2^{100}

4096 → 12 2^{12}

2048 → 11

1024 → 10

512 → 9

256 → 7

128 → 7

64 → 6

32 → 5

16 → 4

8 → 3

4

2

1

4294967296

10^{12}

1 sec

10^6 10^6

$1 . 10^6$

[3, 4, 6, 7, 10, 12, 14, 17]
0 1 2 3 4 5 6 7

target = 12

Ans = 5

n = 1000

n = 1000

20

8

(n)

Linear search

```
for(i=0; i<n; i++){
  if(arr[i] == target){
    return i
  }
}
```

Binary Search → sorted

[3, 4, 6, 7, 10, 12, 14, 17]
0 1 2 3 4 5 6 7

l r l mid

target = 9

```
while( l <= r){
  ·) Mid
  Cases
  I  ↳ arr[mid] > target
        r = mid - 1
  II ↳ arr[mid] < target
        l = mid+1
  III ↳ arr(mid) == target
        return mid
}
```

target = 7

[10, 20, 30, 40, 50, 60, 70, 80, 90, 123, 144, 456];
0 1 2 3 4 5 6 7 8 9 10 11

r l mid

ceil = 10

```
w (l<=r)
  arr[mid] = target
    return mid
  arr[mid] < target
    l = mid+1
  arr(mid) > target
    r = mid-1
    ceil = arr(mid)
```

First Occurence

[1, 1, 1, 1, 1, 2, 2, 2, 2, 3, 4, 4, 4, 4, 4, 4, 4, 4, 7, 7]
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

l mid

target = 4

ans = 10

$\frac{10+10}{2} = \frac{20}{2} = 10$

```
arr(mid) == target
  ans = mid
  r = mid - 1
arr(mid) > target
  r = mid - 1
arr(mid) < target
  l = mid+1
```