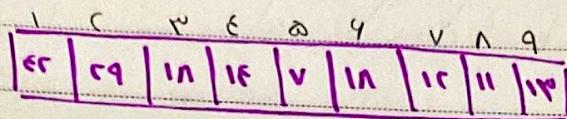


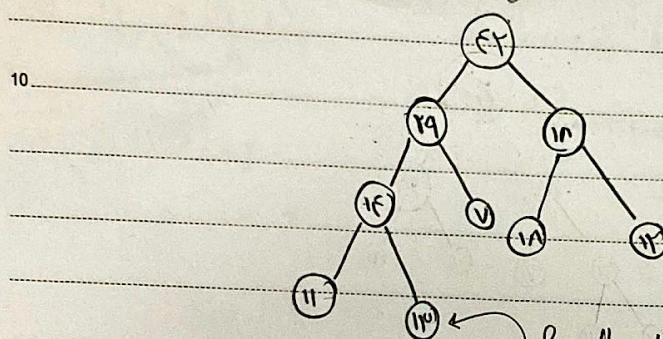
99arry 1 noالجداول
البيانات

iii) MaxHeap



5

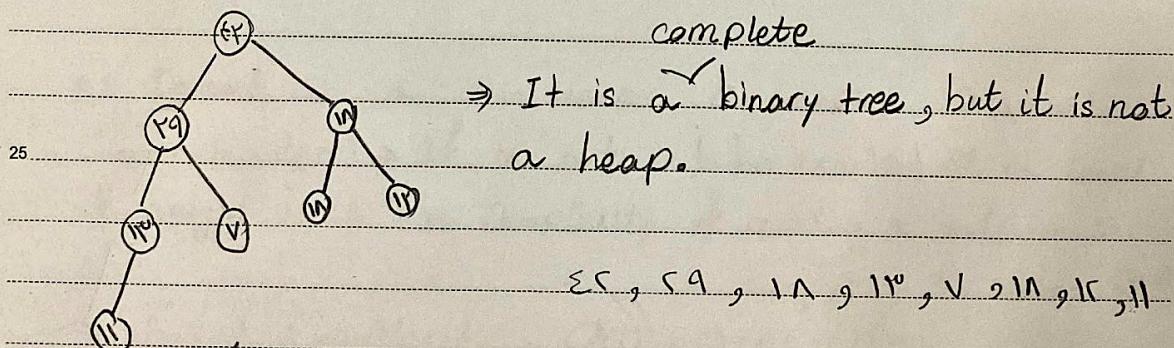
Max-Heap \Rightarrow The key or value of each node is always greater than its children nodes, and the key or value of the root node is always the largest.



15) MaxHeap \Rightarrow هي معيار لازم برأي صحفى في المنهج و
هو إزاحة العنصر المطلوب من الميناء

• إزاحة العنصر المطلوب من الميناء

- ① Delete the node that contains the value you want deleted in the heap.
- ② Replace the deleted node with the "farthest right location" of the lowest level.



55, 59, 11, 18, 10, 15, 11

incomplete child to Parent node \Rightarrow $\cancel{55}$ $\cancel{59}$ $\cancel{11}$ $\cancel{18}$ $\cancel{10}$ $\cancel{15}$ $\cancel{11}$

SALEH \Rightarrow SiftDown SiftUp

❀ السؤال الرابع: ما هي صيغة تحليل التعقيد؟

أمثلة على صيغة تحليل التعقيد

c) Insert in a sorted array:

5

I O_{worst} ?

\Rightarrow In a sorted array, a search operation

is performed by using $\geq O(\lg n)$ binary search and

? II $O_{\text{amortized}}$?

then insert operation is performed

$\hookrightarrow O\left(\frac{n(n-1)}{n}\right)$ followed by shifting the elements.

10

$\Rightarrow O_{\text{worst}}(n)$ [all the elements
 $= O(n)$ may have to be moved]

15

d) Extract max in a Max-Heap: O_{worst} $O_{\text{amortized}}$

\rightarrow ويجيء thing

$O_{\text{worst}}(1)$ or $O_{\text{worst}}(\lg n)$ \rightarrow Because of Siftdown

20

$$O_{\text{amortized}} = O(\lg n)$$

e) Insert in a min-heap: O_{worst} $O_{\text{amortized}}$

$O_{\text{worst}}(\lg n) \rightarrow$ If a node is to be inserted at a level
of height $H \rightarrow$ Time Complexity of adding a node is: $O(1)$

\rightarrow " swapping the nodes: $O(H)$ "

\rightarrow Total Complexity $\rightarrow O(1) + O(H) = O(H)$

$H = \lg n$ $\rightarrow O_{\text{worst}}(\lg n)$
SALEH for a complete

binary tree

Amortized (1)

(4)

for i from 1 to 12 domakeSet(i) $\Rightarrow \{1\} \{2\} \{3\} \{4\} \{5\} \{6\} \{7\} \{8\}$

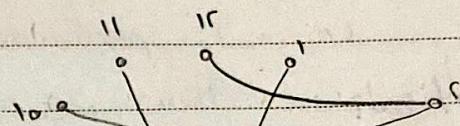
Union (c, 1.)

 $\{1\}$ $\{2\}$ $\{3\}$ $\{4\}$ $\{5\}$

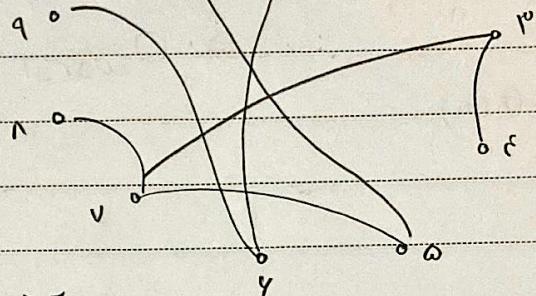
Union (v, 2)

 $\{15\}$

Union (q, 3)



Union (r, 4)



Union (w, 11)

Union (v, n)

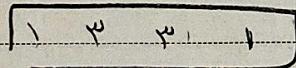
Union (u, w)

Union (s, c)

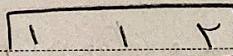
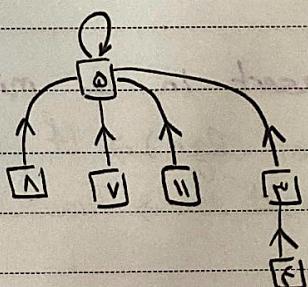
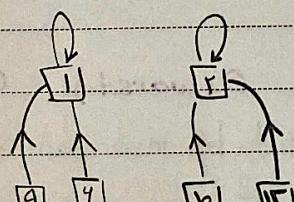
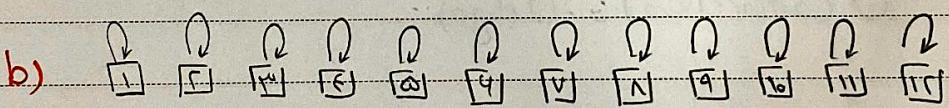
Union (q, 4)

print (Find(4)) $\Rightarrow 1$ print (Find(w)) $\Rightarrow 10$ print (Find(11)) $\Rightarrow 11$ print (Find(9)) $\Rightarrow 1$

a)

Rank(a) = Rank(11) \leftarrow ⁺¹ ~~programm~~ $\Rightarrow 11$

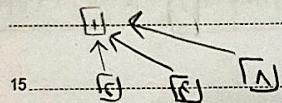
b)



SALEH

c) makeset $\rightarrow \{1\} \quad \{2\} \quad \{3\} \quad \{4\} \quad \dots \quad \{n\}$

<u>1</u>	for \Rightarrow	(1, 1)	(1, 2)	(1, 3)	(1, 4)
5		(2, 1)	(2, 2)	(2, 3)	(2, 4)
		(3, 1)	(3, 2)	(3, 3)	(3, 4)
		(4, 1)	(4, 2)	(4, 3)	(4, 4)
		(5, 1)	(5, 2)	(5, 3)	(5, 4)
		(6, 1)	(6, 2)	(6, 3)	(6, 4)
		(7, 1)	(7, 2)	(7, 3)	(7, 4)
		(8, 1)	(8, 2)	(8, 3)	(8, 4)
		(9, 1)	(9, 2)	(9, 3)	(9, 4)
		(10, 1)	(10, 2)	(10, 3)	(10, 4)
10		(11, 1)	(11, 2)	(11, 3)	(11, 4)
		(12, 1)	(12, 2)	(12, 3)	(12, 4)
		(13, 1)	(13, 2)	(13, 3)	(13, 4)
		(14, 1)	(14, 2)	(14, 3)	(14, 4)
		(15, 1)	(15, 2)	(15, 3)	(15, 4)
		(16, 1)	(16, 2)	(16, 3)	(16, 4)
		(17, 1)	(17, 2)	(17, 3)	(17, 4)
		(18, 1)	(18, 2)	(18, 3)	(18, 4)
		(19, 1)	(19, 2)	(19, 3)	(19, 4)
		(20, 1)	(20, 2)	(20, 3)	(20, 4)



<u>2</u>	for \Rightarrow	(1, 1)	(1, 2)	(1, 3)	(1, 4)
20		(2, 1)	(2, 2)	(2, 3)	(2, 4)
		(3, 1)	(3, 2)	(3, 3)	(3, 4)
		(4, 1)	(4, 2)	(4, 3)	(4, 4)
		(5, 1)	(5, 2)	(5, 3)	(5, 4)
		(6, 1)	(6, 2)	(6, 3)	(6, 4)
		(7, 1)	(7, 2)	(7, 3)	(7, 4)
		(8, 1)	(8, 2)	(8, 3)	(8, 4)
		(9, 1)	(9, 2)	(9, 3)	(9, 4)
		(10, 1)	(10, 2)	(10, 3)	(10, 4)

<u>3</u>	\Rightarrow	(1, 1)	(1, 2)	(1, 3)	(1, 4)
25		(2, 1)	(2, 2)	(2, 3)	(2, 4)
		(3, 1)	(3, 2)	(3, 3)	(3, 4)
		(4, 1)	(4, 2)	(4, 3)	(4, 4)
		(5, 1)	(5, 2)	(5, 3)	(5, 4)
		(6, 1)	(6, 2)	(6, 3)	(6, 4)
		(7, 1)	(7, 2)	(7, 3)	(7, 4)
		(8, 1)	(8, 2)	(8, 3)	(8, 4)
		(9, 1)	(9, 2)	(9, 3)	(9, 4)
		(10, 1)	(10, 2)	(10, 3)	(10, 4)

Maximum Height $\Rightarrow 7$

- ②
- | | |
|-------------------------------------|------------------------------------|
| $(\text{AVARCCO}_5, 19) \checkmark$ | $(\text{AVACIΣN}_4, 5) \checkmark$ |
| $(\text{AΣYCO}_3, 15) \checkmark$ | $(\text{AVACCO}_1, 9) \checkmark$ |
| $(\text{AVATC}_0, 18) \checkmark$ | $(\text{AΣC}_0, 18)$ |
| $(\text{AVACC}_0, 18) \checkmark$ | $(\text{AVACCO}_9, 10) \checkmark$ |
| $(\text{AVACC}_0, 18) \checkmark$ | $(\text{AVACCO}_0, 10) \checkmark$ |
| $(\text{AVACC}_0, 10) \checkmark$ | $(\text{AVACCO}_0, 14) \checkmark$ |

