Assignment 2 - Social Network Analysis

Part I

Start by installing the "igraph" package. Once you have installed igraph, load the package.

Now upload the data file "discipline-data.csv" as a data frame called "D1". Each row is a disciplinary action from a teacher to a student so the first line shows that teacher "E" sent student "21" to the principal. It also shows the gender of both the teacher and student and the student's main elective field of study ("major""") and the field that the teacher instructs in ("t.expertise").

Before you proceed, you will need to change the data type of the student id variable. Since it is a number R will automatically think it is an integer and code it as such (look at the list of variables by clicking on the data frame arrow in the Data pane. Here you will see the letters "int"" next to the stid variable, that stands for integer). However, in this case we are treating the variable as a category, there is no numeric meaning in the variable. So we need to change the format to be a category, what R calls a "factor". We can do this with the following code:

```
library(igraph)
```

```
##
## Attaching package: 'igraph'

## The following objects are masked from 'package:stats':
##
##     decompose, spectrum

## The following object is masked from 'package:base':
##
##     union
```

```
D1 <- read.csv("discipline-data.csv")
D1$stid <- as.factor(D1$stid)
```

igraph requires data to be in a particular structure. There are several structures that it can use but we will be using a combination of an "edge list" and a "vertex list". As you might imagine the edge list contains a list of all the relationships between students and teachers and any characteristics of those edges that we might be interested in. There are two essential variables in the edge list a "from" variable and a "to" variable that descibe the relationships between vertices (a disciplinary action is given "from" and teacher "to" a student). While the vertix list contains all the characteristics of those vertices, in our case gender and major.

So let's convert our data into an edge list!

First we will isolate the variables that are of interest: tid and stid

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:igraph':
##
##     as_data_frame, groups, union
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
D2 <- select(D1, tid, stid)
```

Since our data represnts every time a teacher sends a student to the principal there are multiple rows when the same teacher sends the same student. We want to collapse these into a single row, with a variable that shows how many times a teacher-student pair appears.

```
EDGE <- count(D2, tid, stid)

names(EDGE) <- c("from", "to", "count")
```

EDGE is your edge list. Now we need to make the vertex list, a list of all the teachers and students and their characteristics in our network.

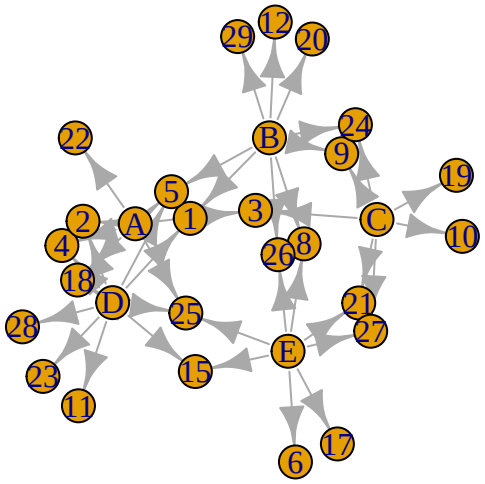
```
#First we will separate the teachers from our original data frame
V.TCH <- select(D1, tid, t.gender, t.expertise)
#Remove all the repeats so that we just have a list of each teacher and their characteristics
V.TCH <- unique(V.TCH)
#Add a variable that describes that they are teachers
V.TCH$group <- "teacher"

#Now repeat this process for the students
V.STD <- select(D1, stid, s.gender, s.major)
V.STD <- unique(V.STD)
V.STD$group <- "student"

#Make sure that the student and teacher data frames have the same variables names
names(V.TCH) <- c("id", "gender", "topic", "group")
names(V.STD) <- c("id", "gender", "topic", "group")

#Bind the two data frames together (you will get a warning because the teacher data frame has 5 types o
VERTEX <- bind_rows(V.TCH, V.STD)
```

```
## Warning in bind_rows_(x, .id): Unequal factor levels: coercing to character

## Warning in bind_rows_(x, .id): binding character and factor vector,
## coercing into character vector

## Warning in bind_rows_(x, .id): binding character and factor vector,
## coercing into character vector

## Warning in bind_rows_(x, .id): Unequal factor levels: coercing to character

## Warning in bind_rows_(x, .id): binding character and factor vector,
```

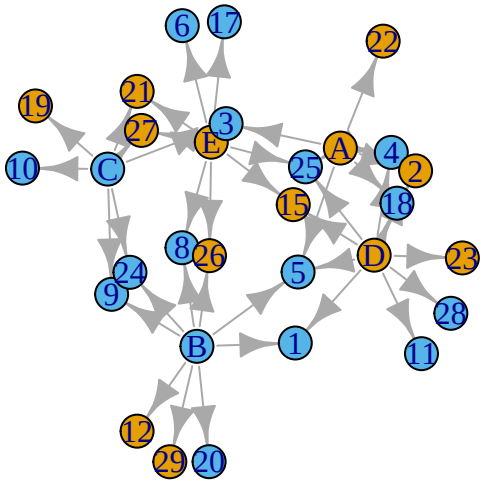
```
## coercing into character vector

## Warning in bind_rows_(x, .id): binding character and factor vector,
## coercing into character vector
```

Now we have both a Vertex and Edge list it is time to plot our graph!

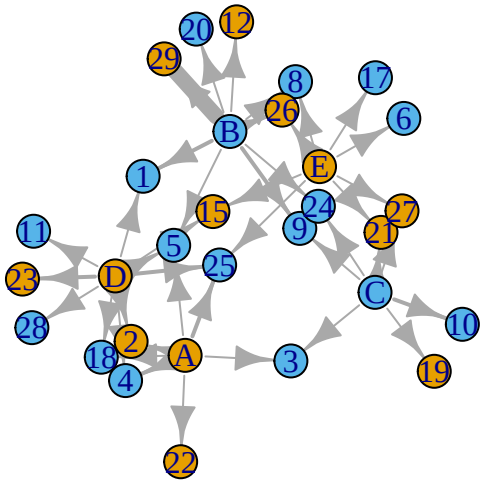
```
#Load the igraph package

library(igraph)

#First we will make an object that contains the graph information using our two dataframes EDGE and VER

g <- graph.data.frame(EDGE, directed=TRUE, vertices=VERTEX)

#Now we can plot our graph using the force directed graphing technique - our old friend Fruchertman-Rei

plot(g,layout=layout.fruchterman.reingold)
```




```
#There are many ways to change the attributes of the graph to represent different characteristics of th

plot(g,layout=layout.fruchterman.reingold, vertex.color=VERTEX$gender)
```



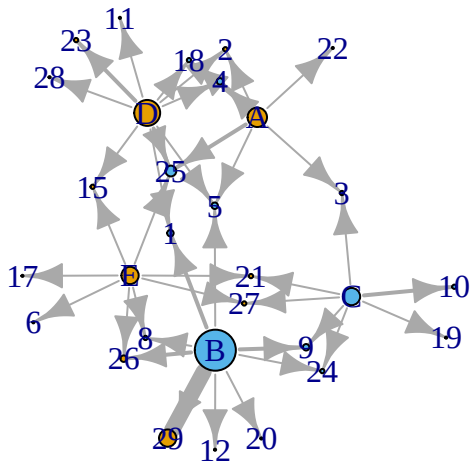

```
#We can change the thickness of the edge according to the number of times a particular teacher has sent

plot(g,layout=layout.fruchterman.reingold, vertex.color=VERTEX$gender, edge.width=EDGE$count)
```



Part II

In Part II your task is to look up in the igraph documentation and create a graph that sizes the student vertices in terms of the number of disciplinary actions they have recieved, and the teachers in terms of the number of disciplinary actions they have given out.

```
V.TCH.SIZE <- D2 %>%
  group_by(tid) %>%
  summarize(size = n())
names(V.TCH.SIZE) <- c("id", "size")

V.STD.SIZE <- D2 %>%
  group_by(stid) %>%
  summarize(size = n())
names(V.STD.SIZE) <- c("id", "size")

V.SIZE <- rbind(V.TCH.SIZE, V.STD.SIZE)

VERTEX <- merge(VERTEX, V.SIZE, x.by = "id", y.by = "size")

g <- graph.data.frame(EDGE, directed=TRUE, vertices=VERTEX)

plot(g,layout=layout.fruchterman.reingold, vertex.label = VERTEX$id, vertex.color=VERTEX$gender, vertex
```



Part III

Now practice with data from our class. Please create a **person-network** with the data set hudk4050-classes.csv. To create this network you will need to create a person-class matrix using the tidyr functions and then create a person-person matrix using `t()`. You will then need to plot a matrix rather than a data frame using igraph.

Once you have done this, also look up how to generate the following network metrics: betweeness centrality and dregree. **Who is the most central person in the network?**

```
library(tidyr)
```

```
##
## Attaching package: 'tidyr'
```

```
## The following object is masked from 'package:igraph':
##
##     crossing
```

```
library(dplyr)
library(tibble)
```

```
##
## Attaching package: 'tibble'
```

```
## The following object is masked from 'package:igraph':
##
##     as_data_frame
```

```
library(stringr)
library(igraph)
library(reshape2)
```

```
##
## Attaching package: 'reshape2'
```

```
## The following object is masked from 'package:tidyr':
##
##     smiths
```

```
# Import data
table <- read.table("hudk4050-classes.txt", header = TRUE, sep = ",")

# Crop data
classdata <- table[-c(1:2),c(20:26)]
person_class <- gather(classdata, "QID", "CID", 2:7)
```

```
## Warning: attributes are not identical across measure variables;
## they will be dropped
```

```
person_class <- person_class[,-2]
person_class <- na_if(person_class, "")
person_class <- na.omit(person_class)

# Drop incomplete data
person_class <- subset(person_class, str_detect(person_class[,2], "[A-Z]+\\s*[0-9]+"))

# Format data
person_class[,2] <- gsub("([A-Z]+)\\s*([0-9]+)", "\\1 \\2", person_class[,2])

# Modify ambiguous data
person_class[person_class == 'QMSS-G 5072' | person_class == 'G 5072'] <- 'QMSS 5072'
person_class[person_class == 'QMSS G 5015'] <- 'QMSS 5015'
person_class[person_class == 'QMSS GR 5067' | person_class == 'G 5067'] <- 'QMSS 5067'
person_class <- subset(person_class, CID != 'HUDK 4050')
person_person <- merge(person_class, person_class, by = 'CID')
names(person_person) <- c('CID', 'FROM', 'TO')
person_person <- subset(person_person, !FROM == TO)

person_person.edge <- count(person_person, FROM, TO)
names(person_person.edge) <- c('FROM', 'TO', 'count')

person_person.matrix <- pivot_wider(person_person.edge, names_from = FROM, values_from = count)
person_person.matrix %>% remove_rownames %>% column_to_rownames(var='TO')
```

```
##                   ad3671 adw2184 ajz2123 bkd2115 cc97760n@pace.edu ch3460
```

```
## adw2184                1      NA      NA       1                1      1
## bkd2115                1       1      NA      NA                1      1
## cc97760n@pace.edu      1       1      NA       1               NA     NA
## cy2535                 1       1       2       1                1     NA
## HG2527                 1       1      NA       1                2     NA
## jc5230                 1       1      NA       1                2     NA
## js5498                 1       1      NA       1                2     NA
## ll3358                 1       2      NA       1                2      1
## lr2956                 2       2      NA       1                1      1
## mh3054                 1      NA      NA      NA               NA     NA
## sj2562                 1       1      NA       1                2     NA
## wz2508                 1       1      NA       1                2     NA
## xc2496                 1       1      NA       1                2     NA
## xql2001                1       1      NA       2                1     NA
## XZ2910                 1       1       1       1                1     NA
## yx2531                 1       1       1       1                1     NA
## yz3413                 1       1      NA       1                1     NA
## yz3679                 2       2      NA       1                1      1
## yz3730                 1       1      NA       1                2     NA
## zz2641                 2       2      NA       1                1      1
## zz2726                 1       1       1       1                1     NA
## ad3671                NA       1      NA       1                1     NA
## ch3460                NA       1      NA       1               NA     NA
## dm3487                NA       1      NA       1               NA      3
## jg4191                NA       1      NA       1               NA      3
## kdp2124               NA       1      NA      NA                1      1
## ld2882                NA       1      NA       1               NA      3
## lm3477                NA       1      NA       1               NA      3
## nx2150                NA       1      NA       1               NA      3
## RW2796                NA       1      NA       1               NA      3
## ss5851                NA       1      NA       1               NA      3
## XY2418                NA       1      NA       1               NA      3
## xz2840                NA       1      NA       1               NA      3
## ym2775                NA       1      NA       1               NA      3
## zg2338                NA       1      NA       1               NA      3
## mw3399                NA      NA       1      NA               NA     NA
## ql2360                NA      NA       1      NA                1     NA
## jz3101                NA      NA      NA       1               NA      2
## IB2445                NA      NA      NA      NA                1     NA
## ajz2123               NA      NA      NA      NA               NA     NA
## yq2257                NA      NA      NA      NA               NA     NA
## jh4175                NA      NA      NA      NA               NA     NA
## yl4232                NA      NA      NA      NA               NA     NA
## xn2135                NA      NA      NA      NA               NA     NA
## la2738                NA      NA      NA      NA               NA     NA
##                    cy2535 dm3487 HG2527 IB2445 jc5230 jg4191 jh4175 js5498
## adw2184                 1      1      1     NA      1      1     NA      1
## bkd2115                 1      1      1     NA      1      1     NA      1
## cc97760n@pace.edu       1     NA      2      1      2     NA     NA      2
## cy2535                 NA     NA      1     NA      1     NA     NA      1
## HG2527                  1     NA     NA      1      2     NA     NA      2
## jc5230                  1     NA      2      1     NA     NA     NA      2
## js5498                  1     NA      2      1      2     NA     NA     NA
## ll3358                  1      1      2      1      2      1     NA      2
```

```
## lr2956                1      1      1     NA      1      1     NA      1
## mh3054                NA     NA     NA     NA     NA     NA     NA     NA
## sj2562                1      NA     2      1      2      NA     NA     2
## wz2508                1      NA     2      1      2      NA     NA     2
## xc2496                1      NA     3      1      2      NA     NA     2
## xql2001               1      NA     1      NA     1      NA     1      1
## XZ2910                2      NA     1      NA     1      NA     NA     1
## yx2531                2      NA     1      NA     1      NA     NA     1
## yz3413                1      NA     1      NA     1      NA     NA     1
## yz3679                1      1      1      1      1      1      NA     1
## yz3730                1      NA     2      1      2      NA     NA     2
## zz2641                1      1      1      NA     1      1      NA     1
## zz2726                2      NA     1      1      1      NA     NA     1
## ad3671                1      NA     1      NA     1      NA     NA     1
## ch3460                NA     3      NA     NA     NA     3      NA     NA
## dm3487                NA     NA     NA     NA     NA     3      1      NA
## jg4191                NA     3      NA     NA     NA     NA     NA     NA
## kdp2124               NA     1      1      1      1      1      NA     1
## ld2882                NA     3      NA     NA     NA     3      NA     NA
## lm3477                NA     3      NA     NA     NA     3      NA     NA
## nx2150                NA     3      NA     NA     NA     3      NA     NA
## RW2796                NA     3      NA     NA     NA     3      NA     NA
## ss5851                NA     3      NA     NA     NA     3      NA     NA
## XY2418                NA     3      NA     NA     NA     3      NA     NA
## xz2840                NA     4      NA     NA     NA     3      1      NA
## ym2775                NA     3      NA     NA     NA     3      NA     NA
## zg2338                NA     3      NA     NA     NA     3      NA     NA
## mw3399                1      NA     NA     NA     NA     NA     1      NA
## ql2360                1      NA     1      2      1      NA     NA     1
## jz3101                NA     2      NA     NA     NA     2      NA     NA
## IB2445                NA     NA     1      NA     1      NA     NA     1
## ajz2123               2      NA     NA     NA     NA     NA     NA     NA
## yq2257                1      NA     NA     NA     NA     NA     NA     NA
## jh4175                NA     1      NA     NA     NA     NA     NA     NA
## yl4232                NA     NA     NA     NA     NA     NA     NA     NA
## xn2135                NA     NA     NA     NA     NA     NA     NA     NA
## la2738                NA     NA     NA     NA     NA     NA     NA     NA
##                    jz3101 kdp2124 la2738 ld2882 ll3358 lm3477 lr2956 mh3054
## adw2184               NA       1     NA      1      2      1      2     NA
## bkd2115               1       NA     NA      1      1      1      1     NA
## cc97760n@pace.edu     NA       1     NA     NA      2     NA      1     NA
## cy2535                NA      NA     NA     NA      1     NA      1     NA
## HG2527                NA       1     NA     NA      2     NA      1     NA
## jc5230                NA       1     NA     NA      2     NA      1     NA
## js5498                NA       1     NA     NA      2     NA      1     NA
## ll3358                NA       2     NA      1     NA      1      2     NA
## lr2956                NA       1     NA      1      2      1     NA     NA
## mh3054                NA      NA     NA     NA     NA     NA     NA     NA
## sj2562                NA       1     NA     NA      2     NA      1     NA
## wz2508                NA       1     NA     NA      2     NA      1     NA
## xc2496                NA       1     NA     NA      2     NA      1     NA
## xql2001               NA      NA     NA     NA      1     NA      1     NA
## XZ2910                NA      NA     NA     NA      1     NA      1     NA
## yx2531                NA      NA     NA     NA      1     NA      1     NA
```

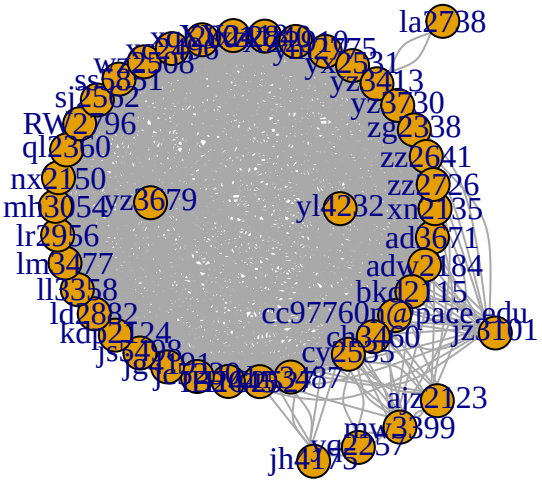
```
## yz3413                NA      NA       1     NA      1     NA      1     NA
## yz3679                NA       1      NA      1      2      1      2      1
## yz3730                NA       1      NA     NA      2     NA      1     NA
## zz2641                NA       1      NA      1      2      1      3     NA
## zz2726                NA      NA      NA     NA      1     NA      1     NA
## ad3671                NA      NA      NA     NA      1     NA      2      1
## ch3460                 2       1      NA      3      1      3      1     NA
## dm3487                 2       1      NA      3      1      3      1     NA
## jg4191                 2       1      NA      3      1      3      1     NA
## kdp2124               NA      NA      NA      1      2      1      1     NA
## ld2882                 2       1      NA     NA      1      3      1     NA
## lm3477                 2       1      NA      3      1     NA      1     NA
## nx2150                 2       1      NA      3      1      3      1     NA
## RW2796                 2       1      NA      3      1      3      1     NA
## ss5851                 2       1      NA      3      1      3      1     NA
## XY2418                 2       1      NA      3      1      3      1     NA
## xz2840                 2       1      NA      3      1      3      1     NA
## ym2775                 2       1      NA      3      1      3      1     NA
## zg2338                 2       1      NA      3      1      3      1     NA
## mw3399                NA      NA      NA     NA     NA     NA     NA     NA
## ql2360                NA       1      NA     NA      1     NA     NA     NA
## jz3101                NA      NA      NA      2     NA      2     NA     NA
## IB2445                NA       1      NA     NA      1     NA     NA     NA
## ajz2123               NA      NA      NA     NA     NA     NA     NA     NA
## yq2257                NA      NA      NA     NA     NA     NA     NA     NA
## jh4175                NA      NA      NA     NA     NA     NA     NA     NA
## yl4232                NA      NA      NA     NA     NA     NA     NA     NA
## xn2135                NA      NA      NA     NA     NA     NA     NA     NA
## la2738                NA      NA      NA     NA     NA     NA     NA     NA
##                    mw3399 nx2150 ql2360 RW2796 sj2562 ss5851 wz2508 xc2496
## adw2184               NA       1      NA      1      1      1      1      1
## bkd2115               NA       1      NA      1      1      1      1      1
## cc97760n@pace.edu     NA      NA       1     NA      2     NA      2      2
## cy2535                 1      NA       1     NA      1     NA      1      1
## HG2527                NA      NA       1     NA      2     NA      2      3
## jc5230                NA      NA       1     NA      2     NA      2      2
## js5498                NA      NA       1     NA      2     NA      2      2
## ll3358                NA       1       1      1      2      1      2      2
## lr2956                NA       1      NA      1      1      1      1      1
## mh3054                NA      NA      NA     NA     NA     NA     NA     NA
## sj2562                NA      NA       1     NA     NA     NA      2      2
## wz2508                NA      NA       1      1      2     NA     NA      2
## xc2496                NA      NA       1     NA      2     NA      2     NA
## xql2001                1      NA      NA     NA      1     NA      1      1
## XZ2910                 1      NA       1     NA      1     NA      1      1
## yx2531                 1      NA       1     NA      1     NA      1      1
## yz3413                NA      NA      NA     NA      1     NA      1      1
## yz3679                NA       1       1      1      1      1      1      1
## yz3730                NA      NA       1     NA      2     NA      2      2
## zz2641                NA       1      NA      1      1      1      1      1
## zz2726                 1      NA       1     NA      1     NA      1      1
## ad3671                NA      NA      NA     NA      1     NA      1      1
## ch3460                NA       3      NA      3     NA      3     NA     NA
## dm3487                NA       3      NA      3     NA      3     NA     NA
```

```
## jg4191                NA      3     NA      3     NA      3     NA     NA
## kdp2124               NA      1      1      1      1      1      1      1
## ld2882                NA      3     NA      3     NA      3     NA     NA
## lm3477                NA      3     NA      3     NA      3     NA     NA
## nx2150                NA     NA     NA      3     NA      3     NA     NA
## RW2796                NA      3     NA     NA     NA      3      1     NA
## ss5851                NA      3     NA      3     NA     NA     NA     NA
## XY2418                NA      3     NA      3     NA      3     NA     NA
## xz2840                NA      3     NA      3     NA      3     NA     NA
## ym2775                NA      3     NA      3     NA      3     NA     NA
## zg2338                NA      3     NA      3     NA      3     NA     NA
## mw3399                NA     NA      1     NA     NA     NA     NA     NA
## ql2360                 1     NA     NA     NA      1     NA      1      1
## jz3101                NA      2     NA      2     NA      2     NA     NA
## IB2445                NA     NA      2     NA      1     NA      1      1
## ajz2123                1     NA      1     NA     NA     NA     NA     NA
## yq2257                NA     NA     NA     NA     NA     NA     NA     NA
## jh4175                 1     NA     NA     NA     NA     NA     NA     NA
## yl4232                NA     NA     NA     NA     NA     NA     NA     NA
## xn2135                NA     NA     NA     NA     NA     NA     NA     NA
## la2738                NA     NA     NA     NA     NA     NA     NA     NA
##                   xn2135 xql2001 XY2418 xz2840 XZ2910 yl4232 ym2775 yq2257
## adw2184               NA       1      1      1      1     NA      1     NA
## bkd2115               NA       2      1      1      1     NA      1     NA
## cc97760n@pace.edu     NA       1     NA     NA      1     NA     NA     NA
## cy2535                NA       1     NA     NA      2     NA     NA      1
## HG2527                NA       1     NA     NA      1     NA     NA     NA
## jc5230                NA       1     NA     NA      1     NA     NA     NA
## js5498                NA       1     NA     NA      1     NA     NA     NA
## ll3358                NA       1      1      1      1     NA      1     NA
## lr2956                NA       1      1      1      1     NA      1     NA
## mh3054                NA      NA     NA     NA     NA     NA     NA     NA
## sj2562                NA       1     NA     NA      1     NA     NA     NA
## wz2508                NA       1     NA     NA      1     NA     NA     NA
## xc2496                NA       1     NA     NA      1     NA     NA     NA
## xql2001               NA      NA     NA     NA      1     NA     NA     NA
## XZ2910                NA       1     NA     NA     NA     NA     NA     NA
## yx2531                NA       1     NA     NA      2     NA     NA     NA
## yz3413                NA       1     NA     NA      1     NA     NA     NA
## yz3679                NA       1      1      1      1     NA      1     NA
## yz3730                NA       1     NA     NA      2     NA     NA     NA
## zz2641                NA       1      1      1      1     NA      1     NA
## zz2726                NA       1     NA     NA      2     NA     NA     NA
## ad3671                NA       1     NA     NA      1     NA     NA     NA
## ch3460                NA      NA      3      3     NA     NA      3     NA
## dm3487                NA      NA      3      4     NA     NA      3     NA
## jg4191                NA      NA      3      3     NA     NA      3     NA
## kdp2124               NA      NA      1      1     NA     NA      1     NA
## ld2882                NA      NA      3      3     NA     NA      3     NA
## lm3477                NA      NA      3      3     NA     NA      3     NA
## nx2150                NA      NA      3      3     NA     NA      3     NA
## RW2796                NA      NA      3      3     NA     NA      3     NA
## ss5851                NA      NA      3      3     NA     NA      3     NA
## XY2418                NA      NA     NA      3     NA     NA      3     NA
```

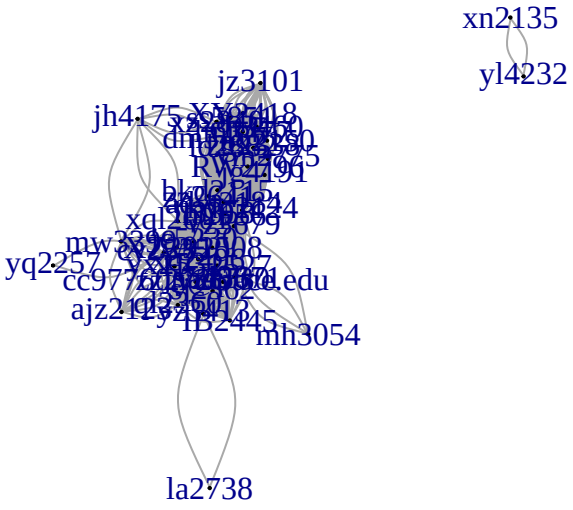
```
## xz2840                NA      NA      3     NA     NA     NA      3     NA
## ym2775                NA      NA      3      3     NA     NA     NA     NA
## zg2338                NA      NA      3      3     NA     NA      3     NA
## mw3399                NA       1     NA     NA      1     NA     NA     NA
## ql2360                NA      NA     NA     NA      1     NA     NA     NA
## jz3101                NA      NA      2      2     NA     NA      2     NA
## IB2445                NA      NA     NA     NA     NA     NA     NA     NA
## ajz2123               NA      NA     NA     NA      1     NA     NA     NA
## yq2257                NA      NA     NA     NA     NA     NA     NA     NA
## jh4175                NA       1     NA      1     NA     NA     NA     NA
## yl4232                 2      NA     NA     NA     NA     NA     NA     NA
## xn2135                NA      NA     NA     NA     NA      2     NA     NA
## la2738                NA      NA     NA     NA     NA     NA     NA     NA
##                    yx2531 yz3413 yz3679 yz3730 zg2338 zz2641 zz2726
## adw2184                 1      1      2      1      1      2      1
## bkd2115                 1      1      1      1      1      1      1
## cc97760n@pace.edu       1      1      1      2     NA      1      1
## cy2535                  2      1      1      1     NA      1      2
## HG2527                  1      1      1      2     NA      1      1
## jc5230                  1      1      1      2     NA      1      1
## js5498                  1      1      1      2     NA      1      1
## ll3358                  1      1      2      2      1      2      1
## lr2956                  1      1      2      1      1      3      1
## mh3054                 NA     NA      1     NA     NA     NA     NA
## sj2562                  1      1      1      2     NA      1      1
## wz2508                  1      1      1      2     NA      1      1
## xc2496                  1      1      1      2     NA      1      1
## xql2001                 1      1      1      1     NA      1      1
## XZ2910                  2      1      1      2     NA      1      2
## yx2531                 NA      1      1      1     NA      1      2
## yz3413                  1     NA      1      1     NA      1      1
## yz3679                  1      1     NA      1      1      2      1
## yz3730                  1      1      1     NA     NA      1      1
## zz2641                  1      1      2      1      1     NA      1
## zz2726                  2      1      1      1     NA      1     NA
## ad3671                  1      1      2      1     NA      2      1
## ch3460                 NA     NA      1     NA      3      1     NA
## dm3487                 NA     NA      1     NA      3      1     NA
## jg4191                 NA     NA      1     NA      3      1     NA
## kdp2124                NA     NA      1      1      1      1     NA
## ld2882                 NA     NA      1     NA      3      1     NA
## lm3477                 NA     NA      1     NA      3      1     NA
## nx2150                 NA     NA      1     NA      3      1     NA
## RW2796                 NA     NA      1     NA      3      1     NA
## ss5851                 NA     NA      1     NA      3      1     NA
## XY2418                 NA     NA      1     NA      3      1     NA
## xz2840                 NA     NA      1     NA      3      1     NA
## ym2775                 NA     NA      1     NA      3      1     NA
## zg2338                 NA     NA      1     NA     NA      1     NA
## mw3399                  1     NA     NA     NA     NA     NA      1
## ql2360                  1     NA      1      1     NA     NA      1
## jz3101                 NA     NA     NA     NA      2     NA     NA
## IB2445                 NA     NA      1      1     NA     NA      1
## ajz2123                 1     NA     NA     NA     NA     NA      1
```

```
## yq2257                NA      NA      NA      NA      NA      NA      NA
## jh4175                NA      NA      NA      NA      NA      NA      NA
## yl4232                NA      NA      NA      NA      NA      NA      NA
## xn2135                NA      NA      NA      NA      NA      NA      NA
## la2738                NA       1      NA      NA      NA      NA      NA
```

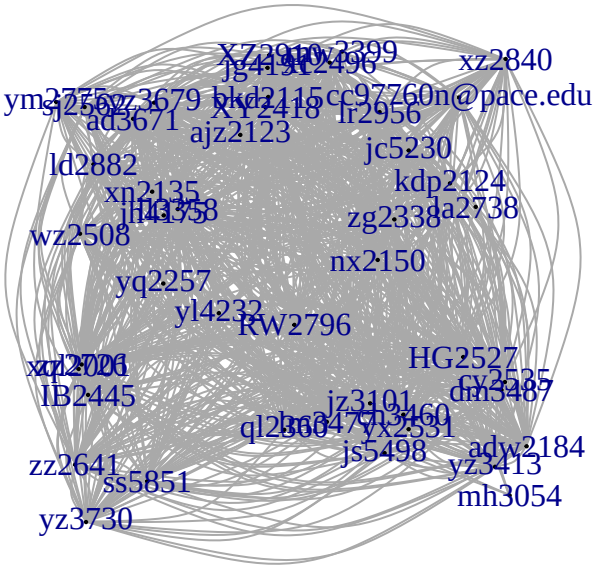
```
person_person.graph <- graph_from_data_frame(person_person.edge, directed=FALSE)
layout <- layout.reingold.tilford(person_person.graph, circular=T)
plot(person_person.graph, layout=layout)
```




```
plot(person_person.graph, layout=layout.fruchterman.reingold(person_person.graph), vertex.label = V(pers
```




```
plot(person_person.graph, layout=layout.random, vertex.label = V(person_person.graph)$FROM, vertex.size
```



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