

Assignment 3

CMPT307

Summer 2020

Assignment 3

Due Wed July 15 at 23:59

4 problems, 40 points.

*** For questions 1, 3, and 4, please describe your algorithm in pseudocode, then use several sentences to explain your idea.*

1. Describe an algorithm to compute the reversal (also called transpose) $rev(G)$ of a directed graph in $O(V + E)$ time. (10 points)
2. Given a directed graph G . Let v denote a vertex of G , and $S(v)$ be the strong component of G that contains v . For two arbitrary vertices $u, v \in G$, prove that u can reach v if and only if $S(u)$ can reach $S(v)$ in $scc(G)$. (10 points)
3. Given an undirected graph G with weighted edges and a minimum spanning tree T of G , describe an algorithm (use pseudocode) to update the minimum spanning tree T when the weight of a single edge e is increased. The input to your algorithm is the edge e and its new weight value. You should modify the spanning tree T so that it is still a minimum spanning tree. (10 points)

Hint: Consider the cases $e \in T$ and $e \notin T$ separately.

4. Given a directed graph G with weighted edges, describe an algorithm to find the shortest path from one vertex s to another vertex t . There is exactly one edge in G that is with negative weight. (10 points)

Hint: Consider modifying Dijkstra's algorithm. Of course other ideas could also be great.