

CS 202 - Fundamental Structures of Computer Science 2

Homework 4 – Balanced Search Trees, Hashing, and Graphs


Student Name: Esad İsmail Tök

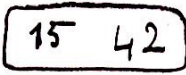
Student ID: 21801679

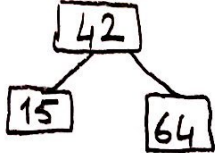
Section: 2

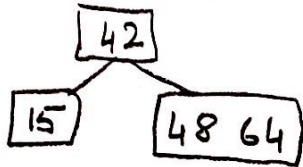
Question 1

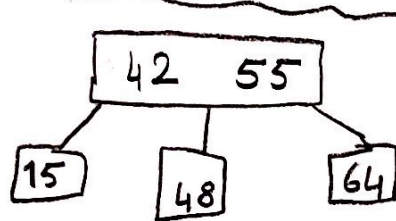
1) 2-3 Tree

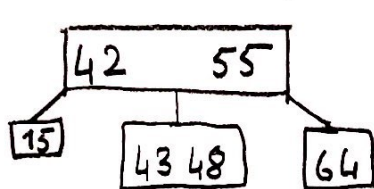
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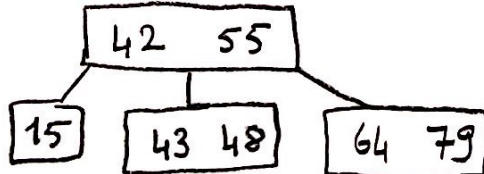
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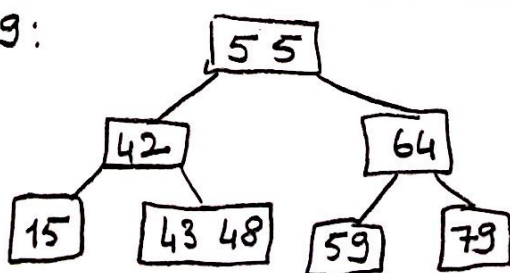
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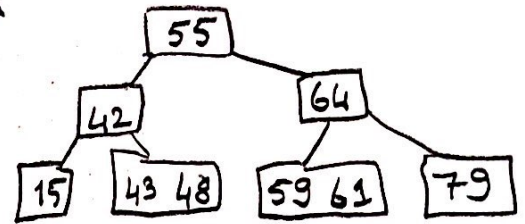
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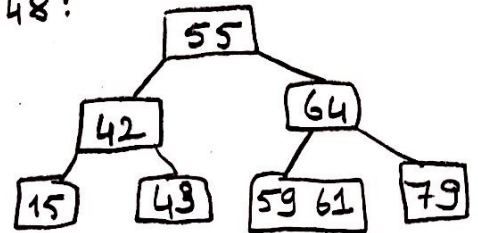
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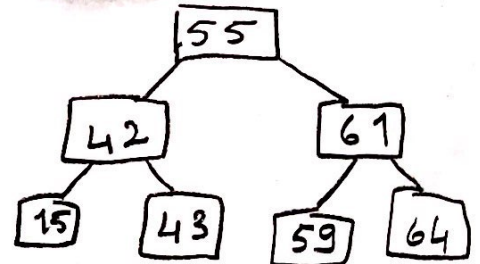
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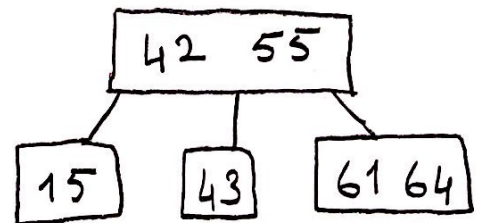
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Delete 79:



Delete 59:



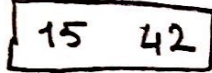
Question 1

2) 2-3-4 Tree

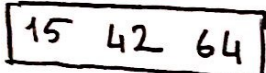
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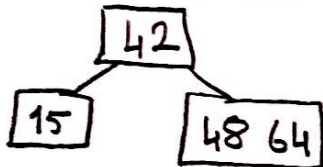
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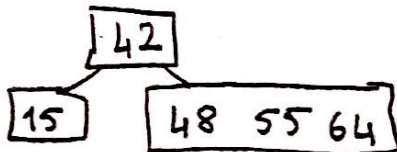
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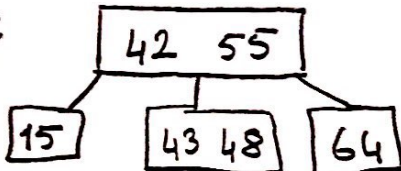
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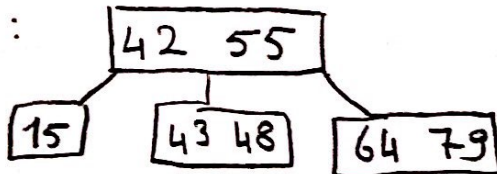
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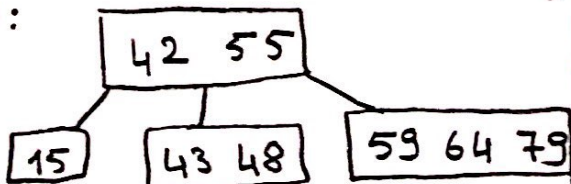
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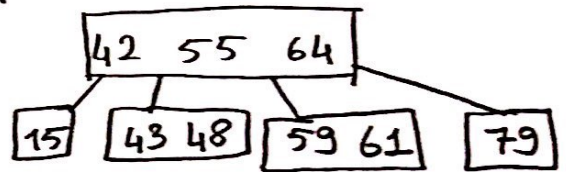
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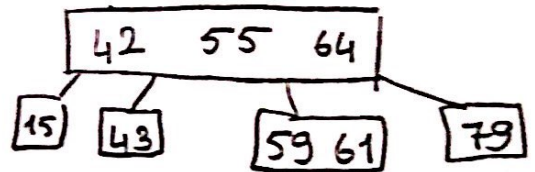
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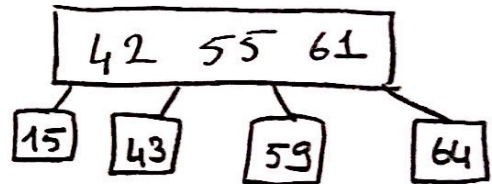
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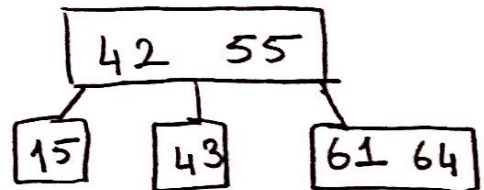
Delete 48:



Delete 79:



Delete 59:



Question 1

Node
Color
Representation

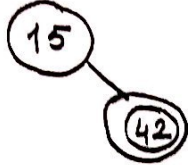
⊙ → Red Node
○ → Black Node

3) Red-black Tree

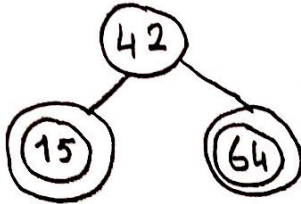
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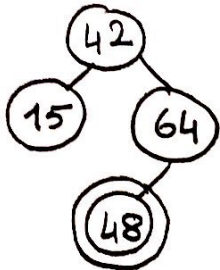
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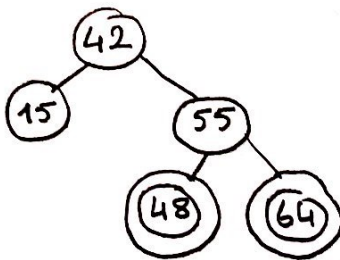
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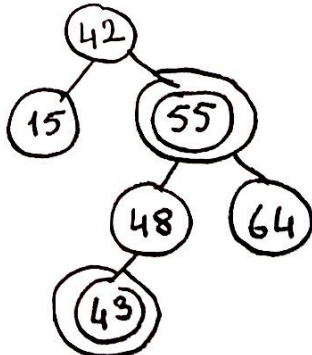
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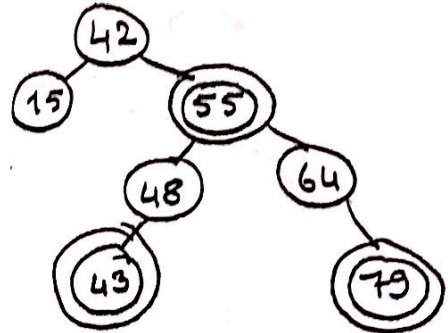
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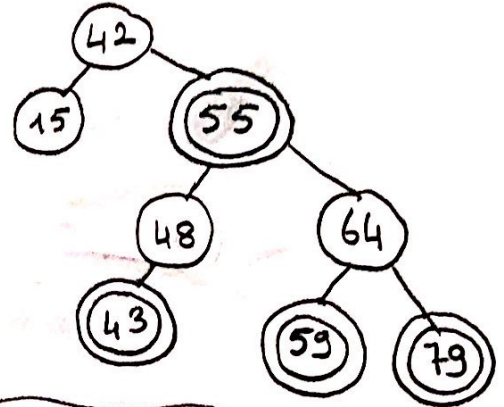
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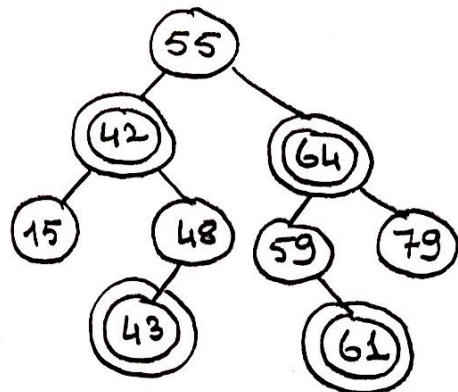
Insert 79:



Insert 59:



Insert 61:



Question 2

1) Open Addressing with linear probing

Index	Data Value
0	
1	
2	
3	
4	
5	22
6	23
7	24
8	39
9	40
10	26
11	41
12	43
13	
14	
15	
16	

* Note: A key cannot be included in the hash table more than once. Therefore the last key in the insertion which is 26 is not added into the table.

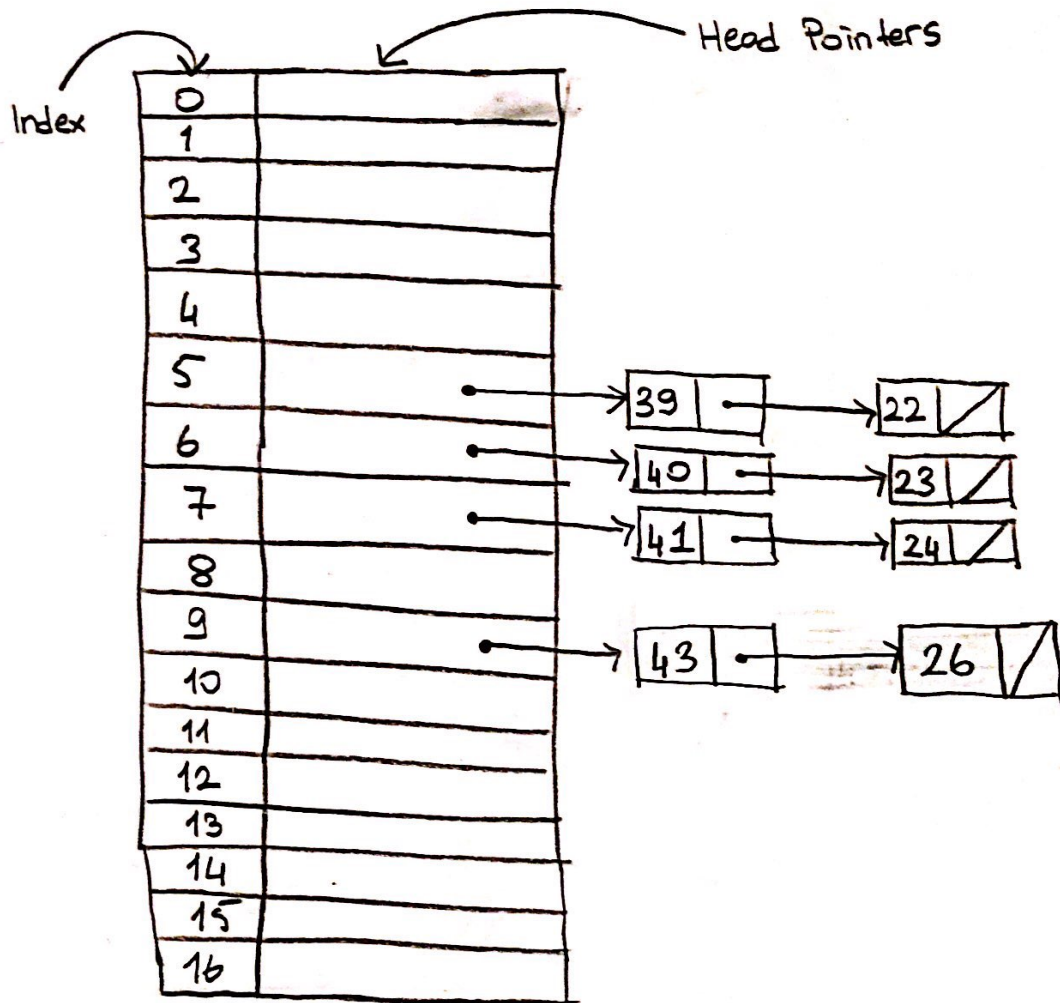
2) Open Addressing with quadratic probing

Index	Data
0	
1	43
2	
3	
4	
5	22
6	23
7	24
8	41
9	39
10	40
11	
12	
13	26
14	
15	
16	

* Note: A key cannot be included in the hash table more than once. So the last key in the insertion which is 26 is not added into the table.

Question 2

3) Separate Chaining



* Note: In separate chaining the newly added nodes are placed at the beginning of a linked list so that insertion is done in $O(1)$ time.

* Note: A key cannot be included in the hash table more than once. Therefore the last key in the insertion which is 26 is not added into the hash table.