

# ***A User Study of Attribute Visualization Tools and Their Role in Understanding Biological Networks***

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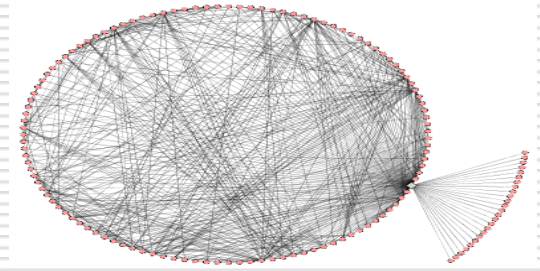
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# Problem Definition

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- With the growth of databases of biological relationships
    - networks can be large and complicated
    - visual analysis has become increasingly important
  - Our goal:
    - Study how different attribute visualization approaches affect users' ability to understand and analyze biological networks
    - Observe whether the differences in attribute visualization tools help the user better understand complex networks
  - Study of three Cytoscape tools for selecting nodes by Gene Ontology annotations in networks from Michigan Molecular Interaction (MiMI) database
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# Attribute Visualization Using Cytoscape

## □ Data Panel and NCIBI's Attribute Browser

The screenshot displays the Cytoscape Desktop interface with a network graph and several panels for attribute visualization. The network graph shows a central node (CSF1R) connected to various other nodes (e.g., RUNX1, THOC3, GRB2, INPP5B, FYN, PIK3R2, CSF1, SOCS1, PIK3R1, SOCS2, RASA1, YES1, LYN, CBL, INPPL, SHC1, GRAP2). The nodes are color-coded (yellow, green, red, grey).

**Detailed Selection Information Panel:**

```
Network
csf1r Homo sapiens protein All Data Sou

Attributes
Biological Process: No values selected.
```

**Data Panel:**

ID	Component	Function	
3635	cytoplasm [GO:0005737]; membrane [GO:0016020]	hydrolase activity [GO:0016787]; inositol or phosph...	apopto
2885	cytosol [GO:0005829]	epidermal growth factor receptor binding [GO:0005...	cell-ce
9021		protein binding [GO:0005515]; protein kinase inhibi...	anti-ap
8651	cytoplasm [GO:0005737]	insulin-like growth factor receptor binding [GO:0005...	cytokin
7525	cytoplasm [GO:0005737]; membrane fraction [GO:0...	ATP binding [GO:0005524]; non-membrane spanni...	glucos
6654	intracellular [GO:0005622]	DNA binding [GO:0003677]; guanyl-nucleotide exh...	Ras pi
1435	extracellular region [GO:0005576]; extracellular spa...	macrophage colony stimulating factor receptor bind...	cell dif
5921	cytoplasm [GO:0005737]; intracellular [GO:0005622]	GTPase binding [GO:0051020]; potassium channel...	cytokin
5295	intracellular [GO:0005622]; phosphoinositide 3-kin...	ErbB-3 class receptor binding [GO:0043125]; insuli...	insulin

**Attributes-Node Browser Panel:**

Select one or more attribute and attribute value...

Switch to Current Network | Set Attributes from Selection

Clear Selection | Done

Action on selection...

clear nodes before each choice

combine nodes of successive choices

Multiple attributes...

and multiple attribute-values

or multiple attribute-values

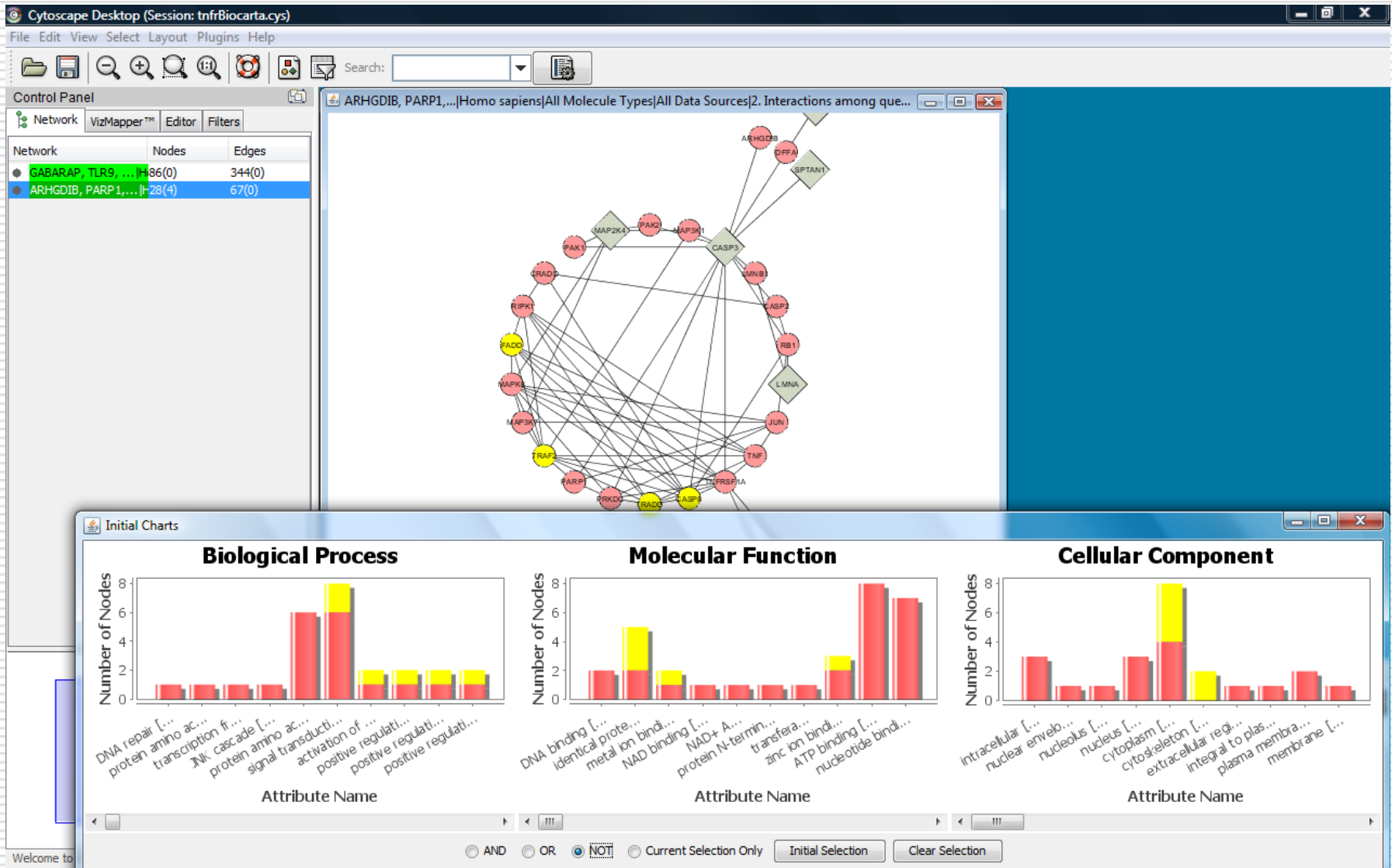
Attributes

- Biological Process
- Cellular Component
- Molecular Function

Biological Process

- Cell communication
- JAK-STAT cascade
- Signal transduction
- actin cytoskeleton organization and biogenesis
- activation of MAPK activity
- anti-apoptosis
- cell adhesion
- cell surface receptor linked signal transduction
- cytokinesis
- embryonic development
- epidermal growth factor receptor signaling pathway
- erythrocyte differentiation

# Attribute Charts Plug-in



# User Study

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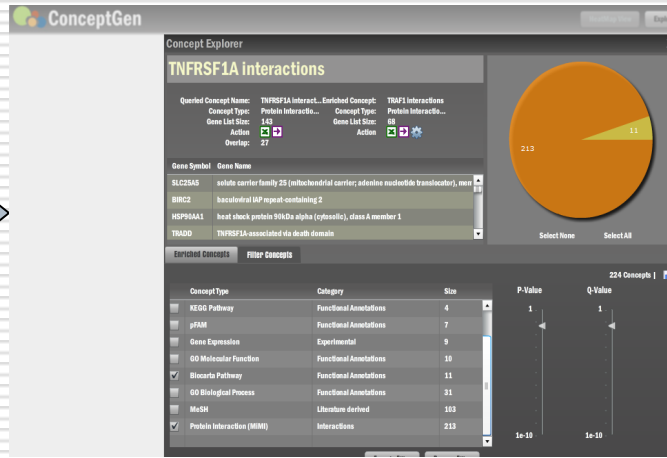
## □ Design

- Pre-questionnaire
- Three tasks to perform with the attribute visualization tools
- Post-questionnaire

## □ Challenges

- Measuring “understanding”
    - Number of tasks completed, task completion time, number of prompts needed, ...
  - Defining and selecting different tasks
    - One basic task, one intermediate and one advanced task
  - Creating PPI networks for the tasks
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# Creating the PPI Networks



	A	B	C
Gene ID	Gene Symbol	Gene Name	
1			
2	SLC25A5	292	
3	BIRC2	329	
4	HSP90AA1	3320	
5	TRADD	8717	
6	TRAF2	7186	
7	BAG2	9532	
8	RIPK2	8767	
9	TIMM50	92609	
10	TUBB4	10382	
11	HSPA9	3313	
12	NAP1L1	4673	
13	TNFRSF1A	7132	
14	TRAF1	7185	
15	TUBB	203068	
16	ACTG1	71	
17	CFLAR	8837	
18	TUBA3C	7278	
19	CASP10	843	
20	HSPA1L	3305	
21	RNC2	5965	
22	RPS3	6188	

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