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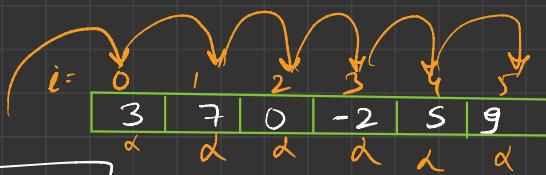
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## Binary Search

→ Linear Search →  $n - \text{size}$   
worst case →  $n$  comparison



array → 1000 values  
L.S. → worst case

Key = 2 → absent / Not found

1000 comparison

for ( $0 \rightarrow n$ )

T.C  
 $O(n)$

if ( $\text{arr}[i] == \text{key}$ )

return  $i;$

}

}

return -1;

# Binary Search

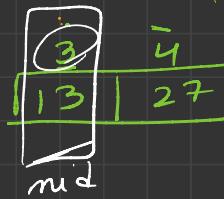
Condition  
Element should be in monotonic function

0	1	2	3	4
3	5	9	13	27

Ex:

- ① find mid
- ② compare mid / key
- ③ = → return index  
! = part decide

Key = 13



$$\begin{aligned} \text{mid} &= \frac{(s+e)}{2} \\ &= \frac{(3+4)}{2} \\ &= \frac{7}{2} = 3 \end{aligned}$$

$$13 == 13$$

True → return Index

ans = 3

0	1	2	3	4	5
3	7	11	13	19	27

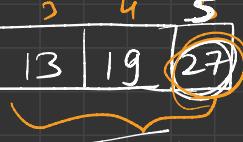
$$key = \underline{\underline{27}}$$

$$\text{mid} = \left( \frac{s+c}{2} \right) = \left( \frac{0+5}{2} \right) = \frac{5}{2} = 2$$

$$(11) = 27$$

$$27 > 11$$

3	4	5
13	19	27


  
 → mid  
 → compare  
 → F → Return  
 = ! = part click

$$(19) = 27$$

$$27 > 19$$

$$\text{mid} = \left( \frac{3+5}{2} \right) = \frac{8}{2} = 4$$

5
27

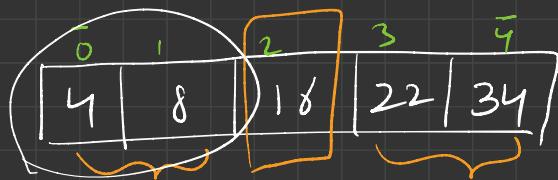
$$\text{mid} = \left( \frac{s+c}{2} \right) = \left( \frac{5+5}{2} \right) = 5$$

$$27 == 27$$

Time  
↓

return 5

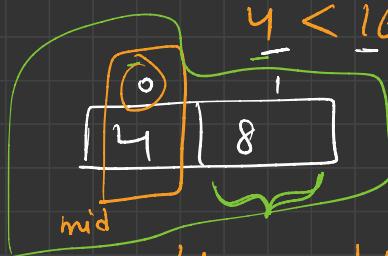
ans = 5



Key  
4.

$$\text{mid} = \left( \frac{s+e}{2} \right) = \frac{4+8}{2} = 6$$

$$16 > 4$$



$$\text{mid} = \left( \frac{s+e}{2} \right) = \frac{0+1}{2} = 0$$

$$4 < 16$$

$$4 = 4$$

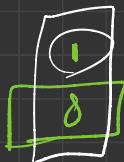
↳ TRUE

return 0;

Key 8  
4! = 8

8 > 4

$\boxed{\text{ans} = 0}$



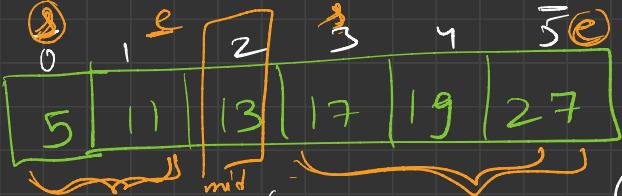
$$\text{mid} = \left( \frac{s+e}{2} \right) = \left( \frac{0+1}{2} \right) = 0.5$$

$$8 = 8$$

↳ TRUE

return 1;

$\boxed{\text{ans} = 1}$



$$\text{mid} = \left( \frac{s+c}{2} \right) = \left( \frac{0+5}{2} \right) = \frac{5}{2} = 2$$

$s = \text{mid} + 1$

$\text{key}$   
25

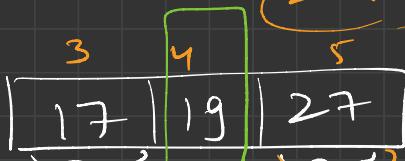
$c = \text{mid} - 1$

$|13| = 25$

$25 > 13$

$\text{left} \rightarrow c = \text{mid} - 1$

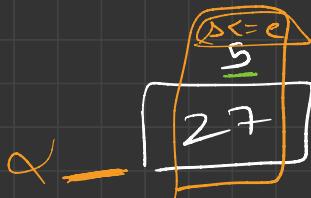
$\text{right} \rightarrow s = \text{mid} + 1$



$$\text{mid} = \left( \frac{s+c}{2} \right) = \left( \frac{3+5}{2} \right) = \frac{8}{2} = 4$$

$|19| = 25$

$25 > 19$



$s > c \alpha$

$$\text{mid} = \left( \frac{s+c}{2} \right) = \left( \frac{5+5}{2} \right) = 5$$

$|27| = 25 \times$

$25 < 27$

$\Rightarrow \text{return } -1$

NOT FOUND

$$s = 0, \quad e = n - 1$$

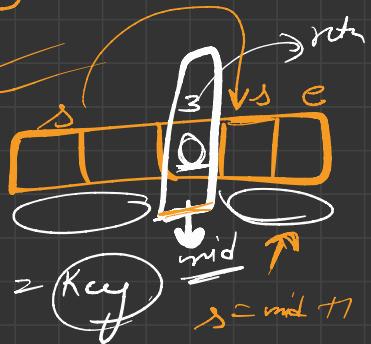
$$\text{mid} = \left( \frac{s+e}{2} \right)$$

$\sqrt{d}$   $\sqrt{t}$        $\rightarrow s \leq \text{end}$  /  $s \leq e$

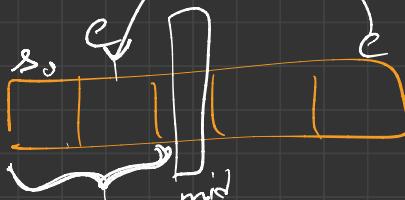


while ( $s \leq e$ )

if  $\text{arr}[mid] = \text{key}$



$\hookleftarrow$



$\text{key} < \text{arr}[mid]$

$\hookleftarrow$

left

?  $e = \text{mid} - 1$

$\text{mid} = \left( \frac{\text{start} + \text{end}}{2} \right)$

$$mid = \left( \frac{\underline{start} + \underline{end}}{2} \right)$$

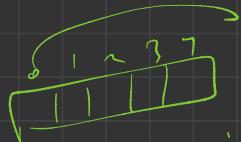
$$\text{int} \rightarrow \boxed{2^{31} - 1}$$

$$\text{start} = \boxed{2^{31} - 1}$$

$$\text{end} = \boxed{2^{31} - 1}$$

Value  
↓

Int says  
k button



$$mid = \left( \frac{s+e}{2} \right)$$

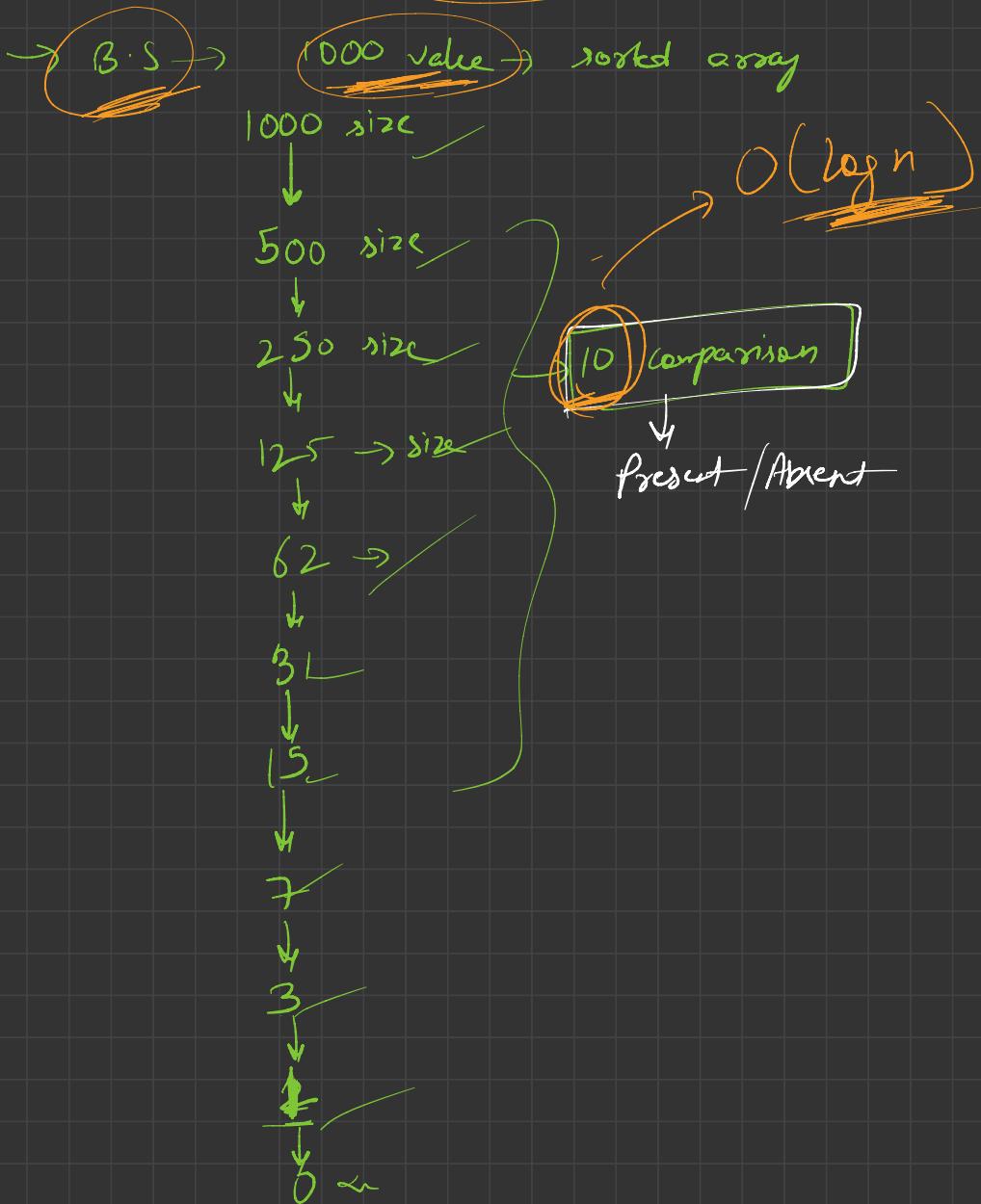
$$\Rightarrow \boxed{s + \left( \frac{e-s}{2} \right)}$$

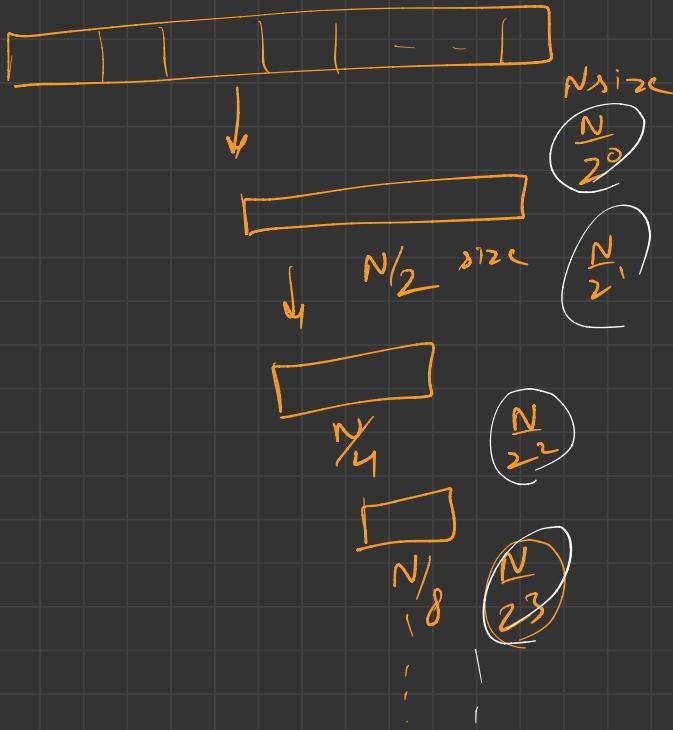
Chaloki'

$$= s + \frac{e}{2} - \frac{s}{2}$$

$$= \frac{s}{2} + \frac{e}{2} = \boxed{\left( \frac{s+e}{2} \right)}$$

$\rightarrow L.S \rightarrow$  ~~1000 values~~ → array  
Worst case  $\rightarrow$  ~~1000 comparison~~ →  $O(n)$





$$\frac{N}{2^K} = 1$$

$$N = 2^K$$

$$K = \log N$$

$O(\log N)$

Rotated  
S.

Stack up

Area low

ROT

PRATA

Book