c) Find

4) Draw a representation of an initial empty list after performing the following sequence of operations

add(0,4), add(0,3), add(0,2), add(2,1), add(1,5), add(1,6)
add(3,7), add(0,8)

7) Starting with an empty 2-4 tree insert back of the given letters, into the tree in the order given, show your work and clearly indicate the final value of the 2-4 tree after all insertions.

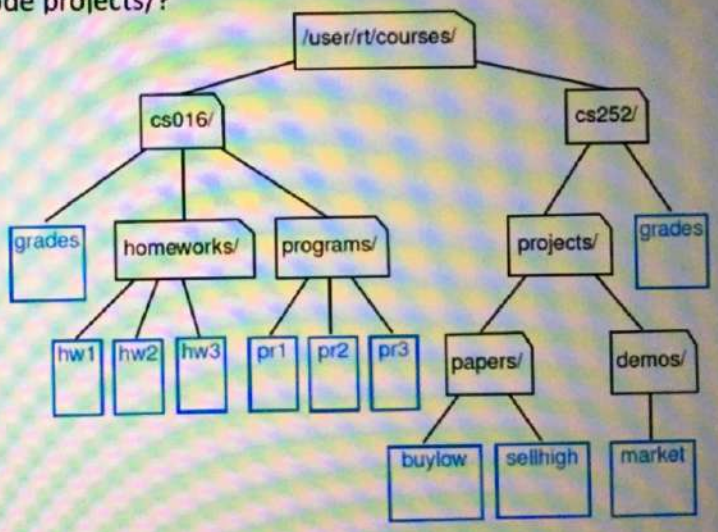
6, 12, 1, 13, 5, 19, 8, 18, 15, 20, 9, 14, 7

5. Draw the binary tree representation of the following arithmetic expression:

$$(((5+2) * (2-1))/((2+9)+((7-2)-1)) *8)$$

Ruler Ink to Shape Ink to Math
Stencils Convert

2. The following questions refer to the tree of Figure 8.3.
   a. Which node is the root?
   b. What are the internal nodes?
   c. How many descendants does node cs016/ have?
   d. How many ancestors does node cs016/ have?
   e. What are the siblings of node homeworks/?
   f. Which nodes are in the subtree rooted at node projects/?
   g. What is the depth of node papers/?
   h. What is the height of the tree?



Notes Comments

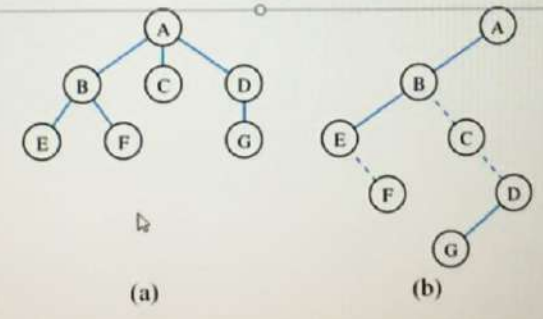
2) Given a H- Heap storing 15 [1 ..... 15]
array-based representation of complete binary tree

a) Find preorder traversal of H
b) Find inorder traversal of H
c) Find postorder traversal of H

10. We can define a binary tree representation T′ for an ordered general tree T as follows (see Figure 8.21):
    - For each position p of T, there is an associated position p′ of T′.
    - If p is a leaf of T, then p′ in T′ does not have a left child; otherwise the left child of p′ is q′, where q is the first child of p in T.
    - If p has a sibling q ordered immediately after it in T, then q′ is the right child of p′ in T; otherwise p′ does not have a right child.

Given such a representation T′ of a general ordered tree T, answer each of the following questions:

- Is a preorder traversal of T′ equivalent to a preorder traversal of T?
- Is a postorder traversal of T′ equivalent to a postorder traversal of T?
- Is an inorder traversal of T′ equivalent to one of the standard traversals of T? If so, which one?



(a) (b)

Figure 8.21: Representation of a tree with a binary tree: (a) tree T; (b) binary tree T' for T. The dashed edges connect nodes of T' that are siblings in T.

1. Draw the 11-entry hash table that results from using the hash function, $h(i) = (3i + 5) \bmod 10$, to hash the keys 12, 44, 83, 88, 23, 14, 1, 39, 20, 16, and 5, assuming collisions are handled by linear probing. (Non-anonymous question ⓘ)
(30 Points)

IMG-3700.JPG

File number limit: 1 Single file size limit: 10MB Allowed file types: Word, Excel, PPT, PDF, Image, Video, Audio

2. If we insert the entries (4, A), (10, B), (7, C), (5, D), and (12, E), in this order, into an initially empty binary search tree, what will it look like? (Non-anonymous question ⓘ)
(15 Points)

IMG-3702.JPG

File number limit: 1 Single file size limit: 10MB Allowed file types: Word, Excel, PPT, PDF, Image, Video, Audio

3. Consider the sequence of keys (5,16,22,45,2,40,18,30,3,12,1). Draw the result of inserting entries with these keys (in the given order) into an initially empty (2,4) tree.
(Non-anonymous question ⓘ)
(25 Points)

IMG-3701.JPG

File number limit: 1 Single file size limit: 10MB Allowed file types: Word, Excel, PPT, PDF, Image, Video, Audio

4. Consider the sequence of keys (5,16,22,45,2,40,18,30,3,12,1). Draw the result of inserting entries with these keys (in the given order) into an initially empty red-black tree.
(Non-anonymous question ⓘ)
(30 Points)

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File number limit: 1 Single file size limit: 10MB Allowed file types: Word, Excel, PPT, PDF, Image, Video, Audio

COMPUTER ENGINEERING DATA STRUCTURES MIDTERM

Name/Surname: _____

Student Number: _____

Problem 1 (10 points) Show the results of the following sequence of events, by drawing the state of the data structure: **add(1) add(2) add(5) add(7) add(8), add(9), remove(), remove()** Where add and remove are the operations that correspond to the basic operations in a:

a) Stack

b) Queue

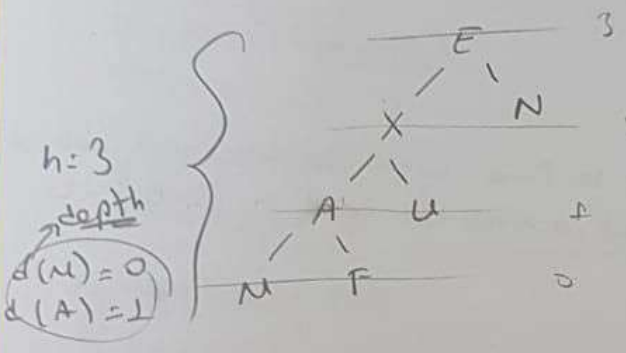
Problem 2 (15 points) for the input values inserted in the following order 35 33 42 10 14 19 27 44 26 31 construct a heap.

Inorder = LCR = 4 2 5 1 3

Preorder = CLR = 1 2 4 5 3

Postorder = LRC = 4 5 2 3 1

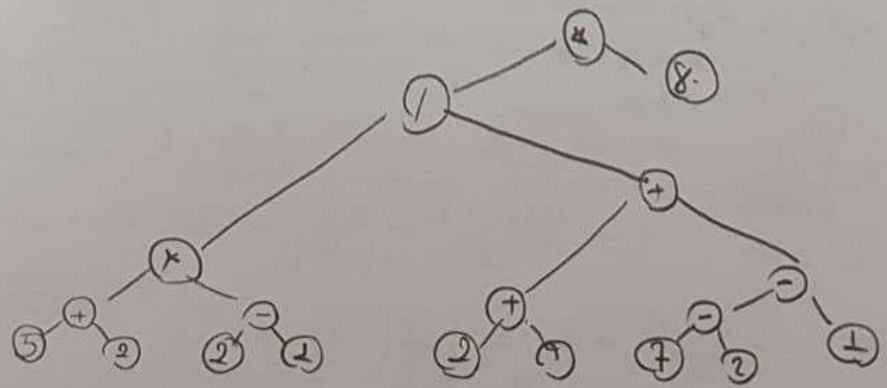
① Draw a binary tree T that simultaneously satisfies, the following:
- Each internal node of T stores single character
- A preorder traversal of T yields EXAMFUN
- An inorder traversal of T yields MAFXUEN



XANFU
NAFXU

② internal root = Çocuğu olalar
external root = Çocuk olalar.

④ Draw the binary representation of following arithmetic expression
((5+2) * (2-1)) / ((2+9) + ((7-2)-1) * 8)



3-) Draw a representation of an initial empty list after performing the following sequence of operations

add(0,4), add(0,3), add(0,2), add(a,1), add(1,5)

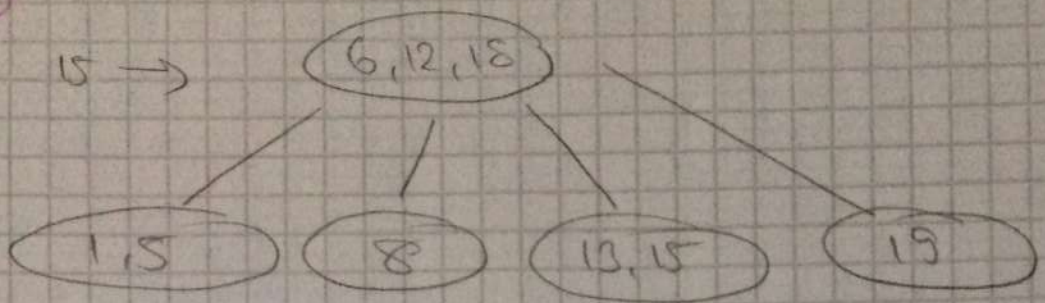
add(1,6), add(3,7), add(0,8)

Solution:

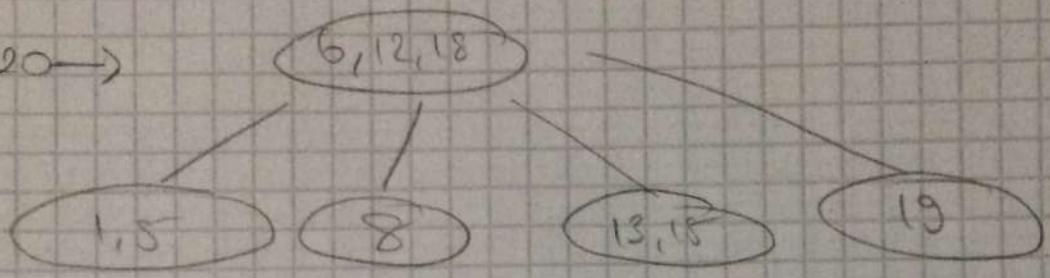
	Return Value	List Status
add(0,4)	–	(4)
add(0,3)	–	(3,4)
add(0,2)	–	(2,3,4)
add(a,1)	Error	(2,3,4)
add(1,5)	–	(2,5,3,4)
add(1,6)	–	(2,6,5,3,4)
add(3,7)	–	(2,6,5,7,3,4)
add(0,8)	–	(8,2,6,5,7,3,4)

(1)

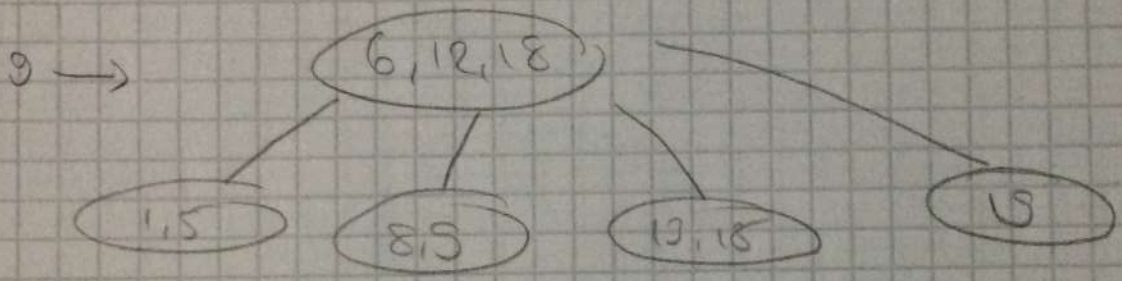
15 →


6,12,18
1,5
8
13,15
19

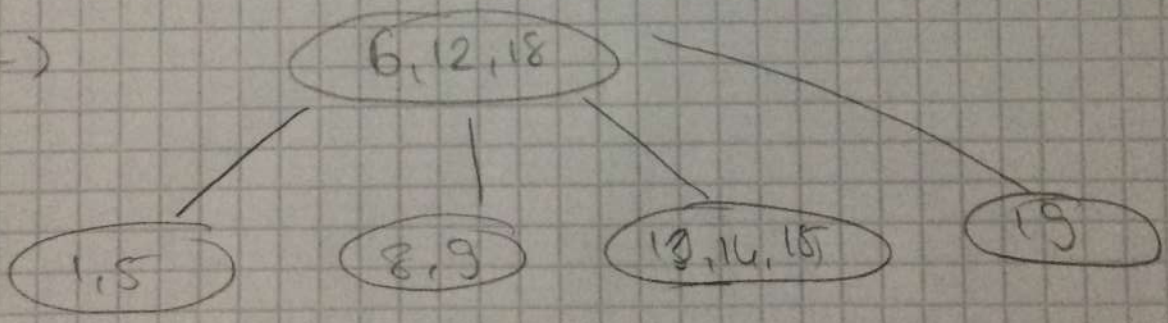
20 →


6,12,18
1,5
8
13,15
19

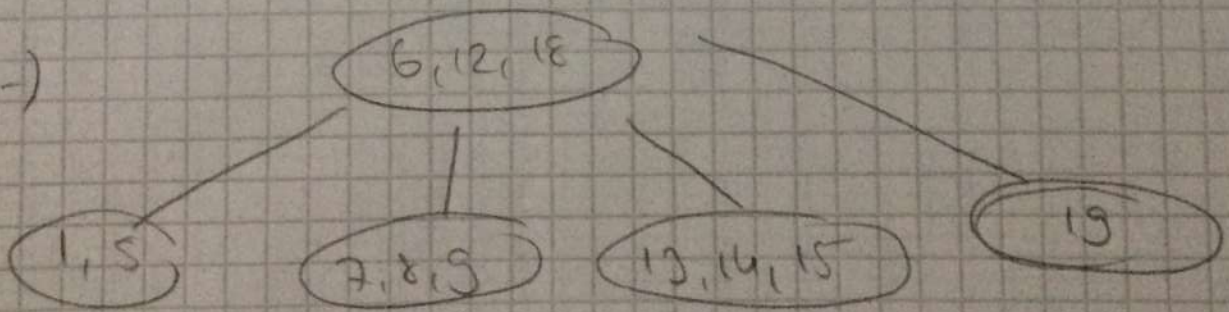
9 →


6,12,18
1,5
8,9
13,15
19

14 →


6,12,18
1,5
8,9
13,14,15
19

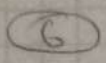
7 →


6,12,18
1,5
7,8,9
13,14,15
19

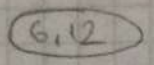
7-) Starting with an empty 2-4 tree insert back of the given letters, into the tree in the order given, show your work and clearly indicate the final value of the 2-4 tree after all insertions

(6, 12, 1, 13, 5, 19, 8, 18, 15, 20, 9, 14, 7)

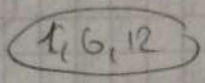
6 →



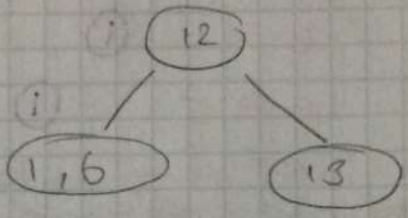
12 →



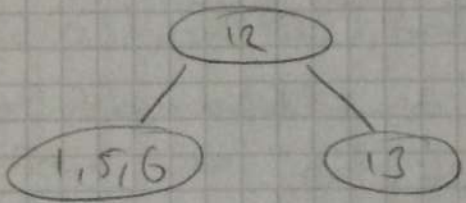
1 →



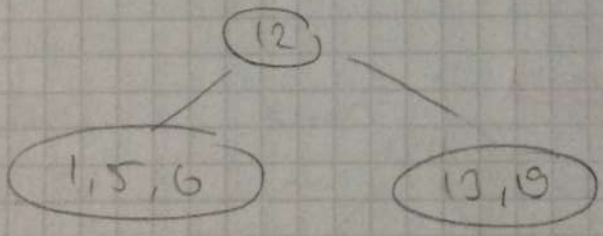
13 →



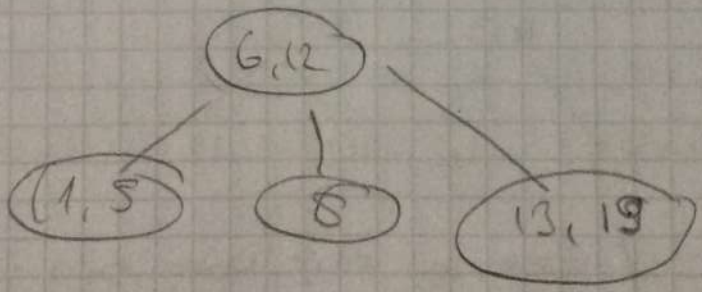
5 →



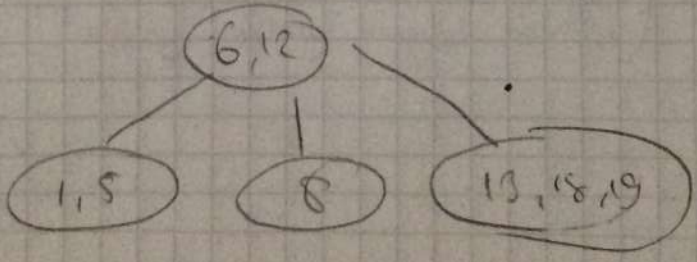
19 →



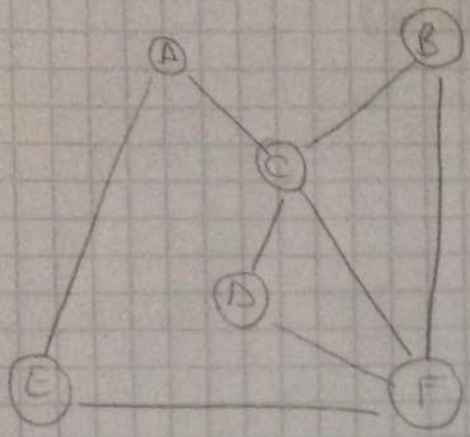
8 →



18 →



5-) a-) Show the adjacency matrix representation for the graph.



Solution:

	A	B	C	D	E	F
	0	1	2	3	4	5
A → 0		1			1	
B → 1			1			1
C → 2	1	1		1		1
D → 3			1			1
E → 4	1					1
F → 5		1	1	1	1	

simetrik

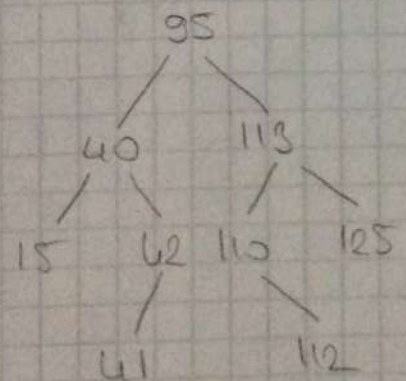
b-) What would be the number of zeros in the adjacency matrix of the given graph.

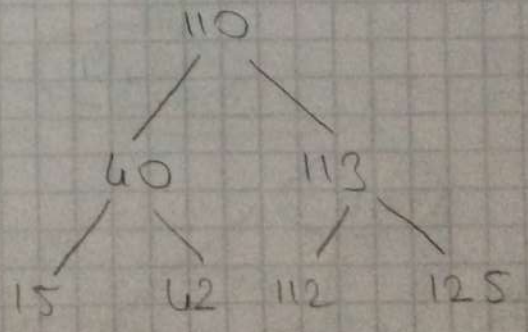
Solution: 6'da 1'ler dışında kalan yerler sıfır olur.

$36 - 16 = 20$ tane

6-) Given the following Binary Search Tree, show its value after deleting 95.

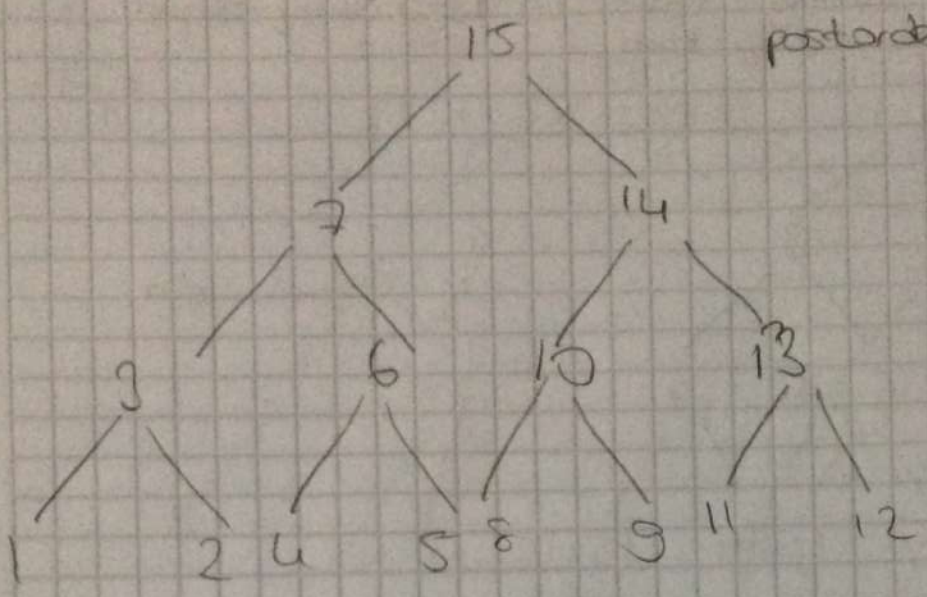
Solution:





(istenen sayı silinir. Daha sonra silinen sayının sağındaki en soldaki olan silinen sayının yerine yazılır.)

c-) Find postorder traversal of H



postorder → Left-Right-Parat

3-) Draw a representation of an initial empty list after performing the following sequence of operations

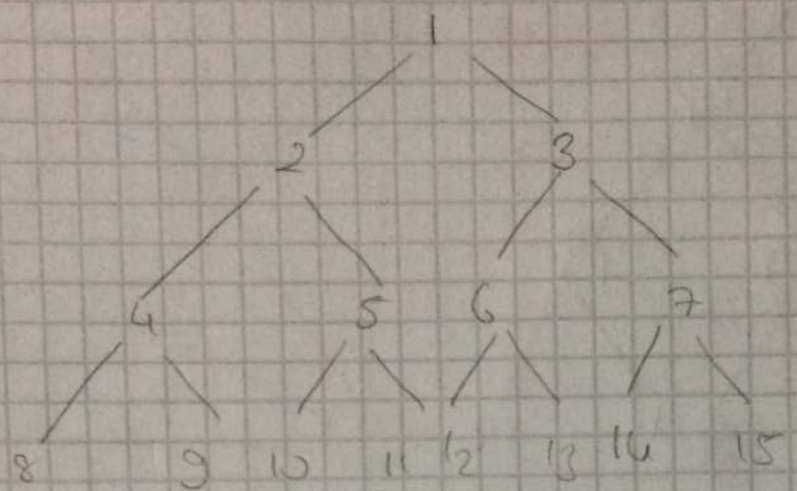
add(0,4), add(0,3), add(0,2), add(a,1), add(1,5)

add(1,6), add(3,7), add(0,8)

Solution:

	Return Value	List Contents
add(0,4)	–	(4)
add(0,3)	–	(3,4)
add(0,2)	–	(2,3,4)
add(a,1)	Error	(2,3,4)
add(1,5)	–	(2,5,3,4)
add(1,6)	–	(2,6,5,3,4)
add(3,7)	–	(2,6,5,7,3,4)
add(0,8)	–	(8,2,6,5,7,3,4)

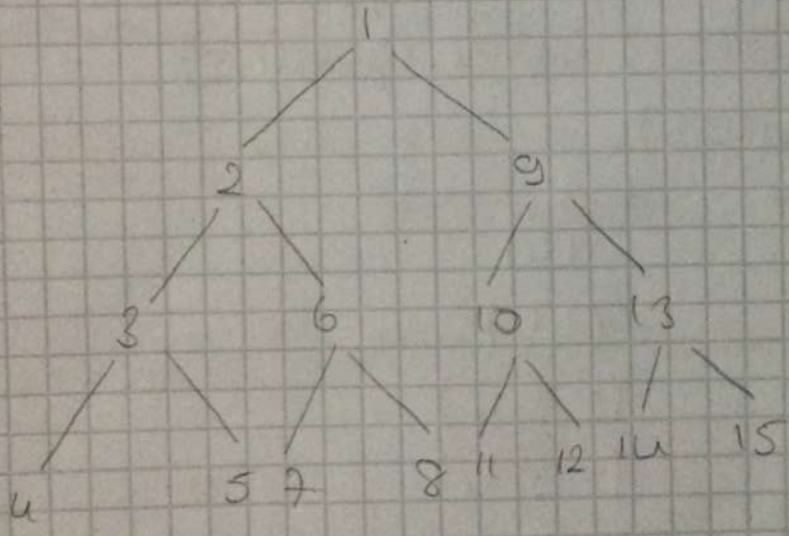
2-) Given a H-Heap storing 15[1--- 15] array-based representation of complete binary tree.



Görmek için

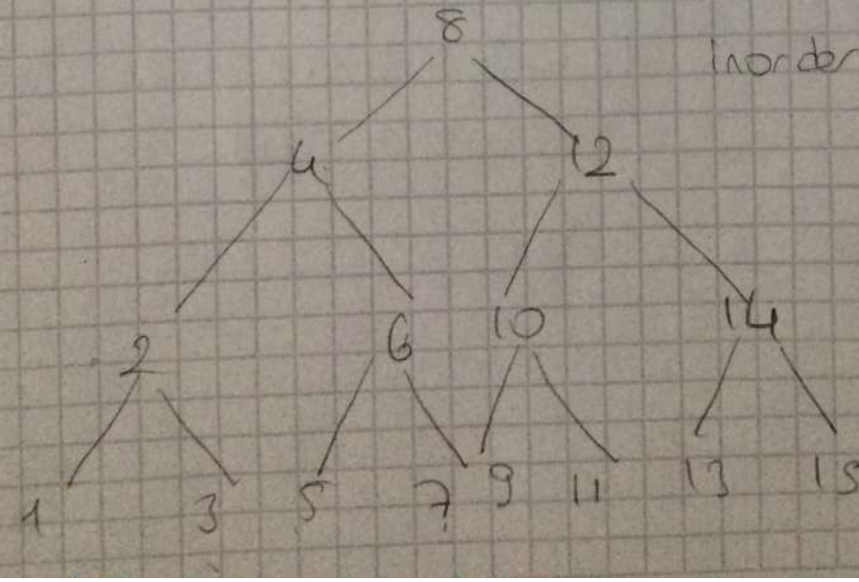
a-) Find preorder traversal of H

preorder → parat-left-right



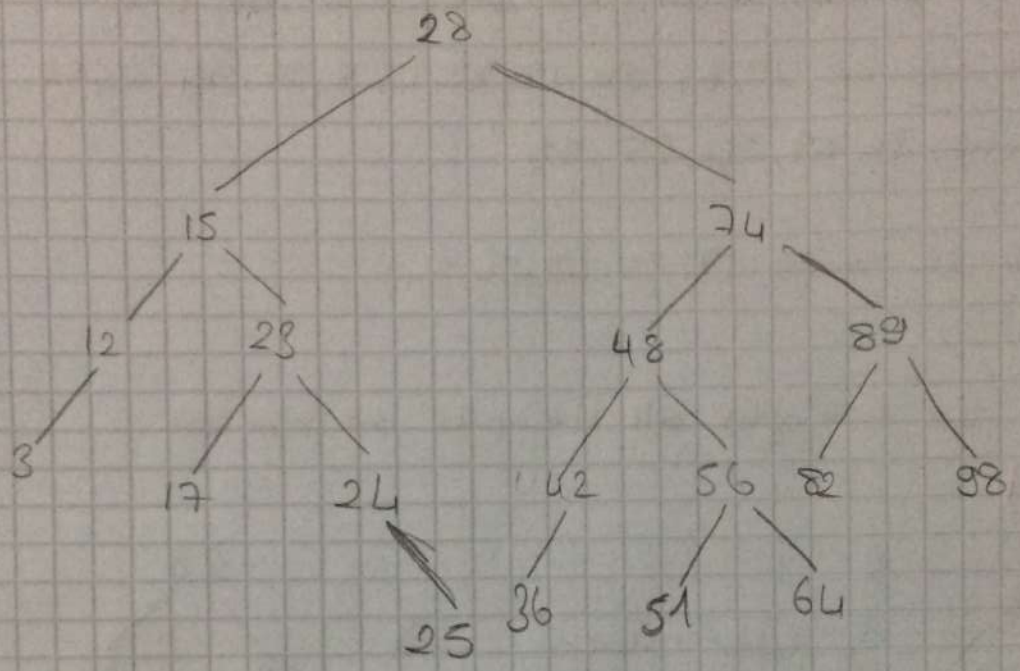
b-) Find inorder traversal of H

inorder → Left - Parent - Right



1'in cevabı (a)

⇒



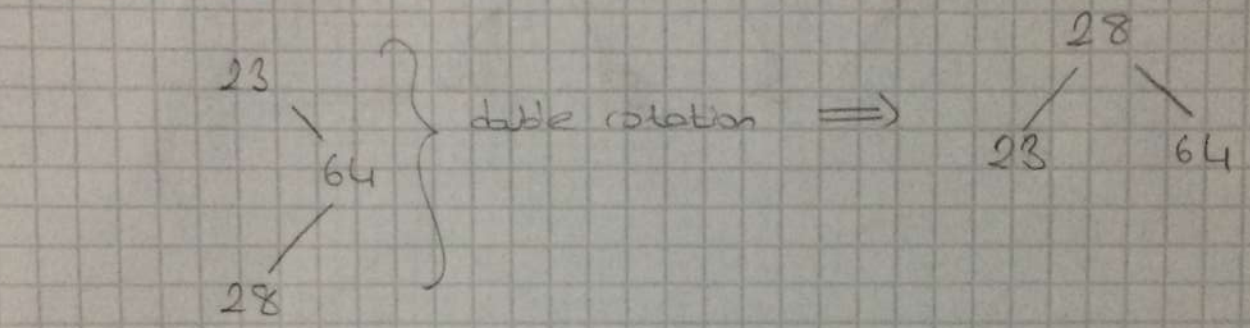
1-) Using the given sequence of inputs build an AVL tree, then remove the nodes in the given order from the tree.

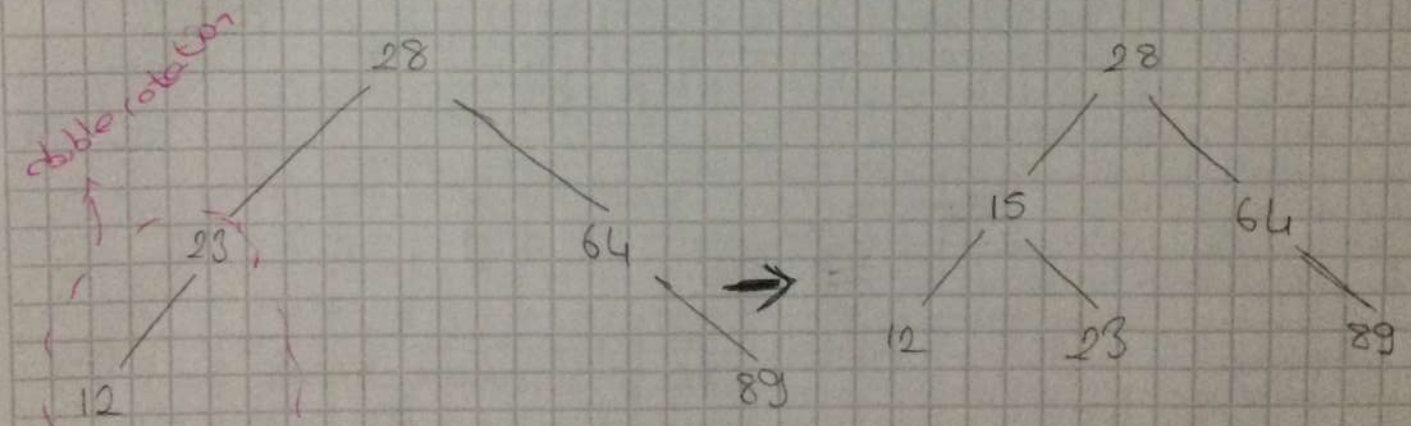
Input sequence: 23, 64, 28, 12, 89, 15, 3, 98, 74, 82, 56
17, 42, 86, 48, 24, 25, 51,

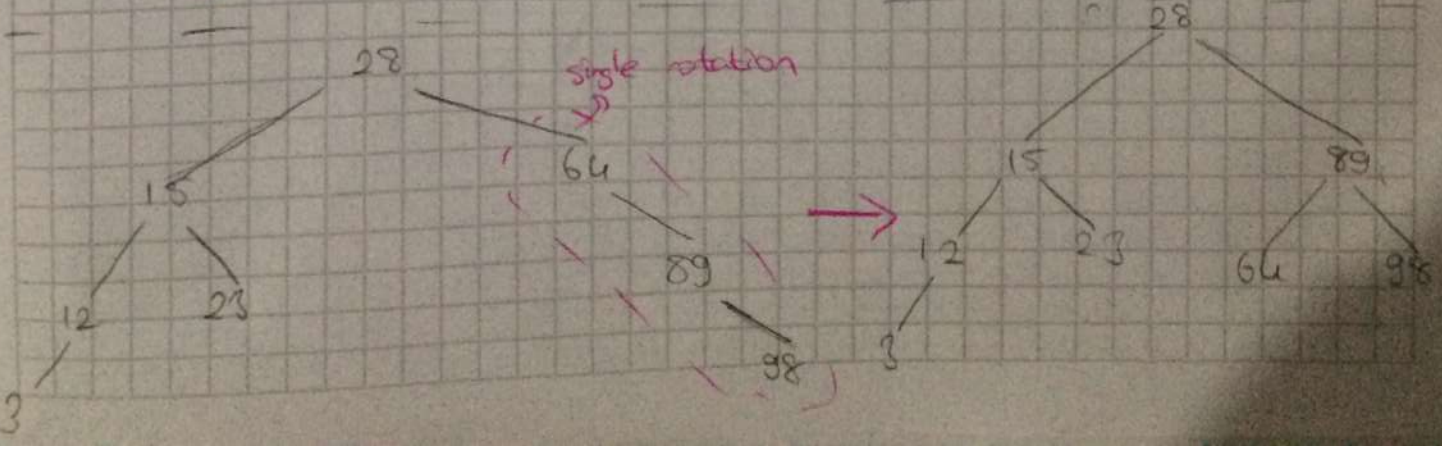
Node to remove: 17, 89, 42, 56, 64

a-) Show the tree after all the inputs are inserted.

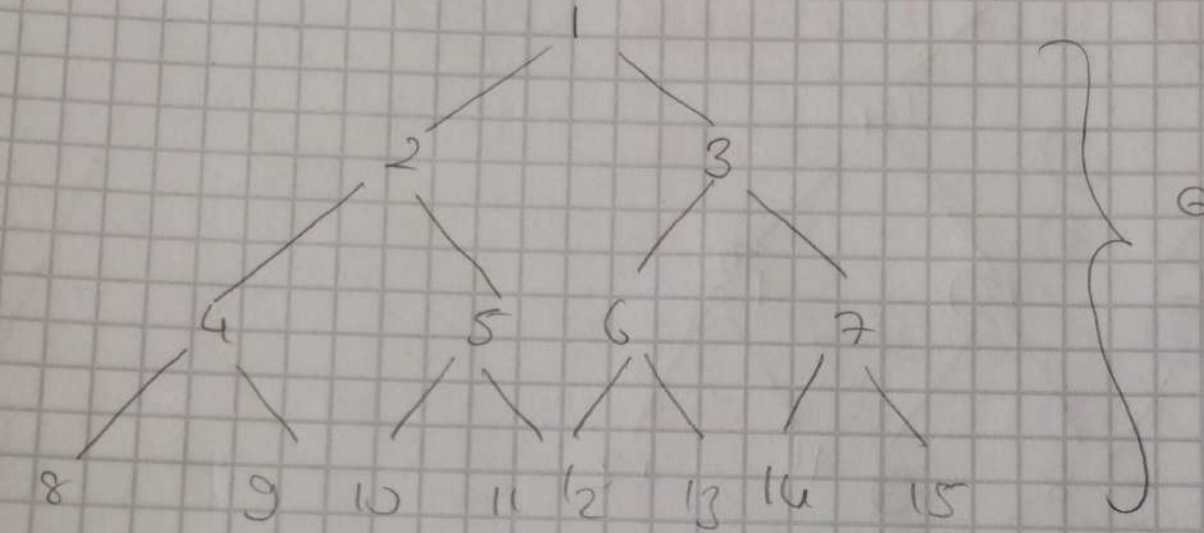
Solution:





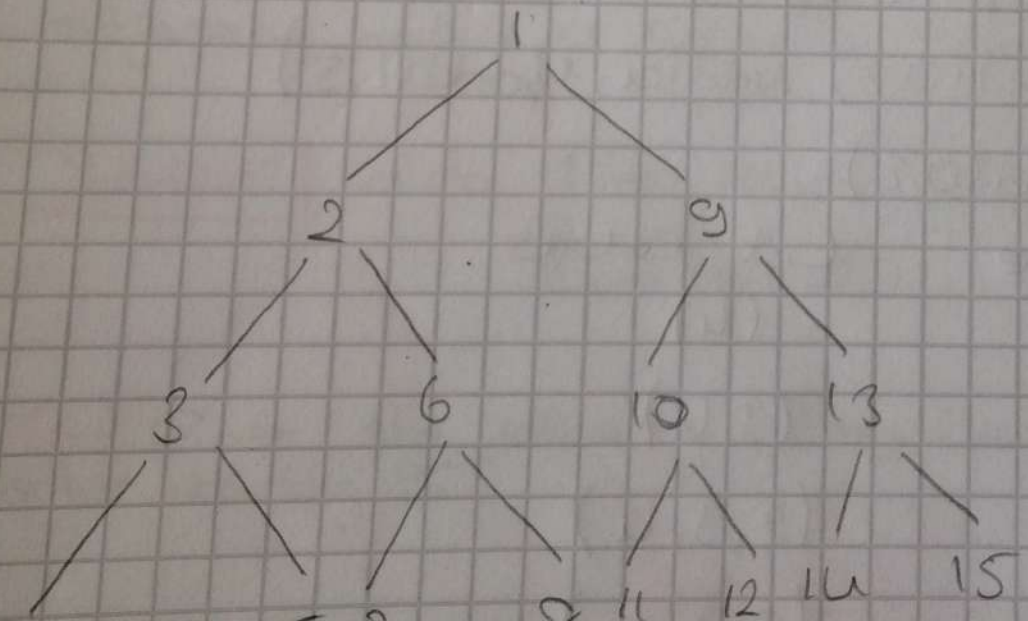


2-) Given a H-Heap storing 15[1 ---- 15] array-based representation of complete binary tree.



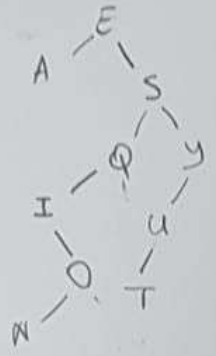
a-) Find preorder traversal of H

preorder → parent-left-right

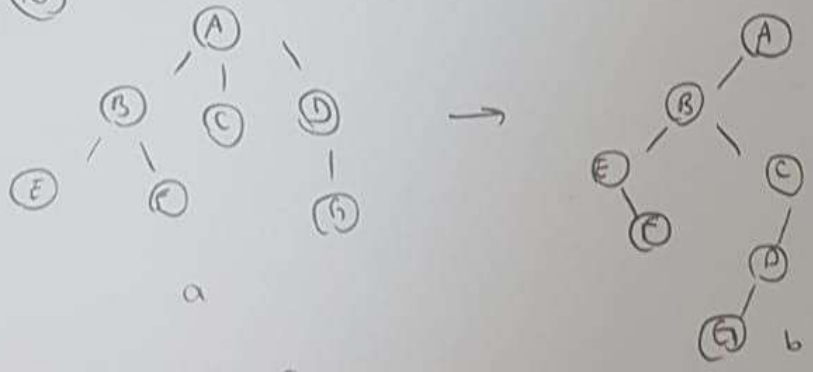


(12) Draw the BST that results when you insert the keys EASYQUESTION, in order that into an initially empty tree. How many compares are needed to ~~wrong~~ build the tree?

$1+1+2+2+3+(1)+(2)+4+3+4+5 = \frac{28}{7}$



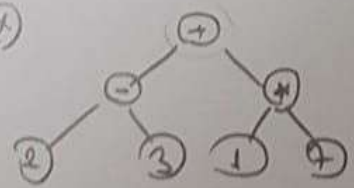
(10)



preorder = C L R
inorder = L C R
postorder = L R C

	a	b
preorder	A B E F C D G	A B E F L D G
inorder	E B F A C D G ?	E F B C G D A ?
postorder	E F B G G D A	F E G D C B A

(24)



preorder : + - 2 3 * 1 7
inorder = 2 - 3 + 1 * 7
postorder = 2 3 - 1 7 * +

Breath first Tree 'ye give you:

+	-	*	2	3	1	7

+, -, *, 2, 3, 1, 7

c) Find position

4) Draw a representation of an initial empty list after performing the following sequence of operations

add(0,4), add(0,3), add(0,2), add(2,1), add(1,5), add(1,6) add(3,7), add(0,8)

7) Starting with an empty 2-4 tree insert back of the given letters, into the tree in the order given, show your work and clearly indicate the final value of the 2-4 tree after all insertions.

6, 12, 1, 13, 5, 19, 8, 18, 15, 20, 9, 14, 7

1) (20 p) Using the given sequence of inputs build an AVL tree, then remove the nodes in the given order from the tree.

Input Sequence: 23, 64, 28, 12, 89, 15, 3, 98, 74, 82, 56, 17, 42, 36, 48, 24, 25, 51

Nodes to remove: 17, 89, 42, 56, 64

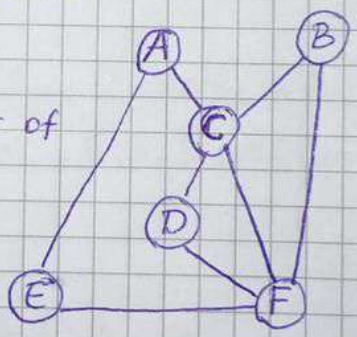
a) Show the tree after all the inputs are inserted.

b) Show the tree after all the nodes are removed.

3) (20 p) Write a recursive algorithm that will check if an array A of integers contains an integer A[i] that is the multiplication of two integers that appear earlier in A, that is, such that $A[i] = A[j] * A[k]$ for $j, k < i$?

5) a) (10 p) Show the adjacency matrix representation for the graph.

b) (5 p) What would be the number of zeros in the adjacency matrix of the given graph.



6) (15 p) Given the following Binary Search Tree, show its value after deleting 95.