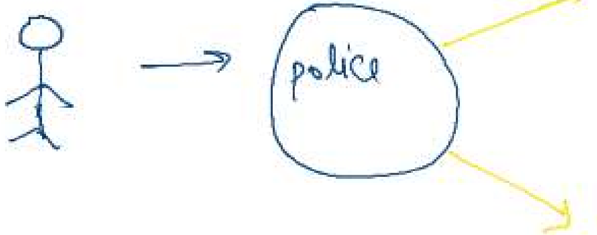
Binary Search



identity (target) ⇒ To be searched

last location (searching space)

Linear Search

arr =

0	1	2	3	4	5	6
1	6	3	6	5	8	9

~~i~~ ~~i~~ ~~i~~ ~~i~~ i ⇓

$\boxed{i = 4 \text{ return}}$

target = 5

TC = O(n)

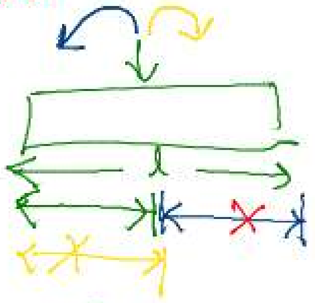
Binary Search

target = 'good'

"sparrow"

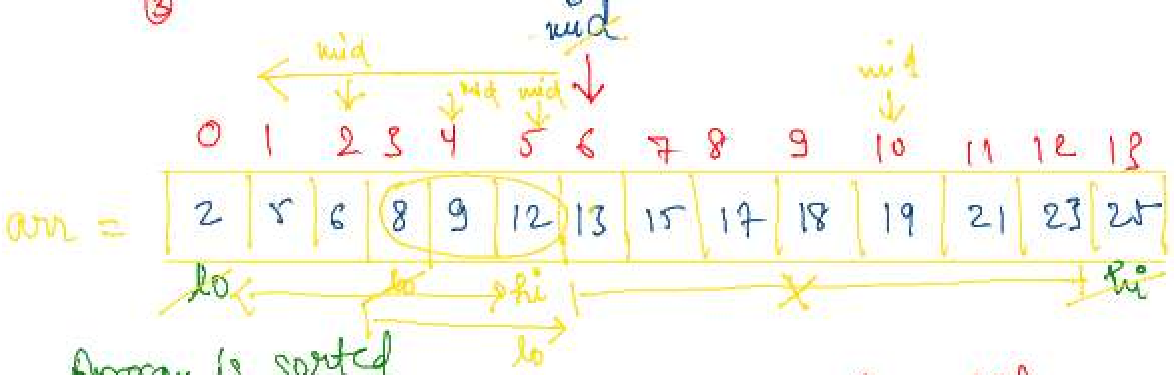
Dictionary →

l ↑



1. greater = left
2. equal = return i (index)
3. smaller = Right

mid



arr =

0	1	2	3	4	5	6	7	8	9	10	11	12	13
2	5	6	8	9	12	13	15	17	18	19	21	23	25

Array is sorted

target = 12

```
while (lo<=hi){
    mid = (lo+hi)/2
    if( arr[mid] == target){
        sysо( mid);          → 5
        return;
    } else if( arr[mid] > target){
        hi = mid-1;
    } else {
        lo = mid+1;
    }
}
```

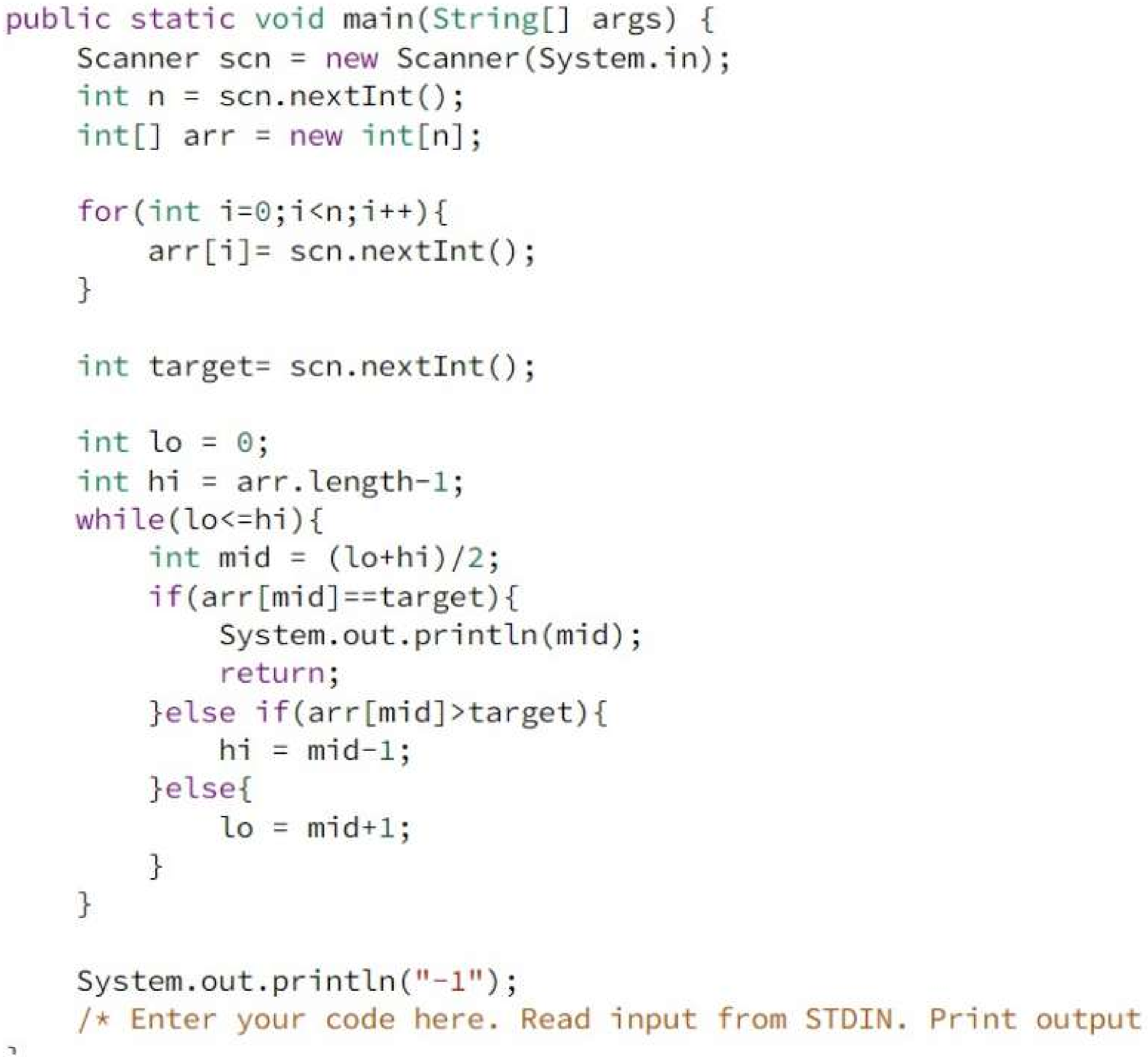
n
| 1 compai.
n/2
| 1 comparisn
n/2x2
| 1 com
n/8
:
1 element

TC = (log n)

BS — ① Your data have some internal functionily so that you will be able to discard half of your searchspace by only one comparison, Then you can apply B.S.

Question

Binary Search



```java
public static void main(String[] args) {
    Scanner scn = new Scanner(System.in);
    int n = scn.nextInt();
    int[] arr = new int[n];

    for(int i=0;i<n;i++){
        arr[i]= scn.nextInt();
    }

    int target= scn.nextInt();

    int lo = 0;
    int hi = arr.length-1;
    while(lo<=hi){
        int mid = (lo+hi)/2;
        if(arr[mid]==target){
            System.out.println(mid);
            return;
        }else if(arr[mid]>target){
            hi = mid-1;
        }else{
            lo = mid+1;
        }
    }

    System.out.println("-1");
    /* Enter your code here. Read input from STDIN. Print output
}
```

Question

Square Root

BS < target = √79
search space

400 > 79

1600 > 79

4*4 < 79

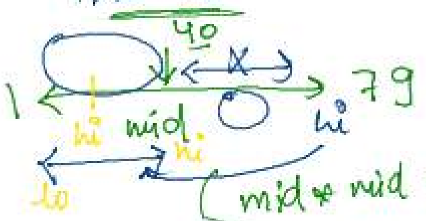
16 < 79

5*5 < 79

6x6 < 79

n = 79

ans =



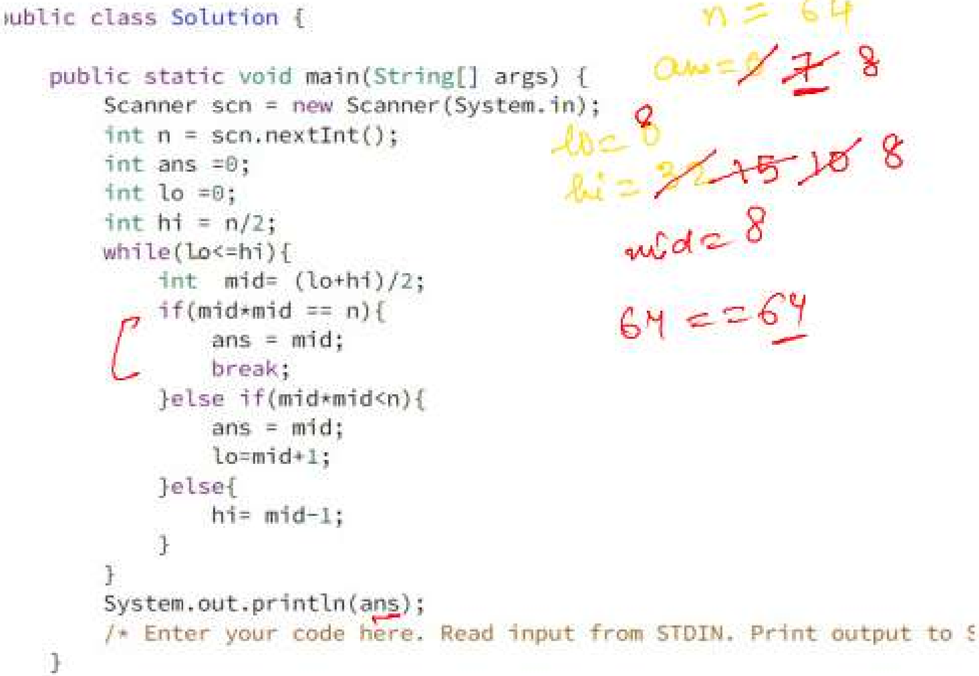
(mid * mid == n){
Sysn( );
retun

10*10 > 79

5*5 < 79

}
(mid * mid < n){
ans = mid ;
lo = mid+1;
}else{
hi = mid-1;
}

n = 64
ans = ~~0~~ ~~7~~ 8
lo = 8
hi = ~~32~~ ~~15~~ ~~10~~ 8
mid = 8
64 == 64



```
ublic class Solution {

    public static void main(String[] args) {
        Scanner scn = new Scanner(System.in);
        int n = scn.nextInt();
        int ans =0;
        int lo =0;
        int hi = n/2;
        while(lo<=hi){
            int  mid= (lo+hi)/2;
            if(mid*mid == n){
                ans = mid;
                break;
            }else if(mid*mid<n){
                ans = mid;
                lo=mid+1;
            }else{
                hi= mid-1;
            }
        }
        System.out.println(ans);
        /* Enter your code here. Read input from STDIN. Print output to S
    }
```

Question

ch= d

arr = [a b c d e f]

ans = e

m -1 4

ch= c

mid mid

0 1 2 3 4 5

[a b c d e f]

~~lo~~ hi lo ~~hi~~

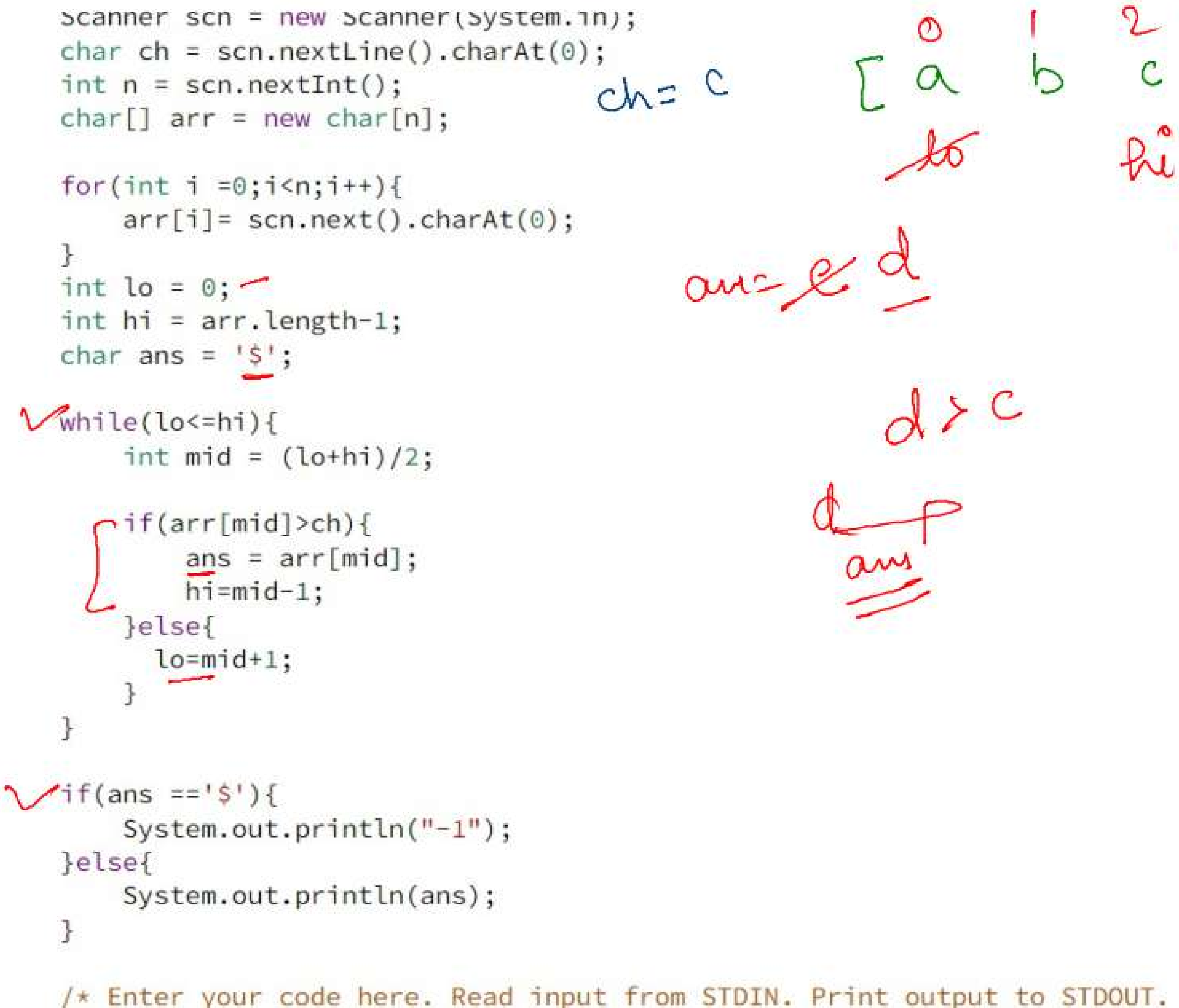
c < c

ans= ~~e~~ d

d > c e > c

d P

ans



```
Scanner scn = new Scanner(System.in);
char ch = scn.nextLine().charAt(0);
int n = scn.nextInt();
char[] arr = new char[n];

for(int i =0;i<n;i++){
    arr[i]= scn.next().charAt(0);
}
int lo = 0;
int hi = arr.length-1;
char ans = '$';

while(lo<=hi){
    int mid = (lo+hi)/2;

    if(arr[mid]>ch){
        ans = arr[mid];
        hi=mid-1;
    }else{
      lo=mid+1;
    }
}

if(ans =='$'){
    System.out.println("-1");
}else{
    System.out.println(ans);
}

/* Enter your code here. Read input from STDIN. Print output to STDOUT.
```