

Problem Set 4

Due DateSeptember 26, 2022 8pm MT
Name **Your Name**
Student ID **Your Student ID**
Collaborators **List Your Collaborators Here**

Contents

Instructions	1
Honor Code (Make Sure to Virtually Sign)	2
10 Standard 10 - Flow Networks: Terminology	3
11 Standard 11 - Flow Networks: Ford–Fulkerson	5
11.1 Problem 11(a)	5
11.2 Problem 11(b)	6
11.3 Problem 11(c)	7
11.4 Problem 11(d)	8

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 Gradescope 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 are welcome and encouraged to collaborate with your classmates, as well as consult outside resources. You must **cite your sources in this document**. **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, Reddit, StackExchange, etc., for help on an assignment is a violation of the Honor Code.
- You **must** virtually sign the Honor Code (see Section). Failure to do so will result in your assignment not being graded.

Honor Code (Make Sure to Virtually Sign)

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

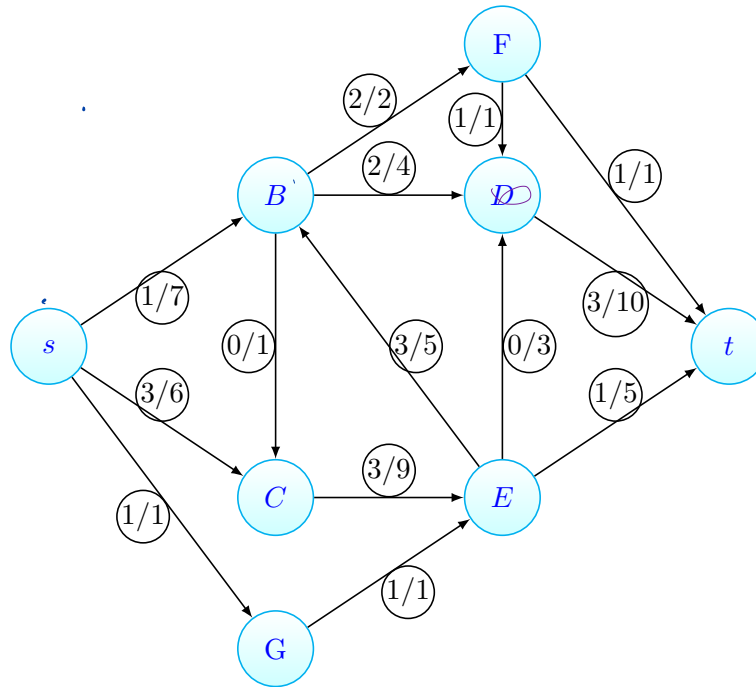
- Any collaborations and external sources have been clearly cited in this document.
- I have not posted to external services including, but not limited to Chegg, Reddit, StackExchange, etc.
- I have neither copied nor provided others solutions they can copy.

Agreed (signature here).

□

10 Standard 10 - Flow Networks: Terminology

Problem 10. Consider the following flow network, with the following flow configuration f as indicated below.



Do the following (there are five parts, (a)–(e), continuing on to the next page).

- (a) Given the current flow configuration f , what is the maximum additional amount of flow that we can push across the edge (B, D) from $B \rightarrow D$? Justify using 1-2 sentences.

Answer.

□

- (b) Given the current flow configuration f , what is the maximum amount of flow that B can push backwards to E ? Do **not** consider whether E can reroute that flow elsewhere; just whether B can push flow backwards. Justify using 1-2 sentences.

Answer.

$B \leftarrow E$
3/5

□

- (c) Given the current flow configuration f , what is the maximum amount of flow that D can push backwards to E ? Do **not** consider whether D can reroute that flow elsewhere; just whether D can push flow backwards. Justify using 1-2 sentences.

Answer.

$D \leftarrow E$
0/3

□

- (d) How much *additional* flow can be pushed along the flow-augmenting path $s \rightarrow B \rightarrow E \rightarrow t$? Do not include the ~~current flow~~ along these edges. Justify using 1-2 sentences.

Answer.

□

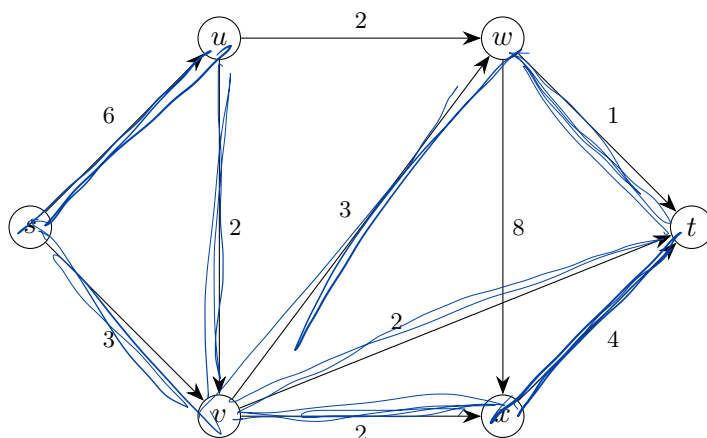
- (e) Find a second flow-augmenting path and indicate the maximum amount of additional flow that can be pushed along the path. Assume that the flow-augmenting path from part (d) has **not** been applied. Justify using 1-2 sentences.

Answer.

□

11 Standard 11 - Flow Networks: Ford–Fulkerson

Problem 11. For Problem 11, consider the following flow network.



Do the following.

11.1 Problem 11(a)

- (a) Consider the flow-augmenting path $s \rightarrow u \rightarrow v \rightarrow t$. Push as much flow through the flow-augmenting path and draw the updated flow network below (we have provided a tikzpicture in the LaTeX comments that you can use and just modify the labels on the edges, or you may hand-draw and embed an image).

Answer.

□

11.2 Problem 11(b)

- (b) Find a flow-augmenting path starting from the updated flow configuration from your answer to part (a). Then do the following: (i) clearly identify both the new flow-augmenting path and the maximum amount of flow that can be pushed through said path; and then (ii) push as much flow through the flow-augmenting path and draw the updated flow network below.

Answer.

□

11.3 Problem 11(c)

- (c) Find a flow-augmenting path starting from the updated flow configuration from your answer to part (b). Then do the following: (i) clearly identify both the new flow-augmenting path and the maximum amount of flow that can be pushed through said path; and then (ii) push as much flow through the flow-augmenting path and draw the updated flow network below.

Answer.

□

11.4 Problem 11(d)

- (d) Using the flow configuration from part (c), finish executing the Ford–Fulkerson algorithm. Include the following here: (i) your flow network, reflecting the maximum-valued flow configuration you found, and (ii) the corresponding minimum capacity cut. There may be multiple minimum capacity cuts, but you should identify the one corresponding to your maximum-valued flow configuration. Then (iii) finally, compare the value of your flow to the capacity of the cut.

Answer.

□