

Complex Networks: Quiz #7

Due on Dec 31, 2018

RUOPENG XU
18M38179

Problem 1

Make a program of computing degree assortativity of Karate club network.

Answer 1

```
import networkx as nx

G = nx.karate_club_graph()
result = nx.degree_assortativity_coefficient(G)
print("the degree assortativity of karate club is", result)
```

The result is:

```
the degree assortativity of karate club is -0.47561309768461457
```

Problem 2

What are the input(s) and output(s) of modularity? What does the output(s) mean?

Answer 2

As shown in the slide, the modularity is $Q = \frac{1}{2m} \sum_{ij} (A_{ij} - \frac{k_i k_j}{2m}) \delta(c_i, c_j)$

The input is : 1.the Adjacency Matrix of the network; 2.the degree of each node; 3.whether node i and node j are in the same group; 4. the number of edges in the network.

The output is : the modularity, *which measures the strength of division of a network into groups. Networks with high modularity have dense connections between the nodes within modules but sparse connections between nodes in different modules.*(from wiki)

Problem 3

Find the value of modularity when all vertices are classified in one group

Answer 3

The definition of modularity equals the sum of "probability edge is in module i " minus the sum of "probability a random edge would fall into module i ".

In this case, only have one group, so the "probability edge is in module i ", and the "probability a random edge would fall into module i " also equals to 1, so the final result is 0 when all the nodes are in one group.

Problem 4

Read chapter 5 of “Network, Crowds and Markets”. What does structural balance in international relations (sometimes) cause? Please discuss its reasons with an example of shifting alliances preceding World War I.

<https://www.cs.cornell.edu/home/kleinber/networks-book/networks-book-ch05.pdf>

Answer 4

Structural balance can sometimes provide an effective explanation for the behavior of nations during various international crises.

In the relationship, for every set of three nodes, if a triangle with one or three positive, the structure is balanced; if a triangle with zero or two positive relationship, the structure is unbalanced.

Considering the conceptual description of a balance structure, it will like:

Two group of friends (all + in the group) and they have the same negative relationship.

And it is the only way to have a balance network.

In the international relationship in World War I:

At first, the Italy have to join the war. After Italy joined, the relationship became unbalanced: On one hand, there are many ‘-’ relationships in the network, so they will come together to fight the same enmity. On the other hand, AH, Germany and Italy had already generated a stable relationship. As a result, they generated two group of positive and these two groups are enmity, this network became balanced, all of the triangles in this network is balanced.