

# CMSC5733 Social Computing

## Exercise 1

Deadline: 23:59:59, October 7(Monday), 2013

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 [cmsc5733@gmail.com](mailto: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.

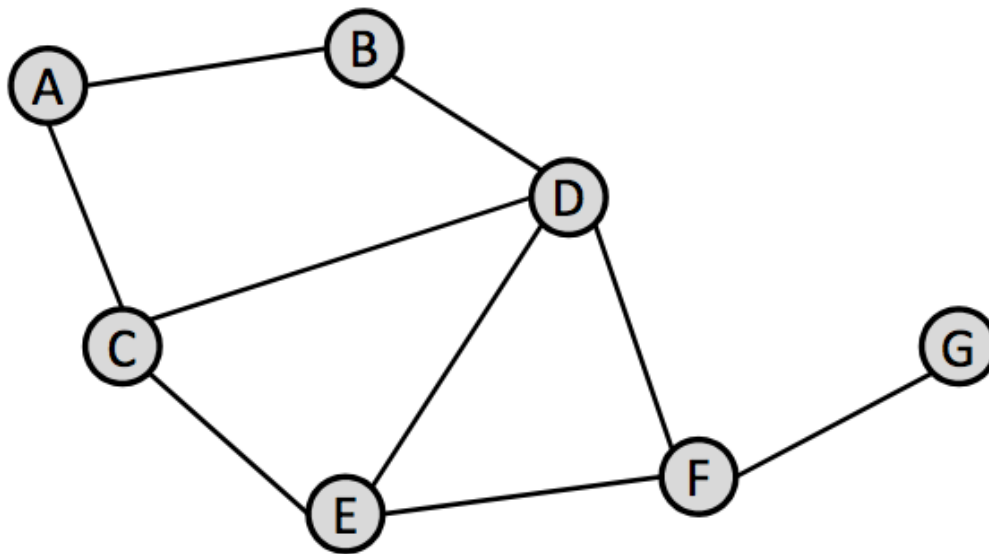


Figure 1: A graph with 7 nodes

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?
2. (15pt) Figure 2 shows graph  $G$ ,  $n = 5$ , which contains nodes  $v_1, v_2, v_3, v_4, v_5$ .

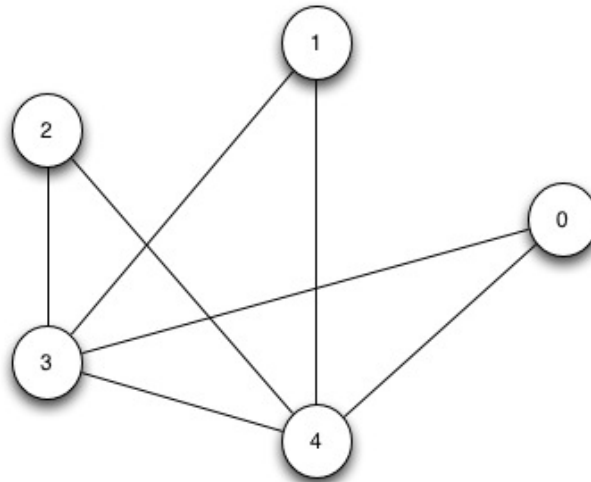
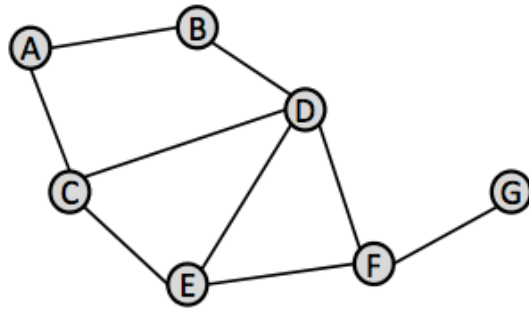


Figure 2: A graph with 5 nodes

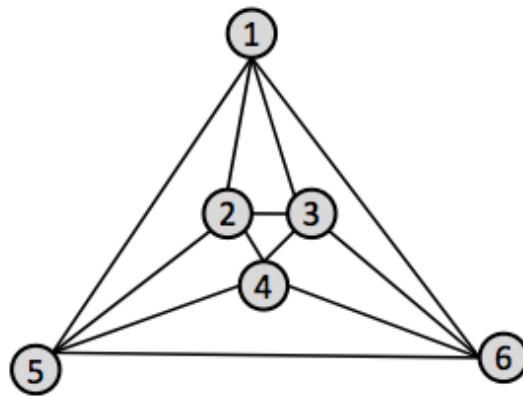
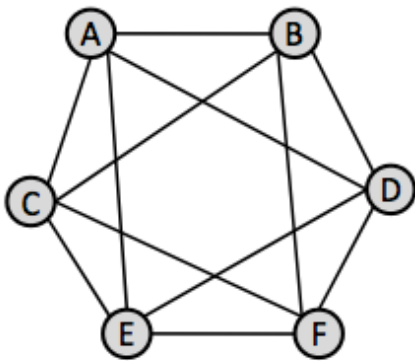
Questions:

- (1) What is the density of Figure 2?
- (2) What is the degree sequence of the graph of Figure 2?
- (3) What is the average path length of the graph of Figure 2?
3. (20pt) (1) Start out with a ring lattice with each node being connected to one neighbor on each side (that's one neighbor to the left, and one neighbor to the right). Sketch the network. What is the cluster coefficient for this network?
- (2) Assume that the number of nodes in the ring lattice is even, and that the nodes are numbered from 1 to  $n$ . In addition to the edges specified in (a), connect the closest even nodes to one another (e.g. node 4 connects to nodes 2 and 6, and node 2 connects to node  $n$  and node 4). Sketch the network. What is the cluster coefficient of the graph?
4. (30pt) Below is an undirected network.



- (1) Find the closeness of vertex D and F in the graph.
- (2) Find the betweenness of vertex D and F in the graph.

5. (Extra Credit 30pt) Below are two undirected networks.



- (1) Are the two graphs below isomorphism? If yes, give the mapping of the vertices.
- (2) Is there a Eulerian path in the left graph above? If so, write the sequence of vertices in the path. If not, explain your answer.
- (3) In the following graph, which one has the highest clustering coefficient? Why?

