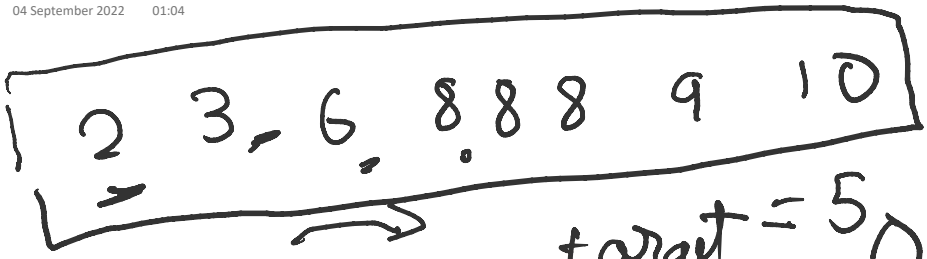
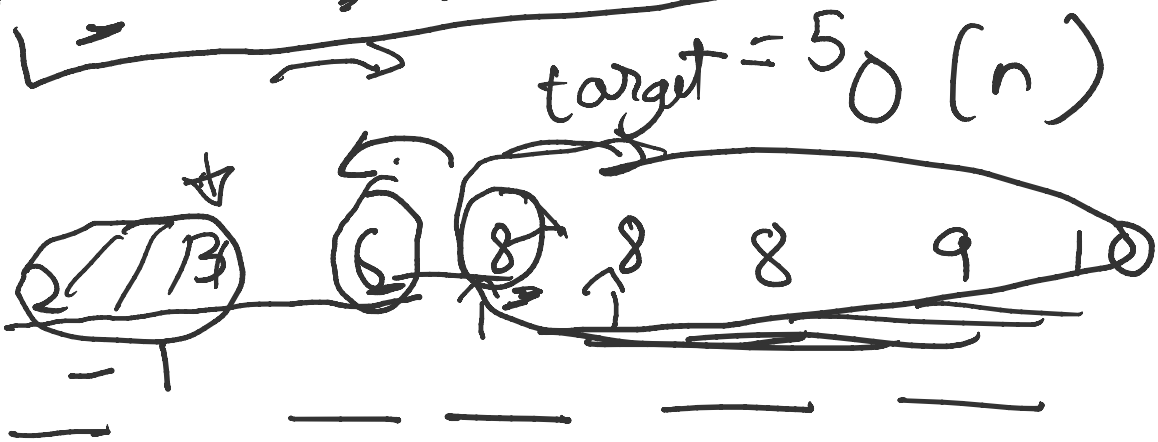
Binary Search

04 September 2022 01:04



8 > 5




```
int l = 0, r = n-1;
while(l <= r){
  //same as (l+r)/2, but prevents overflow
  int mid = l + (r-l)/2;
  if(arr[mid] == target){
    //element found
    return mid;
  }
  else if(arr[mid] > target){
    //element must lie somewhere on the left
    r = mid-1;
  } else {
    //element must lie somewhere on the right
    l = mid+1;
  }
}
return -1;
```

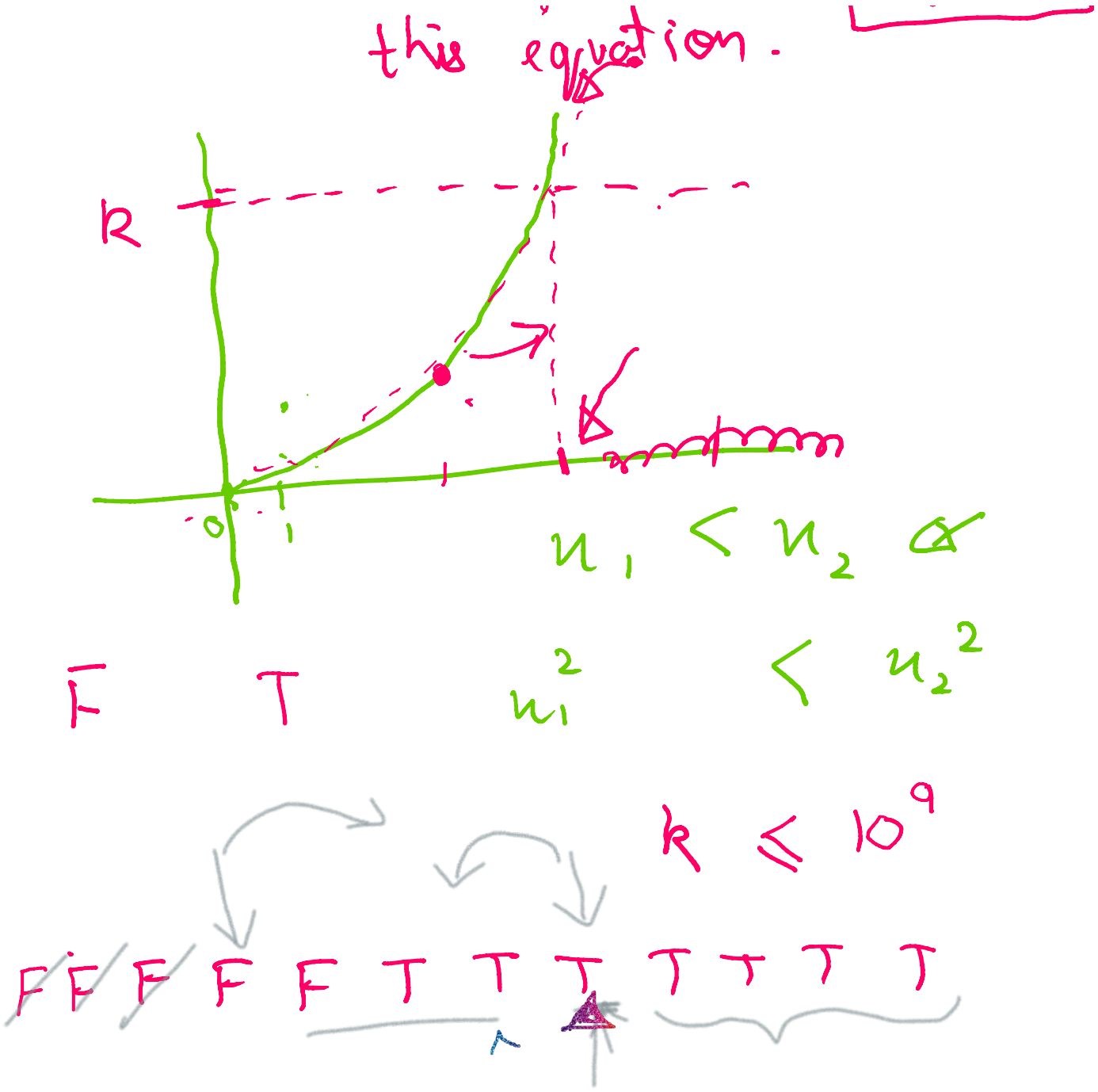
arr [n]

BSOA

Q) $x^2 + x \geq k$

find out the min x that satisfies this equation.

$k \geq 0$




```
0 <= K <= 10^9

Bool f(x,k){
    Returns x^2 + x > k;
}

Double Low = 0
Double High = 10^5
Ans = High .
eps = 10^-7 .
While(abs(Low-High) > eps):
    Mid = (Low + High)/2
    If(f(Mid,k) == True):
        Ans = Min(Ans, Mid)
        High = Mid
    Else:
        Low = Mid
```

0.1 0.2 0.3 0.4

L H

H'

L=0 H=1

1/2 1/4 1/8 ∞

Else:
    Low = Mid

Return ans;.

1/2 1/4 1/8 .....

0.00000001

0 1/2 1/4 1/8 1/16 ..

0.0000001

$\Rightarrow \log(10^{12})$

0 eps 2 eps .... V * eps

High

$V = \frac{High}{eps} = \frac{10^5}{10^{-7}} = 10^{7+5} = 10^{12}$

$\log_2 10^{12} = ?$

$\approx 40 \sim 50$

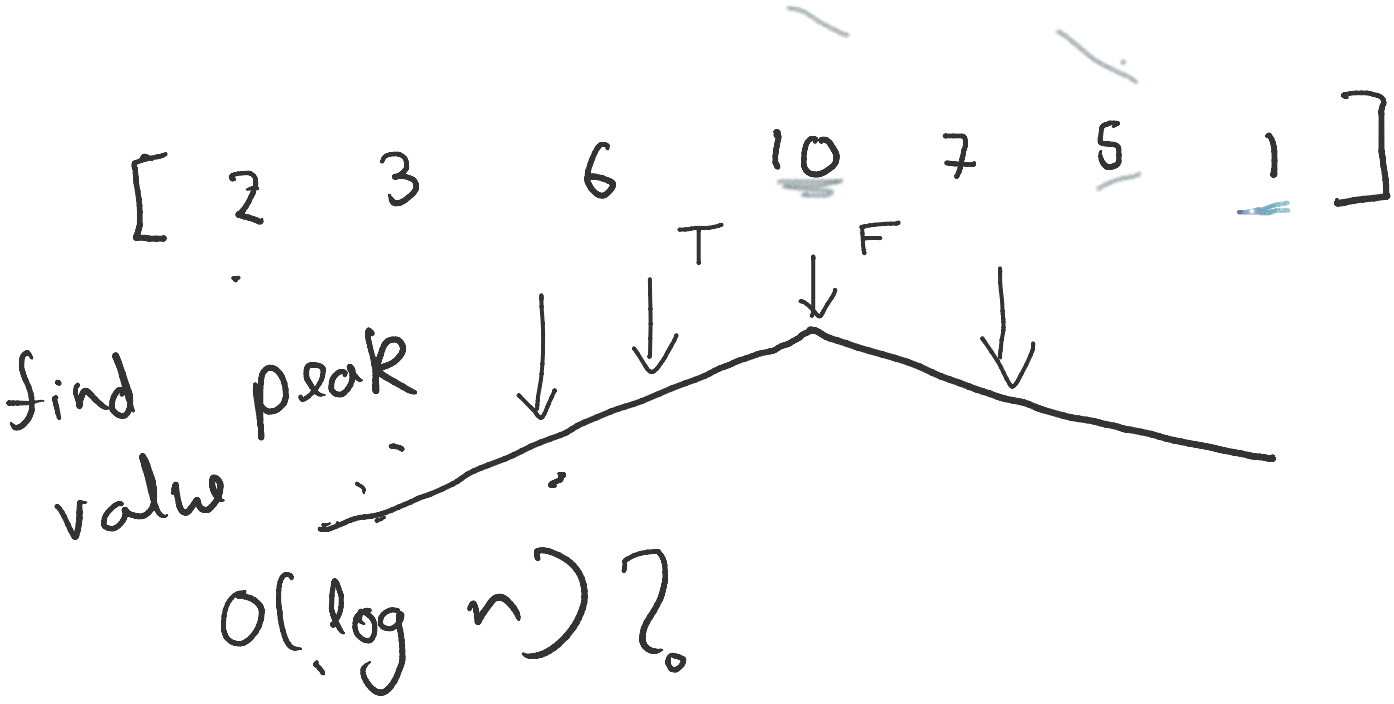
```
Bool f(x,k){
    Returns x^2 + x > k;
}
```

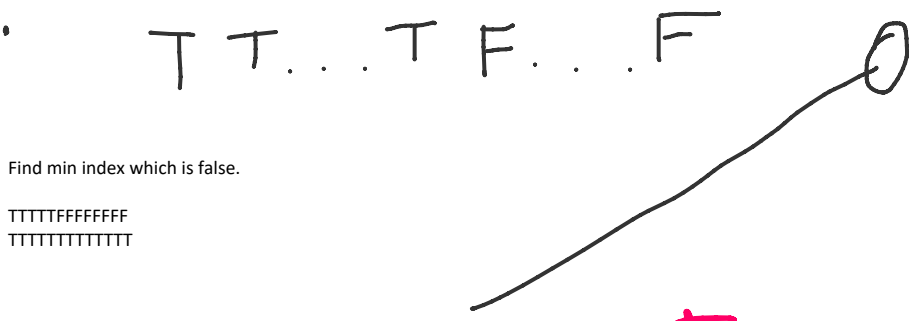
```
Double Low = 0
Double High = 10^5
Ans = High
For(int ctr = 0; ctr < 100; ctr++):
    Mid = (Low + High)/2
    If(f(Mid,k) == True):
        Ans = Mid
        High = Mid
    Else:
        Low = Mid

Return ans;
```

1 Condition you require:

- Function should be monotonic in nature.
- For a given value of x, you can calculate f(x) in sufficient time.





Find min index which is false.

TTTTTFFFFFFF
TTTTTTTTTTTT

Sort

Given arr:
K ops

Each op: increase any element by 1
Find max median of array.

sort

middle = median.

0 1 2 5 6 20 25

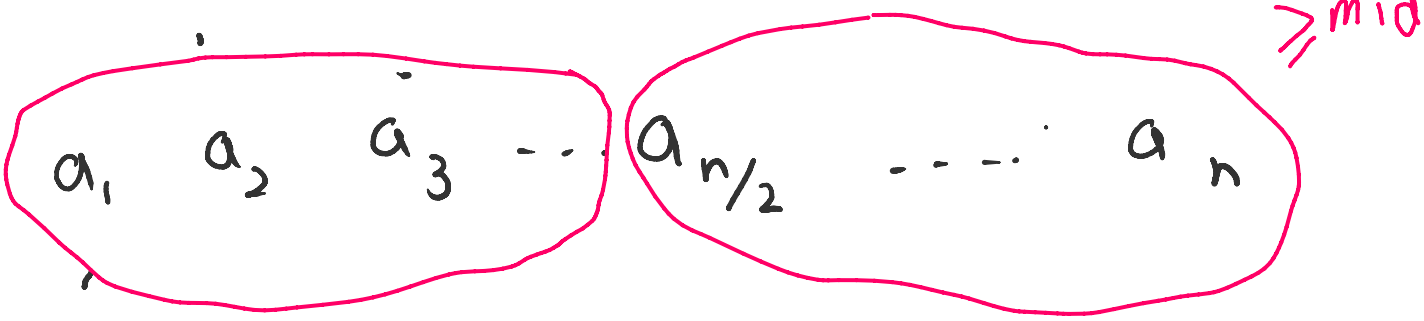
Binary search on median.

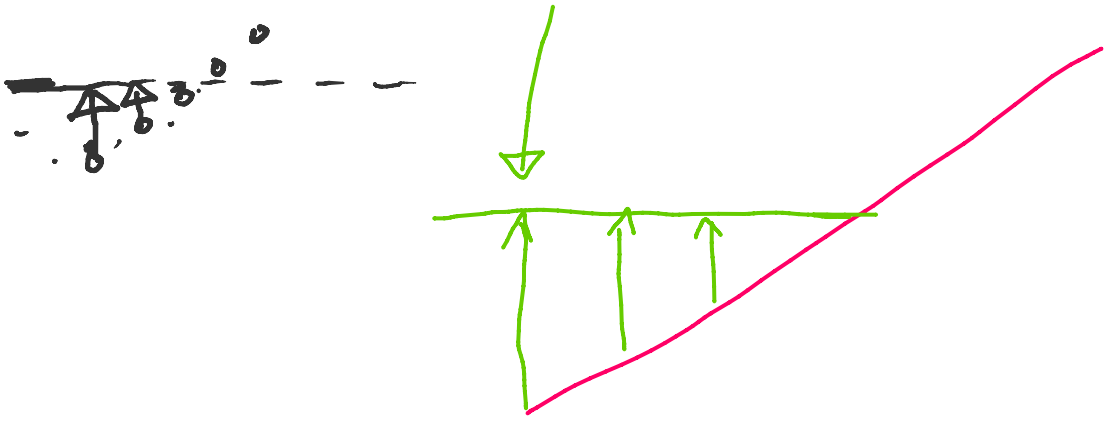
k ops. med $\geq m$

fun(arr, mid, k) :- T ✓
F ✗

$m-2$ $m-1$ m $m+1$ $m+2$

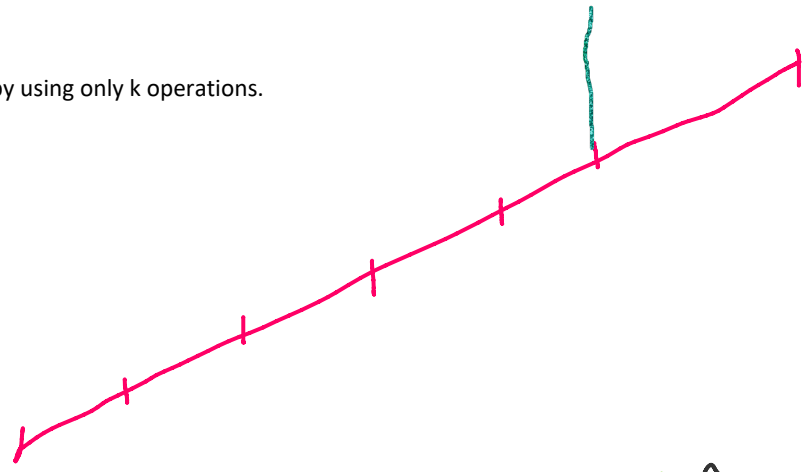
T F F F k mid

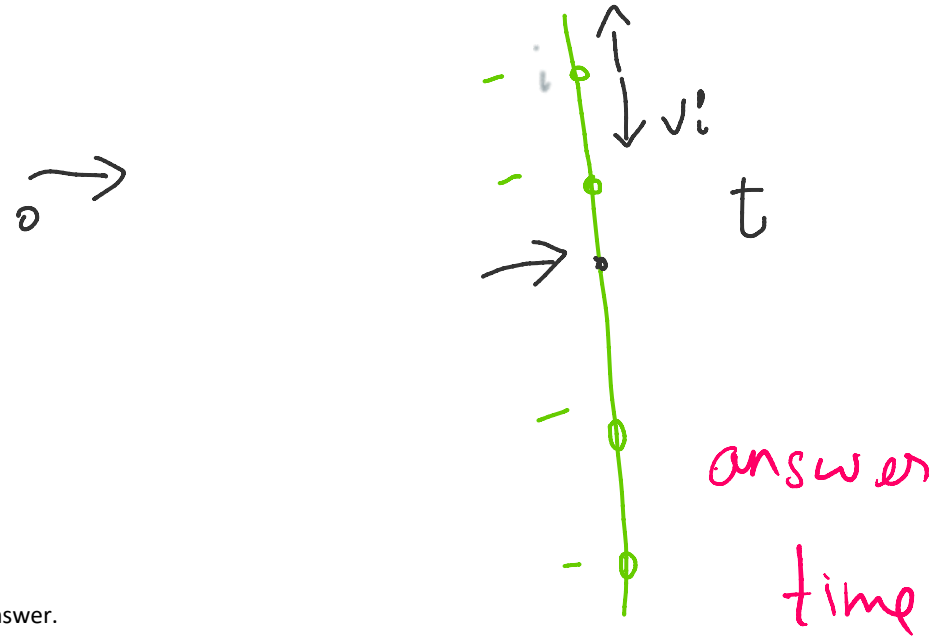




m

For a given array,
If we can make its median >= mid by using only k operations.
= > T or F.





When we look at time:

If T' is our optimal answer,

T' + val is also possible:
T' - val is not possible
T'-val < T'

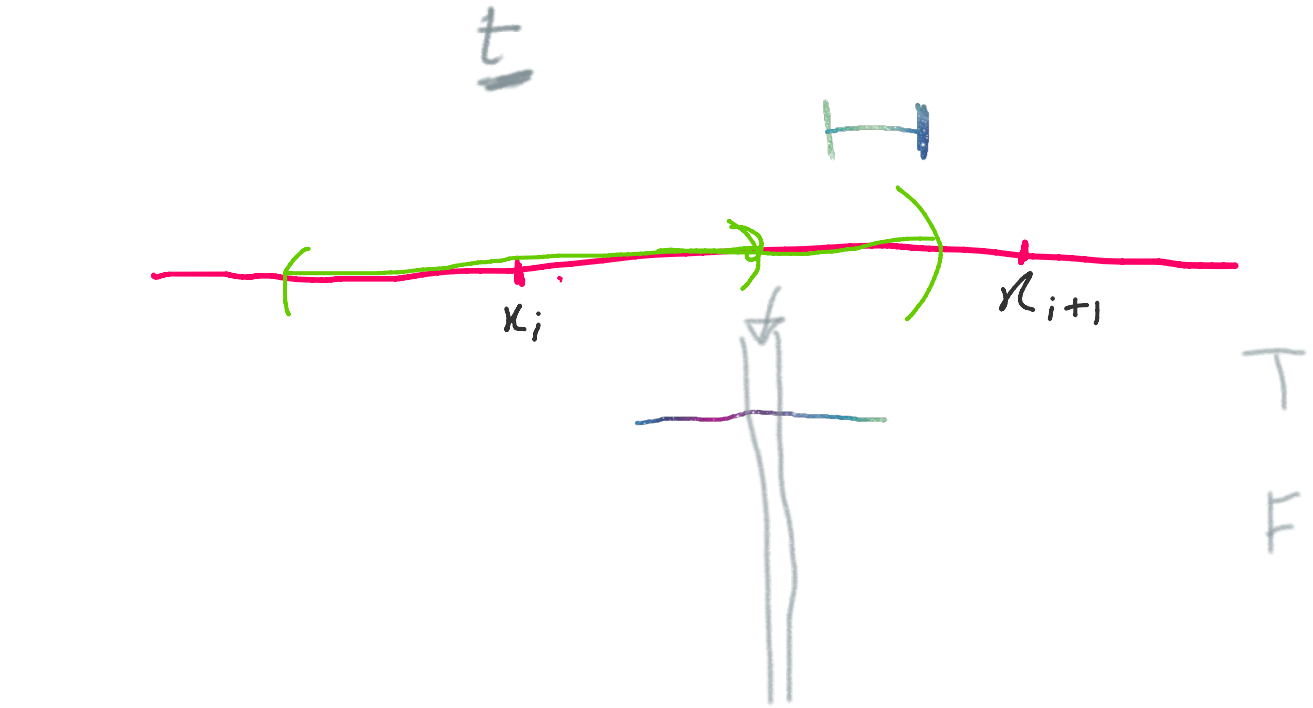
T'-val should have been the optimal answer.

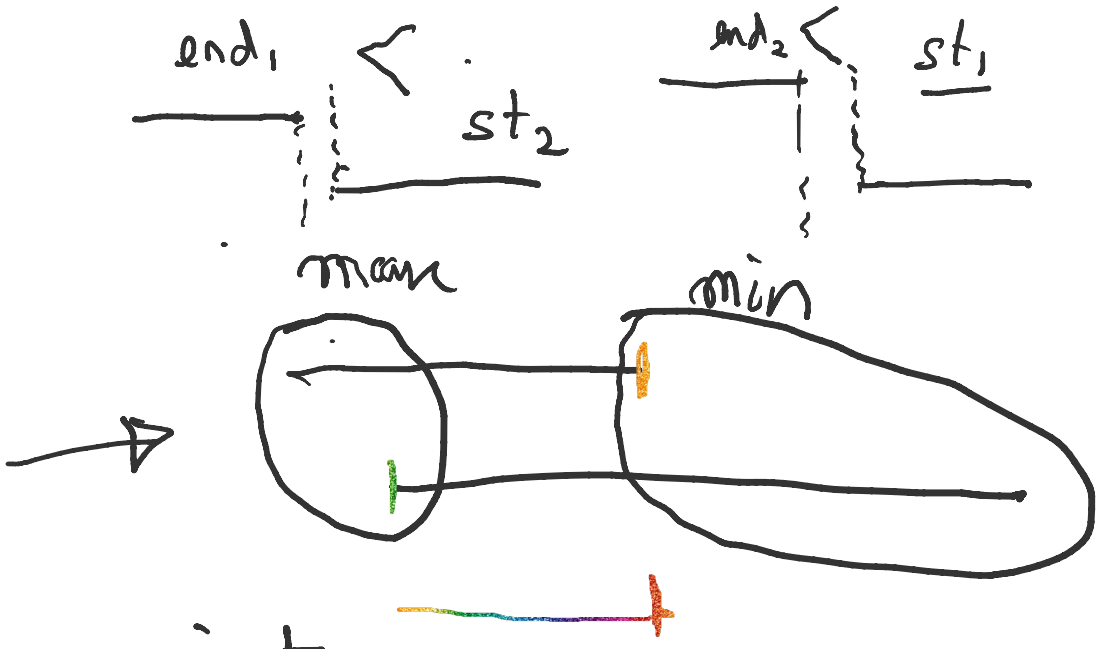
F F F F F T T T T T

Fun(people, midtime):
Returns false if impossible
Else true.

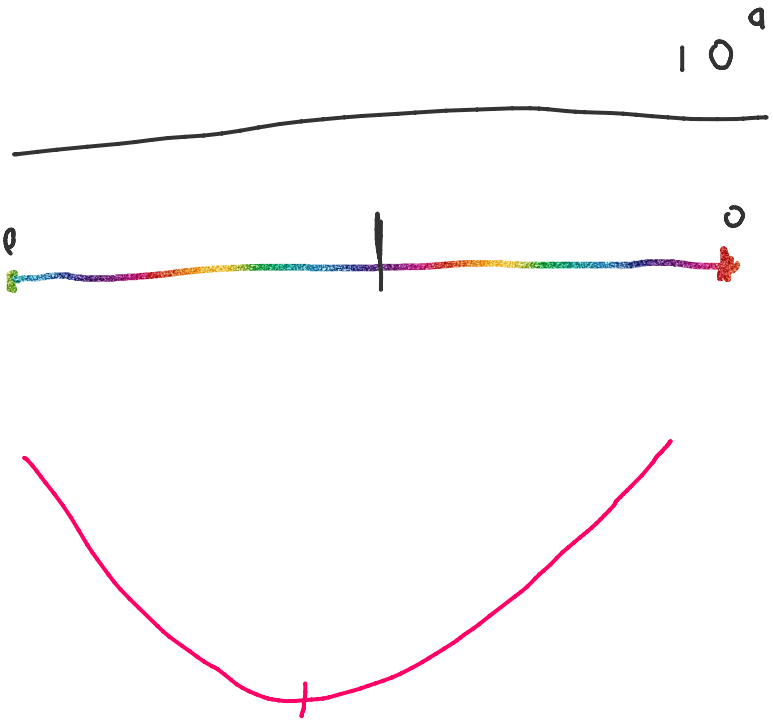
Fun = solve this problem.

Fun = solve this problem.





int



$$\frac{10^9}{2}$$