Searching

- Linear Search
- Binary Search
  - Basic
  - non-sorted
  - real no.
  - ans
  - minimax search prob
  - maximal avg
  - graph X
- Ternary Search
- Input Search
- Problem Solving

Linear Search

target → 6

x ~~2~~ 2

[1, 3, 5, 7, 11, 13, 17, 19, -1, 6, 5]

Search Space → size → n

→ n-1

→ n-2

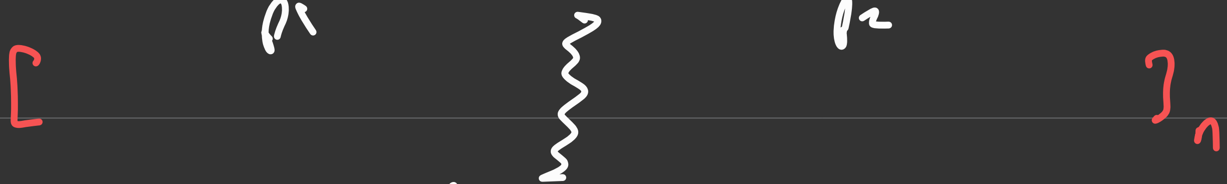
⋮

$$T(n) = T(n-1) + O(1)$$

↳ $\underline{\underline{O(n)}}$

Binary Search

Binary search says that if you have a search space of size n, then we can divide the space in $n/2$, by discarding one half of the space based on some property:



To search an element in an already sorted array, we can apply BS.

Why? Because, if we divide our array in 2 parts, one of the part will satisfy one of the following property.

- either all elements of the part are less
- or all the elements of the part are more

[~~1, 3, 5, 7, 11, 13, 17, 19~~, 23, 29, 31, 37, 41, 43, 47, 53]

lo mid hi

target = 37

$$T(n) = T\left(\frac{n}{2}\right) + O(1)$$

$$T(n) = \cancel{T\left(\frac{n}{2}\right)} + O(1)$$

$$\cancel{T\left(\frac{n}{2}\right)} = \cancel{T\left(\frac{n}{4}\right)} + O(1)$$

$$\cancel{T\left(\frac{n}{4}\right)} = \cancel{T\left(\frac{n}{8}\right)} + O(1)$$

$$\vdots$$

$$\cancel{T(2)} = T(1) + O(1)$$

$$T(n) = T(1) + k \times O(1)$$

$$n \to \frac{n}{2} \to \frac{n}{2^2} \ldots \frac{n}{2^k}$$

$$\frac{n}{2^k} = 1 \to k = \log_2 n$$

k terms

$$\to \vdots = \boxed{\frac{\cancel{n}}{2^k}}$$

$$\to O(\log n)$$

$$mid \rightarrow \frac{lo + hi}{2} = \frac{lo + hi + lo - lo}{2} = \frac{2lo + hi - lo}{2}$$

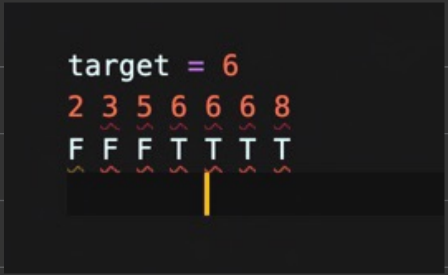
$$\frac{2lo}{2} + \frac{h - lo}{2} = lo + \frac{hi - lo}{2}$$

Q => Given a sorted array where elements can be repeated. Given a target element find the index of the first element that is greater than or equal to target. (or which is not less than target)

0	1	2				
10	20	30	30	30	40	50

↳ target → 30

ans → 2



```
target = 6
2 3 5 6 6 6 8
F F F T T T T
```

Q:) You are given a rotated sorted array

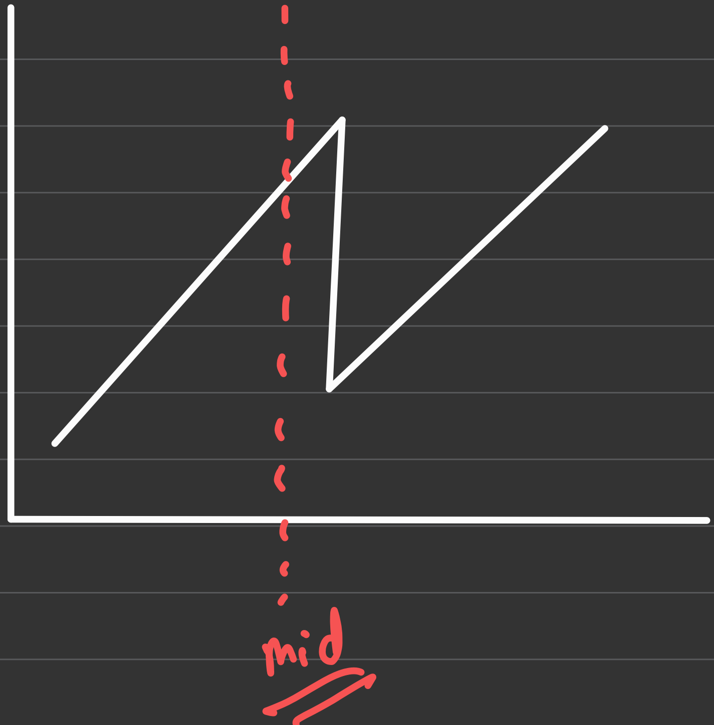
You rotated a sorted array. Given a
shifted
target find the index of target

6, 7, 9, 15, 19, 23

~~forget~~ →

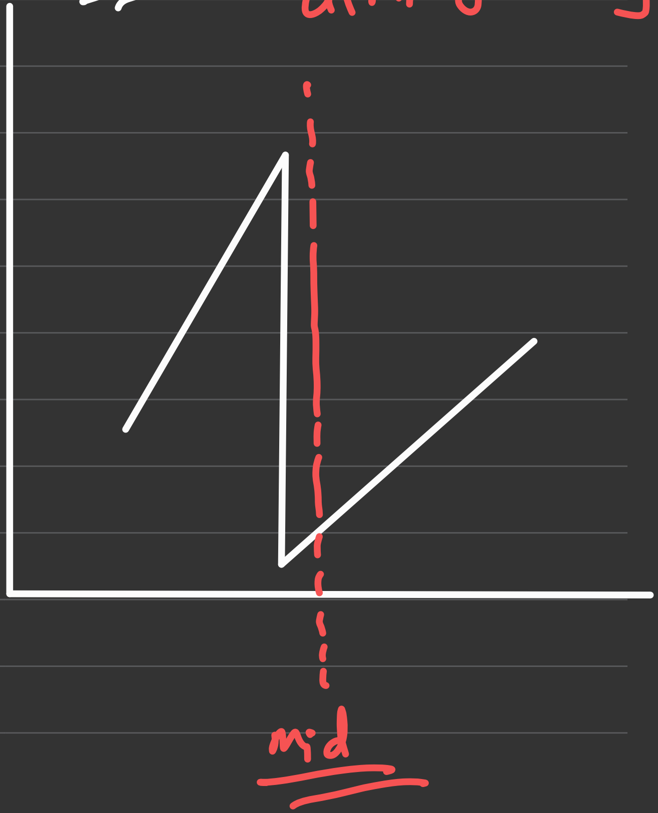
Case I

a[mid] > a[lo]



Case II

a[mid] < a[lo]



i 2 4 6 7 9 1

$\uparrow$ mid

$\boxed{2 < 6}$

ii 2, 4, 6, -15, -12, -5, -4, -3, -1

2 10, 12, 13, 14, 15, 2, 3, 4, 5, 6, 7, 8, 9

Q→ Given an array, find any one element in the array that follows the property.

$a[i] > a[i+1]$ (if $i+1$ exist)

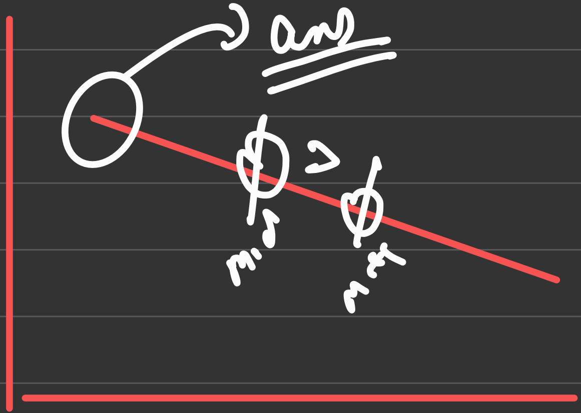
and

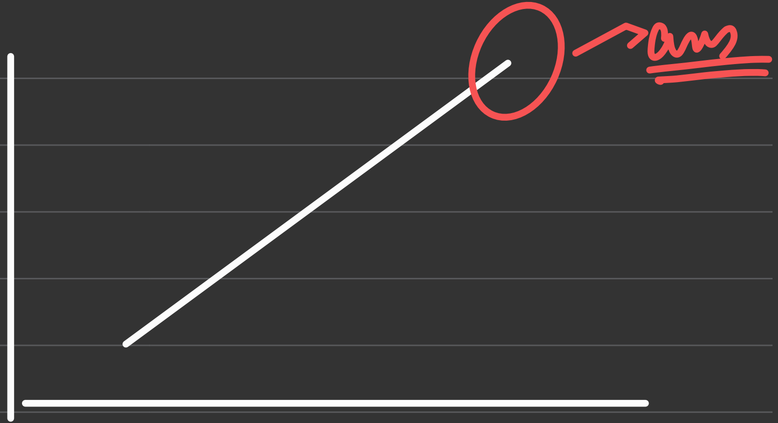
$a[i] < a[i-1]$ (if $i-1$ exist)

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

5 ans

$3 < 5 > 6$



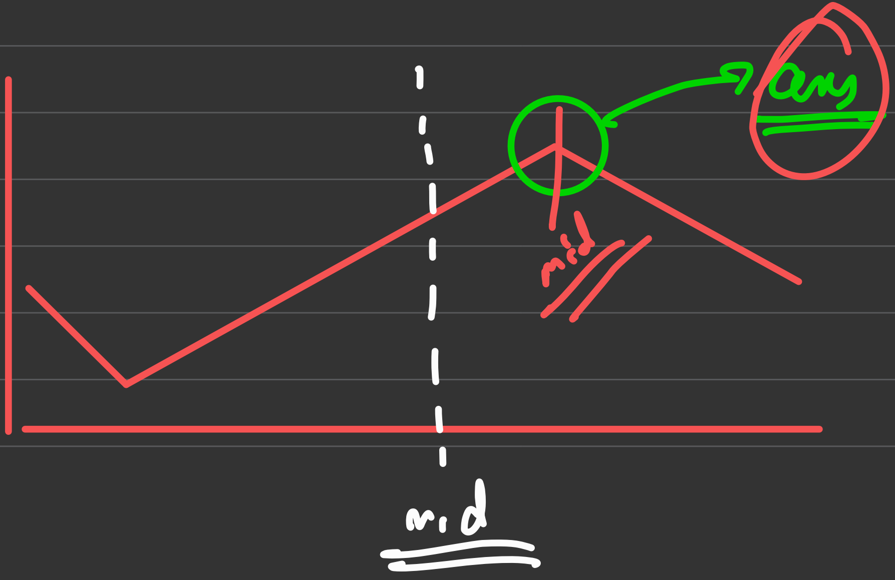


a[mid] < a[mid+1]

↳ inc

else

↳ dec



Q: [1 2. 3 . - - - - - - n]

→ Given n:

→ assume, you already have a fun isbad(i) return while it is a bad version or not.

→ [T T T T T T T F F F F F F]

$n = 2^{31}$

lo = 1 } hi = n

mid → isbad(mid)