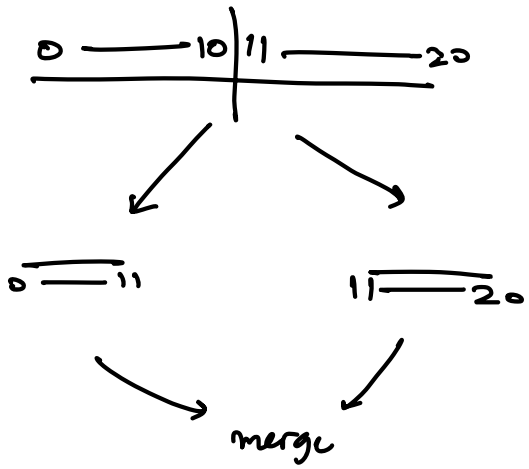
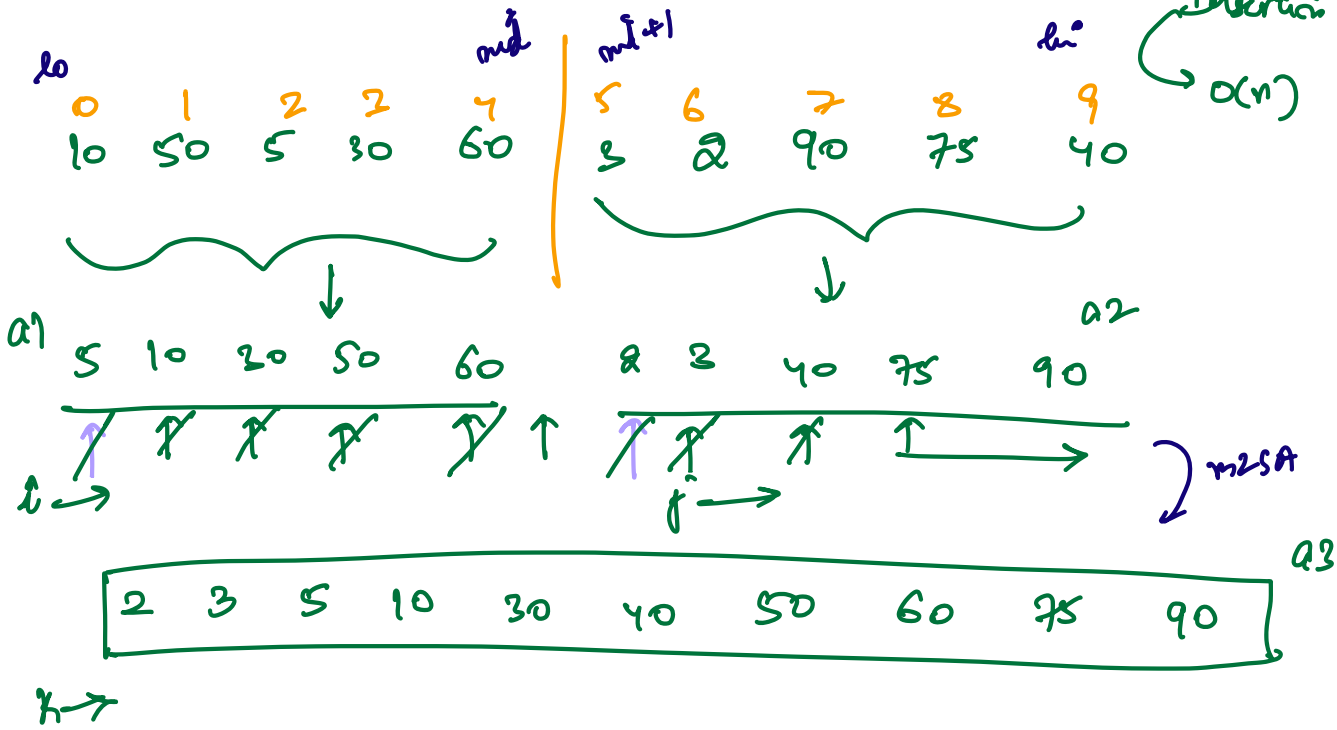
Brute force
Binary Search

Divide & Conquer



Merge Sort O(n log n)

changes: O(n)
Bubble, Selection, Insertion } O(n²)
O(n)



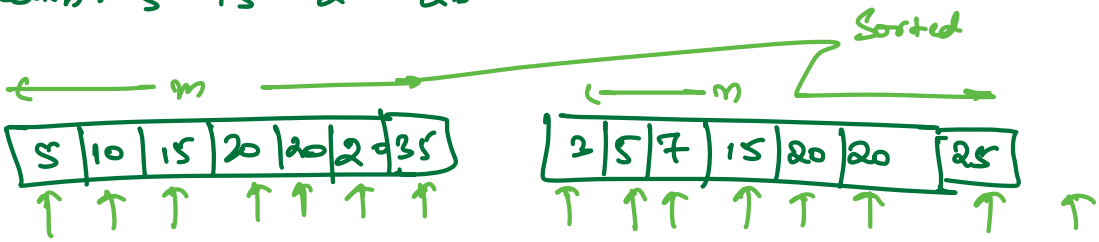
MS → without extra space TC?

m2SA → intersection of 2 arrays

Union: 2 5 5 7 10 15 15 20 20 20 25 25 30

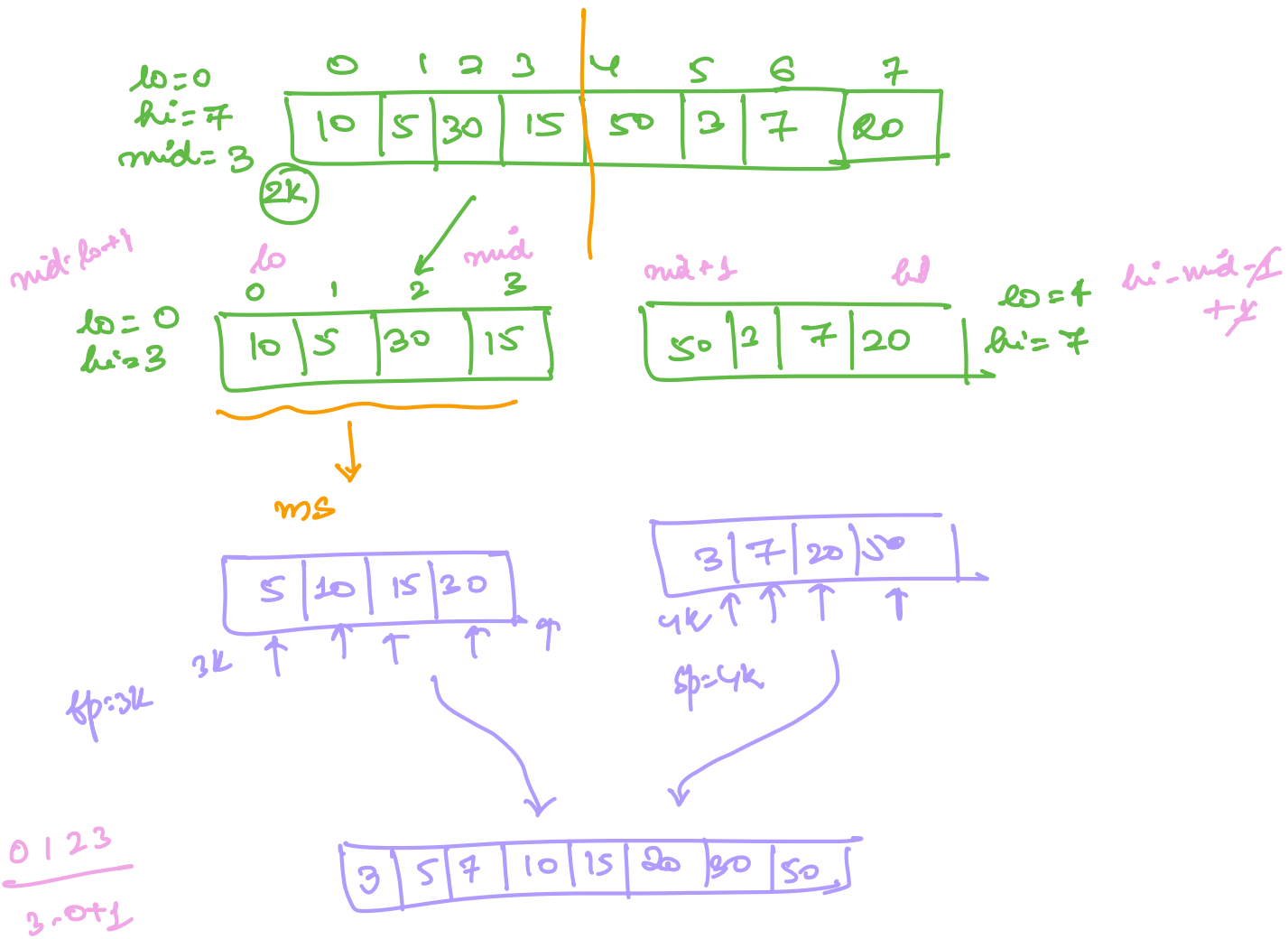
2 5 7 10 15 20 25 30

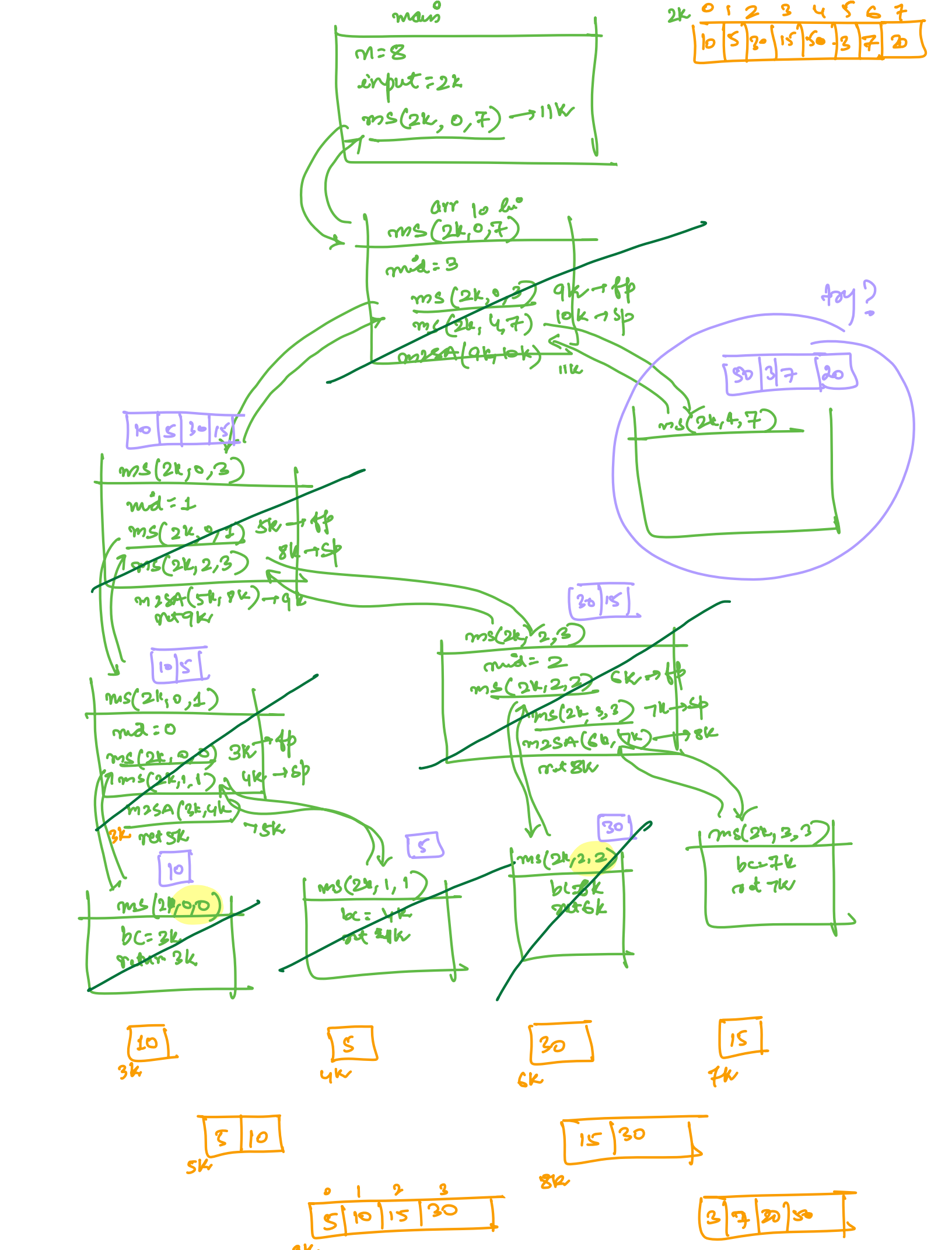
Intersection: 5 15 20 20



O(m+n)

5 15 20 20




main
n=8
input=2k
ms(2k, 0, 7) → 11k
2k 0 1 2 3 4 5 6 7
10 5 30 15 50 3 7 20
arr lo hi
ms(2k,0,7)
mid=3
ms(2k,0,3) 9k → fp
ms(2k,4,7) 10k → sp
m2SA(9k,10k)
11k
try?
50 3 7 20
ms(2k,4,7)
10 5 30 15
ms(2k,0,3)
mid=1
ms(2k,0,1) 5k → fp
ms(2k,2,3) 8k → sp
m2SA(5k,8k) → 9k
ret 9k
30 15
ms(2k,2,3)
mid=2
ms(2k,2,2) 6k → fp
ms(2k,3,3) 7k → sp
m2SA(6k,7k) → 8k
ret 8k
10 5
ms(2k,0,1)
mid=0
ms(2k,0,0) 3k → fp
ms(2k,1,1) 4k → sp
m2SA(3k,4k) → 5k
3k ret 5k
10
ms(2k,0,0)
bc=3k
return 3k
5
ms(2k,1,1)
bc=4k
ret 4k
30
ms(2k,2,2)
bc=6k
ret 6k
ms(2k,3,3)
bc=7k
ret 7k
10
3k
5
4k
30
6k
15
7k
5 10
5k
15 30
8k
0 1 2 3
5 10 15 30
3 7 20 50

10k

3	5	7	10	15	20	30	50

11k

Recurrence Relation:

Rec calls m2sA

$$T(n) = T\left(\frac{n}{2}\right) + T\left(\frac{n}{2}\right) + n$$

$$T(n) = 2T\left(\frac{n}{2}\right) + n \checkmark$$

$$2T\left(\frac{n}{2}\right) = 2^2 T\left(\frac{n}{4}\right) + \frac{n}{2}\cdot 2 \checkmark$$

$$2^2 T\left(\frac{n}{4}\right) = 2^3 T\left(\frac{n}{8}\right) + \frac{n}{4}\cdot 2^2 \checkmark$$

$\log_2 n$

$$2^{\log_2 n}\, T\left(\frac{n}{2^{\log_2 n}}\right) = 1 \cdot 2^{\log_2 n} \checkmark$$

m2sA:
n, n
n + n

$\frac{n}{2}, \frac{n}{2}$

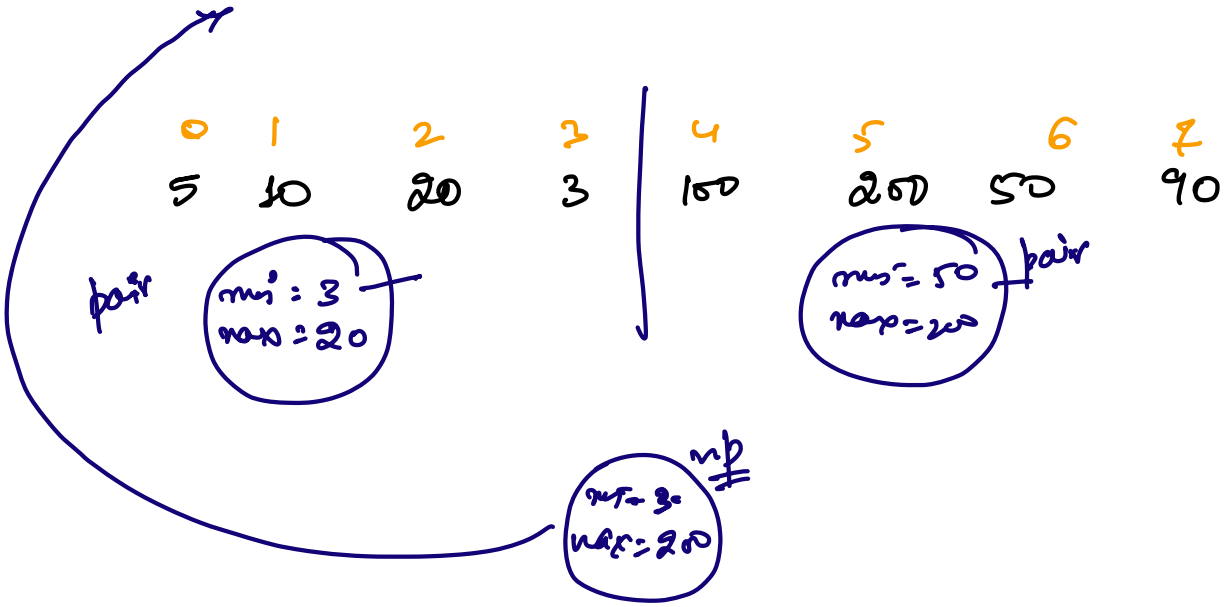
$\frac{n}{2} + \frac{n}{2} = n$

$$T(n) = \underbrace{n + n + n \text{ ---------- } n}_{\log_2 n \text{ times}}$$

$$\boxed{T(n) = n \cdot \log_2 n}$$

Space?

BS
SS
IS
} $O(n^2)$


0 1 2 3 4 5 6 7
5 10 20 3 100 200 50 90
pair
min = 3
max = 20
min = 50
max = 200
pair
min
max = 3
max = 20