CS 3510 – Assignment 4

Due Friday, July 2, 2022 at 11:59pm on Canvas

Instructor: Shahrokh Shahi

- Please type your answers (LaTeX is highly recommended) and upload a single PDF file named `<Your-GT-Account>.pdf`, e.g., GBurdell3.pdf, including all your answers. You can submit multiple times. Canvas keeps track of the submissions and append a version number when you re-submit. We always grade your most recent submissions.
- Please read the policies, and do not forget to acknowledge your collaborators and cite your references.
- If you do not understand a question, please ask on Piazza or come to office hours well ahead of the due date.
- It is recommended to start reviewing the course material by reading the lecture slides and reviewing the demo codes. Then, the suggested readings from textbooks and solving the practice problems can provide the additional preparation for solving the homework problems. Please note, for the textbook readings, you do not need to cover the topics which have not been covered in the lectures.

Suggested Reading

	CLRS	KT
Section(s)	Chapter 22-23	Chapter 3, 4

Suggested Practice Problems

	CLRS	KT
Practice problems	Exercise: 22.1-(1-6), 22.2-(1,2,4,5), 22.3-(2,3,7), 22.4-(1,5), 22.5-(2,3) 23.1-(1,2,5), 23.2-(1,2) Problems: 22-4, 23-3	Exercise: chapter 3: 1, 2, 6, 10 chapter 4: 2, 8, 9, 10

Additional reading and problems:
– DPV (Chapter 3, 5)

1 Graph Traversal (20 pts)

Let $G = (V, E)$ be an undirected graph with the additional property that every edge also has a color, either red or blue. Let u and v be distinct vertices in $G = (V, E)$.

(a) (10 pts) Design an efficient (linear) algorithm that decides whether or not there exists a path from u to v such that the path contains only red edges. Justify the correctness of your algorithm and discuss the running time.

(b) (10 pts) Design an efficient (linear) algorithm that decides whether or not there exists a path from u to v such that within the path, all blue edges appear after all red edges .Justify the correctness of your algorithm and discuss the running time.

2 Graph Traversal (10 pts)

For each of the two following statements, decide whether it is **T**rue or **F**alse. If it is true, provide a short explanation and if it is false, give a counterexample.

(a) (5 pts) Given a tree $T = (V, E_T)$, we run both BFS and DFS starting from the same node s.
`True or False?` The resulting BFS tree and DFS tree are the same.

(b) (5 pts) Given a graph $G = (V, E)$, we run BFS and DFS starting from the same node s, and obtain the same traversal tree by both algorithms.
`True or False?` The graph G is a tree.

3 Minimum Spanning Tree (10 pts)

Suppose $G = (V, E)$ is a weighted connected graph and let $e = (u, v)$ be a minimum-weight edge in the given graph G. Show that $e = (u, v)$ belongs to some minimum spanning tree of G.

4 Minimum Spanning Tree (10 pts)

Let $G = (V, E)$ be an undirected, connected, weighted graph, and let F be a subgraph of G such that it is a forest (i.e. F includes one or more trees and does not contain any cycles). Design an efficient algorithm to find a spanning tree that contains all the edges of F, and that has minimum cost among all spanning trees containing F.