assignment2

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# 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:

discipline\_data <- read.csv("~/Desktop/2019fall/core methods in edm/assignment2/assignment 1015/discipline-data.csv")  
D1<-data.frame(discipline\_data)  
D1

## tid stid s.gender s.major t.gender t.expertise  
## 1 E 21 female art female art  
## 2 A 4 male math female biology  
## 3 A 25 male biology female biology  
## 4 E 15 female english female art  
## 5 D 1 male biology female art  
## 6 E 8 male english female art  
## 7 B 8 male english male math  
## 8 E 25 male biology female art  
## 9 A 25 male biology female biology  
## 10 C 10 male art male biology  
## 11 D 4 male math female art  
## 12 B 26 female art male math  
## 13 D 23 female art female art  
## 14 A 3 male art female biology  
## 15 C 21 female art male biology  
## 16 A 4 male math female biology  
## 17 E 27 female art female art  
## 18 B 29 female art male math  
## 19 B 5 male art male math  
## 20 A 5 male art female biology  
## 21 D 18 male biology female art  
## 22 D 28 male math female art  
## 23 D 11 male art female art  
## 24 E 17 male biology female art  
## 25 B 26 female art male math  
## 26 B 1 male biology male math  
## 27 B 29 female art male math  
## 28 C 9 male biology male biology  
## 29 B 9 male biology male math  
## 30 B 9 male biology male math  
## 31 D 25 male biology female art  
## 32 C 27 female art male biology  
## 33 B 12 female art male math  
## 34 C 24 male art male biology  
## 35 B 24 male art male math  
## 36 C 3 male art male biology  
## 37 D 5 male art female art  
## 38 D 25 male biology female art  
## 39 B 1 male biology male math  
## 40 E 26 female art female art  
## 41 A 22 female biology female biology  
## 42 D 2 female math female art  
## 43 C 19 female biology male biology  
## 44 D 15 female english female art  
## 45 E 6 male biology female art  
## 46 D 23 female art female art  
## 47 C 10 male art male biology  
## 48 B 20 male biology male math  
## 49 A 18 male biology female biology  
## 50 A 2 female math female biology  
## 51 B 29 female art male math  
## 52 B 29 female art male math  
## 53 B 29 female art male math  
## 54 B 29 female art male math  
## 55 B 29 female art male math  
## 56 B 29 female art male math

D1$stid <- as.factor(D1$stid)  
D1

## tid stid s.gender s.major t.gender t.expertise  
## 1 E 21 female art female art  
## 2 A 4 male math female biology  
## 3 A 25 male biology female biology  
## 4 E 15 female english female art  
## 5 D 1 male biology female art  
## 6 E 8 male english female art  
## 7 B 8 male english male math  
## 8 E 25 male biology female art  
## 9 A 25 male biology female biology  
## 10 C 10 male art male biology  
## 11 D 4 male math female art  
## 12 B 26 female art male math  
## 13 D 23 female art female art  
## 14 A 3 male art female biology  
## 15 C 21 female art male biology  
## 16 A 4 male math female biology  
## 17 E 27 female art female art  
## 18 B 29 female art male math  
## 19 B 5 male art male math  
## 20 A 5 male art female biology  
## 21 D 18 male biology female art  
## 22 D 28 male math female art  
## 23 D 11 male art female art  
## 24 E 17 male biology female art  
## 25 B 26 female art male math  
## 26 B 1 male biology male math  
## 27 B 29 female art male math  
## 28 C 9 male biology male biology  
## 29 B 9 male biology male math  
## 30 B 9 male biology male math  
## 31 D 25 male biology female art  
## 32 C 27 female art male biology  
## 33 B 12 female art male math  
## 34 C 24 male art male biology  
## 35 B 24 male art male math  
## 36 C 3 male art male biology  
## 37 D 5 male art female art  
## 38 D 25 male biology female art  
## 39 B 1 male biology male math  
## 40 E 26 female art female art  
## 41 A 22 female biology female biology  
## 42 D 2 female math female art  
## 43 C 19 female biology male biology  
## 44 D 15 female english female art  
## 45 E 6 male biology female art  
## 46 D 23 female art female art  
## 47 C 10 male art male biology  
## 48 B 20 male biology male math  
## 49 A 18 male biology female biology  
## 50 A 2 female math female biology  
## 51 B 29 female art male math  
## 52 B 29 female art male math  
## 53 B 29 female art male math  
## 54 B 29 female art male math  
## 55 B 29 female art male math  
## 56 B 29 female art male math

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:stats':  
##   
## filter, lag

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

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

## tid stid  
## 1 E 21  
## 2 A 4  
## 3 A 25  
## 4 E 15  
## 5 D 1  
## 6 E 8  
## 7 B 8  
## 8 E 25  
## 9 A 25  
## 10 C 10  
## 11 D 4  
## 12 B 26  
## 13 D 23  
## 14 A 3  
## 15 C 21  
## 16 A 4  
## 17 E 27  
## 18 B 29  
## 19 B 5  
## 20 A 5  
## 21 D 18  
## 22 D 28  
## 23 D 11  
## 24 E 17  
## 25 B 26  
## 26 B 1  
## 27 B 29  
## 28 C 9  
## 29 B 9  
## 30 B 9  
## 31 D 25  
## 32 C 27  
## 33 B 12  
## 34 C 24  
## 35 B 24  
## 36 C 3  
## 37 D 5  
## 38 D 25  
## 39 B 1  
## 40 E 26  
## 41 A 22  
## 42 D 2  
## 43 C 19  
## 44 D 15  
## 45 E 6  
## 46 D 23  
## 47 C 10  
## 48 B 20  
## 49 A 18  
## 50 A 2  
## 51 B 29  
## 52 B 29  
## 53 B 29  
## 54 B 29  
## 55 B 29  
## 56 B 29

Since our data represents 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.

D2$stid <- as.character(D2$stid)  
D2$tid<-as.character(D2$tid)  
D2

## tid stid  
## 1 E 21  
## 2 A 4  
## 3 A 25  
## 4 E 15  
## 5 D 1  
## 6 E 8  
## 7 B 8  
## 8 E 25  
## 9 A 25  
## 10 C 10  
## 11 D 4  
## 12 B 26  
## 13 D 23  
## 14 A 3  
## 15 C 21  
## 16 A 4  
## 17 E 27  
## 18 B 29  
## 19 B 5  
## 20 A 5  
## 21 D 18  
## 22 D 28  
## 23 D 11  
## 24 E 17  
## 25 B 26  
## 26 B 1  
## 27 B 29  
## 28 C 9  
## 29 B 9  
## 30 B 9  
## 31 D 25  
## 32 C 27  
## 33 B 12  
## 34 C 24  
## 35 B 24  
## 36 C 3  
## 37 D 5  
## 38 D 25  
## 39 B 1  
## 40 E 26  
## 41 A 22  
## 42 D 2  
## 43 C 19  
## 44 D 15  
## 45 E 6  
## 46 D 23  
## 47 C 10  
## 48 B 20  
## 49 A 18  
## 50 A 2  
## 51 B 29  
## 52 B 29  
## 53 B 29  
## 54 B 29  
## 55 B 29  
## 56 B 29

EDGE <- count(D2, tid, stid)  
  
names(EDGE) <- c("from", "to", "count")  
EDGE

## # A tibble: 41 x 3  
## from to count  
## <chr> <chr> <int>  
## 1 A 18 1  
## 2 A 2 1  
## 3 A 22 1  
## 4 A 25 2  
## 5 A 3 1  
## 6 A 4 2  
## 7 A 5 1  
## 8 B 1 2  
## 9 B 12 1  
## 10 B 20 1  
## # … with 31 more rows

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 of id (A,B,C,D,E) and the student has 25 (1-30), this isn't a problem)  
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

VERTEX

## id gender topic group  
## 1 E female art teacher  
## 2 A female biology teacher  
## 3 D female art teacher  
## 4 B male math teacher  
## 5 C male biology teacher  
## 6 21 female art student  
## 7 4 male math student  
## 8 25 male biology student  
## 9 15 female english student  
## 10 1 male biology student  
## 11 8 male english student  
## 12 10 male art student  
## 13 26 female art student  
## 14 23 female art student  
## 15 3 male art student  
## 16 27 female art student  
## 17 29 female art student  
## 18 5 male art student  
## 19 18 male biology student  
## 20 28 male math student  
## 21 11 male art student  
## 22 17 male biology student  
## 23 9 male biology student  
## 24 12 female art student  
## 25 24 male art student  
## 26 22 female biology student  
## 27 2 female math student  
## 28 19 female biology student  
## 29 6 male biology student  
## 30 20 male biology student

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

#Load the igraph package  
  
library(igraph)

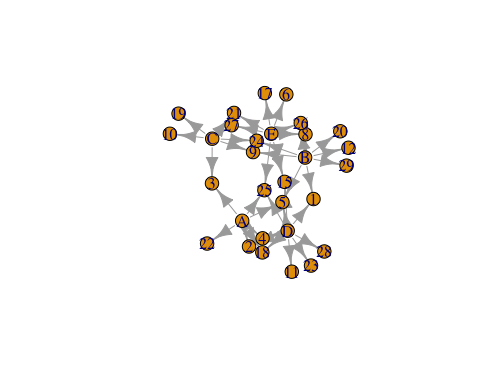
##   
## Attaching package: 'igraph'

## The following objects are masked from 'package:dplyr':  
##   
## as\_data\_frame, groups, union

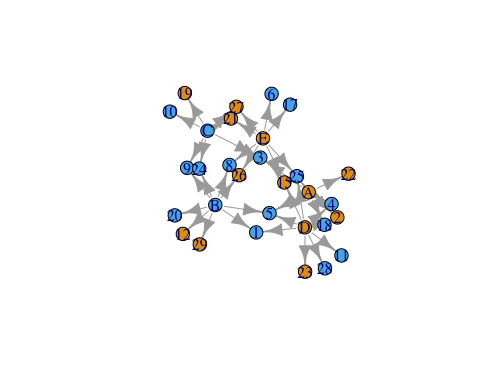
## The following objects are masked from 'package:stats':  
##   
## decompose, spectrum

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

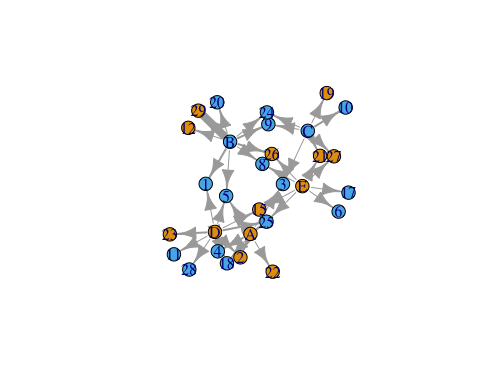
#First we will make an object that contains the graph information using our two dataframes EDGE and VERTEX. Notice that we have made "directed = TRUE" - our graph is directed since discipline is being given from a teacher to a student.  
  
g <- graph.data.frame(EDGE, directed=TRUE, vertices=VERTEX)  
  
#Now we can plot our graph using the force directed graphing technique - our old friend Fruchertman-Reingold!  
  
plot(g,layout=layout.fruchterman.reingold)



#There are many ways to change the attributes of the graph to represent different characteristics of the newtork. For example, we can color the nodes according to gender.  
  
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 a particular student to the principal.  
  
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](http://igraph.org/r/) in the igraph documentation and create a graph that sizes the student vertices in terms of the number of disciplinary actions they have received, and the teachers in terms of the number of disciplinary actions they have given out.

library(igraph)  
#set edge  
DT<-EDGE%>%group\_by(from)%>%  
 summarise(count=sum(count))  
names(DT) <- c("id", "count")  
  
DT

## # A tibble: 5 x 2  
## id count  
## <chr> <int>  
## 1 A 9  
## 2 B 19  
## 3 C 8  
## 4 D 12  
## 5 E 8

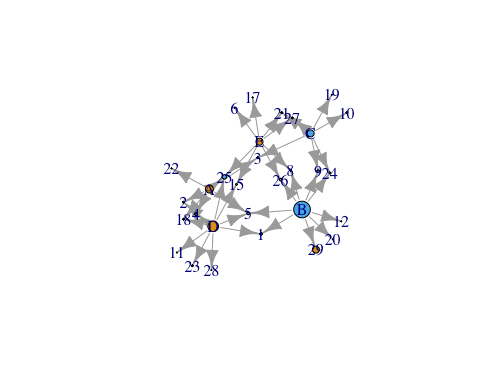
DS<-EDGE%>%group\_by(to)%>%  
 summarise(count=sum(count))  
names(DS) <- c("id", "count")  
DS

## # A tibble: 25 x 2  
## id count  
## <chr> <int>  
## 1 1 3  
## 2 10 2  
## 3 11 1  
## 4 12 1  
## 5 15 2  
## 6 17 1  
## 7 18 2  
## 8 19 1  
## 9 2 2  
## 10 20 1  
## # … with 15 more rows

New\_df<-(bind\_rows(DT,DS))  
New\_df

## # A tibble: 30 x 2  
## id count  
## <chr> <int>  
## 1 A 9  
## 2 B 19  
## 3 C 8  
## 4 D 12  
## 5 E 8  
## 6 1 3  
## 7 10 2  
## 8 11 1  
## 9 12 1  
## 10 15 2  
## # … with 20 more rows

VERTEX\_NEW<-merge(VERTEX,New\_df, by ="id")  
  
g\_new <- graph.data.frame(EDGE, directed=TRUE, vertices=VERTEX\_NEW)  
  
plot(g\_new,layout=layout.fruchterman.reingold, vertex.color=VERTEX\_NEW$gender,vertex.size=VERTEX\_NEW$count)



## 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.

raw\_data <- read.csv("~/Desktop/2019fall/core methods in edm/assignment2/assignment 1015/hudk4050-classes.csv")  
  
#select useful columns  
install.packages("tidyverse",repos = "http://cran.us.r-project.org")

##   
## The downloaded binary packages are in  
## /var/folders/7n/3w87168x3kv3dj0nskjj52r80000gp/T//RtmpH7ykEs/downloaded\_packages

install.packages("tidyr",repos = "http://cran.us.r-project.org")

##   
## The downloaded binary packages are in  
## /var/folders/7n/3w87168x3kv3dj0nskjj52r80000gp/T//RtmpH7ykEs/downloaded\_packages

library(tidyr)

##   
## Attaching package: 'tidyr'

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

install.packages("dplyr",repos = "http://cran.us.r-project.org")

##   
## The downloaded binary packages are in  
## /var/folders/7n/3w87168x3kv3dj0nskjj52r80000gp/T//RtmpH7ykEs/downloaded\_packages

data\_new<-unite(raw\_data, Name, "First.Name","Last.Name", sep = " ")  
data\_new

## Start.Date End.Date Response.Type IP.Address Progress  
## 1 10/3/19 15:14 10/3/19 15:15 IP Address 160.39.69.129 100  
## 2 10/3/19 15:14 10/3/19 15:15 IP Address 160.39.69.28 100  
## 3 10/3/19 15:14 10/3/19 15:16 IP Address 160.39.69.129 100  
## 4 10/3/19 15:14 10/3/19 15:16 IP Address 160.39.69.129 100  
## 5 10/3/19 15:14 10/3/19 15:16 IP Address 160.39.69.129 100  
## 6 10/3/19 15:14 10/3/19 15:16 IP Address 160.39.69.129 100  
## 7 10/3/19 15:15 10/3/19 15:16 IP Address 160.39.69.129 100  
## 8 10/3/19 15:14 10/3/19 15:16 IP Address 160.39.69.129 100  
## 9 10/3/19 15:14 10/3/19 15:16 IP Address 160.39.69.28 100  
## 10 10/3/19 15:15 10/3/19 15:16 IP Address 160.39.69.129 100  
## 11 10/3/19 15:14 10/3/19 15:16 IP Address 160.39.69.129 100  
## 12 10/3/19 15:14 10/3/19 15:16 IP Address 160.39.69.129 100  
## 13 10/3/19 15:14 10/3/19 15:16 IP Address 160.39.69.28 100  
## 14 10/3/19 15:14 10/3/19 15:16 IP Address 160.39.69.129 100  
## 15 10/3/19 15:15 10/3/19 15:16 IP Address 160.39.69.129 100  
## 16 10/3/19 15:14 10/3/19 15:17 IP Address 160.39.69.129 100  
## 17 10/3/19 15:14 10/3/19 15:17 IP Address 160.39.69.129 100  
## 18 10/3/19 15:14 10/3/19 15:17 IP Address 160.39.69.129 100  
## 19 10/3/19 15:14 10/3/19 15:17 IP Address 160.39.69.129 100  
## 20 10/3/19 15:14 10/3/19 15:17 IP Address 160.39.69.129 100  
## 21 10/3/19 15:14 10/3/19 15:17 IP Address 160.39.69.129 100  
## 22 10/3/19 15:15 10/3/19 15:17 IP Address 160.39.69.129 100  
## 23 10/3/19 15:15 10/3/19 15:17 IP Address 160.39.69.129 100  
## 24 10/3/19 15:14 10/3/19 15:17 IP Address 160.39.69.28 100  
## 25 10/3/19 15:14 10/3/19 15:17 IP Address 160.39.69.129 100  
## 26 10/3/19 15:14 10/3/19 15:18 IP Address 160.39.69.129 100  
## 27 10/3/19 15:15 10/3/19 15:18 IP Address 160.39.69.129 100  
## 28 10/3/19 15:14 10/3/19 15:18 IP Address 160.39.69.129 100  
## 29 10/3/19 15:14 10/3/19 15:18 IP Address 160.39.69.28 100  
## 30 10/3/19 15:16 10/3/19 15:18 IP Address 160.39.69.129 100  
## 31 10/3/19 15:14 10/3/19 15:18 IP Address 160.39.69.129 100  
## 32 10/3/19 15:14 10/3/19 15:18 IP Address 160.39.69.129 100  
## 33 10/3/19 15:15 10/3/19 15:18 IP Address 160.39.69.28 100  
## 34 10/3/19 15:17 10/3/19 15:18 IP Address 160.39.69.129 100  
## 35 10/3/19 15:17 10/3/19 15:18 IP Address 160.39.69.28 100  
## 36 10/3/19 15:17 10/3/19 15:18 IP Address 160.39.69.28 100  
## 37 10/3/19 15:16 10/3/19 15:18 IP Address 160.39.69.129 100  
## 38 10/3/19 15:15 10/3/19 15:18 IP Address 160.39.69.129 100  
## 39 10/3/19 15:14 10/3/19 15:18 IP Address 160.39.69.129 100  
## 40 10/3/19 15:14 10/3/19 15:18 IP Address 160.39.69.129 100  
## 41 10/3/19 15:14 10/3/19 15:18 IP Address 160.39.69.129 100  
## 42 10/3/19 15:14 10/3/19 15:18 IP Address 160.39.69.129 100  
## 43 10/3/19 15:14 10/3/19 15:18 IP Address 160.39.69.28 100  
## 44 10/3/19 15:16 10/3/19 15:18 IP Address 160.39.69.28 100  
## 45 10/3/19 15:14 10/3/19 15:19 IP Address 160.39.69.129 100  
## 46 10/3/19 15:14 10/3/19 15:19 IP Address 160.39.69.129 100  
## 47 10/3/19 15:15 10/3/19 15:19 IP Address 160.39.69.129 100  
## 48 10/3/19 15:14 10/3/19 15:19 IP Address 160.39.69.129 100  
## 49 10/3/19 15:16 10/3/19 15:21 IP Address 160.39.69.28 100  
## 50 10/3/19 15:19 10/3/19 15:27 IP Address 160.39.69.129 100  
## 51 10/3/19 15:23 10/3/19 15:28 IP Address 172.58.235.63 100  
## 52 10/3/19 15:15 10/3/19 15:44 IP Address 160.39.69.28 100  
## 53 10/3/19 15:14 10/3/19 15:47 IP Address 160.39.69.129 100  
## Duration..in.seconds. Finished Recorded.Date Response.ID  
## 1 87 TRUE 10/3/19 15:15 R\_27dJLX5hbdxjUoR  
## 2 72 TRUE 10/3/19 15:15 R\_5iMeogh9eblmKml  
## 3 92 TRUE 10/3/19 15:16 R\_2PBDZUj91ZLieEG  
## 4 89 TRUE 10/3/19 15:16 R\_TcSbqrLAvFdIPqV  
## 5 95 TRUE 10/3/19 15:16 R\_3HC97LFgU5DZru2  
## 6 80 TRUE 10/3/19 15:16 R\_1rBtDP9kpwXmQ79  
## 7 66 TRUE 10/3/19 15:16 R\_1mqHZTquhCweI7n  
## 8 105 TRUE 10/3/19 15:16 R\_2DOmRnikBCqIq6e  
## 9 122 TRUE 10/3/19 15:16 R\_1QmRu26LD6MGEze  
## 10 62 TRUE 10/3/19 15:16 R\_YX2DnCiQTzgbMn7  
## 11 144 TRUE 10/3/19 15:16 R\_2c165wrzVdhz3Dc  
## 12 126 TRUE 10/3/19 15:16 R\_urJtBRAXy6FQeVH  
## 13 159 TRUE 10/3/19 15:16 R\_2uNU9ZbZpepw6Rb  
## 14 118 TRUE 10/3/19 15:16 R\_6Xw4usZOXrDvC3T  
## 15 70 TRUE 10/3/19 15:16 R\_3fUDfoBX0hoCL6J  
## 16 151 TRUE 10/3/19 15:17 R\_3MijAmcOkAyJrfP  
## 17 163 TRUE 10/3/19 15:17 R\_2E9VCHYM93KuxOy  
## 18 186 TRUE 10/3/19 15:17 R\_1NF8yJ5Ok9lkQm7  
## 19 158 TRUE 10/3/19 15:17 R\_2S1UmcQ2jVajs8e  
## 20 155 TRUE 10/3/19 15:17 R\_ebSole9AhZKmCZP  
## 21 162 TRUE 10/3/19 15:17 R\_1Ntu2tkMN6mOzHa  
## 22 142 TRUE 10/3/19 15:17 R\_2s6j78wCDgaep1V  
## 23 158 TRUE 10/3/19 15:17 R\_2zdW6dJE4rXbquD  
## 24 166 TRUE 10/3/19 15:17 R\_1OI85NgX9RJufcQ  
## 25 174 TRUE 10/3/19 15:17 R\_1DPckCcNUFqD7o7  
## 26 208 TRUE 10/3/19 15:18 R\_sv4ED1kwW93m5CV  
## 27 175 TRUE 10/3/19 15:18 R\_1hYdq1FHyZ0iFTT  
## 28 209 TRUE 10/3/19 15:18 R\_27NK13IpZP2AADM  
## 29 217 TRUE 10/3/19 15:18 R\_3ndCM7SHRXHPGsK  
## 30 85 TRUE 10/3/19 15:18 R\_3EQ2EXsAeTyQFNW  
## 31 211 TRUE 10/3/19 15:18 R\_2yjXiMjdk6hXO9n  
## 32 217 TRUE 10/3/19 15:18 R\_2fk9oC8JUdNdqFn  
## 33 163 TRUE 10/3/19 15:18 R\_33lsAhghE4hAC1u  
## 34 52 TRUE 10/3/19 15:18 R\_2Tpj0MpsyzEpQsy  
## 35 74 TRUE 10/3/19 15:18 R\_1OIuLXOOqMdfCeV  
## 36 54 TRUE 10/3/19 15:18 R\_31RTIRsgjZW7rw7  
## 37 134 TRUE 10/3/19 15:18 R\_3MsVhg9ACOUgsR3  
## 38 184 TRUE 10/3/19 15:18 R\_3Jxb82Gzl9u2H1L  
## 39 248 TRUE 10/3/19 15:18 R\_9SIx7QbtsTlismZ  
## 40 259 TRUE 10/3/19 15:18 R\_30qTnVlRvPUGWGI  
## 41 232 TRUE 10/3/19 15:18 R\_3CrE39NRq8M1tVD  
## 42 249 TRUE 10/3/19 15:18 R\_3ezDHe5GFBWreTI  
## 43 264 TRUE 10/3/19 15:18 R\_2aIxBdruL2dOEMd  
## 44 171 TRUE 10/3/19 15:18 R\_2SpYZYRtS9bTGCU  
## 45 268 TRUE 10/3/19 15:19 R\_1Q0l7L2OctsFxVC  
## 46 304 TRUE 10/3/19 15:19 R\_3GozoBcPMx5Gbsc  
## 47 222 TRUE 10/3/19 15:19 R\_3exf52H2nv2ns8z  
## 48 312 TRUE 10/3/19 15:19 R\_3nCRn7ALL9Wcyx6  
## 49 307 TRUE 10/3/19 15:21 R\_214DiGxiPYEJQO3  
## 50 474 TRUE 10/3/19 15:27 R\_V21R9DlAPZBSfux  
## 51 288 TRUE 10/3/19 15:28 R\_1ODG5LnfvKpBZIu  
## 52 1711 TRUE 10/3/19 15:44 R\_1pLlUcOHWHjy6C1  
## 53 1977 TRUE 10/3/19 15:47 R\_2B35cGkqBuD0Ov5  
## Recipient.Last.Name Recipient.First.Name Recipient.Email  
## 1 NA NA NA  
## 2 NA NA NA  
## 3 NA NA NA  
## 4 NA NA NA  
## 5 NA NA NA  
## 6 NA NA NA  
## 7 NA NA NA  
## 8 NA NA NA  
## 9 NA NA NA  
## 10 NA NA NA  
## 11 NA NA NA  
## 12 NA NA NA  
## 13 NA NA NA  
## 14 NA NA NA  
## 15 NA NA NA  
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## 20 NA NA NA  
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## 46 NA NA NA  
## 47 NA NA NA  
## 48 NA NA NA  
## 49 NA NA NA  
## 50 NA NA NA  
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## External.Data.Reference Location.Latitude Location.Longitude  
## 1 NA 40.8000 -73.9763  
## 2 NA 40.8000 -73.9763  
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## 12 NA 40.8000 -73.9763  
## 13 NA 40.8000 -73.9763  
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## 25 NA 40.8000 -73.9763  
## 26 NA 40.8000 -73.9763  
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## 29 NA 40.8000 -73.9763  
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## 31 NA 40.8000 -73.9763  
## 32 NA 40.8000 -73.9763  
## 33 NA 40.8000 -73.9763  
## 34 NA 40.8000 -73.9763  
## 35 NA 40.8000 -73.9763  
## 36 NA 40.8000 -73.9763  
## 37 NA 40.8000 -73.9763  
## 38 NA 40.8000 -73.9763  
## 39 NA 40.8000 -73.9763  
## 40 NA 40.8000 -73.9763  
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## 42 NA 40.8000 -73.9763  
## 43 NA 40.8000 -73.9763  
## 44 NA 40.8000 -73.9763  
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## 46 NA 40.8000 -73.9763  
## 47 NA 40.8000 -73.9763  
## 48 NA 40.8000 -73.9763  
## 49 NA 40.8000 -73.9763  
## 50 NA 40.8000 -73.9763  
## 51 NA 40.7415 -74.2330  
## 52 NA 40.8000 -73.9763  
## 53 NA 40.8000 -73.9763  
## Distribution.Channel User.Language Name  
## 1 anonymous EN Artemas Wang  
## 2 anonymous EN Yawei Zhu  
## 3 anonymous EN Ningyao Xu  
## 4 anonymous EN Qiyang Lin  
## 5 anonymous EN Bernell Downer  
## 6 anonymous EN Ruiqi Wang  
## 7 anonymous EN Leonardo Restrepo  
## 8 anonymous EN Zhaozhuo Zheng  
## 9 anonymous EN Jiancong Shen  
## 10 anonymous EN ZIFAN CAO  
## 11 anonymous EN Allison Teevan  
## 12 anonymous EN Yiwen Ma  
## 13 anonymous EN Beibei Cao  
## 14 anonymous EN yixiao li  
## 15 anonymous EN xinyi zhou  
## 16 anonymous EN Jingru Zhang  
## 17 anonymous EN Ziyuan Guo  
## 18 anonymous EN Timothy Lee  
## 19 anonymous EN XI YANG  
## 20 anonymous EN Chenyu Yan  
## 21 anonymous EN Yiyi Xie  
## 22 anonymous EN Di Mao  
## 23 anonymous EN Han Wang  
## 24 anonymous EN Xiaowen Chen  
## 25 anonymous EN Anqi Duan  
## 26 anonymous EN Ling Ai  
## 27 anonymous EN Yiwei Qi  
## 28 anonymous EN jiahao guo  
## 29 anonymous EN LINGLING MIAO  
## 30 anonymous EN Shijie Shao  
## 31 anonymous EN Yujun Zhang  
## 32 anonymous EN chaoxiong chen  
## 33 anonymous EN Lintong Li  
## 34 anonymous EN ZIMO CHEN  
## 35 anonymous EN HAN GE  
## 36 anonymous EN Alysandra Zhang  
## 37 anonymous EN Yixuan Zhu  
## 38 anonymous EN XUDIAN ZHANG  
## 39 anonymous EN YAQI LU  
## 40 anonymous EN Christine Odenath  
## 41 anonymous EN David Pearce  
## 42 anonymous EN Chengxuan Hu  
## 43 anonymous EN Zhongyuan Zhang  
## 44 anonymous EN Maho Hayashi  
## 45 anonymous EN Minruo Wang  
## 46 anonymous EN Jie Chen  
## 47 anonymous EN INDIRA BATAYEVA  
## 48 anonymous EN Eudora Xinyi Niu  
## 49 anonymous EN Joellyn Heng  
## 50 anonymous EN Yigao Liu  
## 51 anonymous EN Wanruo Zhang  
## 52 anonymous EN Suwon Jung  
## 53 anonymous EN Luyi Dai  
## UNI..the.two.letters.followed.by.four.numbers.that.make.up.your.email.address..eg.kh4513.  
## 1 adw2184  
## 2 yz3413  
## 3 nx2150  
## 4 ql2360  
## 5 bkd2115  
## 6 RW2796  
## 7 lr2956  
## 8 zz2726  
## 9 js5498  
## 10 ZC2323  
## 11 art2172  
## 12 ym2775  
## 13 bc2824  
## 14 yl4284  
## 15 XZ2910  
## 16 jz3101  
## 17 zg2338  
## 18 xql2001  
## 19 XY2418  
## 20 cy2535  
## 21 yx2531  
## 22 dm3487  
## 23 hw2663  
## 24 xc2496  
## 25 ad3671  
## 26 la2738  
## 27 yq2257  
## 28 jg4191  
## 29 lm3477  
## 30 ss5851  
## 31 yz3679  
## 32 cc97760n@pace.edu  
## 33 ll3358  
## 34 ZC2505  
## 35 HG2527  
## 36 ajz2123  
## 37 yz3730  
## 38 xz2840  
## 39 yl3984  
## 40 CLO2112  
## 41 kdp2124  
## 42 ch3460  
## 43 zz2641  
## 44 mh3054  
## 45 mw3399  
## 46 jc5230  
## 47 IB2445  
## 48 xn2135  
## 49 jh4175  
## 50 yl4232  
## 51 wz2508  
## 52 sj2562  
## 53 ld2882  
## Class.1 Class.2 Class.3 Class.4 Class.5 Class.6  
## 1 HUDK 4050 HUDK 4052 HUDM 5026   
## 2 HUDK 4050 HUDK 4052 HUDK 5053   
## 3 HUDK 4050 HUDM 4125 HUDM 5126 HUDM 5026   
## 4 HUDK 4050 HUDM 4122 HUDK 4029 HUDK 4080   
## 5 HUDK 4050 HUDK 4052 HUDM 5126 QMSS GR5067   
## 6 HUDM4125 HUDM5026 HUDM5126 A&HA4063   
## 7 HUDM 5122 HUDM 5026 HUDK 4052 HUDK 4050   
## 8 HUDK4050 HUDK4052 HUDM4122 HUDM4120   
## 9 HUDK 4052 HUDK 4050 HUDK 4029 HUDM 4050   
## 10 HUDK4050   
## 11 HUDK 4050   
## 12 HUDK 4050 HUDM 5026 HUDM 5126 HUDM 4125   
## 13 HUDK 4050 EDPE 6151 EDPE 4155 EDPA 4047   
## 14 HUDK4050 IFSF4090002 EDPS4002001 EDPS4021001   
## 15 HUDK4050 HUDM4122 HUDK4052 MSTU4039   
## 16 HUDK 4050 HUDM 4125 HUDM 5126 ORLD 4051   
## 17 HUDK4050 HUDM5026 HUDM4125 HUDM5126   
## 18 HUDK 4050 HUDK 4052 G 5067 G 5072   
## 19 HUDK4050 HUDM4125 HUDM5026 HUDM5126   
## 20 CCPX 4023 HUD 4120 HUDK 4050 HUDK 4052 HUDM 4122   
## 21 HUDK 4052 HUDK 4050 B 8306 HUDM 4122   
## 22 HUDM 5026 HUDM 5126 HUDM 4125 HUDK4050 QMSS G 5015   
## 23 HUDK 4050 HUDK 5011 MSTU 5027   
## 24 HUDK4029 HUDK4050 HUDK4052 HUDM5123   
## 25 HUDK 4050 HUDK 4052 MSTU 4052 HUDM 5122   
## 26 HUDK4050 HUDK5053 MSTU5002 MSTU4023   
## 27 HUDK 4050 HUDK 5023 HUD 4120   
## 28 HUDK4050 HUDM4125 HUDM5126 HUDM5026   
## 29 HUDM 4125 HUDM 5026 HUDM 5126 HUDK 4050   
## 30 HUDK4050 HUDM4125 HUDM5026 HUDM5126   
## 31 HUDK4050 HUDK4052 HUDK4080 HUDM5026 MSTU4052   
## 32 HUDK4050 HUDK4052 HUDK4029 CCPJ5056   
## 33 HUDM 5026 HUDK 4052 HUDK 4050 HUDK 4029   
## 34 4050 4125 5026 5126   
## 35 HUDK4050 HUDK4052 HUDK4029 MSTU4031 HUDM5123   
## 36 HUDM4122 CCPX4023 HUDK4050   
## 37 HUDK 4050 HUDK 4052 HUDK 4029 MSTU 4039   
## 38 HUDK 4050 HUDM 4125 HUDM 5026 HUDM 5126 QMSS 5015   
## 39 HUDK 4050 EDPE 4056 ORLD 4085 EDPA 6002   
## 40 BBSN 5007 HUDK 4050   
## 41 HUDK 4050 HUDK 4029 BBSN 5019 HUDM 5026 BBSN 4904   
## 42 HUDK4050 HUDM4125 HUDM5126 HUDM5026   
## 43 HUDK 4050 HUDK 4052 HUDM 5122 HUDM 5026   
## 44 HUDK 4050 MSTU 4000 MSTU 5003 MSTU 4083 MSTU 4052   
## 45 HUDK4050 HUDM4122 QMSS-G5072 ITSF4098   
## 46 HUDK 4050 HUDK 4052 HUDK 4029 COMS 4706   
## 47 HUDK4029 HUDK4080 HUDM4120 HUDK4050   
## 48 ITSF4090 ITSF5008 ITSF5035 HUDK4050   
## 49 HUDK 4050 QMSS 5010 QMSS 5015 QMSS 5072 STAT 4205 QMSS 5021  
## 50 HUDK4050 ITSF4090 ITSF4025 ITSF5035   
## 51 HUDK4050 HUDK4029 HUDK4052 CCPJ5062 A&HA4063   
## 52 HUDK4050 HUDK4052 HUDK4029   
## 53 HUDK 4050 HUDM 4125 HUDM 5026 HUDM 5126   
## I.agree.to.participate.in.this.study  
## 1 Yes  
## 2 Yes  
## 3 Yes  
## 4 Yes  
## 5 Yes  
## 6 Yes  
## 7 Yes  
## 8 Yes  
## 9 Yes  
## 10 Yes  
## 11 No  
## 12 Yes  
## 13 Yes  
## 14 Yes  
## 15 Yes  
## 16 Yes  
## 17 Yes  
## 18 Yes  
## 19 Yes  
## 20 Yes  
## 21 Yes  
## 22 Yes  
## 23 Yes  
## 24 Yes  
## 25 Yes  
## 26 Yes  
## 27 Yes  
## 28 Yes  
## 29 Yes  
## 30 Yes  
## 31 Yes  
## 32 Yes  
## 33 Yes  
## 34 Yes  
## 35 Yes  
## 36 Yes  
## 37 Yes  
## 38 No  
## 39 Yes  
## 40 Yes  
## 41 No  
## 42 No  
## 43 Yes  
## 44 Yes  
## 45 Yes  
## 46 Yes  
## 47 Yes  
## 48 No  
## 49 Yes  
## 50 Yes  
## 51 Yes  
## 52 Yes  
## 53 Yes  
## WHO.MAY.VIEW.MY.PARTICIPATION.IN.THIS.STUDY  
## 1 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 2 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 3 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 4 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 5 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 6 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 7 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 8 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 9 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 10 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 11 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 12 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 13 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 14 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 15 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 16 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 17 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 18 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 19 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 20 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 21 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 22 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 23 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 24 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 25 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 26 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 27 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 28 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 29 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 30 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 31 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 32 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 33 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 34 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 35 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 36 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 37 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 38 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 39 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 40 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 41 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 42 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 43 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 44 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 45 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 46 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 47 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 48 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 49 I consent to allow written materials viewed at an educational setting or at a conference outside of Teachers College  
## 50 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 51 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 52 I do not consent to allow written materials viewed outside of Teachers College Columbia University  
## 53 I do not consent to allow written materials viewed outside of Teachers College Columbia University

rownames(data\_new) <- data\_new$Name  
class <- data\_new %>% select(Student\_name = 'Name',  
 Class1 = 'Class.1',  
 Class2 = 'Class.2',  
 Class3 = 'Class.3',  
 Class4 = 'Class.4',  
 Class5 = 'Class.5',  
 Class6 = 'Class.6')  
class

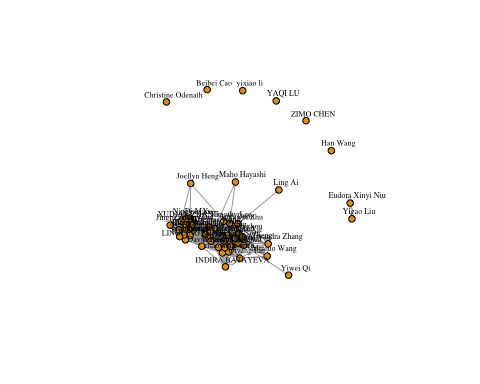
## Student\_name Class1 Class2 Class3  
## Artemas Wang Artemas Wang HUDK 4050 HUDK 4052 HUDM 5026  
## Yawei Zhu Yawei Zhu HUDK 4050 HUDK 4052 HUDK 5053  
## Ningyao Xu Ningyao Xu HUDK 4050 HUDM 4125 HUDM 5126  
## Qiyang Lin Qiyang Lin HUDK 4050 HUDM 4122 HUDK 4029  
## Bernell Downer Bernell Downer HUDK 4050 HUDK 4052 HUDM 5126  
## Ruiqi Wang Ruiqi Wang HUDM4125 HUDM5026 HUDM5126  
## Leonardo Restrepo Leonardo Restrepo HUDM 5122 HUDM 5026 HUDK 4052  
## Zhaozhuo Zheng Zhaozhuo Zheng HUDK4050 HUDK4052 HUDM4122  
## Jiancong Shen Jiancong Shen HUDK 4052 HUDK 4050 HUDK 4029  
## ZIFAN CAO ZIFAN CAO HUDK4050   
## Allison Teevan Allison Teevan HUDK 4050   
## Yiwen Ma Yiwen Ma HUDK 4050 HUDM 5026 HUDM 5126  
## Beibei Cao Beibei Cao HUDK 4050 EDPE 6151 EDPE 4155  
## yixiao li yixiao li HUDK4050 IFSF4090002 EDPS4002001  
## xinyi zhou xinyi zhou HUDK4050 HUDM4122 HUDK4052  
## Jingru Zhang Jingru Zhang HUDK 4050 HUDM 4125 HUDM 5126  
## Ziyuan Guo Ziyuan Guo HUDK4050 HUDM5026 HUDM4125  
## Timothy Lee Timothy Lee HUDK 4050 HUDK 4052 G 5067  
## XI YANG XI YANG HUDK4050 HUDM4125 HUDM5026  
## Chenyu Yan Chenyu Yan CCPX 4023 HUD 4120 HUDK 4050  
## Yiyi Xie Yiyi Xie HUDK 4052 HUDK 4050 B 8306  
## Di Mao Di Mao HUDM 5026 HUDM 5126 HUDM 4125  
## Han Wang Han Wang HUDK 4050 HUDK 5011 MSTU 5027  
## Xiaowen Chen Xiaowen Chen HUDK4029 HUDK4050 HUDK4052  
## Anqi Duan Anqi Duan HUDK 4050 HUDK 4052 MSTU 4052  
## Ling Ai Ling Ai HUDK4050 HUDK5053 MSTU5002  
## Yiwei Qi Yiwei Qi HUDK 4050 HUDK 5023 HUD 4120  
## jiahao guo jiahao guo HUDK4050 HUDM4125 HUDM5126  
## LINGLING MIAO LINGLING MIAO HUDM 4125 HUDM 5026 HUDM 5126  
## Shijie Shao Shijie Shao HUDK4050 HUDM4125 HUDM5026  
## Yujun Zhang Yujun Zhang HUDK4050 HUDK4052 HUDK4080  
## chaoxiong chen chaoxiong chen HUDK4050 HUDK4052 HUDK4029  
## Lintong Li Lintong Li HUDM 5026 HUDK 4052 HUDK 4050  
## ZIMO CHEN ZIMO CHEN 4050 4125 5026  
## HAN GE HAN GE HUDK4050 HUDK4052 HUDK4029  
## Alysandra Zhang Alysandra Zhang HUDM4122 CCPX4023 HUDK4050  
## Yixuan Zhu Yixuan Zhu HUDK 4050 HUDK 4052 HUDK 4029  
## XUDIAN ZHANG XUDIAN ZHANG HUDK 4050 HUDM 4125 HUDM 5026  
## YAQI LU YAQI LU HUDK 4050 EDPE 4056 ORLD 4085  
## Christine Odenath Christine Odenath BBSN 5007 HUDK 4050   
## David Pearce David Pearce HUDK 4050 HUDK 4029 BBSN 5019  
## Chengxuan Hu Chengxuan Hu HUDK4050 HUDM4125 HUDM5126  
## Zhongyuan Zhang Zhongyuan Zhang HUDK 4050 HUDK 4052 HUDM 5122  
## Maho Hayashi Maho Hayashi HUDK 4050 MSTU 4000 MSTU 5003  
## Minruo Wang Minruo Wang HUDK4050 HUDM4122 QMSS-G5072  
## Jie Chen Jie Chen HUDK 4050 HUDK 4052 HUDK 4029  
## INDIRA BATAYEVA INDIRA BATAYEVA HUDK4029 HUDK4080 HUDM4120  
## Eudora Xinyi Niu Eudora Xinyi Niu ITSF4090 ITSF5008 ITSF5035  
## Joellyn Heng Joellyn Heng HUDK 4050 QMSS 5010 QMSS 5015  
## Yigao Liu Yigao Liu HUDK4050 ITSF4090 ITSF4025  
## Wanruo Zhang Wanruo Zhang HUDK4050 HUDK4029 HUDK4052  
## Suwon Jung Suwon Jung HUDK4050 HUDK4052 HUDK4029  
## Luyi Dai Luyi Dai HUDK 4050 HUDM 4125 HUDM 5026  
## Class4 Class5 Class6  
## Artemas Wang   
## Yawei Zhu   
## Ningyao Xu HUDM 5026   
## Qiyang Lin HUDK 4080   
## Bernell Downer QMSS GR5067   
## Ruiqi Wang A&HA4063   
## Leonardo Restrepo HUDK 4050   
## Zhaozhuo Zheng HUDM4120   
## Jiancong Shen HUDM 4050   
## ZIFAN CAO   
## Allison Teevan   
## Yiwen Ma HUDM 4125   
## Beibei Cao EDPA 4047   
## yixiao li EDPS4021001   
## xinyi zhou MSTU4039   
## Jingru Zhang ORLD 4051   
## Ziyuan Guo HUDM5126   
## Timothy Lee G 5072   
## XI YANG HUDM5126   
## Chenyu Yan HUDK 4052 HUDM 4122   
## Yiyi Xie HUDM 4122   
## Di Mao HUDK4050 QMSS G 5015   
## Han Wang   
## Xiaowen Chen HUDM5123   
## Anqi Duan HUDM 5122   
## Ling Ai MSTU4023   
## Yiwei Qi   
## jiahao guo HUDM5026   
## LINGLING MIAO HUDK 4050   
## Shijie Shao HUDM5126   
## Yujun Zhang HUDM5026 MSTU4052   
## chaoxiong chen CCPJ5056   
## Lintong Li HUDK 4029   
## ZIMO CHEN 5126   
## HAN GE MSTU4031 HUDM5123   
## Alysandra Zhang   
## Yixuan Zhu MSTU 4039   
## XUDIAN ZHANG HUDM 5126 QMSS 5015   
## YAQI LU EDPA 6002   
## Christine Odenath   
## David Pearce HUDM 5026 BBSN 4904   
## Chengxuan Hu HUDM5026   
## Zhongyuan Zhang HUDM 5026   
## Maho Hayashi MSTU 4083 MSTU 4052   
## Minruo Wang ITSF4098   
## Jie Chen COMS 4706   
## INDIRA BATAYEVA HUDK4050   
## Eudora Xinyi Niu HUDK4050   
## Joellyn Heng QMSS 5072 STAT 4205 QMSS 5021  
## Yigao Liu ITSF5035   
## Wanruo Zhang CCPJ5062 A&HA4063   
## Suwon Jung   
## Luyi Dai HUDM 5126

#make the students with courses.   
person\_class <- class %>%  
 tibble::rowid\_to\_column() %>%   
 gather(key = class,  
 value = course\_num,  
 c(Class1, Class2, Class3, Class4, Class5, Class6), -Student\_name) %>%  
 select(Student\_name, course\_num) %>%  
 filter(!is.na(course\_num)) %>%  
 arrange(Student\_name)

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

#clean the data  
#I found that the course numbers are typed in, thus, the course codes are not in the same format. We need to have some steps to work on cleaning  
#The first step is to make sure the foundational formats are same, such that, there is a blank between department name and number.   
person\_class$course\_num <- gsub(pattern = " ",  
 replacement = "",  
 x = person\_class$course\_num)  
#Some student didn't provide the department name in the course code. We will remove that record.  
person\_class <- person\_class %>%  
 filter(Student\_name != "ZIMO")  
#Some other replacements of formatting  
person\_class$course\_num <- gsub(pattern = "QMSS",  
 replacement = "G",  
 x = person\_class$course\_num)  
  
person\_class$course\_num <- gsub(pattern = "QMSS-",  
 replacement = "",  
 x = person\_class$course\_num)  
  
person\_class$course\_num <- gsub(pattern = "GG",  
 replacement = "G",  
 x = person\_class$course\_num)  
person\_class$course\_num <- gsub(pattern = "GR",  
 replacement = "G",  
 x = person\_class$course\_num)  
#Since all of us are taking the same course as HUDK 4050. So everyone was linked. In order to have a more obvious looking. We will filter out the HUDK 4050 records.  
person\_class<- person\_class %>%  
 filter(course\_num != "HUDK4050")  
#Yah! It seems that we have a cleaned data now!😄🎉  
inclass<-ifelse(person\_class$course\_num=="",person\_class$inclass<-0,person\_class$inclass<-1)  
DF<-person\_class[!person\_class$course\_num=="",]  
DF<-spread(DF,course\_num,inclass,fill=0)

#Now,it's the time to build the matrix.   
  
person\_class\_data<-subset(DF,select= -Student\_name)  
  
#create matrix  
person\_class\_matrix<-as.matrix(DF)  
row.names(person\_class\_matrix)<-DF$Student\_name  
person\_class\_matrix<-person\_class\_matrix[,-1]  
person\_class\_matrix<-apply(person\_class\_matrix,2,as.numeric)  
class\_person\_matrix<-t(person\_class\_matrix)  
row.names(person\_class\_matrix)<-DF$Student\_name  
person\_person\_matrix <- person\_class\_matrix%\*%class\_person\_matrix  
  
  
#Change the diagonals to NA becasue they won't connect to themselves  
diag(x = person\_person\_matrix) <- NA  
person\_person\_graph <- graph\_from\_adjacency\_matrix(person\_person\_matrix, mode = "undirected")  
plot.igraph(person\_person\_graph,  
 layout = layout.fruchterman.reingold,  
 vertex.size = 7,  
 vertex.label.cex =0.5 ,  
 vertex.label = DF$Student\_name,  
 vertex.label.dist=1.5,  
 vertex.label.color="black")



Once you have done this, also [look up](http://igraph.org/r/) how to generate the following network metrics: betweeness centrality and degree. **Who is the most central person in the network?**

# degree  
#Betweenness Centrality  
betweeness\_centrality <- betweenness(person\_person\_graph)  
betweeness\_centrality[betweeness\_centrality == max(betweeness\_centrality)]

## [1] 73.90173

#It seems that Yujun is the betweenness Centrality  
# Degree  
degrees <- degree(person\_person\_graph)  
degrees[degrees == max(degrees)]

## [1] 48

#It seems that Lintong is the betweeness Centrality

Once you have done this, also [look up](http://igraph.org/r/) how to generate the following network metrics: betweeness centrality and dregree. **Who is the most central person in the network?**

### To Submit Your Assignment

Please submit your assignment by first “knitting” your RMarkdown document into an html file and then comit, push and pull request both the RMarkdown file and the html file.