Q Given a rotated sorted array with distinct elements. Search given element K.

1 2 3 | 4 5 6 7

4 5 6 7 1 2 3

K → left
K → right

left — $arr[i] >= arr[0]$

right — smaller than left part — $arr[i] < arr[0]$

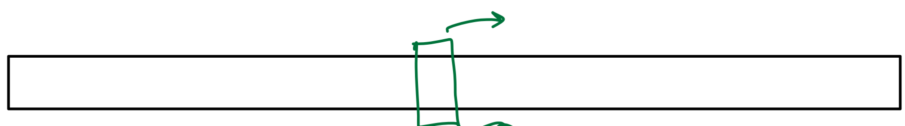
K

find the ranges or rotation point

first index of right part → t

find t

$(0 - t-1)$ $(t \rightarrow n-1)$



mid

$arr[mid] >= arr[0]$

left part

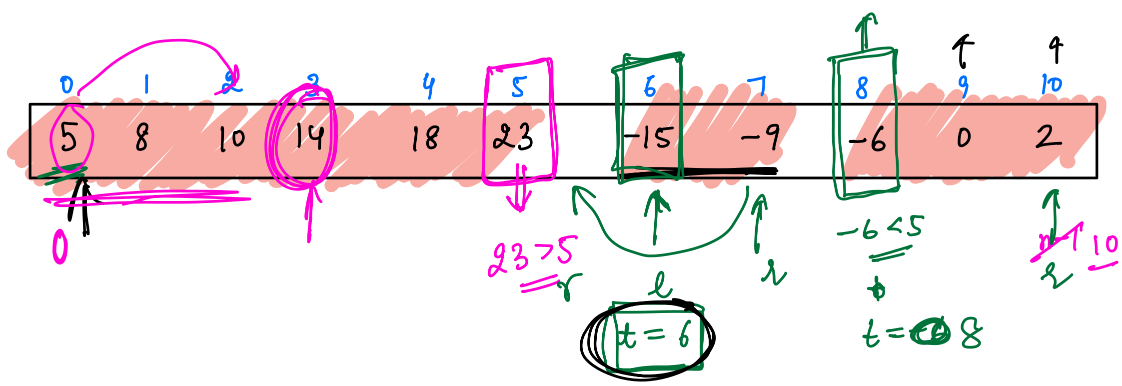
$l = mid+1$

$arr[mid] < arr[0]$

right sorted

$t = mid$

$r = mid-1$



l > r

left	right
0–5	6–10

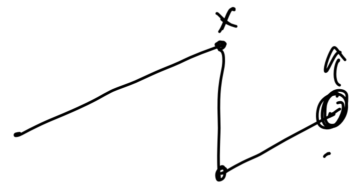
t = findindex( );

K — if(arr[0] > k)

BS(arr[], t, n-1).

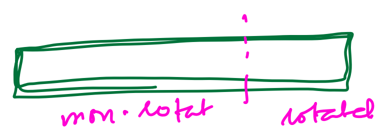
else

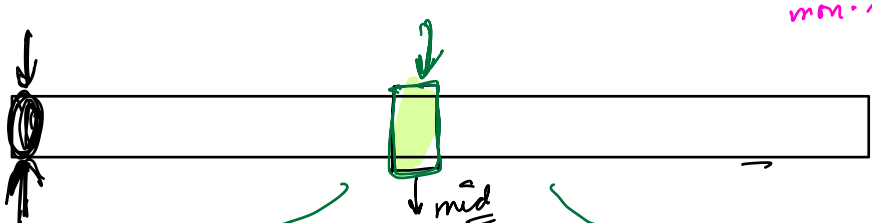
BS(arr, 0, t-1)



log(n) + log(n)

↓ t   ↓ K



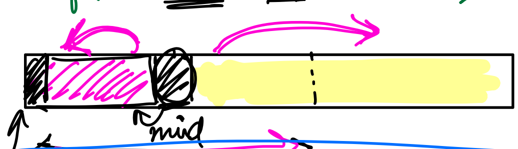


arr[mid] == k

done ✓

mid is in left part

if(arr[0] <= arr[mid])

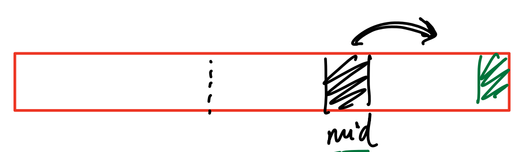


arr[0] =< target && target < arr[mid]

r = mid-1

mid is in right part

(arr[0] > arr[mid])

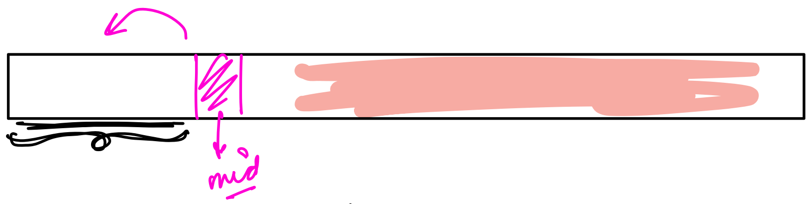


target > arr[mid] &&

target <= arr[n-1]

else

l = mid+1



l = mid+1

else

r = mid-1

arr[0] → arr[mid]

0	1	2	3	4	5	6	7	8	9	10
5	8	10	14	18	23	-15	-9	-6	0	2

ta = 14

l	r	mid	arr[mid]	
0	10	5	23 > 5	14 >= 5 && 14 < 23, r = mid-1
0	4	2	10 > 5	~~14 >= 5 && 14 < 10~~
3	4	3	14 == 14	✓

0	1	2	3	4	5	6	7	8	9	10	11
10	10	10	12	10	10	10	10	10	10	10	10

linear search

10 >= arr[0] +1

12 >= 10

Appl BS on ans

① Find square root of positive integers N

⇓

integral part

$10 \rightarrow 3$

$16 \rightarrow 4$

$29 \rightarrow 5$

$i = 1$

$i * i <= n$

↓ update

fail → break

T.C: $\sqrt{N}$

least value ⇒ 1

largest ⇒ N

N = 1

1 * 1 <= 70		ans = 1
2 * 2	<= 70	ans = 2
3 * 3	<= 70	ans = 3
⋮		
7 * 7	<= 70	ans = 7
8 * 8	<= 70	ans = 8
9 * 9	> 70	

$1 \longrightarrow N$

1 ———— N

mid

mid * mid < N → ans = mid, l = mid + 1

mid * mid == N

mid * mid > N → r = mid − 1

1 → min(N, 10^9)

~~$1 \le N \le 10^9$~~

1 — 10^9

$1 \le N \le 10^{18}$

$N = 10^{18}$

1 — 10^{18}

mid: $\frac{10^{18}}{2} * \frac{10^{18}}{2}$

larger data ~~int~~ mid = (l+r)/2;

mid * mid == n

Q Given an array of positive integers. Find maximum k such that there is no subarray of length k with sum > B.

0	1	2	3	4	5	6	7
3	2	5	4	6	3	7	2

B = 20

20

ans = 0

K = 1 — ~~ans = 1~~

K = 2 ✓ ~~ans = 2~~

K = 3 ~~ans = 3~~

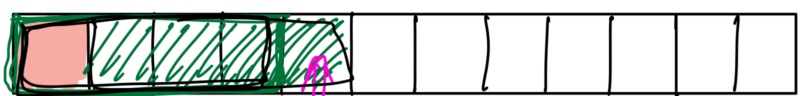
K = 4 ✓ ans = 4

K = 5 ✗

K = 6 ✗

i = 1 ⟶ N

for every i check if it's possible



sum + arr[i] − arr[i−k]

T.C : $O(n^2)$

length

1 ⟶ n

mid

if all subarray of length mid have a sum <= B → $O(n)$

Yes:

ans = mid

l = mid+1

No:

r = mid−1

```
int ans=0;
int l=1 , r=N;        => search space => BS on length 1 -> n
  1 -> 12
while ( l <= r)                 3 2 5 4 6 3 7 2     1->8
{                                                    (4)
    int mid = (l+r)/2;
    if (check( arr, mid, B))   true — if all subar of length
    {                                mid  <= B.
                                7 - 11
        ans = mid;   l = mid+1;          TC (N log N)
    }                                              (11)
    else {    r = mid-1;       | | | | | | | | | | | | | (B=11)
}
return ans;
                              window size
bool check( int arr[], int k, int B)
{     // This f^n will tell if k can be a possible ans or not
      sum = 0
      // first window sum        0 -> k-1
      if (sum > B) return false;
O(N)  for( i=k; i<n; i++)
      {          sum += arr[i] - arr[i-k];
                 if( sum > B)
                     return false;
      }
      return true;
}
```

Q

multiples of 4 $\equiv 100/4 = 25$

multiple of 6 $\equiv 100/6 \equiv 16$

multiples of 4 or 6 ~~25+16~~

12, 24, 36, 48, 60, 72, 84, 96

LCM(4, 6) 100/12 = 8

$A \cup B = A + B - A \cap B$

25 16 − 8 = 33

$\frac{100}{4} + \frac{100}{16} - \frac{100}{LCM(4,16)}$

$1 \to x$ a or b

$$\boxed{\text{count of a or b} = \frac{x}{a} + \frac{x}{b} - \frac{x}{LCM(a,b)}}$$

$$\frac{a \times b}{gcd(a,b)}$$

Q Find N^{th} Magical Number, given A and B.

N^{th} multiple of A or B

A = 2, B = 3, N = 8

1	2	3	4	5	6	7	8
2	3	4	6	8	9	10	12

```
for (i=1 ; i< ∞ ; i++)
{
        if( i%A==0 || i%B==0)
              cnt++;
              if (cnt==N)
                  return i;
}
```

1 ✗
2 ✓
3 ✓
4 ✓
5 ✗
6 ✓
7 ✗
8 ✓
9 ✓
10 ✓
11 ✗
12 ✓

cnt=8

a = 3
b = 8
N = 8

a < b

a = 2
b = 3
N = 10

1 —— a*N —— b*N

$8*8 = 64$

$1 \to 64$

$3*8 = 24$

do

30

min(a,b) —— min(a,b) * N

target : N^{th} multiple

a or b

n^{th}

n

min(a,b) —— mid —— min(a,b) * N

total no. of multiple of a or b

< n

l = mid + 1

= n

ans = mid
r = mid - 1

> n

r = mid - 1

$$x = \frac{mid}{a} + \frac{mid}{b} - \frac{mid}{LCM(a,b)}$$

where

a = 5 b = 7 n = 3

mid

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	0	0	1	1	2	2	2	3	3	3	3	4	5

ans

A = 2 , B = 3   N = 10

2 —— 11 —— 20

7

$$\frac{11}{2} + \frac{11}{3} - \frac{11}{6} = 5 + 3 - 1 = 7$$

l = mid + 1
l = 12

12 —— 16 —— 20

11

$$\frac{16}{2} + \frac{16}{3} - \frac{16}{6} = 8 + 5 - 2 = 11$$

r = mid - 1

$\downarrow 8^{th}$

12 13 15

$l = mid+1$

$6+4-2 = 8$

9^{th}

14 15

$l = mid+1$

$\frac{14}{2} + \frac{14}{3} - \frac{14}{6} = 9$

10'mll ans = 15

$7+5-2$ $r = 15-1$

15

$r = 14$ $l = 15$

Doubts

0	1	2	3	4	5	6	7	8	9	10
5	8	10	14	18	23	-15	-9	-6	0	2

l	r	mid	
0	10	5	$23 > 5$
6	10	8	$-6 < 5$
6	7	6	

$K = -9$

$-9 < 5$

tar >= a[0] && tar < a[...]

$l = mid+1$