Assignment 5
CS532, Web Science, Spring 2017
Old Dominion University, Computer Science Dept

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Question 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.

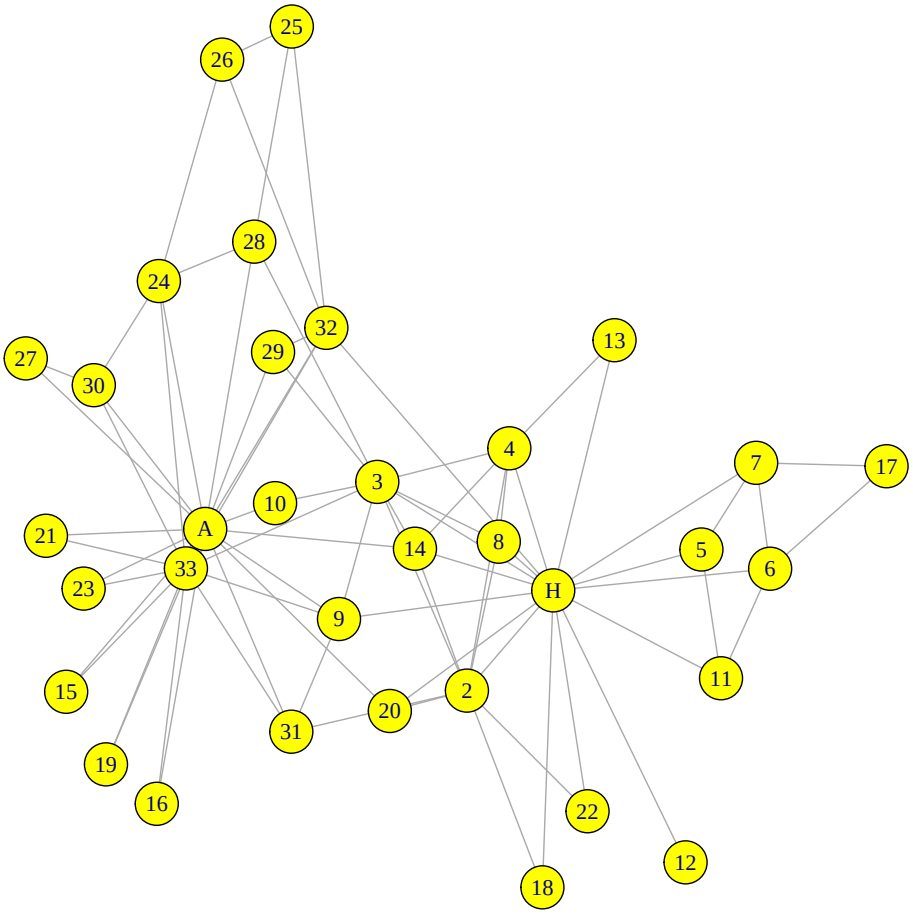
Answer:

I started by plotting the Karate Club social interaction graph prior to the fission. I wrote a simple R script to plot the graph.

Listing 1: Karate Club Social Interaction Graph Before Club Fission in R

```
> library(igraph)
> library(igraphdata)
> data(karate)
> plot.igraph(karate,
+             vertex.color="yellow",
+             vertex.size = 10,
+             main="Karate Club Social Interaction Graph Before Club Fission"
+ )
>
```

Karate Club Social Interaction Graph Before Club Fission

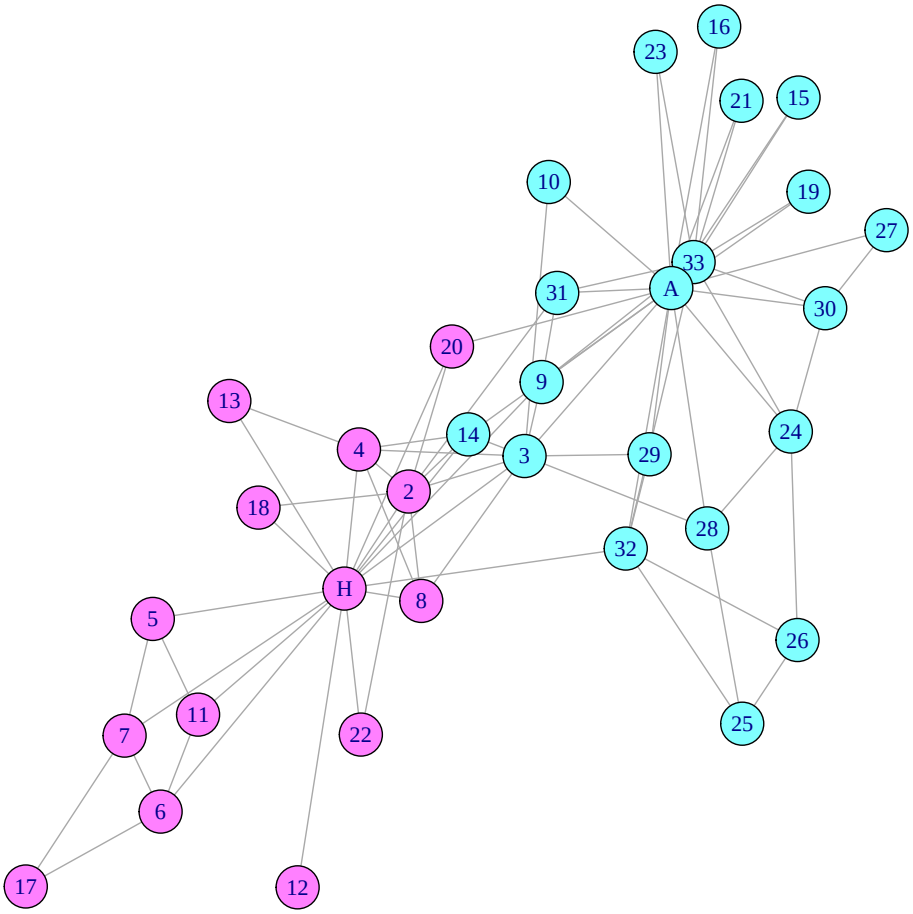


Now it's time to predict the result of the split of the Karate club using the edge-betweenness-community-detection algorithm and comparing the result to the actual split.

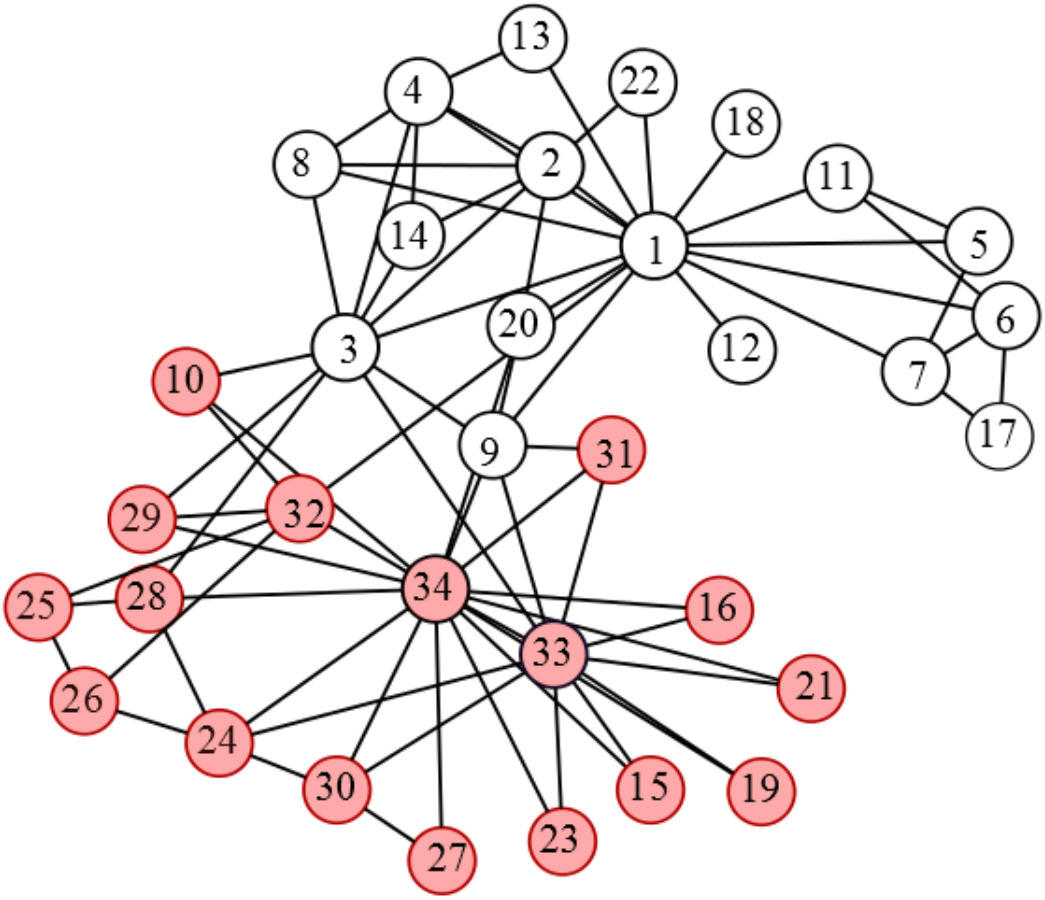
Listing 2: Predicted Karate Club Social Interaction Graph if the Club splits into 2 groups in R

```
> 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"
+ )
>
```

Predicted Karate Club Social Interaction Graph if the Club splits into 2 groups



The Actual Split: This image is taken from this link:
https://en.wikipedia.org/wiki/Zachary%27s_karate_club
In this plot, node 1 stands for the instructor "Mr. Hi", node 34 for the president, "John A".



Comparing the two previous graphs, we find that the number of misses is 3. The corresponding nodes are 3, 9, and 14.

Computing the accuracy of our prediction:

The error can be calculated by dividing the number of misses by the total number of nodes and multiply the result by 100.

$$E = (M/T) \times 100 = 8.8\%$$

Therefore the accuracy of our prediction is 91.2%

Included Files:

Q1_R_Code.R, 2.pdf, after.png, before.pdf

Question 2:

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?

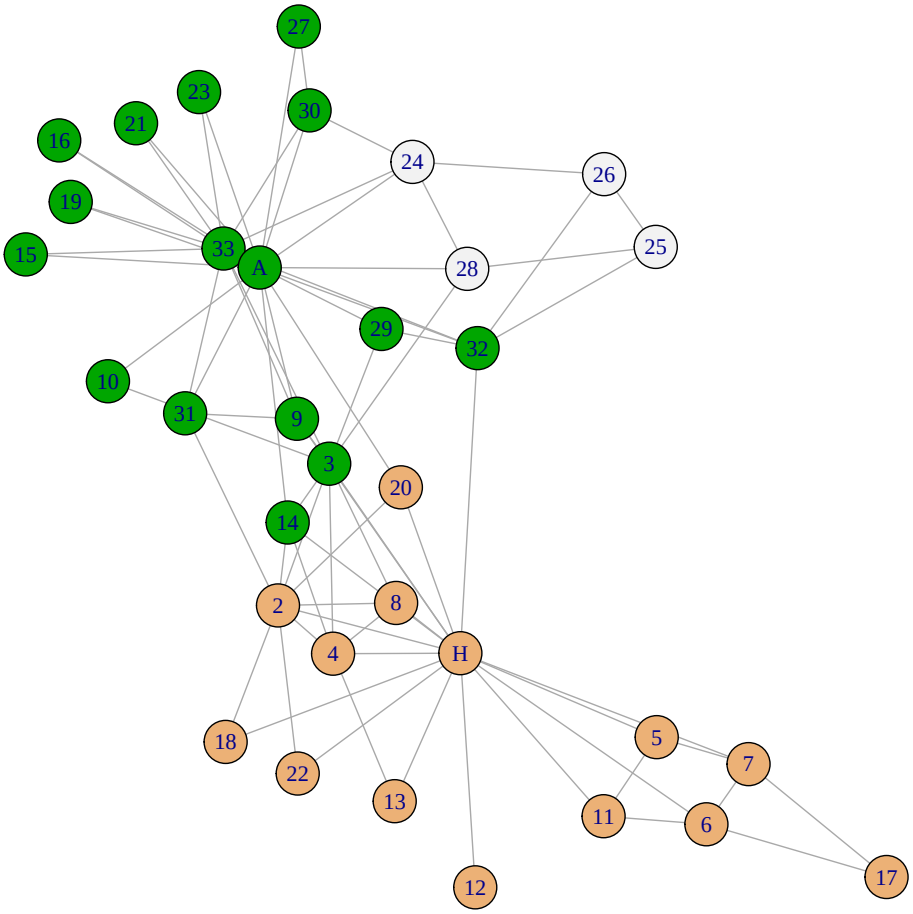
Answer:

The prediction for the split of the karate club into more than two groups can be done in a similar fashion. Changing the R code accordingly gives us the desired graphs for the split into 3, 4, or 5 groups.

Listing 3: Predicted Karate Club Social Interaction Graph if the Club splits into 3 groups in R

```
> 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 if the Club splits
    into 3 groups"
+ )
>
```

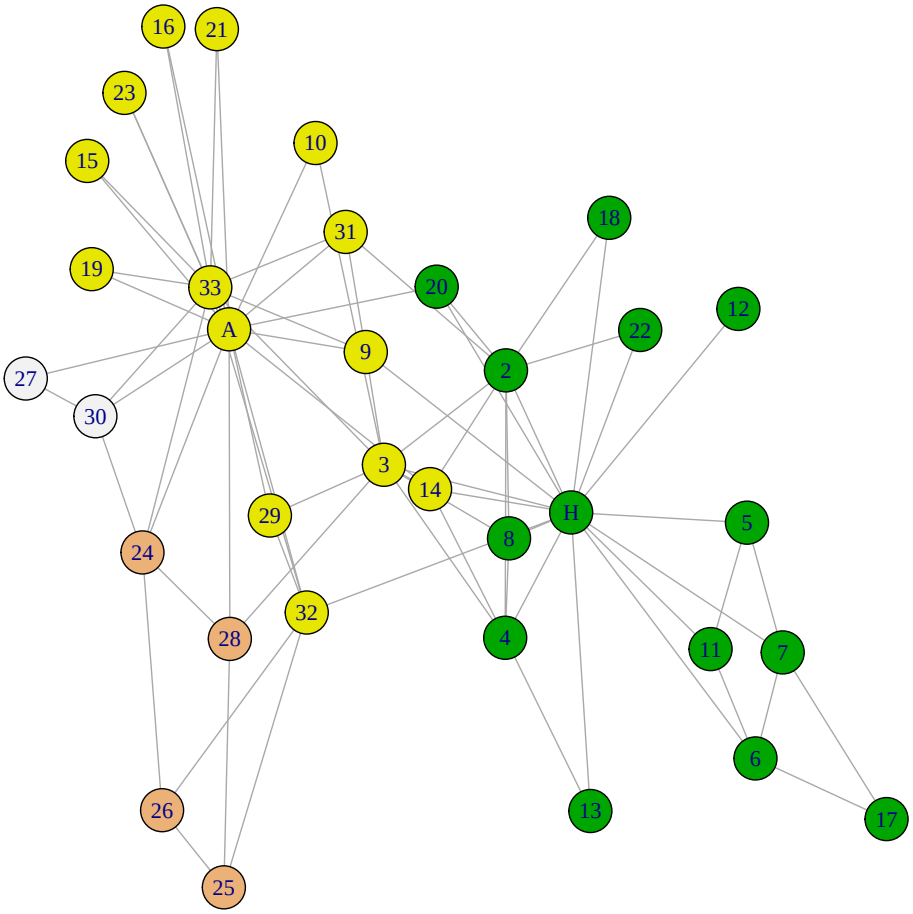
Predicted Karate Club Social Interaction Graph if the Club splits into 3 groups



Listing 4: Predicted Karate Club Social Interaction Graph if the Club splits into 4 groups in R

```
> 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 if the Club splits
    into 4 groups"
+ )
>
```

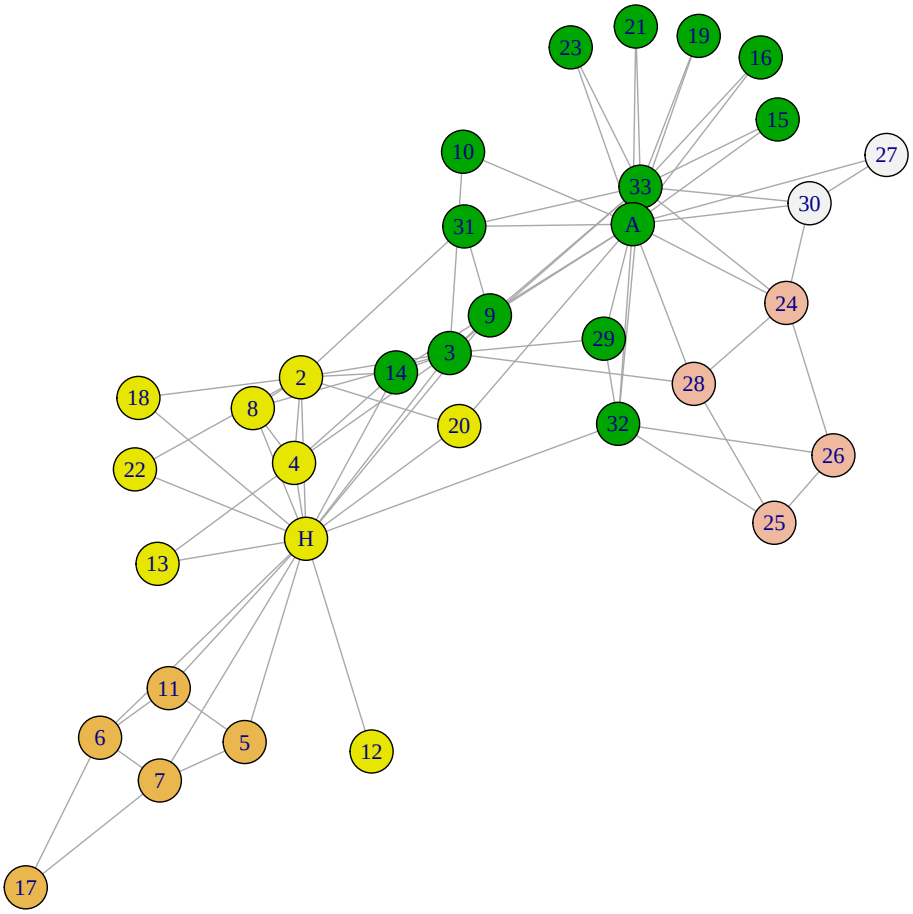
Predicted Karate Club Social Interaction Graph if the Club splits into 4 groups



Listing 5: Predicted Karate Club Social Interaction Graph if the Club splits into 5 groups in R

```
> 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 if the Club splits
    into 5 groups"
+ )
>
```

Predicted Karate Club Social Interaction Graph if the Club splits into 5 groups



Included Files:

Q2_R_Code.R, 3.pdf, 4.pdf, 5.pdf