CS330HW5

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Problem 1A

Let (u, v) signify a directed edge pointing from vertex u to vertex v. Using this notation, the edges of the DFS tree are,

$$(1,3), (1,4), (4,2), (2,5), (5,6), (6,7)$$

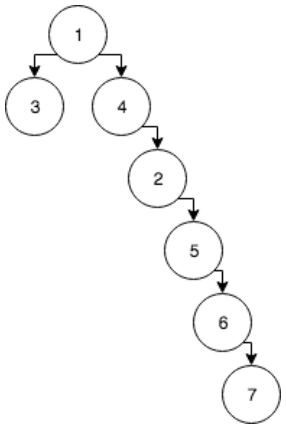

Figure 1: DFS tree

Problem 1B

Pre-order: 1, 3, 4, 2, 5, 6, 7
Post-order: 3, 7, 6, 5, 2, 4, 1

Explanation:

Pre-order is defined as the order in which the elements enter the stack and post-order is the order in which the elements leave the stack. The stack at every step is given below, which the left indicating the bottom of the stack and the right indicating the top.

step	stack
1	1
2	1, 3
3	1, 4
4	1, 4, 2
5	1, 4, 2, 5
6	1, 4, 2, 5, 6
7	1, 4, 2, 5, 6, 7
8	1, 4, 2, 5, 6
9	1, 4, 2, 5
10	1, 4, 2, 5
11	1, 4, 2
12	1, 4
13	1
14	-

Problem 1C

In *Problem 1A* 6 tree edges were given. However, the original graph has 10 edges. Therefore, there are 4 edges in the graph that are not tree edges. They are: $(2,1), (4,6), (7,4), (7,3)$. They are classified as following- Back edges: $(2,1)$ and $(7,4)$, Forward edge: $(4,6)$, Cross edge: $(7,3)$.

$(2,1)$: **Back edge**.

One can get from vertex 2 to vertex 1 following the directed links backwards in the DFS tree graph, meaning it is a back edge. Additionally,for a back edge (u,v), $pre(v) < pre(u) < post(u) < post(v)$. In the ordering described in *Problem1B* it is clear to see $pre(1) < pre(2) < post(2) < post(1)$.

$(4,6)$: **Forward edge**.

One can get from vertex 4 to vertex 6 following the directed links in the DFS tree graph, meaning it is a forward edge. Additionally,for a forward edge (u,v), $pre(u) < pre(v) < post(v) < post(u)$. In the ordering described in *Problem1B* it is clear to see $pre(4) < pre(6) < post(6) < post(4)$.

$(7,4)$: **Back edge**.

One can get from vertex 7 to vertex 4 following the directed links backwards in the DFS tree graph, meaning it is a back edge. Additionally,for a back edge (u,v), $pre(v) < pre(u) < post(u) < post(v)$. In the ordering described in *Problem1B* it is clear to see $pre(4) < pre(7) < post(7) < post(4)$.

$(7,3)$: **Cross edge**.

One can get from vertex 7 to vertex 3 by first following the directed links backwards in the DFS tree graph to Vertex 1 then following the links forward

to 3, meaning it is a cross edge. Additionally,for a cross edge (u, v), $pre(v) < post(v) < pre(u) < post(u)$. In the ordering described in *Problem1B* it is clear to see $pre(3) < post(3) < pre(7) < pre(7)$.