CS201 Data Structures and Algorithms
Autumn 2020
Assignment 2
Total marks: 10
Due on 21st November
Cut-off date: 23rd November (with 25% penalty)
Penalty for violating naming convention: 2.5%

Notes
- You are expected to solve this assignment manually and submit the relevant files in the required format.
- There are three questions in this assignment and the maximum marks is 10.
- Each student gets a unique directed edge-weighted graph - the same graph must be used for all the three questions.
- Please see the attachment (graphs.zip) to get the graph given to you. The graph is in a file named <roll-no>.txt, where <roll-no> is your roll no.
- The format of the graph file is the following:
  - First line contains 2 integers - the number of vertices (n) and the number of edges (m) respectively.
  - The vertices are numbered from 0 to n-1.
  - Then there are m lines where each line represents one directed weighted edge.
  - Each line representing a directed weighted edge is of the form "u v w" - this implies that there is a directed edge from u to v where the weight of the edge is w.
- In the following questions, the graph given to you is denoted as G.
- Please do not assume anything. If you have any doubt, please send an email to the TA ccing the instructor.

Q1. Do a DFS on G. While doing the DFS, whenever there is a tie, the preference must go to the lowest numbered vertex. This implies that:
- The starting vertex is 0
- Once a vertex u is discovered, if there are two edges ua and ub such that both a and b are undiscovered, then the next visited vertex must be a (assuming a < b).
- If one full DFS visit is completed and there are still undiscovered vertices, then the next DFS visit will start on the vertex with lowest label among all undiscovered vertices.

The task is to find the discovery time and finish time of each vertex. Assume that the time starts from 1 (i.e., the discovery time for the vertex 0 is 1). Submit a file <roll-no>-1.txt where each line is of the form "u d f", where u is the label of a vertex, d is the discovery time of u, and f is the finish time of u. Please order the vertices from 0 to n-1. Please see a sample answer file in an attachment.

This question carries 3 marks. You get full marks if the answer is fully correct, 0 marks otherwise.

Q2. Categorize the edges of G based on the DFS done as per Q1. Submit a file named <roll-no>-2.txt where each line is of the form "u v <type>", where "u v" represents a directed edge and <type> is one of "t" (for tree edge), "f" (for forward edge), "b" (for backward edge), "c" (for cross edge). Please see a sample answer file in an attachment.

This question carries 3 marks. Please order the edges in the order given in the input file. You get full marks if the answer is fully correct, 0 marks otherwise.

Q3. Apply Dijkstra's algorithm on G and obtain the order in which the vertices are added to the set S (recall that whenever a vertex is added to S, its shortest distance from the source is already obtained - see Section 24.3 in the textbook.). Consider the source vertex as 0.

Submit a file named "<rolll-no>-3.txt" which contains exactly n lines which depict the order (one vertex per line) in which the vertices are added to S. See an example as attachment.

This question carries 4 marks. You get full marks if the answer is fully correct, 0 marks otherwise.