- What is Greedy ?
- Free Cars
- Candy Distribution
- Maximum Jobs

Contest 4

LL, Queues

Reattempt → 1 more

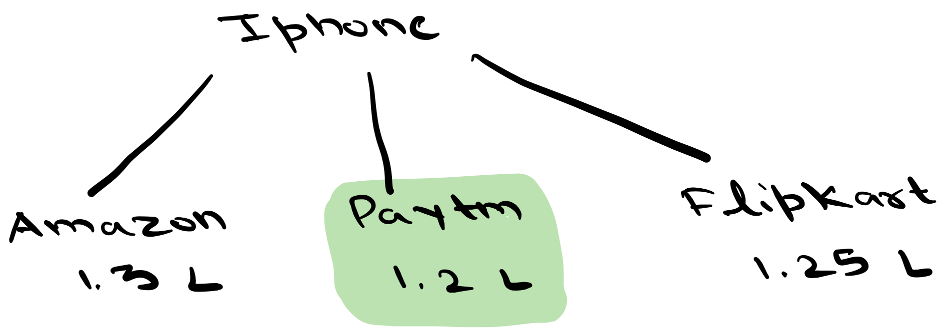
Contest → 19 Jan

Trees, Heaps and Greedy

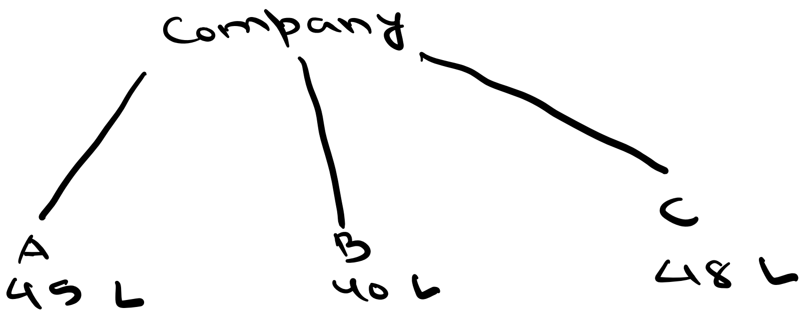
Greedy

↓

Maximize our profit and minimizing our loss



Considering → Price (Min)



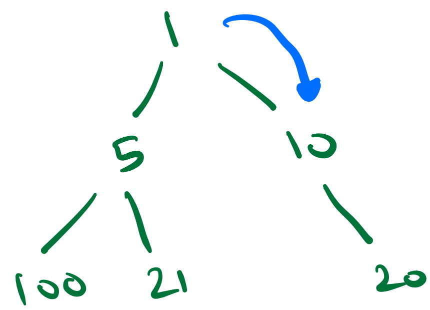
→ Job is remote

→ Work Culture

→ Project

→ Timings

Greedy - It is an approach to solve optimisation problems by making locally optimal choices.



Max sum from root to leaf

1. Free Cars

There is a limited sale going on for toys.

A[i] → sale end time for ith toy

B[i] → happiness of ith toy

Time starts with t=0, and it takes 1 unit of time to buy 1 toy and toy can only be bought if t < A[i].

Buy toys such that sum of happiness is max.

sale end time

	0	1	2	3	4
A[] :	3	1	3	2	3
B[] :	6	5	3	1	9

happiness

$t = \cancel{0}\ \cancel{1}\ \cancel{2}\ 3$

Toy	→	H
0	→	6
2	→	3
4	→	9
		18

Idea : Pick toys in order of happiness

	0	1	2	3	4
A[] :	3	1	3	2	3
B[] :	6	5	3	1	9

$t = \cancel{0}\ \cancel{1}\ \cancel{2}\ 3$

t	→	H
4	→	9
0	→	6
2	→	3
		18

	0	1	2	3	4
A[] :	3	1	3	2	3
B[] :	6	5	3	1	9

T → H

1 → 5

4 → 9

0 → 6

20

$t = \cancel{0}\,\cancel{1}\,\cancel{2}\;3$

	0	1
A [ ] :	1	2
B [ ] :	3	1500

t = 0/1

t = 0

Greed

$t = \cancel{0}\;1$

T → H

1 → 1500

1500

$t = \cancel{0}\,\cancel{1}\;2$

T → H

0 → 3

1 → 1500

1503

Idea: Pick toys in order of time

	0	1	2	3	4	5	6	7	8
A →	1,	3,	3,	3,	5,	5,	5,	~~8~~ 6	6
B →	5,	2,	7,	1,	4,	3,	8,	1	x

$t = \cancel{0}\,\cancel{1}\,\cancel{2}\,\cancel{3}\,\cancel{4}\,\cancel{5}\;6$

unbuy 2 t = 4

Buy 8 t = 5

$$\boxed{\begin{matrix} 5 & \cancel{2} & 7 \\ 4 & 3 & 8 \\ 1 & & \end{matrix}}$$

	0	1	2	3	4	5	6	7	8
A →	1	3	3	3	5	5	5	6	6
B →	5	2	7	1	4	3	8	1	

1 < Min Happiness

Leave it

8 > Min (2)

t = ~~0~~ ~~1~~ ~~2~~ ~~3~~ ~~4~~ ~~5~~ 6

5	~~2~~	
7	4	
3	8	1

Pseudo code

1. Sort toys in ascending order of time.
   ↓ N log N

2.
```
Minheap mh
    t = 0
    for (i=0 ; i<n ; i++) {                    N log N
        if (t < A[i]) {
            mh.insert (B[i])
            t++
        }
        else {
            if (B[i] > mh.getmin()) {
                mh.extractMin()        // t--
                mh.insert (B[i])       // t++
            }
        }
    }
```

3. Remove all elements from heap, add them and return sum. → N log N

TC : $O(N \log N)$ SC : $O(N)$

2. Candy Distribution

There are N students with their marks. Teacher has to give them candies such that

a) Every student should've atleast 1 candy

b) Students with more marks than any of his/her neighbours have more candies than them.

Find minimum candies to distribute.

	0	1	2	3
A :	1	5	2	1
	1	~~1~~ ~~2~~ 3	~~1~~ 2	1

ans → 1+3+2+1 = 7

	0	1	2	3
A :	8	10	6	2
	1	~~1~~ ~~2~~ 3	~~1~~ 2	1

ans → 7

A :	4	4	4	4	4
	1	1	1	1	1

ans → 5

A :	1	6	3	1	10	12	20	5	2
	1	~~1~~ ~~2~~ 3	~~1~~ 2	1	~~1~~ 2	~~1~~ 3	~~1~~ 4	~~1~~ 2	1

ans → 19

A : 1 6 3 1 10 12 20 5 2

1 ~~x2~~ x3 x2 1 x2 x3 x4 x2 1

sc a < b > c

Candies 3 4 7

```
① int c[n] = {1}
② for (i=1 ; i < n ; i++) {
       if ( A[i] > A[i-1])
             c[i] = c[i-1] +1
   }

③ for (i=n-2 ; i ≥ 0 ; i--) {
       if (A[i] > A[i+1])
           c[i] = max (c[i], c[i+1]+1)
   }

④ return sum (C[])
```

TC : O(N)

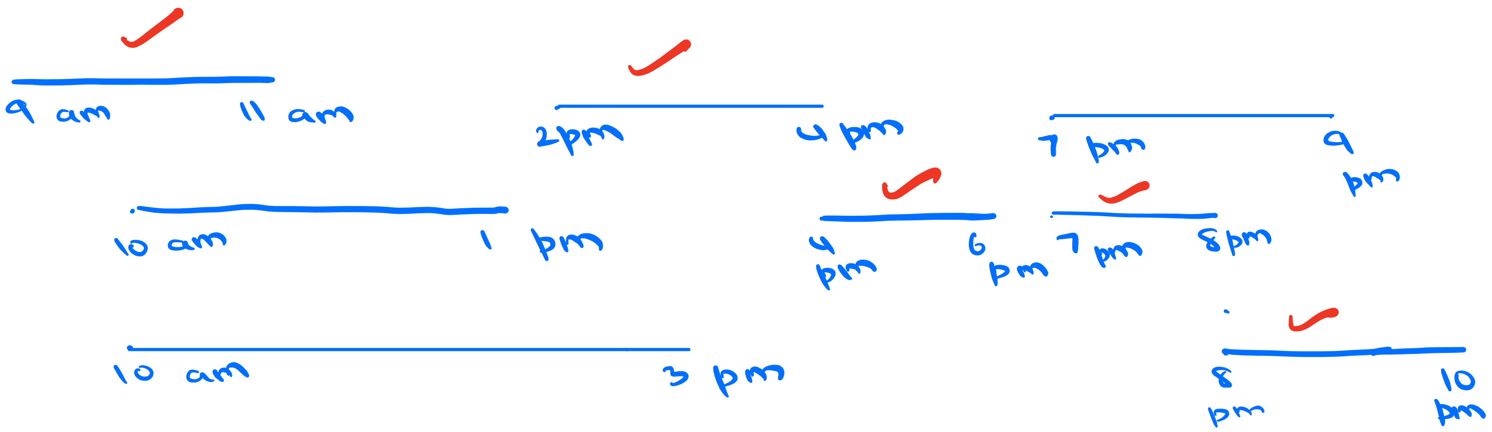
SC : O(N)

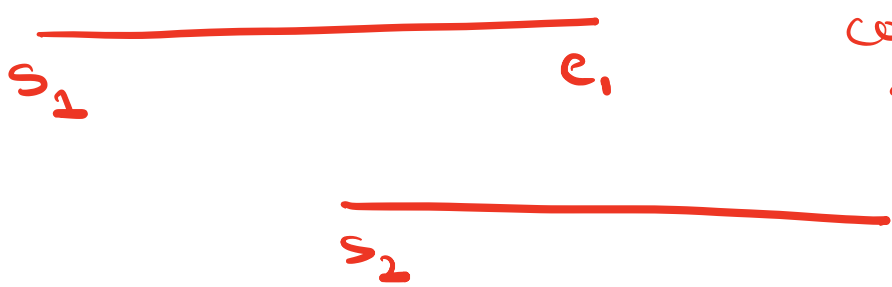
10:40

3. Maximum Jobs

Given N jobs with their start & end times. Find max no. of jobs that can be completed if only 1 job can be done at a time.

ans = 5

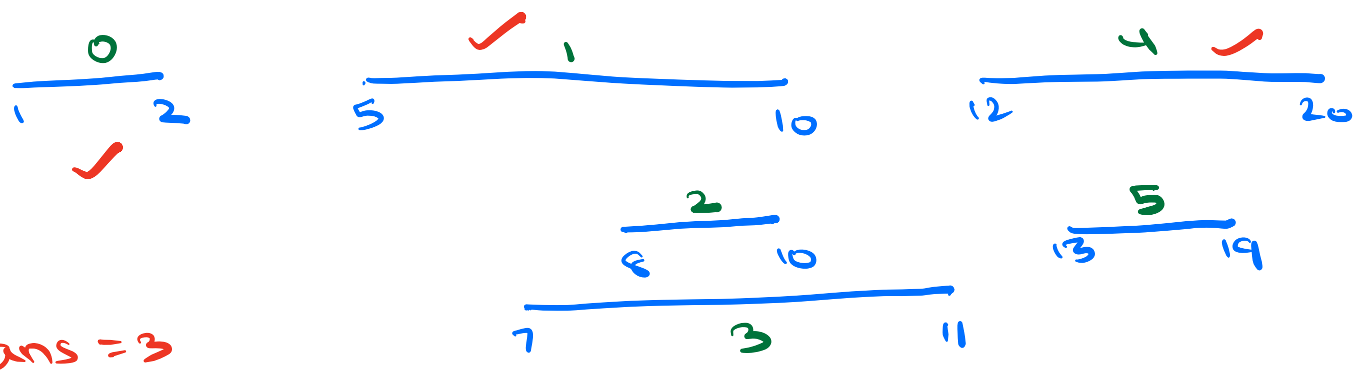




conflict

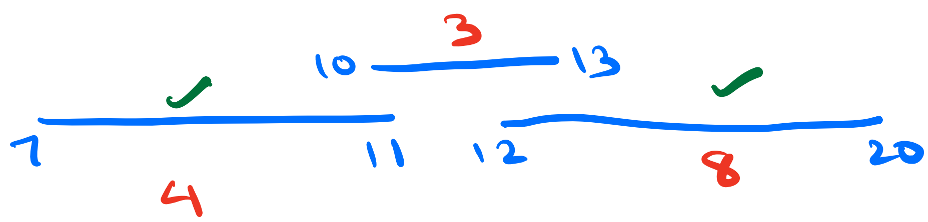
$s_2 < e_1$

	0	1	2	3	4	5
S →	1	5	8	7	12	13
E →	2	10	10	11	20	19



ans = 3

Idea 1 : Pick jobs based on duration



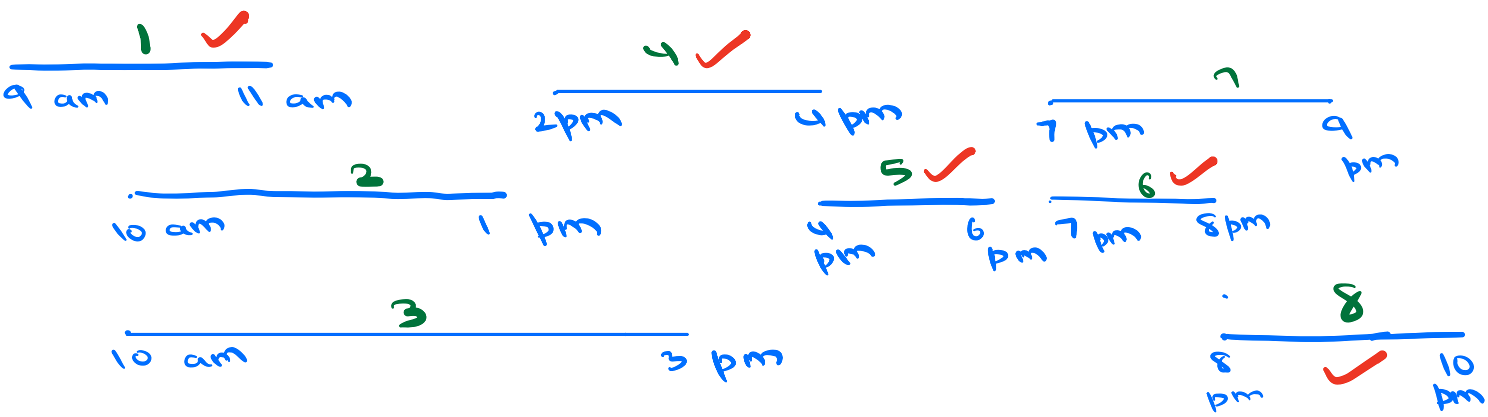
greedy
ans = 1 X

optimal
ans = 2

Idea 2 : Pick jobs based on start early

Idea 3 : Pick jobs which end early

start early
dur 1
len



```
class Pair {
    int s, e
    Pair (x, y) {
        s = x
        e = y
    }
}
```

```
      0   1   2   3
s → [1   5   8   7]
e → [2   11  10  6]

      0     1     2   3
Job → [1,2  5,11  —   — ]
```

```
int solve(int[] s, int[] e) {

    Pair job[s.len]
    for (i = 0; i < s.len; i++) {        → N
        job[i] = new Pair(s[i], e[i])
    }

    Arrays.sort(jobs, compare)           → NlogN

    ans = 1
    prevjobend = jobs[0].e
    for (i = 1; i < jobs.len; i++) {     → N
        if (jobs[i].s ≥ prevjobend) {
            ans++
            prevjobend = jobs[i].e
        }
    }
    return ans
}
```

```
bool compare(pair u, pair v) {
    if (u.e < v.e)
            return true        u comes 1st
    else
            return false       v comes 1st
}
```

TC: O(Nlog N)   SC: O(N)

sorting algo + jobs[]

Merge N Sorted Arrays

0 - [2, 3, 11, 15, 20]
1 - [1, 5, 7, 9]
2 - [0, 2, 4]
3 - [-2, 5, 10, 20]

We've to merge these sorted arrays.

Idea:

- If we want to merge 2 sorted arrays, then we need 2 pointers.
- If we want to merge 3 sorted arrays, then we need 3 pointers.
- If we want to merge n sorted arrays, then we need n pointers. ⇒ complexity becomes very high we need to keep track of N pointers.

Optimized:

New: [-2, 0, 1 . . . . .]

elem, ar, idx

2, 0, 0
~~1, 1, 0~~
~~0, 2, 0~~
-~~2, 3, 0~~
5, 3, 1

2, 2, 1
5, 1, 1

1. MinHeap of Point

```
class Point {
    int elem
    int arno
    int idx
}
```

2. Insert every ar's 0 idx element in min heap

```
list<int> l
```

3.

```
while ( mh.size () > 0 ) {
    Point p = mh.extractmin()
    l. add (p. elem)
    if (p. idx + 1 < p. arno. size()) {
        mh. insert({ arno[elem], arno, idx+1 })
    }
}
```

Total no. of elem in n arrays → x

TC: O (x log n)

SC: O(N)