CMSC5733 Social Computing

Exercise #2

Deadline: 23:59:59, Oct. 2 (Friday), 2015

Late submission will lead to marks deduction. Days of 1, 2, 3, and 4 or above will cause 10%, 30%, 60% and 100% marks deduction, respectively.

Submission Guidelines: Please send the PDF file to email address cuhk.cmsc5733@gmail.com with your name and student ID.

1. (35pt) City X wants to build a supermarket for the 7 municipal regions. Figure 1 shows a graph of 7 municipal regions. Assume that the links in this graph represent equal transit times for each region to reach neighboring regions. The city wants to reduce transit time from the supermarket to all regions.

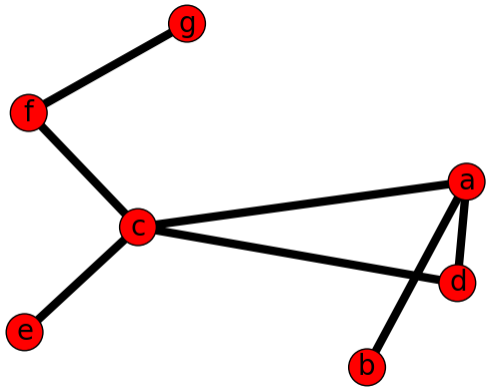


Figure 1: A graph with 7 nodes

Questions:

(1) What are the radius of the node A, D, and F?

(2) What is the diameter of the graph?

(3) What is the center of the graph?

(4) Which region (node) is the best place to locate the supermarket? Why?

(5) What is the Adjacency matrix of the graph shown in Fig. 1? What is the Laplacian matrix of the graph?

(6) What node(s) is (are) the farthest from the central node, and how far?

(7) The deletion of which vertex will make the network unconnected? (Give one example.)

2. (15pt) Figure 2 shows graph G, n = 5, which contains nodes a, b, c, d, and e.

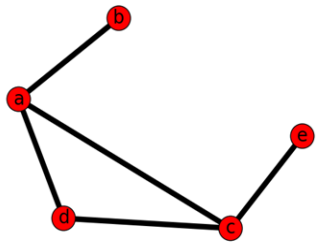


Figure 2: A graph with 5 nodes

Questions:

(1) What is the density of the graph in Figure 2?

(2) What is the degree sequence of the graph in Figure 2?

(3) What is the average path length of the graph in Figure 2?

3. (20pt) Given a graph as shown in Figure 3, calculate the cluster coefficient of node 5 and the cluster coefficient of the graph. (Remarks: please show the calculation procedure.)

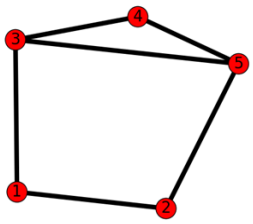
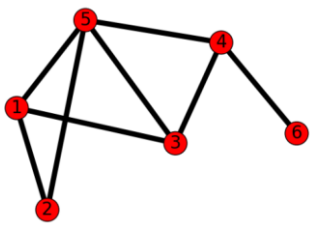


Figure 3: A graph with 5 nodes

4. (30pt) Below is an undirected network. (Remarks: please show the calculation procedure.)



(1) Find the closeness of vertex 3 and 5 in the graph.

(2) Find the betweenness of vertex 3 and 5 in the graph.

Closeness of a node is the reciprocal of sum of the shortest path distances from the node to all other nodes. Since sum of distances depends on the number of nodes in the graph, closeness is normalized by the sum of minimum possible distances (n-1).[1]

Betweenness of a node is the sum of the fraction of all-pairs shortest paths that pass through the node. [2]

5. (Extra Credit 20pt) Which network, binary tree, toroidal, or hypercube, has the shortest average path length for $4 \leq n \leq 9$? Demonstrate the reason.

[1]http://networkx.readthedocs.org/en/networkx-1.10/reference/generated/networkx.algorithms.centrality.closeness_centrality.html?highlight=closeness#networkx.algorithms.centrality.closeness_centrality

[2]http://networkx.readthedocs.org/en/networkx-1.10/reference/generated/networkx.algorithms.centrality.betweenness_centrality.html#networkx.algorithms.centrality.betweenness_centrality