

Quiz 5 - BFS/DFS

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Contents

1	Instructions	1
2	Honor Code (Make Sure to Virtually Sign)	2
3	Standard 5- BFS/DFS	3
3.1	Problem 2	3

1 Instructions

- The solutions **should be typed**, using proper mathematical notation. We cannot accept hand-written solutions. Here's a short intro to \LaTeX .
- You should submit your work through the **class Canvas page** only. Please submit one PDF file, compiled using this \LaTeX template.
- You may not need a full page for your solutions; pagebreaks are there to help Gradescope automatically find where each problem is. Even if you do not attempt every problem, please submit this document with no fewer pages than the blank template (or Gradescope has issues with it).
- You **may not collaborate with other students**. **Copying from any source is an Honor Code violation. Furthermore, all submissions must be in your own words and reflect your understanding of the material.** If there is any confusion about this policy, it is your responsibility to clarify before the due date.
- Posting to **any** service including, but not limited to Chegg, Discord, Reddit, StackExchange, etc., for help on an assignment is a violation of the Honor Code.
- You **must** virtually sign the Honor Code (see Section 2). Failure to do so will result in your assignment not being graded.

2 Honor Code (Make Sure to Virtually Sign)

Problem 1. • My submission is in my own words and reflects my understanding of the material.

- Any collaborations and external sources have been clearly cited in this document.
- I have not posted to external services including, but not limited to Chegg, Reddit, StackExchange, etc.
- I have neither copied nor provided others solutions they can copy.

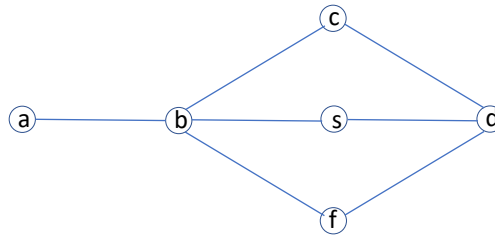
Agreed (signature here).

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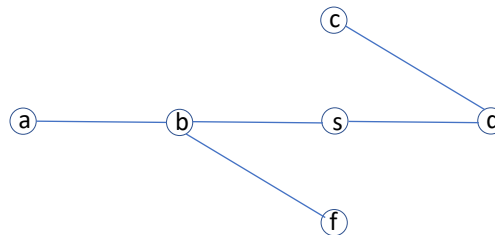
3 Standard 5- BFS/DFS

3.1 Problem 2

Problem 2. Consider the following graph with the source node s :



(i). Is it possible to obtain the following tree using BFS? Clearly justify your answer.



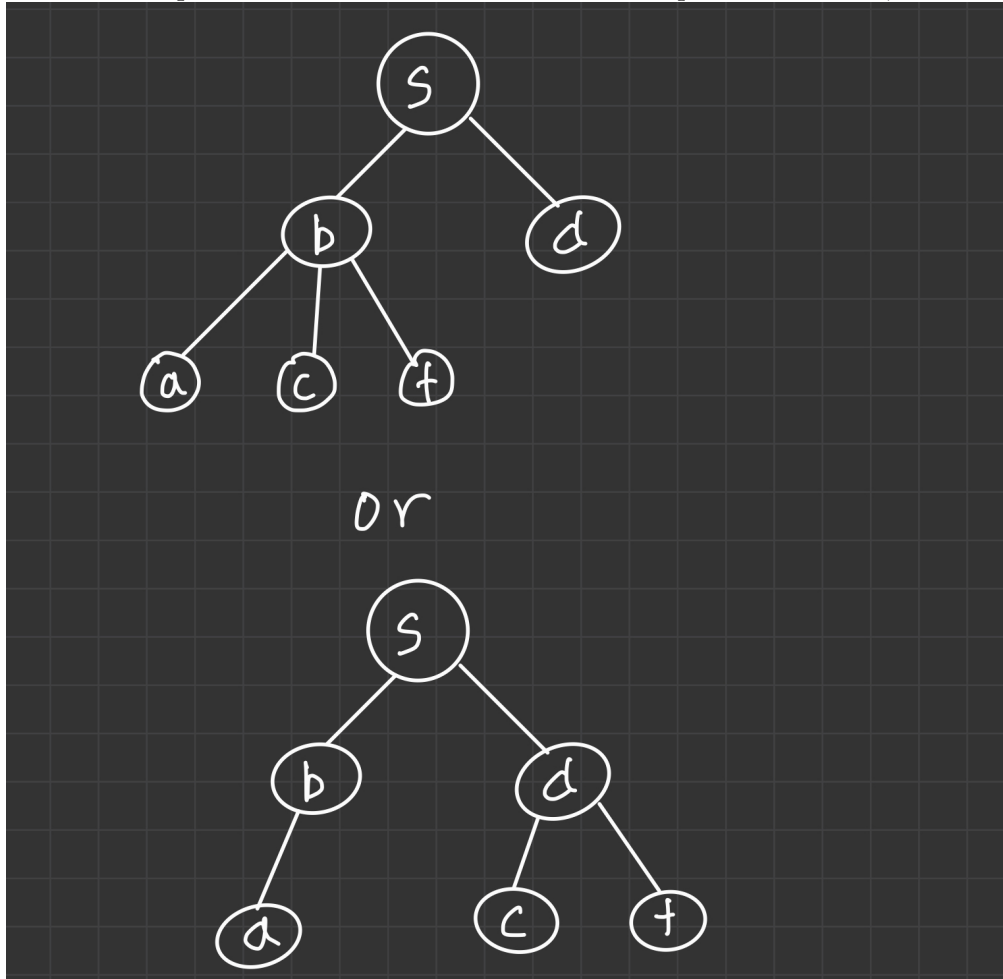
(ii). Is it possible to obtain a shortest path tree using BFS? Clearly justify your answer; and if your answer is yes, give such a shortest path tree obtained using BFS. Here the length of a path is defined as the number of edges on the path.

Answer. **Part I**

- It is impossible to obtain the tree shown in above. In the BFS algorithm, it examines all of the unvisited neighbors of the current vertex before examining vertices further.
- One of the possibility: content in priority queue is $Q = [s]$
- $Q = [b,d]$
- $Q = [d,a,c,f]$
- $Q = [a,c,f]$
- $Q = [c,f]$
- $Q = [f]$
- $Q = []$ Algorithm terminates
- If we poll b before d from queue (d is already in queue), all remaining nodes, a , c and f , will be added into Q . Then, b is connected to a, c and f at the same time.
- If we poll d before b from queue (b is already in queue), c and f will be added into queue. Then d is connected to c and f at the same time.
- Thus, there is no way to have the tree shown in above, like d connect to c and b connect f . Because, BFS will visit all of the unvisited neighbors of the current vertex before examining vertices further. Either b or d must connect node c and node f at the same time.

Part II

- YES, the graph is unweighted, undirected and fixed source node at s. And, BFS algorithm will visit every unvisited node that in the same depth in tree. And the result of BFS will result in single-source shortest path trees. In other words, for any vertex v in the Graph, the s to v path in T is a shortest s to v path in G.
- The shortest path from s to b or d is 1 and shortest path from s to a,c and f is 2.



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