# CS 4/512 Project 4

# Graph Search and Shortest Path

The project should be implemented in C# or C++. Place your results in a zipped project folder named CS4412Pj3<yourLastName>.zip and submit through moodle. It should contain a .doc document containing the written question answers. **You must use your project 3 priority queue code** **to receive a grade above 0 on the project.**

**Part 1: Directed non-weighted graph**

1. **(7 points)** Generate a 10x10 integer array with 24% of the cells (0 through 9) randomly initialized to 1 and the rest set to -1. 1 represents the presence of a directed edge between two nodes. The rows are the “from” vertices and the columns are the “to” vertices. We will use -1 to represent the absence of an edge. Create a graphic display (circles and lines) that displays the above graph as represented by the 10x10 array. (What algorithm will you use to you place your nodes on the display?). As discussed in class, note 4.6 contains code that displays circles and lines that must be used to receive a grade on the project.
2. Depth first search
   1. **(24 points)** Implement a depth first search from vertex 0 to the first encounter of vertex 9. Display the nodes in order for this path.
   2. **(3 points)** What is the length of the path your depth-first search encountered on its way to locating vertex 9? How many nodes were visited in reaching vertex 9
   3. **(3 points)** What is the BigO (best, worse, average) of your depth-first search? Carefully and fully justify your analysis.
3. Breath First Search
   1. **(19 points)** Implement a breadth first search from vertex 0 to the first encounter of vertex 9.
   2. **(8 points)** Display a tree with node 0 as the root showing your breath-first search pattern.
   3. **(3 points)** Assuming each edge is length 1, what is the shortest distance between node 0 and node 9? (The answer may be infinity.)
   4. **(3 points)** What is the BigO (best, worse, average) of your breadth-first search? Carefully and fully justify your analysis.

**Part 2: Directed positive weighted graph**

1. **(4 points)** Generate a 10x10 integer array with 20% of the cells initialized to a randomly generated positive integer between 1 and 20 with the rest set to -1. A positive edge weight represents the presence of a positive weight directed edge between two nodes. The rows are the “from” vertices and the columns are the “to” vertices. We will use -1 to represent the absence of an edge. Modify your graphics display from part 1 to show this new graph with weighted edges including the direction of the edges.
2. **Shortest Path through positive weighted directed cyclic graph**
   1. **(20 points)** Develop an algorithm to locate the shortest path from vertex 0 to vertex 10.
   2. **(3 points)** Display the shortest path including vertices along the path, edge weights, and total weighted distance.
   3. **(3 points)** What is the BigO (best, worse, average) of your shortest path algorithm search? Carefully and fully justify your analysis. How does the percent of your initial matric fill affect your BigO analysis?