

大數據行銷研究



Tamkang
University
淡江大學

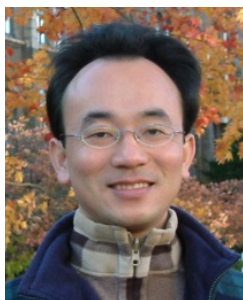
Big Data Marketing Research

社會網絡分析量測與實務
(Measurements and Practices of
Social Network Analysis)

1051BDMR10

MIS EMBA (M2262) (8638)

Thu, 12,13,14 (19:20-22:10) (D409)



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<http://mail.tku.edu.tw/myday/>

2016-12-16



課程大綱 (Syllabus)

週次 (Week)	日期 (Date)	內容 (Subject/Topics)
1	2016/09/16	中秋節 (調整放假一天) (Mid-Autumn Festival Holiday)(Day off)
2	2016/09/23	大數據行銷研究課程介紹 (Course Orientation for Big Data Marketing Research)
3	2016/09/30	資料科學與大數據行銷 (Data Science and Big Data Marketing)
4	2016/10/07	大數據行銷分析與研究 (Big Data Marketing Analytics and Research)
5	2016/10/14	測量構念 (Measuring the Construct)
6	2016/10/21	測量與量表 (Measurement and Scaling)

課程大綱 (Syllabus)

週次 (Week)	日期 (Date)	內容 (Subject/Topics)
7	2016/10/28	大數據行銷個案分析 I (Case Study on Big Data Marketing I)
8	2016/11/04	探索性因素分析 (Exploratory Factor Analysis)
9	2016/11/11	確認性因素分析 (Confirmatory Factor Analysis)
10	2016/11/18	期中報告 (Midterm Presentation)
11	2016/11/25	社群運算與大數據分析 (Social Computing and Big Data Analytics)
12	2016/12/02	社會網路分析 (Social Network Analysis)

課程大綱 (Syllabus)

週次 (Week)	日期 (Date)	內容 (Subject/Topics)
13	2016/12/09	大數據行銷個案分析 II (Case Study on Big Data Marketing II)
14	2016/12/16	社會網絡分析量測與實務 (Measurements and Practices of Social Network Analysis)
15	2016/12/23	大數據情感分析 (Big Data Sentiment Analysis)
16	2016/12/30	金融科技行銷研究 (FinTech Marketing Research)
17	2017/01/06	期末報告 I (Term Project Presentation I)
18	2017/01/13	期末報告 II (Term Project Presentation II)

**Measurements
and
Practices
of
Social Network Analysis**

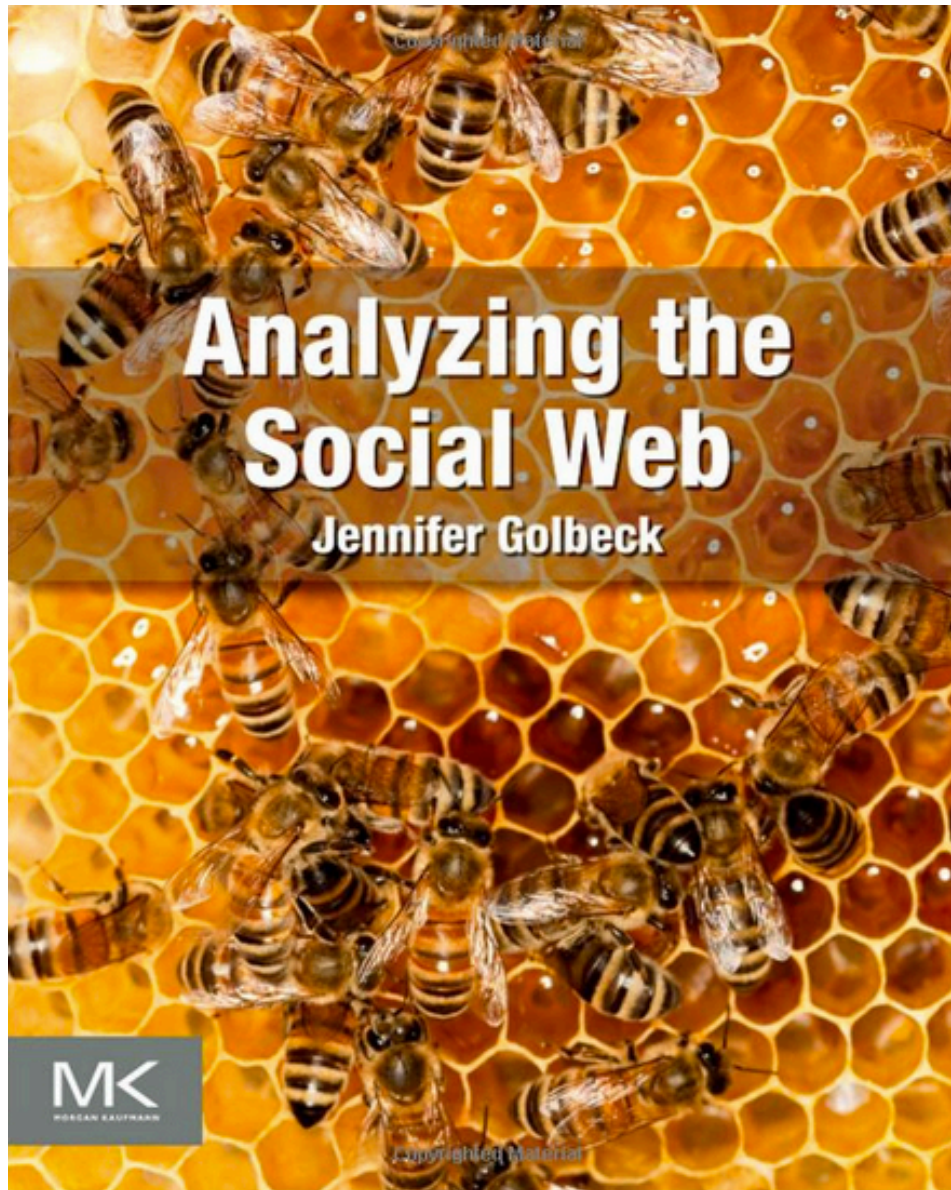
Social Computing

- Social Network Analysis
- Link mining
- Community Detection
- Social Recommendation

Business Insights
with
Social Analytics

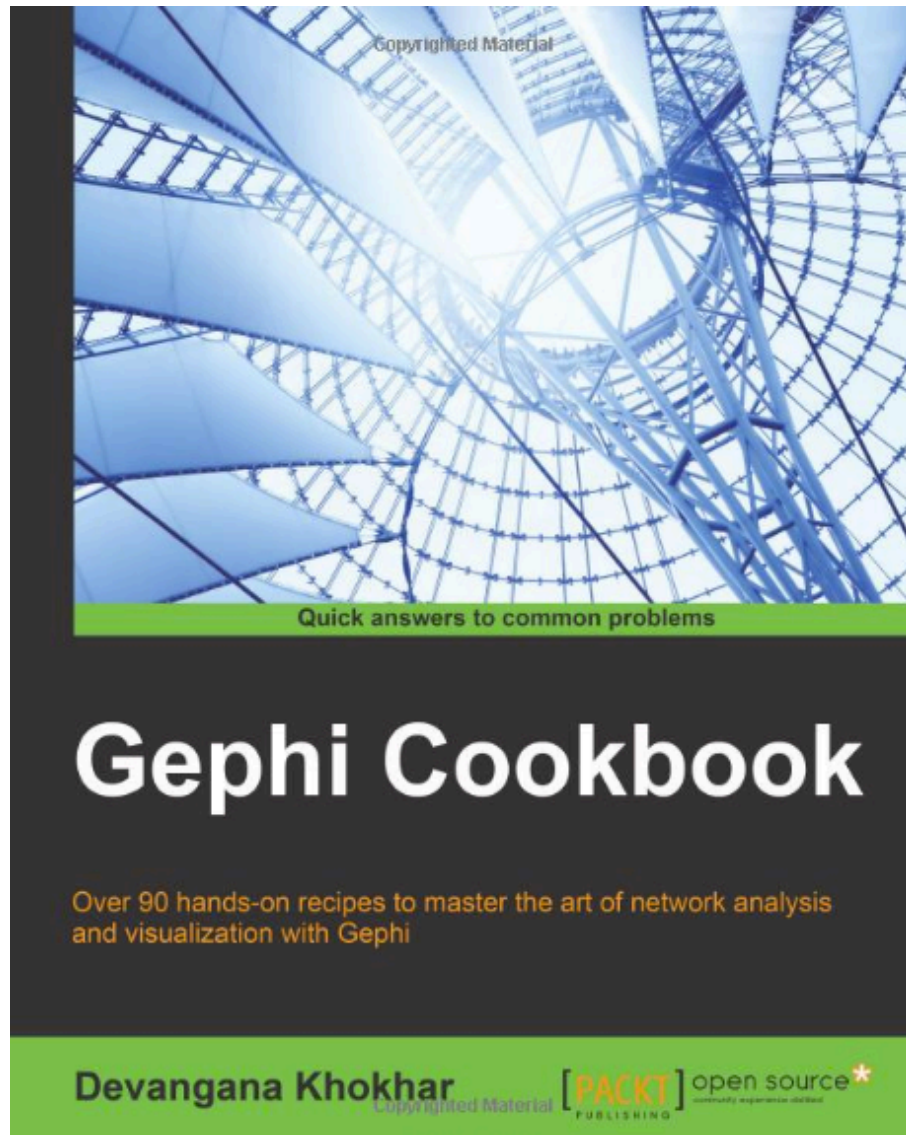
Analyzing the Social Web: Social Network Analysis

Jennifer Golbeck (2013), **Analyzing the Social Web**, Morgan Kaufmann



Source: <http://www.amazon.com/Analyzing-Social-Web-Jennifer-Golbeck/dp/0124055311>

Devangana Khokhar (2015), Gephi Cookbook, Packt Publishing



Social Network Analysis (SNA)

Facebook TouchGraph

TouchGraph Photos x

box.touchgraph.com/facebook/TGFacebookBrowser.php?&signed_request=Gi-L3_6HrZ0S3SjxAXGdHR0rhMzqBjUnvFJ9vE4W6vg.eyJhbGdvcm00aG0iOiJITUFDI☆

Profiles Networks

Show Top 100 Friends Show All Friends Upload Advanced Restart

Zoom: Spacing:

Min-Yuh Day
 Networks: None
 Mutual Friends: 681

Facebook Profile

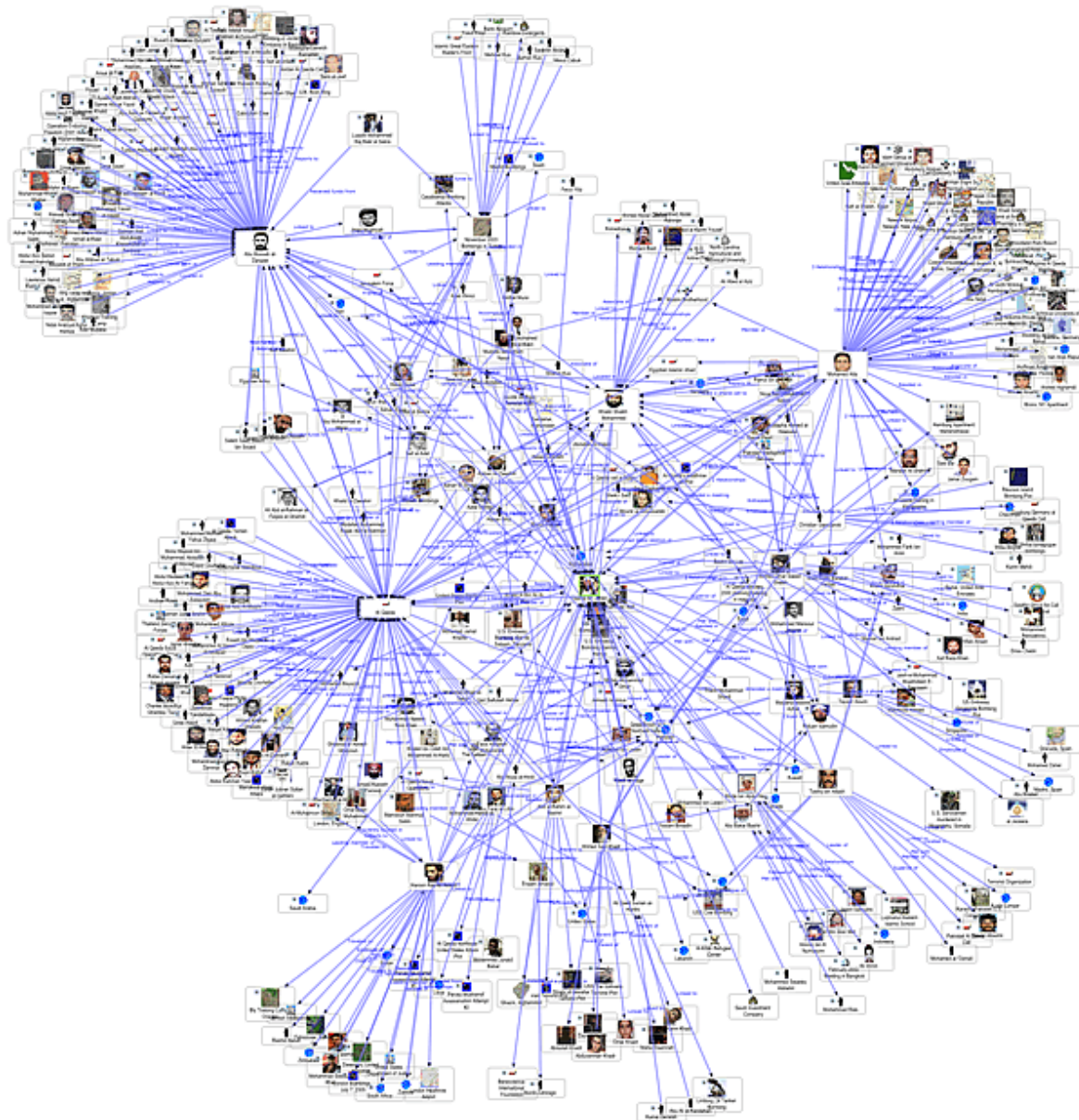
Network All All List Photo

Name	Rank #	Friend #	民
Min-Yuh Day	1	681	
Gladys Hsieh	2	85	
黃西田	3	74	
施盛賢	4	67	
John Lee	5	104	
Kevin Tu	6	61	
Yung Yu Shih	7	45	
Wei Chen	8	107	
Chichang Jou	9	50	
Allen Green	10	81	
黃煒勳	11	65	
梁德昭	12	44	
Eric Chen	13	51	
吳錦波	14	39	
Jessica Tien	15	49	
蔡名宜	16	112	
Enrico Lu	17	59	
YaHan Hsieh	18	64	
王慧雯	19	56	
薛聖譚	20	80	
蝦米	21	73	

ICCU

powered by TouchGraph

Social Network Analysis



Social Network Analysis

- A **social network** is a social structure of people, related (**directly** or **indirectly**) to each other through a common relation or interest
- **Social network analysis (SNA)** is the study of social networks to understand their **structure** and **behavior**

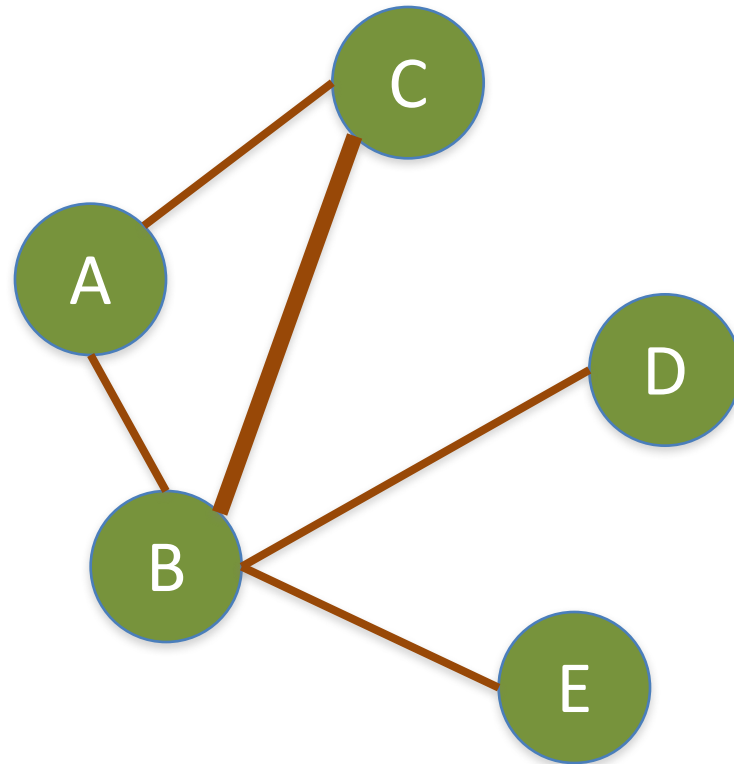
Social Network Analysis (SNA)

Centrality

Prestige

Graph Theory

Graph



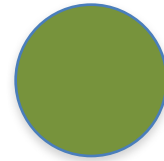
Graph

$$g = (V, E)$$

Vertex (Node)



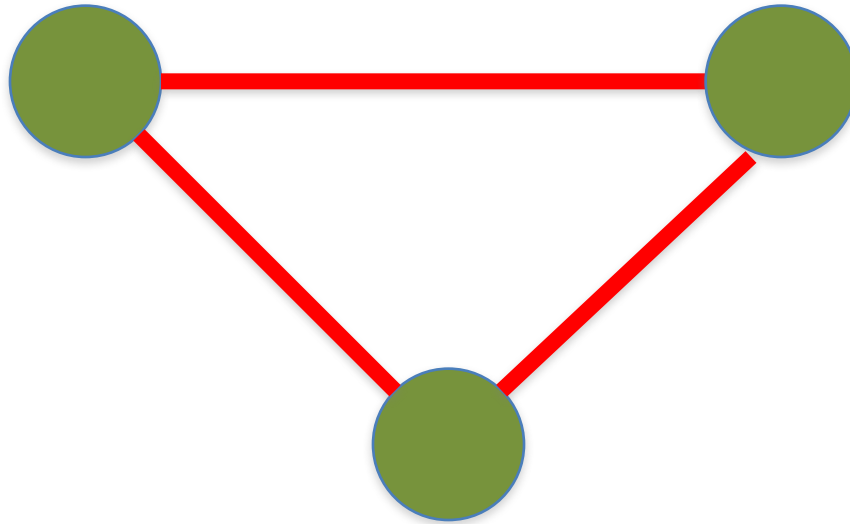
Vertices (Nodes)



Edge



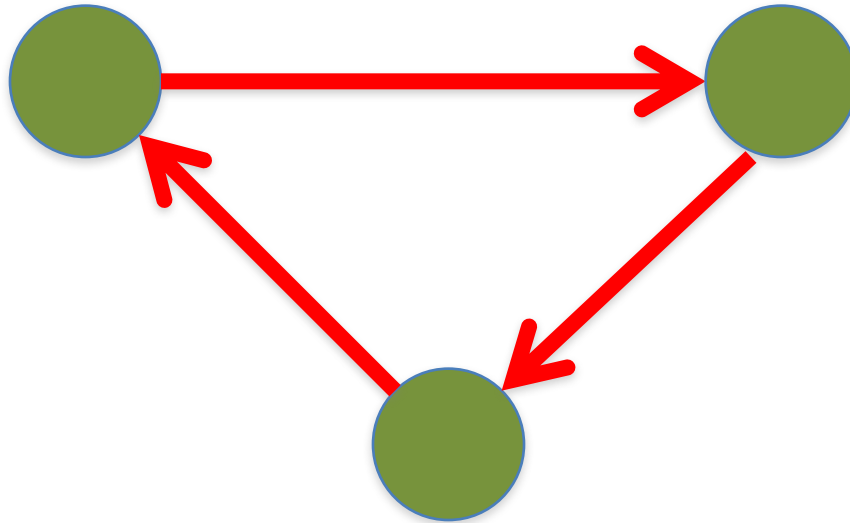
Edges



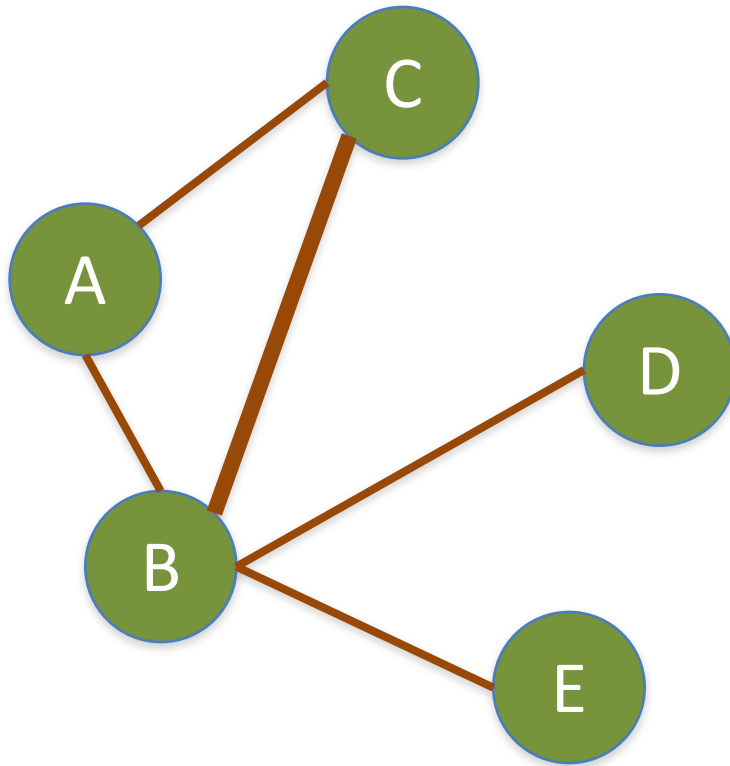
Arc



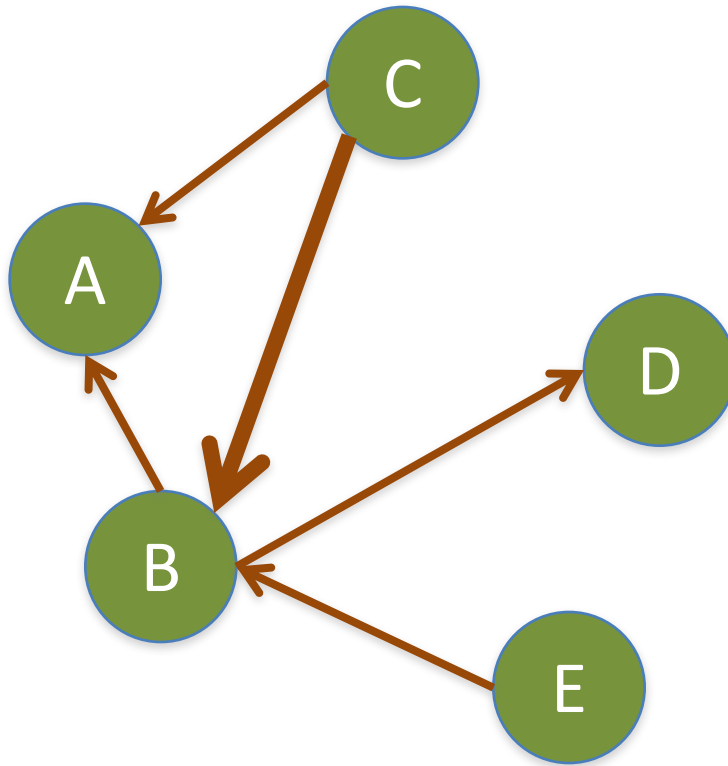
Arcs



Undirected Graph

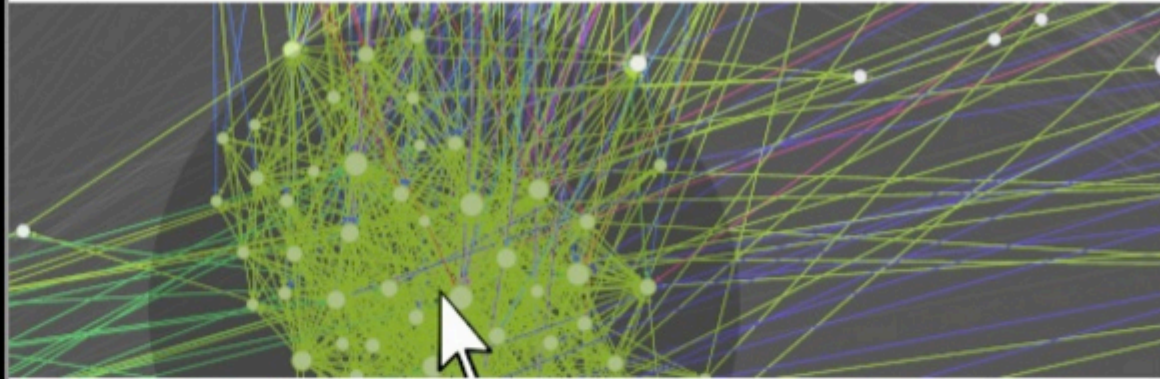
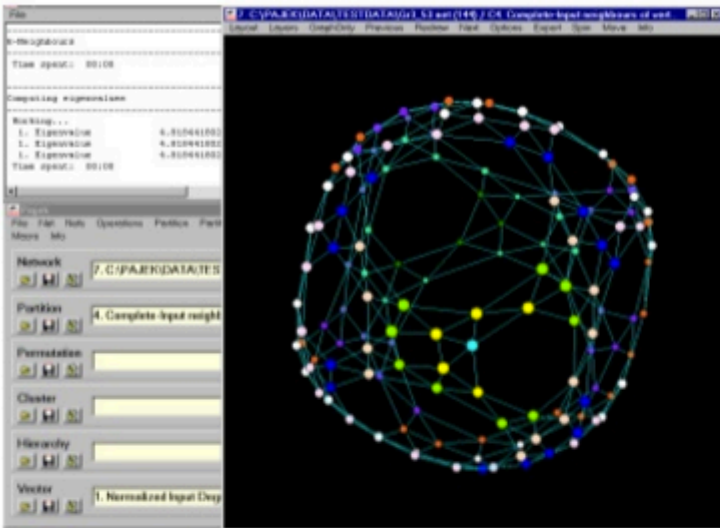


Directed Graph



Measurements of Social Network Analysis

Exploratory Network Analysis



1 see the network

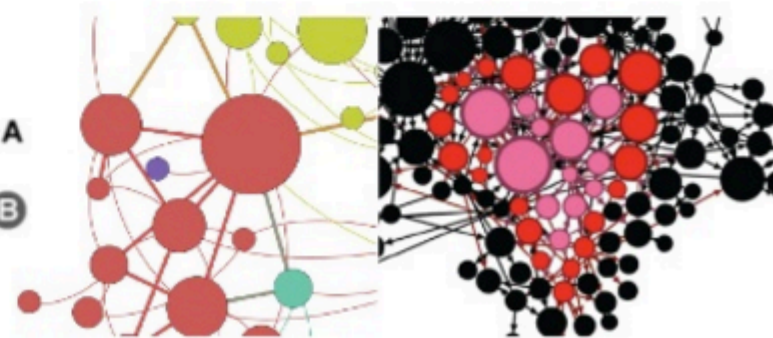
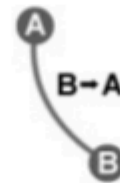
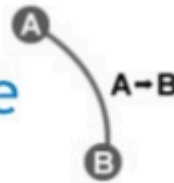
1st graph viz tool: Pajek (1996)
Vladimir Batagelj, Andrej Mrvar

2 interact in real time

Gephi prototype (2008)
group, filter, compute metrics...

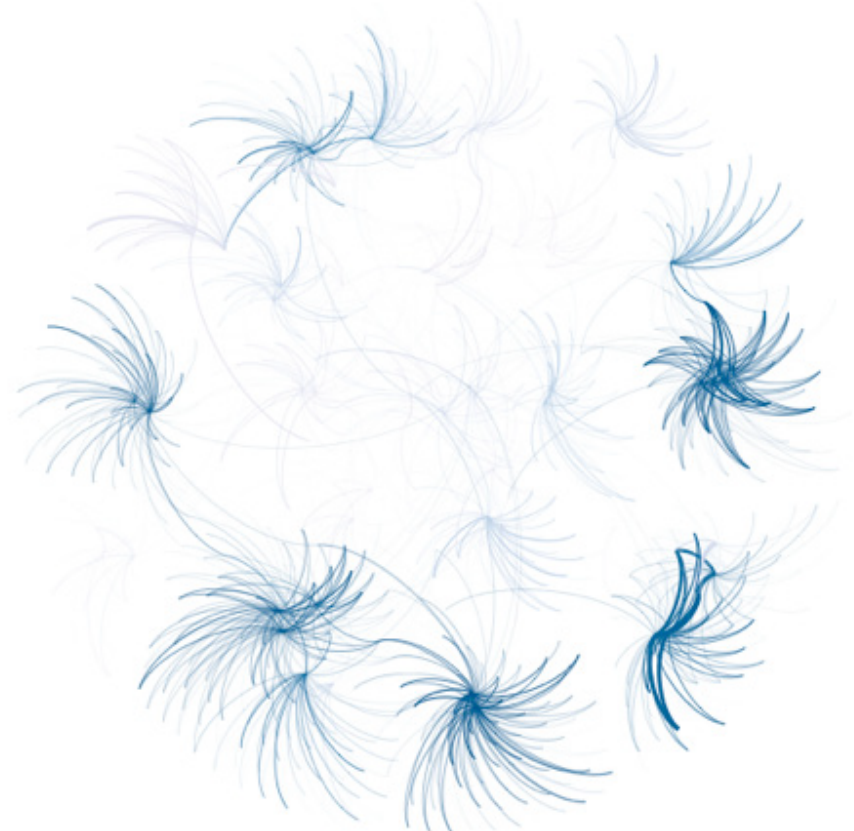
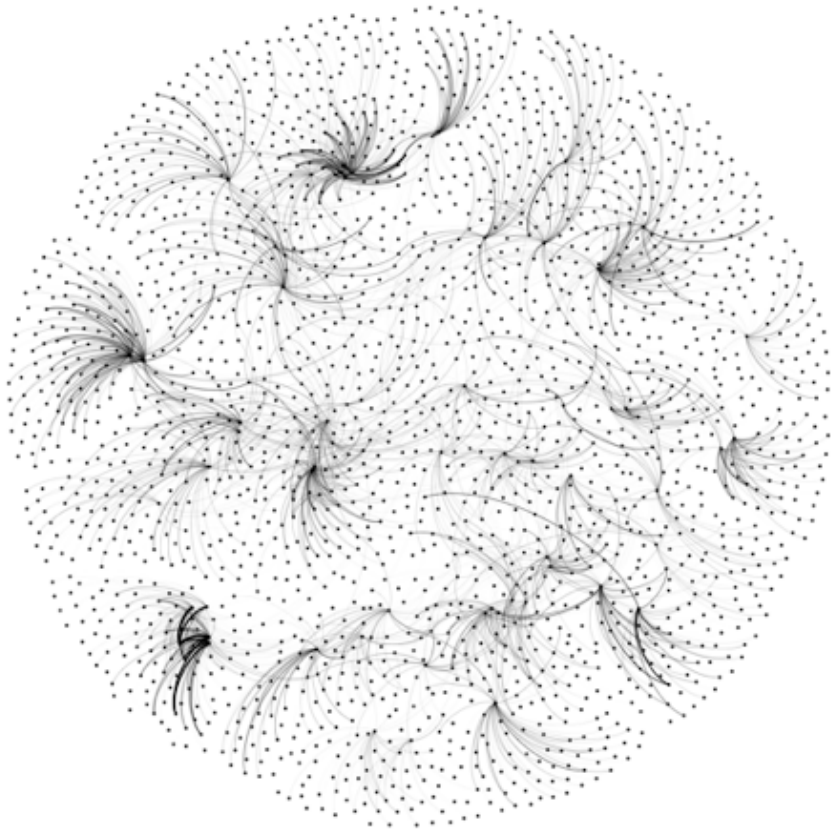
3 build a visual language

size by rank, color by partition,
label, curved edges, thickness...



Looking for a “Simple Small Truth”?

What Data Visualization Should Do?



1. Make complex things **simple**
2. Extract **small** information from large data
3. Present **truth**, do not deceive

Measurements

Looking for Orderness in Data

Make varying 3 cursors simultaneously to extract meaningful patterns

MICRO level MACRO level



at different levels

1 dimension N dimensions



on multiple dimensions

T+0 T+N

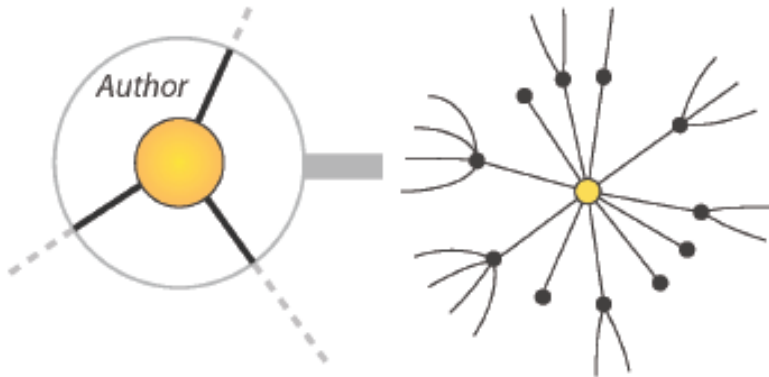
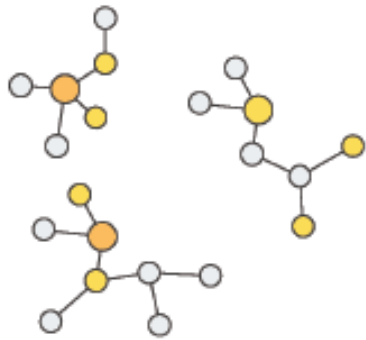


at time scale

“Zoom” cursor on Quantitative Data

MICRO level

MACRO level



Global

- connectivity
- density
- centralization

Local

- communities
- bridges between communities
- local centers vs periphery

Individual

- centrality
- distances
- neighborhood
- location
- local authority vs hub

“Crossing” cursor on Quantitative Data



Social

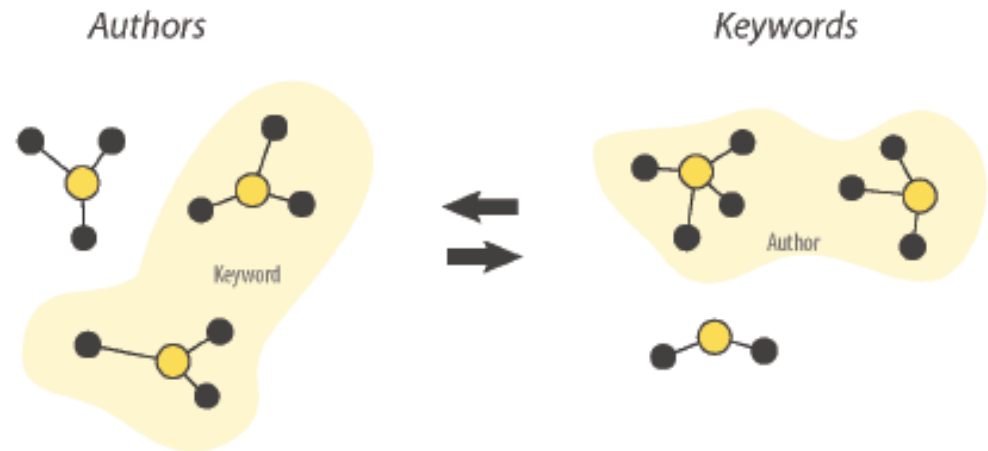
- who with whom
- communities
- brokerage
- influence and power
- homophily

Semantic

- topics
- thematic clusters

Geographic

- spatial phenomena



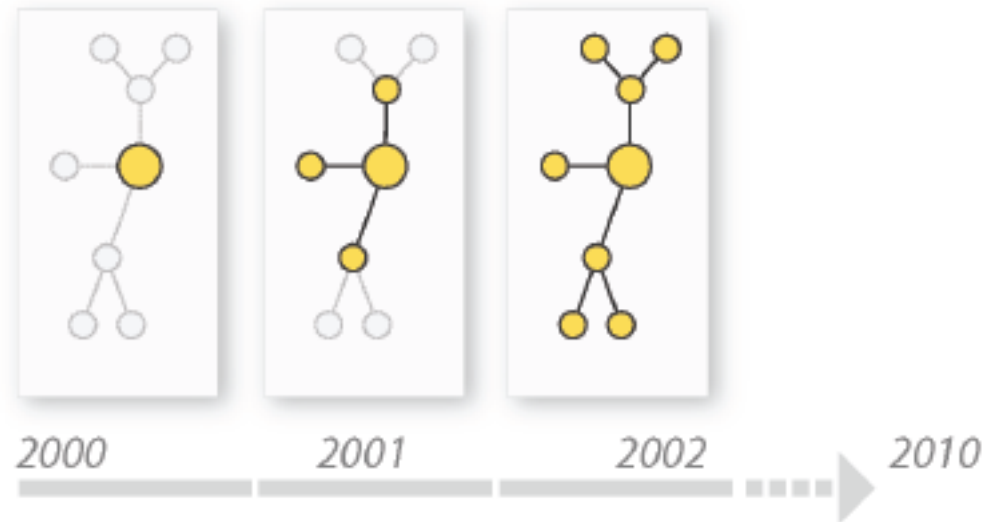
“Timeline” cursor on Temporal Data



Evolution of social ties

Evolution of communities

Evolution of topics



SNA Guideline

nodes

1 - 100

lists + edges in bonus, focus on qualitative data

100 - 1,000

How attributes explain the structure?

- easy to read, “obvious” patterns
- focus on entities (in context)
- metrics are tools to describe the graph (centrality, bridging...)
- links help to build and interpret categories of entities

challenge: mix attribute crossing and connectivity

1,000 - 50,000

How the structure explains attributes?

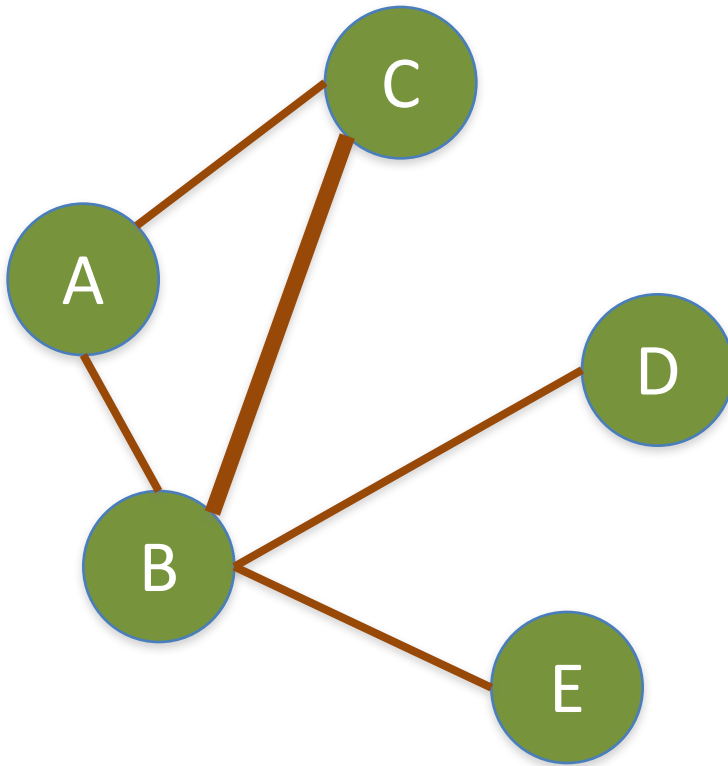
- hard to read, problem of “hidden signals”:
track patterns with various layouts and filtering
- focus on structures
- metrics are tools to build the graph (cosine similarity...)
- categories help to understand the structure

challenge: pattern recognition

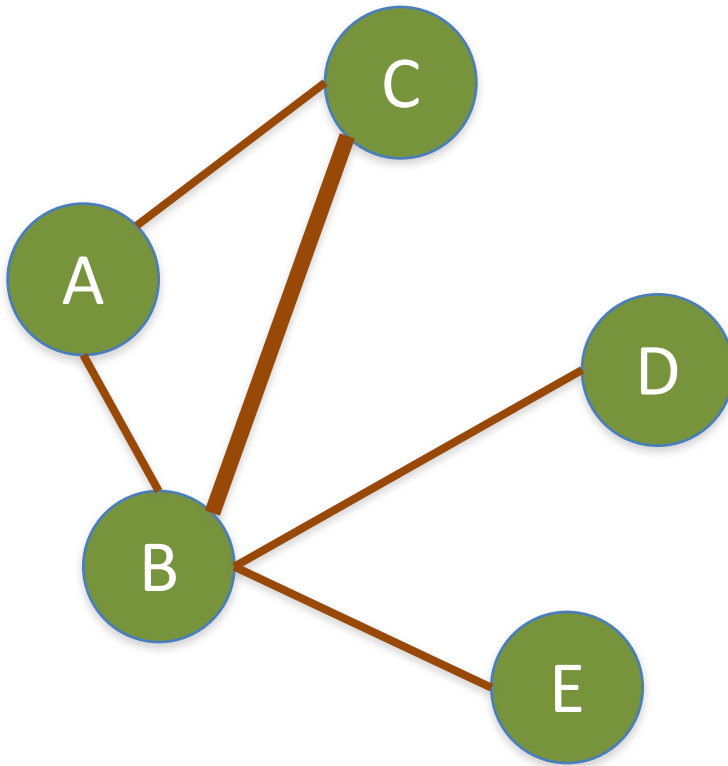
> 50,000

require high computational power

Degree

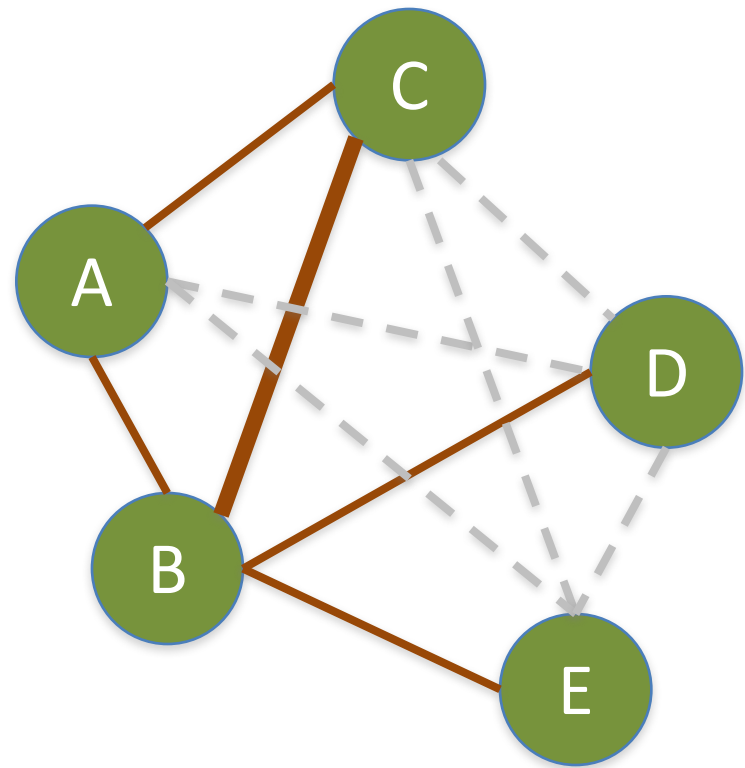


Degree



A: 2
B: 4
C: 2
D: 1
E: 1

Density

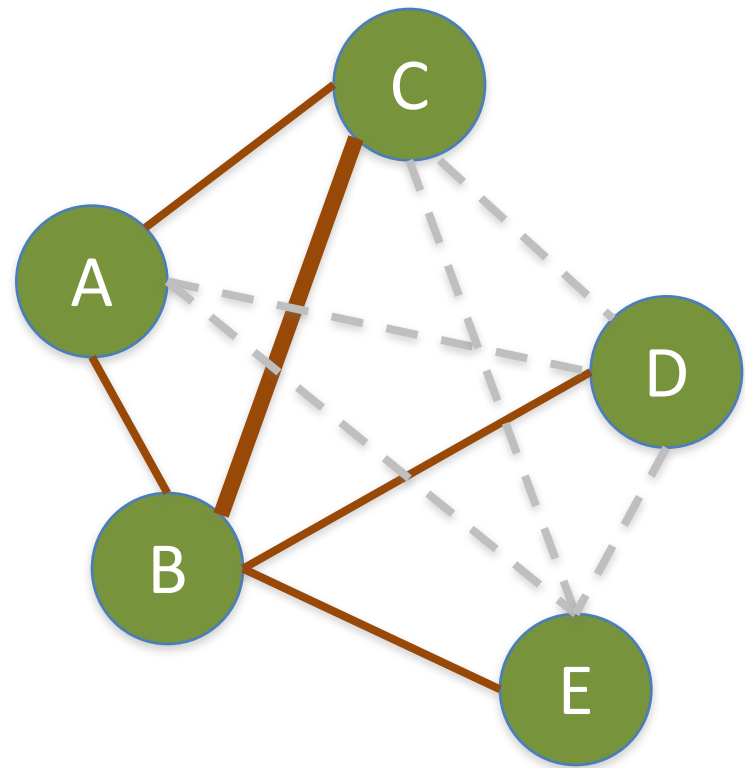


Density

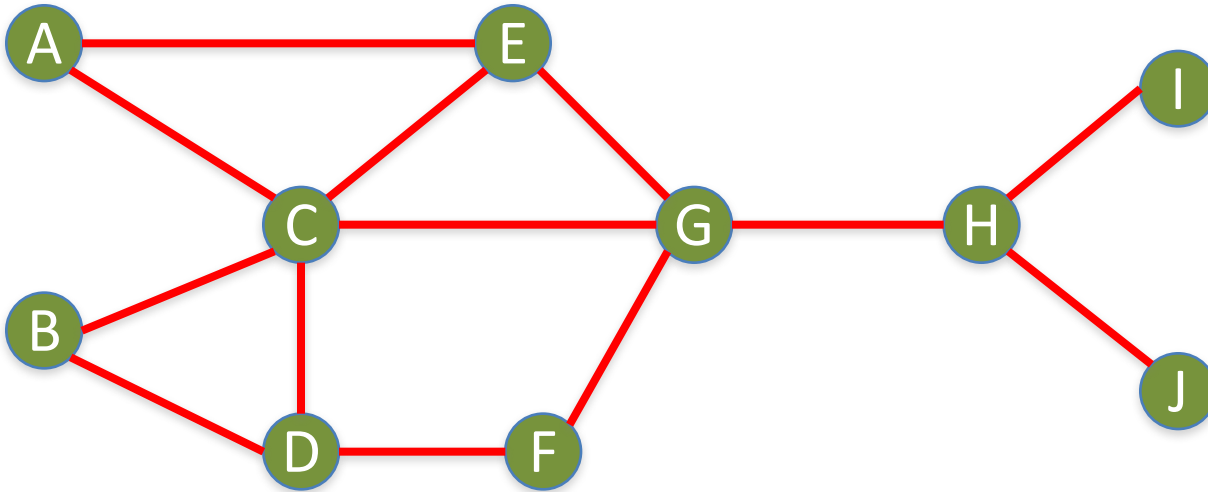
Edges (Links): 5

Total Possible Edges: 10

Density: $5/10 = 0.5$



Density



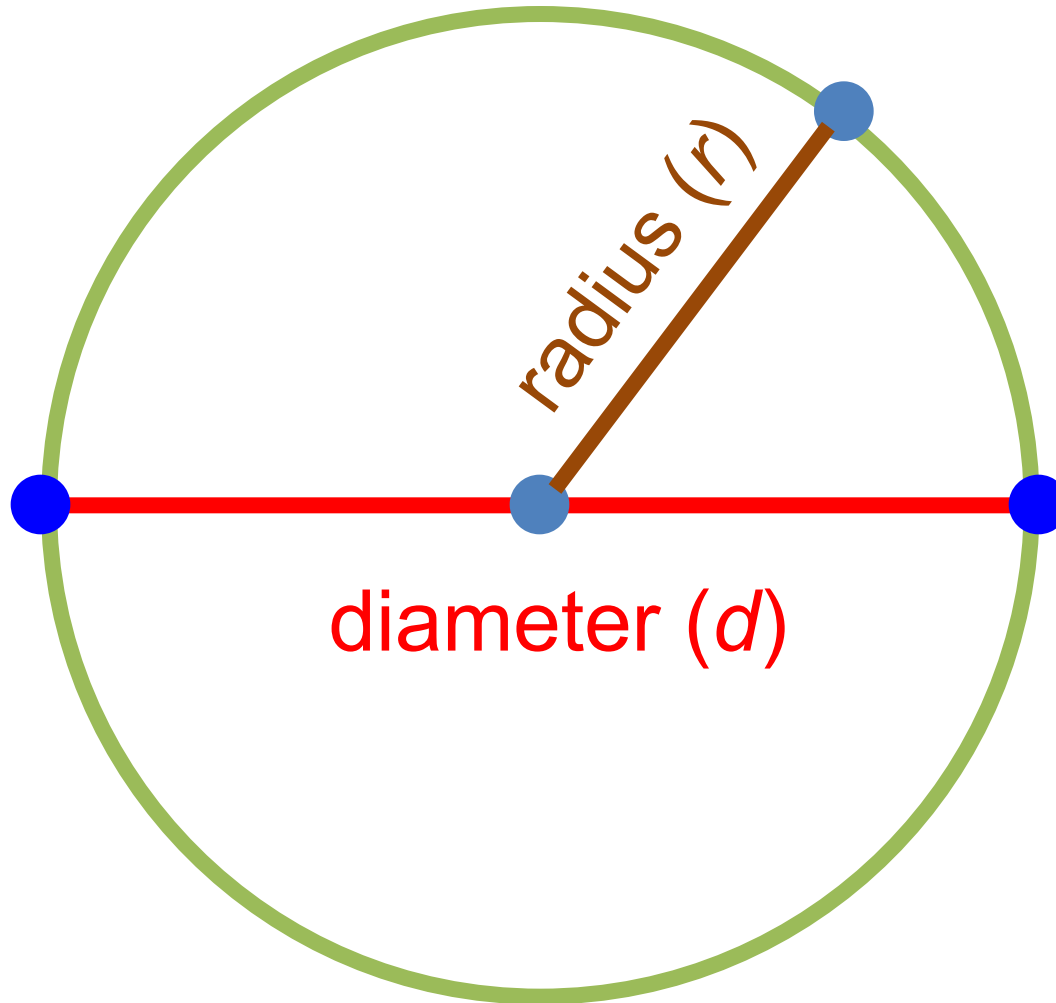
Nodes (n): 10

Edges (Links): 13

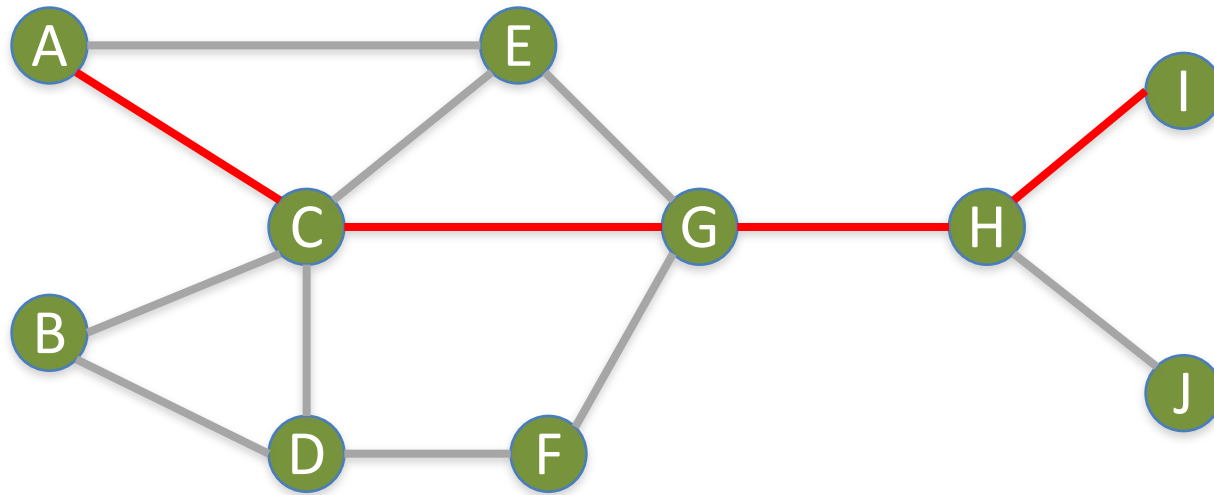
Total Possible Edges: $(n * (n-1)) / 2 = (10 * 9) / 2 = 45$

Density: $13/45 = 0.29$

Diameter

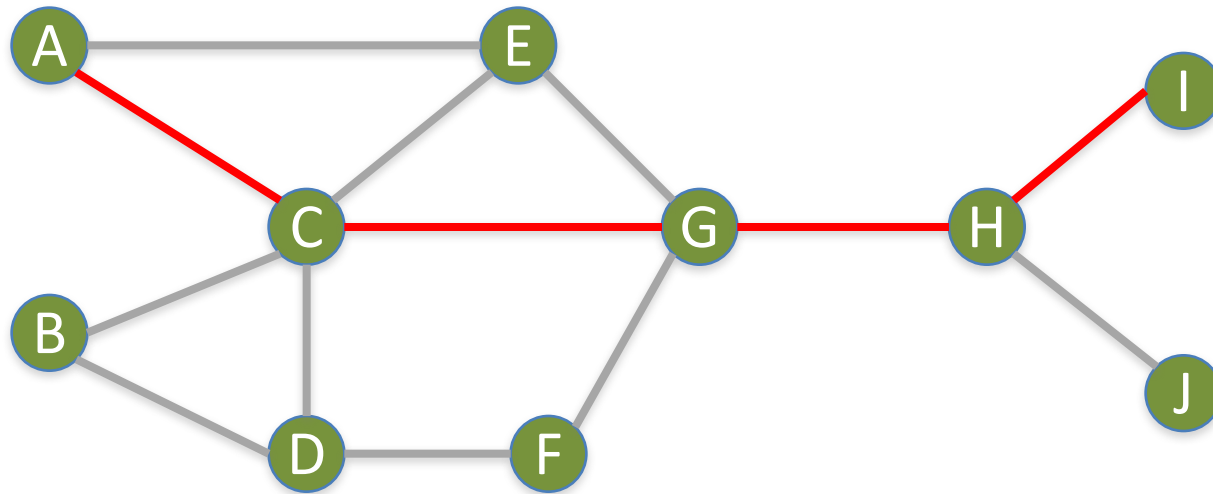


Diameter



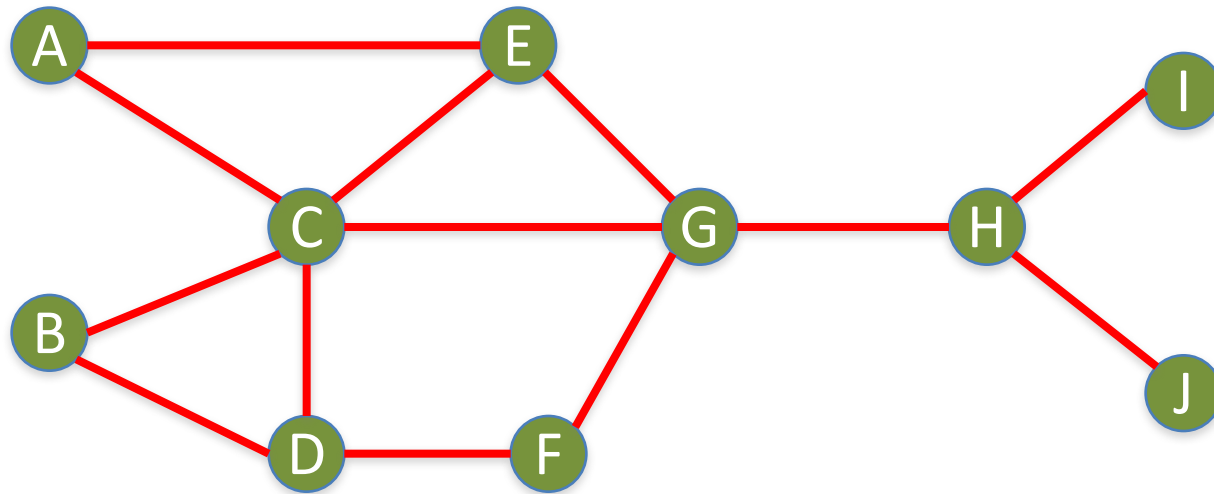
Diameter

Geodesic Path (Shortest Path)



A → I : Diameter = 4

Which Node is Most **Important**?



Centrality

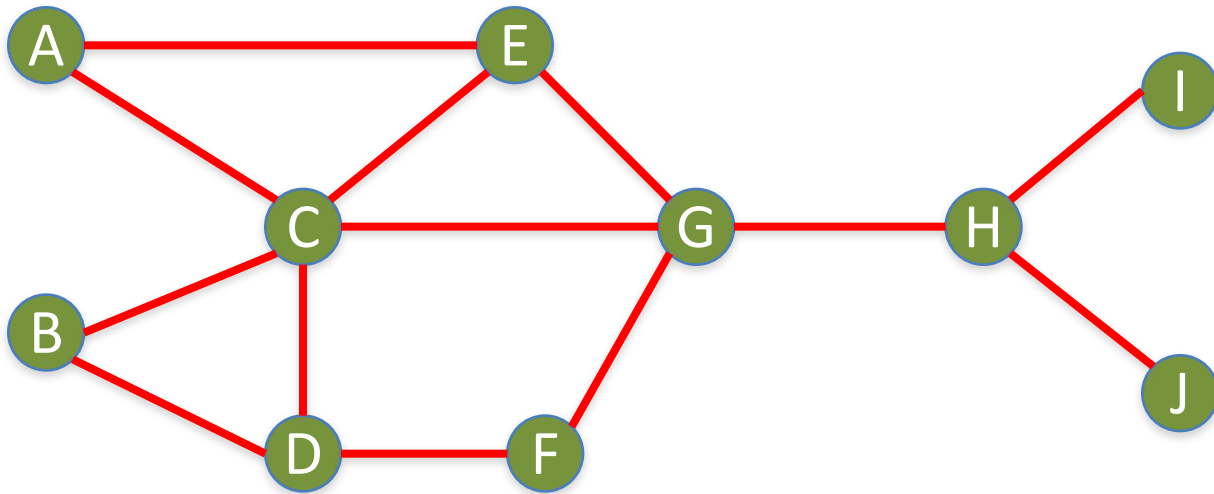
- **Important or prominent actors** are those that are linked or involved with other actors extensively.
- A person with extensive contacts (links) or communications with many other people in the organization is considered more important than a person with relatively fewer contacts.
- The links can also be called **ties**.
A **central actor** is one involved in many ties.

Social Network Analysis (SNA)

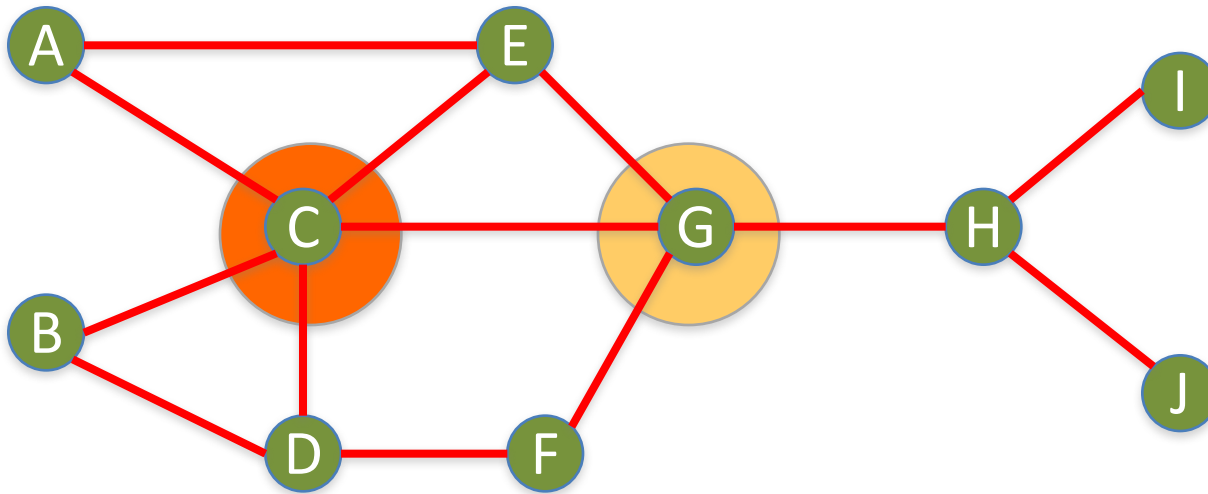
- Degree Centrality
- Betweenness Centrality
- Closeness Centrality

Degree Centrality

Social Network Analysis: Degree Centrality



Social Network Analysis: Degree Centrality



Node	Score	Standardized Score
A	2	$2/10 = 0.2$
B	2	$2/10 = 0.2$
C	5	$5/10 = 0.5$
D	3	$3/10 = 0.3$
E	3	$3/10 = 0.3$
F	2	$2/10 = 0.2$
G	4	$4/10 = 0.4$
H	3	$3/10 = 0.3$
I	1	$1/10 = 0.1$
J	1	$1/10 = 0.1$

Betweenness Centrality

Betweenness centrality:

Connectivity

Number of shortest paths
going through the actor

Betweenness Centrality

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

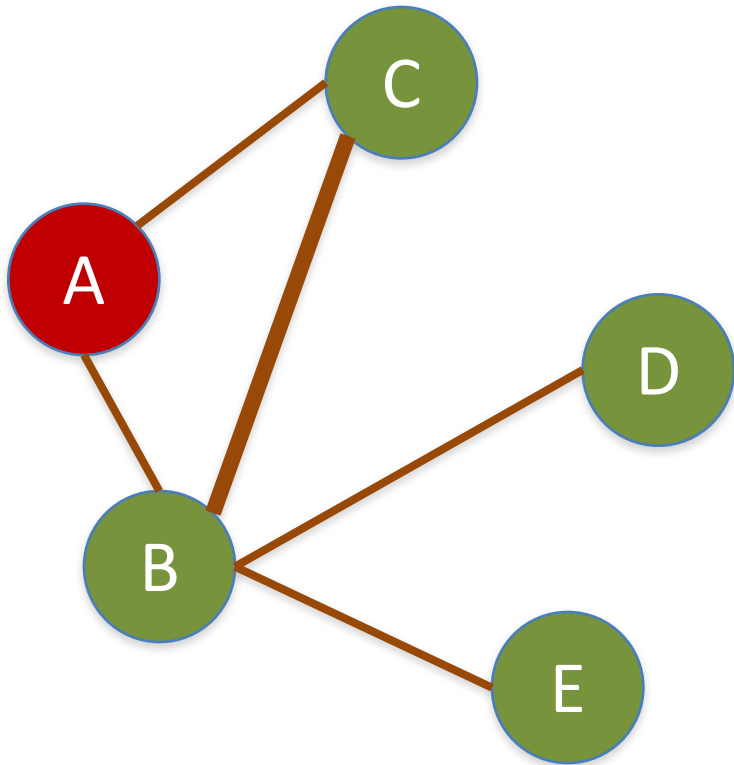
Where g_{jk} = the number of shortest paths connecting jk
 $g_{jk}(i)$ = the number that actor i is on.

Normalized Betweenness Centrality

$$C'_B(i) = C_B(i) / [(n-1)(n-2) / 2]$$

**Number of pairs of vertices
excluding the vertex itself**

Betweenness Centrality



A:

$$B \rightarrow C: 0/1 = 0$$

$$B \rightarrow D: 0/1 = 0$$

$$B \rightarrow E: 0/1 = 0$$

$$C \rightarrow D: 0/1 = 0$$

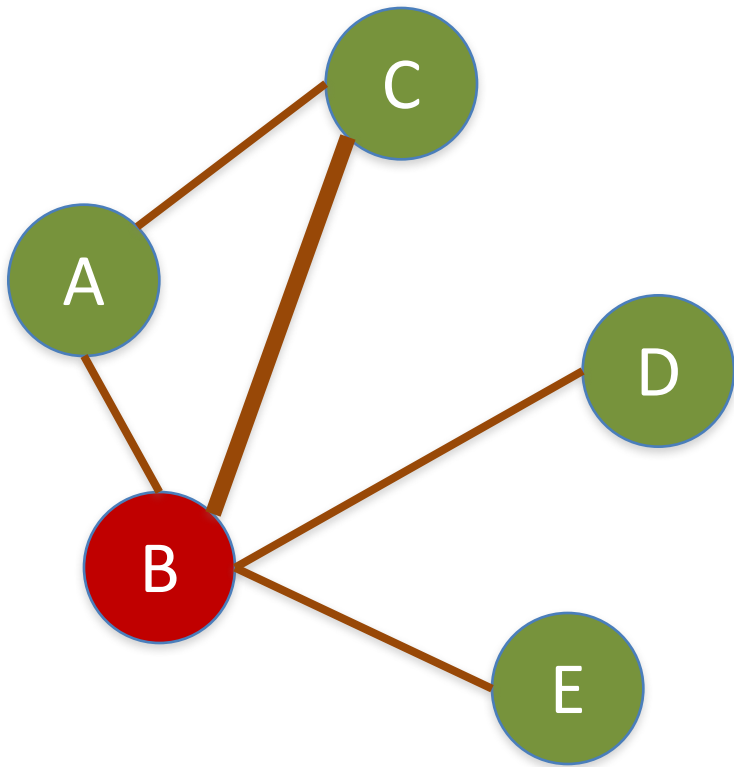
$$C \rightarrow E: 0/1 = 0$$

$$D \rightarrow E: 0/1 = 0$$

Total: 0

A: Betweenness Centrality = 0

Betweenness Centrality



B:

$$A \rightarrow C: 0/1 = 0$$

$$A \rightarrow D: 1/1 = 1$$

$$A \rightarrow E: 1/1 = 1$$

$$C \rightarrow D: 1/1 = 1$$

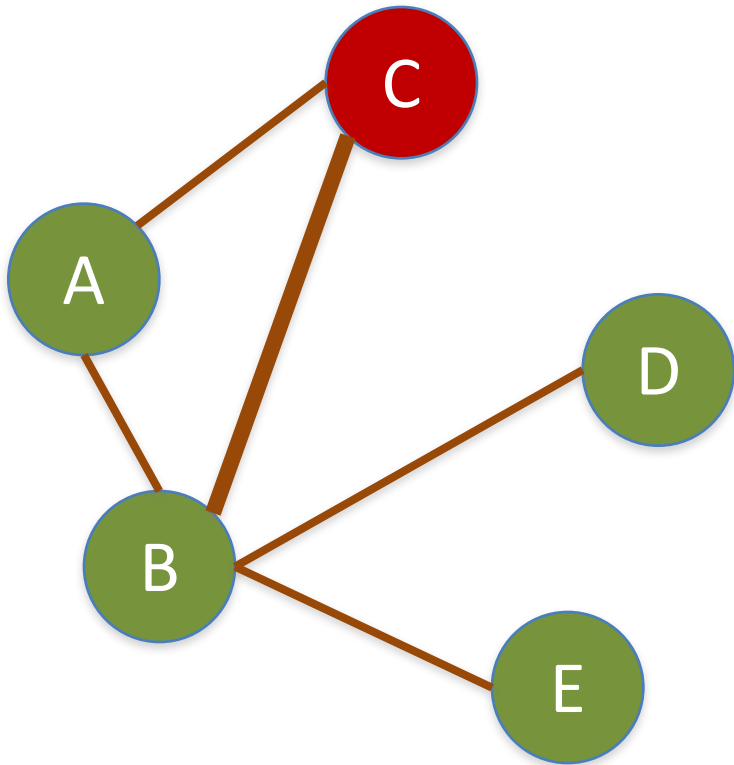
$$C \rightarrow E: 1/1 = 1$$

$$D \rightarrow E: 1/1 = 1$$

Total: 5

B: Betweenness Centrality = 5

Betweenness Centrality



C:

$$A \rightarrow B: 0/1 = 0$$

$$A \rightarrow D: 0/1 = 0$$

$$A \rightarrow E: 0/1 = 0$$

$$B \rightarrow D: 0/1 = 0$$

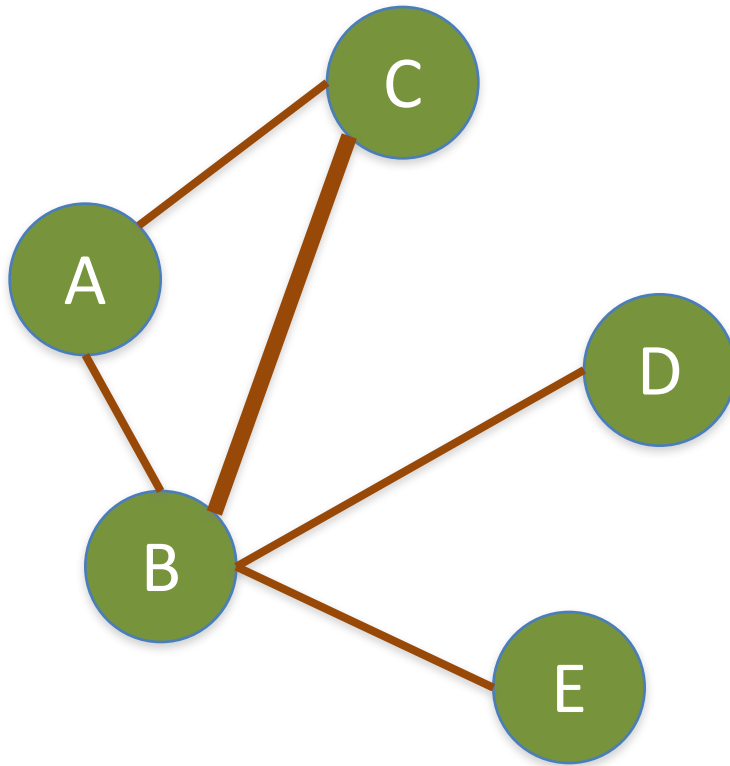
$$B \rightarrow E: 0/1 = 0$$

$$D \rightarrow E: 0/1 = 0$$

Total: 0

C: Betweenness Centrality = 0

Betweenness Centrality



A: 0

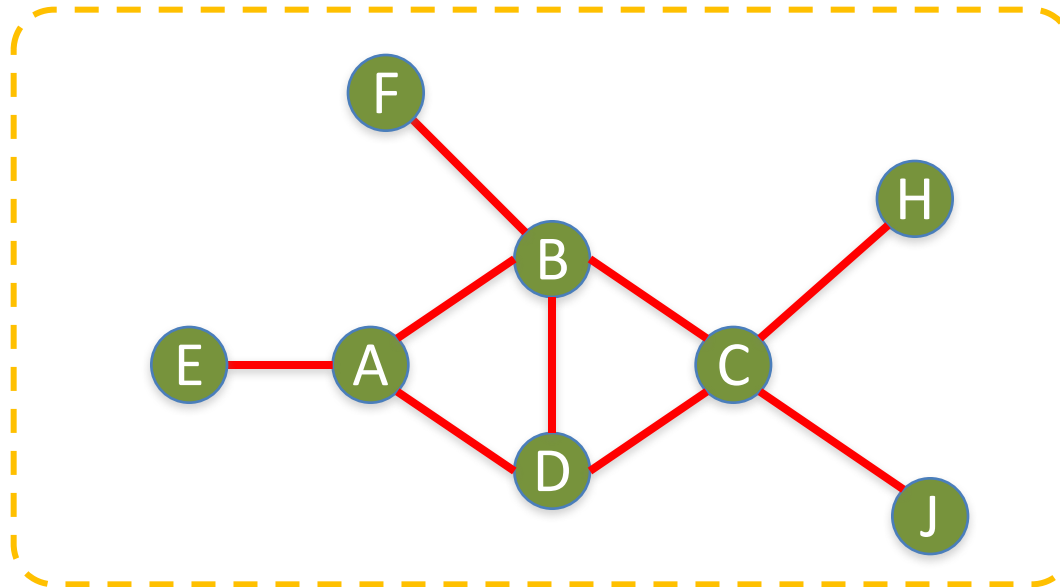
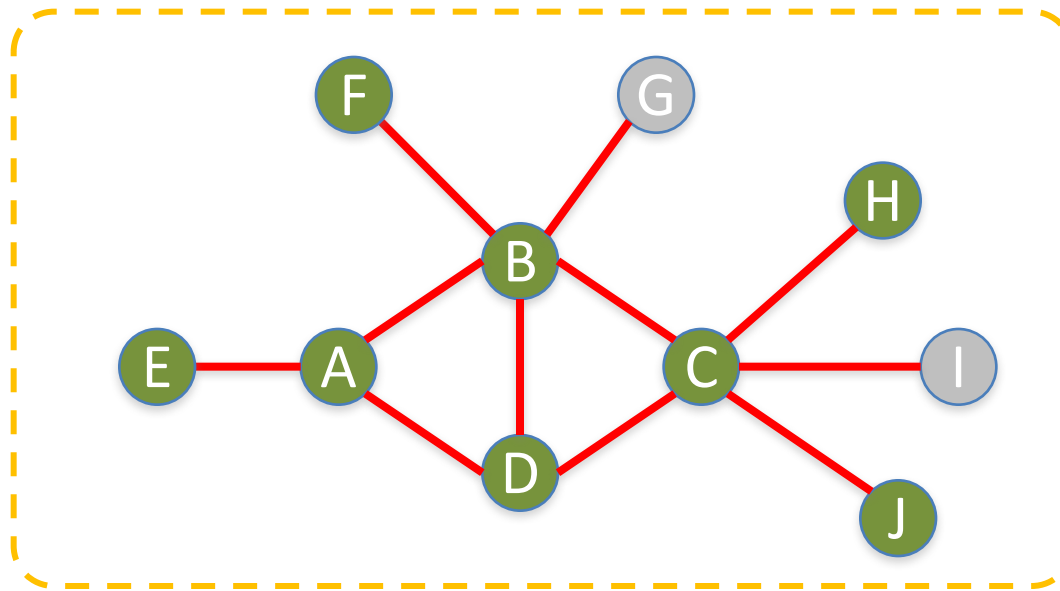
B: 5

C: 0

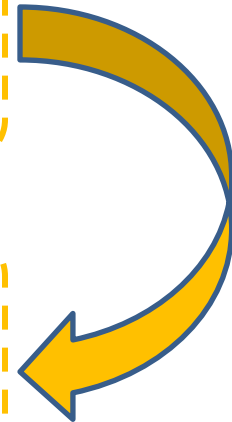
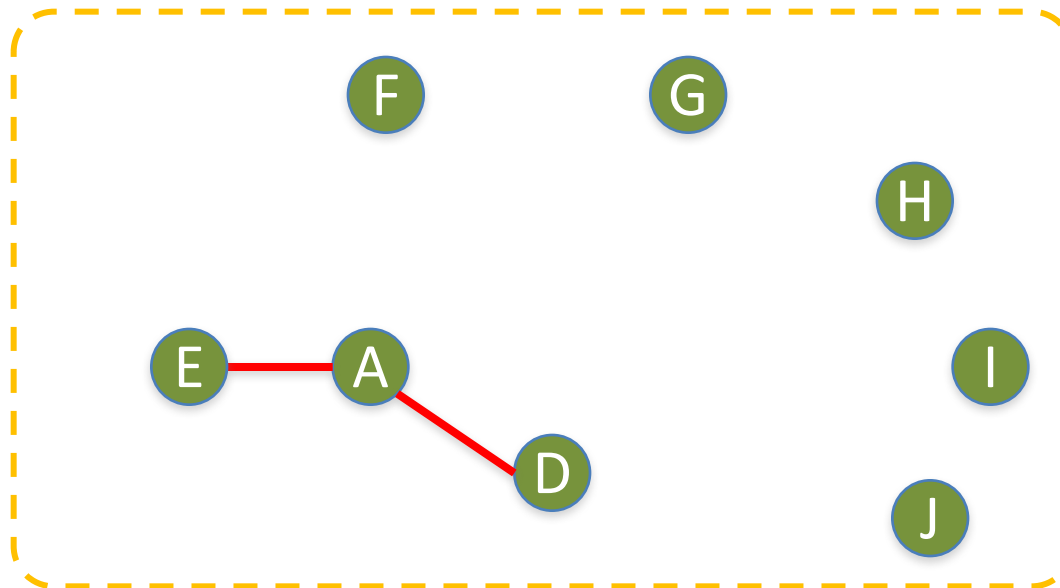
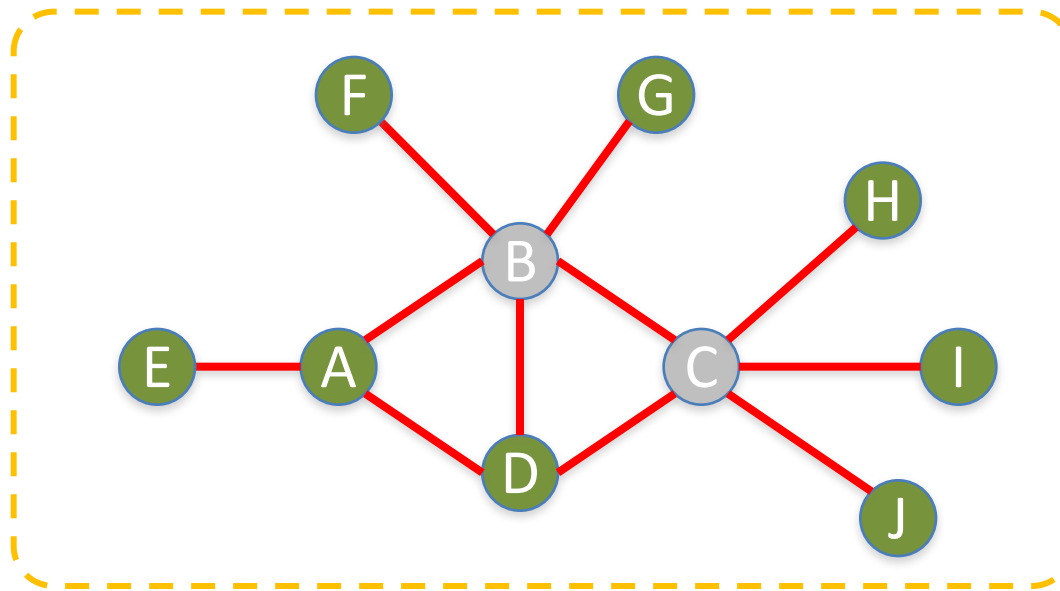
D: 0

E: 0

Which Node is Most **Important**?

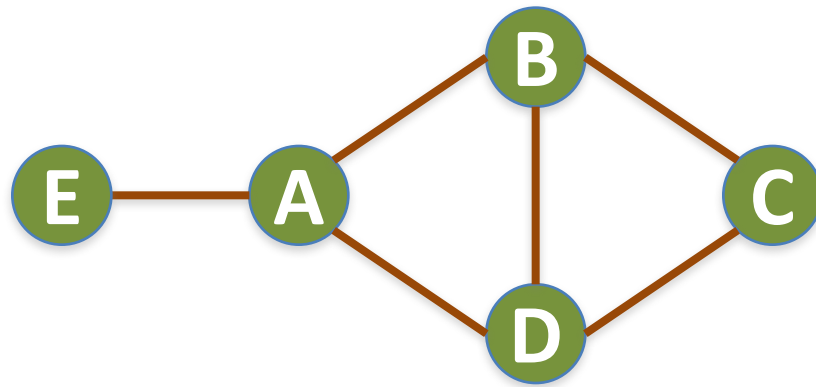


Which Node is Most **Important**?

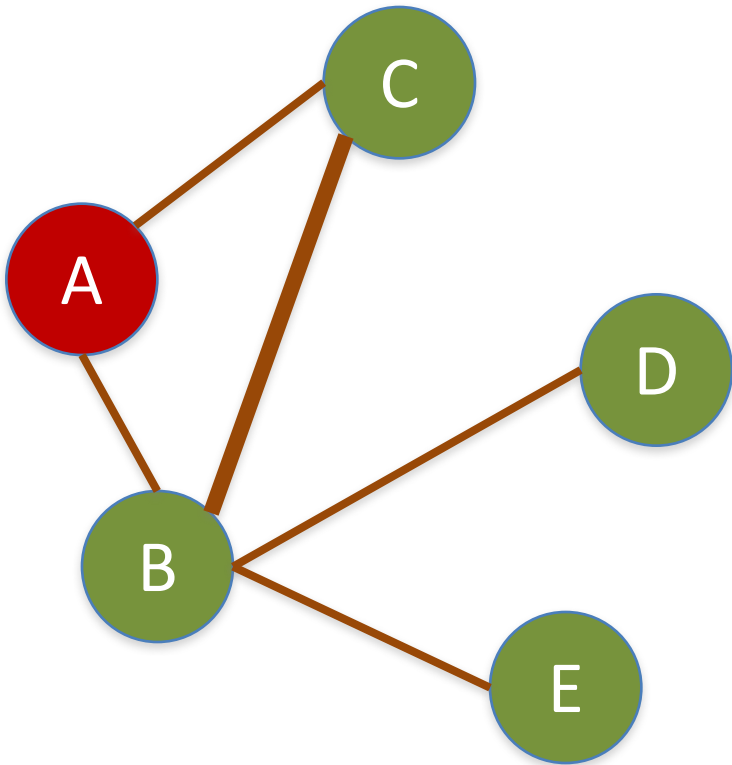


Betweenness Centrality

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



Betweenness Centrality



A:

$$B \rightarrow C: 0/1 = 0$$

$$B \rightarrow D: 0/1 = 0$$

$$B \rightarrow E: 0/1 = 0$$

$$C \rightarrow D: 0/1 = 0$$

$$C \rightarrow E: 0/1 = 0$$

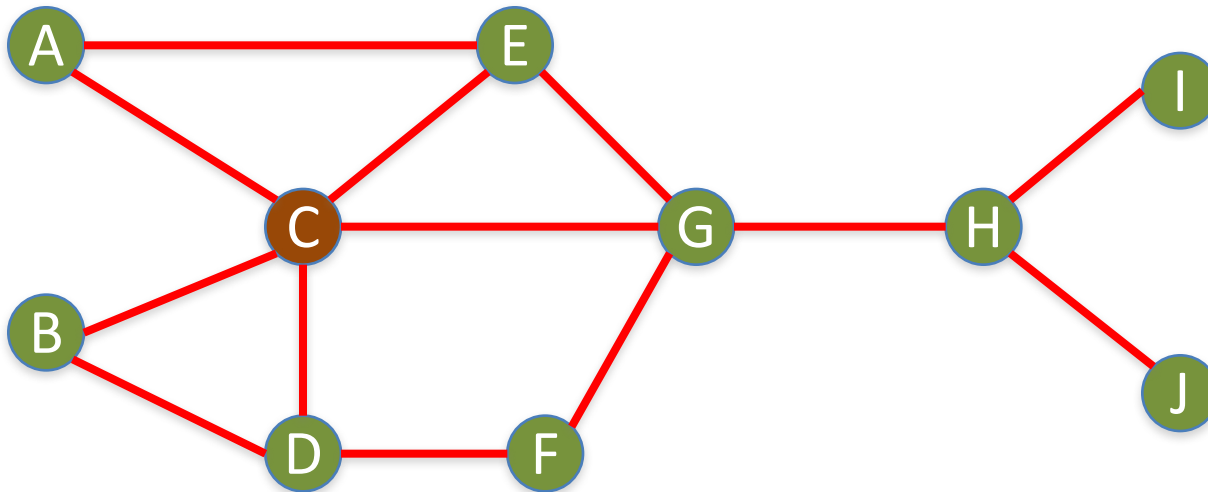
$$D \rightarrow E: 0/1 = 0$$

Total: 0

A: Betweenness Centrality = 0

Closeness
Centrality

Social Network Analysis: Closeness Centrality

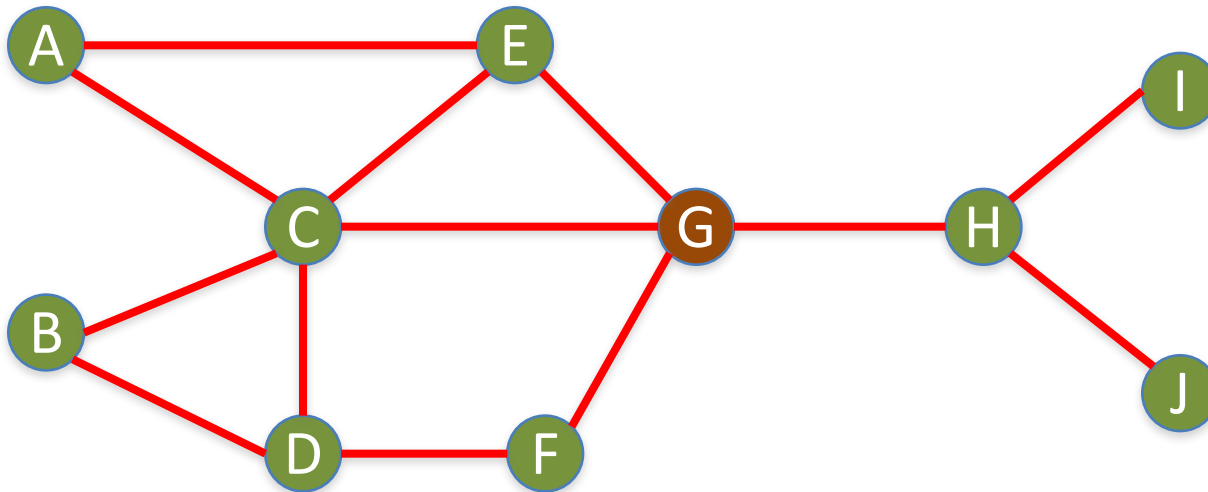


C→A: 1
C→B: 1
C→D: 1
C→E: 1
C→F: 2
C→G: 1
C→H: 2
C→I: 3
C→J: 3

Total=15

C: Closeness Centrality = $15/9 = 1.67$

Social Network Analysis: Closeness Centrality

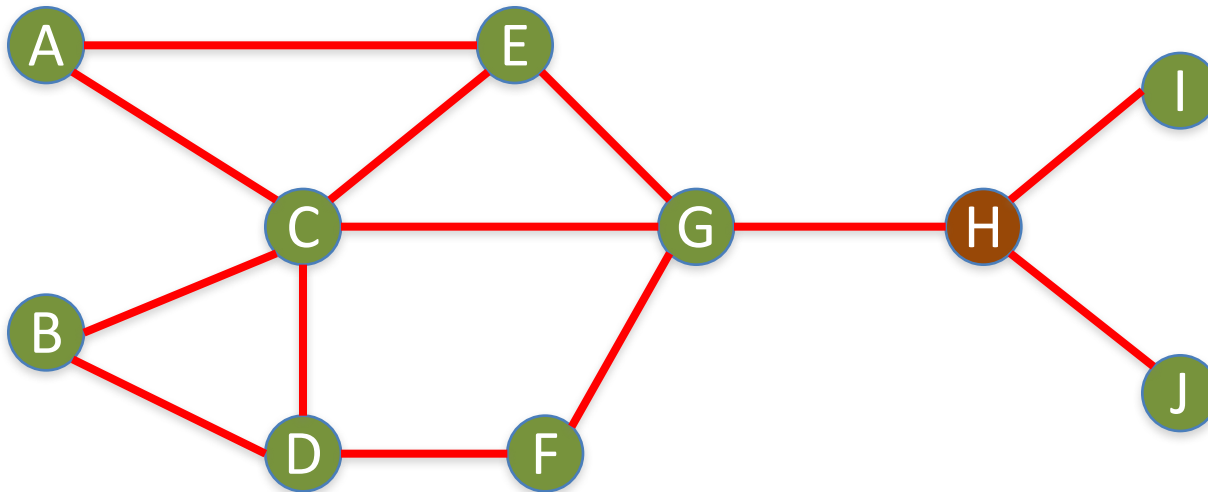


G→A: 2
G→B: 2
G→C: 1
G→D: 2
G→E: 1
G→F: 1
G→H: 1
G→I: 2
G→J: 2

Total=14

G: Closeness Centrality = $14/9 = 1.56$

Social Network Analysis: Closeness Centrality



H→A: 3

H→B: 3

H→C: 2

H→D: 2

H→E: 2

H→F: 2

H→G: 1

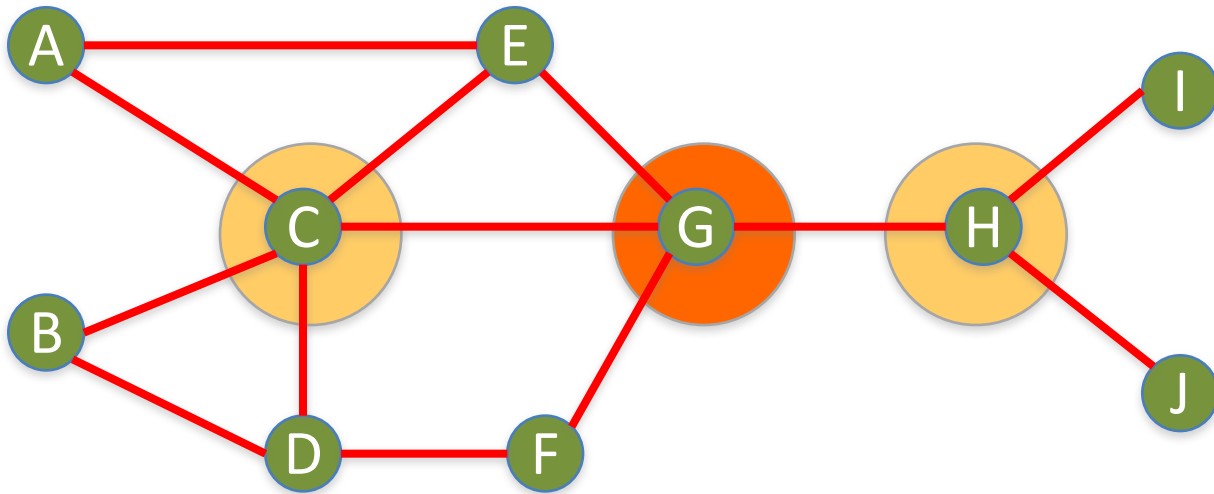
H→I: 1

H→J: 1

Total=17

H: Closeness Centrality = $17/9 = 1.89$

Social Network Analysis: Closeness Centrality



G: Closeness Centrality = $14/9 = 1.56$ ①

C: Closeness Centrality = $15/9 = 1.67$ ②

H: Closeness Centrality = $17/9 = 1.89$ ③

Social Network Analysis (SNA)

importance of neighbors

Eigenvector centrality

Eigenvector centrality:
Importance of a node
depends on
the importance of its neighbors

Social Network Analysis: Closeness Centrality

Sum of the reciprocal distances

$$C_C(p_k) = \sum_{i=1}^n d(p_i, p_k)^{-1}$$

where $d(p_j, p_k)$ is the geodesic distance (shortest paths) linking p_j, p_k

Social Network Analysis: Betweenness Centrality

$$C_B(p_k) = \sum_{i < j}^n \frac{g_{ij}(p_k)}{g_{ij}}; \quad i \neq j \neq k$$

where g_{ij} is the geodesic distance (shortest paths) linking p_i and p_j and $g_{ij}(p_k)$ is the geodesic distance linking p_i and p_j that contains p_k .

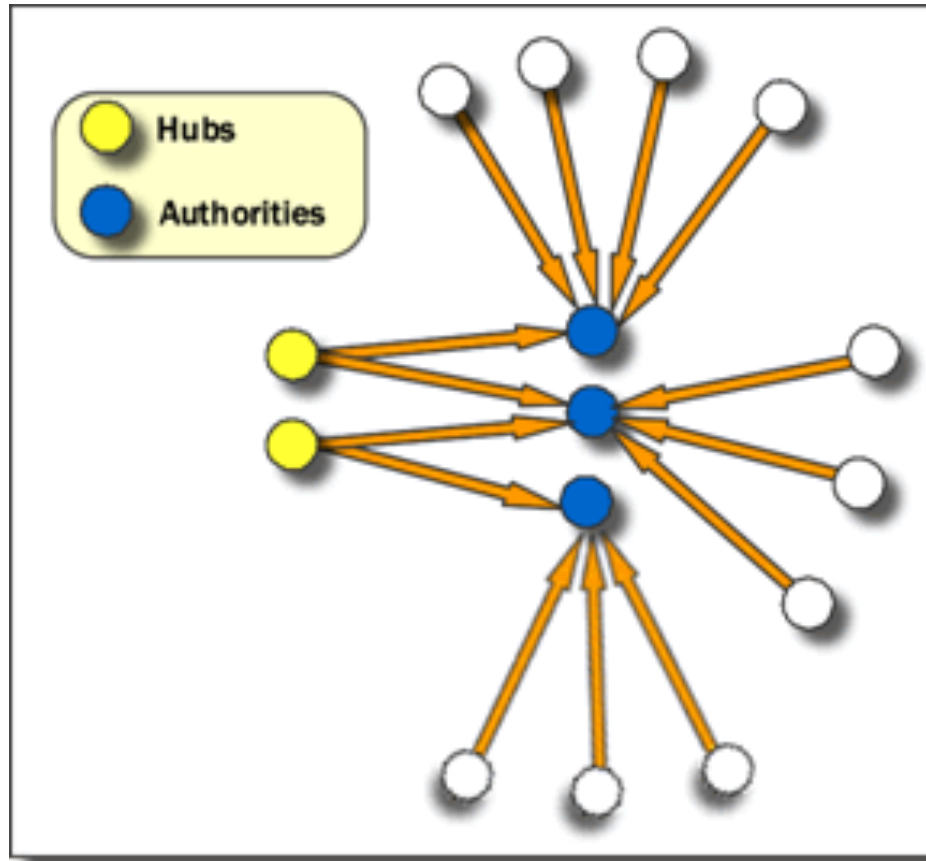
Social Network Analysis: Degree Centrality

$$C_D(p_k) = \sum_{i=1}^n a(p_i, p_k)$$

where $a(p_i, p_k) = 1$ if and only if p_i and p_k are connected by a line
0 otherwise

$$C'_D(p_k) = \frac{\sum_{i=1}^n a(p_i, p_k)}{n-1}$$

Social Network Analysis: Hub and Authority



Hubs are entities that point to a relatively large number of authorities. They are essentially the mutually reinforcing analogues to authorities. Authorities point to high hubs. Hubs point to high authorities. You cannot have one without the other.

Application of SNA

Social Network Analysis of Research Collaboration in Information Reuse and Integration

Example of SNA Data Source


















dblp
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IRI 2010: Las Vegas, NV, USA

-    **Proceedings of the IEEE International Conference on Information Reuse and Integration, IRI 2010, 4-6 August 2010, Las Vegas, Nevada, USA.** IEEE Systems, Man, and Cybernetics Society 2010
-    Reda Alhajj, James B. D. Joshi, Mei-Ling Shyu: **Message from Program Co-Chairs.** 1
-    Stuart Harvey Rubin, Shu-Ching Chen: **Forward.** 1
-    Lotfi A. Zadeh: **Precision of meaning - toward computation with natural language.** 1-4
-    Reda Alhajj, Shu-Ching Chen, Gongzhu Hu, James B. D. Joshi, Gordon K. Lee, Stuart Harvey Rubin, Mei-Ling Shyu, Lotfi A. Zadeh: **Panel title: Critical need for funding of basic and applied research in large-scale computing.** 1

Automation, Integration and Reuse across Various Apps

-    László István Etesi, André Csillaghy, Lin-Ching Chang: **A message-based interoperability framework with application to astrophysics.** 1-6
-    Awny Alnusair, Tian Zhao, Eric Bodden: **Effective API navigation and reuse.** 7-12
-    Manabu Ohta, Ryohei Inoue, Atsuhiko Takasu: **Empirical evaluation of active sampling for CRF-based analysis of pages.** 13-18
-    Qunzhi Zhou, Viktor K. Prasanna: **Workflow management of simulation based computation processes in transportation domain.** 19-24

Source: <http://www.informatik.uni-trier.de/~ley/db/conf/iri/iri2010.html>

Research Question

- RQ1: What are the scientific **collaboration patterns** in the IRI research community?
- RQ2: Who are the **prominent researchers** in the IRI community?

Methodology

- Developed a simple **web focused crawler** program to download literature information about all IRI papers published between **2003 and 2010** from **IEEE Xplore** and **DBLP**.
 - **767** paper
 - **1599** distinct author
- Developed a program to convert the list of coauthors into the **format of a network file** which can be readable by social network analysis software.
- **UCInet** and **Pajek** were used in this study for the social network analysis.

Top10 prolific authors (IRI 2003-2010)

1. Stuart Harvey Rubin
2. Taghi M. Khoshgoftaar
3. Shu-Ching Chen
4. Mei-Ling Shyu
5. Mohamed E. Fayad
6. Reda Alhajj
7. Du Zhang
8. Wen-Lian Hsu
9. Jason Van Hulse
10. Min-Yuh Day

Data Analysis and Discussion

- **Closeness Centrality**
 - Collaborated widely
- **Betweenness Centrality**
 - Collaborated diversely
- **Degree Centrality**
 - Collaborated frequently
- **Visualization of Social Network Analysis**
 - Insight into the structural characteristics of research collaboration networks

Top 20 authors with the highest **closeness** scores

Rank	ID	Closeness	Author
1	3	0.024675	Shu-Ching Chen
2	1	0.022830	Stuart Harvey Rubin
3	4	0.022207	Mei-Ling Shyu
4	6	0.020013	Reda Alhajj
5	61	0.019700	Na Zhao
6	260	0.018936	Min Chen
7	151	0.018230	Gordon K. Lee
8	19	0.017962	Chengcui Zhang
9	1043	0.017962	Isai Michel Lombera
10	1027	0.017962	Michael Armella
11	443	0.017448	James B. Law
12	157	0.017082	Keqi Zhang
13	253	0.016731	Shahid Hamid
14	1038	0.016618	Walter Z. Tang
15	959	0.016285	Chengjun Zhan
16	957	0.016285	Lin Luo
17	956	0.016285	Guo Chen
18	955	0.016285	Xin Huang
19	943	0.016285	Sneh Gulati
20	960	0.016071	Sheng-Tun Li

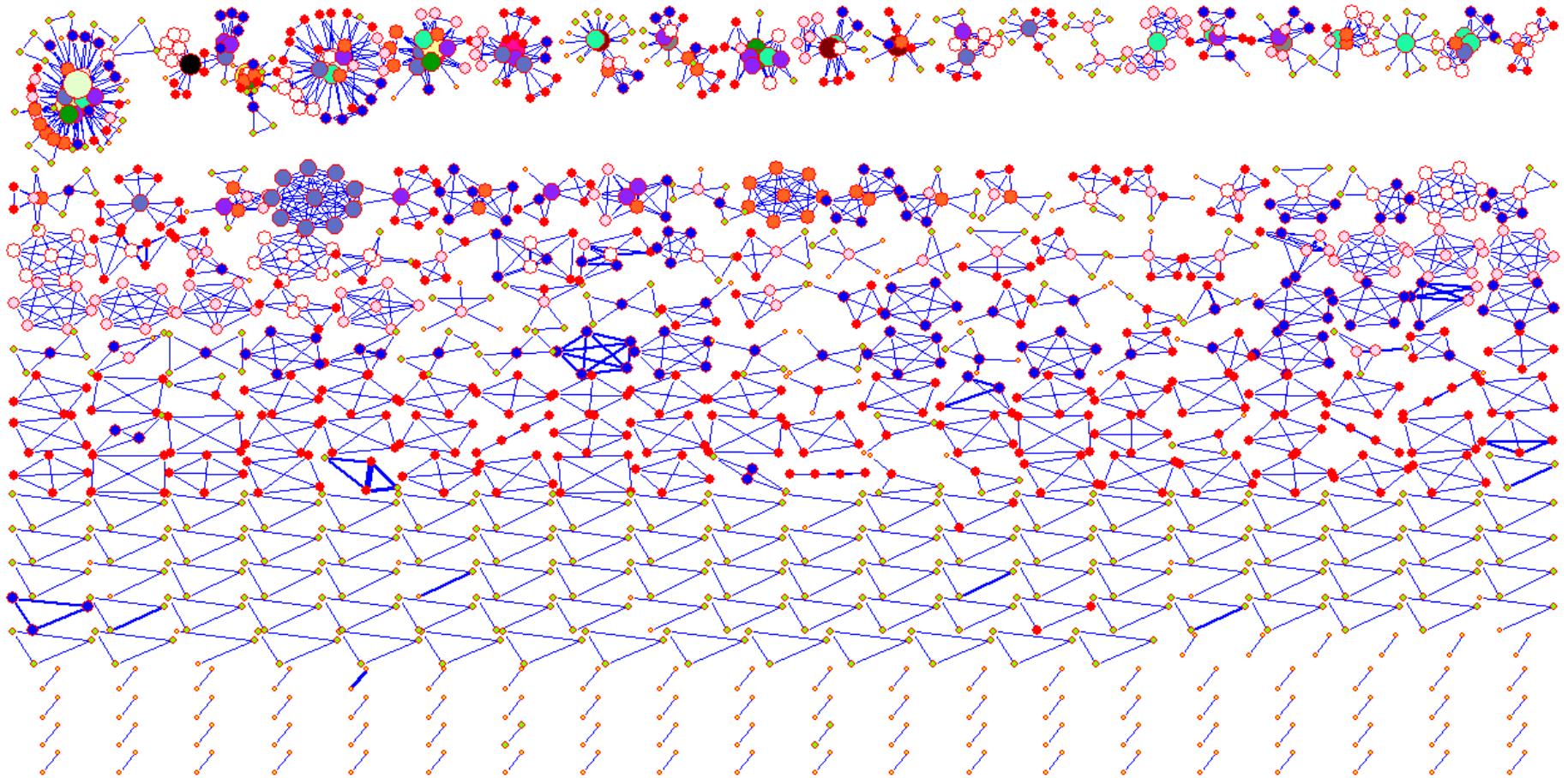
Top 20 authors with the highest **betweenness** scores

Rank	ID	Betweenness	Author
1	1	0.000752	Stuart Harvey Rubin
2	3	0.000741	Shu-Ching Chen
3	2	0.000406	Taghi M. Khoshgoftaar
4	66	0.000385	Xingquan Zhu
5	4	0.000376	Mei-Ling Shyu
6	6	0.000296	Reda Alhajj
7	65	0.000256	Xindong Wu
8	19	0.000194	Chengcui Zhang
9	39	0.000185	Wei Dai
10	15	0.000107	Narayan C. Debnath
11	31	0.000094	Qianhui Althea Liang
12	151	0.000094	Gordon K. Lee
13	7	0.000085	Du Zhang
14	30	0.000072	Baowen Xu
15	41	0.000067	Hongji Yang
16	270	0.000060	Zhiwei Xu
17	5	0.000043	Mohamed E. Fayad
18	110	0.000042	Abhijit S. Pandya
19	106	0.000042	Sam Hsu
20	8	0.000042	Wen-Lian Hsu

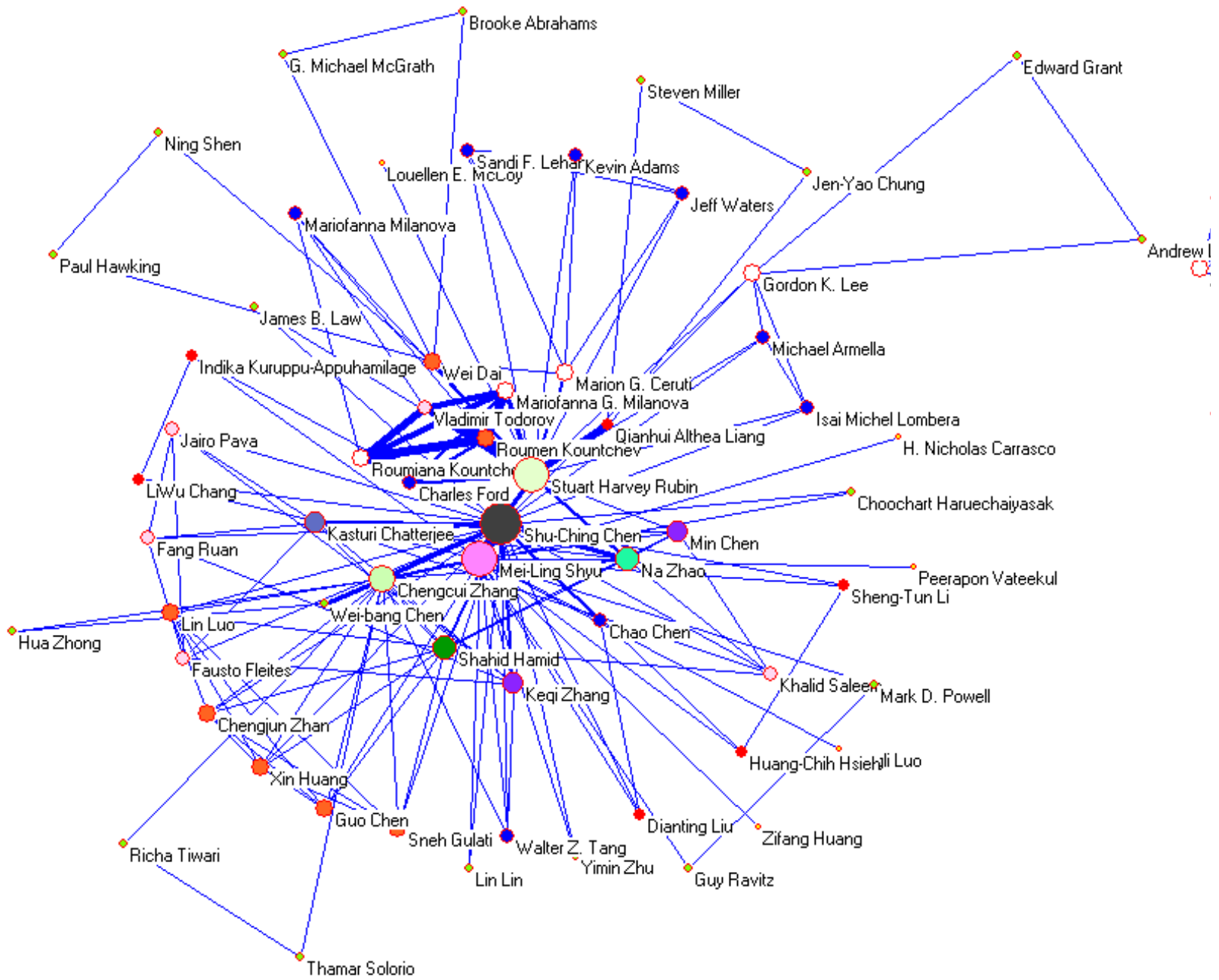
Top 20 authors with the highest **degree** scores

Rank	ID	Degree	Author
1	3	0.035044	Shu-Ching Chen
2	1	0.034418	Stuart Harvey Rubin
3	2	0.030663	Taghi M. Khoshgoftaar
4	6	0.028786	Reda Alhajj
5	8	0.028786	Wen-Lian Hsu
6	10	0.024406	Min-Yuh Day
7	4	0.022528	Mei-Ling Shyu
8	17	0.021277	Richard Tzong-Han Tsai
9	14	0.017522	Eduardo Santana de Almeida
10	16	0.017522	Roumen Kountchev
11	40	0.016896	Hong-Jie Dai
12	15	0.015645	Narayan C. Debnath
13	9	0.015019	Jason Van Hulse
14	25	0.013767	Roumiana Kountcheva
15	28	0.013141	Silvio Romero de Lemos Meira
16	24	0.013141	Vladimir Todorov
17	23	0.013141	Mariofanna G. Milanova
18	5	0.013141	Mohamed E. Fayad
19	19	0.012516	Chengcui Zhang
20	18	0.011890	Waleed W. Smari

Visualization of IRI (IEEE IRI 2003-2010) co-authorship network (global view)

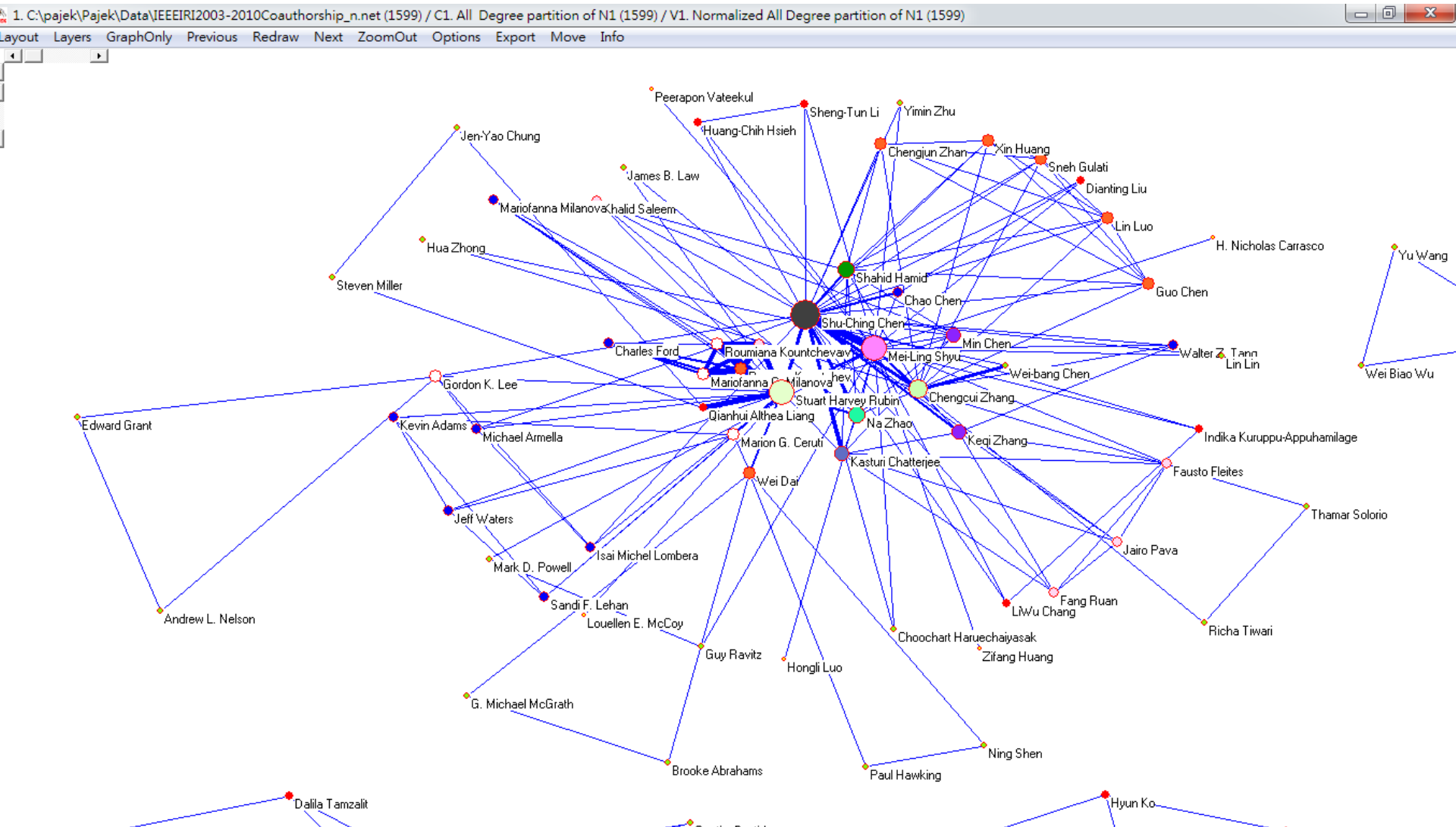


Source: Min-Yuh Day, Sheng-Pao Shih, Weide Chang (2011),
"Social Network Analysis of Research Collaboration in Information Reuse and Integration"



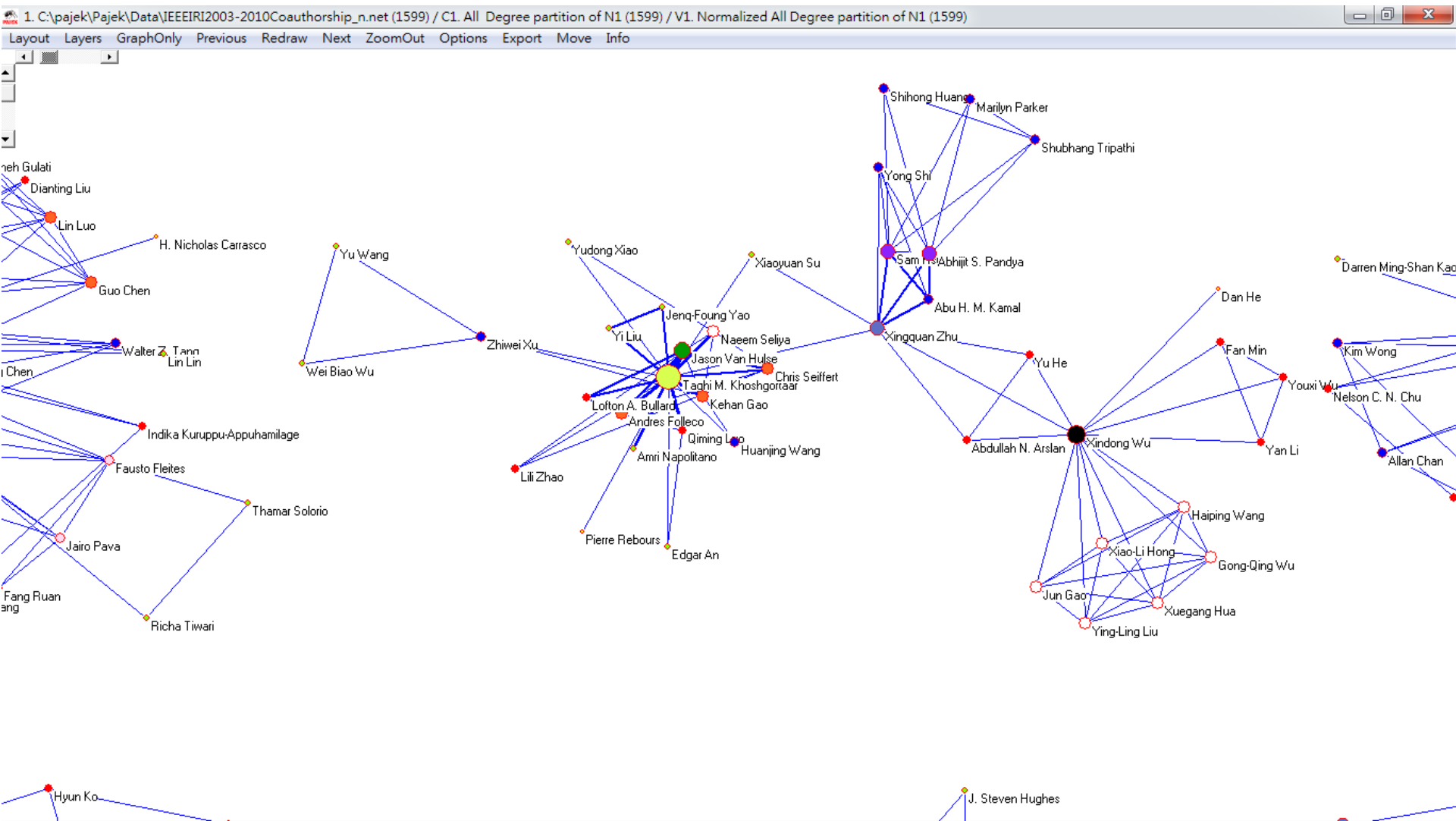
Source: Min-Yuh Day, Sheng-Pao Shih, Weide Chang (2011),
 "Social Network Analysis of Research Collaboration in Information Reuse and Integration"

Visualization of Social Network Analysis

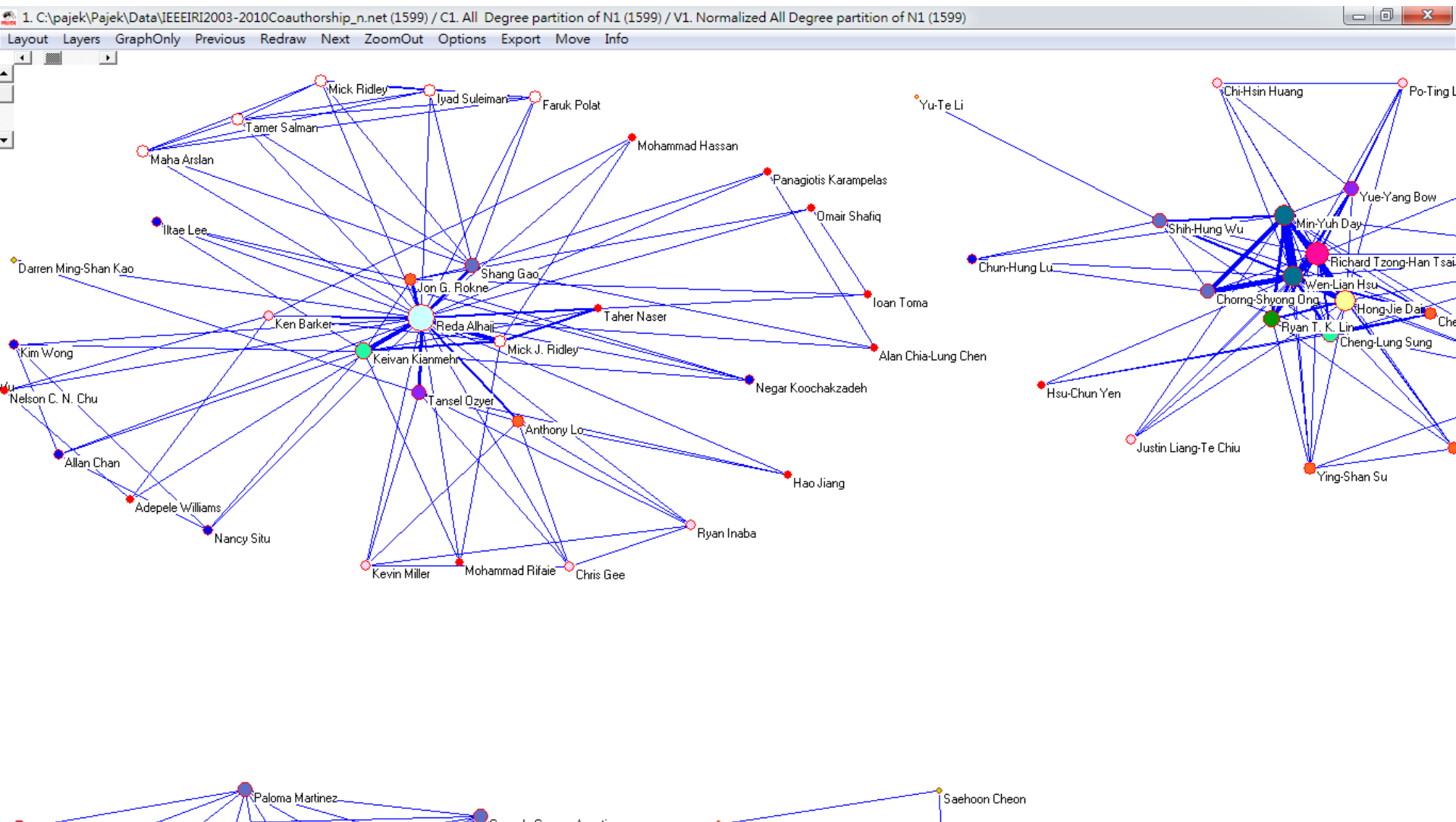


Source: Min-Yuh Day, Sheng-Pao Shih, Weide Chang (2011),
"Social Network Analysis of Research Collaboration in Information Reuse and Integration"

Visualization of Social Network Analysis



Visualization of Social Network Analysis

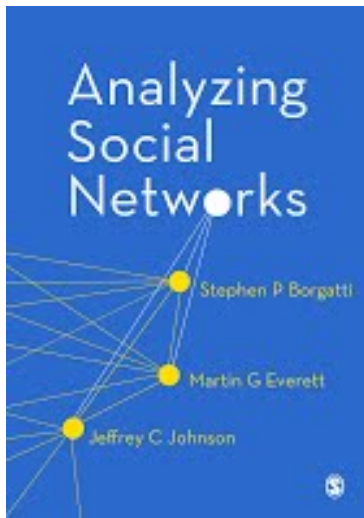


Source: Min-Yuh Day, Sheng-Pao Shih, Weide Chang (2011),
"Social Network Analysis of Research Collaboration in Information Reuse and Integration"

Tools of Social Network Analysis

Social Network Analysis (SNA) Tools

- **NetworkX**
- **igraph**
- **Gephi**
- **UCINet**
- **Pajek**



Tools of Social Network Analysis

- Focused Desktop Tools
 - **Gephi**
 - Ucinet
 - Pajek
 - NodeXL
 - Cytoscape

Tools of Social Network Analysis

- Developer Tools
 - NetworkX
 - iGraph
 - SNAP
 - sigma.js

Gephi



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The Open Graph Viz Platform

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

Runs on Windows, Mac OS X and Linux.

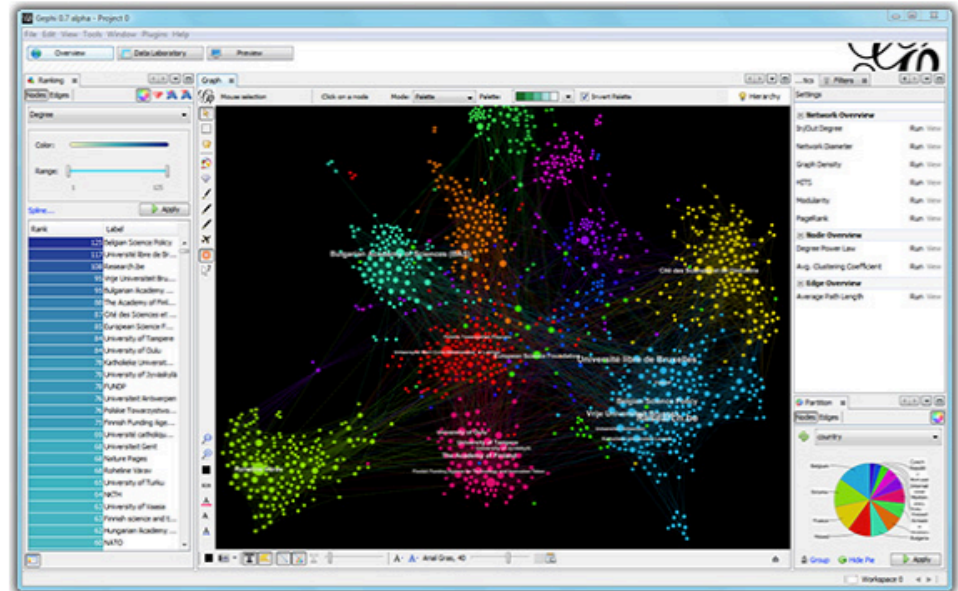
[Learn More on Gephi Platform >](#)



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

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► [Quick start](#)

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APPLICATIONS

- ✓ **Exploratory Data Analysis:** intuition-oriented analysis by networks manipulations in real time.
- ✓ **Link Analysis:** revealing the underlying structures of associations between objects.
- ✓ **Social Network Analysis:** easy creation of social

Like Photoshop™ for graphs.

— the Community

LATEST NEWS

► [Gephi updates with 0.9.1 version](#)

PAPERS



<https://gephi.org/>

UCINET



UCINET Software

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Links

- Analytic Technologies
 - NetDraw
 - E-Net
- LINKS Center
 - Workshop
- Steve Borgatti

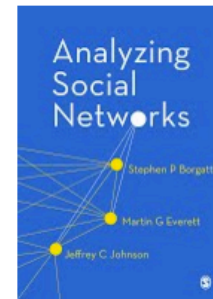
New! UCINET-oriented book on social network analysis now available! See [details](#).

UCINET 6 for Windows is a software package for the analysis of social network data. It was developed by Lin Freeman, Martin Everett and Steve Borgatti. It comes with the NetDraw network visualization tool.

If you use the software, please cite it. Here is a sample citation:

- **Borgatti, S.P., Everett, M.G. and Freeman, L.C. 2002. Ucinet for Windows: Software for Social Network Analysis. Harvard, MA: Analytic Technologies.**

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- The program can be [downloaded](#) and used for free for 90 days. In addition, students can [purchase](#) the downloaded program for \$40. Faculty and government can purchase the downloaded program for \$150, and all others pay \$250. Site licenses and extremely generous volume discounts are available.
- Note that all purchases are provided as electronic downloads. If necessary you can order a CD from us for an exorbitant fee, but there is no reason to do this. Purchasers of the software are welcome to burn their own CDs at will. They are also free to download the program to all of their computers.
- For more details, including questions about taxes, shipping costs, payment methods, etc., please visit the [Order Info](#) page.

News

[Week-long workshop on SNA](#)

The LINKS Center at the University of Kentucky is offering its annual 1-week summer workshop on social network analysis June 6-10, 2016 on the University of Kentucky campus ...
Posted Mar 15, 2016, 12:54 PM by Steve Borgatti

Showing posts 1 - 1 of 9.
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Current Version

Version 6.614 | 22 May 2016 Changed Network|Compare aggregate proximity matrices|partition to be able to handle missing values Changed the CLI's IPF routine to default to treating diagonal values

Pajek



Networks / Pajek



Program for Large Network Analysis

In January 2008 this page was replaced by [Pajek Wiki](#).

Pajek runs on Windows and is free for noncommercial use.

DOWNLOAD [Pajek](#)

Data: [test networks](#), [GPHs](#), [GEDs](#), [PDB files](#).

[Screenshots](#); [History](#); [Manual \(pdf\)](#); [Papers/presentations](#); [Applications](#); [in News](#); [Examples](#): [SVG](#), [PDF](#).

How to ? [English](#) / [Slovene](#) / [Japanese](#) (problems with IE - download and use Acrobat reader).

[Pajek nicely runs on Linux via Wine](#), [Converting Excel/text into Pajek format](#),
[Pajek to SVG animation](#), [WoS to Pajek](#).

Slides from [NICTA workshop](#), Sydney, Australia, June 14-17, 2005.

Slides from [workshop at GD'05](#), Limerick, Ireland, Sept 11-14, 2005.

[Pajek workshop](#) at [XXVIII Sunbelt Conference](#), St. Pete Beach, Florida, USA, January 22-27, 2008: [slides](#).

[Network analysis course](#) at [ECPR Summer School in Methods and Techniques](#), Ljubljana, Slovenia, July 30 - August 16, 2008.

W. de Nooy, A. Mrvar, V. Batagelj: *Exploratory Social Network Analysis with Pajek*, CUP, January 2005; ESNA page.
P. Doreian, V. Batagelj, A. Ferligoj: *Generalized Blockmodeling*, CUP, November 2004.

Chapter about Pajek: V. Batagelj, A. Mrvar: *Pajek - Analysis and Visualization of Large Networks*.
in Jünger, M., Mutzel, P., (Eds.) *Graph Drawing Software*. Springer, Berlin 2003. p. 77-103 / [Amazon](#).


An improved version of the paper presented at [Sunbelt'97](#) was published in [Connections](#) 21(1998)2, 47-57 - V. Batagelj,
A. Mrvar: *Pajek - Program for Large Network Analysis* ([PDF](#); [PRISON.KIN](#)).

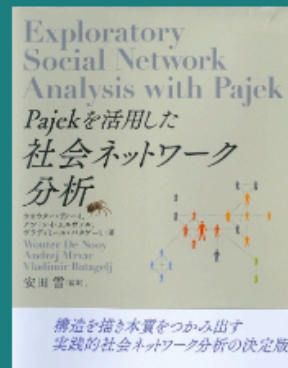
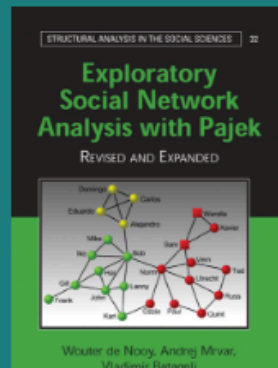
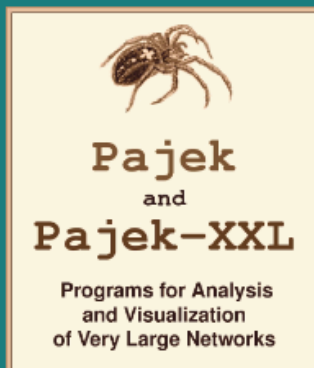
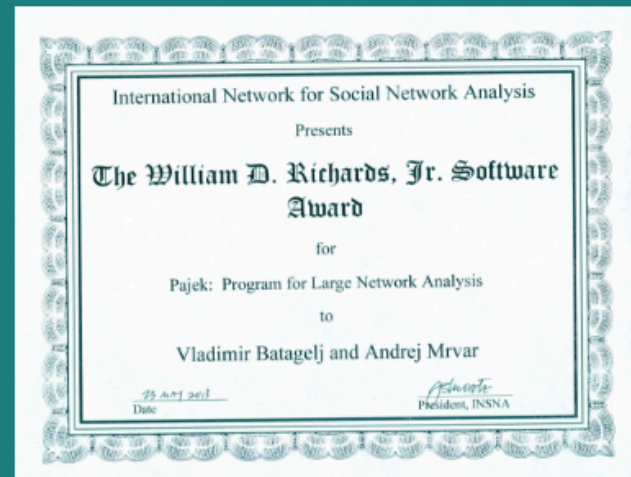
Our layouts for *Graph-Drawing Competitions*: [GD95](#), [GD96](#), [GD97](#), [GD98](#), [GD99](#), [GD00](#), [GD01](#) and [GD05](#).

<http://vlado.fmf.uni-lj.si/pub/networks/pajek/>

Pajek

Pajek: analysis and visualization of large networks

	Ver.	32 bit	64 bit
May 10, 2016	4.10	Web Start  Install Shield Install-Zip Portable	Web Start  Install Shield Install-Zip Portable
March 1, 2016	4.09	Install Shield Install-Zip Portable	Install Shield Install-Zip Portable
Sept. 25, 2011	2.05	zip	zip
		Pajek mailing list	Datasets



NodeXL

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NodeXL: Network Overview, Discovery and Exploration for Excel

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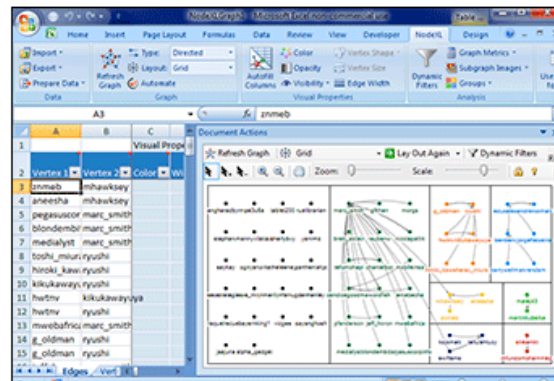
CURRENT	NodeXL Basic Excel Template 2014
DATE	Thu Jan 23, 2014 at 7:00 AM
STATUS	Beta
DOWNLOADS	213,252
RATING	★★★★☆ 17 ratings Review this release

MOST HELPFUL REVIEWS

★★★★☆ Install on Windows 10 Pro 64-bit I gives an error message: 'Customized functionality in this application will not work because the c...' [\(more\)](#)

NodeXL Basic is a free, open-source template for Microsoft® Excel® 2007, 2010, 2013 and 2016 that makes it easy to explore network graphs. With NodeXL, you can enter a network edge list in a worksheet, click a button and see your graph, all in the familiar environment of the Excel window.

NodeXL Pro offers additional features that extend NodeXL Basic, providing easy access to social media network data streams, advanced network metrics, and text and sentiment analysis, and



<https://nodexl.codeplex.com/>

Cytoscape



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Cytoscape

Network Data Integration, Analysis, and Visualization in a Box

Introduction

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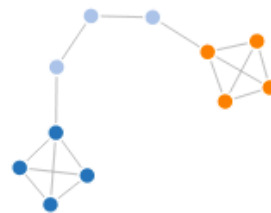
NetworkX

NetworkX

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High-productivity software for complex networks

NetworkX is a Python language software package for the creation, manipulation, and study of the structure, dynamics, and functions of complex networks.



[Documentation](#)

all documentation

[Examples](#)

using the library

[Reference](#)

all functions and methods

Features

- Python language data structures for graphs, digraphs, and multigraphs.
- Many standard graph algorithms
- Network structure and analysis measures
- Generators for classic graphs, random graphs, and synthetic networks
- Nodes can be "anything" (e.g. text, images, XML records)
- Edges can hold arbitrary data (e.g. weights, time-series)
- Open source [BSD license](#)
- Well tested: more than 1800 unit tests, >90% code coverage
- Additional benefits from Python: fast prototyping, easy to teach, multi-platform

Versions

Latest Release

networkx-1.11
30 January 2016
[downloads](#) | [docs](#) | [pdf](#)

Development

2.0dev
[github](#) | [docs](#) | [pdf](#)
build passing
coverage 94%

Contact

[Mailing list](#)
[Issue tracker](#)



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<https://networkx.github.io/>

igraph



Products ▾

News

On github



igraph – The network analysis package

igraph is a collection of network analysis tools with the emphasis on **efficiency**, **portability** and ease of use. igraph is **open source** and free. igraph can be programmed in **R**, **Python** and **C/C++**.

igraph R package

python-igraph

igraph C library

R/igraph 1.0.0

Repositories at Github

R/igraph 0.7.1

C/igraph 0.7.1

R/igraph 0.7.0

python-igraph 0.7.0

C/igraph 0.7.0

R/igraph 0.6.5

Recent news

R/igraph 1.0.0

June 24, 2015

Release Notes

This is a new major release, with a lot of UI changes. We tried to make it easier to use, with short and easy to remember, consistent function names. Unfortunately

<http://igraph.org/redirect.html>



- SNAP for C++ ▶
- SNAP for Python ▶
- SNAP Datasets ▶
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- People
- Papers
- Citing SNAP
- Links
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Open positions

Open research positions in **SNAP** group are available [here](#).

Stanford Network Analysis Project

• SNAP for C++: Stanford Network Analysis Platform

Stanford **Network Analysis Platform (SNAP)** is a general purpose network analysis and graph mining library. It is written in C++ and easily scales to massive networks with hundreds of millions of nodes, and billions of edges. It efficiently manipulates large graphs, calculates structural properties, generates regular and random graphs, and supports attributes on nodes and edges. SNAP is also available through the [NodeXL](#) which is a graphical front-end that integrates network analysis into Microsoft Office and Excel.

• Snap.py: SNAP for Python

Snap.py is a Python interface for SNAP. It provides performance benefits of SNAP, combined with flexibility of Python. Most of the SNAP C++ functionality is available via Snap.py in Python.

• Stanford Large Network Dataset Collection

A collection of more than 50 large network datasets from tens of thousands of nodes and edges to tens of millions of nodes and edges. It includes social networks, web graphs, road networks, internet networks, citation networks, collaboration networks, and communication networks.

• Tutorials

Tutorials on using SNAP, on methods to analyze large network data, on ways how to think about networks and how to model them at the level of network structure, and on methods to study evolution and dynamics of diffusion and cascading behavior in networks.

- Tutorial on [Large Scale Network Analytics with SNAP](#) will be held at [WWW-15](#) conference, Florence, Italy, May 18, 2015. [More info](#).

sigma.js

sigma.js

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TUTORIAL

v1.1.0

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Sigma is a JavaScript library **dedicated to graph drawing**. It makes easy to publish networks on Web pages, and allows developers to integrate network exploration in rich Web applications.

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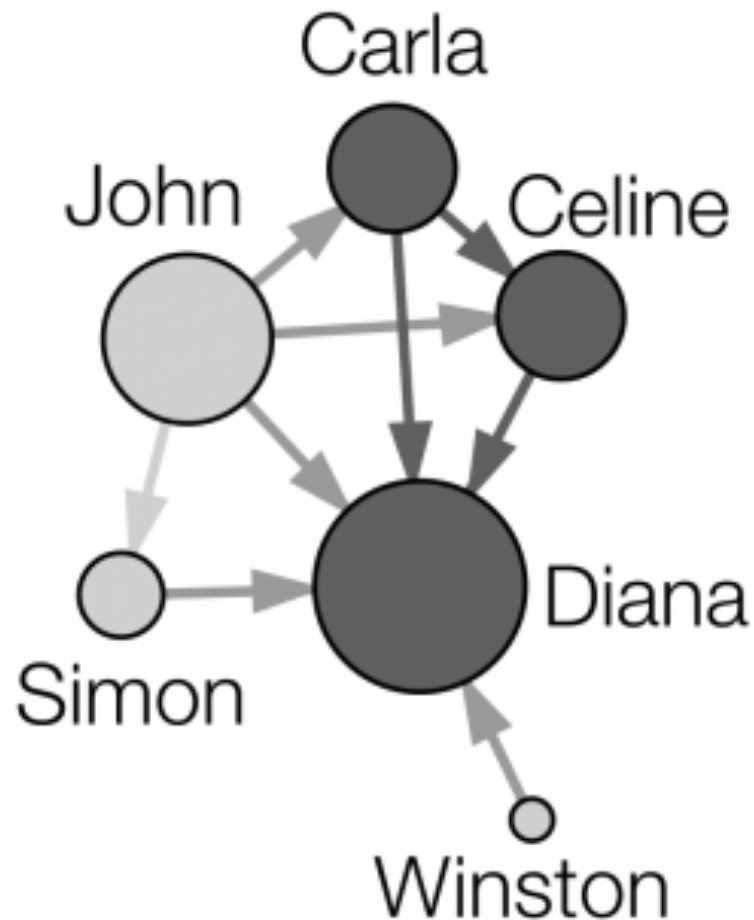
DOWNLOAD V1.1.0 

SCIENCESPO - MÉDIALAB

<http://sigmajs.org/>

Gephi: Social Network Analysis and Visualization

Network Analysis and Visualization with Gephi



Nodes

Id,Label,Attribute

1,John,1

2,Carla,2

3,Simon,1

4,Celine,2

5,Winston,1

6,Diana,2

Edges

Source,Target

1,2

1,3

1,4

1,6

2,4

2,6

3,6

4,6

5,6

Nodes and Edges

CSV Text Data for Gephi

Nodes1.csv

```
Id,Label,Attribute
1,John,1
2,Carla,2
3,Simon,1
4,Celine,2
5,Winston,1
6,Diana,2
```

Edges1.csv

```
Source,Target
1,2
1,3
1,4
1,6
2,4
2,6
3,6
4,6
5,6
```

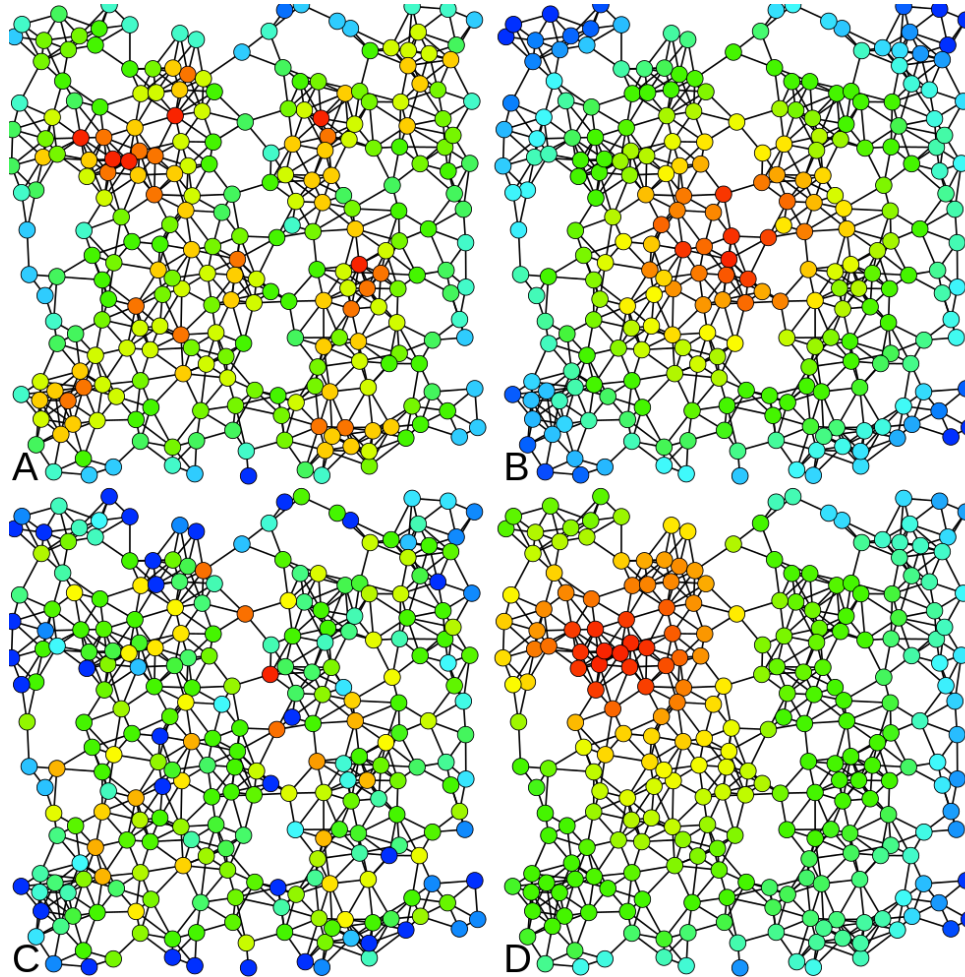
Nodes1.csv

×

```
Id,Label,Attribute
1,John,1
2,Carla,2
3,Simon,1
4,Celine,2
5,Winston,1
6,Diana,2
```

A = Degree centrality
number of connexions

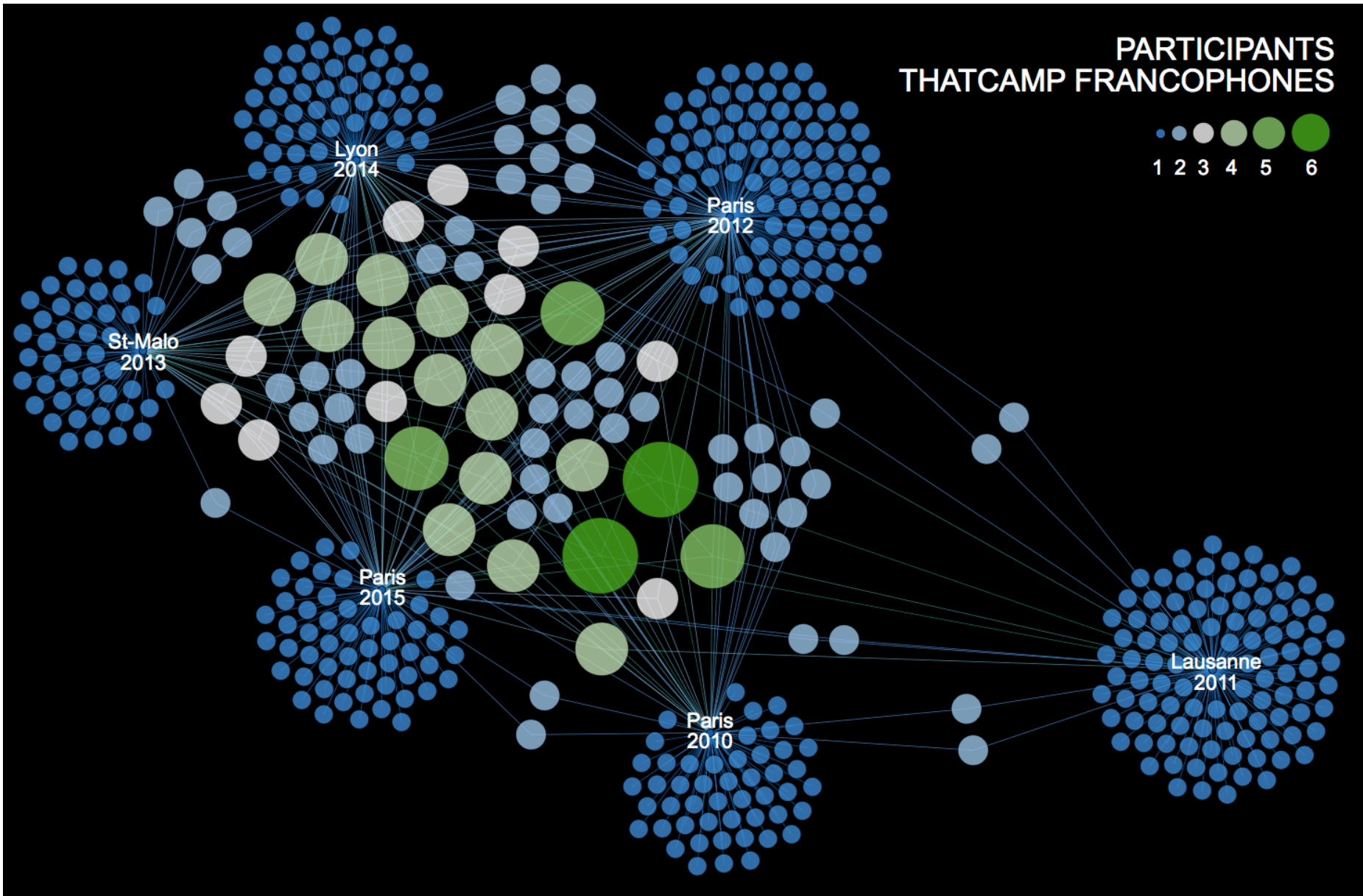
B = Closeness centrality
closeness to the entire network



C = Betweenness centrality
bridges nodes

D = Eigenvector centrality
connection to well-connected nodes

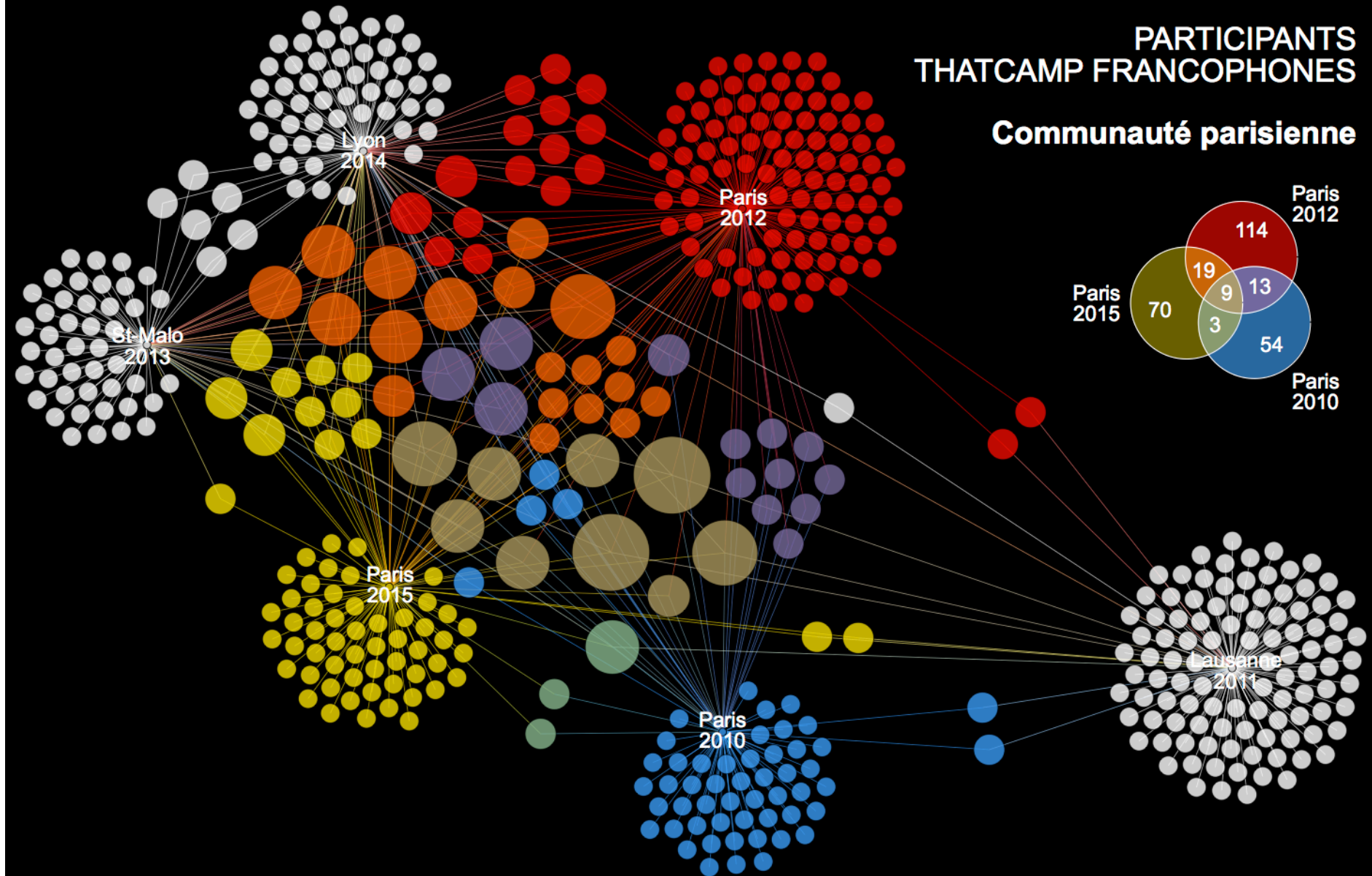
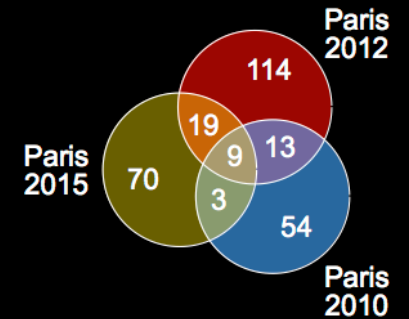
Conference Participants



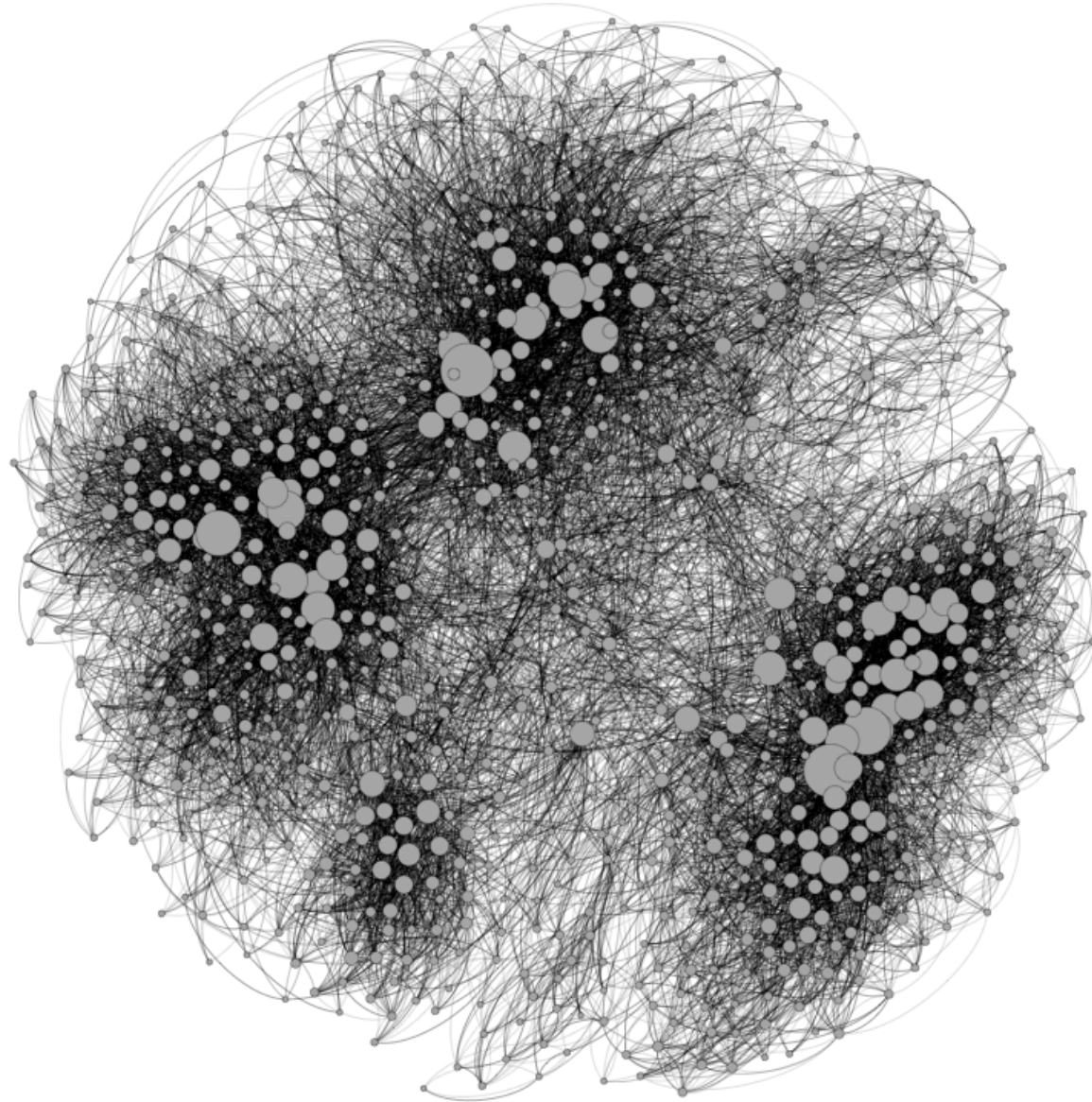
Conference Participants

PARTICIPANTS THATCAMP FRANCOPHONES

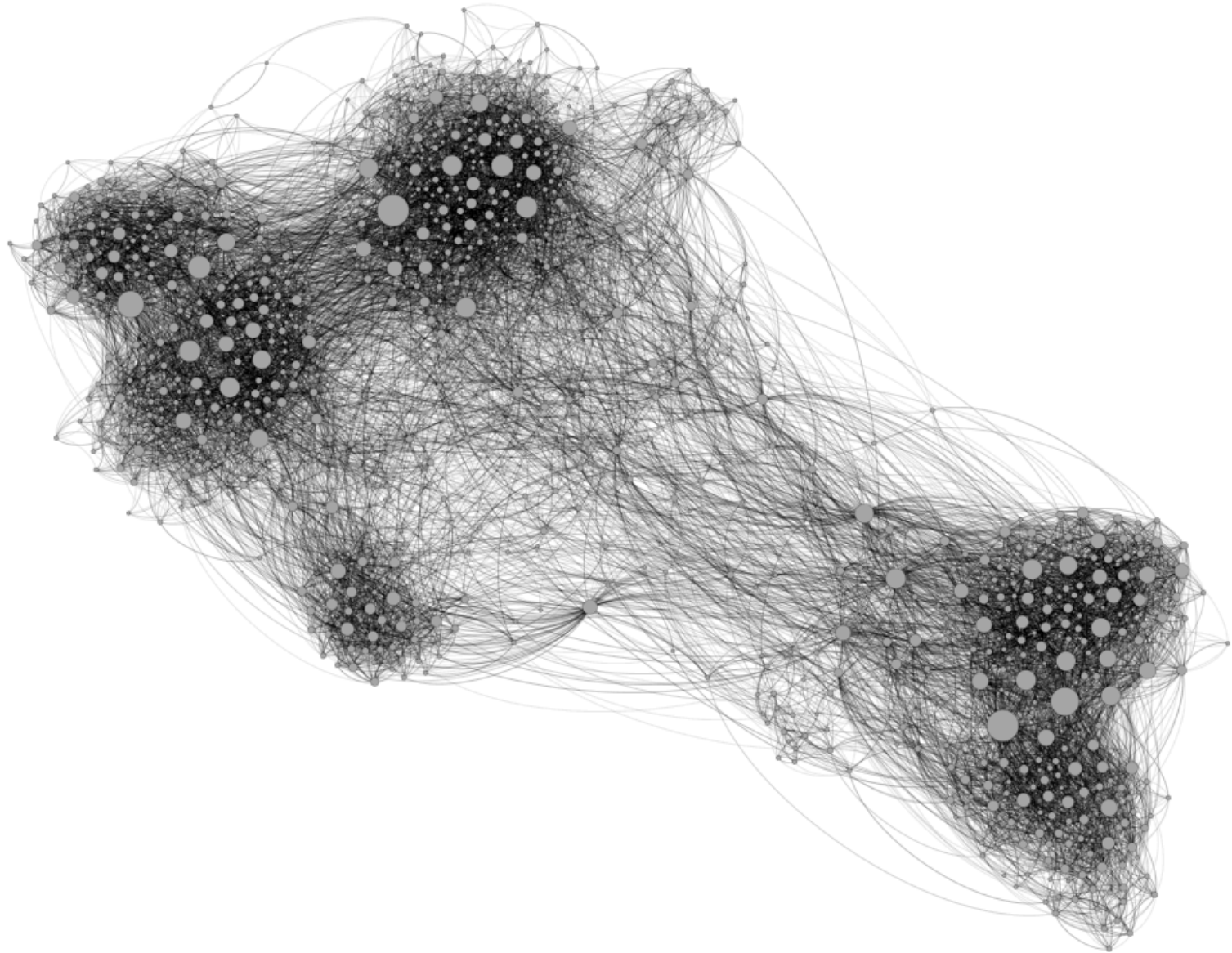
Communauté parisienne



Fruchterman Reingold



Force Atlas 2

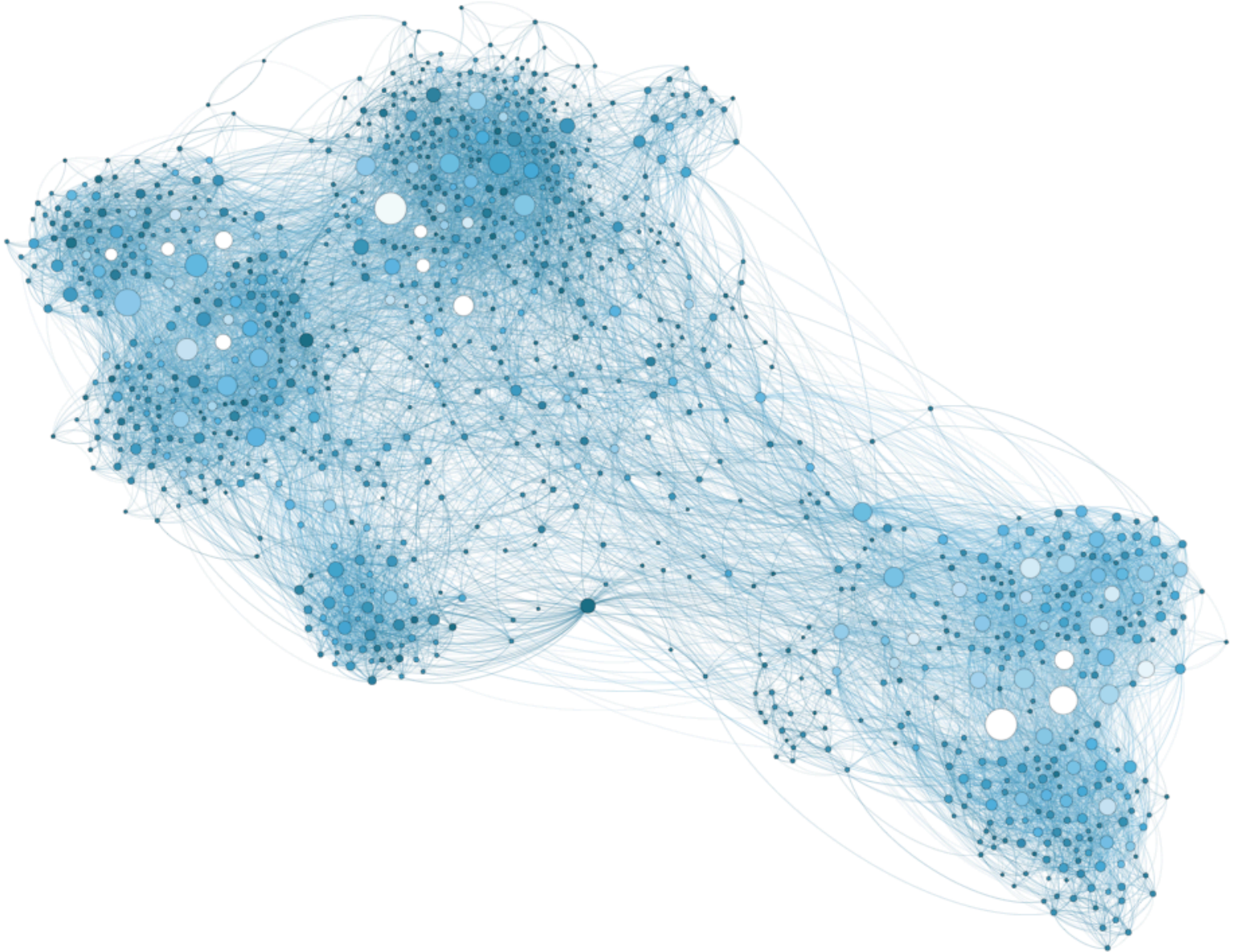


Nodes' color

Weighted In-Degree

The image shows a screenshot of the 'Ranking' dialog box in Gephi, specifically for 'Nodes'. The dialog is titled 'Ranking' and has a close button (X) in the top right corner. Below the title bar, there are two tabs: 'Nodes' (selected) and 'Edges'. To the right of the tabs are four icons: a rainbow circle, a red triangle, a blue 'A', and a red 'A'. Below the tabs is a dropdown menu showing 'Weighted In-Degree'. Underneath the dropdown is a 'Color' section with a horizontal color scale bar. The bar is currently set to a light blue color. Below the color bar is a 'Range' section with a horizontal range slider. The slider is set to a range from 0.0 to 210.0. At the bottom left of the dialog is a 'Spline...' button. At the bottom right is an 'Apply' button with a green play icon.

Weighted In-Degree



Network Diameter

Betweenness Centrality

Closeness 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

Statistics x Filters

Settings


Network Overview

Average Degree		Run	●
Avg. Weighted Degree	25.486	Run	?
Network Diameter		Run	●
Graph Density		Run	●
HITS		Run	●
Modularity	0.57	Run	?
PageRank		Run	●
Connected Components		Run	●

Node Overview

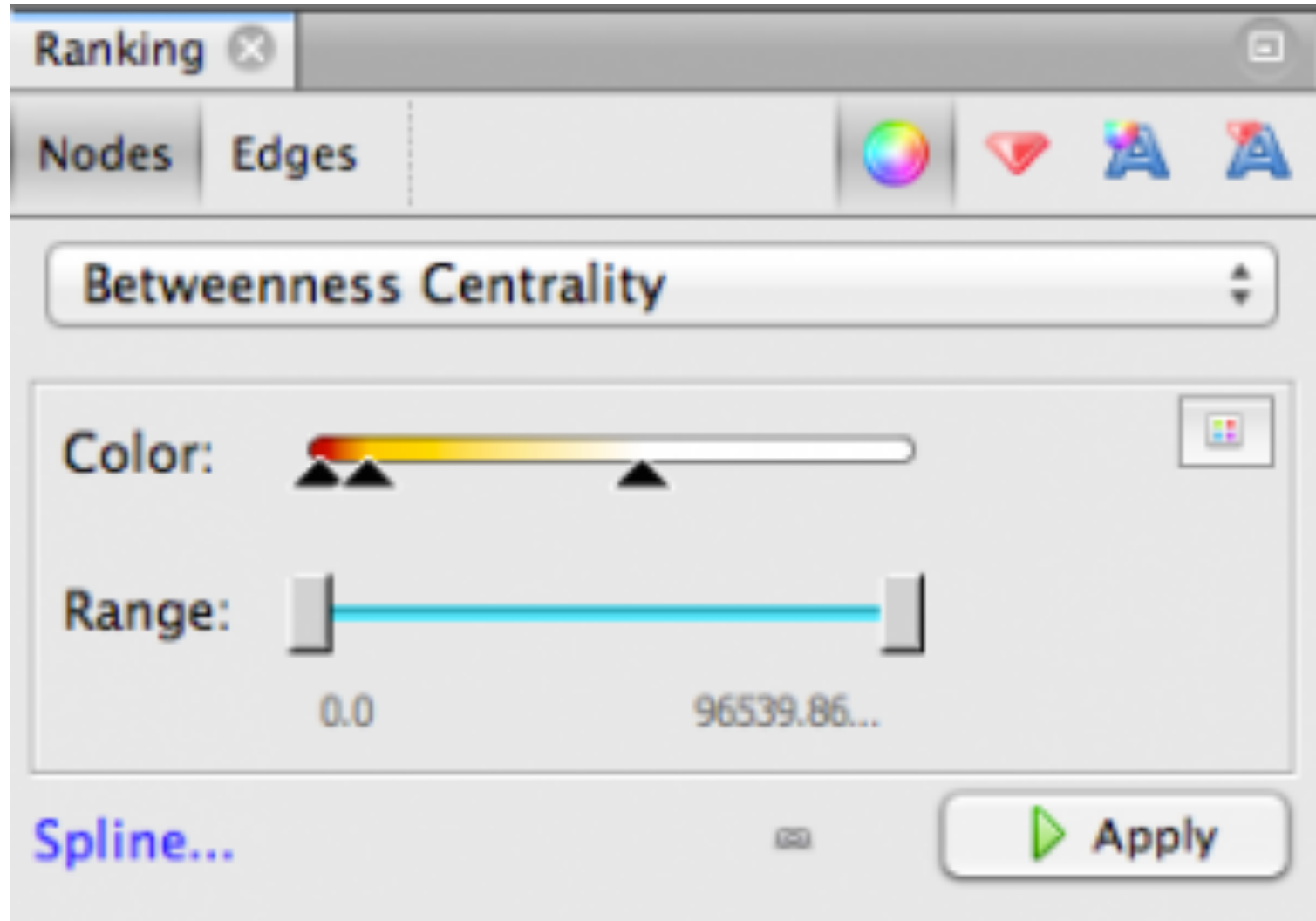
Avg. Clustering Coefficient		Run	●
Eigenvector Centrality		Run	●

Edge Overview



Nodes' color

Betweenness Centrality

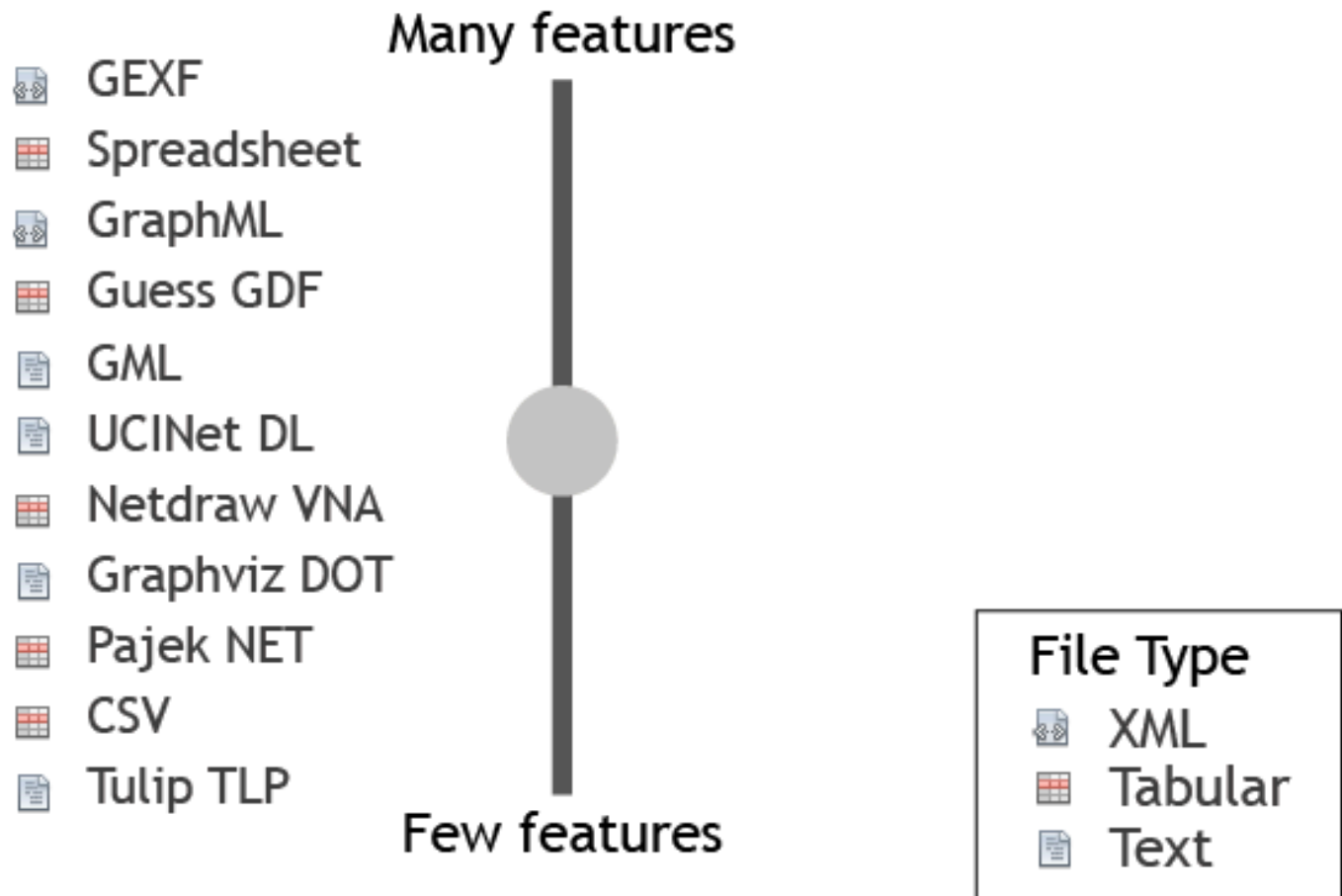


Gephi Supported Graph Formats

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

Gephi Supported Graph Formats

Do you need...



Gephi



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The Open Graph Viz Platform

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

Runs on Windows, Mac OS X and Linux.

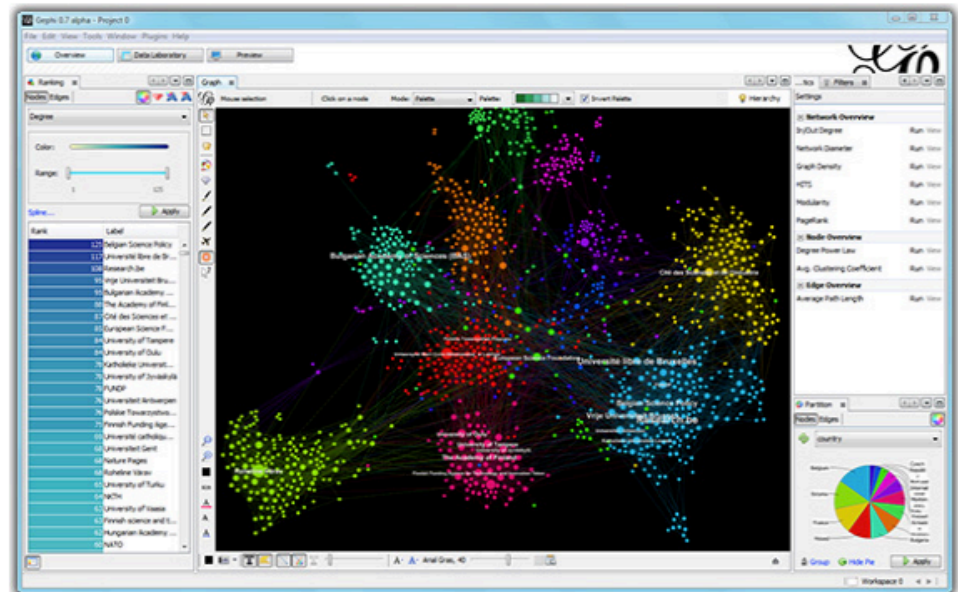
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APPLICATIONS

- ✓ **Exploratory Data Analysis:** intuition-oriented analysis by networks manipulations in real time.
- ✓ **Link Analysis:** revealing the underlying structures of associations between objects.
- ✓ **Social Network Analysis:** easy creation of social

Like Photoshop™ for graphs.

— the Community

LATEST NEWS

► [Gephi updates with 0.9.1 version](#)

PAPERS



<https://gephi.org/>

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Download

Gephi is an open-source and multiplatform software distributed under the dual license [CDDL 1.0](#) and [GNU General Public License v3](#).

Official Releases

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

Gephi 0.9.1 is the latest stable release.

Download Gephi for Mac OSX

Version 0.9.1

If you have an older Gephi on your computer, you should uninstall it first, [see the installation instructions](#).

All downloads:

- [Download Gephi 0.9.1 for Mac OS X](#)
- [Download Gephi 0.9.1 for Windows](#)
- [Download Gephi 0.9.1 for Linux](#)
- [Download Gephi 0.9.1 sources](#)
- [Download Older Versions](#)

Sources:

Gephi uses [GitHub](#) to host the source code and track issues. The [trunk](#) repository is the most up-to-date version but may be unstable. The last stable version is located in the release tab on [GitHub](#).

Localization

Localization is available in **French, Spanish, Japanese, Brazilian Portuguese, Russian, Chinese, Czech** and **German**. In Gephi, simply go to **Tools -> Languages** to switch.

<https://gephi.org/users/download/>

 Stay informed
blog, twitter & more

 Contribute
code, doc, test & more

 Report a Bug

 Request a Feature

 Share your ideas

Ways to get help

- [2\) Get Personal Help](#)
- [3\) Other Gephi Support](#)
- [4\) Get Professional Training Courses](#)

New to Gephi?

- [Installing Gephi](#)
- [System Requirements](#)
- [Quick Start Guide](#)
- [Customizing Gephi with plugins](#)

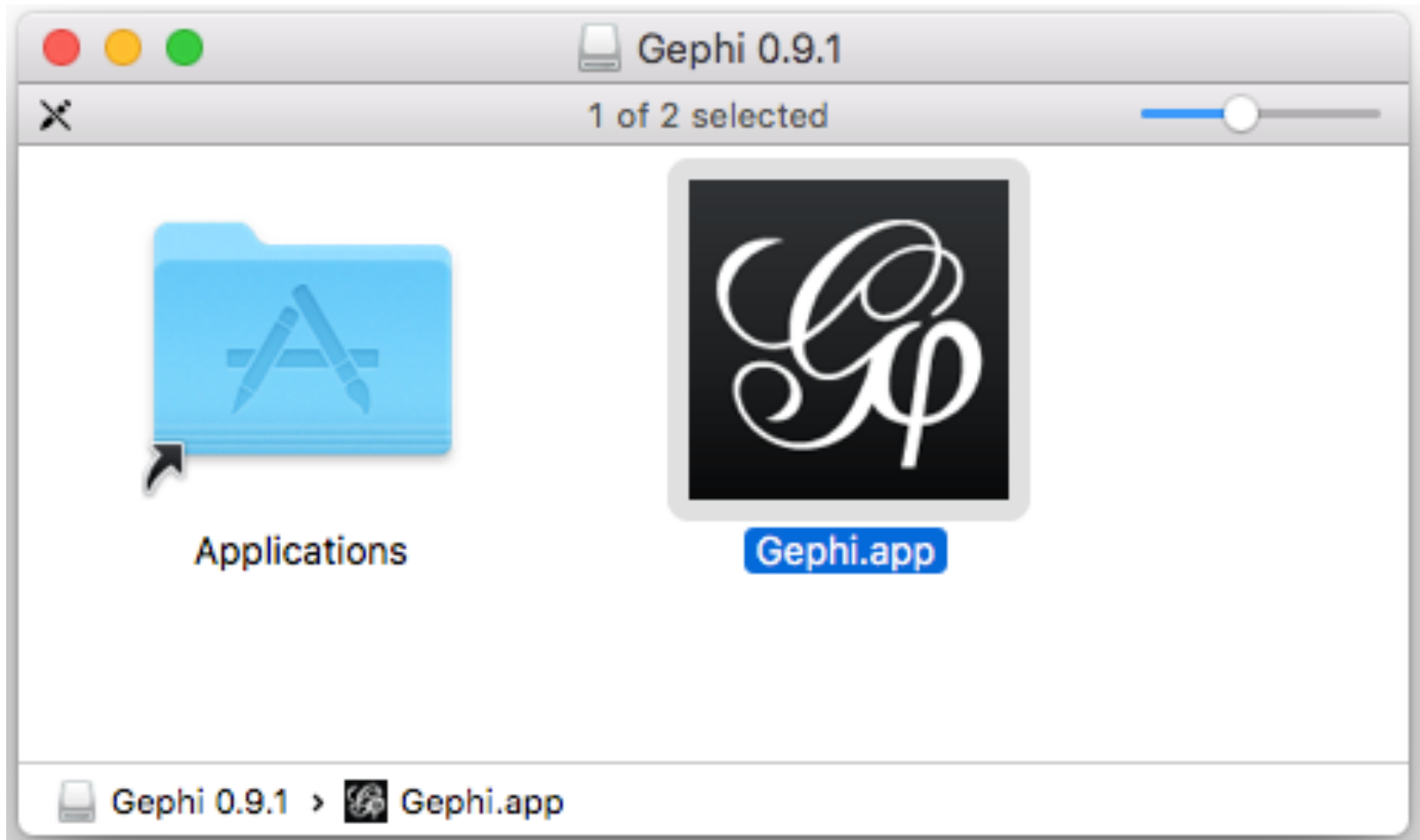
Download Gephi



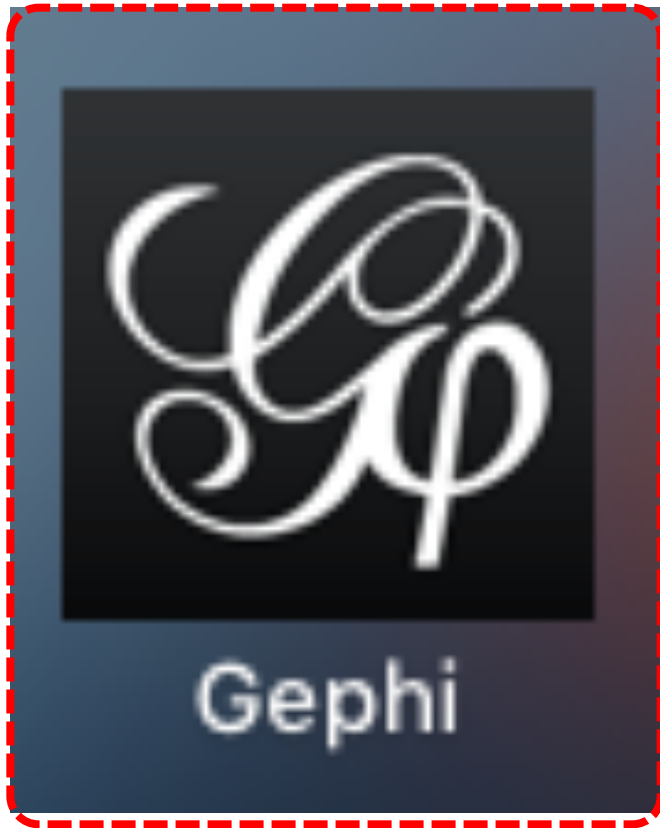
gephi-0.9.1-macos.dmg

Disk Image - 121.1 MB

Gephi 0.9.1



Gephi



Gephi.app

Gephi:
New Project
Import
Nodes1.csv and
Edges1.csv
to Gephi

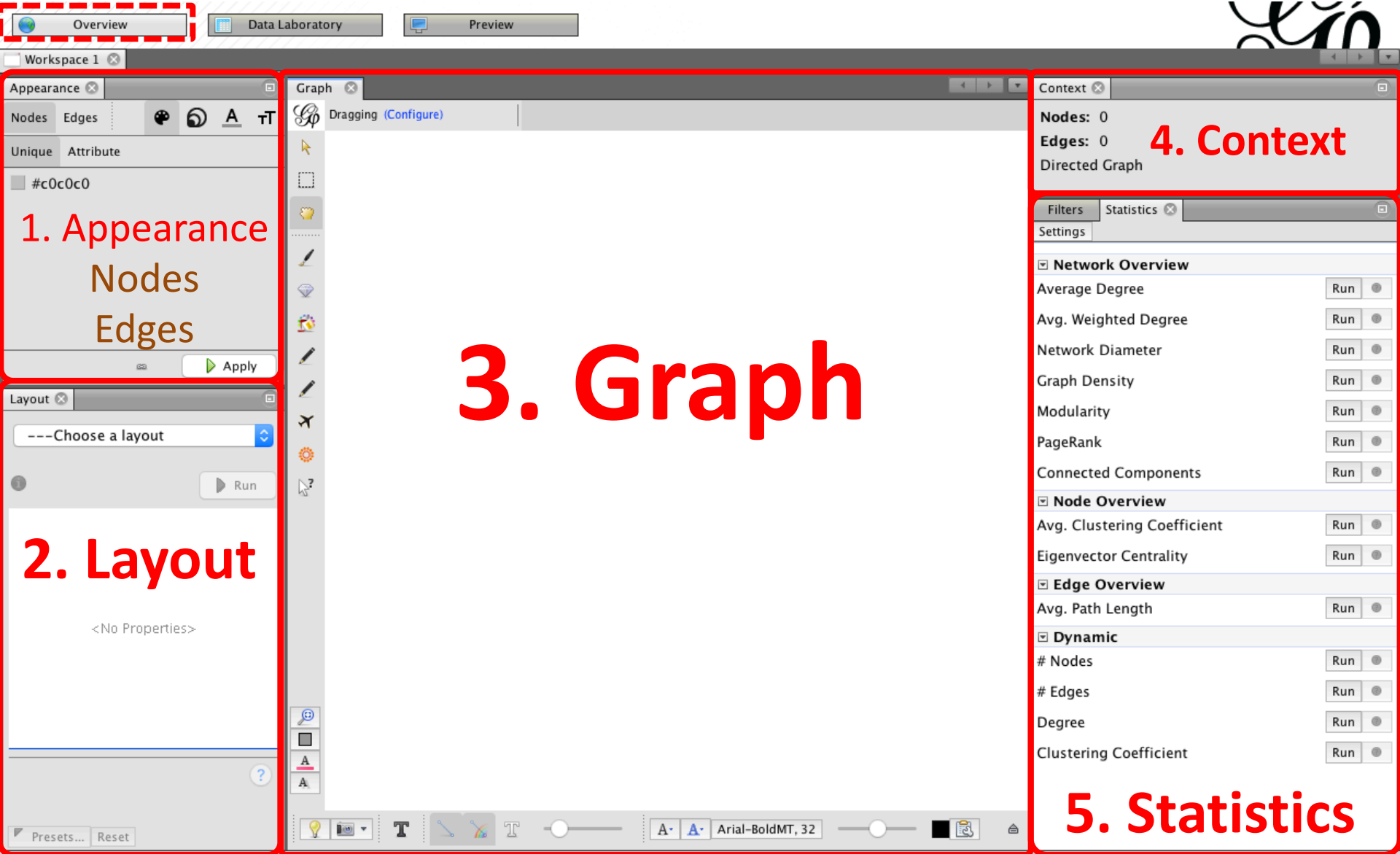
Gephi New Project



The screenshot displays the Gephi software interface. At the top, there are three tabs: 'Overview', 'Data Laboratory', and 'Preview'. Below these is a 'Data Table' window with 'Nodes', 'Edges', and 'Configuration' tabs. A 'Filter:' input field is visible on the right. The main area shows a 'Welcome' dialog box with the following content:

- Welcome to Gephi** (with the Gephi logo)
- Open recent** (empty list)
- New Project**
 - [New Project](#) (highlighted with a red dashed box)
 - [Open Graph File...](#)
- Samples**
 - [Les Miserables.gexf](#)
 - [Java.gexf](#)
 - [Power Grid.gml](#)
- Open at startup**

Gephi Overview



1. Appearance
Nodes
Edges

2. Layout

3. Graph

4. Context

5. Statistics

Filters

Gephi Data Laboratory: Import Spreadsheet



The screenshot displays the Gephi Data Laboratory interface. At the top, there are three tabs: 'Overview', 'Data Laboratory' (highlighted with a red dashed box), and 'Preview'. Below the tabs is a workspace area labeled 'Workspace 1'. The main interface is divided into a top toolbar and a bottom toolbar. The top toolbar includes buttons for 'Nodes', 'Edges', 'Configuration', 'Add node', 'Add edge', 'Search/Replace', 'Import Spreadsheet' (highlighted with a red dashed box), 'Export table', and 'More actions'. A 'Filter:' input field is also present. The main area shows a table with columns 'Id', 'Label', and 'Interval'. The bottom toolbar contains various data manipulation tools: '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', and 'Create column with list of regex matching groups'.

Gephi Data Laboratory: Import Spreadsheet



The screenshot displays the Gephi Data Laboratory interface. At the top, there are three tabs: 'Overview', 'Data Laboratory' (highlighted with a red dashed box), and 'Preview'. Below the tabs, the main workspace shows a 'Data Table' with columns for 'Id', 'Label', and 'Interval'. The 'Import Spreadsheet' button in the top toolbar is also highlighted with a red dashed box.

The 'Import spreadsheet' dialog box is open, showing the following options:

- Steps:**
 1. General options
 2. Import settings
- General options:**
 - Choose a CSV file to import: [Text field with a red error icon and a red dashed box around the ellipsis button '...']
 - Separator: [Dropdown menu showing 'Co...']
 - As table: [Dropdown menu showing 'Edges table']
 - Charset: [Dropdown menu showing 'UTF-8']
- Preview:** [Empty text area]
- Error message:** Invalid CSV file (with a red error icon)
- Buttons:** Help, < Back, Next >, Finish, Cancel

At the bottom of the interface, there is a toolbar with various data manipulation actions:

- 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

Import Nodes1.csv to 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

Import spreadsheet

Steps

1. General options
2. Import settings

General options

Choose a CSV file to import:

/imyday/Documents/SCDBA/SNA_Data/Nodes1.csv

Open

SNA_Data

Name	D.
Edges1.csv	...
Nodes1.csv	...

File Format: All Files

Cancel Open

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

Nodes1.csv

Id,Label,Attribute

1,John,1

2,Carla,2

3,Simon,1

4,Celine,2

5,Winston,1

6,Diana,2

Import Nodes1.csv to Gephi



Workspace 1

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

Import spreadsheet

Steps

1. General options
2. Import settings

General options

Choose a CSV file to import:

/imyday/Documents/SCDBA/SNA_Data/Nodes1.csv

Separator: As table: Charset:

Co... Nodes ta... UTF-8

Preview:

Id	Label	Attribute
1	John	1
2	Carla	2
3	Simon	1
4	Celine	2
5	Winston	1
6	Diana	2

Help < Back **Next >** Finish Cancel

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

Import Nodes1.csv to Gephi



The screenshot shows the Gephi Data Laboratory interface. At the top, there are tabs for 'Overview', 'Data Laboratory', and 'Preview'. Below these is a 'Workspace 1' tab and a 'Data Table' tab. The 'Data Table' tab is active, showing a table with columns 'Id', 'Label', and 'Interval'. A dialog box titled 'Import spreadsheet' is open in the center. The dialog has two panes: 'Steps' and 'Import settings'. The 'Steps' pane shows a list: 1. General options, 2. Import settings. The 'Import settings' pane contains the following text: 'New columns are created with the specified type. A generated id is assigned if missing. Unless the option 'Force nodes to be created as new ones' is en'. Below this text, under 'Imported columns:', there are three checked items: 'Id' (String), 'Label' (String), and 'Attribute' (String). There is also an unchecked checkbox for 'Force nodes to be created as new ones'. At the bottom of the dialog, there are buttons for 'Help', '< Back', 'Next >', 'Finish' (highlighted with a red dashed border), and 'Cancel'. At the bottom of the main interface, there is a toolbar with various actions: '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', and 'Create column with list of regex matching groups'.

Import Nodes1.csv to Gephi



Id	Label	Interval	Attribute
1	John		1
2	Carla		2
3	Simon		1
4	Celine		2
5	Winston		1
6	Diana		2

Nodes1.csv

```
Id,Label,Attribute  
1,John,1  
2,Carla,2  
3,Simon,1  
4,Celine,2  
5,Winston,1  
6,Diana,2
```

- 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

Import Edges1.csv to Gephi



The screenshot shows the Gephi Data Laboratory interface. At the top, there are three tabs: 'Overview', 'Data Laboratory', and 'Preview'. Below these is a 'Workspace 1' tab. The main area is titled 'Data Table' and contains a 'Nodes' tab and an 'Edges' tab, both of which are highlighted with red dashed boxes. The 'Edges' tab is active, showing a 'Configuration' section with several buttons: 'Add node', 'Add edge', 'Search/Replace', 'Import Spreadsheet', 'Export table', and 'More actions'. The 'Import Spreadsheet' button is also highlighted with a red dashed box. Below the configuration section is a table with columns: 'Source', 'Target', 'Type', 'Id', 'Label', 'Interval', and 'Weight'. At the bottom of the interface is a toolbar with various actions: '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', and 'Create column with list of regex matching groups'.

Import Edges1.csv to 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: Source

Source Target Type Id Label Interval Weight

Import spreadsheet

Steps

1. General options
2. Import settings

General options

Choose a CSV file to import:

/Documents/SCDBA/SNA_Data/Edges1.csv

Open

SNA_Data

Name

- Edges1.csv
- Nodes1.csv

File Format: All Files

Cancel Open

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

Edges1.csv

Source, Target

1,2

1,3

1,4

1,6

2,4

2,6

3,6

4,6

5,6

Import Edges1.csv to Gephi



Workspace 1

Data Laboratory

Preview

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

Import spreadsheet

Steps

1. General options
2. Import settings

General options

Choose a CSV file to import:

/Documents/SCDBA/SNA_Data/Edges1.csv

Separator: Comma

Nodes table

Edges table

Charset: UTF-8

Preview:

Source	Target
1	2
1	3
1	4
1	6
2	4
2	6
3	6
4	6

Help < Back Next > Finish Cancel

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

Edges table

Import Edges1.csv to 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: | Source

Source | Target | Type | Id | Label | Interval | Weight

Import spreadsheet

Steps

1. General options
2. Import settings

General options

Choose a CSV file to import:
/Documents/SCDBA/SNA_Data/Edges1.csv

Separator: | As table: | Charset:
Co... | **Edges table** | UTF-8

Preview:

Source	Target
1	2
1	3
1	4
1	6
2	4
2	6
3	6
4	6

Help | < Back | **Next >** | Finish | Cancel

Edges table

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

Import Edges1.csv to 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: | Source

Source	Target	Type	Id	Label	Interval	Weight
--------	--------	------	----	-------	----------	--------

Import spreadsheet

Steps

1. General options
2. **Import settings**

Import settings

New columns are created with the specified type. A generated id is assigned if missing or already existing. Edges need 'Source' and 'Target' columns with the id of the nodes. If no 'Type' column is provided, all edges will be directed. If an edge already exists, attributes will be ignored, but the edge will be updated.

Imported columns:

- Source
String
- Target
String
- Create missing nodes

Help | < Back | Next > | **Finish** | Cancel

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

Import Edges1.csv to 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: Source

Source	Target	Type	Id	Label	Interval	Weight
1	2	Directed	0			1.0
1	3	Directed	1			1.0
1	4	Directed	2			1.0
1	6	Directed	3			1.0
2	4	Directed	4			1.0
2	6	Directed	5			1.0
3	6	Directed	6			1.0
4	6	Directed	7			1.0
5	6	Directed	8			1.0

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

Gephi Overview



The screenshot displays the Gephi software interface. At the top, there are tabs for 'Overview' (highlighted with a red dashed box), 'Data Laboratory', and 'Preview'. Below these is 'Workspace 1'. The main interface is divided into several panels:

- Appearance:** Contains 'Nodes' and 'Edges' settings. The 'Nodes' section shows 'Unique' and 'Attribute' options, with a color selection set to '#c0c0c0'. An 'Apply' button is visible.
- Layout:** Features a dropdown menu for selecting a layout, currently set to '---Choose a layout'. A 'Run' button is present below the dropdown.
- Graph:** The central workspace showing a directed graph with 6 nodes and 9 edges. The graph is currently in a 'Dragging (Configure)' state.
- Context:** A sidebar on the right displaying network statistics:
 - Nodes:** 6
 - Edges:** 9
 - Directed Graph**Below this, there are sections for 'Network Overview', 'Node Overview', 'Edge Overview', and 'Dynamic' statistics, each with a 'Run' button and a progress indicator.
 - Network Overview:** Average Degree, Avg. Weighted Degree, Network Diameter, Graph Density, Modularity, PageRank, Connected Components.
 - Node Overview:** Avg. Clustering Coefficient, Eigenvector Centrality.
 - Edge Overview:** Avg. Path Length.
 - Dynamic:** # Nodes, # Edges, Degree, Clustering Coefficient.

At the bottom of the interface, there is a toolbar with various tools and a status bar showing the font 'Arial-BoldMT, 32'.

Gephi Overview: Graph



Overview Data Laboratory Preview

Workspace 1

Appearance x Graph x Context x

Nodes Edges Dragging (Configure)

Unique Attribute

#c0c0c0

Apply

Layout x

---Choose a layout

Run

<No Properties>

Presets... Reset

Nodes: 6
Edges: 9
Directed Graph

Filters Statistics x Settings

Network Overview

- Average Degree Run
- Avg. Weighted Degree Run
- Network Diameter Run
- Graph Density Run
- Modularity Run
- PageRank Run
- Connected Components Run

Node Overview

- Avg. Clustering Coefficient Run
- Eigenvector Centrality Run

Edge Overview

- Avg. Path Length Run

Dynamic

- # Nodes Run
- # Edges Run
- Degree Run
- Clustering Coefficient Run

Gephi Overview: Layout



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes | Edges | Dragging (Configure)

Unique | Attribute

#c0c0c0

Apply

Layout

---Choose a layout

- Fruchterman Reingold
- Label Adjust
- Noverlap
- OpenOrd
- Random Layout
- Rotate
- Yifan Hu
- Yifan Hu Proportional**

<No Properties>

Presets... Reset

Nodes: 6
Edges: 9
Directed Graph

Filters | Statistics | Settings

Network Overview

- Average Degree
- Avg. Weighted Degree
- Network Diameter
- Graph Density
- Modularity
- PageRank
- Connected Components

Node Overview

- Avg. Clustering Coefficient
- Eigenvector Centrality

Edge Overview

- Avg. Path Length

Dynamic

- # Nodes
- # Edges
- Degree
- Clustering Coefficient

Gephi Overview: Layout

Yifan Hu Proportional



Overview Data Laboratory Preview

Workspace 1

Appearance Graph Context

Nodes Edges Unique Attribute #c0c0c0 Apply

Layout Yifan Hu Proportional Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu Proportional

Presets... Reset

Dragging (Configure)

Nodes: 6
Edges: 9
Directed Graph

Filters Statistics Settings

Network Overview

Average Degree	Run
Avg. Weighted Degree	Run
Network Diameter	Run
Graph Density	Run
Modularity	Run
PageRank	Run
Connected Components	Run

Node Overview

Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run

Edge Overview

Avg. Path Length	Run
------------------	-----

Dynamic

# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run

Font: Arial-BoldMT, 32

Gephi Overview: Layout

Yifan Hu



Overview Data Laboratory Preview

Workspace 1

Appearance Graph Context

Nodes Edges Unique Attribute

#c0c0c0

Apply

Layout

Yifan Hu

Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Dragging (Configure)

Context

Nodes: 6
Edges: 9
Directed Graph

Filters Statistics Settings

Network Overview

Average Degree	Run
Avg. Weighted Degree	Run
Network Diameter	Run
Graph Density	Run
Modularity	Run
PageRank	Run
Connected Components	Run

Node Overview

Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run

Edge Overview

Avg. Path Length	Run
------------------	-----

Dynamic

# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run

Arial-BoldMT, 32

Appearance: Nodes Color



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges **Color**

Unique Attribute

#c0c0c0

Apply

Layout

Yifan Hu

Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Dragging (Configure)

```
graph TD; N1(( )) --> N2(( )); N2 --> N3(( )); N2 --> N4(( )); N2 --> N5(( )); N3 --> N4; N4 --> N6(( )); N5 --> N6;
```

Context

Nodes: 6
Edges: 9
Directed Graph

Filters | Statistics | Settings

Network Overview

Average Degree	Run
Avg. Weighted Degree	Run
Network Diameter	Run
Graph Density	Run
Modularity	Run
PageRank	Run
Connected Components	Run

Node Overview

Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run

Edge Overview

Avg. Path Length	Run
------------------	-----

Dynamic

# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run

Font: Arial-BoldMT, 32

Nodes Color / Attribute / Apply



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes | Edges | Unique | Attribute

Attribute

■	2	(50%)
■	1	(50%)

Apply

Layout | Yifan Hu | Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thres	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Dragging (Configure)

```

graph TD
    N1(( )) --> N2(( ))
    N2 --> N3(( ))
    N2 --> N4(( ))
    N3 --> N5(( ))
    N4 --> N5
    N5 --> N6(( ))
    N6 --> N3
    N6 --> N4
    N6 --> N7(( ))
    N7 --> N3
    N7 --> N4
    
```

Context

Nodes: 6
Edges: 9
Directed Graph

Filters | Statistics | Settings

Network Overview

Average Degree	Run
Avg. Weighted Degree	Run
Network Diameter	Run
Graph Density	Run
Modularity	Run
PageRank	Run
Connected Components	Run

Node Overview

Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run

Edge Overview

Avg. Path Length	Run
------------------	-----

Dynamic

# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run

Arial-BoldMT, 32

Show Node Labels



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Dragging (Configure)

Unique Attribute

Attribute

2 (50%)
1 (50%)

Apply

Layout

Yifan Hu

Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Show Node Labels

Context

Nodes: 6
Edges: 9
Directed Graph

Filters | Statistics | Settings

Network Overview

Average Degree	Run
Avg. Weighted Degree	Run
Network Diameter	Run
Graph Density	Run
Modularity	Run
PageRank	Run
Connected Components	Run

Node Overview

Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run

Edge Overview

Avg. Path Length	Run
------------------	-----

Dynamic

# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run

Show Node Labels



The screenshot displays a network visualization software interface. The main workspace shows a directed graph with six nodes and nine edges. The nodes are labeled with names: Winston, Celine, Diana, Carla, John, and Simon. The nodes are colored: Winston, John, and Simon are green; Celine, Diana, and Carla are pink. The edges are black arrows connecting the nodes.

The interface includes several panels:

- Appearance:** Shows node and edge settings. Under 'Attribute', there are two categories: '2' (50%) and '1' (50%).
- Layout:** Shows the 'Yifan Hu' layout algorithm selected. A 'Run' button is visible.
- Yifan Hu's properties:** A table of parameters for the Yifan Hu layout algorithm.
- Barnes-Hut's properties:** A table of parameters for the Barnes-Hut layout algorithm.
- Context:** Shows graph statistics: Nodes: 6, Edges: 9, Directed Graph.
- Filters:** A section for applying filters to the graph.
- Statistics:** A section for running various network statistics.
- Settings:** A section for configuring the graph visualization.

The bottom toolbar contains various tools, including a text tool (highlighted with a red box) and a home button (also highlighted with a red box). The text tool is currently active, and the text 'Winston' is being edited on the graph.

Yifan Hu's properties	
Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties	
Quadtree Max Level	10
Theta	1.2

Show Labels



Overview Data Laboratory Preview

Workspace 1

Appearance Graph Context

Nodes Edges Unique Attribute

Attribute

2 (50%)
1 (50%)

Layout Yifan Hu

Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Dragging (Configure)

```
graph TD; Winston((Winston)) --> Diana((Diana)); Winston --> John((John)); Winston --> Simon((Simon)); Celine((Celine)) --> Diana; Celine --> John; Celine --> Carla((Carla)); Diana --> John; Diana --> Simon; John --> Simon; Carla --> John; Carla --> Simon;
```

Context

Nodes: 6
Edges: 9
Directed Graph

Filters Statistics Settings

Network Overview

Average Degree	Run
Avg. Weighted Degree	Run
Network Diameter	Run
Graph Density	Run
Modularity	Run
PageRank	Run
Connected Components	Run

Node Overview

Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run

Edge Overview

Avg. Path Length	Run
------------------	-----

Dynamic

# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run

Winston Celine Diana Carla John Simon

Yifan Hu

Arial-BoldMT, 32

Global Edges Labels



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Dragging (Configure)

Unique Attribute

Attribute

2 (50%)
1 (50%)

Apply

Layout

Yifan Hu

Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Winston
Celine
Diana
Carla
John
Simon

Global Edges Labels

Background color: Zoom Highlight selection

Autoselect neighbor

Context

Nodes: 6
Edges: 9
Directed Graph

Filters Statistics

Settings

Network Overview

Average Degree	Run
Avg. Weighted Degree	Run
Network Diameter	Run
Graph Density	Run
Modularity	Run
PageRank	Run
Connected Components	Run

Node Overview

Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run

Edge Overview

Avg. Path Length	Run
------------------	-----

Dynamic

# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run

Labels



The screenshot shows a network visualization software interface. The main window displays a graph with six nodes and nine edges. The nodes are labeled with names: Winston, Celine, Diana, Carla, John, and Simon. The nodes are colored: Winston, John, and Simon are green; Celine, Diana, and Carla are pink. The edges are black lines connecting the nodes.

The interface includes several panels:

- Appearance:** Shows node and edge attributes. Under 'Attribute', there are two categories: '2' (50%) and '1' (50%).
- Layout:** Shows 'Yifan Hu' as the selected layout.
- Yifan Hu's properties:** A table of properties for the Yifan Hu layout:

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4
- Barnes-Hut's properties:** A table of properties for the Barnes-Hut layout:

Quadtree Max Level	10
Theta	1.2
- Context:** Shows graph statistics: Nodes: 6, Edges: 9, Directed Graph.
- Filters Statistics:** A section with various network metrics and 'Run' buttons:

Average Degree	Run
Avg. Weighted Degree	Run
Network Diameter	Run
Graph Density	Run
Modularity	Run
PageRank	Run
Connected Components	Run
Node Overview	
Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run
Edge Overview	
Avg. Path Length	Run
Dynamic	
# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run
- Labels Configuration Panel:** A red dashed box highlights the 'Labels' configuration panel. It has tabs for 'Global', 'Edges', and 'Labels'. The 'Labels' tab is selected. It contains settings for 'Node' and 'Edge' labels:

<input checked="" type="checkbox"/> Node	Font: Arial-BoldMT, 32	Color: ■	Size: <input type="text"/>
<input type="checkbox"/> Edge	Font: Arial-BoldMT, 32	Color: ■	Size: <input type="text"/>

Labels Node Size



The screenshot displays a network visualization software interface. The central graph shows six nodes: Winston (green), Diana (pink), Celine (pink), John (green), Simon (green), and Carla (pink). Edges connect Winston to Diana, Diana to Celine, Diana to John, John to Celine, John to Simon, and Celine to Carla. The interface includes several panels:

- Appearance:** Shows node and edge styles. The 'Attribute' dropdown is set to 'Attribute'. A color palette shows two colors: pink (2 nodes, 50%) and green (1 node, 50%).
- Graph:** Shows the graph being edited. The 'Dragging (Configure)' mode is active.
- Context:** Displays graph statistics: Nodes: 6, Edges: 9, Directed Graph.
- Filters Statistics:** Includes sections for Network Overview, Node Overview, Edge Overview, and Dynamic.
- Layout:** Shows the current layout is 'Yifan Hu'. A 'Run' button is present.
- Yifan Hu's properties:** Lists various parameters such as Optimal Distance (100.0), Relative Strength (0.2), Initial Step size (20.0), Step ratio (0.95), Adaptive Cooling (checked), Convergence Thresh (1.0E-4), and Barnes-Hut's properties (Quadtrees Max Level 10, Theta 1.2).
- Yifan Hu:** Shows the current font is 'Arial-BoldMT, 32'. A red dashed box highlights the 'Labels' tab and the 'Node' font size slider.

Labels Node Font Size



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Dragging (Configure)

Unique Attribute

Attribute

2 (50%)
1 (50%)

Layout | Yifan Hu

Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Graph

Context

Nodes: 6
Edges: 9

Font

Family	Style	Size
Arial	Regular	24
Arial Black	Bold	24
Arial Hebrew	Italic	26
Arial Hebrew Scholar	Bold Italic	28
Arial Narrow		32
Arial Rounded MT Bold		36
Arial Unicode MS		40
Athelas		44
Avenir		48
Avenir Next		52

Preview

Aa Bb Yy Zz

OK Cancel

Dynamic

# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run

Global Edges Labels

Node

Font: **Arial-BoldMT, 24** Color:

Size:

Edge

Font: Arial-BoldMT, 32 Color:

Size:

Labels Node Size



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Unique Attribute | Filters Statistics | Settings

Attribute

2 (50%)
1 (50%)

Apply

Layout

Yifan Hu

Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Dragging (Configure)

```
graph TD; Winston((Winston)) --> Diana((Diana)); Diana --> Celine((Celine)); Diana --> John((John)); John --> Celine; John --> Simon((Simon)); John --> Carla((Carla));
```

Context

Nodes: 6
Edges: 9
Directed Graph

Network Overview

Average Degree	Run
Avg. Weighted Degree	Run
Network Diameter	Run
Graph Density	Run
Modularity	Run
PageRank	Run
Connected Components	Run

Node Overview

Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run

Edge Overview

Avg. Path Length	Run
------------------	-----

Dynamic

# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run

Global | Edges | Labels

Node

Font: Arial-BoldMT, 24 | Color:

Size:

Edge

Font: Arial-BoldMT, 32 | Color:

Size:

Labels Scaled



The screenshot displays a network visualization application with the following components:

- Appearance Panel:** Shows node and edge settings. Under 'Nodes', there are two categories: 'Attribute' (2 nodes, 50%) and 'Unique' (1 node, 50%).
- Layout Panel:** Shows the name 'Yifan Hu' and a 'Run' button. Below it, 'Yifan Hu's properties' are listed: Optimal Distance (100.0), Relative Strength (0.2), Initial Step size (20.0), Step ratio (0.95), Adaptive Cooling (checked), and Convergence Thresh (1.0E-4). 'Barnes-Hut's properties' include Quadtree Max Level (10) and Theta (1.2).
- Graph Panel:** The central area shows a directed graph with 6 nodes and 9 edges. Nodes are labeled: Winston (green), Celine (red), Diana (red), John (green), Simon (green), and Carla (red). Edges connect Winston to Diana, Diana to Celine, Diana to John, John to Celine, John to Carla, and Simon to both Diana and John.
- Context Panel:** Provides statistics for the graph: Nodes: 6, Edges: 9, Directed Graph. It includes sections for Network Overview (Average Degree, Avg. Weighted Degree, Network Diameter, Graph Density, Modularity, PageRank, Connected Components), Node Overview (Avg. Clustering Coefficient, Eigenvector Centrality), Edge Overview (Avg. Path Length), and Dynamic (Node and Edge counts, Degree, Clustering Coefficient). Each metric has a 'Run' button.
- Labeling Panel:** A red dashed box highlights a font selection menu. The menu shows 'Arial-BoldMT, 24' as the current font. Below it, three options are listed: 'AA Fixed', '% Scaled' (which is checked), and 'AA Node size'. The 'Labels' button is also visible.

Labels Color

The screenshot displays a network visualization software interface. The main window shows a graph with five nodes: Winston, Diana, Ce, Jo, and Simon. Diana is the central node, with arrows pointing to her from Winston, Ce, and Jo, and arrows pointing from her to Simon. The nodes are colored: Winston, Ce, and Jo are green; Diana is pink; and Simon is green. A 'Choose a Color' dialog box is open, showing a color wheel and various color selection options. The dialog box includes a color wheel, a vertical color bar, and input fields for Hue (2), Sat (96), Bri (99), Red (252), Green (17), Blue (9), Hex (FC1109), and Alpha (128). The 'OK' button is highlighted. The software interface includes several panels: 'Appearance' (Nodes, Edges, Unique, Attribute), 'Graph' (Dragging (Configure)), 'Layout' (Yifan Hu, Run), and 'Dynamic' (# Nodes, # Edges, Degree, Clustering Coefficient). The 'Dynamic' panel has 'Run' buttons for each property. The 'Appearance' panel shows 'Attribute' with two items: 2 (50%) and 1 (50%). The 'Layout' panel shows 'Yifan Hu' with a 'Run' button. The 'Dynamic' panel shows '# Nodes', '# Edges', 'Degree', and 'Clustering Coefficient', each with a 'Run' button. The 'Graph' panel shows 'Dragging (Configure)'. The 'Appearance' panel shows 'Nodes' and 'Edges' tabs, and 'Unique' and 'Attribute' sub-tabs. The 'Attribute' sub-tab shows two items: 2 (50%) and 1 (50%). The 'Layout' panel shows 'Yifan Hu' with a 'Run' button. The 'Dynamic' panel shows '# Nodes', '# Edges', 'Degree', and 'Clustering Coefficient', each with a 'Run' button. The 'Graph' panel shows 'Dragging (Configure)'. The 'Appearance' panel shows 'Nodes' and 'Edges' tabs, and 'Unique' and 'Attribute' sub-tabs. The 'Attribute' sub-tab shows two items: 2 (50%) and 1 (50%).

Labels Color



The screenshot displays a network visualization software interface. The central canvas shows a directed graph with six nodes: Winston (green), Diana (pink), Celine (pink), John (green), and Carla (pink). Edges connect Winston to Diana, Diana to Celine, Celine to Diana, Celine to John, John to Diana, John to Carla, and Diana to John. The interface is divided into several panels:

- Appearance:** Shows node and edge settings. Under 'Attribute', there are two categories: '2' (50%) and '1' (50%).
- Layout:** Shows 'Yifan Hu' as the layout algorithm. Below it, 'Yifan Hu's properties' are listed: Optimal Distance (100.0), Relative Strength (0.2), Initial Step size (20.0), Step ratio (0.95), Adaptive Cooling (checked), Convergence Thresh (1.0E-4). 'Barnes-Hut's properties' are also listed: Quadtree Max Level (10), Theta (1.2).
- Graph:** Shows 'Dragging (Configure)' and various tool icons.
- Context:** Shows 'Nodes: 6', 'Edges: 9', and 'Directed Graph'. It includes 'Filters', 'Statistics', and 'Settings' tabs. Under 'Network Overview', there are several metrics with 'Run' buttons: Average Degree, Avg. Weighted Degree, Network Diameter, Graph Density, Modularity, PageRank, and Connected Components. Under 'Node Overview', there are: Avg. Clustering Coefficient, Eigenvector Centrality. Under 'Edge Overview', there is: Avg. Path Length. Under 'Dynamic', there are: # Nodes, # Edges, Degree, and Clustering Coefficient.
- Bottom Panel:** Shows font settings for 'Node' (Arial-BoldMT, 24) and 'Edge' (Arial-BoldMT, 32). A red box highlights a small icon in the bottom right of this panel.

Gephi Statistics: Average Degree



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Unique Attribute

Attribute

2 (50%)
1 (50%)

Layout | Yifan Hu | Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Print | Copy | Save | Close

HTML Report

Degree Report

Results:

Average Degree: 3.000

Degree Distribution

Value	Count
1	1.00
2	1.00
3	2.00

Context

Nodes: 6
Edges: 9
Directed Graph

Filters | Statistics | Settings

Network Overview

- Average Degree: 3 Run
- Avg. Weighted Degree Run
- Network Diameter Run
- Graph Density Run
- Modularity Run
- PageRank Run
- Connected Components Run

Node Overview

- Avg. Clustering Coefficient Run
- Eigenvector Centrality Run

Edge Overview

- Avg. Path Length Run

Dynamic

- # Nodes Run
- # Edges Run
- Degree Run
- Clustering Coefficient Run

Gephi Statistics: Average Degree



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Unique Attribute

Attribute

2 (50%)
1 (50%)

Apply

Layout | Yifan Hu | Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Print | Copy | Save | Close

HTML Report

In-Degree Distribution

Value	Count
1	2
5	1

Out-Degree Distribution

Value	Count
1	2
5	1

Context

Nodes: 6
Edges: 9
Directed Graph

Filters | Statistics | Settings

Network Overview

- Average Degree: 3 Run
- Avg. Weighted Degree: Run
- Network Diameter: Run
- Graph Density: Run
- Modularity: Run
- PageRank: Run
- Connected Components: Run

Node Overview

- Avg. Clustering Coefficient: Run
- Eigenvector Centrality: Run

Edge Overview

- Avg. Path Length: Run

Dynamic

- # Nodes: Run
- # Edges: Run
- Degree: Run
- Clustering Coefficient: Run

Gephi Statistics: Avg. Weighted Degree



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Unique Attribute

Attribute

2 (50%)
1 (50%)

Apply

Layout | Yifan Hu | Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Print | Copy | Save | Close

HTML Report

Weighted Degree Report

Results:

Average Weighted Degree: 1.500

Degree Distribution

Value	Count
1	1.00
2	1.00
3	2.00
4	1.00

Context

Nodes: 6
Edges: 9
Directed Graph

Filters | Statistics | Settings

Network Overview

Average Degree	3	Run
Avg. Weighted Degree	1.5	Run
Network Diameter		Run
Graph Density		Run
Modularity		Run
PageRank		Run
Connected Components		Run

Node Overview

Avg. Clustering Coefficient		Run
Eigenvector Centrality		Run

Edge Overview

Avg. Path Length		Run
------------------	--	-----

Dynamic

# Nodes		Run
# Edges		Run
Degree		Run
Clustering Coefficient		Run

Gephi Statistics: Network Diameter



The screenshot displays the Gephi software interface. At the top, there are tabs for 'Overview', 'Data Laboratory', and 'Preview'. Below these is 'Workspace 1'. The main area is divided into several panels: 'Appearance' (Nodes, Edges, Unique, Attribute), 'Graph' (Dragging (Configure)), 'Context' (Nodes: 6, Edges: 9, Directed Graph), 'Filters', 'Statistics', and 'Settings'. A 'Graph Distance settings' dialog box is open in the center, showing options for 'Distance' (Directed/Undirected) and 'Normalize Centralities in [0,1]'. Below these are definitions for 'Betweenness Centrality', 'Closeness Centrality', and 'Eccentricity'. The 'Statistics' panel on the right is highlighted with a red dashed border and contains a list of metrics with 'Run' buttons: Network Overview (Average Degree: 3, Avg. Weighted Degree: 1.5, Network Diameter, Graph Density, Modularity, PageRank, Connected Components), Node Overview (Avg. Clustering Coefficient, Eigenvector Centrality), Edge Overview (Avg. Path Length), and Dynamic (# Nodes, # Edges, Degree, Clustering Coefficient). The bottom of the interface shows a 'Layout' panel with 'Yifan Hu' selected and a 'Presets... Reset' button.

Gephi Statistics: Network Diameter



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Unique Attribute

Attribute

2 (50%)
1 (50%)

Apply

Layout | Yifan Hu | Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Dragging (Configure)

HTML Report

Graph Distance Report

Parameters:
Network Interpretation: directed

Results:
Diameter: 1
Radius: 0
Average Path length: 1.0

Betweenness Centrality Distribution

Count	Value
1.0	1.0

Print | Copy | Save | Close

Context

Nodes: 6
Edges: 9
Directed Graph

Filters | Statistics | Settings

Network Overview

Average Degree	3	Run
Avg. Weighted Degree	1.5	Run
Network Diameter	1	Run
Graph Density		Run
Modularity		Run
PageRank		Run
Connected Components		Run

Node Overview

Avg. Clustering Coefficient		Run
Eigenvector Centrality		Run

Edge Overview

Avg. Path Length	1	Run
------------------	---	-----

Dynamic

# Nodes		Run
# Edges		Run
Degree		Run
Clustering Coefficient		Run

Gephi Statistics: Graph Density



The screenshot displays the Gephi software interface. At the top, there are tabs for 'Overview', 'Data Laboratory', and 'Preview'. Below these, the 'Workspace 1' is visible. The main window is divided into several panels: 'Appearance' (Nodes, Edges, Unique, Attribute), 'Graph' (Dragging), and 'Context' (Nodes: 6, Edges: 9, Directed Graph). The 'Statistics' window is open, showing a list of metrics with 'Graph Density' highlighted. The 'HTML Report' window is also open, displaying the 'Graph Density Report' for a directed network. The report includes parameters and results.

Graph Density Report

Parameters:
Network Interpretation: directed

Results:
Density: 0.300

Statistics Window:

- Nodes: 6
- Edges: 9
- Directed Graph
- Filters
- Statistics
- Settings
- Network Overview
 - Average Degree: 3
 - Avg. Weighted Degree: 1.5
 - Network Diameter: 1
 - Graph Density: 0.3
 - Modularity
 - PageRank
 - Connected Components
- Node Overview
 - Avg. Clustering Coefficient
 - Eigenvector Centrality
- Edge Overview
 - Avg. Path Length: 1
- Dynamic
 - # Nodes
 - # Edges
 - Degree
 - Clustering Coefficient

Gephi Statistics: Modularity



The screenshot displays the Gephi software interface. At the top, there are tabs for 'Overview', 'Data Laboratory', and 'Preview'. The main workspace shows a graph with a 'Modularity settings' dialog box open. The dialog box has the following content:

Modularity settings

Modularity
Community detection algorithm.

- Randomize: Produce a better decomposition but increases computation time
- Use weights: Use edge weight

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

Buttons: Cancel, OK

On the right side, the 'Context' panel is visible, showing graph statistics:

- Nodes: 6
- Edges: 9
- Directed Graph

The 'Statistics' panel is also visible, showing various network metrics:

- Network Overview
 - Average Degree: 3
 - Avg. Weighted Degree: 1.5
 - Network Diameter: 1
 - Graph Density: 0.3
- Modularity: Run
- PageRank: Run
- Connected Components: Run
- Node Overview
 - Avg. Clustering Coefficient: Run
 - Eigenvector Centrality: Run
- Edge Overview
 - Avg. Path Length: 1
- Dynamic
 - # Nodes: Run
 - # Edges: Run
 - Degree: Run
 - Clustering Coefficient: Run

The bottom of the interface shows the 'Appearance' panel with 'Nodes' and 'Edges' tabs, and the 'Layout' panel with 'Yifan Hu' selected. The 'Yifan Hu's properties' section includes: Optimal Distance (100.0), Relative Strength (0.2), Initial Step size (20.0), Step ratio (0.95), Adaptive Cooling (checked), Convergence Thresh (1.0E-4), and Barnes-Hut's properties (Quadtree Max Level: 10, Theta: 1.2).

Gephi Statistics: Modularity



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes | Edges | Unique | Attribute

Attribute

2 (50%)
1 (50%)

HTML Report

Modularity Report

Parameters:
Randomize: On
Use edge weights: On
Resolution: 1.0

Results:
Modularity: 0.000
Modularity with resolution: 0.000
Number of Communities: 1

Size Distribution

Size (number of nodes)	Count
6.0	1

Filters | Statistics

Settings

- Network Overview**
 - Average Degree: 3 [Run]
 - Avg. Weighted Degree: 1.5 [Run]
 - Network Diameter: 1 [Run]
 - Graph Density: 0.3 [Run]
 - Modularity: 0 [Run]**
 - PageRank: [Run]
 - Connected Components: [Run]
- Node Overview**
 - Avg. Clustering Coefficient: [Run]
 - Eigenvector Centrality: [Run]
- Edge Overview**
 - Avg. Path Length: 1 [Run]
- Dynamic**
 - # Nodes: [Run]
 - # Edges: [Run]
 - Degree: [Run]
 - Clustering Coefficient: [Run]

Print | Copy | Save | Close

Gephi Statistics: Connected Components



The screenshot displays the Gephi software interface. At the top, there are tabs for 'Overview', 'Data Laboratory', and 'Preview'. Below these is the 'Workspace 1' tab. The main interface is divided into several panels:

- Appearance:** Shows 'Nodes' and 'Edges' settings. Under 'Nodes', there are two categories: 'Unique' and 'Attribute'. The 'Attribute' dropdown is set to 'Attribute'. Below this, there are two color-coded items: a pink square with '2 (50%)' and a green square with '1 (50%)'. There is also a 'Run' button.
- Layout:** Shows 'Yifan Hu' as the selected layout. There is a 'Run' button.
- Yifan Hu's properties:** A table of properties for the selected layout:

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4
- Barnes-Hut's properties:** A table of properties for the selected layout:

Quadtree Max Level	10
Theta	1.2
- Yifan Hu:** A section with a question mark icon and 'Presets...' and 'Reset' buttons.
- Graph:** The central area shows a 'Dragging (Configure)' tooltip. A 'Connected Components settings' dialog box is open, showing options for 'Directed' (selected) and 'Undirected'. The 'Directed' option is described as 'Detects strongly & weakly connected components', while 'Undirected' is 'Detects only weakly connected components'. There are 'Cancel' and 'OK' buttons.
- Context:** Shows network statistics: 'Nodes: 6', 'Edges: 9', and 'Directed Graph'. Below this is the 'Statistics' window, which is highlighted with a red dashed border. It shows various network metrics with 'Run' buttons:

Network Overview	
Average Degree	3 Run
Avg. Weighted Degree	1.5 Run
Network Diameter	1 Run
Graph Density	0.3 Run
Modularity	0 Run
PageRank	Run
Connected Components	Run
Node Overview	
Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run
Edge Overview	
Avg. Path Length	1 Run
Dynamic	
# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run
- Global Edges Labels:** Shows font and size settings for nodes and edges. Node font is 'Arial-BoldMT, 24' and edge font is 'Arial-BoldMT, 32'. There are sliders for size and color pickers.

Gephi Statistics: Connected Components



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes | Edges | Unique | Attribute

Attribute

2 (50%)
1 (50%)

Apply

Layout | Yifan Hu

Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Print | Copy | Save | Close

HTML Report

Connected Components Report

Parameters:
Network Interpretation: directed

Results:
Number of Weakly Connected Components: 1
Number of Strongly Connected Components: 6

Size Distribution

Component Size	Count
1	1.0

Context

Nodes: 6
Edges: 9
Directed Graph

Filters | Statistics | Settings

Network Overview

Average Degree	3	Run
Avg. Weighted Degree	1.5	Run
Network Diameter	1	Run
Graph Density	0.3	Run
Modularity	0	Run
PageRank		Run
Connected Components	1	Run

Node Overview

Avg. Clustering Coefficient		Run
Eigenvector Centrality		Run

Edge Overview

Avg. Path Length	1	Run
------------------	---	-----

Dynamic

# Nodes		Run
# Edges		Run
Degree		Run
Clustering Coefficient		Run

Appearance Nodes Size



Overview | Data Laboratory | Preview

Workspace 1

Appearance x

Nodes Edges

Unique Attribute Size

In-Degree

Min size: 5 Max size: 30

Apply

Layout x

Yifan Hu

Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Graph x

Dragging (Configure)

```
graph TD; Winston((Winston)) --> Diana((Diana)); Diana((Diana)) --> Celine((Celine)); Diana((Diana)) --> John((John)); Diana((Diana)) --> Simon((Simon)); John((John)) --> Celine((Celine)); John((John)) --> Carla((Carla)); Simon((Simon)) --> John((John)); Simon((Simon)) --> Diana((Diana));
```

Context x

Nodes: 6
Edges: 9
Directed Graph

Filters Statistics x

Settings

Network Overview

Average Degree	3	Run
Avg. Weighted Degree	1.5	Run
Network Diameter	1	Run
Graph Density	0.3	Run
Modularity	0	Run
PageRank		Run
Connected Components	1	Run

Node Overview

Avg. Clustering Coefficient		Run
Eigenvector Centrality		Run

Edge Overview

Avg. Path Length	1	Run
------------------	---	-----

Dynamic

# Nodes		Run
# Edges		Run
Degree		Run
Clustering Coefficient		Run

Appearance Nodes Size

Attribute / In-Degree



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes | Edges | Unique | Attribute

In-Degree

---Choose an attribute

Degree

In-Degree

Out-Degree

Out-Degree

Weighted Out-Degree

In-Degree

Closeness Centrality

Apply

Layout

Yifan Hu

Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Dragging (Configure)

```
graph TD; Winston((Winston)) --> Diana((Diana)); Celine((Celine)) --> Diana; John((John)) --> Diana; Carla((Carla)) --> Diana; Simon((Simon)) --> Diana; Simon --> John;
```

Context

Nodes: 6

Edges: 9

Directed Graph

Filters | Statistics | Settings

Network Overview

Average Degree	3	Run
Avg. Weighted Degree	1.5	Run
Network Diameter	1	Run
Graph Density	0.3	Run
Modularity	0	Run
PageRank		Run
Connected Components	1	Run

Node Overview

Avg. Clustering Coefficient	Run
Eigenvector Centrality	Run

Edge Overview

Avg. Path Length	1	Run
------------------	---	-----

Dynamic

# Nodes	Run
# Edges	Run
Degree	Run
Clustering Coefficient	Run

Yifan Hu

Arial-BoldMT, 24

Appearance Nodes Size

Attribute / In-Degree / Min size / Max size / Apply

The screenshot displays a network visualization software interface. The central graph shows six nodes: Winston, Celine, Diana, John, Simon, and Carla. Diana is the largest node, colored pink, and is the central hub. Other nodes are smaller and colored green or pink. Edges connect the nodes, forming a network structure.

The interface includes several panels:

- Appearance Panel:** Shows the 'Nodes' tab selected. The 'Attribute' dropdown is set to 'In-Degree'. The 'Min size' is set to 5 and the 'Max size' is set to 30. The 'Apply' button is highlighted with a red dashed box.
- Context Panel:** Displays network statistics:
 - Nodes: 6
 - Edges: 9
 - Directed Graph
- Statistics Panel:** Shows various network metrics with 'Run' buttons:
 - Network Overview: Average Degree (3), Avg. Weighted Degree (1.5), Network Diameter (1), Graph Density (0.3), Modularity (0), PageRank, Connected Components (1).
 - Node Overview: Avg. Clustering Coefficient, Eigenvector Centrality.
 - Edge Overview: Avg. Path Length (1).
 - Dynamic: # Nodes, # Edges, Degree, Clustering Coefficient.
- Layout Panel:** Shows 'Yifan Hu' as the selected layout algorithm with a 'Run' button.
- Properties Panel:** Shows properties for 'Yifan Hu's properties' and 'Barnes-Hut's properties'.

Appearance Edges

Attribute / Weight / Color



The screenshot displays a graph visualization software interface. The central graph shows six nodes: Diana (large pink circle), Celine (pink circle), Carla (pink circle), John (green circle), Simon (green circle), and Winston (green circle). Directed edges connect the nodes: Diana to Celine, Diana to Carla, Diana to John, Diana to Simon, Celine to Diana, Celine to Carla, Carla to Diana, John to Diana, John to Carla, John to Simon, and Simon to Diana. The interface includes several panels:

- Appearance Panel (Edges):** Shows 'Weight' and 'Color' settings. A color palette is open, with 'Default' selected. Red dashed boxes highlight the 'Edges' tab, the 'Weight' field, and the 'Color' dropdown menu.
- Context Panel:** Displays graph statistics: Nodes: 6, Edges: 9, Directed Graph. It also includes sections for Network Overview, Node Overview, and Edge Overview with various metrics and 'Run' buttons.
- Properties Panel (Yifan Hu):** Lists properties for the selected node, including Optimal Distance (100.0), Relative Strength (0.2), Initial Step size (20.0), Step ratio (0.95), Adaptive Cooling (checked), Convergence Thresh (1.0E-4), and Barnes-Hut's properties (Quadtrees Max Level 10, Theta 1.2).

Appearance Edges

Attribute / Weight / Color / Apply



Overview | Data Laboratory | Preview

Workspace 1

Appearance Edges

Nodes Edges Unique Attribute

Weight

Color: [Color Picker]

Spline... [Apply]

Layout Yifan Hu [Run]

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thresh	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Graph Dragging (Configure)

```
graph TD; Winston --> Diana; Diana --> Celine; Celine --> Carla; Carla --> Diana; Diana --> John; John --> Carla; John --> Simon;
```

Context Nodes: 6 Edges: 9 Directed Graph

Filters Statistics Settings

Network Overview

Average Degree	3	Run
Avg. Weighted Degree	1.5	Run
Network Diameter	1	Run
Graph Density	0.3	Run
Modularity	0	Run
PageRank		Run
Connected Components	1	Run

Node Overview

Avg. Clustering Coefficient		Run
Eigenvector Centrality		Run

Edge Overview

Avg. Path Length	1	Run
------------------	---	-----

Dynamic

# Nodes		Run
# Edges		Run
Degree		Run
Clustering Coefficient		Run

Presets... Reset

Yifan Hu

Arial-BoldMT, 24

Gephi Data Laboratory



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	Attribute	In-Degr...	Out-De...	Degree	Weighted In-...	Weighted Out-...	Weighted ...	Eccentri...	Closeness Ce...	Harmonic Closeness ...	Betweenness C...	Modularity...	Compon...	Strongly-Conn...
1	John	1	0	4	4	4	0.0	4.0	4.0	1.0	1.0	1.0	0.0	0	0	4
2	Carla	2	1	2	3	3	1.0	2.0	3.0	1.0	1.0	1.0	0.0	0	0	3
3	Simon	1	1	1	2	2	1.0	1.0	2.0	1.0	1.0	1.0	0.0	0	0	2
4	Celine	2	2	1	3	3	2.0	1.0	3.0	1.0	1.0	1.0	0.0	0	0	1
5	Winston	1	0	1	1	1	0.0	1.0	1.0	1.0	1.0	1.0	0.0	0	0	5
6	Diana	2	5	0	5	5	5.0	0.0	5.0	0.0	0.0	0.0	0.0	0	0	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

Gephi Preview



Overview Data Laboratory **Preview**

Workspace 1

Preview Settings

63 Preview

Presets

Default

Settings Manage renderers

Nodes

Border Width 1.0

Border Color custom [0,0...]

opacity 100.0

Node Labels

Show Labels

Font Arial 12 Plain

Proportional size

Color custom [0,0...]

Shorten label

Max characters 30

Outline size 0.0

Outline color custom [25...]

Outline opacity 80.0

Box

Box color parent

Box opacity 100.0

Edges

Show Edges

Thickness 1.0

Rescale weight

Color mixed

Opacity 100.0

Curved

Preview ratio: 100%

Refresh

Export: SVG/PDF/PNG

Background Reset zoom - +

Gephi Preview: Show Labels



Overview | Data Laboratory | **Preview**

Workspace 1

Preview Settings

Presets: Default

Settings | Manage renderers

Nodes

- Border Width: 1.0
- Border Color: custom [0,0...]
- opacity: 100.0

Node Labels

- Show Labels:
- Font: Arial 8 Plain
- Proportional size:
- Color: original
- Shorten label:
- Max characters: 12
- Outline size: 2.0
- Outline color: custom [25...]
- Outline opacity: 40.0
- Box:
- Box color: parent
- Box opacity: 100

Edges

- Show Edges:
- Thickness: 1.0
- Rescale weight:
- Color: mixed
- Opacity: 100.0
- Curved:

Preview ratio: 100%

Refresh

Export: SVG/PDF/PNG

Background | Reset zoom | - | +

Gephi Preview: Default Straight



Overview | Data Laboratory | Preview

Workspace 1

Preview Settings | Preview

Presets

Default Straight

Settings | Manage renderers

opacity	100.0
Node Labels	
Show Labels	<input checked="" type="checkbox"/>
Font	Arial 8 Plain
Proportional size	<input checked="" type="checkbox"/>
Color	custom [0,0,...
Shorten label	<input checked="" type="checkbox"/>
Max characters	14
Outline size	2.0
Outline color	custom [25,...
Outline opacity	80.0
Box	<input type="checkbox"/>
Box color	parent
Box opacity	100.0
Edges	
Show Edges	<input checked="" type="checkbox"/>
Thickness	1.0
Rescale weight	<input type="checkbox"/>
Color	mixed
Opacity	100.0
Curved	<input type="checkbox"/>
Radius	0.0
Edge Arrows	
Size	3.0

Preview ratio: 100%

Refresh

Export: SVG/PDF/PNG

Background | Reset zoom | - | +

Gephi Preview: Default Straight



Overview | Data Laboratory | Preview

Workspace 1

Preview Settings | Preview

Presets: Default Straight

Settings | Manage renderers

opacity: 100.0

Node Labels

- Show Labels:
- Font: Arial 12 Plain
- Proportional size:
- Color: custom [0,0,...
- Shorten label:
- Max characters: 30
- Outline size: 0.0
- Outline color: custom [25,...
- Outline opacity: 80.0
- Box:
- Box color: parent
- Box opacity: 100.0

Edges

- Show Edges:
- Thickness: 1.0
- Rescale weight:
- Color: mixed
- Opacity: 100.0
- Curved:
- Radius: 0.0
- Edge Arrows: Size: 3.0

Preview ratio: 100%

Export: SVG/PDF/PNG

Refresh

Background | Reset zoom | - | +

```
graph TD; Winston((Winston)) --> Diana((Diana)); John((John)) --> Diana; Celine((Celine)) --> Diana; Carla((Carla)) --> Diana; John --> Celine; John --> Carla; Simon((Simon)) --> John; Celine <--> Carla;
```

Gephi Preview: Export SVG/PDF/PNG



Overview | Data Laboratory | Preview

Workspace 1

Preview Settings | Preview

Presets: Default Straight

Settings | Manage renderers

opacity	100.0
Node Labels	
Show Labels	<input checked="" type="checkbox"/>
Font	Arial 12 Plain
Proportional size	<input type="checkbox"/>
Color	custom [0,0,...
Shorten label	<input type="checkbox"/>
Max characters	30
Outline size	0.0
Outline color	custom [25,...
Outline opacity	80.0
Box	<input type="checkbox"/>
Box color	parent
Box opacity	100.0
Edges	
Show Edges	<input checked="" type="checkbox"/>
Thickness	1.0
Rescale weight	<input type="checkbox"/>
Color	mixed
Opacity	100.0
Curved	<input type="checkbox"/>
Radius	0.0
Edge Arrows	
Size	3.0

Preview ratio: 100%

Refresh

Export: SVG/PDF/PNG

Background | Reset zoom | - | +

```
graph TD; Winston((Winston)) --> Diana((Diana)); Celine((Celine)) --> Diana; Simon((Simon)) --> Diana;
```

Export dialog box:

Save As: SNA_Gephi_1

SNA_Data

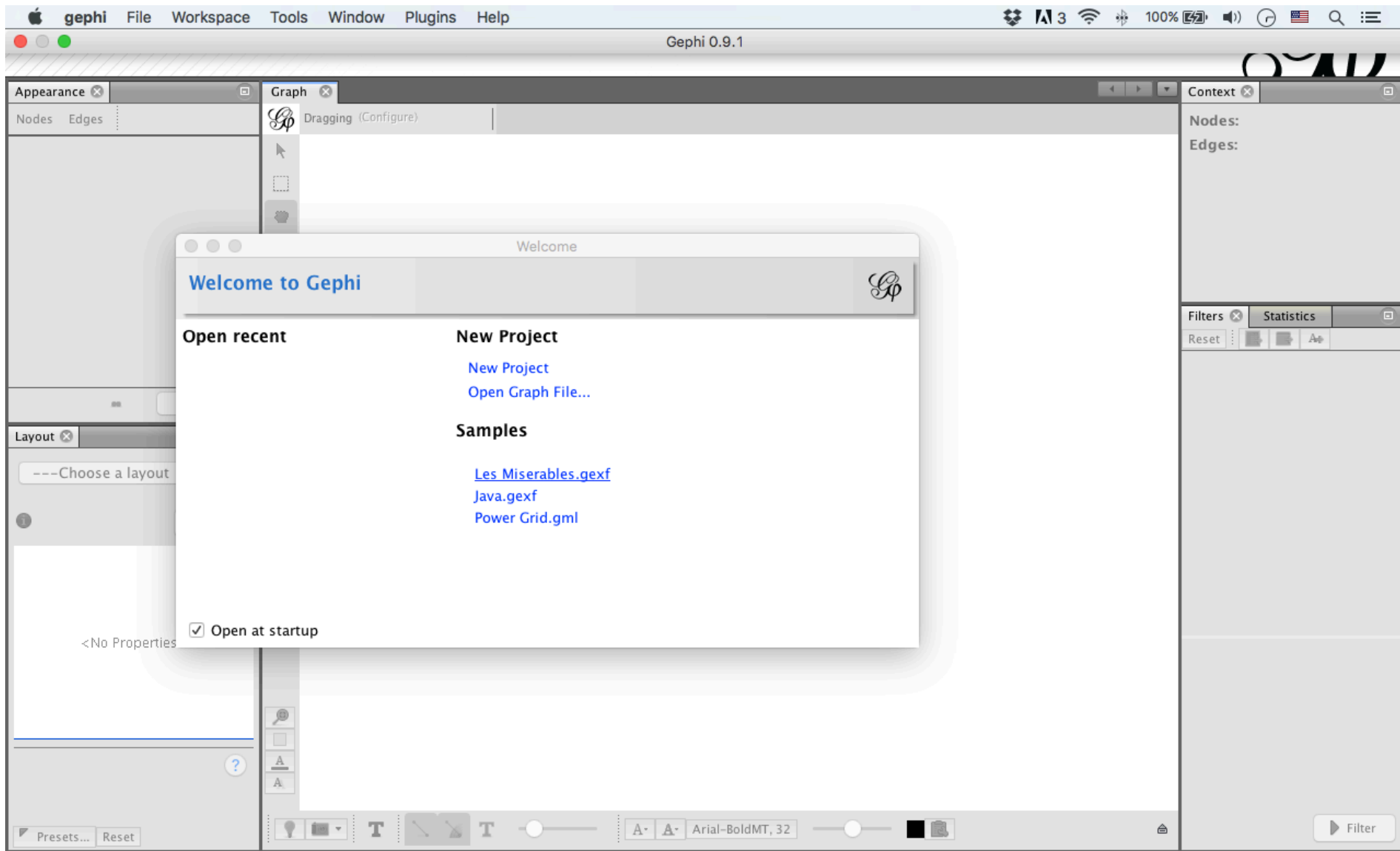
Name	...	D.
Edges1.csv
Nodes1.csv

File Format: PNG Files (*.png)

New Folder | Cancel | Save | Options...

Open Gephi Samples

Gephi Samples



Gephi Samples

Les Miserables.gexf



The screenshot shows the Gephi software interface with a 'Welcome' dialog box open. The dialog box has a title bar 'Welcome' and a 'Welcome to Gephi' header. It is divided into three main sections: 'Open recent', 'New Project', and 'Samples'. The 'Samples' section contains three entries: 'Les Miserables.gexf', 'java.gexf', and 'Power Grid.gml'. The 'Les Miserables.gexf' entry is highlighted with a red dashed box, and a tooltip is visible next to it, containing the text 'Coappearance Network of Characters in 'Les Miserables' (D. E. Knuth)'. Below the 'Samples' section, there is a checkbox labeled 'Open at startup' which is checked. The background shows the main Gephi interface with tabs for 'Overview', 'Data Laboratory', and 'Preview'. The 'Graph' tab is active, showing a 'Dragging (Configure)' window. The 'Context' panel on the right shows 'Nodes:' and 'Edges:' sections. The 'Filters' and 'Statistics' panels are also visible. The bottom status bar shows 'Presets... Reset', a search icon, a help icon, a text tool, a selection tool, a zoom slider, and the text 'Arial-BoldMT, 32'.

Gephi Import Report

Source: Stream .gexf

Issues Report

Nodes	Issues
<i>i</i> GEXF version 1.3	INFO

Graph Type: Undirected

of Nodes: 77

of Edges: 254

Dynamic Graph: no

Dynamic Attributes: no

Multi Graph: no

More options...

New graph

Append Graph

Cancel OK

Gephi Overview



Overview Data Laboratory Preview

Workspace 1

Appearance Graph Context

Nodes Edges Unique Attribute

#c0c0c0

Apply

Layout

---Choose a layout

Run

<No Properties>

Presets... Reset

Dragging (Configure)

Nodes: 77
Edges: 254
Undirected Graph

Filters Statistics

Reset

Library

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

Queries

Drag filter here

Filter

Gephi Layout



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Dragging (Configure)

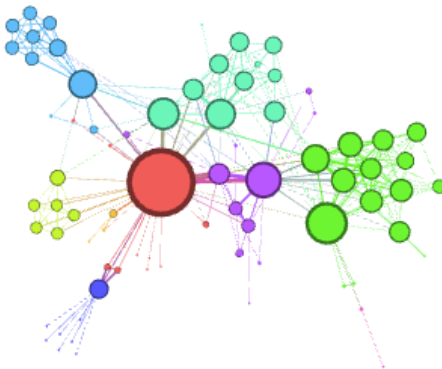
Unique Attribute

#c0c0c0

Apply

Layout

- Choose a layout
- Contraction
- Expansion
- Force Atlas
- ForceAtlas 2
- Fruchterman Reingold
- Label Adjust
- Noverlap
- OpenOrd



Nodes: 77
Edges: 254
Undirected Graph

Filters | Statistics

Reset

Library

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

Queries

Drag filter here

Presets... Reset

Arial-BoldMT, 32

Filter

Gephi Layout: Force Atlas



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Unique Attribute

#c0c0c0

Apply

Layout

Force Atlas

Run

Force Atlas

Inertia	0.1
Repulsion strength	200.0
Attraction strength	10.0
Maximum displacement	10.0
Auto stabilize force	<input checked="" type="checkbox"/>
Autostab Strength	80.0
Autostab sensibility	0.2
Gravity	30.0

Force Atlas

Presets... Reset

Filters | Statistics

Reset

Library

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

Queries

Drag filter here

Filter

Gephi Layout: Contraction



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Dragging (Configure)

Unique Attribute

#c0c0c0

Apply

Layout

Contraction

Run

properties

Scale factor 0.8

Contraction

Presets... Reset

Nodes: 77
Edges: 254
Undirected Graph

Filters | Statistics

Reset

Library

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

Queries

Drag filter here

Filter

Gephi Layout: Expansion



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes | Edges | Unique | Attribute

#c0c0c0

Apply

Layout

Expansion

Run


properties

Scale factor 0.8

Expansion

Presets... Reset

Dragging (Configure)



Nodes: 77
Edges: 254
Undirected Graph

Filters | Statistics

Reset

Library

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

Queries

Drag filter here

Filter

Gephi Layout: ForceAtlas 2



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes | Edges | Unique | Attribute

#c0c0c0

Apply

Layout

ForceAtlas 2

Stop

Threads

Threads number 3

Performance

Tolerance (speed) 1.0

Approximate Repu

Approximation 1.2

Tuning

Scaling 10.0

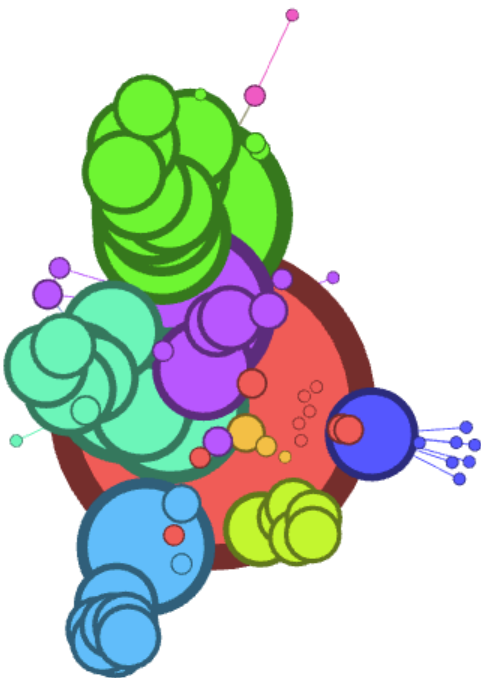
Stronger Gravity

Gravity 1.0

ForceAtlas 2

Presets... Reset

Dragging (Configure)



Nodes: 77
Edges: 254
Undirected Graph

Filters | Statistics

Reset

Library

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

Queries

Drag filter here

Filter

Gephi Layout: Fruchterman Reingold



Overview Data Laboratory Preview

Workspace 1

Appearance Graph Context

Nodes Edges Unique Attribute

#c0c0c0

Apply

Layout

Fruchterman Reingold

Stop

Fruchterman Reingold

Area	10000.0
Gravity	10.0
Speed	1.0

Fruchterman Reingold

Presets... Reset

Nodes: 77
Edges: 254
Undirected Graph

Filters Statistics

Reset

Library

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

Queries

Drag filter here

Filter

Gephi Layout: OpenOrd



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes | Edges | Unique | Attribute

#c0c0c0

Apply

Layout

OpenOrd

Run

Stages

Liquid (%)	25
Expansion (%)	25
Cooldown (%)	25
Crunch (%)	10
Simmer (%)	15

OpenOrd

Edge Cut	0.8
Num Threads	3
Num Iterations	750

OpenOrd

Presets... Reset

Dragging (Configure)

Nodes: 77
Edges: 254
Undirected Graph

Filters | Statistics

Reset

Library

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

Queries

Drag filter here

Filter

Gephi Layout: Yifan Hu



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Dragging (Configure)

Unique Attribute

#c0c0c0

Apply

Layout

Yifan Hu

Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thres	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu

Presets... Reset

Nodes: 77
Edges: 254
Undirected Graph

Filters | Statistics

Reset

Library

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

Queries

Drag filter here

Filter

Gephi Layout: Yifan Hu Proportional



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Unique Attribute | #c0c0c0 | Apply

Layout | Yifan Hu Proportional | Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thres	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu Proportional

Presets... Reset

Nodes: 77
Edges: 254
Undirected Graph

Filters | Statistics | Reset | Library | Attributes | Dynamic | Edges | Operator | Topology | Saved queries | Queries | Drag filter here | Filter

Gephi Data Laboratory: Nodes



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	Modularity Class
0	Myriel		0
1	Napoleon		0
10	Labarre		1
11	Valjean		1
12	Marguerite		1
13	MmeDeR		1
14	Isabeau		1
15	Gervais		1
16	Tholomyes		2
17	Listolier		2
18	Fameuil		2
19	Blacheville		2
2	MlleBaptistine		1
20	Favourite		2
21	Dahlia		2
22	Zephine		2
23	Fantine		2
24	MmeThenardier		7
25	Thenardier		7
26	Cosette		6
27	Javert		7
28	Fauchelevant		4
29	Bamatobois		3
3	MmeMagloire		1
30	Perpetue		2
31	Simplice		2
32	Scaufflaire		1
33	Woman1		1
34	Judge		3
35	Champmathieu		3

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

Gephi Data Laboratory: Edges



Overview **Data Laboratory** Preview

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
1	0	Undirected	0			1.0
2	0	Undirected	1			8.0
3	0	Undirected	2			10.0
3	2	Undirected	3			6.0
4	0	Undirected	4			1.0
5	0	Undirected	5			1.0
6	0	Undirected	6			1.0
7	0	Undirected	7			1.0
8	0	Undirected	8			2.0
9	0	Undirected	9			1.0
11	0	Undirected	13			5.0
11	2	Undirected	12			3.0
11	3	Undirected	11			3.0
11	10	Undirected	10			1.0
12	11	Undirected	14			1.0
13	11	Undirected	15			1.0
14	11	Undirected	16			1.0
15	11	Undirected	17			1.0
17	16	Undirected	18			4.0
18	16	Undirected	19			4.0
18	17	Undirected	20			4.0
19	16	Undirected	21			4.0
19	17	Undirected	22			4.0
19	18	Undirected	23			4.0
20	16	Undirected	24			3.0
20	17	Undirected	25			3.0
20	18	Undirected	26			3.0
20	19	Undirected	27			4.0
21	16	Undirected	28			3.0
21	17	Undirected	29			3.0

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

Gephi Data Laboratory: Export table to CSV file



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	Modularity Class
0	Myriel		0
1	Napoleon		0
10	Labarre		1
11	Valjean		1
12	Marguerite		1
13	MmeDeR		1
14	Isabeau		1
15	Gervais		1
16	Tholomyes		2
17	Listolier		2
18	Fameuil		2
19	Blacheville		2
2	MlleBaptistine		1
20	Favourite		2
21	Dahlia		2
22	Zephine		2
23	Fantine		2
24	MmeThenardier		7
25	Thenardier		7
26	Cosette		6
27	Javert		7
28	Fauchelevant		4
29	Bamatabois		3
3	MmeMagloire		1
30	Perpetue		2
31	Simlice		2
32	Scaufflaire		1
33	Woman1		1
34	Judge		3
35	Champmathieu		3

Export table to CSV file

Separator: Comma

Charset: UTF-8

Columns:

- Id
- Label
- Interval
- Modularity Class

Cancel OK

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

Gephi Preview



Overview Data Laboratory **Preview**

Workspace 1

Preview Settings Preview

Presets

Default

Settings Manage renderers

Nodes

Border Width	1.0
Border Color	custom [0,0... ..]
opacity	100.0

Node Labels

Show Labels	<input type="checkbox"/>
Font	Arial 12 Plain ...
Proportional size	<input checked="" type="checkbox"/>
Color	custom [0,0... ..]
Shorten label	<input type="checkbox"/>
Max characters	30
Outline size	0.0
Outline color	custom [25... ..]
Outline opacity	80.0
Box	<input type="checkbox"/>
Box color	parent ...
Box opacity	100.0

Edges

Show Edges	<input checked="" type="checkbox"/>
Thickness	1.0
Rescale weight	<input type="checkbox"/>
Color	mixed ...
Opacity	100.0
Curved	<input checked="" type="checkbox"/>

Preview ratio: 100%

Refresh

Export: SVG/PDF/PNG

Background Reset zoom - +

Gephi Preview: Export SVG/PDF/PNG



The screenshot shows the Gephi Preview window with the 'Preview' tab selected. The 'Preview Settings' panel on the left is visible, showing various rendering options for nodes and edges. The main preview area displays a network graph with blue and green nodes and edges. An 'Export' dialog box is open, showing the following details:

- Save As:** Gephi_SNA
- Folder:** SNA
- File Format:** PNG Files (*.png)
- Buttons:** New Folder, Cancel, Save, Options...

At the bottom of the Preview window, the 'Export' dropdown is set to 'SVG/PDF/PNG'.

Gephi Overview: Text Labels



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes Edges | Unique Attribute | #c0c0c0 | Apply

Layout | Yifan Hu Proportional | Run

Yifan Hu's properties

Optimal Distance	100.0
Relative Strength	0.2
Initial Step size	20.0
Step ratio	0.95
Adaptive Cooling	<input checked="" type="checkbox"/>
Convergence Thres	1.0E-4

Barnes-Hut's properties

Quadtree Max Level	10
Theta	1.2

Yifan Hu Proportional

Presets... Reset

Dragging (Configure)

Context

Nodes: 77
Edges: 254
Undirected Graph

Filters | Settings

Network Overview

- Average Degree
- Avg. Weighted Degree
- Network Diameter
- Graph Density
- Modularity
- PageRank
- Connected Components

Node Overview

- Avg. Clustering Coef
- Eigenvector Centralit

Edge Overview

- Avg. Path Length

Dynamic

- # Nodes
- # Edges
- Degree
- Clustering Coefficient

Global | Edges | Labels

Node

Font: Arial-BoldMT, 32 | Color:

Size:

Edge

Font: Arial-BoldMT, 32 | Color:

Size:

Size: Scaled | Color: Text | Hide non-selected

Gephi Overview: Text Labels



Overview | Data Laboratory | Preview

Workspace 1

Appearance | Graph | Context

Nodes | Edges | Unique | Attribute

#c0c0c0

Apply

Layout | Yifan Hu Proportional | Run

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- PageRank
- Connected Components

Node Overview

- Avg. Clustering Coefficient
- Eigenvector Centrality

Edge Overview

- Avg. Path Length

Dynamic

- # Nodes
- # Edges
- Degree
- Clustering Coefficient

Font: Arial-BoldMT, 32

Comparison of Social Network Analysis (SNA) Tools

General Comparison of SNA Tools

Software	NETWORKX	IGRAPH	GEPHI	PAJEK
TYPE	LIBRARY	LIBRARY	STAND ALONE	STAND ALONE
PLATFORM	PYTHON	PYTHON\R\C LIBRARY	WINDOWS	WINDOWS
COMPUTATIONAL TIME	FAST	FAST	FAST	MEDIUM
NO. OF NODES	1 MILLION	1 MILLION	0.15 MILLION	1 MILLION

Naheed Akhtar (2014)

Network Types Supported by SNA Tools

Graph type	Networkx	IGraph	Gephi	Pajek
1-Mode network	Yes	Yes	Yes	Yes
2-Mode network Graph	Yes	Yes	Yes	Yes
Multirelational network Graph	No	No	No	Yes
Temporarily network Graph	Yes	No	No	Yes

Naheed Akhtar (2014)

Graph Layout

Supported by SNA Tools

Layout	Networkx	IGraph	Pajek	Gephi
Circular layout	Yes	Yes	Yes	Yes
Random layout	Yes	Yes	Yes	No
Spectral layout	Yes	No	No	No
Spring layout	Yes	Yes	Yes	Yes
Graphviz layout	Yes	No	No	No
Kamanda kawai	No	Yes	Yes	No
Fruchterman reingold	No	Yes	Yes	No
Force Atlas layout	No	No	Yes	No

Naheed Akhtar (2014)

Execution Time for SNA Features

SNA Features	Networkx	IGraph	Gephi	Pajek
Load time	54.67 sec.	3.707 sec	29 sec	3 sec
Degree centrality	58.57 sec	6.199 sec	4 sec	2 sec
Graph degree	60.87 sec	6.22 sec	4 sec	2 sec
Page rank	120.78 sec	9.81 sec	10 sec	No
Hits	57.23 sec	15.43	8 sec	No
Cliques	66.98 sec	9.35 sec	Na	No
Density	58.94 sec	3.302 sec	4 sec	No
Modularity	81 .4 sec	9 sec	30 sec	6 sec
Network diameter	35 sec	3.51 sec	120 sec	No
Core	65.84 sec	6.532 sec	No	1 sec
Cohesion	No	8.943 sec	No	No
Clustering coefficient	3303.99 sec	1800 sec	1200 sec	108 sec
Hub	76.57	5.831 sec	3 sec	No
Authority	Array is to big	6.783 sec	3 sec	No

Naheed Akhtar (2014)

Comparative analysis of Social Networking Analysis tools

Software	Pajek	Gephi	Social Network Visualizer	Netlytic	Graphviz
Version	1.26	0.7 alpha	1.56 Beta	Tier 1,2,3	2.38.0
Type	Stand-alone software	Stand-alone software	Stand-alone software	Stand-alone software	Stand-alone software
Platform	Windows	Java	Windows	Windows	Windows
License	Free	GNU GPL	Free	Tier 1,2 (Free) Tier 3 (CS)	Free
Expectable Computing Time	Fast(C)	Medium(JAVA)	Fast(C)	Medium(JAVA)	Fast(C)
Tractable number of nodes	500000 nodes	150000 nodes	100000 nodes	300000 nodes	1400000 nodes
Time to load 10 ⁵ nodes and 10 ⁶ edges	24 seconds	40 seconds	46 seconds	50 seconds	34 seconds
File formats					
GML	No	Yes	Yes	Yes	No
Pajek(.net)	No	Important Only	No	No	No
GraphML	Export only	Yes	Yes	Yes	No
DL	Yes	Yes	Yes	Yes	No
GEXF	No	Yes	Yes	Yes	No
Graph types					
Two-mode graphs	Yes	No	No	No	Yes
Multi-relational graphs	Yes	No	No	Yes	Yes
Temporality	Yes	No	No	Yes	Yes
Visualization layouts					
FruchtermanReingold	Yes	Yes	Yes	Yes	No
Kamada Kawai	Yes	Yes	No	No	Yes
Other spring layouts	No	Yes	Yes	No	Yes
Indicators					
Degree centrality	Yes	Yes	Yes	Yes	Yes
Betweenness centrality	Yes	Yes	Yes	Yes	Yes
Closeness centrality	Yes	Yes	Yes	Yes	Yes
Dyad census	No	No	No	No	No
Triad census	Yes	No	No	No	No
HITS	No	Yes	Yes	No	No
Page Rank	No	Yes	Yes	Yes	No
Clustering Algorithms					
Edge Betweenness	No	No	No	Yes	No
Walktrap	No	No	No	Yes	No
Springlass	No	No	No	Yes	No
Dendogram Display	Yes	Yes	Yes	Yes	Yes

Comparative analysis of Social Networking Analysis tools

Software	Pajek	Gephi
Version	1.26	0.7 alpha
Type	Stand-alone software	Stand-alone software
Platform	Windows	Java
License	Free	GNU GPL
Expectable Computing Time	Fast(C)	Medium(JAVA)
Tractable number of nodes	500000 nodes	150000 nodes
Time to load 10^5 nodes and 10^6 edges	24 seconds	40 seconds
File formats		
GML	No	Yes
Pajek(.net)	No	Important Only
GraphML	Export only	Yes
DL	Yes	Yes
GEXF	No	Yes
Graph types		
Two-mode graphs	Yes	No
Multi-relational graphs	Yes	No
Temporality	Yes	No

Comparative analysis of Social Networking Analysis tools

Software	Pajek	Gephi
Visualization layouts		
FruchtermanReingold	Yes	Yes
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Closeness centrality	Yes	Yes
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Triad census	Yes	No
HITS	No	Yes
Page Rank	No	Yes
Clustering Algorithms		
Edge Betweenness	No	No
Walktrap	No	No
Spinglass	No	No
Dendogram Display	Yes	Yes

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<http://analyzingthesocialweb.com/course-materials.shtml>
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