Department of Computer Science

Gujarat University

Certificate

Roll No: 30 Seat No: _____

This is to certify that Mr./~~Ms.~~ Rathod Ajinkya Sreekant student of MCA Semester – III has duly completed his/~~her~~ term work for the semester ending in December 2020, in the subject of _____ **Data Structures (DS)** towards partial fulfillment of his/~~her~~ Degree of Masters in Computer Applications.

Date of Submission
11 - December - 2020

Internal Faculty

Head of Department

Department Of Computer Science
Rollwala Computer Centre
Gujarat University

MCA –III

Subject: - DATA STRUCTURES

Name :- Ajinkya Rathod

Roll No.: - 30 **Exam Seat No.: -_____**

Sr. No.	Contents	Date	Signature
1.	Infix to Postfix	11/12/2020	
2	Binary Search Tree	11/12/2020	
3	Expression Tree	11/12/2020	
4	AVL Tree	11/12/2020	
5	UnWeighted Graph Shortest Path	11/12/2020	
6	Weighted Graph Shortest Path	11/12/2020	
7	Kruskal's Mininmum Spanning Tree	11/12/2020	
8	S-paly	11/12/2020	
9	Delete MIN	11/12/2020	
10	B Tree	11/12/2020	
11	B+ Tree	11/12/2020	
12	B* Tree	11/12/2020	

Date __/__/____
Page _____

Name :- Ajinkya Rathod.

class :- MCA -3.

Subject :- Data structures

Roll no :- 30.

Date / /
Page 1

Assignment - 1.

Infix, prefix, & Post fix noration :->

① $(x + y + z) * (A + B - c)$

-> Post fix :-

$((xy+)+z) * ((AB+)-c)$
$((xy+)z+) * ((AB+)C-)$
$xy+z+AB+C-*$

-> Prefix :-

$((x+y)+z) * ((A+B)-c)$
$(+(+xy)z) * (+(+AB)-c)$

$++xyz*-+ABC$

② $(A/B - c) + (D * E)$

-> Post fix :-

$((A/B)-c) + (D*E)$
$(AB/-c) + (DE*)$
$AB/c- DE*+$

→ prefix

((A/B)-C) + (D*E)
(/AB)-C) + (*DE)
(-/ABC) + (*DE)

+ -/ABC *DE

③. ((((A+B) + (C/D))) * (E-(F*G)))

→ Post fix:-

(((AB+)+(CD/)) * (E-(FG*)))
((AB+CD/+) * (EFG*-)

AB+CD/+EFG*-*

→ Prefix:-

((C + AB) + (/CD)) * (E-(*FG))
(++AB/CD) * (-E*FG)
* ++AB/CD-E*FG

(4). ((x * y) * (z * w) - (A + B * C - D)

→ Post fix :-

(xy * * z * w) - (A + B * C - D)

xy * z * w * - (A + BC * - D)

xy * z * w * - ABC * + D

xy * z * w * ABC * + D.

→ Pre fix :-

* * * xyzw - (A + * BC - D)

* * * xyzw - - + A * BCD

- * * * xyzw - + A * BCD

(5). A / B / c + D * E - F

→ Post fix :-

A B / c / + D E * - F

A B / c / D E * + F -

→ Prefix :-

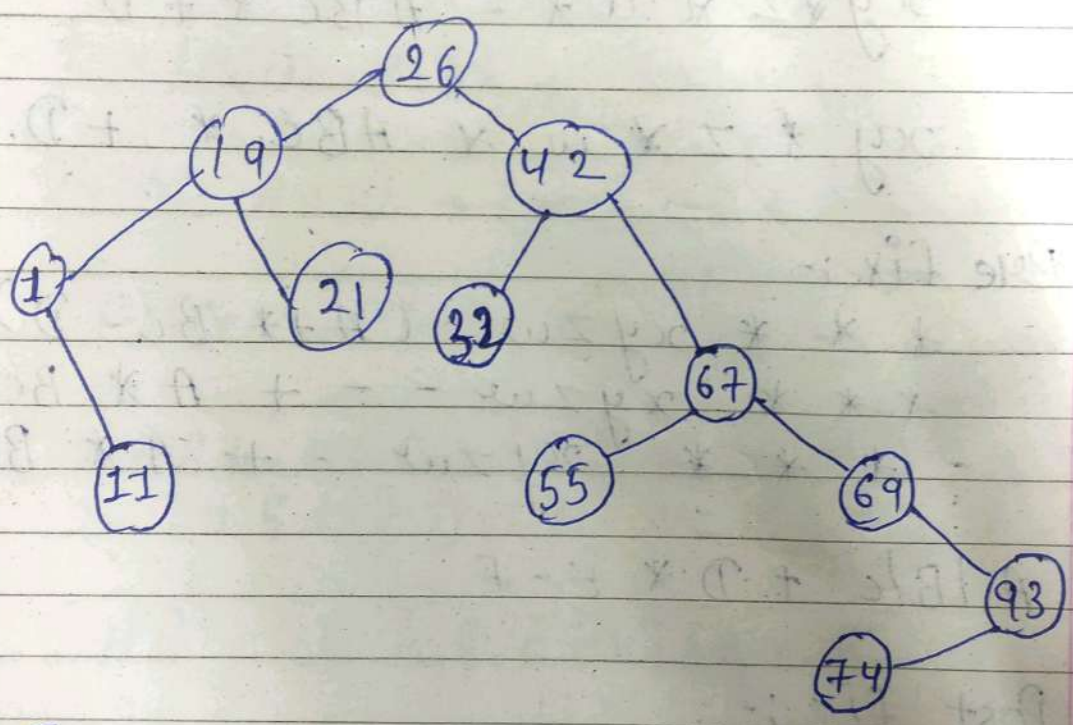
/ / A B C + P * E - F

/ / A B C + * D E - F

- + / / A B C * D E F

Q.2. Create BST for following data & perform all 3 traversals on resultant tree.

(1). 26, 19, 42, 67, 21, 1, 69, 55, 93, 74, 32, 11

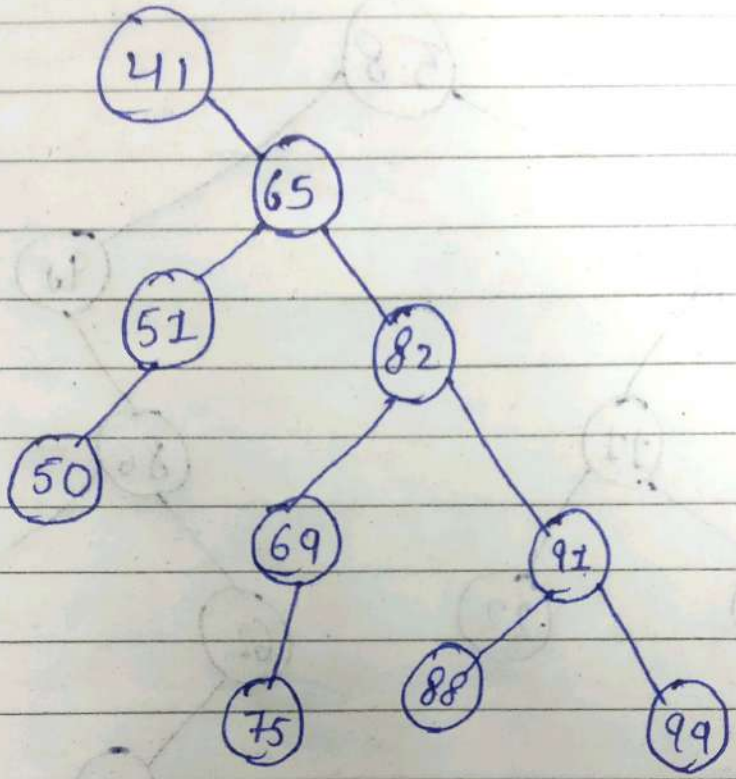


→ In order Traversals:- (L Root R)
1, 11, 19, 21, 26, 32, 42, 55, 67, 69, 74, 93.

→ Pre order Traversals:- (Root LR)
26, 19, 1, 11, 21, 42, 32, 67, 55, 69, 93, 74.

→ Post order Traversals:- (L R Root)
11, 1, 21, 19, 32, 55, 74, 93, 69, 67, 42, 26

(2). 41, 65, 82, 91, 51, 50, 69, 75, 88, 99.

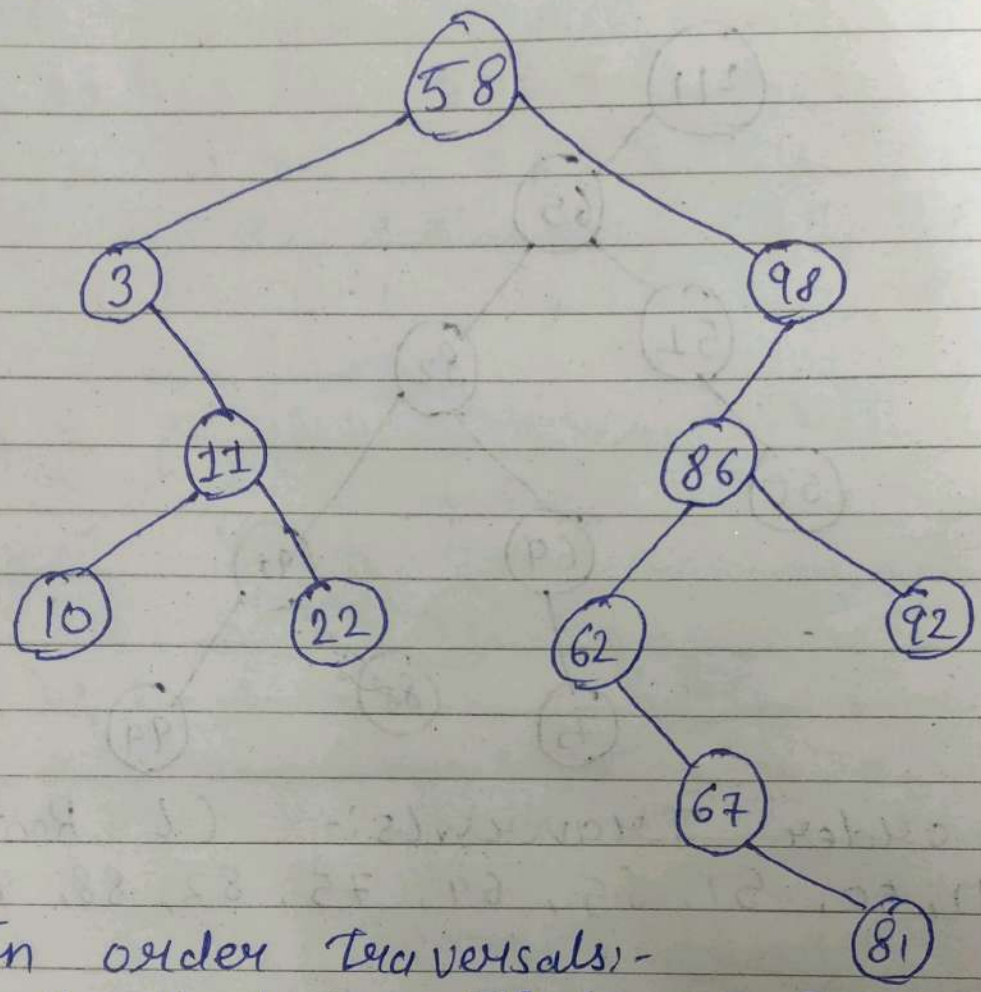


→ In order Traversals :- (L Root R)
41, 50, 51, 65, 69, 75, 82, 88, 91, 99.

→ Pre order Traversals :- (Root LR)
41, 65, 51, 50, 82, 69, 75, 91, 88, 99.

→ Post order Traversals :- (L R Root)
50, 51, 75, 69, 88, 99, 91, 82, 65, 41

③ 58, 3, 98, 11, 86, 22, 62, 67, 81, 92,

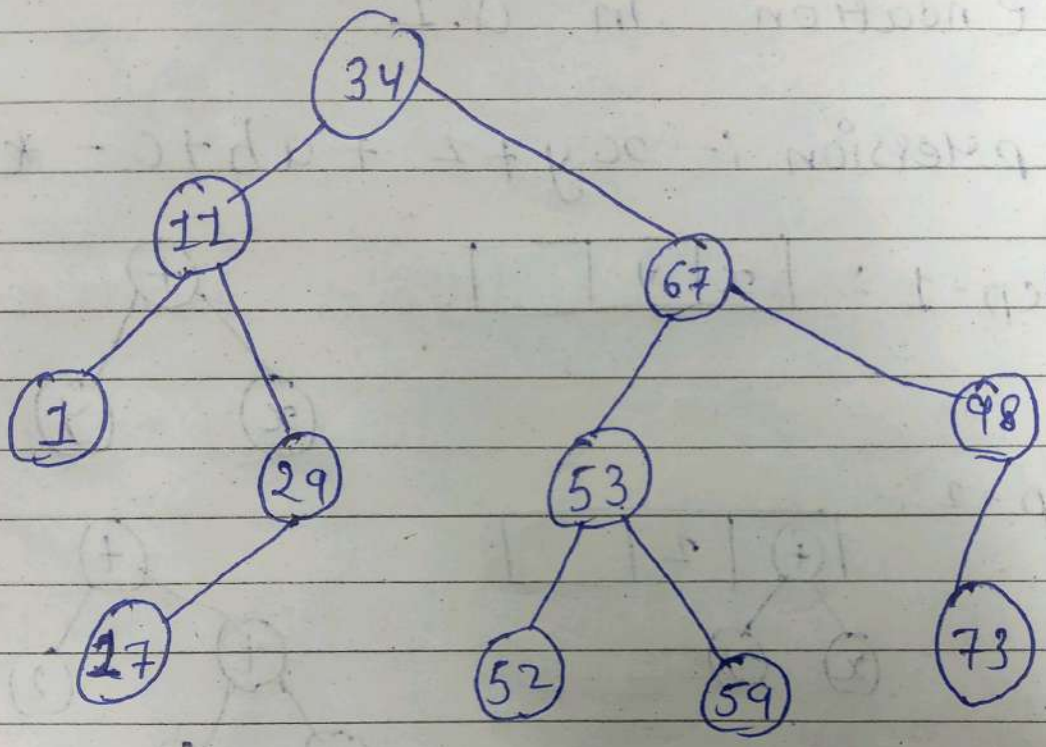


→ In order Traversals:-
3, 10, 11, 22, 58, 62, 67, 81, 86, 92, 98

→ Pre order Traversals:-
58, 3, 11, 10, 22, 98, 86, 62, 67, 81, 92

→ Post order Traversals:-
10, 22, 11, 3, 81, 67, 62, 92, 86, 98, 58.

(4) 34, 11, 67, 98, 1, 73, 53, 29, 52, 17, 59.



→ In order Traversals:-
1, 11, 17, 29, 34, 52, 53, 59, 67, 73, 98

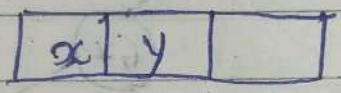
→ In pre order Traversals:-
34, 11, 1, 29, 17, 67, 53, 52, 59, 98, 73.

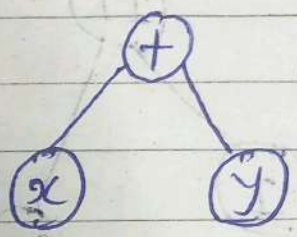
→ Post order Traversals:-
1, 17, 29, 11, 52, 59, 53, 73, 98, 67, 34

Q.3. Create Expression Tree from the equation in Q.1.

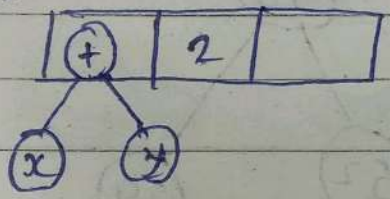
1) Expression :- x y + z + a b + c - *

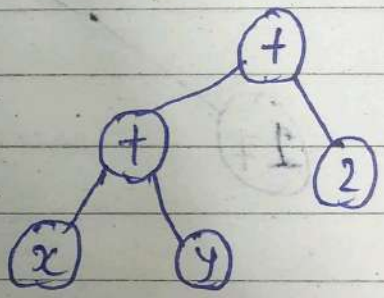
Step-1 :



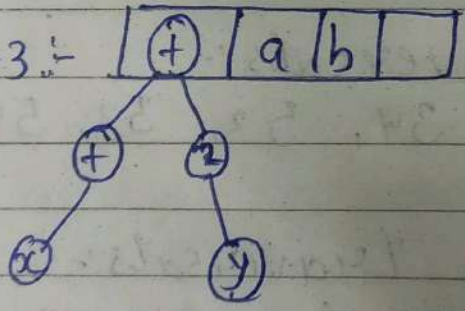


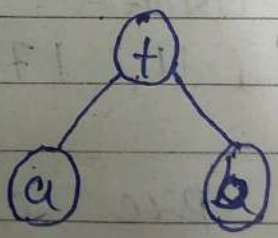
Step-2 :-





Step-3 :-





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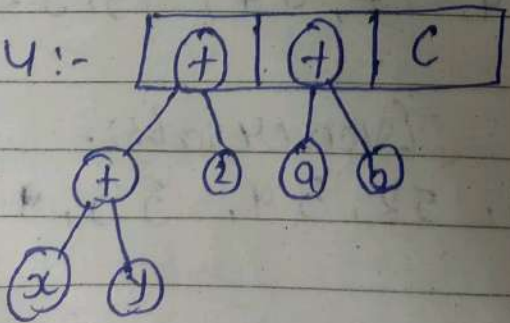
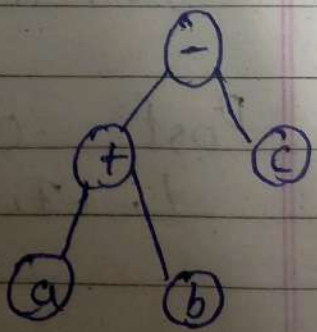
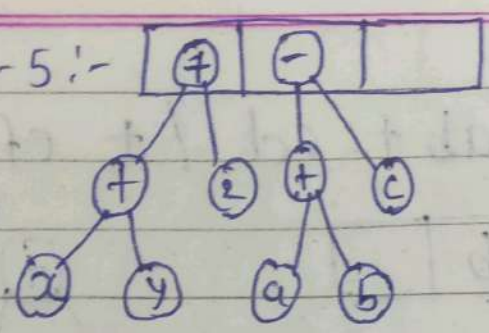
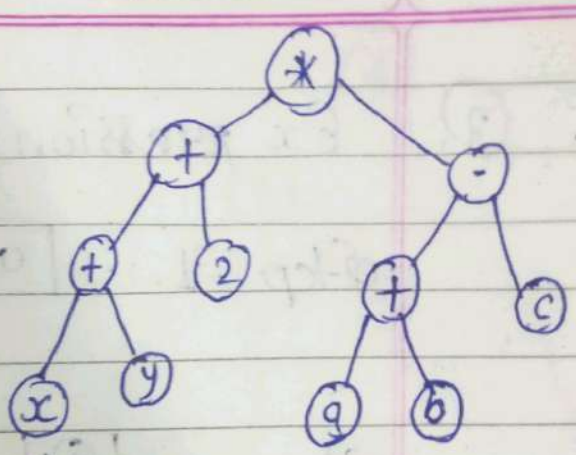




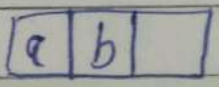
Step -5 :-

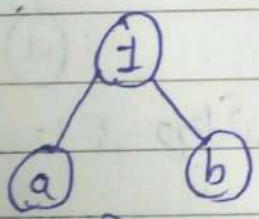




(2). Expression :- a b / c - d e * +

Step-1 :-





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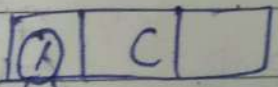
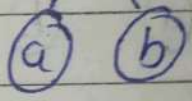
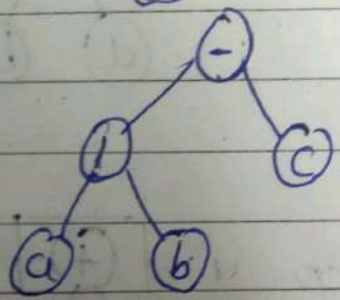
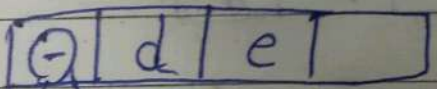
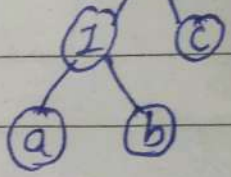


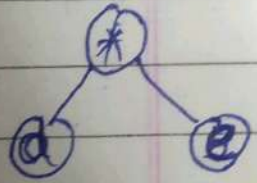




Step-3 :-







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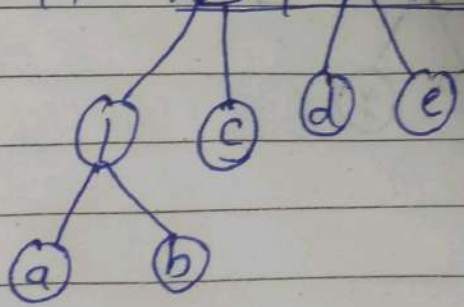
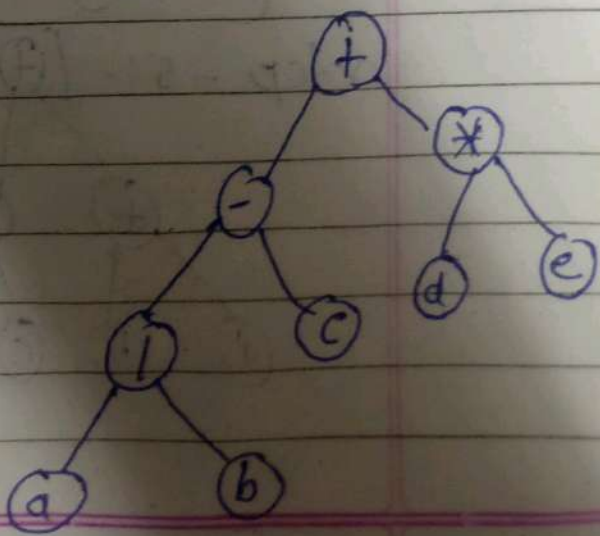
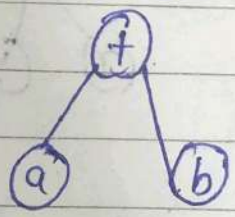




③ Expression:- ab + cd / + efg * - *

Step -1 :-



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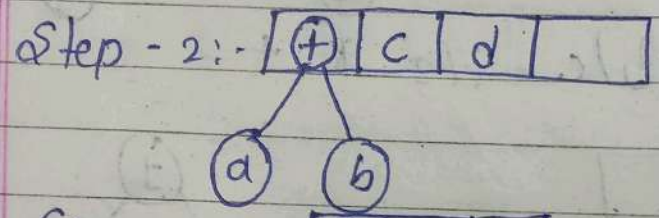

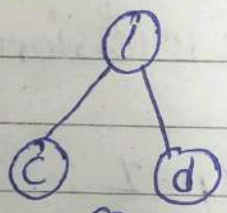

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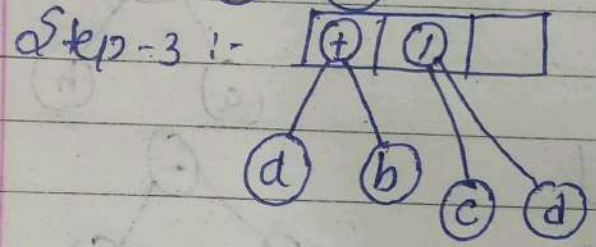

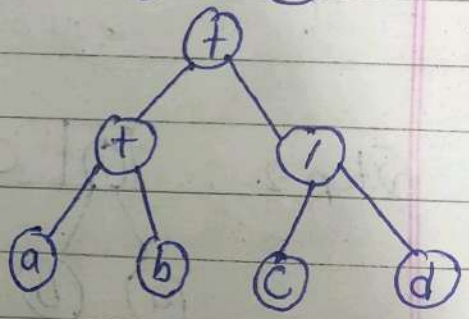

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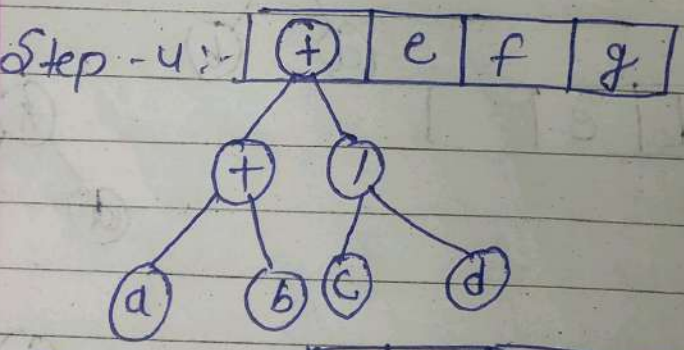

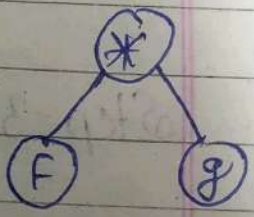

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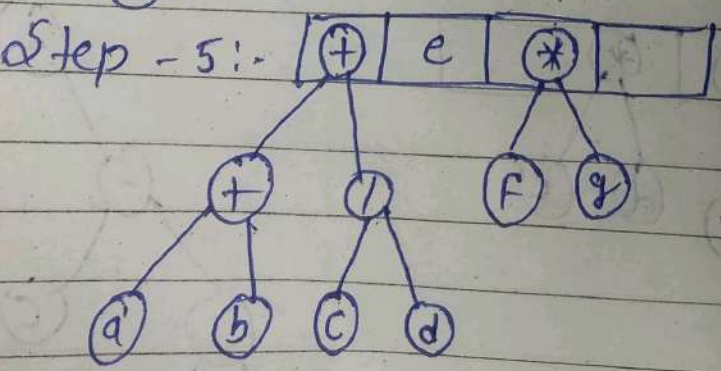

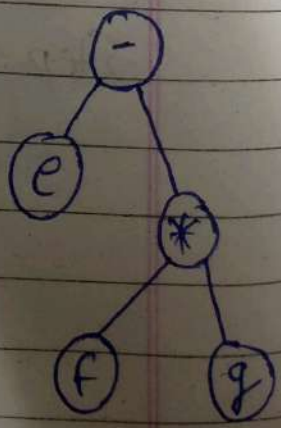

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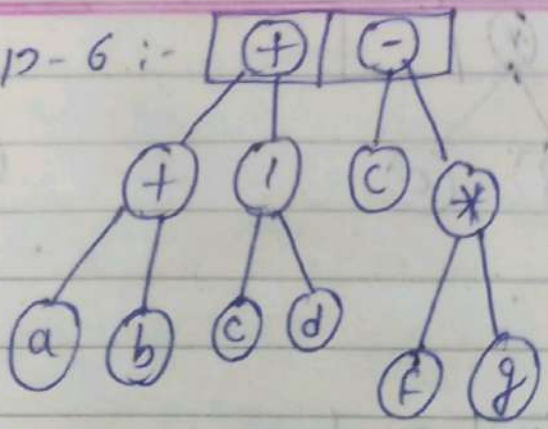
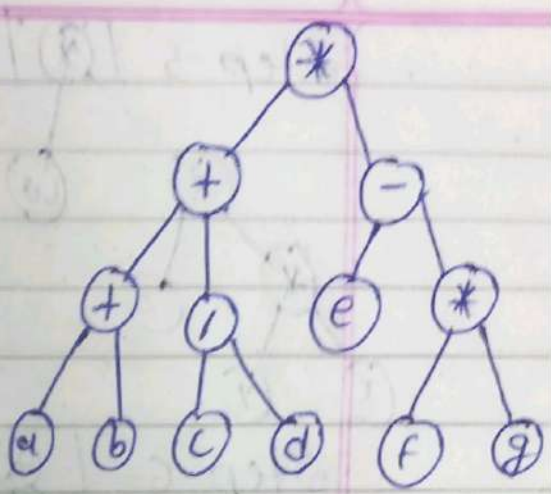
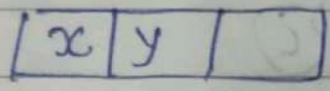
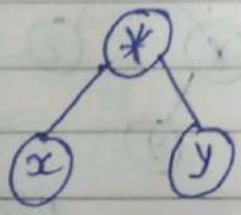




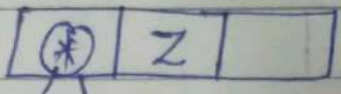
(4) Expression :- $xy * z * w * ABC * + D - -$

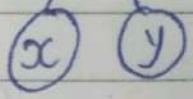
Step-1

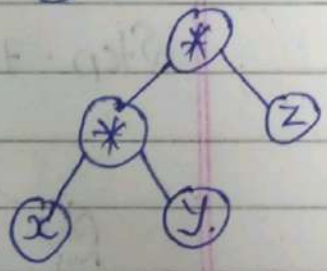




Step-2







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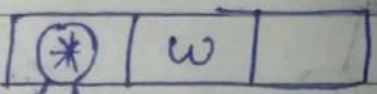
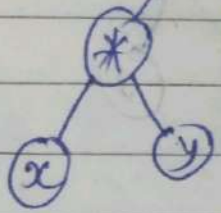
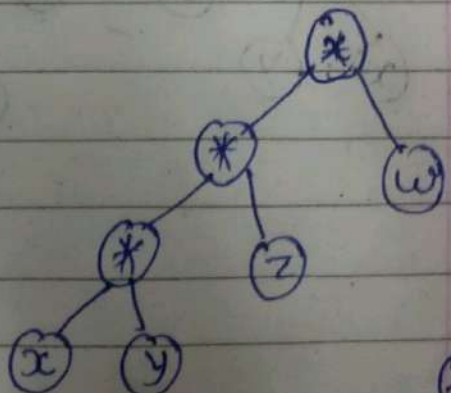
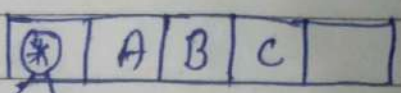
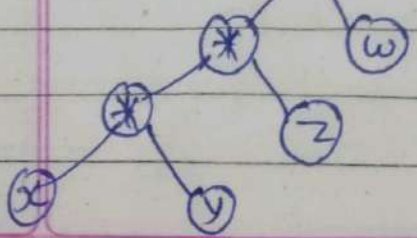


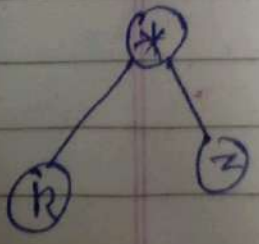




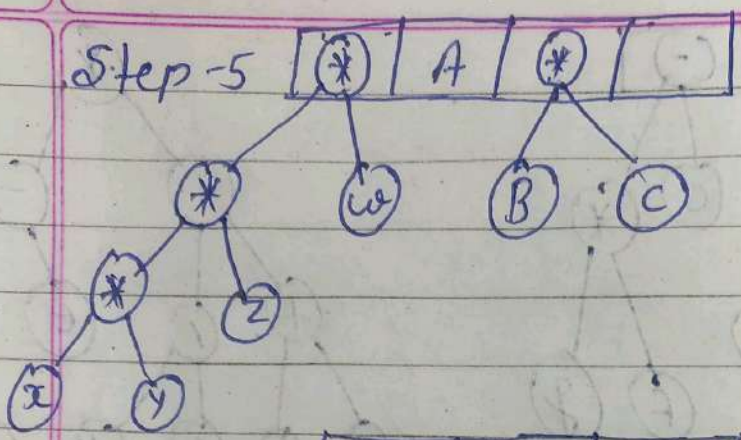
Step-4 :-

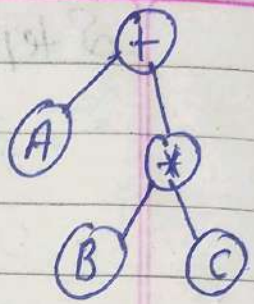




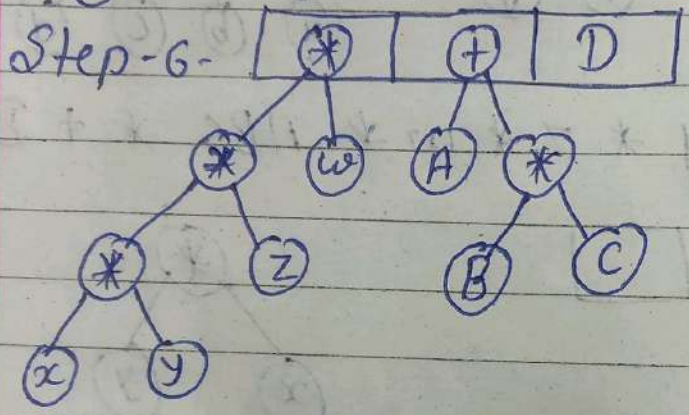


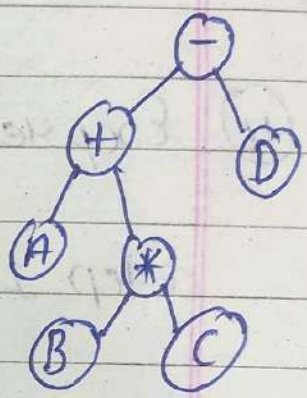
Step-5





Step-6





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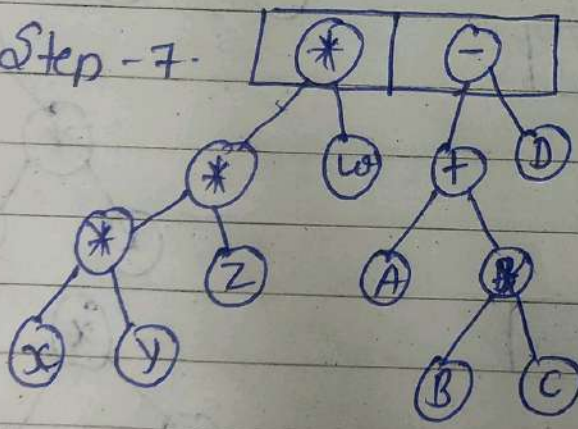
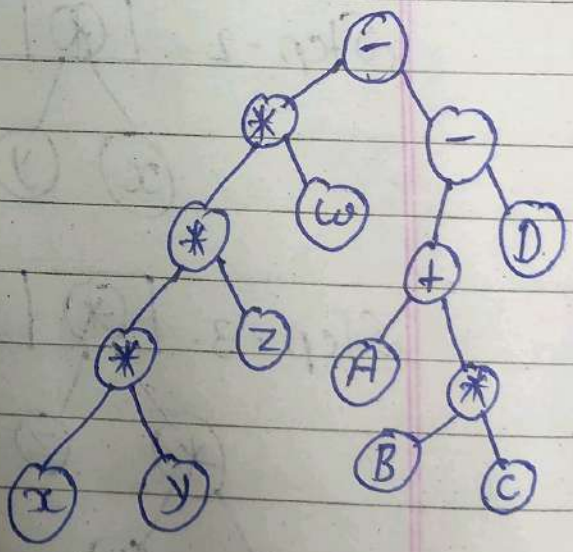
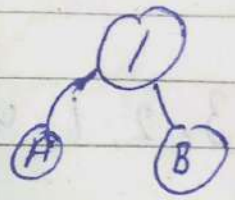


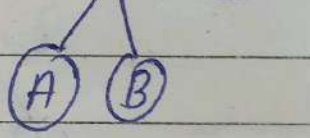


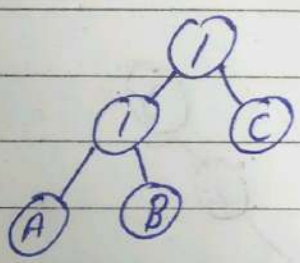
(5) Expression :- AB / C / DE * + F - .

Step-1 [A | B]

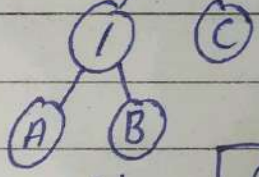


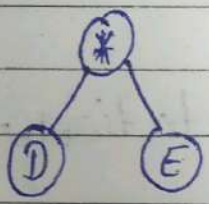
Step-2 [/ | C]



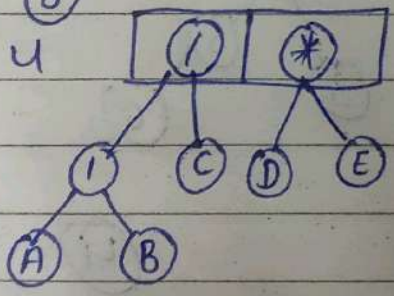


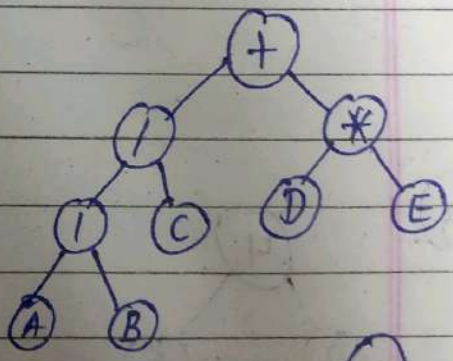
Step-3 [/ | D | E]



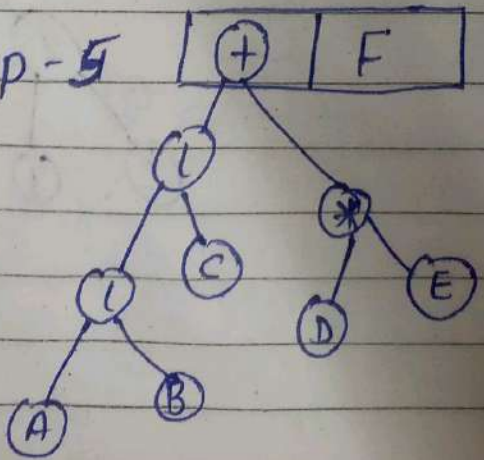


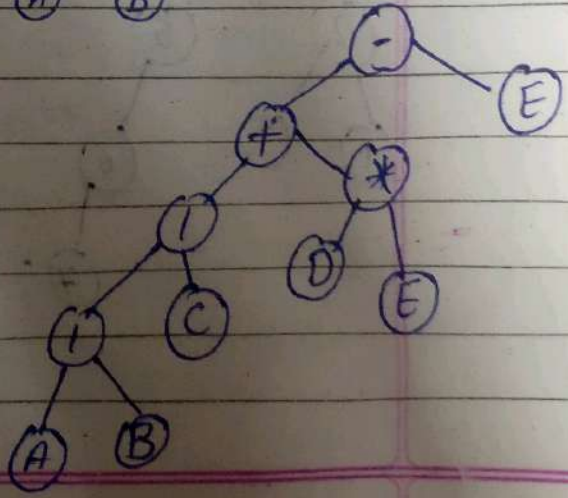
Step-4 [/ | *]





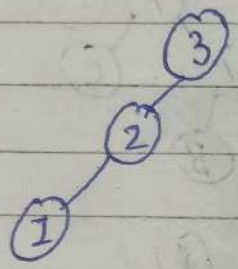
Step-5 [+ | F]



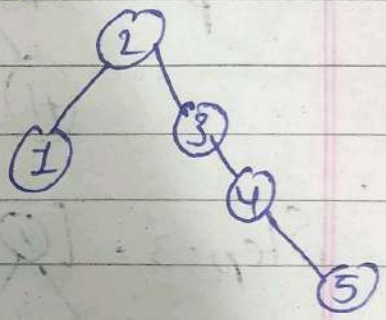


Q.4. AVL Tree (Rotation LL, RR, LR, RL)
(Balance factor $L^L - h^R$ (-1, 0, 1)

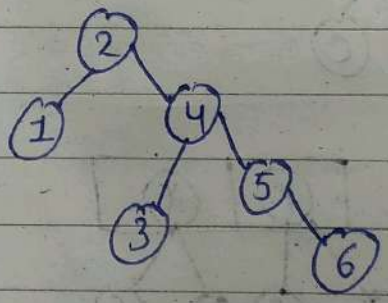
(1). 3, 2, 1, 4, 5, 6, 7, 16, 15, 14, 13, 12, 11, 10, 8, 9



Rotation - 1.



Rotation - 2



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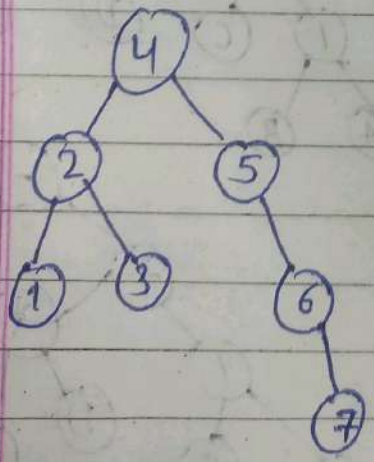

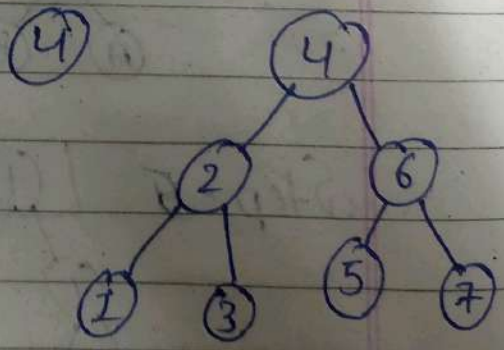

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Page 15

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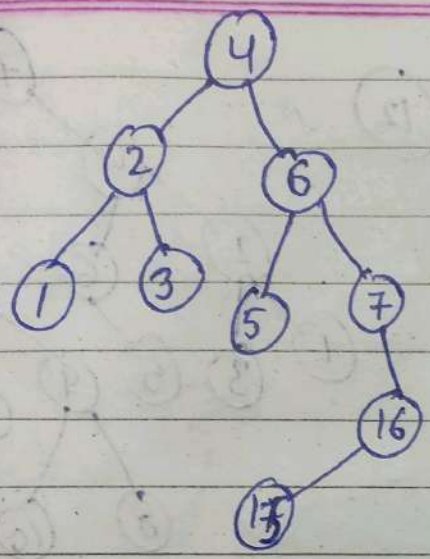

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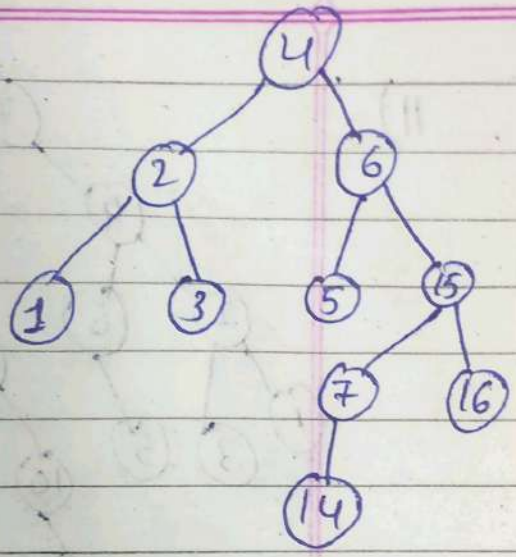

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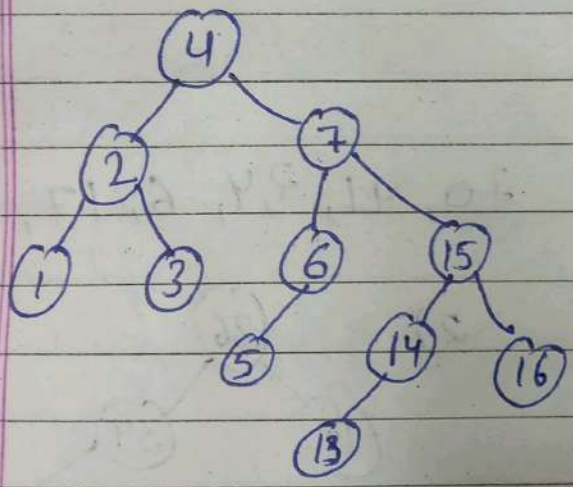

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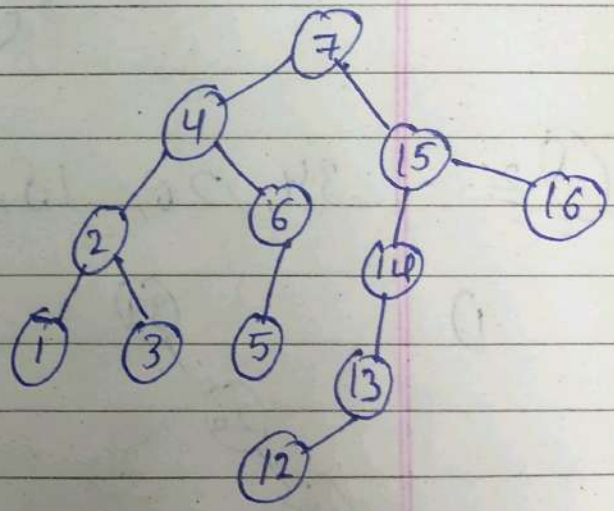

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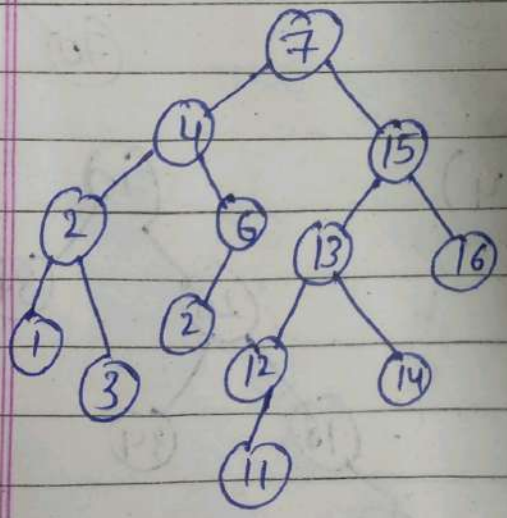

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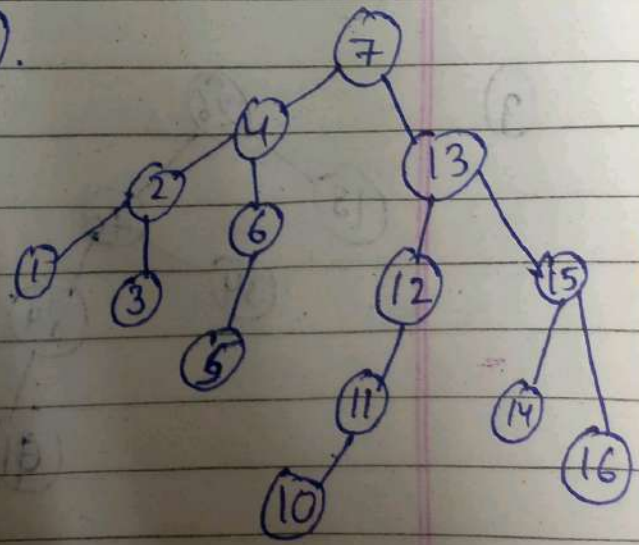

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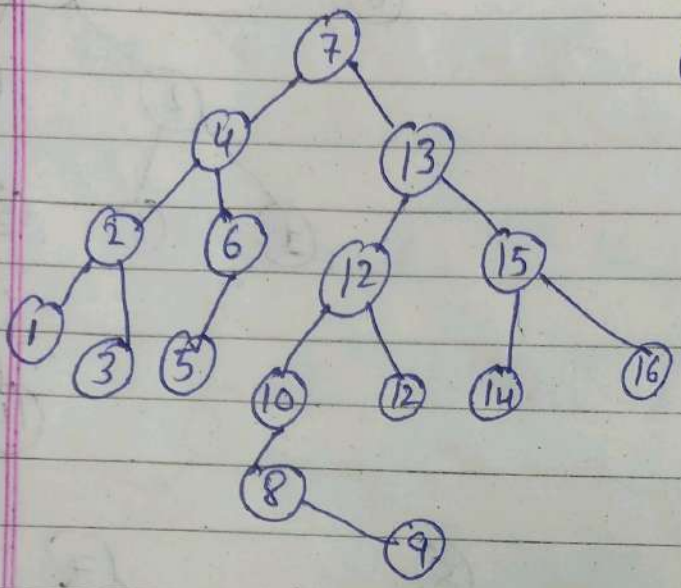

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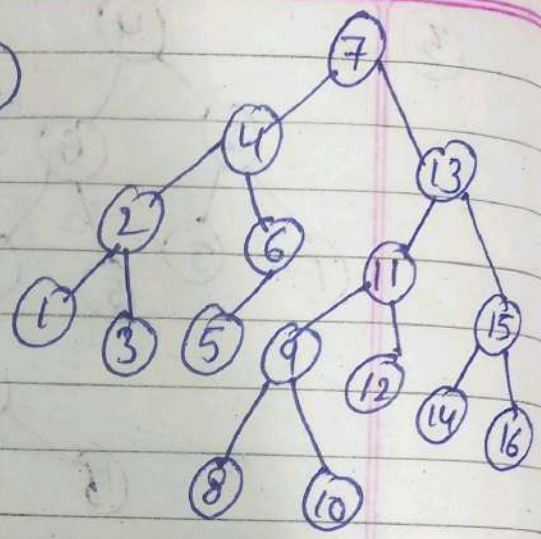

Q2. 34, 26, 18, 84, 70, 91, 24, 6, 17, 48, 55, 10

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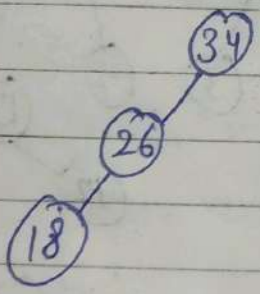

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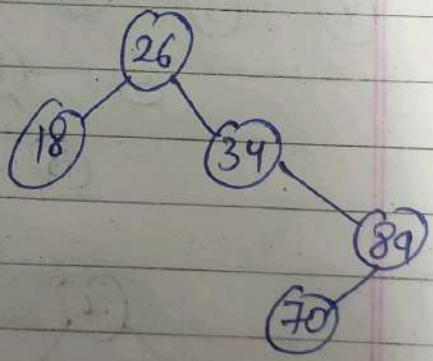

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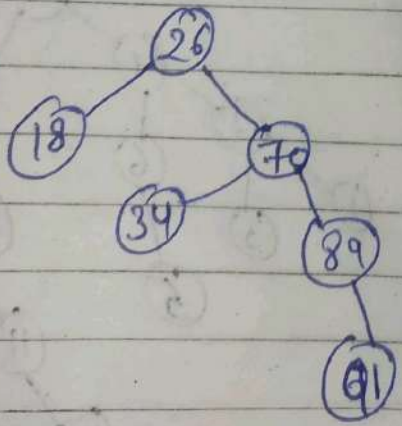

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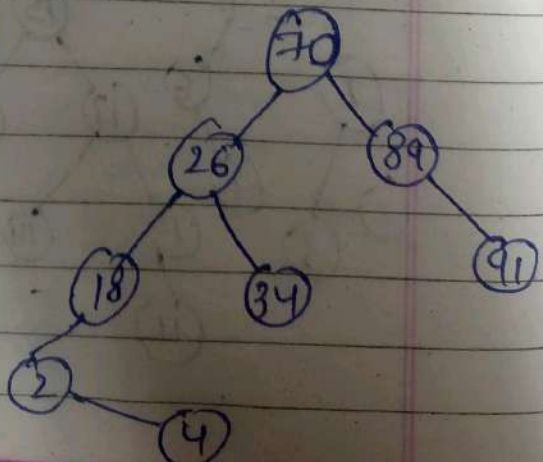

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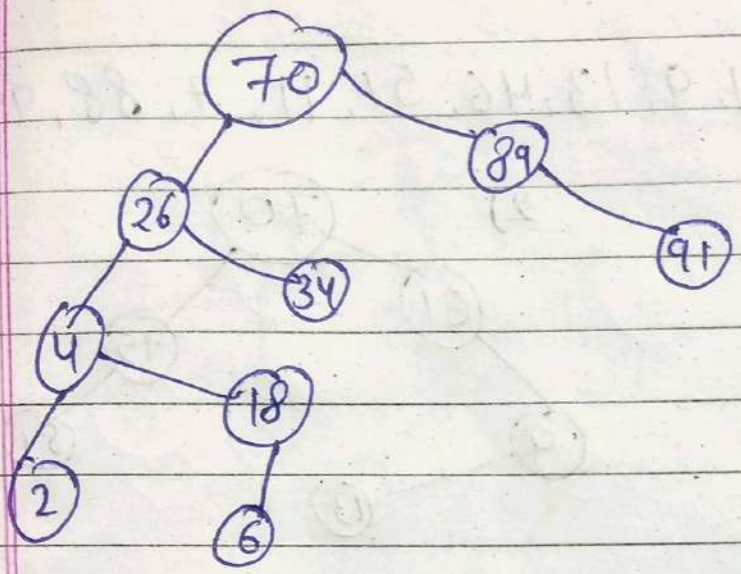
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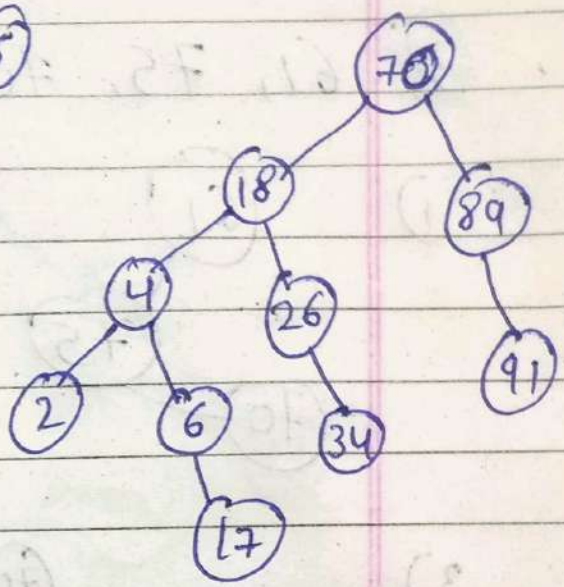
6)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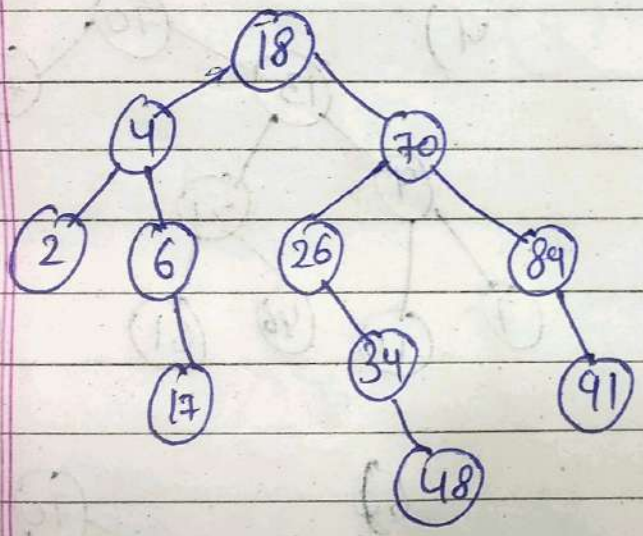
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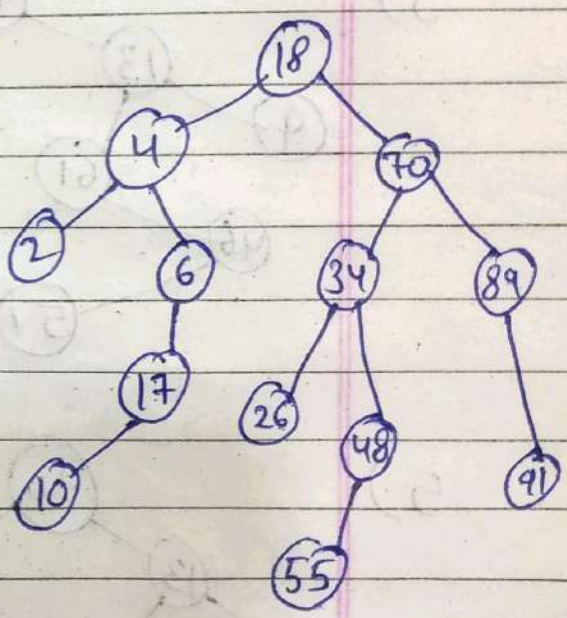
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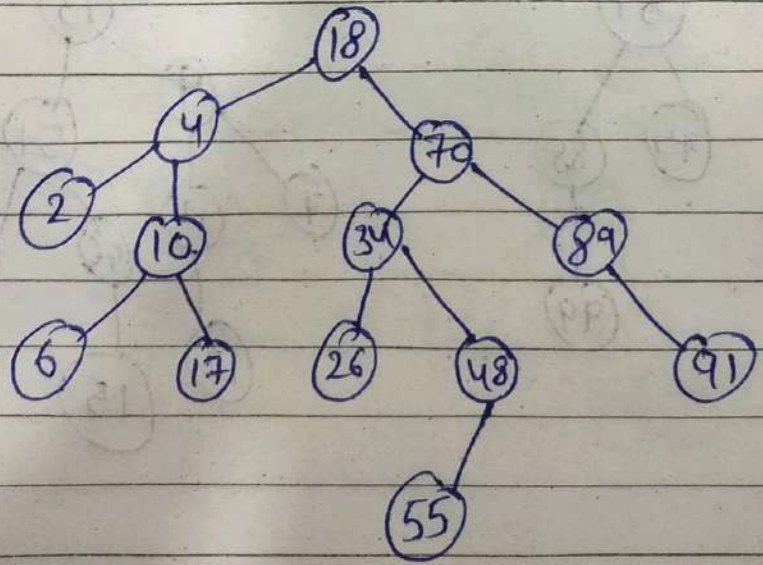
9)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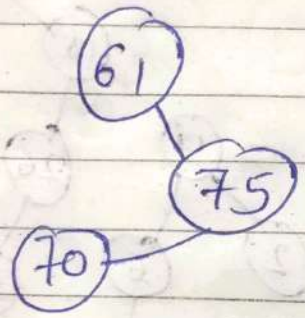

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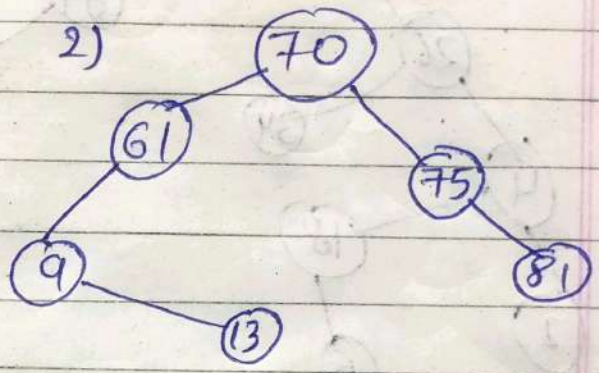

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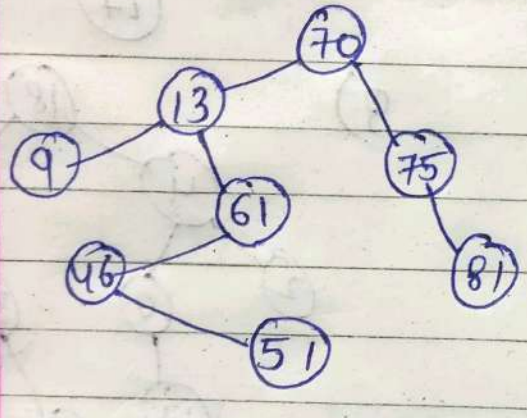

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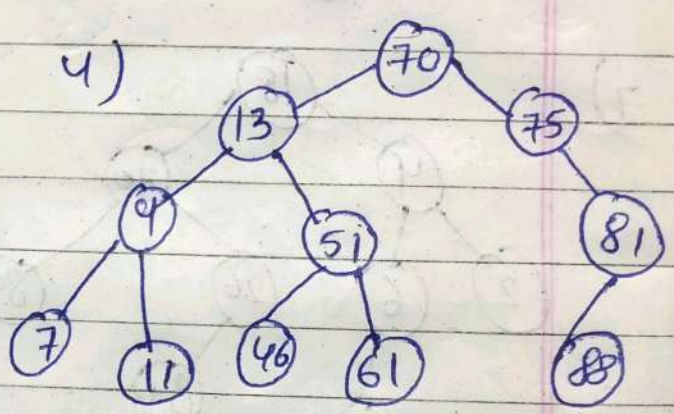

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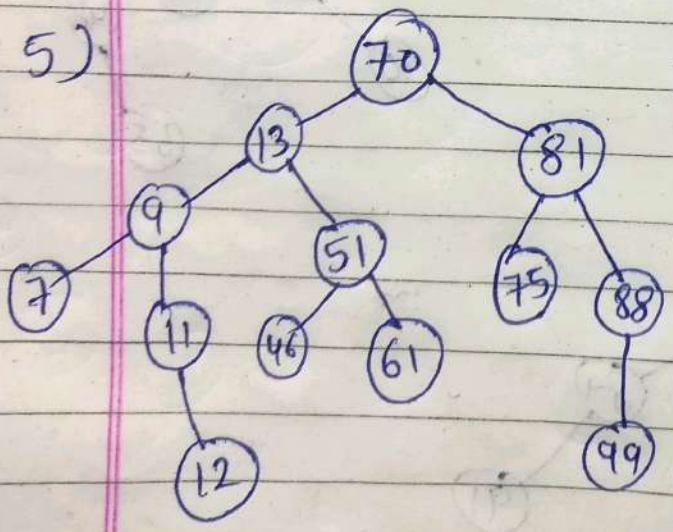

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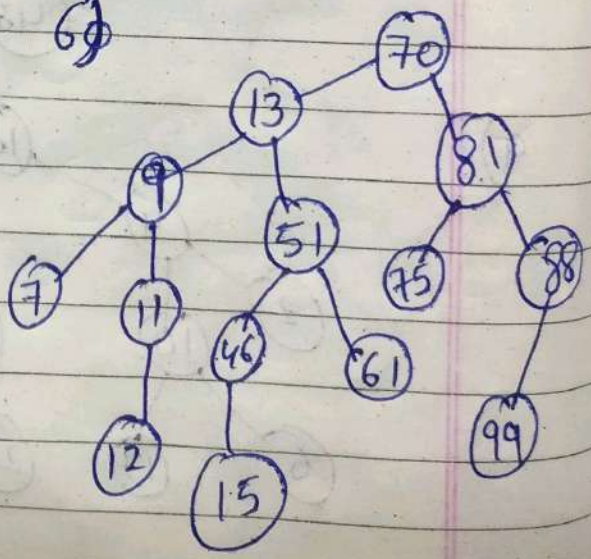

(1)

Splay tree :-

Date __/__/____
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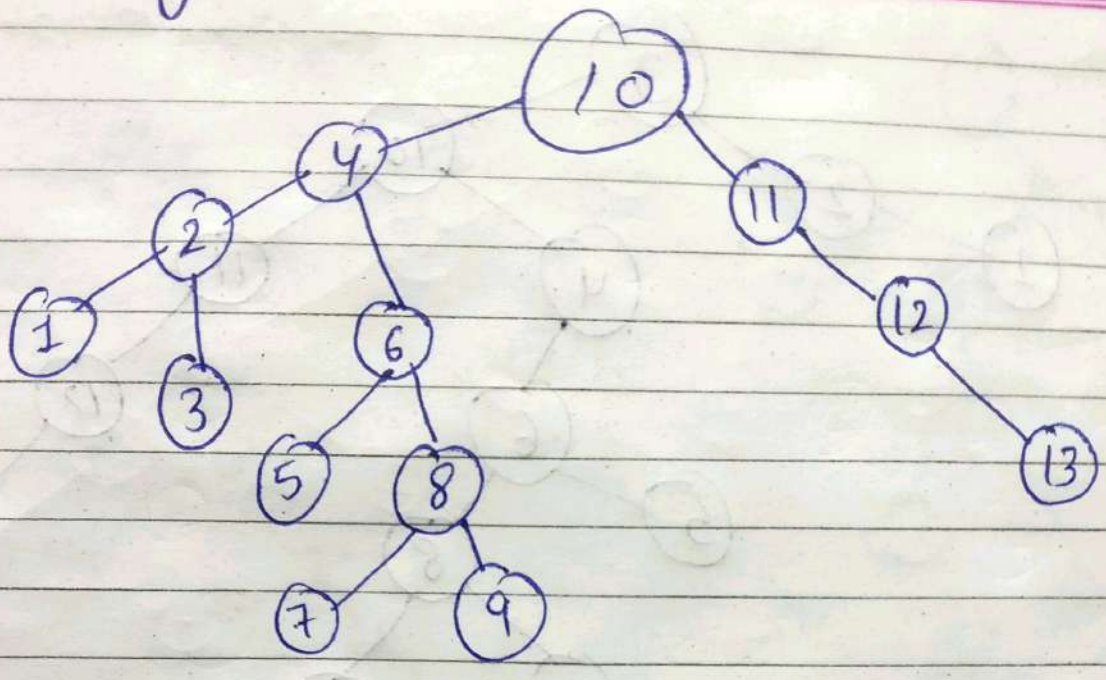
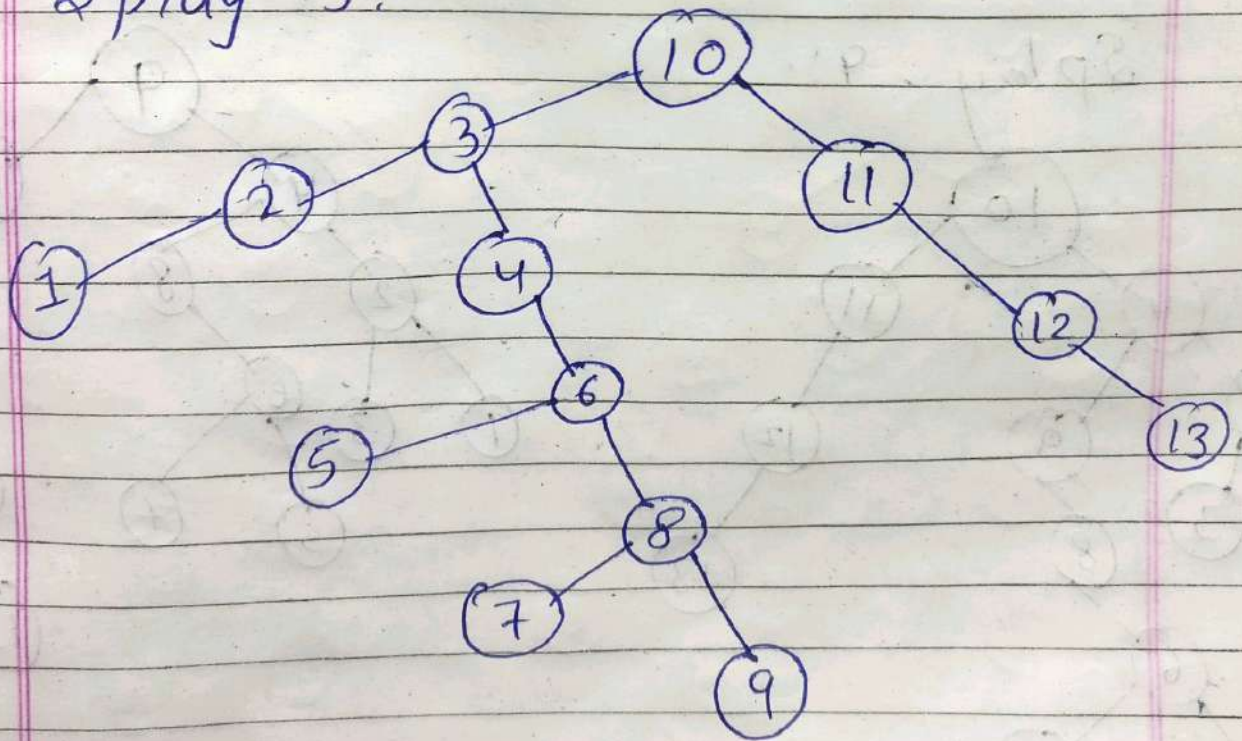
(1)



Splay 3 :-



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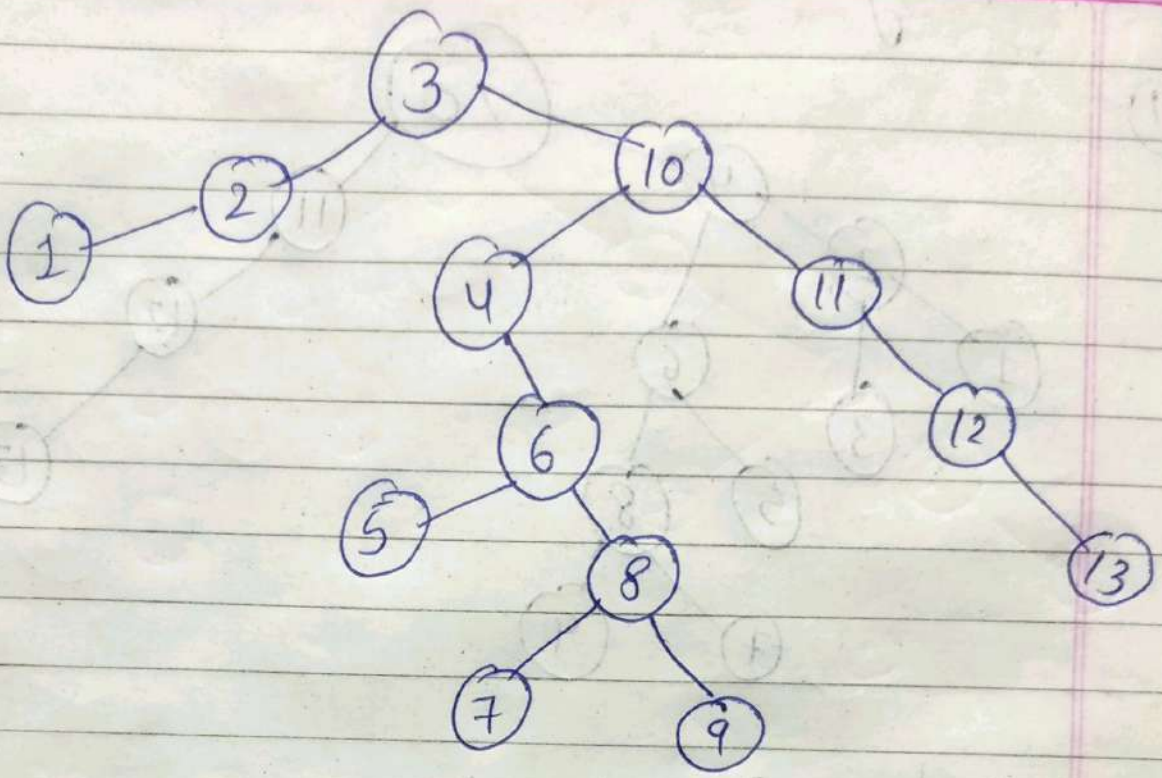

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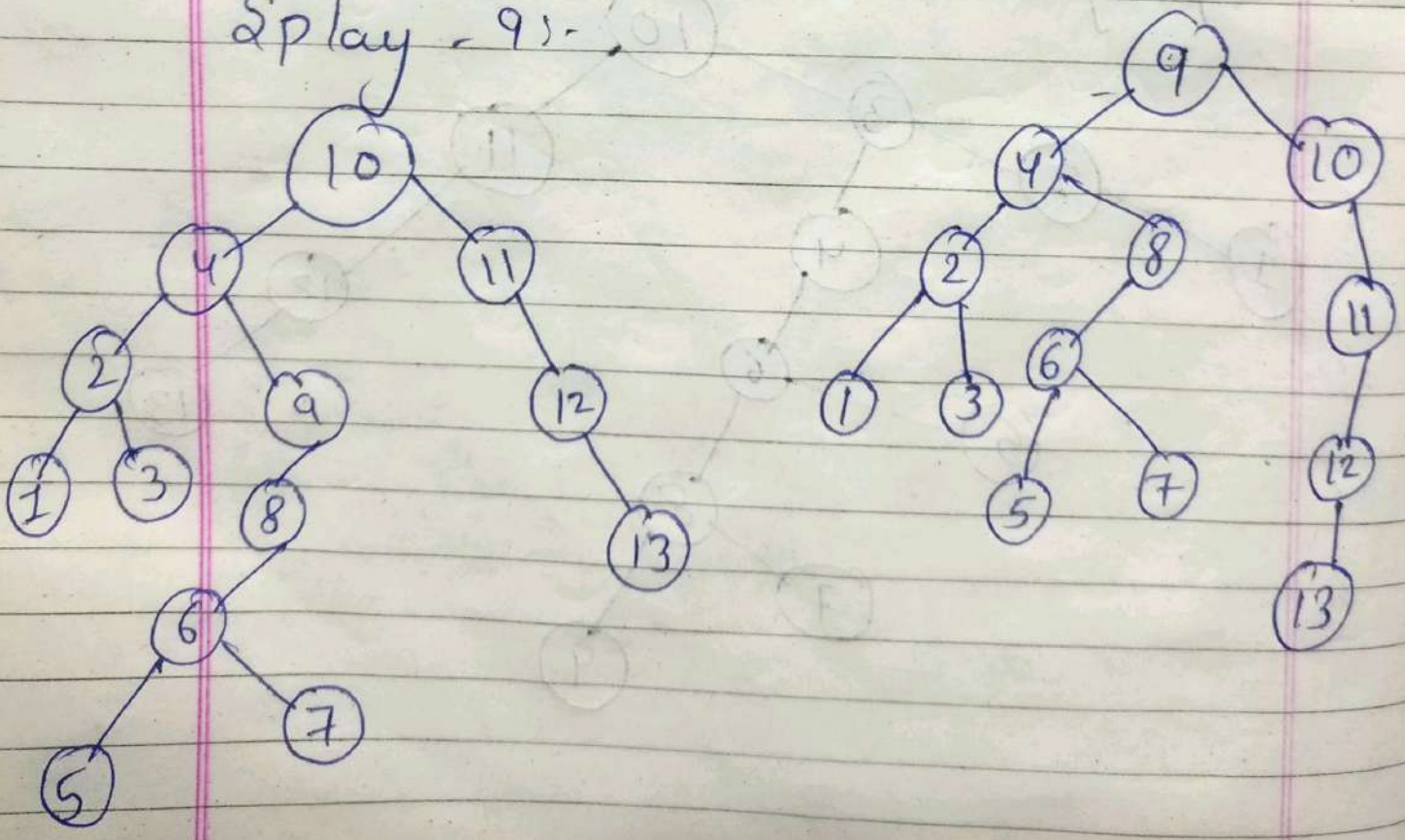

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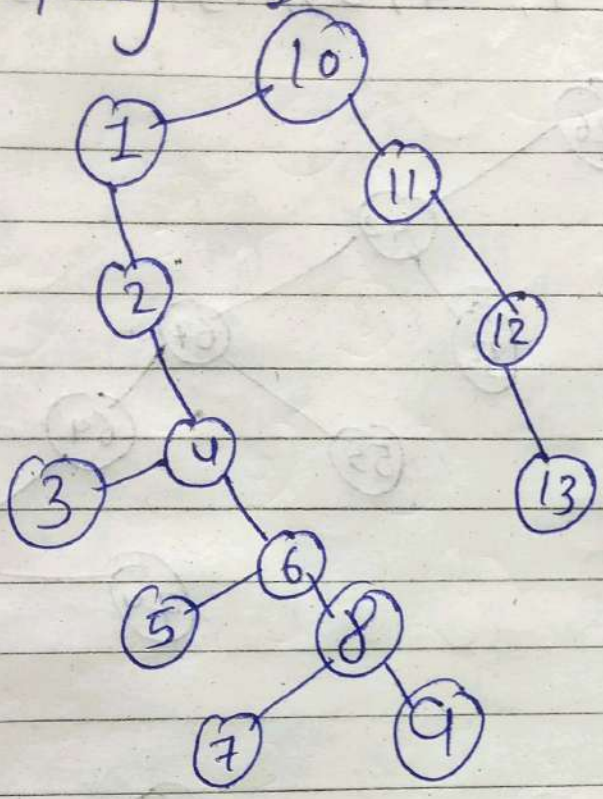

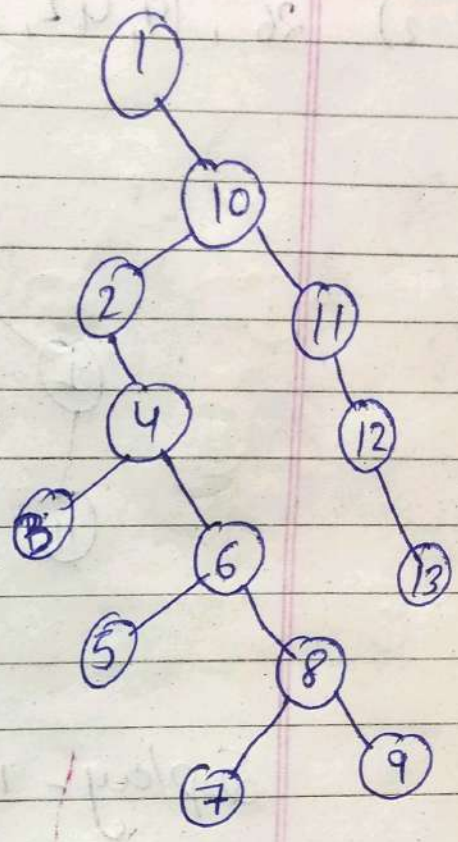

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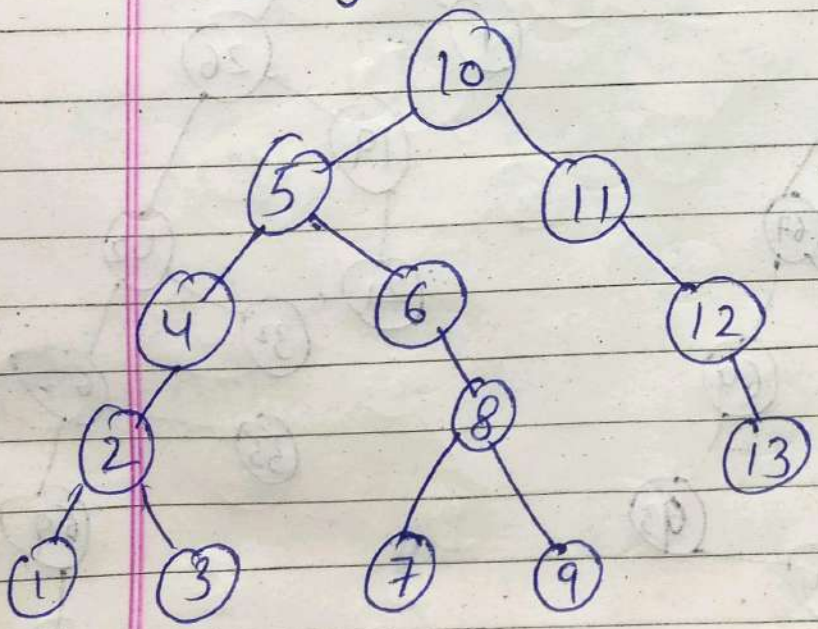

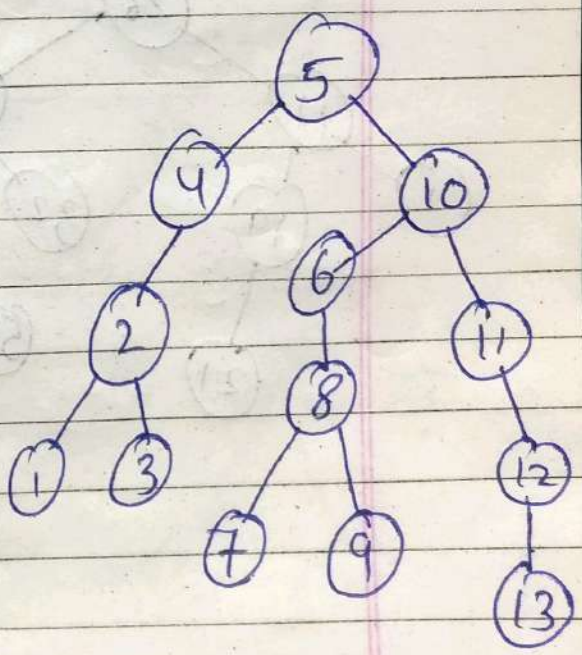

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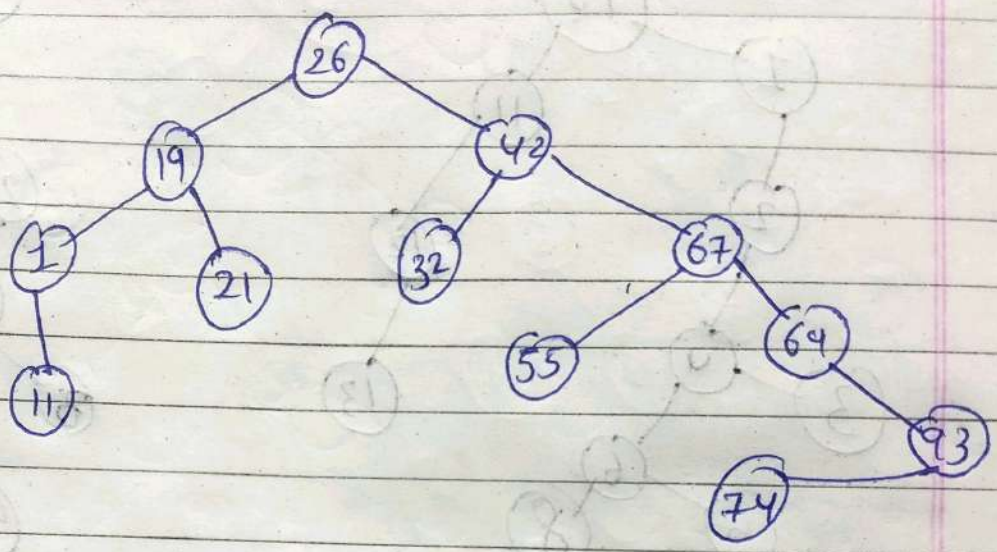
2) 26, 19, 42, 67, 21, 1, 69, 55, 93, 74, 32, 11.



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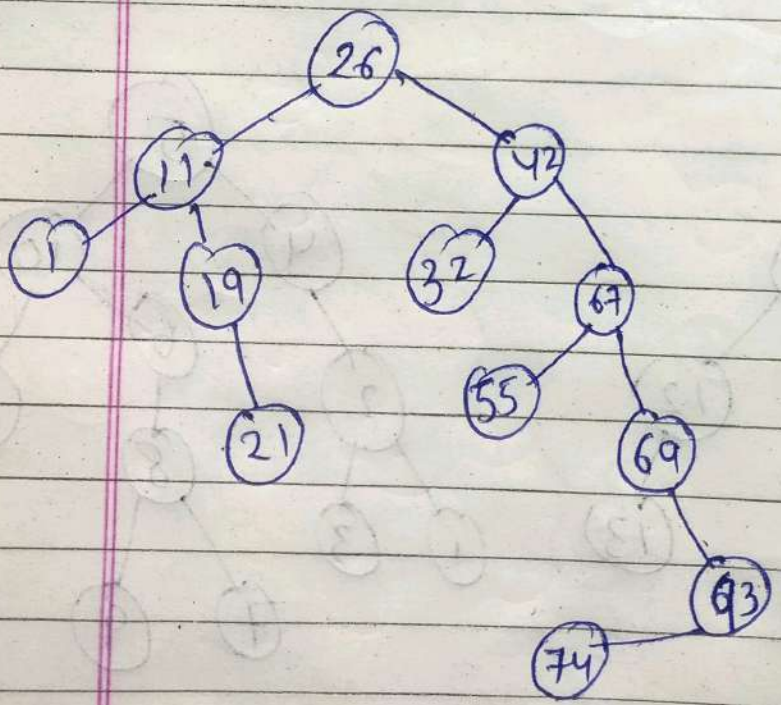

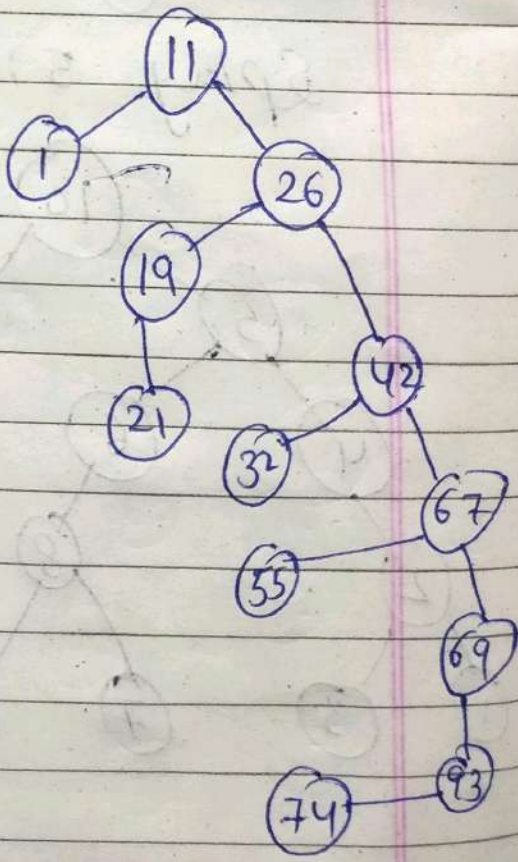

(3)

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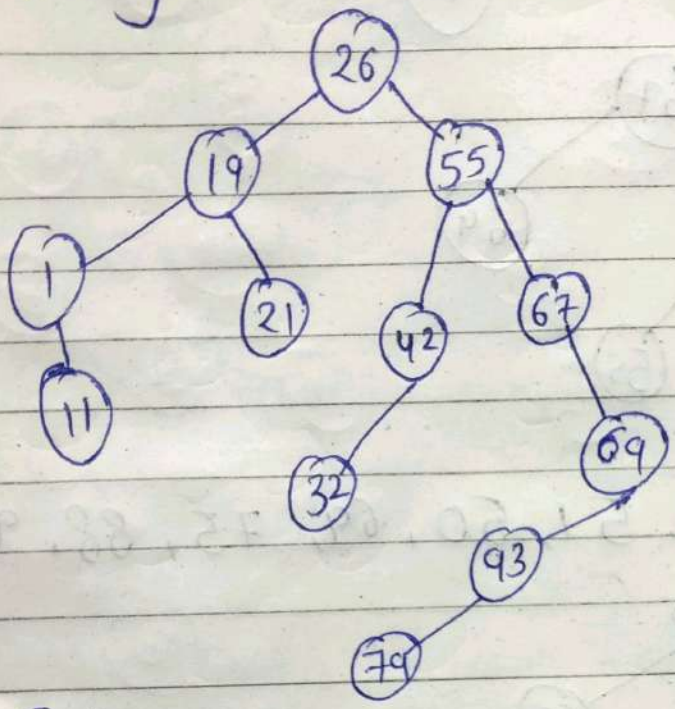
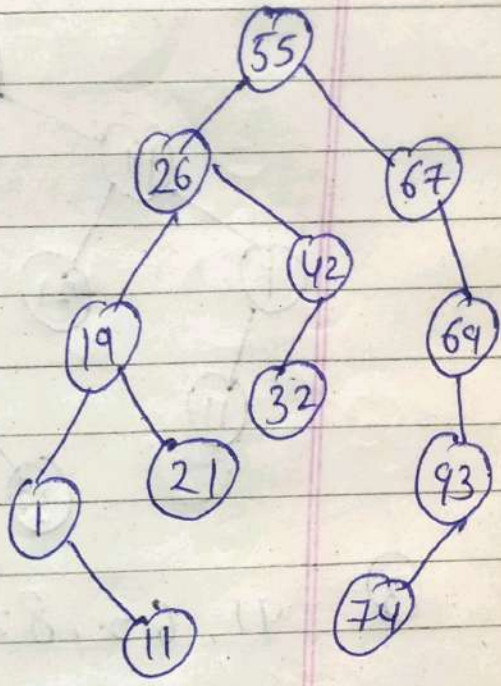
Splay - 55 :-





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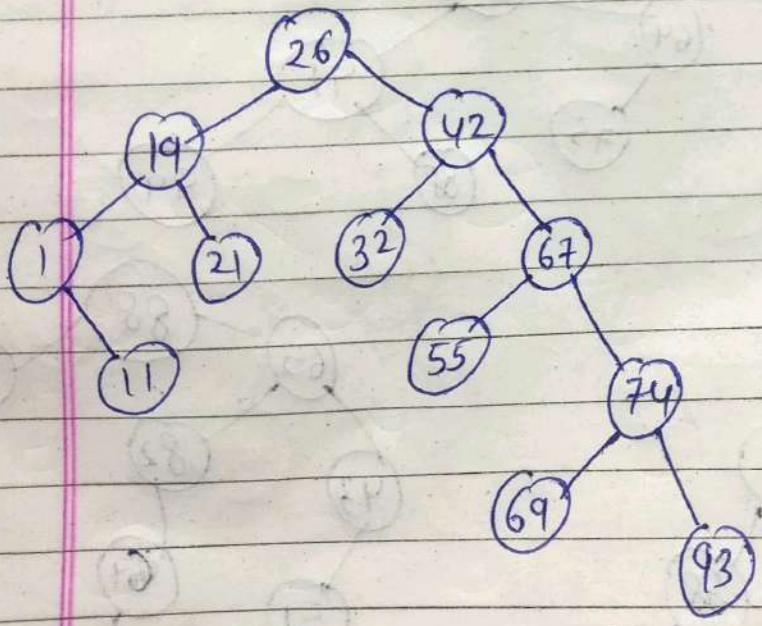

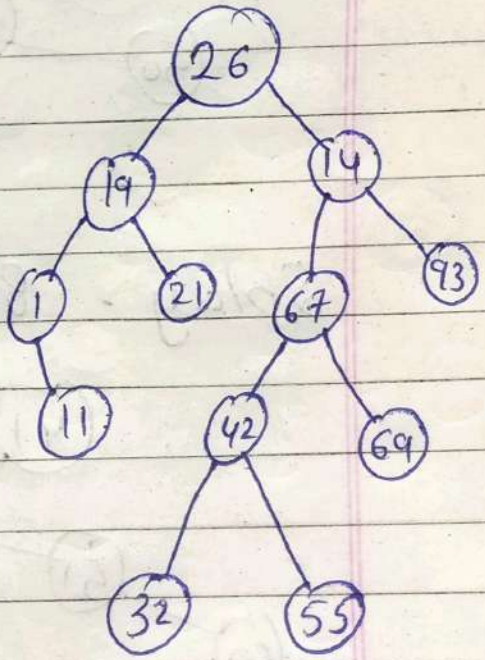

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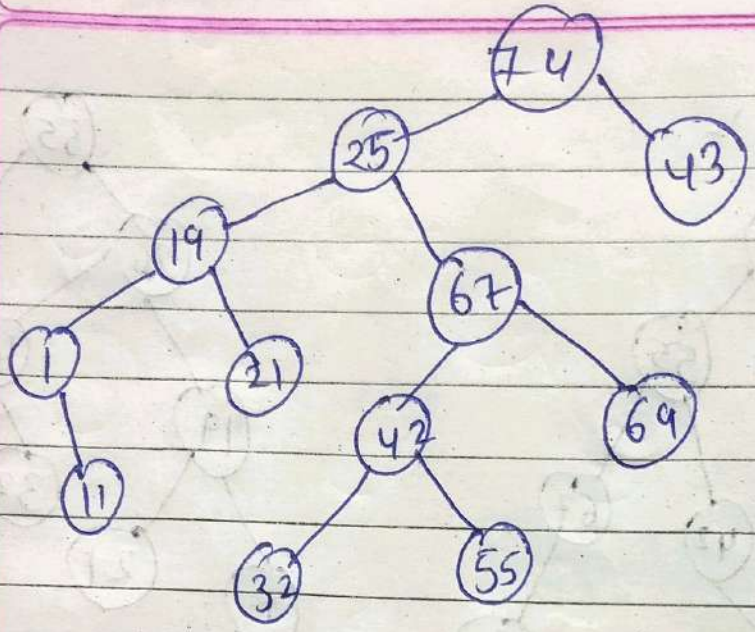
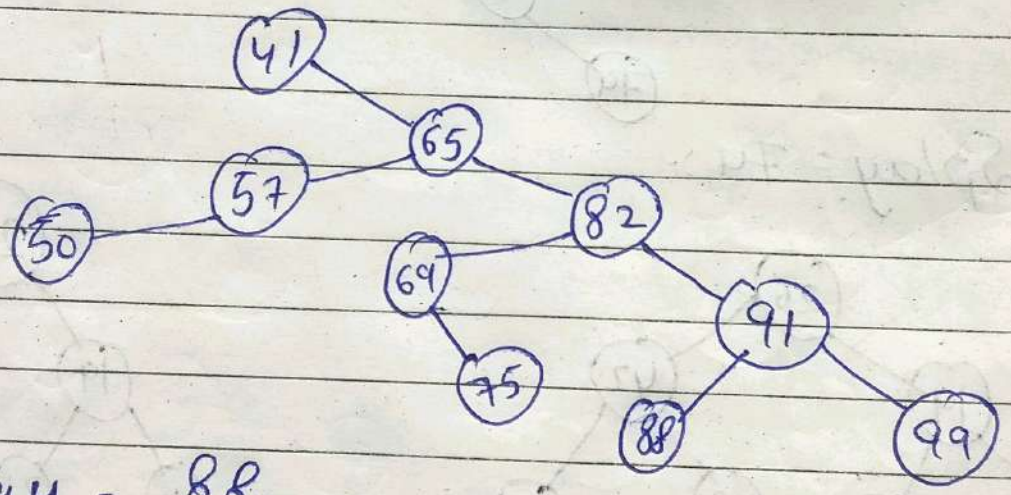


3 41, 65, 82, 91, 51, 50, 69, 75, 88, 99.



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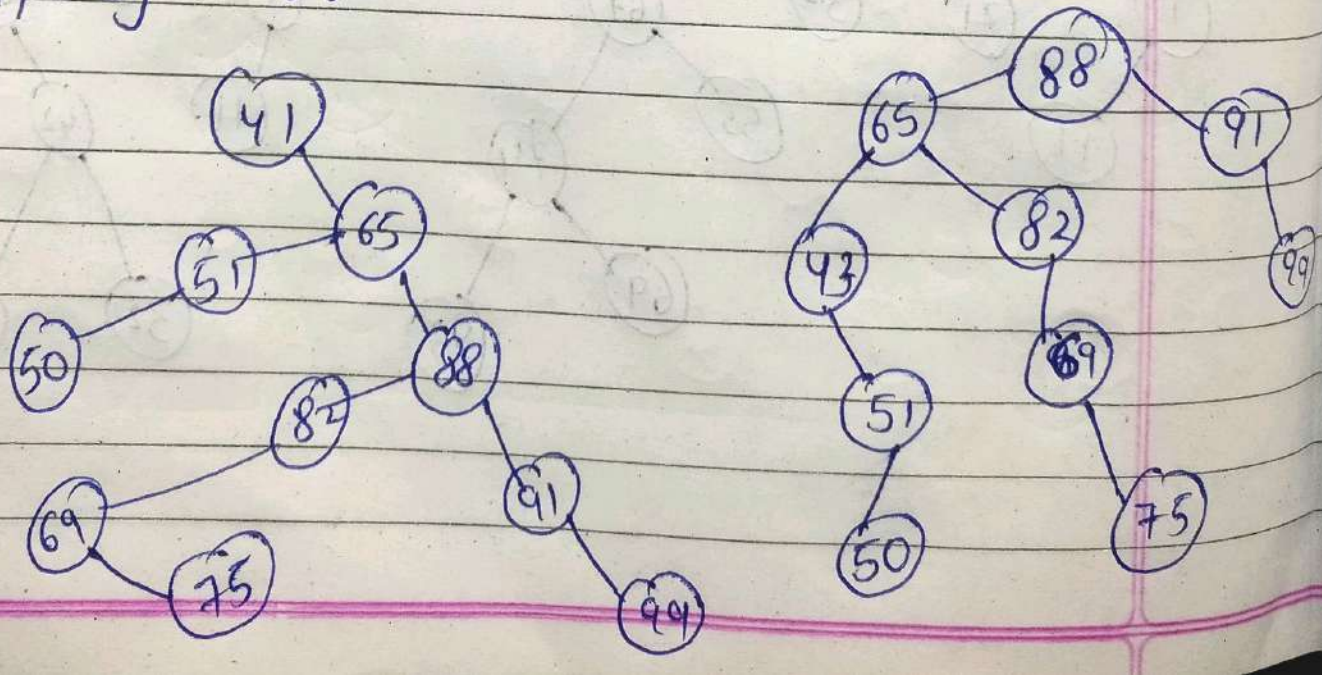
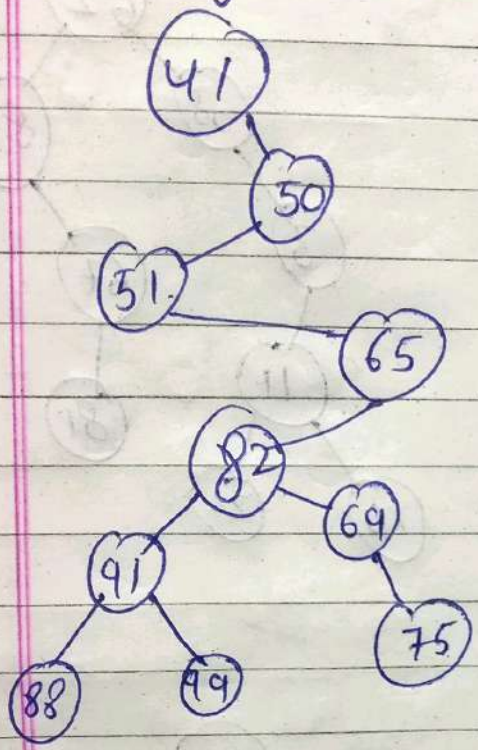
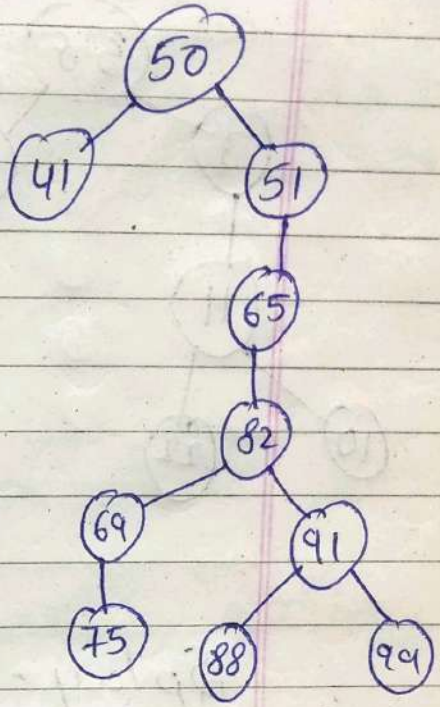
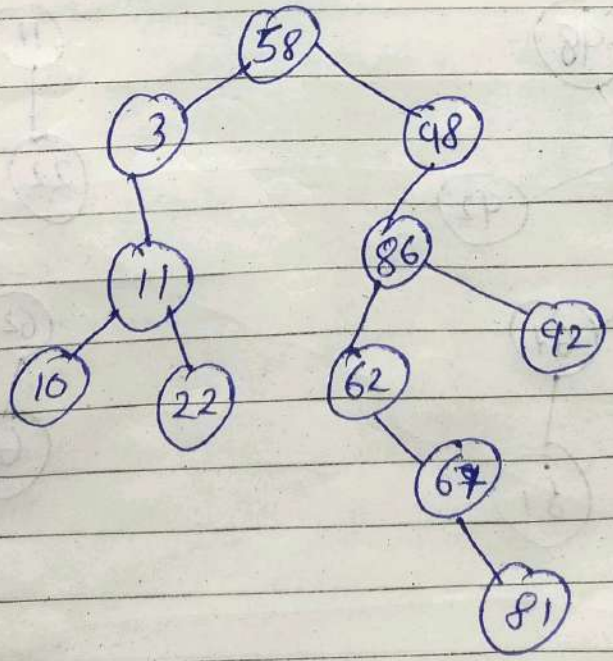


7) Splay - 50





8) 58, 3, 98, 11, 86, 22, 62, 67, 81, 92, 10.



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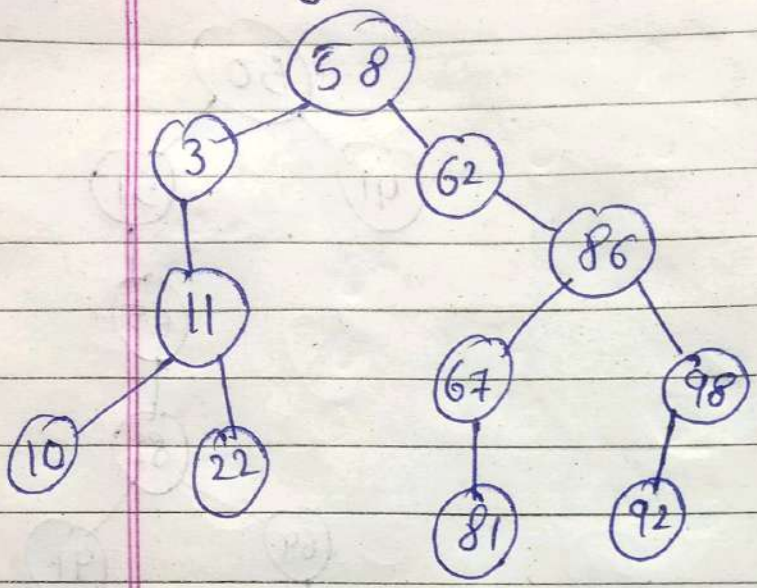
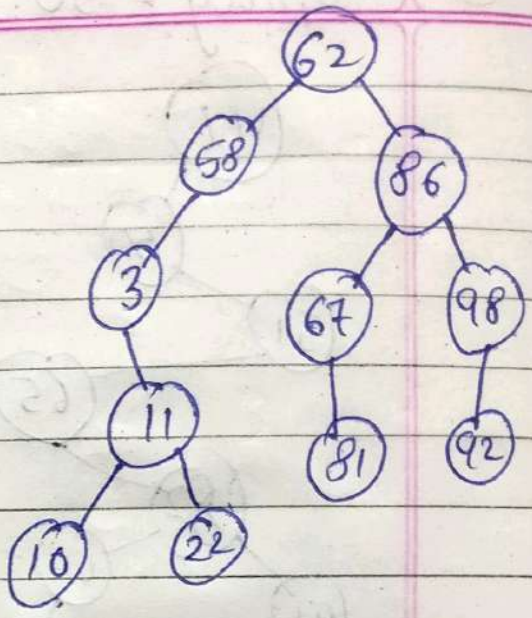
(8) Splay - 62 :-





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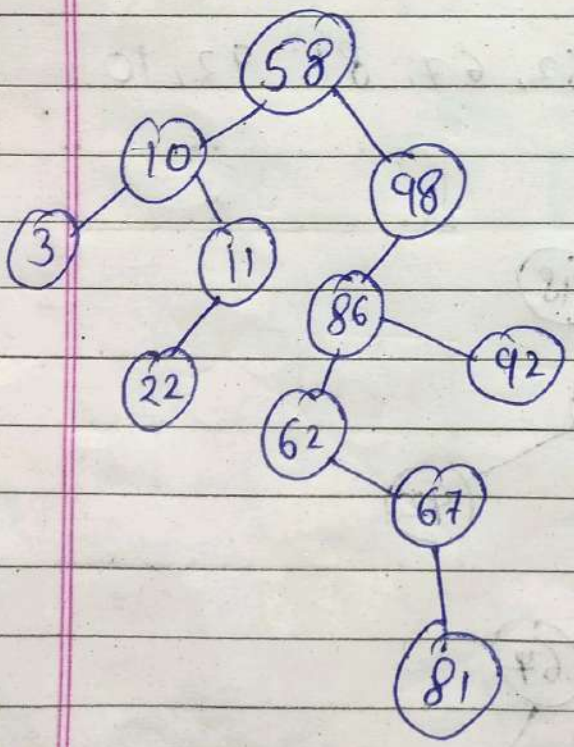

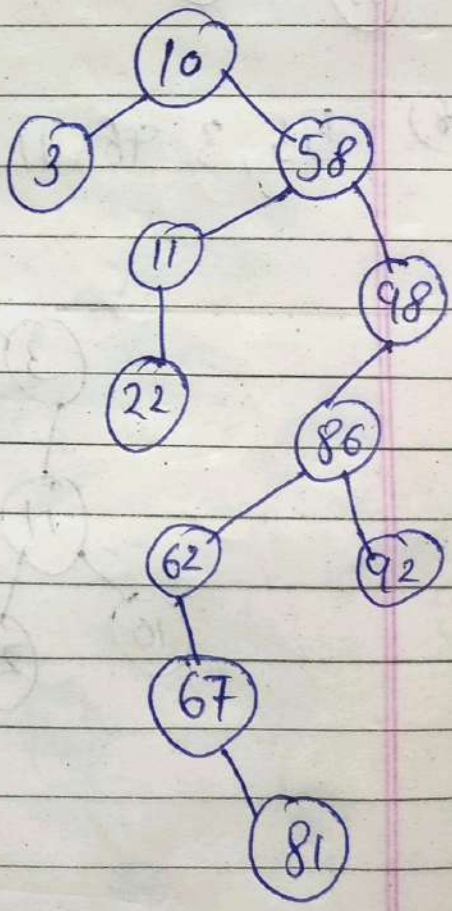

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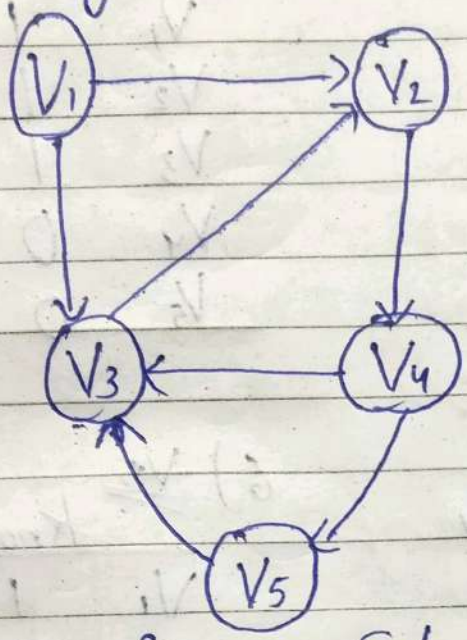
Assignment - 2

Q.1. Unweighted Shortest Path.

1)



V_1 is Starting Node.

1) Initial State

	Known	dv	Pv
V_1	0	∞	0
V_2	0	∞	0
V_3	0	∞	0
V_4	0	∞	0
V_5	0	∞	0

2) V_1

	Know	dv	Pv
V_1	1	0	0
V_2	0	1	V_1
V_3	0	1	V_1
V_4	0	∞	0
V_5	0	∞	0

3) V_2

	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	0	1	V_1
V_4	0	2	V_2
V_5	0	∞	0

4) V_3

	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	1	1	V_1
V_4	0	2	V_2
V_5	0	∞	0

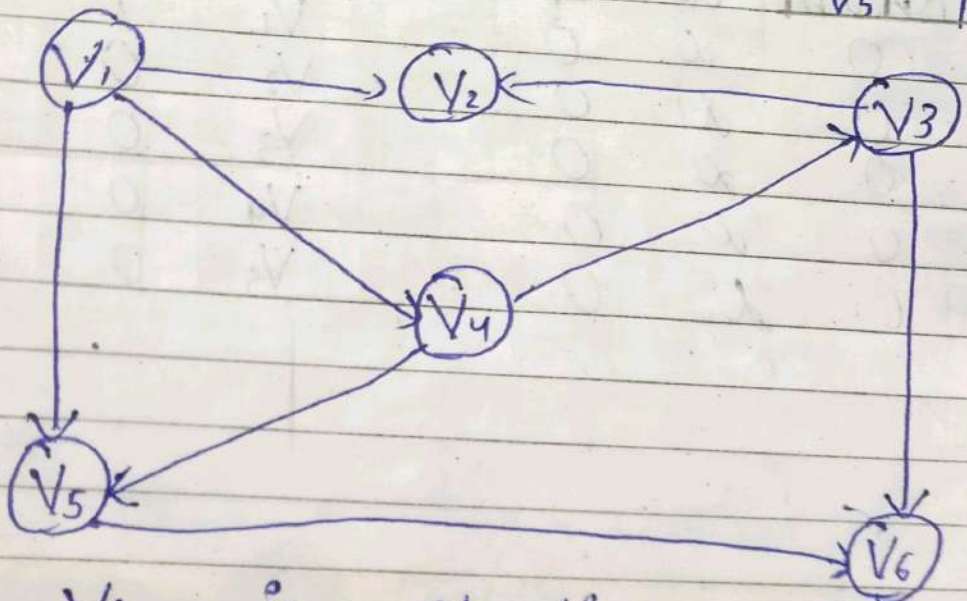
5) V_4

	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	1	1	V_1
V_4	1	2	V_2
V_5	0	3	V_4

6) V_5

	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	1	1	V_1
V_4	1	2	V_2
V_5	1	3	V_4

(2)



V_1 is Starting note:-

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1) Initial State

	Known	dv	Pv
V_1	0	∞	0
V_2	0	∞	0
V_3	0	∞	0
V_4	0	∞	0
V_5	0	∞	0
V_6	0	∞	0

2) V_1

	Known	dv	Pv
V_1	1	0	0
V_2	0	1	V_1
V_3	0	∞	0
V_4	0	1	V_1
V_5	0	1	V_1
V_6	0	∞	0

3) V_2

	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	0	∞	0
V_4	0	1	V_1
V_5	0	1	V_1
V_6	0	∞	0

4) V_4

	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	0	2	V_4
V_4	1	1	V_1
V_5	0	1	V_1
V_6	0	∞	0

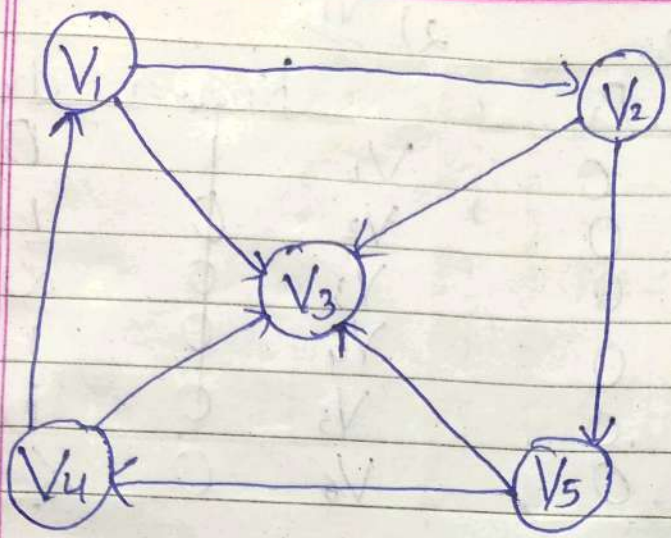
5) V_5

	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	0	2	V_4
V_4	1	1	V_1
V_5	1	1	V_1
V_6	0	2	V_5

6) V_3

	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	1	2	V_4
V_4	1	1	V_1
V_5	1	1	V_1
V_6	0	2	V_5

3)



V_1 is Starting Node.

(1) Initial state.

	Known	dv	Pv
V_1	0	∞	0
V_2	0	∞	0
V_3	0	∞	0
V_4	0	∞	0
V_5	0	∞	0

2) V_1

	Known	dv	Pv
V_1	1	0	0
V_2	0	1	V_1
V_3	0	1	V_1
V_4	0	1	V_1
V_5	0	∞	0

3) V_2

	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	0	1	V_1
V_4	0	1	V_1
V_5	0	2	V_2

4) V_3

	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	1	1	V_1
V_4	0	1	V_1
V_5	0	2	V_2

5) V_4

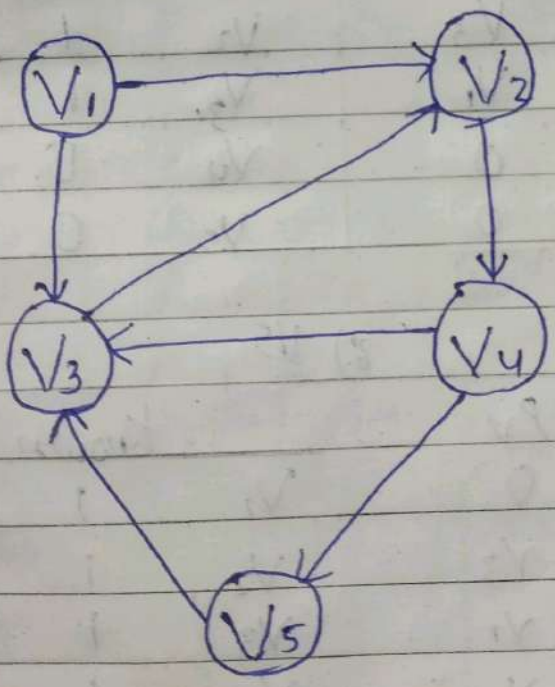
	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	1	1	V_2
V_4	1	1	V_1
V_5	0	2	V_2

6) V_5

	Known	dv	Pv
V_1	1	0	0
V_2	1	1	V_1
V_3	1	1	V_1
V_4	1	1	V_1
V_5	1	2	V_2

Q.2 weighted & shortest Path.

1)



V_1 is starting node.

1) Initial state

	Known	dv	P_V
V_1	0	0	0
V_2	0	∞	0
V_3	0	∞	0
V_4	0	∞	0
V_5	0	∞	0

2) V_1

	Known	dv	P_V
V_1	1	0	0
V_2	0	6	V_1
V_3	0	1	V_1
V_4	0	∞	0
V_5	0	∞	0

3) V_3

	Known	dv	P_V
V_1	1	0	0
V_2	0	3	V_3
V_3	1	1	V_1
V_4	0	∞	0
V_5	0	∞	0

4) V_2

	Known	dv	P_V
V_1	1	0	0
V_2	1	3	V_3
V_3	1	1	V_1
V_4	0	5	V_2
V_5	0	∞	0

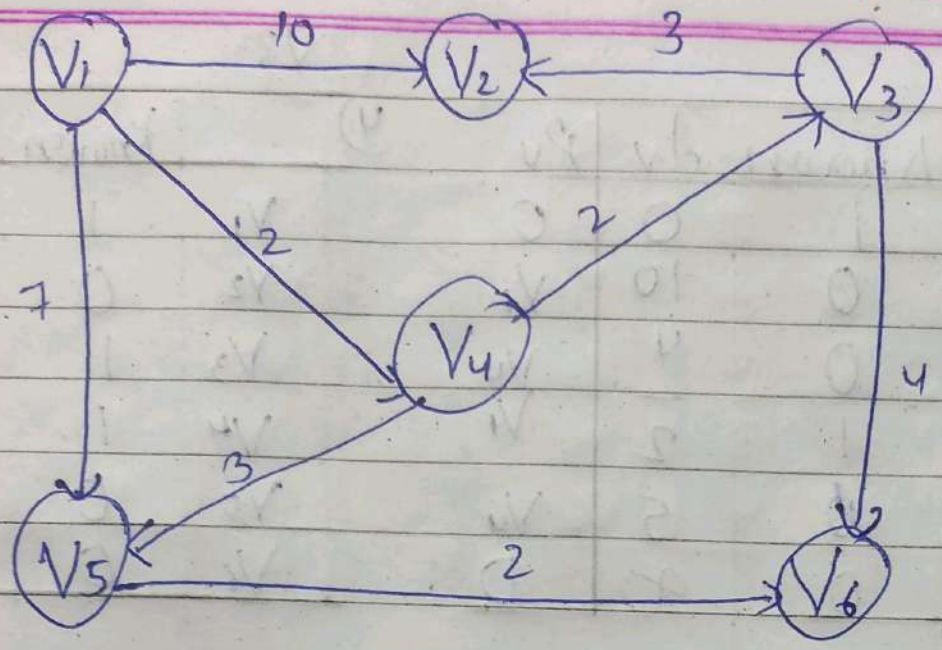
5) V_4

	Known	dv	P_V
V_1	1	0	0
V_2	1	3	V_3
V_3	1	1	V_1
V_4	1	5	V_2
V_5	0	7	V_4

6) V_5

	Known	dv	P_V
V_1	1	0	0
V_2	1	3	V_3
V_3	1	1	V_1
V_4	1	5	V_2
V_5	1	7	V_4

(2)



→ V_1 is Starting Node.

1) Initial State

	known	dv	Pv
V_1	0	0	0
V_2	0	∞	0
V_3	0	∞	0
V_4	0	∞	0
V_5	0	∞	0
V_6	0	∞	0

2) V_1

	known	dv	Pv
V_1	1	0	0
V_2	0	10	V_1
V_3	0	∞	0
V_4	0	2	V_1
V_5	0	7	V_1
V_6	0	∞	0

③. V_4

	Known	dv	Pv
V_1	1	0	0
V_2	0	10	V_1
V_3	0	4	V_4
V_4	1	2	V_1
V_5	0	5	V_4
V_6	0	9	0

④ V_3

	Known	dv	Pv
V_1	1	0	0
V_2	0	7	V_3
V_3	1	4	V_4
V_4	1	2	V_1
V_5	0	5	V_4
V_6	0	8	V_3

⑤ V_5

	Known	dv	Pv
V_1	1	0	0
V_2	0	7	V_3
V_3	1	4	V_4
V_4	1	2	V_1
V_5	1	5	V_4
V_6	0	7	V_5

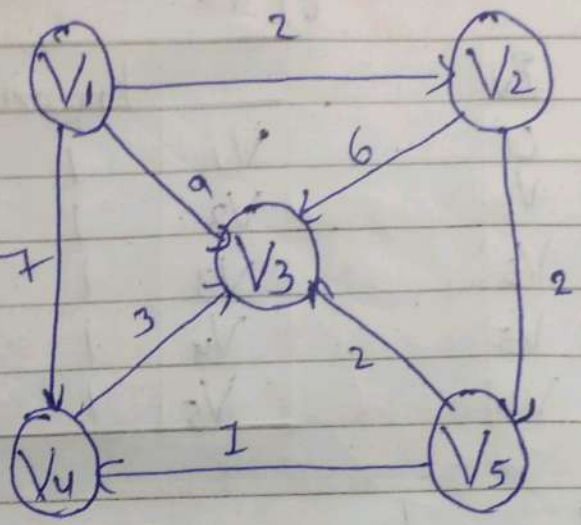
⑥ V_2

	Known	dv	Pv
V_1	1	0	0
V_2	1	7	V_3
V_3	1	4	V_4
V_4	1	2	V_1
V_5	1	5	V_4
V_6	0	7	V_5

⑦ V_6

	Known	dv	Pv
V_1	1	0	0
V_2	1	7	V_3
V_3	1	4	V_4
V_4	1	2	V_1
V_5	1	5	V_4
V_6	1	7	V_5

③



→ V_1 is starting Node

1) Initial state

	known	dv	Pv
V_1	0	0	0
V_2	0	∞	0
V_3	0	∞	0
V_4	0	∞	0
V_5	0	∞	0

2) V_1

	known	dv	Pv
V_1	1	0	0
V_2	0	2	V_1
V_3	0	9	V_1
V_4	0	7	V_1
V_5	0	∞	0

3) V_2

	known	dv	Pv
V_1	1	0	0
V_2	1	2	V_1
V_3	0	8	V_2
V_4	0	7	V_1
V_5	0	4	V_2

4) V_5

	known	dv	Pv
V_1	1	0	0
V_2	1	2	V_1
V_3	0	6	V_5
V_4	0	5	V_5
V_5	1	4	V_2

5) V_4

	Known	dv	Pv
V_1	1	0	0
V_2	1	2	V_1
V_3	0	6 / 5	V_5
V_4	1	5	V_5
V_5	1	4	V_2

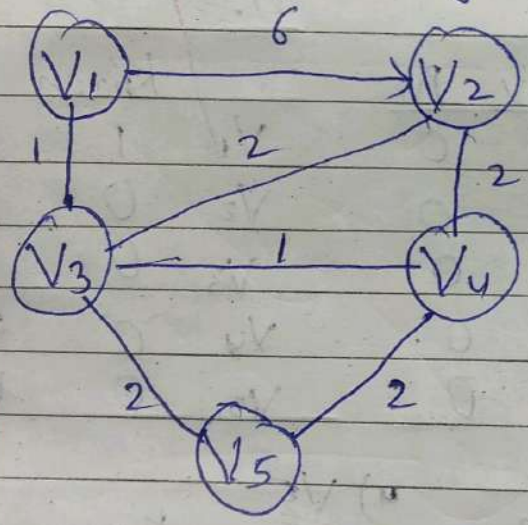
6) V_3

	Known	dv	Pv
V_1	1	0	0
V_2	1	2	V_1
V_3	1	6	V_5
V_4	1	5	V_5
V_5	1	4	V_2

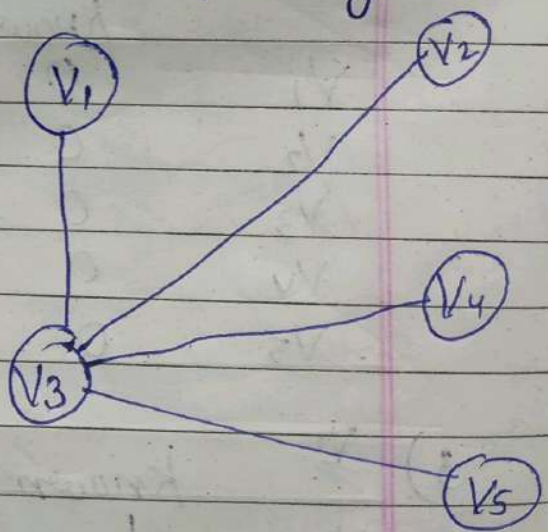
Q3 minimum Spanning Tree :-

* Kruskal's Algorithm :-

(i)

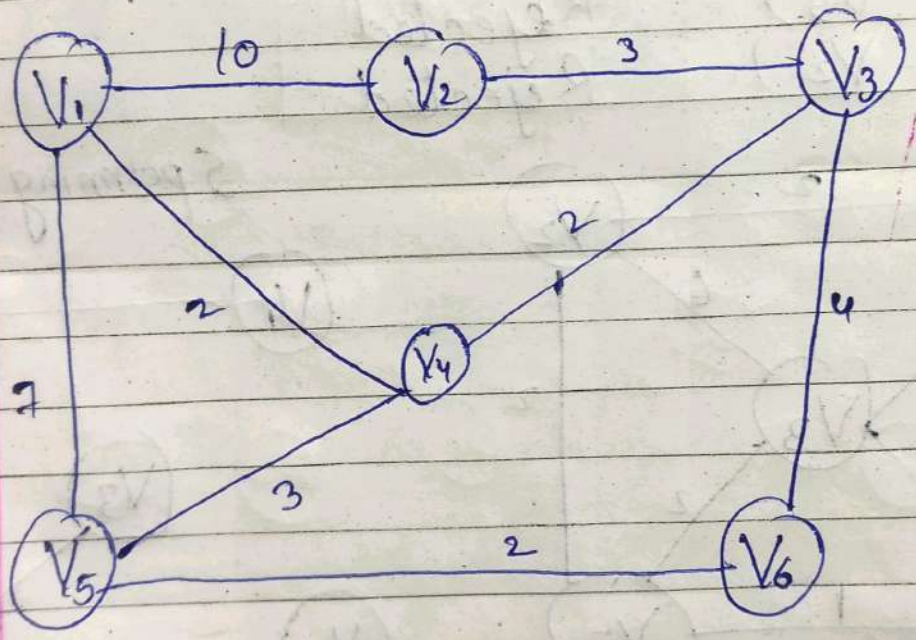


Spanning Tree

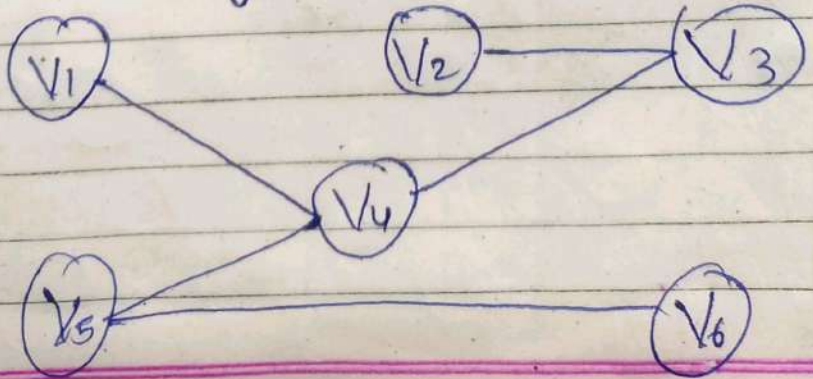


Weight		
1	(V_1, V_3)	Accepted
1	(V_3, V_4)	Accepted
2	(V_2, V_3)	Accepted
2	(V_2, V_4)	Rejected
2	(V_3, V_5)	Accepted
2	(V_4, V_5)	Rejected
6	(V_1, V_2)	Rejected.

2)



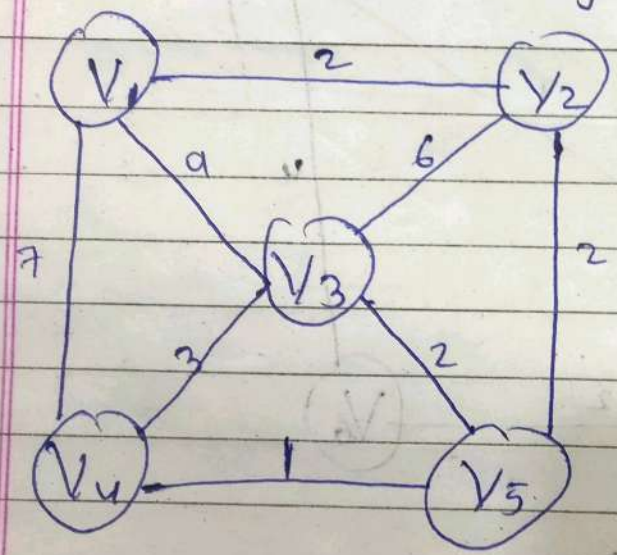
Spanning tree



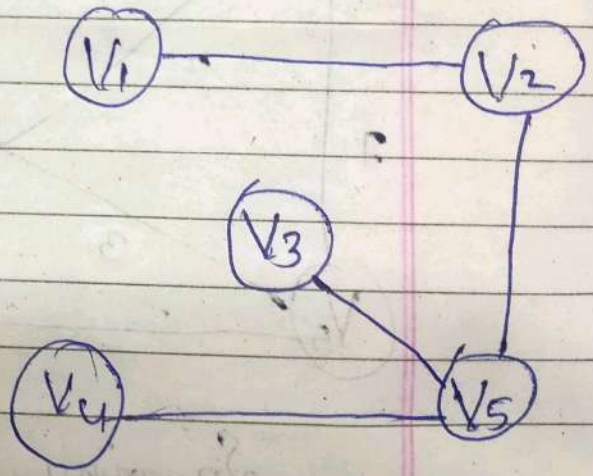
* Kruskal's

2	(V_1, V_4)	Accepted
2	(V_5, V_8)	Accepted
2	(V_3, V_4)	Accepted
3	(V_2, V_3)	Accepted
3	(V_4, V_5)	Accepted
4	(V_3, V_6)	Rejected
7	(V_1, V_5)	Rejected
10	(V_1, V_2)	Rejected

3)



Spanning tree

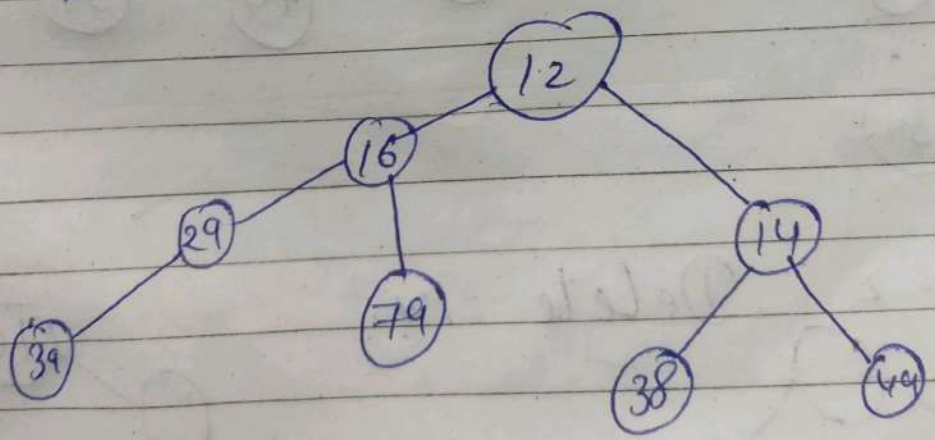


* Kruskals

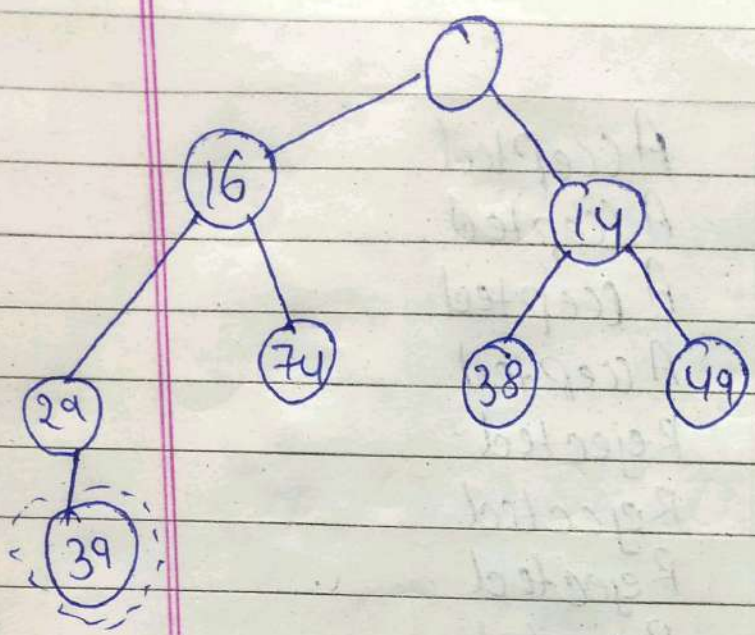
1	(V_4, V_5)	Accepted
2	(V_1, V_2)	Accepted
2	(V_2, V_5)	Accepted
2	(V_3, V_5)	Accepted
3	(V_3, V_4)	Rejected
6	(V_2, V_3)	Rejected
7	(V_1, V_4)	Rejected
9	(V_1, V_3)	Rejected.

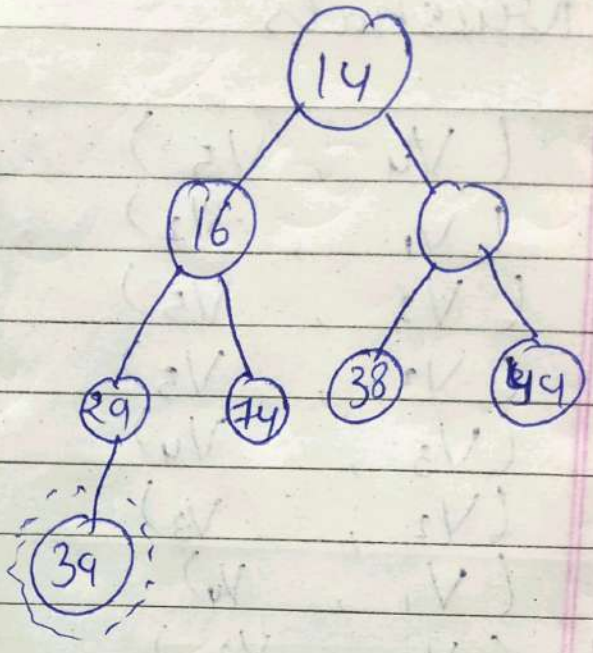
① Heap Sort.

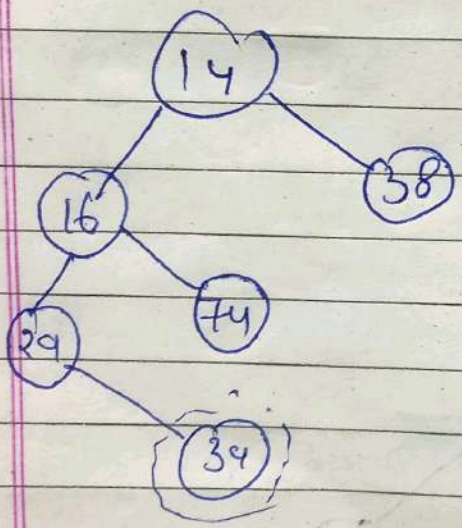
Delete min.

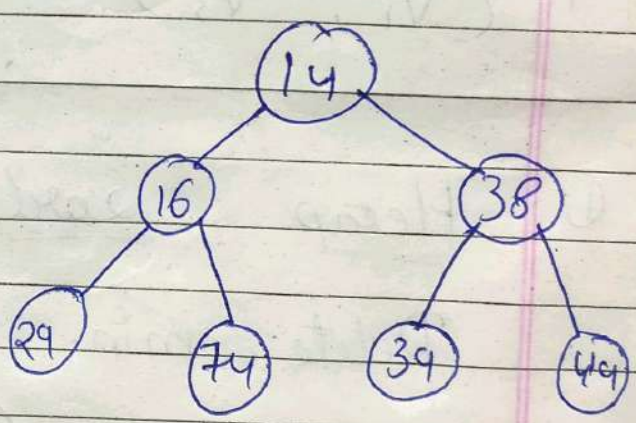


Step - 1 - Delete - 12.

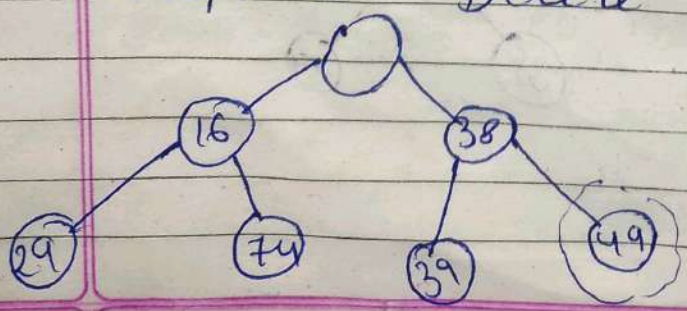


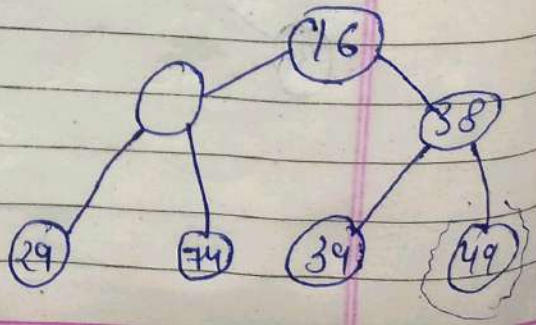


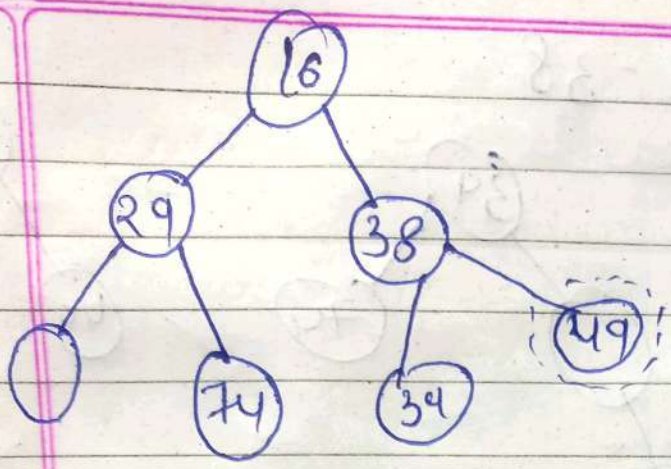


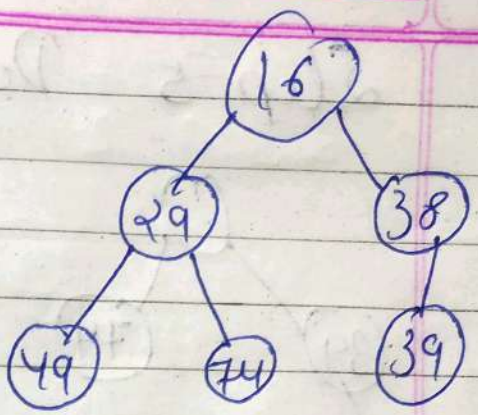


Step - 2 Delete - 14.

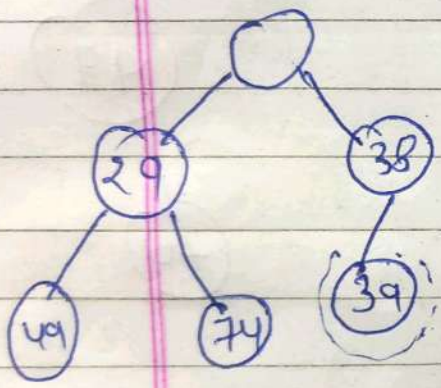


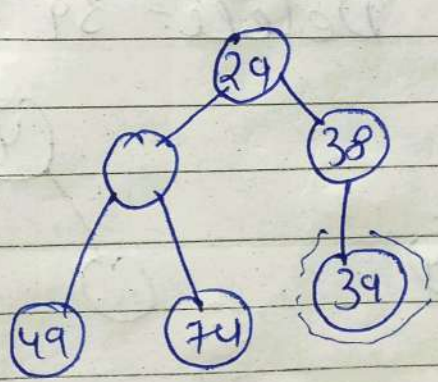


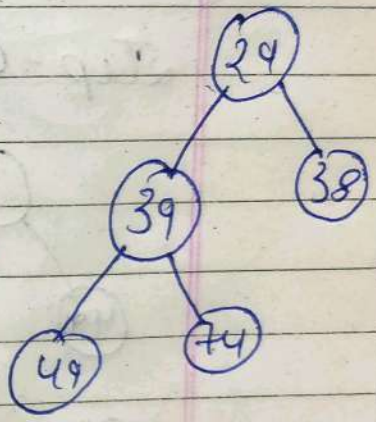




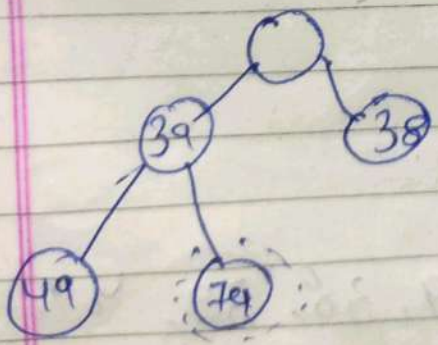
Step - 3 - Delete -16.

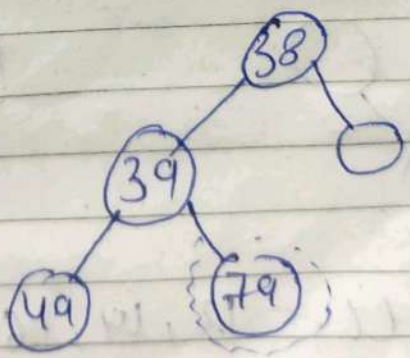


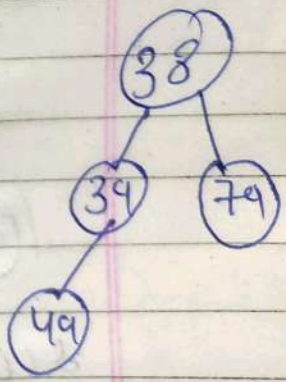




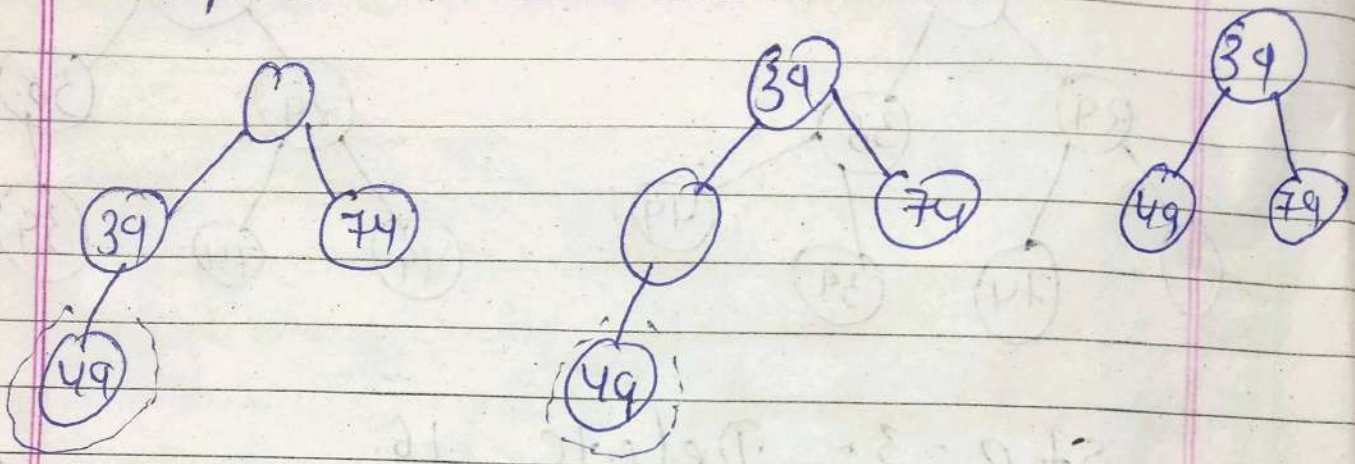
Step - 4 - Delete -29.



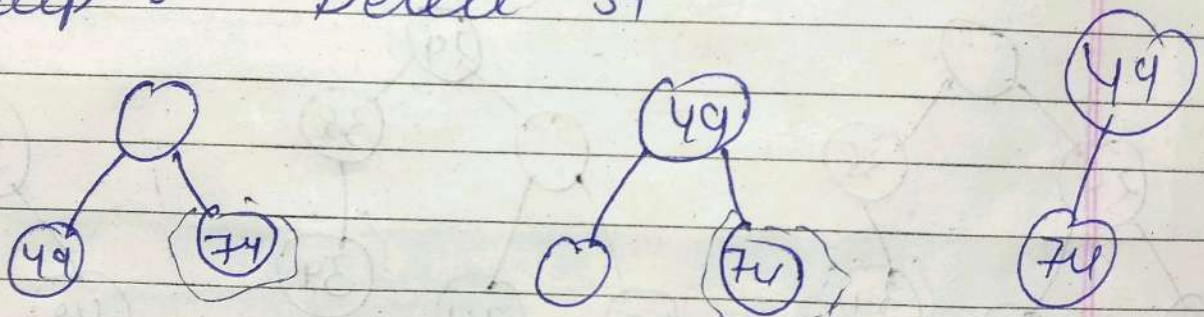




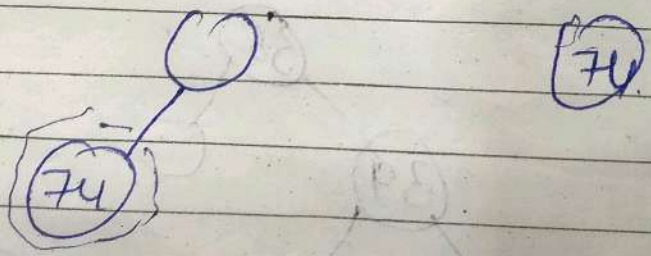
Step-5 - Delete - 38



Step-6 - Delete - 39

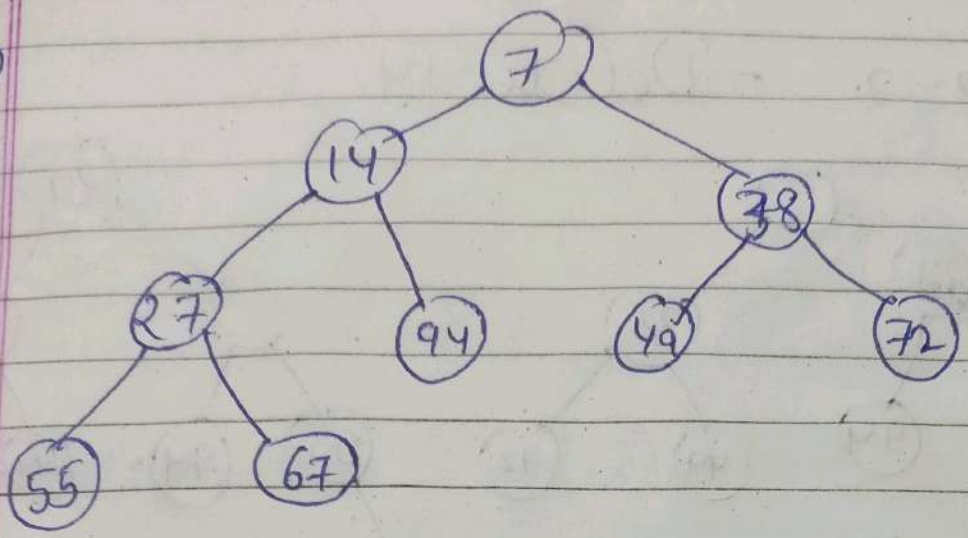


Step-7 - Delete - 49.

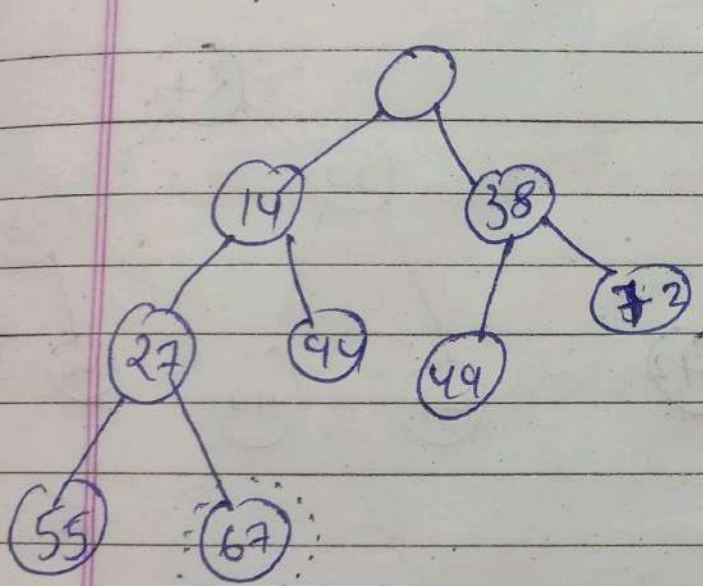


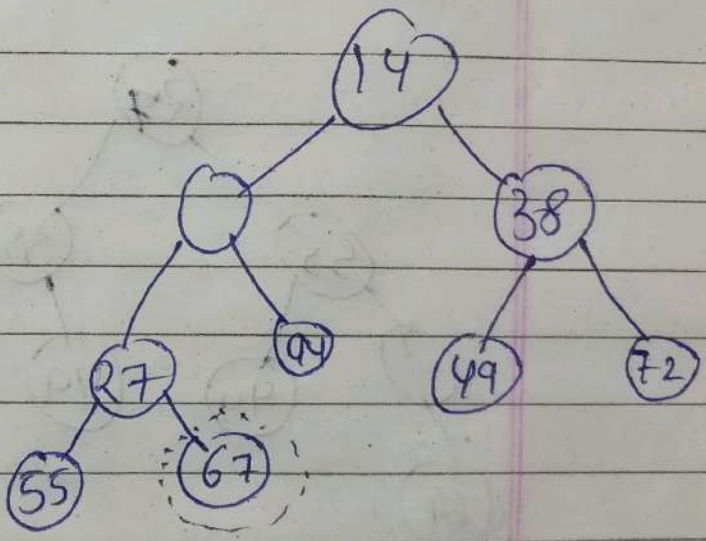
Result = 12, 14, 16, 29, 38, 39, 49, 74.

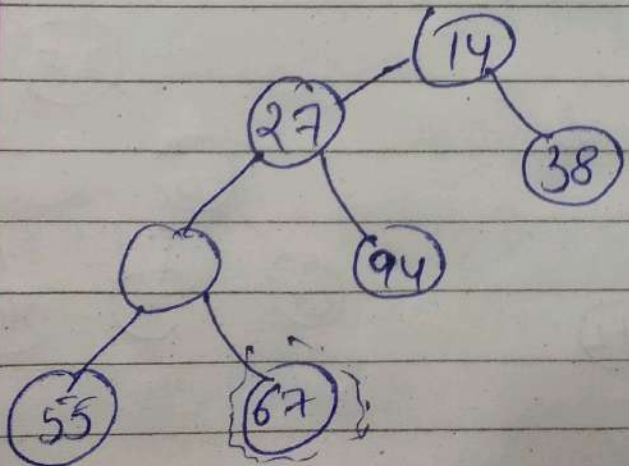
(2)

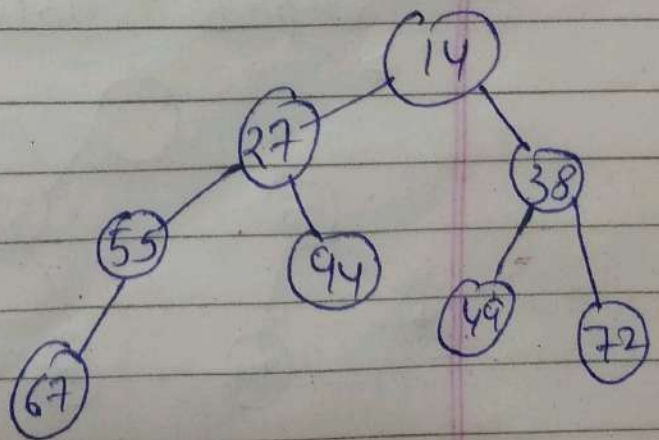


Step - 1 - Delete 7

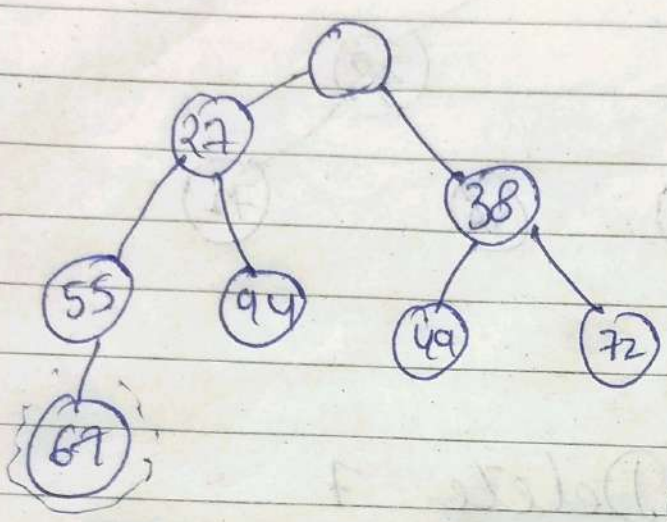


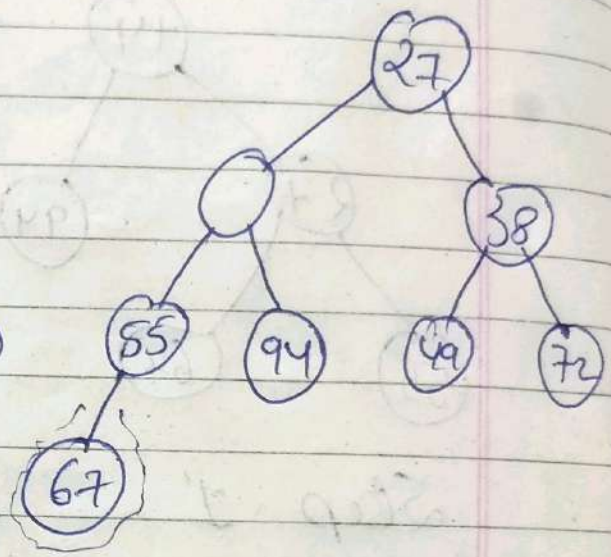


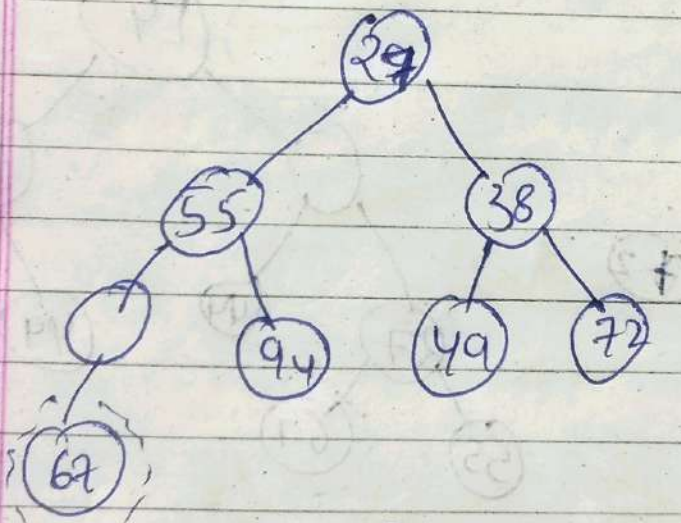


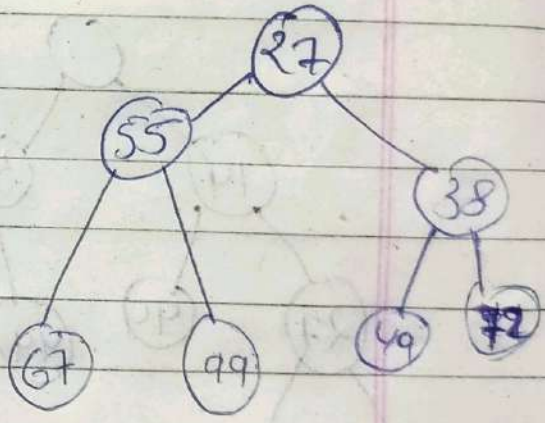


Step-2 - Delete-14.

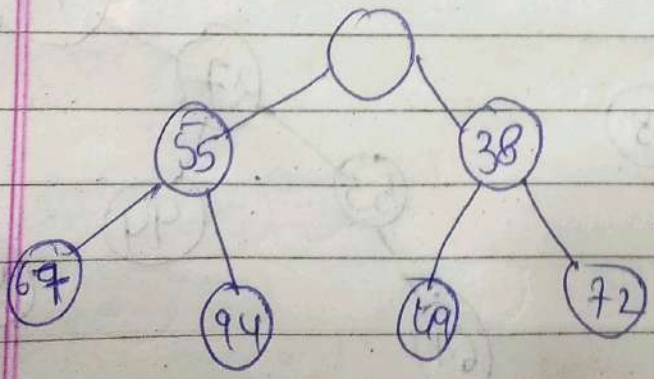


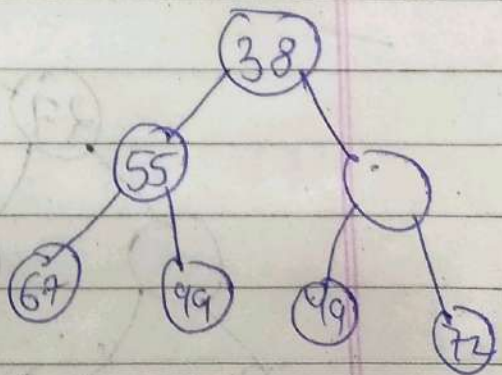


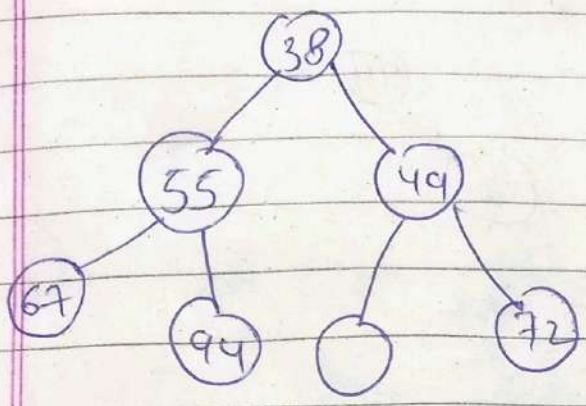


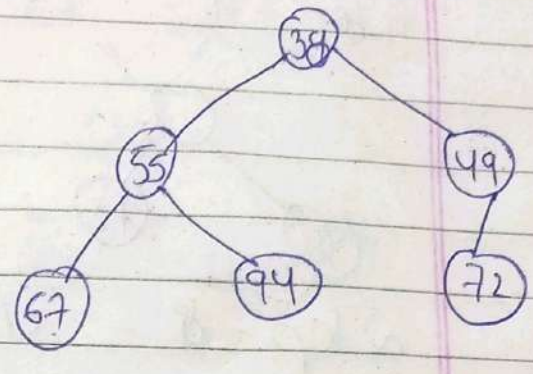


Step-3. Delete-27

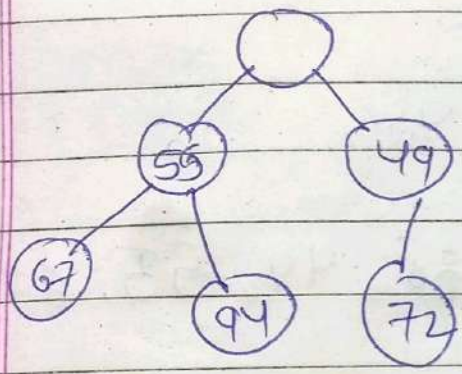


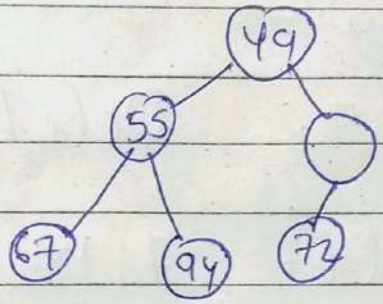


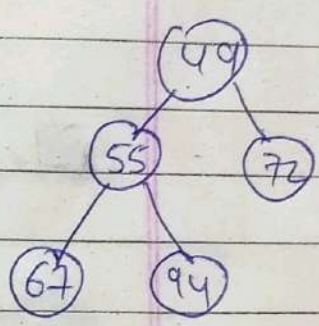




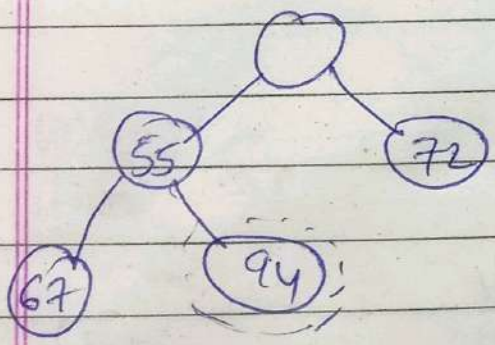
Step - 4 - Delete - 38

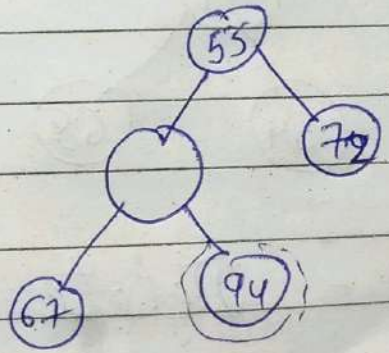


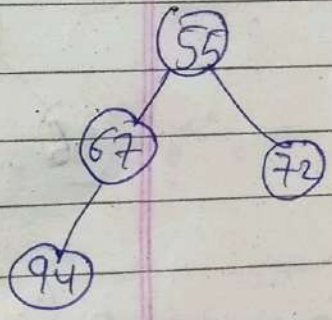




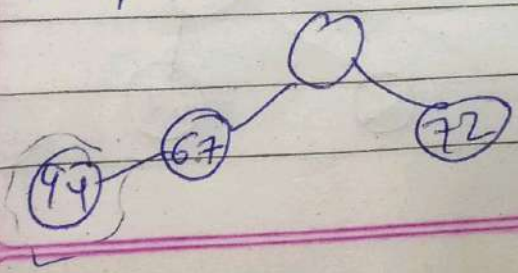
Step - 5 - Delete 49

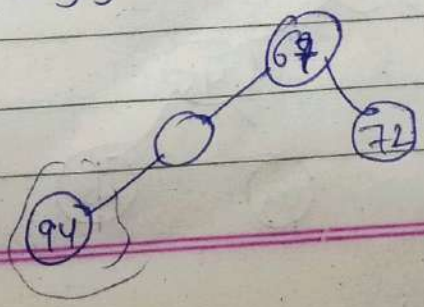


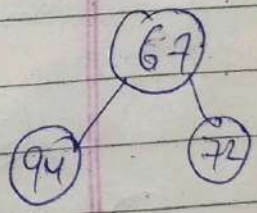




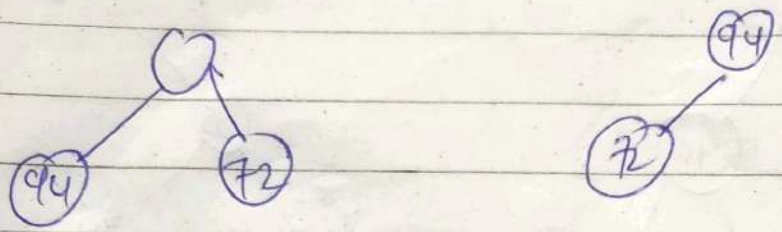
Step - 6 - Delete - 55







Step - 7 - Delete - 67

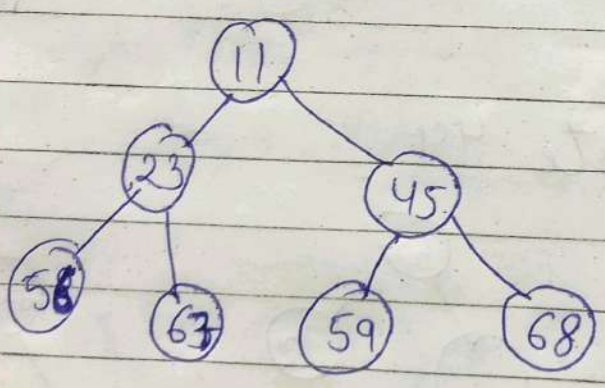


Step - 8 - delete - 72

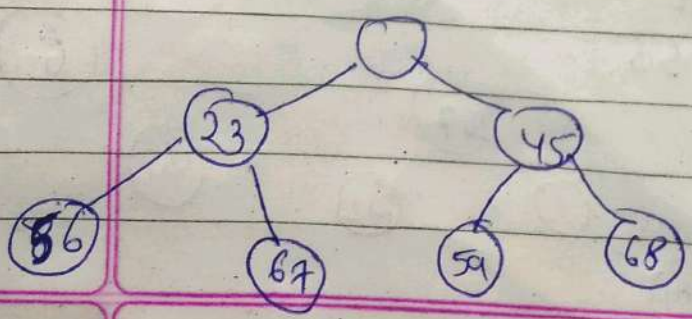
Step - 9. Delete - 94.

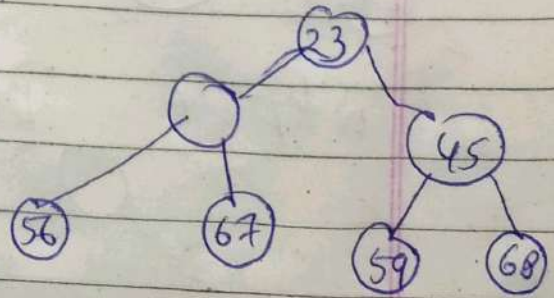
result = 7, 14, 21, 38, 49, 55, 67, 72, 94

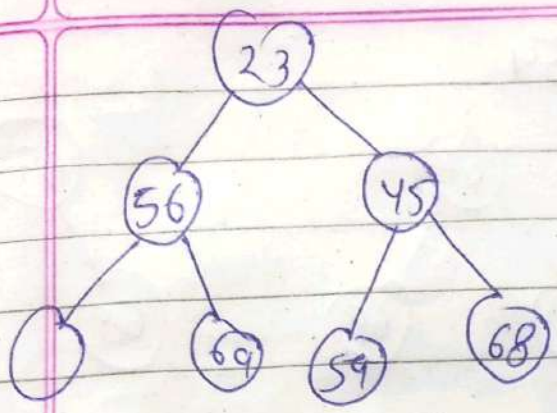
(3)

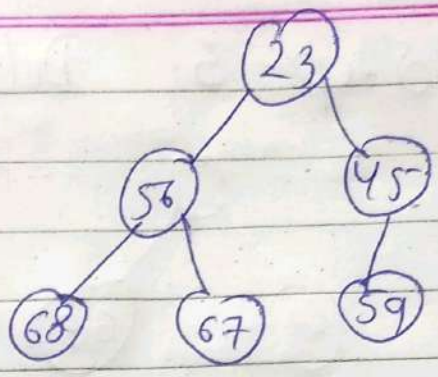


Step - 1 - Delete - 11.

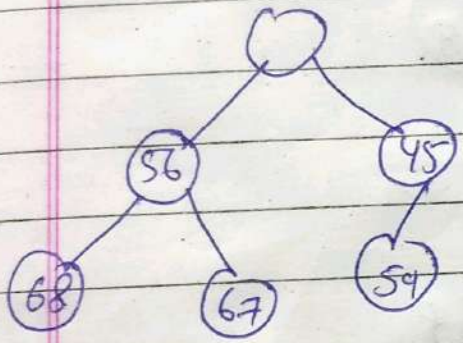


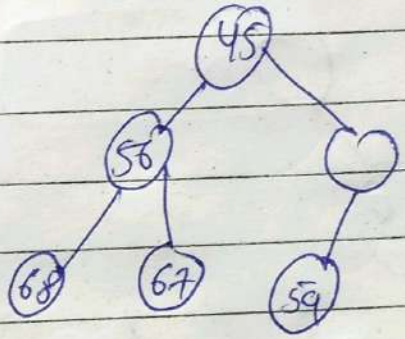


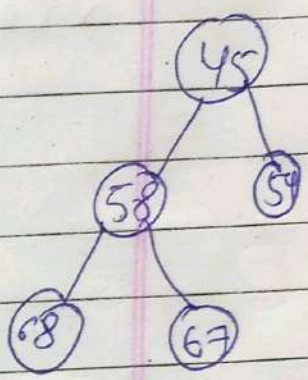




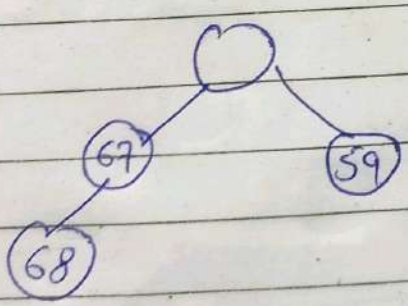
Step - 2 - Delete - 23.

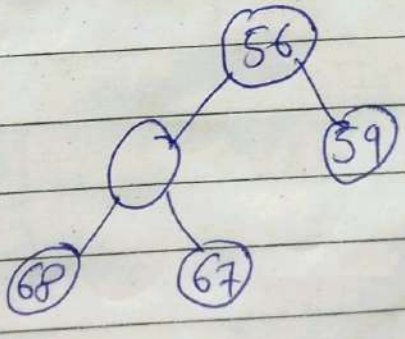


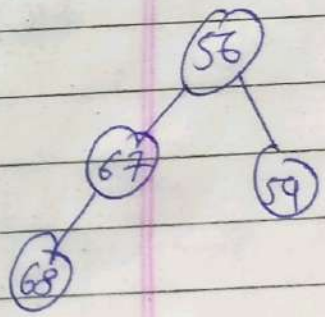




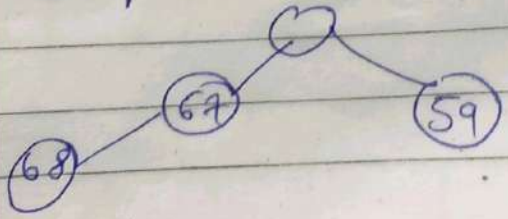
Step - 3 - Delete - 45

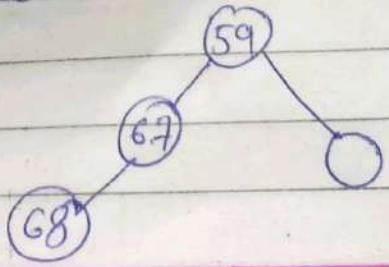


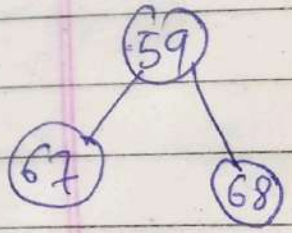




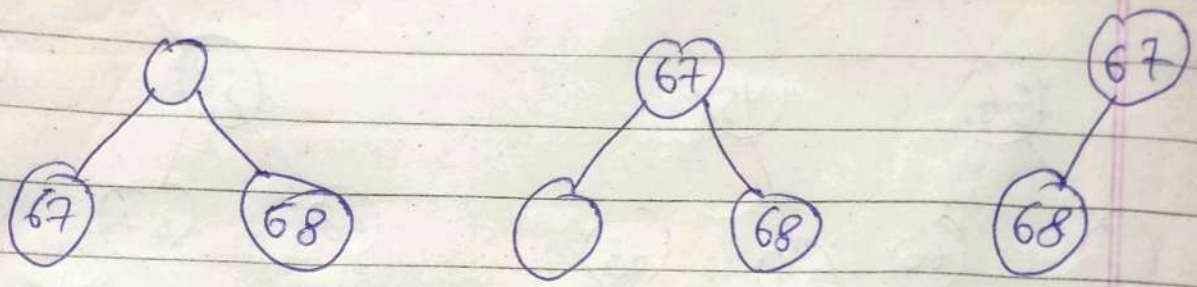
Step - 4. - Delete - 56.



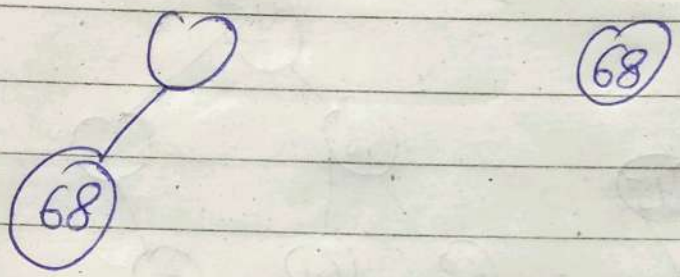




Step - 5. Delete - 54



Step - 6. Delete - 67



Step - 7 delete - 68

result - 11, 23, 45, 56, 59, 67, 68

Date / /
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Assignment -3.

* B - Tree :→ order - 3.

6, 95, 47, 32, 28, 75, 87, 35, 51, 16, 59, 89, 97, 99.

1) [6]

2) [6 95]

3) [6 95 47]

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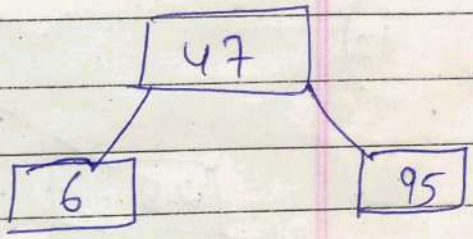

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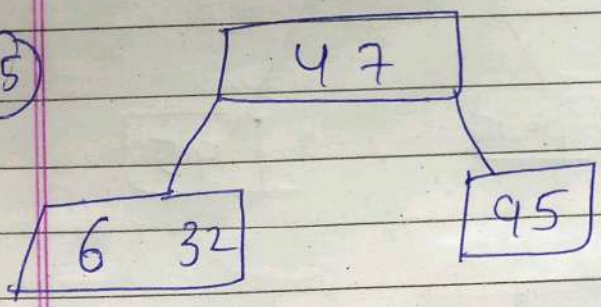

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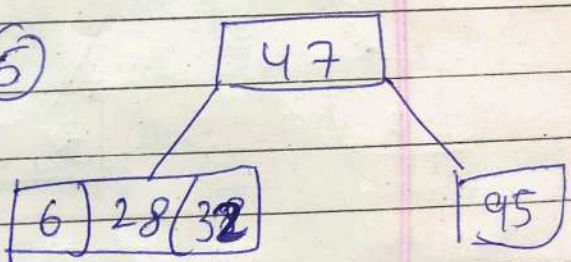

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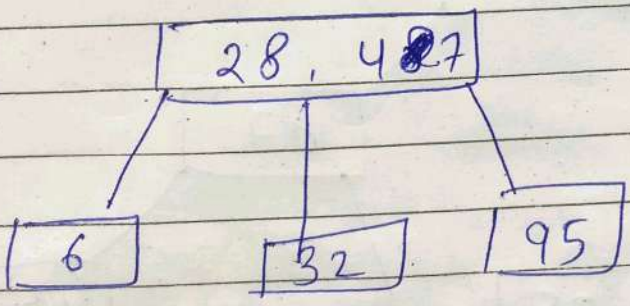

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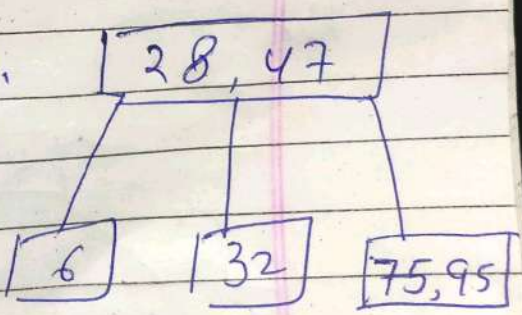

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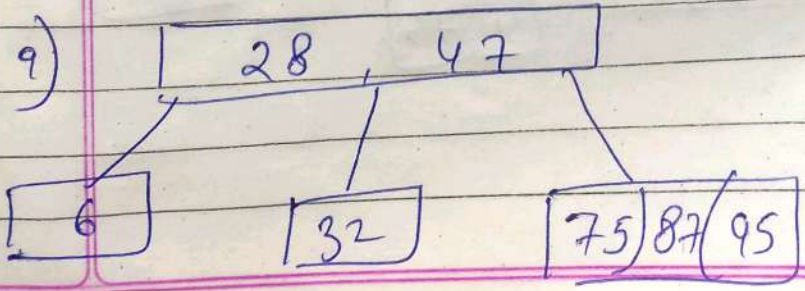

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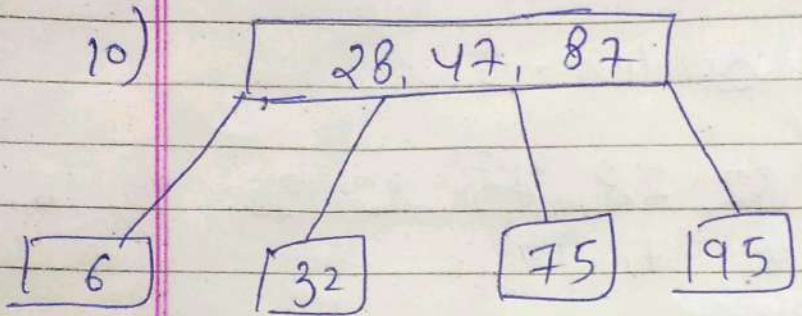
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95

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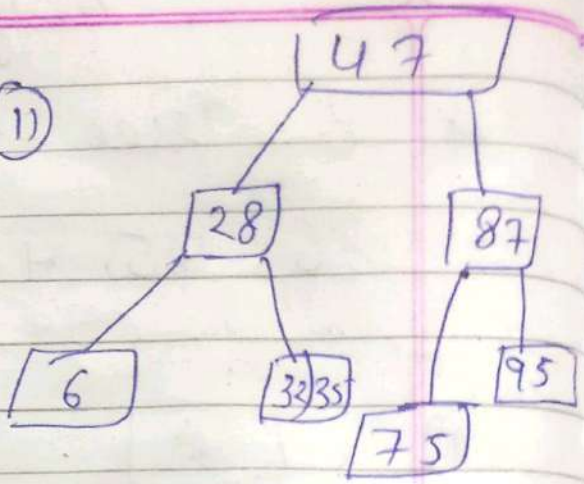
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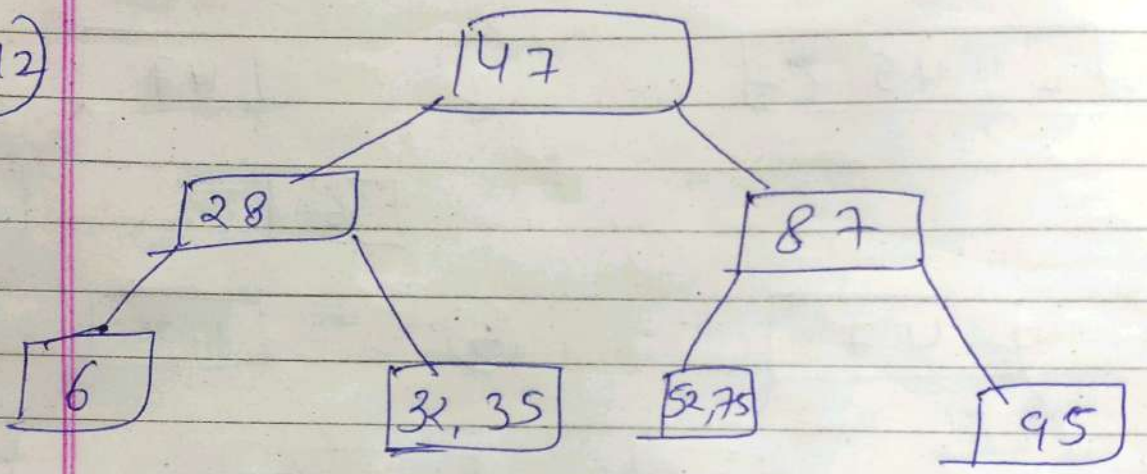
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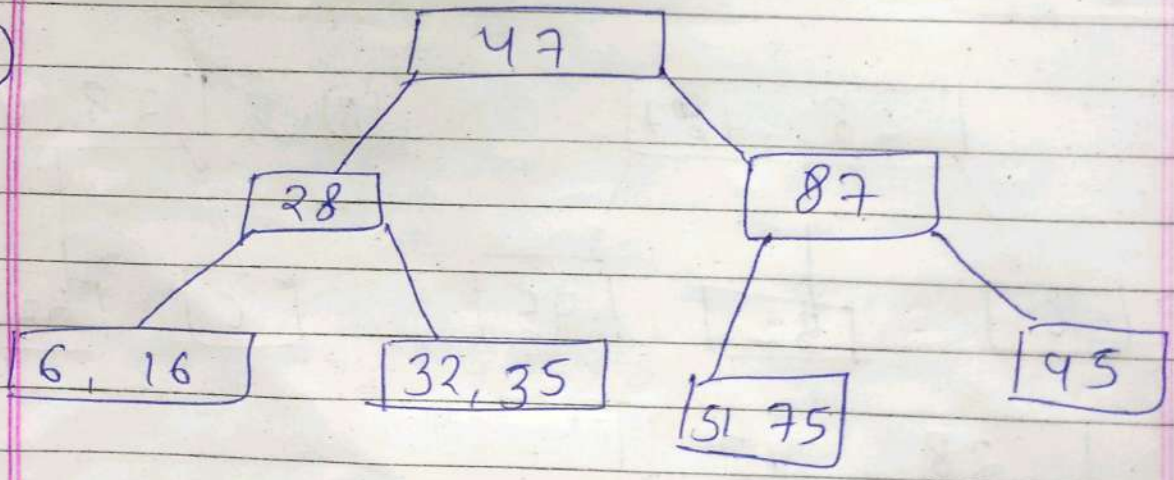
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32, 35
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95

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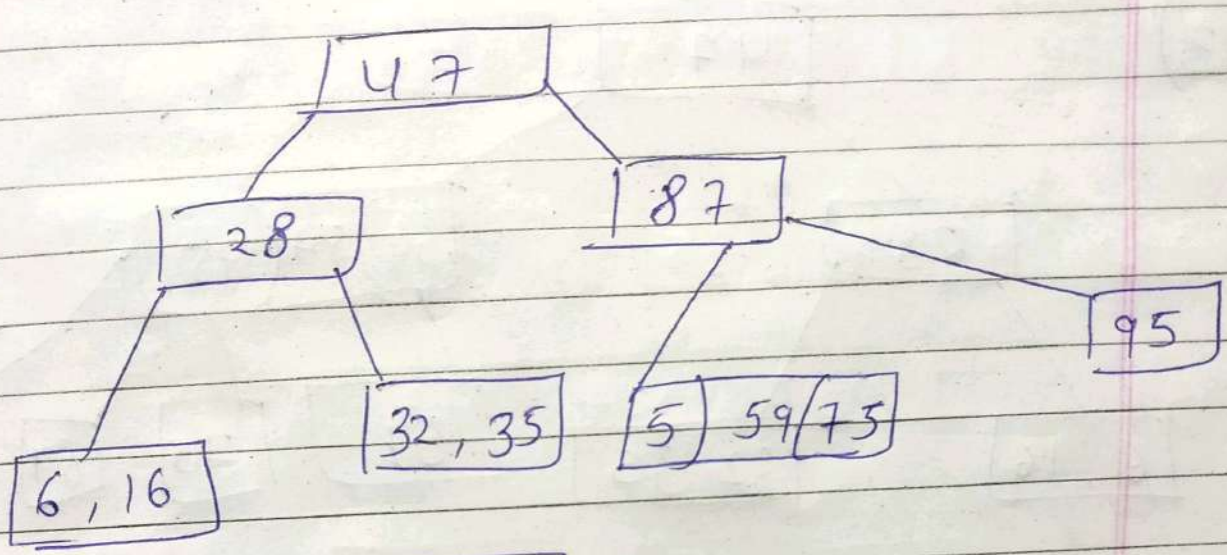
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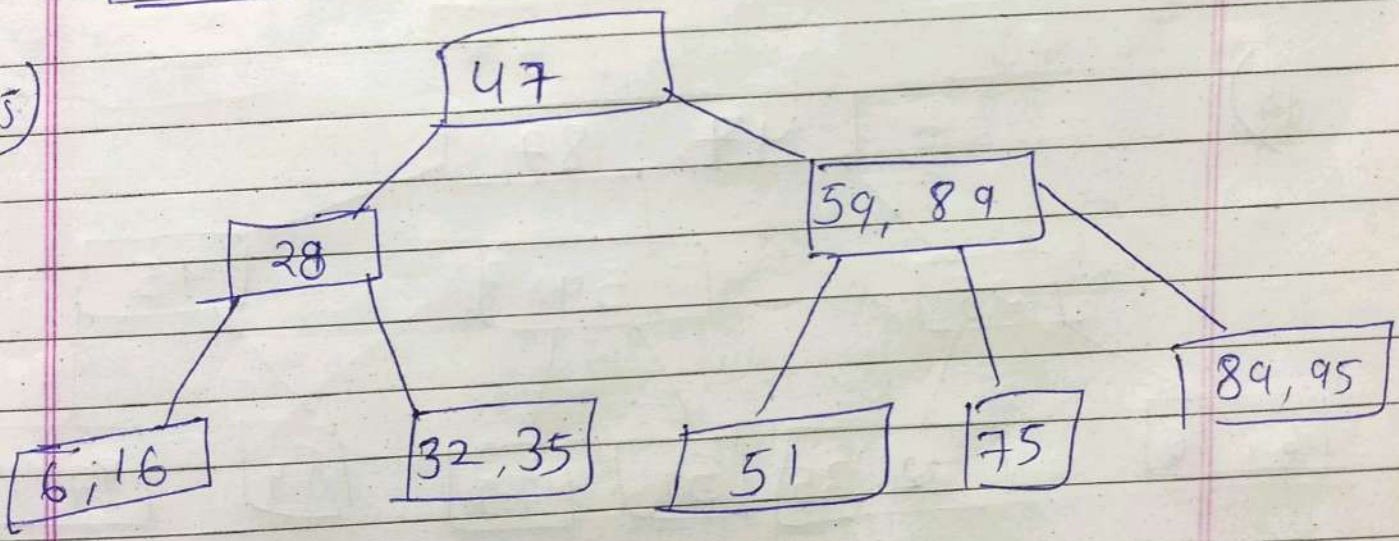
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89, 95

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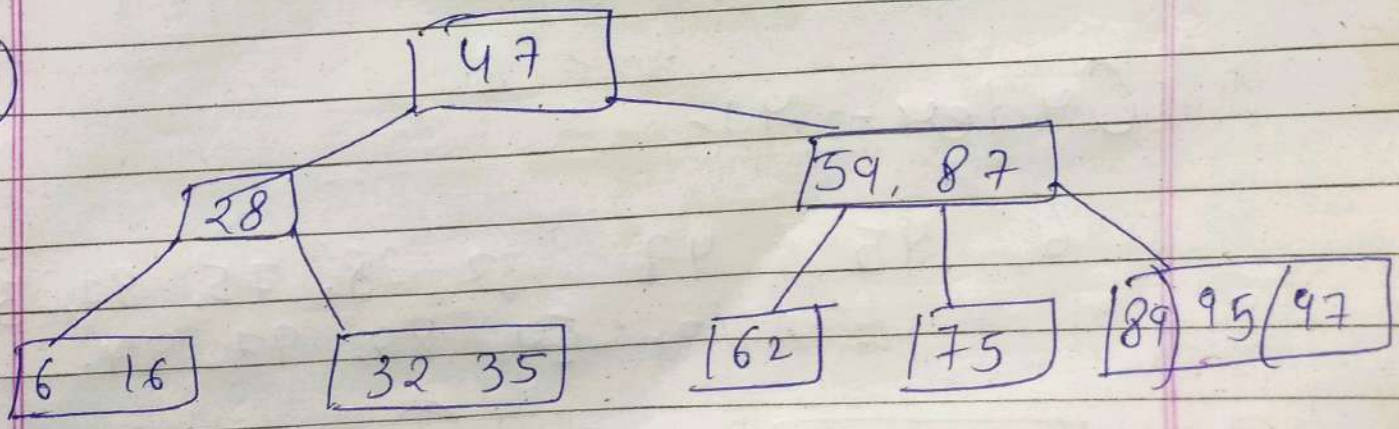
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59, 87
6 16
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75
89
95
97

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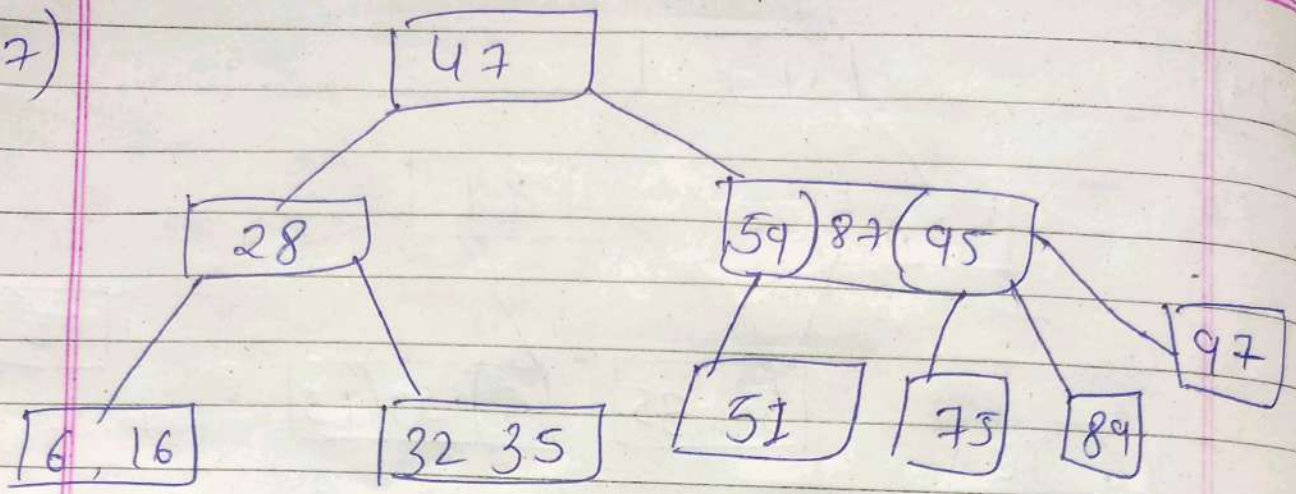

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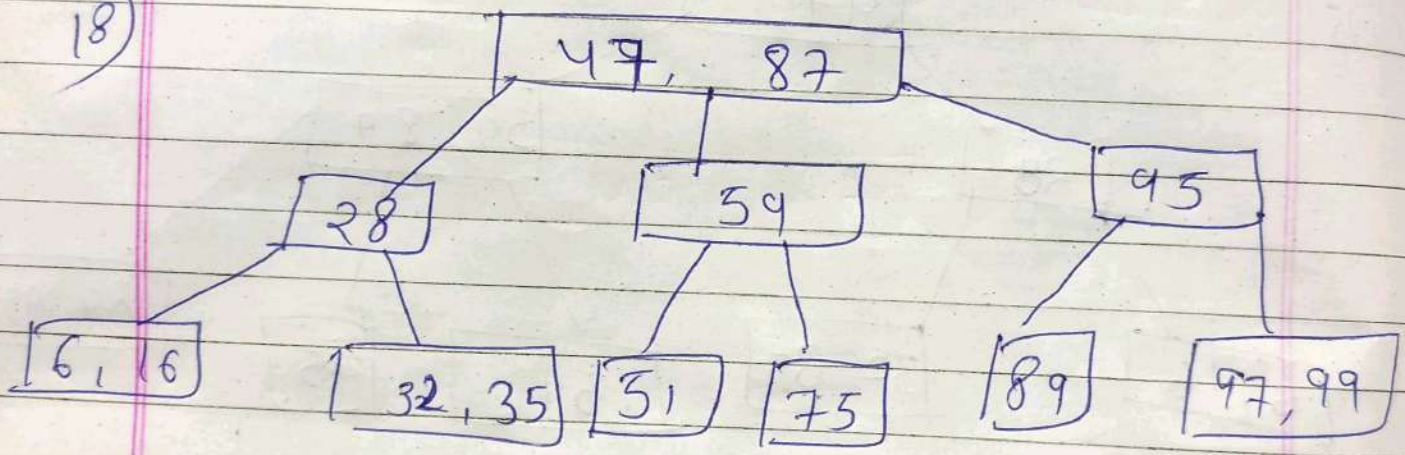

Order - 4 :-

6, 95, 47, 32, 28, 75, 87, 38, 51, 16, 59, 84, 97, 99.

(1) 6

(2) 6, 95

Date / /
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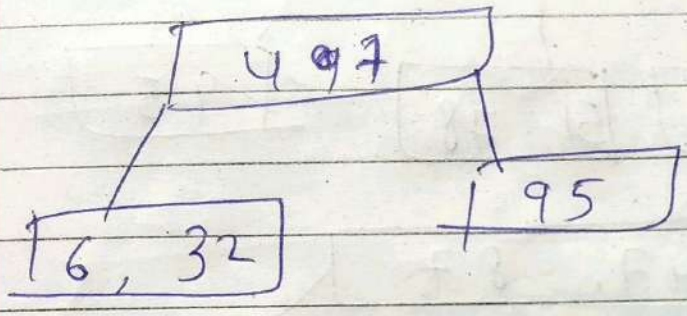
③ [6, 47 95]

④ [6, 32, 47, 95]

⑤



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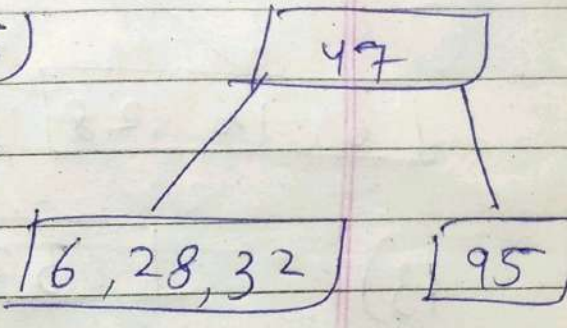

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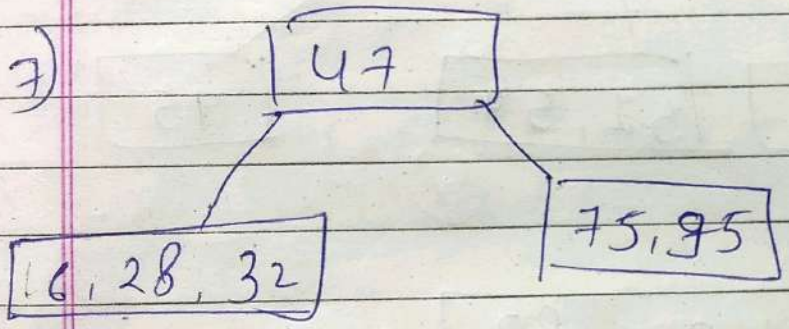

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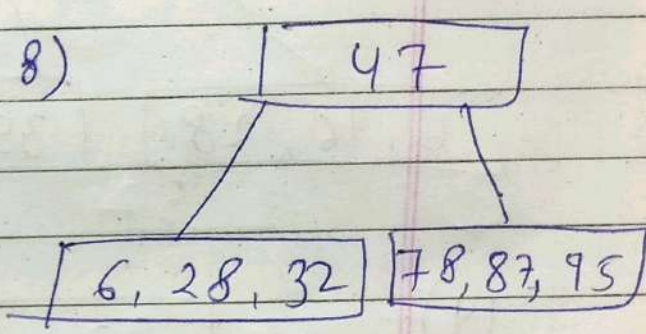

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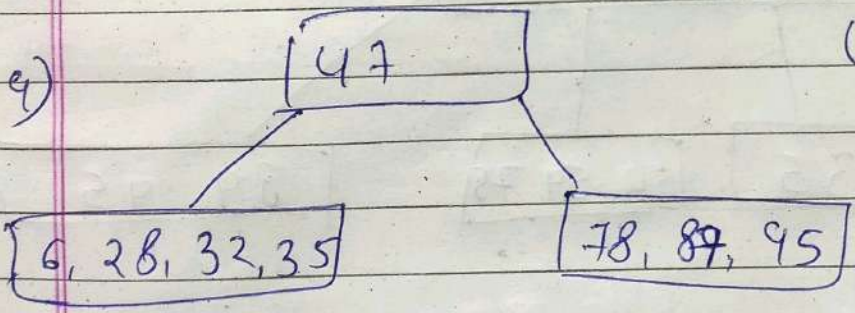

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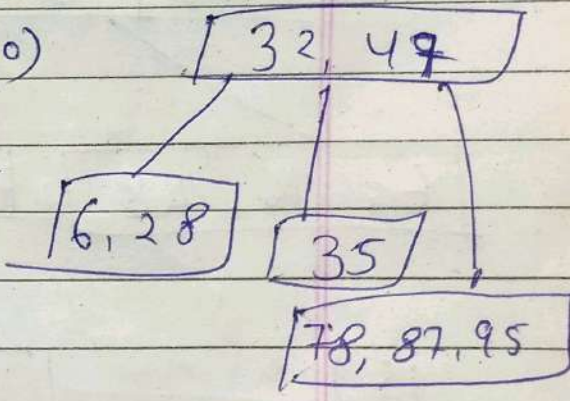

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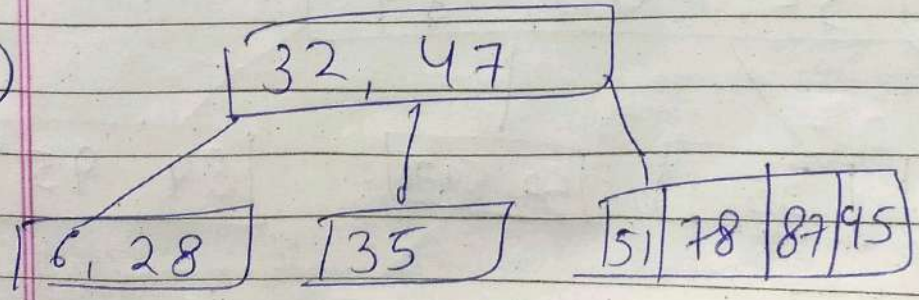

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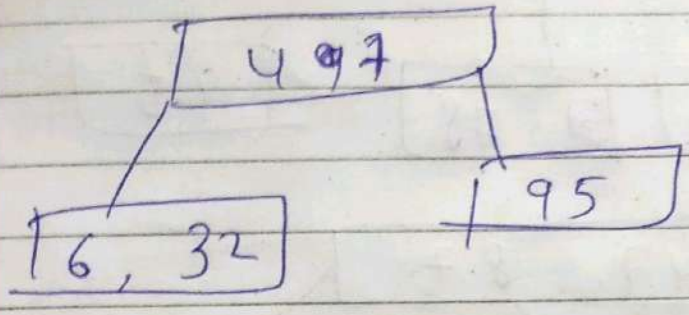
3) 6, 47 95

4) 6, 32, 47, 95

5)



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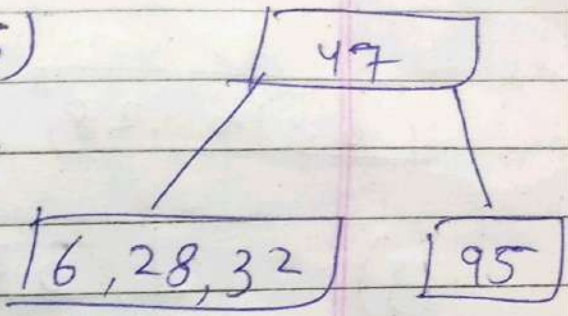

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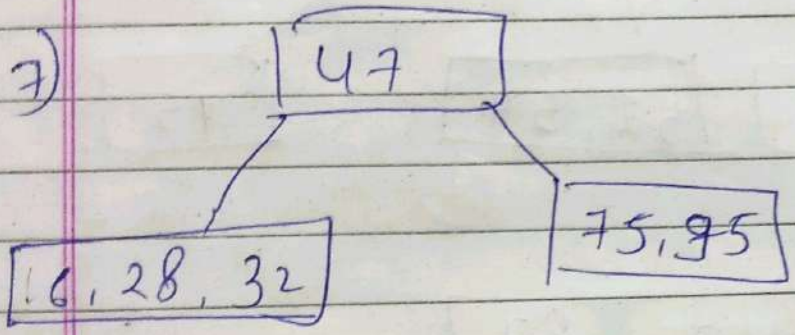

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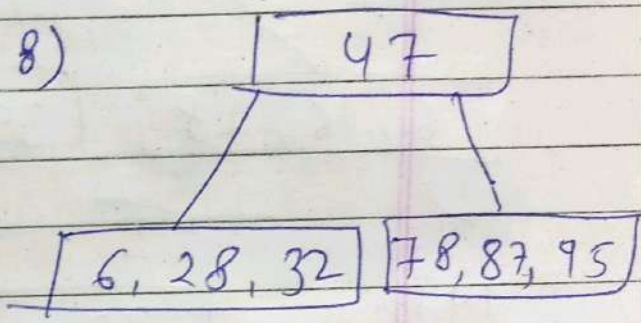

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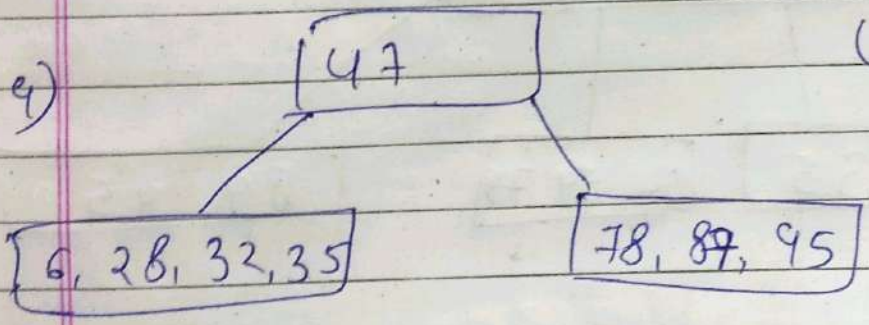

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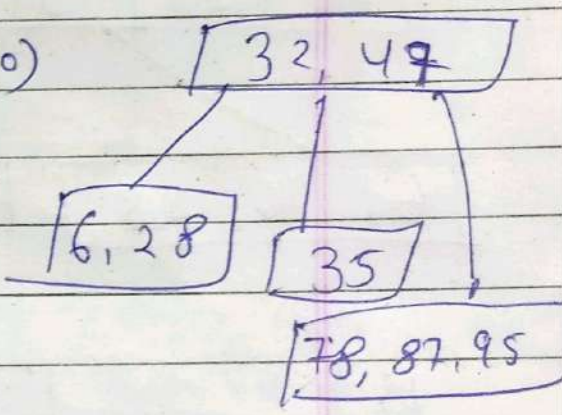

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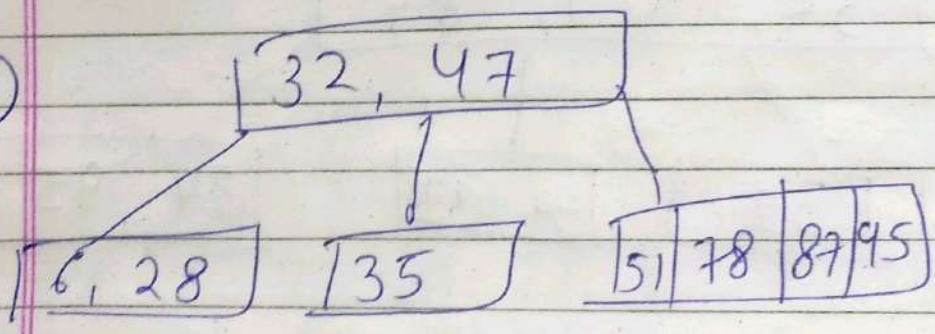

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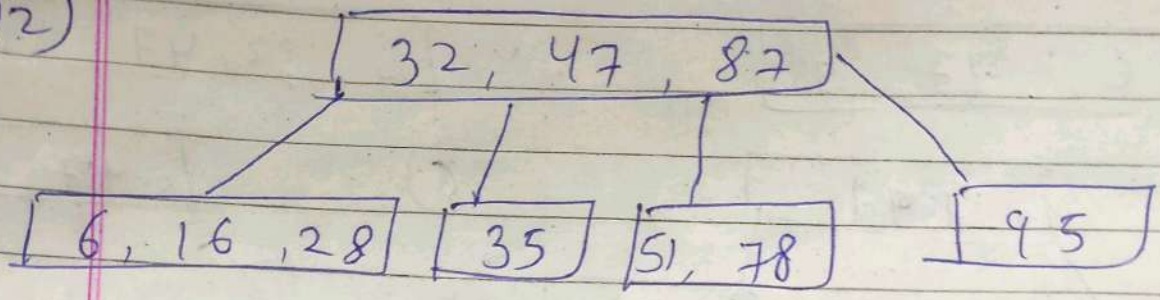
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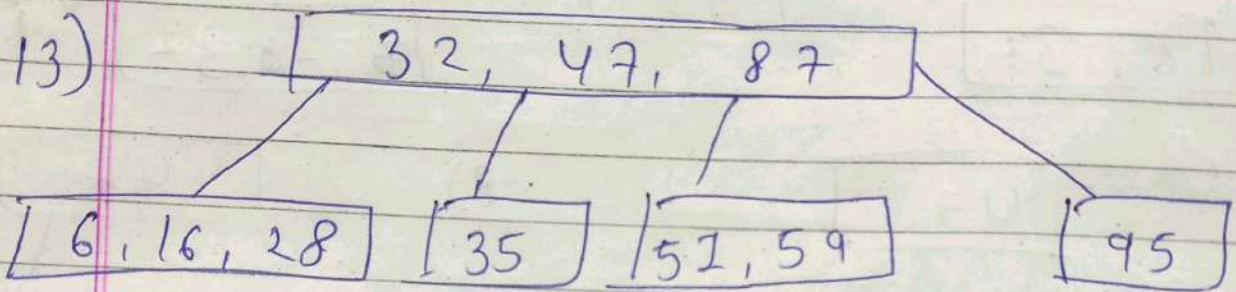
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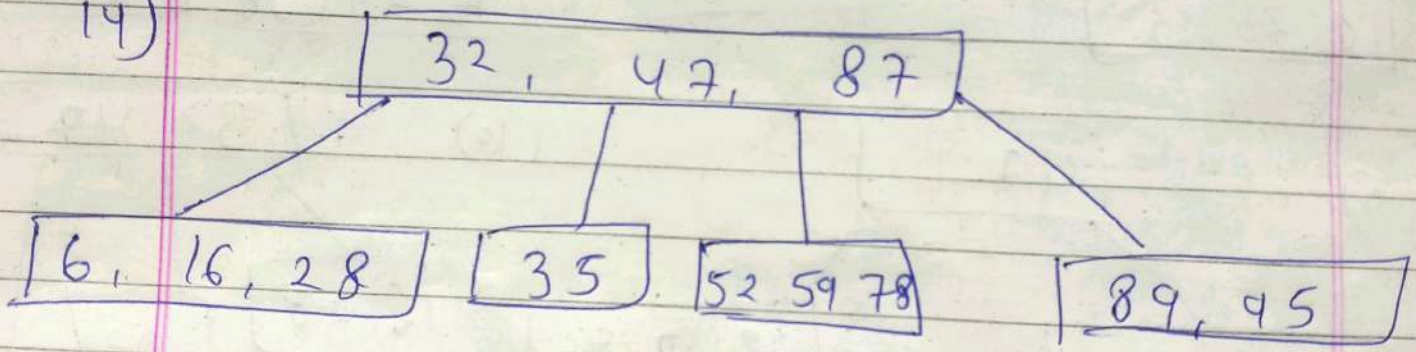
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89, 95

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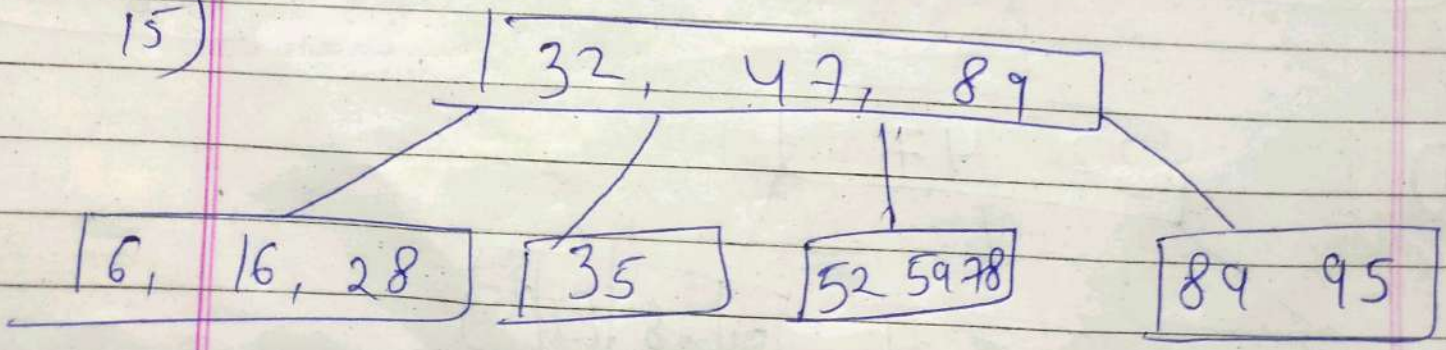
32, 47, 89
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52 59 78
89 95

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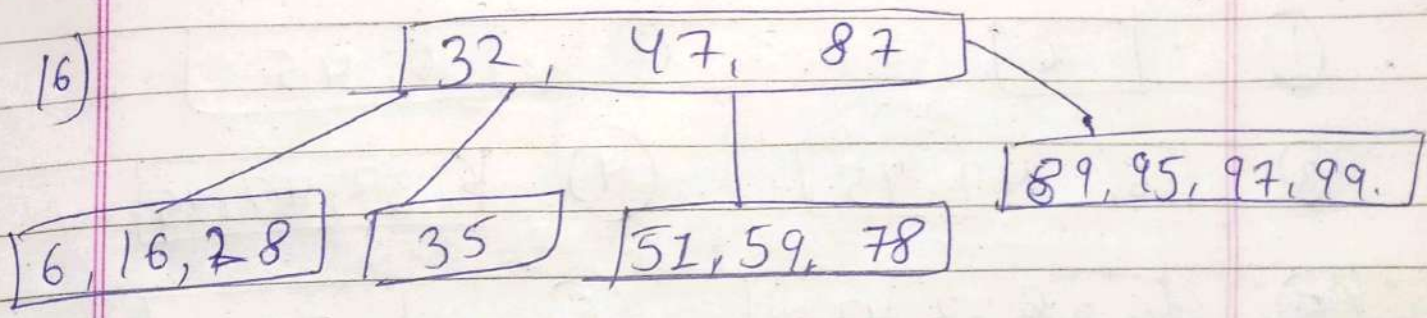
16)



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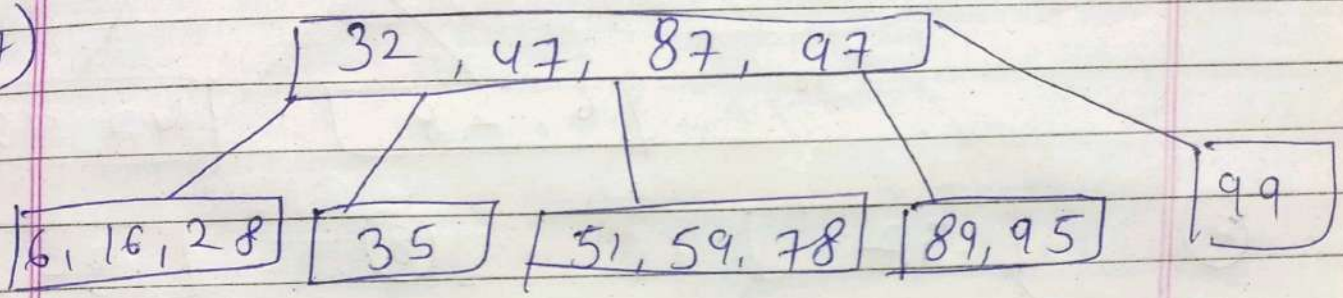

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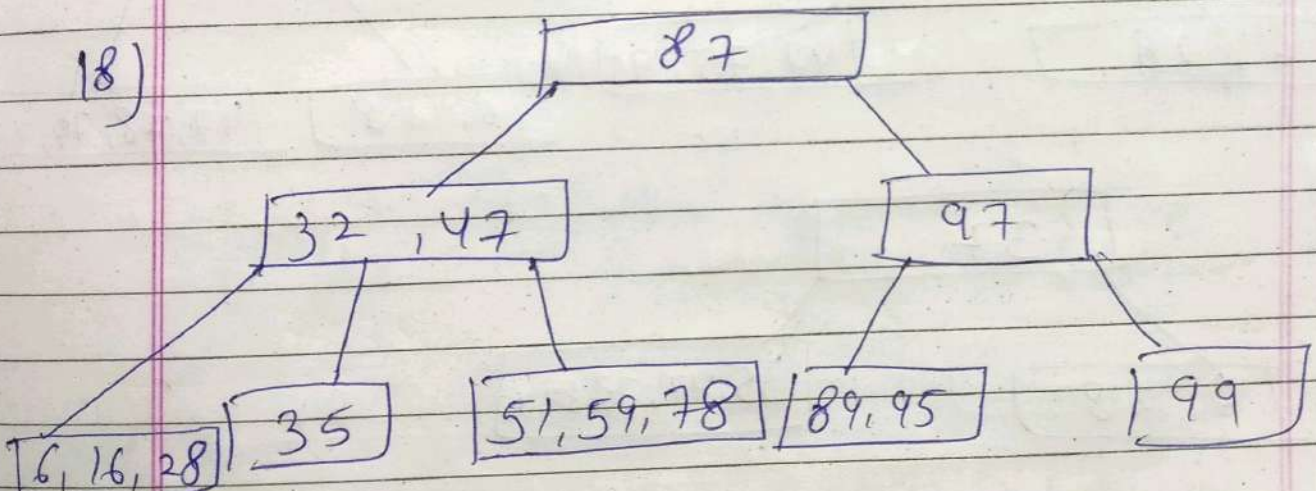

Order - 5.

6, 95, 47, 32, 28, 75, 87, 35, 51, 16, 59, 89, 97, 99.

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① [6]

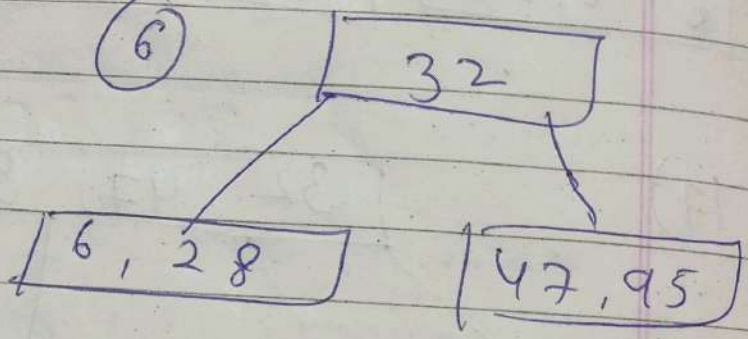
② [6, 95]

③ [6, 47, 95]

④ [6, 32, 47, 95]

⑤ [6, 28, 32, 47, 95]

⑥



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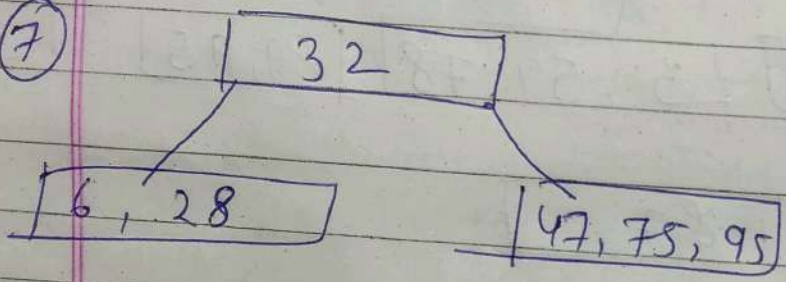

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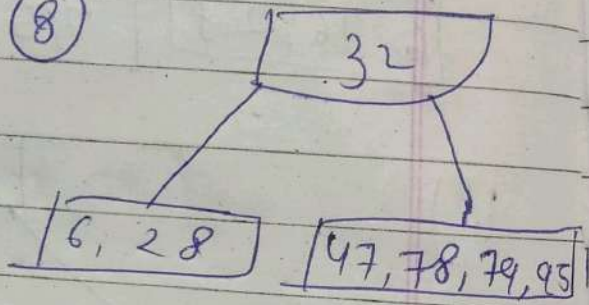

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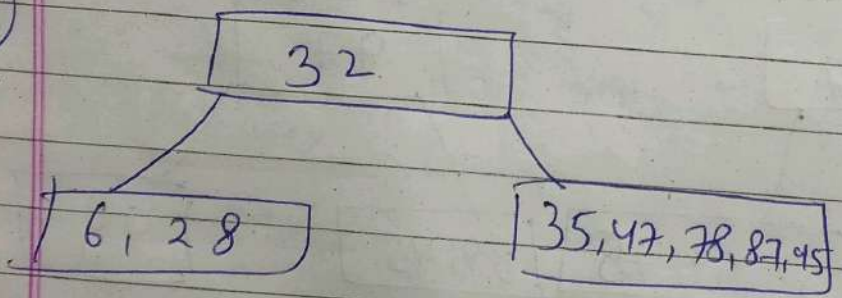

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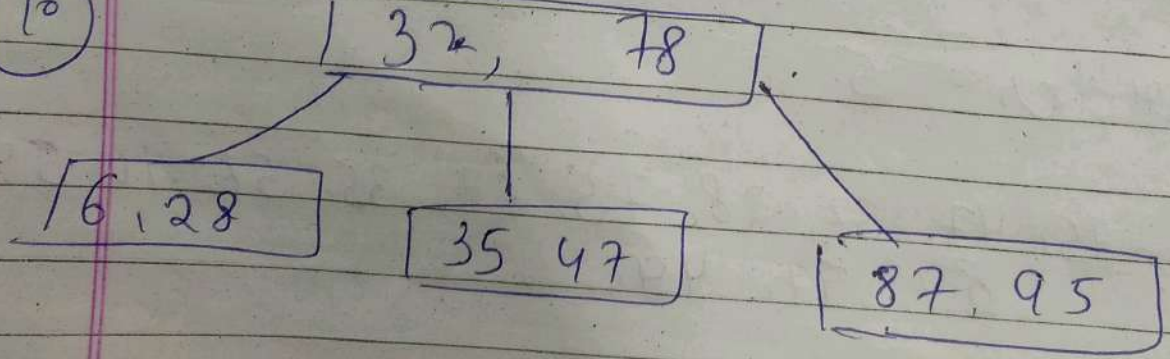

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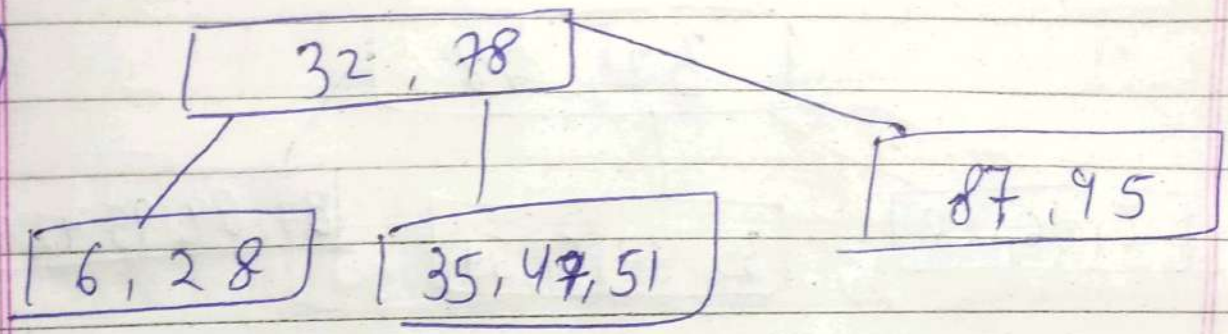

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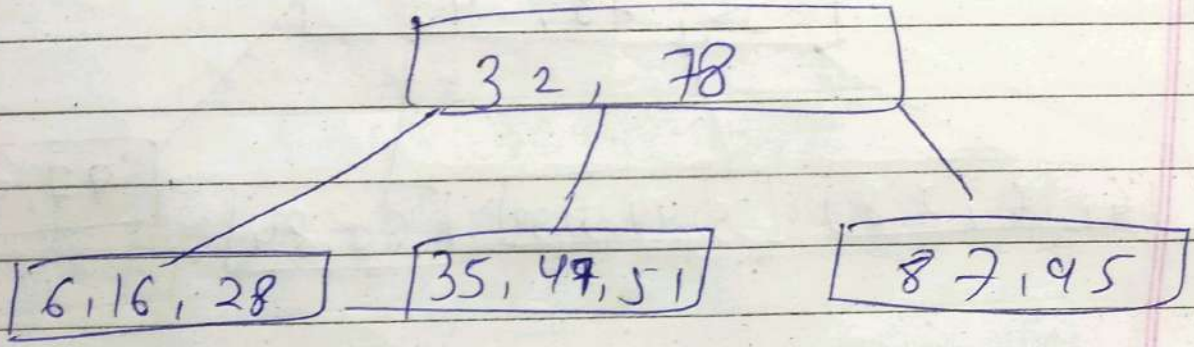

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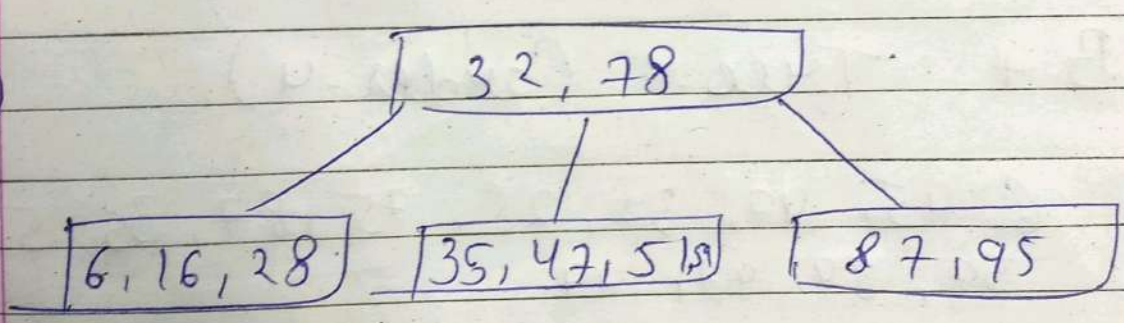

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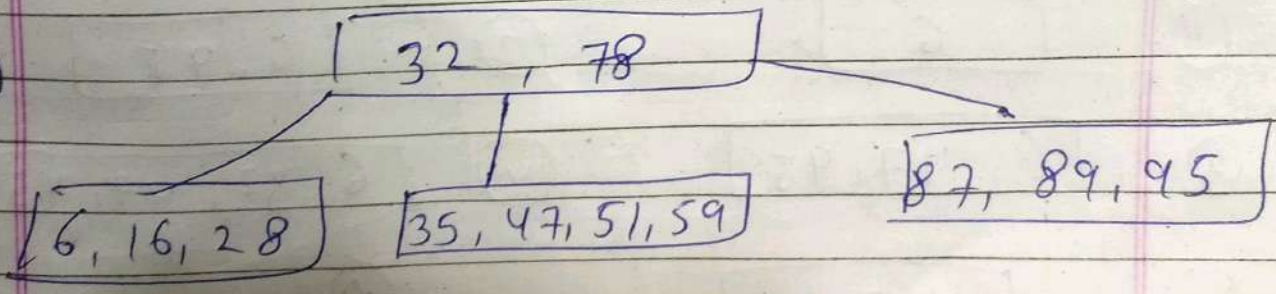

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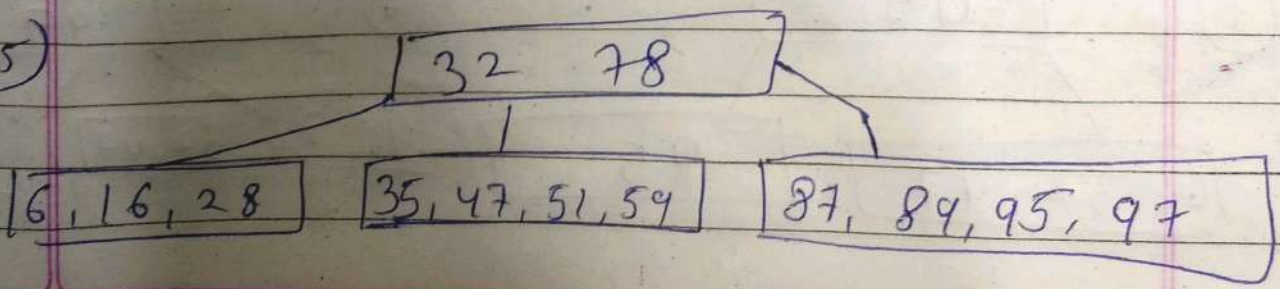

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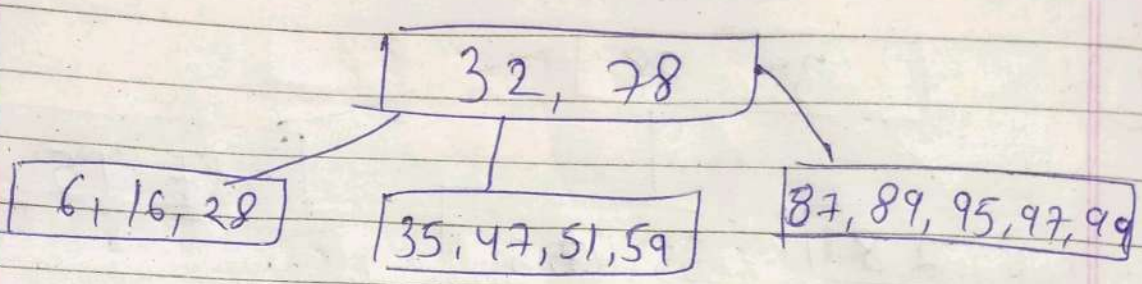

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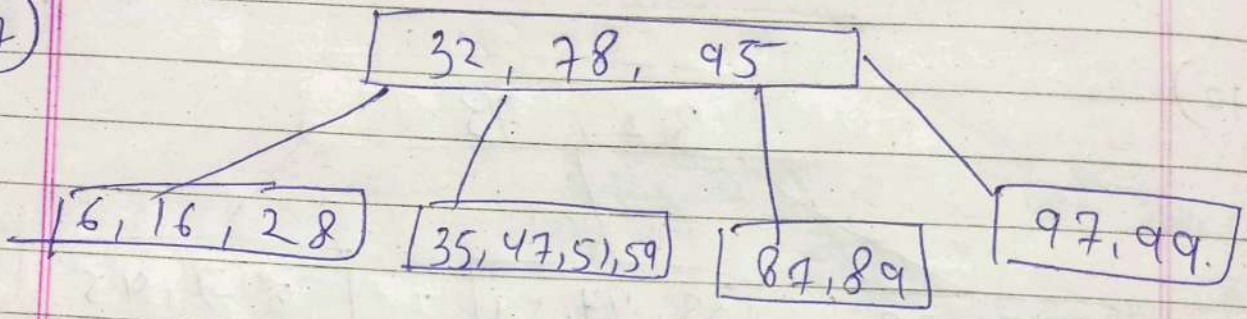


B + Tree. (order-4)

6, 95, 47, 32, 28, 75, 87, 35, 51, 16, 59, 89, 97, 99.

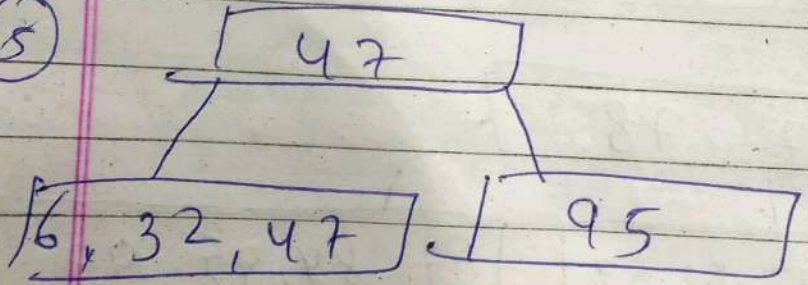
① 6

② 6, 95

③ 6, 47, 95

④ 6, 32, 47, 95

⑤



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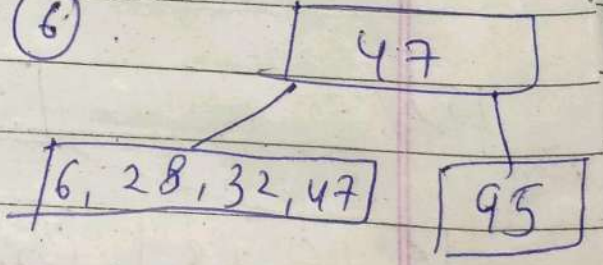

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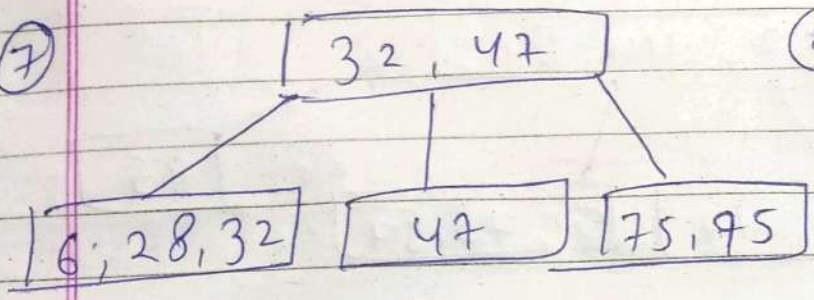

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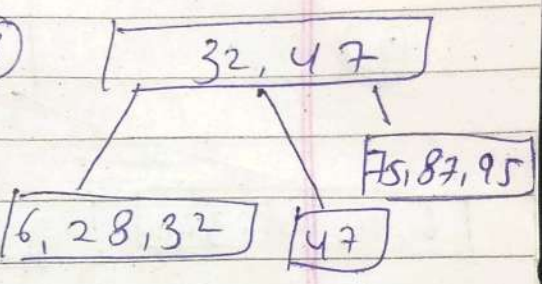

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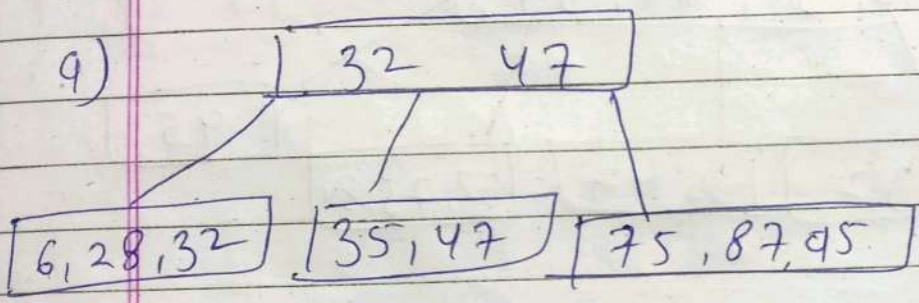

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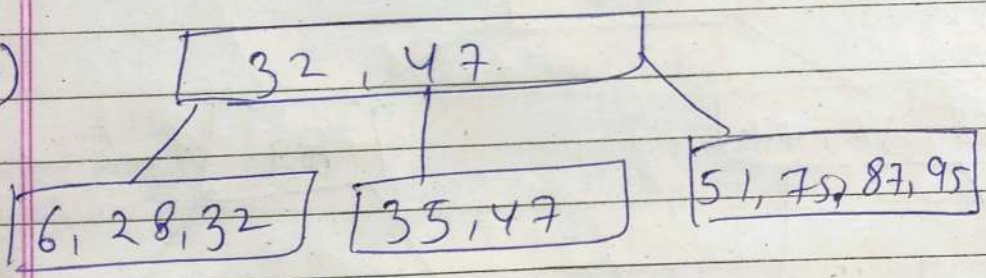

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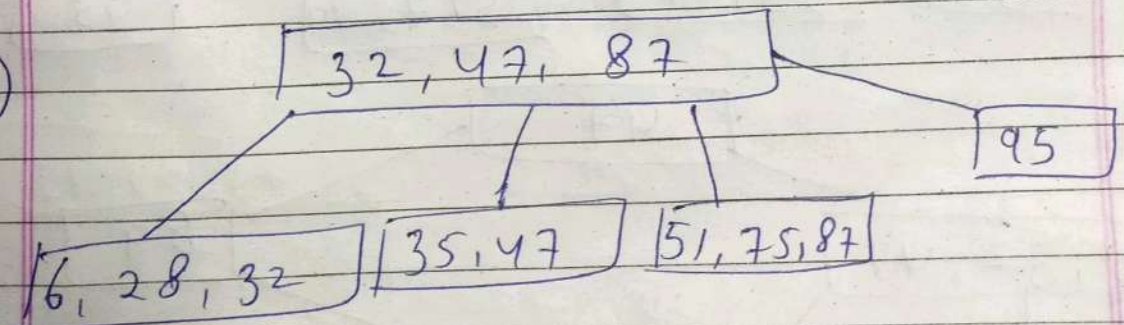

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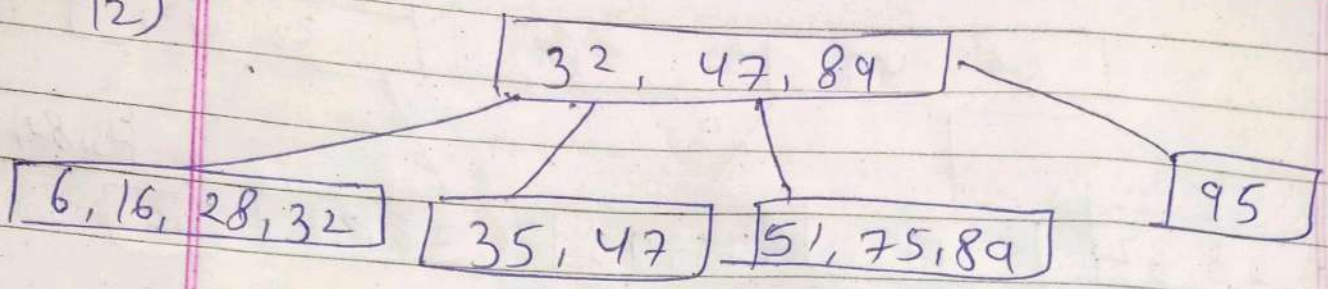

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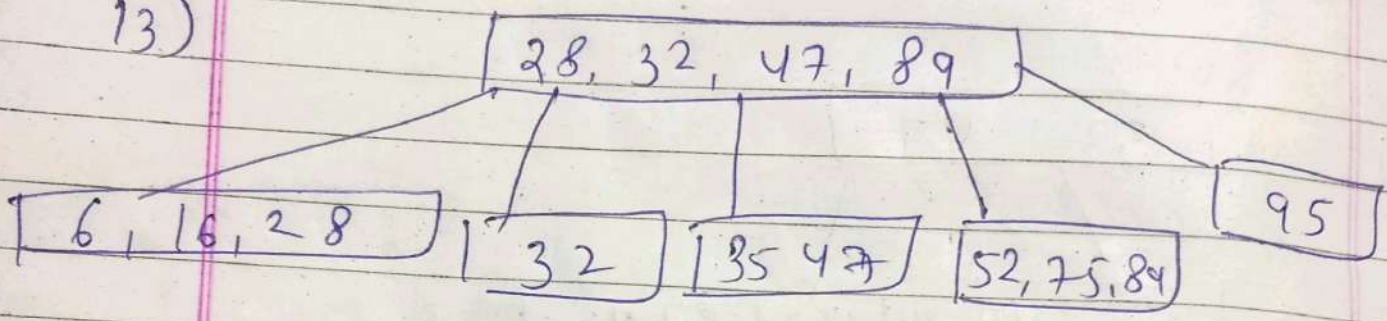

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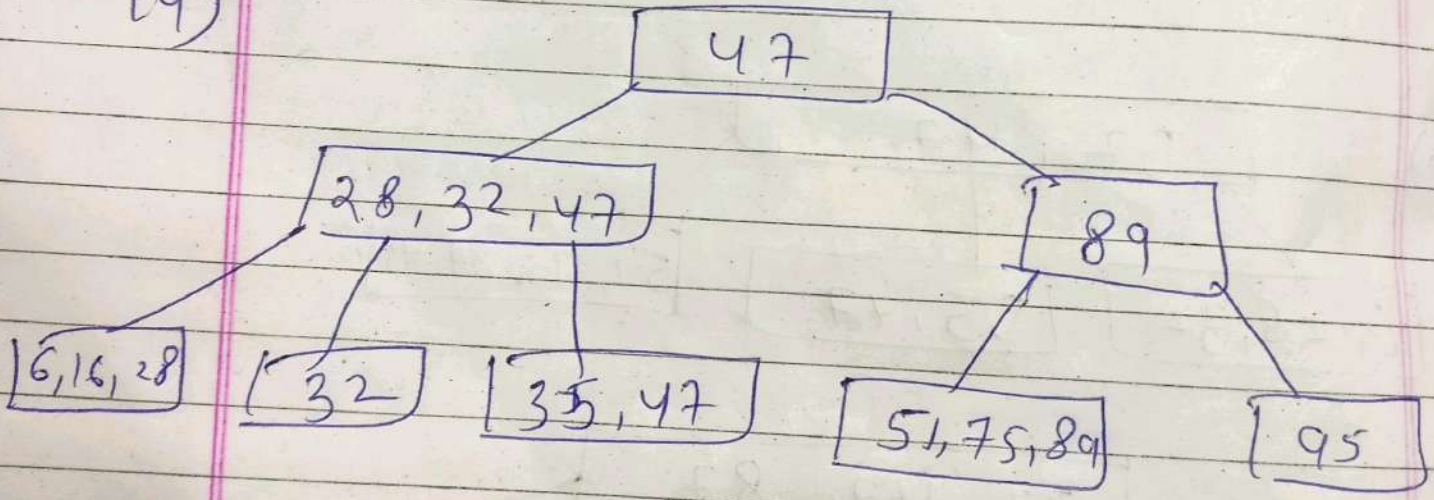

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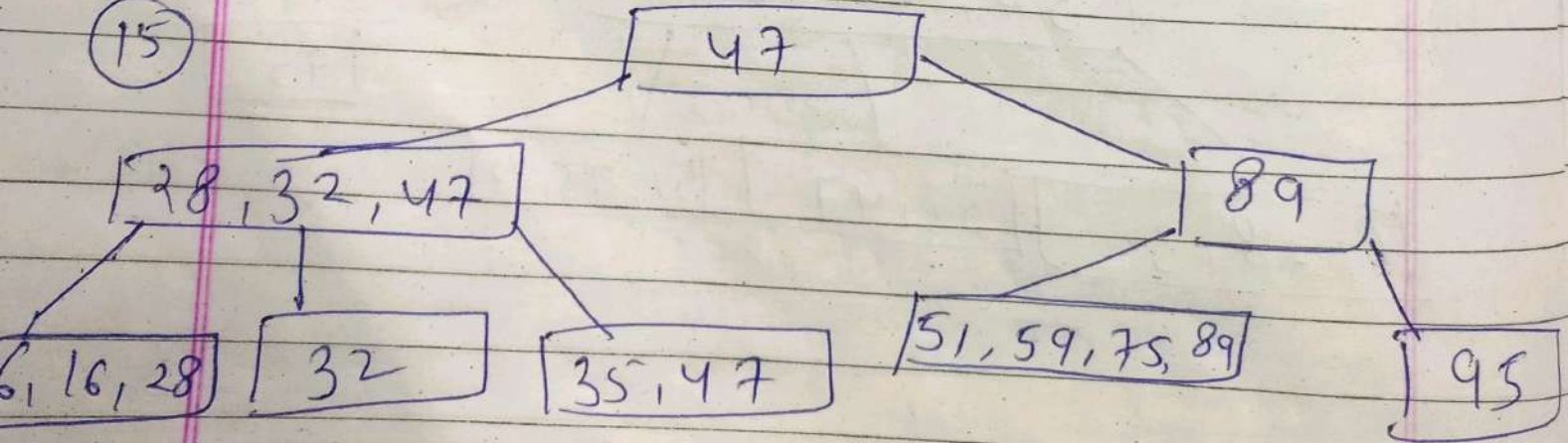

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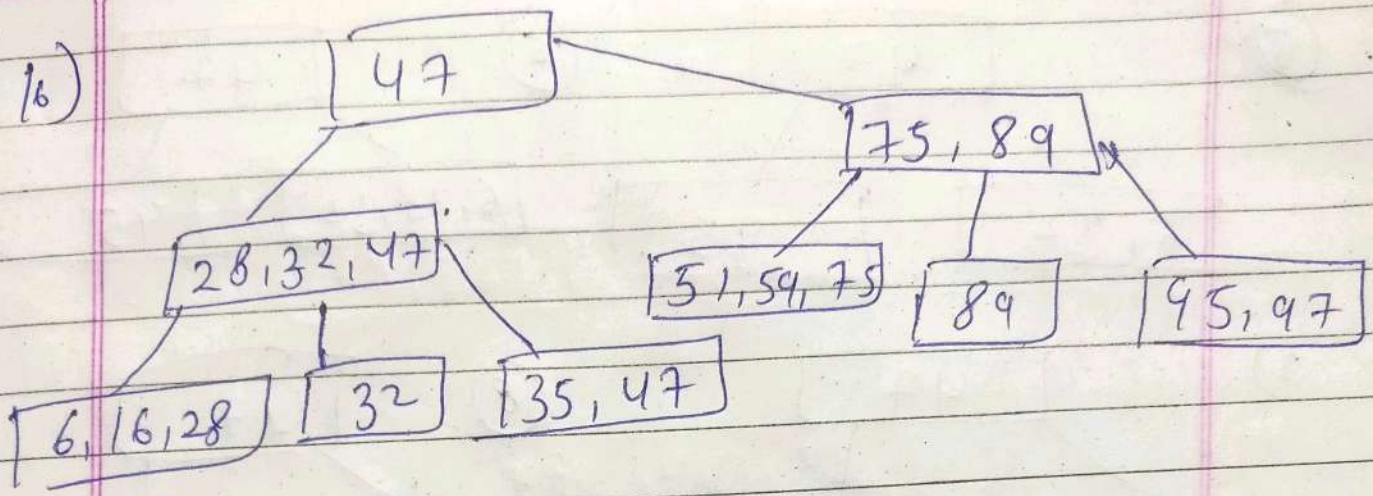
16)



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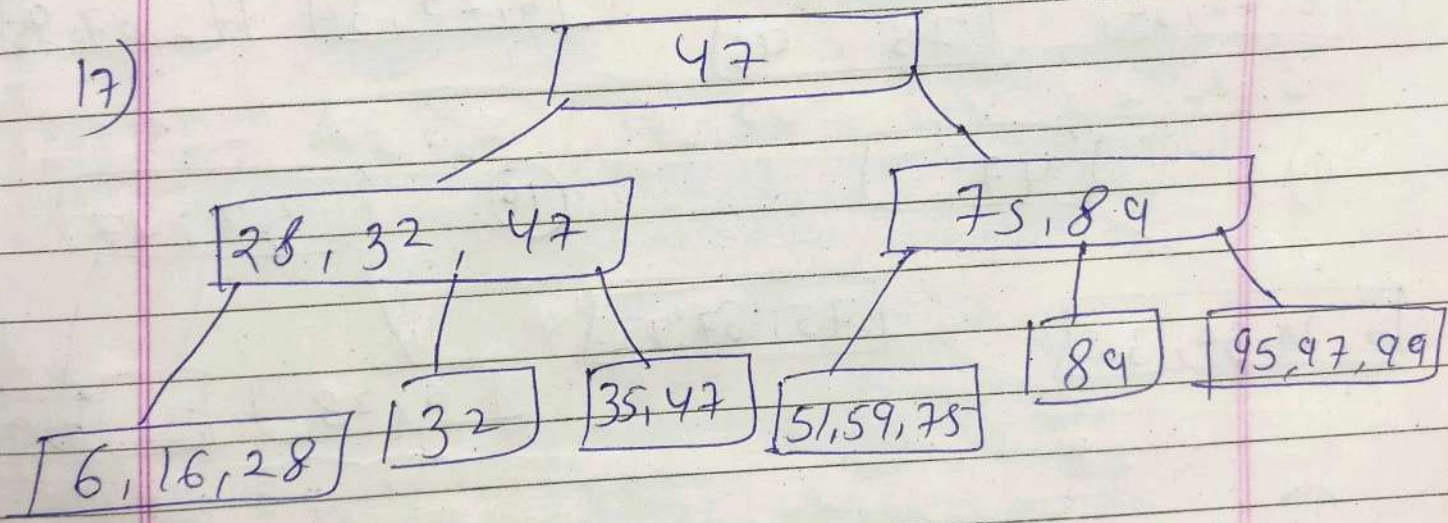

B * Tree (order - 4)

6, 95, 47, 32, 28, 78, 87, 95, 52, 16, 59, 89, 97, 99.

① 6

② 6, 95

③ 6, 47, 95

④ 6, 32, 47, 95

Date __/__/____
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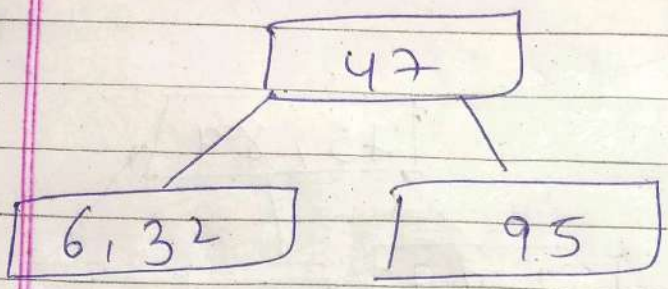

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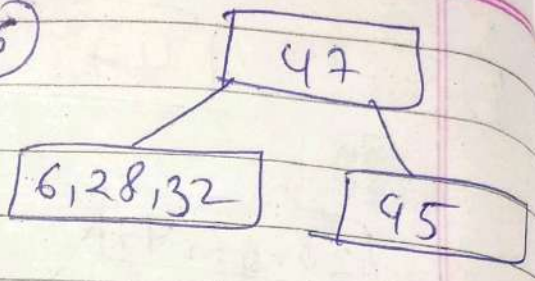

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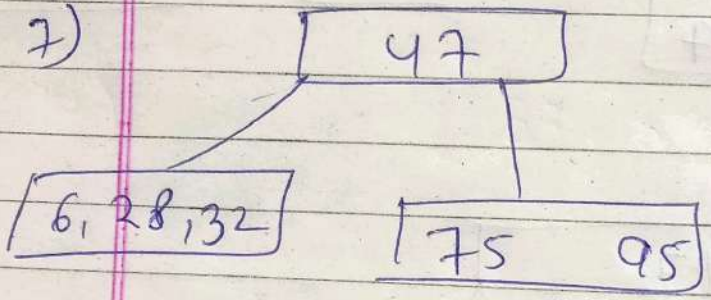

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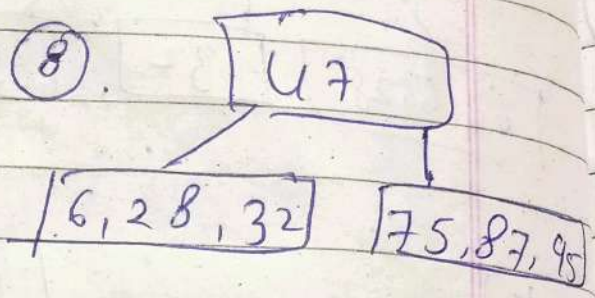

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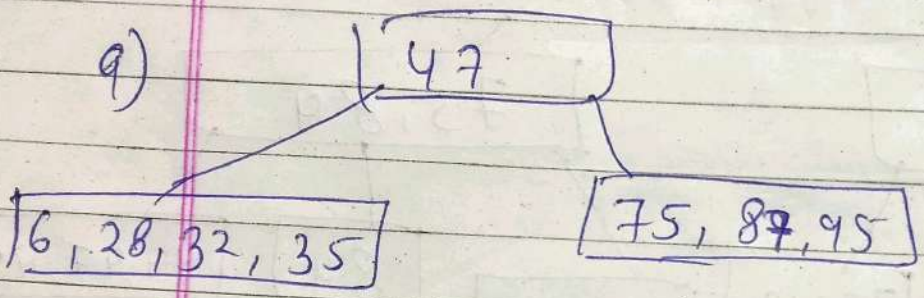

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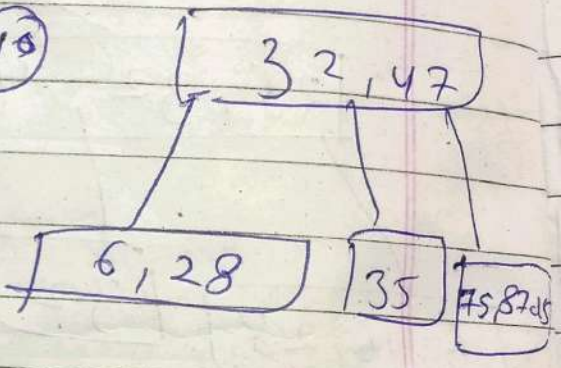

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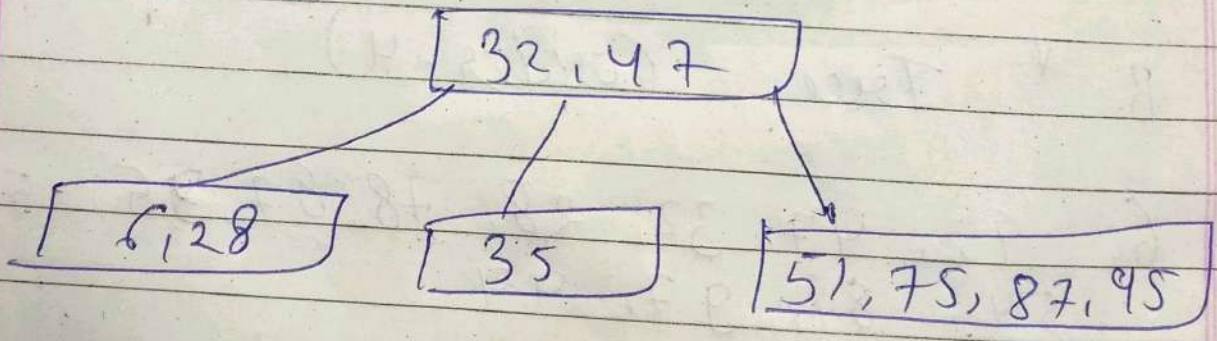

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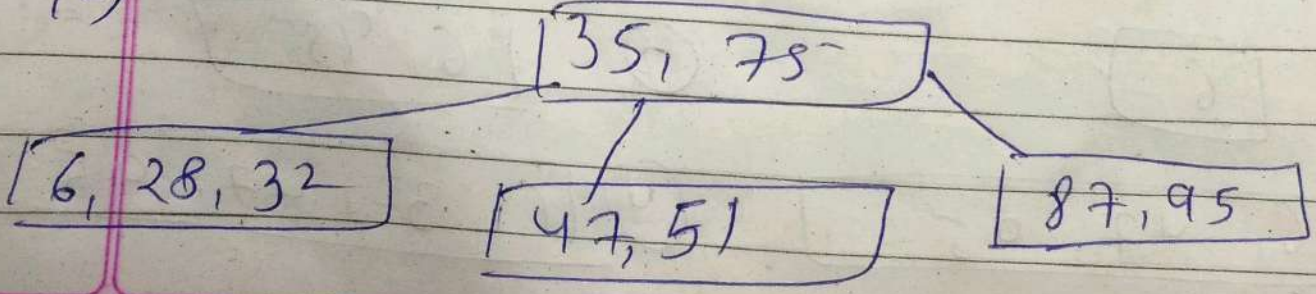

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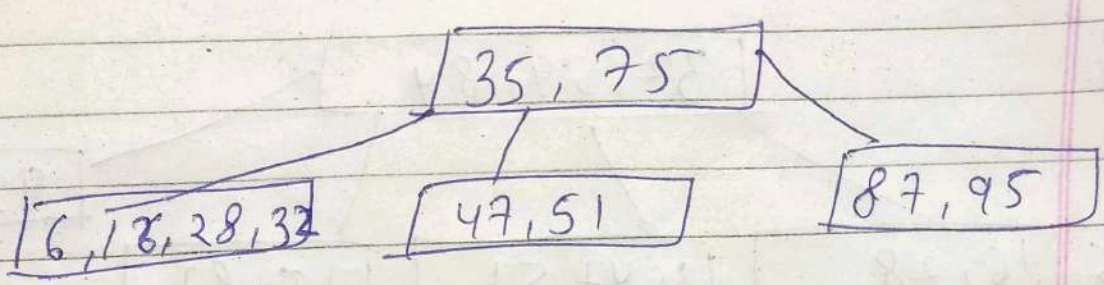

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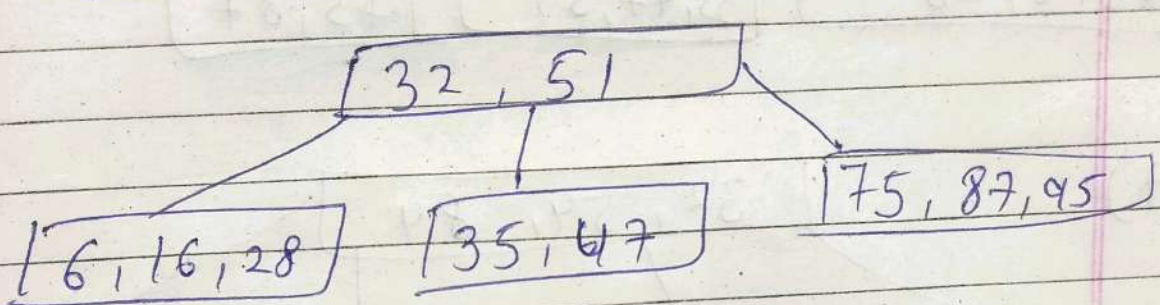

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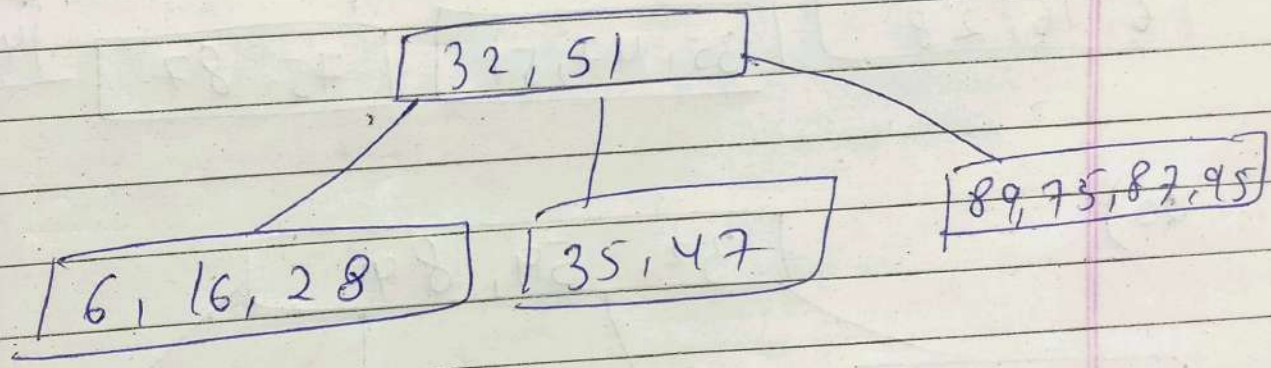

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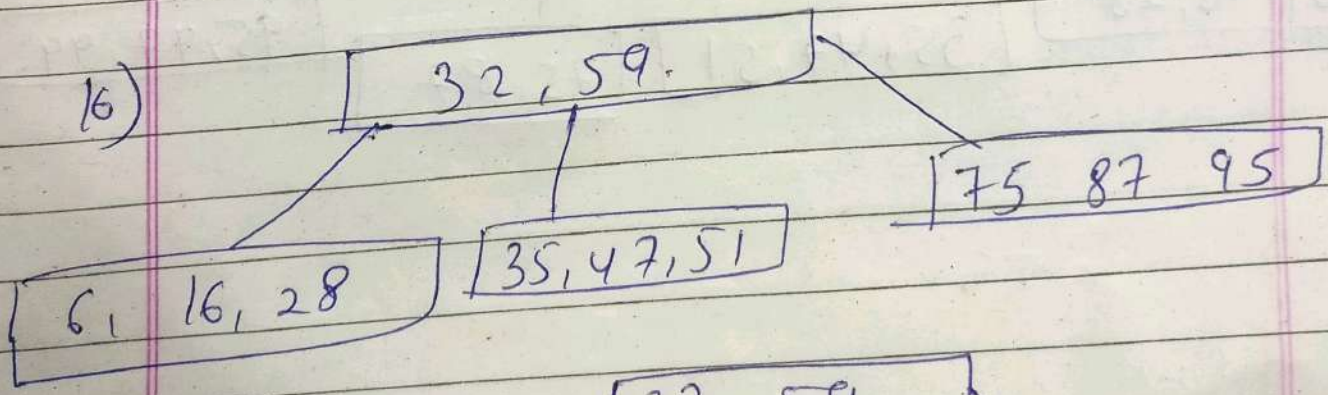

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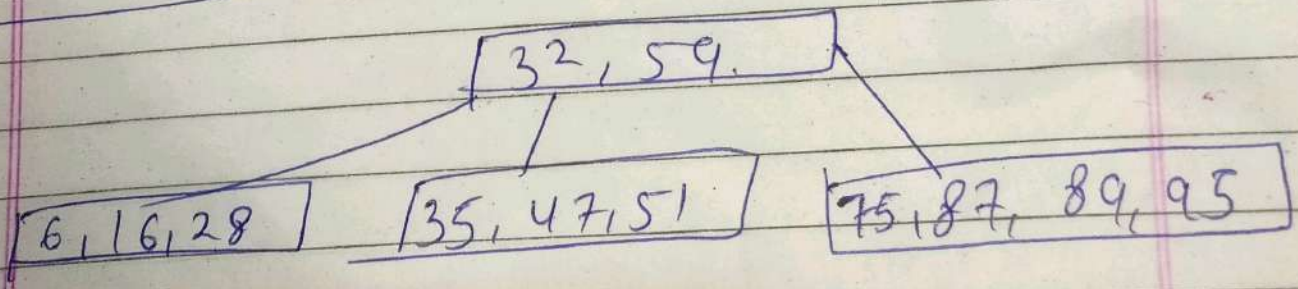

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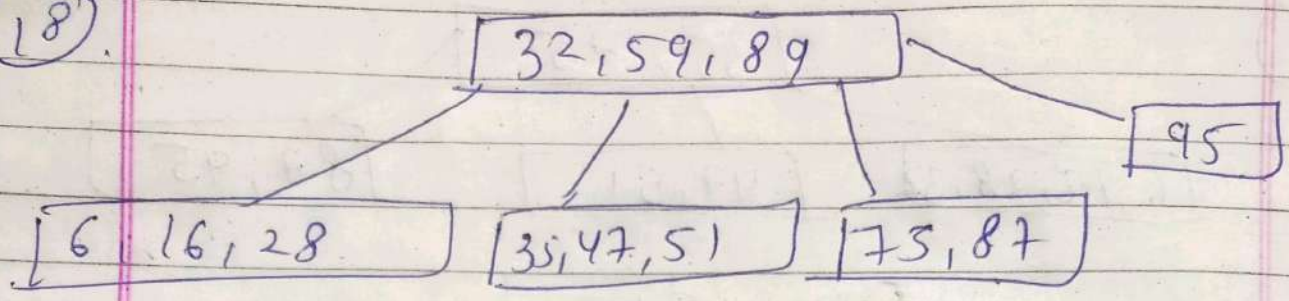

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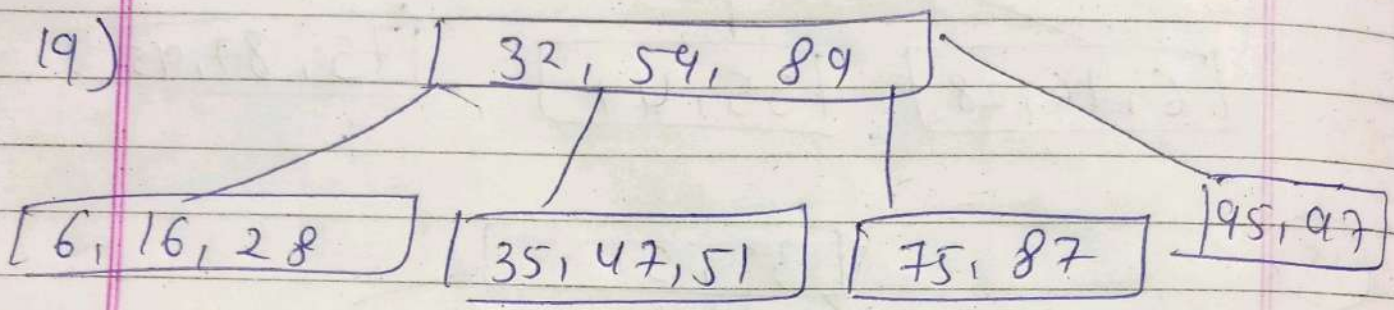

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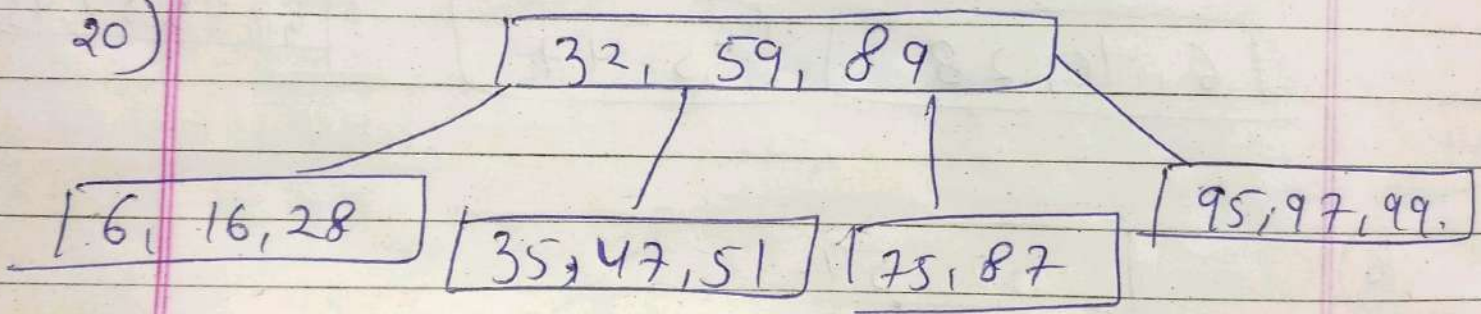

D E P A R T M E N T O F C O M P U T E R S C I E N C E
R O L L W A L A C O M P U T E R C E N T R E
G U J A R A T U N I V E R S I T Y
M.C.A. – III

R O L L NO : 30
N A M E : Ajinkya Rathod
S U B J E C T : DATA STRUCTURE

NO.	TITLE	DATE	SIGN
	ASSIGNMENT -1		
1	Polynomial Addition with Array	11/12/2020	
2	Polynomial Multiplication with Array	11/12/2020	
3	Polynomial Addition with LL	11/12/2020	
4	Polynomial Multiplication with LL	11/12/2020	
5	Singly Linked List (3 Insertions, 3 Deletions, Counting, Display List)	11/12/2020	
6	Stack with Array	11/12/2020	
7	Stack with LL	11/12/2020	
8	Factorial with Recursion	11/12/2020	
9	Fibonacci Series with Recursion	11/12/2020	
10	Any other Series with Recursion(eg. sine series)	11/12/2020	
11	Equation validation with brackets(using Array And Linklist)	11/12/2020	
12	Infix to Postfix Conversion	11/12/2020	
13	Postfix Expression Evaluation	11/12/2020	
14	Queue with Array	11/12/2020	
15	Queue with Linked List	11/12/2020	
16	Circular Queue with Array	11/12/2020	
17	Circular Queue with Linked List	11/12/2020	
18	Circular Linked List(All Insertions, All Deletions & Display)	11/12/2020	
	ASSIGNMENT -2		
1	Doubly Linklist(All Operation)	11/12/2020	
2	Doubly Circuler Linklist(All Operation)	11/12/2020	
3	Bubble Sort	11/12/2020	
4	Selection Sort	11/12/2020	
5	Insertion Sort	11/12/2020	

D E P A R T M E N T O F C O M P U T E R S C I E N C E
R O L L W A L A C O M P U T E R C E N T R E
G U J A R A T U N I V E R S I T Y
M.C.A. – III

R O L L NO : 30
N A M E : Ajinkya Rathod
S U B J E C T : DATA STRUCTURE

6	Linear Search	11/12/2020	
7	Binary Search	11/12/2020	
8	Expressio Tree	11/12/2020	
9	Binary Search Tree(Recursive)	11/12/2020	
10	Binary Search Tree(Non-Recursive)	11/12/2020	
	ASSIGNMENT -3		
1	UnWeighted Graph Shortest Path	11/12/2020	
2	Dijkastra's Weighted Graph Shortest Path	11/12/2020	
3	Priority Queue Using MIN Heap	11/12/2020	
4	MAX Heap	11/12/2020	
5	Heap Sort	11/12/2020	
6	Quick Sort	11/12/2020	
7	Radix Sort	11/12/2020	
8	Shell Sort	11/12/2020	
9	Merge Sort	11/12/2020	
10	BFS DFS	11/12/2020	
11	Prims Minimum Spanning Tree	11/12/2020	
12	Kruskals Minimum Spanning Tree	11/12/2020	

Roll No : 30
Name : Ajinkya Rathod
Subject : Data Structure
Class : MCA-3

ASSIGNMENT -1

==========
1. Polynomial Addition with Array
==========

```
#include<stdio.h>
#include<conio.h>

void main()
{
	int n,n1,n2,poly1[10]={0}, poly2[10]={0},poly3[10]={0},i,j,res;

	printf("\n Enter Max of polynomial:");
	scanf("%d",&n1);

	printf("\n Enter Polynomial 1..");
	for(i=0;i<=n1;i++)
	{
		printf("\n Enter Poly co_%d :", i);
		scanf("%d",&poly1[i]);
	}

	printf("\n Enter Max of polynomial 2:");
	scanf("%d",&n2);

	printf("\n Enter Polynomial 2..");
	for(i=0;i<=n2;i++)
	{
		printf("\n Enter Poly co_%d :", i);
		scanf("%d",&poly2[i]);
	}

	printf("\n Polynomial 1..=> ");
	for(i=n1;i>=0;i--)
	{
		if(poly1[i]>=0)
		{
```

```
                if(i!=n1)
                {
                        printf("+ ");
                }
        }
        printf("%dX^%d ",poly1[i],i);
    }

    printf("\n Polynomial 2..=> ");
    for(i=n2;i>=0;i--)
    {
        if(poly2[i]>=0)
        {
                if(i!=n2)
                {
                        printf("+ ");
                }
        }
        printf("%dX^%d ",poly2[i],i);
    }

    res=(n1>n2)?n1:n2;
    for(i=0;i<=res;i++)
    {
        poly3[i]=poly1[i]+poly2[i];
    }

    printf("\n Addition of two polynomial");
    printf("\n-------------------------- \n");
    for(i=(res);i>=0;i--)
    {

        if(poly3[i]>=0)
        {
                if(i!=(res))
                {
                        printf("+ ");
                }
        }
        printf("%dX^%d ",poly3[i],i);
    }
    getch();
}
```

==========
OUTPUT
==========

```
 Enter Max of polynomial:5

 Enter Polynomial 1..
 Enter Poly co_0 :-9

 Enter Poly co_1 :6

 Enter Poly co_2 :3

 Enter Poly co_3 :2

 Enter Poly co_4 :2

 Enter Poly co_5 :2

 Enter Max of polynomial 2:4

 Enter Polynomial 2..
 Enter Poly co_0 :4

 Enter Poly co_1 :-9

 Enter Poly co_2 :0

 Enter Poly co_3 :1

 Enter Poly co_4 :3

 Polynomial 1..=> 2X^5 + 2X^4 + 2X^3 + 3X^2 + 6X^1 -9X^0
 Polynomial 2..=> 3X^4 + 1X^3 + 0X^2 -9X^1 + 4X^0
 Addition of two polynomial
--------------------------
2X^5 + 5X^4 + 3X^3 + 3X^2 -3X^1 -5X^0

========
OUTPUT
========

 Enter Max of polynomial:4

 Enter Polynomial 1..
 Enter Poly co_0 :-9

 Enter Poly co_1 :6

 Enter Poly co_2 :3
```

```
 Enter Poly co_3 :0

 Enter Poly co_4 :2

 Enter Max of polynomial 2:4

 Enter Polynomial 2..
 Enter Poly co_0 :4

 Enter Poly co_1 :-9

 Enter Poly co_2 :0

 Enter Poly co_3 :1

 Enter Poly co_4 :3

 Polynomial 1..=> 2X^4 + 0X^3 + 3X^2 + 6X^1 -9X^0
 Polynomial 2..=> 3X^4 + 1X^3 + 0X^2 -9X^1 + 4X^0
 Addition of two polynomial
--------------------------
5X^4 + 1X^3 + 3X^2 -3X^1 -5X^0
```

==========

2. Polynomial Multiplication with Array

==========

```
#include<stdio.h>
#include<conio.h>

void main()
{
	int n,n1,n2,poly1[10], poly2[10],poly3[50][50],poly4[50]
[50],i,j,res,coff,pw,k=0,sum;

	printf("\n Enter Max of polynomial:");
	scanf("%d",&n1);

	printf("\n Enter Polynomial 1..");
	for(i=0;i<=n1;i++)
	{
		printf("\n Enter Poly co_%d :", i);
		scanf("%d",&poly1[i]);
	}
```

```
printf("\n Enter Max of polynomial 2:");
scanf("%d",&n2);

printf("\n Enter Polynomial 2..");
for(i=0;i<=n2;i++)
{
	printf("\n Enter Poly co_%d :", i);
	scanf("%d",&poly2[i]);
}

printf("\n Polynomial 1..=> ");
for(i=n1;i>=0;i--)
{
	if(poly1[i]>=0)
	{
		if(i!=n1)
		{
			printf("+ ");
		}
	}
	printf("%dX^%d ",poly1[i],i);
}

printf("\n Polynomial 2..=> ");
for(i=n2;i>=0;i--)
{
	if(poly2[i]>=0)
	{
		if(i!=n2)
		{
			printf("+ ");
		}
	}
	printf("%dX^%d ",poly2[i],i);
}

if(n1==n2)
{
	res=n1;
}
else if(n1>n2)
{
	res=n1;
}
else
{
	res=n2;
```

```
}

k=0;
for(i=0;i<=n1;i++)
{
	for(j=0;j<=n2;j++)
	{
		coff=poly1[i]*poly2[j];
		pw=i+j;

		poly3[k][0]=coff;
		poly3[k][1]=pw;
		k++;
	}
}


for(k=0;k<=(n1+n2);k++)
{
	sum=0;
	for(i=0;i<((n1+1)*(n2+1));i++)
	{
		if(poly3[i][1]==k)
		{
			sum = sum + poly3[i][0];
		}
	}
	poly4[k][0]=sum;
	poly4[k][1]=k;
}


printf("\n Multiplication of Polynomial");
printf("\n----------------------------\n");

for(i=(n1+n2);i>=0;i--)
{
	for(j=0;j<1;j++)
	{
		if(poly4[i][j]>=0)
		{
			if(i!=(n1+n2))
			{
				printf("+ ");
			}
		}
	printf("%dX^%d ",poly4[i][j], poly4[i][j+1]);
	}
```

```
        }
        getch();
}
```

```
=========
OUTPUT
=========

 Enter Max of polynomial:4

 Enter Polynomial 1..
 Enter Poly co_0 :-9

 Enter Poly co_1 :6

 Enter Poly co_2 :3

 Enter Poly co_3 :0

 Enter Poly co_4 :2

 Enter Max of polynomial 2:4

 Enter Polynomial 2..
 Enter Poly co_0 :4

 Enter Poly co_1 :-9

 Enter Poly co_2 :0

 Enter Poly co_3 :1

 Enter Poly co_4 :3

 Polynomial 1..=> 2X^4 + 0X^3 + 3X^2 + 6X^1 -9X^0
 Polynomial 2..=> 3X^4 + 1X^3 + 0X^2 -9X^1 + 4X^0
 Multiplication of Polynomial
----------------------------
6X^8 + 2X^7 + 9X^6 + 3X^5 -13X^4 -36X^3 -42X^2 + 105X^1 -36X^0
```

```
================================
3. Polynomial Addition with Link List
================================
```

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

struct Poly
{
	int coff;
	int pw;
	struct Poly *next;
};

struct Poly * Create_Poly(struct Poly *first,struct Poly **last )
{
	int n;
	printf("\n Enter Max of polynomial:");
	scanf("%d",&n);

	while(n!=-1)
	{
		struct Poly *new_node=NULL;

		new_node=(struct Poly *)malloc(sizeof(struct Poly));

		printf("\n Enter coeffcient:");
		scanf("%d",&new_node->coff);
		printf("\n Enter Power:");
		scanf("%d",&new_node->pw);
		new_node->next=NULL;

		if(first==NULL)
		{
			first=new_node;
			*last=first;
		}
		else
		{
			(*last)->next=new_node;
			(*last)=new_node;
		}
		n--;
	}
	printf("\n List Created Successfully.");
	return first;
}
void Display(struct Poly *first)
{
	struct Poly *p;
	p=first;
```

```
	while(p!=NULL)
	{
		if(p->coff>=0)
		{
				if(p!=first)
				{
					printf("+ ");
				}

		}
		printf("%dX^%d ",p->coff,p->pw);
		p=p->next;
	}


}

void  Addition(struct Poly *first,struct Poly *first_2,struct Poly *first_3,struct
Poly **last_3)
{
	int n,n1,n2,p1_coff=0,p2_coff=0,sum;
	struct Poly *p,*p2,*outer_first,*outer_first_2;

	n1=first->pw;		//max coeff poly1
	n2=first->pw;		//max coeff poly2
	if(n1>n2)
		n=n1;//n is the maximum coefficient from two poly
	else
		n=n2;

	outer_first=first;
	outer_first_2=first_2;


	while(outer_first!=NULL || outer_first_2!=NULL)
	{
		struct Poly *new_node=NULL;

		new_node=(struct Poly *)malloc(sizeof(struct Poly));

			new_node->next=NULL;

		p=first;
		p2=first_2;
		p1_coff=0;
		p2_coff=0;
```

```
while(n<=p->pw && p->next!=NULL)
{

	if(p->pw==n)
	{
		p1_coff=p->coff;
	}

	if(n==0 && p->next->pw==0)
	{
		p1_coff=p->next->coff;
	}
	p=p->next;

}
while(n<=p2->pw && p2->next!=NULL)
{
	if(p2->pw==n)
	{
		p2_coff=p2->coff;
	}
	if(n==0 && p2->next->pw==0)
	{
		p2_coff=p2->next->coff;
	}
	p2=p2->next;
}


sum=(p1_coff)+(p2_coff);
new_node->coff=sum;
new_node->pw=n;

/// add the node
if(first_3==NULL)
{
	first_3=new_node;
	(*last_3)=first_3;
}
else
{
	(*last_3)->next=new_node;
	(*last_3)=new_node;
}


if(outer_first!=NULL)
{
```

```
                outer_first=outer_first->next;
        }

        if(outer_first_2!=NULL)
        {
                outer_first_2=outer_first_2->next;
        }
        n--;

    }

    printf("\n Addition of two Polynomial");
    printf("\n--------------------------\n");

    Display(first_3);
}

void main()
{
    struct Poly *first=NULL;
    struct Poly *last=NULL;

    struct Poly *first_2=NULL;
    struct Poly *last_2=NULL;

    struct Poly *first_3=NULL;
    struct Poly *last_3=NULL;

    int ch,count;
    char choice='n';

    printf("\n---------------");
    printf("\n 1.Create two Polynomial");
    printf("\n 2.Display");
    printf("\n 3.Addition");
    printf("\n---------------");

    do
    {
        printf("\n Enter Your choice:");
        scanf("%d",&ch);
        switch(ch)
        {
            case 1:
                    first=Create_Poly(first,&last);
                    first_2=Create_Poly(first_2,&last_2);
                    break;
            case 2:
```

```
                                printf("\n Polynomial 1.. -> ");
                                Display(first);

                                printf("\n Polynomial 2.. -> ");
                                Display(first_2);
                                break;
                        case 3:
                                Addition(first,first_2,first_3,&last_3);
                                break;
                }
                printf("\n Do You want to continue:");
                scanf(" %c",&choice);


        }while(choice=='y' || choice=='Y');


        getch();
}
```

==========
OUTPUT
==========

```
---------------
 1.Create two Polynomial
 2.Display
 3.Addition
---------------
 Enter Your choice:1

 Enter Max of polynomial:4

 Enter coeffcient:2

 Enter Power:4

 Enter coeffcient:0

 Enter Power:3

 Enter coeffcient:3

 Enter Power:2

 Enter coeffcient:6
```

```
 Enter Power:1

 Enter coeffcient:-9

 Enter Power:0

 List Created Successfully.
 Enter Max of polynomial:4

 Enter coeffcient:3

 Enter Power:4

 Enter coeffcient:1

 Enter Power:3

 Enter coeffcient:0

 Enter Power:2

 Enter coeffcient:-9

 Enter Power:1

 Enter coeffcient:4

 Enter Power:0

 List Created Successfully.
 Do You want to continue:y

 Enter Your choice:2

 Polynomial 1.. -> 2X^4 + 0X^3 + 3X^2 + 6X^1 -9X^0
 Polynomial 2.. -> 3X^4 + 1X^3 + 0X^2 -9X^1 + 4X^0
 Do You want to continue:y

 Enter Your choice:3

  Addition of two Polynomial
--------------------------
5X^4 + 1X^3 + 3X^2 -3X^1 -5X^0
 Do You want to continue:n


=========
OUTPUT-2
```

```
=========

--------------
 1.Create two Polynomial
 2.Display
 3.Addition
--------------
 Enter Your choice:1

 Enter Max of polynomial:5

 Enter coeffcient:2

 Enter Power:5

 Enter coeffcient:2

 Enter Power:4

 Enter coeffcient:2

 Enter Power:3

 Enter coeffcient:3

 Enter Power:2

 Enter coeffcient:6

 Enter Power:1

 Enter coeffcient:-9

 Enter Power:0

 List Created Successfully.
 Enter Max of polynomial:4

 Enter coeffcient:3

 Enter Power:4

 Enter coeffcient:1

 Enter Power:3

 Enter coeffcient:0
```

```
 Enter Power:2

 Enter coeffcient:-9

 Enter Power:1

 Enter coeffcient:4

 Enter Power:0

 List Created Successfully.
 Do You want to continue:y

 Enter Your choice:2

 Polynomial 1.. -> 2X^5 + 2X^4 + 2X^3 + 3X^2 + 6X^1 -9X^0
 Polynomial 2.. -> 3X^4 + 1X^3 + 0X^2 -9X^1 + 4X^0
 Do You want to continue:y

 Enter Your choice:3

 Addition of two Polynomial
--------------------------
2X^5 + 5X^4 + 3X^3 + 3X^2 -3X^1 -5X^0
 Do You want to continue:n
```

==========
4. Polynomial Multiplication with LL
==========

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

struct Poly
{
        int coff;
        int pw;
        struct Poly *next;
};

struct Poly * Create_Poly(struct Poly *first,struct Poly **last )
{
        int n;
```

```
	printf("\n Enter Max of polynomial:");
	scanf("%d",&n);

	while(n!=-1)
	{
		struct Poly *new_node=NULL;

		new_node=(struct Poly *)malloc(sizeof(struct Poly));

		printf("\n Enter coeffcient:");
		scanf("%d",&new_node->coff);
		printf("\n Enter Power:");
		scanf("%d",&new_node->pw);
		new_node->next=NULL;

		if(first==NULL)
		{
			first=new_node;
			*last=first;
		}
		else
		{
			(*last)->next=new_node;
			(*last)=new_node;
		}
		n--;
	}
	printf("\n List Created Successfully.");
	return first;
}
void Display(struct Poly *first)
{
	struct Poly *p;
	p=first;

	while(p!=NULL)
	{
		if(p->coff>=0)
		{
				if(p!=first)
				{
					printf("+ ");
				}

		}
		printf("%dX^%d ",p->coff,p->pw);
		p=p->next;
	}
```

```
}

void  Multiplication(struct Poly *first,struct Poly *first_2,struct Poly
*first_3,struct Poly **last_3)
{
	int n,n1,n2,coff1,coff2,pw1,pw2,max_co,sum=0,found=0;

	struct Poly *p,*p2,*first_temp=NULL,*last_temp=NULL;

	n1=first->pw;		//max coeff poly1
	n2=first->pw;		//max coeff poly2


	//cross multiply
	p=first;
	while(p!=NULL)
	{
		coff1=p->coff;
		pw1=p->pw;
		p2=first_2;
		while(p2!=NULL)
		{
			struct Poly *new_node=NULL;

			new_node=(struct Poly *)malloc(sizeof(struct Poly));
			new_node->next=NULL;

			coff2=p2->coff;
			pw2=p2->pw;


			new_node->coff=(coff1*coff2);
			new_node->pw=(pw1+pw2);

			/// add the node
			if(first_temp==NULL)
			{
				first_temp=new_node;
				last_temp=first_temp;
			}
			else
			{
				last_temp->next=new_node;
				last_temp=new_node;
			}
```

```
                p2=p2->next;
        }
        p=p->next;
}


max_co=(n1+n2);

for(int i=max_co;i>=0;i--)
{
        p=first_temp;
        sum=0;
        found=0;
        while(p!=NULL)
        {
                if(p->pw==i)
                {
                        sum=sum+p->coff;
                        found=1;
                }

                p=p->next;
        }

        if(found)
        {
                struct Poly *new_node=NULL;
                new_node=(struct Poly *)malloc(sizeof(struct Poly));
                new_node->next=NULL;
                new_node->coff=sum;
                new_node->pw=i;

                if(first_3==NULL)
                {
                        first_3=new_node;
                        (*last_3)=first_3;
                }
                else
                {
                        (*last_3)->next=new_node;
                        (*last_3)=new_node;
                }

        }

}
```

```
        printf("\n Multiplication of two Polynomial");
        printf("\n--------------------------\n");

        Display(first_3);
}

void main()
{
        struct Poly *first=NULL;
        struct Poly *last=NULL;

        struct Poly *first_2=NULL;
        struct Poly *last_2=NULL;

        struct Poly *first_3=NULL;
        struct Poly *last_3=NULL;

        int ch,count;
        char choice='n';

        printf("\n---------------");
        printf("\n 1.Create two Polynomial");
        printf("\n 2.Display");
        printf("\n 3.Addition");
        printf("\n---------------");

        do
        {
                printf("\n Enter Your choice:");
                scanf("%d",&ch);
                switch(ch)
                {
                        case 1:
                                        first=Create_Poly(first,&last);
                                        first_2=Create_Poly(first_2,&last_2);
                                        break;
                        case 2:
                                        printf("\n Polynomial 1.. -> ");
                                        Display(first);

                                        printf("\n Polynomial 2.. -> ");
                                        Display(first_2);
                                        break;
                        case 3:
                                        Multiplication(first,first_2,first_3,&last_3);
```

```
                                    break;
                }
                printf("\n Do You want to continue:");
                scanf(" %c",&choice);


        }while(choice=='y' || choice=='Y');


        getch();
}
```

==========
OUTPUT
==========

```
---------------
 1.Create two Polynomial
 2.Display
 3.Addition
---------------
 Enter Your choice:1

 Enter Max of polynomial:4

 Enter coeffcient:2

 Enter Power:4

 Enter coeffcient:0

 Enter Power:3

 Enter coeffcient:3

 Enter Power:2

 Enter coeffcient:6

 Enter Power:1

 Enter coeffcient:-9

 Enter Power:0

 List Created Successfully.
 Enter Max of polynomial:4
```

```
 Enter coeffcient:3

 Enter Power:4

 Enter coeffcient:1

 Enter Power:3

 Enter coeffcient:0

 Enter Power:2

 Enter coeffcient:-9

 Enter Power:1

 Enter coeffcient:4

 Enter Power:0

 List Created Successfully.
 Do You want to continue:y

 Enter Your choice:2

 Polynomial 1.. -> 2X^4 + 0X^3 + 3X^2 + 6X^1 -9X^0
 Polynomial 2.. -> 3X^4 + 1X^3 + 0X^2 -9X^1 + 4X^0
 Do You want to continue:y

 Enter Your choice:3

 Multiplication of two Polynomial
--------------------------
6X^8 + 2X^7 + 9X^6 + 3X^5 -13X^4 -36X^3 -42X^2 + 105X^1 -36X^0
 Do You want to continue:n
```

==========

5. Singly Linked List (3 Insertions, 3 Deletions, Counting, Display List)

==========

```
#include<stdio.h>
```

```
#include<conio.h>
#include<malloc.h>

struct Stud
{
	int data;
	struct Stud *next;
};

struct Stud * CreateList(struct Stud *first,struct Stud **last )
{
	int n;
	printf("\n Enter number of nodes you want to create:");
	scanf("%d",&n);

	while(n!=0)
	{

		struct Stud *new_node=NULL;

		new_node=(struct Stud *)malloc(sizeof(struct Stud));

		printf("\n Enter data:");
		scanf("%d",&new_node->data);
		new_node->next=NULL;

		if(first==NULL)
		{
			first=new_node;
			*last=first;
		}
		else
		{
			(*last)->next=new_node;
			(*last)=new_node;
		}
		n--;
	}
	printf("\n List Created Successfully.");
	return first;
}
struct Stud * InsertEnd(struct Stud *first,struct Stud **last )
{
	struct Stud *new_node=NULL;
	new_node=(struct Stud *)malloc(sizeof(struct Stud));

	printf("\n Enter data:");
	scanf("%d",&new_node->data);
```

```
	new_node->next=NULL;

	if(first==NULL)
	{
		first=new_node;
		*last=first;
	}
	else
	{
		(*last)->next=new_node;
		(*last)=new_node;
	}
	printf("\n Node Added Successfully.");
	return first;
}
struct Stud * InsertBeg(struct Stud *first,struct Stud *last )
{
	struct Stud *new_node=NULL;
	new_node=(struct Stud *)malloc(sizeof(struct Stud));

	printf("\n Enter data:");
	scanf("%d",&new_node->data);
	new_node->next=NULL;

	if(first==NULL)
	{
		first=new_node;
		last=first;
	}
	else
	{
		new_node->next=first;
		first=new_node;
	}
	printf("\n Node Added Successfully.");
	return first;
}

struct Stud * InsertAnywhere(struct Stud *first,struct Stud **last )
{

	struct Stud *new_node=NULL;

	int N=0,pos=0,cnt=0,insert=0;
	struct Stud *p,*temp;
	p=first;

	while(p!=NULL)			//count the number of nodes
```

```
{
	p=p->next;
	N=N+1;
}
printf("\n cnt is:%d",N);

new_node=(struct Stud *)malloc(sizeof(struct Stud));
printf("\n Enter data:");
scanf("%d",&new_node->data);
new_node->next=NULL;

if(first==NULL)			//if list empty insert 1 node at begning
{
		first=new_node;
		*last=first;
		insert=1;
}
else
{
	printf("\n Enter pogision where you have to add the nodes:");
	scanf("%d",&pos);
}

if(pos>=0 && pos<=(N+1))
{

	if(N==1)		//if only 1 node in the list
	{
		if(pos==1)		//if we have to add at first position
		{
			new_node->next=first;
			first=new_node;
			insert=1;
		}
		else if(pos==2)	//if we have to add at 2nd position
		{
			first->next=new_node;
			(*last)=new_node;
			insert=1;
		}
	}
	else		//there is multiple node in list
	{
		p=first;
		cnt=1;
		while(p!=NULL)
		{
			if(cnt==(pos-1))
```

```
                        {
                                if(pos==(N+1))     //at the end
                                {
                                        (*last)->next=new_node;
                                        (*last)=new_node;
                                        insert=1;
                                }
                                else            //at anywhere
                                {
                                        temp=p->next;
                                        p->next=new_node;
                                        new_node->next=temp;
                                        insert=1;
                                }
                        }
                        p=p->next;
                        cnt++;

                }

        }

        if(insert)
        {
                printf("\n Node Added Successfully.");
        }
    }
    else
    {
        printf("Invalid position");
    }

    return first;
}

struct Stud * DeleteBeg(struct Stud *first,struct Stud **last )
{
    struct Stud *temp;

    if(first==NULL)
    {
        printf("\n List is Empty.");
    }
    else
    {
        if(first==(*last))    //if only one node is exist
        {
                temp=first;
```

```
                free(temp);
                first=NULL;
                (*last)=NULL;
                printf("\n Deleted Successfully.");
        }
        else            //delete node from the begining
        {
                temp=first;
                first=first->next;
                free(temp);
                printf("\n Deleted Successfully.");
        }
    }
    retur  n first;
}

struct Stud * DeleteEnd(struct Stud *first,struct Stud **last )
{
    struct Stud *temp,*p;

    if(first==NULL)
    {
        printf("\n List is Empty.");
    }
    else
    {
        if(first==(*last))    //if only one node is exist
        {
                temp=first;
                free(temp);
                first=NULL;
                (*last)=NULL;
                printf("\n Deleted Successfully.");
        }
        else
        {
                p=first;
                while(p->next->next!=NULL)
                {
                        p=p->next;
                }
                temp=p->next;
                p->next=NULL;
                (*last)=p;
                free(temp);
                printf("\n Deleted Successfully.");
        }
    }
```

```
	return first;
}

struct Stud * DeleteAnywhere(struct Stud *first,struct Stud **last )
{
	struct Stud *temp,*p;
	int N=0,pos=0,cnt=0,found=0;

	p=first;
	while(p!=NULL)			//count the number of nodes
	{
		p=p->next;
		N=N+1;
	}


	if(first==NULL)
	{
		printf("\n List is Empty.");
	}

	if(N==1)	//if only one node into the list
	{
		temp=first;
		free(temp);
		first=NULL;
		(*last)=NULL;
		found=1;
	}
	else
	{
		printf("\n Enter pogision which you want to delete a node:");
		scanf("%d",&pos);
	}

	if(N!=1 && pos>0 && pos<=N)
	{
		if(pos==1)			//delete node from the begining
		{
			temp=first;
			first=first->next;
			free(temp);
			found=1;


		}
		else if(pos==N) //delete from the end
		{
```

```
                p=first;
                while(p->next->next!=NULL)
                {
                        p=p->next;
                }
                temp=p->next;
                p->next=NULL;
                (*last)=p;
                free(temp);
                found=1;

        }
        else            //delete from anywhere
        {
                p=first;
                cnt=1;
                while(p!=NULL)
                {
                        if(cnt==(pos-1))
                        {
                                temp=p->next;
                                p->next=p->next->next;
                                free(temp);

                        }
                        p=p->next;
                        cnt++;

                }
        }
        found=1;
    }


    if(found)
    {
        printf("\n Deleted Successfully.");
    }
    else
    {
        printf("\n Invalid Position..");
    }

    return first;
}
int CountNode(struct Stud *first)
{
    struct Stud *p;
```

```
	int cnt=0;

	p=first;
	while(p!=NULL)			//count the number of nodes
	{
		p=p->next;
		cnt=cnt+1;
	}
	printf("\n Total number of nodes is:%d",cnt);
	return cnt;
}


void Display(struct Stud *first)
{
	struct Stud *p;
	p=first;

	while(p!=NULL)
	{
		printf("%d ",p->data);
		p=p->next;
	}
}
void main()
{
	struct Stud *first=NULL;
	struct Stud *last=NULL;

	int ch,count;
	char choice='n';

	printf("\n---------------");
	printf("\n 1.Create List");
	printf("\n 2.Insert End");
	printf("\n 3.Insert Begning ");
	printf("\n 4.Insert Anywhere");
	printf("\n 5.Delete Begning");
	printf("\n 6.Delete End");
	printf("\n 7.Delete Anywhere");
	printf("\n 8.Count Nodes");
	printf("\n 9.Display");
	printf("\n---------------");

	do
	{
		printf("\n Enter Your choice:");
		scanf("%d",&ch);
```

```
            switch(ch)
            {
                  case 1:
                              first=CreateList(first,&last);
                              break;
                  case 2:
                              first=InsertEnd(first,&last);
                              break;
                  case 3:
                              first=InsertBeg(first,last);
                              break;
                  case 4:
                              first=InsertAnywhere(first,&last);
                              break;
                  case 5:
                              first=DeleteBeg(first,&last);
                              break;
                  case 6:
                              first=DeleteEnd(first,&last);
                              break;
                  case 7:first=DeleteAnywhere(first,&last);
                              break;
                  case 8:
                              count=CountNode(first);
                              break;
                  case 9:
                              Display(first);
                              break;
            }
            printf("\n Do You want to continue:");
            scanf(" %c",&choice);


      }while(choice=='y' || choice=='Y');


      getch();
}

========
OUTPUT
========

---------------
 1.Create List
 2.Insert End
 3.Insert Begning
 4.Insert Anywhere
```

```
 5.Delete Begning
 6.Delete End
 7.Delete Anywhere
 8.Count Nodes
 9.Display
---------------
 Enter Your choice:y

 Do You want to continue:
 Enter Your choice:1

 Enter number of nodes you want to create:3

 Enter data:10

 Enter data:20

 Enter data:30

 List Created Successfully.
 Do You want to continue:y

 Enter Your choice:8

 Total number of nodes is:3
 Do You want to continue:y

 Enter Your choice:9
10 20 30
 Do You want to continue:y

 Enter Your choice:2

 Enter data:89

 Node Added Successfully.
 Do You want to continue:y

 Enter Your choice:3

 Enter data:4

 Node Added Successfully.
 Do You want to continue:y

 Enter Your choice:9
4 10 20 30 89
 Do You want to continue:y
```

```
 Enter Your choice:4

 cnt is:5
 Enter data:3

 Enter pogision where you have to add the nodes:3

 Node Added Successfully.
 Do You want to continue:y

 Enter Your choice:9
4 10 3 20 30 89
 Do You want to continue:y

 Enter Your choice:5

 Deleted Successfully.
 Do You want to continue:y

 Enter Your choice:9
10 3 20 30 89
 Do You want to continue:y

 Enter Your choice:6

 Deleted Successfully.
 Do You want to continue:y

 Enter Your choice:9
10 3 20 30
 Do You want to continue:y

 Enter Your choice:7

 Enter pogision which you want to delete a node:2

 Deleted Successfully.
 Do You want to continue:y

 Enter Your choice:9
10 20 30
 Do You want to continue:n


======================
6. Stack with Array
======================
```

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>
int top = -1;


void Push(int stack[],int size,int key)
{
	if(top>=(size-1))
	{
		printf("\n Overflow..");
	}
	else
	{
		top=top+1;
		stack[top]=key;
	}
}

int Pop(int stack[],int size)
{
	int data;

	if(top==-1)
	{
		printf("\n Underflow...");
		//data=-1;
		return NULL;
	}
	else
	{
		data=stack[top];
		top=top-1;
	}

	return data;
}

void Display(int stack[],int size)
{
	int i;

	if(top>-1)
	{
		for(i=top;i>=0;i--)
		{
			printf("%d ",stack[i]);
```

```
		}
	}
	else
	{
		printf("\n Stack is Empty...");
	}
}

void main()
{
	int stack[10],ch,size=3,key,res;
	char choice='n';

	printf("\n---------");
	printf("\n 1.push");
	printf("\n 2.pop");
	printf("\n 3.Display");
	printf("\n---------");
	do
	{
		printf("\n Enter Your Choice:");
		scanf("%d",&ch);
		switch(ch)
		{
			case 1: printf("\n Enter Key:");
				scanf("%d",&key);
				Push(stack,size,key);
				break;
			case 2:
				res=Pop(stack,size);
				printf("\n Element is:%d",res);
				break;
			case 3:
				Display(stack,size);
				break;
		}
		printf("\n Do you want to continue..");
		scanf(" %c",&choice);

	}while(choice=='Y' || choice=='y');

	getch();
}
```

==========
OUTPUT
==========

```
---------
 1.push
 2.pop
 3.Display
---------
 Enter Your Choice:1

 Enter Key:10

 Do you want to continue..y

 Enter Your Choice:1

 Enter Key:20

 Do you want to continue..y

 Enter Your Choice:1

 Enter Key:30

 Do you want to continue..y

 Enter Your Choice:1

 Enter Key:40

 Overflow..
 Do you want to continue..y

 Enter Your Choice:3
30 20 10
 Do you want to continue..y

 Enter Your Choice:2

 Element is:30
 Do you want to continue..y

 Enter Your Choice:2

 Element is:20
 Do you want to continue..y

 Enter Your Choice:2

 Element is:10
```

```
Do you want to continue..y

Enter Your Choice:2

Underflow...
Element is:0
Do you want to continue..
```

==========
7. Stack with Link List
==========

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

struct Stack
{
	int data;
	struct Stack *next;
};

struct Stack *first;


void Push(int key)
{
	struct Stack *new_node=NULL;
	new_node=(struct Stack *)malloc(sizeof(struct Stack));
	new_node->data=key;
	if(first==NULL)			//if list is empty
	{
		new_node->next=NULL;
		first=new_node;
	}
	else
	{
		new_node->next=first;
		first=new_node;
	}
}

int Pop()
```

```
{
	struct Stack *temp;
	int data;

	if(first==NULL)
	{
		printf("\n Underflow..");
		return NULL;
	}
	else
	{
		temp=first;
		first=first->next;
		data=temp->data;
		free(temp);
		return data;
	}

}

void Display()
{
	struct Stack *p;
	p=first;

	while(p!=NULL)
	{
		printf("%d ",p->data);
		p=p->next;
	}
}
void main()
{

	int ch,count,key,res;
	char choice='n';

	printf("\n---------------");
	printf("\n 1.Push ");
	printf("\n 2.Pop");
	printf("\n 3.Display");
	printf("\n---------------");

	do
	{
		printf("\n Enter Your choice:");
		scanf("%d",&ch);
		switch(ch)
```

```
            {
                  case 1:       printf("\n Enter Key:");
                                scanf("%d",&key);

                                Push(key);
                                break;
                  case 2:
                                res=Pop();
                                printf("\n Element is:%d",res);
                                break;
                  case 3:
                                Display();
                                break;
            }
            printf("\n Do You want to continue:");
            scanf(" %c",&choice);

      }while(choice=='y' || choice=='Y');


      getch();
}
```

```
=========
OUTPUT
=========

---------------
 1.Push
 2.Pop
 3.Display
---------------
 Enter Your choice:1

 Enter Key:10

 Do You want to continue:y

 Enter Your choice:1

 Enter Key:20

 Do You want to continue:y

 Enter Your choice:1

 Enter Key:30
```

```
 Do You want to continue:y

 Enter Your choice:3
30 20 10
 Do You want to continue:y

 Enter Your choice:2

 Element is:30
 Do You want to continue:y

 Enter Your choice:3
20 10
 Do You want to continue:y

 Enter Your choice:2

 Element is:20
 Do You want to continue:y

 Enter Your choice:2

 Element is:10
 Do You want to continue:y

 Enter Your choice:2

 Underflow..
 Element is:0
 Do You want to continue:
```

==========
8. Factorial with Recursion
==========

```
#include<stdio.h>
#include<conio.h>

int fact(int n)
{
	if(n==1)
		return 1;
	else
		return n*fact(n-1);
}
```

```
void main()
{
	int no,res;
	printf("\n Enter Number:");
	scanf("%d",&no);

	res=fact(no);

	printf("\n %d",res);
	getch();

}
```

```
=======
OUTPUT
=======

Enter Number:5

 120
```

```
==================================
9. Fibonacci Series with Recursion
==================================
#include<stdio.h>
#include<conio.h>

int Fibo(int n)
{
	if(n==0)
		return 0;
	else if(n==1)
		return 1;
	else
		return (Fibo(n-1) + Fibo(n-2));
}
void main()
{
	int n,res;
	printf("\n Enter Number:");
	scanf("%d",&n);

	for(int i=0;i<n;i++)
	{
		printf("%d ",Fibo(i));
```

```
	}

	getch();

}
```

```
========
OUTPUT
========

Enter Number:10
0 1 1 2 3 5 8 13 21 34
```

```
==========================================
10. Any other Series with Recursion(eg. sine series)
==========================================

#include<stdio.h>
#include<conio.h>
#include<math.h>
double sinx(double,int);
int fact(int);
void main()
{
	int n;
	double x,ans;
	printf("Enter value of x: ");
	scanf("%lf",&x);
	printf("Enter how many terms you want to calculate: ");
	scanf("%d",&n);
	ans=sinx(x,n);
	printf("\nsin(%.2f) = %.4f",x,ans);
	getch();
}

double sinx(double x,int n)
{
	if(n==1)
		return x;
	else if(n%2==0)
			return (sinx(x,n-1) - (pow(x,(2*n-1))/(fact(2*n-1))));
	else
		return (sinx(x,n-1) + (pow(x,(2*n-1))/(fact(2*n-1))));
}
```

```
int fact(int num)
{
	if(num==2)
		return 2;
	else
	{
		num=num*fact(num-1);
		return num;
	}
}
```

```
=========
OUTPUT
=========

Enter value of x: 2
Enter how many terms you want to calculate: 3

sin(2.00) = 0.9333
```

```
==========================================
11. Equation validation with brackets  using Array
==========================================

#include<stdio.h>
#include<conio.h>
#include<malloc.h>
int top = -1;

void Push(char stack[],int size,char key)
{
	if(top>=(size-1))
	{
		printf("\n Overflow..");
	}
	else
	{
		top=top+1;
		stack[top]=key;
	}
}

char Pop(char stack[],int size)
{
```

```
	int data;

	if(top==-1)
	{
		printf("\n Underflow...");
		return NULL;
	}
	else
	{
		data=stack[top];
		stack[top]=NULL;
		top=top-1;
	}

	return data;
}

void Display(char stack[],int size)
{
	int i;

	if(top>-1)
	{
		for(i=top;i>=0;i--)
		{
			printf("%c ",stack[i]);
		}
	}
	else
	{
		printf("\n Stack is Empty...");
	}
}

char stackPop(char stack[])
{
	if(top!=0)
	{
		return stack[top];
	}
	else
		return stack[top];
}
void main()
{
	char str[20],stack[20],key,prv_char;

	int i,cnt=0,size,invalid=0;
```

```
	printf("\n Enter String:");
	scanf("%s",str);

	for(int i=0;str[i]!='\0';i++)
	{
		cnt++;
	}
	size=cnt;
	for(int i=0;str[i]!='\0';i++)
	{

		key=str[i];

		if(key=='(' || key=='{' || key=='[')
		{
			Push(stack,size,key);
		}
		else if(key==')' || key=='}' || key==']')
		{
			prv_char=stackPop(stack);

			if(prv_char=='{' && key=='}' || prv_char=='(' && key==')'
|| prv_char=='[' && key==']')
			{
				Pop(stack,size);
			}
			else
			{
				printf("\n Invalid Expression...");
				invalid=1;
				break;
			}
		}

	}
	if(!invalid)
	{
		printf("Bracket are Balanced.. :)");
	}
	getch();
}
```

```
=======
OUTPUT
=======

 Enter String:{[]()}
Bracket are Balanced.. :)
```

==========
11. Equation validation with brackets using Link List
==========

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

struct Queue
{
	char data;
	struct Queue *next;
};
void Push(struct Queue **front,struct Queue **rear, char key)
	//Insert Beg
{
	struct Queue *new_node=NULL;
	new_node=(struct Queue *)malloc(sizeof(struct Queue));

	new_node->data=key;
	new_node->next=NULL;

	if((*front)==NULL)
	{
		(*front)=new_node;
		(*rear)=(*front);
	}
	else
	{
		new_node->next=(*front);
		(*front)=new_node;
	}

}

char stackPop(struct Queue *front)
{
	 return front->data;
}
char Pop(struct Queue **front,struct Queue **rear )	//delete beg
{
	struct Queue *temp;
	char key;
	if((*front)==NULL)
```

```
	{
		printf("\n List is Empty.");
	}
	else
	{
		if((*front)==(*rear))	//if only one node is exist
		{
			temp=(*front);
			key=temp->data;
			free(temp);
			(*front)=NULL;
			(*rear)=NULL;

		}
		else		//delete node from the begining
		{
			temp=(*front);
			(*front)=(*front)->next;
			key=temp->data;
			free(temp);

		}
	}
	return key;
}


void Display(struct Queue *front)
{
	struct Queue *p;
	p=front;

	if(p==NULL)
	{
		printf("\n Queue is empty..");
	}
	{
		while(p->next!=front)
		{
			printf("%d ",p->data);
			p=p->next;
		}
		printf("%d ",p->data);
	}
}


void main()
```

```
{
	struct Queue *front=NULL;
	struct Queue *rear=NULL;

	char str[20],key,prv_char;

	int i,cnt=0,size,invalid=0;
	printf("\n Enter String:");
	scanf("%s",str);

	for(int i=0;str[i]!='\0';i++)
	{
		cnt++;
	}
	size=cnt;
	for(int i=0;str[i]!='\0';i++)
	{

		key=str[i];

		if(key=='(' || key=='{' || key=='[')
		{
			Push(&front,&rear,key);
		}
		else if(key==')' || key=='}' || key==']')
		{
			prv_char=stackPop(front);

			if(prv_char=='{' && key=='}' || prv_char=='(' && key==')'
|| prv_char=='[' && key==']')
			{
				Pop(&front,&rear);
			}
			else
			{
				printf("\n Invalid Expression...");
				invalid=1;
				break;
			}
		}

	}
	if(!invalid)
	{
		printf("Bracket are Balanced.. :)");
	}
	getch();
}
```

```
=======
OUTPUT
=======

 Enter String:{[]}[]
Bracket are Balanced.. :)
```

```
=========================================
12. Infix to Postfix Conversion Using Link List
=========================================
#include<stdio.h>
#include<conio.h>
#include<malloc.h>
int top = -1;

void Push(char stack[],int size,char key)
{
	if(top>=(size-1))
	{
		printf("\n Overflow..");
	}
	else
	{
		top=top+1;
		stack[top]=key;
	}
}

char Pop(char stack[],int size)
{
	int data;

	if(top==-1)
	{
		printf("\n Underflow...");
		return NULL;
	}
	else
	{

		data=stack[top];
		stack[top]=NULL;
		top=top-1;
```

```
	}

	return data;
}

void Display(char stack[],int size)
{
	int i;

	if(top>-1)
	{
		for(i=top;i>=0;i--)
		{
			printf("%c ",stack[i]);
		}
	}
	else
	{
		printf("\n Stack is Empty...");
	}
}

char stackPop(char stack[])
{
	if(top!=-1)
	{
		return stack[top];
	}
	else
	{
		return stack[0];
	}
}

bool balance_bracket(char str[],char stack[],int size)
{
	char key,prv_char;

	int i,cnt=0,invalid=0;



	for(int i=0;str[i]!='\0';i++)
	{

		key=str[i];
```

```
		if(key=='(' || key=='{' || key=='[')
		{
			Push(stack,size,key);
		}
		else if(key==')' || key=='}' || key==']')
		{
			prv_char=stackPop(stack);

			if(prv_char=='{' && key=='}' || prv_char=='(' && key==')'
|| prv_char=='[' && key==']')
			{
				Pop(stack,size);
			}
			else
			{
				printf("\n Invalid Expression...");
				invalid=1;
				break;
			}
		}

	}

	if(invalid)
	{
		return 0;
	}
	else
		return 1;

}

bool isOperand(char ch)
{

	if(ch>=65 && ch<=90 || ch>=97 && ch<=122)
	{
		return 1;
	}
	else
		return 0;
}
bool isOperator(char ch)
{
	if(ch=='+' || ch=='-' || ch=='/' || ch=='*')
		return 1;
	else
		return 0;
```

```
}

int Precedence(char ch)
{
	if(ch=='+' || ch=='-')
		return 1;
	else if(ch=='*' || ch=='/')
		return 2;
	else if(ch=='(')
		return 0;
	else
		return -1;
}
void infix_to_postfix(char stack[],char str[],int size_str)
{
	int i;
	bool res;
	char stack_val,stack_2[20],ch;

	for(int i=0;str[i]!='\0';i++)
	{
		if(str[i]=='(')
		{
			Push(stack,size_str,str[i]);
		}
		else if(isOperand(str[i]))	//if this is operand then display
		{
			printf("%c",str[i]);
		}
		else if(isOperator(str[i])) //if this is operator then
		{
			//stack_val=stackPop(stack);		// take the stck value
			while(isOperator(str[i]) &&
(Precedence(stack_val=stackPop(stack)) >= Precedence(str[i])))
	//check te priority
			{
				ch=Pop(stack,size_str);
				printf("%c",ch);
			}

			if(str[i]!='(')
			{
				Push(stack,size_str,str[i]);
			}
			else
				Push(stack,size_str,str[i]);
		}
		else if(str[i]==')')
```

```
                {
                        ch=Pop(stack,size_str);
                        while(ch!='(')                  // take the stck value)
                        {
                                printf("%c",ch);
                                ch=Pop(stack,size_str);
                        }
                }
        }
        while(top!=-1)
        {
                ch=Pop(stack,size_str);
                printf("%c",ch);
        }


}
void main()
{
        char str[20],stack[20],stack_2[20],key,prv_char;

        int i,cnt=0,size,invalid=0;
        printf("\n Enter String:");
        scanf("%s",str);

        for(int i=0;str[i]!='\0';i++)
        {
                cnt++;
        }
        size=cnt;
        if(balance_bracket(str,stack,size))
        {
                infix_to_postfix(stack,str,size);
        }
        else
        {
                printf("Invalid Expression...Try Again.");
        }
        getch();
}
```

==========
OUTPUT
==========

```
 Enter String:(a+b)*(a}
```

```
 Invalid Expression...Invalid Expression...Try Again.


 Enter String:A+B*C+D
ABC*+D+


 Enter String:(A+B)*(C+D)
AB+CD+*


 Enter String:A*B+C*D
AB*CD*+


 Enter String:A+B+C+D
AB+C+D+
```

==========
13. Postfix Expression Evaluation
==========

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>
int top = -1;

void Push(float stack[],int size,float key)
{
	if(top>=(size-1))
	{
		printf("\n Overflow..");
	}
	else
	{
		top=top+1;
		stack[top]=key;

	}
}

float Pop(float stack[],int size)
{
	float data;

	if(top==-1)
	{
		printf("\n Underflow...");
```

```
		return NULL;
	}
	else
	{

		data=stack[top];
		stack[top]=NULL;
		top=top-1;

	}

	return data;
}

bool isOperand(char ch)
{
	if(ch>=65 && ch<=90 || ch>=97 && ch<=122)
	{
		return 1;
	}
	else
		return 0;
}
bool isOperator(char ch)
{
	if(ch=='+' || ch=='-' || ch=='/' || ch=='*')
		return 1;
	else
		return 0;
}

void Evaluation_postfix(float stack[],char str[],int size_str)
{
	float value,value2,res2,res1;
	int i,result;

	char op,stack_val,ch;

	for(int i=0;str[i]!='\0';i++)
	{
		if(isOperand(str[i]))
		{

			printf("\n Enter Value for %c:",str[i]);
			scanf("%f",&value);


			Push(stack,size_str,value);
```

```
		}
		else if(isOperator(str[i]))
		{
			op=str[i];
			res2=Pop(stack,size_str);
			res1=Pop(stack,size_str);

			if(op=='+')
				result=res1 + res2;
			else if(op=='-')
				result=res1 - res2;
			else if(op=='*')
				result=res1 * res2;
			else if(op=='/')
				result=res1 / res2;

			Push(stack,size_str,result);
		}
	}

	printf("Evalution is:%.2f",Pop(stack,size_str));
}

void main()
{
	char str[20],key,prv_char;

	float stack[20];
	int i,cnt=0,size,invalid=0;
	printf("\n Enter String:");
	scanf("%s",str);

	for(int i=0;str[i]!='\0';i++)
	{
		cnt++;
	}
	size=cnt;

	Evaluation_postfix(stack,str,size);


	getch();
}
```

==========

OUTPUT

```
==========

 Enter String:AB+CD+/

 Enter Value for A:7

 Enter Value for B:8

 Enter Value for C:3

 Enter Value for D:2
Evalution is:3.00

==========
OUTPUT
==========

 Enter String:AB+C/D*E+

 Enter Value for A:100

 Enter Value for B:200

 Enter Value for C:2

 Enter Value for D:5

 Enter Value for E:7
Evalution is:757.00
```

```
==================
14. Queue with Array
==================

#include<stdio.h>
#include<conio.h>


int front =-1;
int rear = -1;

void insert(int key,int size,int queue[])
```

```
{
	if(rear==(size-1))
	{
		printf("\n Overflow");
	}
	else
	{
		if(front==-1)
		{
			front=0;
		}
		rear +=1;
		queue[rear]=key;
	}
}

void del(int queue[])
{
	if(front==-1)
	{
		printf("\n underflow");

	}
	else if(front==rear)
	{
		printf("\n Deleted item is:%d",queue[front]);
		front=-1;
		rear=-1;
	}
	else
	{
		printf("\n Deleted item is:%d",queue[front]);
		front=front+1;
	}
}

void Display(int queue[])
{
	int i;

	if(front ==-1)
	{
		printf("Queue is Empty");
	}
	else
	{

		for(i=front;i<=rear;i++)
```

```
		{
			printf("%d ",queue[i]);
		}
	}

}



void main()
{

	int queue[10],ch,count,key,res,size=5;
	char choice='n';


	printf("\n---------------");
	printf("\n 1.insert ");
	printf("\n 2.delete");
	printf("\n 3.Display");
	printf("\n---------------");

	do
	{
		printf("\n Enter Your choice:");
		scanf("%d",&ch);
		switch(ch)
		{
			case 1:		printf("\n Enter Key:");
					scanf("%d",&key);

					insert(key,size,queue);
					break;
			case 2:
					del(queue);
					break;
			case 3:
					Display(queue);
					break;

		}
		printf("\n Do You want to continue:");
		scanf(" %c",&choice);

	}while(choice=='y' || choice=='Y');
```

```
        getch();
}
```

```
=======
OUTPUT
=======


---------------
 1.insert
 2.delete
 3.Display
---------------
 Enter Your choice:1

 Enter Key:1

 Do You want to continue:y

 Enter Your choice:1

 Enter Key:2

 Do You want to continue:y

 Enter Your choice:3
1 2
 Do You want to continue:y

 Enter Your choice:2

 Deleted item is:1
 Do You want to continue:y

 Enter Your choice:2

 Deleted item is:2
 Do You want to continue:y

 Enter Your choice:3
Queue is Empty
 Do You want to continue:n



========================
15. Queue with Linked List
========================
```

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>
static int count =0;
int size=2;

struct Queue
{
	int data;
	struct Queue *next;
};
struct Queue * Insert(struct Queue *front,struct Queue **rear )
	//Insert End
{
	if(count>size-1)
	{
		printf("\n Overflow");

	}
	else
	{
		struct Queue *new_node=NULL;
		new_node=(struct Queue *)malloc(sizeof(struct Queue));

		printf("\n Enter data:");
		scanf("%d",&new_node->data);
		new_node->next=NULL;

		if(front==NULL)
		{
			front=new_node;
			*rear=front;
			count++;
		}
		else
		{
			(*rear)->next=new_node;
			(*rear)=new_node;
			count++;
		}
		printf("\n Node Added Successfully.");
	}
	return front;
}

struct Queue * Dele(struct Queue *front,struct Queue **rear )		//Delete
from begining
{
```

```
	struct Queue *temp;

	if(front==NULL)				//hear front is front and rear is rear
	{
		printf("\n Queue is Empty..Underflow");
	}
	else
	{
		if(front==(*rear))  //if only one node is exist
		{
			temp=front;
			printf("\n Deleted Item is: %d",temp->data);
			free(temp);
			front=NULL;
			(*rear)=NULL;
			count--;

		}
		else		//delete node from the begining
		{
			temp=front;
			printf("\n Deleted Item is: %d",temp->data);
			front=front->next;
			free(temp);
			count--;
		}
	}
	return front;
}


void Display(struct Queue *front)
{
	struct Queue *p;
	p=front;

	while(p!=NULL)
	{
		printf("%d ",p->data);
		p=p->next;
	}
}
void main()
{
	struct Queue *front=NULL;
	struct Queue *rear=NULL;

	int ch,count;
```

```
        char choice='n';

        printf("\n---------------");
        printf("\n 1.Insert");
        printf("\n 2.Delete");
        printf("\n 3.Display");
        printf("\n---------------");

        do
        {
                printf("\n Enter Your choice:");
                scanf("%d",&ch);
                switch(ch)
                {
                        case 1:
                                        front=Insert(front,&rear);
                                        break;
                        case 2:
                                        front=Dele(front,&rear);
                                        break;
                        case 3:
                                        Display(front);
                                        break;
                }
                printf("\n Do You want to continue:");
                scanf(" %c",&choice);

        }while(choice=='y' || choice=='Y');


        getch();
}
```

==========
OUTPUT
==========

```
---------------
 1.Insert
 2.Delete
 3.Display
---------------
 Enter Your choice:1

 Enter data:20

 Node Added Successfully.
 Do You want to continue:y
```

```
 Enter Your choice:1

 Enter data:45

 Node Added Successfully.
 Do You want to continue:y

 Enter Your choice:1

 Overflow
 Do You want to continue:y

 Enter Your choice:3
20 45
 Do You want to continue:y

 Enter Your choice:2

 Deleted Item is: 20
 Do You want to continue:y

 Enter Your choice:2

 Deleted Item is: 45
 Do You want to continue:y

 Enter Your choice:2

 Queue is Empty..Underflow
 Do You want to continue:y

 Enter Your choice:2

 Queue is Empty..Underflow
 Do You want to continue:n
```

==========

16. Circular Queue with Array

==========

```
#include<stdio.h>
#include<conio.h>
int size =3;
static int count =0;
```

```
int front =-1;
int rear = -1;

void insert(int key,int size,int queue[])
{
	if(count>(size-1))
	{
		printf("\n Overflow");
	}
	else if(front==0 && rear==(size-1))
	{
		printf("\n Overflow");
	}
	else if((rear+1) ==front)
	{
		printf("\n Overflow");
	}
	else if(front!=0 && rear==(size - 1))
	{
		if(front == -1)
		{
			front=0;
		}
			rear=0;
			queue[rear]=key;
		count++;
	}
	else
	{
		if(front == -1)
		{
			front=0;
		}
		rear +=1;
		queue[rear]=key;
		count++;
	}
}

void del(int queue[])
{
	if(front==-1)
	{
		printf("\n underflow");

	}
	else if(front==rear)
```

```
	{
		printf("\n Deleted item is:%d",queue[front]);
		front=-1;
		rear=-1;
		count--;
	}
	else if(front == (size-1) && front>rear)
	{

		printf("\n Deleted item is:%d",queue[front]);
		front=0;
		count--;
	}
	else
	{
		printf("\n Deleted item is:%d",queue[front]);
		front+=1;
		count--;
	}
}

void Display(int queue[])
{
	int i;

	if(front ==-1)
	{
		printf("Queue is Empty");
	}
	else
	{
		if( front <= rear )
		{
			for(i=front;i<=rear;i++)
			{
				printf("%d ",queue[i]);
			}
		}
		else
		{
			for(i=front;i<size;i++)
			{
				printf("%d ",queue[i]);
			}

			for(i=0;i<=rear;i++)
			{
				printf("%d ",queue[i]);
```

```
                }
            }
        }

}


void main()
{

        int queue[10],ch,count,key,res;
        char choice='n';


        printf("\n---------------");
        printf("\n 1.insert ");
        printf("\n 2.delete");
        printf("\n 3.display");
        printf("\n---------------");

        do
        {
            printf("\n Enter Your choice:");
            scanf("%d",&ch);
            switch(ch)
            {
                case 1:     printf("\n Enter Key:");
                            scanf("%d",&key);

                            insert(key,size,queue);
                            break;
                case 2:
                            del(queue);
                            break;
                case 3: Display(queue);
                            break;

            }
            printf("\n Do You want to continue:");
            scanf(" %c",&choice);

        }while(choice=='y' || choice=='Y');


        getch();
}

========
```

OUTPUT

```
========
---------------
 1.insert
 2.delete
 3.display
---------------
 Enter Your choice:1

 Enter Key:10

 Do You want to continue:y

 Enter Your choice:1

 Enter Key:20

 Do You want to continue:y

 Enter Your choice:1

 Enter Key:30

 Do You want to continue:y

 Enter Your choice:3
10 20 30
 Do You want to continue:y

 Enter Your choice:2

 Deleted item is:10
 Do You want to continue:y

 Enter Your choice:2

 Deleted item is:20
 Do You want to continue:y

 Enter Your choice:3
30
 Do You want to continue:y

 Enter Your choice:2

 Deleted item is:30
 Do You want to continue:y
```

```
 Enter Your choice:3
Queue is Empty
 Do You want to continue:n
```

```
================================
17. Circular Queue with Linked List
================================
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

struct Queue
{
	int data;
	struct Queue *next;
};
struct Queue * Insert(struct Queue *front,struct Queue **rear )
	//Insert End
{
	struct Queue *new_node=NULL;
	new_node=(struct Queue *)malloc(sizeof(struct Queue));

	printf("\n Enter data:");
	scanf("%d",&new_node->data);
	new_node->next=NULL;

	if(front==NULL)
	{
		front=new_node;
		*rear=front;
	}
	else
	{
		(*rear)->next=new_node;
		(*rear)=new_node;
		new_node->next=front;
	}

	return front;
}

struct Queue * Dele(struct Queue *front,struct Queue **rear )		//Delete
from begining
{
```

```
	struct Queue *temp;

	if(front==NULL)				//hear front is front and rear is rear
	{
		printf("\n Queue is Empty..Underflow");
	}
	else
	{
		if(front==(*rear))  //if only one node is exist
		{
			temp=front;
			printf("\n Deleted Item is: %d",temp->data);
			free(temp);
			front=NULL;
			(*rear)=NULL;

		}
		else		//delete node from the begining
		{
			temp=front;
			printf("\n Deleted Item is: %d",temp->data);
			front=front->next;
			free(temp);
			(*rear)->next=front;
		}
	}
	return front;
}


void Display(struct Queue *front)
{
	struct Queue *p;
	p=front;

	if(p==NULL)
	{
		printf("\n Queue is empty..");
	}
	{
		while(p->next!=front)
		{
			printf("%d ",p->data);
			p=p->next;
		}
		printf("%d ",p->data);
	}
}
```

```
void main()
{
	struct Queue *front=NULL;
	struct Queue *rear=NULL;

	int ch,count;
	char choice='n';

	printf("\n---------------");
	printf("\n 1.Insert");
	printf("\n 2.Delete");
	printf("\n 3.Display");
	printf("\n---------------");

	do
	{
		printf("\n Enter Your choice:");
		scanf("%d",&ch);
		switch(ch)
		{
			case 1:
					front=Insert(front,&rear);
					break;
			case 2:
					front=Dele(front,&rear);
					break;
			case 3:
					Display(front);
					break;
		}
		printf("\n Do You want to continue:");
		scanf(" %c",&choice);

	}while(choice=='y' || choice=='Y');


	getch();
}
```

```
========
OUTPUT
========

---------------
 1.Insert
 2.Delete
 3.Display
---------------
```

```
Enter Your choice:1

Enter data:10

Do You want to continue:y

Enter Your choice:1

Enter data:20

Do You want to continue:y

Enter Your choice:1

Enter data:30

Do You want to continue:y

Enter Your choice:3
10 20 30
Do You want to continue:y

Enter Your choice:2

Deleted Item is: 10
Do You want to continue:y

Enter Your choice:2

Deleted Item is: 20
Do You want to continue:y

Enter Your choice:3
30
Do You want to continue:y

Enter Your choice:2

Deleted Item is: 30
Do You want to continue:y

Enter Your choice:2

Queue is Empty..Underflow
Do You want to continue:n
```

```
================================================
=
18. Circular Linked List(All Insertions, All Deletions & Display)
================================================
==

#include<stdio.h>
#include<conio.h>
#include<malloc.h>


struct Stud
{
	int data;
	struct Stud *next;
};

struct Stud * InsertEnd(struct Stud *first,struct Stud **last )
{
	struct Stud *new_node=NULL;
	new_node=(struct Stud *)malloc(sizeof(struct Stud));

	printf("\n Enter data:");
	scanf("%d",&new_node->data);
	new_node->next=NULL;

	if(first==NULL)
	{
		first=new_node;
		*last=first;
	//	new_node->next=first;
	}
	else
	{
		(*last)->next=new_node;
		(*last)=new_node;
		new_node->next=first;
	}

	return first;
}

struct Stud * InsertBeg(struct Stud *first,struct Stud *last )
{
	struct Stud *new_node=NULL;
	new_node=(struct Stud *)malloc(sizeof(struct Stud));

	printf("\n Enter data:");
```

```
	scanf("%d",&new_node->data);
	new_node->next=NULL;

	if(first==NULL)
	{
		first=new_node;
		last=first;
	//	last->next=first;

	}
	else
	{

		new_node->next=first;
		first=new_node;
		last->next=first;
	}

	return first;
}
struct Stud * DeleteBeg(struct Stud *first,struct Stud **last )
{
	struct Stud *temp;

	if(first==NULL)
	{
		printf("\n Stud is Empty..Underflow");
	}
	else
	{
		if(first==(*last))    //if only one node is exist
		{
			temp=first;
			printf("\n Deleted Item is: %d",temp->data);
			free(temp);
			first=NULL;
			(*last)=NULL;

		}
		else           //delete node from the begining
		{
			temp=first;
			printf("\n Deleted Item is: %d",temp->data);
			first=first->next;
			free(temp);
			(*last)->next=first;
		}
	}
```

```
	return first;
}


struct Stud * DeleteEnd(struct Stud *first,struct Stud **last )
{
	struct Stud *temp,*p;

	if(first==NULL)
	{
		printf("\n List is Empty.");
	}
	else
	{
		if(first==(*last))    //if only one node is exist
		{
			temp=first;
			free(temp);
			first=NULL;
			(*last)=NULL;

		}
		else
		{
			p=first;
			while(p->next->next!=first)
			{
				p=p->next;
			}
			temp=p->next;
			printf("\n Deleted Item is: %d",temp->data);
			p->next=first;
			(*last)=p;
			free(temp);
		}
	}
	return first;
}

void Display(struct Stud *first,struct Stud *last)
{
	struct Stud *p;
	p=first;

	while(p->next!=first)
	{
		printf("%d ",p->data);
		p=p->next;
```

```
	}
	printf("%d ",p->data);
}
void main()
{
	struct Stud *first=NULL;
	struct Stud *last=NULL;

	int ch,count;
	char choice='n';

	printf("\n---------------");
	printf("\n 1.Insert End");
	printf("\n 2.Insert Begning ");
	printf("\n 3.Delete Begning");
	printf("\n 4.Delete End");
	printf("\n 5.Display");
	printf("\n---------------");

	do
	{
		printf("\n Enter Your choice:");
		scanf("%d",&ch);
		switch(ch)
		{
			case 1:
					first=InsertEnd(first,&last);
					break;
			case 2:
					first=InsertBeg(first,last);
					break;
			case 3:
					first=DeleteBeg(first,&last);
					break;
			case 4:
					first=DeleteEnd(first,&last);
					break;
			case 5:
					Display(first,last);
					break;
		}
		printf("\n Do You want to continue:");
		scanf(" %c",&choice);


	}while(choice=='y' || choice=='Y');
```

```
        getch();
}
```

```
=========
OUTPUT
=========

---------------
 1.Insert End
 2.Insert Begning
 3.Delete Begning
 4.Delete End
 5.Display
---------------
 Enter Your choice:1

 Enter data:10

 Do You want to continue:y

 Enter Your choice:2

 Enter data:20

 Do You want to continue:y

 Enter Your choice:1

 Enter data:40

 Do You want to continue:y

 Enter Your choice:2

 Enter data:60

 Do You want to continue:y

 Enter Your choice:5
60 20 10 40
 Do You want to continue:y

 Enter Your choice:3

 Deleted Item is: 60
 Do You want to continue:y
```

```
 Enter Your choice:5
20 10 40
 Do You want to continue:y

 Enter Your choice:4

 Deleted Item is: 40
 Do You want to continue:y

 Enter Your choice:5
20 10
 Do You want to continue:n
```

ASSIGNMENT -2

==========
1. Doubly Link List.
==========

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

struct Stud
{
	int data;
	struct Stud *next,*prev;
};



struct Stud * CreateList(struct Stud *first,struct Stud **last )
{
	int n;
	printf("\n Enter number of nodes you want to create:");
	scanf("%d",&n);

	while(n!=0)
	{

		struct Stud *new_node=NULL;
		struct Stud *temp=NULL;
```

```
            new_node=(struct Stud *)malloc(sizeof(struct Stud));

            printf("\n Enter data:");
            scanf("%d",&new_node->data);
            new_node->next=NULL;
            new_node->prev=NULL;

            if(first==NULL)
            {
                  first=new_node;
                  new_node->prev=NULL;
                  new_node->next=NULL;
                  *last=first;
            }
            else
            {
                  temp=(*last);
                  (*last)->next=new_node;
                  new_node->prev=temp;
                  new_node->next=NULL;
                  (*last)=new_node;
            }
            n--;
      }
      printf("\n List Created Successfully.");
      return first;
}

struct Stud * InsertEnd(struct Stud *first,struct Stud **last )
{
      struct Stud *new_node=NULL;
      struct Stud *temp=NULL;

      new_node=(struct Stud *)malloc(sizeof(struct Stud));

      printf("\n Enter data:");
      scanf("%d",&new_node->data);
      new_node->next=NULL;
      new_node->prev=NULL;

      if(first==NULL)
      {
            first=new_node;
            new_node->prev=NULL;
            new_node->next=NULL;
            *last=first;
      }
```

```
	else
	{
		temp=(*last);
		(*last)->next=new_node;
		new_node->prev=temp;
		new_node->next=NULL;
		(*last)=new_node;
	}	printf("\n Node Added Successfully.");
	return first;
}

struct Stud * InsertBeg(struct Stud *first,struct Stud *last )
{
	struct Stud *new_node=NULL;
	struct Stud *temp=NULL;

	new_node=(struct Stud *)malloc(sizeof(struct Stud));

	printf("\n Enter data:");
	scanf("%d",&new_node->data);

	new_node->next=NULL;
	new_node->prev=NULL;

	if(first==NULL)
	{
		first=new_node;
		new_node->next=NULL;
		new_node->prev=NULL;
		last=first;
	}
	else
	{
		new_node->next=first;
		new_node->prev=NULL;
		first=new_node;
	}
	printf("\n Node Added Successfully.");
	return first;
}


struct Stud * InsertAnywhereBefore(struct Stud *first,struct Stud **last )
{
	int val;
	struct Stud *new_node=NULL;
	struct Stud *temp=NULL;
	struct Stud *p;
```

```
	new_node=(struct Stud *)malloc(sizeof(struct Stud));

	printf("\n Enter data:");
	scanf("%d",&new_node->data);
	new_node->next=NULL;
	new_node->prev=NULL;

	printf("\n Enter the value befor you want to add:");
	scanf("%d",&val);

	p=first;

	while(p!=NULL && p->data!=val)
	{
		printf("%d ",p->data);
		p=p->next;

	}
		printf("%d ",p->data);


		if(p->prev==NULL)	//at the first
		{
			new_node->next=p;
			new_node->prev=NULL;
			p->prev=new_node;
			first=new_node;
		}
		else
		{
			new_node->next=p;
			new_node->prev=p->prev;
			p->prev->next=new_node;
			new_node->next->prev=new_node;
		}

	return first;
}

struct Stud * InsertAnywhereAfter(struct Stud *first,struct Stud **last )
{
	int val;
	struct Stud *new_node=NULL;
	struct Stud *temp=NULL;
	struct Stud *p;

	new_node=(struct Stud *)malloc(sizeof(struct Stud));
```

```
	printf("\n Enter data:");
	scanf("%d",&new_node->data);
	new_node->next=NULL;
	new_node->prev=NULL;

	printf("\n Enter the value befor you want to add:");
	scanf("%d",&val);

	p=first;

	while(p!=NULL && p->data!=val)
	{
		printf("%d ",p->data);
		p=p->next;

	}
		printf("%d ",p->data);


		if(p->next==NULL)	//at the first
		{

			new_node->prev=p;
			new_node->next=NULL;
			p->next=new_node;
			(*last)=new_node;
		}
		else
		{
			new_node->next=p->next;
			new_node->prev=p;
			p->next=new_node;
			new_node->next->prev=new_node;

		}

	return first;
}

struct Stud * DeleteBeg(struct Stud *first,struct Stud **last )
{
	struct Stud *temp;

	if(first==NULL)
	{
		printf("\n List is Empty.");
	}
```

```
	else
	{
		if(first==(*last))	//if only one node is exist
		{
			temp=first;
			free(temp);
			first=NULL;
			(*last)=NULL;
			printf("\n Deleted Successfully.");
		}
		else		//delete node from the begining
		{
			temp=first;
			first=first->next;
			first->prev=NULL;
			free(temp);
			printf("\n Deleted Successfully.");
		}
	}
	return first;
}

struct Stud * DeleteEnd(struct Stud *first,struct Stud **last )
{
	struct Stud *temp,*p;

	if(first==NULL)
	{
		printf("\n List is Empty.");
	}
	else
	{
		if(first==(*last))	//if only one node is exist
		{
			temp=first;
			free(temp);
			first=NULL;
			(*last)=NULL;
			printf("\n Deleted Successfully.");
		}
		else
		{
			temp=(*last);
			(*last)=(*last)->prev;
			free(temp);
			(*last)->next=NULL;
			printf("\n Deleted Successfully.");
		}
```

```
	}
	return first;
}


void Display(struct Stud *first)
{
	struct Stud *p;
	p=first;

	while(p!=NULL)
	{
		printf("%d ",p->data);
		p=p->next;
	}
}
void main()
{
	struct Stud *first=NULL;
	struct Stud *last=NULL;

	int ch,count;
	char choice='n';

	printf("\n---------------");
	printf("\n 1.Create List");
	printf("\n 2.Insert End");
	printf("\n 3.Insert Begning ");
	printf("\n 4.Insert Anywhere Before");
	printf("\n 5.Insert Anywhere After");
	printf("\n 6.Delete Begning");
	printf("\n 7.Delete End");
	printf("\n 8.Display");
	printf("\n---------------");

	do
	{
		printf("\n Enter Your choice:");
		scanf("%d",&ch);
		switch(ch)
		{
			case 1:
				first=CreateList(first,&last);
				break;
			case 2:
				first=InsertEnd(first,&last);
				break;
			case 3:
```

```
                                first=InsertBeg(first,last);
                                break;
                        case 4:
                                first=InsertAnywhereBefore(first,&last);
                                break;
                        case 5:
                                first=InsertAnywhereAfter(first,&last);
                                break;
                        case 6:
                                first=DeleteBeg(first,&last);
                                break;
                        case 7:
                                first=DeleteEnd(first,&last);
                                break;
                        case 8:
                                Display(first);
                                break;
                }
                printf("\n Do You want to continue:");
                scanf(" %c",&choice);


        }while(choice=='y' || choice=='Y');


        getch();
}
```

```
========
OUTPUT
========

---------------
 1.Create List
 2.Insert End
 3.Insert Begning
 4.Insert Anywhere Before
 5.Insert Anywhere After
 6.Delete Begning
 7.Delete End
 8.Display
---------------
 Enter Your choice:1

 Enter number of nodes you want to create:2

 Enter data:10
```

```
 Enter data:20

 List Created Successfully.
 Do You want to continue:y

 Enter Your choice:2

 Enter data:30

 Node Added Successfully.
 Do You want to continue:y

 Enter Your choice:4

 Enter data:3

 Enter the value befor you want to add:10
10
 Do You want to continue:y

 Enter Your choice:8
3 10 20 30
 Do You want to continue:y

 Enter Your choice:6

 Deleted Successfully.
 Do You want to continue:y

 Enter Your choice:8
10 20 30
 Do You want to continue:y

 Enter Your choice:7

 Deleted Successfully.
 Do You want to continue:y

 Enter Your choice:8
10 20
 Do You want to continue:n


========================
2. Doubly Circuler Link List.
========================
```

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

struct Stud
{
	int data;
	struct Stud *next,*prev;
};

struct Stud * CreateList(struct Stud *first,struct Stud **last )
{
	int n;
	printf("\n Enter number of nodes you want to create:");
	scanf("%d",&n);

	while(n!=0)
	{

		struct Stud *new_node=NULL;
		struct Stud *temp=NULL;

		new_node=(struct Stud *)malloc(sizeof(struct Stud));

		printf("\n Enter data:");
		scanf("%d",&new_node->data);
		new_node->next=NULL;
		new_node->prev=NULL;

		if(first==NULL)
		{
			first=new_node;
			new_node->prev=NULL;
			new_node->next=NULL;
			*last=first;
		}
		else
		{
			temp=(*last);
			(*last)->next=new_node;
			new_node->prev=temp;
			(*last)=new_node;
			(*last)->next=first;
			first->prev=(*last);
		}
		n--;
	}
	printf("\n List Created Successfully.");
```

```
	return first;
}

struct Stud * InsertEnd(struct Stud *first,struct Stud **last )
{
	struct Stud *new_node=NULL;
	struct Stud *temp=NULL;

	new_node=(struct Stud *)malloc(sizeof(struct Stud));

	printf("\n Enter data:");
	scanf("%d",&new_node->data);
	new_node->next=NULL;
	new_node->prev=NULL;

	if(first==NULL)
		{
			first=new_node;
			new_node->prev=NULL;
			new_node->next=NULL;
			*last=first;
		}
		else
		{
			temp=(*last);
			(*last)->next=new_node;
			new_node->prev=temp;
			(*last)=new_node;
			(*last)->next=first;
			first->prev=(*last);
		}
	return first;
}

struct Stud * InsertBeg(struct Stud *first,struct Stud *last )
{
	struct Stud *new_node=NULL;
	struct Stud *temp=NULL;

	new_node=(struct Stud *)malloc(sizeof(struct Stud));

	printf("\n Enter data:");
	scanf("%d",&new_node->data);

	new_node->next=NULL;
	new_node->prev=NULL;

	if(first==NULL)
```

```
	{
		first=new_node;
		new_node->next=NULL;
		new_node->prev=NULL;
		last=first;
	}
	else
	{
		new_node->next=first;
		new_node->next->prev=first;  //new_node->next->prev=first;
change mam says
		first=new_node;
		first->prev=last;
		last->next=first;
	}
	printf("\n Node Added Successfully.");
	return first;
}

struct Stud * InsertAnywhereBefore(struct Stud *first,struct Stud **last )
{
	int val;
	struct Stud *new_node=NULL;
	struct Stud *temp=NULL;
	struct Stud *p;

	new_node=(struct Stud *)malloc(sizeof(struct Stud));

	printf("\n Enter data:");
	scanf("%d",&new_node->data);
	new_node->next=NULL;
	new_node->prev=NULL;

	printf("\n Enter the value befor you want to add:");
	scanf("%d",&val);

	p=first;

	while(p->next!=first && p->data!=val)
	{
		printf("%d ",p->data);
		p=p->next;

	}
		printf(" %d ",p->data);


		if(p->prev==(*last))	//at the first
```

```
		{

			new_node->next=p;
			new_node->prev=(*last);
			p->prev=new_node;
			first=new_node;
			(*last)->next=first;

		}
		else
		{
			new_node->next=p;
			new_node->prev=p->prev;
			p->prev->next=new_node;
			new_node->next->prev=new_node;
		}

	return first;
}

struct Stud * InsertAnywhereAfter(struct Stud *first,struct Stud **last )
{
	int val;
	struct Stud *new_node=NULL;
	struct Stud *temp=NULL;
	struct Stud *p;

	new_node=(struct Stud *)malloc(sizeof(struct Stud));

	printf("\n Enter data:");
	scanf("%d",&new_node->data);
	new_node->next=NULL;
	new_node->prev=NULL;

	printf("\n Enter the value After you want to add:");
	scanf("%d",&val);

	p=first;

	while(p->next!=first && p->data!=val)
	{
		printf("%d ",p->data);
		p=p->next;

	}
		printf("%d ",p->data);
```

```
            if(p->next==first)  //at the last
            {
                  new_node->prev=p;
                  new_node->next=first;
                  p->next=new_node;
                  (*last)=new_node;
                  first->prev=(*last);
            }
            else
            {
                  new_node->next=p->next;
                  new_node->prev=p;
                  p->next=new_node;
                  new_node->next->prev=new_node;
            }

      return first;
}


struct Stud * DeleteBeg(struct Stud *first,struct Stud **last )
{
      struct Stud *temp;

      if(first==NULL)
      {
            printf("\n List is Empty.");
      }
      else
      {
            if(first==(*last))    //if only one node is exist
            {
                  temp=first;
                  free(temp);
                  first=NULL;
                  (*last)=NULL;
                  printf("\n Deleted Successfully.");
            }
            else           //delete node from the begining
            {
                  temp=first;
                  first=first->next;
                  first->prev=(*last);
                  (*last)->next=first;
                  free(temp);
                  printf("\n Deleted Successfully.");
            }
      }
```

```
	return first;
}


struct Stud * DeleteEnd(struct Stud *first,struct Stud **last )
{
	struct Stud *temp,*p;

	if(first==NULL)
	{
		printf("\n List is Empty.");
	}
	else
	{
		if(first==(*last))    //if only one node is exist
		{
			temp=first;
			free(temp);
			first=NULL;
			(*last)=NULL;
			printf("\n Deleted Successfully.");
		}
		else
		{
			temp=(*last);
			(*last)=(*last)->prev;
			(*last)->next=first;
			first->prev=(*last);
			free(temp);
			printf("\n Deleted Successfully.");
		}
	}
	return first;
}


void Display(struct Stud *first)
{
	struct Stud *p;
	p=first;

	if(p==NULL)
	{
		printf("\n List is empty.");
	}
	else
	{
		while(p->next!=first)
```

```
		{
			printf("%d ",p->data);
			p=p->next;
		}
		printf("%d ",p->data);
	}
}
void main()
{
	struct Stud *first=NULL;
	struct Stud *last=NULL;

	int ch,count;
	char choice='n';

	printf("\n---------------");
	printf("\n 1.Create List");
	printf("\n 2.Insert End");
	printf("\n 3.Insert Begning ");
	printf("\n 4.Insert Anywhere Before");
	printf("\n 5.Insert Anywhere After");
	printf("\n 6.Delete Begning");
	printf("\n 7.Delete End");
	printf("\n 8.Display");
	printf("\n---------------");

	do
	{
		printf("\n Enter Your choice:");
		scanf("%d",&ch);
		switch(ch)
		{
			case 1:
				first=CreateList(first,&last);
				break;
			case 2:
				first=InsertEnd(first,&last);
				break;
			case 3:
				first=InsertBeg(first,last);
				break;
			case 4:
				first=InsertAnywhereBefore(first,&last);
				break;
			case 5:
				first=InsertAnywhereAfter(first,&last);
				break;
			case 6:
```

```
                                first=DeleteBeg(first,&last);
                                break;
                        case 7:
                                first=DeleteEnd(first,&last);
                                break;
                        case 8:
                                Display(first);
                                break;
                }
                printf("\n Do You want to continue:");
                scanf(" %c",&choice);


        }while(choice=='y' || choice=='Y');


        getch();
}
```

```
===========
OUTPUT
===========
---------------
 1.Create List
 2.Insert End
 3.Insert Begning
 4.Insert Anywhere Before
 5.Insert Anywhere After
 6.Delete Begning
 7.Delete End
 8.Display
---------------
 Enter Your choice:1

 Enter number of nodes you want to create:2

 Enter data:10

 Enter data:20

 List Created Successfully.
 Do You want to continue:y

 Enter Your choice:2

 Enter data:45
```

```
 Do You want to continue:y

 Enter Your choice:3

 Enter data:7

 Node Added Successfully.
 Do You want to continue:y

 Enter Your choice:8
7 10 20 45
 Do You want to continue:y

 Enter Your choice:4

 Enter data:88

 Enter the value befor you want to add:7

 Do You want to continue:y

 Enter Your choice:5

 Enter data:96

 Enter the value After you want to add:20
88 7 10 20
 Do You want to continue:y

 Enter Your choice:8
88 7 10 20 96 45
 Do You want to continue:y

 Enter Your choice:6

 Deleted Successfully.
 Do You want to continue:y

 Enter Your choice:8
7 10 20 96 45
 Do You want to continue:y

 Enter Your choice:7

 Deleted Successfully.
 Do You want to continue:n
```

==========
3. Bouble Sort
==========

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

void GetData(int num[],int n)
{
	int i;
	for(i=0;i<n;i++)
	{
		printf("\n Enter Value:");
		scanf("%d",&num[i]);
	}

}
void Display(int num[],int n)
{
	int i;
	for(i=0;i<n;i++)
	{
		printf("%d ",num[i]);
	}

}
void Sort(int num[],int n)
{
	int i,j,temp;
	for(i=0;i<n-1;i++)
	{
		for(j=0;j<n-i-1;j++)
		{
			if(num[j]>num[j+1])
			{
				temp=num[j];
				num[j]=num[j+1];
				num[j+1]=temp;
			}
		}
	}

}
void main()
{
```

```
        int num[20],i,n;

        printf("\n Enter value of n:");
        scanf("%d",&n);

        GetData(num,n);
        printf("\n\n Before Sorted..\n");
        Display(num,n);

        Sort(num,n);
        printf("\n\n After Sorted..\n");
        Display(num,n);
        getch();
}
```

```
=========
OUTPUT
=========
Enter value of n:5

 Enter Value:12

 Enter Value:7

 Enter Value:66

 Enter Value:4

 Enter Value:89


 Before Sorted..
12 7 66 4 89

 After Sorted..
4 7 12 66 89
```

```
==================
4. Selection Sort
==================

#include<stdio.h>
#include<conio.h>
#include<malloc.h>

void GetData(int num[],int n)
```

```
{
	int i;
	for(i=0;i<n;i++)
	{
		printf("\n Enter Value:");
		scanf("%d",&num[i]);
	}

}
void Display(int num[],int n)
{
	int i;
	for(i=0;i<n;i++)
	{
		printf("%d ",num[i]);
	}

}

void Selection_Sort(int num[],int n)
{
	int min,temp,index;


	for(int i=0;i<n-1;i++)
	{
		min=i;
		for(int j=i+1;j<n;j++)
		{
			if(num[j]<num[min])
			{
				min=j;
			}
		}
		temp=num[i];
		num[i]=num[min];
		num[min]=temp;
	}
}
void main()
{
	int num[20],i,n;

	printf("\n Enter value of n:");
	scanf("%d",&n);

	GetData(num,n);
	printf("\n\n Before Sorted..\n");
```

```
	Display(num,n);

	Selection_Sort(num,n);
	printf("\n\n After Sorted..\n");
	Display(num,n);

	getch();
}
```

==========
OUTPUT
==========

```
 Enter value of n:5

 Enter Value:45

 Enter Value:0

 Enter Value:42

 Enter Value:12

 Enter Value:2


 Before Sorted..
45 0 42 12 2

 After Sorted..
0 2 12 42 45
```

==========
5. Insertion Sort
==========

```
#include<stdio.h>
#include<conio.h>


void GetData(int num[],int n)
{
	int i;
```

```
	for(i=0;i<n;i++)
	{
		printf("\n Enter Value:");
		scanf("%d",&num[i]);
	}

}
void Display(int num[],int n)
{
	int i;
	for(i=0;i<n;i++)
	{
		printf("%d ",num[i]);
	}

}

void Insertion_Sort(int num[],int n)
{
	int i,j,k,temp;


	for(i=0;i<n;i++)
	{
		for(j=i+1;j<n;j++)
		{
			if(num[j]<num[i])
			{
				temp = num[j];
				for(k=j;k>0;k--)
				{
					num[k] = num[k-1];
				}
				num[i]=temp;
			}

		}
	}
}
void main()
{
	int num[20],i,n;

	printf("\n Enter value of n:");
	scanf("%d",&n);

	GetData(num,n);
	printf("\n\n Before Sorted..\n");
```

```
        Display(num,n);

        Insertion_Sort(num,n);
        printf("\n\n After Sorted..\n");
        Display(num,n);

        getch();
}
```

```
=========
OUTPUT
=========

 Enter value of n:5

 Enter Value:45

 Enter Value:0

 Enter Value:42

 Enter Value:12

 Enter Value:2


 Before Sorted..
45 0 42 12 2

 After Sorted..
0 2 12 42 45
```

```
=============
6. Linear Search
=============

#include<stdio.h>
#include<conio.h>
#include<malloc.h>

void GetData(int num[],int n)
{
        int i;
```

```
	for(i=0;i<n;i++)
	{
		printf("\n Enter Value:");
		scanf("%d",&num[i]);
	}

}
void Display(int num[],int n)
{
	int i;
	for(i=0;i<n;i++)
	{
		printf("%d ",num[i]);
	}

}


void Liner_Search(int num[],int n)
{
	int i,no,found=0;
	printf("\n Enter Value you want to search:");
	scanf("%d",&no);

	for(i=0;i<n;i++)
	{
		if(no==num[i])
		{
			printf("%d is on %d position.",no,i);
			found=1;
			break;
		}
	}
	if(!found)
		printf("\n Element is not present");

}
void main()
{
	int num[20],i,n;

	printf("\n Enter value of n:");
	scanf("%d",&n);

	GetData(num,n);
	printf("\n\n Before Sorted..\n");
	Display(num,n);
```

```
	Liner_Search(num,n);
	getch();
}
```

==========
OUTPUT
==========

```
 Enter value of n:5

 Enter Value:12

 Enter Value:7

 Enter Value:66

 Enter Value:4

 Enter Value:89

12 7 66 4 89


 Enter Value you want to search:66
66 is on 3 position.
```

==========
7. Binary Search
==========

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

void GetData(int num[],int n)
{
	int i;
	for(i=0;i<n;i++)
	{
		printf("\n Enter Value:");
		scanf("%d",&num[i]);
	}

}
void Display(int num[],int n)
{
	int i;
```

```
	for(i=0;i<n;i++)
	{
		printf("%d ",num[i]);
	}

}


void Binary_Search(int num[],int n)
{
	int key,found=0,mid,first,last,index;

	printf("\n Enter Value you want to search:");
	scanf("%d",&key);

	first=0;
	last=n-1;

	while(first<last)
	{
		mid=(first+last)/2;

		if(key == num[mid])
		{
			found=1;
			printf("%d is found at %d position",key,mid);
			index=mid;
			break;
		}
		else if(key<mid)
		{
			last=mid-1;
		}
		else if(key>mid)
		{
			first=mid+1;
		}
	}
	if(!found)
		printf("\n Element is not present");

}
void main()
{
	int num[20],i,n;

	printf("\n Enter value of n:");
	scanf("%d",&n);
```

```
        GetData(num,n);
        printf("\n\n Before Sorted..\n");
        Display(num,n);

        Binary_Search(num,n);
        Binary_Search(num,n);
        Binary_Search(num,n);
        Binary_Search(num,n);
        getch();
}
```

```
========
OUTPUT
========
 Enter value of n:10

 Enter Value:1

 Enter Value:2

 Enter Value:4

 Enter Value:5

 Enter Value:6

 Enter Value:7

 Enter Value:8

 Enter Value:9

 Enter Value:10

 Enter Value:12


 Before Sorted..
1 2 4 5 6 7 8 9 10 12
 Enter Value you want to search:3

 Element is not present
 Enter Value you want to search:2
2 is found at 1 position
 Enter Value you want to search:11
```

```
 Element is not present
 Enter Value you want to search:45

 Element is not present
```

```
================
8 .Expression Tree
================
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
int top = -1;

struct Tree
{
	int data;
	struct Tree *next,*prev;
};

void Push(struct Tree *stack[],int size,struct Tree *key)
{
	if(top>=(size-1))
	{
		printf("\n Overflow..");
	}
	else
	{
		top=top+1;
		stack[top]=(key);

	}
}

struct Tree * Pop(struct Tree *stack[],int size)
{
	struct Tree *data;

	if(top==-1)
	{
		printf("\n Underflow...");
		return NULL;
	}
	else
	{
```

```
		data=stack[top];
		stack[top]=NULL;
		top=top-1;
	}

	return data;
}

bool isOperand(char ch)
{
	if(ch>=65 && ch<=90 || ch>=97 && ch<=122)
	{
		return 1;
	}
	else
		return 0;
}
bool isOperator(char ch)
{
	if(ch=='+' || ch=='-' || ch=='/' || ch=='*')
		return 1;
	else
		return 0;
}
struct Tree * CreateTree(struct Tree *root,char key)
{

	struct Tree *newnode=NULL;

	newnode=(struct Tree *)malloc(sizeof(struct Tree));
	newnode->data = key;
	newnode->next=NULL;
	newnode->prev=NULL;

	return newnode;
}



void InOrder(struct Tree *root)
{
	if(root!=NULL)
	{
		InOrder(root->prev);
		printf("%c ",root->data);
		InOrder(root->next);
	}
}
```

```
struct Tree * ExpressionTree(char str[],int size_str,struct Tree * root)
{
	struct Tree *stack[20];

	struct Tree *p,*first,*second;

	for(int i=0;str[i]!='\0';i++)
	{
		if(isOperand(str[i]))
		{
			p = CreateTree(root,str[i]);
			Push(stack,20,p);
		}
		else
		{
			p = CreateTree(root,str[i]);

			first = Pop(stack,20);
			second = Pop(stack,20);

			p->next=first;
			p->prev=second;

			Push(stack,20,p);

		}
	}
	first = Pop(stack,20);

	return first;

}
void main()
{
	struct Tree *first=NULL;
	struct Tree *last=NULL;
	struct Tree *res=NULL;

	int key,ch,count,n;
	char choice='n';

	char str[20],prv_char;


	int i,cnt=0,size,invalid=0;
	printf("\n Enter String:");
```

```
	scanf("%s",str);

	for(int i=0;str[i]!='\0';i++)
	{
		cnt++;
	}
	size=cnt;

	first = ExpressionTree(str,size,first);

	InOrder(first);

	getch();
}
```

```
=========
OUTPUT
=========

 Enter String:AB/C-DE*+
A / B - C + D * E
```

```
=========
OUTPUT
=========

 Enter String:XY+Z+AB+C-*
X + Y + Z * A + B - C
```

```
==============================
9. Binary Search Tree ( Recursive)
==============================
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
int top = -1;

struct Tree
{
	int data;
	struct Tree *next,*prev;
```

```
};

struct Tree * SearchTree(struct Tree *root,int key)
{

		if(root==NULL)
			return NULL;
		if(key>root->data)
			return SearchTree(root->next,key);

		if(key < root->data)
			return SearchTree(root->prev,key);
		else
			return root;
}

struct Tree * CreateTree(struct Tree *root,int key)
{

	struct Tree *newnode=NULL;

	newnode=(struct Tree *)malloc(sizeof(struct Tree));
	newnode->data = key;
	newnode->next=NULL;
	newnode->prev=NULL;

	return newnode;
}


struct Tree *Insert(struct Tree *root, int key)
{

	 if(root == NULL)
	 {
		return CreateTree(root,key);
	 }

	 if (key < root->data)
	 {
		root->prev = Insert(root->prev, key);
	 }
	 else
	 {
		root->next = Insert(root->next, key);
	 }
  return root;
}
```

```
void InOrder(struct Tree *root)
{
	if(root!=NULL)
	{
		InOrder(root->prev);
		printf("%d ",root->data);
		InOrder(root->next);
	}
}
void PreOrder(struct Tree *root)
{
	if(root!=NULL)
	{
		printf("%d ",root->data);
		PreOrder(root->prev);
		PreOrder(root->next);
	}
}
void PostOrder(struct Tree *root)
{
	if(root!=NULL)
	{
		PostOrder(root->prev);
		PostOrder(root->next);
		printf("%d ",root->data);
	}
}

void main()
{
	struct Tree *first=NULL;
	struct Tree *last=NULL;
	struct Tree *res=NULL;

	int key,ch,count,n;
	char choice='n';

	printf("\n---------------");
	printf("\n 1.Create Tree");
	printf("\n---------------");

	printf("\n Enter the number of nodes:");
	scanf("%d",&n);
	for(int i=0;i<n;i++)
	{
		printf("\n Enter Key:");
```

```
        scanf("%d",&key);


        first = Insert(first,key);
}


printf("\n\n---------------");
printf("\n 1.Insert Node");
printf("\n 2.InOder");
printf("\n 3.PreOder");
printf("\n 4.PostOder");
printf("\n 5.Search");
printf("\n 7.Exit");
printf("\n---------------");

do
{

        printf("\n\n Enter Your choice:");
        scanf("%d",&ch);
        while(ch<1 || ch>7)
        {
                printf("\n Invalid Choice");
                printf("\n Enter Your choice Again:");
                scanf("%d",&ch);

        }

        switch(ch)
        {
                case 1:
                                printf("\n Enter Key:");
                                scanf("%d",&key);

                                first = Insert(first,key);
                                break;
                case 2:
                                printf("\n");
                                InOrder(first);
                                break;
                case 3:
                                printf("\n");
                                PreOrder(first);
                                break;
                case 4:
                                printf("\n");
                                PostOrder(first);
```

```
                        break;
                case 5:
                        printf("\n Enter Key you want to search:");
                        scanf("%d",&key);

                        res=SearchTree(first,key);
                        if(res==NULL)
                        {
                                printf("\n Node is not found");
                        }
                        else
                        {
                                printf("%d node is found.",res->data);
                        }
                        break;
                case 7:
                        exit(0);
                        break;

                }
        }while(ch!=7);


        getch();
}
```

```
==========
OUTPUT
==========

---------------
 1.Create Tree
---------------
 Enter the number of nodes:11

 Enter Key:36

 Enter Key:20

 Enter Key:15

 Enter Key:17

 Enter Key:29

 Enter Key:25

 Enter Key:31
```

```
 Enter Key:49

 Enter Key:83

 Enter Key:65

 Enter Key:95


---------------
 1.Insert Node
 2.InOder
 3.PreOder
 4.PostOder
 5.Search
 7.Exit
---------------

 Enter Your choice:1

 Enter Key:91


 Enter Your choice:2

15 17 20 25 29 31 36 49 65 83 91 95

 Enter Your choice:3

36 20 15 17 29 25 31 49 83 65 95 91

 Enter Your choice:4

17 15 25 31 29 20 65 91 95 83 49 36

 Enter Your choice:5

 Enter Key you want to search:65
65 node is found.

 Enter Your choice:7
```

```
====================================
10. Binary Search Tree (Non-Recursive)
====================================

#include<stdio.h>
#include<conio.h>
#include<stdlib.h>

int top = -1;

struct Tree
{
	int data;
	struct Tree *next,*prev;
};

void Push(struct Tree *stack[],int size,struct Tree *key)
{
	if(top>=(size-1))
	{
		printf("\n Overflow..");
	}
	else
	{
		top=top+1;
		stack[top]=(key);

	}
}

struct Tree * Pop(struct Tree *stack[],int size)
{
	struct Tree *data;

	if(top==-1)
	{
		printf("\n Underflow...");
		return NULL;
	}
	else
	{
		data=stack[top];
		stack[top]=NULL;
		top=top-1;
	}

	return data;
}
```

```
struct Tree * Top(struct Tree * stack[])
{
	struct Tree *data;
	data=stack[top];

	if(top!=-1)
		return data;
	else
		return NULL;
}
struct Tree * SearchTree(struct Tree *root, int key)
{

	struct Tree *p;


	p=root;

	while(p!=NULL)
	{
		if(key>p->data)
			p=p->next;
		else if(key < p->data)
			p=p->prev;
		if(key == p->data)
		{
			printf("key is found");
			return p;
			break;
		}
	}

	return NULL;
}

struct Tree * CreateTree(struct Tree *root)
{
	int n;
	printf("\n Enter number of nodes you want to create:");
	scanf("%d",&n);

	while(n!=0)
	{
		struct Tree *newnode=NULL;
		newnode=(struct Tree *)malloc(sizeof(struct Tree));

		printf("\n Enter data:");
```

```
        scanf("%d",&newnode->data);
        newnode->next=NULL;
        newnode->prev=NULL;

        struct Tree *p = NULL;


        if(root==NULL)
        {
                root=newnode;
        }
        else
        {
                p= root;
                while (1)
                {
                        if(newnode->data < p->data)
                        {
                                if(p->prev==NULL)
                                {
                                        p->prev=newnode;
                                        break;
                                }
                                else
                                {
                                        p=p->prev;
                                }
                        }
                        else
                        {
                                if(newnode->data > p->data)
                                {
                                        if(p->next==NULL)
                                        {
                                                p->next=newnode;
                                                break;
                                        }
                                        else
                                        {
                                                p=p->next;
                                        }
                                }
                        }
                }
        }
        n--;
}
return root;
```

```
}
struct Tree * InsertTree(struct Tree *root)
{

		struct Tree *newnode=NULL;
		newnode=(struct Tree *)malloc(sizeof(struct Tree));

		printf("\n Enter data:");
		scanf("%d",&newnode->data);
		newnode->next=NULL;
		newnode->prev=NULL;

		struct Tree *p = NULL;


		if(root==NULL)
		{
			root=newnode;
		}
		else
		{
			p= root;
			while (1)
			{
				if(newnode->data < p->data)
				{
					if(p->prev==NULL)
					{
						p->prev=newnode;
						break;
					}
					else
					{
						p=p->prev;
					}
				}
				else
				{
					if(newnode->data > p->data)
					{
						if(p->next==NULL)
						{
							p->next=newnode;
							break;
						}
						else
						{
							p=p->next;
```

```
                                        }
                                    }
                                }
                            }
                    }

        return root;
}

void inOrder(struct Tree *root)
{
        struct Tree *p;
        p=root;

        struct Tree *stack[20];

        while( top!=-1 || p!=NULL )
        {
                if(p!=NULL)
                {
                        Push(stack,10,p);
                        p=p->prev;
                }
                else
                {
                        p=Pop(stack,20);
                        printf("%d ",p->data);
                        p=p->next;
                }
        }
}
void PreOrder(struct Tree *root)
{
        struct Tree *p;
        p=root;

        struct Tree *stack[20];

        while( top!=-1 || p!=NULL )
        {
                if(p!=NULL)
                {

                        Push(stack,20,p);
                        printf("%d ",p->data);
                        p=p->prev;
                }
                else
```

```
		{
			p=Pop(stack,20);
			p=p->next;
		}
	}
}
void PostOrder(struct Tree *root)
{
	struct Tree *p;
	struct Tree *res;
	p=root;

	struct Tree *stack[20];

	while( top!=-1 || p!=NULL )
	{

		while(p!=NULL)
		{
			Push(stack,10,p);
			p=p->prev;
		}
		while(top!=-1 && (p=Top(stack))->data < 0)
		{
					p=Pop(stack,20);
					printf("%d ",(p->data*-1));
					p->data = (p->data)*-1;   ///for maing value
again positive extra
		}
		if(top!=-1)
		{
			p=Top(stack);
			p->data = (p->data)*-1;
			p=p->next;
		}
		else
		{
			break;
		}
	}
}

int MinValue(struct Tree *root)
{
	struct Tree *p;
	p=root;

	while(p->prev!=NULL)
```

```
	{
		p=p->prev;
	}
	return p->data;
}

int MaxValue(struct Tree *root)
{
	struct Tree *p;
	p=root;

	while(p->next!=NULL)
	{
		p=p->next;
	}
	return p->data;
}

void EmptyStack(struct Tree *stack[])
{
	struct Tree *p;
	while(top!=-1)
	{
		p=Pop(stack,20);
	}
}
void DeleteNode(struct Tree *root)
{
	int key,max,old_key=0;
	struct Tree *p,*add;

	printf("\n Enter Key:");
	scanf("%d",&key);



	struct Tree *stack[20];


	p=root;
	while( top!=-1 || p!=NULL )
	{

		while(p!=NULL)
		{
			Push(stack,10,p);
			if(key!=p->data)
```

```
                {

                        p=p->prev;
                }
                else
                {

                        /// if key is leaf node
                        if(p->prev==NULL && p->next==NULL)  //key is a
leaf node
                        {
                                p=Pop(stack,20);                        //go up
                                p=Pop(stack,20);
                                if(p->prev!=NULL &&  p->prev->data==key)
                //check key is left
                                {
                                        p->prev=NULL;
                                        printf("%d key is deleted",key);
                                        if(p->data < 0)
                                        {
                                                p->data = (p->data)*-1;
                                        }
                                        if(old_key!=0)
                                        {
                                                add=SearchTree(root,old_key);
                                                add->data=key;
                                        }
                                        break;
                                }
                                if(p->next!=NULL && p->next->data==key)
            //check key is right
                                {
                                        p->next=NULL;
                                        printf("%d key is deleted",key);
                                        if(p->data < 0)
                                        {
                                                p->data = (p->data)*-1;
                                        }
                                        if(old_key!=0)
                                        {
                                                add=SearchTree(root,old_key);
                                                add->data=key;
                                        }
                                        break;
                                }
                        }
                        else if(p->next==NULL || p->prev==NULL)
                        {
```

```
                        //if key has a single child
                        if(p->next==NULL )  //key has left single child
                        {
                                if(p->prev->prev==NULL && p->prev-
>next==NULL)
                                {
                                        p->prev->data=p->data;
                                        p->prev=NULL;
                                        printf("%d key is deleted",key);
                                        if(old_key!=0)
                                        {
                                                add=SearchTree(root,old_key);
                                                add->data=key;
                                        }
                                        EmptyStack(stack);
                                        break;
                                }
                        }
                        if(p->prev==NULL)    //key has  rigth single child
                        {
                                if(p->next->prev==NULL && p->next-
>next==NULL)
                                {
                                        p->data=p->next->data;
                                        p->next=NULL;
                                        printf("%d key is deleted",key);
                                        if(old_key!=0)
                                        {
                                                add=SearchTree(root,old_key);
                                                add->data=key;
                                        }
                                        EmptyStack(stack);
                                        break;
                                }
                        }

                        }
                        else
                        {
                                max=MaxValue(p->prev);
                        //      printf("\n max is %d \n",max);
                                old_key=key;
                                key=max;

                        }
```

```
                }
        }

        while(top!=-1 && (p=Top(stack))->data < 0)
        {
                        p=Pop(stack,20);
                        //      printf("%d ",(p->data*-1));
                        p->data = (p->data)*-1;   ///for maing value
again positive extra
        }

        if(top!=-1)
        {
                p=Top(stack);
                p->data = (p->data)*-1;
                p=p->next;
        }
        else
        {
                break;
        }

    }
}
void main()
{
    struct Tree *first=NULL;
    struct Tree *last=NULL;
    struct Tree *res=NULL;

    int ch,count,key;
    char choice='n';

    printf("\n---------------");
    printf("\n 1.Create Tree");
    printf("\n---------------");
    first=CreateTree(first);


    printf("\n\n---------------");
    printf("\n 1.Insert Node");
    printf("\n 2.InOder");
    printf("\n 3.PreOder");
    printf("\n 4.PostOder");
    printf("\n 5.Search");
    printf("\n 6.Min");
    printf("\n 7.Max");
    printf("\n 8.Delete");
```

```
        printf("\n 9.Exit");
        printf("\n---------------");

        do
        {

                printf("\n\n Enter Your choice:");
                scanf("%d",&ch);
                while(ch<1 || ch>9)
                {
                        printf("\n Invalid Choice");
                        printf("\n Enter Your choice Again:");
                        scanf("%d",&ch);

                }

                switch(ch)
                {
                        case 1:
                                        first=InsertTree(first);
                                        break;
                        case 2:
                                        printf("\n");
                                        inOrder(first);
                                        break;
                        case 3:
                                        printf("\n");
                                        PreOrder(first);
                                        break;
                        case 4:
                                        printf("\n");
                                        PostOrder(first);
                                        break;
                        case 5:
                                        printf("\n Enter key:");
                                        scanf("%d",&key);

                                        res=SearchTree(first,key);
                                        if(res==NULL)
                                        {
                                                printf("\n Node is not found");
                                        }
                                        break;
                        case 6:
                                        MinValue(first);
                                        printf("\n Minimum value is:
%d",MinValue(first));
                                        break;
```

```
                    case 7:
                                MaxValue(first);
                                printf("\n Minimum value is:
%d",MaxValue(first));
                                break;
                    case 8:
                                DeleteNode(first);
                                break;
                    case 9:
                                exit(0);
                                break;

                }
        }while(ch!=9);


        getch();
}
```

```
===========
OUTPUT
===========

---------------
 1.Create Tree
---------------
 Enter number of nodes you want to create:8

 Enter data:36

 Enter data:28

 Enter data:16

 Enter data:13

 Enter data:20

 Enter data:59

 Enter data:47

 Enter data:75


---------------
 1.Insert Node
```

```
 2.InOder
 3.PreOder
 4.PostOder
 5.Search
 6.Min
 7.Max
 8.Exit
---------------

 Enter Your choice:1

 Enter data:91


 Enter Your choice:2

13 16 20 28 36 47 59 75 91

 Enter Your choice:3

36 28 16 13 20 59 47 75 91

 Enter Your choice:4

13 20 16 28 47 91 75 59 36

 Enter Your choice:5

 Enter key:45

 Node is not found

 Enter Your choice:5

 Enter key:13
key is found

 Enter Your choice:6

 Minimum value is:13

 Enter Your choice:7

 Minimum value is:91

 Enter Your choice:8
```

```
==============
Output -> Delete
==============

---------------
 1.Create Tree
---------------
 Enter number of nodes you want to create:17

 Enter data:29

 Enter data:18

 Enter data:35

 Enter data:10

 Enter data:12

 Enter data:16

 Enter data:23

 Enter data:19

 Enter data:25

 Enter data:6

 Enter data:8

 Enter data:30

 Enter data:67

 Enter data:54

 Enter data:90

 Enter data:51

 Enter data:57


---------------
 1.Insert Node
 2.InOder
```

```
 3.PreOder
 4.PostOder
 5.Search
 6.Min
 7.Max
 8.Delete
 9.Exit
---------------

 Enter Your choice:2

6 8 10 12 16 18 19 23 25 29 30 35 51 54 57 67 90

 Enter Your choice:8

 Enter Key:67

57 key is deleted

 Enter Your choice:2

6 8 10 12 16 18 19 23 25 29 30 35 51 54 57 90

 Enter Your choice:8

 Enter Key:18

16 key is deleted

 Enter Your choice:2

6 8 10 12 16 19 23 25 29 30 35 51 54 57 90

 Enter Your choice:8

 Enter Key:16

12 key is deleted

 Enter Your choice:2

6 8 10 12 19 23 25 29 30 35 51 54 57 90

 Enter Your choice:8

 Enter Key:44
```

Enter Your choice:2

6 8 10 12 19 23 25 29 30 35 51 54 57 90

Enter Your choice:8

ASSIGNMENT -3

==========
1)UnWeighted Graph Shortest Path
==========

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

int front =-1;
int rear = -1;

struct node{
        int data;
        struct node * next;
};

struct table{
```

```
        int node_name_value;
        int known;
        int distance;
        int  path;
};
struct node * InsertEnd(struct node **first,struct node **last )
{
        struct node *new_node=NULL;
        new_node=(struct node *)malloc(sizeof(struct node));

        printf("\n Enter Adjacent:");
        scanf("%d",&new_node->data);
        new_node->next=NULL;

        if((*first)==NULL)
        {
                (*first)=new_node;
                (*last)=*first;
        }
        else
        {
                (*last)->next=new_node;
                (*last)=new_node;
        }

        return (*first);
}

void display(struct node n1[], int n)
{
        struct node *p;
        int i;
        for(int i=0;i<n;i++)
        {
                printf("\n %d --->",n1[i].data);

                p=n1[i].next;

                while(p!=NULL)
                {
                        printf("%d ",p->data);
                        p=p->next;
                }
        }

}

void display_table(struct table t1[], int total_vertex)
```

```
{
	printf("\n V\t Known\t Dv\t Pv");
	for(int i=0;i<total_vertex;i++)
	{
		printf("\n %d\t %d\t %d\t
%d",t1[i].node_name_value,t1[i].known,t1[i].distance,t1[i].path);
	}
}

void insert(int key,int size,int queue[])
{
	if(rear==(size-1))
	{
		printf("\n Overflow");
	}
	else
	{
		if(front==-1)
		{
			front=0;
		}
		rear +=1;
		queue[rear]=key;
	}
}

void del(int queue[])
{
	if(front==-1)
	{
		printf("\n underflow");

	}
	else if(front==rear)
	{
		//printf("\n Deleted item is:%d",queue[front]);
		front=-1;
		rear=-1;
	}
	else
	{
		//printf("\n Deleted item is:%d",queue[front]);
		front=front+1;
	}
}


void sortest_path(struct table t1[], int total_vertex,struct node n1[],int start)
```

```
{
	int reachable,V;
	int cur_dis=0;
	struct node *W;   //for recahble
	int i;
	int queue[10];
	int size=10;


	insert(start,size,queue);

	while(front!=-1)
	{
		V = queue[front];

		//	V =n1[i].data;	// data

				W = n1[V-1].next; //address of list


				t1[V-1].known = 1;
				del(queue);

				while(W!=NULL)
				{
					reachable = W->data;
					if(t1[reachable-1].distance == -1)
					{
						t1[reachable-1].distance = t1[V-
1].distance + 1;
						t1[reachable-1].path =V;
						insert(reachable,size,queue);
					}

					W=W->next;
				}


		printf("\n \n ");
		display_table(t1,total_vertex);
	}
}


void main()
{
	struct node n1[7];
	struct node *p;
```

```
int n,n2,total_vertex,start;

printf("\n Enter how many nodes you create n:");
scanf("%d",&total_vertex);              //total vertex = total V1,V2...V7

for(int i=0;i<total_vertex;i++)
{
        printf("\n Enter graph Node::");
        scanf("%d",&n1[i].data);

        n1[i].next =NULL;
        struct node *first =NULL;
        struct node *last =NULL;


        printf("\n Enter total number of adjacent of %d ::",n1[i].data);
        scanf("%d",&n2);


        for(int j=0;j<n2;j++)
        {
                first=InsertEnd(&first,&last);
                n1[i].next =first;
        }
}

display(n1,total_vertex);

struct table t1[7];

//INITIAL TABLE

printf("\n Enter starting node:");
scanf("%d",&start);



for(int i=0;i<total_vertex;i++)
{
        t1[i].node_name_value = i+1;
        t1[i].known =0;

        if(i==(start-1))
        {
                t1[i].distance = 0;
        }
        else
        {
```

```
                t1[i].distance = -1;
            }
            t1[i].path = 0;

        }


        display_table(t1,total_vertex);  //initial table
        //DISPLAY
        sortest_path(t1,total_vertex,n1,start);


        getch();
}
```

==========
OUTPUT
==========

```
 Enter how many nodes you create n:7

 Enter graph Node::1

 Enter total number of adjacent of 1 ::2

 Enter Adjacent:2

 Enter Adjacent:4

 Enter graph Node::2

 Enter total number of adjacent of 2 ::2

 Enter Adjacent:4

 Enter Adjacent:5

 Enter graph Node::3

 Enter total number of adjacent of 3 ::2

 Enter Adjacent:1

 Enter Adjacent:6

 Enter graph Node::4
```

```
Enter total number of adjacent of 4 ::3

Enter Adjacent:6

Enter Adjacent:7

Enter Adjacent:5

Enter graph Node::5

Enter total number of adjacent of 5 ::1

Enter Adjacent:7

Enter graph Node::6

Enter total number of adjacent of 6 ::0

Enter graph Node::7

Enter total number of adjacent of 7 ::1

Enter Adjacent:6

1 --->2 4
2 --->4 5
3 --->1 6
4 --->6 7 5
5 --->7
6 --->
7 --->6
V      Known   Dv      Pv
1      0       -1      0
2      0       -1      0
3      0       0       0
4      0       -1      0
5      0       -1      0
6      0       -1      0
7      0       -1      0
Enter starting node:3


V      Known   Dv      Pv
1      0       1       3
2      0       -1      0
3      1       0       0
4      0       -1      0
```

5	0	-1	0
6	0	1	3
7	0	-1	0

V	Known	Dv	Pv
1	1	1	3
2	0	2	1
3	1	0	0
4	0	2	1
5	0	-1	0
6	0	1	3
7	0	-1	0

V	Known	Dv	Pv
1	1	1	3
2	0	2	1
3	1	0	0
4	0	2	1
5	0	-1	0
6	1	1	3
7	0	-1	0

V	Known	Dv	Pv
1	1	1	3
2	1	2	1
3	1	0	0
4	0	2	1
5	0	3	2
6	1	1	3
7	0	-1	0

V	Known	Dv	Pv
1	1	1	3
2	1	2	1
3	1	0	0
4	1	2	1
5	0	3	2
6	1	1	3
7	0	3	4

V	Known	Dv	Pv
1	1	1	3
2	1	2	1

3	1	0	0
4	1	2	1
5	1	3	2
6	1	1	3
7	0	3	4

V	Known	Dv	Pv
1	1	1	3
2	1	2	1
3	1	0	0
4	1	2	1
5	1	3	2
6	1	1	3
7	1	3	4

==========
OUTPUT 2
==========

Enter how many nodes you create n:5

Enter graph Node::1

Enter total number of adjacent of 1 ::2

Enter Adjacent:2

Enter Adjacent:3

Enter graph Node::2

Enter total number of adjacent of 2 ::1

Enter Adjacent:4

Enter graph Node::4

Enter total number of adjacent of 4 ::1

Enter Adjacent:5

Enter graph Node::3

Enter total number of adjacent of 3 ::1

```
Enter Adjacent:2

Enter graph Node::5

Enter total number of adjacent of 5 ::1

Enter Adjacent:3

1 --->2 3
2 --->4
4 --->5
3 --->2
5 --->3
Enter starting node:1

V      Known   Dv     Pv
1      0       0      0
2      0       -1     0
3      0       -1     0
4      0       -1     0
5      0       -1     0


V      Known   Dv     Pv
1      1       0      0
2      0       1      1
3      0       1      1
4      0       -1     0
5      0       -1     0


V      Known   Dv     Pv
1      1       0      0
2      1       1      1
3      0       1      1
4      0       2      2
5      0       -1     0


V      Known   Dv     Pv
1      1       0      0
2      1       1      1
3      1       1      1
4      0       2      2
5      0       2      3


V      Known   Dv     Pv
```

1	1	0	0
2	1	1	1
3	1	1	1
4	1	2	2
5	0	2	3

V	Known	Dv	Pv
1	1	0	0
2	1	1	1
3	1	1	1
4	1	2	2
5	1	2	3

==========

2)Dijkastra's Weighted Graph Shortest Path

==========

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

int front =-1;
int rear = -1;

struct node{
        int data;
        int weight;
        struct node * next;
};

struct table{
        int node_name_value;
        int known;
        int distance;
        int  path;
};
struct node * InsertEnd(struct node **first,struct node **last )
{
        struct node *new_node=NULL;
        new_node=(struct node *)malloc(sizeof(struct node));

        printf("\n Enter Adjacent:");
        scanf("%d",&new_node->data);
```

```
        printf("\n Enter Weight:");
        scanf("%d",&new_node->weight);

        new_node->next=NULL;

        if((*first)==NULL)
        {
                (*first)=new_node;
                (*last)=*first;
        }
        else
        {
                (*last)->next=new_node;
                (*last)=new_node;
        }

        return (*first);
}

void display(struct node n1[], int n)
{
        struct node *p;
        int i;
        for(int i=0;i<n;i++)
        {
                printf("\n %d --->",n1[i].data);

                p=n1[i].next;

                while(p!=NULL)
                {
                        printf("%d ",p->data);
                        p=p->next;
                }
        }

}

void display_table(struct table t1[], int total_vertex)
{
        printf("\n V\t Known\t Dv\t Pv");
        for(int i=0;i<total_vertex;i++)
        {
                printf("\n %d\t %d\t %d\t
%d",t1[i].node_name_value,t1[i].known,t1[i].distance,t1[i].path);
        }
}
```

```
void insert(int key,int size,int queue[])
{
	if(rear==(size-1))
	{
		printf("\n Overflow");
	}
	else
	{
		if(front==-1)
		{
			front=0;
		}
		rear +=1;
		queue[rear]=key;
	}
}

void del(int queue[])
{
	if(front==-1)
	{
		printf("\n underflow");

	}
	else if(front==rear)
	{
		//printf("\n Deleted item is:%d",queue[front]);
		front=-1;
		rear=-1;
	}
	else
	{
		//printf("\n Deleted item is:%d",queue[front]);
		front=front+1;
	}
}


int MIN(struct table t1[], int total_vertex)
{
	int min,i,j,index=0,flag=0;

	for(i=0;i<total_vertex;i++)
	{
		if(t1[i].known==0 &&  t1[i].distance!=-1)
		{
			min=t1[i].distance;
```

```
                index = i;

                for(j=i+1;j<total_vertex;j++)
                {
                        if(t1[j].known==0 &&  t1[j].distance!=-1)
                        {
                                if(min > t1[j].distance)
                                {
                                        min = t1[j].distance;
                                        index = j;
                                        flag=1;
                                }
                        }
                }
                if(flag==1){i=j;}
        }
    }
    return index;
}



void sortest_path(struct table t1[], int total_vertex,struct node n1[])
{
    int reachable,V;
    int cur_dis=0;
    struct node *W;   //for recahble
    int i,start;
    int queue[10];
    int size=10,min,index;



    for(i=0;i<total_vertex;i++)
    {
        min = MIN(t1 , total_vertex);


        V = n1[min].data;
        W = n1[min].next;

                t1[min].known = 1;

                        while(W!=NULL)
                        {
                                reachable = W->data;

                                if(t1[reachable-1].distance == -1)
```

```
                                {
                                        t1[reachable-1].distance = t1[V-
1].distance + W->weight;
                                t1[reachable-1].path =V;
                                }
                                else
                                {
                                if(t1[V-1].distance + W->weight <=
t1[reachable-1].distance)
                                //if(t1[reachable-1].distance == -1)
                                {
                                        t1[reachable-1].distance = t1[V-
1].distance + W->weight;
                                        t1[reachable-1].path =V;
                                }

                                }
                                W=W->next;

                        }

                printf("\n \n ");
                display_table(t1,total_vertex);
        }
}


void main()
{
        struct node n1[7];
        struct node *p;
        int n,n2,total_vertex,start;

        printf("\n Enter how many nodes you create n:");
        scanf("%d",&total_vertex);              //total vertex = total V1,V2...V7

        for(int i=0;i<total_vertex;i++)
        {
                printf("\n Enter graph Node::");
                scanf("%d",&n1[i].data);

                n1[i].next =NULL;
                struct node *first =NULL;
                struct node *last =NULL;


                printf("\n Enter total number of adjacent of %d ::",n1[i].data);
                scanf("%d",&n2);
```

```
        for(int j=0;j<n2;j++)
        {
                first=InsertEnd(&first,&last);
                n1[i].next =first;
        }
}

display(n1,total_vertex);

printf("\n Enter starting node:");
scanf("%d",&start);



struct table t1[7];

//INITIAL TABLE


for(int i=0;i<total_vertex;i++)
{
        t1[i].node_name_value = i+1;
        t1[i].known =0;

        if(i==(start-1))
        {
                t1[i].distance = 0;
        }
        else
        {
                t1[i].distance = -1;
        }
        t1[i].path = 0;

}


display_table(t1,total_vertex);  //initial table
//DISPLAY
sortest_path(t1,total_vertex,n1);


getch();
}
```

OUTPUT

```
 Enter how many nodes you create n:5

 Enter graph Node::1

 Enter total number of adjacent of 1 ::2

 Enter Adjacent:2

 Enter Weight:6

 Enter Adjacent:3

 Enter Weight:1

 Enter graph Node::2

 Enter total number of adjacent of 2 ::1

 Enter Adjacent:4

 Enter Weight:2

 Enter graph Node::3

 Enter total number of adjacent of 3 ::1

 Enter Adjacent:2

 Enter Weight:2

 Enter graph Node::4

 Enter total number of adjacent of 4 ::2

 Enter Adjacent:3

 Enter Weight:1

 Enter Adjacent:5

 Enter Weight:2

 Enter graph Node::5
```

```
Enter total number of adjacent of 5 ::1

Enter Adjacent:3

Enter Weight:2

1 --->2 3
2 --->4
3 --->2
4 --->3 5
5 --->3
Enter starting node:1

V      Known   Dv     Pv
1      0       0      0
2      0       -1     0
3      0       -1     0
4      0       -1     0
5      0       -1     0


V      Known   Dv     Pv
1      1       0      0
2      0       6      1
3      0       1      1
4      0       -1     0
5      0       -1     0


V      Known   Dv     Pv
1      1       0      0
2      0       3      3
3      1       1      1
4      0       -1     0
5      0       -1     0


V      Known   Dv     Pv
1      1       0      0
2      1       3      3
3      1       1      1
4      0       5      2
5      0       -1     0


V      Known   Dv     Pv
1      1       0      0
2      1       3      3
```

```
3       1       1       1
4       1       5       2
5       0       7       4


V       Known   Dv      Pv
1       1       0       0
2       1       3       3
3       1       1       1
4       1       5       2
5       1       7       4



============
OUTPUT
============



Enter how many nodes you create n:6

Enter graph Node::1

Enter total number of adjacent of 1 ::3

Enter Adjacent:2

Enter Weight:10

Enter Adjacent:4

Enter Weight:2

Enter Adjacent:5

Enter Weight:7

Enter graph Node::2

Enter total number of adjacent of 2 ::0

Enter graph Node::3

Enter total number of adjacent of 3 ::2

Enter Adjacent:2
```

```
Enter Weight:3

Enter Adjacent:6

Enter Weight:4

Enter graph Node::4

Enter total number of adjacent of 4 ::2

Enter Adjacent:3

Enter Weight:2

Enter Adjacent:5

Enter Weight:3

Enter graph Node::5

Enter total number of adjacent of 5 ::1

Enter Adjacent:6

Enter Weight:2

Enter graph Node::6

Enter total number of adjacent of 6 ::0

1 --->2 4 5
2 --->
3 --->2 6
4 --->3 5
5 --->6
6 --->
Enter starting node:1

V       Known   Dv      Pv
1       0       0       0
2       0       -1      0
3       0       -1      0
4       0       -1      0
5       0       -1      0
6       0       -1      0


V       Known   Dv      Pv
```

1	1	0	0
2	0	10	1
3	0	-1	0
4	0	2	1
5	0	7	1
6	0	-1	0

V	Known	Dv	Pv
1	1	0	0
2	0	10	1
3	0	4	4
4	1	2	1
5	0	5	4
6	0	-1	0

V	Known	Dv	Pv
1	1	0	0
2	0	7	3
3	1	4	4
4	1	2	1
5	0	5	4
6	0	8	3

V	Known	Dv	Pv
1	1	0	0
2	0	7	3
3	1	4	4
4	1	2	1
5	1	5	4
6	0	7	5

V	Known	Dv	Pv
1	1	0	0
2	0	7	3
3	1	4	4
4	1	2	1
5	1	5	4
6	1	7	5

V	Known	Dv	Pv
1	1	0	0
2	1	7	3
3	1	4	4

```
4     1     2     1
5     1     5     4
6     1     7     5
```

==========
3)Priority Queue Using MIN Heap
==========

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
int size = 15;
static int index=0;

void swap(int arr[],int index1,int index2)
{
	int temp;

	temp=arr[index1];
	arr[index1] = arr[index2];
	arr[index2] =temp;
}

void InsertPriorityQueue(int arr[],int value)		// Prioity queue insert / Min heap Insert
{
	int parent,child,i;
	index++;
	i=index;

	if(index >size+1)
	{
		printf("\n Heap is full");
	}
	else
	{
		arr[index] = value;

		while(i>1)
		{
			parent =i/2;
			child = arr[i];

			if(arr[parent] > child)
			{
```

```
                        swap(arr,i/2,i);
                        i=parent;
                }
                else
                {
                        break;
                }
        }

    }


}

void Display(int arr[],int n)
{

    if(n==0)
    {
        printf("Queue is Empty");
    }
    else
    {
        printf("\n");
        for(int i=1;i<=n;i++)
        {
            printf("%d ",arr[i]);
        }
    }
}
void DeletePriorityQueue(int arr[], int* N) //n is total members in queue
{
    //hear *N is used for make n value  n-1  after the function
    int i=1,left,right,last;
    int n=*N;


    if(n==0)
    {
        printf("\n queue is empty");
    }
    else
    {
        printf("\n Deleted item is : %d",arr[i]);

        while(i<n)
        {
            left = 2*i;
```

```
                right = 2*i + 1;
                last = n;
                if(left<n && right<n)
                {
                        if(arr[left]>arr[right] )
                        {
                                if(arr[right]<arr[last])
                                {
                                        arr[i]=arr[right];
                                        i=right;
                                }
                                else
                                {
                                        arr[i] = arr[last];
                                        i=last;
                                }
                        }
                        else if(arr[left]<arr[right] )
                        {
                                if( arr[left]<arr[last])
                                {
                                        arr[i] = arr[left];
                                        i=left;
                                }
                                else
                                {
                                        arr[i]=arr[last];
                                        i=last;
                                }
                        }
                }
                else
                {
                        break;
                }
        }
        if(i!=1)   // if i==1 then there is last node so we cant give any
value to it
        {
                arr[i] = arr[last];
        }
        n--;
        *N = n;
    }
}

void main()
{
```

```
        int n=0,i,ch,size,arr[20],value;
        char choice = 'n';

        printf("\n----------");
        printf("\n 1.Insert");
        printf("\n 2.Delete");
        printf("\n 3.Display");
        printf("\n 4.exit");
        printf("\n----------");

        do
        {
                printf("\n Enter your choice:");
                scanf("%d",&ch);

                switch(ch)
                {
                        case 1:
                                        n++;
                                        printf("\n Enter node :");
                                        scanf("%d",&value);
                                        InsertPriorityQueue(arr,value);

                                        break;
                        case 2:
                                        DeletePriorityQueue(arr,&n);
                                        break;
                        case 3:
                                        Display(arr,n);
                                        break;
                        case 4:
                                        exit(0);
                                        break;
                }
        }while(ch!=4);
        getch();
}

==============
OUTPUT
==============
----------
 1.Insert
 2.Delete
 3.Display
 4.exit
----------
 Enter your choice:1
```

```
Enter node :12

Enter your choice:1

Enter node :16

Enter your choice:1

Enter node :14

Enter your choice:1

Enter node :29

Enter your choice:1

Enter node :74

Enter your choice:1

Enter node :38

Enter your choice:1

Enter node :49

Enter your choice:38

Enter your choice:1

Enter node :39

Enter your choice:3

12 16 14 29 74 38 49 39
Enter your choice:2

Deleted item is : 12
Enter your choice:3

14 16 38 29 74 39 49
Enter your choice:2

Deleted item is : 14
Enter your choice:3

16 29 38 49 74 39
```

```
 Enter your choice:2

 Deleted item is : 16
 Enter your choice:3

29 39 38 49 74
 Enter your choice:2

 Deleted item is : 29
 Enter your choice:3

38 39 74 49
 Enter your choice:2

 Deleted item is : 38
 Enter your choice:3

39 49 74
 Enter your choice:2

 Deleted item is : 39
 Enter your choice:3

39 49
 Enter your choice:2

 Deleted item is : 39
 Enter your choice:3

39
 Enter your choice:2

 Deleted item is : 39
 Enter your choice:3
Queue is Empty
 Enter your choice:2

 queue is empty
 Enter your choice:4
```

==========

4)MAX Heap

==========

```
#include<stdio.h>
```

```
#include<conio.h>
#include<stdlib.h>
int size = 15;
static int index=0;

void swap(int arr[],int index1,int index2)
{
	int temp;

	temp=arr[index1];
	arr[index1] = arr[index2];
	arr[index2] =temp;
}

void Insert_MAX_Heap(int arr[],int value)		// MAX heap Insert
{
	int parent,child,i;
	index++;
	i=index;

	if(index >size+1)
	{
		printf("\n Heap is full");
	}
	else
	{
		arr[index] = value;

		while(i>1)
		{
			parent =i/2;
			child = arr[i];

			if(arr[parent] < child)
			{
				swap(arr,i/2,i);
				//index = parent;
				i=parent;
			}
			else
			{
				break;
			}
		}

	}
```

```
}

void Display(int arr[],int n)
{

	if(n==0)
	{
		printf("Queue is Empty");
	}
	else
	{
		printf("\n");
		for(int i=1;i<=n;i++)
		{
			printf("%d ",arr[i]);
		}
	}
}
void Delete_MAX_Heap(int arr[], int* N) //n is total members in queue
{
	//hear *N is used for make n value  n-1  after the function
	int i=1,left,right,last;
	int n=*N;


	if(n==0)
	{
		printf("\n queue is empty");
	}
	else
	{
		printf("\n Deleted item is : %d",arr[i]);

		while(i<n)
		{
			left = 2*i;
			right = 2*i + 1;
			last = n;
			if(left<n && right<n)
			{
				if(arr[left]<arr[right] )
				{
					if(arr[right]>arr[last])
					{
						arr[i]=arr[right];
						i=right;
					}
					else
```

```
                                {
                                        arr[i] = arr[last];
                                        i=last;
                                }
                        }
                        else if(arr[left]>arr[right] )
                        {
                                if( arr[left]>arr[last])
                                {
                                        arr[i] = arr[left];
                                        i=left;
                                }
                                else
                                {
                                        arr[i]=arr[last];
                                        i=last;
                                }
                        }
                }
                else
                {
                        break;
                }
        }
        if(i!=1)   // if i==1 then there is last node so we cant give any
value to it
        {
                arr[i] = arr[last];
        }
        n--;
        *N = n;
    }
}

void main()
{
    int n=0,i,ch,size,arr[20],value;
    char choice = 'n';

    printf("\n----------");
    printf("\n 1.Insert");
    printf("\n 2.Delete");
    printf("\n 3.Display");
    printf("\n 4.exit");
    printf("\n----------");

    do
    {
```

```
		printf("\n Enter your choice:");
		scanf("%d",&ch);

		switch(ch)
		{
			case 1:
					n++;
					printf("\n Enter node :");
					scanf("%d",&value);
					Insert_MAX_Heap(arr,value);

					printf("\n After Insert");
					for(int j=1;j<=n;j++)
					{
						printf("%d ",arr[j]);
					}
					break;
			case 2:
					Delete_MAX_Heap(arr,&n);
					break;
			case 3:
					Display(arr,n);
					break;
			case 4:
					exit(0);
					break;
		}
	}while(ch!=4);
	getch();
}
```

```
==============
OUTPUT
==============
----------
 1.Insert
 2.Delete
 3.Display
 4.exit
----------
 Enter your choice:1

 Enter node :31

 After Insert31
 Enter your choice:1

 Enter node :41
```

```
After Insert41 31
Enter your choice:1

Enter node :59

After Insert59 31 41
Enter your choice:1

Enter node :26

After Insert59 31 41 26
Enter your choice:1

Enter node :53

After Insert59 53 41 26 31
Enter your choice:1

Enter node :58

After Insert59 53 58 26 31 41
Enter your choice:1

Enter node :97

After Insert97 53 59 26 31 41 58
Enter your choice:2

Deleted item is : 97
Enter your choice:3

59 53 58 26 31 41
Enter your choice:2

Deleted item is : 59
Enter your choice:3

58 53 41 26 31
Enter your choice:2

Deleted item is : 58
Enter your choice:3

53 31 41 26
Enter your choice:2

Deleted item is : 53
```

```
 Enter your choice:3

41 31 26
 Enter your choice:2

 Deleted item is : 41
 Enter your choice:3

41 31
 Enter your choice:2

 Deleted item is : 41
 Enter your choice:3

41
 Enter your choice:2

 Deleted item is : 41
 Enter your choice:3
Queue is Empty
 Enter your choice:2

 queue is empty
 Enter your choice:4
```

==========
5)Heap Sort
==========

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>


void swap(int *num1,int *num2)
{
	int *temp;

	*temp=*num1;
	*num1 = *num2;
	*num2 =*temp;
}
void heapify(int arr[],int n,int i)
```

```
{
	int largest,l,r,temp;

	largest = i;
	l = 2*i+ 1 ;
	r = 2*i + 2;

	if(l<n && arr[l] > arr[largest])
	{
		largest = l;
	}
	if(r<n && arr[r] > arr[largest])
	{
		largest = r;
	}
	if(largest!=i)  //here we check that is largest is changed
	{
		//swap(&arr[i],&arr[largest]);

		temp = arr[i];
		arr[i]=arr[largest];
		arr[largest]=temp;

		heapify(arr,n,largest);
	}
}

void HeapSort(int arr[],int n)
{
	int temp;

	for(int i=n/2;i>=0;i--)
	{
		heapify(arr,n,i);
	}

	for(int i=n;i>=0;i--)
	{
		temp = arr[0];
		arr[0] = arr[i];
		arr[i] = temp;

		heapify(arr,i,0);

	}
}
```

```
void Display(int arr[],int n)
{

		for(int i=1;i<=n;i++)
		{
			printf("%d ",arr[i]);
		}

}

void main()
{
	int n,i,ch,size,arr[20],value;
	char choice = 'n';

	printf("\n Enter total elements");
	scanf("%d",&n);

	for(i=1;i<=n;i++)
	{
		printf("\n Enter value : ");
		scanf("%d",&arr[i]);
	}

	HeapSort(arr,n);

	printf("\n final \n");
	 for (int i=1; i<=n; ++i)
	  printf("%d ",arr[i]);


	getch();
}
```

```
========
OUTPUT
=======

 Enter total elements7

 Enter value : 30

 Enter value : 17

 Enter value : 15

 Enter value : 1
```

```
 Enter value : 5

 Enter value : 10

 Enter value : 20

 final
1 5 10 15 17 20 30

========
OUTPUT
=======

 Enter total elements
10

 Enter value : 1

 Enter value : 10

 Enter value : 2

 Enter value : 3

 Enter value : 4

 Enter value : 1

 Enter value : 2

 Enter value : 100

 Enter value : 23

 Enter value : 2

 final
1 1 2 2 2 3 4 10 23 100
```

```
====================
6)Quick Sort
====================
```

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

void GetData(int num[],int n)
{
	int i;
	for(i=0;i<n;i++)
	{
		printf("\n Enter Value:");
		scanf("%d",&num[i]);
	}

}
void Display(int num[],int n)
{
	int i;
	for(i=0;i<n;i++)
	{
		printf("%d ",num[i]);
	}

}




void quicksort(int number[25],int first,int last){
   int i, j, pivot, temp;

   if(first<last){
      pivot=first;
      i=first;
      j=last;

      while(i<j){
         while(number[i]<=number[pivot]&&i<last)
            i++;
         while(number[j]>number[pivot])
            j--;
         if(i<j){
            temp=number[i];
            number[i]=number[j];
            number[j]=temp;
         }
      }
```

```
    temp=number[pivot];
    number[pivot]=number[j];
    number[j]=temp;
    quicksort(number,first,j-1);
    quicksort(number,j+1,last);

  }
}
void main()
{
       int num[20],i,n;

       printf("\n Enter value of n:");
       scanf("%d",&n);

       GetData(num,n);
       printf("\n\n Before Sorted..\n");
       Display(num,n);

       quicksort(num,0,n-1);
       printf("\n\n After Sorted..\n");
       Display(num,n);
       getch();
}
```

==========
OUTPUT
==========

```
 Enter value of n:7

 Enter Value:6

 Enter Value:4

 Enter Value:5

 Enter Value:1

 Enter Value:2

 Enter Value:7

 Enter Value:3


 Before Sorted..
6 4 5 1 2 7 3
```

```
 After Sorted..
1 2 3 4 5 6 7
```

```
=======================
7)Radix Sort
=======================

#include<stdio.h>
#include<conio.h>
#include <math.h>
#include<malloc.h>


struct ArrayNode{
	int data;
	struct node * next;
	struct node * inerrNodeLast;
};

struct node {
	int data;
	struct node *next;
};

struct node * InsertEnd(struct node **first,struct node **last ,int data)
{

	struct node *new_node=NULL;
	new_node=(struct node *)malloc(sizeof(struct node));

	new_node->data = data;
	new_node->next=NULL;

	if((*first)==NULL)
	{
		(*first)=new_node;
		(*last)=*first;
	}
	else
	{
		(*last)->next=new_node;
		(*last)=new_node;
	}
```

```
	return (*first);
}

int max(int arr[], int n)
{
	int i,max,digit=0;

	max=arr[0];

	for(i=1;i<n;i++)
	{
		if(max<arr[i])
			max =arr[i];
	}

	return max;
}

void Display(struct ArrayNode struct_arr[])
{
		struct node *p;

	for(int i=0;i<10;i++)
	{
		printf("\n %d --->",struct_arr[i].data);

		p=struct_arr[i].next;

		while(p!=NULL)
		{
			printf("%d ",p->data);
			p=p->next;
		}


	}
}
void main()
{
	int i,j,array_data[20];
	int n,data,rem,max_digit, modValue;

	int index=0,array_data2[20],w,m,k;

	struct ArrayNode struct_arr[10];
	struct node *p;

	printf("\n Enter n:");
```

```
scanf("%d",&n);

for(i=0;i<n;i++)
{
	printf("\n Enter data:");
	scanf("%d",&array_data[i]);
}

max_digit = max(array_data,n);

for(w=1;max_digit/w>0;w*=10)
{

	for( k=0;k<10;k++)
	{
		struct_arr[k].data = k;
		struct_arr[k].next = NULL;
		struct_arr[k].inerrNodeLast =NULL;
	}


	for(i=0;i<n;i++)
	{

		rem = (array_data[i] /w) % 10;

		for(j=0;j<10;j++)
		{
			struct node *first = NULL;
			struct node *last= NULL;

			if(rem == j)  //struct_arr[k].data
			{
				if(struct_arr[j].next == NULL)
				{

first=InsertEnd(&first,&last,array_data[i]);
					struct_arr[j].next = first;
					struct_arr[j].inerrNodeLast = last;
				}
				else
				{
					first = struct_arr[j].next;
					last = struct_arr[j].inerrNodeLast;

first=InsertEnd(&first,&last,array_data[i]);
					struct_arr[j].next = first;
					struct_arr[j].inerrNodeLast = last;
```

```
                                }
                        }//if
                }//end of for j

        }// end of for i
        index=0;
        for(int o=0;o<10;o++)
        {

                //printf("\n %d --->",o);

                p=struct_arr[o].next;

                while(p!=NULL)
                {
                        array_data[index]=p->data;
                //      printf("--> %d ",p->data);
                        p=p->next;
                        index++;

                }

        }

        printf("\n Array\n----------\n");
        for( m =0 ;m<n;m++)
        {
                printf("%d ",array_data[m]);
        }
    }
    getch();
}
```

==========
OUTPUT
==========

```
 Enter n:10

 Enter data:15

 Enter data:1

 Enter data:321

 Enter data:10

 Enter data:802
```

```
 Enter data:2

 Enter data:123

 Enter data:90

 Enter data:109

 Enter data:11

 Array
------------
10 90 1 321 11 802 2 123 15 109
 Array
------------
1 802 2 109 10 11 15 321 123 90
 Array
------------
1 2 10 11 15 90 109 123 321 802
```

==========
8) Shell Sort
==========

```
#include<stdio.h>
#include<conio.h>
#include <math.h>

void swap(int arr[],int index1,int index2)
{
	int temp;

	temp=arr[index1];
	arr[index1] = arr[index2];
```

```
	arr[index2] =temp;
}
void main()
{
	int arr[20] ; //= {81,94,11,96,12,35,17,95,28,58,41,75,15};

	int n; // = 13;
	printf("\n Enter n:");
	scanf("%d",&n);

	for(int i=0;i<n;i++)
	{
		printf("\n Enter Value:");
		scanf("%d",&arr[i]);
	}



	int increment =5;
	int tempIndex;

	printf("\n \nbefore Sorting");
	for(int j=0;j<n;j++)
	{
		printf("%d ",arr[j]);
	}
	printf("\n ------------");

	while(increment!=0)
	{
		printf("\nFor Increment %d",increment);
		printf("\n--------------------------");
		for(int i=0;i<n;i++)
		{
			if(i + increment<n)
			{
				tempIndex = i + increment;
				if(arr[i] > arr[tempIndex])
				{
					swap(arr,i,tempIndex);
				}
			}

			if((i - increment )>=0)
			{
				tempIndex = i - increment;
				if(arr[i] < arr[tempIndex])
				{
```

```
                                swap(arr,i,tempIndex);
                        }
                }

                printf("\n");

                for(int j=0;j<n;j++)
                {
                        printf("%d ",arr[j]);
                }
        }
        increment =(increment/2);
    }


    printf(" \n \nAfter Sorting");
    for(int j=0;j<n;j++)
    {
        printf("%d ",arr[j]);
    }

    getch();
}
```

==========
OUTPUT
==========

Enter n:13

Enter Value:81

Enter Value:94

Enter Value:11

Enter Value:96

Enter Value:12

Enter Value:35

Enter Value:17

Enter Value:95

Enter Value:28

```
 Enter Value:58

 Enter Value:41

 Enter Value:75

 Enter Value:15


before Sorting81 94 11 96 12 35 17 95 28 58 41 75 15


For Increment 5
--------------------------
35 94 11 96 12 81 17 95 28 58 41 75 15
35 17 11 96 12 81 94 95 28 58 41 75 15
35 17 11 96 12 81 94 95 28 58 41 75 15
35 17 11 28 12 81 94 95 96 58 41 75 15
35 17 11 28 12 81 94 95 96 58 41 75 15
35 17 11 28 12 41 94 95 96 58 81 75 15
35 17 11 28 12 41 75 95 96 58 81 94 15
35 17 11 28 12 41 75 15 96 58 81 94 95
35 17 11 28 12 41 75 15 96 58 81 94 95
35 17 11 28 12 41 75 15 96 58 81 94 95
35 17 11 28 12 41 75 15 96 58 81 94 95
35 17 11 28 12 41 75 15 96 58 81 94 95
For Increment 2
--------------------------
11 17 35 28 12 41 75 15 96 58 81 94 95
11 17 35 28 12 41 75 15 96 58 81 94 95
11 17 12 28 35 41 75 15 96 58 81 94 95
11 17 12 28 35 41 75 15 96 58 81 94 95
11 17 12 28 35 41 75 15 96 58 81 94 95
11 17 12 15 35 28 75 41 96 58 81 94 95
11 17 12 15 35 28 75 41 96 58 81 94 95
11 17 12 15 35 28 75 41 96 58 81 94 95
11 17 12 15 35 28 75 41 81 58 96 94 95
11 17 12 15 35 28 75 41 81 58 96 94 95
11 17 12 15 35 28 75 41 81 58 95 94 96
11 17 12 15 35 28 75 41 81 58 95 94 96
11 17 12 15 35 28 75 41 81 58 95 94 96
For Increment 1
--------------------------
11 17 12 15 35 28 75 41 81 58 95 94 96
11 12 17 15 35 28 75 41 81 58 95 94 96
11 12 15 17 35 28 75 41 81 58 95 94 96
```

```
11 12 15 17 35 28 75 41 81 58 95 94 96
11 12 15 17 28 35 75 41 81 58 95 94 96
11 12 15 17 28 35 75 41 81 58 95 94 96
11 12 15 17 28 35 41 75 81 58 95 94 96
11 12 15 17 28 35 41 75 81 58 95 94 96
11 12 15 17 28 35 41 58 75 81 95 94 96
11 12 15 17 28 35 41 58 75 81 95 94 96
11 12 15 17 28 35 41 58 75 81 94 95 96
11 12 15 17 28 35 41 58 75 81 94 95 96
11 12 15 17 28 35 41 58 75 81 94 95 96

After Sorting11 12 15 17 28 35 41 58 75 81 94 95 96


==========================
9) Merge Sort
==========================


#include<stdio.h>
#include<conio.h>
#include<malloc.h>

void GetData(int num[],int n)
{
	int i;
	for(i=0;i<n;i++)
	{
		printf("\n Enter Value:");
		scanf("%d",&num[i]);
	}

}
void Display(int num[],int n)
{
	int i;
	for(i=0;i<n;i++)
	{
		printf("%d ",num[i]);
	}

}


void merge_sort(int i, int j, int a[], int temp[]) {
   if (j <= i) {
      return;
   }
```

```
   int mid = (i + j) / 2;

   merge_sort(i, mid, a, temp);
   merge_sort(mid + 1, j, a, temp);

   int left = i;
   int right = mid + 1;
   int k;

   for (k = i; k <= j; k++) {
      if (left == mid + 1) {      // left pointer has reached the limit
         temp[k] = a[right];
         right++;
      } else if (right == j + 1) {       // right pointer has reached the limit
         temp[k] = a[left];
         left++;
      } else if (a[left] < a[right]) {       // pointer left points to smaller element
         temp[k] = a[left];
         left++;
      } else {       // pointer right points to smaller element
         temp[k] = a[right];
         right++;
      }
   }

   for (k = i; k <= j; k++) {      // copy the elements from temp[] to a[]
      a[k] = temp[k];
   }
}

void main()
{
       int num[20],i,n,temp[100];

       printf("\n Enter value of n:");
       scanf("%d",&n);

       GetData(num,n);
       printf("\n\n Before Sorted..\n");
       Display(num,n);

       merge_sort(0, n - 1, num, temp);
       printf("\n\n After Sorted..\n");
       Display(num,n);
       getch();
}

============
```

OUTPUT
==========

Enter value of n:7

Enter Value:6

Enter Value:4

Enter Value:5

Enter Value:1

Enter Value:2

Enter Value:7

Enter Value:3

Before Sorted..
6 4 5 1 2 7 3

After Sorted..
1 2 3 4 5 6 7

==========
10) BFS , DFS
==========

```
#include<stdio.h>
#include<conio.h>
#include<malloc.h>

int front =-1;
int rear = -1;


void insert(int key,int size,int queue[])
{
        if(rear==(size-1))
        {
```

```
		printf("\n Overflow");
	}
	else
	{
		if(front==-1)
		{
			front=0;
		}
		rear +=1;
		queue[rear]=key;
	}
}

void del(int queue[])
{
	if(front==-1)
	{
		printf("\n underflow");

	}
	else if(front==rear)
	{
		//printf("\n Deleted item is:%d",queue[front]);
		front=-1;
		rear=-1;
	}
	else
	{
		//printf("\n Deleted item is:%d",queue[front]);
		front=front+1;
	}
}




struct node{
	int data;
	struct node * next;
};

struct table{
	int node_name_value;
	int known;
	int distance;
	int  path;
};
```

```
struct node * InsertEnd(struct node **first,struct node **last )
{
	struct node *new_node=NULL;
	new_node=(struct node *)malloc(sizeof(struct node));

	printf("\n Enter Adjacent:");
	scanf("%d",&new_node->data);
	new_node->next=NULL;

	if((*first)==NULL)
	{
		(*first)=new_node;
		(*last)=*first;
	}
	else
	{
		(*last)->next=new_node;
		(*last)=new_node;
	}

	return (*first);
}


void display_table(struct table t1[], int total_vertex)
{
	printf("\n V\t Known\t Dv\t Pv");
	for(int i=0;i<7;i++)
	{
		printf("\n %d\t %d\t %d\t
%d",t1[i].node_name_value,t1[i].known,t1[i].distance,t1[i].path);
	}
}




void sortest_path(struct table t1[], int total_vertex,struct node n1[])  // this is
for BFS
{
	int reachable,V;
	int cur_dis=0;
	struct node *W;   //for recahble
	int i,start;
	int queue[10];
	int size=10;

	int bfsIndex = 0;  // bfs index
```

```
	int BFS[10]; //breath first search



	printf("\n Enter starting node:");
	scanf("%d",&start);

	insert(start,size,queue);
	BFS[bfsIndex] = start;
	bfsIndex++;

	while(front!=-1)
	{
		V = queue[front];

				W = n1[V-1].next; //address of list


				t1[V-1].known = 1;
				del(queue);

				while(W!=NULL)
				{
					reachable = W->data;
					if(t1[reachable-1].distance == -1)
					{
						t1[reachable-1].distance = t1[V-
1].distance + 1;
						t1[reachable-1].path =V;
						insert(reachable,size,queue);
						BFS[bfsIndex] = reachable;
						bfsIndex++;
					}

					W=W->next;
				}
	}

	printf("\n-----BFS-----\n");
	for(int i=0;i<bfsIndex;i++)
	{
		printf("V%d ",BFS[i]);
	//	bfsIndex++;

	}
}

int visited[10];
```

```
void DFS(struct table t1[], int total_vertex,struct node n1[],int start)
{
	int reachable,V;
	int cur_dis=0;
	struct node *W;   //for recahble
	int i;
	int stack[10],size=10;

	visited[start-1]=1;
	printf("V%d  ",start);

	W = n1[start-1].next;	//address of list


				while(W!=NULL)
				{
					reachable = W->data;
					if(visited[reachable-1] !=1)
					{
						DFS(t1,total_vertex,n1,reachable);
					}
					W=W->next;
				}

}



void main()
{
	struct node n1[7];
	struct node *p;
	int n,n2,total_vertex,start;

	printf("\n Enter how many nodes you create n:");
	scanf("%d",&total_vertex);		//total vertex = total V1,V2...V7

	for(int i=0;i<total_vertex;i++)
	{
		printf("\n Enter graph Node::");
		scanf("%d",&n1[i].data);

		n1[i].next =NULL;
		struct node *first =NULL;
		struct node *last =NULL;
```

```
		printf("\n Enter total number of adjacent of %d ::",n1[i].data);
		scanf("%d",&n2);



		for(int j=0;j<n2;j++)
		{
			first=InsertEnd(&first,&last);
			n1[i].next =first;
		}
	}


	struct table t1[7];

	//INITIAL TABLE

	printf("\n Enter starting node:");
	scanf("%d",&start);


	for(int i=0;i<total_vertex;i++)
	{
		t1[i].node_name_value = i+1;
		t1[i].known =0;

		if(i==(start -1))
		{
			t1[i].distance = 0;
		}
		else
		{
			t1[i].distance = -1;
		}
		t1[i].path = 0;

	}

	//BFS
	sortest_path(t1,total_vertex,n1);

	printf("\n---------\n   DFS   \n---------\n");
	DFS(t1,total_vertex,n1,start);

	getch();
}
```

==========
OUTPUT
==========

```
 Enter how many nodes you create n:7

 Enter graph Node::1

 Enter total number of adjacent of 1 ::2

 Enter Adjacent:2

 Enter Adjacent:4

 Enter graph Node::2

 Enter total number of adjacent of 2 ::2

 Enter Adjacent:4

 Enter Adjacent:5

 Enter graph Node::3

 Enter total number of adjacent of 3 ::2

 Enter Adjacent:1

 Enter Adjacent:6

 Enter graph Node::4

 Enter total number of adjacent of 4 ::3

 Enter Adjacent:6

 Enter Adjacent:7

 Enter Adjacent:5

 Enter graph Node::5

 Enter total number of adjacent of 5 ::1

 Enter Adjacent:7

 Enter graph Node::6
```

```
 Enter total number of adjacent of 6 ::0

 Enter graph Node::7

 Enter total number of adjacent of 7 ::1

 Enter Adjacent:6

 Enter starting node:1

 Enter starting node:1

-----BFS-----
V1 V2 V4 V5 V6 V7

---------
  DFS
---------
V1  V2  V4  V6  V7  V5
```

```
================================
11)Prims Minimum Spanning Tree
================================

#include<stdio.h>
#include<conio.h>
#include<malloc.h>

int front =-1;
int rear = -1;

struct node{
        int data;
        int weight;
        struct node * next;
};

struct table{
        int node_name_value;
        int known;
        int distance;
        int  path;
};
struct node * InsertEnd(struct node **first,struct node **last )
```

```
{
	struct node *new_node=NULL;
	new_node=(struct node *)malloc(sizeof(struct node));

	printf("\n Enter Adjacent:");
	scanf("%d",&new_node->data);


	printf("\n Enter Weight:");
	scanf("%d",&new_node->weight);

	new_node->next=NULL;

	if((*first)==NULL)
	{
		(*first)=new_node;
		(*last)=*first;
	}
	else
	{
		(*last)->next=new_node;
		(*last)=new_node;
	}

	return (*first);
}

void display(struct node n1[], int n)
{
	struct node *p;
	int i;
	for(int i=0;i<n;i++)
	{
		printf("\n %d --->",n1[i].data);

		p=n1[i].next;

		while(p!=NULL)
		{
			printf("%d ",p->data);
			p=p->next;
		}
	}

}

void display_table(struct table t1[], int total_vertex)
{
```

```
	printf("\n V\t Known\t Dv\t Pv");
	for(int i=0;i<total_vertex;i++)
	{
		printf("\n %d\t %d\t %d\t
%d",t1[i].node_name_value,t1[i].known,t1[i].distance,t1[i].path);
	}
}

void insert(int key,int size,int queue[])
{
	if(rear==(size-1))
	{
		printf("\n Overflow");
	}
	else
	{
		if(front==-1)
		{
			front=0;
		}
		rear +=1;
		queue[rear]=key;
	}
}

void del(int queue[])
{
	if(front==-1)
	{
		printf("\n underflow");

	}
	else if(front==rear)
	{
		//printf("\n Deleted item is:%d",queue[front]);
		front=-1;
		rear=-1;
	}
	else
	{
		//printf("\n Deleted item is:%d",queue[front]);
		front=front+1;
	}
}


int MIN(struct table t1[], int total_vertex)
{
```

```
	int min,i,j,index=0,flag=0;

	for(i=0;i<total_vertex;i++)
	{
		if(t1[i].known==0 &&  t1[i].distance!=-1)
		{
			min=t1[i].distance;
			index = i;

			for(j=i+1;j<total_vertex;j++)
			{
				if(t1[j].known==0 &&  t1[j].distance!=-1)
				{
					if(min > t1[j].distance)
					{
						min = t1[j].distance;
						index = j;
						flag=1;
					}
				}
			}
			if(flag==1){i=j;}
		}
	}
	return index;
}



void sortest_path(struct table t1[], int total_vertex,struct node n1[])
{
	int reachable,V;
	int cur_dis=0;
	struct node *W;   //for recahble
	int i,start;
	int queue[10];
	int size=10,min,index;



	for(i=0;i<total_vertex;i++)
	{
		min = MIN(t1 , total_vertex);


		V = n1[min].data;
		W = n1[min].next;
```

```
                t1[min].known = 1;

                        while(W!=NULL)
                        {
                                reachable = W->data;

                                if(t1[reachable-1].distance == -1)
                                {
                                        t1[reachable-1].distance = t1[V-
1].distance;
                                    t1[reachable-1].path =V;
                                }
                        /*      else
                                {
                                        if(t1[V-1].distance <= t1[reachable-
1].distance)
                                        //if(t1[reachable-1].distance == -1)
                                        {
                                                t1[reachable-1].distance = t1[V-
1].distance;
                                                t1[reachable-1].path =V;
                                        }

                                }
                                */
                                W=W->next;

                        }

                printf("\n \n ");
                display_table(t1,total_vertex);
        }
}


void main()
{
        struct node n1[7];
        struct node *p;
        int n,n2,total_vertex,start;

        printf("\n Enter how many nodes you create n:");
        scanf("%d",&total_vertex);              //total vertex = total V1,V2...V7

        for(int i=0;i<total_vertex;i++)
        {
                printf("\n Enter graph Node::");
                scanf("%d",&n1[i].data);
```

```
        n1[i].next =NULL;
        struct node *first =NULL;
        struct node *last =NULL;


        printf("\n Enter total number of adjacent of %d ::",n1[i].data);
        scanf("%d",&n2);


        for(int j=0;j<n2;j++)
        {
                first=InsertEnd(&first,&last);
                n1[i].next =first;
        }
}

display(n1,total_vertex);

printf("\n Enter starting node:");
scanf("%d",&start);



struct table t1[7];

//INITIAL TABLE


for(int i=0;i<total_vertex;i++)
{
        t1[i].node_name_value = i+1;
        t1[i].known =0;

        if(i==(start-1))
        {
                t1[i].distance = 0;
        }
        else
        {
                t1[i].distance = -1;
        }
        t1[i].path = 0;

}


display_table(t1,total_vertex);  //initial table
```

```
        //DISPLAY
        sortest_path(t1,total_vertex,n1);


        getch();
}
```

OUTPUT

```
 Enter how many nodes you create n:5

 Enter graph Node::1

 Enter total number of adjacent of 1 ::2

 Enter Adjacent:2

 Enter Weight:6

 Enter Adjacent:3

 Enter Weight:1

 Enter graph Node::2

 Enter total number of adjacent of 2 ::1

 Enter Adjacent:4

 Enter Weight:2

 Enter graph Node::3

 Enter total number of adjacent of 3 ::1

 Enter Adjacent:2

 Enter Weight:2

 Enter graph Node::4

 Enter total number of adjacent of 4 ::2

 Enter Adjacent:3

 Enter Weight:1
```

```
Enter Adjacent:5

Enter Weight:2

Enter graph Node::5

Enter total number of adjacent of 5 ::1

Enter Adjacent:3

Enter Weight:2

1 --->2 3
2 --->4
3 --->2
4 --->3 5
5 --->3
Enter starting node:1

V      Known   Dv      Pv
1      0       0       0
2      0       -1      0
3      0       -1      0
4      0       -1      0
5      0       -1      0


V      Known   Dv      Pv
1      1       0       0
2      0       0       1
3      0       0       1
4      0       -1      0
5      0       -1      0


V      Known   Dv      Pv
1      1       0       0
2      0       0       1
3      1       0       1
4      0       -1      0
5      0       -1      0


V      Known   Dv      Pv
1      1       0       0
2      1       0       1
3      1       0       1
```

```
4       0       0       2
5       0       -1      0


V       Known   Dv      Pv
1       1       0       0
2       1       0       1
3       1       0       1
4       1       0       2
5       0       0       4


V       Known   Dv      Pv
1       1       0       0
2       1       0       1
3       1       0       1
4       1       0       2
5       1       0       4
```

==========
12)Kruskals Minimum Spanning Tree
==========

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
int size = 15;
static int index=0;

struct node{
        int data;
        int weight;
        struct node * next;
};


struct node * InsertEnd(struct node **first,struct node **last )
{
        struct node *new_node=NULL;
        new_node=(struct node *)malloc(sizeof(struct node));

        printf("\n Enter Adjacent:");
        scanf("%d",&new_node->data);
```

```
	printf("\n Enter Weight:");
	scanf("%d",&new_node->weight);

	new_node->next=NULL;

	if((*first)==NULL)
	{
		(*first)=new_node;
		(*last)=*first;
	}
	else
	{
		(*last)->next=new_node;
		(*last)=new_node;
	}

	return (*first);
}

void swap(int arr[][20],int index1,int index2)
{
	int temp;

	temp=arr[index1][2];
	arr[index1][2] = arr[index2][2];
	arr[index2][2] =temp;
}

void BuildHeap(int arr[][20],int size)		// Prioity queue insert / Min heap
Insert
{
	int temp[3] = {0};
	for(int row=0;row<size;row++){
		for(int row2=row+1;row2<size;row2++){
			if(arr[row][2]>arr[row2][2]){
				temp[0] = arr[row][0];
				temp[1] = arr[row][1];
				temp[2] = arr[row][2];

				arr[row][0] = arr[row2][0];
				arr[row][1] = arr[row2][1];
				arr[row][2] = arr[row2][2];

				arr[row2][0] = temp[0];
				arr[row2][1] =temp[1];
				arr[row2][2] =temp[2];
			}
```

```
		}
	}

}


void Display(int arr[],int n)
{

	if(n==0)
	{
		printf("Queue is Empty");
	}
	else
	{
		printf("\n");
		for(int i=1;i<=n;i++)
		{
			printf("%d ",arr[i]);
		}
	}
}
void DeleteMin(int arr[][20], int* N) //n is total members in queue
{
	//hear *N is used for make n value  n-1  after the function
	int i=1,left,right,last;
	int n=*N;


	if(n==0)
	{
		printf("\n queue is empty");
	}
	else
	{
		printf("\n Deleted item is : %d",arr[i]);

		while(i<n)
		{
			left = 2*i;
			right = 2*i + 1;
			last = n;
			if(left<n && right<n)
			{
				if(arr[left][2]>arr[right][2] )
				{
					if(arr[right][2]<arr[last][2])
					{
```

```
                                        arr[i][2]=arr[right][2];
                                        i=right;
                                }
                                else
                                {
                                        arr[i][2] = arr[last][2];
                                        i=last;
                                }
                        }
                        else if(arr[left][2]<arr[right][2] )
                        {
                                if( arr[left][2]<arr[last][2])
                                {
                                        arr[i][2] = arr[left][2];
                                        i=left;
                                }
                                else
                                {
                                        arr[i][2]=arr[last][2];
                                        i=last;
                                }
                        }
                }
                else
                {
                        break;
                }
        }
        if(i!=1)   // if i==1 then there is last node so we cant give any
value to it
        {
                arr[i][2] = arr[last][2];
        }
        n--;
        *N = n;
    }
}

void Initialize(int S[] ,int totalNodes)
{

    for(int k=0;k <(totalNodes + 2);k++)
    {
        S[k] = 0;
        printf(" -> %d",k);
    }

}
```

```
int Find(int x,int S[])
{
	if(S[x]==0)
	{
		return x;
	}
	else
		return Find(S[x],S);
}

void SetUnion(int S[], int root1,int root2)
{
	S[root2] = root1;
}
int ReadGraphIntoHeapArray(struct node graph[],int HeapArray[][20], int
totalNodes)
{
	struct node *p;
	int i=0,j,res;
	for(int j=0;j<totalNodes;j++)
	{
		printf("\n %d --->",graph[j].data);

		res=graph[j].data;
		p=graph[j].next;


		while(p!=NULL)
		{
			HeapArray[i][0]=res;

			HeapArray[i][1]=p->data;
			HeapArray[i][2]=p->weight;
			i++;
			printf("%d ",p->data);
			p=p->next;

		}
	}
	return i;

}
void Kruskals(struct node graph[] ,int totalNodes){

	int S[20];  // s is set
```

```
	int HeapArray[20][20];  // array for heap
	int edgesAcepted;
	int Uset,Vset,U,V;
	int flag=0;
	//Initialize(S,totalNodes);  //initialize array/set with zero



	size = ReadGraphIntoHeapArray(graph,HeapArray,totalNodes);
	for(int k=0;k<(totalNodes +1);k++)
	{
		S[k] = 0;
	}
	printf("\n Before Sorting");
	for(int i=0;i<size;i++)
	{
		printf(" \n %d %d %d",HeapArray[i][0],HeapArray[i]
[1],HeapArray[i][2]);
	}

	BuildHeap(HeapArray,size);  // sorting array
	printf("\n After Sorting");

	for(int i=0;i<size;i++)
	{
		printf(" \n\n %d %d %d",HeapArray[i][0],HeapArray[i]
[1],HeapArray[i][2]);
	}
	int index2 =0;
	edgesAcepted =0;

	while(index2 < size )  //total nodes
	{

		U = HeapArray[index2][0];
		V = HeapArray[index2][1];
		printf("\n U-> %d   V-> %d   ",U,V);
		Uset = Find(U,S);
		Vset = Find(V,S);
		//printf("Ust-> %d   Vset-> %d   ",Uset,Vset);
		flag=0;
		if(Uset !=Vset)
		{
			flag=1;
			edgesAcepted++;
			SetUnion(S,Uset,Vset);
		}
		index2++;
```

```
		if(flag==1)
			printf("-----> Accepted");
		else
			printf("------> NotAccepted");
	}

	printf("\n------------------\n");
	for(int k=1;k<(totalNodes+1);k++)
	{
		printf("  %d" , S[k]);
	}
}

void main()
{
	struct node n1[7];   //n1 is the graph
	struct node *p;
	int n,n2,total_vertex,start;



	printf("\n Enter how many nodes you create n:");
	scanf("%d",&total_vertex);              //total vertex = total V1,V2...V7

	for(int i=0;i<total_vertex;i++)
	{
		printf("\n Enter graph Node::");
		scanf("%d",&n1[i].data);

		n1[i].next =NULL;
		struct node *first =NULL;
		struct node *last =NULL;


		printf("\n Enter total number of adjacent of %d ::",n1[i].data);
		scanf("%d",&n2);


		for(int j=0;j<n2;j++)
		{
			first=InsertEnd(&first,&last);
			n1[i].next =first;
		}
	}



	Kruskals(n1,total_vertex);
```

```
        getch();
}
```

```
============
OUTPUT
============
```

```
 Enter how many nodes you create n:5

 Enter graph Node::1

 Enter total number of adjacent of 1 ::2

 Enter Adjacent:2

 Enter Weight:6

 Enter Adjacent:3

 Enter Weight:1

 Enter graph Node::2

 Enter total number of adjacent of 2 ::1

 Enter Adjacent:4

 Enter Weight:2

 Enter graph Node::3

 Enter total number of adjacent of 3 ::1

 Enter Adjacent:2

 Enter Weight:2

 Enter graph Node::4

 Enter total number of adjacent of 4 ::2

 Enter Adjacent:5

 Enter Weight:2

 Enter Adjacent:3
```

```
 Enter Weight:1

 Enter graph Node::5

 Enter total number of adjacent of 5 ::1

 Enter Adjacent:3

 Enter Weight:2

 1 --->2 3
 2 --->4
 3 --->2
 4 --->5 3
 5 --->3
Before Sorting
 1 2 6
 1 3 1
 2 4 2
 3 2 2
 4 5 2
 4 3 1
 5 3 2
 After Sorting

 1 3 1

 4 3 1

 3 2 2

 4 5 2

 2 4 2

 5 3 2

 1 2 6
 U-> 1   V-> 3   -----> Accepted
 U-> 4   V-> 3   -----> Accepted
 U-> 3   V-> 2   -----> Accepted
 U-> 4   V-> 5   -----> Accepted
 U-> 2   V-> 4   ------> NotAccepted
 U-> 5   V-> 3   ------> NotAccepted
 U-> 1   V-> 2   ------> NotAccepted
-------------------
  4  4  1  0  4
```