Wednesday, 10 July 2024
9:08PM

Agenda

↳ Problems

↳ Binary Search on Answers

1) Rot-d Sorted Array

1, 2, 3, 4, 5, 6, 7, 8

$lo=0$ $mid=3$
$hi=7$

$7 > 3$ ②

✗

4	5	6	7	8	1	2	3
0	1	2	3	4	5	6	7

$lo=4$ $mid=5$
$hi=7$

1) Linear Search → $O(n)$ 8,1
                              ✗

$lo=6$ $mid=6$
$hi=7$ ✓

2) Binary Search (Updated)   1 < 3
   ↳ sorted

   mid

i) Check if A[mid] == target
   return mid

2) else

is left sorted   or   right part is
ζ sorted
   target lies   target lies in
   in the left   the right
   part ?   part

search in   search   search   search
left   in right   in right   in left
hi = mid - 1   lo = mid + 1   lo = mid + 1   hi = mid - 1

5, 6, 1, 2, 3, 4   6

2) Peak index in mountain array

1, 2, 3, 4, 2, 1

0   10

1) 1, 2, 3, 4, 2, 1

O(n)

2)

4
3
2
1
2
1
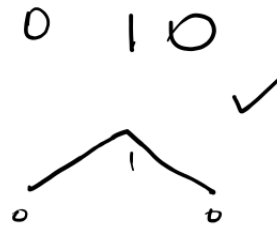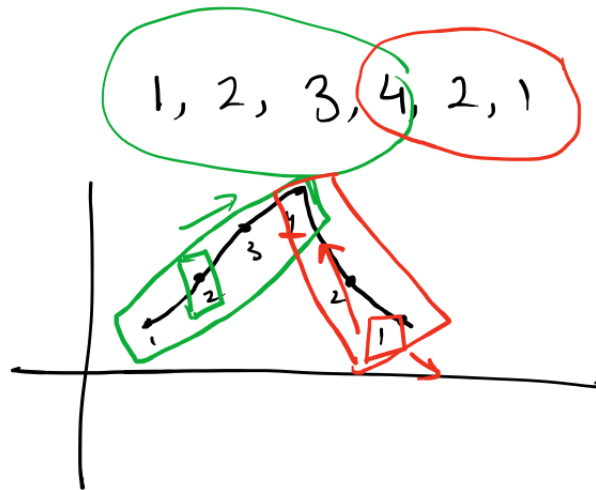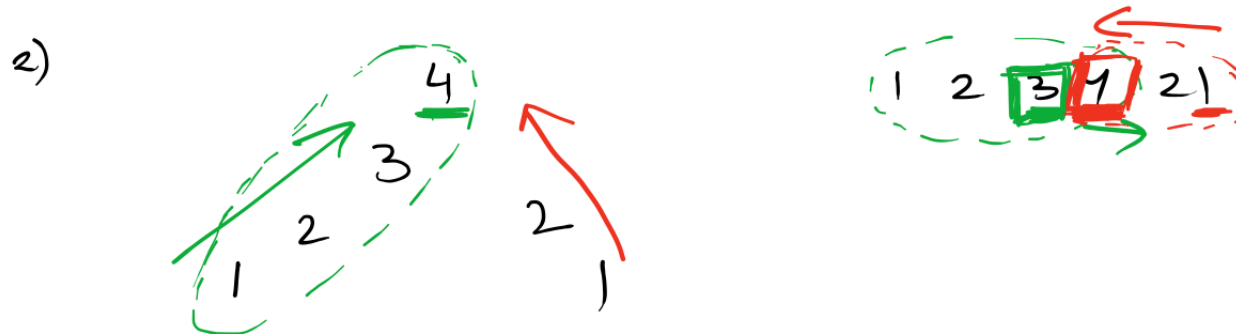
1 2 3 4 2 1

Check if we are on the

○ increasing side → more right
on the
decreasing side → move left

0 1 2 3 4 5

1 2 3 → 4 > 2 → 1

lo = ~~0~~3
hi = 5

mid = 2
↳ lo = mid + 1

lo = 3   mid = 4 ✗
hi = 5   hi = mid - 1 ?? ✗
           ↳ hi = mid

lo = 3   mid = 3
hi = 4
           ↳ hi = 3

lo = 3
hi = 3

3) Search in Bitonic Array
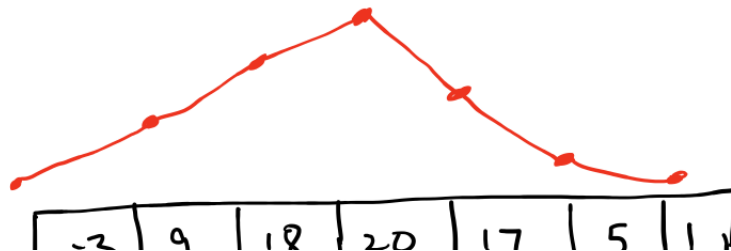
17

Strictly Increasing
+
Strictly decreasing

| -2 | 9 | 18 | 20 | 17 | 5 | 1 |

20, 15, 12, 7, 2,0 → Bitonic Array?

✓   ↳ Yes

↑

20

1, 2, 3, 4, 5   → Yes

1, 2, 3, 4, 5   5

↳ strictly increasing?   ↳ strictly decreasing?

[10]   Sorted in increasing? ✓   ↓
        Sorted in decreasing? ✓   Yes

        1 2 3   3 2 1   → Bitonic Array?

                                Not

        ← SI ✓   SD? → No

Not mounted

1, 1   ✗ Not Bitonic

1   ✓ Bitonic

| -3 | 9 | 18 | 20 | 17 | 5 | 1 |
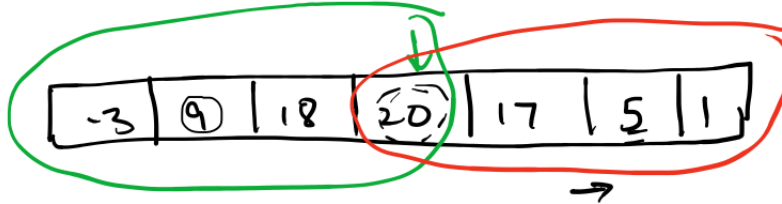
17   1 2 3
                ↑
1) Linear search
   ↳ O(n)   1 2

2) Binary search ??.
   ↳ Find the Peak element (index)
   Left [0, Peak]   Right [Peak, n-1]
   ↳   ↳ BS on

3) Peak element

1   10   3   4   2

① Linear search

② Binary Search ??
↳ 2?. No
Updated BS?.

B.S

11 , 10 , ③ , 4,12

10

$A[mid-1] < A[mid]$

10

3

③

9 7
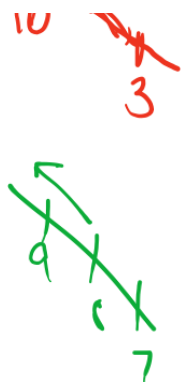
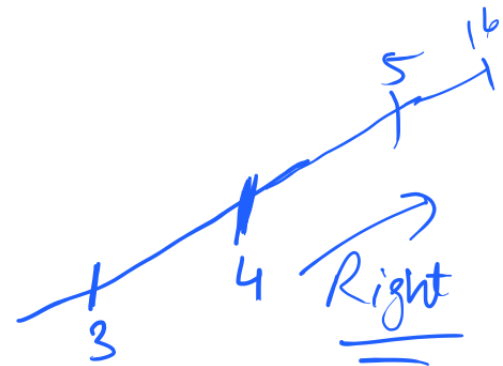Peak on left

$A[mid-1] > A[mid]$

Peak is on left
side

⑩

1 ↑ 3

mid

Peak is mid ✓

4

$A[mid] > A[mid+1]$

↳ mid is ans

③

Peak on right

$A[mid+1] > A[mid]$

↳ Peak on right

5 16
3 4 Right

10   9 > 8   7   6

mid

$A[mid-1] > A[mid]$

9 8 =>

1 9 8 7

mid-1 mid

mid is on
decreasing
path
⇓
Ans on left

hi = mid -1

mid
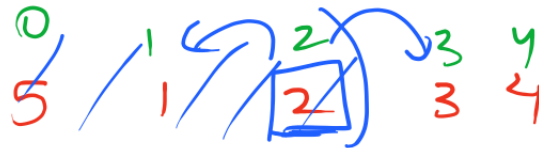
mid-1   mid+1

mid is
the peak
⇓
Ans is mid
⇓
return mid

mid   mid+1

mid   mid on
Ans on increasing
right side   path

lo = mid +1

mid-1 < mid < mid+1 ⇒ ③ mid < mid+1

$mid-1 < mid > mid+1 \implies ②$

$mid-1 > mid > mid+1 \implies mid-1 > mid ①$

$mid-1 > mid < mid+1 \implies ①$ or ③

$lo = 0$
$hi = 4$

$mid = 2$

$lo = 3$
$hi = 4$

$mid = 3$

$Mid > Mid - 1$

③

$Mid < Mid + 1$

$lo = mid + 1$

$lo = 4$
$hi = 4$

$mid = 4$

$1, 2, 3$

$n-1$

0