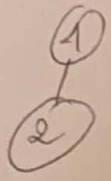
Lab 7

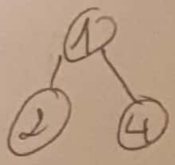
Problem 1: 1, 2, 4, 4, 5, 6, 9, 11, 12, 12, 17

insert 1

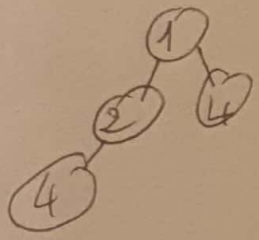
insert 2



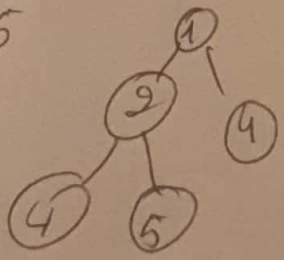
insert 4



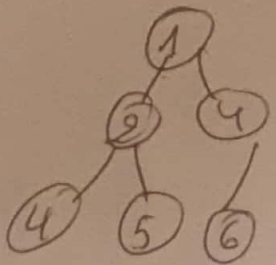
insert 4



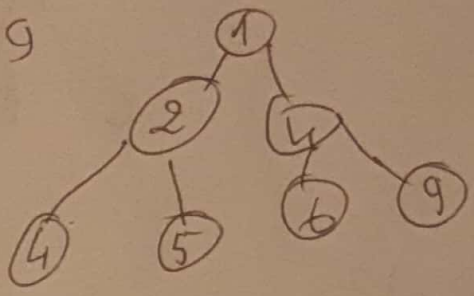
insert 5



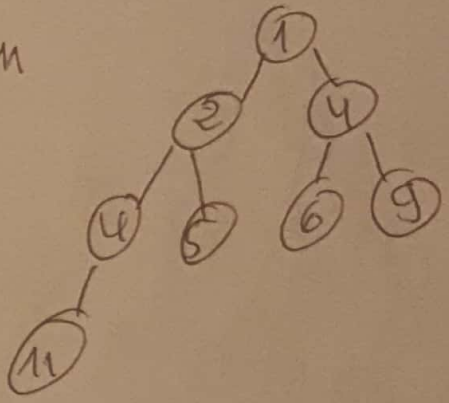
insert 6



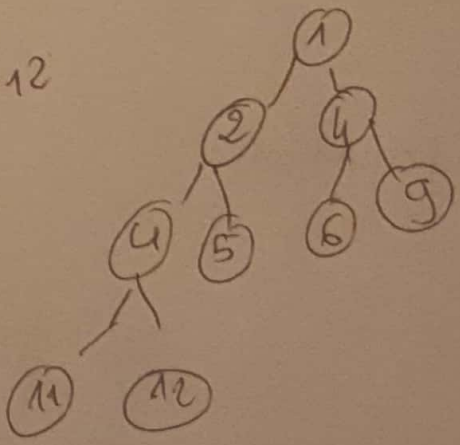
insert 9



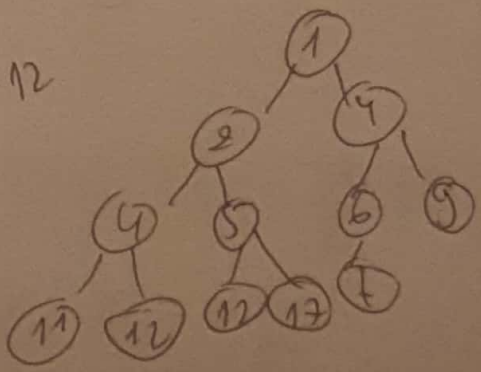
insert 11



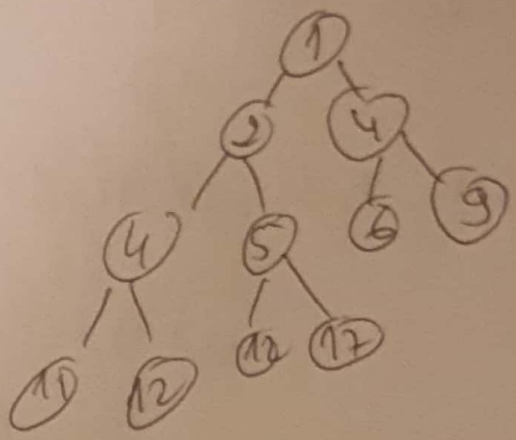
insert 12



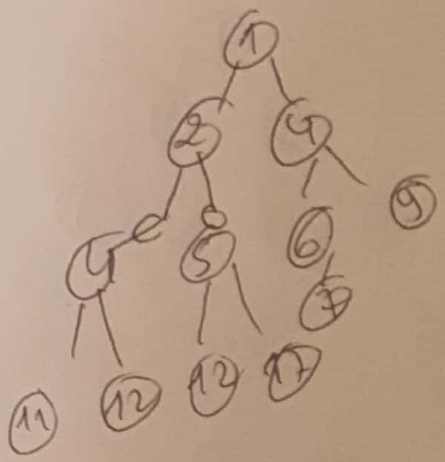
insert 12



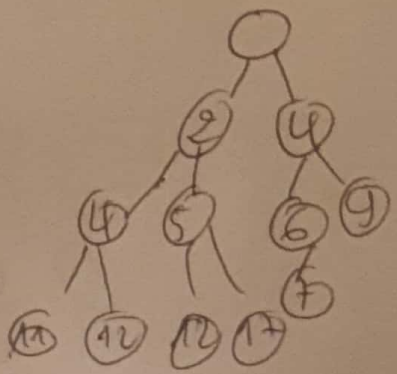
insert 12



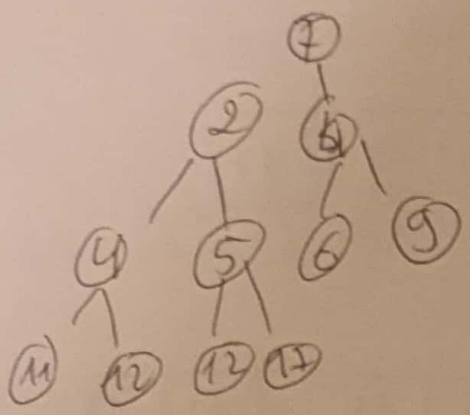
b) insert 7



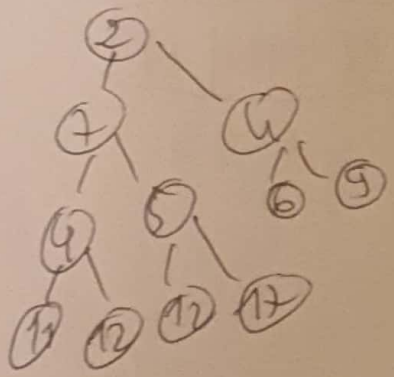
c) removemin



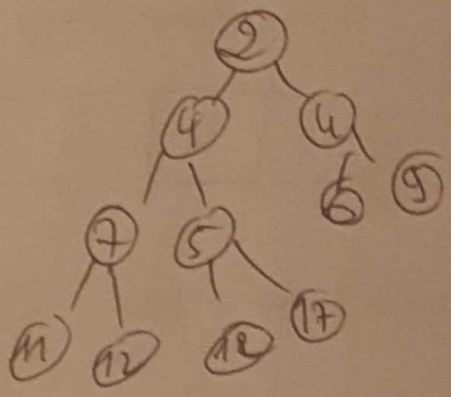
-ving the last element to pos min



- do down heap



→ downheap



D- present in an array

2	4	4	7	5	6	9	11	12	12	17
0	1	2	3	4	5	6	7	8	9	10

E- a

left child → $2i+1$

right child → $2i+2$

parent node $\left(\frac{i-1}{2}\right)$

2	4	4	7	5	6	9	11	12	12	17	14
0	1	2	3	4	5	6	7	8	9	10	11

parent = 14 $= \frac{11-1}{2} = 5$

2	4	4	7	5	6	9	11	12	12	17	14

remove 2

14	4	4	7	5	6	9	11	12	12	17

then down heap

4	4	14	7	5	6	9	11	12	12	17

then down heap again

4	4	6	7	5	14	9	11	12	12	17

problem 2 : sort [1, 4 3, 9, 12, 2, 4

phase 1 : heap fication

1) 1 | 4, 3, 9, 12, 2, 4

2) 14 | 3 9 12 24 → upheap 41 | 3 9 12 24

3) 4 13 | 9 12 24

upheadex

4) 41 3 9 | 12 24 → 9 4 3 1 | 12 24

5) 9 4 3 1 12 12 | 4 → no heap

6) 12 9 3 14 2 → upheap 12 9 4 2 3

+ removeMax

12 ▭ 9 4 14 23 → 3 9 14 21 _

down heap

9 3 4 14 2 → down heap 9 4 4 13 2 | 12

9 ▭ 4 4 1 3 2 | 12 → 4 3 4 12 | 9 12

4 ▭ 3 4 12 | 9 12 → 2 3 4 1 | 9 12

down heap

4 3 2 1 _ | 9 12 → 4 3 2 1 | 4 9 12

4 ▭ 3 2 1 | 4 9 12 → 1 3 2 _ | 4 9 12

down heap

3 1 2 _ | 4 9 12 → 3 1 2 | 4 4 9 12

↓

1 ▭ | 2 3 4 4 9 12 → no element to swap

1 2 3 4 4 9 12 → sorted

problem 3: (b)

11, 5, 2, 3, 17, 24, 1

k = 11

A1 = [5 2 3] A2 [17, 24, 11]

BUH (A1 [5, 2, 3])

k = 5

A1 = [2], H2 [3]

BUH (A [2])

k = 2 A1 = ∅ (2)

BUH A[3]

k = 3 A2 = ∅ (3)

take the 2 nodes and the key

= T1

Now BUH (A2 [17, 24, 11]

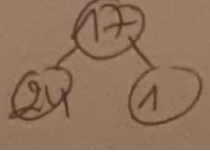
k = 17

A1 [24] A2 = 1

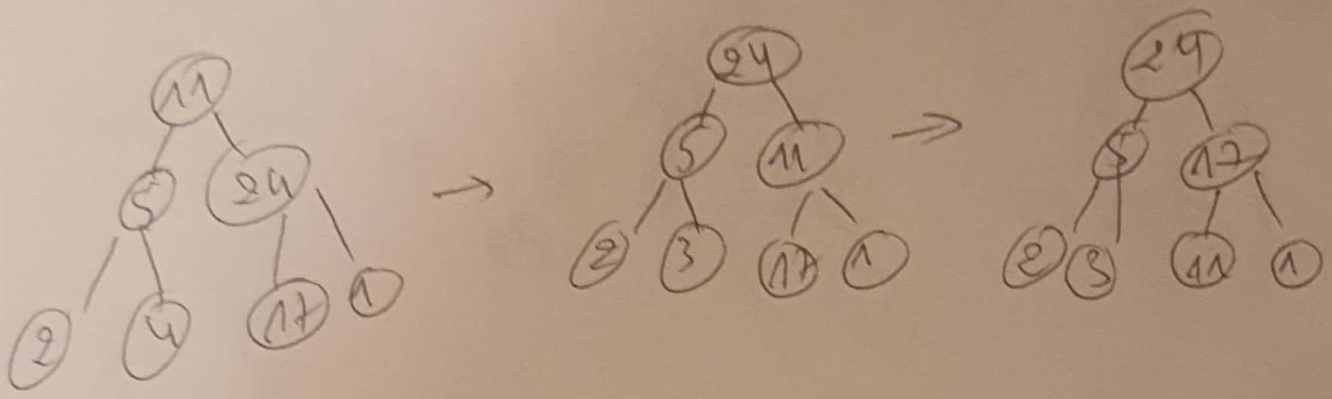
BUH (A[24] A1 ∅ (24)

BUH A2 A2 [1] ∅ (1)

take 2 nodes and the key



take 2 trees and the key



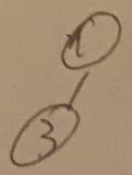
4) draw Max heap using keys [1, 21]

Our keys will be

1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21

insert 1

insert 3

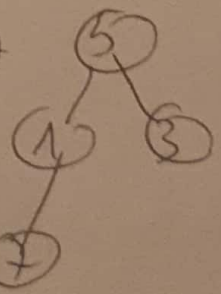


UH

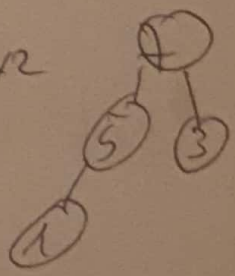
insert 5

UH

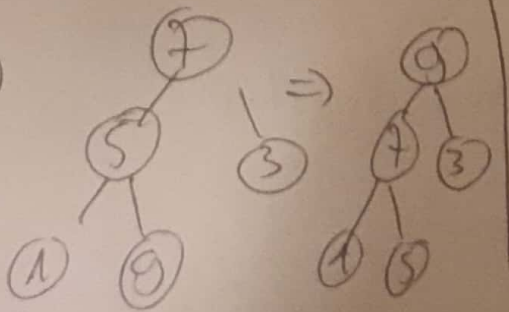
insert 7



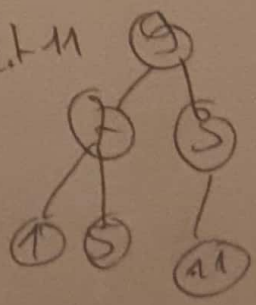
UHx2



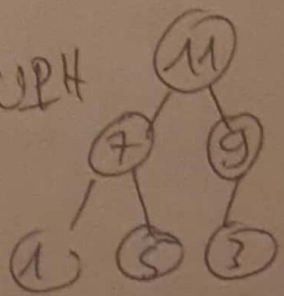
insert 9

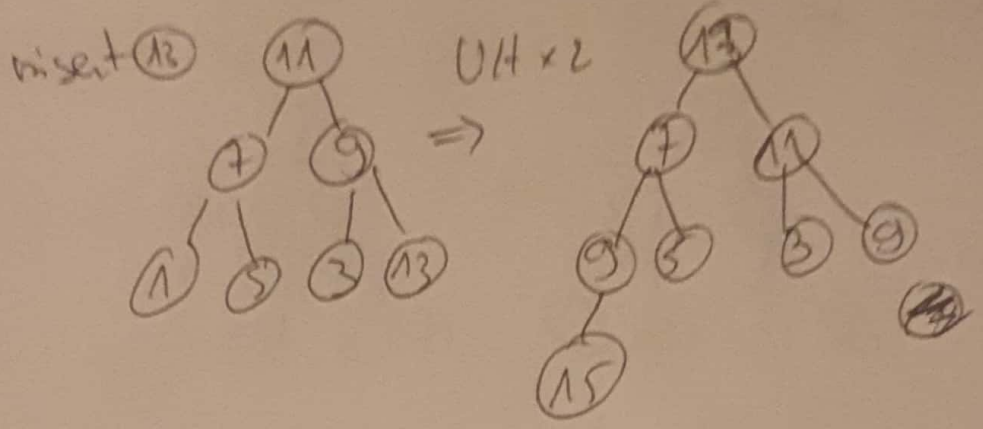


insert 11

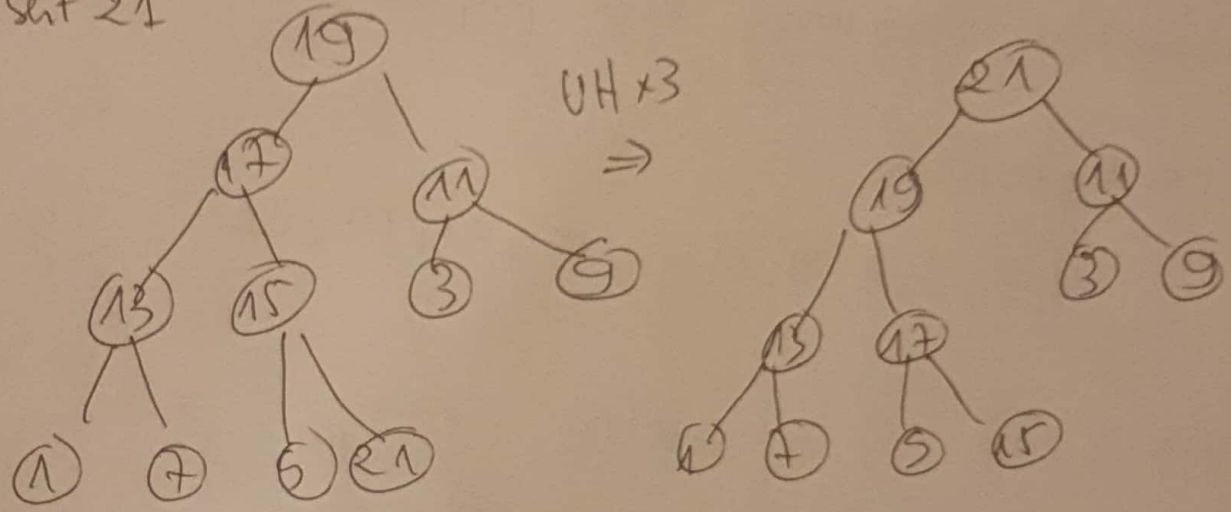


UPH





Insert 21



Problem 5:

10, 3, 7, 6, 4, 12, 5, 2, 12, 10, 1

$n = 11$

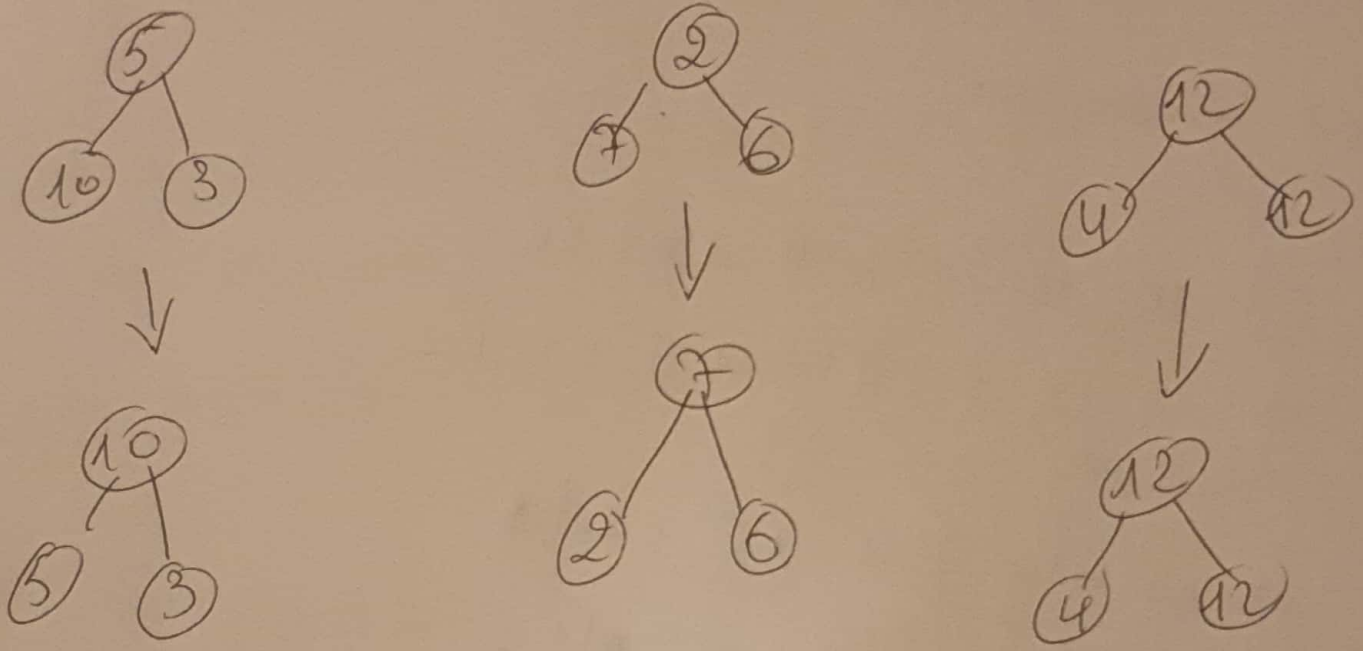
Step 1: make $\frac{n+1}{2}$ single item heaptree

$\frac{12}{2} = 6$

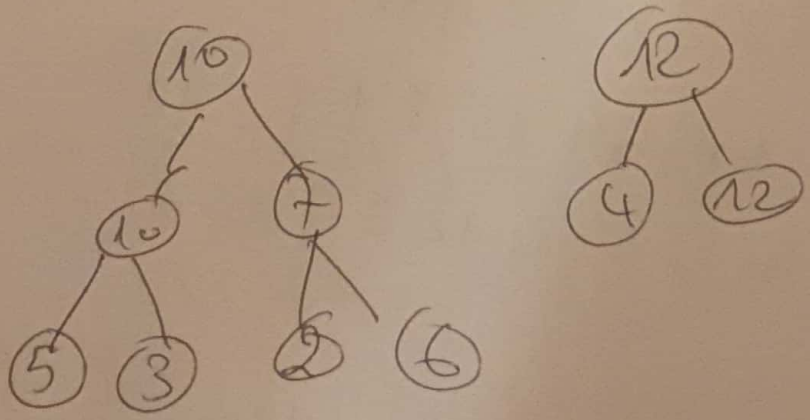
10, 3, 7, 6, 4, 12

10 3 7 6 4 12

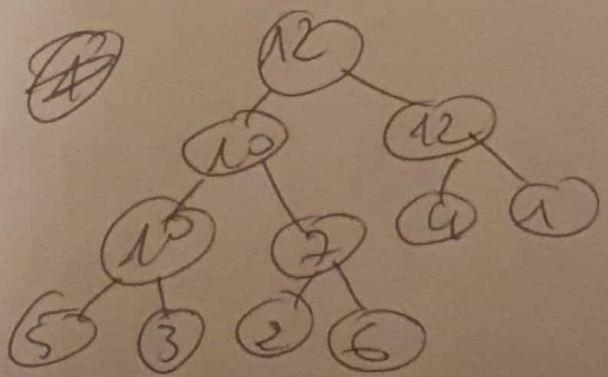
pull next $\frac{n+1}{8}$ = 3



pull next $\frac{n+1}{8} = \frac{11+1}{8} = 1$



Finally



The array obtained is (10)

12	10	12	10	7	4	1	5	3	2	6

phase 2 : remove max

12 □ 10 12 10 7 4 1 5 3 2 6

6 10 12 10 7 4 1 5 3 2 | 12

12 10 6 10 7 4 1 5 3 2 | 12

12 10 7 10 6 4 1 5 3 | 12 12

12 □ 10 7 10 6 4 1 5 3 2 | 12

dumheap x3 2 10 7 10 6 4 1 5 3 1 | 12

10 10 7 5 6 4 1 2 3 | 12 12

10 □ 6 7 5 3 4 1 2 | 10 12 12

2 6 7 5 3 4 | 10 12 12

7 6 4 5 3 2 1 | 10 12 12

7 □ 6 4 5 3 2 1 | 10 10 12 12

1 6 4 5 3 2 | _ 10 10 12 12

6 5 4 1 3 2 | 7 10 10 12 12

6 ▱ 5 4 1 3 2 | 7 10 10 12 12

2 5 4 1 3 | _ 7 10 10 12 12

5 3 4 1 2 | 6 7 10 10 12 12

5 □ 3 4 1 2 | 6 7 10 10 12 12

2 3 4 1 | _ 6 7 10 10 12 12

4 3 4 4 1 | 5 6 7 10 10 12 12

4 □ 3 2 1 | 5 6 7 10 10 12 12

1 3 2 1 | _ 5 6 7 10 10 12 12

3 2 1 | 4 5 6 7 10 10 12 12

3 □ 1 2 | 4 5 6 7 8 10 10 12 12

2 1 | _ 4 5 6 7 8 10 10 12 12

1 2 3 4 5 6 7 8 10 10 12 12

(2) □ 1 | 3 4 5 6 7 10 10 12 12

1 | _ 3 4 5 6 7 10 10 12 12

1 | 2 3 4 5 6 7 10 10 12 12

1 □ | 2 3 4 5 6 7 10 10 12 12

finally 1 2 3 4 5 6 7 10 10 12 12