STAT6289 Network HW4

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I. Background

The data is about the Hollywood movies and actors' data. There are 1365 nodes (160 movies and 1205 actors) and 1600 edges in the network data. As the data has two types of nodes, one is actor node and the other one is group nodes, we will use affiliation network knowledge to analysis it.

Affiliation network: It is a network where members are affiliated with one another based on co-membership in a group, or co-participation in some type of event. In this homework, we will use two-mode network and Bipartite graphs to analysis network.

Also, in all these three parts, we will use kinds of methods to extract information from the network to show plots via different angles (movie and actor subgraph).

II. Part I

The vertex has an attribution called name, so we can use it to see the name of movies and actors. Also, we can check the type of the nodes as the network is a two-mode model. If the node belongs to actor, the type should be false and the group corresponding type is true. What we can see from the analysis is that the first 160 nodes have the true type and the rest 1205 have false type.

```{r}
V(h1)$type[155:165]
```

```
 [1]  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE
```

Here is the summary of the data.

```{r}
h1
```

```
IGRAPH 9cdab39 UN-B 1365 1600 --
+ attr: name (v/c), type (v/l), year (v/n), IMDBrating (v/n), MPAArating (v/c)
+ edges from 9cdab39 (vertex names):
 [1] Inception          --Leonardo DiCaprio    Inception          --Joseph Gordon-Levitt
 [3] Inception          --Ellen Page           Inception          --Tom Hardy
 [5] Inception          --Ken Watanabe         Inception          --Dileep Rao
 [7] Inception          --Cillian Murphy       Inception          --Tom Berenger
 [9] Inception          --Marion Cotillard     Inception          --Pete Postlethwaite
[11] Alice in Wonderland--Johnny Depp          Alice in Wonderland--Mia Wasikowska
[13] Alice in Wonderland--Helena Bonham Carter Alice in Wonderland--Anne Hathaway
[15] Alice in Wonderland--Crispin Glover       Alice in Wonderland--Matt Lucas
+ ... omitted several edges
```

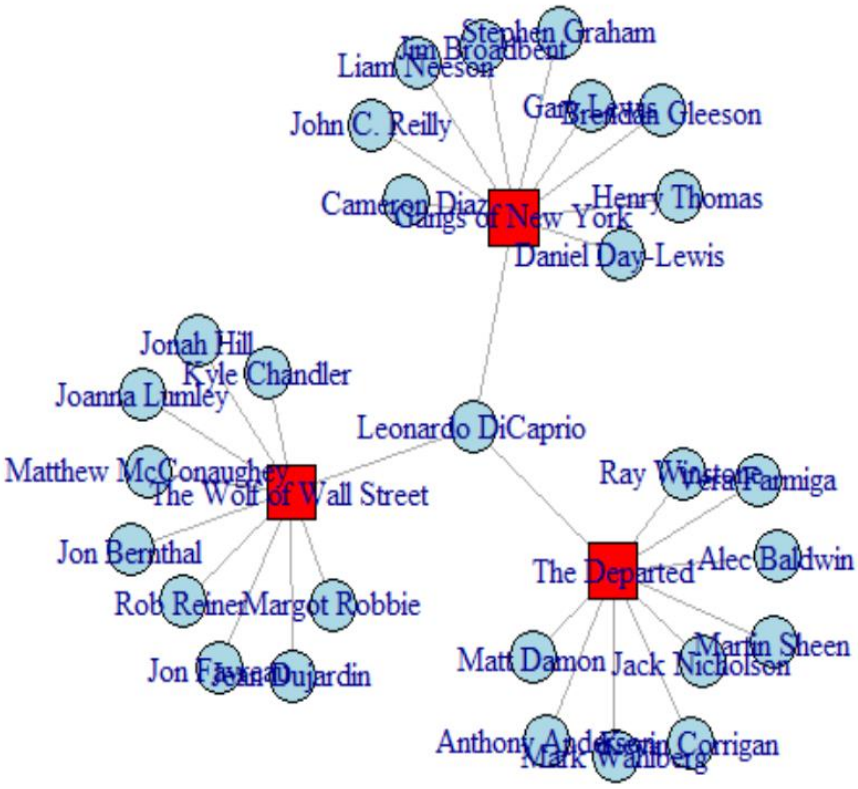
There are 1365 nodes and 1600 edges (160 movies and 1205 actors). There are a few attributes in the data: name, type(to show 2-mode),year, rating, etc.

According to the summary, we can know that the name is the vertex of character, type is true or false, the year is numeric, two ratings one is numeric and the other one is character (R/PG-13).

```r
#if type is group, we use square to represent node, if it is actor, use circle
V(h1)$shape <- ifelse(
   V(h1)$type==TRUE,
   "square","circle")

#same idea to use corresponding color
V(h1)$color <- ifelse(
   V(h1)$type==TRUE,
   "red","lightblue")
```

We can use *if-else* function to attribute shapes and colors to nodes according to the type of nodes.

The next step, we can draw some specific network graph. By using filtering character, we can find three movies' nodes and their actors nodes.



The next step is to figure out how many actors in each movie.

```{r}
#to show number of movies each actor has, 955 actors engaged in one movie
#only one actor has 8 moives and it turned out to be HarryPorter
table(degree(h1,v=V(h1)[type==FALSE]))

#average number of movies each actor has
mean(degree(h1,v=V(h1)[type==FALSE]))

V(h1)$deg <- degree(h1)
V(h1)[type==FALSE & deg > 4]$name
#to show the actor that has more than 4 moives
```

```
  1   2   3   4   5   6   7   8
955 165  47  23  11   2   1   1
[1] 1.327801
 [1] "Leonardo DiCaprio" "Emma Watson"       "Richard Griffiths" "Harry Melling"
 [5] "Daniel Radcliffe"  "Rupert Grint"      "James Franco"      "Ian McKellen"
 [9] "Martin Freeman"    "Bradley Cooper"    "Christian Bale"    "Samuel L. Jackson"
[13] "Natalie Portman"   "Brad Pitt"         "Liam Neeson"
```

It turns out that 955 actors only act one movie and the max number of movies one single actor has is 8. The average number is 1.328. And we can filter those actors whose degrees are more than four. Those actors are familiar with us.

```{r}
busy_actor <- data.frame(cbind(Actor = V(h1)[type==FALSE& deg > 4]$name,Movies =
V(h1)[type==FALSE& deg > 4]$deg))
busy_actor[order(busy_actor$Movies,decreasing=TRUE),]
# to show the busy actors and their corresponding number of movies
```

	Actor <chr>	Movies <chr>
5	Daniel Radcliffe	8
11	Christian Bale	7
1	Leonardo DiCaprio	6
2	Emma Watson	6
3	Richard Griffiths	5
4	Harry Melling	5
6	Rupert Grint	5
7	James Franco	5
8	Ian McKellen	5
9	Martin Freeman	5

1-10 of 15 rows Previous 1 2

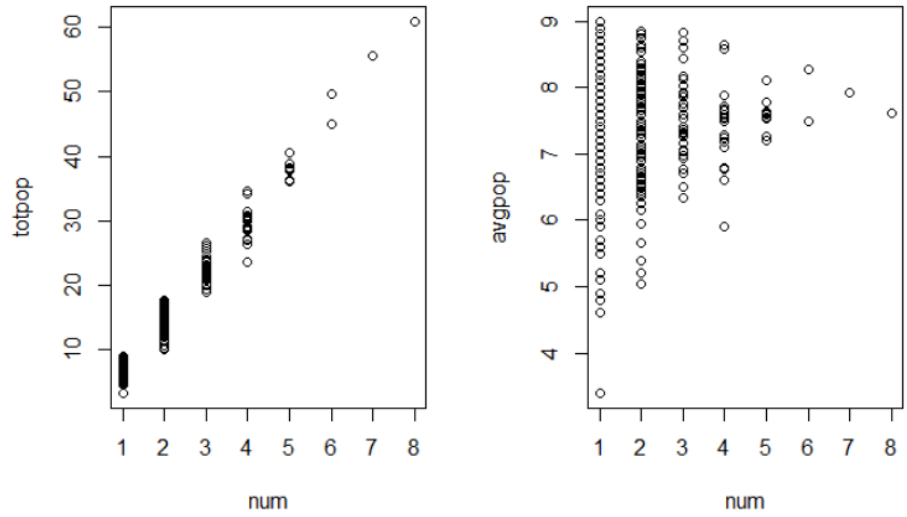
Here is the list that showed how many movies one single actor has. It showed that the HorryPoter series' actor appeared mostly.

For the next step, we can analysis how popular the actors are and the relationship between busyness and popular level.

	Actor <chr>	Popularity <chr>
3	Daniel Radcliffe	60.9
4	Christian Bale	55.5
1	Leonardo DiCaprio	49.6
2	Emma Watson	45
5	Brad Pitt	40.5

5 rows

The table showed the total score is similar which the last table.

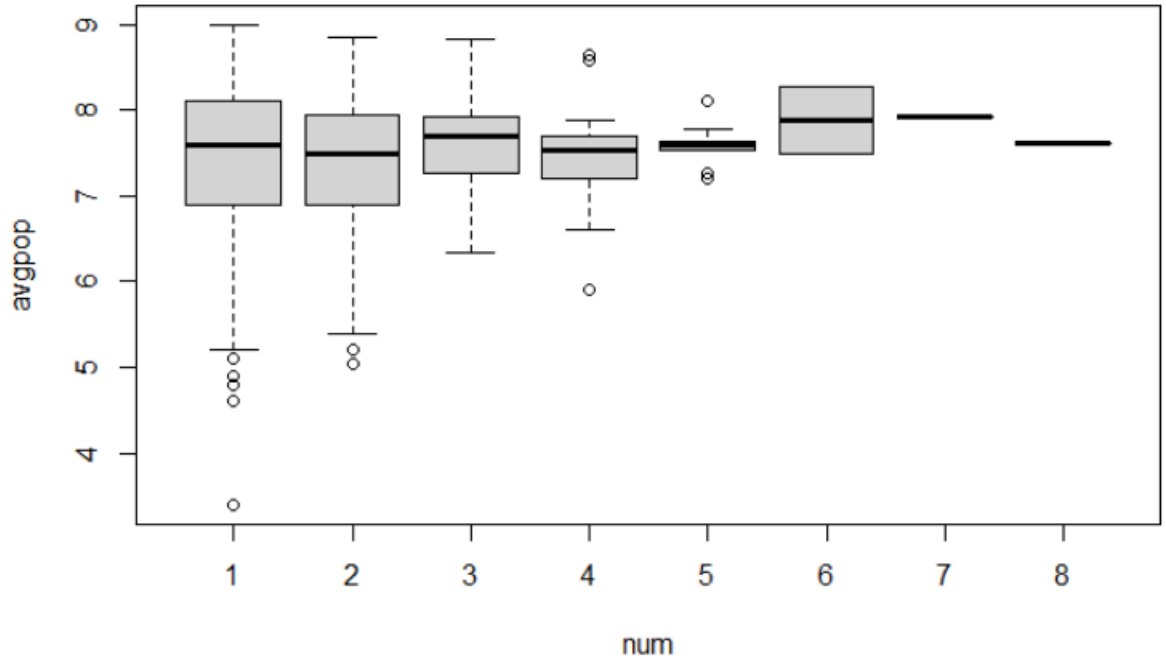



```{r}
summary(lm(avgpop~num))
```

```
Call:
lm(formula = avgpop ~ num)

Residuals:
    Min      1Q  Median      3Q     Max
-3.9858 -0.4330  0.1977  0.6170  1.6142

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  7.33868    0.05440 134.911   <2e-16 ***
num          0.04714    0.03527   1.337    0.182
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.9605 on 1203 degrees of freedom
Multiple R-squared:  0.001483,  Adjusted R-squared:  0.0006528
F-statistic: 1.786 on 1 and 1203 DF,  p-value: 0.1816
```

```
There is no significance to show the more movies the actor has the more population the actor is.
```

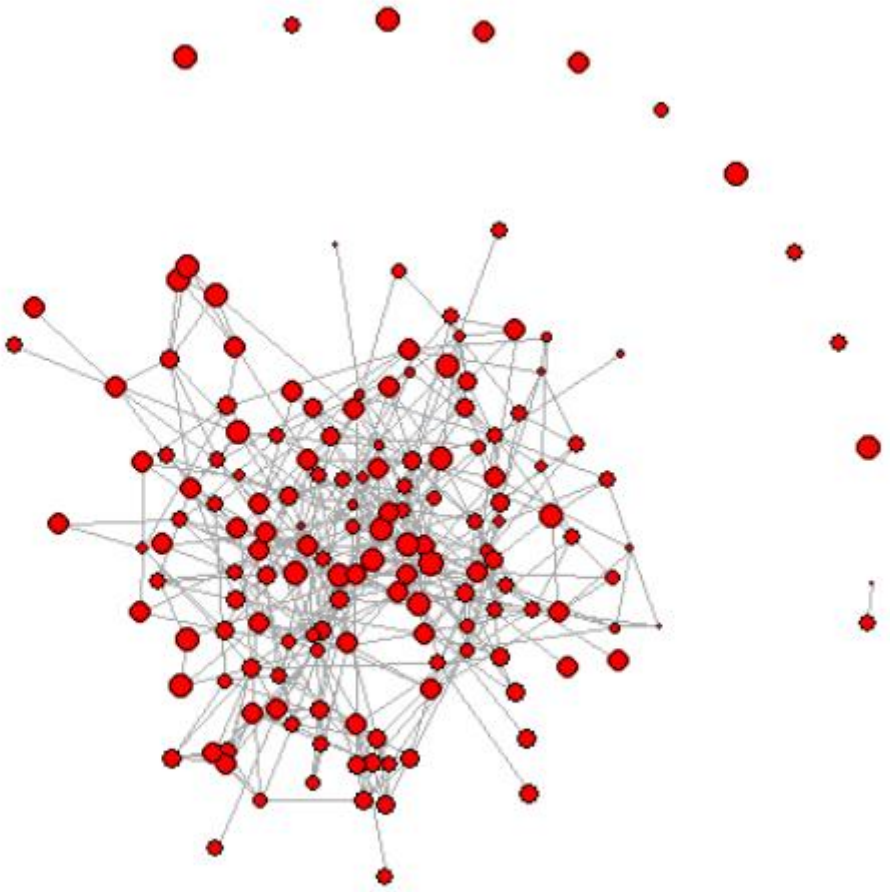
From the results above, we can know that the parameter of number is not significant. So we can get the result the number of movies has no relationship with popular.



And from the boxplot, we can see that whatever the number is, the rate of popular is always around 7.5.

We will do the projection. We will divide the network into actor network and movie network. Here are the summaries.

```
IGRAPH bf2d173 UNW- 1205 6903 --
+ attr: name (v/c), year (v/n), IMDBrating (v/n), MPAArating (v/c), shape (v/c),
| color (v/c), deg (v/n), totrating (v/n), avgrating (v/n), weight (e/n)
+ edges from bf2d173 (vertex names):
 [1] Leonardo DiCaprio--Joseph Gordon-Levitt Leonardo DiCaprio--Ellen Page
 [3] Leonardo DiCaprio--Tom Hardy            Leonardo DiCaprio--Ken Watanabe
 [5] Leonardo DiCaprio--Dileep Rao           Leonardo DiCaprio--Cillian Murphy
 [7] Leonardo DiCaprio--Tom Berenger         Leonardo DiCaprio--Marion Cotillard
 [9] Leonardo DiCaprio--Pete Postlethwaite   Leonardo DiCaprio--Jonah Hill
[11] Leonardo DiCaprio--Matthew McConaughey  Leonardo DiCaprio--Margot Robbie
[13] Leonardo DiCaprio--Kyle Chandler        Leonardo DiCaprio--Rob Reiner
+ ... omitted several edges
IGRAPH bf2d173 UNW- 160 472 --
+ attr: name (v/c), year (v/n), IMDBrating (v/n), MPAArating (v/c), shape (v/c),
| color (v/c), deg (v/n), totrating (v/n), avgrating (v/n), weight (e/n)
+ edges from bf2d173 (vertex names):
 [1] Inception--The Wolf of Wall Street    Inception--Django Unchained
 [3] Inception--The Departed               Inception--Gangs of New York
 [5] Inception--Catch Me If You Can        Inception--The Dark Knight Rises
 [7] Inception--10 Things I Hate About You Inception--Batman Begins
 [9] Inception--The Dark Knight            Inception--Training Day
[11] Inception--Big Fish
+ ... omitted several edges
```

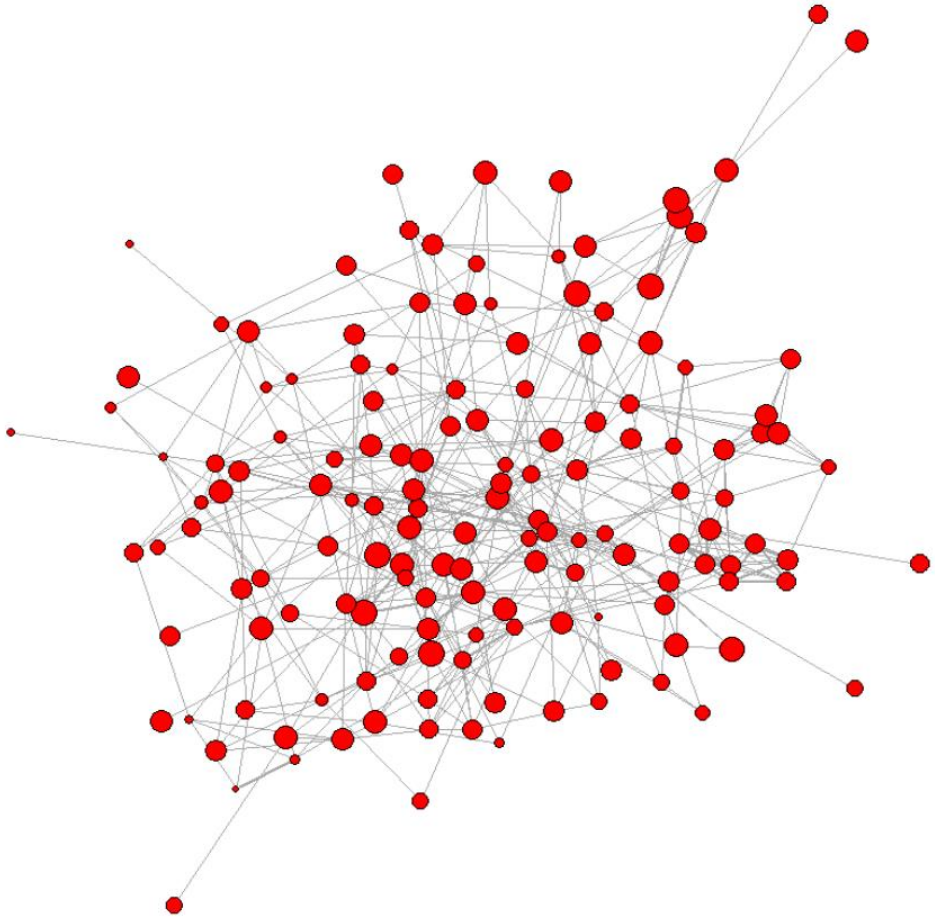


When analyzing the movie network, there are some results shown below. There are 12 clusters in the network. The largest membership size is 148 and the rest of clusters are 1 or 2.

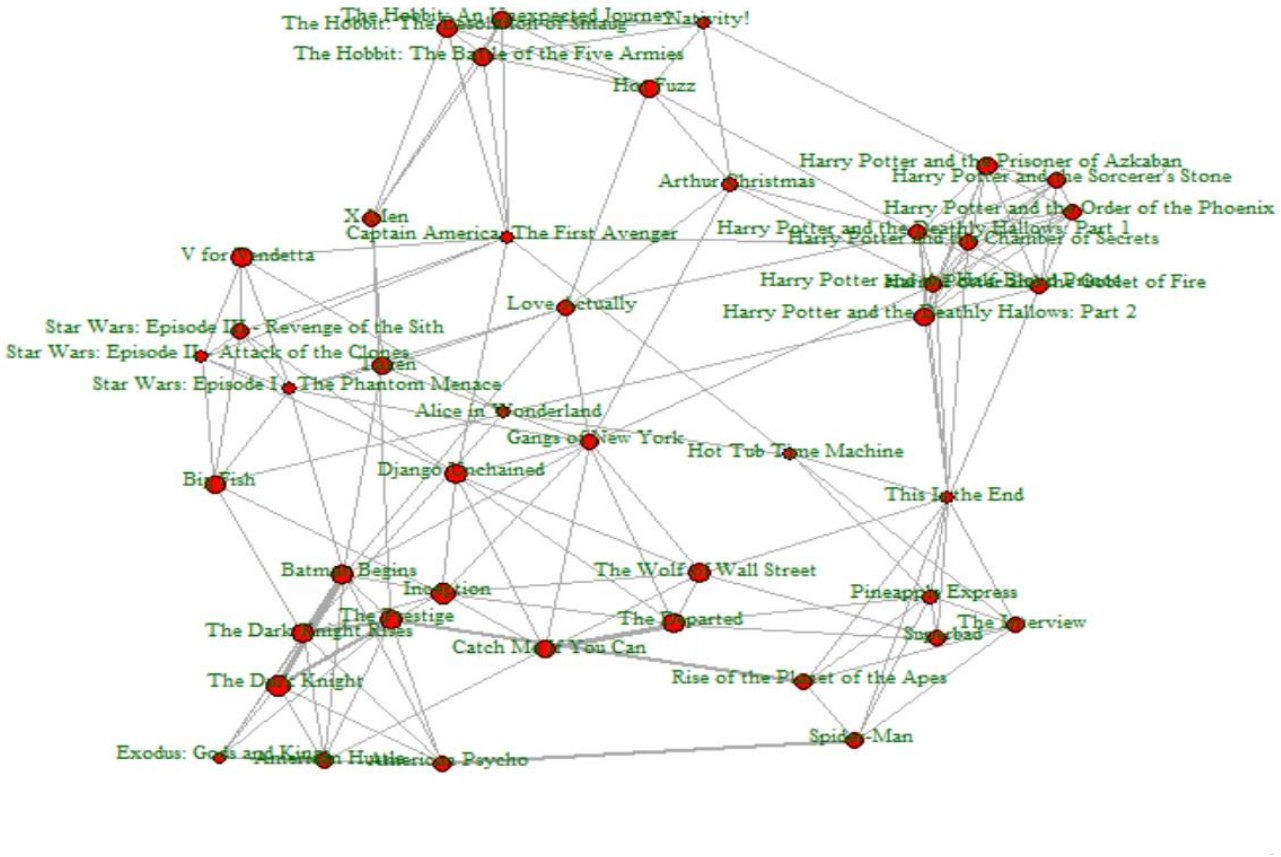
```{r}
graph.density(h1.mov)
no.clusters(h1.mov)
clusters(h1.mov)$csize
table(E(h1.mov)$weight)
```

```
[1] 0.03710692
[1] 12
 [1] 148   1   1   1   1   1   1   2   1   1   1   1

  1   2   3   4   5   6   7  10
411  21  12  16   6   1   2   3
```



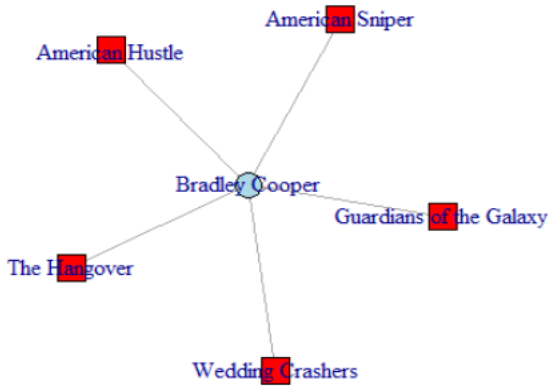
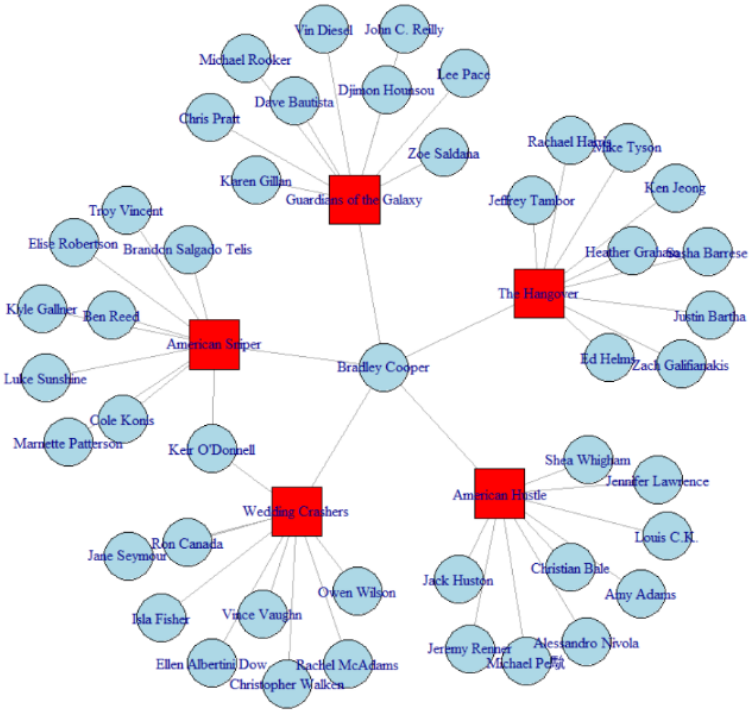
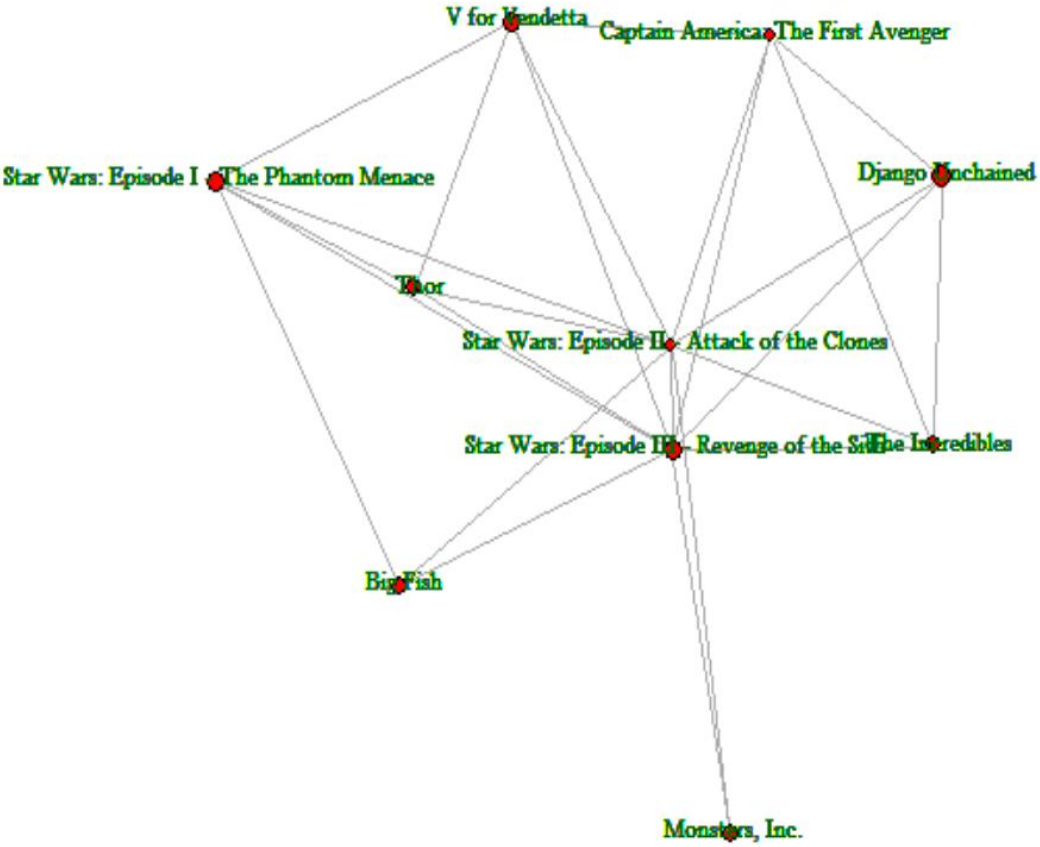
Above is the largest cluster for the movie network. Also, we calculated the coreness of the network. We visualized the plot to show the nodes that coreness larger than four.



We can see that in this cluster, some movies are quite reasonable related. For example, there are Hobbit (The lord of the ring) series, Harry Potter series, Star Wars series and some movies shared the same famous celebrities.

III. Part II

In this part, we need to extract the actor Bradley Cooper's movies' related actors.

```
Part II  Bradley Cooper
```{r}
    h4 <- subgraph.edges(h1,
    E(h1)[inc(V(h1)[name %in%
    c("Bradley Cooper")])])
    plot(h4, layout = layout_with_kk)
```
```



The graph showed the actor's related movies.

```
```{r}
V(h4)[type==TRUE]$name
```
```

```
[1] "Guardians of the Galaxy" "American Sniper"         "American Hustle"
[4] "The Hangover"            "Wedding Crashers"
```

Here are the list of movies and we will apply the list to show the related actors.


Vin Diesel
John C. Reilly
Michael Rooker
Lee Pace
Dave Bautista
Djimon Hounsou
Chris Pratt
Zoe Saldana
Karen Gillan
Guardians of the Galaxy
Rachael Harris
Mike Tyson
Jeffrey Tambor
Ken Jeong
Heather Graham
Sasha Barrese
The Hangover
Justin Bartha
Ed Helms
Zach Galifianakis
Troy Vincent
Elise Robertson
Brandon Salgado Telis
Kyle Gallner
Ben Reed
American Sniper
Bradley Cooper
Luke Sunshine
Cole Konis
Marnette Patterson
Keir O'Donnell
Shea Whigham
Jennifer Lawrence
American Hustle
Louis C.K.
Wedding Crashers
Ron Canada
Jane Seymour
Christian Bale
Jack Huston
Amy Adams
Owen Wilson
Vince Vaughn
Isla Fisher
Jeremy Renner
Alessandro Nivola
Michael Peña
Ellen Albertini Dow
Rachel McAdams
Christopher Walken

IV. Part III

For this part, we need to draw the plot to show how many movies are related to the movie Star Wars III. According to the function induced.subgraph, the vids is the condition to select nodes. At first, we select the movies are neighbor to Star Wars III, but not include SW III itself. So, the network plot only showed nine nodes. Therefore, I made a combination of the single node SW III and neighbors. So, the plot is shown below:



V. Appendix

````
---
title: "Network_HW4"
author: "Chenrui Xu"
date: "2021/2/28"
output: html_document
---

```{r}
library(UserNetR)
library(statnet)
library(igraph)
```

```{r}
data(hwd)
h1=hwd
```

```{r}
V(h1)$name[1:10]
```

```{r}
V(h1)$name[155:165]
```

```{r}
V(h1)$type[1:10]
```

```{r}
V(h1)$type[155:165]
```
So we can get that the first 160 index are the movies and from 161, the rest of them are actors.

Here is the summary of the data.
```{r}
h1
```
There are 1365 nodes and 1600 edges (160 movies and 1205 actors). There are a few attributes in the data: name, type(to show 2-mode),year, rating, etc.

```{r}
#if type is group, we use square to represent node, if it is actor, use circle
V(h1)$shape <- ifelse(
    V(h1)$type==TRUE,
````
````

```
    "square","circle")

#same idea to use corresponding color
V(h1)$color <- ifelse(
    V(h1)$type==TRUE,
    "red","lightblue")
```

```{r}
#create a subgraph that filter three movies to analysis
h2 <- subgraph.edges(h1,
E(h1)[inc(V(h1)[name %in%
c("The Wolf of Wall Street",
  "Gangs of New York",
  "The Departed")])])
plot(h2, layout = layout_with_kk)
```

```{r}
#to show number of movies each actor has, 955 actors engaged in one movie
#only one actor has 8 moives and it turned out to be HarryPorter
table(degree(h1,v=V(h1)[type==FALSE]))

#average number of movies each actor has
mean(degree(h1,v=V(h1)[type==FALSE]))

V(h1)$deg <- degree(h1)
V(h1)[type==FALSE & deg > 4]$name
#to show the actor that has more than 4 moives
```

```{r}
busy_actor <- data.frame(cbind(Actor = V(h1)[type==FALSE& deg > 4]$name,Movies = V(h1)[type==FALSE& deg > 4]$deg))
busy_actor[order(busy_actor$Movies,decreasing=TRUE),]
# to show the busy actors and their corresponding number of movies
```

```{r}
for (i in 161:1365) {
  V(h1)[i]$totrating <- sum(V(h1)[nei(i)]$IMDBrating)
}

for (i in 161:1365) {V(h1)[i]$avgrating <- mean(V(h1)[nei(i)]$IMDBrating)
}
```

```{r}
```

```
V(h1)[161:171]$totrating
```

```{r}
V(h1)[161:171]$avgrating
```

```{r}
pop_actor <- data.frame(cbind(Actor = V(h1)[type==FALSE & totrating > 40]$name,Popularity =V(h1)[type==FALSE &totrating > 40]$totrating))

pop_actor[order(pop_actor$Popularity,decreasing=TRUE),]
```

```{r}
num <- V(h1)[type==FALSE]$deg
avgpop <- V(h1)[type==FALSE]$avgrating
totpop <- V(h1)[type==FALSE]$totrating

op <- par(mfrow=c(1,2))
plot(num,totpop)
plot(num,avgpop)
par(op)
```

```{r}
summary(lm(avgpop~num))
```
There is no significance to show the more movies the actor has the more population the actor is.

The average rating of numbers of movies are around 7.5
```{r}
boxplot(avgpop~num)
```

Projection
```{r}
h1.pr <- bipartite.projection(h1)
h1.act <- h1.pr$proj1
h1.mov <- h1.pr$proj2
h1.act
h1.mov
```

```{r}
op <- par(mar = rep(0, 4))
plot(h1.mov,vertex.color="red",
     vertex.shape="circle",
     vertex.size=(V(h1.mov)$IMDBrating)-3,
```

```
    vertex.label=NA)
par(op)
```

```{r}
graph.density(h1.mov)
no.clusters(h1.mov)
clusters(h1.mov)$csize
table(E(h1.mov)$weight)
```

```{r}
h2.mov <- induced.subgraph(h1.mov,vids=clusters(h1.mov)$membership==1)

plot(h2.mov,vertex.color="red",
edge.width=sqrt(E(h1.mov)$weight),
vertex.shape="circle",
vertex.size=(V(h2.mov)$IMDBrating)-3,
vertex.label=NA)

```

```{r}
table(graph.coreness(h2.mov))
h3.mov <- induced.subgraph(h2.mov,vids=graph.coreness(h2.mov)>4)
h3.mov

plot(h3.mov,vertex.color="red",
vertex.shape="circle",
edge.width=sqrt(E(h1.mov)$weight),
vertex.label.cex=0.7,
vertex.label.color="darkgreen",
vertex.label.dist=0.3,
vertex.size=
    (V(h3.mov)$IMDBrating)-3)


```

Part II Bradley Cooper

```{r}
h4 <- subgraph.edges(h1,
E(h1)[inc(V(h1)[name %in%
c("Bradley Cooper")])])
plot(h4, layout = layout_with_kk)
```

```{r}
```

```
V(h4)[type==TRUE]$name
```

```{r}
h5 <- subgraph.edges(h1,
E(h1)[inc(V(h1)[name %in%c(V(h4)[type==TRUE]$name)
])])
plot(h5, layout = layout_with_kk)
```

Part III
```{r}
summary(h3.mov)
V(h3.mov)
```

```{r}
SW3 <- induced.subgraph(h1.mov,vids=c(V(h1.mov)[nei("Star Wars: Episode III - Revenge of the Sith")],V(h1.mov)[name%in%"Star Wars: Episode III - Revenge of the Sith"]))
```

```{r}
plot(SW3, layout = layout_with_kk,,vertex.color="red",
vertex.shape="circle",
edge.width=sqrt(E(h1.mov)$weight),
vertex.label.cex=0.7,
vertex.label.color="darkgreen",
vertex.label.dist=0.3,
vertex.size=(V(h1.mov)$IMDBrating)-3)
```