CS 202

Homework 4

Section: 1

Ömer Oktay Gültekin

21901413

13.05.2022

Question 1:

a) Insert 2:

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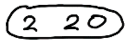

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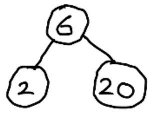

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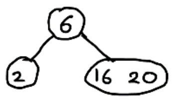

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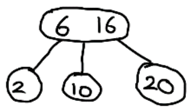

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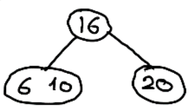

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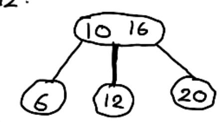

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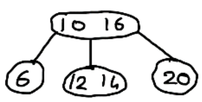

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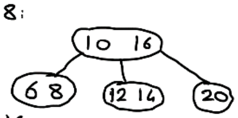

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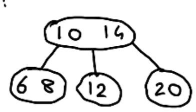

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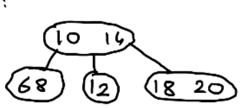

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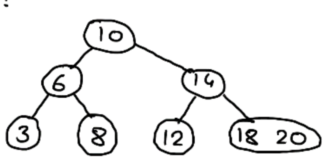

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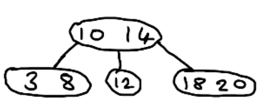

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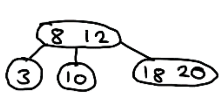
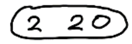


b) Insert 2:

Insert 20:



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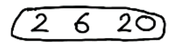

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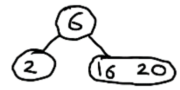

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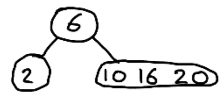

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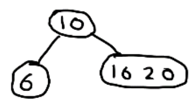

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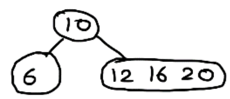

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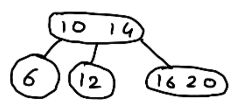

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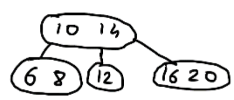

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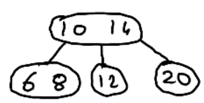

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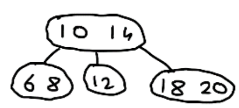

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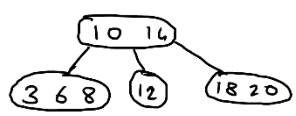

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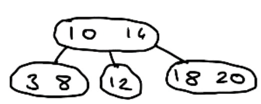

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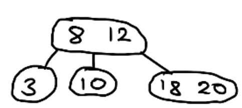


Question 2:

a) Linear Probing

Successful search:

Try 45, 64, 54, 17, 69, 58, 32, 60, 26

45: 6; 64: 12; 54: 2; 17: 4; 69: 4, 5;

58: 6, 7; 32: 6, 7, 8; 60: 8, 9; 26: 0;

$$\text{Avg. no of probes} = \frac{(1+1+1+1+2+2+3+2+1)}{9} = 1.55$$

0	26
1	
2	54
3	
4	17
5	69
6	45
7	58
8	32
9	60
10	
11	
12	64

Unsuccessful Search:

Try 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

0: 0, 1; 1: 1; 2: 2, 3; 3: 3;

4: 4, 5, 6, 7, 8, 9, 10; 5: 5, 6, 7, 8, 9, 10;

6: 6, 7, 8, 9, 10; 7: 7, 8, 9, 10;

8: 8, 9, 10; 9: 9, 10; 10: 10; 11: 11;

12: 12, 0, 1;

$$\text{Avg. no of probes} = \frac{(2+1+2+1+7+6+5+4+3+2+1+1+3)}{9} = 4.22$$

b) Quadratic Probing

Successful search:

Try 45, 64, 54, 17, 69, 58, 32, 60, 26

45 : 6 ; 64 : 12 ; 54 : 2 ; 17 : 4 ; 69 : 4, 5 ;

58 : 6, 7 ; 32 : 6, 7, 10 ; 60 : 8 ; 26 : 0 ;

Avg. no of probes $= \dfrac{(1+1+1+1+2+2+3+1+1)}{9} = 1.44$

0	26
1	
2	54
3	
4	17
5	69
6	45
7	58
8	60
9	
10	32
11	
12	64

Unsuccessful Search:

Try 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

0 : 0, 1 ; 1 : 1 ; 2 : 2, 3 ; 3 : 3 ;

4 : 4, 5, 6, 7, 8, 9 ; 5 : 5, 6, 7, 8, 9 ;

6 : 6, 7, 8, 9 ; 7 : 7, 8, 9 ;

8 : 8, 9 ; 9 : 9 ; 10 : 10, 11 ; 11 : 11 ;

12 : 12, 0, 1 ;

Avg. no of probes $= \dfrac{(2+1+2+1+6+5+4+3+2+1+2+1+3)}{13} = 2.54$

C) Separate Chaining

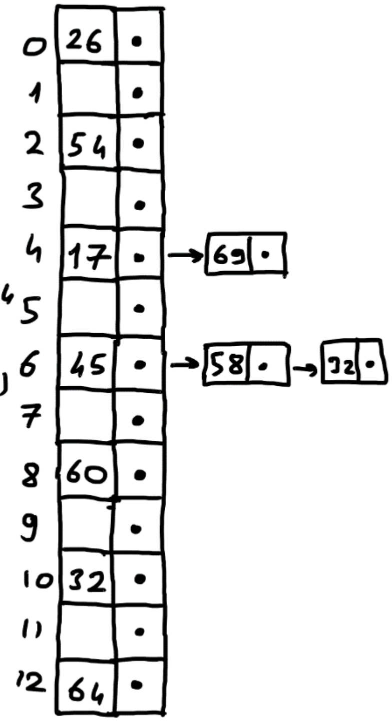
Successful search:

Try 45, 64, 54, 17, 69, 58, 32, 60, 26

45 : 6 ; 64 : 12 ; 54 : 2 ; 17 : 4 ; 69 : 4, 4.1 ;

58 : 6, 6.1 ; 32 : 6, 6.1, 6.2 ; 60 : 8 ; 26 : 0 ;

$$\text{Avg. no of probes} = \frac{(1+1+1+1+2+2+3+1+1)}{9} = 1.44$$



Unsuccessful Search: (Do not proceed if ptr is null)

Try 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

0 : 0 ; 1 : 1 ; 2 : 2 ; 3 : 3 ;

4 : 4, 4.1 ; 5 : 5 ;

6 : 6, 6.1, 6.2 ; 7 : 7 ;

8 : 8 ; 9 : 9 ; 10 : 10 ; 11 : 11 ;

12 : 12 ;

$$\text{Avg. no of probes} = \frac{(1+1+1+1+2+1+3+1+1+1+1+1+1)}{13} = 1.23$$

Question 3-b:

Insertion Operation: Firstly, the operation chooses one of the airports which is given as the source; Secondly, among the edges of this airport, a new edge is placed so that the minimum distance edge is the first entry in the edge list and max is the last entry. The operation makes it twice since it is an undirected graph. Therefore, in the worst case, the operation picks two of the airport and traverse all the edges of them since the distance we give is max. If there are m edges of airport 1 and n edges of airport 2, then worst-case asymptotic complexity is O(m + n), average-case O(m/2 + n/2), and best-case O(1). Practically all of them are closer to O(1).

List Operation: Firstly, the operation chooses one of the airports which is given as the source; Secondly, all of the edges are listed one by one. Therefore, worst-case, average-case, and best-case are the same since all of the edges must be listed. If there are m edges of the airport asymptotic complexities are O(m). Practically they are closer to O (1) since m is a small value.

Minimize Costs Operation: The operation starts from the first airport and since all the edges are listed min to max, there are pointers for all of the airports' unvisited edges and when one of them is visited, the pointer simply points to the next value. Therefore, all edges were traversed at least once. If there are edges that remained unvisited, they are deleted. However, how many times we traverse the same edge is not important since O(n) = O(2n) = O(3n). If there are n edges in total, then asymptotic complexities are O(n).

Shortest Path Operation: This operation is the same as the minimize cost operation. From the source airport, starting from a small edge, the algorithm try to go to the destination airport by trying all the edges one by one. When one edge is selected, the algorithm tries all possible combinations without visiting the visited airports again. Therefore, how many times we traverse the same edge is not important since $O(n) = O(2n) = O(3n)$. If there are n edges in total, then asymptotic complexities are $O(n)$.