Assignment #5

Wednesday, March 4TH, 2018

RANDY DO

Contents

Problem 1

1. We know the result of the Karate Club (Zachary, 1977) split. Prove or disprove that the result of split could have been predicted by the weighted graph of social interactions. How well does the mathematical model represent reality?

Generously document your answer with all supporting equations, code, graphs, arguments, etc.

Clues:
1. Draw original Karate club graph (two connected components) after split (Week 6 lecture, slide 98).
2. Run multiple iterations of graph partioning algorithm (e.g., Girvan-Newman Algorithm) on experimental Karate club graph until the graph splits into two connected components.
3. Compare the connected components of the experimental graph (in 2.) with the original connected components of the split Karate club graph (in 1.). Are they similar?

Useful sources include:

* Original paper

http://aris.ss.uci.edu/~lin/76.pdf

* Week 6 Slides:

https://docs.google.com/presentation/d/1ihf6N8bHgzM5VLAyHkmF_i5JGUBVpCSdsvYpk8XgHwo/edit?usp=sharing

* Slides

http://www-personal.umich.edu/~ladamic/courses/networks/si614w06/ppt/lecture18.ppt

http://clair.si.umich.edu/si767/papers/Week03/Community/CommunityDetection.pptx

* Code and data

https://networkx.github.io/documentation/networkx-1.10/reference/generated/networkx.generators.social.karate_club_graph.html

https://networkx.github.io/documentation/networkx-1.9/examples/graph/karate_club.html

http://nbviewer.ipython.org/url/courses.cit.cornell.edu/info6010/resources/11notes.ipynb

http://stackoverflow.com/questions/9471906/what-are-the-differences-between-community-detection-algorithms-in-igraph/9478989#9478989

http://stackoverflow.com/questions/5822265/are-there-implementations-of-algorithms-for-community-detection-in-graphs

http://konect.uni-koblenz.de/networks/ucidata-zachary

http://vlado.fmf.uni-lj.si/pub/networks/data/ucinet/ucidata.htm#zachary

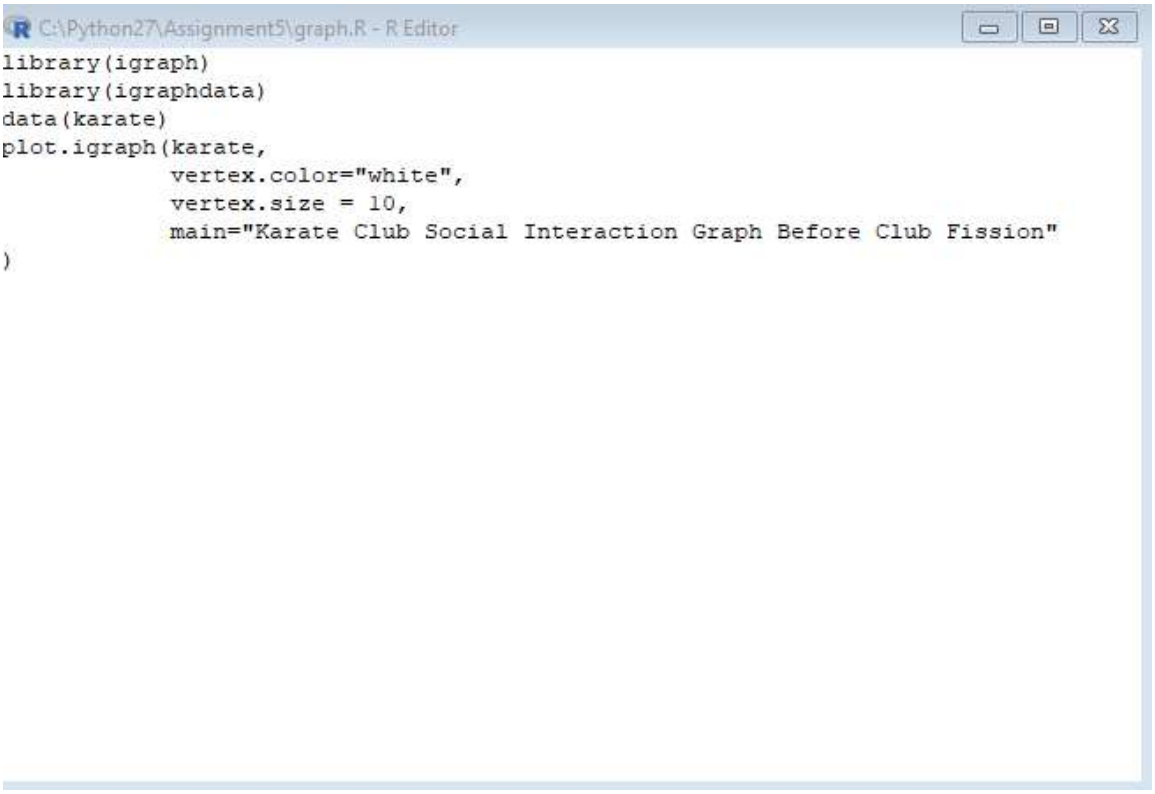
https://snap.stanford.edu/snappy/doc/reference/CommunityGirvanNewman.html

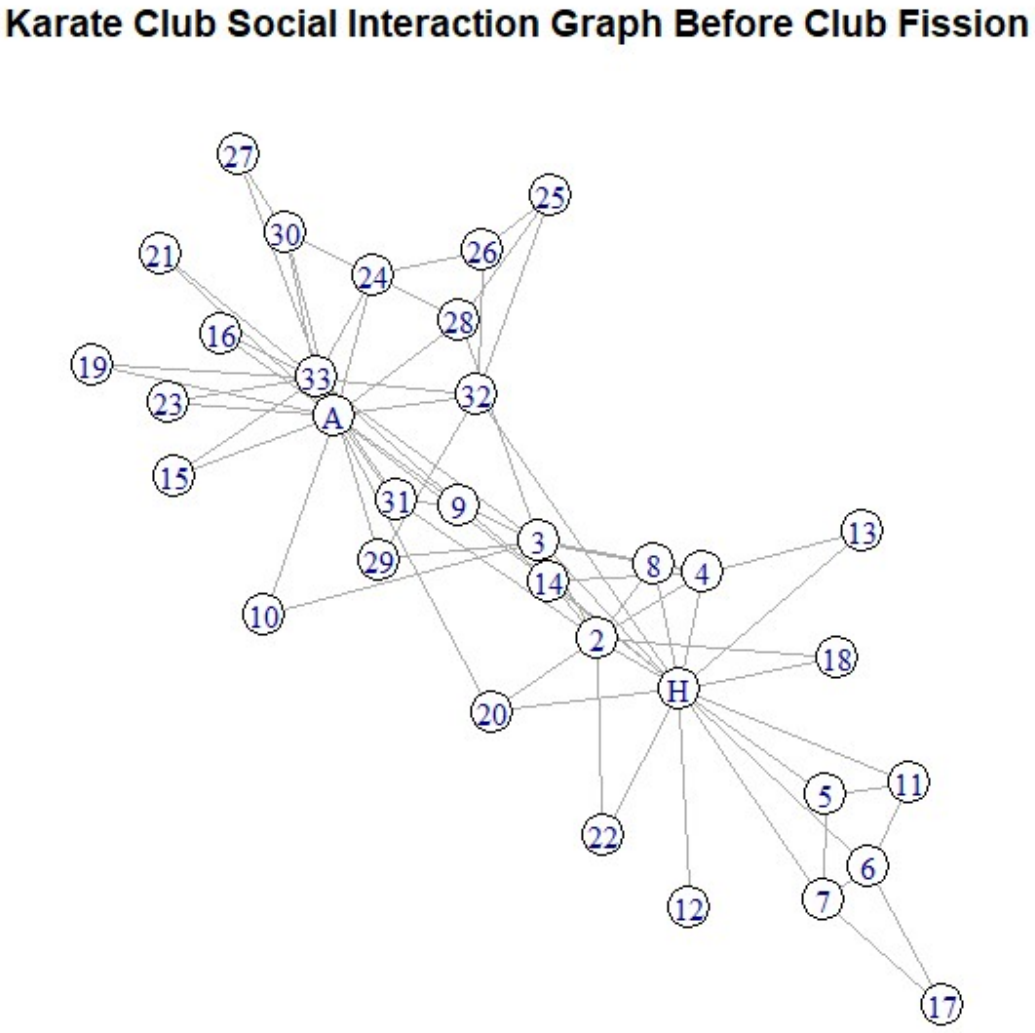
http://igraph.org/python/doc/igraph-pysrc.html#Graph.community_edge_betweenness

Solution:

I was having issues using Windows with igraph, so instead I used script R to create the graph.

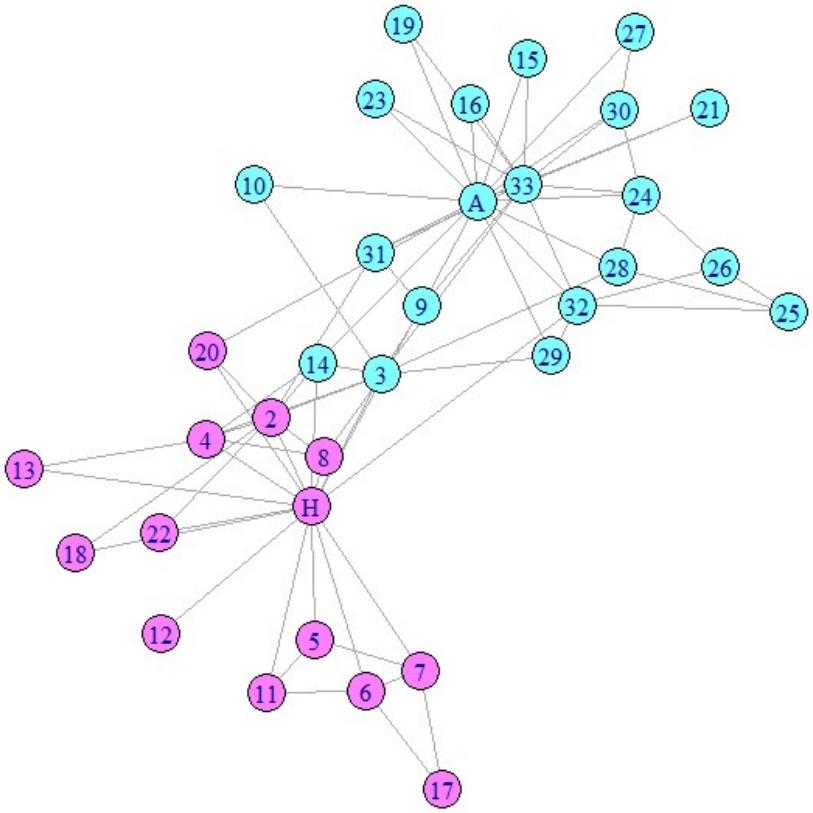
using the data: http://vlado.fmf.uni-lj.si/pub/networks/data/ucinet/ucidata.htm#zachary. The data is named Karate.



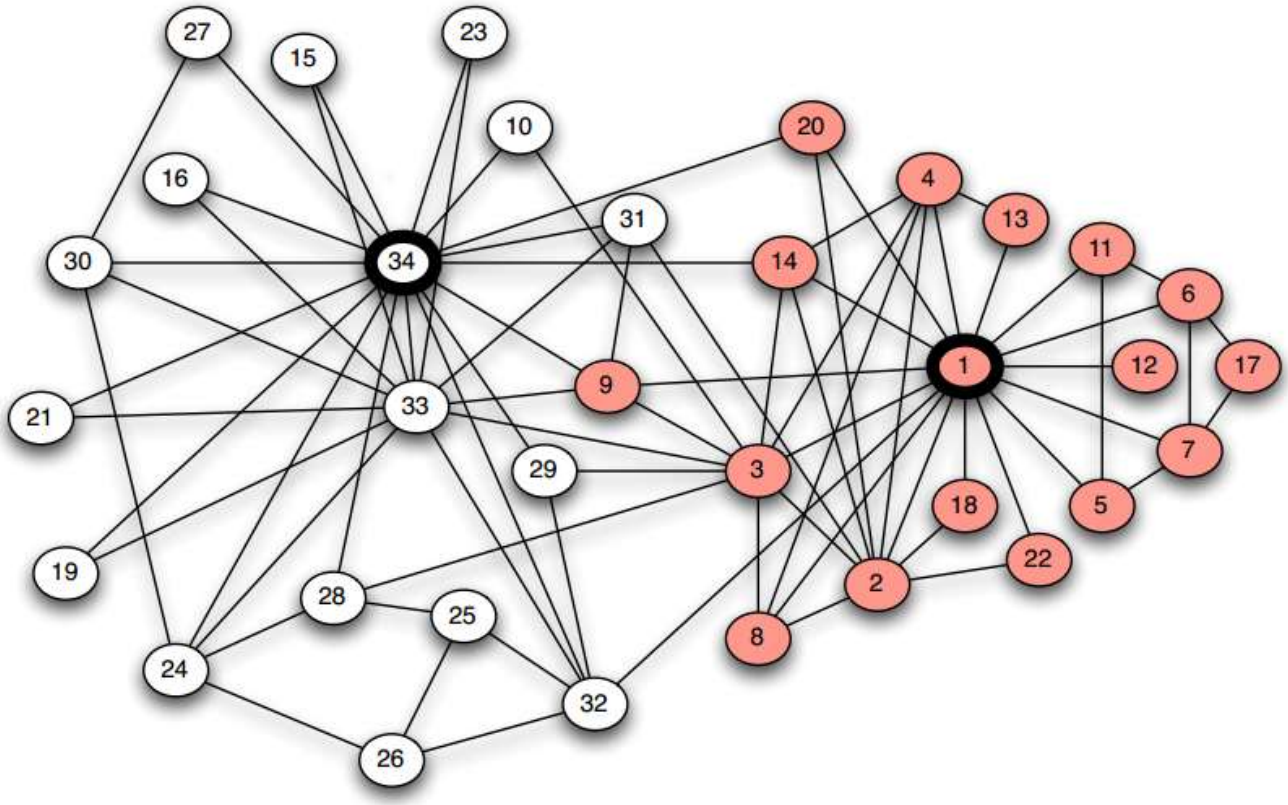


Next is to predict the results of the split of the Karate club. I will be using edge-betweeness-community-dection algorithm.
http://igraph.org/python/doc/igraph-pysrc.html#Graph.community_edge_betweenness

```
library("igraph")
library(igraphdata)
data(karate)
Karate_eb <- edge.betweenness.community(karate)
groups <- cutat(Karate_eb, 2)
colors <- cm.colors(2, 1)
plot(karate,
     vertex.color=colors[groups],
     vertex.size = 10,
     main="Predicted Karate Club Social Interaction Graph if the Club splits into 2 groups"
)
```



Now, I compare the actual split.



https://en.wikipedia.org/wiki/Zachary's_karate_club
see data set at: http://konect.uni-koblenz.de/networks/ucidata-zachary and
http://vlado.fmf.uni-lj.si/pub/networks/data/ucinet/ucidata.htm#zachary

There are 3 numbers that are mussing. **3**, **9**, **14**

The formula for **accuracy** is
E = (M/T) x 100
3/34 x 100 = 8.8%

From this, the accuracy from my graph is **91.2%**

Problem 2

2. Use D3.js's force-directed graph layout to draw the Karate Club Graph before split. Color the nodes according to the factions they belong to (John A or Mr. Hi). After a button is clicked, split the graph based on the original graph split. Include a link to the HTML/JavaScript files in your report and all necessary screenshots.

See: https://bl.ocks.org/mbostock/4062045

https://d3js.org/

Problem 3

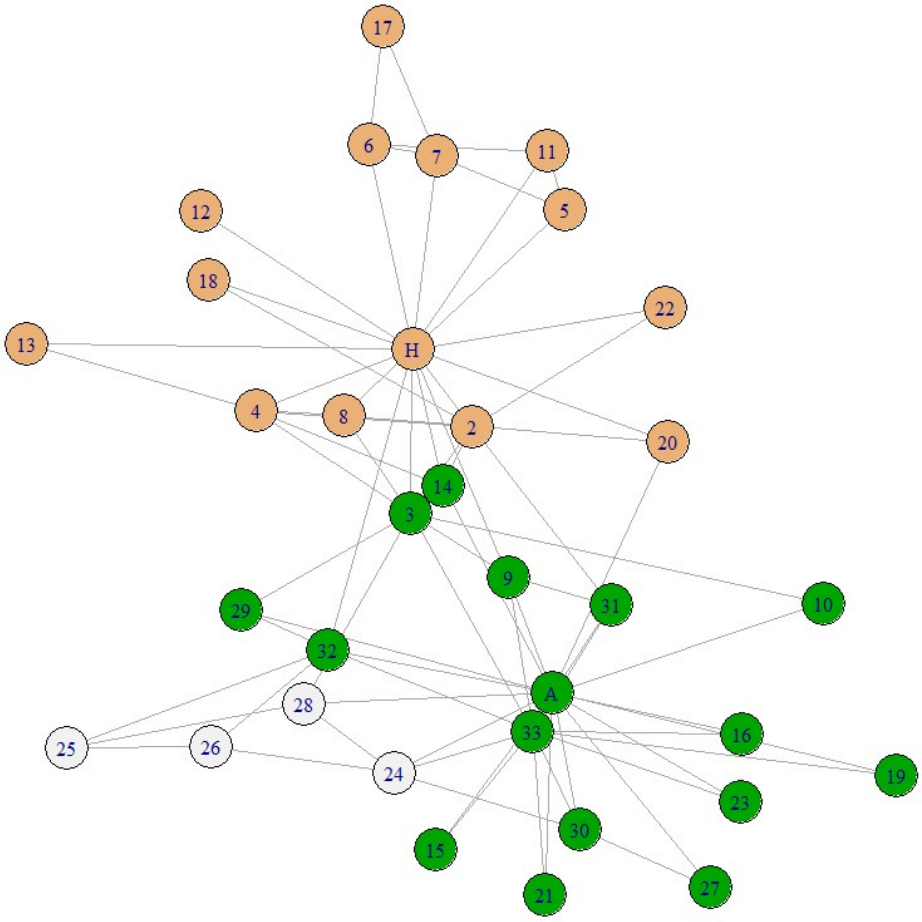
We know the group split in two different groups. Suppose the disagreements in the group were more nuanced -- what would the clubs look like if they split into groups of 3, 4, and 5?

Answers: The processes are very similar to the first problem.

SPLIT 3 GROUPS

```
library("igraph")
library(igraphdata)
data(karate)
Karate_eb <- edge.betweenness.community(karate)
groups <- cutat(Karate_eb, 3)
colors <- terrain.colors(3, 1)
plot(karate,
     vertex.color=colors[groups],
     vertex.size = 10,
     main="Predicted Karate Club Social Interaction Graph when the Club splits into 3 groups"
)
```

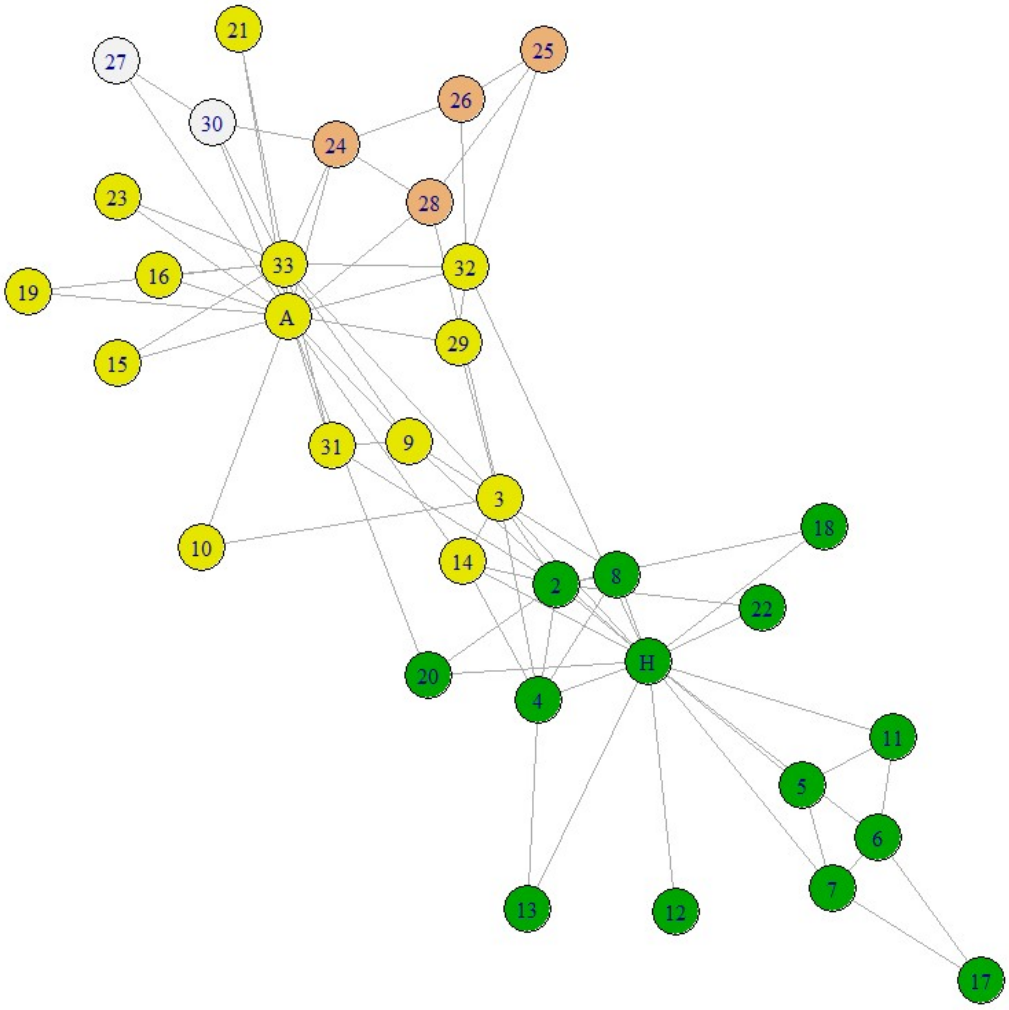
Predicted Karate Club Social Interaction Graph when the Club splits into 3 groups



SPLIT 4 GROUPS

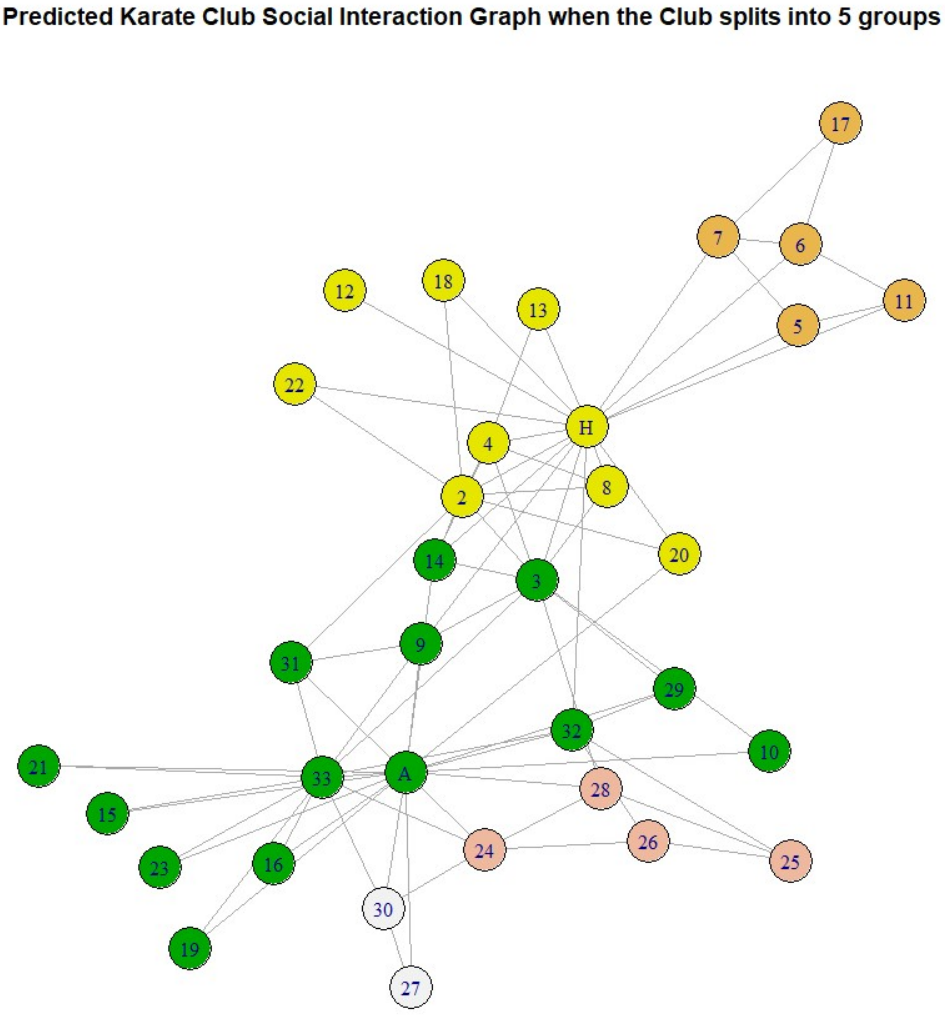
```
library("igraph")
library(igraphdata)
data(karate)
Karate_eb <- edge.betweenness.community(karate)
groups <- cutat(Karate_eb, 4)
colors <- terrain.colors(4, 1)
plot(karate,
     vertex.color=colors[groups],
     vertex.size = 10,
     main="Predicted Karate Club Social Interaction Graph when the Club splits into 4 groups"
)
```

Predicted Karate Club Social Interaction Graph when the Club splits into 4 groups



SPLIT 5 GROUPS

```
library("igraph")
library(igraphdata)
data(karate)
Karate_eb <- edge.betweenness.community(karate)
groups <- cutat(Karate_eb, 5)
colors <- terrain.colors(5, 1)
plot(karate,
     vertex.color=colors[groups],
     vertex.size = 10,
     main="Predicted Karate Club Social Interaction Graph when the Club splits into 5 groups"
)
```



REFERENCE:

http://igraph.org/r/doc/
http://estebanmoro.org/2012/11/temporal-networks-with-igraph-and-r-with-20-lines-of-code/
http://igraph.org/r/doc/graph_from_data_frame.html