CSCI 3104 PS5a

Jonathan Phouminh

TOTAL POINTS

11 / 11

QUESTION 1

7 pts

1.1 2 / 2

✓ + **2 pts** **Correct**

+ **1 pts** partially correct

+ **0 pts** Incorrect or not attempted

1.2 2 / 2

✓ + **2 pts** **All steps correctly followed. Good Work!!!**

+ **1.5 pts** Minor mistake in any one of the steps of Kruskal's Algo. Please refer to the solution file.

+ **1 pts** Minor mistake in either two or three steps of Kruskal's Algo. Please refer to the solution file.

+ **0 pts** Empty solution submitted or incorrect approach followed. Please refer to the solution file.

1.3 1 / 1

✓ + **1 pts** **Correct answer with justification**

+ **0.5 pts** Correct answer without justification

+ **0 pts** Incorrect

Dijkstra's algorithm will not necessarily generate a MST.

1.4 2 / 2

✓ + **2 pts** **Correct**

+ **0 pts** Incorrect/ No solution

QUESTION 2

2 1 / 1

✓ + **0.5 pts** **Correct description of find(v)**

✓ + **0.5 pts** **Correct description of union(a,b)**

+ **0 pts** Incorrect answer or not attempted

+ **0.5 pts** Partially correct

QUESTION 3

3 3 / 3

✓ + **1 pts** **Get first edge correctly.**

✓ + **1 pts** **Get second edge correctly.**

✓ + **1 pts** **Get third edge correctly.**

+ **0 pts** Incorrect/Not attempted

Name: Jonathan Phouminh

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CSCI 3104, Algorithms **Profs. Hoenigman & Agrawal**
Problem Set 5a (11 points) **Fall 2019, CU-Boulder**

Instructions for submitting your solution:

- The solutions **should be typed** and we cannot accept hand-written solutions. Here's a short intro to Latex.
- You should submit your work through **Gradescope** only.
- If you don't have an account on it, sign up for one using your CU email. You should have gotten an email to sign up. If your name based CU email doesn't work, try the identikey@colorado.edu version.
- Gradescope will only accept **.pdf** files (except for code files that should be submitted separately on Gradescope if a problem set has them) and **try to fit your work in the box provided**.
- You cannot submit a pdf which has less pages than what we provided you as Gradescope won't allow it.
- Verbal reasoning is typically insufficient for full credit. Instead, write a logical argument, in the style of a mathematical proof.
- For every problem in this class, you must justify your answer: show how you arrived at it and why it is correct. If there are assumptions you need to make along the way, state those clearly.
- You may work with other students. However, **all solutions must be written independently and in your own words.** Referencing solutions of any sort is strictly prohibited. You must explicitly cite any sources, as well as any collaborators.

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1. (7 pts) Consider the following weighted graph.

PS5/PS5aQ1.png

(a) (2 pts) Run Dijkstra's algorithm on this graph to obtain a tree of shortest paths. Use vertex 1 as the source vertex.

Solution.

VerticeVisited	Distance
1	0
2	2
4	5
5	6
3	16

$cost = 29$

(b) (2 pts) Run Kruskal's algorithm on this graph to obtain a minimum spanning tree.

Solution.

(x, y) = edges from x y
1) (1,2)
2) (2,5)
3) (2,4)
4) (2,3)

(c) (1 pts) Is the tree of shortest paths produced by Dijkstra's algorithm a minimum spanning tree? Justify your answer.

Solution.

The graph produced is a minimim spanning tree because the graph produced is acyclic, includes all vertices, and is the minimum cost path possible where $cost = 29$

(d) (2 pts) Find two vertices u and v, where the $u - v$ path in the Kruskal tree is not a shortest $u - v$ path.

Solution.

We can examine the vertices 1 and 4 and we will see the path from 1-4 using kruskal's algorithm is not the true shortest path from 1-4 because the cost of that path with kruskals is 7 as opposed to the optimal path being 5.

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2. (1 pt) Provide a brief description of what the *find(v)* and *union(A,B)* features of the union-find algorithm produce.

   Solution.

   Union find data structure is intended to maintain partitions of a set of objects, more specfically,
   find(v) returns the name of the group that 'v' belongs to and
   union(c_1,c_2) fuses the group c_1 and c_2 together in a single group.

3. (3 pts) Identify three edges in the following graph G that won't be included in any MST of G. Provide a 3-4 sentence explanation of your answer.

   `PS4/mst_graph_q2.jpg`

   Solution.

   An MST is an acyclic tree , connects all vertices, and produces a minimum total cost of the path to all vertices. We also know that an MST must follow cut properties such that minimum crossing edge of two partitions separated by a cut must be in the MST. Therefore, we can identify edges (A,B), (B,C), (C,D) and know that they will not be in the MST.