

## 1 Karate Club Split Prediction

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?

### Algorithm:

1. Use the package “igraphml”(<http://igraph.org/r/>) to analyze.
2. Load the graph data.
3. Use the edge betweenness community detection algorithm.
4. Cut the merge tree to get 2 communities.
5. Plot the 2 communities.

### Source code:

#### Listing 1: The content of Q1.R

```
library("igraph")
karate = graph.famous("Zachary")
ebc = edge.betweenness.community(karate)
cut = cutat(ebc, 2)
colors = rainbow(2)
plot(karate, vertex.color=colors[cut])
cut
```

### Results:

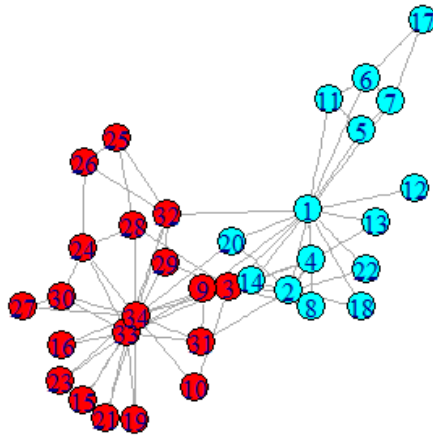


Figure 1: Prediction of Karate Club Splits into 2 Groups

**Table 1: Edge Betweenness Algorithm Result**

Individual Number	Actual Club After Split	Predicted Club After Split	Hit/Miss
1	2	2	Hit
2	2	2	Hit
3	2	1	Miss
4	2	2	Hit
5	2	2	Hit
6	2	2	Hit
7	2	2	Hit
8	2	2	Hit
9	2	1	Miss
10	1	1	Hit
11	2	2	Hit
12	2	2	Hit
13	2	2	Hit
14	2	2	Hit
15	1	1	Hit
16	1	1	Hit
17	2	2	Hit
18	2	2	Hit
19	1	1	Hit
20	2	2	Hit
21	1	1	Hit
22	2	2	Hit
23	1	1	Hit
24	1	1	Hit
25	1	1	Hit
26	1	1	Hit
27	1	1	Hit
28	1	1	Hit
29	1	1	Hit
30	1	1	Hit
31	1	1	Hit
32	1	1	Hit
33	1	1	Hit
34	1	1	Hit

According to these figures, 32(94%) hits and 2(6%) misses. So the result of split could have been predicted by the weighted graph of social interactions. And the accuracy of the mathematical model is 94% based on this case.

## 2 Karate Club Splits into Groups of 3, 4 and 5

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?

### Algorithm:

1. Use the package “igraphml”(<http://igraph.org/r/>) to analyze.
2. Load the graph data.
3. Use the edge betweenness community detection algorithm.
4. Cut the merge tree to get 3 communities.
5. Plot the 3 communities.
4. Cut the merge tree to get 4 communities.
5. Plot the 4 communities.
4. Cut the merge tree to get 5 communities.
5. Plot the 5 communities.

### Source code:

#### Listing 2: The content of Q2.R

```
library("igraph")
karate = graph.famous("Zachary")
ebc = edge.betweenness.community(karate)
cut = cutat(ebc,3)
colors = rainbow(3)
plot(karate, vertex.color=colors[cut])
cut = cutat(ebc,4)
colors = rainbow(4)
plot(karate, vertex.color=colors[cut])
cut = cutat(ebc,5)
colors = rainbow(5)
plot(karate, vertex.color=colors[cut])
```

### Results:

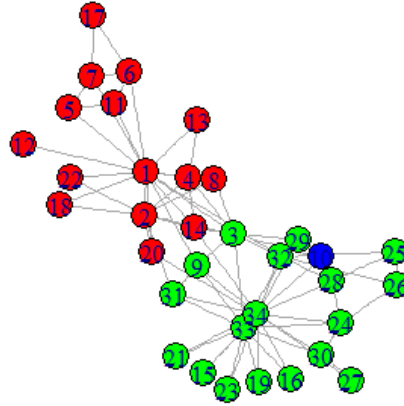


Figure 2: Prediction of Karate Club Splits into 3 Groups

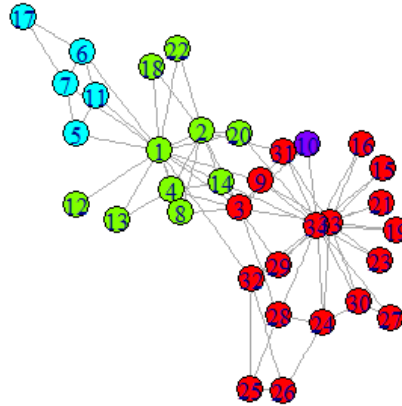


Figure 3: Prediction of Karate Club Splits into 4 Groups

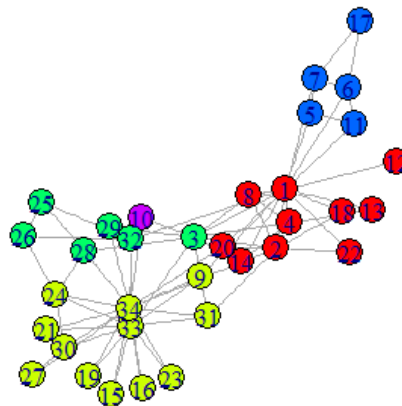


Figure 4: Prediction of Karate Club Splits into 5 Groups