

社會網絡分析工具

Social Network Analysis SNA

臺大圖書館學科服務組

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學員普查

學習動機 & 先備知識



初學的痛苦/今天的磨難

1. 專有名詞
(完全沒聽過!!)
2. 各類演算法
(數學!!理解後可以解讀、畫出最適切的網絡圖與驗證)
3. 各種應用案例
(好玩的地方!!)

課程目標

- 學習社會網絡分析軟體應用
- 軟體：Gephi
- 軟體操作
- 資料處理
- 數據解讀

→ 網絡分析的視覺化高手！
不會寫程式也可以！

課程大綱

- 01 社會網絡分析實際應用
- 02 社會網絡分析基本概念
- 03 Gephi軟體入門—基本功能
- 04 Gephi軟體入門—Overview
- 05 Gephi軟體入門—Data Lab & Preview
- 06 實務操作—資料匯入
- 07 實務操作—Layout
- 08 Gephi Statistic
- 09 Gephi 篩選Filter

01 社會網絡特色與應用

The features & practical application

社會(科學)網絡分析源起

- 緣起：從圖形理論(Graph Theory)發展的量化技巧
 - 量化演算法
 - 圖形視覺化
- 其他學科怎麼看
 - 數學領域 vertex arc
 - 電腦科學 node link
 - 社會科學 actor relation

社會網絡分析特性

和傳統研究方法比較

比較	研究問題	資料蒐集	資料分析	分析項目
傳統量化分析	體重、心血管疾病	公斤、血壓	量化統計檢定	T檢定或相關係數
社會網絡分析	學術研究共著	作者、文章	社會網絡分析	重要的作者、領域分析

差異

- ① 可以將隱性知識視覺化，EX：關係、合作經驗
- ② 不受量化統計母體樣本的限制
- ③ 利用社會網絡分析演算法探究研究面向

A network of science: 150 years of Nature papers



社會網絡分析面向

- 1) 整體社會網絡的全貌 EX小世界網絡
- 2) 節點與節點彼此的連結，來定義節點屬性 EX權威性
- 3) 依據節點屬性分群其子群代表的意義 EX學術領域分析
- 4) 子群之間彼此的關係 EX交流密切與否
- 5) 子群內節點的情形分析 EX子群凝聚力，各子群內使用者特性
- 6) 子群結構的對應 EX使用者相關推薦

社會網絡分析應用

金曲獎最佳男女歌手提名人創作角色分析

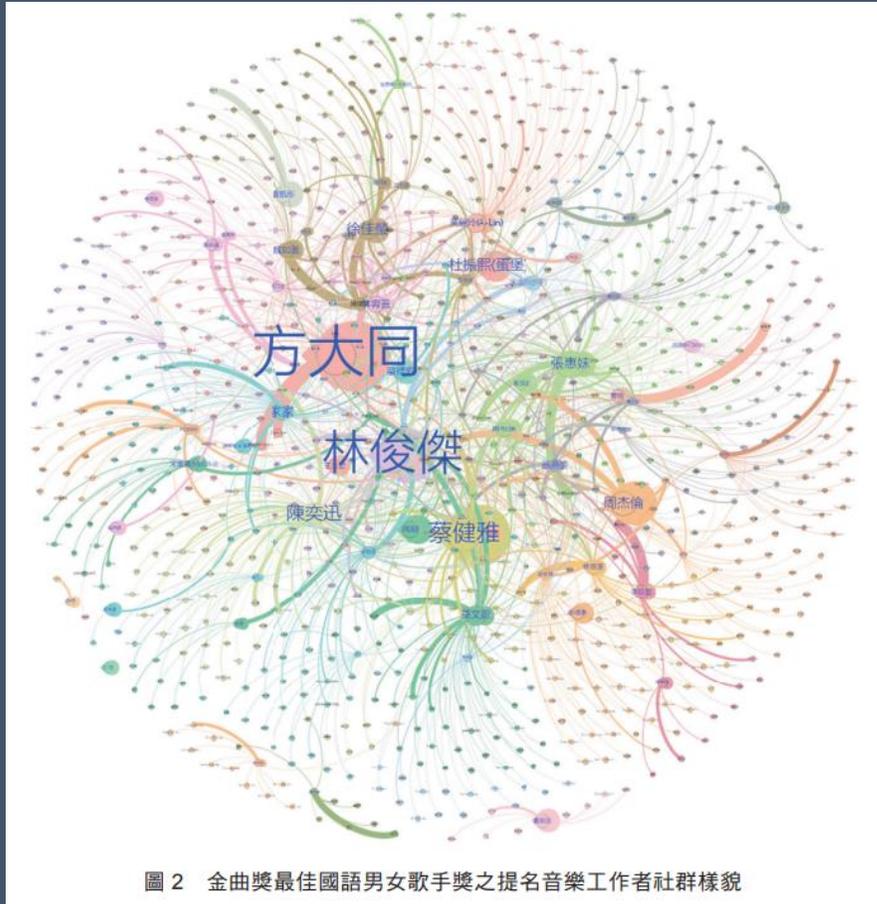


圖 2 金曲獎最佳國語男女歌手獎之提名音樂工作者社群樣貌

范蔚敏、唐牧群 (2019)

金曲獎最佳男女歌手提名人創作角色分析

關係形式：歌—創作人

1. 社群網絡具有相當規模，且社群成員連結程度高，但是有別於小世界網絡現象，整體網絡平均群聚係數數值相對較低，顯示音樂工作者彼此之間合作對象多元，且並未偏好與特定音樂創作人合作之情形。

2. 每位音樂工作者合作程度進行分群，顯示整體網絡有明顯分群，且各分群社群網絡凝聚程度較高。

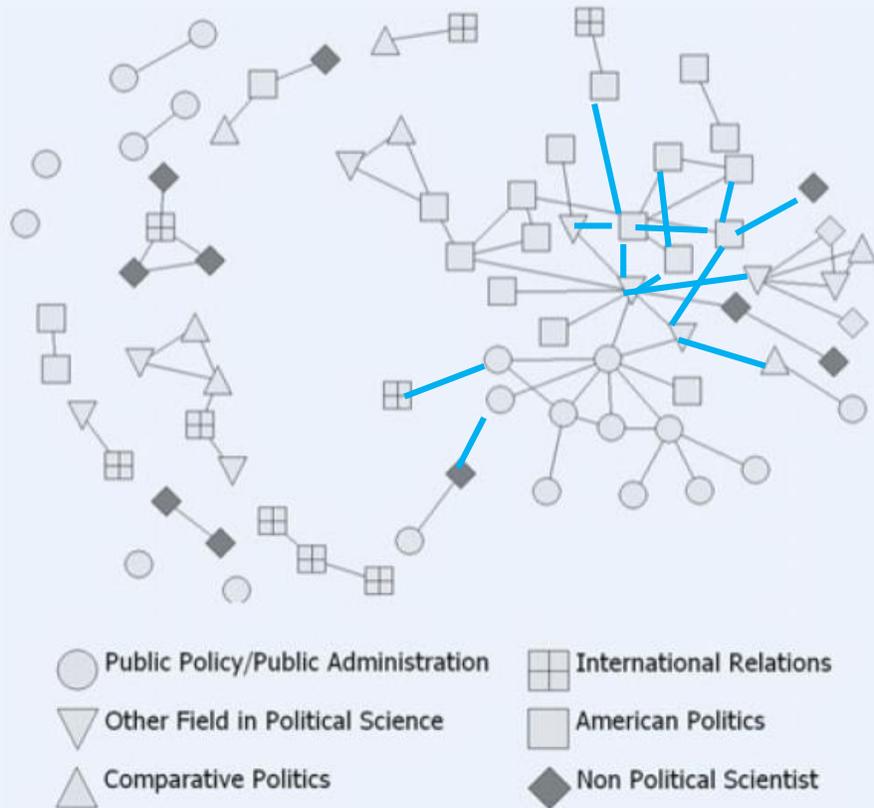
范蔚敏、唐牧群 (2019)。第18屆到第29屆臺灣金曲獎最佳國語男女歌手提名人創作角色分析。數位典藏與數位人文, (3), 43-62。
doi:10.6853/DADH.201904_3.0003

社會網絡分析應用

學術研究者合作情形

Figure 1a

Network of Written Collaboration before 2008 Conference



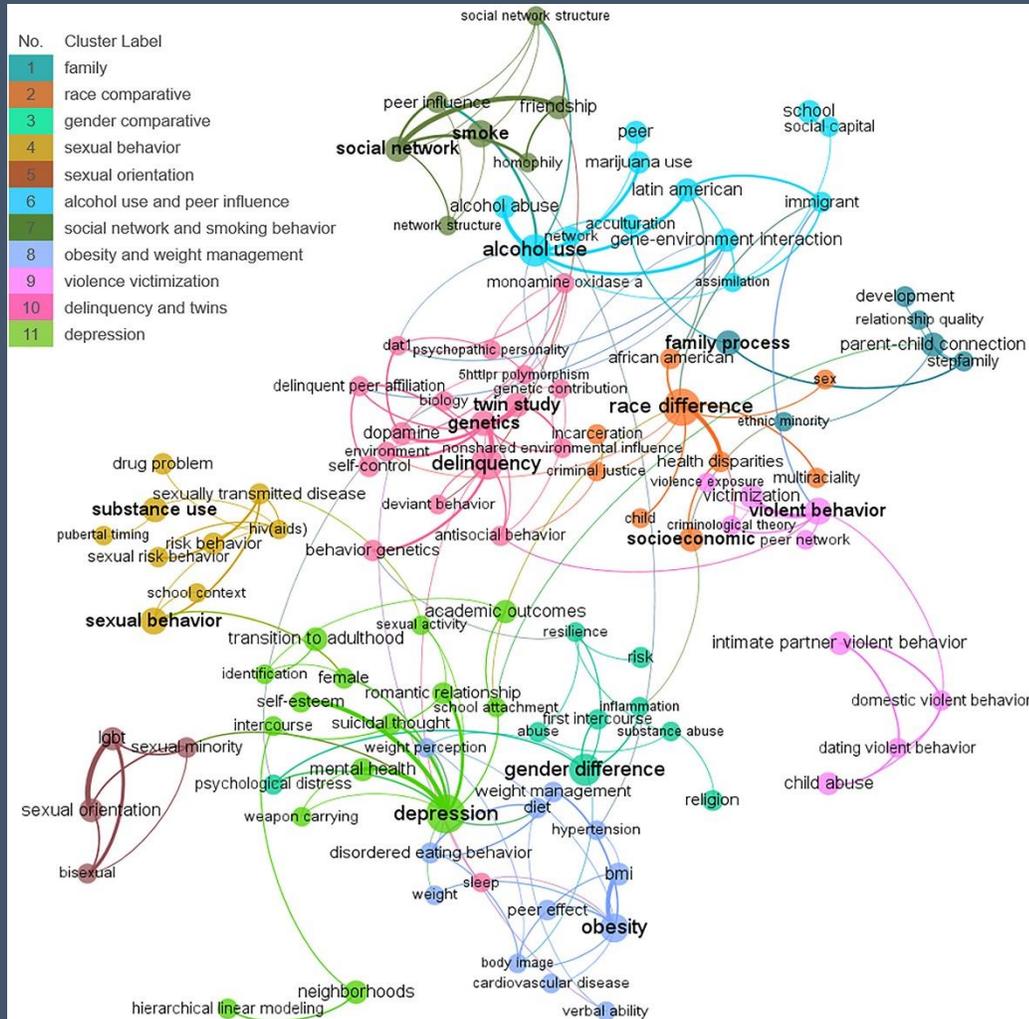
政治科學領域學者參與研討會對於新社群成員協作的模式影響

1. 資料形式：期刊文獻、問卷調查
2. 研究問題：研討會
 - 研究者共同協作論文
 - 促進研究者彼此交流專業意見？
 - 有更多跨領域學者進入政治學領域？

Berardo, R. (2011). Networking Networkers: An Initial Exploration of the Patterns of Collaboration among the Members of a New Community in Political Science. *PS: Political Science & Politics*, 44(1), 69-75. doi:10.1017/S1049096510001885

社會網絡分析應用 領域分析主題共現字

Fan, W.-M., Jeng, W., & Tang, M.-C. (2023). Using data citation to define a knowledge domain: A case study of the Add-Health dataset. *Journal of the Association for Information Science and Technology*, 74(1), 81-98. doi:<https://doi.org/10.1002/asi.24688>



以引用美國國家青少年成人長期研究資料 (the National Longitudinal Study of Adolescent to Adult Health, Add-Health) 的期刊論文為研究範圍，利用作者所下的關鍵字分析引用資料的期刊文獻主題的發展

社會網絡分析應用

環境與兒童肥胖關係

Knapp, E. A., Bilal, U., Burke, B. T., Dougherty, G. B., & Glass, T. A. (2018). A network approach to understanding obesogenic environments for children in Pennsylvania. *Connections*, 38(1), 1-11. doi:doi:10.21307/connections-2018-001

A network approach to understanding obesogenic environments for children in Pennsylvania

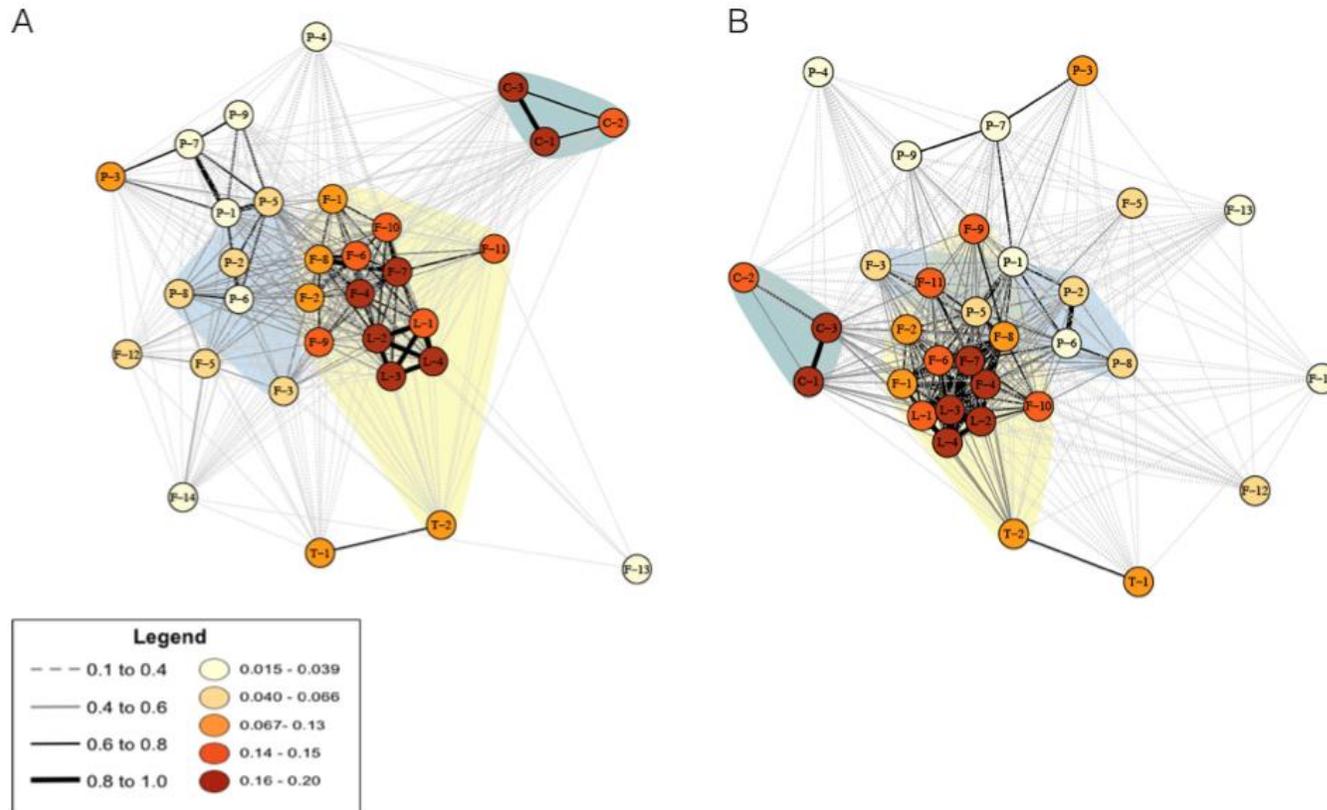
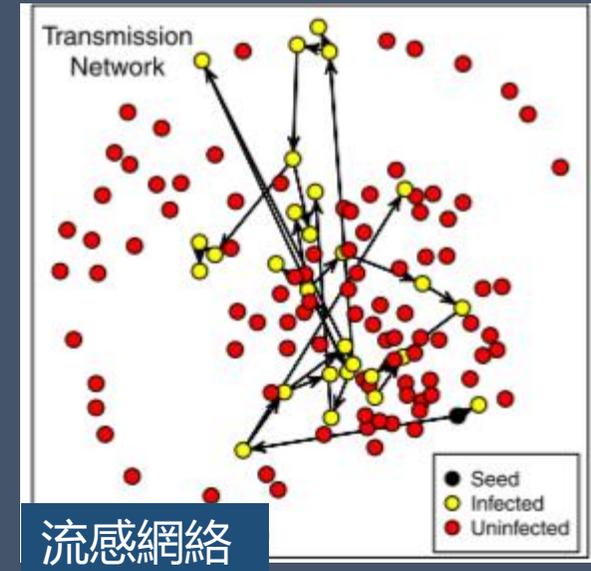
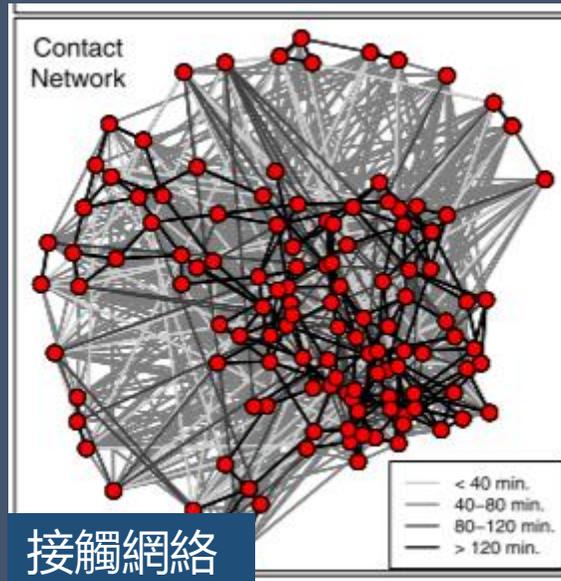
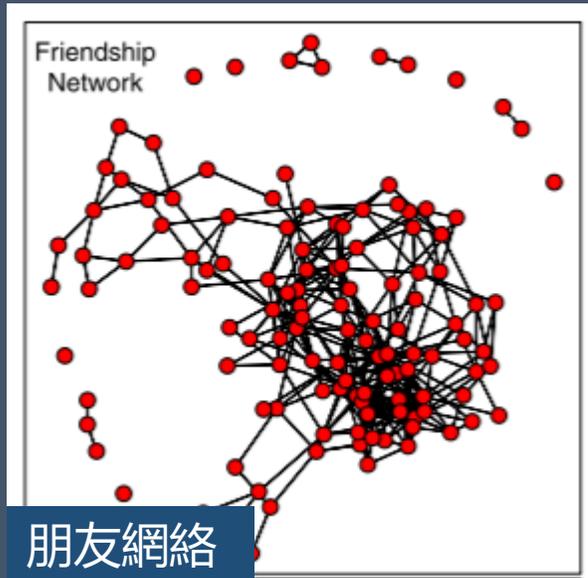


Figure 2: **Network Graphs for 1288 Communities in Pennsylvania, by Quartile of Percent of Children at or Above the 85th Percentile of BMIz.** In communities in the lowest quartile of percent of children who are overweight or obese (A: left), community features appear to be less tightly clustered, i.e., co-occur less often, than in communities in the highest quartile of community BMIz (B: right).

社會網絡分析應用

校園內流感傳染途徑

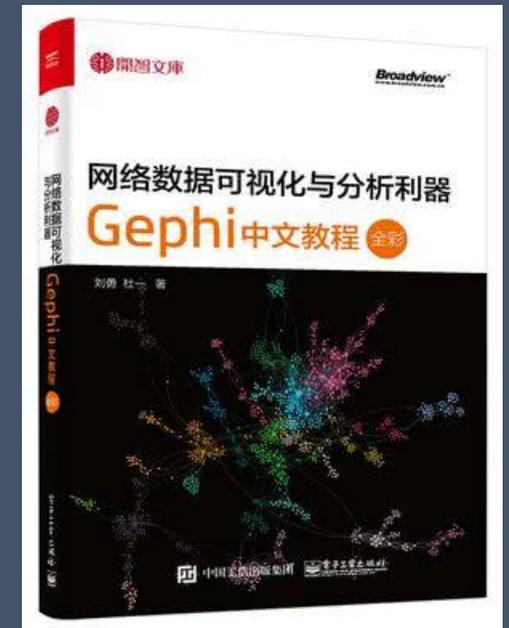
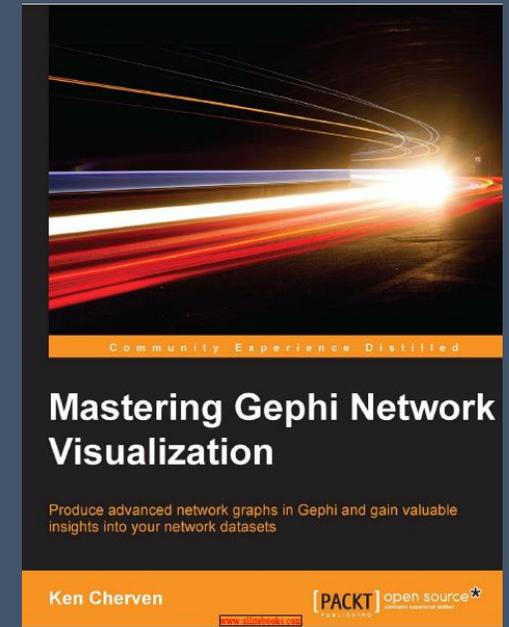
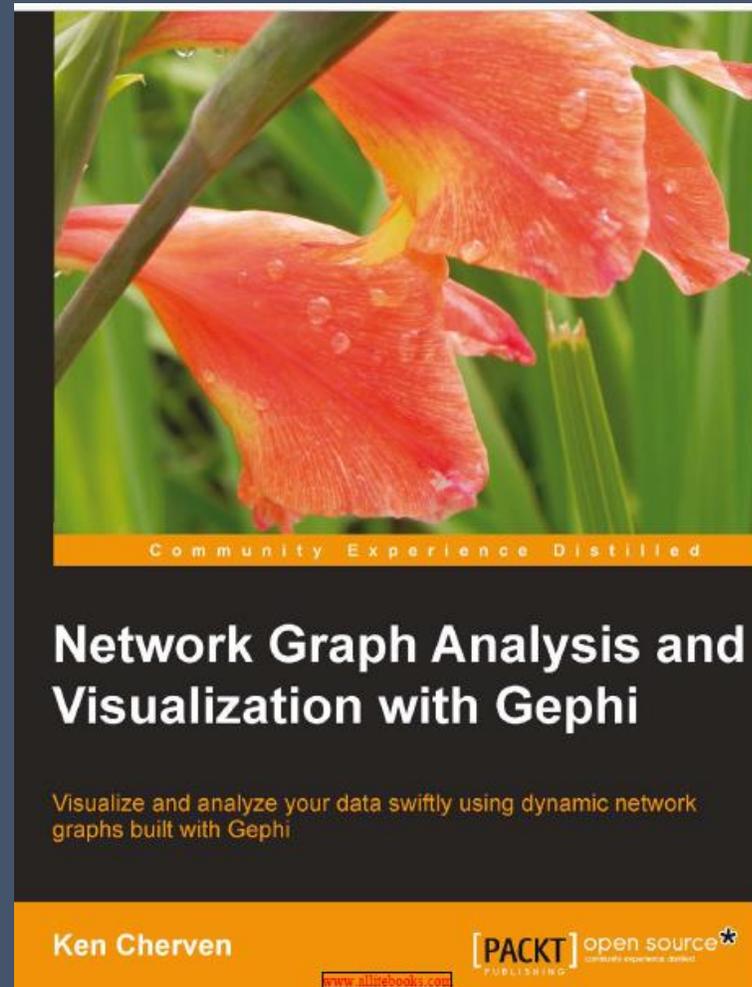
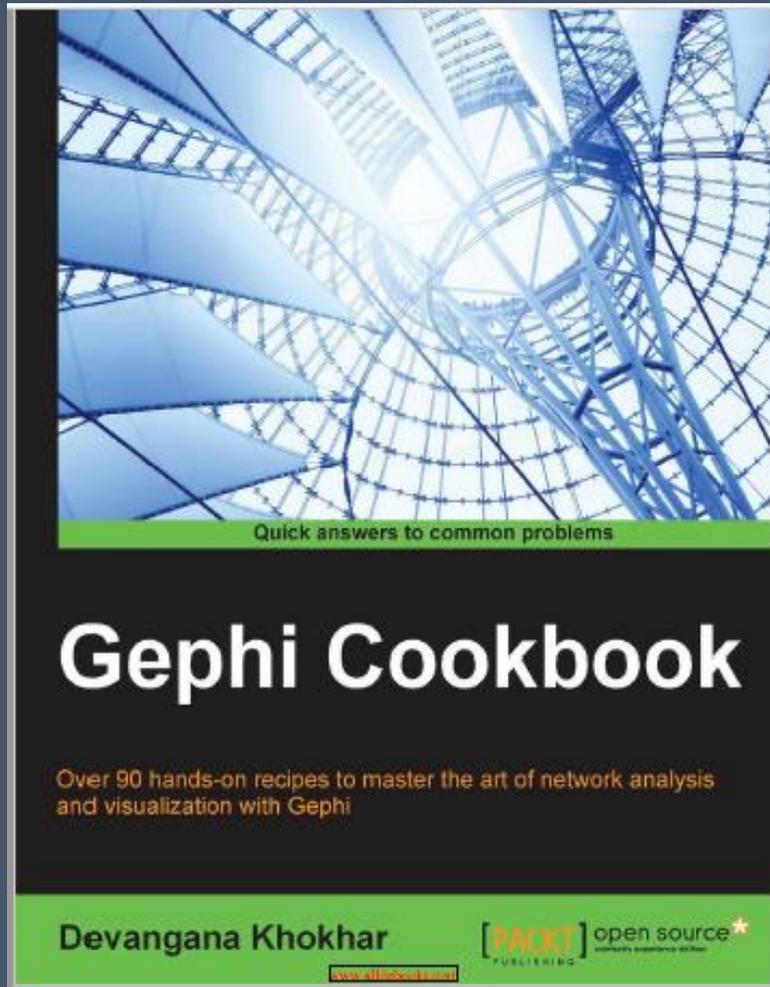


Potter, G. E., Handcock, M. S., Longini, I. M., & Halloran, M. E. (2012). Estimating within-school contact networks to understand influenza transmission. *The Annals of Applied Statistics*, 6(1), 1-26, 26. Retrieved from <https://doi.org/10.1214/11-AOAS505>

社會網絡分析工具介紹

項目	Ucinet	Gephi
作業系統	Windows	任何支持Java. 6 和OpenGL 的系統
支援演算法擴展	否	是
支持矩陣	是	是
網路規模	中型	大型
原始程式碼開放情況	不開放	開放
付費類型	商業60天試用	免費
基本功能	社會網路資料和其他1-mode及2-mode數據分析, 可做矩陣代數和多元統計分析等	圖像資料探索性分析、關聯式資料分析、社交網路分析、生物網路分析等
比較	Network File=>Gephi edge Attribute File=>Gephi node 不支援中文資料 統計功能較多元	Node table Edge table 可處理中文資料 使用介面友善, 視覺化功能佳

社會網絡工具書 Gephi



02 社會網絡基本觀念

Basic concept of SNA

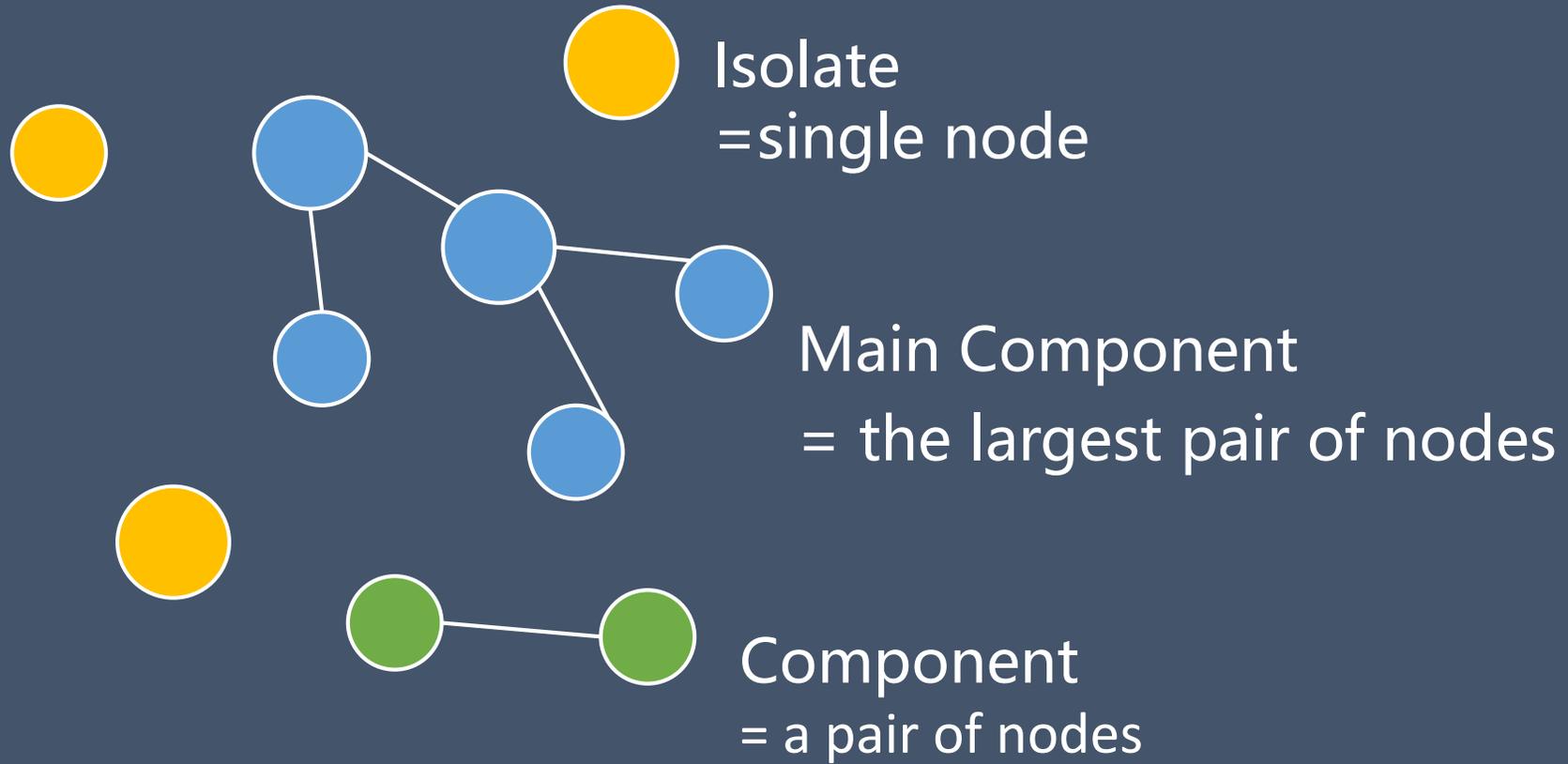
基本觀念

網絡

= 節點 + 連結 = node + edge



概念解釋

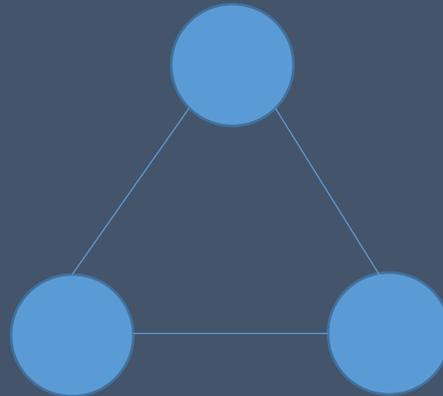


名詞解釋

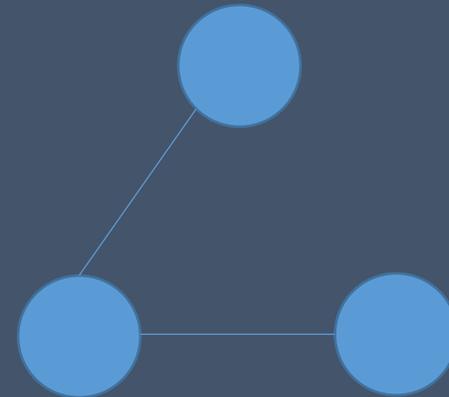
Dyad/ Pair



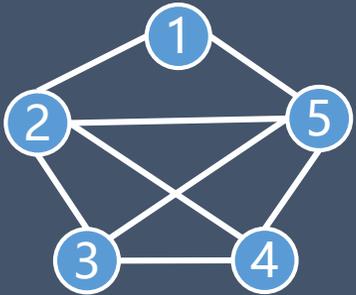
Closure Triad



Triplet



名詞解釋



名詞	定義	例子	EX
walk	節點與連結皆可無限計算	金錢流向	(1-2-5-3-5)
path	節點與連結僅能計算一次	病毒感染	(1-2-3-4)
trial	每一條連結進能計算一次 (節點可重複計算)	八卦訊息	(1-2-3-5-2)
geodesics distance	任兩節點之間最短的path	包裹快遞	(1-2-4)

名詞解釋

- Direction



- Value/weight



概念解釋—圖像基本定義

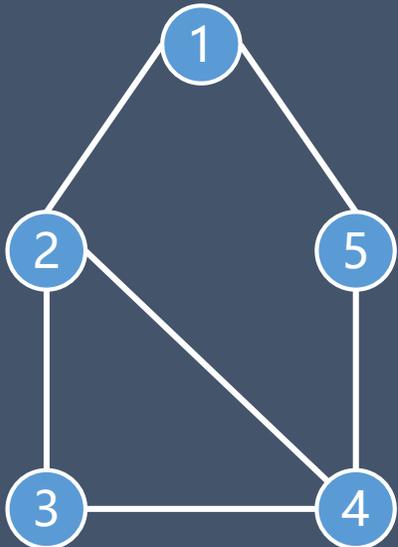
- Graph G $\left\{ \begin{array}{l} \text{a finite set of nodes, } N \text{ (each node is unique)} \\ \text{a finite set of edges, } E \text{ (each edge is unique)} \end{array} \right.$
- Each edge is a pair (n_1, n_2) where $n_1, n_2 \in N$

概念解釋—無向圖(undirected)

$$N = \{ 1, 2, 3, 4, 5 \}$$

$$E = \{ (1,2), (2,3), (2,4), (3,4), (4,5), (5,1) \\ (2,1), (3,2), (4,2), (4,3), (5,4), (1,5) \}$$

All edges are two-way. Edges are unordered pairs.



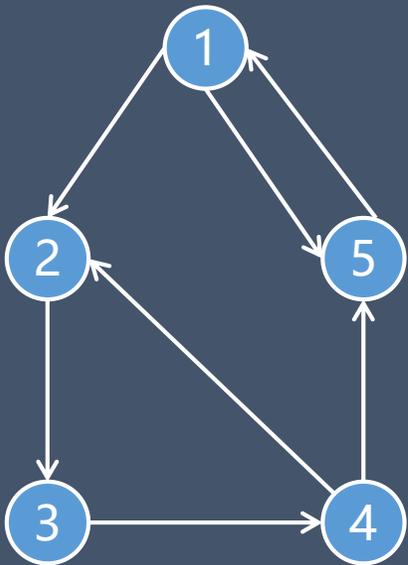
Target Source	1	2	3	4	5
1	0	1	0	0	1
2	1	0	1	1	0
3	0	1	0	1	0
4	0	1	1	0	1
5	1	0	0	1	0

概念解釋—有向圖(directed)

$$N = \{ 1, 2, 3, 4, 5 \}$$

$$E = \{ (1, 2), (1, 5), (2, 3), (3, 4), (4, 2), (4, 5), (5, 1) \}$$

All edges are one-way as indicated by the arrows.
Edges are ordered pairs.



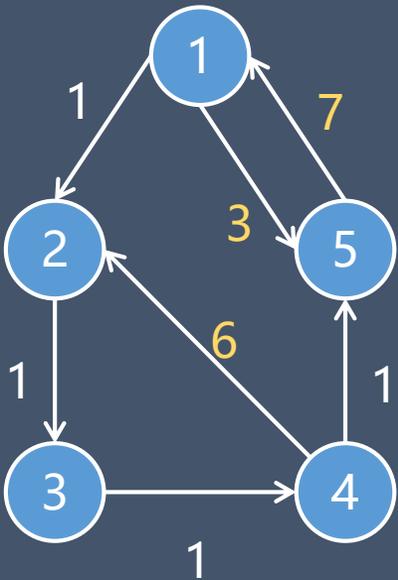
Target Source	1	2	3	4	5
1	0	1	0	0	1
2	0	0	1	0	0
3	0	0	0	1	0
4	0	1	0	0	1
5	1	0	0	0	0

概念解釋—有向圖+權重

$N = \{1, 2, 3, 4, 5\}$

$E = \{(1, 2), (1, 5), (2, 3), (3, 4), (4, 2), (4, 5), (5, 1)\}$

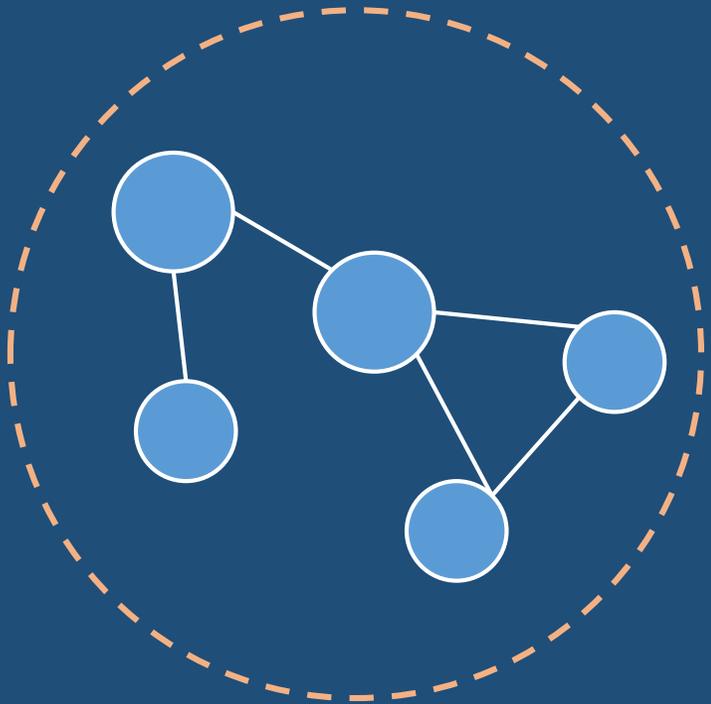
All edges are one-way as indicated by the arrows.
Edges are ordered pairs.



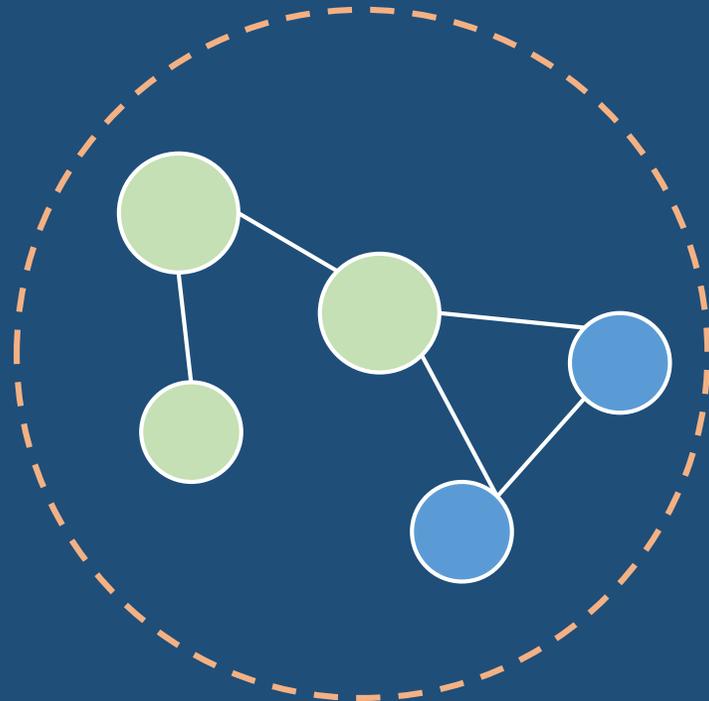
Target \ Source	1	2	3	4	5
1	0	1	0	0	3
2	0	0	1	0	0
3	0	0	0	1	0
4	0	6	0	0	1
5	7	0	0	0	0

概念解釋

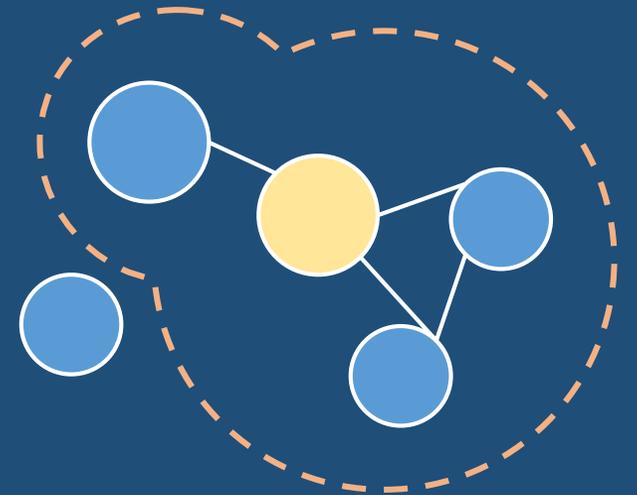
Social Network
One Mode



Social Network
Two Mode

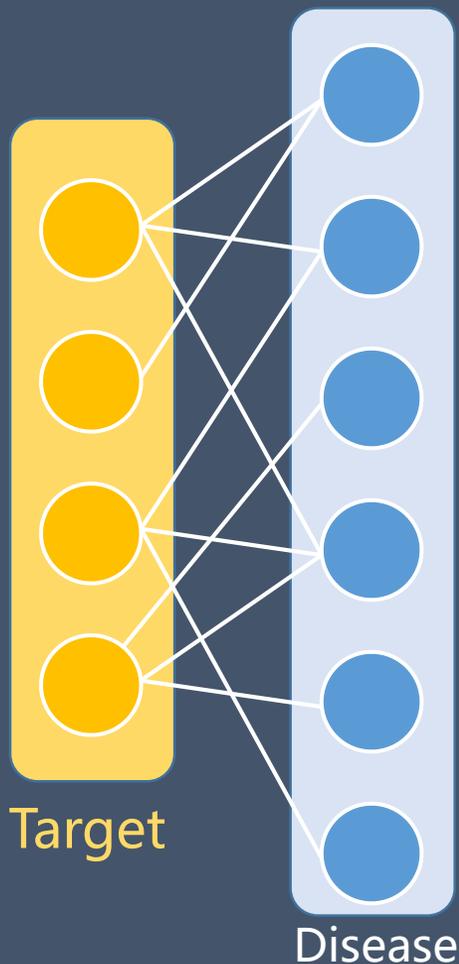


Ego-Centered Network
EgoNet



概念解釋

Bipartite Network
2-mode network



1-partite Network
1-mode network



Multimodal Network

Continuing
reconstructing



概念解釋—計算圖像可能的連結數

Q: For a set N with n elements,
how many possible edges there?

A:

For undirected graphs, the number of pairs in N :
 $= n \cdot (n - 1) / 2$

For directed graphs, the number of ordered pairs in N :
 $= n^2 - n = n \cdot (n - 1)$

Gephi軟體安裝(連結)

安裝外掛程式 種類: Layout、Import、Clustering、Metrics

Updates Available Plugins (57) Downloaded Installed (64) Settings

Check for Newest Search:

Install	Name	Category	Source
<input type="checkbox"/>	Position Ranking	Appeara...	👤👤
<input checked="" type="checkbox"/>	Newman-Girvan Clustering	Clustering	👤👤
<input checked="" type="checkbox"/>	Leiden Algorithm	Clustering	👤👤
<input type="checkbox"/>	Column Calculator	Data Lab...	👤👤
<input type="checkbox"/>	Publish your network to the ...	Export	👤👤
<input type="checkbox"/>	OpenSeadragon Export	Export	👤👤
<input type="checkbox"/>	SigmaExporter	Export	👤👤
<input type="checkbox"/>	PolinodeExporter	Export	👤👤
<input type="checkbox"/>	JSON Exporter	Export	👤👤
<input type="checkbox"/>	Loxa Web Site Export	Export	👤👤
<input type="checkbox"/>	ExportToEarth	Export	👤👤
<input type="checkbox"/>	FilterFromFile	Filter	👤👤
<input type="checkbox"/>	Link Prediction	Filter	👤👤
<input type="checkbox"/>	KBrace Filter	Filter	👤👤
<input type="checkbox"/>	HttpGraph	Generator	👤👤
<input type="checkbox"/>	Erdős-Rényi Generator	Generator	👤👤
<input type="checkbox"/>	Kleinberg Generator	Generator	👤👤

Convert Excel and csv files to networks

Community Contributed Plugin

Version: 1.4.4
Author: Clement Levallois (@seinecle)
Date: 1/9/23
Source: Gephi Thirdparties Plugins
Homepage: <http://www.clementlevallois.net>

Plugin Description

Convert Excel and csv files to networks (including dynamic!)

This plugin helps you import Excel files and csv files into Gephi, by transforming them into networks. It takes the rows of your file and let you define which relations should be found in it.

Install 18 plugins selected, 16MB

Close Help

更新 可用的外掛程式 (27) 已下載 已安裝 (87) 設定

選擇	名稱	種類	活動
<input type="checkbox"/>	Desktop Project	Gephi UI	✓
<input type="checkbox"/>	Desktop Timeline	Gephi UI	✓
<input type="checkbox"/>	Desktop Progress	Gephi UI	✓
<input type="checkbox"/>	Desktop Export	Gephi UI	✓
<input type="checkbox"/>	Desktop Tools	Gephi UI	✓
<input type="checkbox"/>	Settings Upgrader	Gephi UI	✓
<input checked="" type="checkbox"/>	Graphviz Layout	Layout	✓
<input checked="" type="checkbox"/>	Polygon Shaped Nodes	Layout	✓
<input checked="" type="checkbox"/>	EventGraphLayout	Layout	✓
<input checked="" type="checkbox"/>	Circle Pack	Layout	✓
<input checked="" type="checkbox"/>	Map Of Countries	Layout	✓
<input checked="" type="checkbox"/>	MdsLayout	Layout	✓
<input checked="" type="checkbox"/>	Circular Layout	Layout	✓
<input checked="" type="checkbox"/>	Isometric Layout	Layout	✓
<input checked="" type="checkbox"/>	GeoLayout	Layout	✓
<input checked="" type="checkbox"/>	MultiGravity ForceAtlas 2	Layout	✓
<input checked="" type="checkbox"/>	Network Splitter 3D	Layout	✓
<input checked="" type="checkbox"/>	scale layout plugin	Layout	✓
<input type="checkbox"/>	Batik Wrapper	Libraries	✓
<input type="checkbox"/>	DBDrivers	Libraries	✓
<input type="checkbox"/>	Gleem	Libraries	✓

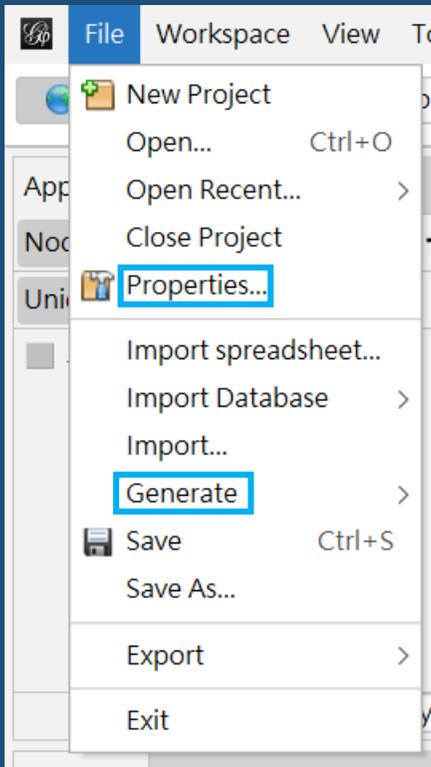
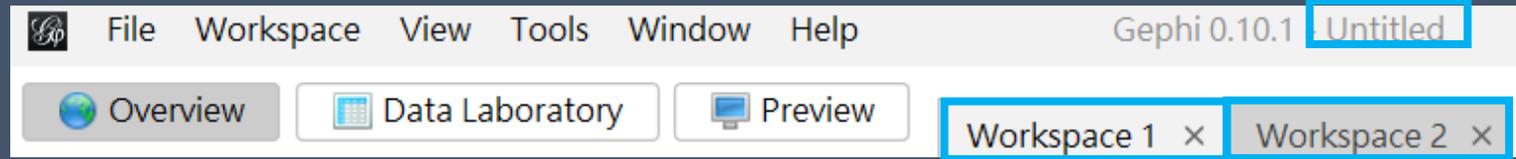
啟用(A) 取消啟用(D) 解除安裝(N) 已選取的外掛程式 1

03 Gephi軟體入門

基本功能列

開啟新專案

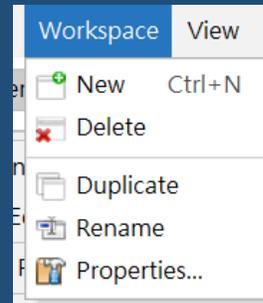
- Project 專案 (每次只能開一個)
 - > Workspace 空白頁(可同時開啟多個)



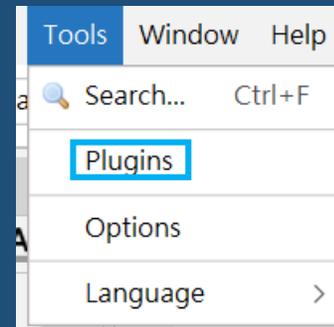
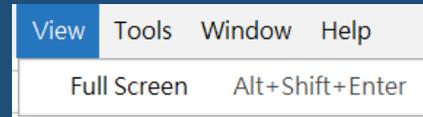
資料匯入
資料匯出
另存新檔

專案資料紀錄
專案名、作者名
關鍵字、描述

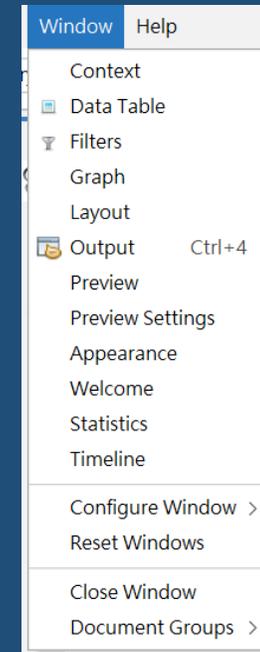
可以產生範例檔案
隨機靜態、多途靜態
動態資料



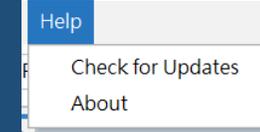
新增空白頁
刪除空白頁
空白頁重新命名



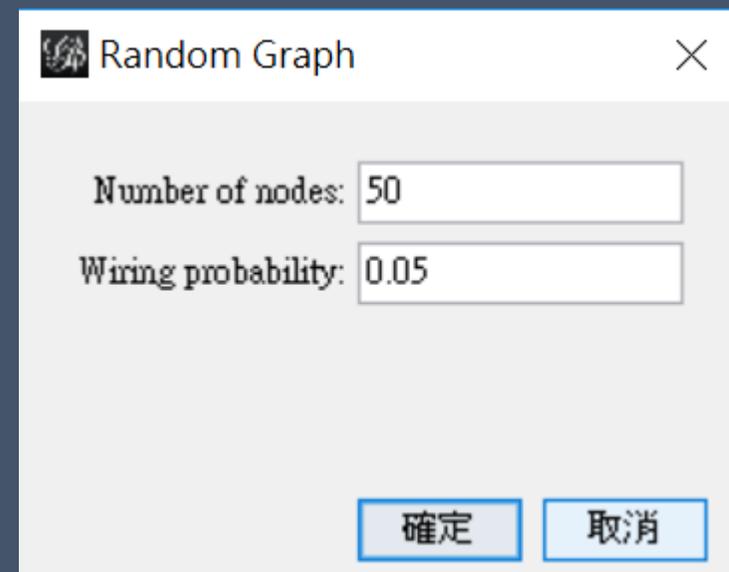
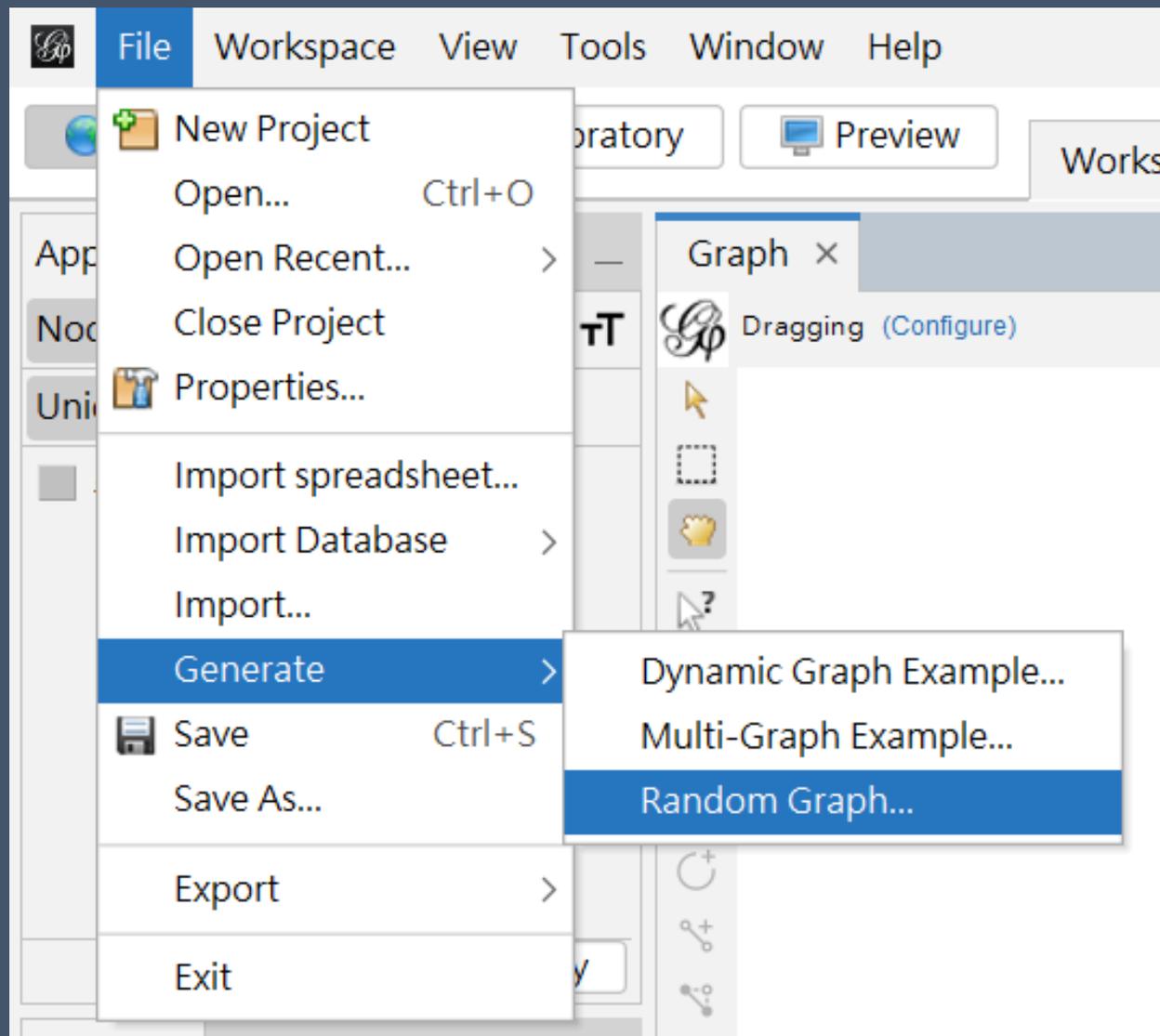
搜尋
外掛程式
進階設定
語言



選用需要的視窗



軟體更新
軟體基本訊息



Gephi軟體入門

04 Overview

4.1 Appearance 圖像外觀處理

Appearance x 圖像外觀處理

Nodes Edges

Unique Partition Ranking

#c0c0c0

Apply

Layout x 圖像呈現佈局

---Choose a layout

Run

<No Properties>

Presets... Reset

Graph x 圖像呈現視窗

Dragging (Configure)

Filters Statistics x

Settings

- Network Overview
- Community Detection
- Node Overview
- Edge Overview
- Dynamic

網絡圖基本資訊

Context x

Nodes: 0

Edges: 0

Directed Graph

篩選條件

Filters x Statistics

Reset

Library

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

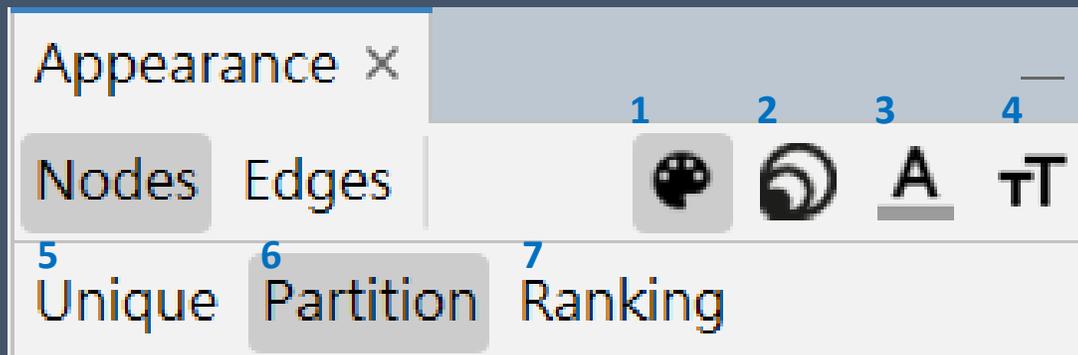
網絡統計

Queries

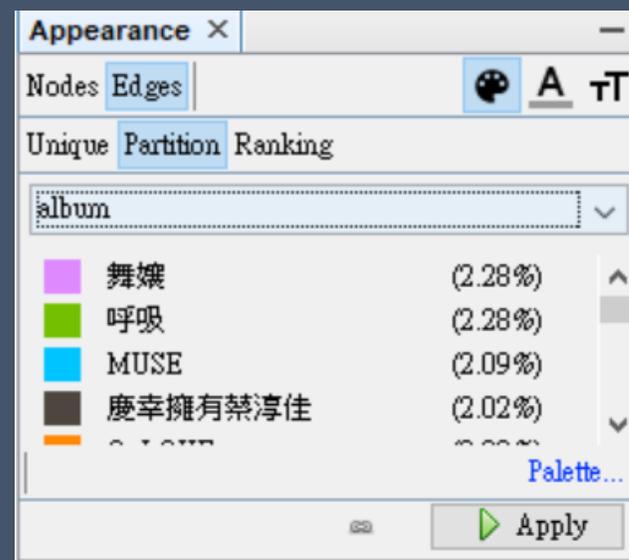
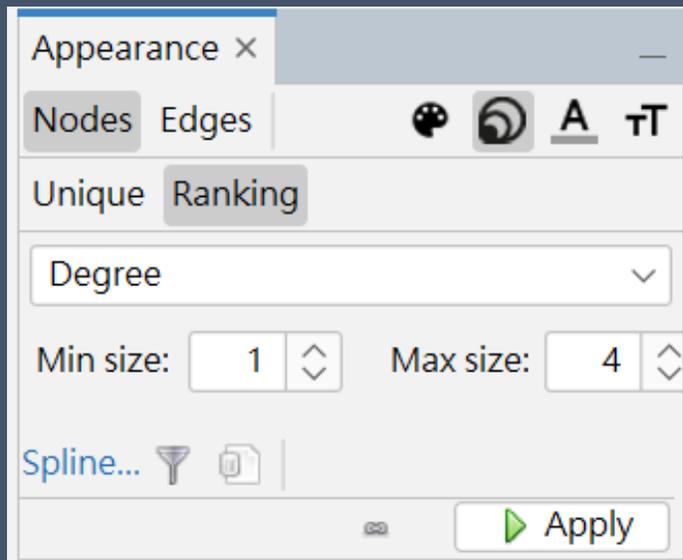
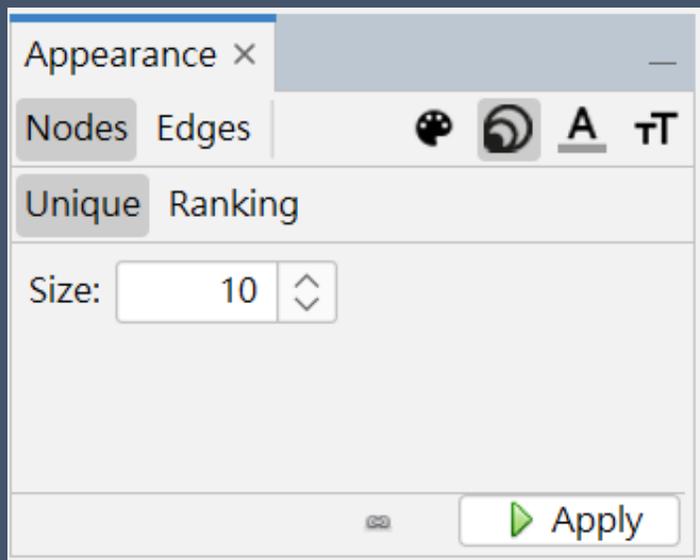
Drag filter here

Select Filter

圖像外觀處理(節點/連結)



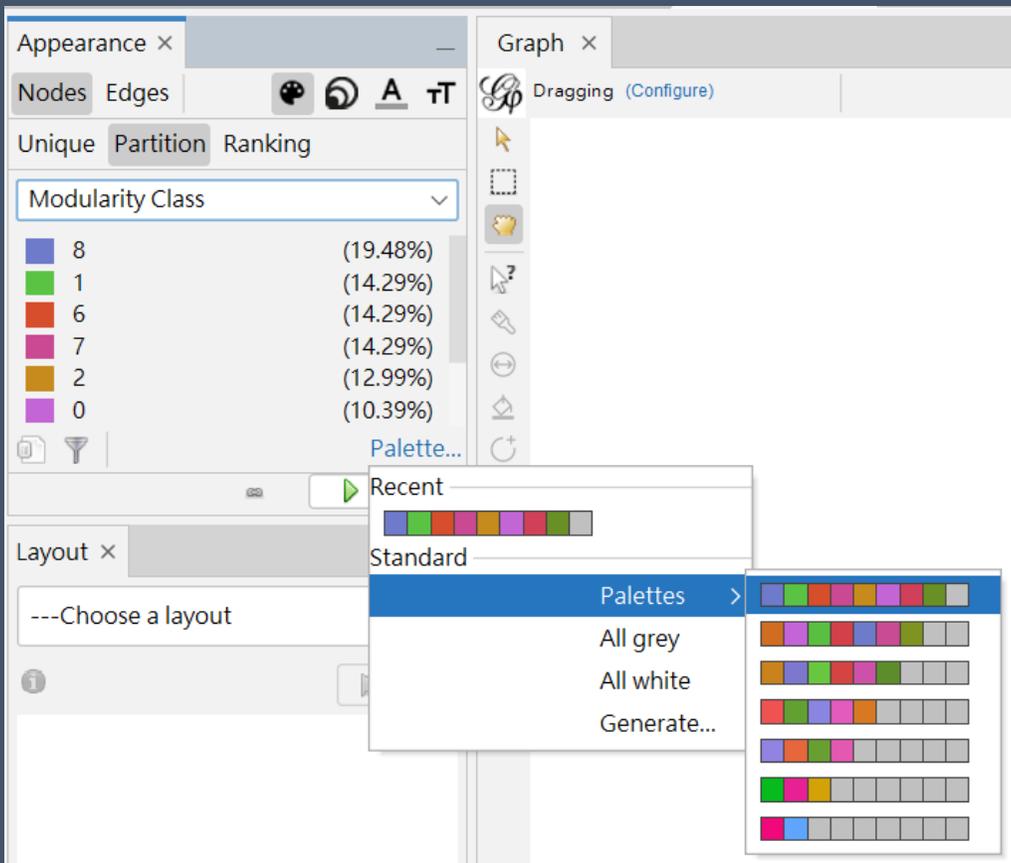
1. 節點顏色
2. 節點大小
3. 節點字體顏色
4. 節點字體大小
5. Unique 每一節點的進行相同動作處理
6. Partition 依據屬性類別進行標示
7. Ranking 依據屬性級距進行標示



圖像外觀處理(節點/連結)

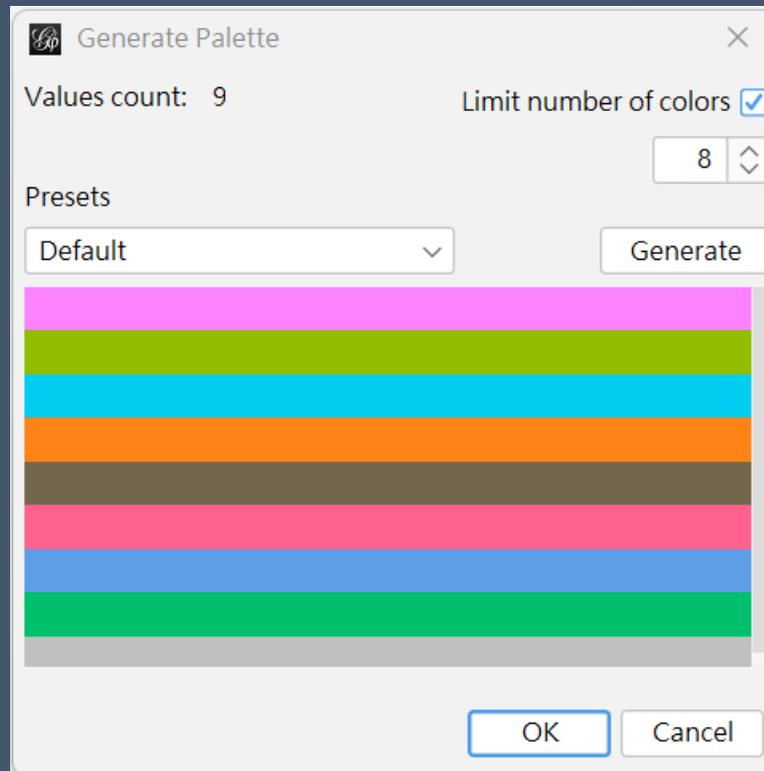
想要換節點顏色

Palette... > Palettes



節點顏色重新產生, 上限20色

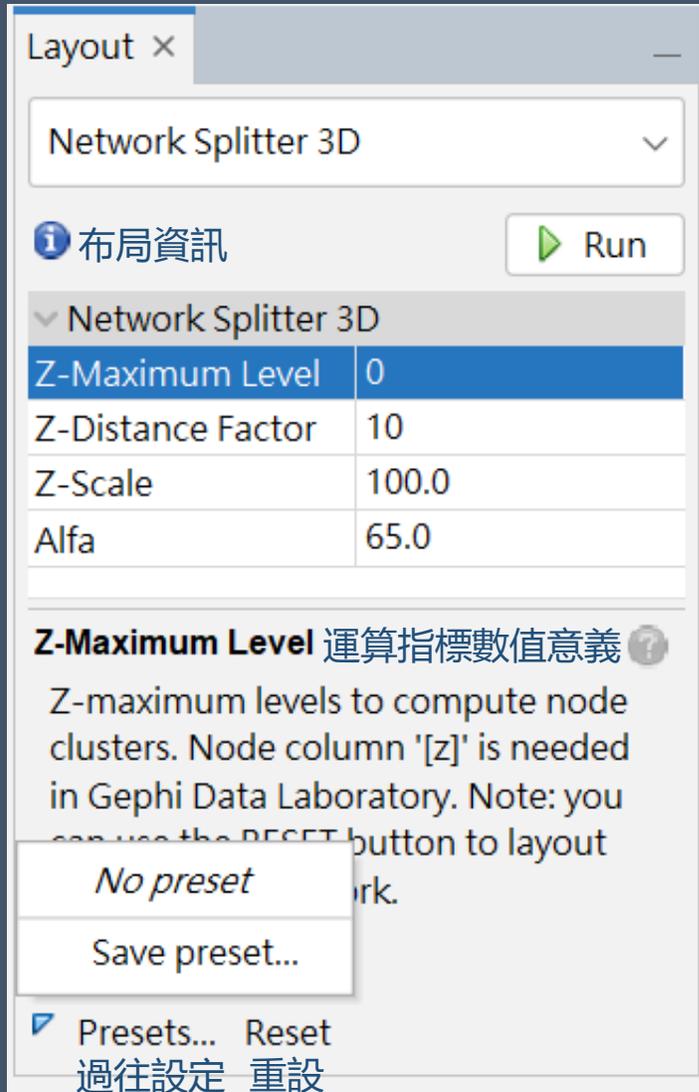
Palette... > Generate...



Gephi軟體入門

4.2 Overview Layout 圖像呈現佈局

基本圖像佈局 Basic Layout



Layout 名稱

作用

Contraction

縮小

Expansion

放大

Rotate

90度選轉

Random Layout

隨機分布

Noverlap

節點不重疊

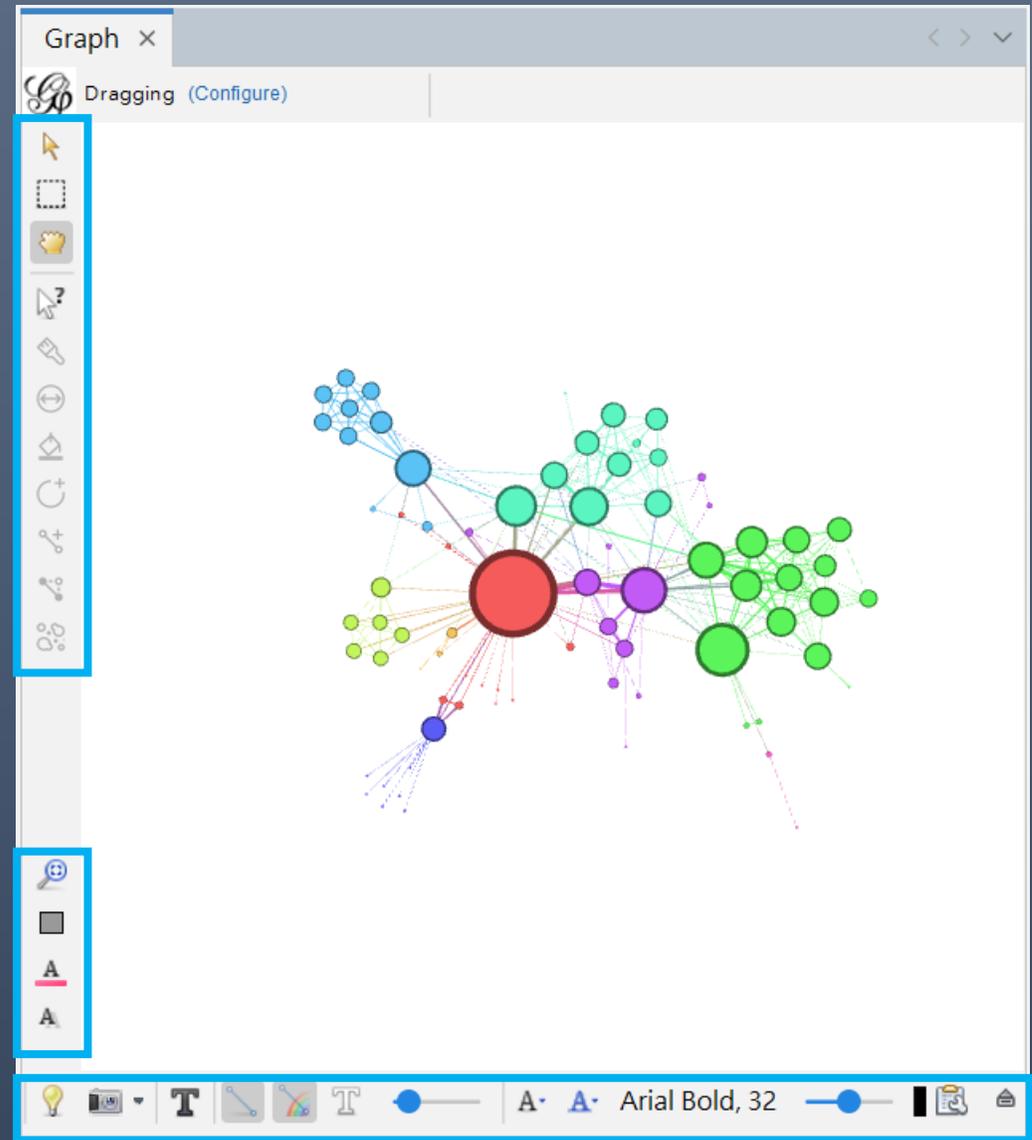
Noverlap	
speed	3.0
ratio	10.0
margin	50.0

速度

節點不重疊比率，數值↑圖像↑
邊緣

Gephi軟體入門

4.3 Overview Graph



選擇節點以及與其相鄰的點



移動節點



用滑鼠左鍵拖曳要移動的節點



節點訊息

Properties 在Overview的節點資訊

Attributes 在Data Laboratory的節點資訊

靜態資料

Static data for node 'Valjean' in the Overview window. The Properties section includes Size (100.0), Position (x, y, z), Color, Label Size, Label Color, and Label Visible. The Attributes section includes Id, Label, Interval, and Modularity Class.

Valjean - Properties	
Size	100.0
Position (x)	-87.930305
Position (y)	17.04457
Position (z)	0.0
Color	[122,1,119]
Label Size	1.0
Label Color	null
Label Visible	<input checked="" type="checkbox"/>

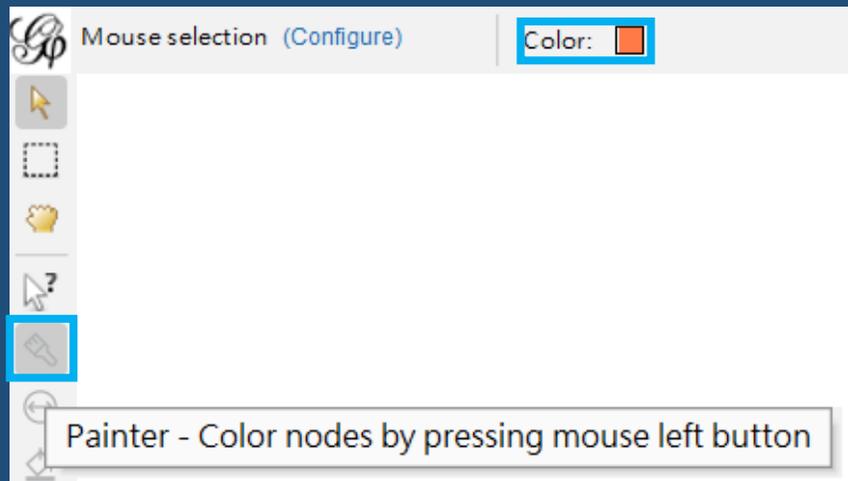
Valjean - Attributes	
Id	11
Label	Valjean
Interval	<尋找空值>
Modularity Class	1

動態資料

Dynamic data for node '張美香(作詞)' in the Data Laboratory window. The Properties section includes Size, Position (x, y, z), Color, Label Size, Label Color, and Label Visible. The Attributes section includes Id, Label, and Timestamp.

張美香(作詞) - Properties	
Size	10.0
Position (x)	-191.93254
Position (y)	454.74103
Position (z)	0.0
Color	[0,0,0]
Label Size	1.0
Label Color	null
Label Visible	<input checked="" type="checkbox"/>

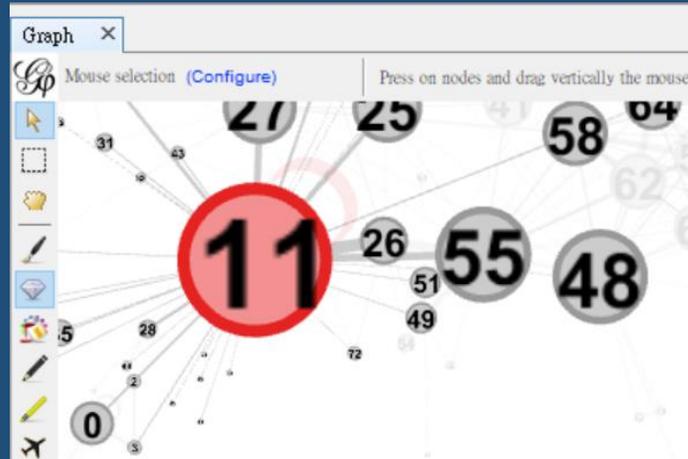
張美香(作詞) - Attributes	
Id	張美香(作詞)
Label	張美香(作詞)
Timestamp	<[21.0]>



選擇右上角顏色框，可以按左鍵將結點填滿顏色



特定節點放大或縮小
用滑鼠左鍵按住節點
滑鼠向上，節點放大，
滑鼠向下，節點縮小



針對某一節點及其鄰近節點進行著色

Graph x 擴散方式

Mouse selection (Configure) Color: ■ Intensity: 30 % Diffusion: Neighbors

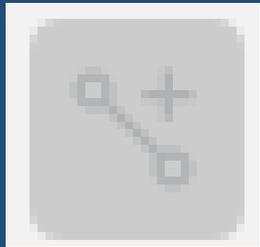
顏色 強度 無 鄰居 鄰居的鄰居 前驅節點 後繼節點

None
Neighbors
Neighbors of Neighbors
Predecessors
Successors

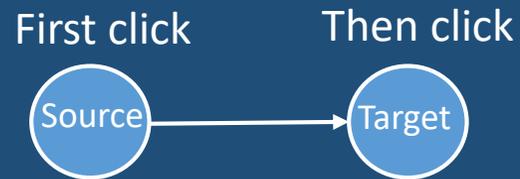
擴散強度



節點鉛筆
可增加節點
one click one node



連結鉛筆
可增加連結
If edge is directed, click from Source to Target



Type: Color: Weight:

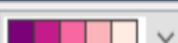


顯示兩節點之間最短距離

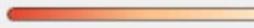


以單一節點為中心，依照距離塗上不同色

色組顏色可以反置：近/深色→遠/淺色、近/淺色→遠/深色

Max distance is 31 Mode: Palette Palette:  Invert Palette

Palette調色盤 五色組(不可調色)

Graph x Mouse selection (Configure) Max distance is 31 Mode: Gradient Gradient:  Don't paint unreachable

Gradient梯度 漸層色(可調色)

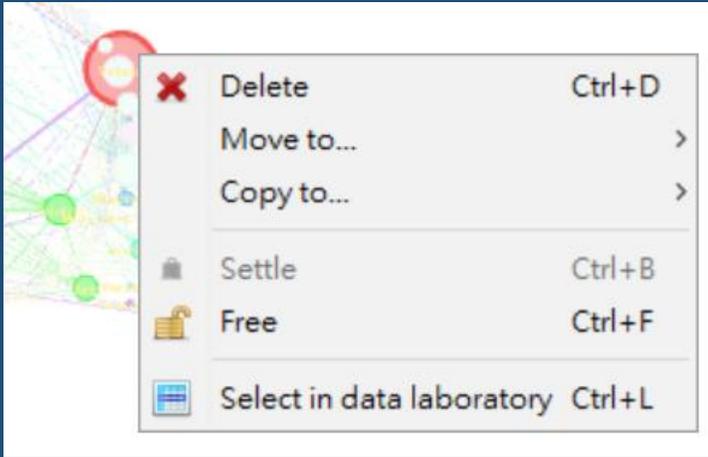
Choose a Color

Hue: 13 Sat: 66 Bti: 92 Red: 235 Green: 113 Blue: 79 Hex: EE714F

Cancel OK

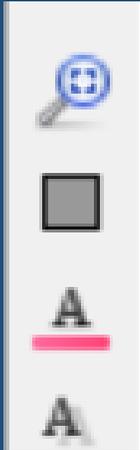
中心節點無法觸及到的節點不加以著色

針對節點按右鍵還可以...



刪除
移動到> 新分頁或其他分頁
複製到> 新分頁或其他分頁
鎖住(在轉換layout時節點不會移動)
解除
在資料實驗室中選取

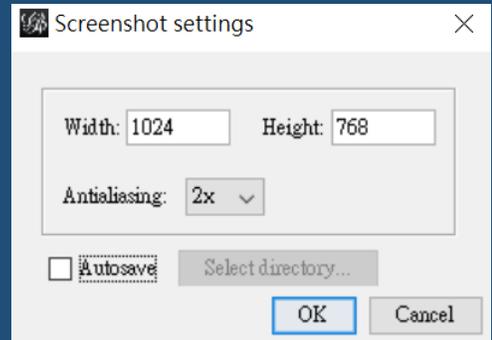
Id	Label
11	Valjean
48	Gavroche
55	Marius
27	Javert
25	Thenardier
23	Fantine
58	Enjolras
62	Courfeyrac
64	Bossuet
63	Bahorel
65	Joly
24	Mme Thenardier
26	Cosette
41	Eponine



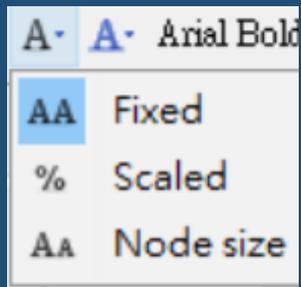
圖像復位
全部節點顏色復位(顏色可選)
節點標籤顏色復位
節點標籤大小復位



按右鍵可選取顏色

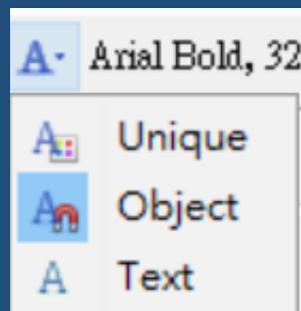


節點標籤
字體大小



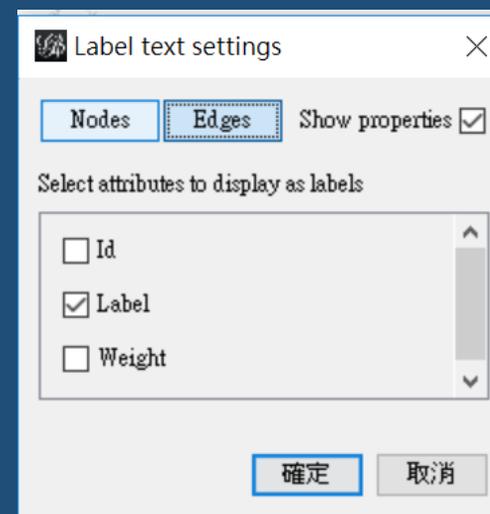
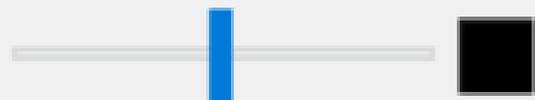
固定大小
依據比例放大
依據節點尺寸縮放

節點標籤
字體顏色



顏色統一顏色
與來源節點相同色

Arial Bold, 32





更多選項

Global Edges Labels

Background color:

Autoselect neighbor
自動選取鄰居

Zoom
放大或縮小

Highlight selection
強調所選

Global Edges Labels

Show
標示不同方向連結顏色

Edge default color:

Scale

Use node color

Selection color

In: Both:

Out:

Global Edges Labels

編輯連結標籤的字體、大小、顏色

Node

Font: Color:

Size:

Edge

Font: Color:

Size:

Size:

Color:

隱藏未選取節點
Hide non-selected

Gephi軟體入門

Overview 4.4 Statistic

網絡概覽

Network Overview	
Average Degree	Run
Avg. Weighted Degree	Run
Network Diameter	Run
Graph Density	Run
HITS	Run
Clustering Coefficient	Run
PageRank	Run
Connected Components	Run
Girvan-Newman Clustering	Run
Leiden algorithm	Run

節點概覽

Node Overview	
Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run
Multidimensional scaling	Run

連結概覽

Edge Overview	
Avg. Path Length	Run

動態資料

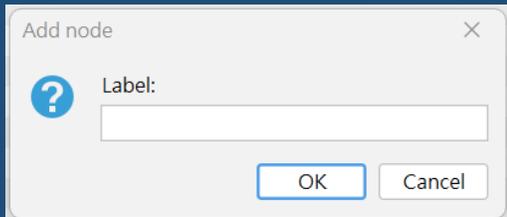
Dynamic	
# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run

Gephi軟體入門

05 Data laboratory & Preview

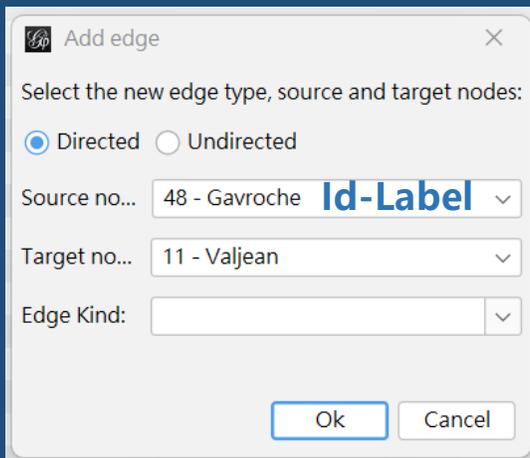
5.1 Data laboratory

+ Add node 新增節點

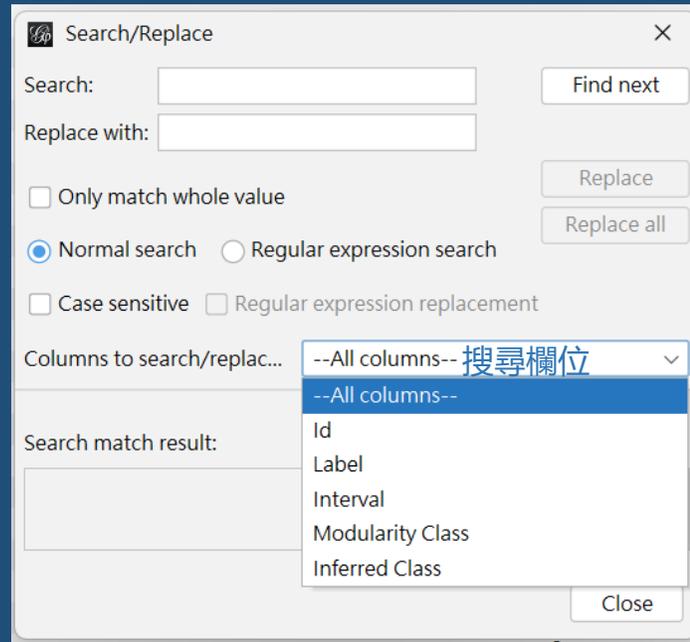


輸入標籤就會新增節點
之後自動產生流水號 Id

+ Add edge 新增連結



Search/Replace 搜尋與取代



Import Spreadsheet Export table

匯入Excel分頁
格式: xlsx、csv

匯出表格資料
格式: CSV



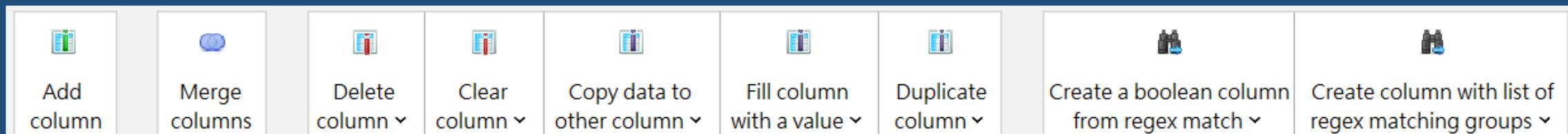
篩選特定節點

選擇欄位

合併欄位

清除欄位

填滿欄位

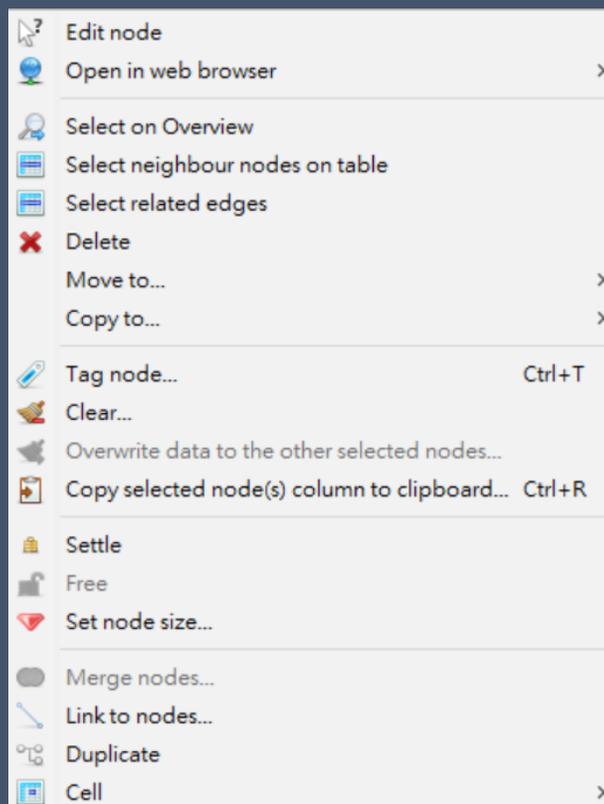


新增欄位

刪除欄位

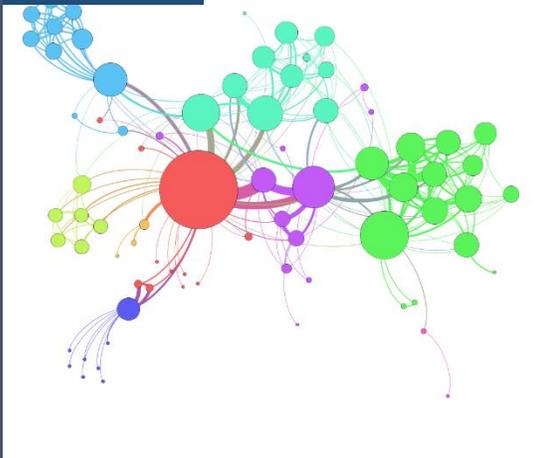
複製資料 Id→Label

複製欄位

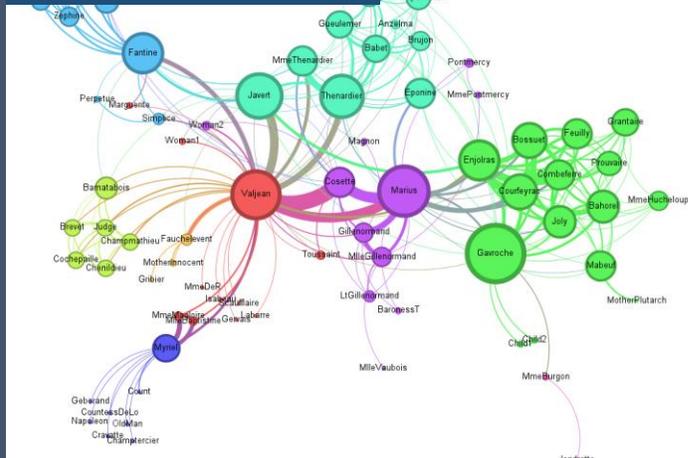


5.2 Preview

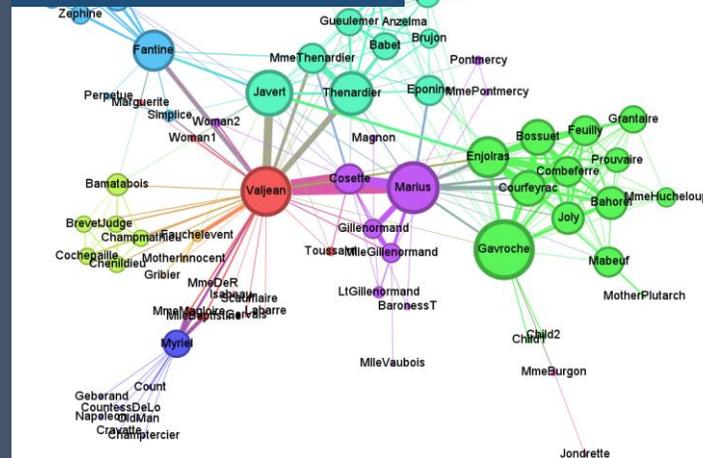
default



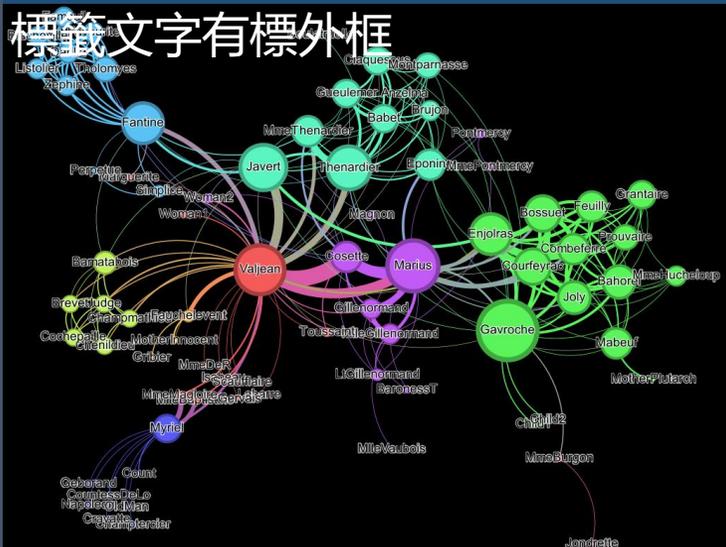
default curved



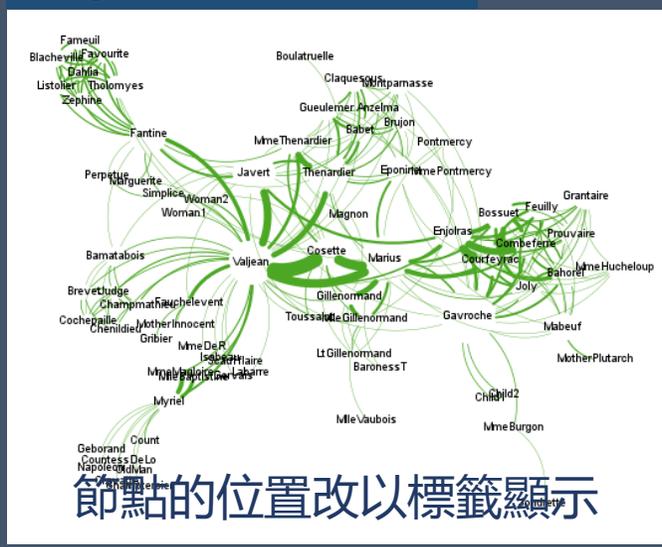
default straight



text outline + black background

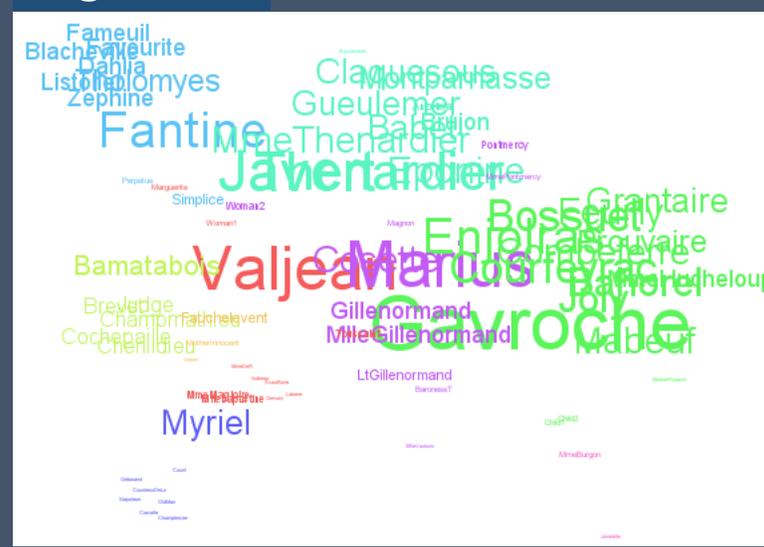


edge custom color



節點的位置改以標籤顯示

tag cloud



▼ Nodes	
Fixed Border Width	<input type="checkbox"/>
Border Width	1.0
Border Color	darker ...
Opacity	0
Per-Node Opacity	<input type="checkbox"/>
▼ Node Labels	
Show Labels	<input checked="" type="checkbox"/>
Font	Arial 12 Plain ...
Proportional size	<input checked="" type="checkbox"/>
Color	parent ...
Shorten label	<input type="checkbox"/>
Max characters	30
Outline size	0.0
Outline color	custom [255,25... ...
Outline opacity	80.0
Box	<input type="checkbox"/>
Box color	parent ...
Box opacity	80.0

節點

固定邊寬
邊框框度
邊框顏色
透明度
個別節點透明度

節點標籤

顯現標籤
字體(字形、大小)
比例大小
顏色
縮短標籤
縮短字元範圍
輪廓大小
輪廓顏色
輪廓透明度
標籤框
標籤框顏色
標籤框透明度

▼ Edges	
Show Edges	<input type="checkbox"/>
Thickness	1.0
Rescale weight	<input type="checkbox"/>
Min. rescaled weight	0.1
Max. rescaled weight	1.0
Color	mixed
Opacity	100.0
Curved	<input checked="" type="checkbox"/>
Radius	0.0
▼ Edge Arrows	
Size	3.0

連結

顯現連結
厚度
重新調整權重
調整權重
調整權重最小值
調整權重最大值
顏色
透明度
曲線
連結節點

節點箭頭

大小

Edge Labels	
Show Labels	<input checked="" type="checkbox"/>
Font	Arial 10 Plain <input type="text"/>
Color	original <input type="text"/>
Shorten label	<input type="checkbox"/>
Max characters	30
Outline size	0.0
Outline color	custom [255,25... <input type="text"/>
Outline opacity	80.0

連結標籤

顯現標籤

字體(字形、大小)

顏色

縮短標籤

最大字體

輪廓大小

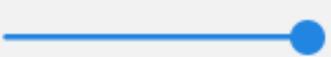
輪廓顏色

輪廓透明度

輸出圖像

顯示多少比例的節點

Preview ratio: 100%



Export: SVG/PDF/PNG

 Refresh

刷新

儲存的檔案格式

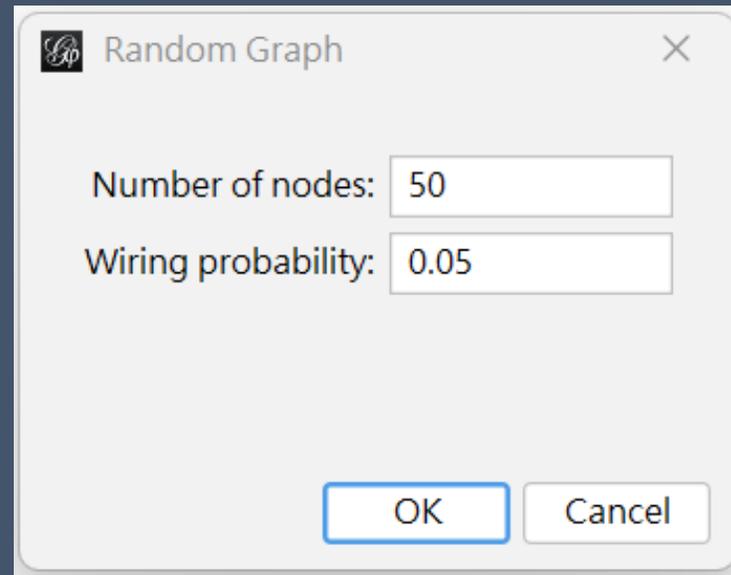
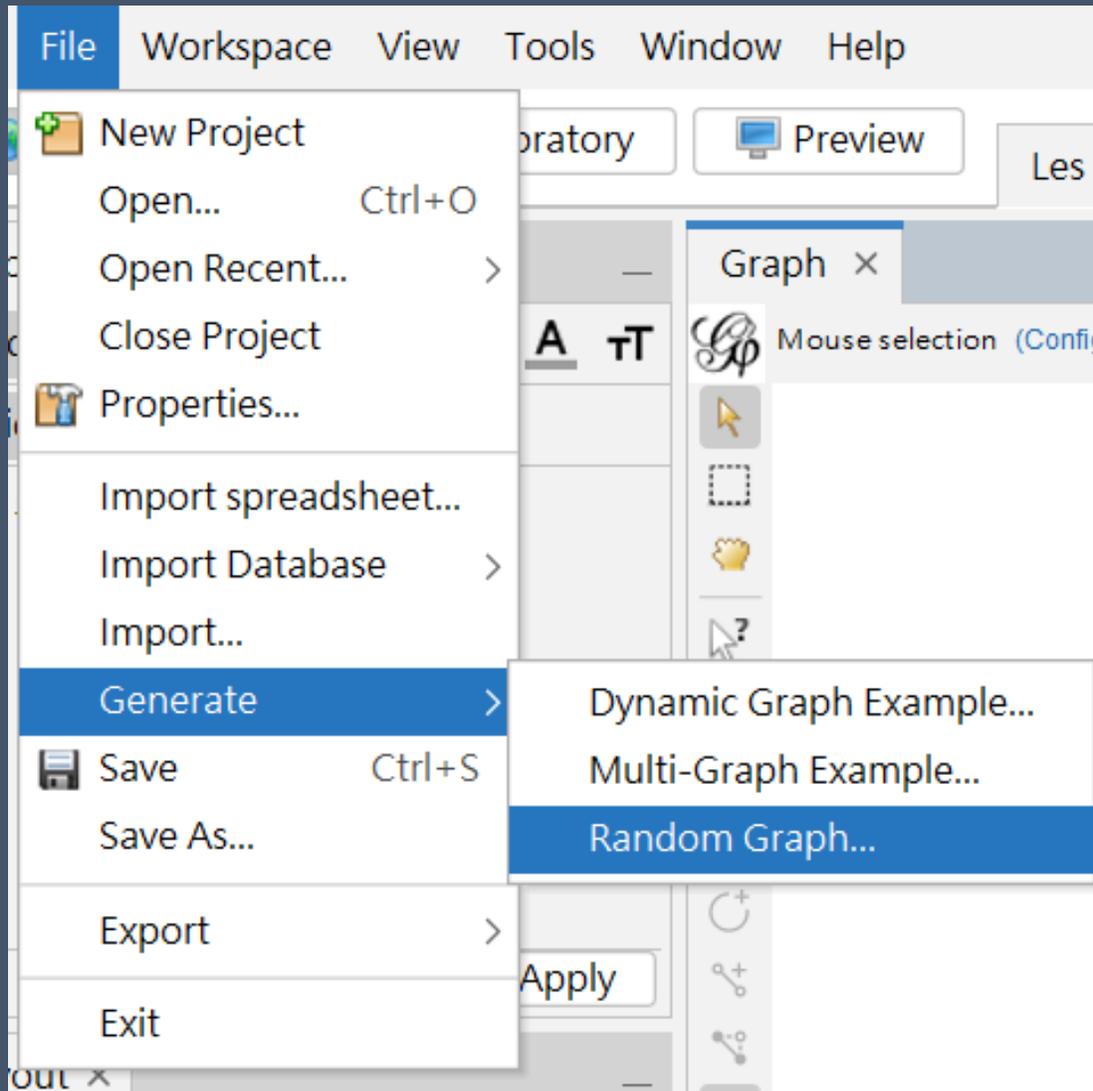
SVG 可縮小放大的向量檔

Gephi實務操作

06資料匯入

- 6.1 隨機產生
- 6.2 單筆建置
- 6.3 Import Spreadsheet
- 6.4 Export and Re-import
- 6.5 Import (Wizard)

6.1 隨機產生有向圖



6.2 單筆建置

Toolbar: + Add node | + Add edge | Search/Replace

Add node

Label:

OK Cancel

Toolbar: + Add edge | Search/Replace | Import Spread

Add edge

Select the new edge type, source and target nodes:

Directed Undirected

Source no... 48 - Gavroche

Target no... 11 - Valjean

Edge Kind:

Ok Cancel

Gephi Excel練習匯入檔案

常見匯入教學用Excel CSV檔案匯入

→實際遇到問題

- 1.中文字碼亂碼
- 2.爬梳資料隱藏字元、
- 3.一旦用Excel編修過後檔案編碼會變成ANSI
需用記事本另存UTF-8格式，以致編修不易

→建議作法

直接用Excel建立節點檔和連結檔分別匯入

Gephi Excel匯入資料格式

節點 Node table

欄位	Id	Label	Type
名稱	序號	節點標籤	節點類型
欄數	一組(必要)	一組	可有多組
內容	數字或文字	數字或文字	數字或文字
範例	0	TOM	M
	1	MARRY	F
	2	JENNY	F
	3	TIM	M

Interval 動態資料欄位

連結 Edge table

欄位	Source	Target	Kind
名稱	來源	目標	種類
欄數	一組(必要)	一組(必要)	一組(非必要)
範例	0	1	Like
	1	2	Comment
	2	3	Share
	3	1	Like
	1	2	Share

連結若有重複，在匯入時，Gephi可以自動計算處理，匯入後數值會顯示在權重欄位

6.3 Import Spreadsheet 匯入資料練習

新專案 > 匯入 Node & Edge
確認匯入檔案名稱與分頁

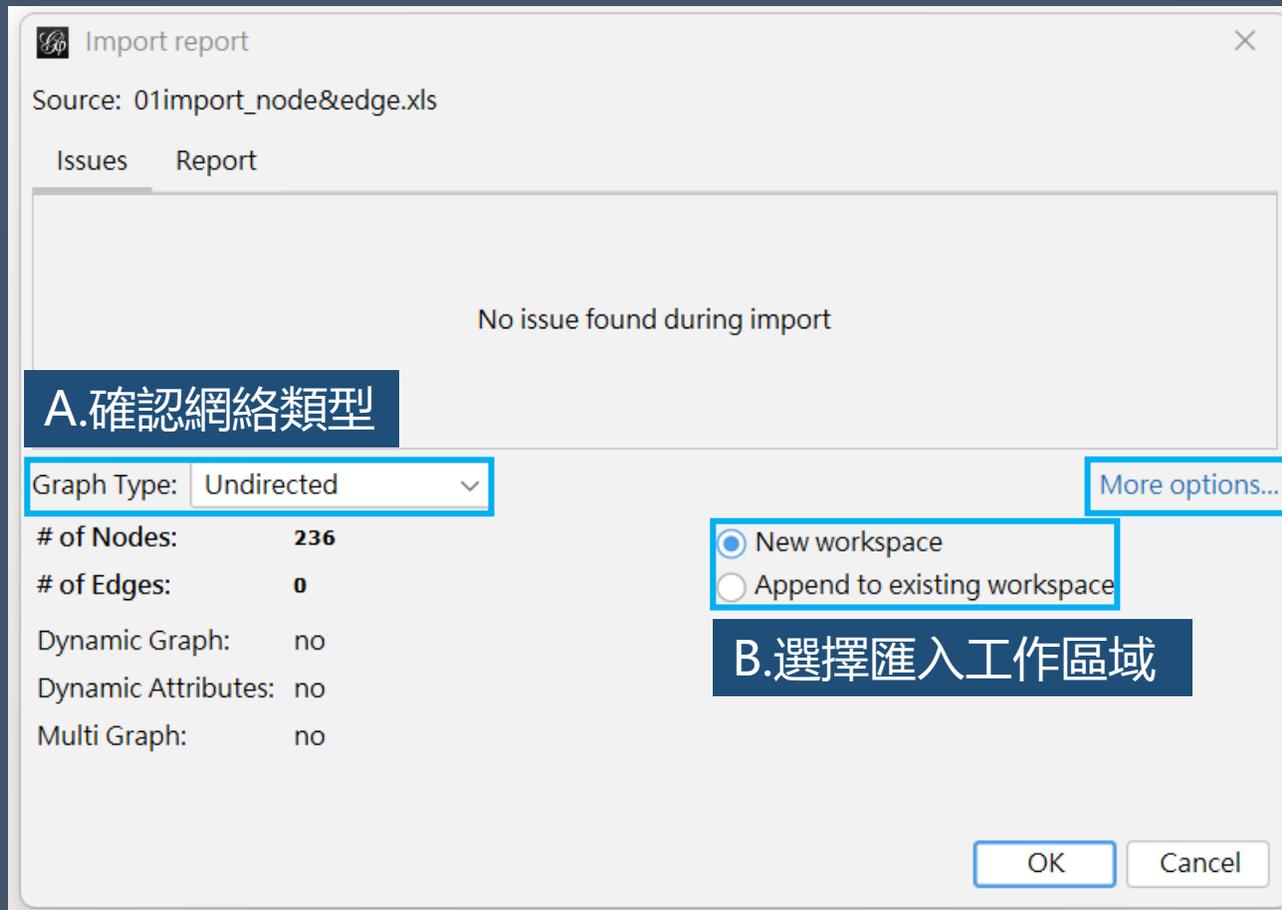
The screenshot shows the 'Spreadsheet (Excel)...' dialog box with the following elements:

- Steps:**
 - General Excel Options
 - Import settings
- General Excel Options (1 of 2):**
 - Excel file to import: D:\學科業務\8HELP+MASTER+FI...01import_node&edge.xls (Annotated with A. 確認檔案名稱)
 - Sheet: node (Annotated with B. 選擇excel分頁)
 - Import as: Nodes table
- Preview:**

Id	Label	timeset	class	g
1789	1789		1A	M
1780	1780		3A	M
1782	1782		3A	M
1783	1783		1A	M
1787	1787		1A	F
1546	1546		4A	F

(Annotated with C. 選擇匯入的資料內容
節點 Node Table
連結 Edge Table)
- Navigation:** < Back, Next >, Finish, Cancel, Help

6.3 Import Spreadsheet 匯入資料練習



C. 連結合併策略

- 加總 *
- 平均 *
- 最大值
- 最小值
- 第一個為主
- 最後一個為主
- 不要合併 *

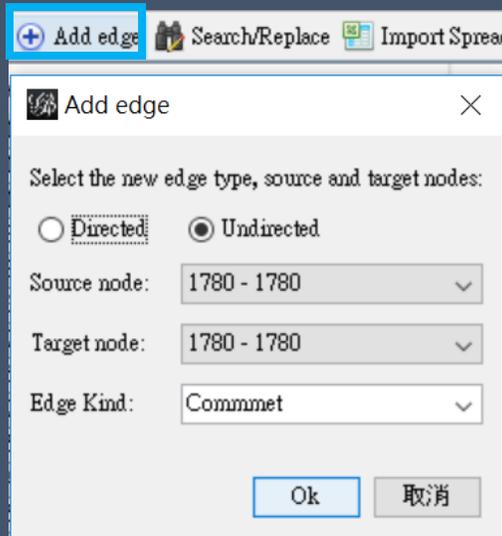
*表示常用



Try it!

開新分頁命名school day，將01import_node&edge.xlsx練習資料匯入

6.4 Export and Re-import

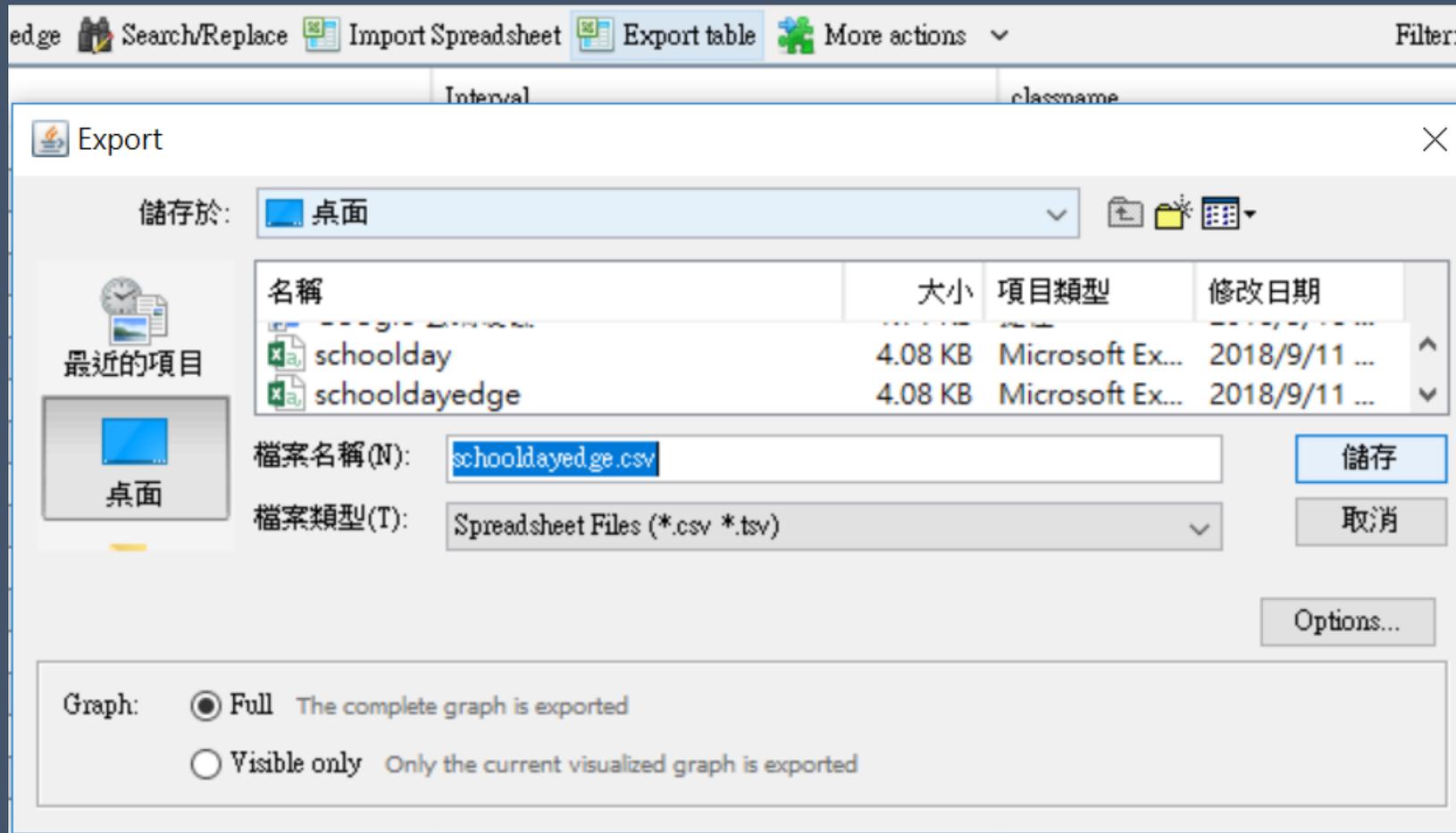


新增單一連結的種類之後，其餘連結的種類要如何新增？

- ① [Gephi] Export Table
> School edge csv
- ② [Excel] Fulfill Kind Column
> Save as xlsx
- ③ [Gephi] Import Edge List
> make sure that the number of edges is correct
> append to existing workspace

Source	Target	Type	Kind
1789	1783	Undirected	comment
1789	1821	Undirected	
1789	1783	Undirected	

① [Gephi] Export Table > School edge csv



② [Excel] Fulfill Kind Column > Save as xlsx

1	Id	Source	Target	Kind	Label	timeset	Weight
2		0	1789	1821	like		1
3		1	1789	1783	like		1
4		2	1789	1778	like		1
5		3	1789	1722	like		1
6		4	1789	1902	like		1
7		5	1789	1892	like		1
8		6	1789	1775	like		1
9		7	1789	1774	like		1
10		8	1789	1711	like		1
11		9	1789	1770	like		1
12		10	1789	1772	like		1
13		11	1789	1732	like		1
14		12	1789	1779	like		1
15		13	1789	1613	like		1
16		14	1789	1500	like		1



③ [Gephi] Import Edge List

- > make sure that the number of edges is correct
- > append to existing workspace

Spreadsheet (Excel)...

步驟

1. General Excel Options
2. Import settings

General Excel Options (1/2)

Excel file to import:
C:\Users\peegray\Desktop\schooldayedge.xlsx

Sheet: schooldayedge Import as: Edges table

Preview:

Source	Target	Type	Kind
1789	1821	Undirected	like
1789	1783	Undirected	like

Nodes: 236
Edges: 5899
Undirected Graph

Filters ×

Reset

Library

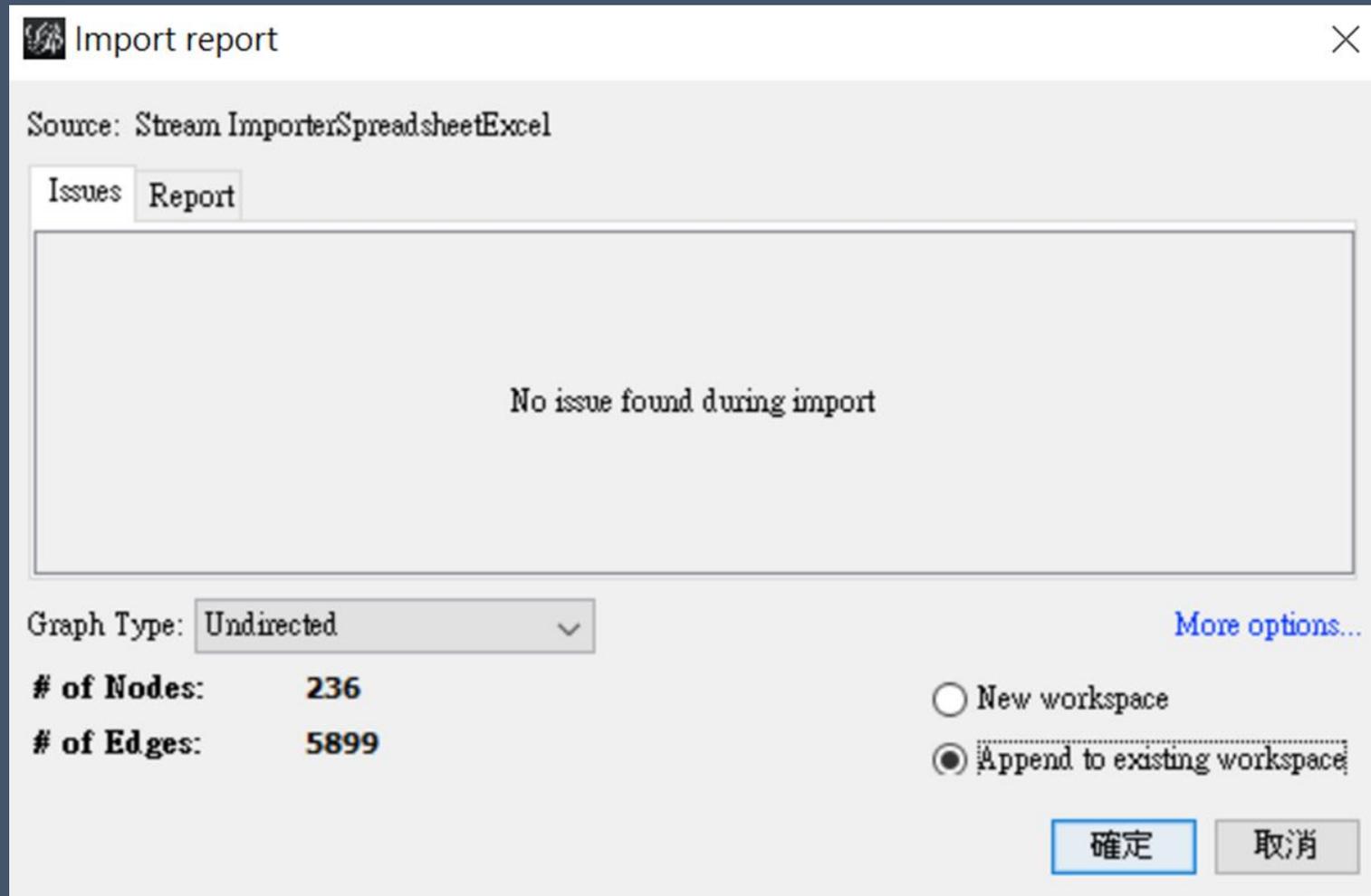
- Attributes
- Dynamic
- Edges
- Operator
- Topology
- Saved queries

Queries
Drag filter here

< 上一步(B) 下一步 > 完成(F) 取消 說明(H)

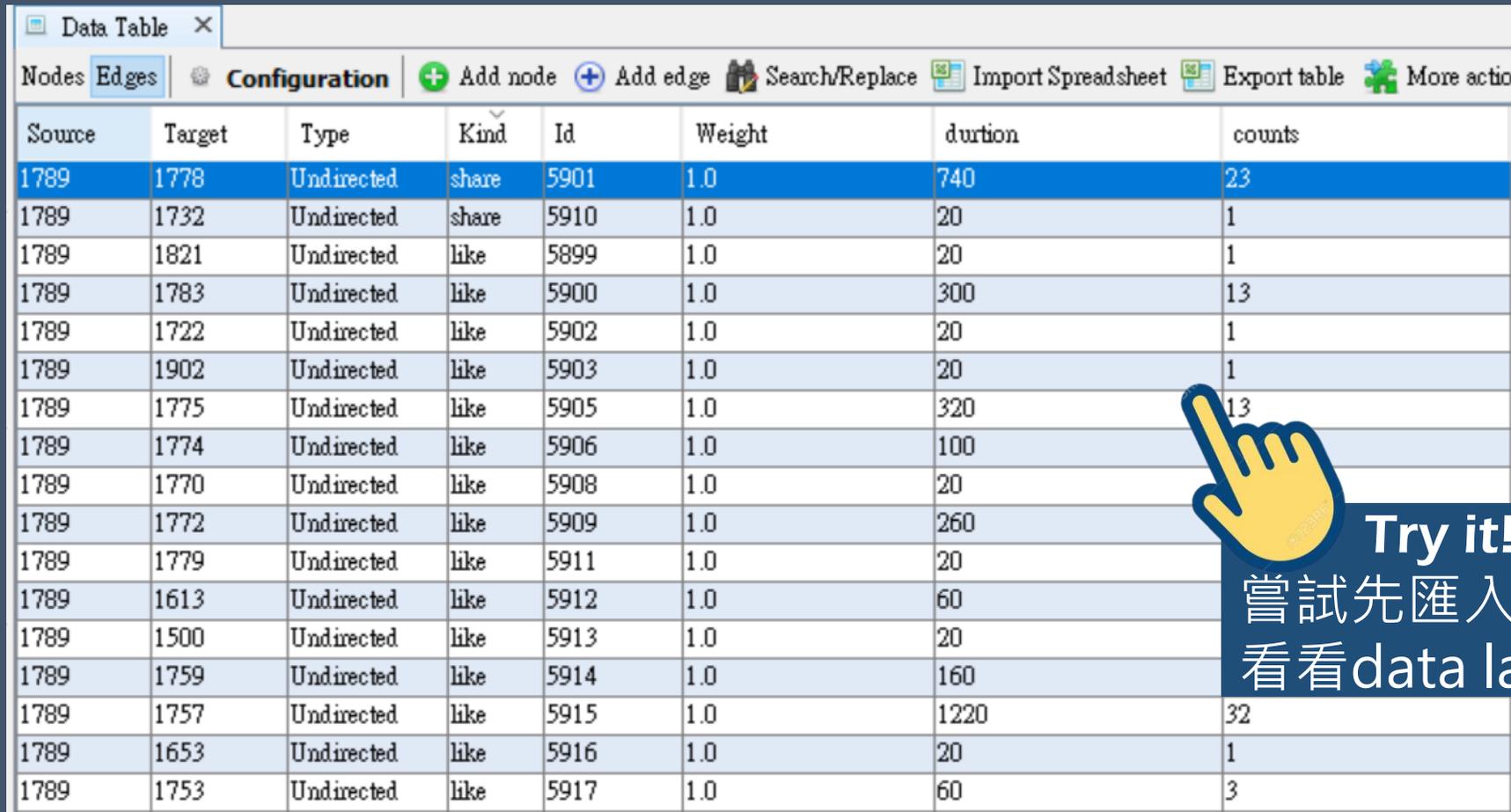
③ [Gephi] Import Edge List

- > make sure that the number of edges is correct
- > append to existing workspace



③ [Gephi] Import Edge List

- > make sure that the number of edges is correct
- > append to existing workspace



Source	Target	Type	Kind	Id	Weight	duration	counts
1789	1778	Undirected	share	5901	1.0	740	23
1789	1732	Undirected	share	5910	1.0	20	1
1789	1821	Undirected	like	5899	1.0	20	1
1789	1783	Undirected	like	5900	1.0	300	13
1789	1722	Undirected	like	5902	1.0	20	1
1789	1902	Undirected	like	5903	1.0	20	1
1789	1775	Undirected	like	5905	1.0	320	13
1789	1774	Undirected	like	5906	1.0	100	
1789	1770	Undirected	like	5908	1.0	20	
1789	1772	Undirected	like	5909	1.0	260	
1789	1779	Undirected	like	5911	1.0	20	
1789	1613	Undirected	like	5912	1.0	60	
1789	1500	Undirected	like	5913	1.0	20	
1789	1759	Undirected	like	5914	1.0	160	
1789	1757	Undirected	like	5915	1.0	1220	32
1789	1653	Undirected	like	5916	1.0	20	1
1789	1753	Undirected	like	5917	1.0	60	3

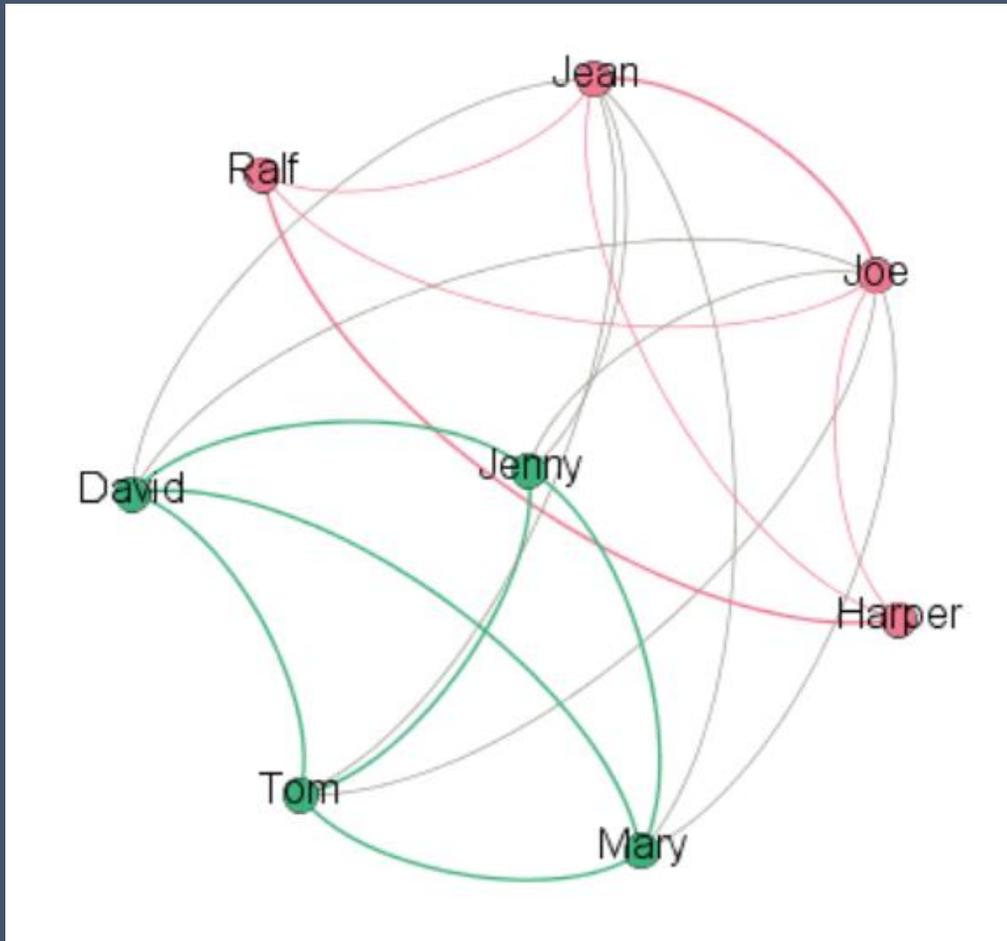
Try it!

嘗試先匯入Edge檔

看看data laboratory的node檔

6.5 Import-

(1) Data importer (similarities)



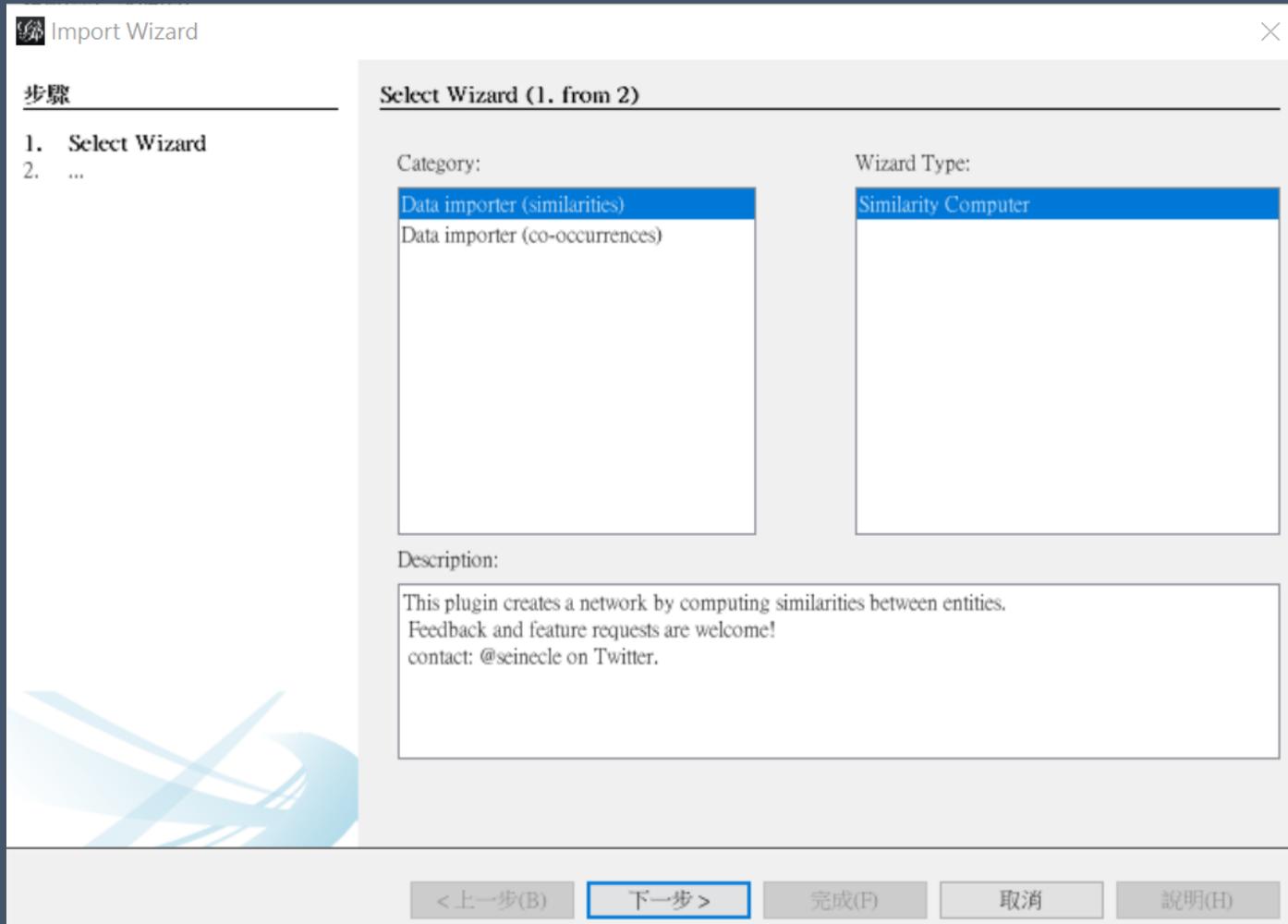
	A	B	C
1	Author	Taste in Ice creams	City preference
2	David	Strawberry	Venice
3	Mary	Strawberry	Venice
4	Jean	Vanilla	Venice
5	Ralf	Vanilla	Paris

	A	B	C	D	E
1	Author	Taste in Ice creams	Intensity of the Taste	City preference	Intensity of the preference
2	David	Strawberry	3	Venice	1
3	Mary	Strawberry	4	Venice	1
4	Jean	Vanilla	3	Venice	1
5	Ralf	Vanilla	3	Paris	1
6					



Each attribute should be followed by a column with a round number indicating the strength or intensity of the attribute

檔案 > Import > Data importer (similarities)



步驟

1. Select Wizard
- 2. Select a csv or excel file**
3. Options
4. Ready to import

Select a csv or excel file (2. from 4)

select file

file includes headers (column titles)

Select the Excel sheet containing the data:

工作表1

Your file should contain:

- first col: the name of the entities which will be the nodes in the network
- second column: an attribute of this entity
- third column: a second attribute of this entity
- fourth column: etc...

< 上一步(B)

下一步 >

完成(F)

取消

說明(H)

步驟

1. Select Wizard
2. Select a csv or excel file
3. **Options**
4. Ready to import

Options (3. from 4)

Is there a value attached to each feature, to indicate its strength or intensity?

	A	B	C	D	E
1	Author	Taste in Ice creams	Intensity of the Taste	City preference	Intensity of the preference
2	David	Strawberry	3	Venice	1
3	Mary	Strawberry	4	Venice	1
4	Jean	Vanilla	3	Venice	1
5	Ralf	Vanilla	3	Paris	1
6					



Each attribute should be followed by a column with a round number indicating the strength or intensity of the attribute

Import report

Source: Data importer (similarities):Similarity Computer

Issues Report

No issue found during import

Graph Type: Undirected

of Nodes: 8

of Edges: 20

Dynamic Graph: no

Dynamic Attributes: no

Multi Graph: no

New workspace

Append to existing workspace

More options...

確定 取消



Try it!

開新分頁命名書目分析

將02import(similarities).xlsx練習資料匯入

檔案 > Import > Data importer (co-occurrences)

Import Wizard

步驟

1. Select Wizard
2. ...

Select Wizard (1. from 2)

Category:

- Data importer (similarities)
- Data importer (co-occurrences)**

Wizard Type:

- Convert Excel and csv files to networks**

Description:

This plugin helps you import Excel or csv files into Gephi, based on entities which co-occur line by line. Feedback and feature requests are welcome!
contact: @seinecle on Twitter.

< 上一步(B) 下一步 > 完成(F) 取消 說明(H)

Excel資料記得要有表頭

Import Wizard

步驟

1. Select Wizard
- 2. Select Excel or csv file**
3. Select agents
4. Subfields in agents
5. Dynamic network?
6. Options
7. Ready to import

Select Excel or csv file (2. from 7)

select file 選擇檔案

file includes headers (column titles)

Select the Excel sheet containing the data:

gephi_drones_fullt 確定分頁

< 上一步(B) 下一步 > 完成(F) 取消 說明(H)

步驟

1. Select Wizard
2. Select Excel or csv file
3. **Select agents**
4. Subfields in agents
5. Dynamic network?
6. Options
7. Ready to import

Select agents (3. from 7)

What are the connections made of?

1. This type of agent:

- applicants_organisations_only
- applicants_use_me**
- cited_count
- cpc_codes_useme
- dois
- extended_family_size

is connected to

2. This type of agent:

- applicants_organisations_only
- applicants_use_me**
- cited_count
- cpc_codes_useme
- dois
- extended_family_size

Example: for a network of co-authors, pick the field of co-authors twice!

選擇相連結欄位
EX: 共同著作

< 上一步(B)

下一步 >

完成(F)

取消

說明(H)

步驟

1. Select Wizard
2. Select Excel or csv file
3. Select agents
- 4. Subfields in agents**
5. Dynamic network?
6. Options
7. Ready to import

Subfields in agents (4. from 7)

applicants_use_me

Is this field made of subfields? If so, what is the delimiter?

comma
semicolon
 tab
 space

Example:

Let's imagine you selected "authors" for agents in the previous screen. Suppose that the field for "authors" is made of several co-authors, separated by semicolon.
 => Please choose "semicolon" as a delimiter.
 (leave the selection empty if no delimiter applies).

欄位是否還有其他子欄
 = 是否還需繼續剖析

選擇剖析符號

- Comma 逗號
- Semicolon 分號
- Tab 製表鍵
- Space 空白鍵

原始資料, 選分號

applicants	applicants_use_me
	MARKOWETZ FRANZ
PARROT	PARROT
FLORIDI	FLORIDIENNE SA SANDERS PROBEL BIOTECHI
	TS LAB ZA OPTICHEN ZAPIS I OBR
	INST TEKHN KIB I ROBOTIKA PRI
	MONOV
	TS LAB ZA OPTICHEN ZAPIS I OBR

< 上一步(B)

下一步 >

完成(F)

取消

說明(H)

步驟

1. Select Wizard
2. Select Excel or csv file
3. Select agents
4. Subfields in agents
5. **Dynamic network?**
6. Options
7. Ready to import

Dynamic network? (5. from 7)

If you want to create a dynamic network, where is the field for time?

Leave blank if the network is not dynamic

! Works only for Excel files at the moment (not csv!).

applicants_organisations_only ▲
applicants_use_me
cited_count
cpc_codes_useme
dois
extended_family_size ▼

一般靜態資料→下一步
建立動態資料→選欄位
注意：僅適用excel檔案 不接受csv

Let's imagine you each of your data entry has a time stamp. You could create a network changing in time, where nodes and their connections appear and disappear along a timeline.
2 time formats allowed: 1984, 2014-09-17 (but not 2014-17-09).
Dates (1984) but also durations (1984,1986) are allowed in this field. For duration, use the comma to separate the start and end dates.

< 上一步(B)

下一步 >

完成(F)

取消

說明(H)

步驟

1. Select Wizard
2. Select Excel or csv file
3. Select agents
4. Subfields in agents
5. Dynamic network?
- 6. Options**
7. Ready to import

Options (6. from 7)

- create links between applicants_use_me agents and links between applicants_use_me agents.
- remove duplicates: lines that have exactly the same values for both types of agents will be removed
- remove self-loops: when an agent is connected to itself

- 於A欄與B欄之間建立連結
- 移除兩節點間具有相同數值的重複連結
- 移除與自身節點相連的連結

→同一文章的co-author會產生連結

< 上一步(B)

下一步 >

完成(F)

取消

說明(H)

步驟

1. Select Wizard
2. Select Excel or csv file
3. Select agents
4. Subfields in agents
5. Dynamic network?
6. Options
7. **Ready to import**

Ready to import (7. from 7)

The conversion process will start when you click the "Finish" button.

A network will be created, where:

applicants_use_me are connected to **applicants_use_me**

Edge weight 連結權重 兩節點之間連結數connection

Frequency 頻率 每一節點出現的次數

- The edge weight will represent the number of connections between any two agents
- Each node (agent) will have an attribute (called "frequency") representing how many times this agent was present in the file.

< 上一步(B)

下一步 >

完成(F)

取消

說明(H)

Source: Data importer (co-occurrences):Convert Excel and csv files to networks

Issues **Report**

Nodes	Issues
problem with line 81 (empty column applicants_use_me). It was skipped in the conversion	WARNING
problem with line 160 (empty column applicants_use_me). It was skipped in the conversion	WARNING
problem with line 161 (empty column applicants_use_me). It was skipped in the conversion	WARNING
problem with line 165 (empty column applicants_use_me). It was skipped in the conversion	WARNING
problem with line 165 (empty column applicants use me). It was skipped in the conversion	WARNING

Graph Type: Undirected [More options...](#)

of Nodes: 5265

of Edges: 5159

Dynamic Graph: no

Dynamic Attributes: no

Multi Graph: no

New workspace

Append to existing workspace



Try it!

開新分頁命名書目分析

將03import(co-occurrence)_biblio.xlsx練習資料匯入

確定

取消

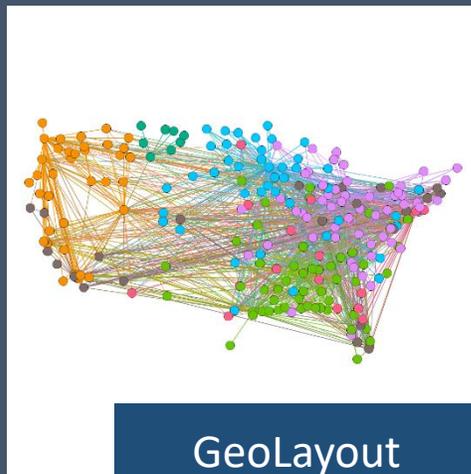
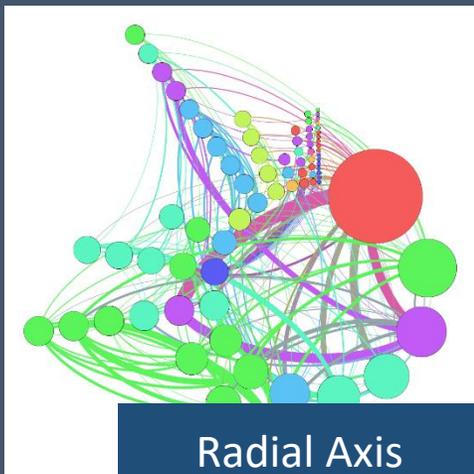
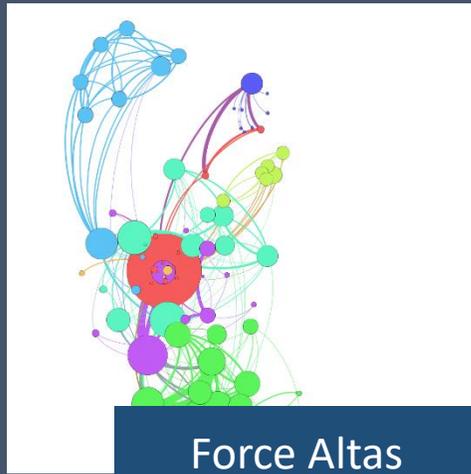
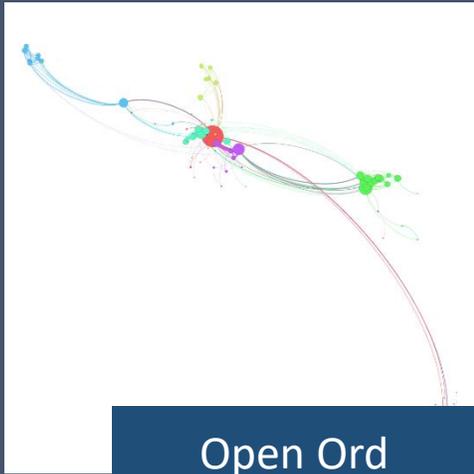
Gephi實務操作

07 Layout 運算布局

布局的種類

- Force-Direct Layout 力引導布局
- Circle Layout 圓形布局
- Geo Layout 地理布局
- Others

運算的圖像佈局



分類

Divisions

1) Open Ord

互補

Complementarities

2) ForceAtlas(3)

3) YiFan Hu(2)

4) Fruntchman-Reingold

排序

Ranking

5) Circular

6) Dual Circle

7) Circle Pack

8) Radial Axis

地圖位置

Geographic Repartition

9) GeoLayout

7.1 Open Ord

S. Martin, W. M. Brown, R. Klavans, and K. Boyack, "OpenOrd: An Open-Source Toolbox for Large Graph Layout," SPIE Conference on Visualization and Data Analysis (VDA), 2011

適用圖像：無向+權重

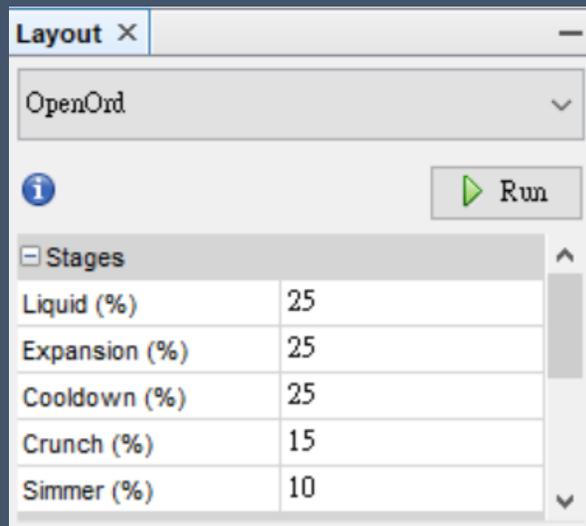
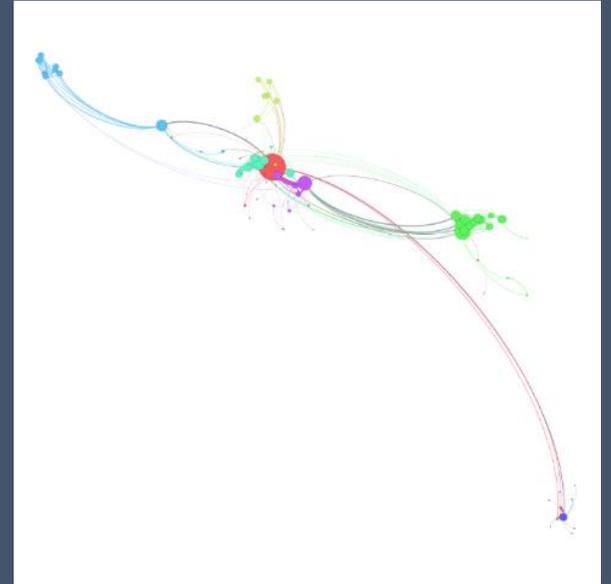
主要用途：用於分群

運算方式：力引導+模擬退火法

複雜程度： $O(N*\log(N))$

可運算節點範圍：100-1000,000(一百萬)

使用連結權重(edge weight)：是



OpenOrd	
Edge Cut	1.0
Num Threads	3
Num Iterations	750
Fixed time	0.2
Random seed	-27741084626281...

0(min)-1(max) 連結段開的數量
數值↑分群越多

1(min) core component數量

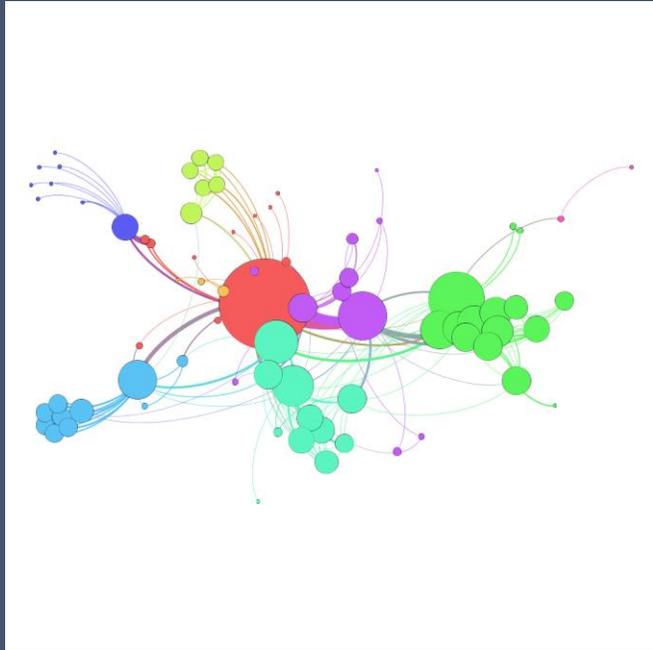
100(min)/750(default)

節點固定的時間 0(不固定)-1(固定)

想像成助鐵匠在選擇敲打的時間
基本都是亂數都可以忽略

7.2.1 Force Atlas

Jacomy, M.Venturini T. Heymann S.and Bastian M.(2014)ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the GephiSoftware.POLS.9(6):p.1-12



適用資料：解讀真實資料，
以最少偏誤地角度明確解讀網絡圖像

主要用途：小世界網絡圖、無尺度網絡圖

Small-World

Scale-free networks

(小的程度中心性的節點很多，
大的程度中心性的節點很少，冪次法則)

複雜程度： $O(N^2)$

可運算節點範圍：1-10,000(一萬)

使用連結權重(edge weight)：是

7.2.1 Force Atlas

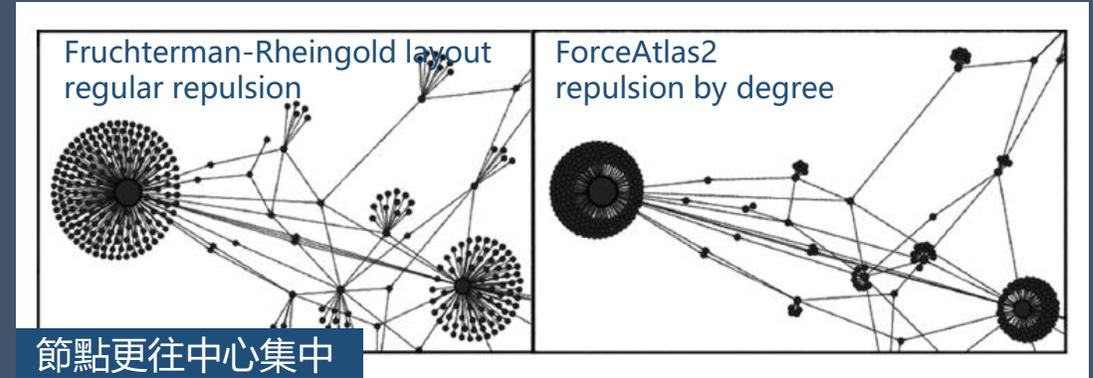
Layout X

Force Atlas

Run

Force Atlas

Inertia	0.1
Repulsion strength	1000.0
Attraction strength	1.0
Maximum displacement	100.0
Auto stabilize function	<input type="checkbox"/>
Autostab Strength	80.0
Autostab sensibility	0.2
Gravity	30.0
Attraction Distrib.	<input type="checkbox"/>
Adjust by Sizes	<input checked="" type="checkbox"/>
Speed	1.0



慣性(數值↑ 運算速度↑ 精確率↓)

互斥程度

吸引程度

最大位移量, 限制每一節點位移距離, 預防部分節點因距離過產生極端互斥

自動穩定功能(活化靜止的不穩定節點, 預防節點忽隱忽現, 會減少運算效率)

自動穩定功能強度(自動穩定功能的強度)

自動穩定功能敏感度

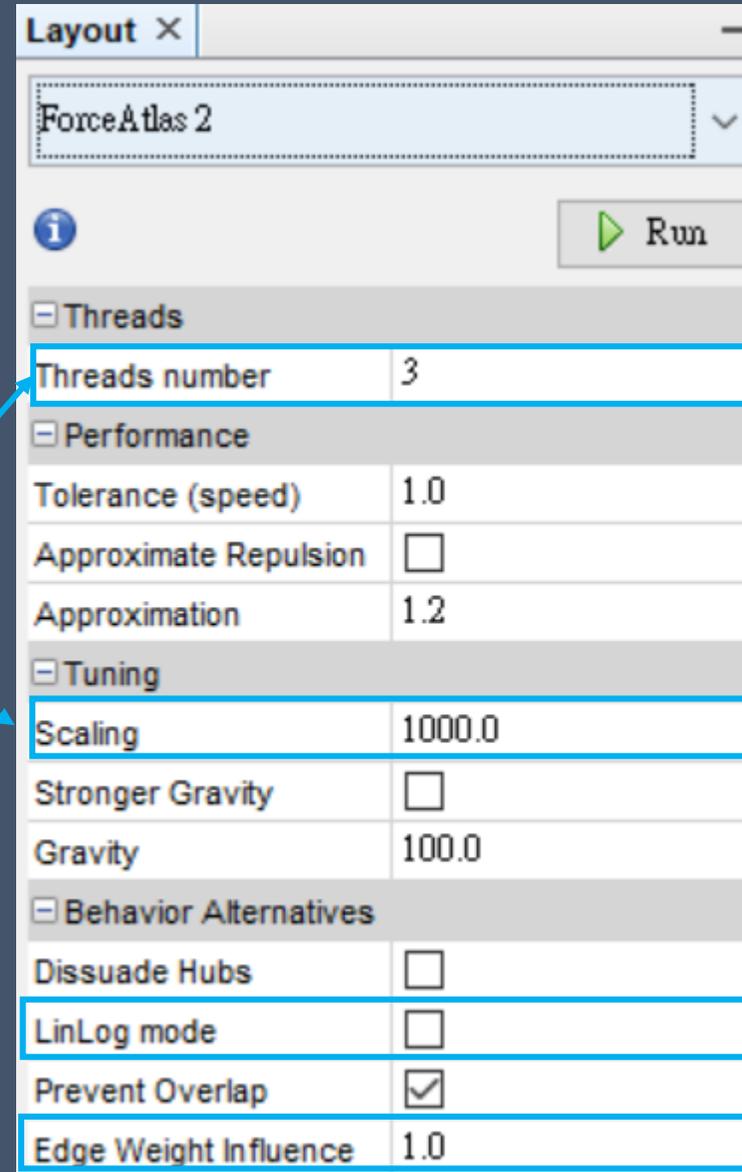
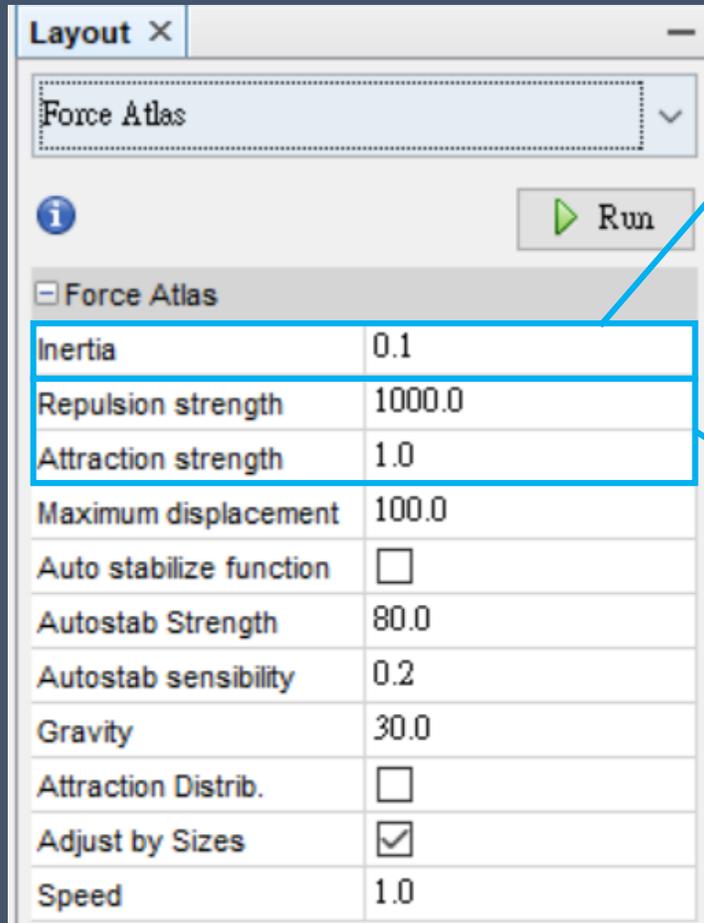
重力(數值↑ 節點越向中心集中)

吸引力分布

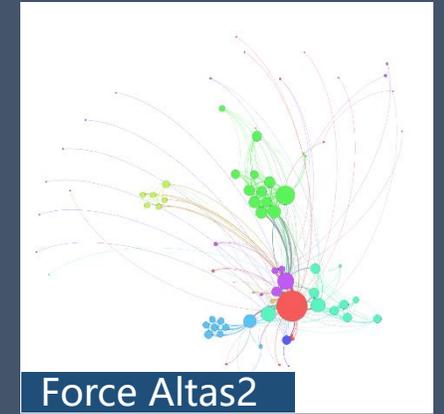
依尺寸調整避免節點重疊

速度

7.2.2 Force Atlas2 改善第一版演算法 V.1



Force Atlas



Force Atlas2

可容許的擺盪程度，數值↓精確率↑，不超過1為佳
 節點距離拉大，可形成較大圖像
 Barnes-Hut演算法最佳化的 θ

數值↑ 互斥程度↑ 清晰度↓

模式	吸引力	互斥力	作用
預設	線性	線性	
Linlog	線性	對數	使分群更緊密的結合

給予每一個連結多少權重，0=沒有

7.2.3 Multigravity ForceAtlas 2

Layout ×

Force Atlas

Run

Force Atlas

Inertia	0.1
Repulsion strength	1000.0
Attraction strength	1.0
Maximum displacement	100.0
Auto stabilize function	<input type="checkbox"/>
Autostab Strength	80.0
Autostab sensibility	0.2
Gravity	30.0
Attraction Distrib.	<input type="checkbox"/>
Adjust by Sizes	<input checked="" type="checkbox"/>
Speed	1.0

Layout ×

ForceAtlas 2

Run

Threads

Threads number	3
----------------	---

Performance

Tolerance (speed)	1.0
Approximate Repulsion	<input type="checkbox"/>
Approximation	1.2

Tuning

Scaling	1000.0
Stronger Gravity	<input type="checkbox"/>
Gravity	100.0

Behavior Alternatives

Dissuade Hubs	<input type="checkbox"/>
LinLog mode	<input type="checkbox"/>
Prevent Overlap	<input checked="" type="checkbox"/>
Edge Weight Influence	1.0

Layout ×

MultiGravity ForceAtlas 2

Run

Threads

Threads number	3
----------------	---

Performance

Tolerance (speed)	1.0
Approximate Repulsion	<input type="checkbox"/>
Approximation	1.2

Tuning

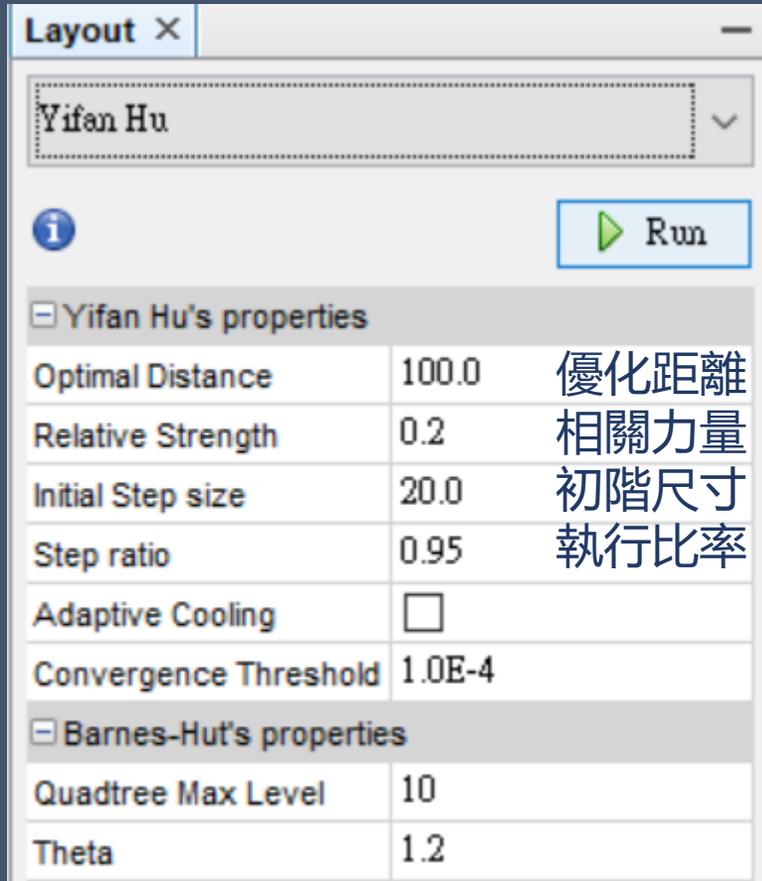
Scaling	2.0
GravityX Scaling	2.5
GravityY Scaling	2.5
Stronger Gravity	<input type="checkbox"/>
Gravity	1.0

Behavior Alternatives

Dissuade Hubs	<input type="checkbox"/>
LinLog mode	<input type="checkbox"/>
Prevent Overlap	<input type="checkbox"/>
Edge Weight Influence	1.0

水平集中
垂直集中

7.3.1 YiFan Hu



優化距離：數值↑，圖像節點分散、數值↓，圖像節點越密
圖像互斥(repulsion)與吸引(attraction)兩力之比例

通常預設是10

在執行演算法時運算與更新時，stepsize的比率
用運adaptive cooling

訂演算法停止的能量聚焦程度，門檻值↓精準率↑

四叉樹最大程度：數值↑、正確率↑

Theta θ ：數值↓、正確率↑

7.3.2 YiFan Hu Proportional

運算的方式和功能與 YiFan Hu 相似

差異在於

圖形節點的配置以比例置換(proportional displacement)的方式進行

還有，可以處理較大的網絡圖

7.4 Fruchterman Reingold

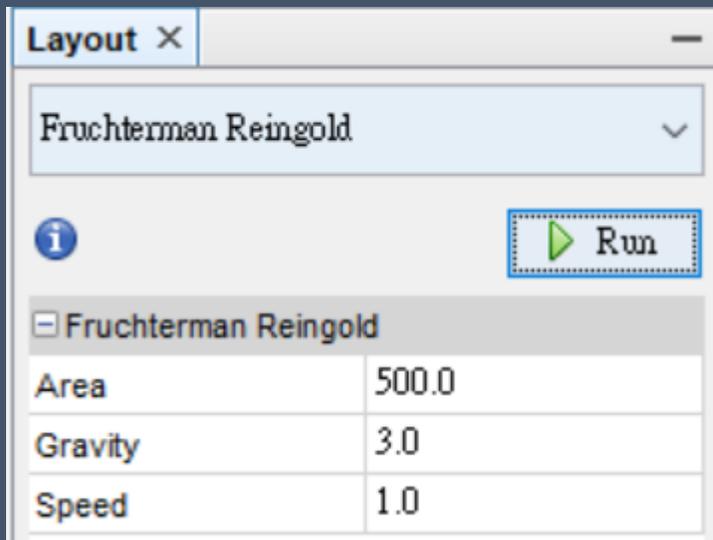
Fruchterman, T. M. J., & Reingold, E. M. (1991). Graph Drawing by Force-Directed Placement. Software: Practice and Experience, 21(11).

運算方式：彈簧模型+靜電力

複雜程度： $O(N^2)$

可運算節點範圍：1-1000

使用連結權重(edge weight)：否!



定義視覺化圖像區域大小
節點與中心距離的程度
演算法聚焦的速度
數值↑、精準度↓

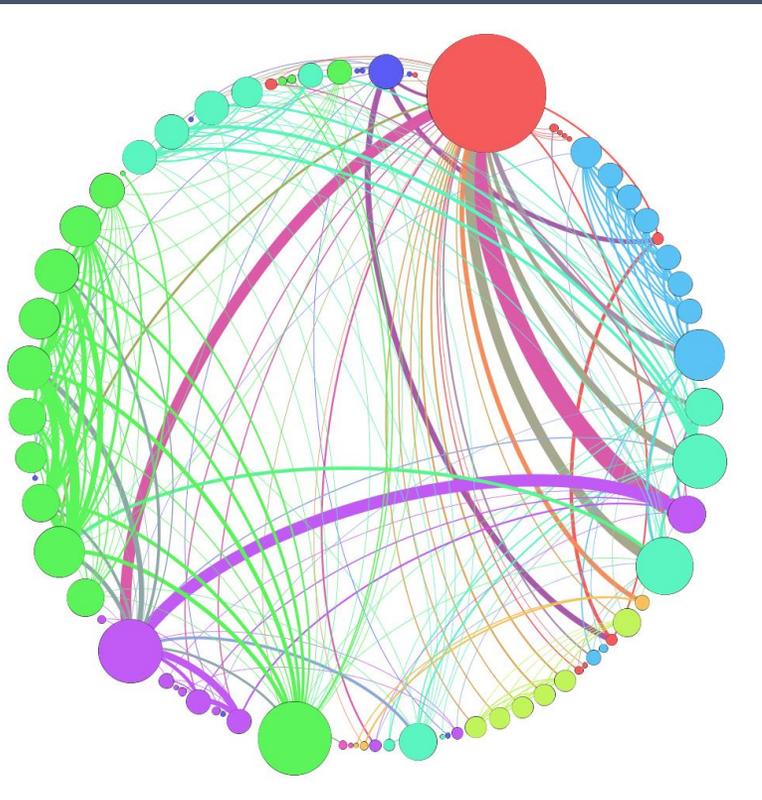
7.5.1 Circular Layout

Matt Groeninger. "Circular layout", Gephi Marketplace, March 2, 2013.
<https://marketplace.gephi.org/plugin/circular-layout/>.

將資料根據設定的屬性(ID、Degree...)排列成圓形，觀察節點與連結之間的分布

複雜程度： $O(N^2)$

可運算節點範圍：1-1,000,000(一百萬)



Layout [X] [Icon]

Circular Layout [v]

[i] [Run]

Circle Properties

Fixed Diameter	<input type="checkbox"/>
Diameter size	500.0
Order Nodes by (decreasing)	Node ID [v]

Node Placement

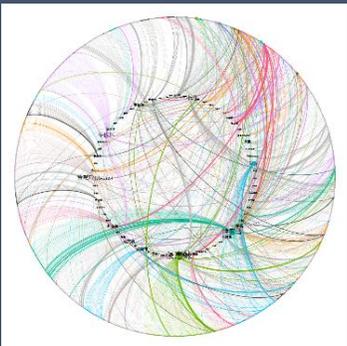
Node Layout Direction	Counter Clockwise [v]
Prevent Node Overlap	<input checked="" type="checkbox"/>

Transition

Enable Transition	<input type="checkbox"/>
Transition Steps	100000.0

調整圖像直徑
圖像直徑排序的屬性(降冪)

節點排序的方向：順時鐘、逆時鐘
預防節點重疊(如有勾選無法Fixed Diameter同時作用)
做一個平滑的過渡到布局
過度需要的步驟數量



7.5.2 Dual Circle Layout

Layout [Close] [Maximize]

Dual Circle Layout [Dropdown]

[Info] [Run]

Node Placement

Upper Order Nodes Outside

Upper Order Count 4

Node Layout Direction Counter... [Dropdown]

Transition

Enable Transition

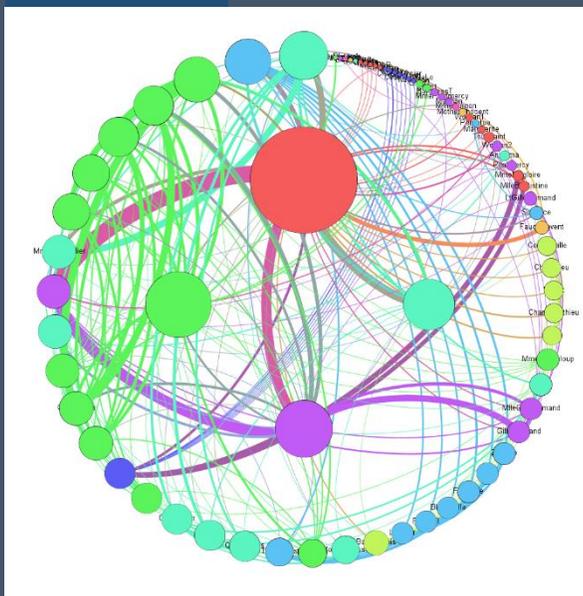
Transition Steps 100000.0

Sorting

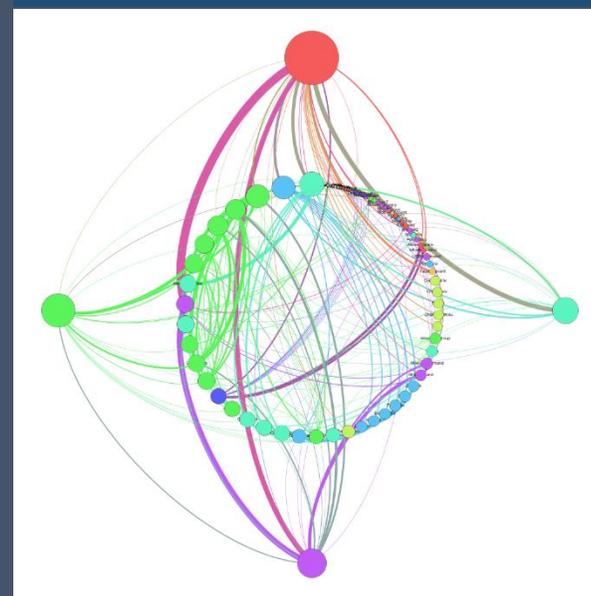
Order Nodes by Degree [Dropdown]

指定節點在外圍
設定外圍節點數
順/逆時鐘

Normal



Upper Order Nodes Outside



7.5.3 Circle Pack

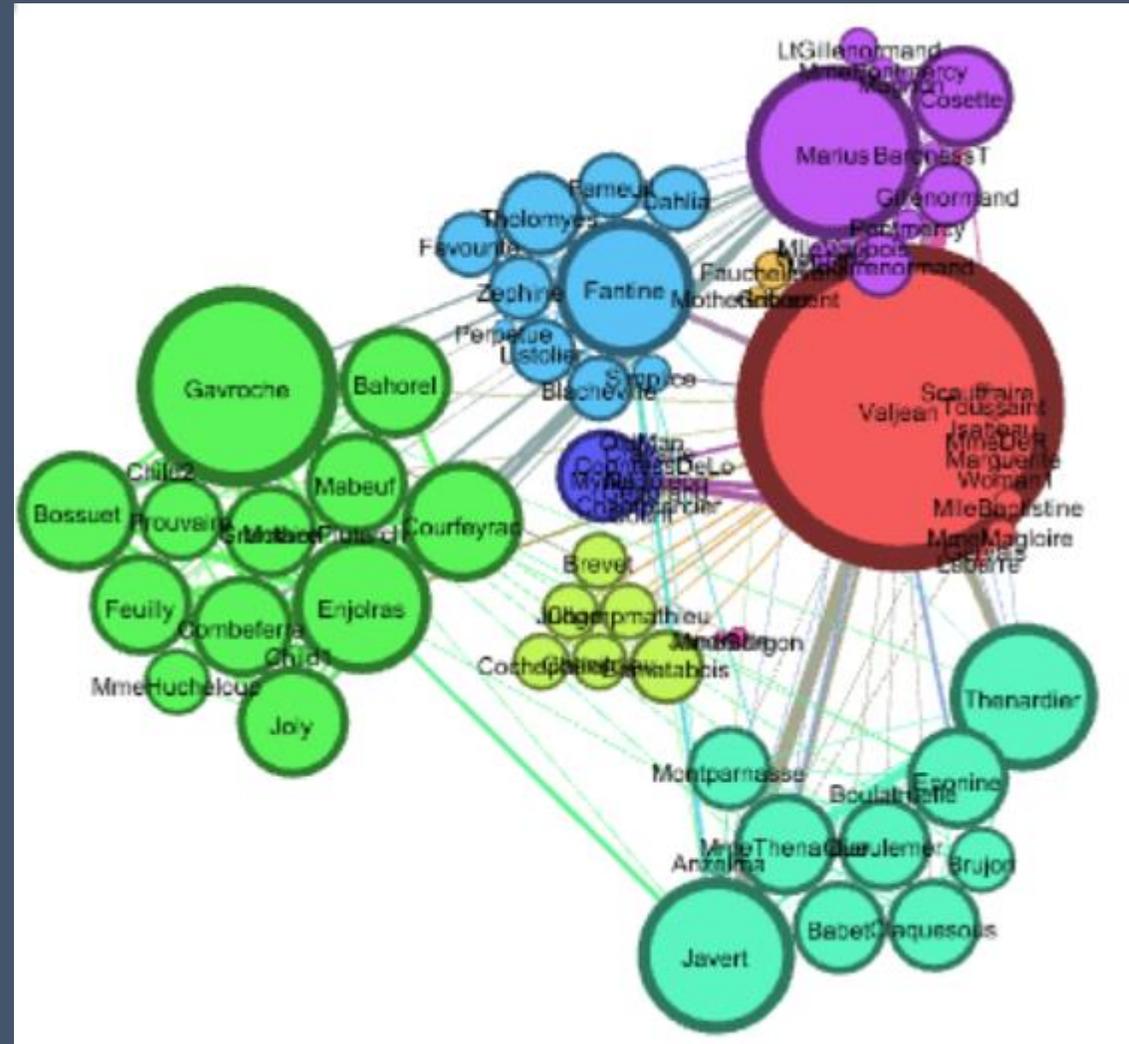
Layout ×

Circle Pack Layout

Run

Hierarchy

Hierarchy1	Modularity Cla...
Hierarchy2	No Selection
Hierarchy3	No Selection
Hierarchy4	No Selection
Hierarchy5	No Selection



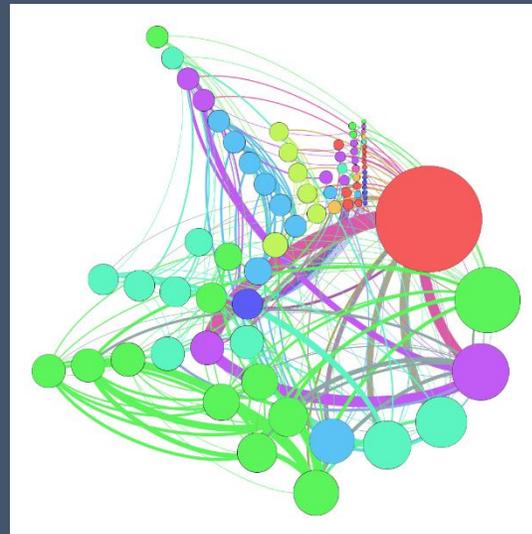
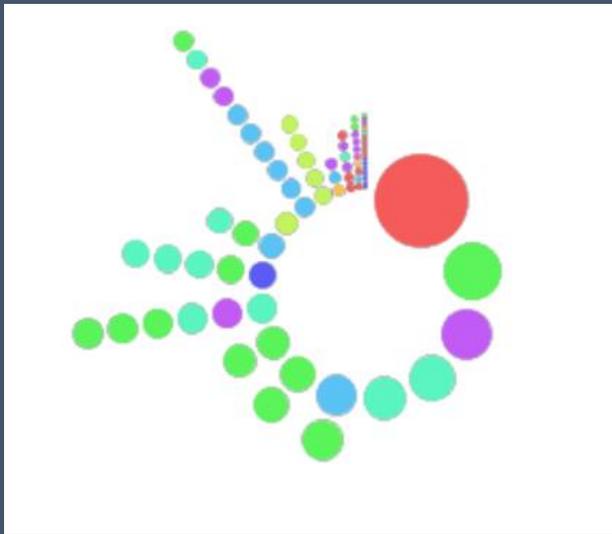
7.5.4 Radial Axis Layout

計算方式：將節點依屬性分組，相似節點分為一組並將其繪製成向外放射的軸線，以此類推

適用目的：用於觀察各組之間節點與連結的分布，進而比較各組之間的同質性(homophily)

複雜程度： $O(N^2)$

可運算節點範圍：1-1,000,000(一百萬)



Layout ×

Radial Axis Layout

i ▶ Run

Layout Tuning

Scaling Width	5.0
Resize Nodes	<input checked="" type="checkbox"/>
Node Size	7

Axis-Spar Control

Knockdown Axes/Spars	<input checked="" type="checkbox"/>
Number of Axes/Spars	5
Knockdown Range	Top Range

Node Placement

Group Nodes by	Out Degree
Node Layout Direction	Counter Clockwise
Order Nodes in Spar/Axis by	Node ID
Ascending Order of Spar/Axis	<input type="checkbox"/>
Draw Spar/Axis as Spiral	<input type="checkbox"/>

Transition

Enable Transition	<input type="checkbox"/>
Transition Steps	100000.0

控制節點之間的空間

重新設定節點的大小

減少軸的數量(=減少分組數)

減成幾之軸(=檢到剩幾組)

減少範圍: top、middle、bottom

節點分組的屬性

節點佈局的方向

軸內的節點排列順序

軸的升冪排列順序

有勾選→顯現社群內的連結

未勾選→顯現社群之間的連結

做一個平滑的過渡到布局

過度需要的步驟數量

7.6 Geo Layout

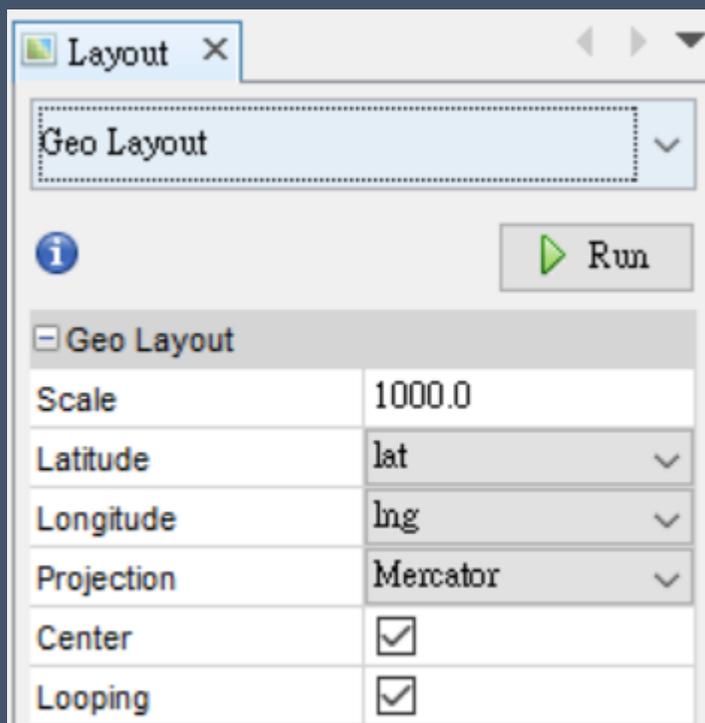
使用經緯度來定位節點

複雜程度: $O(N^2)$

可運算節點範圍: 1-1,000,000(一百萬)

地理資料匯入格式

Id	Label	lng	lng _x	lat	lat _y
0		-92.2244	可空白	34.72944	可空白
1		-81.4422		40.91611	
2		-73.8		42.73333	



整體圖像的大小

緯度

經度

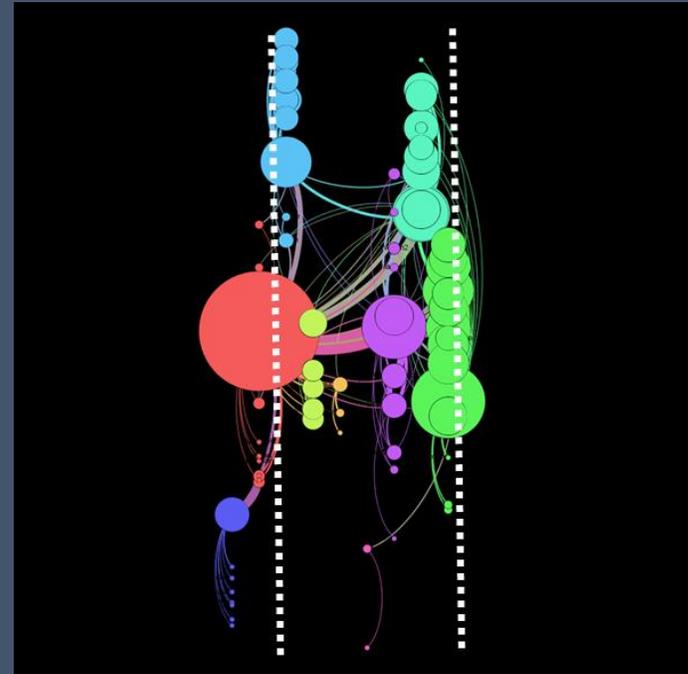
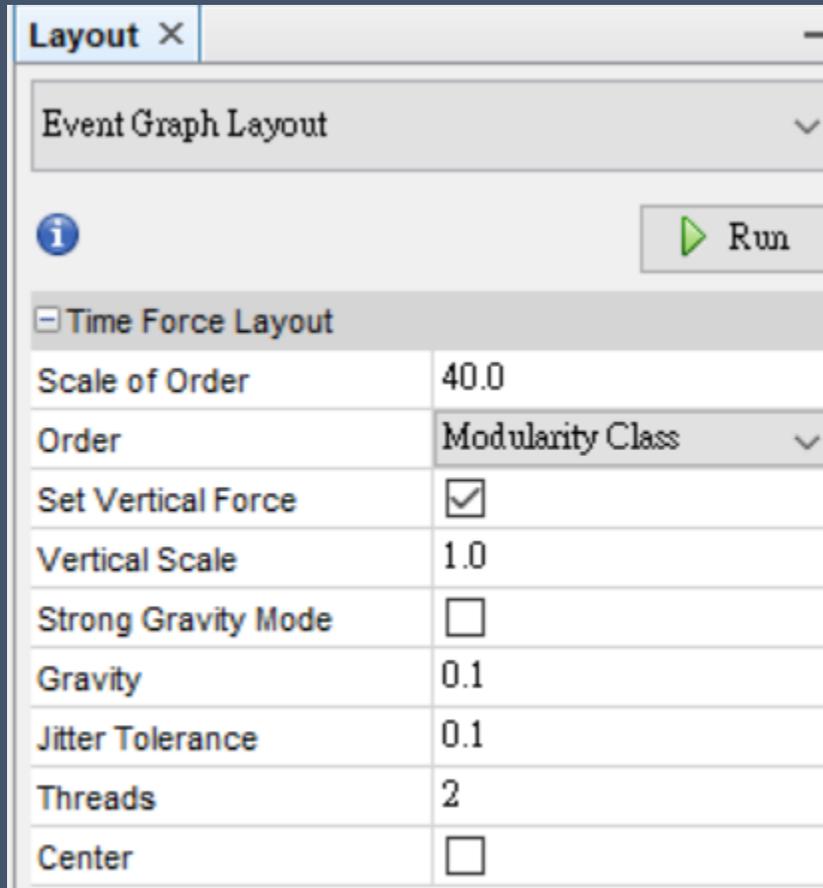
投射投影法(Mercator麥卡托)

放置於圖像中心

持續進行演算

7.7 Event Graph Layout

剛採用此布局時，節點不會整齊的在同一直線上
→調整Vertical Scale+ Jitter Tolerance，才會慢慢集中



軸線之間的距離

排列的屬性

影響垂直軸上的節點位置(越緊的節點會靠得更近，越鬆散的越遠)

將未連結的節點彼此推開的程度

強重力模式

重力

抖動容差

軸數量

向中心聚集

抖動容差：

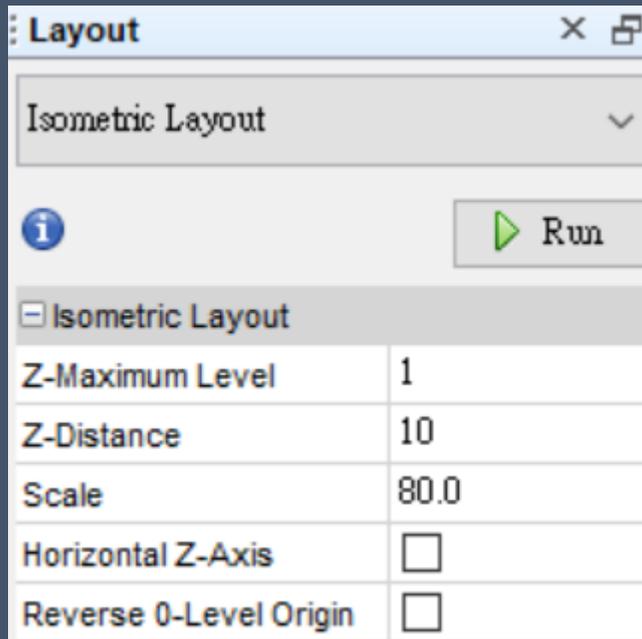
決定當節點撞到其他節點時允許跳轉的節點數量
可以使水平軸上相同位置的節點更容易相互通過

7.9 Isometric Layout

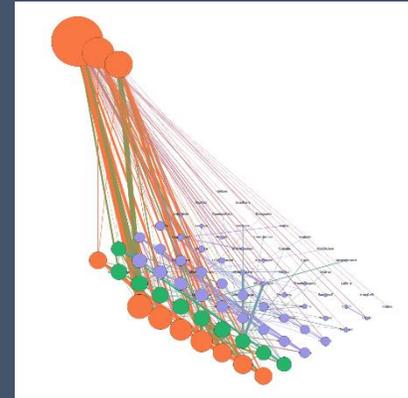
Isometric 等軸測投影

在二維平面呈現三維物體的方法，
三條坐標軸的投影縮放比例相同，
並且任意兩條坐標軸投影之間的角度都是120度。

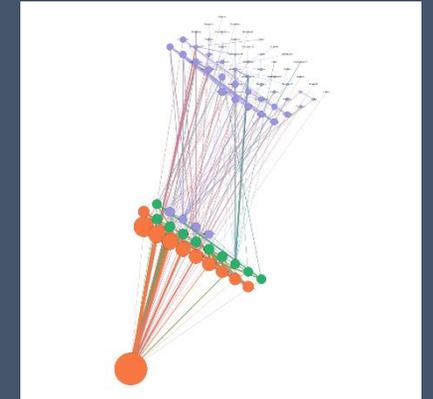
注意 Data laboratory的資料欄位中包含[z] EX: Degree [z]
→執行布局
→Computed Z-Level



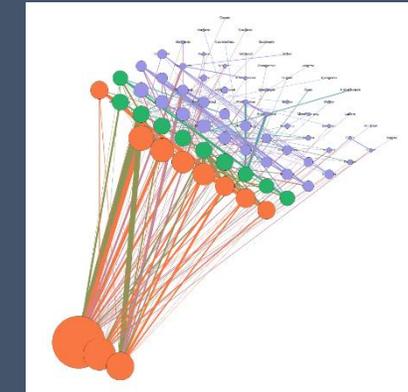
投射的階層數
階層之間的距離
整體網絡大小
水平投射
從Z level=0開始投射



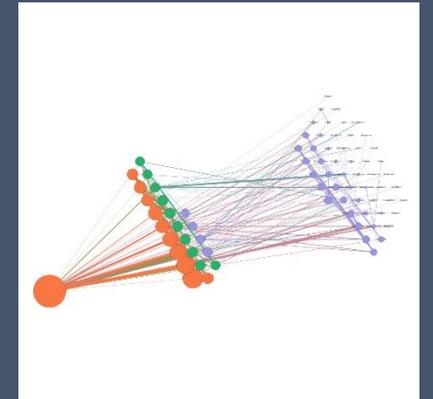
預設 z max level=1



預設 z max level=2



預設 z max level=1
Reverse 0-Level Origin



水平投射



Try it!

1. 在Data Laboratory練習輸入Z值
2. 應用 Isometric Layout

7.10 Network Splitter 3D

Layout ×

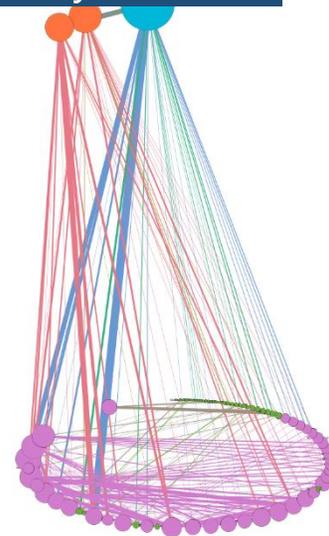
Network Splitter 3D

Run

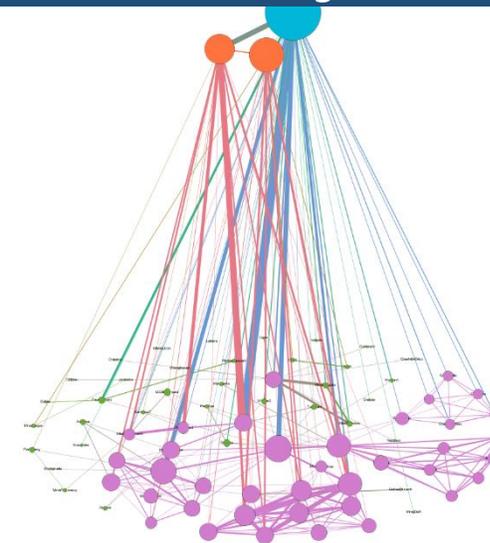
Network Splitter 3D	
Z-Maximum Level	1
Z-Distance Factor	5
Z-Scale	30.0
Alfa	5.0

投射的階層數
階層之間的距離
整體網絡大小
旋轉角度0-360度

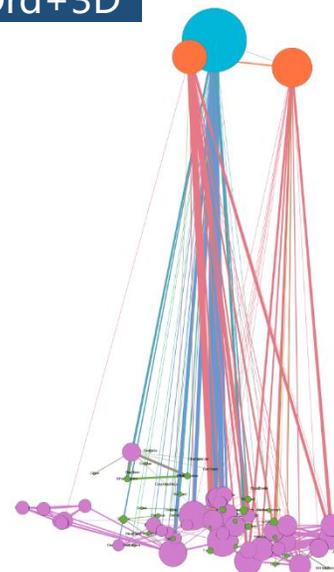
Circle Layout+3D



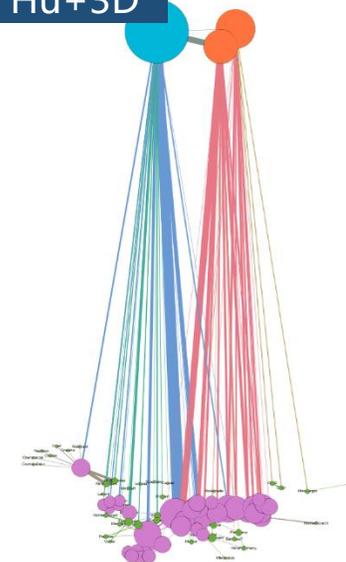
Frutcherman Reingold+3D



OpenOrd+3D



Yifan Hu+3D

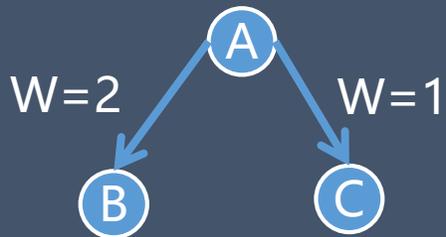
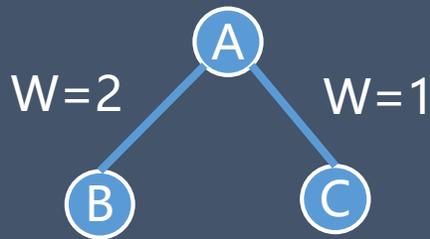
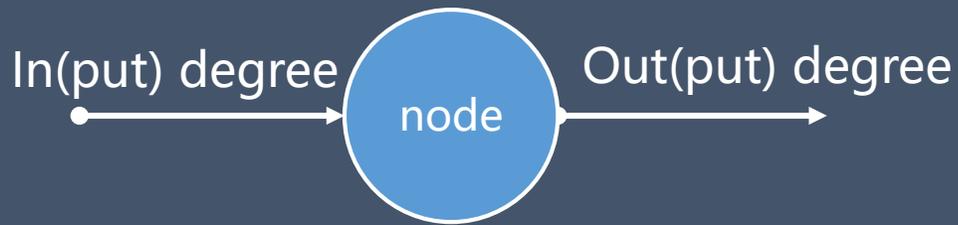


Gephi實務操作

08 Statistic 統計

8.1 網絡概觀

Average degree = edges/nodes



Degree 程度 = indegree + outdegree

單一節點的連結數

Node A degree = 2

Ex: 方大同-林俊傑(1個歌手)

Weighted Degree 加權程度

單一節點【其連結數*各自權重】加總

Node A weighted degree = $1*2 + 1*1 = 3$

Ex: 方大同-林俊傑(合作5次)

Directed Graph 有向圖

weighted InDegree Node B = $1*2 = 2$

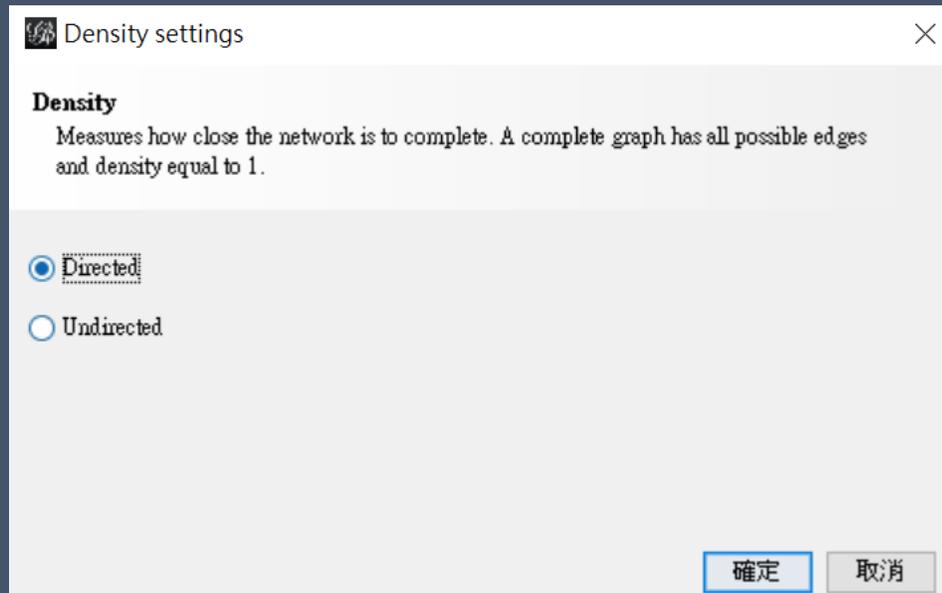
weighted OutDegree Node A = $1*2 + 1*1 = 3$

Graph Density

Graph Density

$$= \frac{\text{the total number of edges present in the graph}}{\text{the total number of edges possible in the graph}}$$

- Directed possible edges = $n(n-1)$
- Undirected possible edges = $[n(n-1)]/2$



Network Diameter 網絡直徑

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

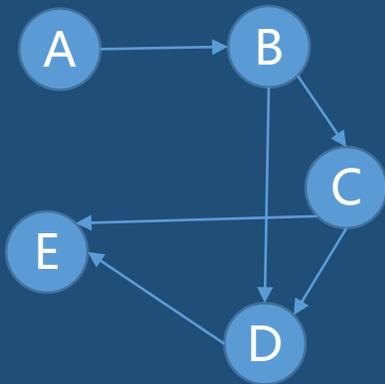
選擇網絡圖方向 正規化中心性程度

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.

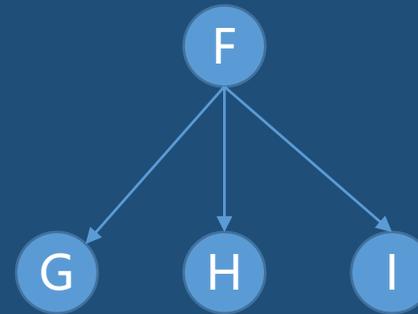
確定 取消

Network Diameter 網絡直徑

Distance	the path of pair of vertexes
Eccentricity	the shortest path of a single vertex to the farthest vertex
Radius 半徑	minimum of eccentricity eccentricity = radius \rightarrow central vertex
Diameter 直徑	maximum of eccentricity eccentricity = diameter \rightarrow periphery vertex *weighted graph diameter the hops of a vertex to the farthest vertex *If the network is disconnected \rightarrow the diameter is infinite 無限大



Eccentricity(A)=3
E(B)=2
E(C)=2
E(D)=2
E(E)=3
Diameter=3
Radius=2



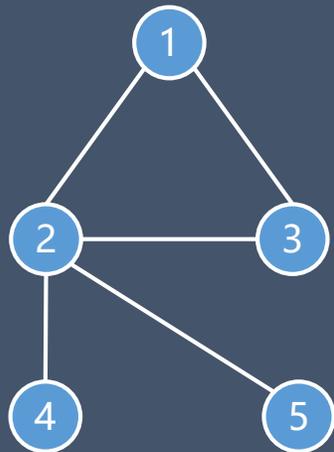
Eccentricity(F)=1
E(G)=2
E(H)=2
E(I)=2
Diameter=2
Radius=1

Average path length

the average number of steps along the shortest paths for all possible pairs of nodes.

網絡內所有可能連結最短路徑的平均長度(連結最短路徑長度總和/連結數)

It is a measure of the efficiency of information or mass transport on a network



$$\text{possible edges} = \frac{5(5-1)}{2} = 10$$

from	to	path	length
1	2	1,2	1
1	3	1,3	1
1	4	1,2,4	2
1	5	1,2,5	2
2	3	2,3	1
2	4	2,4	1
2	5	2,5	1
3	4	3,2,4	2
3	5	3,2,5	2
4	5	4,2,5	2
Sum=15			Average=1.5

Gephi實務操作

Statistic 統計

8.2 網絡與節點中心性_

中介中心性

Network Diameter > Betweenness Centrality

中介中心性(間接中心性)

定義：在節點對之間的最短途徑通過單一節點的頻率
→多數節點須通過該節點以觸及其他節點



$$C_B(i) = \sum_{j < k} g_{jk}(i) / g_{jk}$$

$g_{jk}(i)$ = the number of geodesics that actor i is on
 j k 兩節點之間通過 i 的最短捷徑次數

g_{jk} = the number of geodesics connecting jk
連結 j k 兩節點的最短捷徑個數

Gephi實務操作

Statistic 統計

8.3 網絡與節點中心性_

接近中心性

Network Diameter > Closeness Centrality

Closeness Centrality接近中心性

(directed graph)

$$C(x) = -\frac{N}{\sum_y d(x, y)}$$

節點距離加總→取倒數

定義：該節點到所有節點之最短距離總和之倒數

意涵：在最短時間內，某樣東西流經整個網絡

數值越大代表與其他多數節點的距離越短

某一資訊可以透過該接近中心性高的節點迅速傳達給網絡內的多數的其他節點

舉例：

- (1)人際關係，接近中心性越高，個性越合群
- (2)病毒散播，接近中心性越高，越容易感染

Gephi實務操作

Statistic 統計

8.4 網絡與分群_Modularity

Modularity

Modularity settings [Close]

Modularity
Community detection algorithm.

Randomize Produce a better decomposition but increases computation time **有助於分群會增加演算時間**

Use weights Use edge weight **使用連結權重**

Resolution: Lower to get more communities (smaller ones) and higher than 1.0 to get less communities (bigger ones).

<1 可增加分群結果
>1 可減少分群結果

確定 **取消**

Gephi實務操作

Statistic 統計

8.5 網絡與分群Girvan-
Newman Clustering



This plugin was developed as part of a practical internship at the university of Hagen at the department of theoretical computer science.

Shortest Path Betweenness

- respect edge type
- respect parallel edges

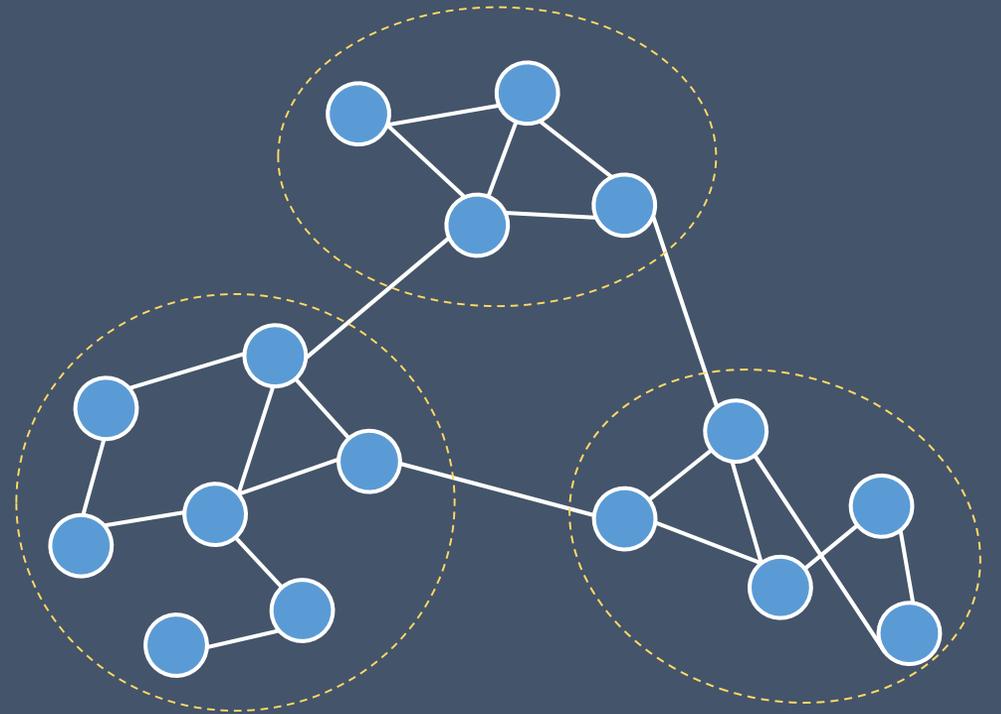
最短路徑中介中心性 計算方式
考量連結方向 → 有向圖
考量平行連結 → 加權計算

Modularity

- respect edge type
- respect parallel edges

分群 計算方式 提供最大的Q值 (網絡分群最佳參數)
考量連結方向 → 有向圖
考量平行連結 → 加權計算

Girvan-Newman Clustering

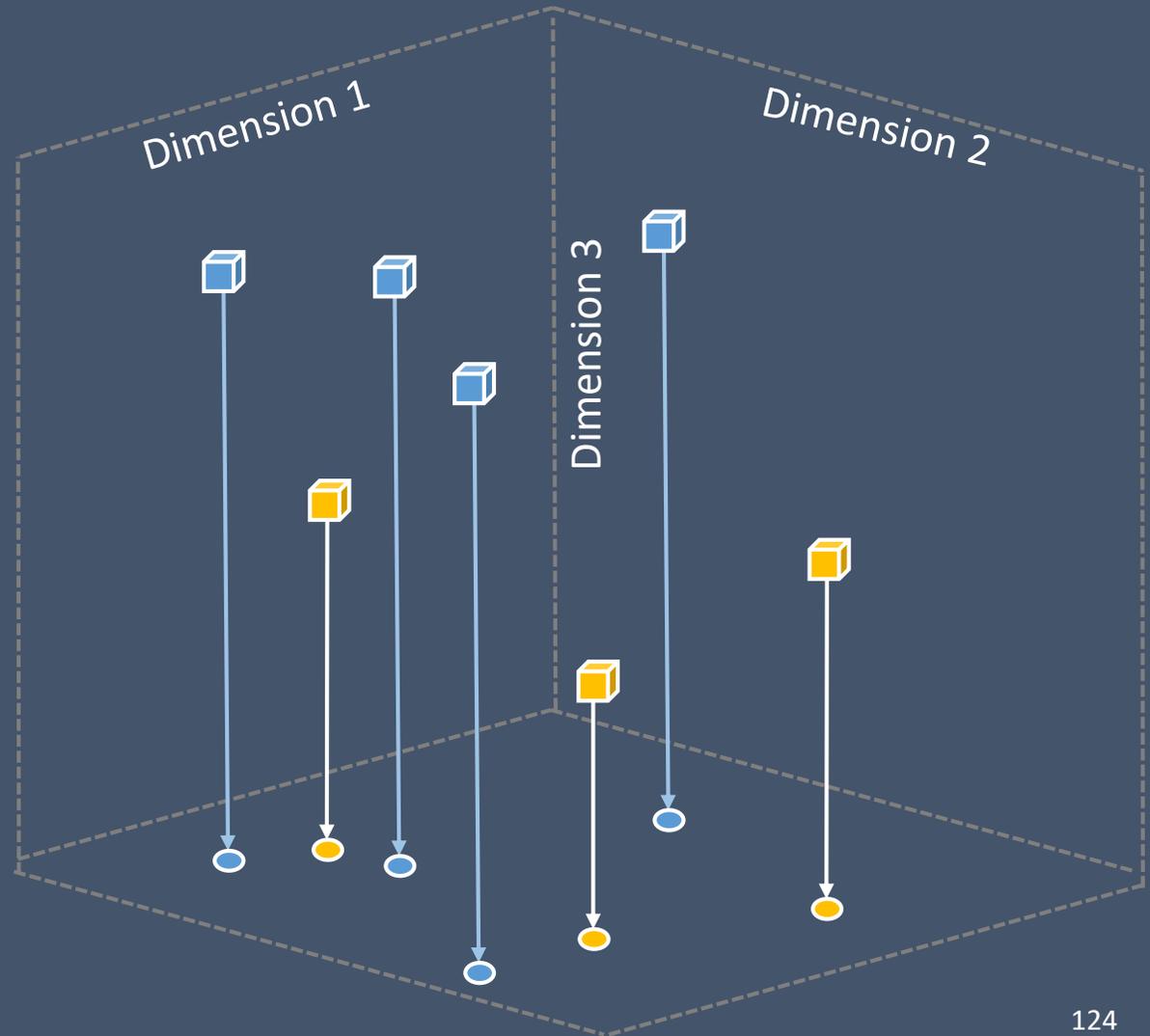
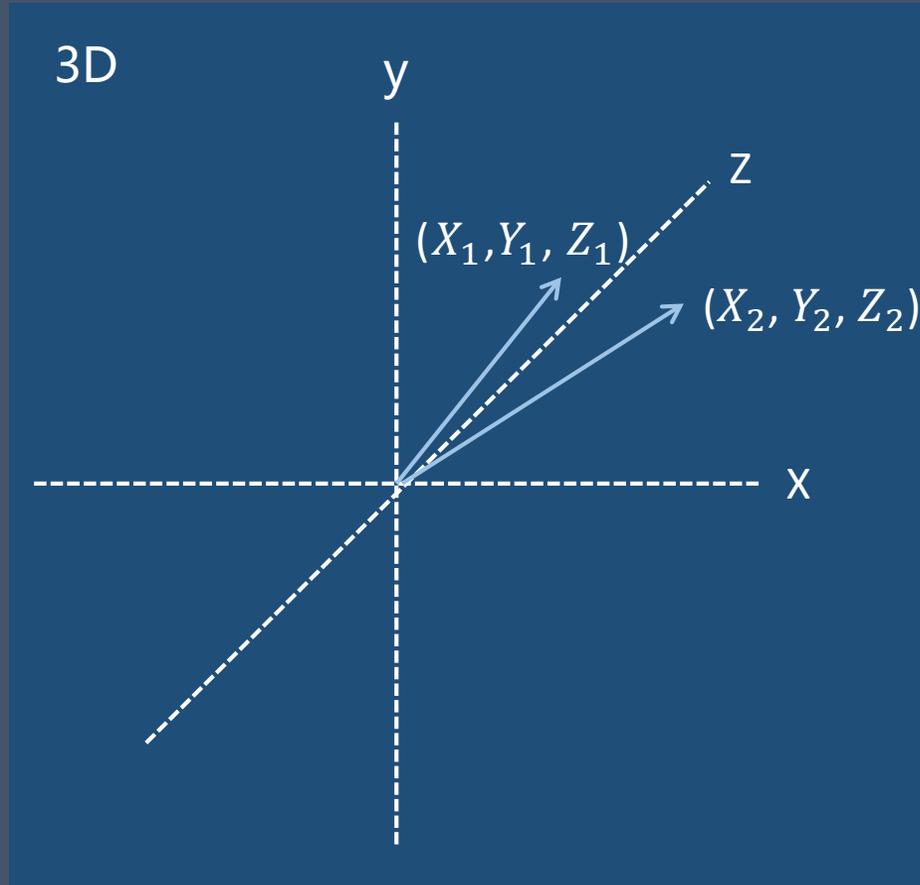


Gephi實務操作

Statistic 統計

8.6 網絡與分群_MDS

Multi-dimensional Scaling



Multi-dimensional Scaling

以距離遠近在多維空間地圖上呈現節點的相似性或相異性
節點間距離越小代表相似程度越高

 Multidimensional Scaling settings ✕

Select the number of dimensions for the resulting configuration: **選擇運算的空間維度，通常是2D或3D**

2 3 4 5 6 7 8 9 10

Treatment of edges:

Don't use edge weights

Edge weights as distances / dissimilarities **相異性**

Edge weights as proximities / similarities **相似性**

Treatments of distances in stress calculation:

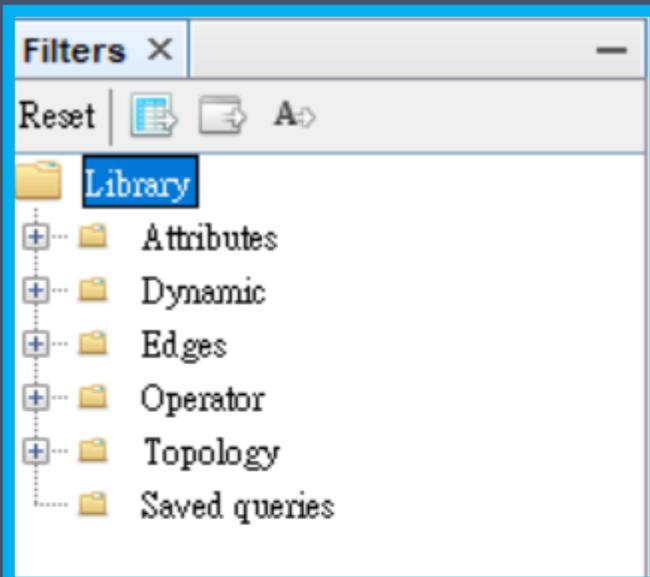
節點長距離節點降權重與短距離節點升權重

Weigh distances equally **節點間權重距離等同**

Gephi實務操作

09 Filter 篩選

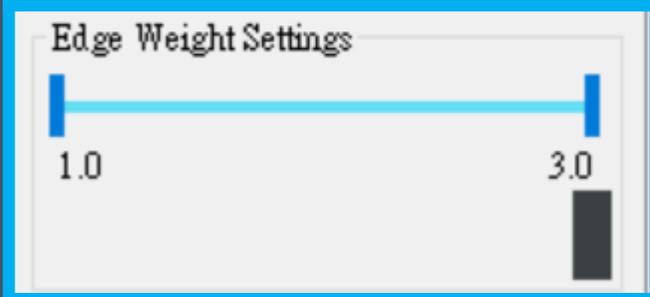
篩選工具



設定條件



條件門檻值



1. Attributes節點屬性
2. Dynamic動態
3. Edges連結
4. Operator操作
5. Topology拓樸學
6. Save Queries 儲存篩選條件

Filter 將符合條件的節點保留在畫面上

Select 保留整個網絡圖並將符合條件的節點凸顯出來

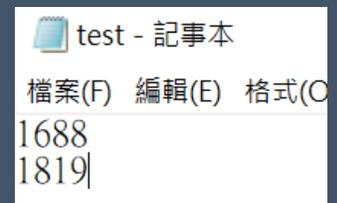
Gephi實務操作

Filter 篩選 9.1 Attribute

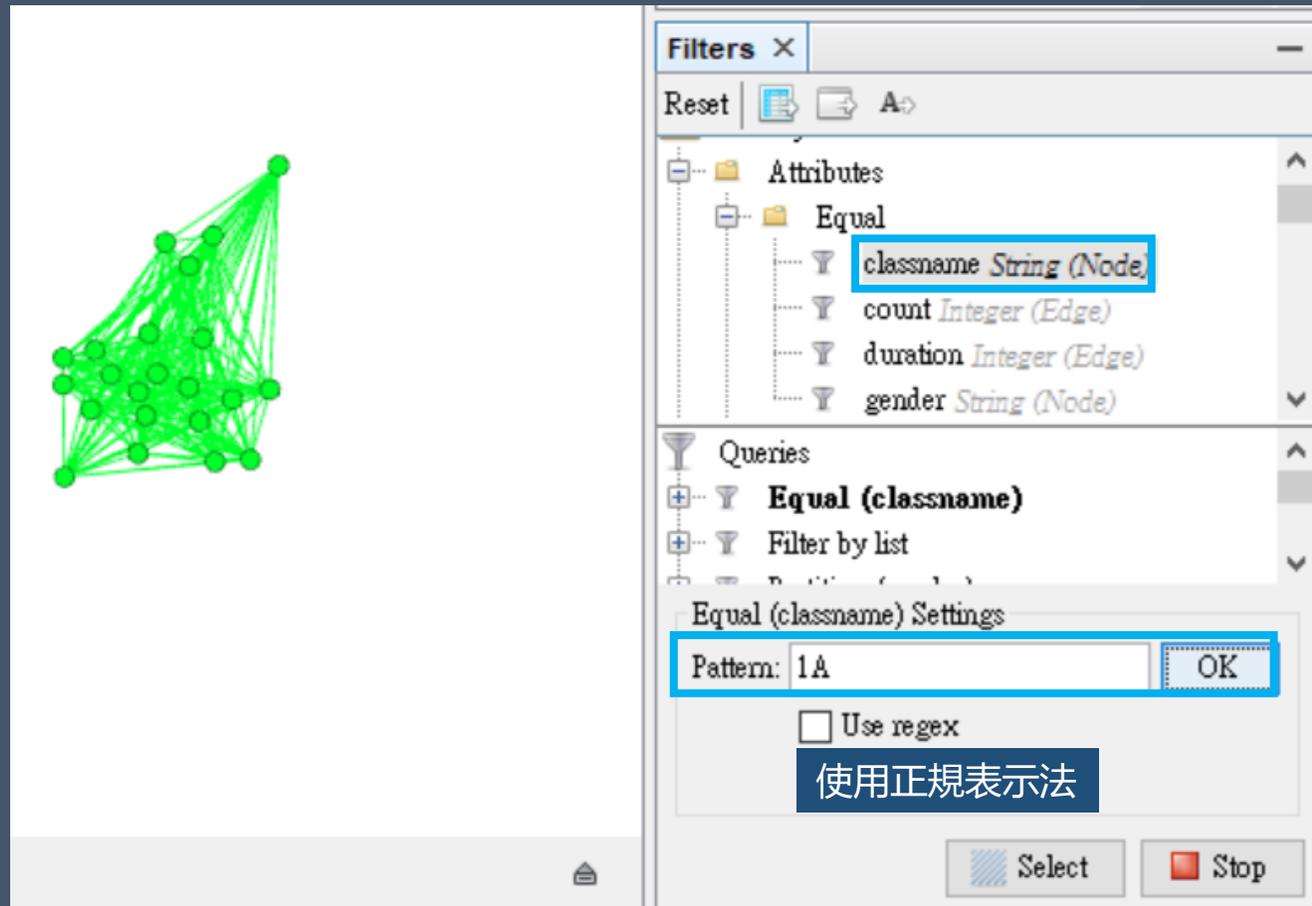
Attributes

Dataset: school day

- 1) Equal: 等於篩選條件
- 2) **Inter Edges**: 著重在分群後單一子群的內部(within)連結
[inter edge within a group]
- 3) **Intra Edges**: 用來找出各分群之間跨群(across-group)的連結路徑
[intra edges across-group]
- 4) Non-null: 隱藏圖像的缺值(missing values)的節點與連結
- 5) Partion: 選擇節點屬性(**node**)以利觀察網絡內的子群體
- 6) Partion Count: 利用節點次數(**node**)來篩選要分析的子群體
- 7) Range: 選擇連結(**edge**)的屬性範圍以利觀察網絡特定節點群
- 8) Filter by label list: 利用記事本儲存節點標籤,
鎖定特定節點進行篩選 a label, a row



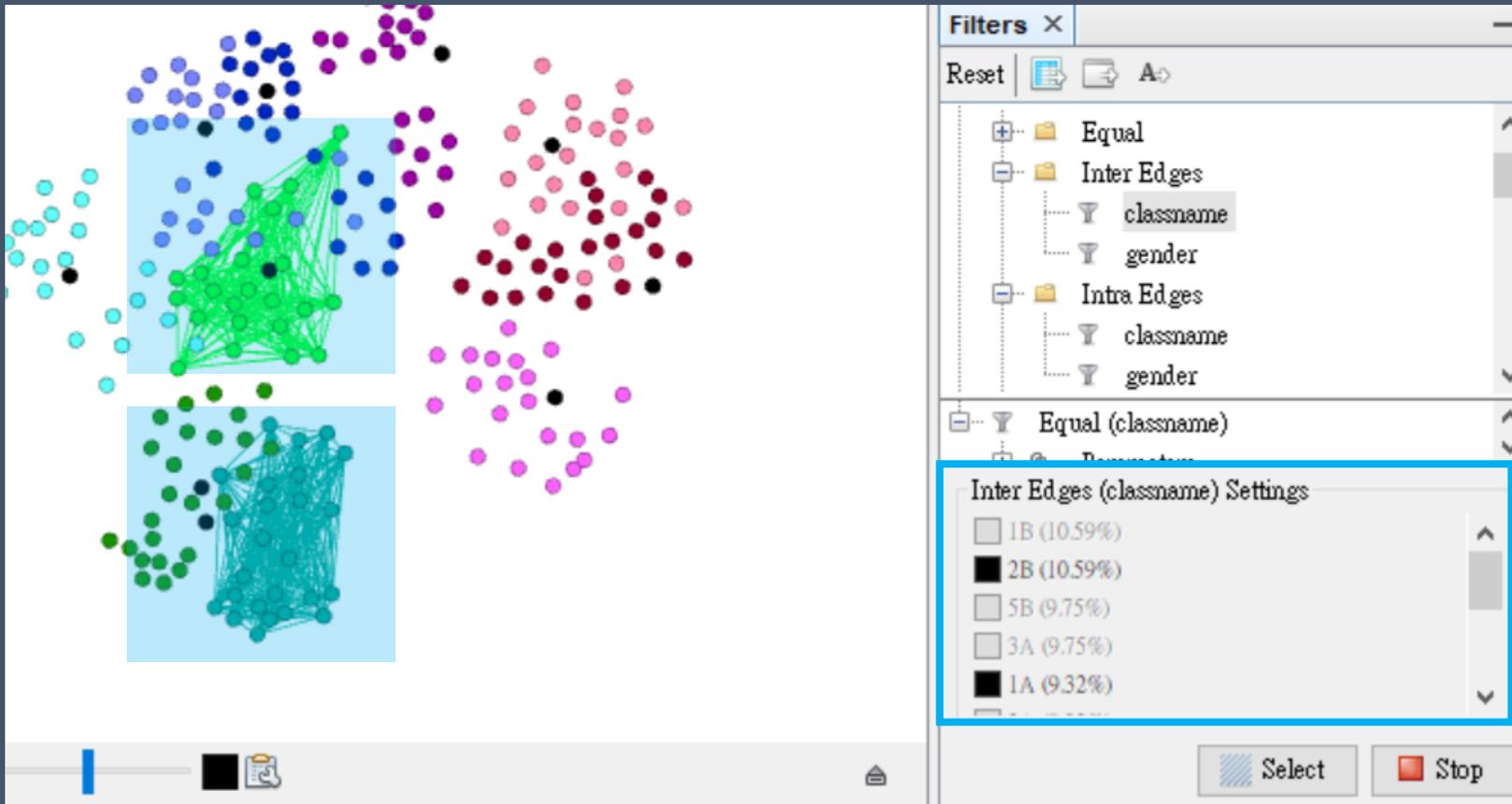
Attributes 1) Equal



The image shows a network graph on the left with green nodes and edges. On the right is a 'Filters' dialog box. The 'Attributes' section is expanded to 'Equal', and 'classname String (Node)' is selected. Below, the 'Queries' section shows 'Equal (classname)' selected. The 'Equal (classname) Settings' section has a 'Pattern' field containing '1A' and an 'OK' button. A blue box highlights the 'Use regex' checkbox, with the text '使用正規表示法' (Use regular expression) written below it. At the bottom are 'Select' and 'Stop' buttons.

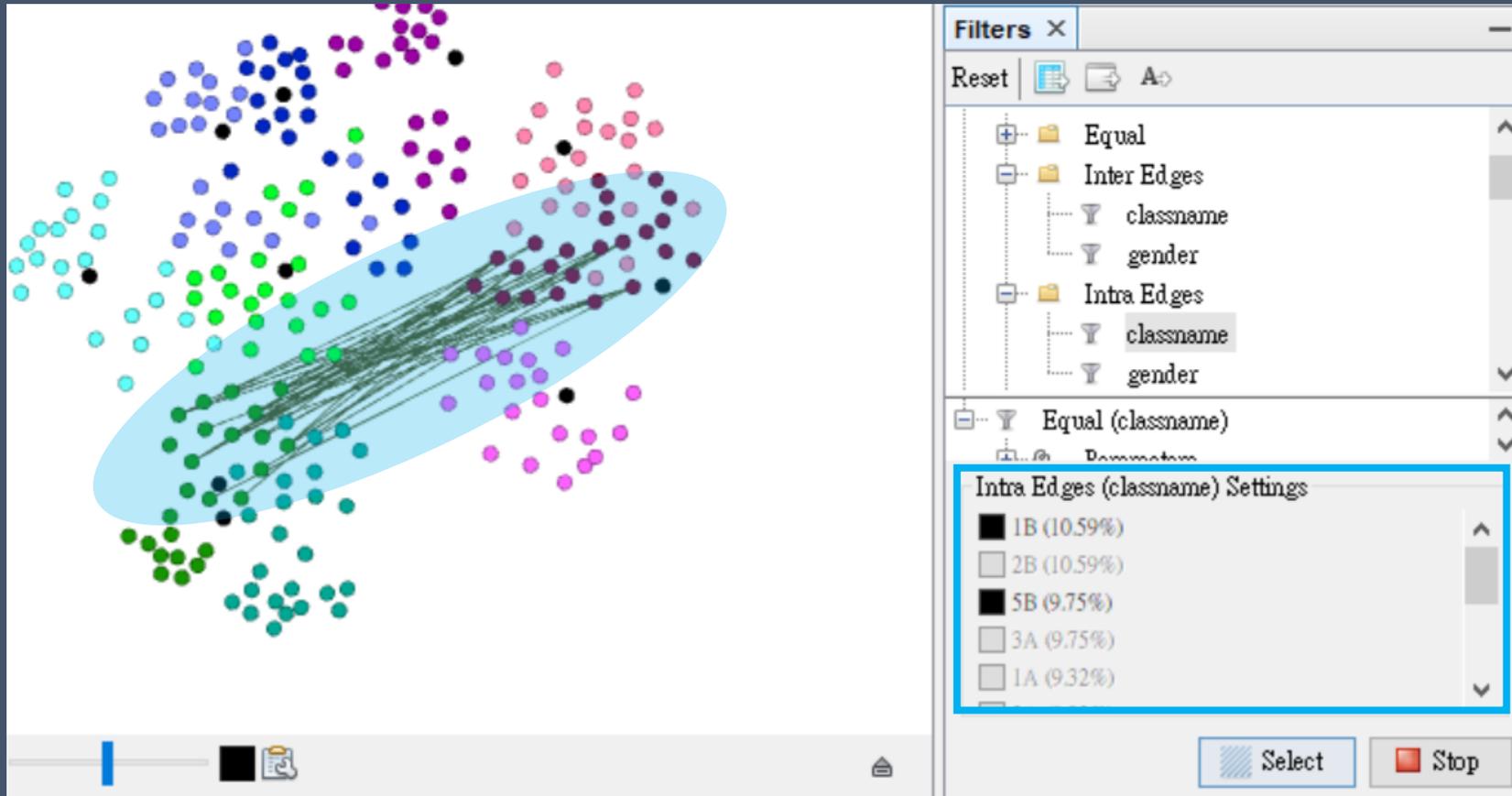
- ① 選擇篩選的屬性
- ② 輸入要篩選的對象：1A(班級) 按下OK
- ③ 選擇Filter

Attributes 2) Inter Edges



著重在分群後單一子群的內部(within)連結，
用於處理同質性較高的網絡或密度較高的網絡

Attributes 3) Intra Edges



著重分群後跨群(cross-group)之間連結，
用來找出各分群之間的連結路徑

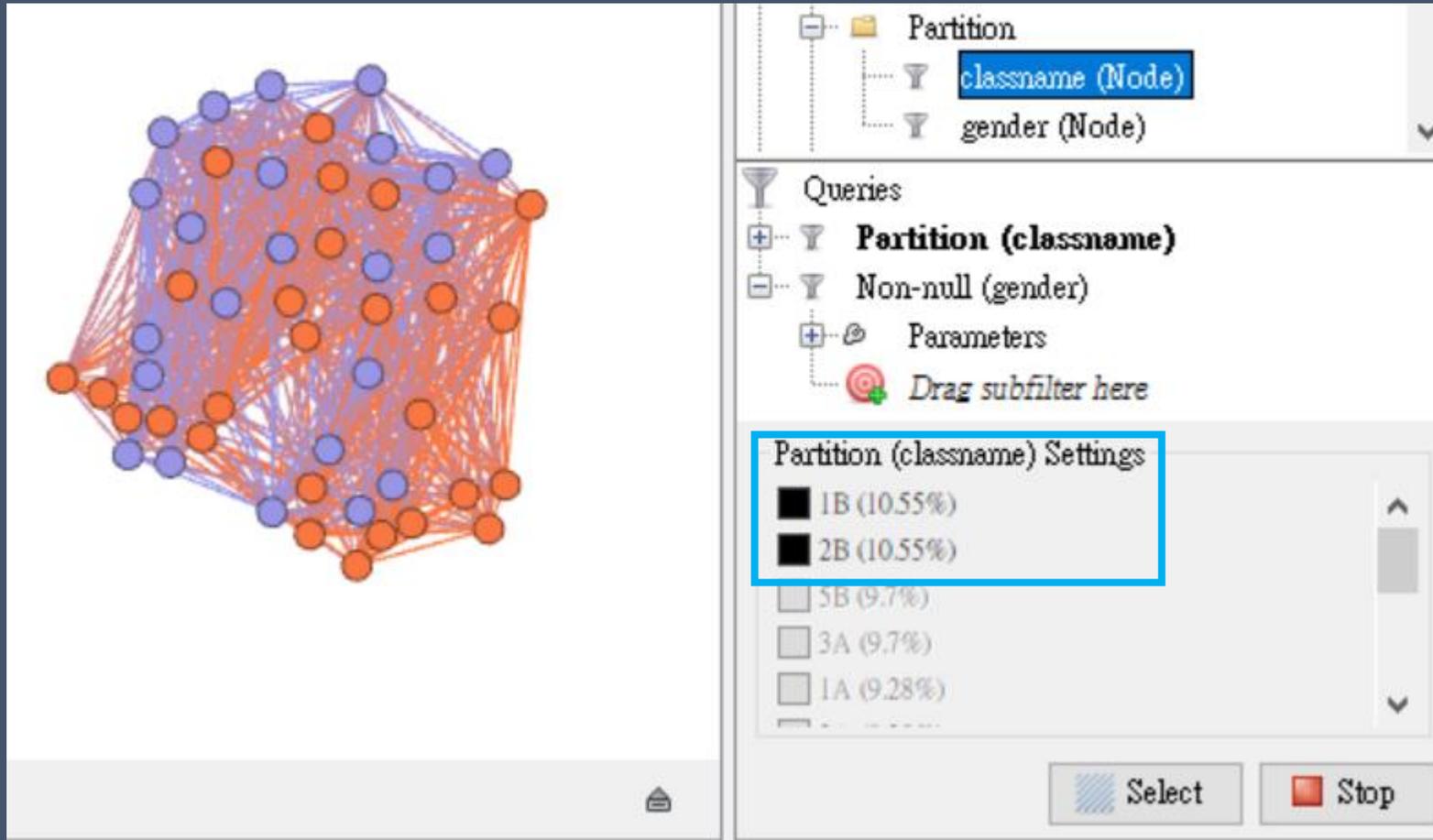
Attributes 4) Non-null

The screenshot displays a graph visualization tool with several panels:

- Appearance:** Shows a legend for the 'gender' attribute with categories: M (47.26%), F (46.41%), Unknown (5.91%), and null (0.42%).
- Filters:** A query 'Non-null (gender)' is selected, with a subfilter 'Drag subfilter here'.
- Graph:** A network graph with nodes colored by gender. A single black node is highlighted with a blue circle at the bottom.

隱藏圖像的缺值(missing values)的節點與連結
注意：範例資料資料集未有空值，操作前請在範例資料集自行新增節點

Attributes 5) Partition



選擇屬性以利觀察網絡內的子集，EX：1B
可選多個子群一同觀察

Attributes 6) Partion Counts

The screenshot displays a network graph on the left and a control panel on the right. The graph consists of 10 green nodes connected by green edges. The control panel on the right is titled 'Partition Count' and includes a tree view with 'classname String (Node)' and 'gender String (Node)' under a folder icon. Below this is a 'Queries' section with a list: 'Partition Count (classname)', 'Partition (classname)', 'Non-null (gender)', 'Parameters', and 'Drag subfilter here'. A 'Partition Count (classname) Settings' section features a slider with values 7 and 14, and a bar chart below it. At the bottom are 'Select' and 'Stop' buttons.

利用節點次數來篩選要分析的子群體，
可鎖定特大或集小的節點群

Attributes 7) Range

The image shows a network visualization interface. On the left, a graph is displayed with nodes of various colors (blue, orange, green) and edges connecting them. On the right, a control panel is visible. The panel has a tree view on the left with the following items: 'gender String (Node)', 'Range' (expanded), 'count Integer (Edge)', 'duration Integer (Edge)', 'Filter by label list', 'Dynamic', 'Edges', 'Edge Type', and 'Edge Weight'. Below this is a 'Queries' section with a filter icon and the text 'Range (count)'. Underneath is a 'Parameters' section. The 'Range (count) Settings' section is highlighted with a blue border and contains a horizontal slider with a blue bar. The slider has the value '87' on the left and '149' on the right. At the bottom of the panel are two buttons: 'Select' (with a blue hatched icon) and 'Stop' (with a red square icon).

選擇連結(edge)的屬性範圍以利觀察網絡特定節點群

Gephi實務操作

Filter 篩選 9.2 Edges

Edges

Dataset: Multigraph Example

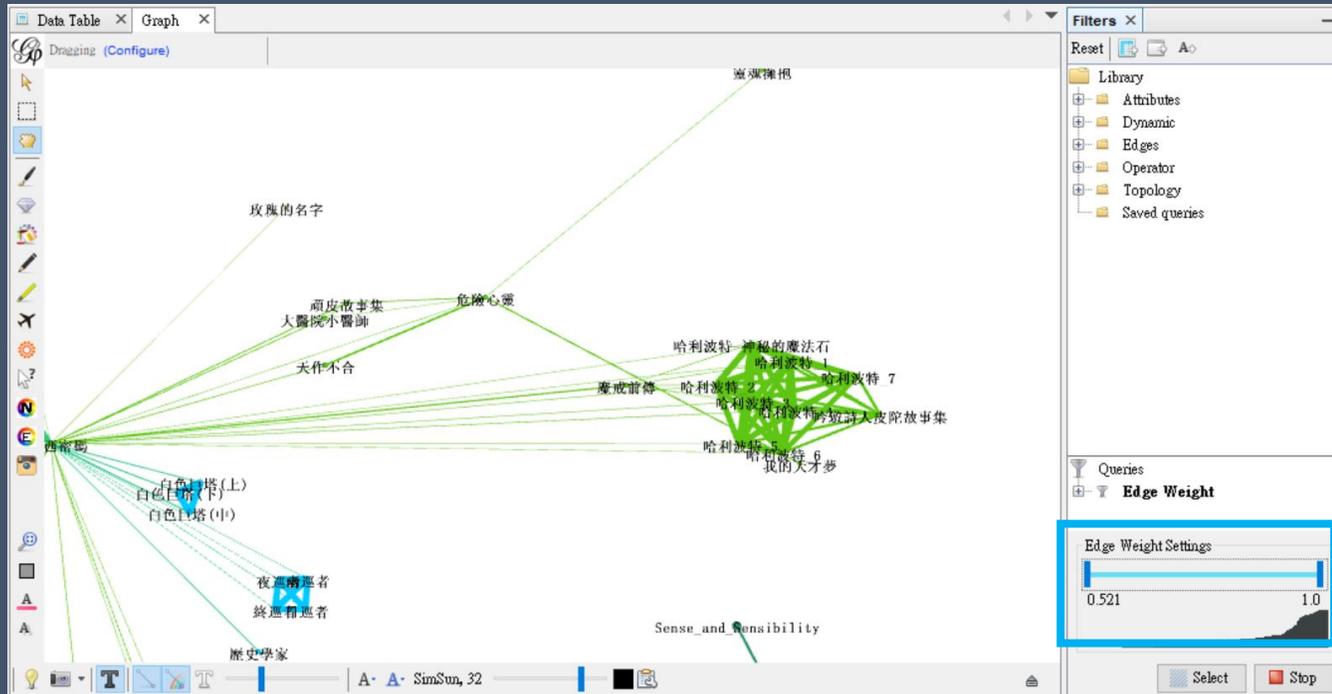
- 1) Edge type: 用來篩選不同種類的連結
- 2) Edge Weight: 利用連結權重值篩選需要的連結
- 3) Mutual Edge: 篩選單向連結, 僅保留雙向連結
- 4) Self-Loop: 移除節點的自我連結(自環)

Edges 1) Edge type 用來篩選不同種類的連結

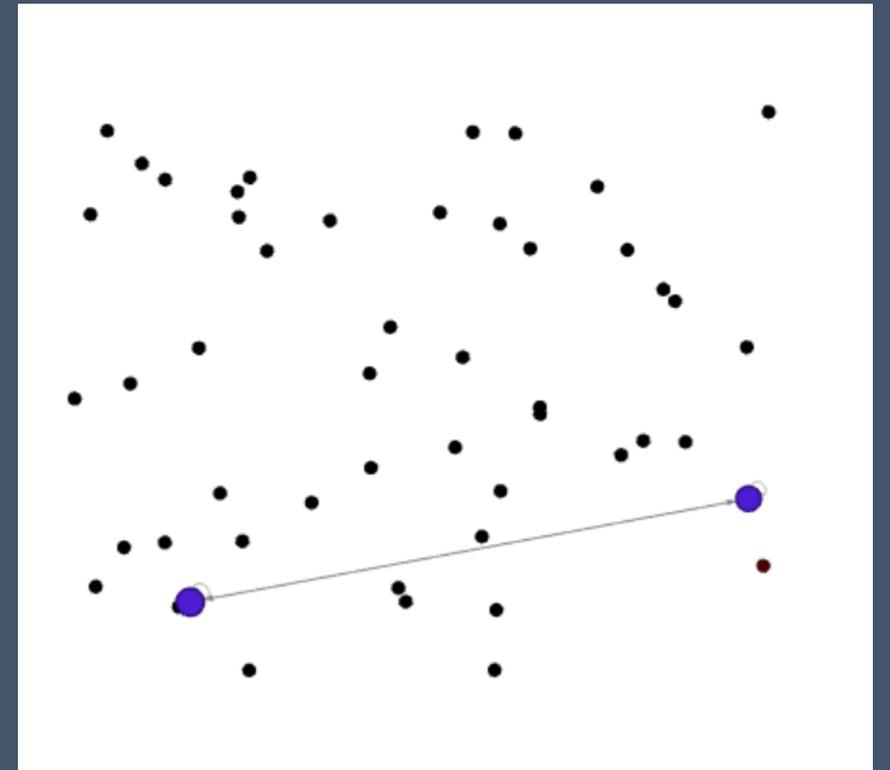
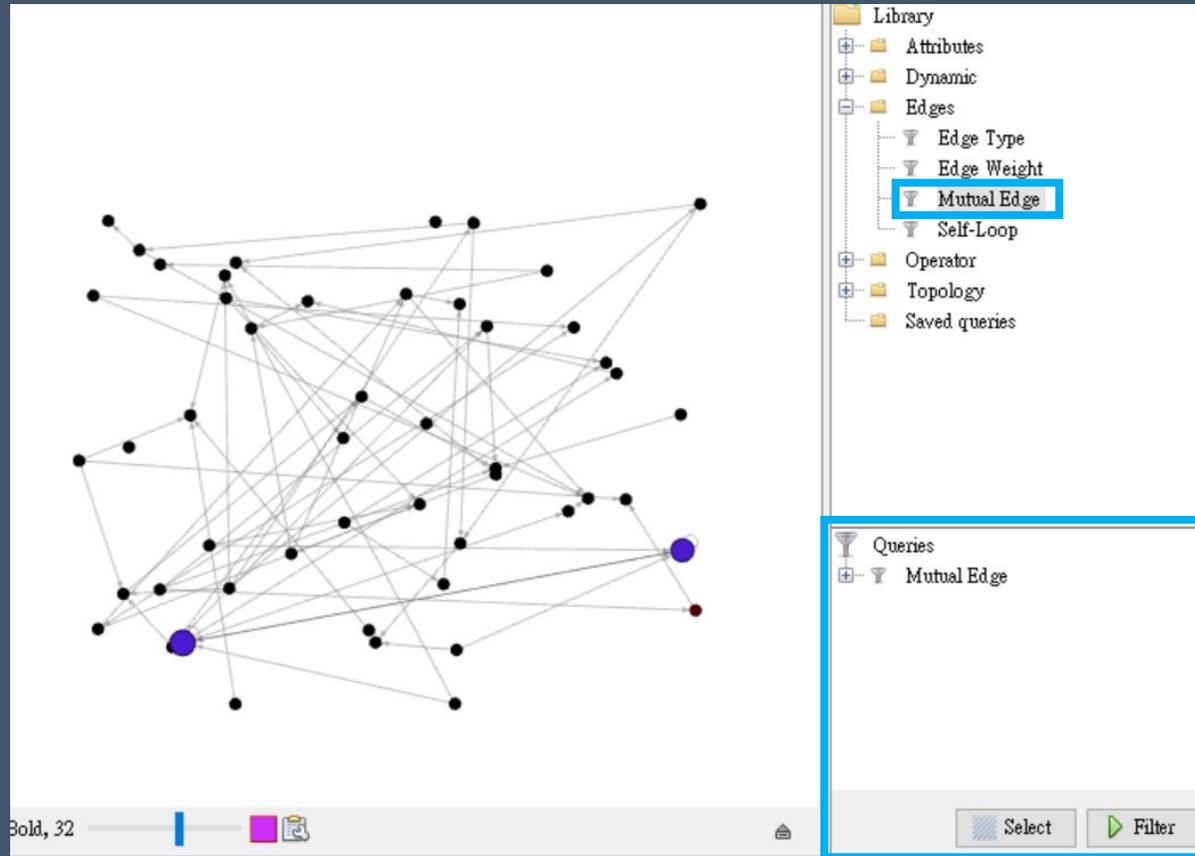
The image shows a network visualization tool interface. On the left is a 3D network graph with nodes colored in blue, green, purple, and red, connected by edges. On the right is a 'Filters' panel with tabs for 'Filters' and 'Statistics'. The 'Filters' tab is active, showing a tree view of filter categories: Library, Attributes, Dynamic, Edges, Operator, Topology, and Saved queries. The 'Edges' category is expanded, and 'Edge Type' is selected and highlighted with a blue box. Below the tree view, a 'Queries' section contains a dropdown menu labeled 'Edge Type Settings' with 'share' selected and highlighted with a blue box. At the bottom of the panel are 'Select' and 'Stop' buttons. The bottom status bar shows 'Arial Bold, 32' and some icons.

Edges 2) Edge weight

利用連結加權篩選需要的連節



Edges 3) Mutual Edges



篩選單向連結，僅保留雙向連結

Edges 4) Self-Loop

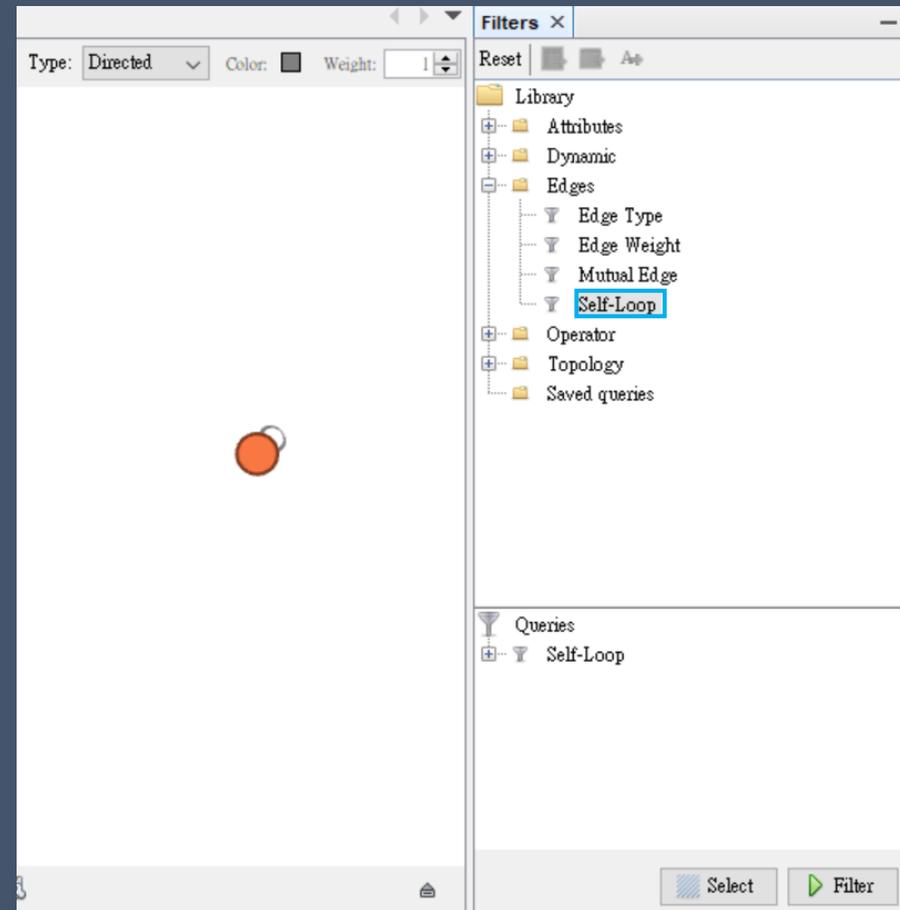


移除節點的自環連結

→ 移除節點自己連自己的連結

→ 該節點與其對外連結都不會消失

(自環連結會影響中心性程度的計算)



Gephi實務操作

Filter 篩選 9.3 Operator

Operator

Dataset: school day

- 1) Intersection: 篩選交叉節點
+Attribute>PartitionCounts>Degrees
- 2) Mask(Edges): 篩選特定範圍連結
- 3) NOT(Edges): 不顯示特定連結 +Attribute>Inter/Intra Edges
- 4) NOT(Nodes): 不顯示特定節點
- 5) UNION: 聯合設定多個篩選條件 +Attribute>Equal or Partition

5) UNION+Equal/Partition

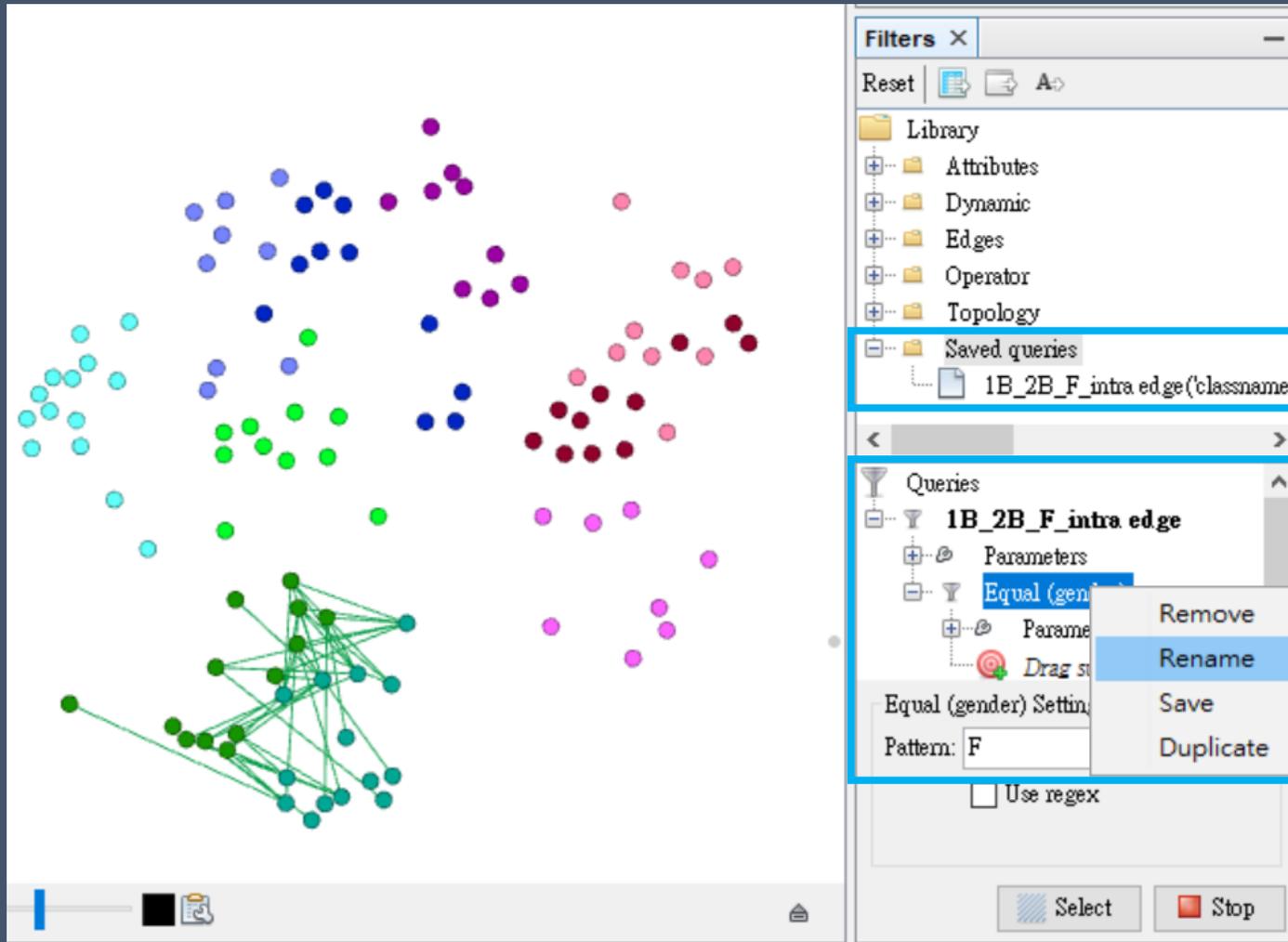
The screenshot shows a network visualization software interface. On the left, a graph is displayed with nodes and edges. The nodes are colored in shades of green and blue, and the edges are green. On the right, a query panel is visible. The panel has a 'Reset' button and a list of filters. The 'Queries' section is highlighted with a blue box. It shows a 'UNION' query with two subfilters: 'Partition (classname)' and 'Equal (Degree)'. Below the 'Equal (Degree)' filter, there are settings for 'Value' (set to 29), 'Minimum' (18), and 'Maximum' (96). The 'Equal (Degree) Settings' section is also highlighted with a blue box.

The diagram illustrates the query structure for UNION+Equal/Partition. It shows a hierarchy of filters. The top level is 'Queries'. Below it, there are two main sections. The first section is 'MASK (Edges)' with a blue box labeled '階層限縮' (Hierarchical Restriction). This section includes 'Partition (classname)' and 'Parameters'. The second section is 'UNION' with a blue box labeled '條件累加' (Condition Accumulation). This section includes 'Equal (classname)', 'Partition (classname)', 'Mutual Edge', and 'Self-Loop'. Both sections have a 'Drag subfilter here' icon.

Gephi實務操作

Filter 篩選 9.4 Saved queries

Saved Queries



The screenshot displays a network graph with nodes colored by class (1B, 2B) and gender (F). A 'Filters' panel on the right shows a 'Saved queries' folder containing a query named '1B_2B_F_intra edge(classname'. Below it, the 'Queries' panel shows the query '1B_2B_F_intra edge' with a context menu open over the 'Equal (gender)' filter, with options like 'Remove', 'Rename', 'Save', and 'Duplicate'. The 'Pattern' field is set to 'F'.

完成下列兩步驟後
Saved queries 出現已存的篩選組合

- ① 選取要設定的篩選組合
Ex: 1B與2B兩班女同學來往關係
Partion > 1B and 2B
+
Equal(gender) > F [記得按OK]
- ② 將篩選組合重新命名, 再儲存

注意: 一定要再Queries視窗先命名,
儲存到Saved Queries就無法命名