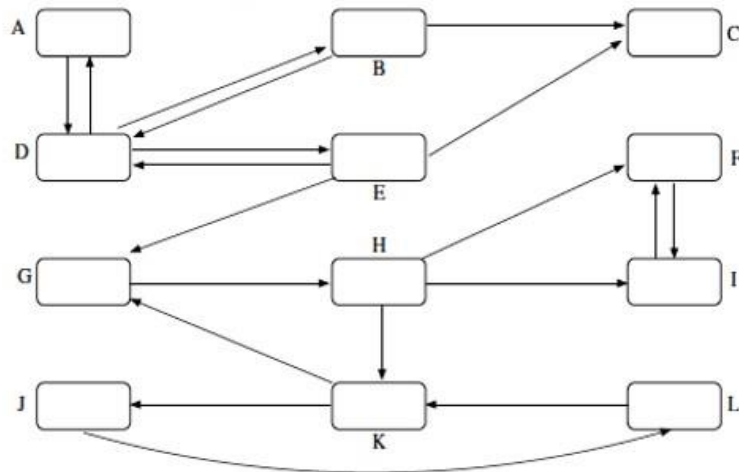


CS: 590 Algorithms

Assignment 5: Graphs exploration (BFS, DFS)

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1. You are give the following graph $G = (V, E)$:



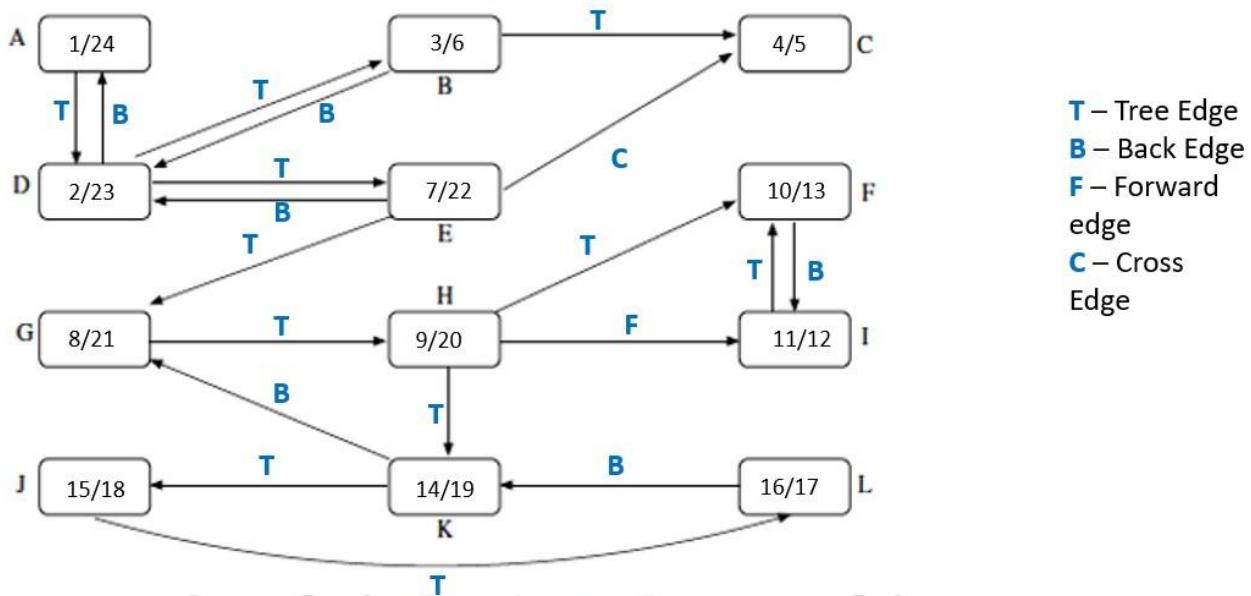
- (a) Perform a DFS (depth-first search) on the given graph. You will visit the nodes in increasing order starting with A (increasing from A to L). Give the discovery $u.d$ and finishing times $u.f$ for every vertex u in the graph. Classify all edges (tree, back, forward, and cross edges).

Solution:

DFS (G) with starting node A

Given discovery $u.d$ and finishing times $u.f$ for every vertex u in the graph

All edges (tree, back, forward and cross edges are classified below)



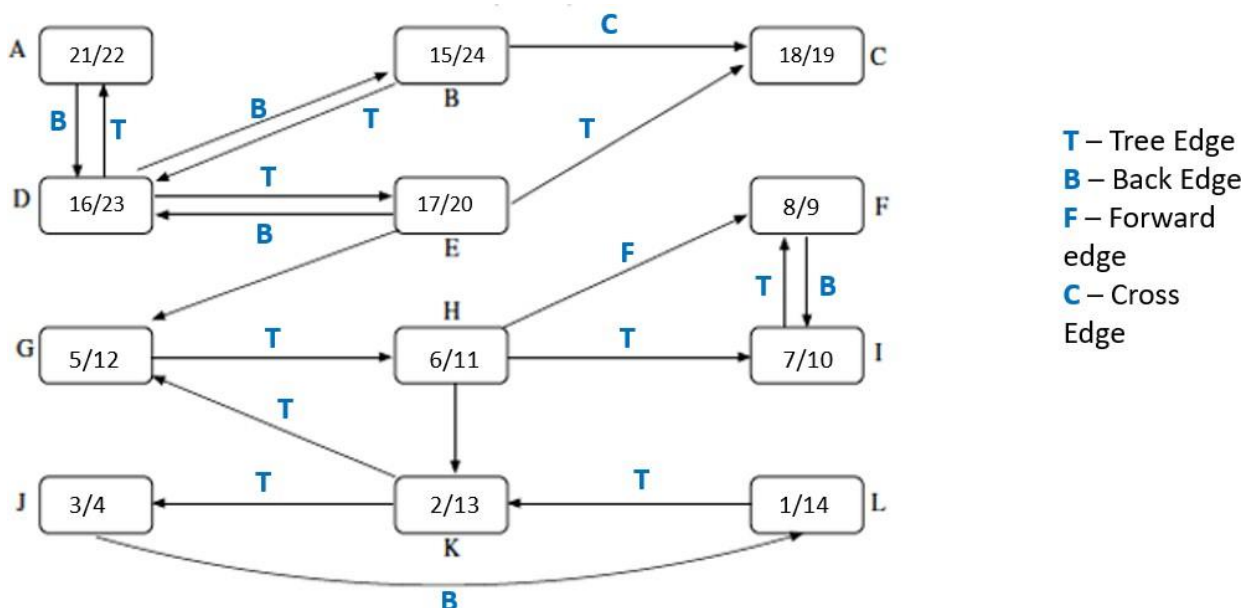
- (b) Perform a DFS (depth-first search) on the given graph. You will visit the nodes in decreasing order starting with L (decreasing from L to A). Give the discovery $u.d$ and finishing times $u.f$ for every vertex u in the graph. Classify all edges (tree, back, forward, and cross edges).

Solution :

DFS (G) with starting node L

Given discovery $u.d$ and finishing times $u.f$ for every vertex u in the graph

All edges (tree, back, forward and cross edges are classified below)

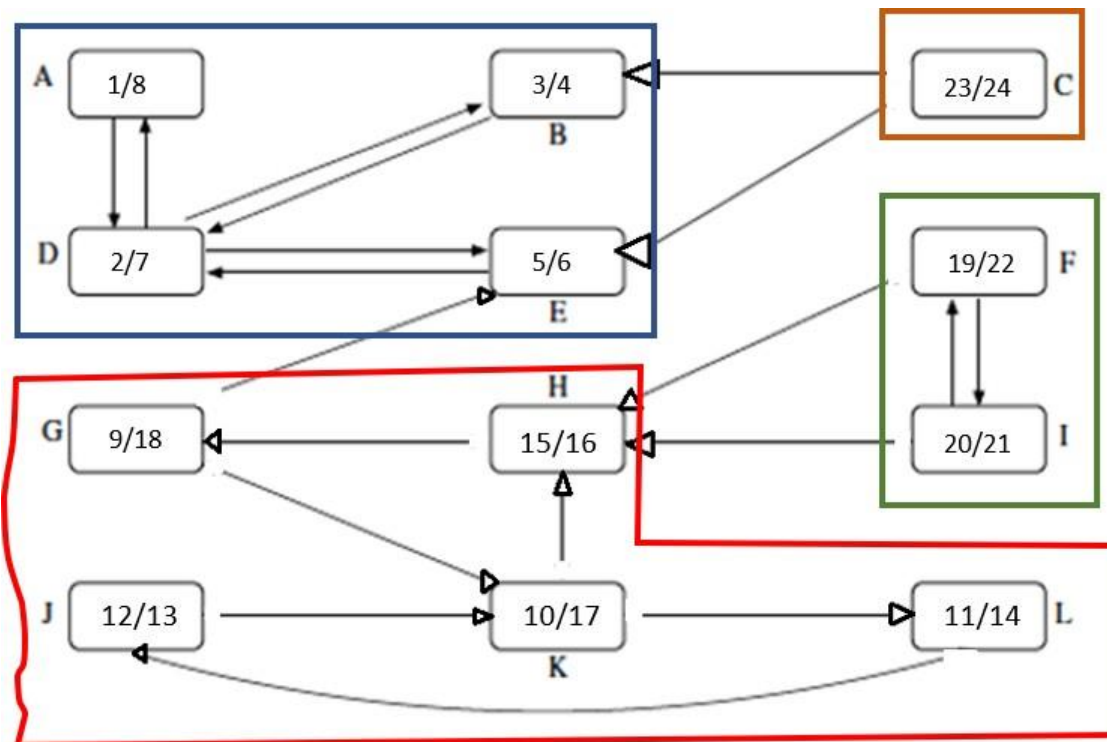


- (c) Determine the strongly connected components (SCC) of the given graph $G = (V, E)$. Use your output of (a) as a starting point for the remainder of the SCC algorithm. Give the discovery and finishing times for the second run of DFS. Give the sets of vertices that form an SCC and draw the corresponding SCC graph.

Solution:

1. DFS(G) (Question 1a) and u.f finishing time computed and ordered by decreasing order of finishing time = A, D, E, G, H, K, J, L, F, I, B, C
2. Computed G^T
3. DFS(G^T) called since vertices in decreasing order of u.f in DFS(G) in (1).
4. Separate SCCs recorded accordingly in graph.

Discovery u.d and finishing times u.f recorded for each vertex for second run of DFS.



Set of vertices that form strongly connected components (SSC) as per above diagram:

A D B E

G K L J H

F I

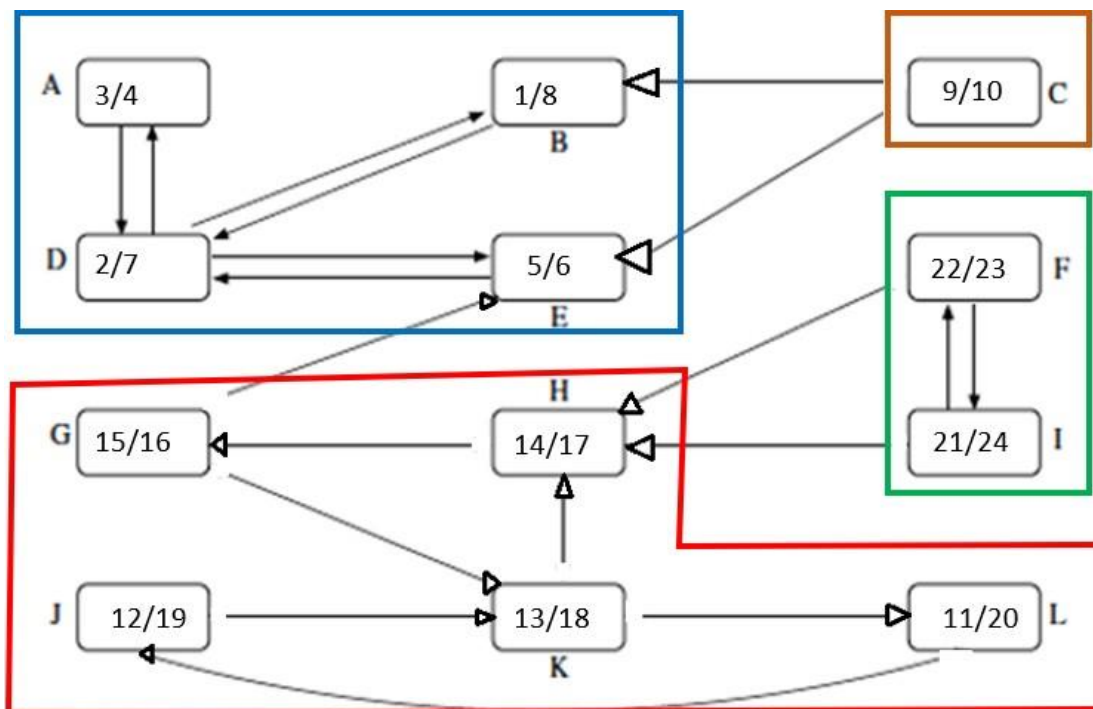
C

- (d) Determine the strongly connected components (SCC) of the given graph $G = (V, E)$. Use your output of (b) as a starting point for the remainder of the SCC algorithm. Give the discovery and finishing times for the second run of DFS. Give the sets of vertices that form an SCC and draw the corresponding SCC graph.

Solution:

1. DFS(G) called in (Question 1b) and u.f finishing time was computed and ordered by decreasing order of finishing time = B, D, A, E, C, L, K, G, H, I, F, J
2. Computed G^T
3. DFS(G^T) called considering vertices in decreasing order of u.f in DFS(G) in (1).
4. Separate SCCs recorded accordingly in graph.

Discovery u.d and finishing times u.f recorded for each vertex for second run of DFS.



Set of vertices that form strongly connected components (SSC) as per above diagram:

B D A E

C

L J K H G

I F

