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Complex Network

Quiz 7

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Code

```
import networkx as nx
G = nx.karate_club_graph()
plt.figure(figsize=(5, 5))
nx.draw_spring(G, node_size=100, node_color='red')
plt.show()

r = nx.degree_assortativity_coefficient(G)
print('%.03f' % r)

>>> -0.476
```

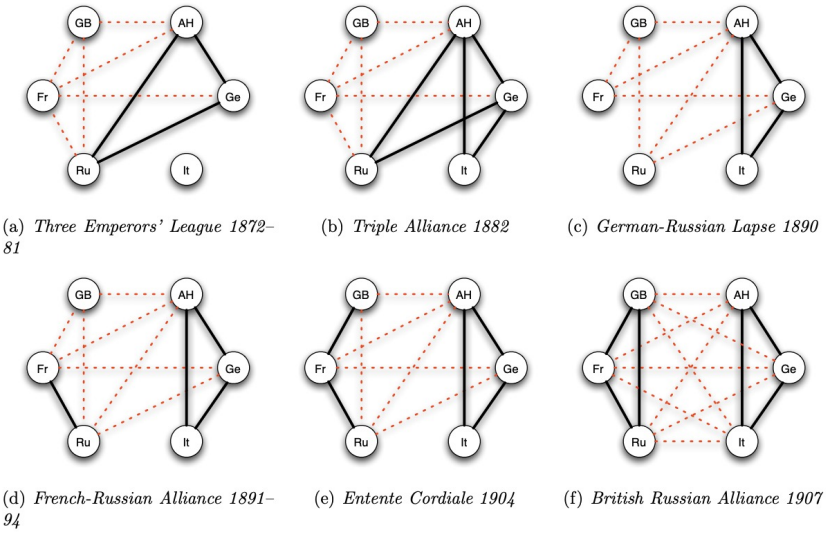
Results

(1) Make a program of computing
See the Code section above.

(2) What are the input(s) and output(s) of modularity? What does the output(s) mean?
The output of modularity is the fraction of the edges that fall within the given groups minus the expected fraction if edges were distributed at random. The output means the connections' density between the nodes within modules. The higher value indicate dense connections within the same module but sparse connections between nodes in different modules.
The inputs of modularity is the probability edge is in module i and the probability a random edge would fall into module i.

(3) Find the value of modularity when all vertices are classified in one group.
When all vertices are classified in one group, the probability of edge in the module is equal to the probability of a random edge would fall into the module because there is only one module and they are both 1. Therefore, the modularity $= Q = \frac{1}{2m}\sum_{ij}(A_{ij} - \frac{k_i k_j}{2m})\delta(c_i, c_j) = \frac{1}{2m}(1-1) = 0$

(4) What does structural balance in international relations (sometimes) cause? Please discuss its reasons with an example of shifting alliances preceding World War I.
Structural balance in international relations can sometimes cause implacably opposed alliances. The status of balance can be seen as a slide into a hard-to-resolve opposition between two sides. For example, Fig1 shows the evolution of alliance in Europe in WWI. There were always two opposition positions between these six countries and the number of countries with the same standpoint is roughly the same no matter how the alliance changes. This is because these countries have to mutually restrict each other to prevent from any one of them is in the dominant position in terms of military power. As long as one country potentially has predominance over the political and military power, the others will automatically ally together. This is the structural balance effect.



(a) *Three Emperors' League 1872–81* (b) *Triple Alliance 1882* (c) *German-Russian Lapse 1890*

(d) *French-Russian Alliance 1891–94* (e) *Entente Cordiale 1904* (f) *British Russian Alliance 1907*

Figure 1: The variation of alliance in Europe in WWI. (Resource: Ch5 Networks, Crowds, and Markets: Reasoning about a Highly Connected World.)