

Name: _____


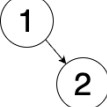
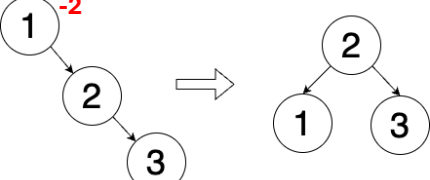
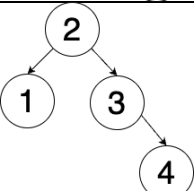
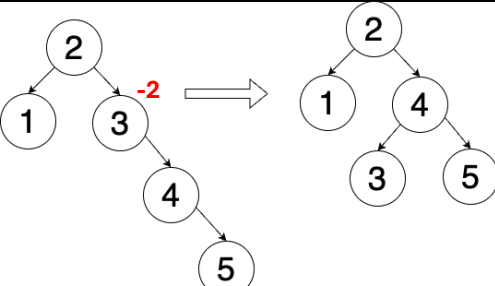
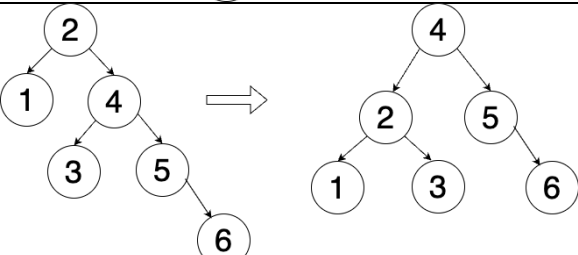
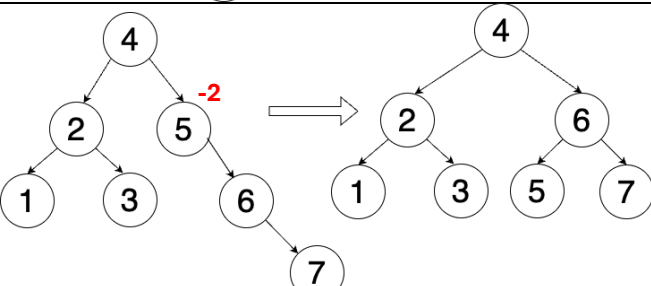
3013 Algorithms Exam 2

Spring 2025

[illegible]

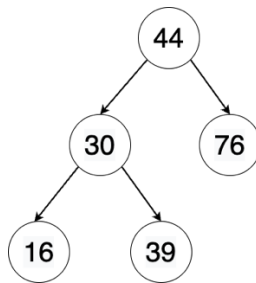
1) AVL Build Tree

Assuming an empty AVL tree you are going to insert 7 numbers in ascending order. After each number is entered you will write below explaining what happened with each step. Also keep drawing an updated tree.

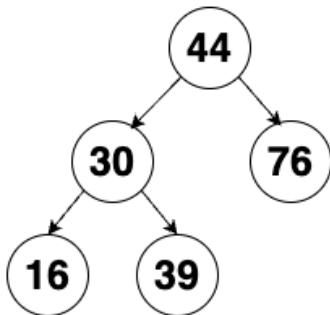
Insert 1	
Insert 2	
Insert 3 1's balance factor is: $0 - 2 = -2$ and causes a rotation	
Insert 4 Nothing happens	
Insert 5 3's balance factor becomes $0 - 2 = -2$ so we rotate.	
Insert 6 2's balance factor = $1 - 3 = -2$ so we rotate	
Insert 7 5's balance factor = $0 - 2 = -2$ so we rotate	

2) AVL Insert

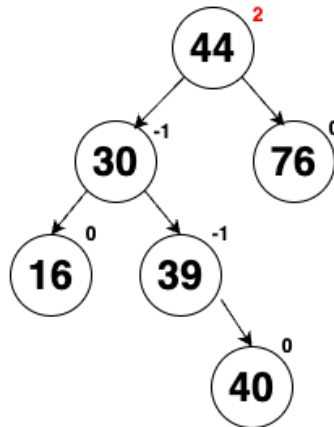
Insert the value 40 into this AVL tree and apply any alterations necessary to maintain the rules of an AVL tree. Make sure you make notations on the left, with your drawing on the right.



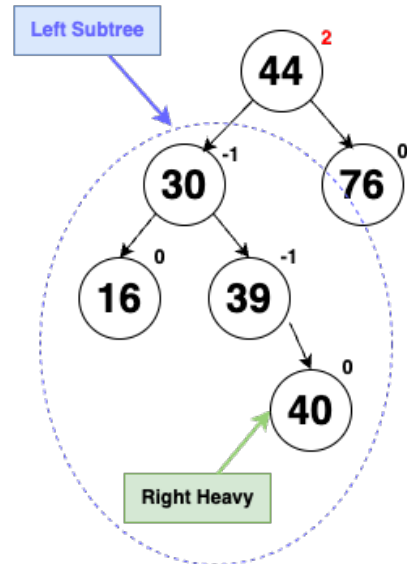
Original Tree



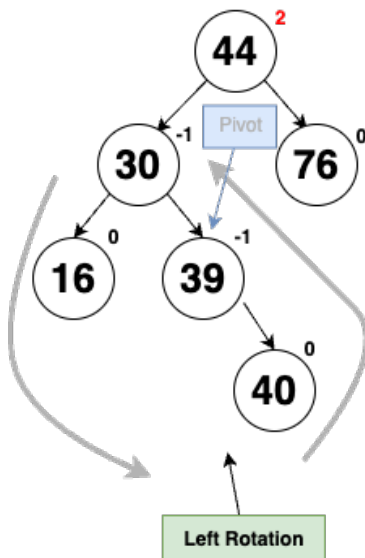
Insert 40
Calculate Avl Values



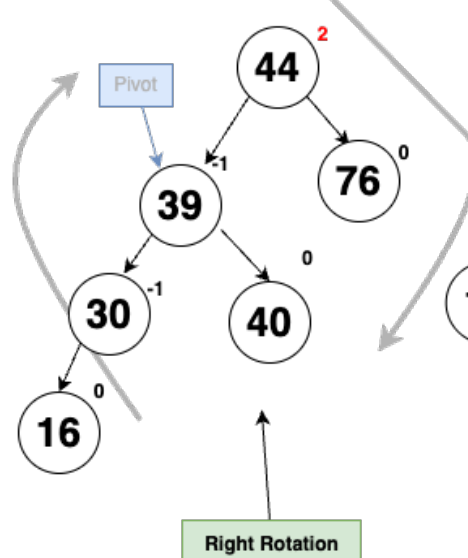
Double Rotation
Necessary



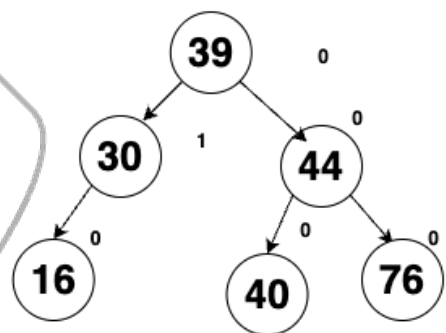
First Rotation



Second Rotation

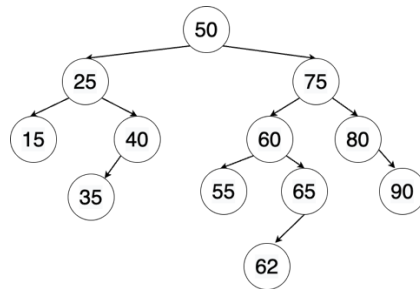


Completed



3) AVL Delete

Delete the value 15 from this AVL tree and ensure that you go through all the steps in order to ensure it remains balance and each AVL value ends up within reason.



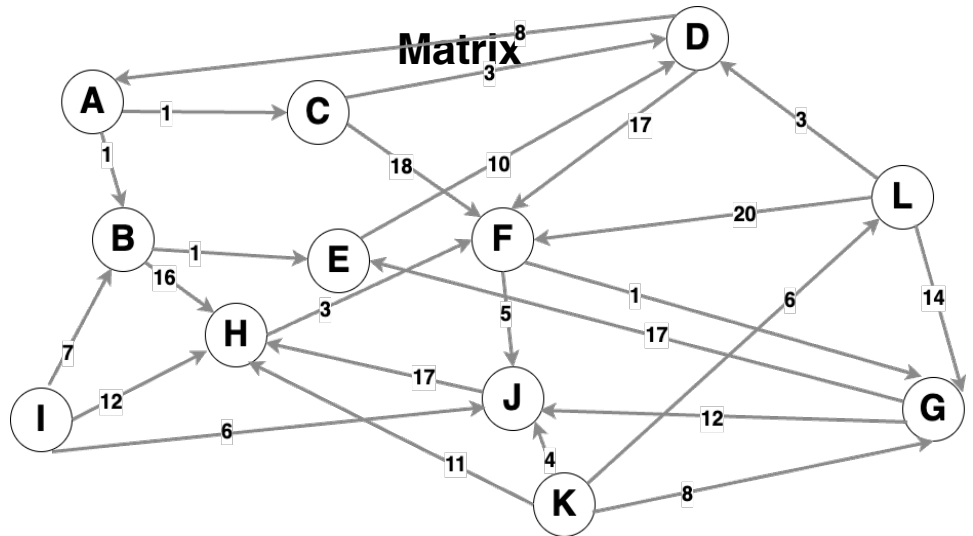
<p>Delete 15 and Calculate AVL Values.</p> <p>We notice we need to do a double rotation.</p>		<p>Recalculate AVL Values.</p> <p>Another double rotation</p>	
<p>First rotation to the right.</p>	<p>Rotation 1</p>	<p>Right</p>	
<p>Second rotation to the left.</p>	<p>Rotation 2</p>	<p>Then left.</p> <p>Avl values now are all in range [-1,0,1]</p>	

4) Graph Representations

Well ... if you don't know what to do, come ask me. Otherwise show a list based and matrix-based representation of the following graph.

List

0	A	<div><div>B,1</div><div>C,1</div></div>
1	B	<div><div>E,1</div><div>H,16</div></div>
2	C	<div><div>D,3</div><div>F,18</div></div>
3	D	<div><div>A,8</div><div>F,17</div></div>
4	E	<div><div>D,10</div></div>
5	F	<div><div>G,1</div><div>J,5</div></div>
6	G	<div><div>E,17</div><div>J,12</div></div>
7	H	<div><div>F,3</div></div>
8	I	<div><div>B,7</div><div>H,12</div><div>J,6</div></div>
9	J	<div><div>H,17</div></div>
10	K	<div><div>G,8</div><div>H,11</div><div>J,4</div><div>L,6</div></div>
11	L	<div><div>D,3</div><div>F,20</div><div>G,14</div></div>

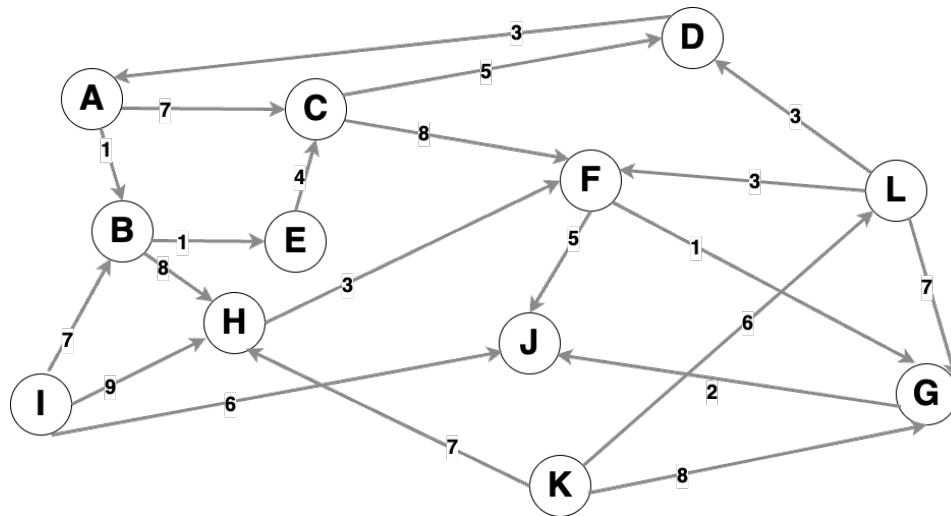


Matrix

	0	1	2	3	4	5	6	7	8	9	10	11
0	A		1	1								
1	B					1			16			
2	C				3		18					
3	D	8					17					
4	E				10							
5	F						1			5		
6	G					17				12		
7	H					3						
8	I		7					12		6		
9	J							17				
10	K						8	11		4		6
11	L				3		20	14				

5) DFS and BFS

Perform a depth first search and a breadth first search using the graph on this page and placing the vertex values (A-L) in the spaces provided below as they become visited.



DFS

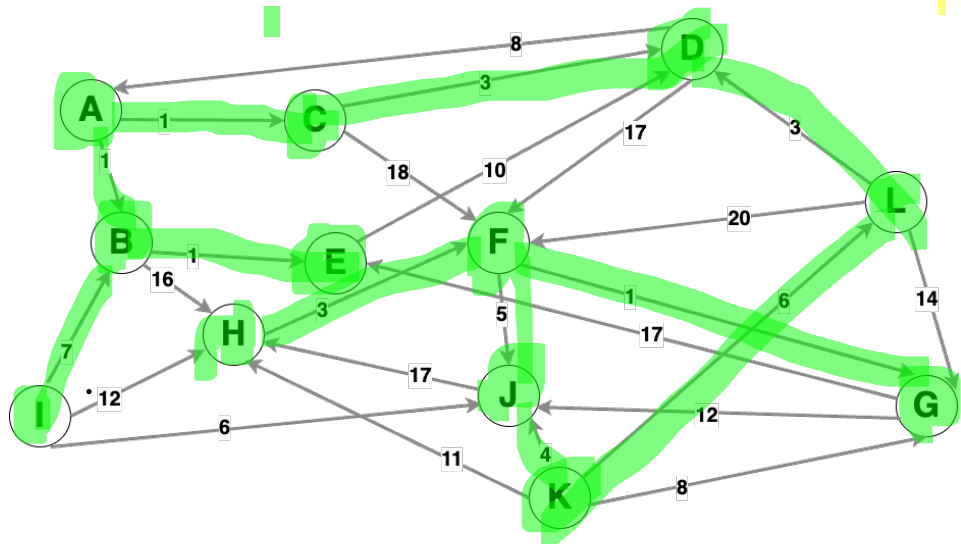
A	C	F	J	G	D	B	H	E	I	K	L
1	2	3	4	5	6	7	8	9	10	11	12

BFS

A	B	C	E	H	D	F	G	J	I	K	L
1	2	3	4	5	6	7	8	9	10	11	12

6) MST: Prims

Add edges to the list on the right as they are added to the MST. Graph edges are typically written in a similar fashion to this: **(Start Vertex, End Vertex, Edge Weight)**. Example: **D to F = (D, F,17)**. Remember when making choices (if it applies here) do them alphabetically.



Edges in MST
(A,B,1)
(A,C,1)
(B,E,1)
(C,D,3)
(D,L,7)
(K,L,6)
(I,B,7)
(J,K,4)
(F,J,5)
(F,G,1)
(H,F,3)

Prims

Initial Set of Vertices

A	B	C	D	E	F	G	H	I	J	K	L
1	2	3	4	5	6	7	8	9	10	11	12

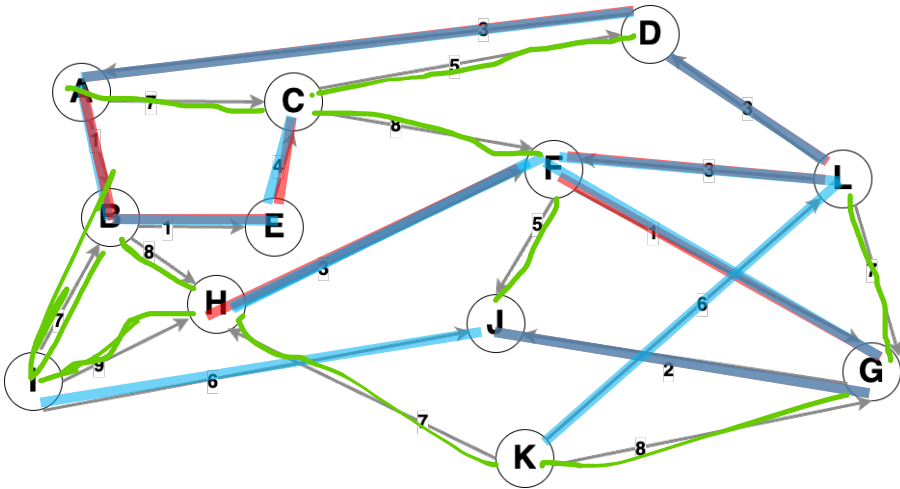
Vertices in the MST

A	B	C	E	D	L	K	I	J	F	G	H
1	2	3	4	5	6	7	8	9	10	11	12

7) MST: Kruskal's

Add edges to the list on the right as they are added to the MST. Refer to previous question for an example. Remember when making choices (if it applies here) do them alphabetically.

Edges not in MST



Edges in MST
(A,B,1)
(B,E,1)
(F,G,1)
(G,J,2)
(A,D,3)
(D,L,3)
(F,L,3)
(F,H,3)
(C,E,4)
(K,L,6)
(I,J,6)

Initial Set of Vertices

A	B	C	D	E	F	G	H	I	J	K	L
1	2	3	4	5	6	7	8	9	10	11	12

Kruskal's Set of Vertices

A	B	E	G	J	D	L	F	H	C	K	I
1	2	3	4	5	6	7	8	9	10	11	12

Not Done....

[illegible]