Assignment 02
Shortest Paths

Please submit your solutions in PDF format. The PDF must be typed, NOT handwritten. Solution for each problem must start on a new page. The solutions should be concise; complicated and half-witted solutions might receive low marks, even when they are correct. Solutions should be submitted on the course website.

Problem 1: Collaborators [2 points]

List the name of the collaborators for this assignment. If you did not collaborate with anyone, write "None" (without the quotes).

Problem 2: Dijkstra Practice [12 points]

Consider the following representation of a graph:

Vertex 1	Vertex 2	W
a	s	13
a	d	3
b	a	1
b	d	10
b	e	4
b	c	12
c	e	9
d	b	2
d	c	7
e	f	0
e	c	8
f	c	5
s	b	6
s	e	11

Each row of the table denotes that there is a directed edge from Vertex 1 to Vertex 2 with weight W. *s* is consider as the source node.

(a) [4 points] Draw the weighted graph.

(b) [4 points] Assume that we run Dijkstra's Algorithm to find the shortest path here. Write down the weight of the shortest path from *s* to all nodes.

(c) [4 points] List the order in which the vertices are removed from the Dijkstra queue.

Problem 3: Vanilla-BFS [4 points]

Without modifying BFS, can we use it to find the shortest path in a weighted graph? Justify your answer.

Problem 4: Longest Paths [12 points]

A path in a graph is simple if it visits any vertex at most once. Your friend Starney Binson comes up to you with this ingenious idea of finding the longest simple path in a graph in polynomial time. He wants to do the following:

1. Negate all the edge weights of the graph
2. Run Bellman-Ford to find the shortest path
3. Negate all the shortest distances found

He claims that the distances will represent the length of the longest simple path in that graph.

(a) [4 points] Draw an example graph where Starney's Algorithm will work.

(b) [8 points] Argue whether Starney's Algorithm will work for all graphs or not. If not, provide a counterexample.

Problem 5: Weight! That's possible? [10 points]

Remember PERT charts from System Analysis and Design Course? No? Alright! Suppose a system analyst is trying to set up a realistic schedule for the data gathering and proposal phases of the systems analysis and design life cycle. The systems analyst looks over the situation and lists activities that need to be accomplished along the way. The list shows that some activities must precede other activities. That means if task u depends on task v, v must be completed before starting u. The time estimates are also determined for each activity. Given the list of activities including their duration and dependencies, describe an algorithm to compute the shortest time to complete all the activities.