

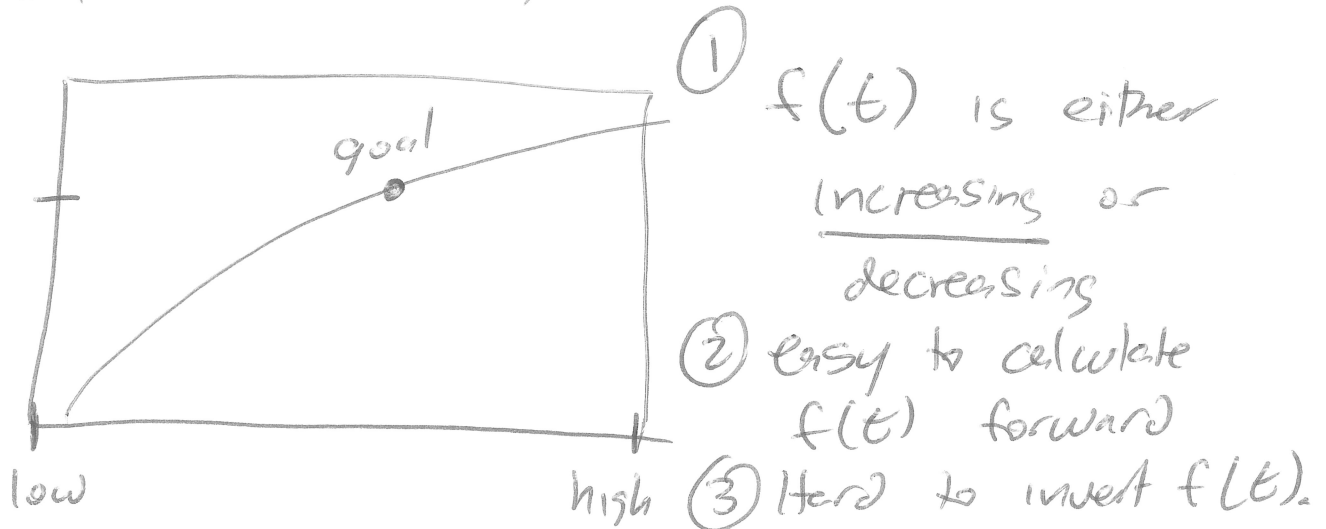
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Binary Search Applications

Etching crystals

$$\frac{f_2 - f_1}{f_1 f_2} = at + b(1 - e^{-ct})$$

Real Valued Binary Search



How

① establish safe low and high bounds for your answer. (function specific)

② Run fixed # of iterations

③ Calculate $mid = (low + high) / 2$
 $f(mid)$

depending on which way target is, reset low or high.

A Careful Approach

2009 World Finals Problem

Land planes: 10, 30, 35, 80 (min diff 5)
20 5 45

Alternate: 10 25 40 80 (min diff 15)
15 15 40 BETTER

Given ranges of time when each plane can land determine the maximum value of the s.t. no two planes land within closer than that time.

P_1	10	50
P_2	30	60
P_3	25	45
P_4	5	90
P_5	40	80

$n \leq 8$
 $\downarrow$
num planes

① Since $n \leq 8$, just try all $\frac{n}{8}!$ orders of landing the planes

Example: if we decide on ordering P_1, P_2, P_3, P_4, P_5 then it makes sense to land P_1 at 10.

What about P_2 ? NOT SO EASY TO FIGURE OUT!

If something seems difficult, try solving an easier version first!

Can we land all 5 planes with a gap of 10 minutes?

P_1 10 50

P_2 30 60

P_3 25 45

P_4 5 90

P_5 40 80

$P_1 = 10$

$P_2 = 30$

$P_3 = 40$

$P_4 = 50$

$P_5 = 60$

✓✓

P_4 ~~80~~ 90 80

P_5

X can't do it.

$t = \text{min gap}$

$f(t) = 1$ can land
 $= 0$ can't



What we'll do:

For each perm

Run binary search on t

low = 0, high = max time

$\Rightarrow$ Simulate the greedy soln
discussed!

Airport Shuttle

Integer Binary Search

Vans

Arrival times: 6, 8, 15, 20, 40, 42, 100, 121, 132,

12 counselors

minimize wait time for any ^{student} ~~counselor~~

Can we pick up all the kids with
wait time of 20 or less?

In an int bin search

$$\text{mid} = (\text{low} + \text{high}) / 2;$$

$$\text{mid} = (\text{low} + \text{high} + 1) / 2;$$

plug in low=2, high=3.

Need for Speed Problem

		time seg1	time seg2	time seg3	time total
3	5				
4	-1	$\frac{4}{-1+c}$	$+\frac{4}{0+c}$	$+\frac{10}{3+c}$	$= 5$

4	0
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10	3
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if c is too big $LHS < 5$
 c is too small $LHS > 5$

$c > +1$ because den > 0 .

$c > -$ speeding
low $\nearrow$ high