A

1) Onur Yaman

2) 2007961

B

3) True

4) True

5) True

6) False

7) True

8) True

9) False

10) True

C

11) proper

12) $O(h)$

13) $O(n \cdot \log n)$

14) True

15) $O(n)$

16) cycle

D

17) Complete binary tree (of heap data structers) is a binary tree such that

- At all level d where $0 \leq d \leq h-1$ each node has two children
- At last level, each nodes are in leftmost position.

18) "Stable" means, after sorting, positions of all pairs whose keys are equal must be same position.
For example, $(3,d), (2,c), (2,b), (1,a)$
after sorting, $(1,a), (2,c), (2,b), (3,d)$
it is stable

E

19) A and C

20) min, remove_min, add, first, last

21) radix sort

F

22) preorder(T, p) :

```
preorder(T, p):
    visit(p)
    for each c in T.children(p)
        if not c visited
            visit(c)
            preorder(T, c)
```

G

23) (a) 5, 6, 23, 16, 20, 18

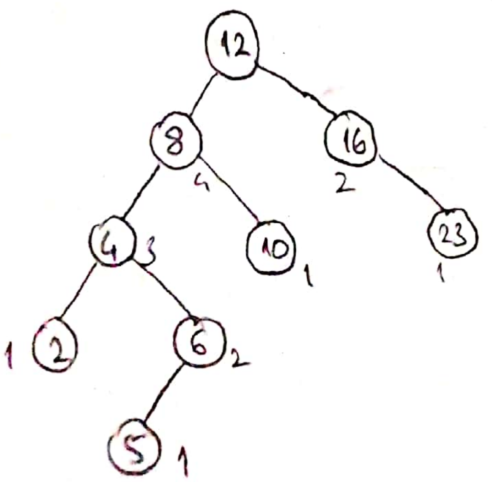
(b) left child of node 18

24) (a) Balanced

(b) Insert 5, then it will be <u>unbalanced</u>.

The pivot is 8.

Case 2, double rotation should be applied. Firstly between 4 and 6. Then, between 6 and 8.



$34 \equiv 1 \mod(11) \Rightarrow i = 3 \Rightarrow index = 1 + 9 \pmod{11}$

	1	23			45				34	

$12 \equiv 1 \mod(11) \Rightarrow i = 4 \Rightarrow index = 1 + 16 \pmod{11}$

$= 6 \mod(11)$

	1	23			45	12			34	

is the final state.

d

28) merge_sort(S1, S2, S)

```
n = len(S)
if n<2:
    return
mid = n//2
S1 = S[0:mid]
S2 = S[mid:n]
merge_sort(S1)
merge_sort(S2)
merge(S1, S2, S)
```

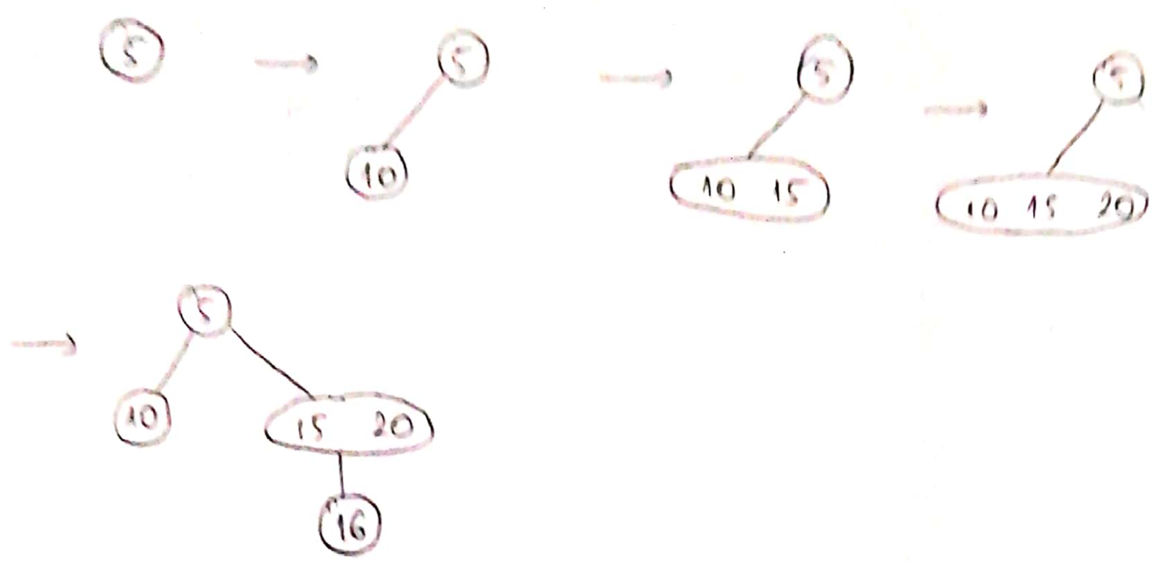
29) Merge sort is a better solution when we want to sort seqences whose problem size is small (50, 100 etc)

We have $1073741847 = 2^{30}$ numbers, if we can take them into a hash table, $2^{30}/2^{10} = 2^{20}$ numbers can be kept in same sorted or unsorted table.

So, in this case, using <u>bucket sort</u> is better solution.

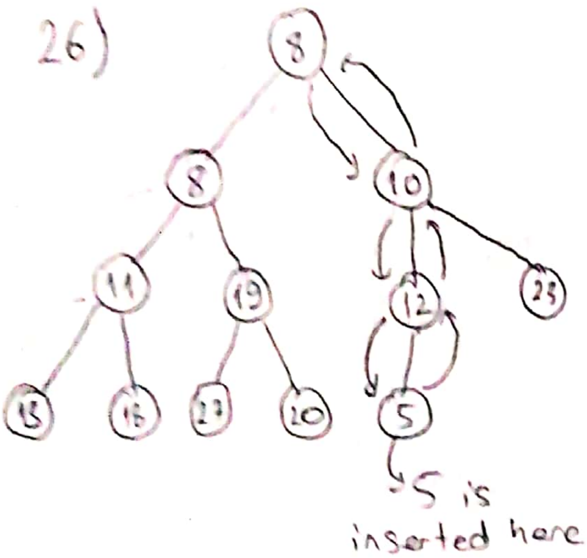
CamScanner ile tarandı

25)



H

26)



Now, by up-heap bubbling, swap operations are made between (5,12), (5,10), (5,8)

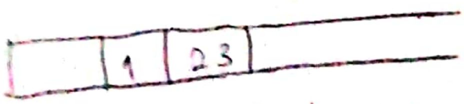
→ now 5 is at root.

At this step, heap property is satisfied, 5 is smallest key and at root.

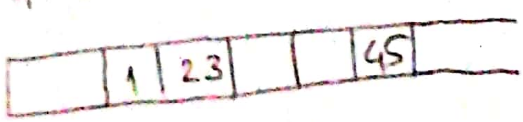
I

27) $1 \equiv 1 \bmod (11)$, note that $\text{index} = (h(x) + f(i)) \bmod 11$ where $f(i) = i^2$

$23 \equiv 2 \bmod (n)$



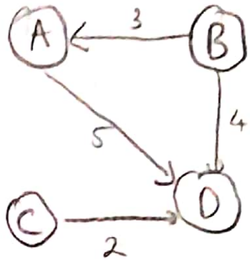
$45 \equiv 1 \bmod (11) \Rightarrow$ collision $\Rightarrow i=2 \Rightarrow \text{index} = 1+4$



K

30) The graph is directed weigthed. Let M[i][j] be the adjacency matrix of the graph.

$$M[i][j] = \begin{array}{c} \\ A \\ B \\ C \\ D \end{array} \begin{array}{c} \begin{array}{cccc} A & B & C & D \end{array} \\ \begin{bmatrix} \infty & \infty & \infty & 5 \\ 3 & \infty & \infty & 4 \\ \infty & \infty & \infty & 2 \\ \infty & \infty & \infty & \infty \end{bmatrix} \end{array}$$



∞ : there is no edge from i to j or j to i or i to i