Name: _____ **ID:** _____

HOMEWORK PROBLEMS #2

2-1 Consider the following two complex network models A and B:

(a) Model A

1) (Initialization) Start with a small-sized star-shaped network.
2) (Process) At every step of i =1,2,...,N, add one node to the existing network. This new node is trying to connect to every existing node according to the following preferential attachment probability, where k_i is the degree of node i:

$$\Pi_i = 1 - \frac{k_i}{\sum k_j}, \quad i = 1,2,...,N$$

3) (End) After finished step N, stop.

What kind of network will you obtain? Briefly explain why you think so.

(b) Model B

- Step 1 (Initialization) Start with a large-sized fully-connected network.
- Step 2 (Process) For every possible pair of nodes, with probability p ($0 < p < 1$, for example p = 0.5) remove the edge between them. Remove all isolated nodes whenever they appear.
- Step 3 (End) After every possible pair of nodes has been operated once and once only, stop.

What kind of network will you obtain? Briefly explain why you think so.

2-2 To generate a WS small-world model, starting from a perfect ring graph, during the rewiring step one may follow either of the following two different operation rules (always avoid self-loops and multiple edges):

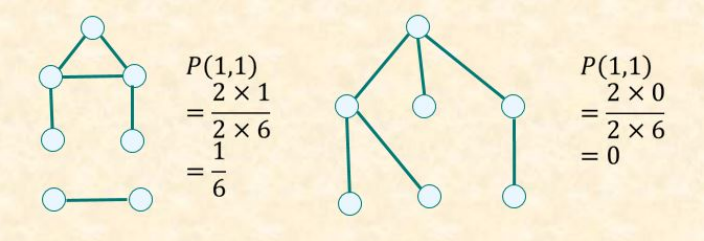
(i) Pick up every pair of connected nodes on the ring, once and once only, randomly disconnect them either at the first end or at the last end of the edge, and then do random rewiring to a third node on the ring.

(ii) Pick up every pair of connected nodes on the ring, once and once only, consistently disconnect the first end (but never disconnect the last end) of the edge, and then do random rewiring to a third node on the ring.

This HW is due on Canvas on Thursday, 24 September 2020

Which operation rule is good and which is bad technically? Briefly explain why you think so.

2-3 Consider the following example shown in Lec-2.ppt.



(a) In Lec-2, it shows degree correlations P(1,1) = 1/6 and P(1,1) = 0

Now, compute: P(1,2), P(1,3), P(2,2), P(2,3), and P(3,3).

(b) For the right-hand graph, compute all edge weights.