

# Network **analysis** and **visualization** in R

Summer Institute in Computational Social Science  
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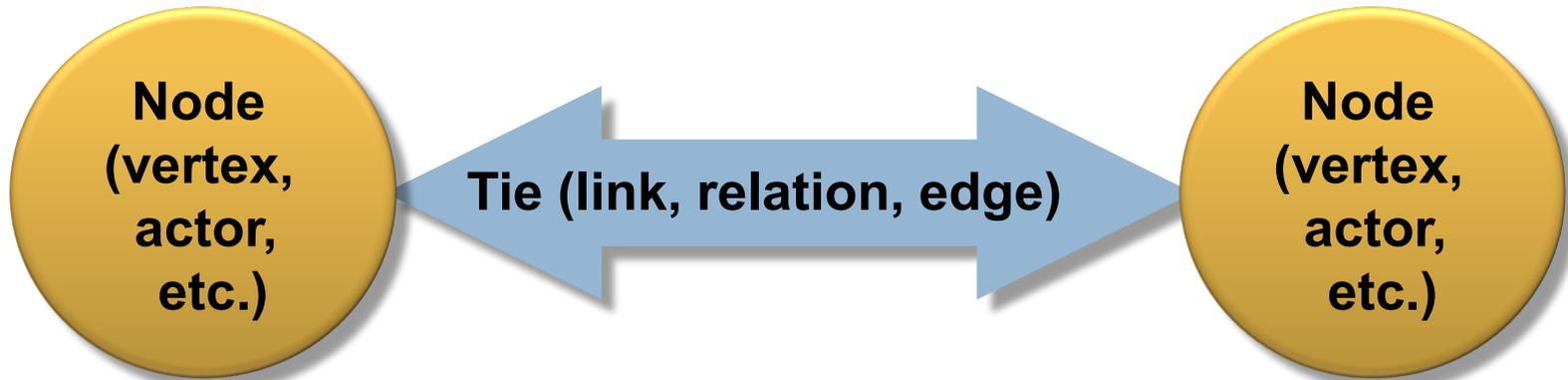
## Tutorial materials

R code (text file): [bitly.com/sicss-net-code](https://bitly.com/sicss-net-code)

Full materials (ZIP): [bitly.com/sicss-net-2021](https://bitly.com/sicss-net-2021)

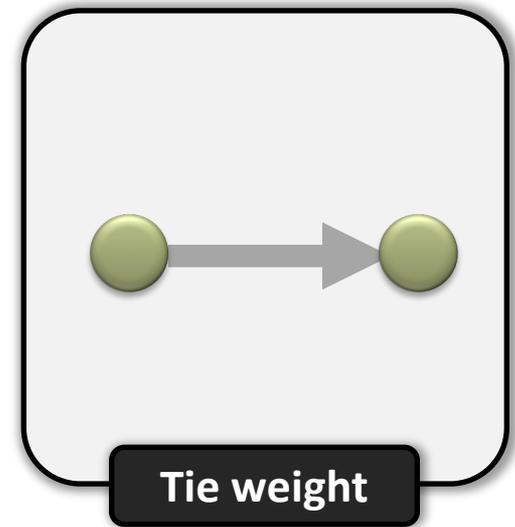
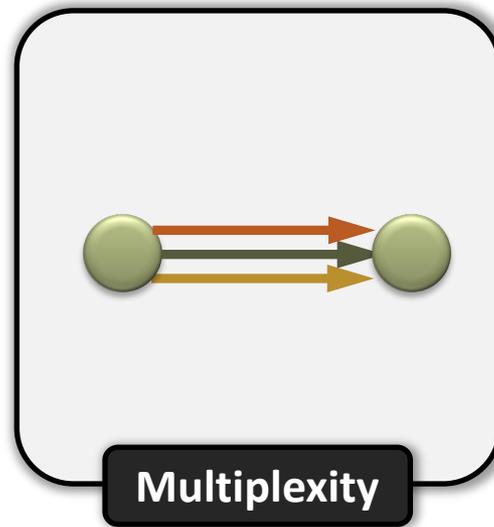
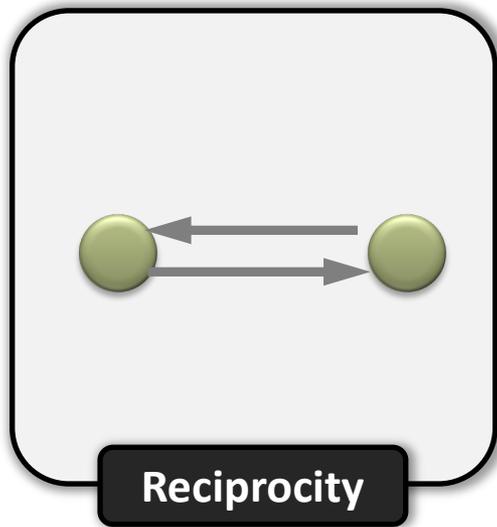
# Network **structure**

# Social networks

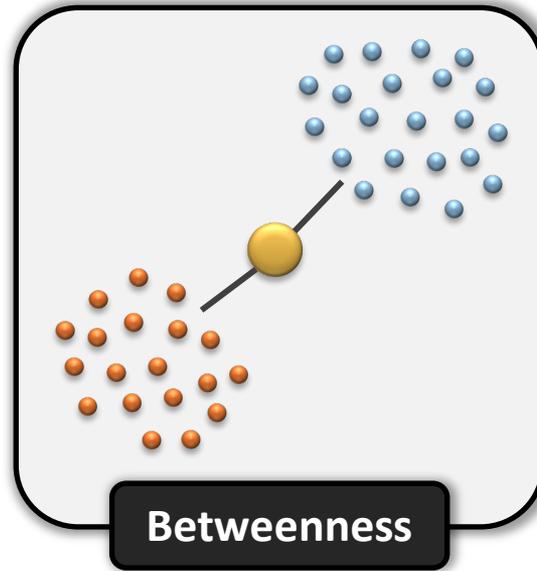
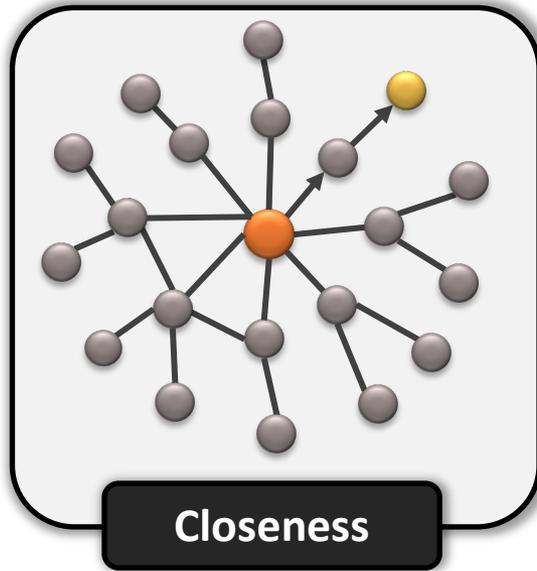
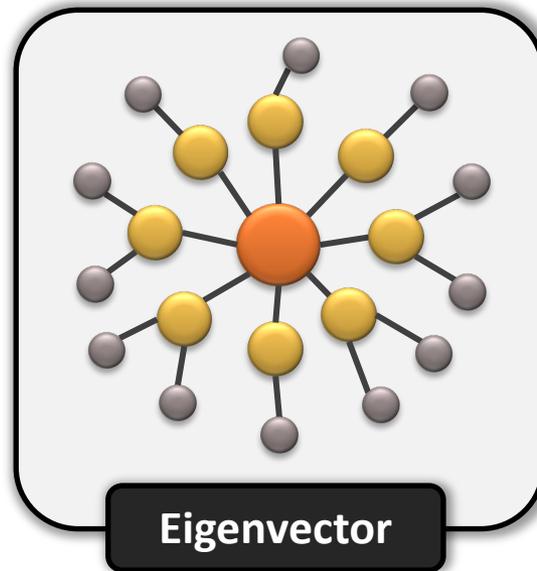
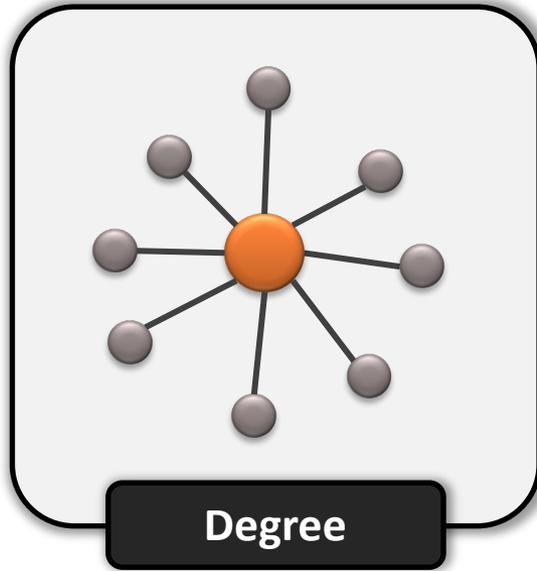


**Network:** A set of entities (people, organizations, websites, etc.) and the ties between them.

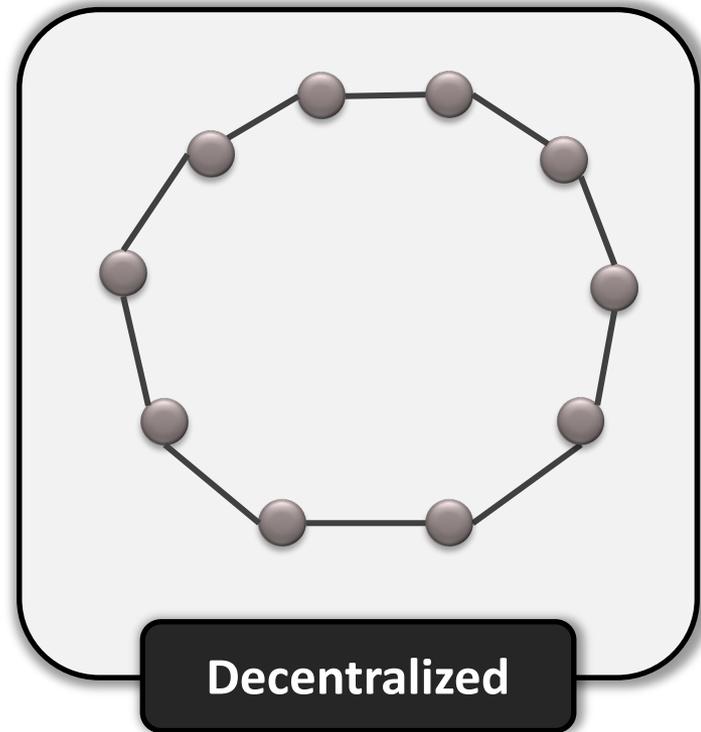
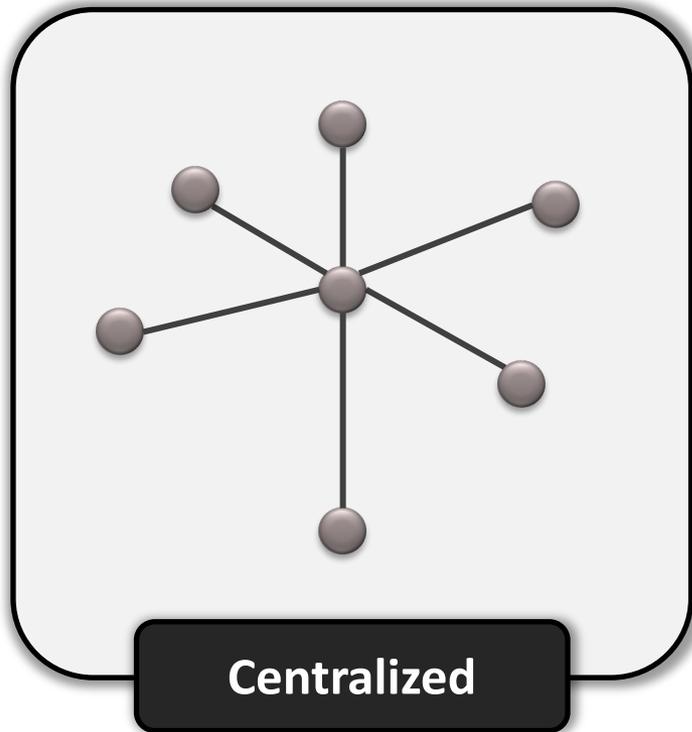
# Relationship characteristics



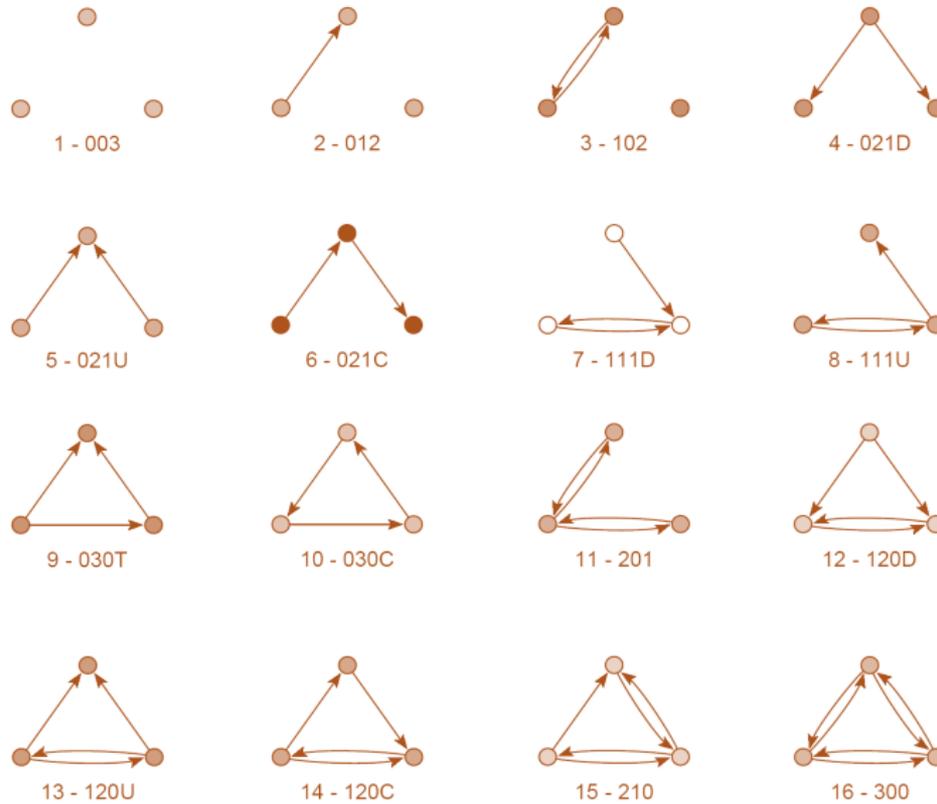
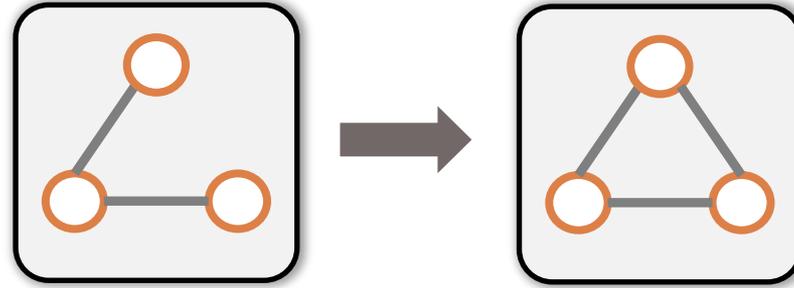
# Node centrality



# Network centralization



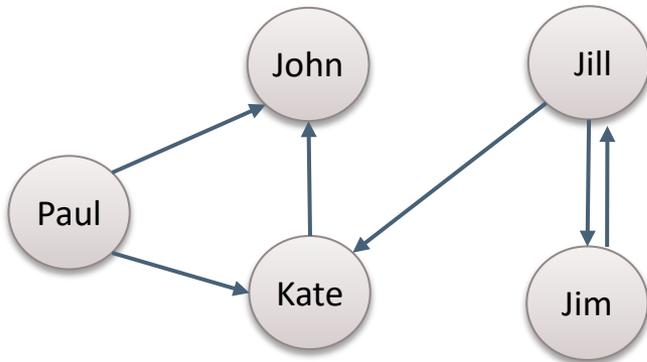
# Clustering coefficient / triadic closure



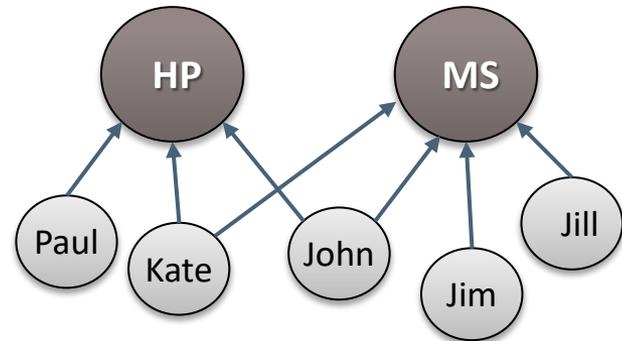


# One and two-mode networks

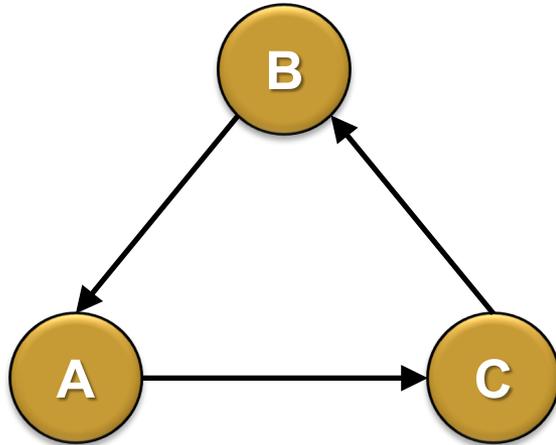
**Adjacency**  
(e.g. friendship nets)



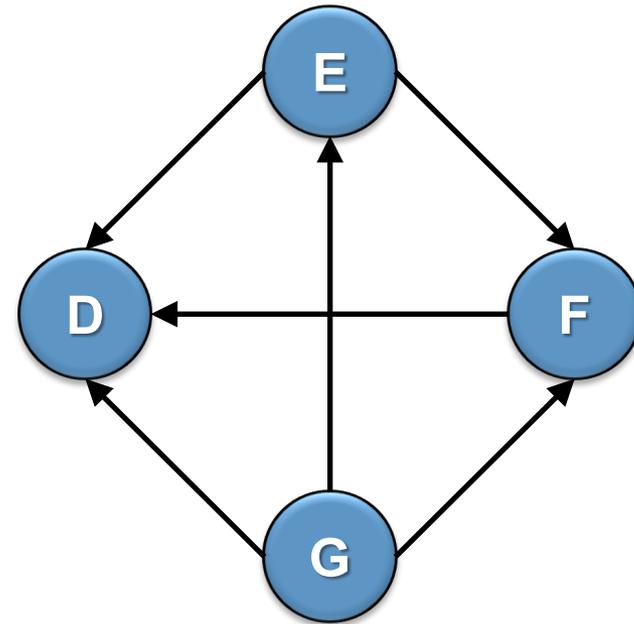
**Affiliation**  
(e.g. employer-employee nets)



# Graph components

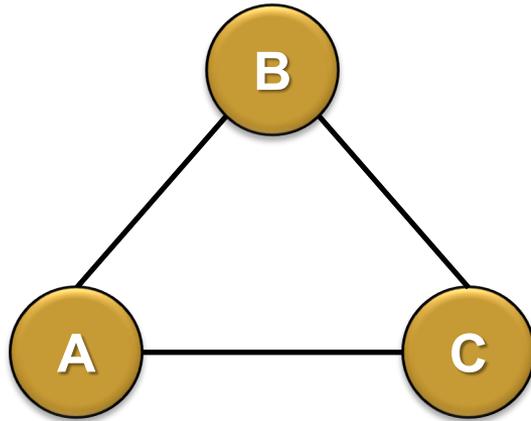


1 weakly connected component  
1 strongly connected component

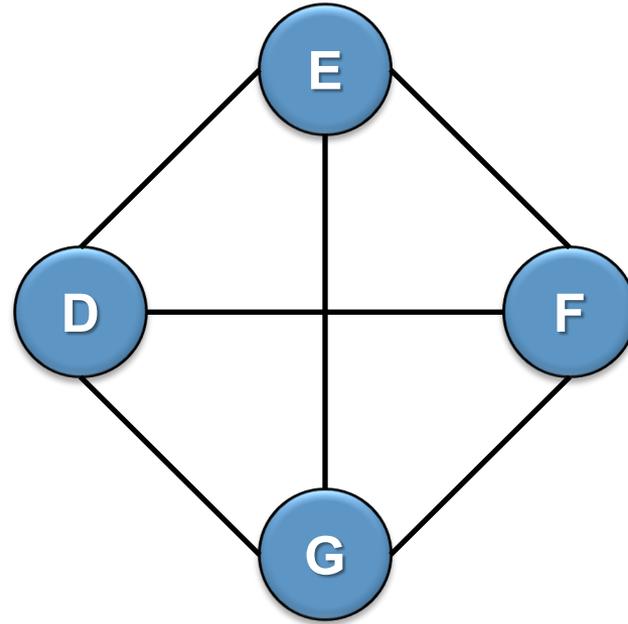


1 weakly connected component  
4 strongly connected components

# Cliques

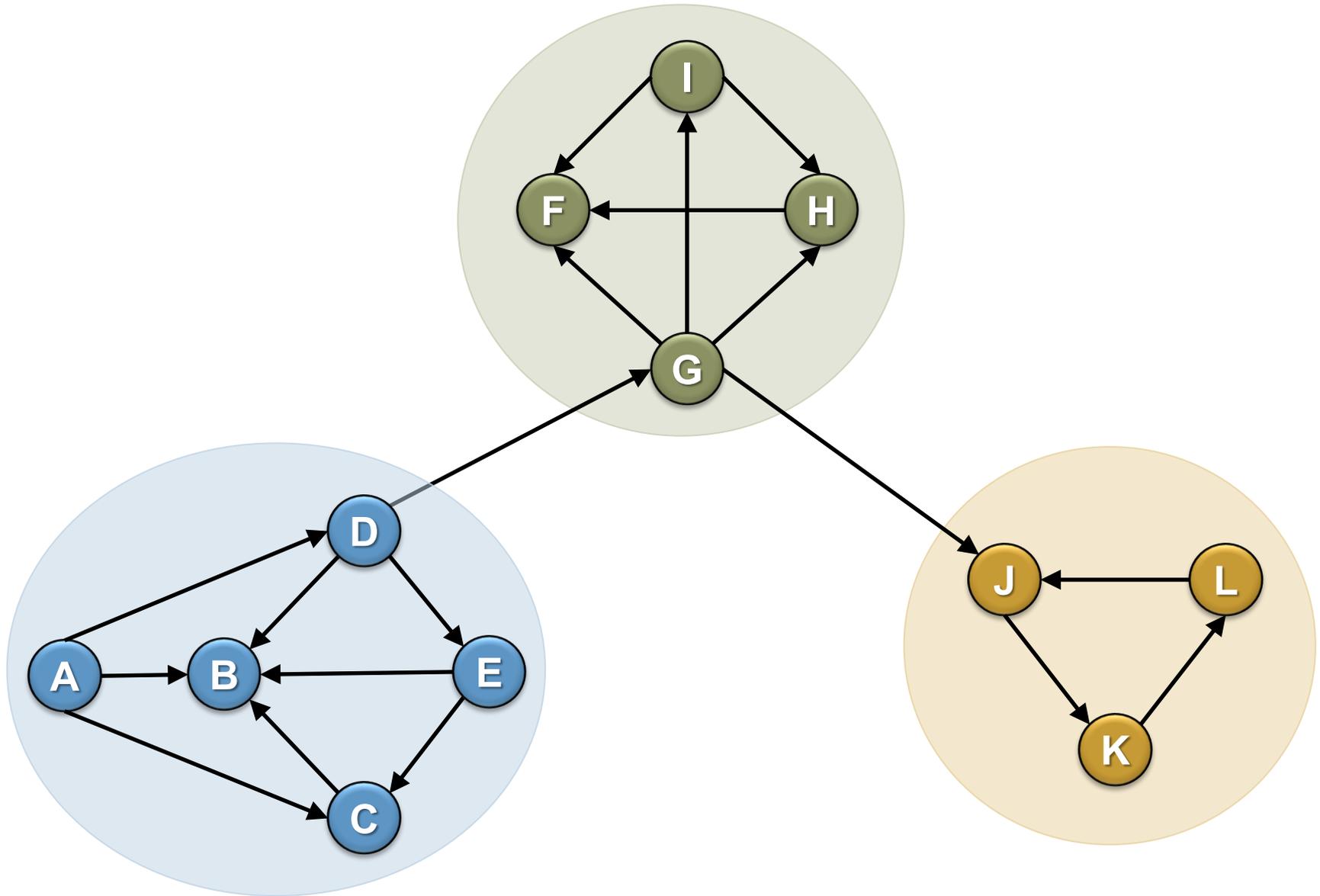


3-clique

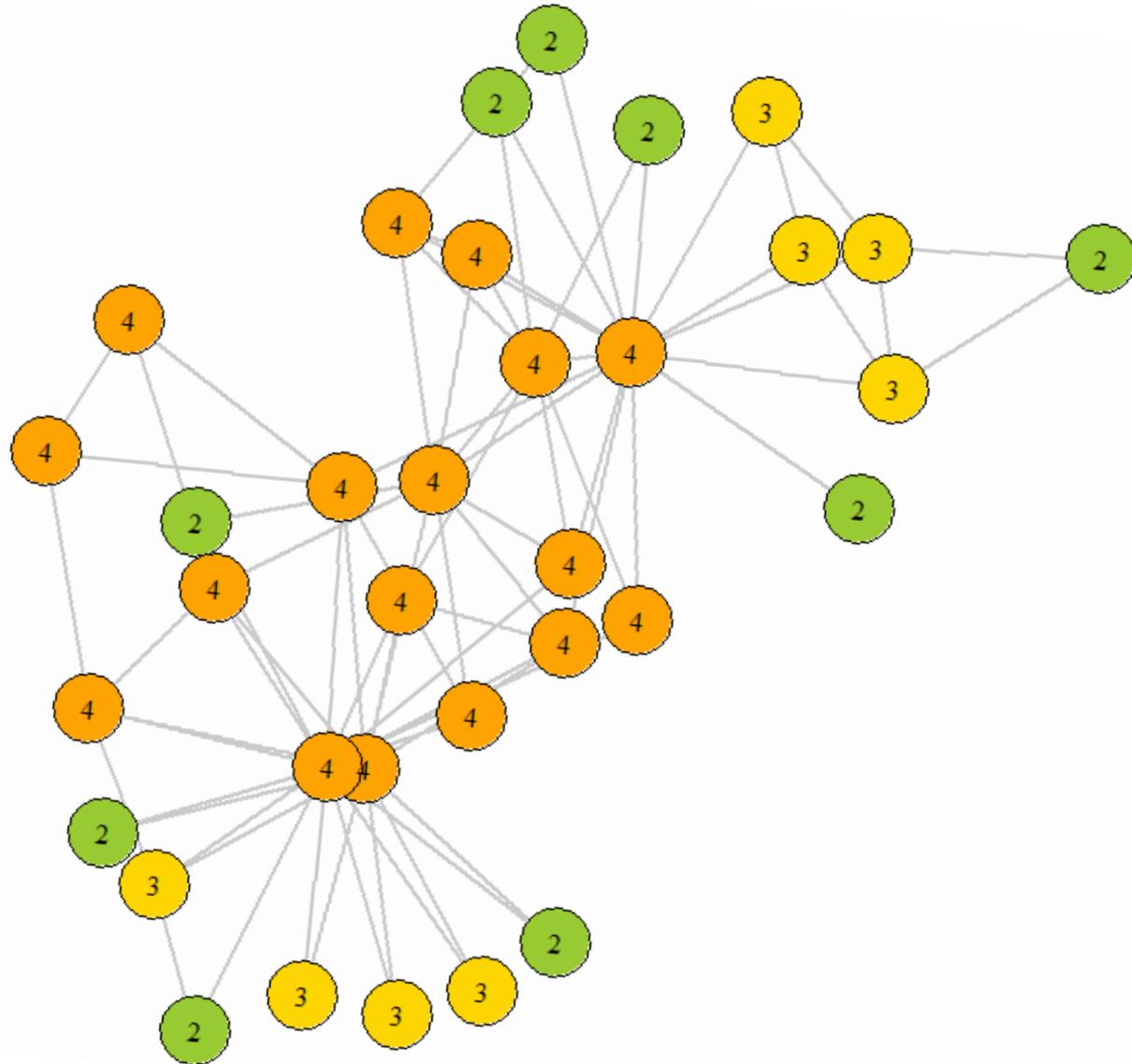


4-clique

# Community detection

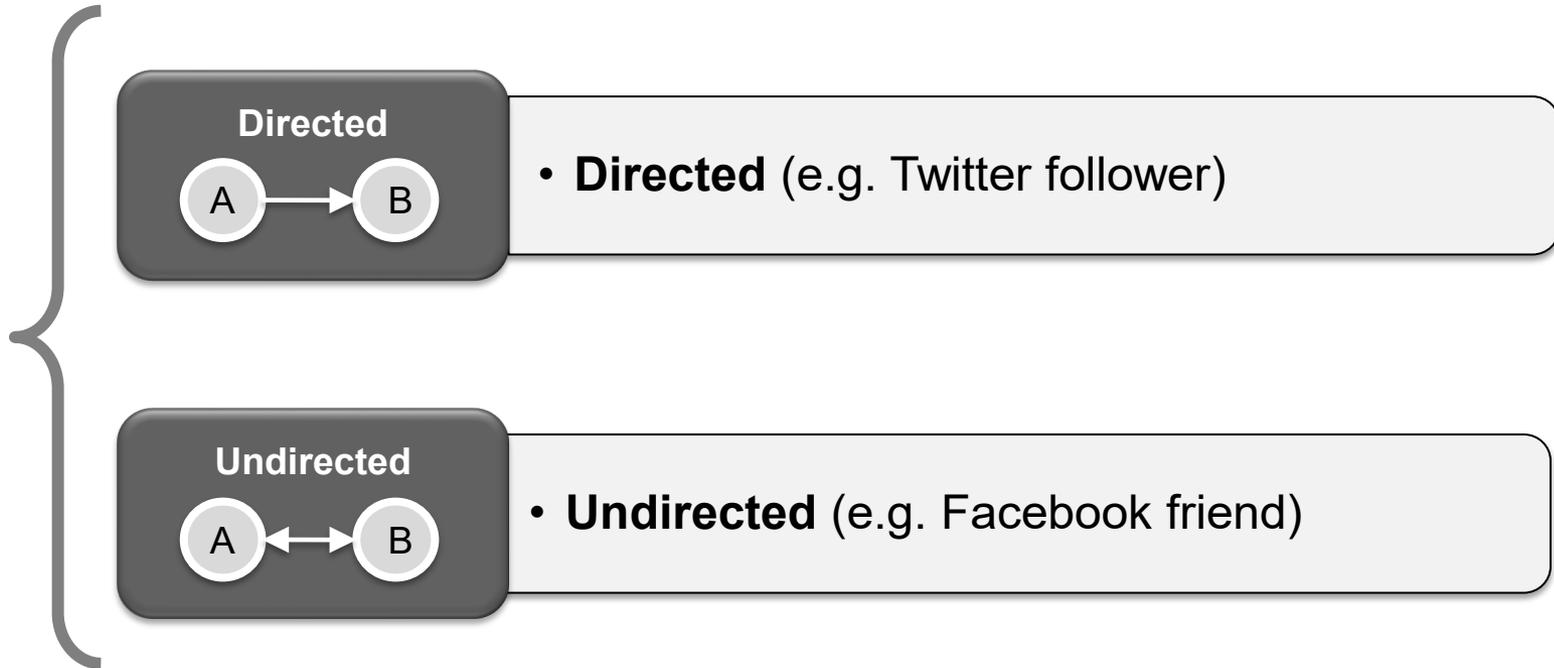


# K-core decomposition

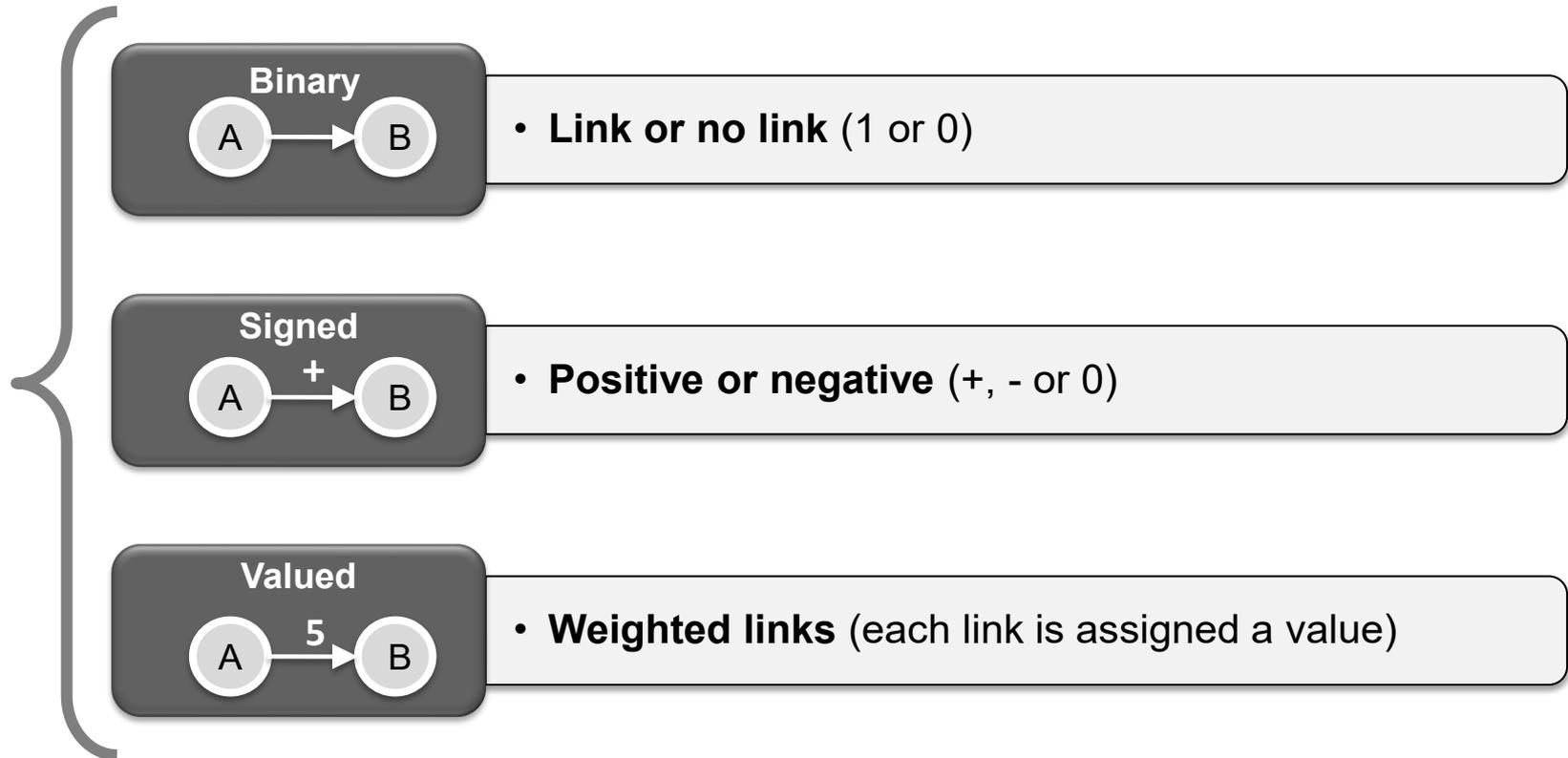


**Network ties**

# Representing **relationship types**



# Representing relationship types

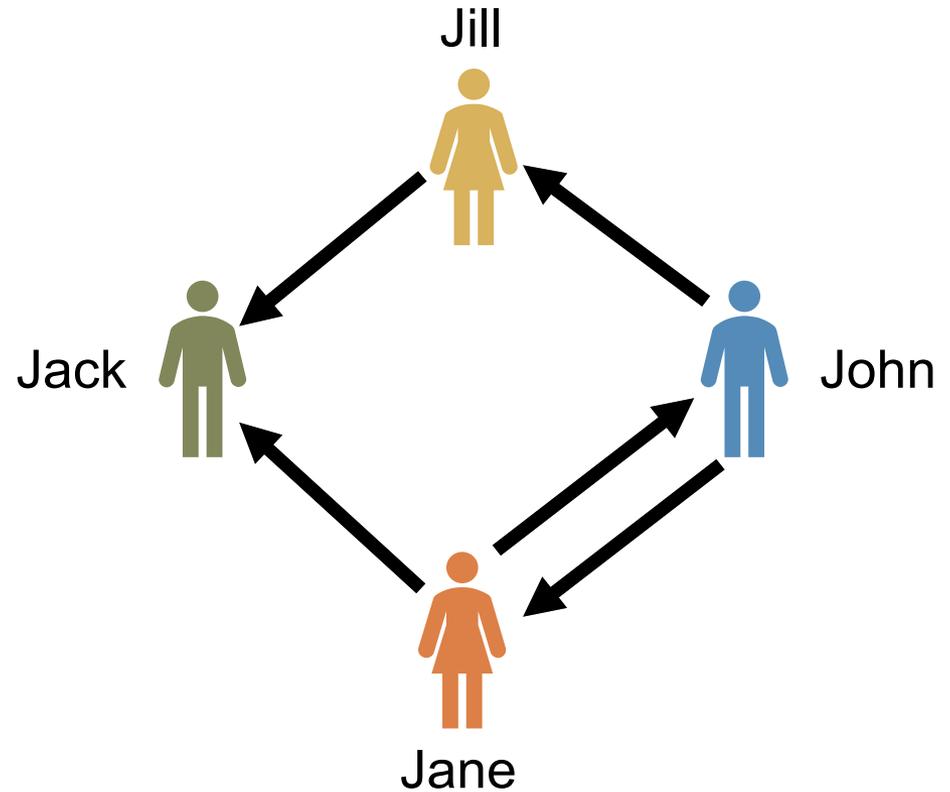




# Network **formats**

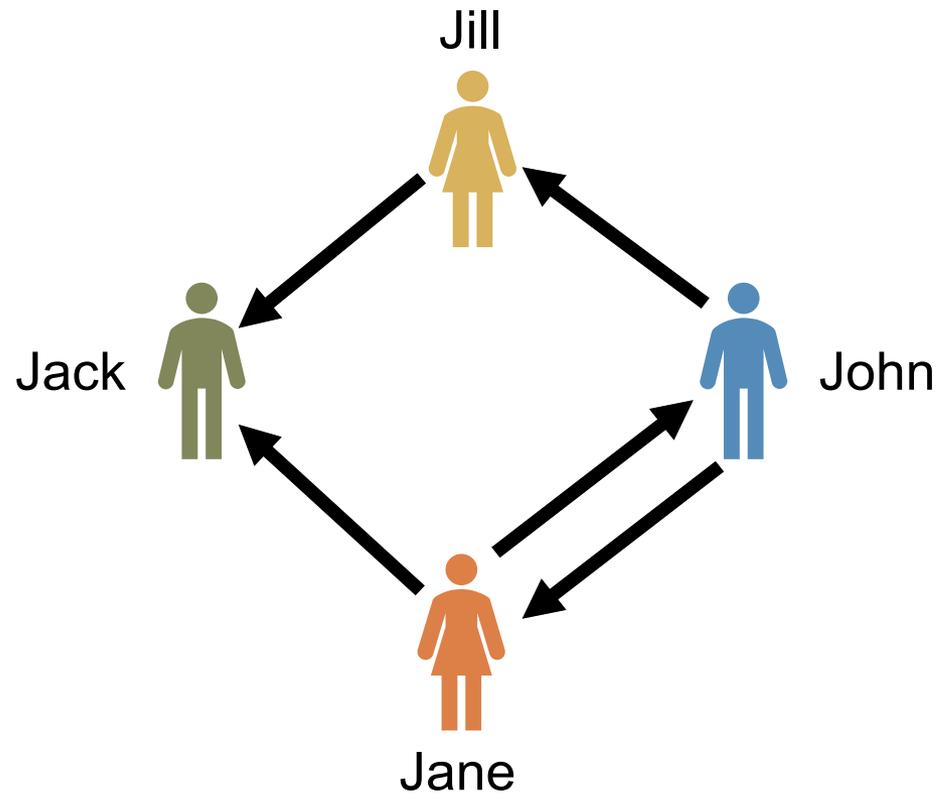
# Data formats: **matrix**

	Jack	Jane	Jill	John
Jack	0	0	0	0
Jane	1	0	0	1
Jill	1	0	0	0
John	0	1	1	0



# Data formats: **edgelist**

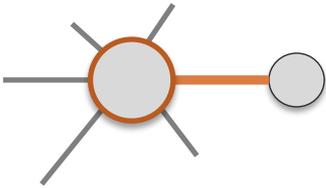
FROM	TO
John	Jill
Jane	Jack
Jill	Jack
Jane	John
John	Jane



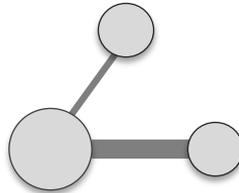
# Network visualization

# Network visualization goals

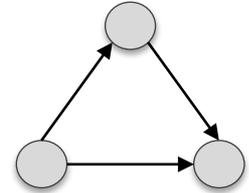
**Key actors and links**



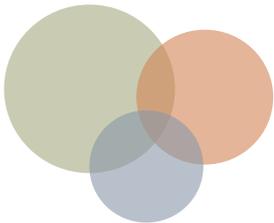
**Relationship strength**



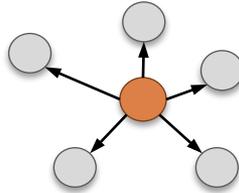
**Structural properties**



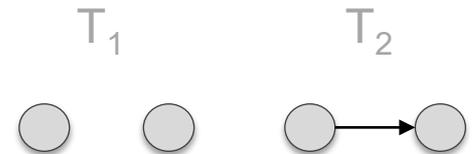
**Communities**



**Diffusion patterns**

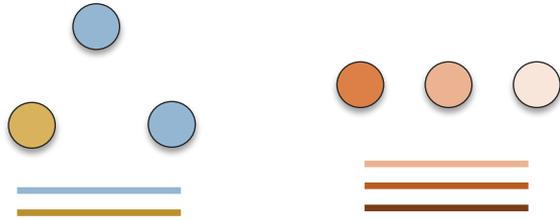


**Network evolution**



# Network visualization controls

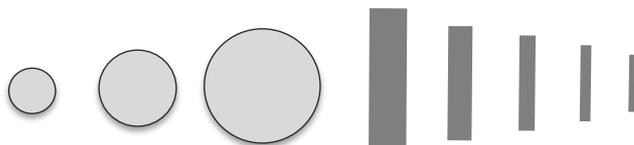
## Color



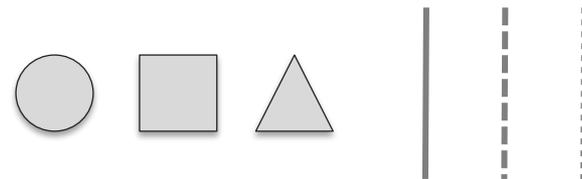
## Position



## Size



## Shape

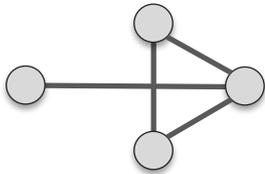


**Honorable mention:** arrows (direction) and labels (identification)

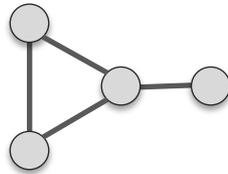
# Layout aesthetics

## Minimize edge crossing

No

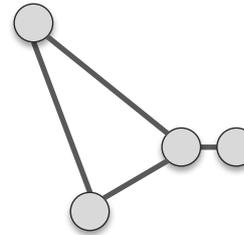


Yes

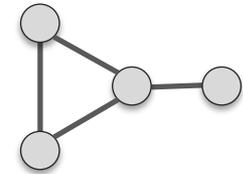


## Uniform edge length

No

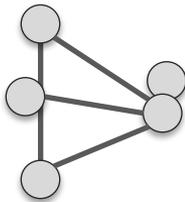


Yes

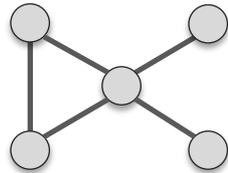


## Prevent overlap

No

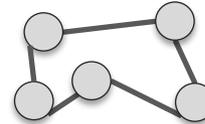


Yes

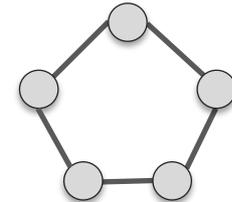


## Symmetry

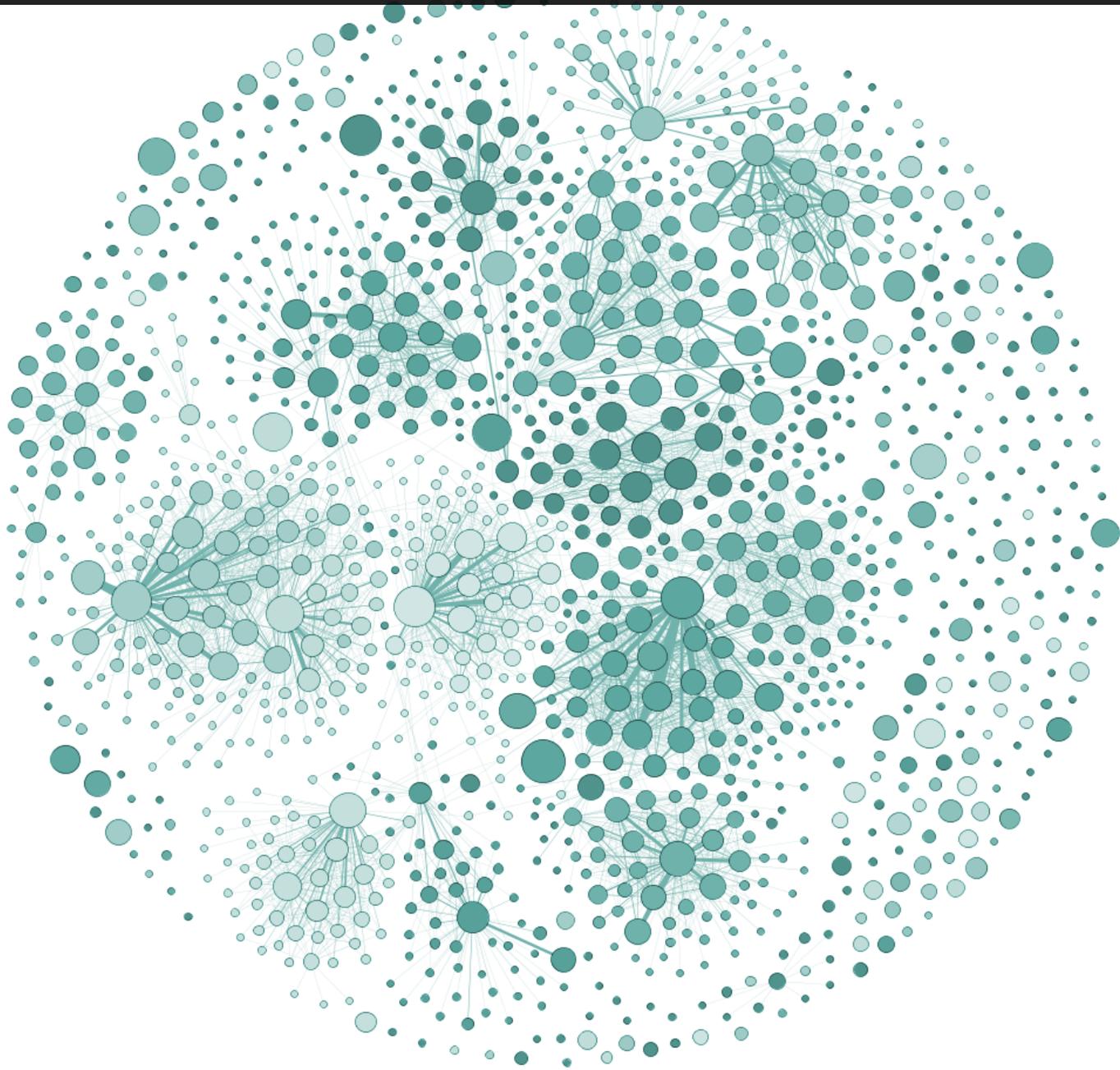
No



Yes



# Force-directed algorithms





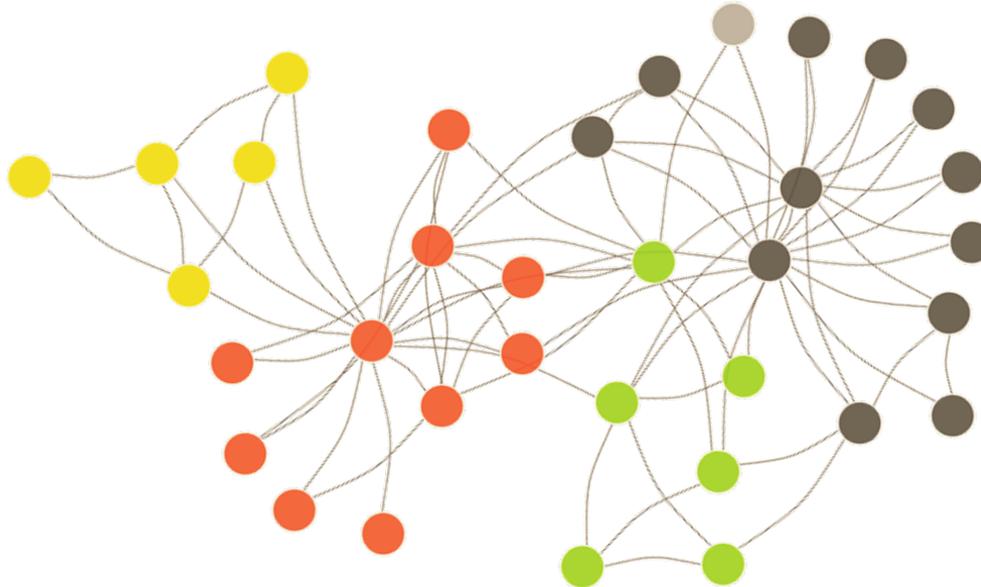
# Quick plotting example with igraph

```
install.packages("igraph")
library(igraph)

# Zachary's karate club network
net <- graph("Zachary")

community <- cluster_edge_betweenness(net)
colrs <- c("tomato", "yellowgreen", "gold", "gray50", "lightsteelblue")
colrs <- colrs[community$membership]

plot(net, edge.color="gray", edge.width=2, edge.curved=.1,
      vertex.color=colrs, vertex.frame.color="white", vertex.size=15,
      vertex.shape="circle", vertex.label=NA, layout=layout_with_kk)
```



# Interactive visualizations with **visNetwork**

```
library("visNetwork")

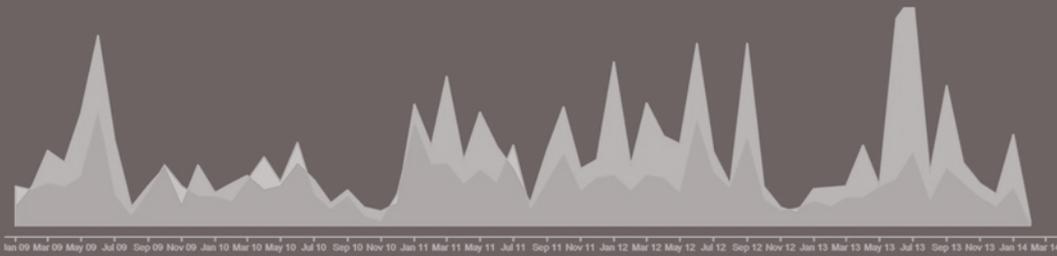
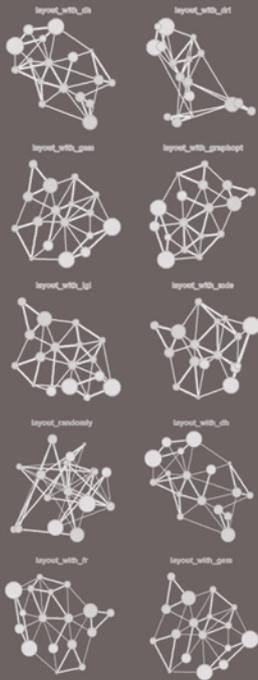
nodes <- data.frame(id = 1:34,
                    color.background = colrs,
                    color.border = "black",
                    color.highlight.background = "orange",
                    color.highlight.border = "black",
                    shape = "dot",
                    shadow = TRUE,
                    title = paste("Node", 1:34),
                    group = paste("Community", community$membership) )

links <- as_edgelist(net)
links <- data.frame(from = links[,1], to = links[,2],
                    color= "black",
                    smooth=TRUE)

visnet <- visNetwork(nodes, links)
visOptions(visnet, highlightNearest = TRUE, selectedBy = "group")
```

Interactive example with visNetwork: [bit.ly/zachary-net](https://bit.ly/zachary-net)





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**kateto.net/network-visualization**

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