BT5240 Computational Systems Biology

Assignment 2

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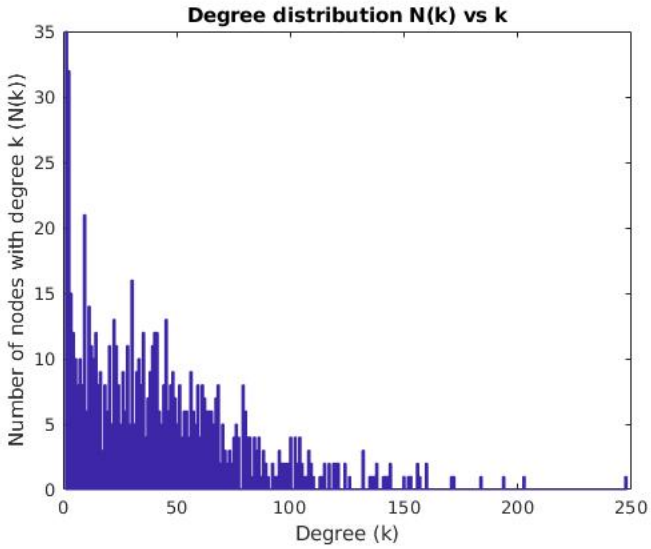
1. **Problem 1**

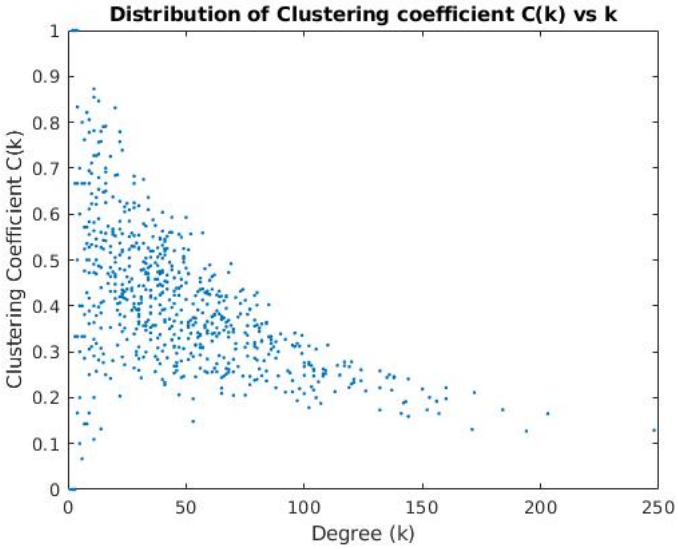
A) Network chosen for analysis: Caltech36 (Facebook Networks)

(a) The assortativity of the network is -0.065273.
The assortativity was calculated based on degree assortativity.
This indicates that high degree nodes are generally connected to low degree nodes, while low (high) degree nodes aren't generally connected to other low (high) degree nodes.

(b) Degree distribution of the network:



(c) The average clustering coefficient of the network is 0.4092944.



This shows that there are a large number of nodes having small degree, while a very small number of nodes have high degree.

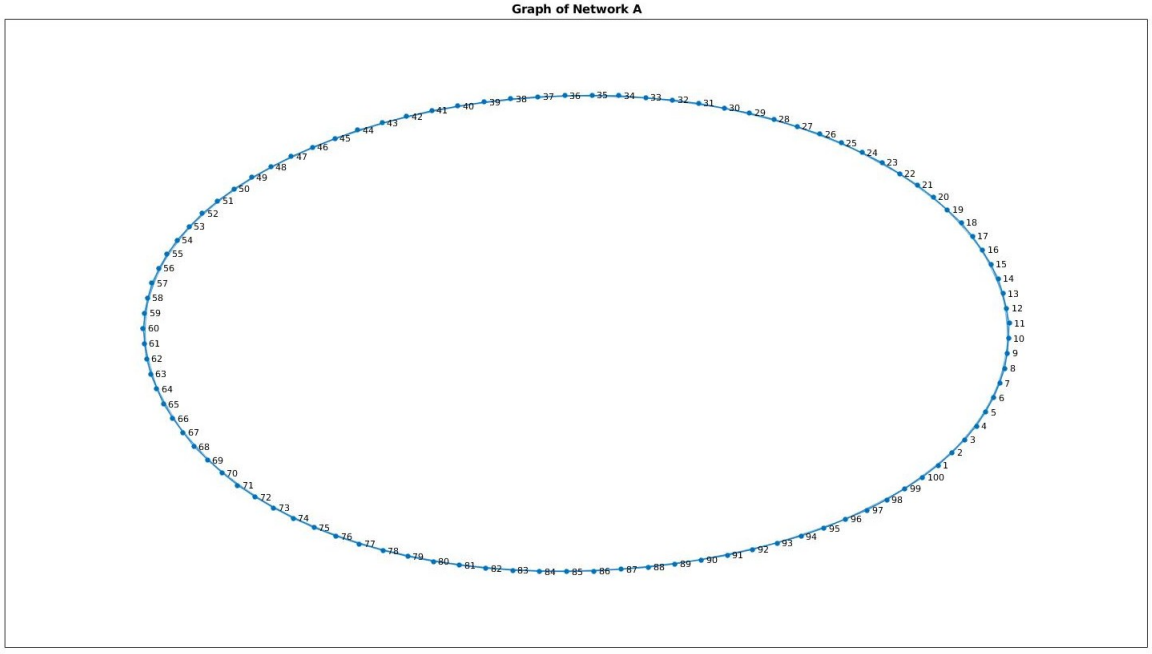
(d) This network resembles a scale-free network. The network has very large number of nodes with small degrees and few nodes having very large degrees.

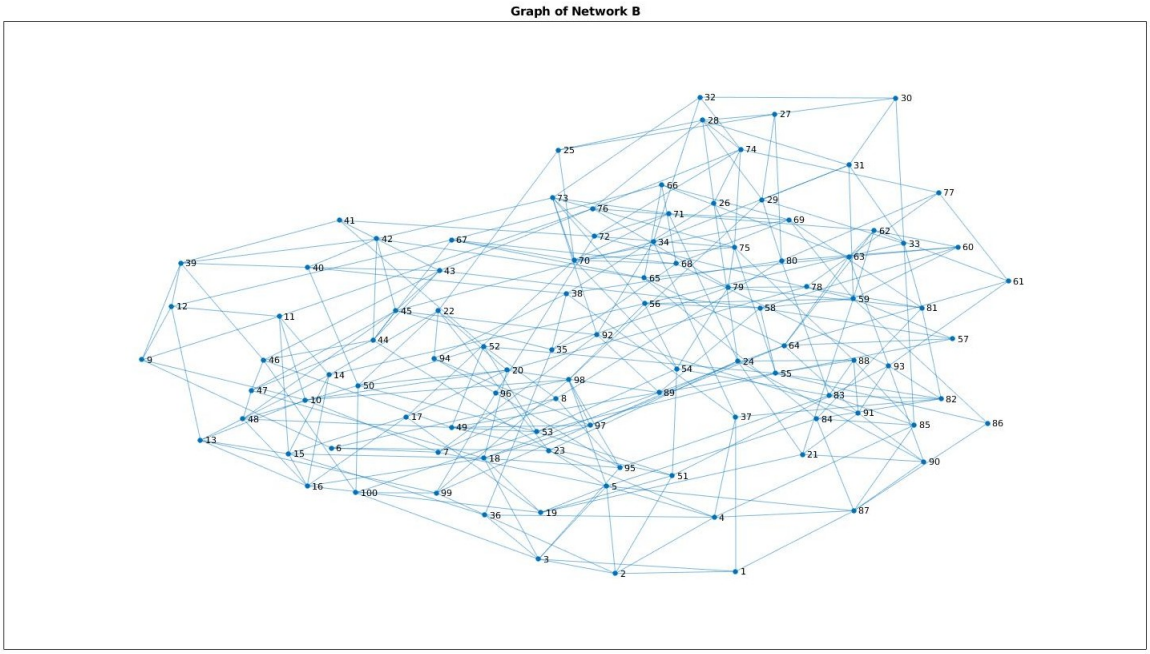
2. **Problem 2**

A) Construction of Network B:

- Adjacency matrix of B is initialized with the adjacency matrix of A (before making it symmetric).
- Probability of re-wiring is to be set by the user `(p)`.
- For each node in B, a random vector of `size = number of nodes is initialized.`
- The values corresponding to the node itself and all the other nodes connected to the node is made `zero(0)` in the random vector.
- A `logical vector` is used to decide whether an edge should be re-wired. This vector is initialized with random values and then thresholded by the `probability of re-wiring(p)`.
- Indices of nodes corresponding to edges being re-wired are mapped onto the random vector and are made zero.
- The random vector is now sorted in `descending order` (to increase randomness) and the indices corresponding to the maximum values are used as the new nodes, post re-wiring.
- The `adjacency matrix(B)` is updated as needed.
- Once all the nodes are operated on, the `adjacency matrix (B)` is made `symmetric (B = B+B')`.

The `probability of re-wiring` considered in this example is: 0.5



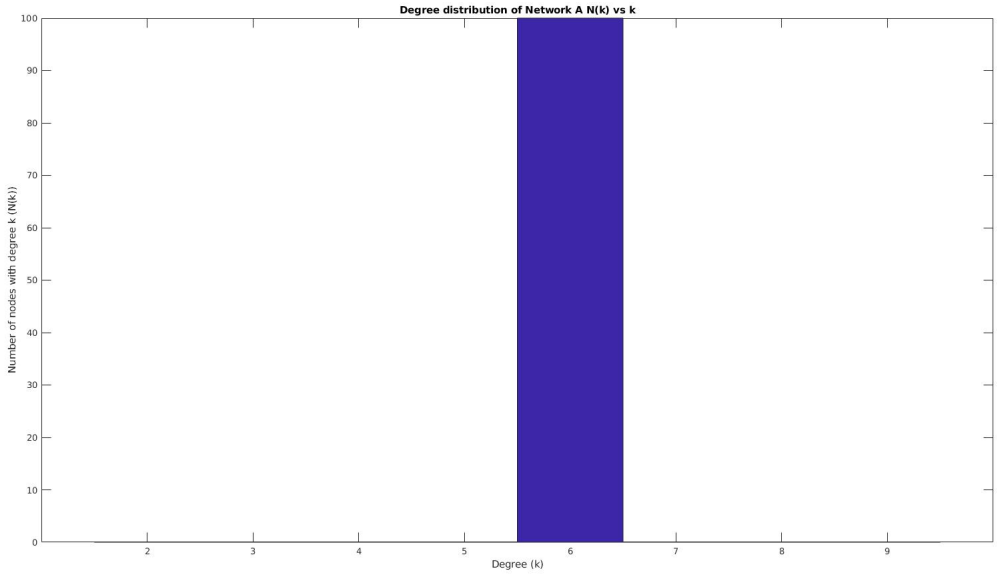


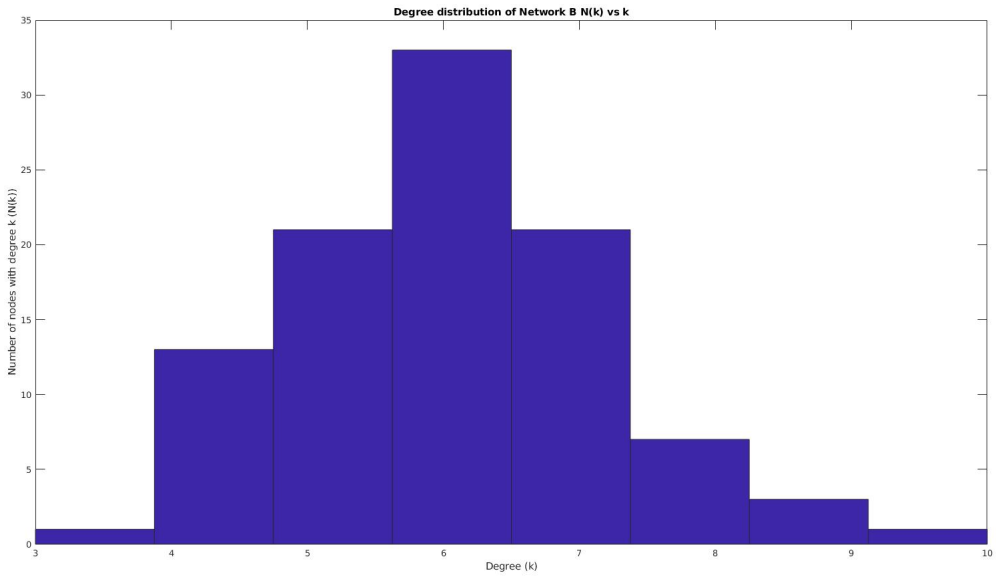
(a) Diameter of Network A: 17
Diameter of Network B: 5

(b) Characteristic path length of Network A: 8.757576
Characteristic path length of Network B: 2.830303

(c) Global clustering coefficient of Network A: 0.600000
Global clustering coefficient of Network B: 0.141608

(d) Degree distributions:





The values corresponding to a random graph are as follows:

- Diameter of random Network: 5
- Characteristic path length of random Network: 2.721010
- Global clustering coefficient of random Network: 0.057484

Comparing the values obtained for Network B, we find that $L_{NetworkB} \lesssim L_{random}$ and $C_{NetworkB} >> C_{random}$, which is characteristic of a 'Real World network'.