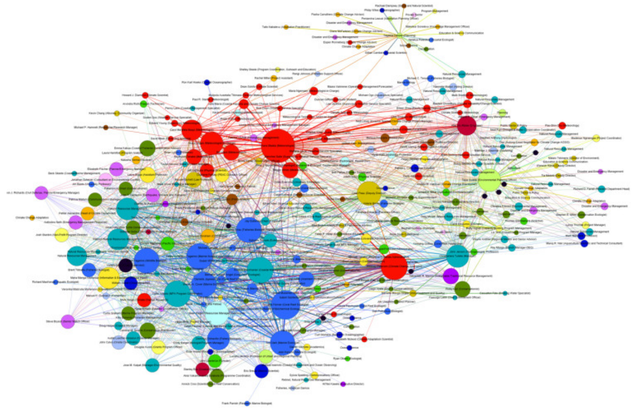
Sadasa Academy



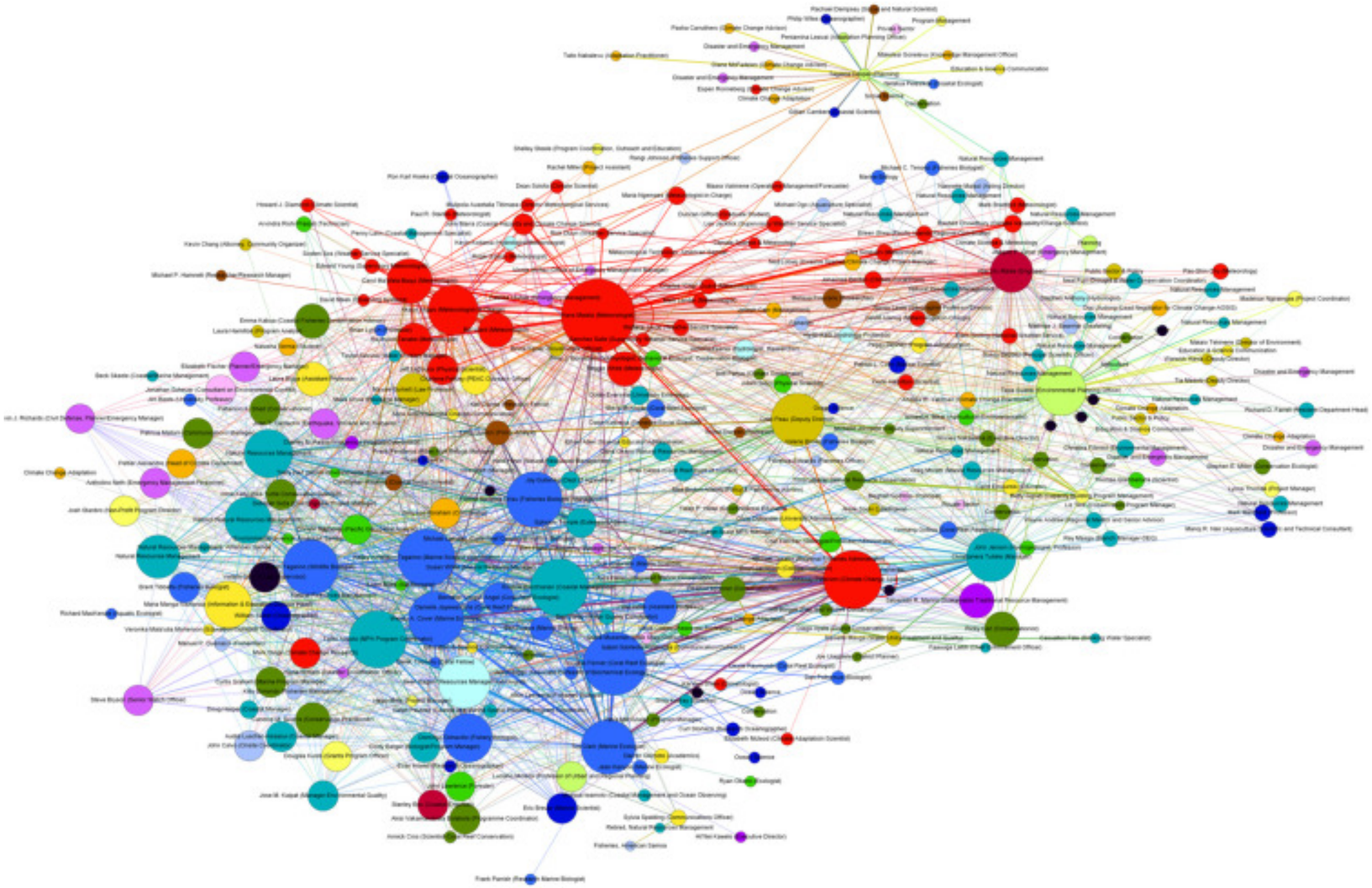
Graph Visualization and Analysis

Using R

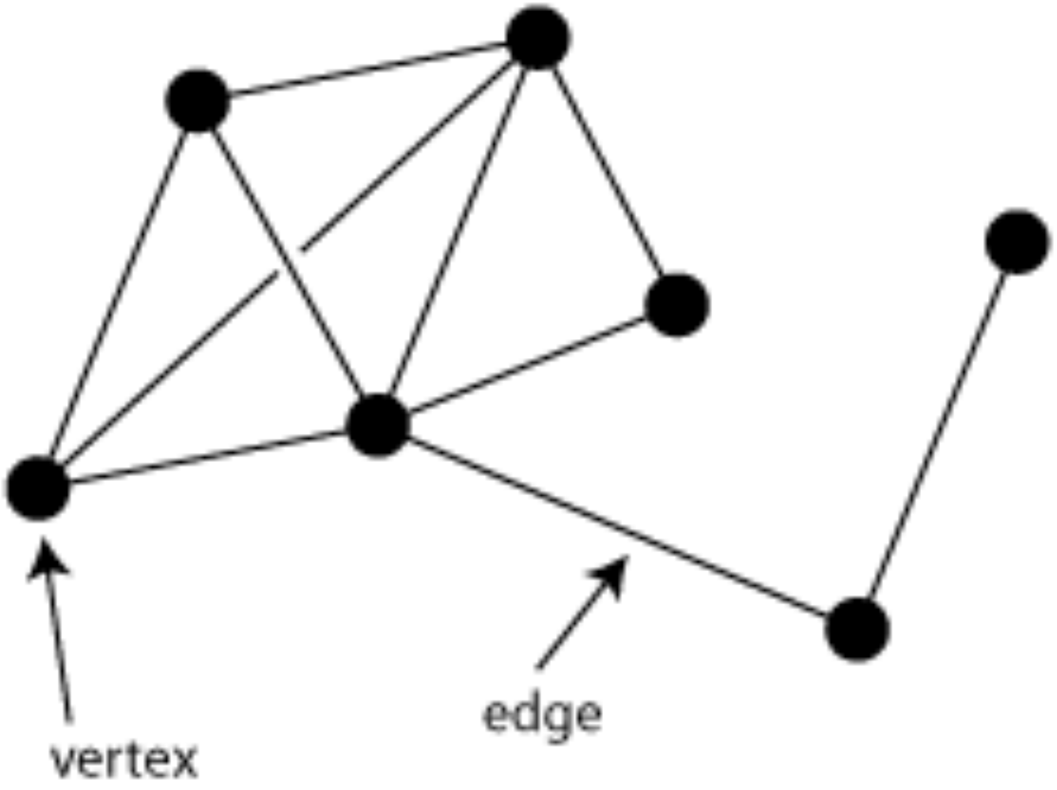
Canggih Puspo Wibowo

Data Science Mentor
Sadasa Academy

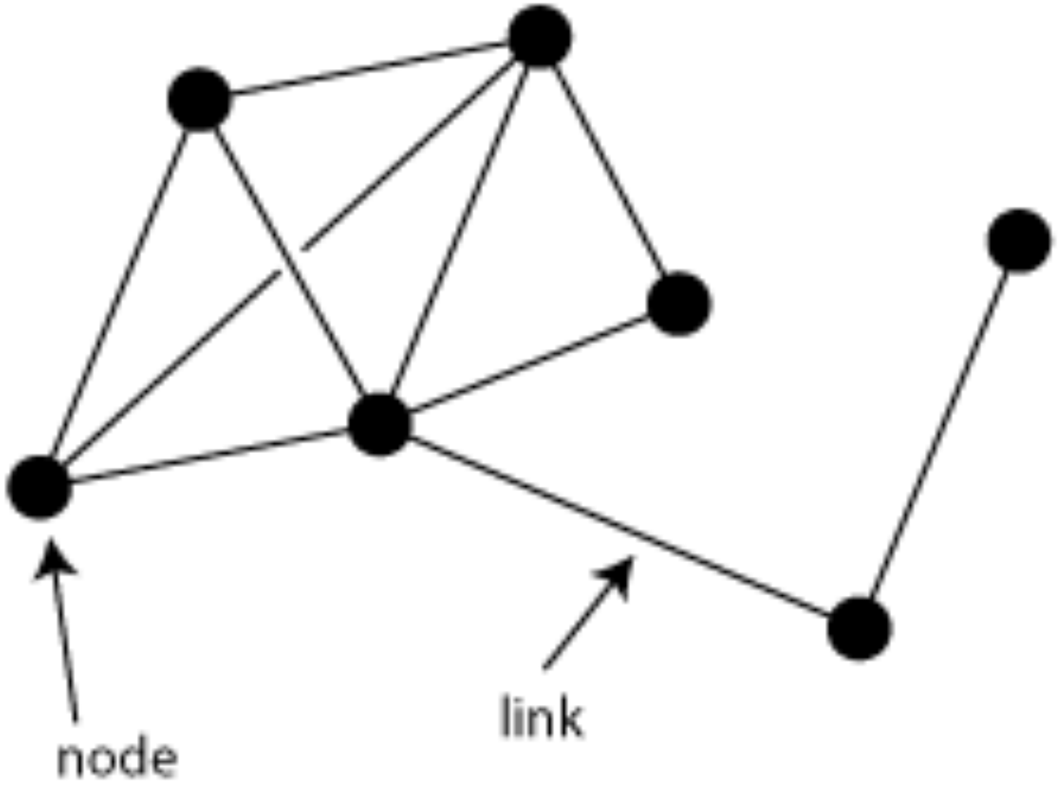
Social Graph/Network



Graph vs Network



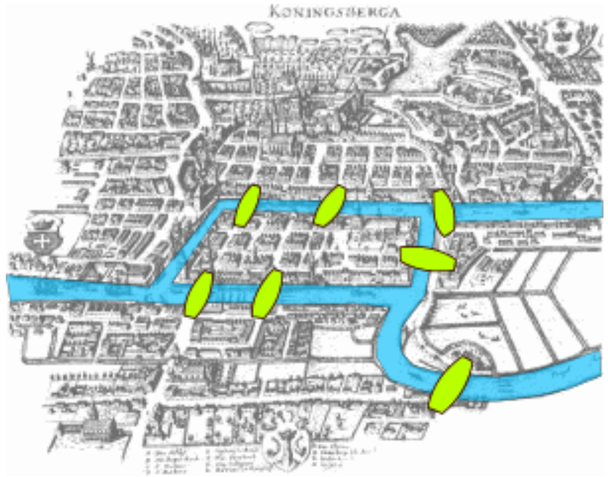
graph

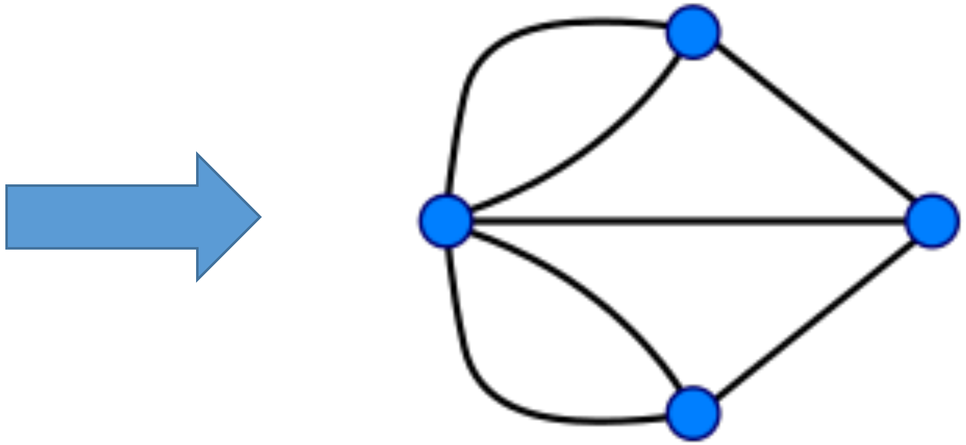


network

Graph Theory

7 Königsberg's bridges





Euler, Leonhard (1736). "Solutio problematis ad geometriam situs pertinentis". *Comment. Acad. Sci. U. Petrop* 8, 128–40.

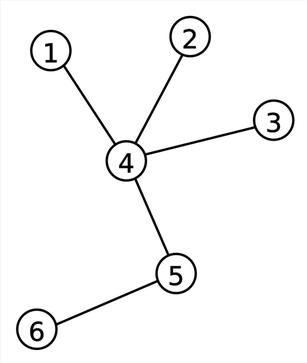
Graph Challenges

Graph Visualization

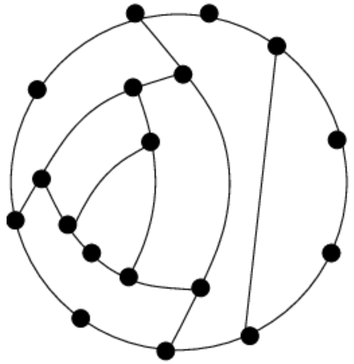
Graph Analysis

Graph Visualization

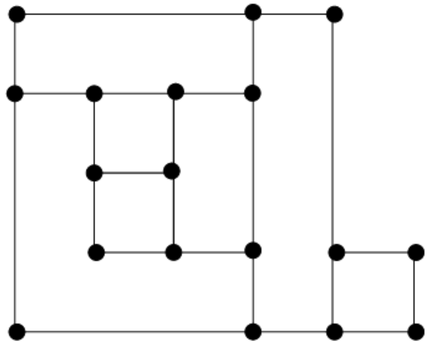
Graph Visualization



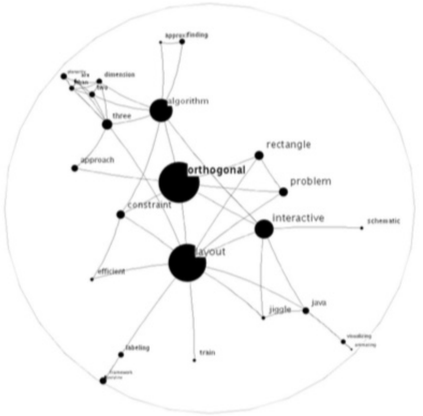
Tree



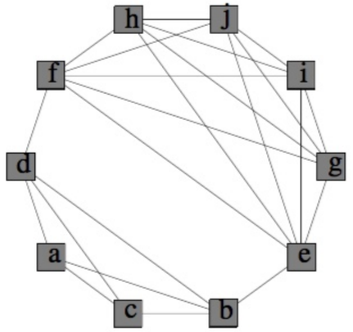
Planar



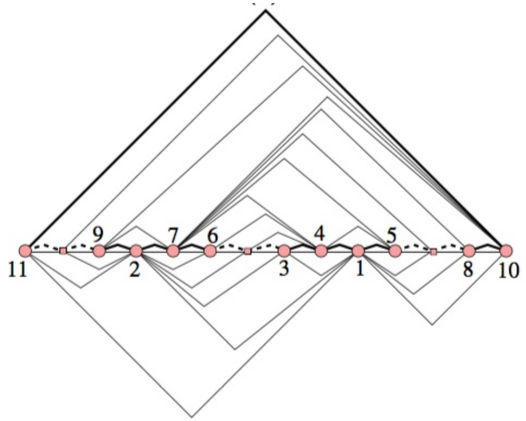
Planar-orthogonal



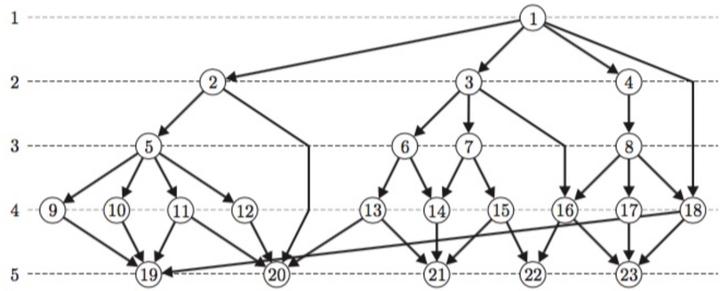
Force-directed



Circular



Spine



Hierarchical

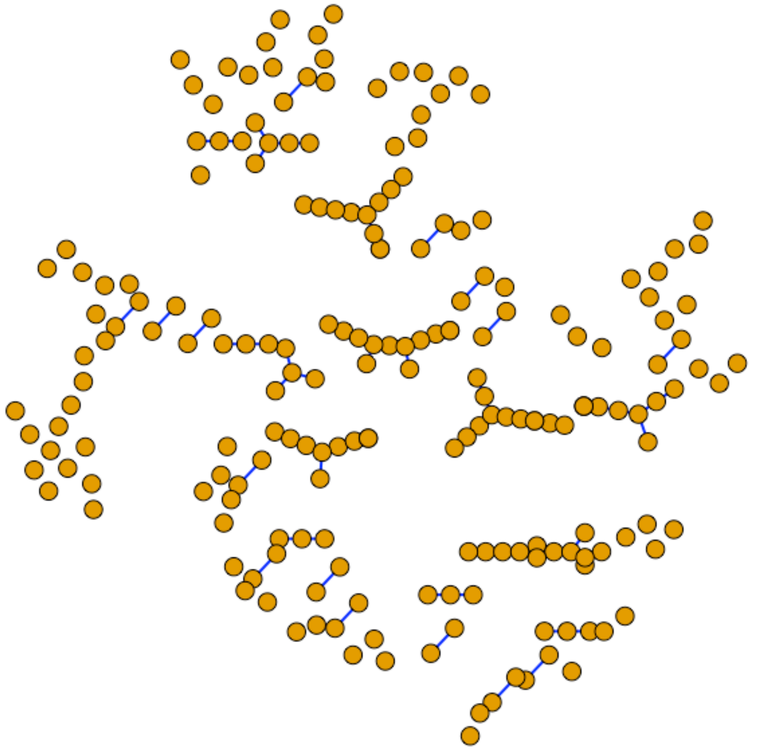
Graph Visualization (2)

1x layouting

continuous layouting

Static Visualization (1)

```
library(igraph)

set.seed(11)
g <- sample_gnp(200, 1/200)

co <- layout_with_mds(g)

plot(g, layout=co,vertex.size=5, edge.width=2,
edge.color="blue", vertex.label = NA)
```

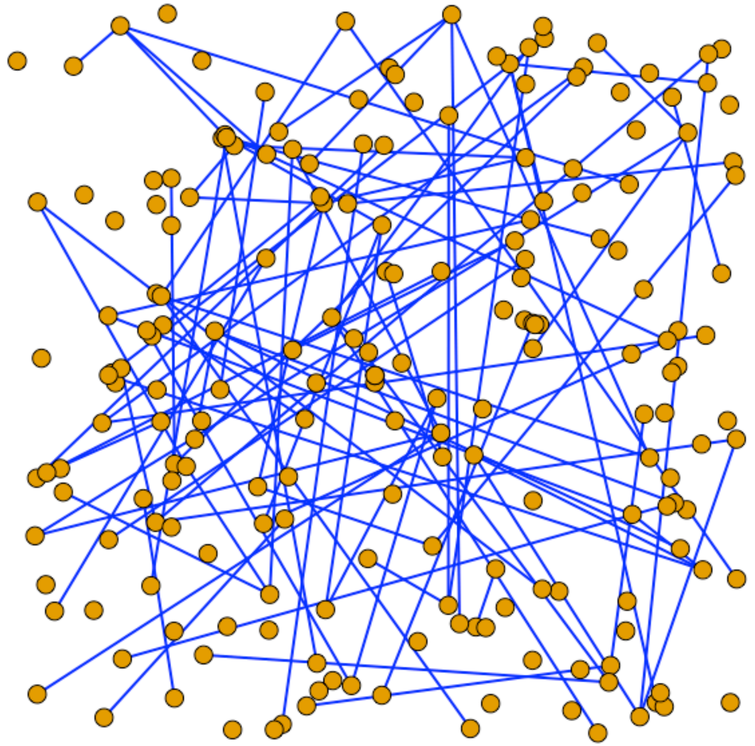


Multidimensional Scaling Layout Algorithm

Cox, T. F. and Cox, M. A. A. (2001) *Multidimensional Scaling*. Second edition. Chapman and Hall.

Static Visualization (2)

```
library(igraph)

set.seed(11)
g <- sample_gnp(200, 1/200)

co <- layout_with_lgl(g)

plot(g, layout=co,vertex.size=5, edge.width=2,
edge.color="blue", vertex.label = NA)
```

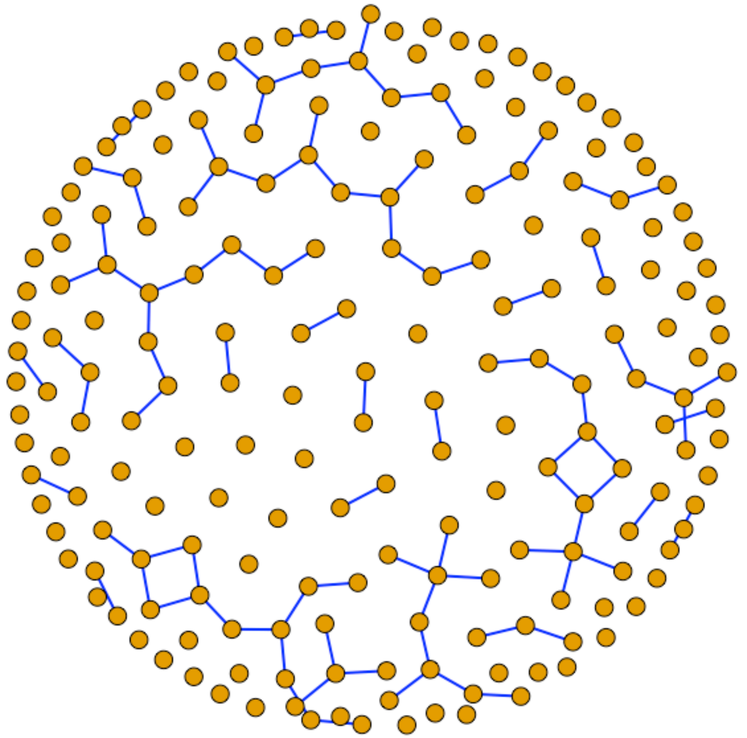


Large Graph Layout Algorithm

Adai AT, Date SV, Wieland S, Marcotte EM. LGL: creating a map of protein function with an algorithm for visualizing very large biological networks. J Mol Biol. 2004 Jun 25;340(1):179-90.

Static Visualization (3)

```
library(igraph)

set.seed(11)
g <- sample_gnp(200, 1/200)

co <- layout_with_kk(g)

plot(g, layout=co,vertex.size=5, edge.width=2,
edge.color="blue", vertex.label = NA)
```

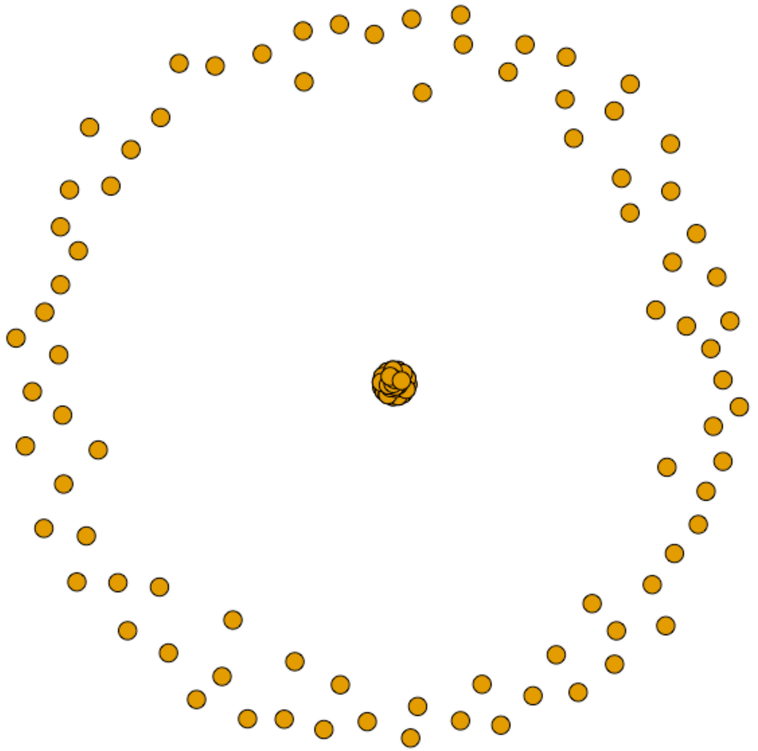


Kamada-Kawaii Layout Algorithm

Kamada, T. and Kawai, S.: An Algorithm for Drawing General Undirected Graphs. *Information Processing Letters*, 31/1, 7–15, 1989.

Static Visualization (4)

```
library(igraph)

set.seed(11)
g <- sample_gnp(200, 1/200)

co <- layout_with_gem(g)

plot(g, layout=co,vertex.size=5, edge.width=2,
edge.color="blue", vertex.label = NA)
```

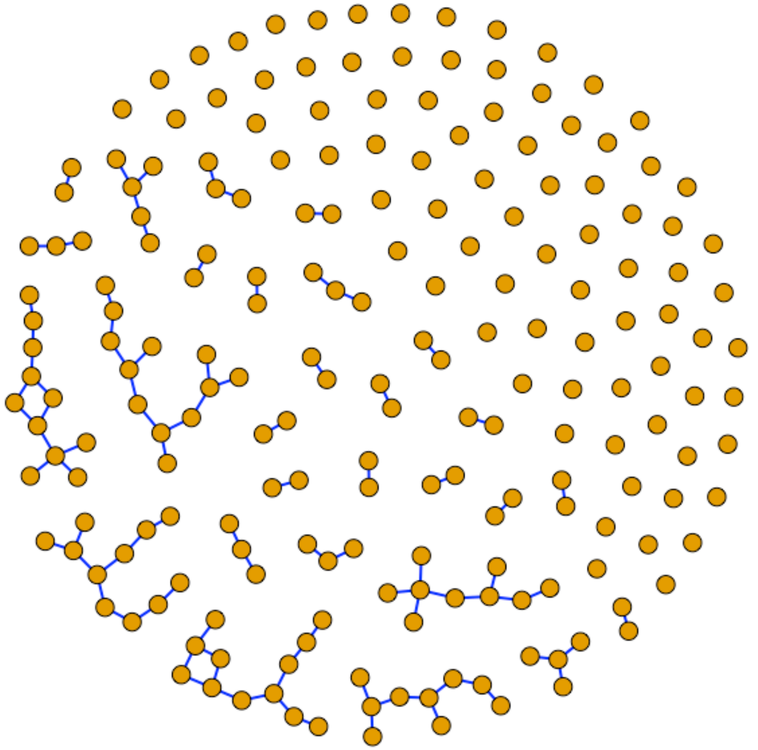


Graph Embedder Layout Algorithm

Arne Frick, Andreas Ludwig, Heiko Mehldau: A Fast Adaptive Layout Algorithm for Undirected Graphs, *Proc. Graph Drawing 1994*, LNCS 894, pp. 388-403, 1995.

Static Visualization (5)

```
library(igraph)

set.seed(11)
g <- sample_gnp(200, 1/200)

co <- layout_with_fr(g)

plot(g, layout=co,vertex.size=5, edge.width=2,
edge.color="blue", vertex.label = NA)
```

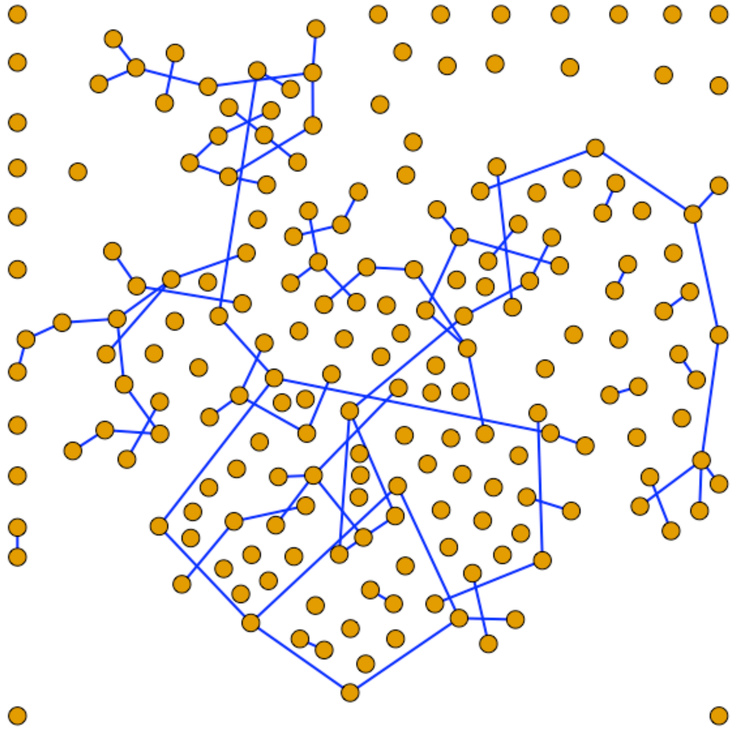


Fruchterman-Reingold Layout Algorithm

Fruchterman, T.M.J. and Reingold, E.M. (1991). Graph Drawing by Force-directed Placement. *Software - Practice and Experience*, 21(11): 1129-1164.

Static Visualization (6)

```
library(igraph)

set.seed(11)
g <- sample_gnp(200, 1/200)

co <- layout_with_dh(g)

plot(g, layout=co,vertex.size=5, edge.width=2,
edge.color="blue", vertex.label = NA)
```

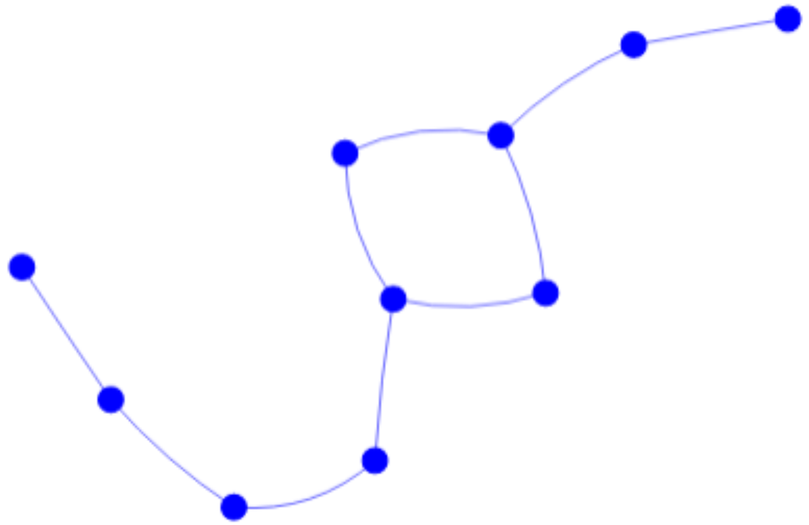


Davidson-Harel Layout Algorithm

Ron Davidson, David Harel: Drawing Graphs Nicely Using Simulated Annealing. *ACM Transactions on Graphics* 15(4), pp. 301-331, 1996.

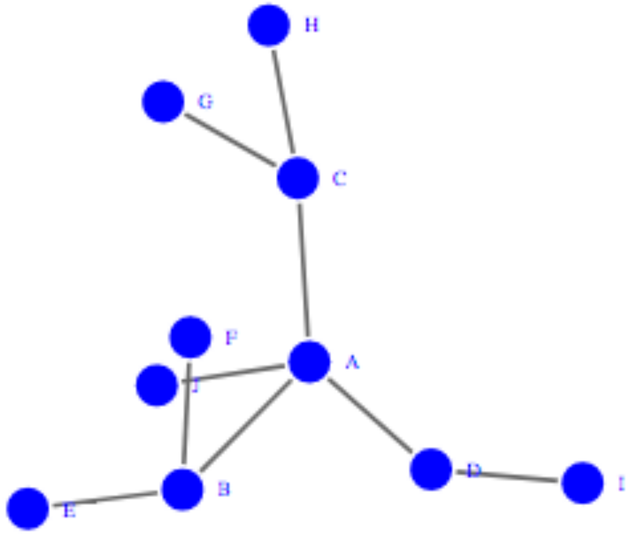
Animated Visualization (1)

```
library(visNetwork)

nodes <- data.frame(id = 1:10,
                    shape = c("dot"),
                    size = 10,
                    color = c("blue"))
edges <- data.frame(from = 1:10, to = c(5, 4, 6, 3, 3,2,2,1,8,7))

visNetwork(nodes, edges) %>%
  visOptions()
```



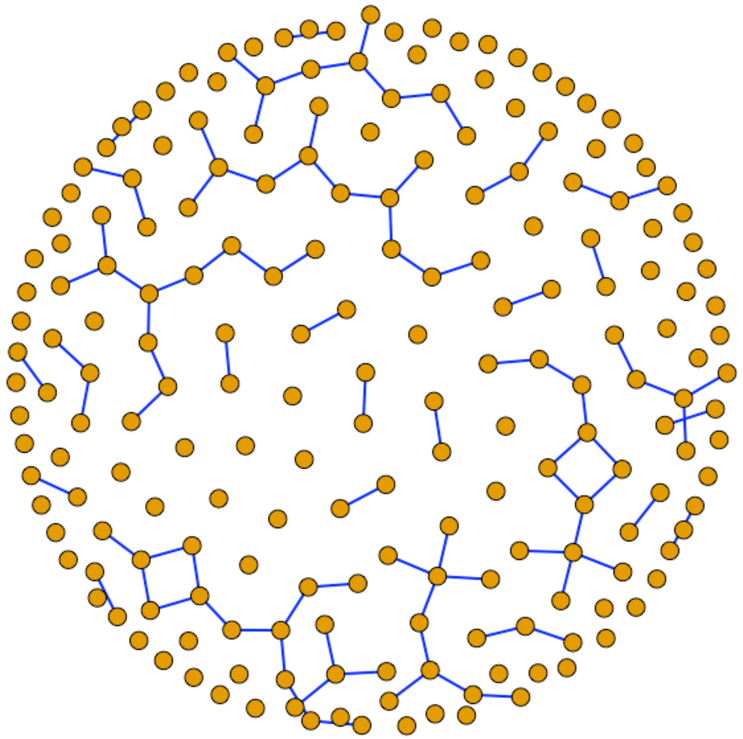
Animated Visualization (2)

```
library(networkD3)

src <- c("A", "A", "A", "A",
         "B", "B", "C", "C", "D")
target <- c("B", "C", "D", "J",
            "E", "F", "G", "H", “I")

networkData <- data.frame(src, target)
simpleNetwork(networkData, nodeColour = "blue", opacity = 1)
```



Graph Analysis

Important Vertices



How to identify
important vertices?

Four Classics Graph Centralities

Degree

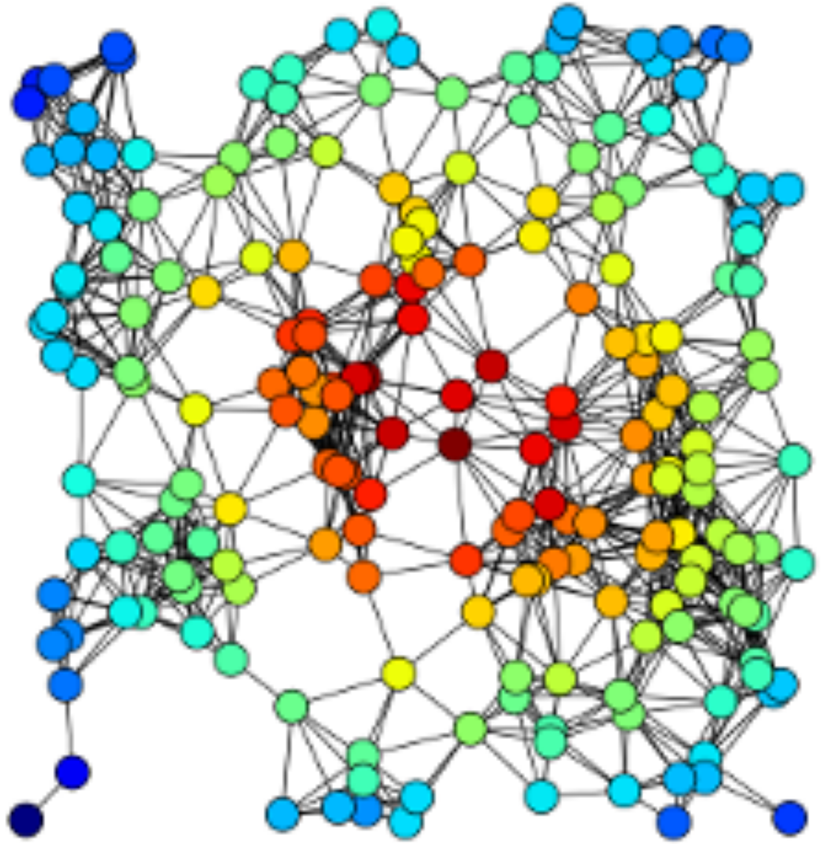
Betweenness

Eigenvector

Closeness

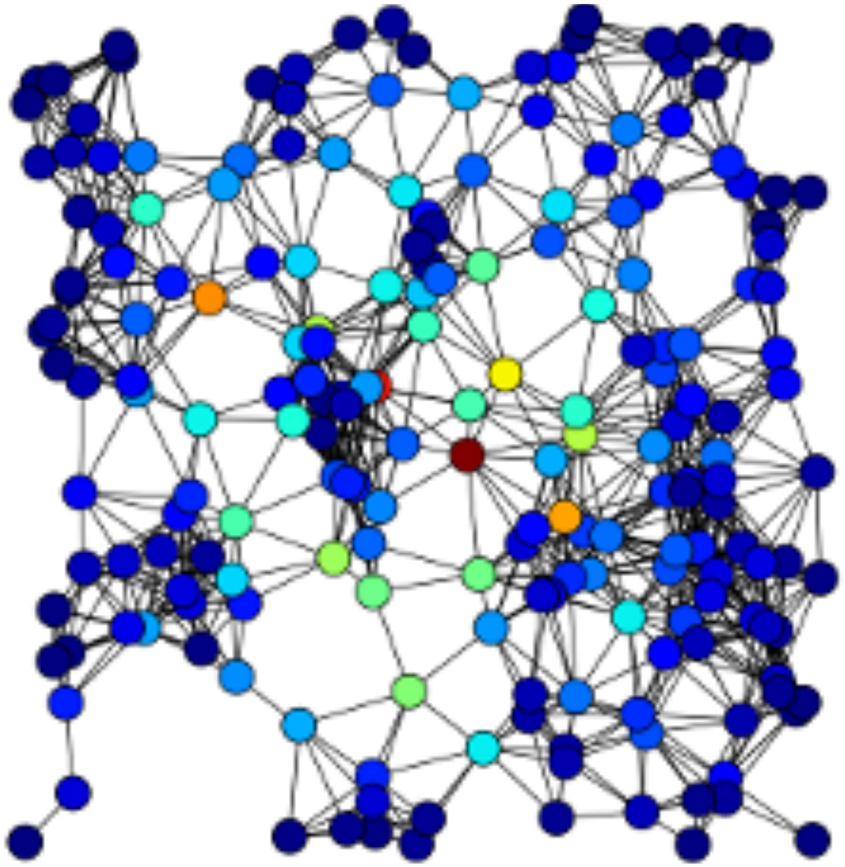
Closeness Centrality

“The Hubs”



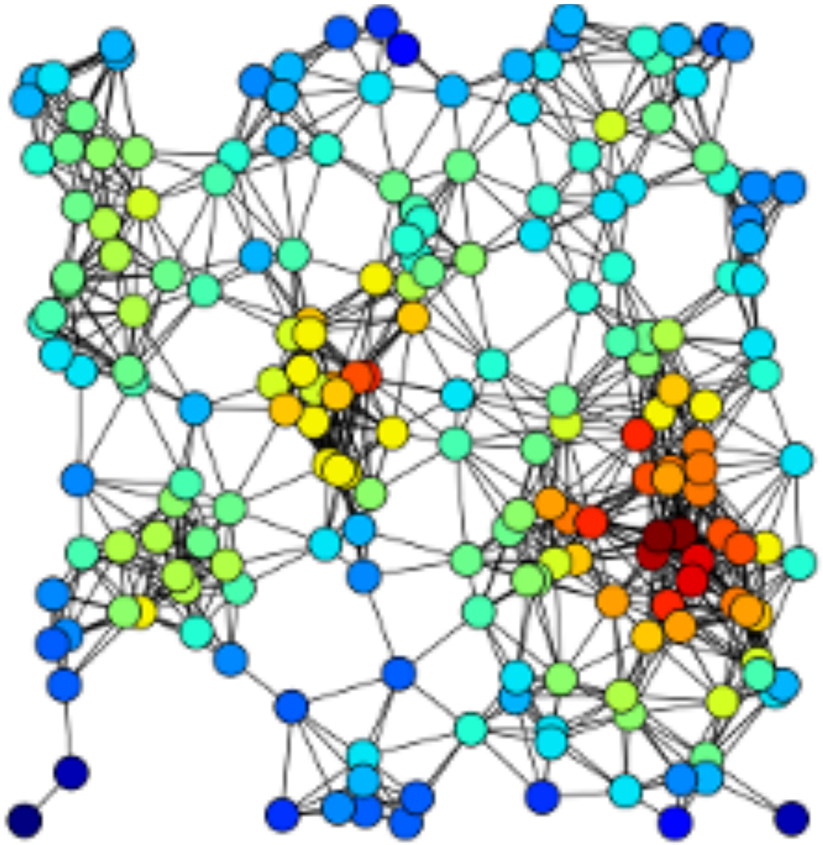
Betweenness Centrality

“The Bridges”



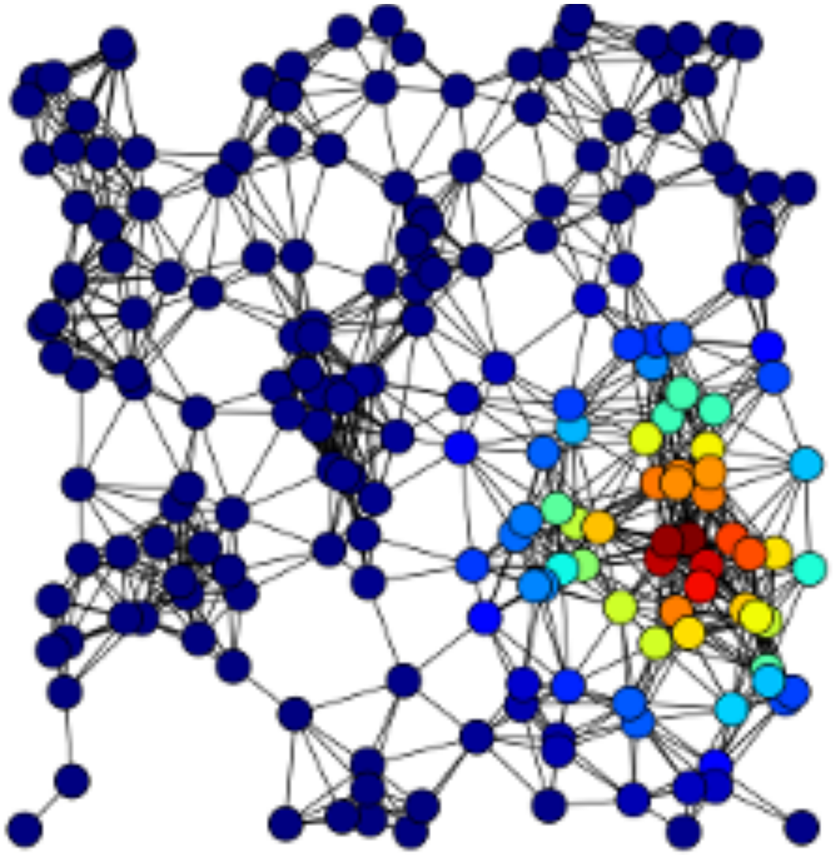
Degree Centrality

“The Celebrities”



Eigenvector Centrality

“The Gray Cardinals”



Kamada-Kawai with Betweenness

```
library(igraph)

set.seed(11)
g <- sample_gnp(200, 1/200)

co <- layout_with_kk(g)

plot(g, layout=co,vertex.size=betweenness(g)/3, edge.width=2,
     edge.color="blue", vertex.label = NA)
```