regex match ▾ Create column with list of regex matching groups ▾ Negate boolean values ▾ Convert column to dynamic ▾

Edges after importing

Gephi 0.9.2 - Bikeshare_202212.gephi

Workspace 1

Data Table

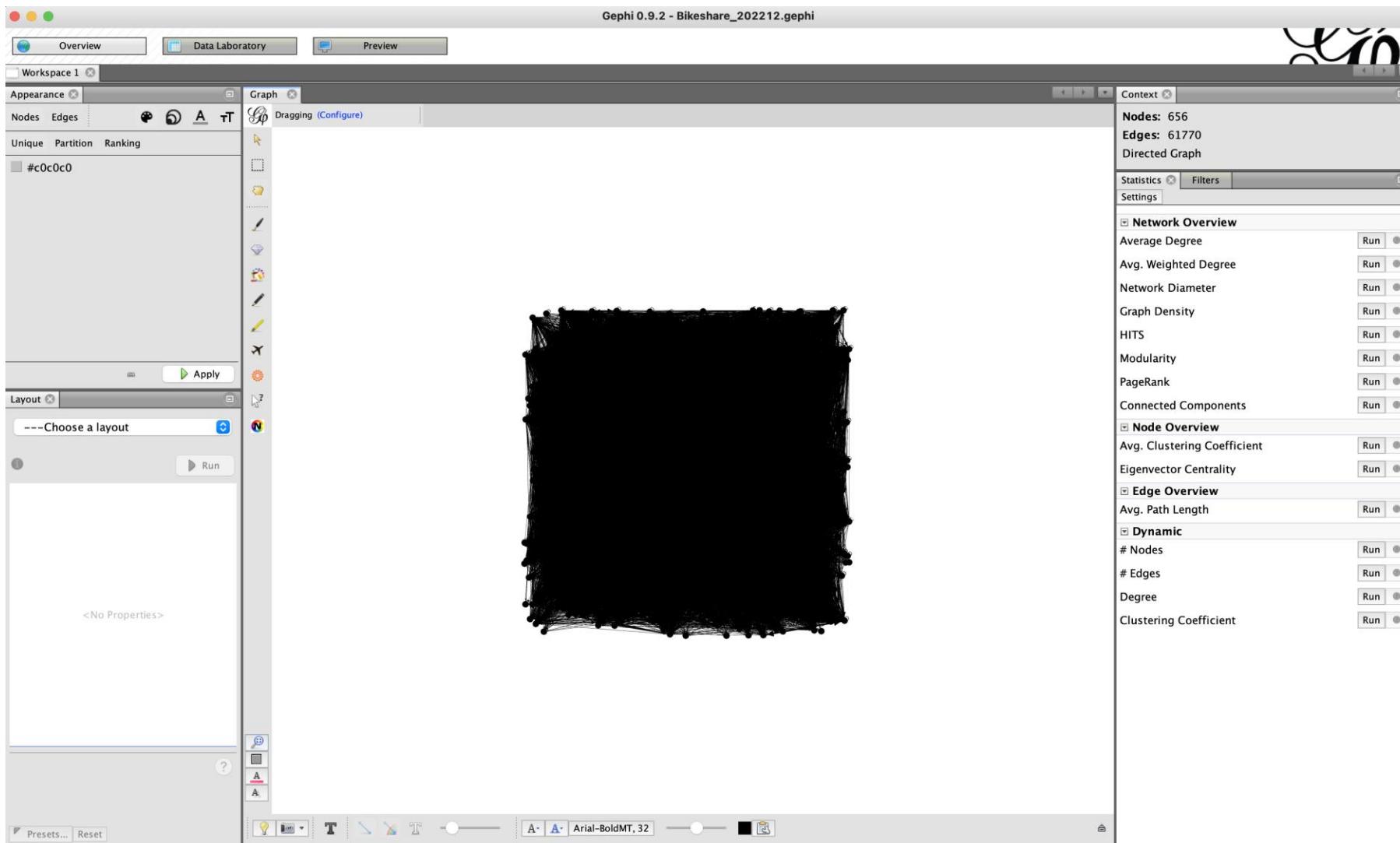
Nodes Edges Configuration Add node Add edge Search/Replace Import Spreadsheet Export table More actions

Filter: Source

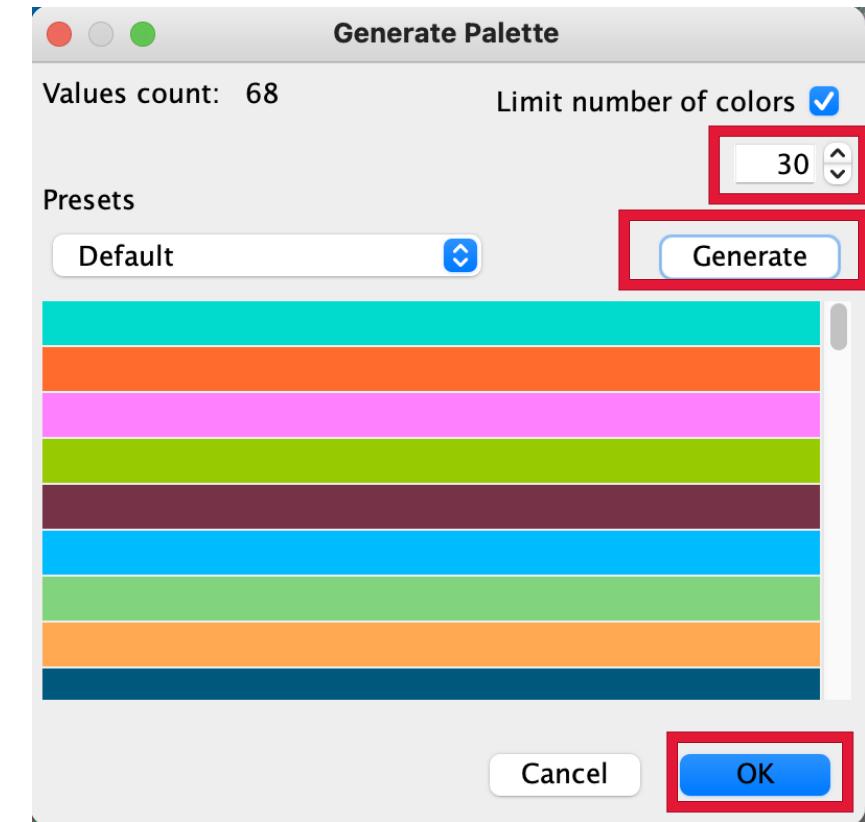
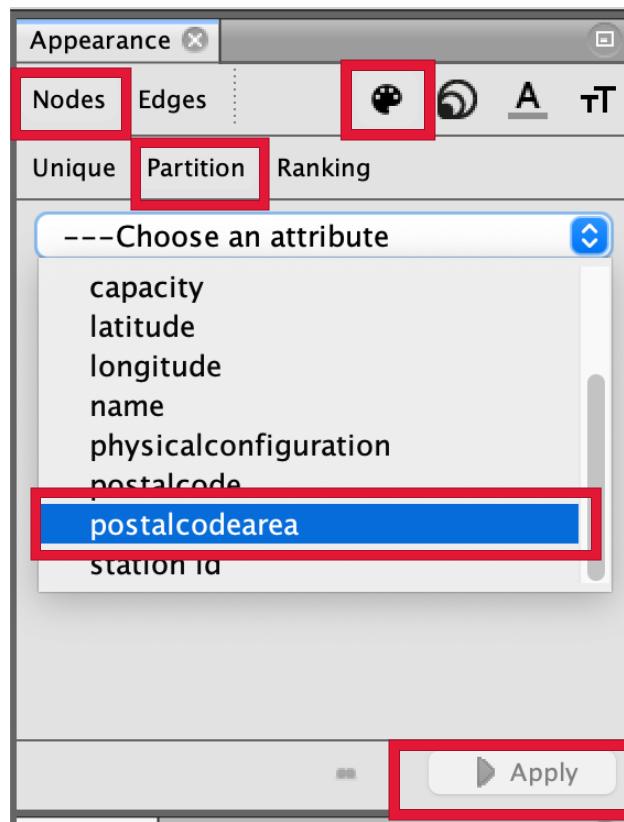
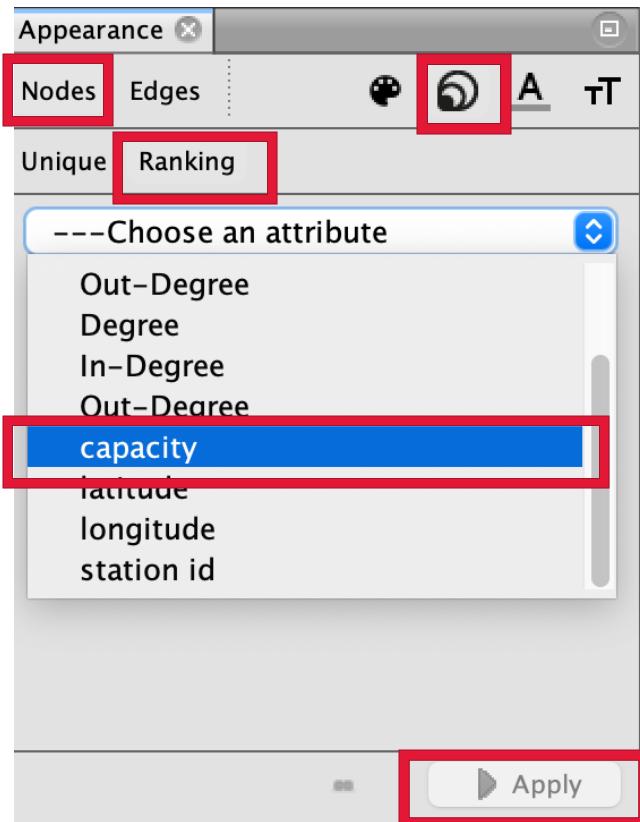
Source	Target	Type	Id	Label	Interval	Weight	startstationid	startstationname	endstationid	endstationname
Charles St W / Balmuto...	University Ave / Elm St	Directed	0			12.0	7281	Charles St W / Balmuto St ...	7004	University Ave / Elm St
King St W / Charlotte St	Bathurst St / Fort York ...	Directed	1			2.0	7324	King St W / Charlotte St (W...)	7176	Bathurst St / Fort York Blvd
Wellington St W / York St	King St W / Portland St	Directed	2			2.0	7469	Wellington St W / York St	7720	
Temperance St / Bay St	Gould St / Mutual St	Directed	3			5.0	7713		7028	Gould St / Mutual St
Soho St / Queen St W	Jarvis St / Richmond St E	Directed	5			21.0	7217	Soho St / Queen St W	7475	Jarvis St / Richmond St E
King St E / Victoria St	Tecumseth St / Queen... Directed	6				11.0	7333	King St E / Victoria St	7245	Tecumseth St / Queen St ...
Lower Simcoe St / Bre...	Fort York Blvd / Capreol...	Directed	7			10.0	7467	Lower Simcoe St / Bremne...	7000	Fort York Blvd / Capreol Ct
Central Tech (Harbor...	King St W / Portland St	Directed	8			2.0	7191	Central Tech (Harbord St)	7720	
Bathurst St / Lennox St	Charles St W / Balmuto...	Directed	9			12.0	7155	Bathurst St / Lennox St	7281	
King St W / Joe Shuster...	Havelock St / Dewson St	Directed	10			1.0	7148	King St W / Joe Shuster Way	7711	Charles St W / Balmuto St ...
Temperance St / Bay St	Bay St / Queens Quay ...	Directed	11			7.0	7713		7016	Bay St / Queens Quay W (...
Ontario Place Blvd / La...	Marilyn Bell Park Tennis C...	Directed	12			21.0	7171	Ontario Place Blvd / Lake ...	7430	Marilyn Bell Park Tennis C...
Bay St / St. Joseph St	Bathurst St/Queens Quay...	Directed	13			2.0	7026	Bay St / St. Joseph St	7203	Bathurst St/Queens Quay...
Bay St / St. Joseph St	D'Arcy St / McCaul St ...	Directed	14			4.0	7041	Edward St / Yonge St	7281	D'Arcy St / McCaul St. SM...
Edward St / Yonge St	Charles St W / Balmuto...	Directed	15			6.0	7646	University Ave / Richmond...	7685	Charles St W / Balmuto St ...
University Ave / Richm...	King / Brant	Directed	16			1.0	7642	Yonge St / St Clair Ave	7538	Vaughan Rd /Wychwood ...
Yonge St / St Clair Ave	Vaughan Rd /Wychwo...	Directed	17			7.0	7418	College Park – Yonge St En...	7248	Baldwin Ave / Spadina Av...
College Park – Yonge ...	Baldwin Ave / Spadina...	Directed	18			7.0	7720		7158	King St W / Stafford St
King St W / Portland St	King St W / Stafford St	Directed	19			13.0	7545	Baldwin St / Henry St	7411	King St W / Stafford St
Baldwin St / Henry St	Little Norway Park	Directed	20			2.0	7545	Baldwin St / Henry St	7253	Little Norway Park
Baldwin St / Henry St	John St / Mercer St – ...	Directed	21			3.0	7375	Front St E / Scott St	7108	John St / Mercer St – SM...
Front St E / Scott St	Front St E / Cherry St	Directed	22			9.0	7040	Euclid Ave / Bloor St W	7061	Front St E / Cherry St
Euclid Ave / Bloor St W	Dalton Rd / Bloor St W	Directed	23			9.0	7158	King St W / Stafford St	7148	Dalton Rd / Bloor St W
King St W / Stafford St	King St W / Joe Shuster... Directed	Directed	24			4.0	7176	Bathurst St / Fort York Blvd	7010	King St W / Joe Shuster Way
Bathurst St / Fort York ...	King St W / Spadina Ave	Directed	25			2.0	7298	Bathurst St / Adelaide St W	7627	King St W / Spadina Ave
Bathurst St / Adelaide ...	Shaw St / Essex St – ...	Directed	26			2.0	7710		7002	Shaw St / Essex St – SMART
11 Spadina Rd	St. George St / Bloor St... Directed	Directed	27			8.0	7542	Queen St W / John St	7184	St. George St / Bloor St W
Queen St W / John St	Ossington Ave / Colleg...	Directed	28			4.0	7526	Bartlett Parkette	7205	Ossington Ave / College St
Bartlett Parkette	Rusholme Park Cres / ...	Directed	29			12.0	7419	Bloor St W / Huron St	7058	Rusholme Park Cres / Col...
Bloor St W / Huron St	Huron St / Harbord St	Directed	30			8.0	7041	Edward St / Yonge St	7012	Huron/ Harbord St
Edward St / Yonge St	Elizabeth St / Edward ...	Directed	31			14.0	7074	King St E / Church St	7104	Elizabeth St / Edward St (...
King St E / Church St	King St E / River St	Directed	32			6.0	7241	519 Church St – SMART	7311	King St E / River St
S19 Church St	Sherbourne St / Isabell...	Directed	33			25.0	7418	College Park – Yonge St En...	7418	Sherbourne St / Isabella St
College Park – Yonge ...	College Park – Yonge ...	Directed	34			21.0	7030	Bay St / Wellesley St W	7542	College Park – Yonge St E...
Bay St / Wellesley St W	Queen St W / John St	Directed	35			20.0	7298	Bathurst St / Adelaide St W	7536	Queen St W / John St
Bathurst St / Adelaide ...	Palmerston Ave / Dun...	Directed	36			10.0	7418	College Park – Yonge St En...	7007	Palmerston Ave / Dundas...
College Park – Yonge ...	College St / Huron St	Directed	37			17.0	7148	King St W / Joe Shuster Way	7205	College St / Huron St
King St W / Joe Shuster...	Rusholme Park Cres / ...	Directed	38			2.0	7718		7416	Rusholme Park Cres / Col...
St. Andrew's Playgroun...	Spadina Ave / Blue Jay...	Directed	39			2.0	7292	Granby St / Church St – S...	7713	Spadina Ave / Blue Jays ...
Granby St / Church St ...	Temperance St / Bay St	Directed	40			19.0	7263	Walton St / Elizabeth St – S...	7491	D'Arcy St / Spadina Ave – ...
Walton St / Elizabeth S...	D'Arcy St / Spadina Av...	Directed	41			8.0				

Add column Merge columns Delete column Clear column Copy data to other column Fill column with a value Duplicate column Create a boolean column from regex match Create column with list of regex matching groups Negate boolean values Convert column to dynamic

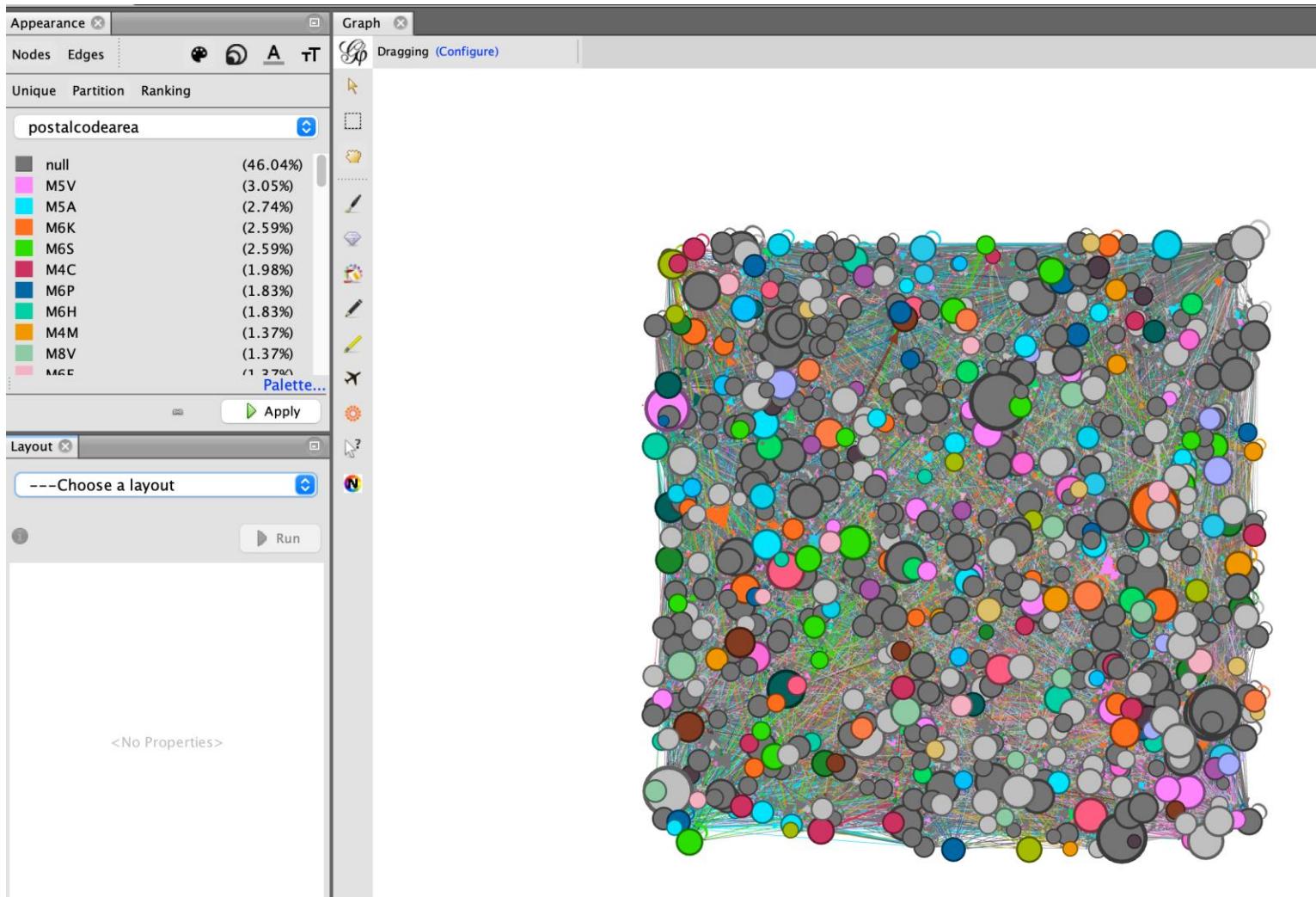
Network graph after importing



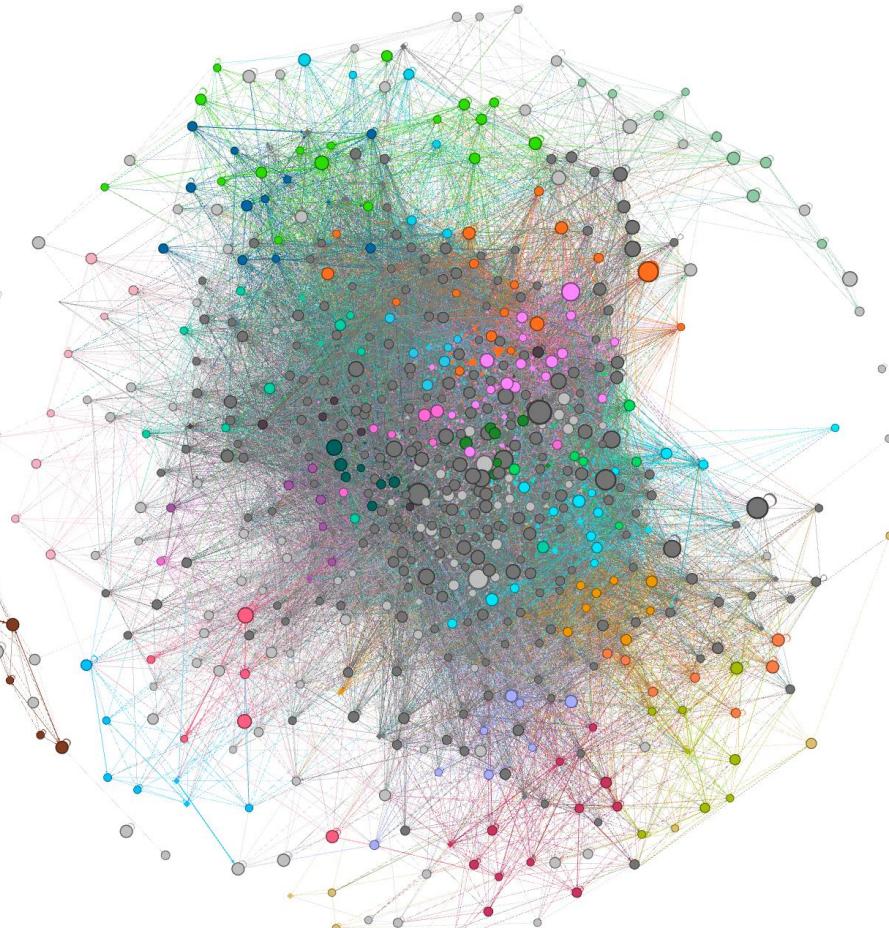
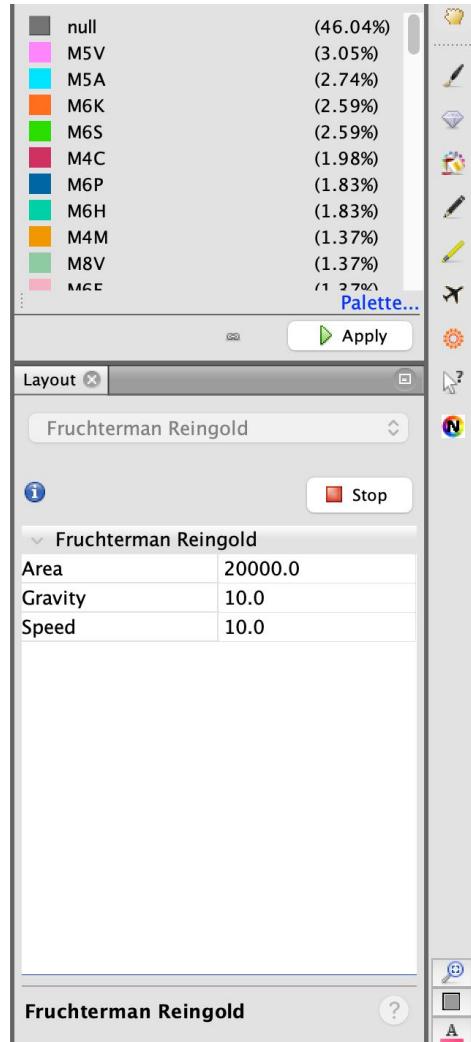
Adjusting node appearance



After changing node appearance



Applying a layout: Fruchterman Reingold

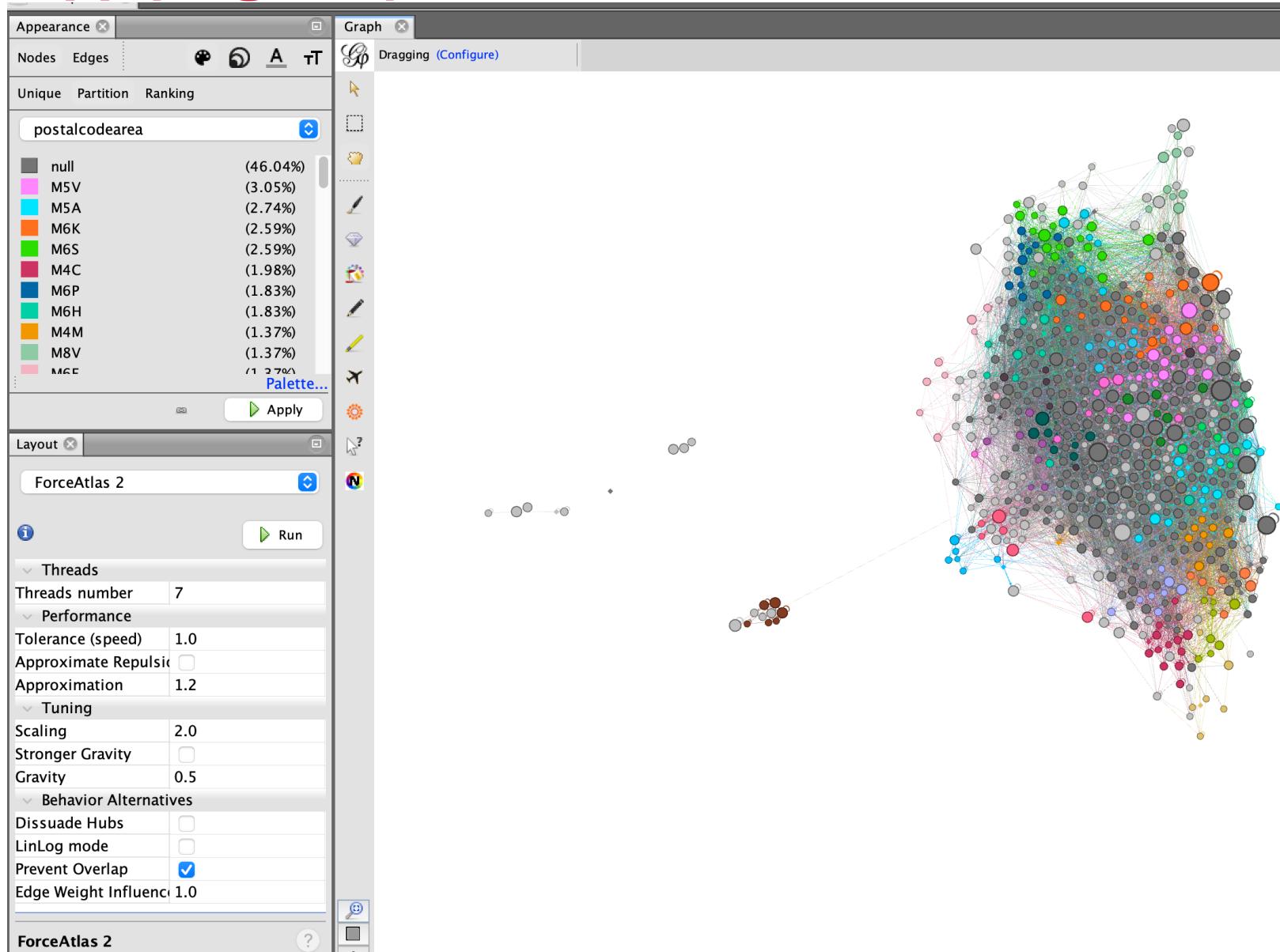


Fruchterman Reingold is a force directed layout – nodes are attracted and repulsed based on relationships. Simulates nodes as mass particles, edges as strings, and energy of the system is minimized.

Results in communities being distinguished.

Note that there are more connections in the middle, less connected nodes on the edges.

Applying a layout: Force Atlas 2



We can continue to layer layouts.

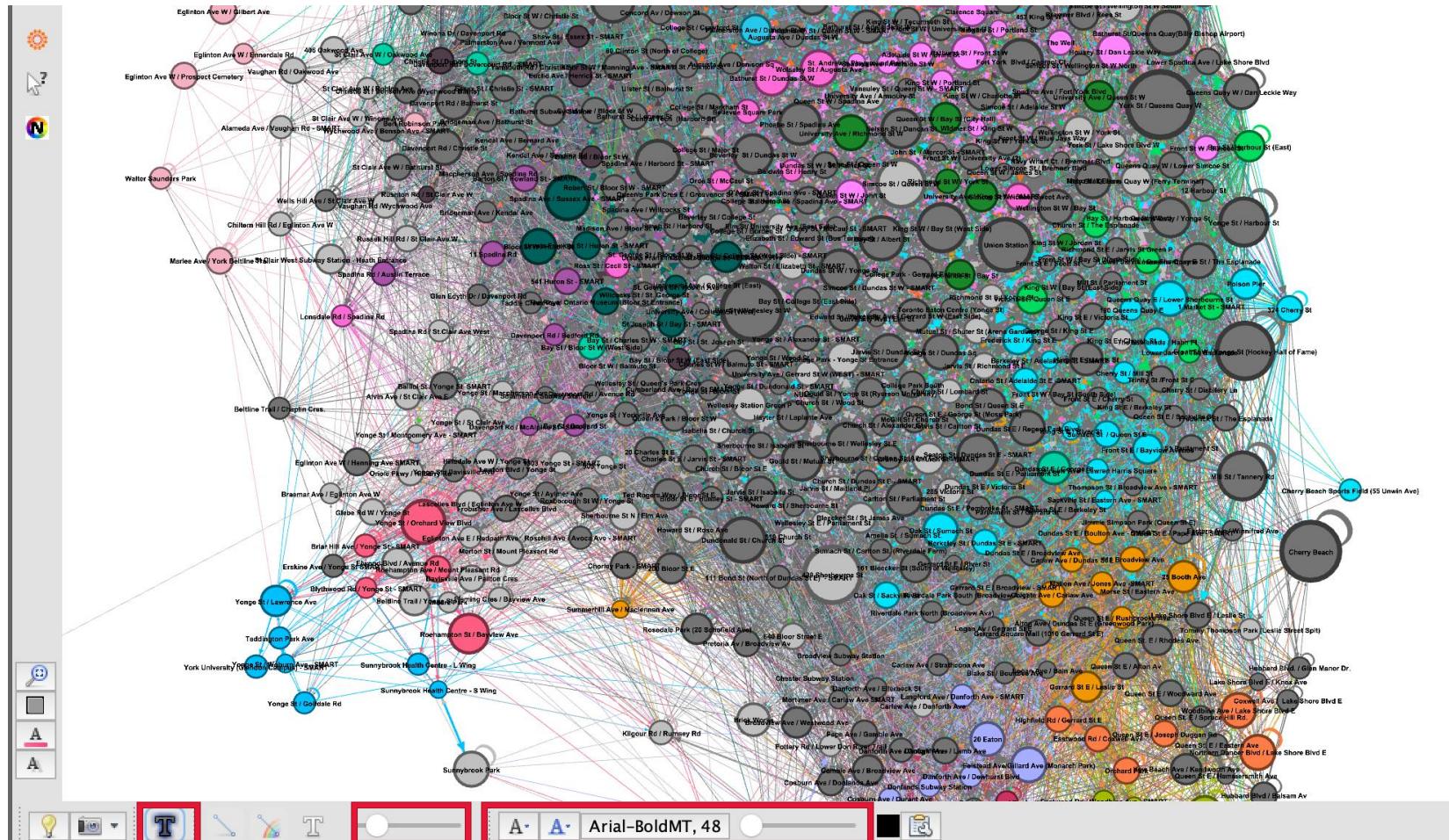
Force Atlas 2 algorithm draws strongly connected nodes together, weaker connected nodes further away.

Note: now we have islands!

Learn more about layouts here:

<https://gephi.org/users/tutorial-layouts/>

Adding and adjusting labels

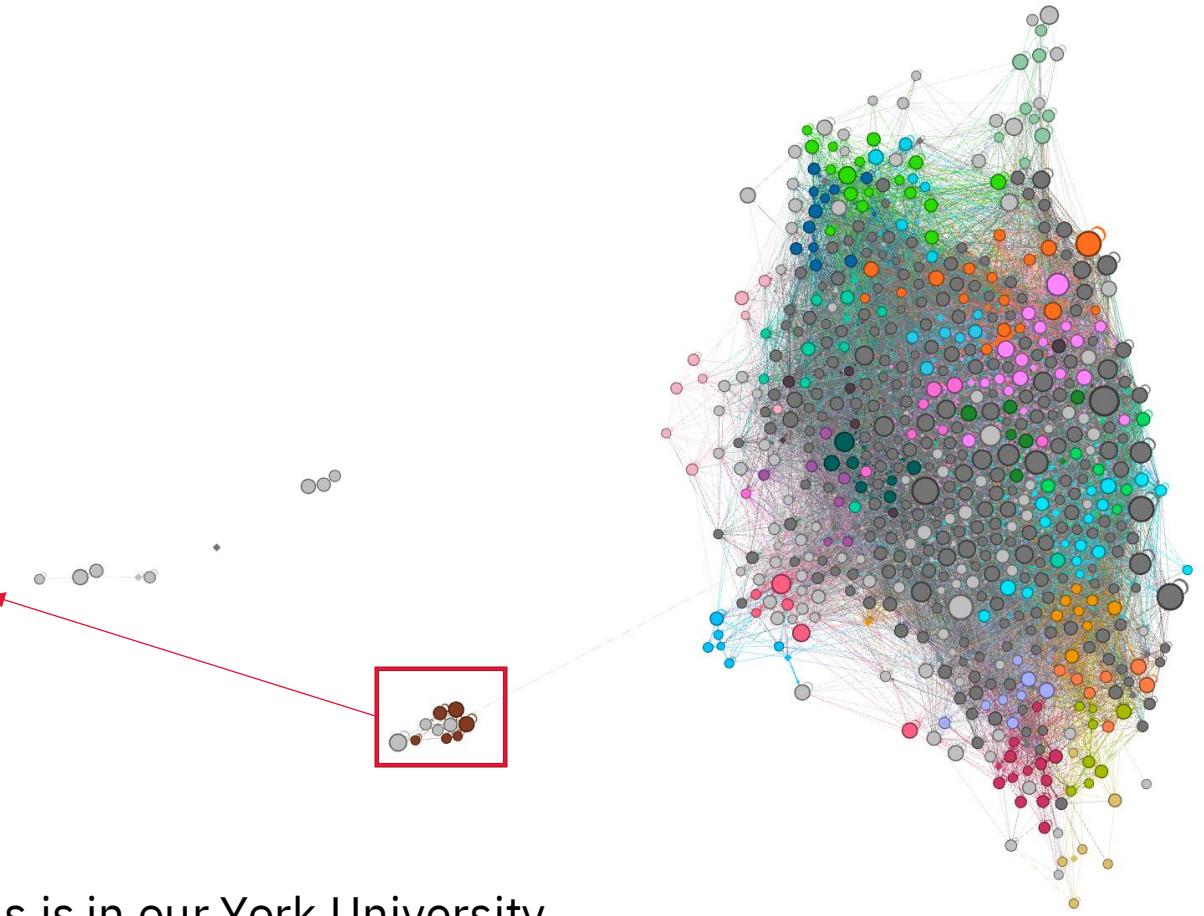
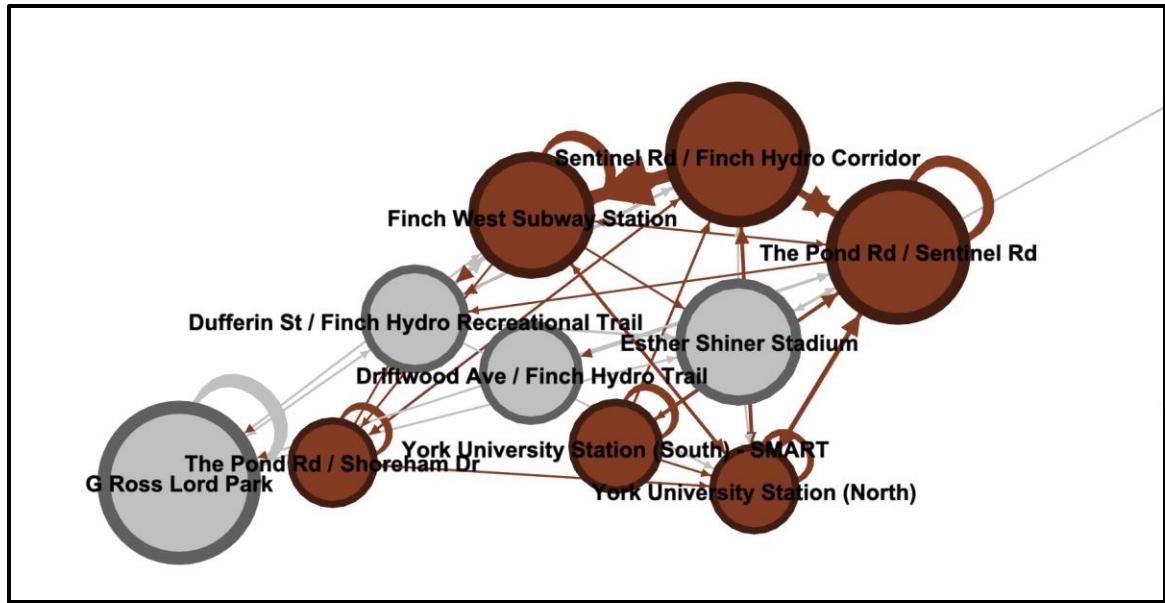


Add/remove
labels

Adjust edge
thickness

Adjust label font,
size, colour

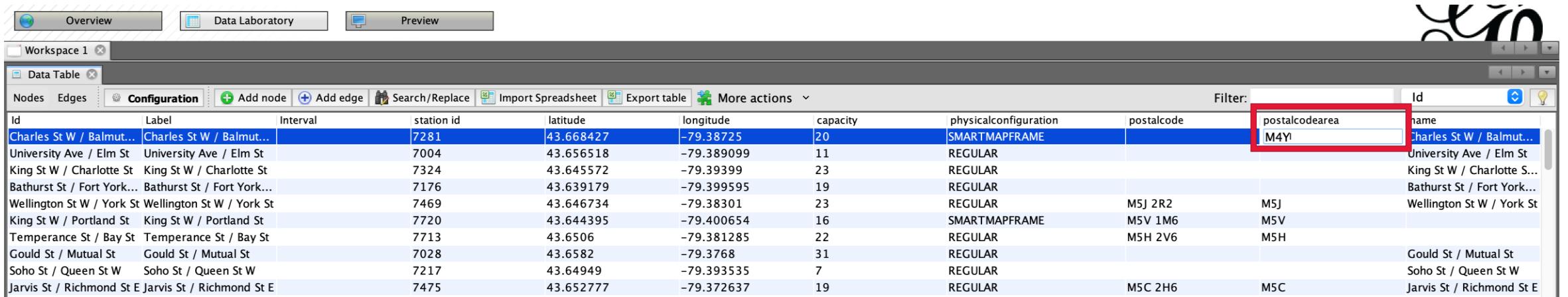
Investigating the connected stations



Now with labels, we can see that this island of stations is in our York University and surrounding area!

Adjusting the visualization

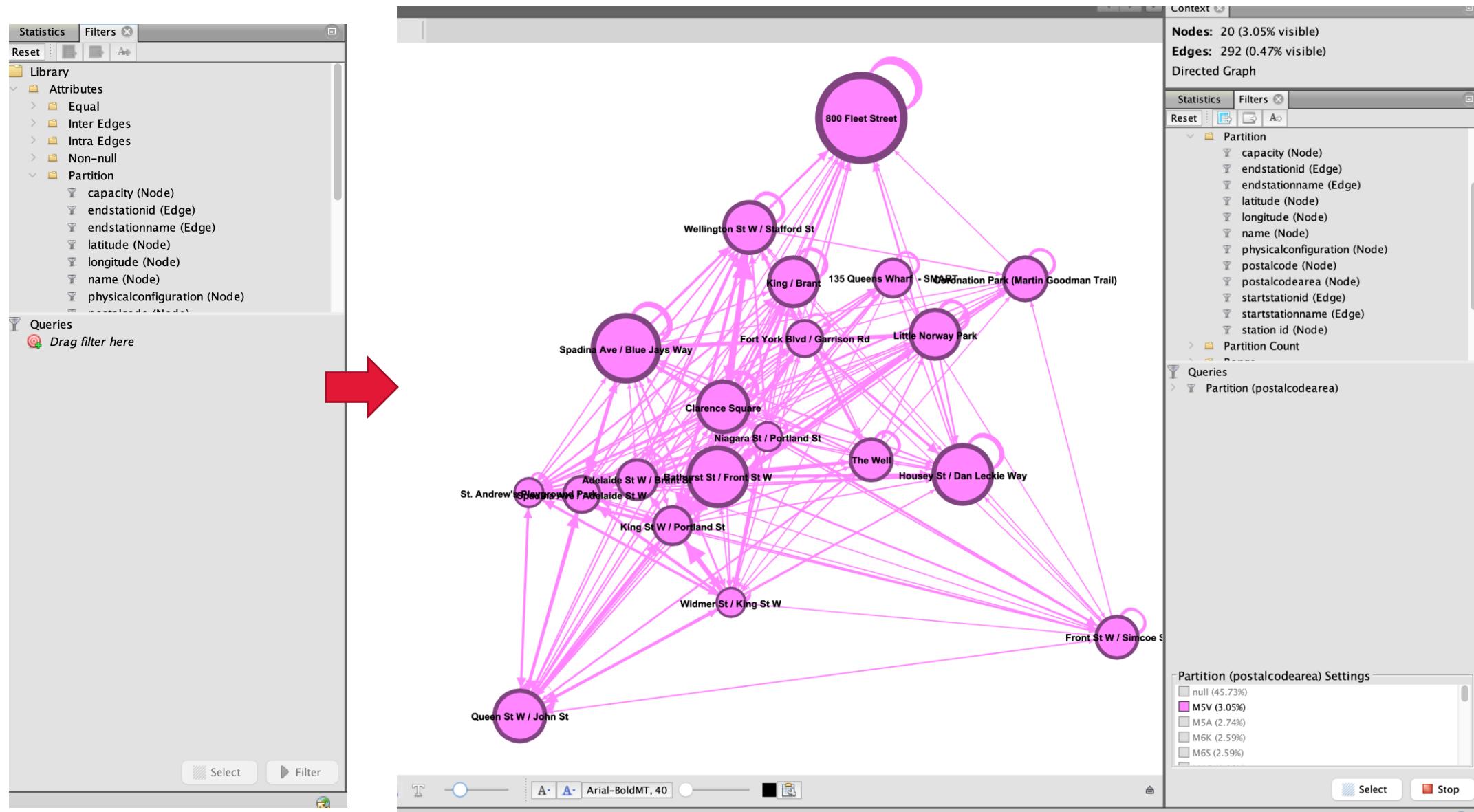
- › Maybe we don't want so many NULLs, especially for those important central stations.
- › We can manually change data in the Data Laboratory



The screenshot shows the Data Laboratory interface with a data table. The table has columns for Id, Label, Interval, station id, latitude, longitude, capacity, physicalconfiguration, postcode, and postalcodearea. The 'postalcodearea' column for the first row ('Charles St W / Balmut...') is highlighted with a red box. The data table contains 12 rows of station information.

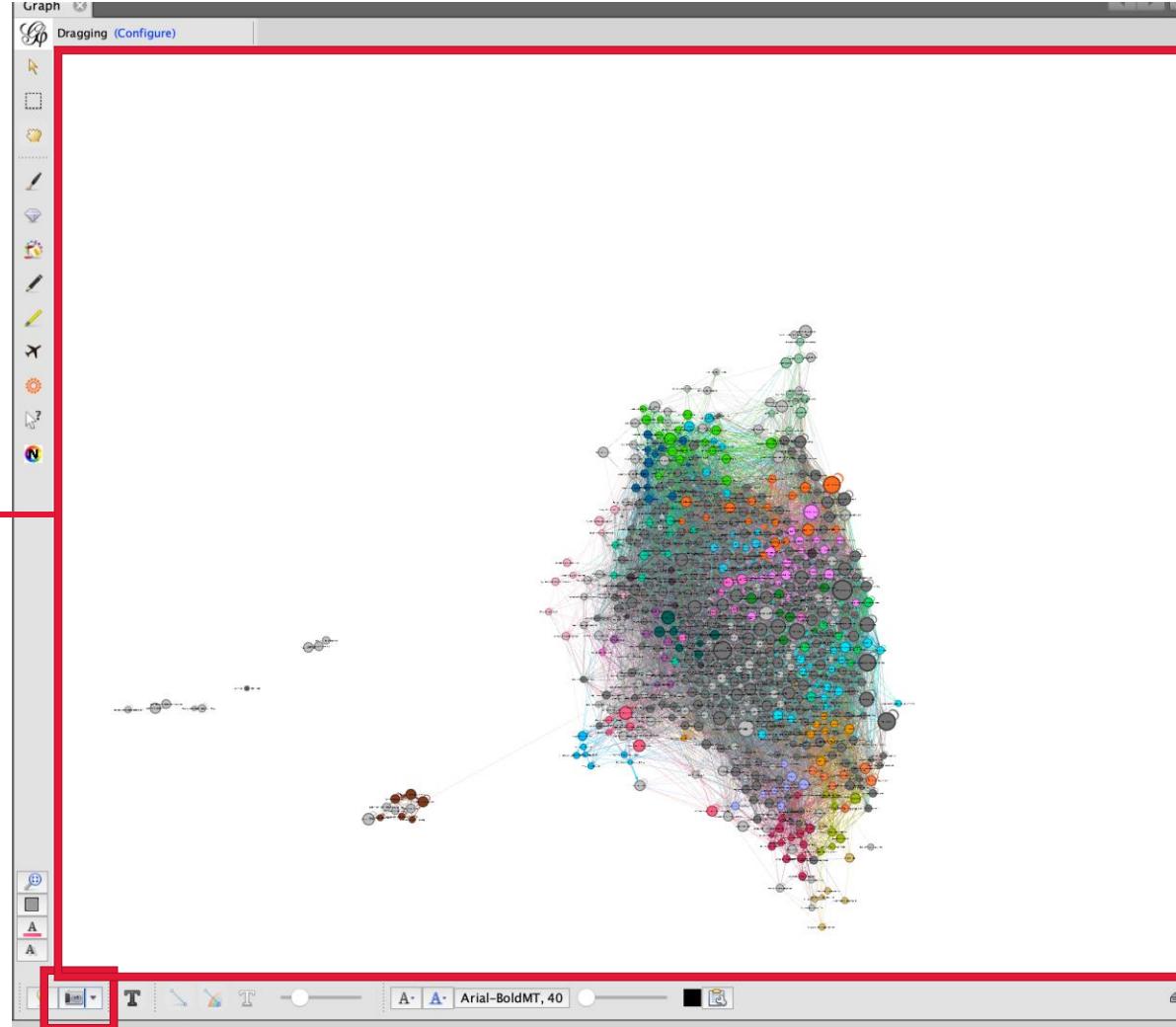
Nodes	Edges	Configuration	Add node	Add edge	Search/Replace	Import Spreadsheet	Export table	More actions	Filter:	Id	name
Charles St W / Balmut...	Charles St W / Balmut...									M4Y	Charles St W / Balmut...
University Ave / Elm St	University Ave / Elm St		7004	43.656518	-79.389099	11	REGULAR				University Ave / Elm St
King St W / Charlotte St	King St W / Charlotte St		7324	43.645572	-79.39399	23	REGULAR				King St W / Charlotte S...
Bathurst St / Fort York...	Bathurst St / Fort York...		7176	43.639179	-79.399595	19	REGULAR				Bathurst St / Fort York...
Wellington St W / York St	Wellington St W / York St		7469	43.646734	-79.38301	23	REGULAR	M5J 2R2	M5J		Wellington St W / York St
King St W / Portland St	King St W / Portland St		7720	43.644395	-79.400654	16	SMARTMAPFRAME	M5V 1M6	M5V		
Temperance St / Bay St	Temperance St / Bay St		7713	43.6506	-79.381285	22	REGULAR	M5H 2V6	M5H		
Gould St / Mutual St	Gould St / Mutual St		7028	43.6582	-79.3768	31	REGULAR				Gould St / Mutual St
Soho St / Queen St W	Soho St / Queen St W		7217	43.64949	-79.393535	7	REGULAR				Soho St / Queen St W
Jarvis St / Richmond St E	Jarvis St / Richmond St E		7475	43.652777	-79.372637	19	REGULAR	M5C 2H6	M5C		Jarvis St / Richmond St E

Using filters to reduce the visualization



Take screenshots to document the process

Note: Screenshot taken is only the visualization shown



Gephi does **NOT** have an undo button, so good documentation is important!

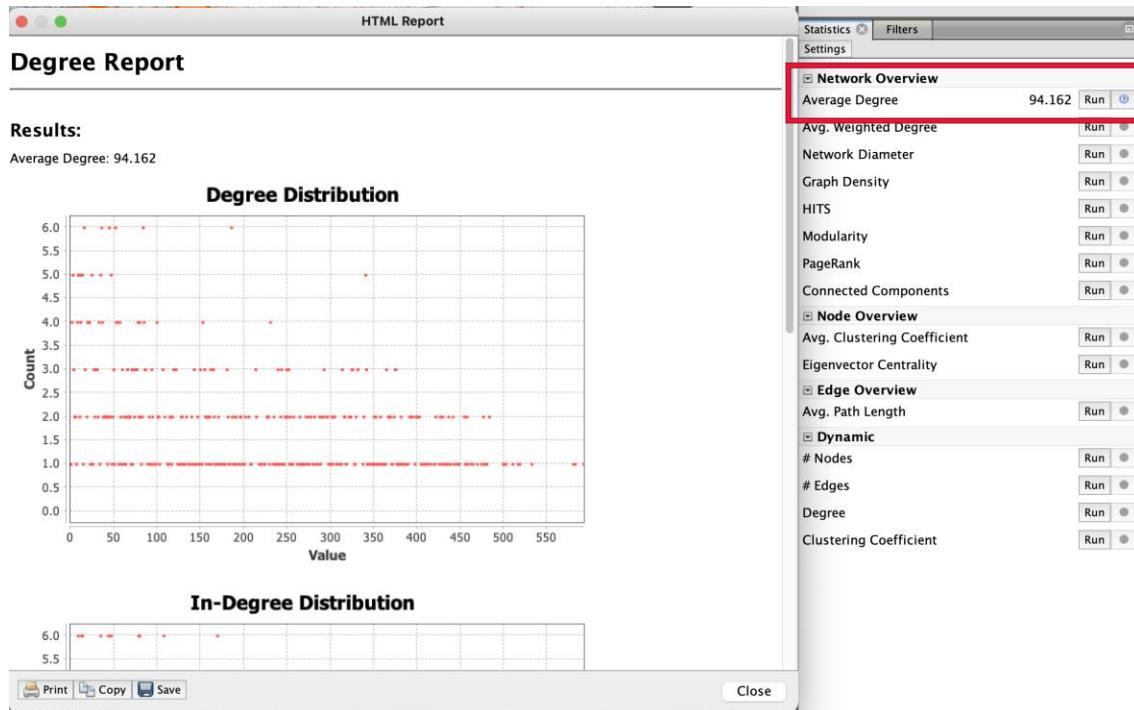
Network analysis: Calculating statistics in Gephi

The screenshot shows the 'Statistics' tab in the Gephi interface. It includes sections for 'Network Overview', 'Node Overview', 'Edge Overview', and 'Dynamic'. Each section contains several metrics with 'Run' buttons and checkboxes.

Section	Metric	Run Button	Checkbox
Network Overview	Average Degree	Run	unchecked
	Avg. Weighted Degree	Run	unchecked
	Network Diameter	Run	unchecked
	Graph Density	Run	unchecked
	HITS	Run	unchecked
	Modularity	Run	unchecked
	PageRank	Run	unchecked
	Connected Components	Run	unchecked
Node Overview	Avg. Clustering Coefficient	Run	unchecked
	Eigenvector Centrality	Run	unchecked
	Edge Overview	Avg. Path Length	Run
Dynamic		# Nodes	Run
	# Edges	Run	unchecked
	Degree	Run	unchecked
	Clustering Coefficient	Run	unchecked

- Gephi provides many statistics it can quickly calculate for your network

Network analysis: Average degree



Overview Data Laboratory Preview

Workspace 1

Data Table

Nodes Edges Configuration Add node Add edge Search/Replace Import Spreadsheet Export table More actions

Id	Label	Interval	station id	latitude	longitude	capacity	physicalconfiguration	postalcode	postalcodearea	name	Filter:		
											In-Degree	Out-Degree	Degree
Charles St W / Ba...	Charles St W / Ba...		7281	43.668427	-79.38725	20	SMARTMAPFRAME	M4Y		Charles St W / Ba...	168	207	375
University Ave / ...	University Ave / ...		7004	43.656518	-79.389099	11	REGULAR			University Ave / ...	133	141	274
King St W / Charl...	King St W / Charl...		7324	43.645572	-79.39399	23	REGULAR			King St W / Charl...	242	212	454
Bathurst St / Fort...	Bathurst St / Fort...		7176	43.639179	-79.399595	19	REGULAR			Bathurst St / Fort...	147	156	303
Wellington St W / ...	Wellington St W / ...		7469	43.646734	-79.38301	23	REGULAR	MSJ 2R2	M5J	Wellington St W / ...	142	122	264
King St W / Portl...	King St W / Portl...		7720	43.644395	-79.400654	16	SMARTMAPFRAME	M5V 1M6	M5V		229	216	445
Temperance St / ...	Temperance St / ...		7713	43.6506	-79.381285	22	REGULAR	M5H 2V6	M5H	Gould St / Mutual...	215	213	428
Gould St / Mutual...	Gould St / Mutual...		7028	43.6582	-79.3768	31	REGULAR				179	195	374

Network analysis: Centrality

Graph Distance settings

Distance
The average graph-distance between all pairs of nodes. Connected nodes have graph distance 1. The diameter is the longest graph distance between any two nodes in the network. (i.e. How far apart are the two most distant nodes).

Directed Normalize Centralities in [0,1]

Undirected

Betweenness Centrality: Measures how often a node appears on shortest paths between nodes in the network.

Closeness Centrality: The average distance from a given starting node to all other nodes in the network.

Eccentricity: The distance from a given starting node to the farthest node from it in the network.

Cancel OK

DIRECTED GRAPH

Statistics Filters Settings

Network Overview

Average Degree	94.162	Run	?
Avg. Weighted Degree	274.405	Run	?

Network Diameter (highlighted with red box)

Graph Density	Run	?
HITS	Run	?
Modularity	Run	?
PageRank	Run	?
Connected Components	Run	?

Node Overview

Avg. Clustering Coefficient	Run	?
-----------------------------	-----	---

Thank you!

- › Contact me at wongalex@yorku.ca
- › Learn more about data visualization from the data visualization research guide:
<https://researchguides.library.yorku.ca/datavisualization/>
- › Book a 1 hour consultation appointment with me at <https://yorku.libcal.com/appointments/wonga>