Office of Portfolio Analysis

NETWORK ANALYSIS CLASS – CYTOSCAPE USER GUIDE-OCTOBER 2017 V1.0

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	Save Save As	Ctrl+S Ctrl+Shift+S		\$					
	Import	,		Network	Þ	File	Ctrl+L		
	Export	,		Table	1	URL	Ctrl+Shift+ Import Network From File		
	Close Window	Ctrl+W		Styles Ontology and Annotation	n	Public Databases	Alt+L		
	Run Script File								
	Print Current Network	Ctrl+P							
	Quit	Ctrl+Q							

Importing a co-author network data into Cytoscape

File \rightarrow Import \rightarrow Network \rightarrow File.

Select the edges file with the isolated nodes added.

🍕 Network file to	load				23
Look in:				- 🤌 📂 🛄 -	
Recent Items	Edge Tabl	e tuberculosis with iso e tuberculosis le Tuberculosis from 1	late 089		
Desktop					
My Documents					
Computer					
	File name:	Edge Table tuberculosis	s with isolate.xlsx		Open
INE (WORK	Files of type:	All Files		•	Cancel



A pop up window will prompt you to set up which column contains the source and target edges, as well as the edges attributes.

Click on a column to edit it. Select All Select None						
source	• 💿 target	•	🖹 weight 🖪			
	0	1	:			
	0	2	:			
	0	3	:			
	0	4				
	0	5				
	0	6	:			
	0	7	:			
	0	8				

Because in co-author network edges don't have a direction, source and target are treated interchangeably. If any change needs to be done to the columns, right click on the column header and several options will appear:

eview		
lick on a column to edit it.	Select Al	Select None
● source (🖹 weight 🔻	
0	1	
0	2 weight	E
0	3 Meaning	
0		
0		
0	7 Data Type:	
0	8 ab 1 123 10 v/n	
dvanced Options		
arancea optionism	[ab] [1] [123] [1.0] [y/n]	

Hover the mouse over each of the icons to learn about the different options.

If a network is big, Cytoscape will ask you if you want to create the network visualization before moving forward.

Create Network Views?	23
Do you want to create a view for your large network This could take a long time.	s now?
OK Cancel	

If you select OK a network visualization will appear in the main panel.



Image: Section of the section of th

Cytoscape panels

Importing nodes attributes

Before doing any changes to the network view, we will import the Nodes' file to match the authors' names to the Sci2 IDs (Sci2 IDs are the Key to link edges and nodes datasets).

🔨 S	🐔 Session: New Session											
File	Edit View Select Layou	it Apps Tools	He	lp								
	New Open	• Ctrl+0			$\Theta_{\mathbf{k}}$	0	\bigcirc	Q		**	I)	٢
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	Import	•		Network			•					
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	Run Script File	I				П						
	Print Current Network	Ctrl+P										
	Quit	Ctrl+Q										

 $\mathsf{File} \rightarrow \mathsf{Import} \rightarrow \mathsf{Table} \rightarrow \mathsf{File}.$

Here we will select the nodes file.



🍕 Data Table file	:					
Look in:	From Sci2				🔹 🤌 🚺	⊡ -
Recent Items	Edge Tabl Edge Tabl etwork n Node Tab	e tuberculosis with e tuberculosis o style le Tuberculosis from	isolate m 1089			
Desktop						
My Documents						
Computer						
Natwork	File name:	Node Table Tubercu	ulosis from 1089.xls>	(Open
NetWORK	Files of type:	All Files			•	Cancel

After opening the selected file the following window will appear:

14.5	hara ta Import Table Datas	To a Notwork Caller	tion		
Wi Colort a Notwork Collection	nere to import Table Data:	TO a NELWORK COllec	uon 👻		
Select a Network Collection	Nu lot r		Lociosopoli	1	
	Network Collection:	Edge Table from Gra	apnz619092934 👻		
	Import Data as:	Node Table Column:	s 👻		
	Key Column for Network:	shared name 🚽			
	Casa Sansitiva Kau Valuaru (
	Case Sensitive Key Values:	<u>v</u>			
🖹 label	I totalDegree	e (Q. id	•		
∎ label Egger, Matthias	 ItotalDegree 	e (Q , id	$\overline{}$		
iabel Egger, Matthias Avila, Dorita	 Interpretent to the second sec	e (Q, id 313 81			
label Egger, Matthias Avila, Dorita Althoff, Keri N	 ItotalDegree 	e 4 id 313 81 140			
iabel Egger, Matthias Avila, Dorita Althoff, Keri N Mugglin, Catrina	 Image: totalDegree 	e 4 id 313 81 140 74	1 2 3		A III
i label Egger, Matthias Avila, Dorita Althoff, Keri N Mugglin, Catrina Wools Kaloustian, Kara	 ItotalDegree 	e 4 id 313 81 140 74 229	1 2 3 4		A III
label Egger, Matthias Avila, Dorita Althoff, Keri N Mugglin, Catrina Wools Kaloustian, Kara Koller, Manuel	 ItotalDegree 	e 4 id 313 140 74 229 87	1 2 3 4 5		, III
label Egger, Matthias Avila, Dorita Althoff, Keri N Mugglin, Catrina Wools Kaloustian, Kara Koller, Manuel Dabis, Francois	 ItotalDegree 	e 4 id 313 81 140 74 229 87 141	1 2 3 4 5 6		
label Egger, Matthias Avila, Dorita Althoff, Keri N Mugglin, Catrina Wools Kaloustian, Kara Koller, Manuel Dabis, Francois Nash. Denis	 ItotalDegree 	e 4 id 313 81 140 74 229 87 141 114	1 2 3 4 5 6 7		* III
label Egger, Matthias Avila, Dorita Althoff, Keri N Mugglin, Catrina Wools Kaloustian, Kara Koller, Manuel Dabis, Francois Nash. Denis	 Image: totalDegree 	e 4 id 313 81 140 74 229 87 141 114	1 2 3 4 5 6 7		* III

Here the most important step is to set the "ID" column as the key to link the edges and nodes files. Label and total degree should be set as nodes' attributes.



So now we have our network with the following information:

For the nodes:

🏚 🔲 🕇	🛍 🎫 f	$\dot{x}(x)$	
shared name	name	📥 label 🖷	totalDegree
0	0	Egger, M	313
1	1	Avila, Do	81
2	2	Althoff, K	140
3	3	Mugglin,	74
4	4	Wools Kal	229
5	5	Koller, M	87
6	6	Dabis, Fr	141
7	7	Nash, Denis	114
8	8	Gsponer, T	93
9	9	Sungkan	74
	10	Menowan	1/17

For the edges:

Table Panel				
	f(x)			
ινштι				
-			1	
📫 shared name	shared interaction	name	interaction	🗰 weight
0 (interacts with) 1	interacts with	0 (interact	interacts with	2
0 (interacts with) 2	interacts with	0 (interact	interacts with	3
0 (interacts with) 3	interacts with	0 (interact	interacts with	1
0 (interacts with) 4	interacts with	0 (interact	interacts with	7
0 (interacts with) 5	interacts with	0 (interact	interacts with	5
0 (interacts with) 6	interacts with	0 (interact	interacts with	5
0 (interacts with) 7	interacts with	0 (interact	interacts with	3
0 (interacts with) 8	interacts with	0 (interact	interacts with	4
0 (interacts with) 9	interacts with	0 (interact	interacts with	1
0 (interacts with) 10	interacts with	0 (interact	interacts with	4
O lintoração with 11	intoracta with	0 (interact	intoracte with	2
Node Table Edge Table	Network Table			



Running Cytoscape stats

Cytoscape can run the network stats at the network as well as the individual nodes and edges' level.

Tools \rightarrow Network Analyzer \rightarrow Network Analysis \rightarrow Analyze Network



A window will ask you if the network you uploaded is undirected or not. Because we are building a coauthor network, we will select "treat the network as undirected"

🍕 NetworkAnalyzer - Netw	vork Interpretation	23
The network contains	only directed edges and they are not	paired.
Interpretation		
	Treat the network as directly	cted.
	Treat the network as und	lirected.
	ОК	Cancel



The results panel will now pop up, showing the network stats.

🛓 Results Panel						3
Network Statistics of Edge Table	e from Graph	2619092934 (undirected)			T	×
Topological Coefficients	istribution	Shortest Dath Length Distri	bution	enuality Share	Meighborg Distribution	
Simple Parameters	Node D	Degree Distribution	Avg.	Clustering C	oefficient Distribution	
Clust Connec N Netwo Character Avg. numl	tering coeffici ted compone letwork diame Network rac ork centralizai Shortest pa ristic path len ber of neighb	ient: 0.873 ents: 53 eter: 13 dius: 1 tion: 0.049 eths: 80867462 (86%) ogth: 4.814 pors: 22.732	Numb Netw Network he Isol Number o Multi-edge Analysi	er of nodes : vork density : terogeneity : lated nodes : of self-loops : e node pairs : s time (sec) :	9675 0.002 1.230 1 0 0 11.434	4

But at the table panel, we can see that individual stats are now available for nodes and edges as well.

Image: Second system Image: Second system Isometry Isometry <thisometry< th=""> Isometry <th< th=""><th>Table Panel</th><th></th><th></th><th></th><th></th><th></th><th></th></th<></thisometry<>	Table Panel						
Iabel Instant Instant Instant Degree Betweenness Egger, Matthias 313 0.2777486 313 0.0252072 Avila, Dorita 81 0.25514345 81 6.566E-5 Althoff, Keri N 140 0.27058505 140 0.00245874 Mugglin, Catrina 74 0.25504936 74 0.0 Wools Kaloustian, 229 0.27112358 229 0.01013716 Koller, Manuel 87 0.25530284 87 1.006E-4 Dabis, Francois 141 0.2590917 141 9.0908E-4 Nash, Denis 114 0.26294856 114 7.01E-4 Gsponer, T 93 0.25551324 93 1.9079E-4 Sungkanuparph, S 74 0.2504936 74 0.0 Mash, Denis 114 0.25504936 114 7.01E-4 Sungkanuparph, S 74 0.25504936 74 0.0 Mode Table Dage Table Network Table 147	* 🗆 +	f(x))				
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Wools Kaloustian, 229 0.27112358 229 0.01013716 Koller, Manuel 87 0.25530284 87 1.006E-4 Dabis, Francois 141 0.2590917 141 9.0908E-4 Nash, Denis 114 0.26294856 114 7.01E-4 Gsponer, T 93 0.25551324 93 1.9079E-4 Sungkanuparph, S 74 0.25504936 74 0.0 Mode Table Edge Table Network Table 147 0.0260274	Mugglin, Catrina	74	0.25504936		74	0.0	
Koller, Manuel 87 0.25530284 87 1.006E-4 Dabis, Francois 141 0.2590917 141 9.0908E-4 Nash, Denis 114 0.26294856 114 7.01E-4 Gsponer, T 93 0.25551324 93 1.9079E-4 Sungkanuparph, S 74 0.25504936 74 0.0 Mode Table Dige Table Network Table 147 0.00260374	Wools Kaloustian,	229	0.27112358		229	0.01013716	
Dabis, Francois 141 0.2590917 I 141 9.0908E-4 Nash, Denis 114 0.26294856 114 7.01E-4 Gsponer, T 93 0.25551324 93 1.9079E-4 Sungkanuparph, S 74 0.25504936 74 0.0 Mode Table Dige Table Network Table 147 0.0250274	Koller, Manuel	87	0.25530284		87	1.006E-4	
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Gsponer, T 93 0.25551324 93 1.9079E-4 Sungkanuparph, S 74 0.25504936 74 0.0 Cathoring 147 0.26762708 147 0.00260274 Node Table Edge Table Network Table 147 0.00260274	Nash, Denis	114	0.26294856		114	7.01E-4	
Sungkanuparph, S 74 0.25504936 74 0.0 Materia Cathorino 147 0.35762708 147 0.00360274 Node Table Edge Table Network Table 147 0.00360274	Gsponer, T	93	0.25551324		93	1.9079E-4	
Mode Table 147 0.025752708 147 0.00250274 Node Table Edge Table Network Table 147 0.00250274	Sungkanuparph, S	74	0.25504936		74	0.0	
Node Table Dige Table Network Table	Cathorino	147	0 76762700		147	0.00060274	
	Node Table Edge Table	Network Table					



(

Table Panel 凬 f(x)۰ ⊞8 П ÷. 📥 shared ii 📥 weight shared name name interaction EdgeBetweenness 0 (interacts with) 1 0 (interacts with) 1 2 interac... interacts... 1355.05246851 0 (interacts with) 2 interac... 0 (interacts with) 2 interacts... 3 8141.86575327 0 (interacts with) 3 interac... 0 (interacts with) 3 interacts... 1 1371.62388795 0 (interacts with) 4 0 (interacts with) 4 7 interac... interacts... 21782.66790649 0 (interacts with) 5 0 (interacts with) 5 5 interac... interacts... 1340.15411876 0 (interacts with) 6 0 (interacts with) 6 5 interac... interacts... 2623.71686236 0 (interacts with) 7 interac... 0 (interacts with) 7 interacts... 3 1930.40583715 0 (interacts with) 8 interac... 0 (interacts with) 8 interacts... 4 1324.79581418 0 (interacts with) 9 interac... 0 (interacts with) 9 interacts... 1 1371.62388795 0 (interacts with) 10 0 (interacts with) 10 4 interacts... 7493.7983363 interac... O (interacte with) 11 1200 66100040 O lintor intoracto. 2 a to ----Node Table Network Table Edge Table

Cytoscape v3.4.0 -Office of Portfolio Analysis User Guide-



Control Panel

The control panel has 3 tabs

Network tab

Here you can see which network you are working with as well as move from one network to another in case you have more than one network.



Cloning a network

To duplicate a network:

File \rightarrow New \rightarrow Network \rightarrow Clone current network

Now you should be able to see this new network at the network's tab

Control Panel	- ×
	cted 🔅
 Edge Table from Graph2619092934 	1
Edge Table from Graph2619092934	9675 109964
 Edge Table from Graph2619092934_1 	1
Edge Table from Graph2619092934_1	9675 109964

To rename the networks, right click on the network and select Rename network form the dropdown box.



Now let's change some of the nodes and edges properties using the stats we have.

St\	ıle	Γz	ah
JU	y i C		

Control	Panel			x	
Network	Style	Select			_
defa	ult		•	•	
Proper	ties 🝷				
Def.	Map.	Вур.			
			Border Paint	•	
			Fill Color	•	
			Height	0 (
			Image/Chart 1	•	
	₽		Label	•	
			Label Color	•	
12			Label Font Size	•	
0			Shape	•	
35.0			Size	•	
255			Transparency	•	
			Width	0 (
V Le	ock nod	e width	and height		
					1
Node	Edge	Networ	k		

Each node/edge property has 3 options for changes:

- *Def:* changes made using this box will target all nodes or edges in the network
- Map: changes using this option will target specific nodes/edges. Here you can use the nodes/edges stats that resulted from running the Tools -> Network Analyzer function (degree, betweenness, etc) to change the nodes properties. For example, you can size and color nodes based on degree centrality.

• *Byp (Bypass)*: this option allows you to change the attributes for only nodes/edges that are selected.



Select tab

👯 Session: New Session		
File Edit View Select Layout Apps Tools Help		
📂 🖹 놓 ╁ 🥰 🗳 🕰		
Control Panel	□ × □	
Network Style Select		
Default filter	•	
Column Filter		
Degree Filter		
Topology Filter		

Here you will be able to select nodes and/or edges based on their properties. For example you can select nodes with degree between 50 and 500.

Main menu/Edit:

📢 Se	essio	n: New Session						
File	Edit	View Select Layout Apps T	ools Help					
		Сору	Ctrl+C	(F)	Θ	(7)	\bigcirc	
_		Cut	Ctrl+X	4	4	4	4	
Cor		Paste	Ctrl+V			×		
Net		Undo: Set Mapping Type	Ctrl+Z					
_		Redo	Ctrl+Y					
De		Create Views		- [•			
		Destroy Views				וו ר		
11		Destroy Networks						
		Destroy Networks						
		Remove Duplicated Edges						
		Remove Self-Loops						
		Delete Selected Nodes and Edg	ges Delete					
		Rename Network						
		Desferences						
		Ficicicics	,					

Here you can do things like removing selected edges and/or nodes.



Main Menu/View



Here you can choose which panels you want to see or hide.

Main Menu/Select

🍕 Session: New	Session				
File Edit View	Select Layout Apps Tools Help				
🛌 🖪	Mouse Drag Selects		10		
	Nodes		•	First Neighbors of Selected Nodes	•
Control Panel	Edges		1	Invert node selection	Ctrl+I
Network Style	Charu all an day and adapa			Hide selected nodes	
≫ ⊗	Show an nodes and edges			Hide unselected nodes	
	Hide selected nodes and edges	_		Show all nodes	
	Hide unselected hodes and edge	5	_	Select all nodes	Ctrl+A
	Select all nodes and edges	Ctrl+Alt+A		Deselect all nodes	Ctrl+Shift+A
	Deselect all nodes and edges	Ctrl+Alt+Shift+A		Nodes connected by selected edges	Ctrl+7
			Г	From ID List file	Ctrl+I

Here you can select all nodes or edges, invert your selection of nodes/edges, and select a list of nodes from a list (nodes names should match exactly the name of the node in the network. Specially important when wanting to highlight PIs in a co-author network. The PI name might not be exactly the same as in the publication' author list).



Bundle Edges Clear All Edge Bends	`Q	2	ññ ()	٢
Control Panel Rotate Network Style Default filter Align and Distribute Choose colur Settings Apply Preferred Layout	F5			
yFiles Layouts Grid Layout Higgschied Layout		Drganic Circular Jierarchic		
Circular Layout Stacked Node Layout	, c	Orthogonal Tree		
Attribute Circle Layout Degree Sorted Circle Layout Prefuse Force Directed Layout Prefuse Force Directed OpenCL Layou Group Attributes Layout	t S	Rotate 90 Degrees Rotate -90 Degrees Rotate -2X Rotale 1/2X Airror X-Avis		
Edge-weighted Force directed (BioLay Edge-weighted Spring Embedded Lay	out) N	Airror Y-Axis		
Inverted Self-Organizing Map Layout	•			

For co-author networks there are many possible layouts. The yFIles \rightarrow Organic usually works well.

Main Menu/Tools

To extract the network components go to Tools \rightarrow Network Analyzer \rightarrow Subnetwork creation \rightarrow Extract connected components

🍕 Session: New Session			
File Edit View Select Layout Apps	ools Help		
🛌 🖪 🔩 🛨 🛷	NetworkAnalyzer	•	Network Analysis
- 🗖 🔍 🎟 🔍	Merge	1	Subnetwork Creation Extract Connected Components
Control Panel Network Style Select Default filter	Workflow Job Status Monitor Command Line Dialog Execute Command File		
Choose column	T		

A window will pop up showing the network connected components. Here you can choose to extract one or more components which will then be able to be treated separately from the full network.



Connected Components of Ed	ge Table from Graph2619092934:
Component 1 (8992)	*
Component 2 (87)	=
Component 3 (65)	
Component 4 (35)	
Component 5 (34)	
Component 6 (28)	
Component 7 (24)	
Component 8 (24)	
	T

This new network will show up listed in the Network tab, below the network from where it came from



You can run the Network analyzer to obtain the stats for this specific component alone

🝕 Session: New Session									
File Edit View Select Layout Apps To	ools Help								
	NetworkA	nalyzer	۱.	Network Analysis		•	Analyze Network		
D V	Merge		•	Subne	twork Creation	•	Analyze Subset of Nodes		
Control Panel	Workflow		•				Batch Analysis		
Network Style Select	Job Status	Monitor					Load Network Statistics		
	Comman	d Line Dial	og				Plot Parameters		
▼ Edge Table from Graph2619092934	Execute C	ommand f	File				Generate Style from Statistics		
Edge Table from Graph26190929	934	9675	109964				Settings		
Edge Table from Graph 26 190	092934(1)	8992	106833				About NetworkAnalyzer		
 Edge Table from Graph2619092934_1 			1						
Edge Table from Graph26190929	934_1	9675	109964						
				1					



🛓 Results Panel								
						± ×		
atistics of Edge Table from	n Graph2619092934	(undirected)	Network Statis	tics of Edg	ge Table from Graph2	619092934(1) (undir 🛓 👔 🕞		
Betweenness Centrality Close			seness Centrality		ntrality Distribution			
Shortest Path Length Distribution		Shared	Neighbors Distrib	ution	Neighborhood Connectivity Distributio			
Simple Parameters	Simple Parameters Node Degree Distr		Avg. Clustering Coefficient Distributio			Topological Coefficients		
Clustering coefficien Connected component Network diamete Network radiu Network centralizatio Shortest path Characteristic path lengt Avg. number of neighbor			59 53 47072 (100%) 15 762	Netw Nu Mu	Number of nodes : 1 Network density : 1 vork heterogeneity : 1 Isolated nodes : (Imber of self-loops : (Iti-edge node pairs : (Analysis time (sec) : 9	8992 0.003 1.207 0 0 9.762		

Main Menu/Help

Cytoscape user manual is available.



Saving in Cytoscape

Saving a Cytoscape file

File \rightarrow Saves as. The default extension for Cytoscape files is .cys

Saving a graph

File \rightarrow Export \rightarrow Network View as Graphics

Saving style

🕻 S	ession: New Session									
ile	Edit View Select Layou	t Apps Tools	s Hel	р						
	New Open	Ctrl+0	•	S	Q	0	\bigcirc	C	1	*
	Open Recent			• × •						
	Save	Ctrl+S								
	Save As	Ctrl+Shift+S		•						
	Import		<u>ا</u>	⊗ ⊗				-		
Export			۱.	Network						
	Close Window Ctrl+W			Network and Network Vie	d View w as G	 iraphics				
	Run Script File			Network Vie	w(s) a	s Web P	age			
	Print Current Network	Ctrl+P		Table						
	Quit	Ctrl+Q		Styles						
M	apping Type	Continuous Ma	pping							

Leave the default style format

🍕 Export Styles		X
Select Styles:	Big Labels Select All BioPAX BioPAX_SIF E Curved default default black •	
Select the export file format:	Style XML (*.xml) 👻	
Save Styles as:	Please select a style file	Browse
		OK Cancel



Importing a saved style

🐔 Se	ession: New Session								
File	Edit View Select Layou	t Apps Tools	Help)					
	New Open Open Recent	Ctrl+O	E	€ □ ×	Q	0	\bigcirc	C	
	Save	Ctrl+S			_				
	Save As	Ctrl+Shift+S	b	-					
	Import	I		Network			•		
	Export	I		Table			•		
	Close Window	Ctrl+W		Styles					
	close window	Currw		Ontology a	nd Ann	otation			
	Run Script File			•					
	Print Current Network	Ctrl+P		•					
	Quit	Ctrl+Q							
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Important: when you import the style, it will not show immediately in the network. You have to look for it in the styles dropdown box. It is usually saved with the name "Default_0" or "Default_1"

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Cytoscape Manual & tutorials

There are many Cytoscape tutorials and manuals available online:

http://manual.cytoscape.org/en/3.4.0/

http://opentutorials.cgl.ucsf.edu/index.php/Tutorial:Introduction_to_Cytoscape#Navigating_Cytoscape

