

## EL9343 Homework 9

(Due April 15<sup>th</sup>, 2022)

No late submission accepted

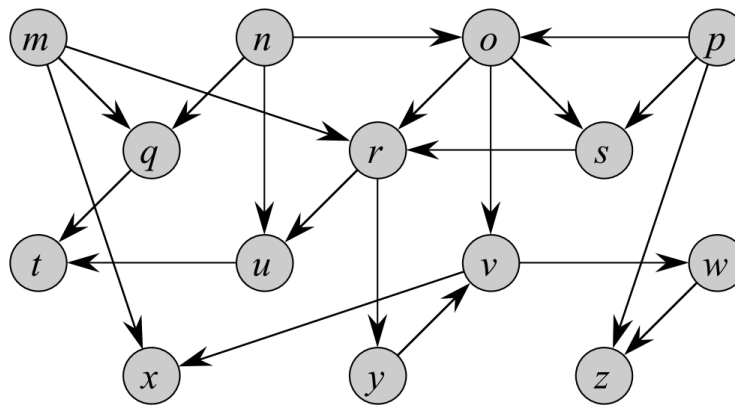
*All problem/exercise numbers are for the third edition of CLRS textbook*

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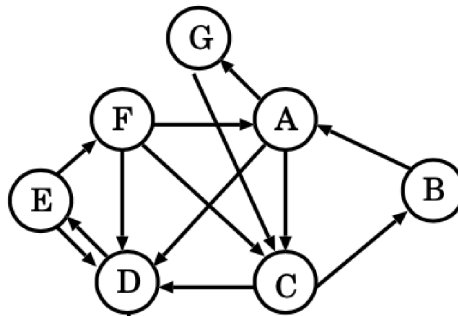
1. Run TOPOLOGICAL-SORT on the graph below. Show the:

- (a) The discovery time and finish time of each node.
- (b) The returned linked-list.

Assume that **for** loop of lines 5—7 of the DFS procedure (page 604 in CLRS) considers the vertices in alphabetical order, and assume the adjacency list is ordered alphabetically.



2. Run the procedure STRONGLY-CONNECTED-COMPONENTS on the graph below, show the finishing times for each node after running DFS in line 1 and DFS forest produced by line 3.



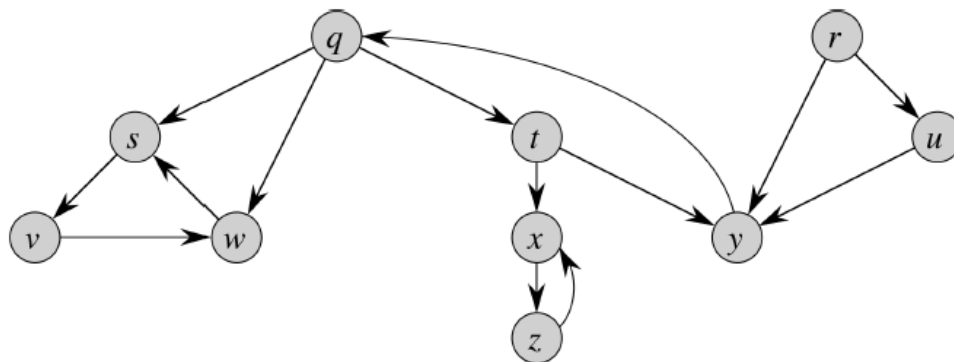
Assume that **for** loop of lines 5—7 of the DFS procedure (page 604 in CLRS) considers the vertices in alphabetical order, and assume the adjacency list is ordered alphabetically.

3. Run the procedure STRONGLY-CONNECTED-COMPONENTS (page 617 in CLRS) on the graph below.

Show the:

- The discovery time and finish time for each node after running DFS in line 1
- The DFS forest produced by line 3
- The component DAG

Assume that **for** loop of lines 5—7 of the DFS procedure (page 604 in CLRS) considers the vertices in alphabetical order, and assume the adjacency list is ordered alphabetically.



4. Given an  $M \times N$  matrix  $D$  and two coordinates  $(a, b)$  and  $(c, d)$  which represent top-left and bottom-right coordinates of a sub-matrix of the given matrix, propose a **dynamic-programming approach** to calculate the sum of all elements in the sub-matrix. What is the time complexity of your solution?

0	-2	-7	0
9	2	-6	2
-4	1	-4	1
-1	8	0	-2

Example of a sub-matrix where  $(a, b) = (1, 0)$  and  $(c, d) = (3, 1)$