Graph Layouts

Load libraries

```r
library(dplyr)
library(igraph)
library(ggplot2)
library(tidygraph)
library(networkD3)
library(visNetwork)
library(knitr) # For table rendering
```

Graph object

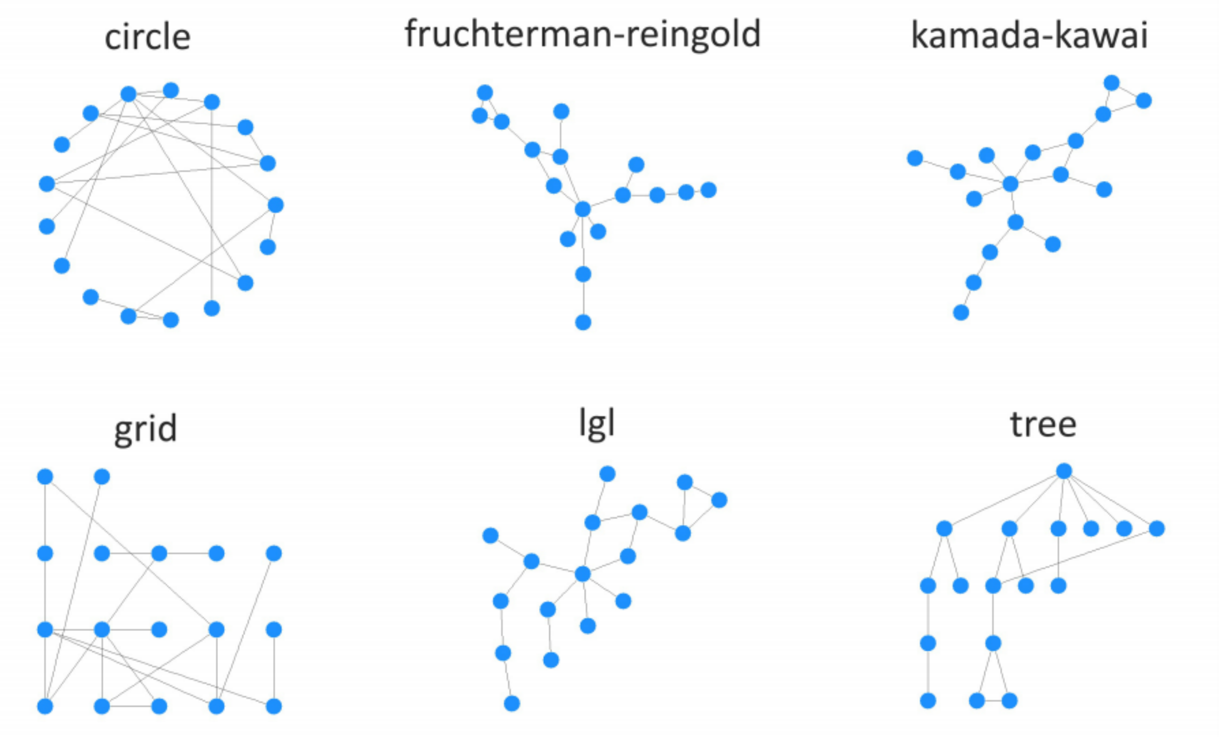
```r
df = read.table("./data/data.tsv", header = T)
veccol = c(rep("pink",5), rep("light blue",6))
g = graph_from_data_frame(df)
```

Network layouts

In very short terms, a layout is the vertical and horizontal placement of nodes when plotting a particular graph structure. Conversely, a layout algorithm is an algorithm that takes in a graph structure (and potentially some additional parameters) and return the vertical and horizontal position of the nodes [1].

Choosing the Appropriate Layout

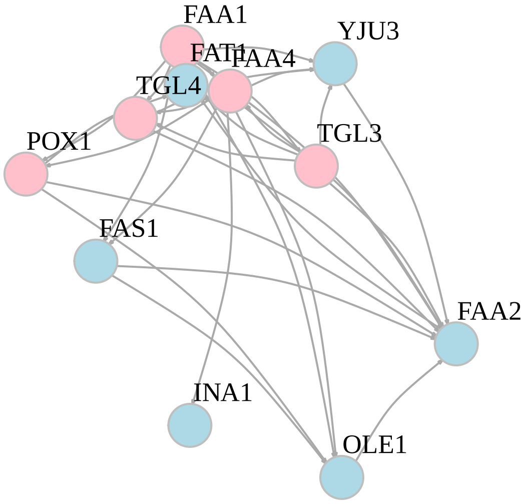
- Minimize edge crossing
- Do not allow vertices to overlap
- Make edge lengths as uniform as possible
- Increase symmetry of the network as much as possible
- Position more influential nodes towards the center



Randomly place vertices on a plane or in 3d space

This function uniformly randomly places the vertices of the graph in two or three dimensions.

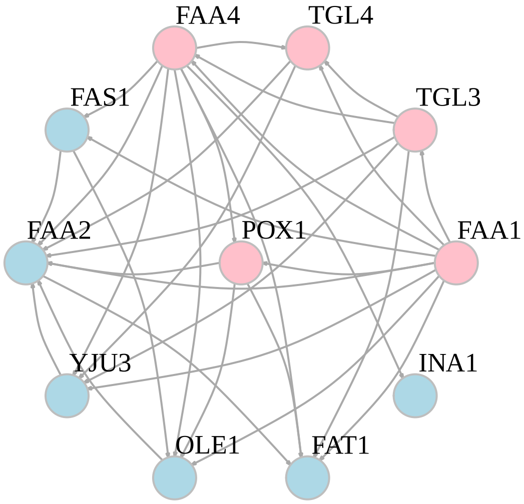
```
plot(g,
     layout=layout_randomly,
     edge.arrow.size=0.1,
     vertex.color=veccol,
     vertex.size=20,
     vertex.frame.color="gray",
     vertex.label.color="black",
     vertex.label.cex=0.8,
     vertex.label.dist=3,
     edge.curved=0.2)
```



Vertices of a graph in a star-shape

A simple layout generator, that places one vertex in the center of a circle and the rest of the vertices equidistantly on the perimeter.

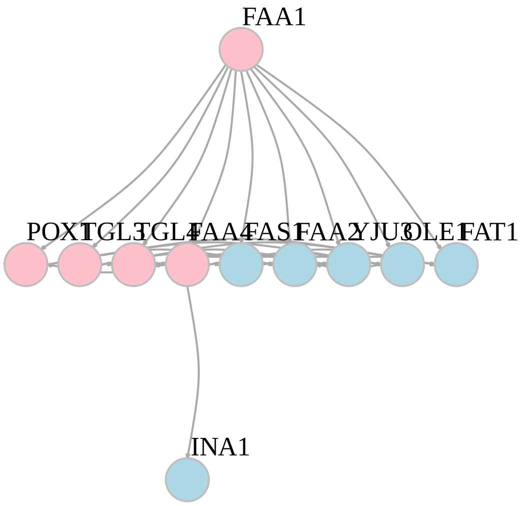
```
plot(g,
     layout=layout_as_star,
     edge.arrow.size=0.1,
     vertex.color=veccol,
     vertex.size=20,
     vertex.frame.color="gray",
     vertex.label.color="black",
     vertex.label.cex=0.8,
     vertex.label.dist=3,
     edge.curved=0.2)
```



Tree Layout (The Reingold-Tilford graph layout algorithm)

A tree-like layout, it is perfect for trees, acceptable for graphs with not too many cycles. Arranges the nodes in a tree where the given node is used as the root. The tree is directed downwards and the parents are centered above its children.

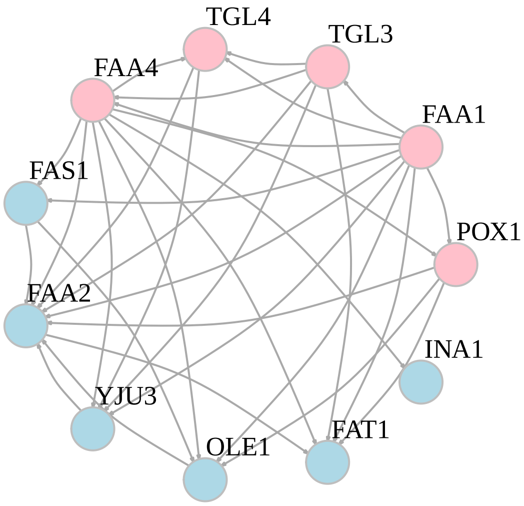
```
plot(g,
     layout=layout_as_tree,
     edge.arrow.size=0.1,
     vertex.color=veccol,
     vertex.size=20,
     vertex.frame.color="gray",
     vertex.label.color="black",
     vertex.label.cex=0.8,
     vertex.label.dist=3,
     edge.curved=0.2)
```



Graph layout with vertices on a circle.

Place vertices on a circle, in the order of their vertex ids.

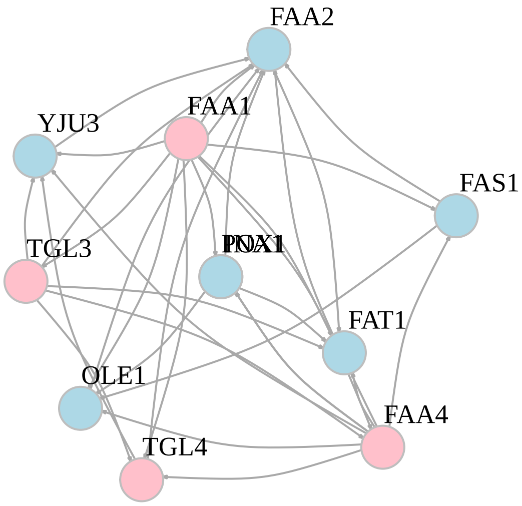
```
plot(g,
     layout=layout_in_circle,
     edge.arrow.size=0.1,
     vertex.color=veccol,
     vertex.size=20,
     vertex.frame.color="gray",
     vertex.label.color="black",
     vertex.label.cex=0.8,
     vertex.label.dist=3,
     edge.curved=0.2)
```



Graph layout with vertices on the surface of a sphere

Place vertices on a sphere, approximately uniformly, in the order of their vertex ids. This is thus a 3d layout

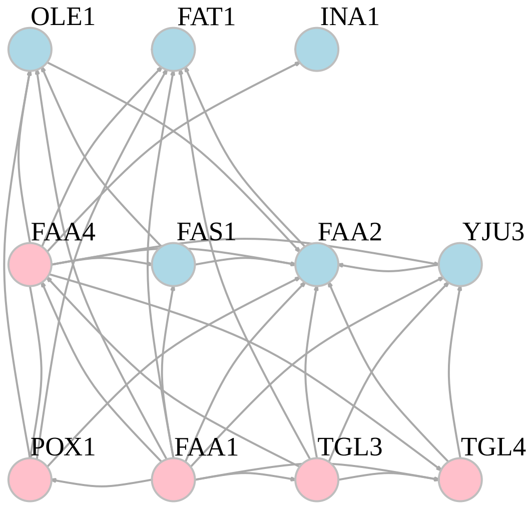
```
plot(g,
     layout=layout_on_sphere,
     edge.arrow.size=0.1,
     vertex.color=veccol,
     vertex.size=20,
     vertex.frame.color="gray",
     vertex.label.color="black",
     vertex.label.cex=0.8,
     vertex.label.dist=3,
     edge.curved=0.2)
```



Simple grid layout

This layout places vertices on a rectangulat grid, in two or three dimensions.

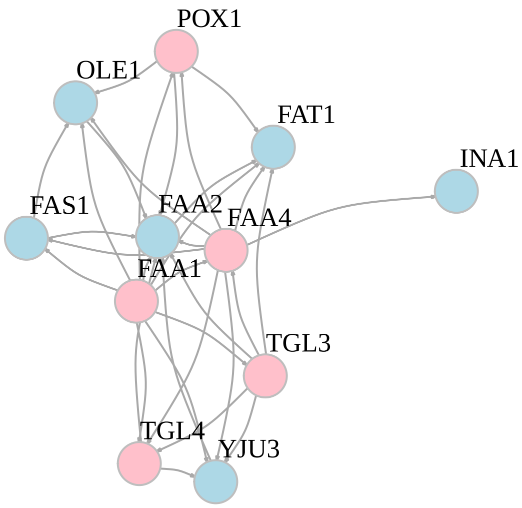
```
plot(g,
     layout=layout_on_grid,
     edge.arrow.size=0.1,
     vertex.color=veccol,
     vertex.size=20,
     vertex.frame.color="gray",
     vertex.label.color="black",
     vertex.label.cex=0.8,
     vertex.label.dist=3,
     edge.curved=0.2)
```



Force-directed layouts (The Fruchterman-Reingold layout algorithm)

Place vertices on the plane using the force-directed layout algorithm by Fruchterman and Reingold.

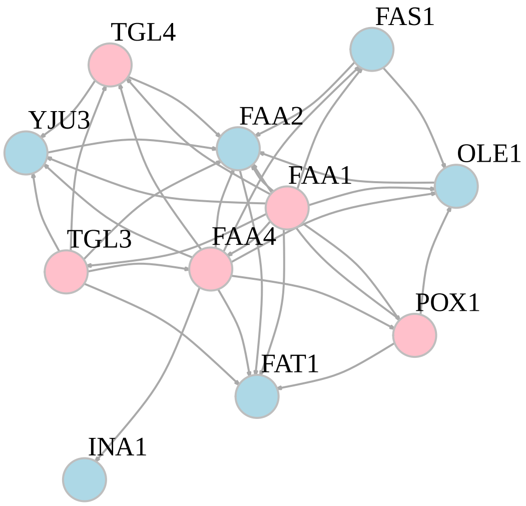
```
plot(g,
     layout=layout_with_fr,
     edge.arrow.size=0.1,
     vertex.color=veccol,
     vertex.size=20,
     vertex.frame.color="gray",
     vertex.label.color="black",
     vertex.label.cex=0.8,
     vertex.label.dist=3,
     edge.curved=0.2)
```



The Kamada-Kawai layout algorithm

Another popular force-directed algorithm that produces nice results for connected graphs is Kamada Kawai

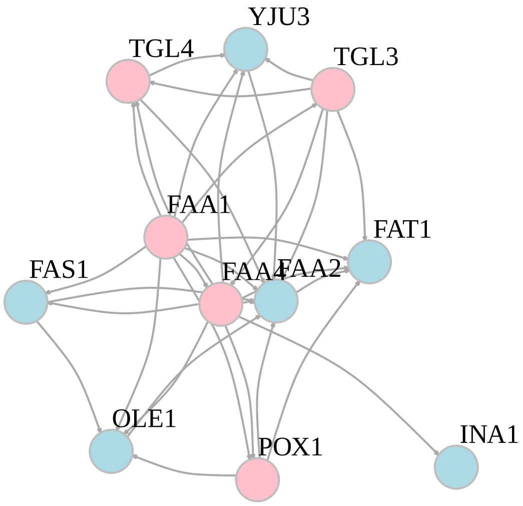
```
plot(g,
     layout=layout_with_kk,
     edge.arrow.size=0.1,
     vertex.color=veccol,
     vertex.size=20,
     vertex.frame.color="gray",
     vertex.label.color="black",
     vertex.label.cex=0.8,
     vertex.label.dist=3,
     edge.curved=0.2)
```



Large Graph Layout

A layout generator for larger graphs.

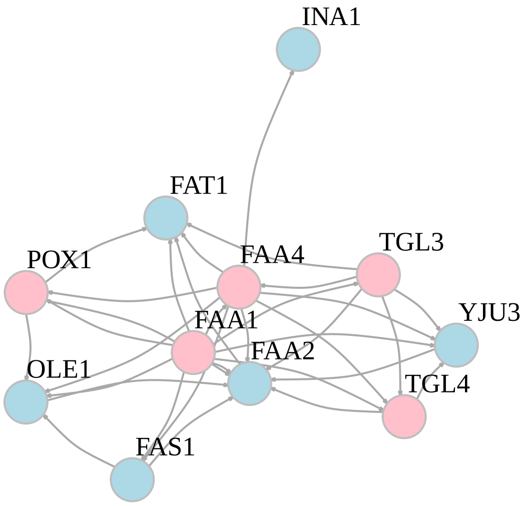
```
plot(g,
     layout=layout_with_lgl,
     edge.arrow.size=0.1,
     vertex.color=veccol,
     vertex.size=20,
     vertex.frame.color="gray",
     vertex.label.color="black",
     vertex.label.cex=0.8,
     vertex.label.dist=3,
     edge.curved=0.2)
```



Automatic layout

This function tries to choose an appropriate graph layout algorithm for the graph, automatically, based on a simple algorithm.

```
plot(g,
     layout=layout_nicely,
     edge.arrow.size=0.1,
     vertex.color=veccol,
     vertex.size=20,
     vertex.frame.color="gray",
     vertex.label.color="black",
     vertex.label.cex=0.8,
     vertex.label.dist=3,
     edge.curved=0.2)
```



On single plot

```
layouts <- grep("^layout_", ls("package:igraph"), value=TRUE)[-1]
layouts <- layouts[!grepl("bipartite|merge|norm|sugiyama|tree", layouts)]
par(mfrow=c(3,3), mar=c(1,1,1,1))
for (layout in layouts) {
  print(layout)
  l <- do.call(layout, list(g))
  plot(g, edge.arrow.mode=0, layout=l, main=layout)
}
```

```
## [1] "layout_as_star"
```

```
## [1] "layout_components"
```

```
## [1] "layout_in_circle"
```

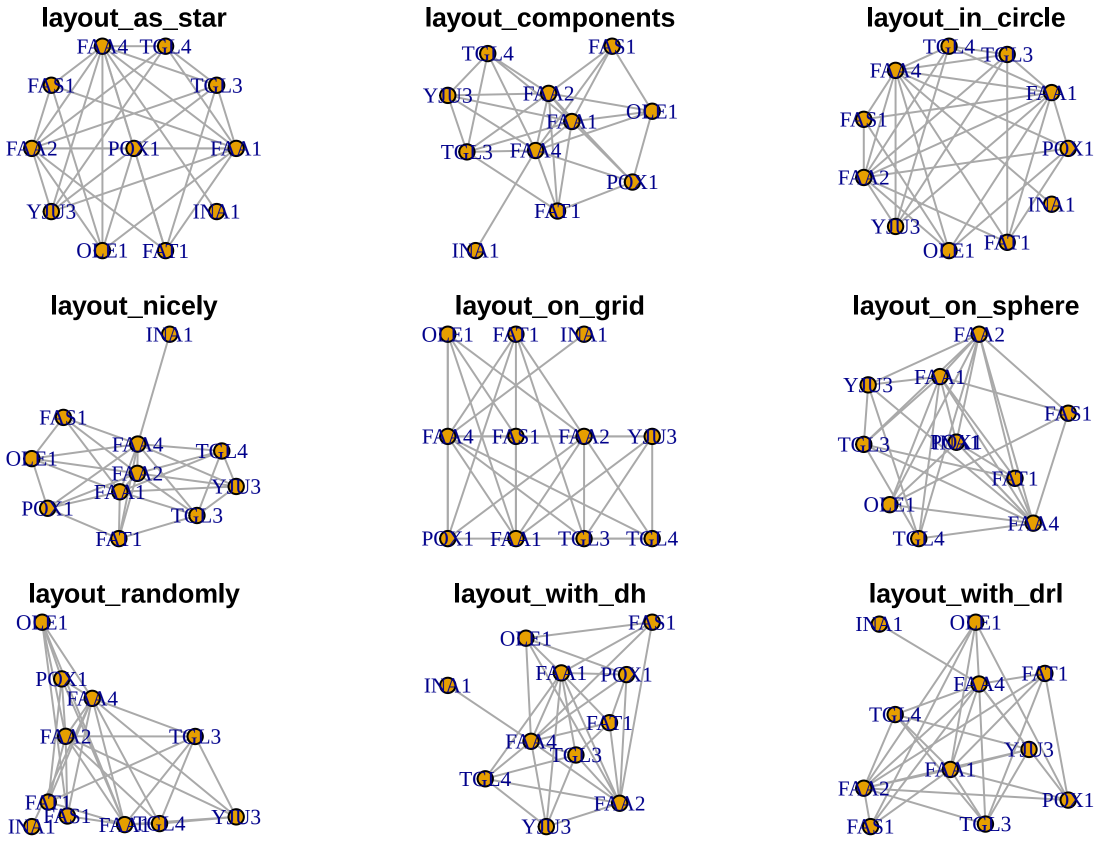
```
## [1] "layout_nicely"
```

```
## [1] "layout_on_grid"
```

```
## [1] "layout_on_sphere"
## [1] "layout_randomly"
```

```
## [1] "layout_with_dh"
```

```
## [1] "layout_with_drl"
```



```
## [1] "layout_with_fr"
```

```
## [1] "layout_with_gem"
```

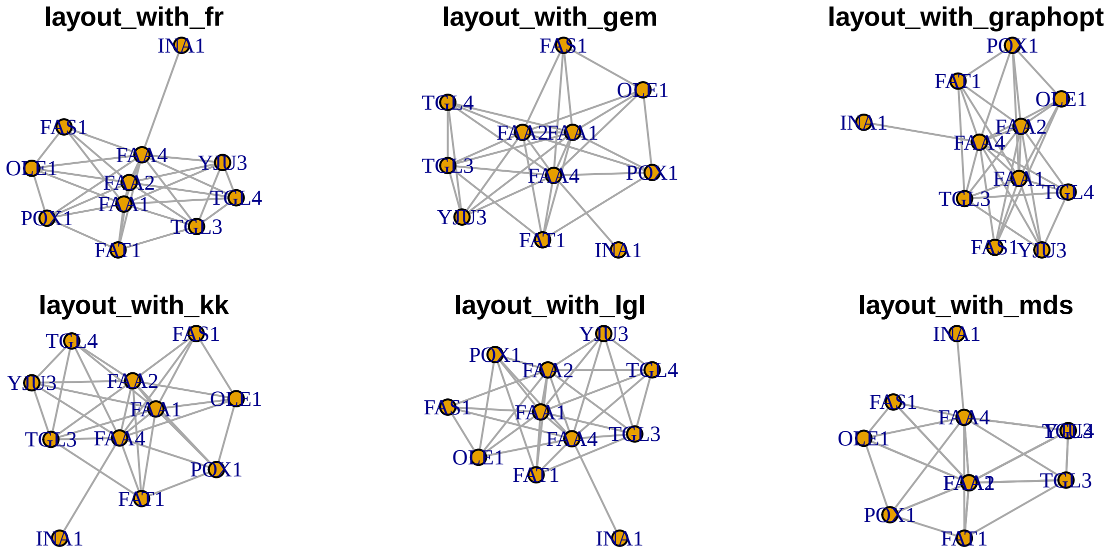
```
## [1] "layout_with_graphopt"
```

```
## [1] "layout_with_kk"
```

```
## [1] "layout_with_lgl"
```

```
## [1] "layout_with_mds"
```

```
par(mfrow=c(1,1))
```



layout_with_fr

layout_with_gem

layout_with_graphopt

layout_with_kk

layout_with_lgl

layout_with_mds

References

1. https://www.data-imaginist.com/2017/ggraph-introduction-layouts/