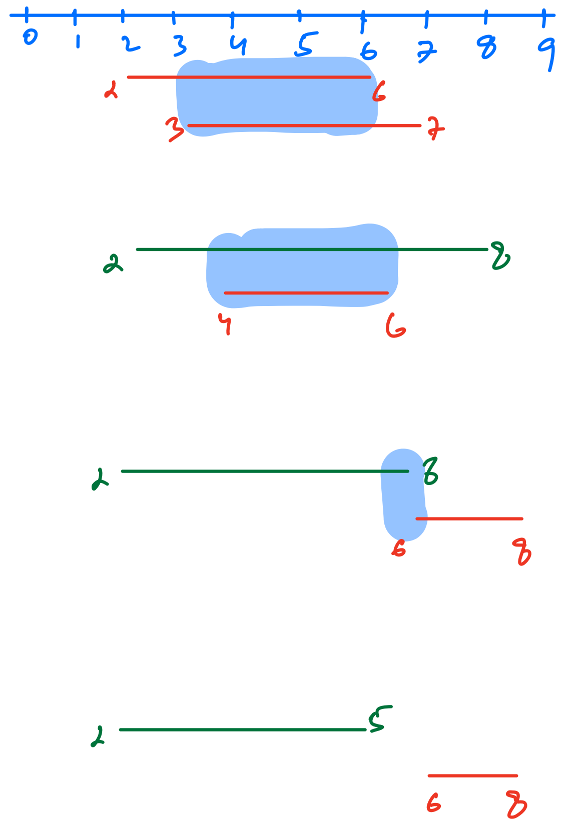
Array 3 : Interview Problems

Merge Intervals

start —— end

$start <= end$

I_1	I_2
(2,6)	(3,7)
(2,8)	(4,6)
(2,6)	(6,8)
(2,5)	(6,8)



(2,7) overlapping

(2,8) overlapping

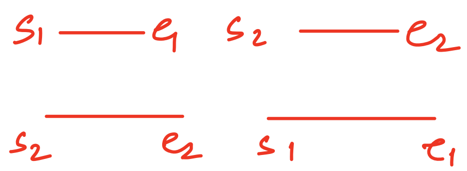
(2,8) overlapping

non-overlapping

Non-overlapping condition

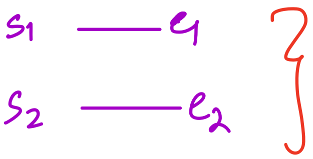
s_1 —— e_1

s_2 —— e_2



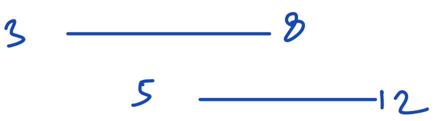
$$\boxed{e_1 < s_2 \quad || \quad e_2 < s_1}$$

Merge 2 overlapping intervals



$\rightarrow$ $st = \min(s_1, s_2)$

$end = \max(e_1, e_2)$



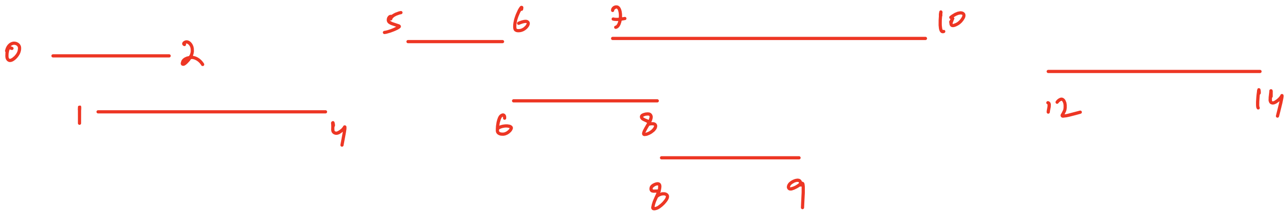
$8 > 5$

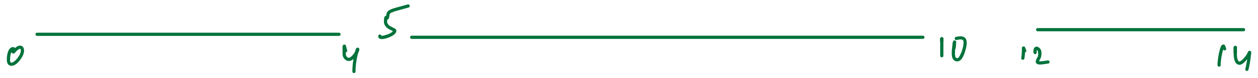
Question1

Given a list of intervals, sorted w.r.t start time. Merge all overlapping intervals & return the sorted list.

$st = [\,0 \quad 1 \quad 5 \quad 6 \quad 7 \quad 8 \quad 12\,]$

$end = [\,2 \quad 4 \quad 6 \quad 8 \quad 10 \quad 9 \quad 14\,]$





output :

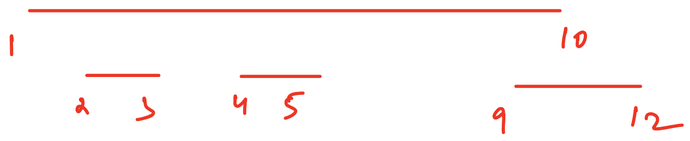
(0,4)

(5,10)

(12,14)

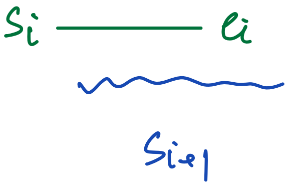
Quiz

(1,10) (2,3) (4,5) (9,12)

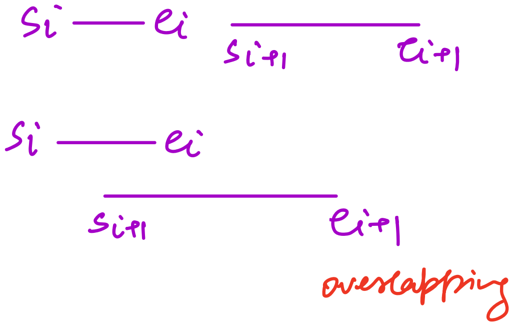


(1,12)

sorted w.r.t start time ?



$s_i <= s_{i+1}$



overlap → $\boxed{s_{i+1} <= e_i}$

Code

(S, E)

```
S = st[0] ,   E = end[0]

for ( i=1  to  n-1) {

    if ( st[i]  <=  E ) {  //overlapping

        E = max ( E,  end[i])

    }
    else {   // not overlapping

        print ( S, E )

        S = st[i]  ,  E = end[i]

    }

}

print ( S, E)
```

min(S, st[i]) → not needed

max (E , end[i])

TC = O(N)

SC = O(1)

st = [0 1 5 6 7 8 12]

end = [2 4 6 8 10 9 14]

↓

S = 0   5   12

E = ~~2~~4   ~~6~~ ~~8~~ 10   14

Scaler wants to do maintenance.

find longest period of no user activity.

DATA = [(9,11) (14,16) (15,20)]

↓ merge

$$\underbrace{\quad}_{9\text{hrs}}[\ (9,11)\underbrace{\quad}_{3\text{hrs}}(14,20)\ ]\underbrace{\quad}_{4\text{hrs}}$$

Question 2

Given an unsorted array of integers. find first missing natural number. $\boxed{>=1}$ natural no.

A = [3 -2 1 7 2] ans = 4

A = [-8 7 2 5 3] ans = 1

A = [4 1 3 2] ans = 5

$A = [5 \quad 3 \quad 1 \quad -1 \quad -2 \quad -4 \quad 7 \quad 2]$ ans = 4

Bruteforce

start from 1 and check which no. is not present in array.

$TC = O(N \times ans)$

max value of ans ? = N+1

N=4 [1 2 3 4]

ans = 5

$TC = O(N^2)$

$SC = O(1)$

Optimize

min. ans = 1

max. ans = N+1

$1 <= ans <= N+1$

$A = [5 \quad 3 \quad 1 \quad -1 \quad -2 \quad -4 \quad 7 \quad 2 \quad 200]$ N=8

T	T	T		T		T	
1	2	3	4	5	6	7	8

lets assume, all a[i] are +ive

$$\begin{array}{cccccc} & 0 & 1 & 2 & 3 & 4 \\ A = [& 3 & 10 & 1 & 7 & 2 \,] \\ & -3 & -10 & -1 & & \end{array}$$

ans = 4

ans index

1 → 0

2 → 1

⋮

if a[i] is -ive

⇒ (i+1) is present in array

Code

```
for (i=0 to n-1) {
    x = abs (a[i])   // ignore -ive sign

    if( x >=1  &&  x <=N) {
        idx = x-1
        if( a[idx] >0)
            a[idx] *= -1
    }
}
```

TC = O(N)

SC = O(1)

```
for ( i=0  to  n-1 ) {
        if (a[i] > 0)
                return i+1
}

return n+1
```

$$\begin{array}{lccc} & 0 & 1 & 2 \\ A = [& \cancel{3} & 4 & \cancel{1} \;] \\ & -3 & & -1 \end{array}$$

$N = 3$ ans = 2

$$\begin{array}{lccc} & 0 & 1 & 2 \\ A = [& 10 & 12 & 13 \;] \end{array}$$

$N = 3$ ans = 1

$$\begin{array}{lccc} & 0 & 1 & 2 \\ A = [& \cancel{1} & \cancel{2} & 2 \;] \\ & -1 & -2 & \end{array}$$

$N = 3$ ans =

$$\begin{array}{lcccc} & & & & 2+1 = \colorbox{lightgreen}{3} \\ & 0 & 1 & \boxed{2} \nearrow & 3 \\ A = [& \cancel{1} & \cancel{2} & 4 & \cancel{2} \;] \\ & -1 & -2 & & -2 \end{array}$$

ans = 3

how to resolve for negative numbers ?

Will -ive ever be our ans ?

NO → so we don't care about them

Should we make them +ive ?

NO → they may fall in ans range

Should we make them 0 ?

NO → we will not be able to mark presence of number

Change them to any big +ive no. → N+2

```
for (i=0 to n-1) {
        if (a[i] <=0 )
                a[i] = N+2
}
```

```
for (i=0 to n-1) {
    x = abs (a[i])   // ignore -ive sign

    if( x >=1 && x <=N) {
        idx = x-1
        if( a[idx] >0)
            a[idx] *= -1
    }
}
for (i=0 to n-1) {
    if (a[i] >0)
        return i+1
}
return n+1
```

TC = O(N)

SC = O(1)

A= [2 -10 1]

$$\begin{array}{ccc} 0 & \boxed{1} & 2 \\ [\ \cancel{2} & \cancel{0} & 1\ ] \\ -2 & 0 & \end{array}$$

[20 -10 1]

$$\begin{array}{ccc} 0 & 1 & \boxed{2} \xrightarrow{} 2+1 = 3 \\ [\ \cancel{20} & 0 & 1\ ] \\ -20 & & \end{array}$$