CS595 Assignment 6

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Q1. 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

Given the graph, the Girvan-Newman algorithm will iteratively remove the edge(s) with highest betweeness. Results are given below.

Figure 1: Girvan-Newman Modularity Algorithm

$$Q = \frac{1}{4m} \sum_{ij} \left(A_{ij} - \frac{k_i k_j}{2m} \right) s_i s_j = \frac{1}{4m} \mathbf{s}^T \mathbf{B} \mathbf{s}$$

```
Given clustering:
[0] 00, 01, 02, 03, 04, 05, 06, 07, 08, 10, 11, 12, 13, 16, 17, 19, 21
[1] 09, 14, 15, 18, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33
Calculated clustering:
[0] 00, 01, 03, 04, 05, 06, 07, 10, 11, 12, 13, 16, 17, 19, 21
[1] 02, 08, 09, 14, 15, 18, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33
Correctness:
Y,Y,N,Y,Y,Y,Y,Y,N,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y,Y
```

32 Hits 2 Misses, 93.75% Hits, 6.25% Misses

It is very close. Students 3 and 9 misses. Leeching off Corren's answer, student 9 evidently was very close to finishing, and thus chose a different group from external stimulii. It is unknown why student 3 chose Mr Hi., so in absence of technical/scientific data, the next best thing is hearsay and rumor - he was most likely fascinated with far eastern culture, fantasized himself a kung fu master, and was petty enough of a man to lean toward asian inline 4s vs the superior American muscle of such legends as fairlanes, mustangs, and other v8s, preferably big-block fords.

See Appendix A for python program to produce graphs (svgs)
See Appendix B for bash script to produce merged pngs

Figure 2: Zachary Karate, Clusters=2, Modularity=0.3599605522682446
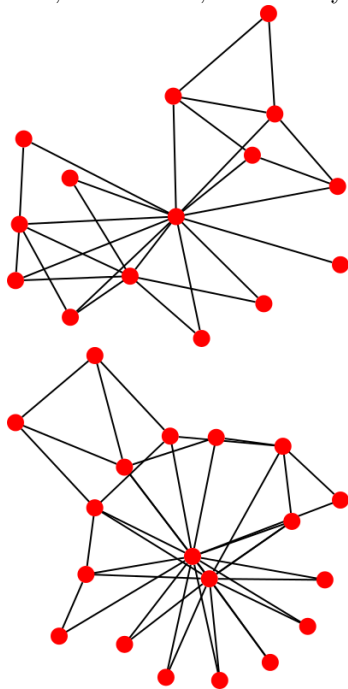
Q2. We know the group split in two different groups. Suppose the disagreements in the group were more nuanced – what would the clubs look like if they split into groups of 3, 4, and 5?

Figure 3: Zachary Karate, Clusters=3, Modularity=0.34878369493754113
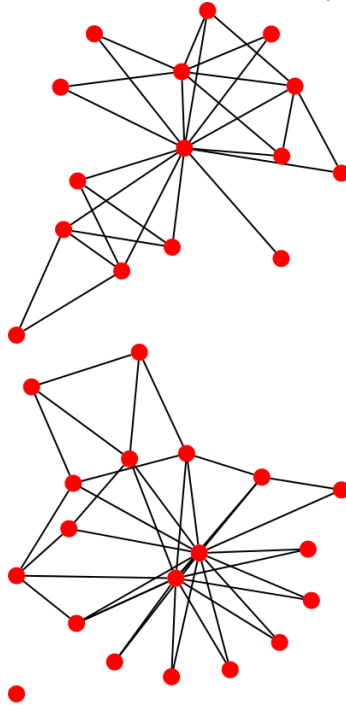
Figure 4: Zachary Karate, Clusters=4, Modularity=0.36324786324786335
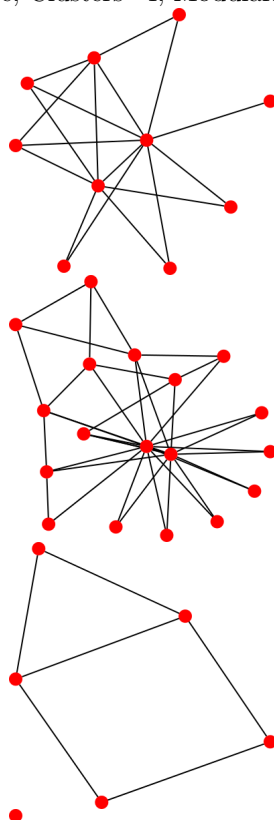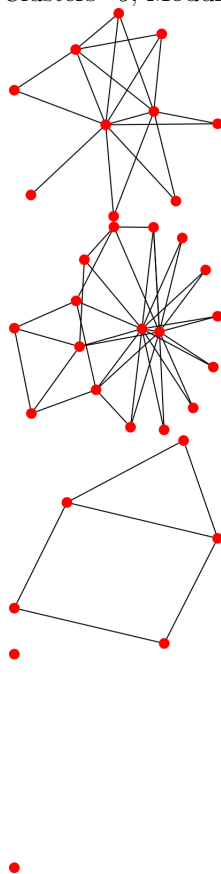
Figure 5: Zachary Karate, Clusters=5, Modularity=0.35174227481919795

Appendix A

```python
#!/usr/bin/python3
import igraph
import sys

DEFAULT_FILE='karate.net'
if len(sys.argv) != 2:
    print('Pass the path to your graph file, defaulting' +
        ' to '+DEFAULT_FILE)
    path=DEFAULT_FILE
else:
        path=sys.argv[1]

for x in range(2, 6):
    k = igraph.load(path)
    vertexDendrogram = k.community_edge_betweenness(
        clusters=x, directed=False)
    vertexClustering = vertexDendrogram.as_clustering()
    print('Modularity: ' + str(vertexClustering.modularity))
    print(vertexClustering)
    i=0
    for subgraph in vertexClustering.subgraphs():
        subgraph.save(str(x)+'-karate-'+str(i)+'.svg', format="svg")
        i+=1
```

Appendix B

```bash
#!/bin/bash
for i in {2..5}; do
        convert $i*.svg -append $i-karate.png
        rm $i*.svg
done
```