# CS 4412 5512 Module 6 Project 6

# Graph Search and Shortest Path

Place your C++ results in a cpp file named CS4412Pj6<yourLastName>.cpp (or 5512) and submit through moodle as well as a similarly named .doc file containing the written question answers. You must use the provided priority queue code when appropriate to receive a grade on the project and your code must read in and use the indicated .txt file for part 1.

**Part 1:**

1. Generate an 8x8 integer array with 30% of the cells 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.
   1. Create a display of the matrix representing the above graph along with a display showing the priority queue, and the table showing the additional needed state information as provided in note 6.4 e.g.:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| G | W | W | W | W | W | W | W |
| 0 | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|  | V1 |  |  |  |  |  |  |

Color

Distance

Vertex#

Prior#

1. Depth first search
   1. Implement a depth first search from vertex 0 to the first encounter of vertex 9.
   2. What is the length of the path your depth-first search encountered on its way to locating vertex 9? Display the nodes in order for this path.
   3. What is the BigO (best, worse, average) of your depth-first search? Carefully and fully justify your analysis.
2. Breath First Search
   1. Implement a breadth first search from vertex 0 to the first encounter of vertex 9.
   2. Display a tree with node 0 as the root showing your breath-first search pattern.
   3. Assuming each edge is length 1, what is the shortest distance between node 0 and node 9? (the answer may be infinity.)
   4. What is the BigO (best, worse, average) of your breadth-first search? Carefully and fully justify your analysis.

**Part 2:**

1. Read in the provided .txt file the first line of which indicates an integer N and the subsequent lines indicating the NXN graph weights. Positive weights are 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. Display this graph in matrix form.
2. Shortest Path through positive weighted directed cyclic graph
   1. Develop an algorithm to locate the shortest path from vertex 0 to the last vertex. Display the shortest path including vertices along the path, edge weights, and total weighted distance.
   2. 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?

**Part 3:**

1. Generate a 10x10 integer array with 30% 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. Display the shortest path including vertices along the path, edge weights, and total weighted distance. Time your code with a randomly generated weighted graph with 20, 50, and 100 nodes.

Grading Rubric

1. 15
2. 20
3. 20
4. 15
5. 20
6. 10