



Binary Search.

sorted array ,

size of the array

search { target }

TC: $O(\log_2 N)$
SC: $O(1)$

- o define range of search
- o divide the range into 2 half
- o eliminate one , and try finding in another

Search Insert position

int[] arr = { 0 1 2 3 4 5 6 7
1, 2, 4, 7, 10, 11, 13, 20 }

ele = 5

first ele. longer than given ele.
return its position

Brute Force

✓ T.C: O(N)
S.C: O(1)

```
for (int i = 0 → n)
{
    if (arr[i] > ele)
        return i;
}
return n;
```

arr = { 1, 3, 5, 6, 7, 10, 13, 20 }

$$\frac{0+7}{2} = 3$$

ele = 2

↑
e_i
↑
mid

just greater value in the array.
cell value of the given ele.

✓ 0 ideal condition for BS

pass = ~~X~~ ~~X~~ 1

{ 0/1, 1/2, 2/5, 3/7, 4/10, 5/11, 6/15 }

ele = 12

↑
ei

↑
si

just greater person

Case 1:

arr[mid] == ele
↑
mid
=

TC: $O(\log N)$
SC: $O(1)$

Case 2:

arr[mid] > ele

ei = mid - 1;
ps = mid;

Case 3:

arr[mid] < ele

si = mid + 1;

find first and last pos.

$\{1, 2, 5, 9, 10\}$

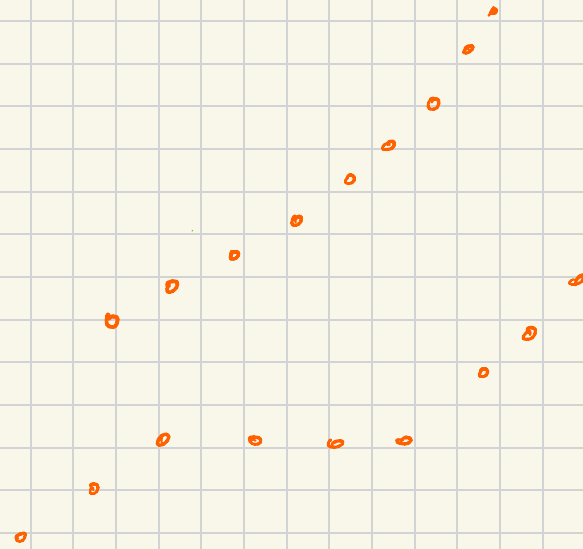
$\{1, 2, 3, 3, 3, 4, 5, 5\}$

diff bet¹⁰

① increasing

② Non-decreasing

}



$\text{int[]} \text{arr} = \{ \overset{0}{1}, \overset{1}{2}, \overset{2}{2}, \overset{3}{3}, \overset{4}{4}, \overset{5}{5}, \overset{6}{5}, \overset{7}{5}, \overset{8}{5}, \overset{9}{6}, \overset{10}{7}, \overset{11}{8}, \overset{12}{9}, \overset{13}{9} \}$

$\text{ele} = 5$

Brute Force

$\text{O}(n)$
2

for (int i = 0 → n)
{

✓

$\text{TC: } \text{O}(n)$
 $\text{SC: } \text{O}(1)$ } ✓

}

{ 0 1 2 3 4 5 6 7 8 9 10
~~1~~, ~~2~~, ~~2~~, ~~2~~, ~~2~~, 3, 4, 5, 5, 6, ~~7~~ }

ok = 2

↑
 a_i

↑
 s_i

↑
 mid

$f_0 = \cancel{2} 1 \checkmark$

find, the ele.

once found, try on the left side

Square root of a number

~~Math.sqrt()~~
Can't use
clear?

$$N = 36$$

$$\text{sqrt}(N) = 6$$

$$N = 100$$

$$\text{sqrt}(100) = 10$$

$$N = 90$$

$$\text{sqrt}(90) = 9$$

$$N = 20$$

$$\text{sqrt}(20) = 4$$

Brute Force

```
for(int i = 1; i <= N/2; i++)  
{  
    if (i * i <= N)  
        pairs = i;  
}
```

TC: $O(N)$
SC: $O(1)$

for (int i = 1; i * i <= N; i++)
{
 pairs = i;
}

$O(\sqrt{N})$
 $O(1)$

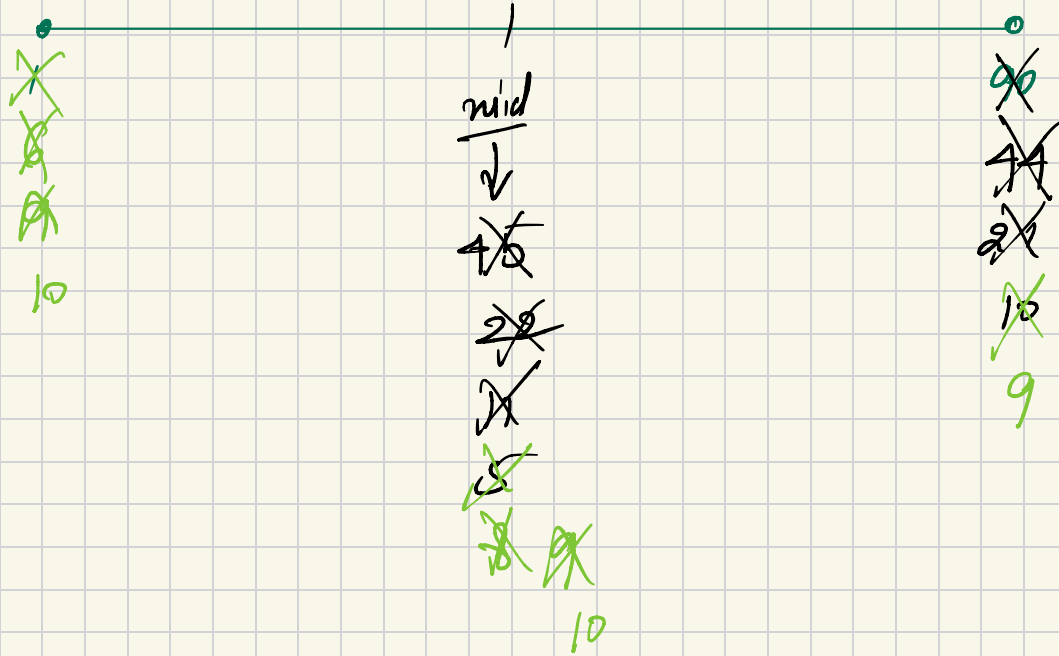
1, 2, 3, ..., \sqrt{N}

$$N = 90$$

pans = ~~\$~~ ~~\$~~ 9 ✓

$$TC: O(\log_2(N))$$

SC:OCID



$$N = 10^8$$

$$\text{sqrt}(N) = \sqrt{10^8}$$

$$O(1) < \log_2 N < \sqrt{N} < N < N^2 < N^3 < N^4 < 2^N$$

$$\log_2(10^8) = 8 \times \log_2 10^{3.1}$$

$$= 27.8$$

$$\approx \boxed{28}$$

$$\log_2(10^4)$$

$$4 \times 3.1$$

$$\approx 13$$

$$\sqrt{\log_2(10^8)}$$

$$8 \times 3.1$$

$$\approx 25$$
