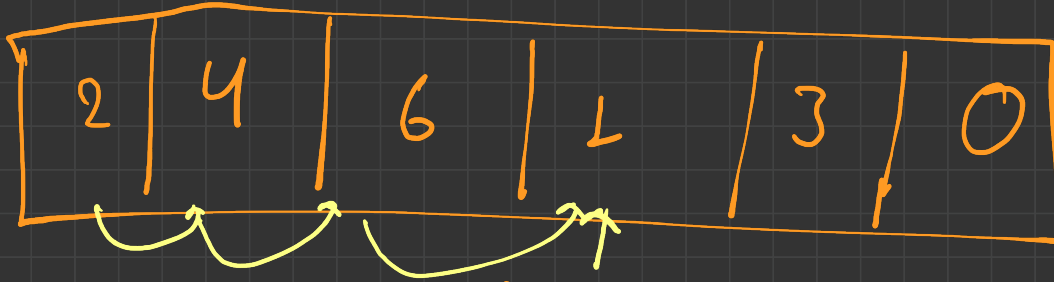


Day - 23

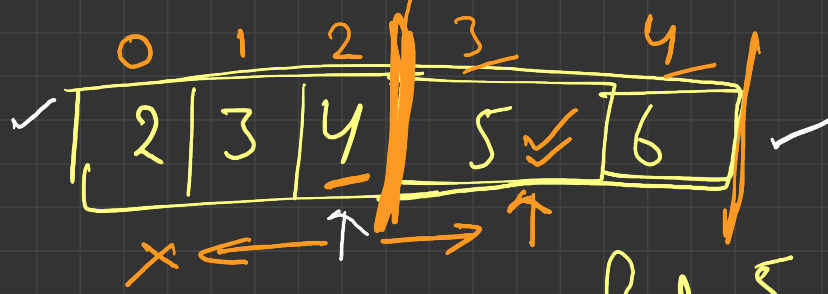
Binary Search



find = 1 ?

$O(n)$

Example



$$\frac{0+4}{2} = \frac{4}{2} = 2$$

$$\underline{2}$$

$$\text{find} = \underline{5}$$

$$\Rightarrow \underline{3}$$

$$\frac{3+4}{2} = \frac{7}{2}$$

$$= \underline{3}$$

M.I =

$$\frac{\text{1st index} + \text{last index}}{2}$$

0	9	10	14	15	18	<u>28</u>	46	48	<u>49</u>	<u>50</u>	<u>61</u>	72
0	1	2	3	4	5	6	7	8	9	10	11	12
			X			X						

X ← (from index 3 to 6)
 X ↑ (at index 6)
 → ✓ (from index 7 to 8)
 X ← (from index 8 to 7)
 ↑ (at index 9)
 → (from index 9 to 10)
 ↑ (at index 11)
 → (from index 11 to 12)
 X (at index 12)

$$\frac{0 + 12}{2} = 6$$

$$\frac{7 + 12}{2} = \frac{19}{2} = 9.5 = 9$$

$$\frac{10 + 12}{2} = \frac{22}{2} = 11$$

$$\frac{10 + 10}{2} = 10$$

find = ~~28~~ 51

50

✓

$$50 = 51$$

X

2	4	6	7	10
0	1	2	3	4

$$\text{find} = 7$$

$$\frac{0+4}{2} = 2$$

$$\text{start} = 0$$

$$\text{end} = 4$$

$$\textcircled{1} \text{ mid} = \frac{\text{start} + \text{end}}{2}$$

$$\textcircled{2} \text{ if (arr[mid] == element)}$$

$$\text{cout} << \text{"find"};$$

Break;

else if (arr[mid] < element)

move to right side $\text{start} = \text{mid} + 1$

else move to left side

$$\text{end} = \text{mid} - 1$$

start = 0

end = n-1

while (start <= end) {

mid = $\frac{\text{start} + \text{end}}{2}$

if (arr[mid] == element) {

cout << "Found";

break;

else if (arr[mid] < element) {

start = mid + 1 }

else

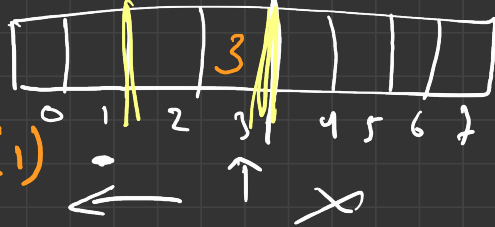
end = mid - 1

$$\frac{N}{2} \rightarrow \frac{N}{2} = 1 \text{ step}$$

$$\frac{N}{4} = 1 \text{ step } 2+1=3$$

$$\frac{N}{2^n} = 1 \text{ step}$$

Best $\rightarrow O(1)$
 $\Rightarrow O(1)$



Arg $\rightarrow O(\log N)$

$$\frac{O(\log N)}{O(\log N)} = 1$$

$x+1$ step

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

$$N = 2^n$$

$$\log N = x \log 2$$

$$x = \frac{\log N}{\log 2} = \log_2 N$$

$$O(\log_2 N)$$

$$\text{mid} = \frac{\text{start} + \text{end}}{2}$$

$$\text{mid} = \frac{\text{end} + \frac{\text{start} - \text{end}}{2}}{2}$$

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

$$\frac{2^{20} + 2^{30}}{2}$$

$$\text{mid} = \frac{2}{2} \quad \text{start} = 0$$

$$\text{end} = 8$$

$$\text{mid} = \text{start} + \frac{\text{end} - \text{start}}{2}$$

$$\frac{1+7}{2} = 4 \quad \frac{0+8-0}{2}$$

$$= 4$$

$$\frac{0+8}{2} = 4$$

$$\frac{1+7-1}{2} = \frac{1+3}{2} = 4$$

32 23 12 11 10 9 8 7 1 0 -1

