

# Magic Index

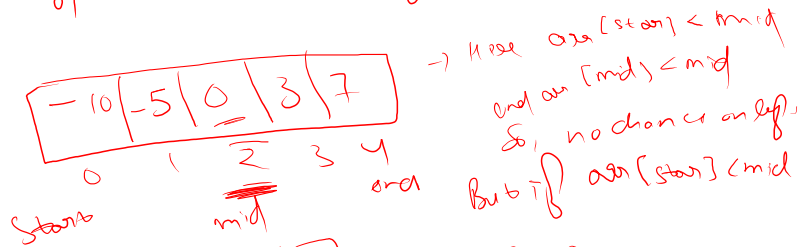
Example  $\rightarrow \{-10, -5, 0, \boxed{3}, 7\}$

$\rightarrow$  Magic Index is an index where  $\text{arr}[i] = i$   
like in the example  $\rightarrow \text{arr}[3] = 3$

Brute force  $\rightarrow$  Linear search when found output is 6.

$$T(n) = O(n)$$

Optimally, we can use Binary search.



$-10, -5, 2, 2, 2, \boxed{3}, 4, 7, 9, 12, 13$   
 $0 \quad 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9 \quad 10$   
 $\text{arr}[5] = 3$   
in this case we know  
 $5 > 3$  so,

$\rightarrow$  obviously at index 4 value will  $\geq 3$  so,  
there is no chance of finding anything there  
so go and search from  $\text{arr}[3]$ ,  
compare 4 and  $\text{arr}[\text{mid}]$   
similarly for  
bigger

Consider the  $\text{arr}[] = \{-10, -5, 2, 2, 2, 3, 4, 7, 9, 12, 13\}$ ,  $\text{arr}[\text{mid}] = 3$

If elements are not distinct, then we see  $\text{arr}[\text{mid}] < \text{mid}$ , we cannot conclude which side the fixed is on.

It could be on left side or on the right side.

We know for sure that since  $\text{arr}[5] = 3$ ,  $\text{arr}[4]$  couldn't be magic index because  $\text{arr}[4]$  must be less than or equal to  $\text{arr}[5]$  (the array is Sorted).

So, the general pattern of our search would be:

- Left Side:  $\text{start} = \text{start}$ ,  $\text{end} = \min(\text{arr}[\text{midIndex}], \text{midIndex} - 1)$
- Right Side:  $\text{start} = \max(\text{arr}[\text{midIndex}], \text{midIndex} + 1)$ ,  $\text{end} = \text{end}$