CSI 33 LECTURE NOTES (Ojakian) Topic 11: Graph Theory in Computer Science

OUTLINE

(References: ch. 14)

1. Graph Theory

1. Graphs

- (a) Definition: Simple Graph (for example: Friendship Network)
 - i. Vertices = Nodes (number of vertices is called the "order" of the graph)
 - ii. Edges = Links (number of edges is called the "size" of the graph)**PROBLEM 1.** For a simple graph of order n, what are the possible number of edges?
- (b) Definition: Directed Graphs (for example: Web links)
 - i. Edges = Arcs

PROBLEM 2. In the web graph, what are some nodes that have a lot of edges pointed to it?

2. Some Special Graphs

The n is the order of the graph in the following.

- (a) Complete (K_n)
- (b) Cycle (C_n)
- (c) Path (P_n)
- (d) Trees (connected and acyclic).

3. <u>Basic Definitions</u>

- (a) Adjacent
- (b) Neighbor
- (c) Connected
- (d) Distance and Shortest Path
- (e) Degree of vertex

4. Representing Graph on computer

- (a) "Adjacency List" representation**PROBLEM 3.** Program this.
- (b) "Adjacency Matrix" Representation **PROBLEM 4.** *Program this.*

5. Some Computations on Graphs

PROBLEM 5. Write a function which takes a graph as input and prints the following statistics:

- (a) All the degrees, in increasing order.
- (b) The sum of the degrees.
- (c) The number of edges in the graph.

Try the function on a number of graphs and see if you can see some pattern?

- (a) In the last part, maybe you observed the following ...
 - i. Handshaking Lemma or Degree Sum Formula
 PROBLEM 6. In any simple graph, how many odd degree vertices are there? Create some random graphs and count!
- 6. Dijkstra's Algorithm

To find the distances between vertices in a graph.

7. An application and a simulation

Small world phenomena (6 degrees of separation ...).

PROBLEM 7. Create random graphs that simulates the world and its connections, and see what the degree of separation is.