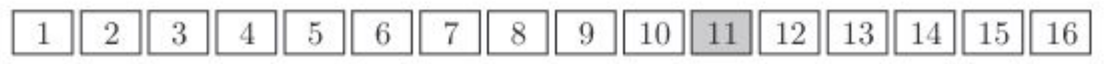
Binary Search

Do Now

I would like to find the index where number 11 in stored in this array

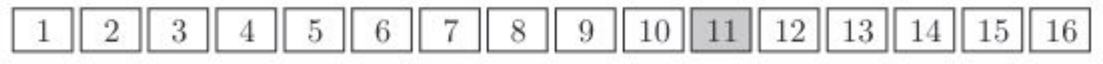


1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

How would you do it?

Do Now

Let's imagine this game, the computer selects an integer value between 1 and 16 and our goal is to guess this number with a minimum number of questions. For each guessed number the computer states whether the guessed number is equal to, bigger or smaller that the number to be guessed.



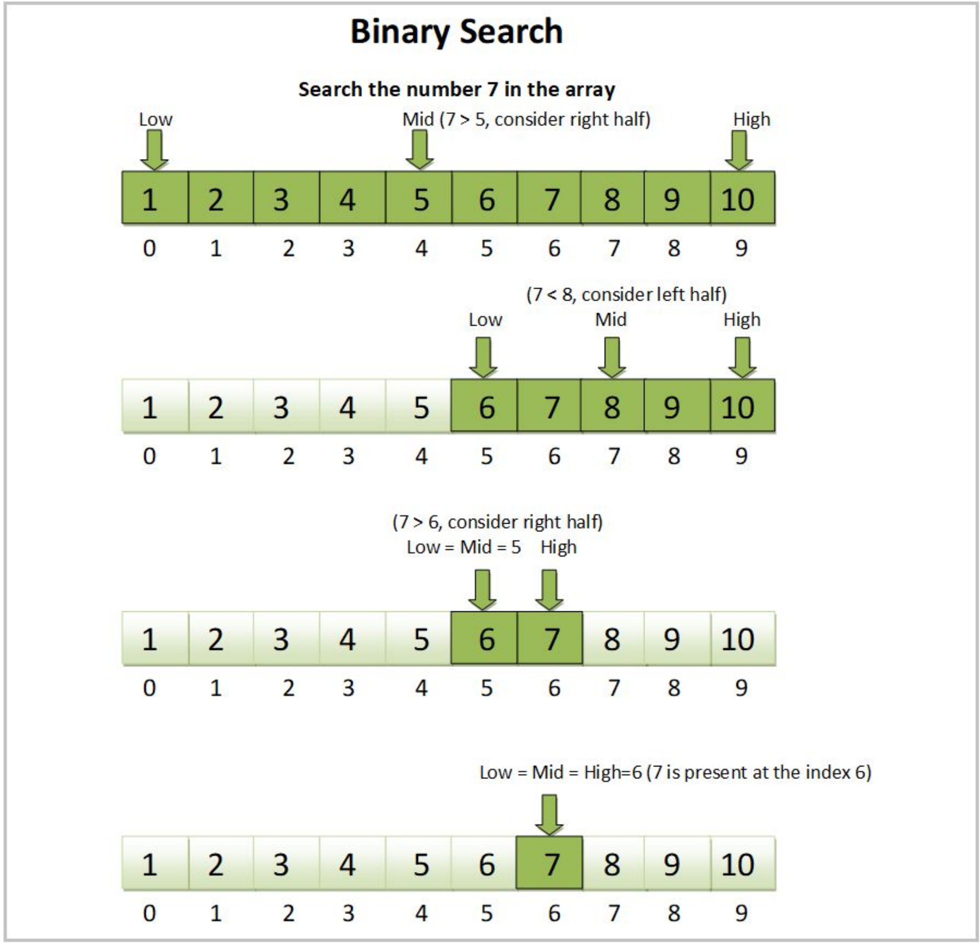
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

How would you do it?

Binary Search

It is an algorithm used to find a target value within a sorted list.

It repeatedly divides the search interval in half.



What values do we need implement the algorithm?

We need two variables:

- Pointer to the beginning of the list
- Pointer to the end of the collection

Binary Search - Algorithm

1. Set the **low** pointer to the beginning of the array (index 0).
2. Set the **high** pointer to the end of the array (array.length - 1).
3. While the **low** is less than or equal to the **end** pointer, repeat these steps:
    a. Calculate the middle element index: **mid = low + (high - low) / 2**.
    b. Compare the value at middle index (**mid**) with the target value.
        - If **arr[mid] i**s equal to the target value, return **mid** (search successful).
        - If **arr[mid]** is less than the target value, set the **low** to **mid + 1.**
        - If **arr[mid]** is greater than the target value, set the **high** to **mid - 1.**
4. If the **low** pointer becomes greater than the **high** pointer, the target value is not in the collection. Return **-1** to indicate that the target is not present.

Coding Time!!!

```
public static int binarySearch(int[ ] arr, int low, int high, int target){
        // Solution should be recursive
}
```

Save your work here:
.../APCSA1/apcsa-assignments-fall-YourUsername/classwork/01_08_binary_search/BinarySearch.java

Time Complexity

Average Case:	O(log n)
Worst Case:	O(log n)
Best Case:	O(1)