COP 4516 - 4/19/22

Binary Search
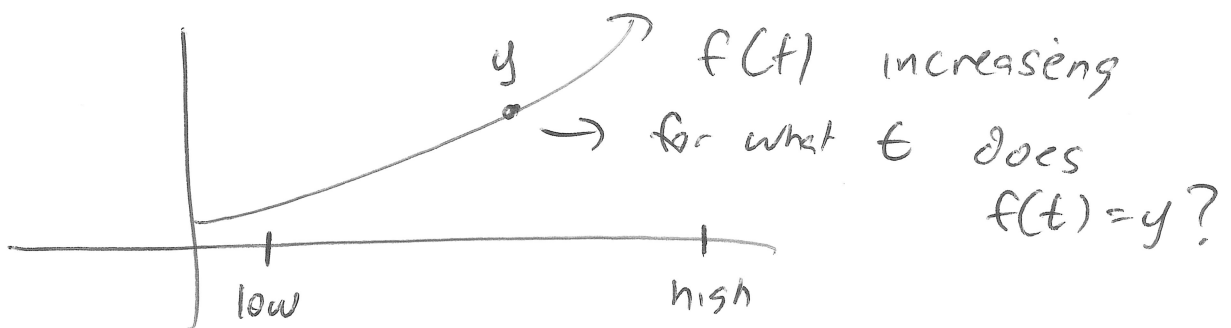
textbook   sorted array, value

     Is value in the array?

     $\longrightarrow O(\lg n)$ time   low, high

$$\frac{f_2 - f_1}{f_2 f_1} = \underbrace{at + b(1 - e^{-ct})}_{\text{at } t \uparrow, \text{ this } \uparrow.}$$

y $f(t)$ increasing

$\rightarrow$ for what t does $f(t) = y$?

low   high

real valued binary search

① be careful w/ choice low, high.
  - make sure low enough, high enough
  - make sure no overflow or arithmetic errors!

② fixed # iterations (60)

③ pay attention   low = mid or ⎤ don't
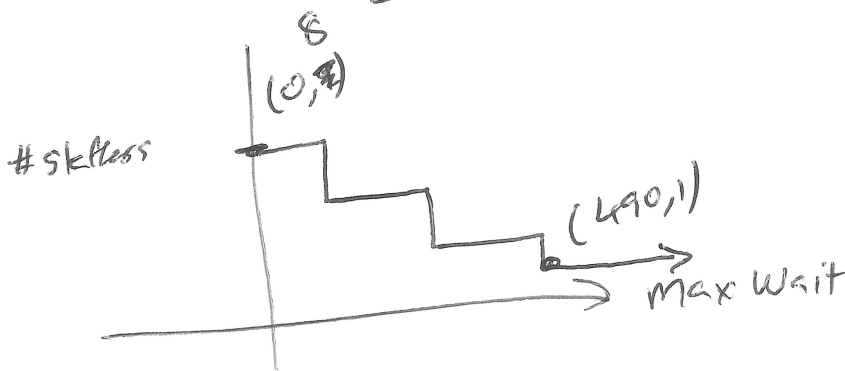   high = mid   ⎦ swap these!

Airport Shuttle

Students Arrive: $\boxed{10, 10, 30}$ $\boxed{200, 205, 210, 215, 220}$ $\boxed{500}$

30-10   220-200   500~500

3 staffers $\Rightarrow$ max wait time 20

(1) had to decide how long to stay

BUT if there was a fixed limit, then we could easily calculate # staffers needed

max = 10 $\boxed{10, 10}$ $\boxed{30}$ $\boxed{200, 205, 210}$ $\boxed{215, 220}$ $\boxed{500}$

#staffers ... (0,4) ... (490,1) ... max wait

binary searchable
Integer binary Search.

Int binary Search

(1) while (low < high)

(2) mid = (low + high)/2
     mid = (low + high + 1)/2   ⎤ One of these
                                   ⎦ test low = 2, high = 3

(3) low = mid   or   low = mid + 1   ⎤
     high = mid   or   high = mid - 1 ⎦
          Depends on the problem!

Careful Approach

land   planes

				Potential	20 Goal Greedy maximize minimum gap btw. plane landings
⑤	P_1	50	70	70	
②	P_2	10	40	20	25
④	P_3	25	60	50	65X Can't do it!
③	P_4	30	45	35	45
①	P_5	5	35	5	5

$$\text{min gap} = \min(20-5, 35-20, 50-35, 70-50)$$
$$= 15$$

max   # planes = 8

Unclear which order to land planes

$\implies$ Just try all 8! orderings!

Can a gap of 20 be achieved?

Binary Search gap (for each permutation)

Bone's Battery

once Floyd Warshall gives you shortest distance btw all pairs

If $k=1$ ans = max (any shortest distance)

If my battery charge is less there are some places I can go and some I can't.

Binary Search battery charge distance

I know charge = 200 miles
Use FW info, and add edge in a new graph btw all pairs of vertices w/ distance
$\leq$ 200. (each edge weight = 1 # recharging)

$\longrightarrow$ Run F-W new graph if max ans $\leq k$, then this charging dist is OR.