CSCI 3104 PS4a

Jonathan Phouminh

TOTAL POINTS

11 / 11

QUESTION 1

1 1 **1 / 1**

✓ **+ 1 pts** **Correct**

+ 0.5 pts Partially correct

+ 0 pts Incorrect or not attempted

QUESTION 2

2 2 **1 / 1**

✓ **+ 1 pts** **Correct**

+ 0.5 pts Partially correct

+ 0 pts Incorrect or not attempted

QUESTION 3

3 3 **3 / 3**

✓ **+ 3 pts** **Mentions the correct number of MSTs**

- 1 pts Incorrect first MST: Correct MST is AE-EB-EF-FG-GC-GD-GH

- 1 pts Incorrect second MST: Correct MST is AE-EF-FB-FG-GC-GD-GH

+ 0 pts Incorrect

+ 1 pts Contains first MST: AE-EB-EF-FG-GC-GD-GH

+ 1 pts Contains second MST: AE-EF-FB-FG-GC-GD-GH

+ 0 pts Click here to replace this description.

QUESTION 4

4 4 **3 / 3**

✓ **+ 1 pts** **Mentioned correctly that MST doesn't change**

✓ **+ 2 pts** **Provided a proper simple logical argument**

+ 1 pts Minor mistakes in providing a simple logical argument. Please refer to the solution file.

+ 0 pts Empty solution submitted or incorrect approach followed

+ 0.5 pts Please mention that MST doesn't change explicitly

QUESTION 5

5 5 **3 / 3**

✓ **+ 1 pts** **Correct conclusion with sufficient explanation.**

✓ **+ 2 pts** **Provide counterexample correctly.**

+ 0 pts Incorrect/Not attempted.

Name: Jonathan Phouminh

ID: 106054641

CSCI 3104, Algorithms **Profs. Hoenigman & Agrawal**
Problem Set 4a (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. (1 pt) What is the definition of a Minimum Spanning Tree (MST)?

   Solution. If G is a graph, T is a sub-graph that is connected, acyclic, includes all vertices, and has minimum weight of all edges.

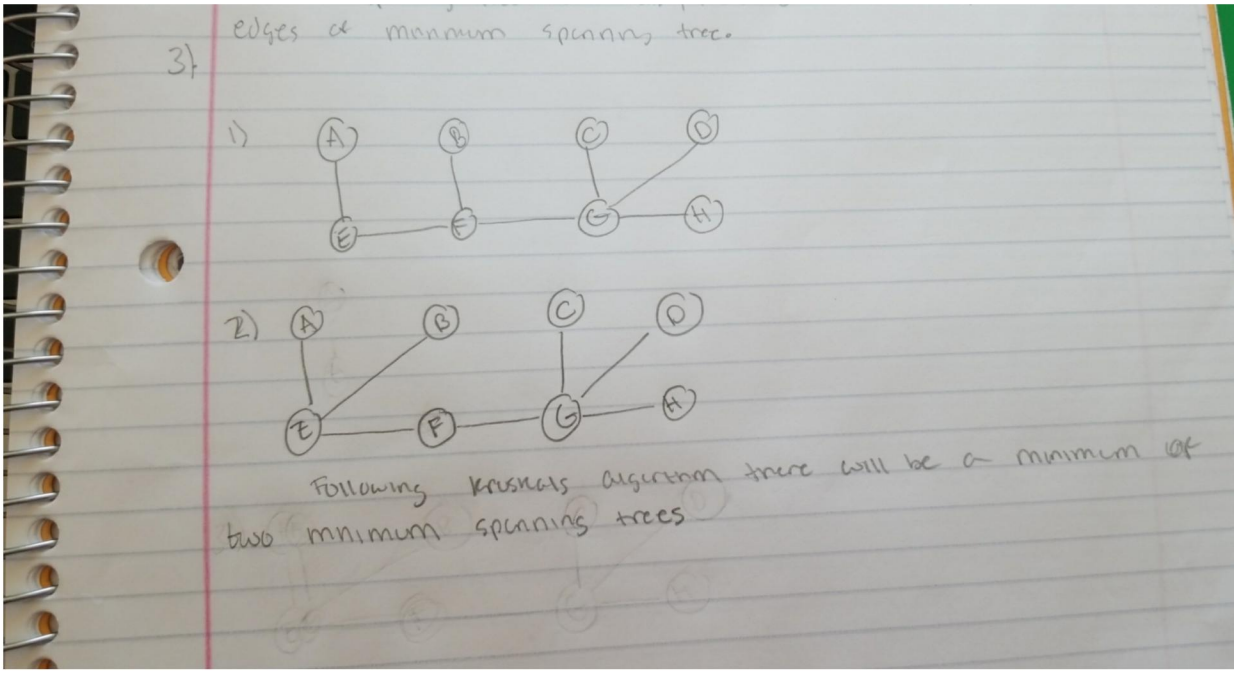
2. (1 pt) Describe in one or two sentences, a greedy rule for constructing an MST.

   Solution. If weight of edge is minimum and adding edge doesn't violate spanning tree conditions, then add edge to set of edges that form minimum spanning tree.

3. (3 pts) How many unique MSTs does the following graph have :

   PS4/mst_graph_q2.jpg

Solution.



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4. (3 pts) Suppose that you have calculated the MST of an undirected graph $G = (V, E)$ with positive edge weights.
   If you increase each edge weight by 2, will the MST change? Prove that it cannot change or give a counterexample if it changes. (Note: Your proof, if there is one, can be a simple logical argument.)

   Solution. The MST will not change because if all edges are increased by weight 2 then the total weight of the MST of the increased graph will just be the previous total weight before increasing the weight, but increased by 2. Therefore, the MST will be the same.

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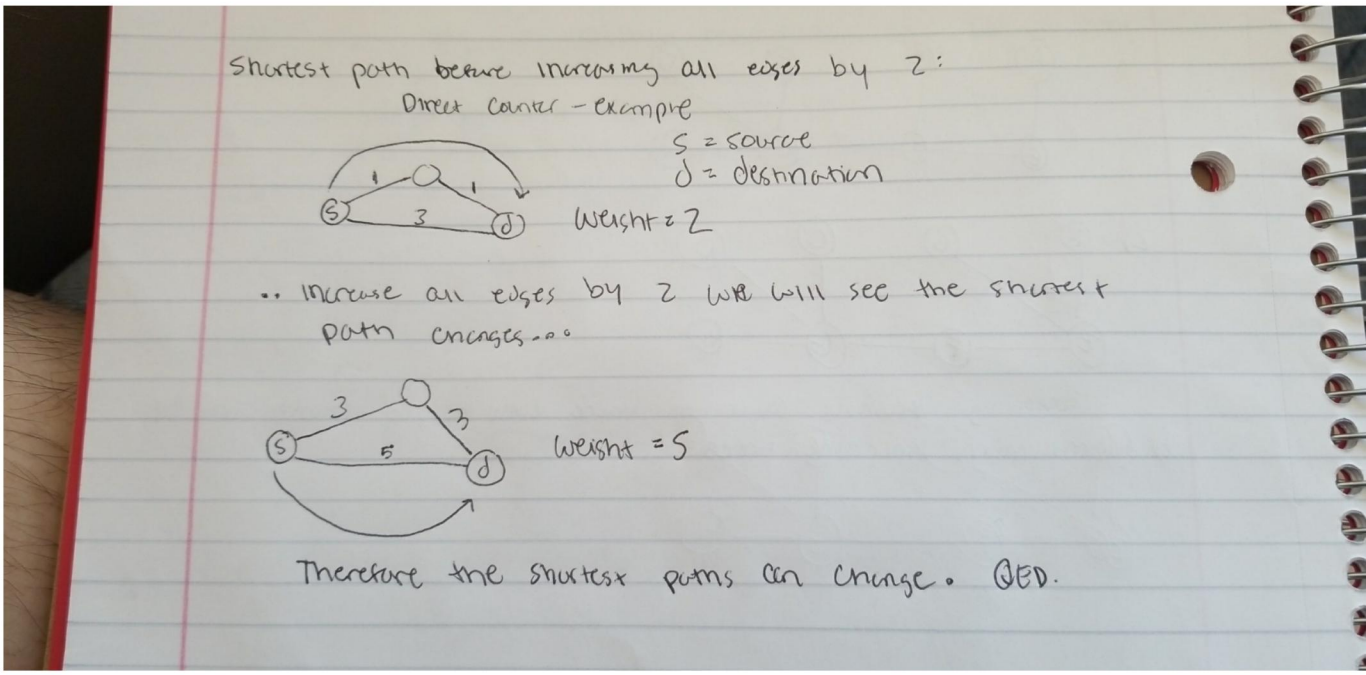
5. (3 pts) Suppose that you have calculated the shortest paths to all vertices from a fixed vertex $s \in V$ of an undirected graph $G = (V, E)$ with positive edge weights.
If you increase each edge weight by 2, will the shortest paths from s change? Prove that it cannot change or give a counterexample if it changes.(Note: Just as in Part a, your proof can be a simple logical argument.)

Solution. If we increase all edges of a graph by 2 we will see that the shortest path from source vertex to s will change. We can demonstrate this through a counter-example.

CounterExample:



Collaborated with: Bao Nguyen