

Design Analysis and Algorithm

Binary Search

Submitted by

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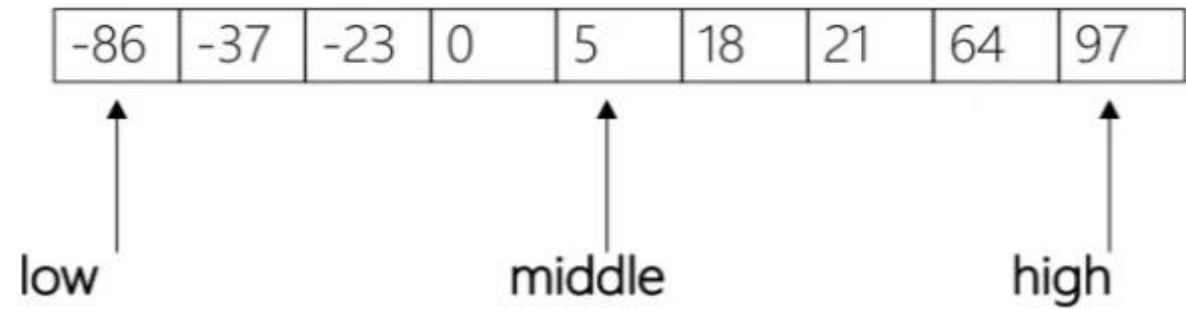
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What is Binary Search?

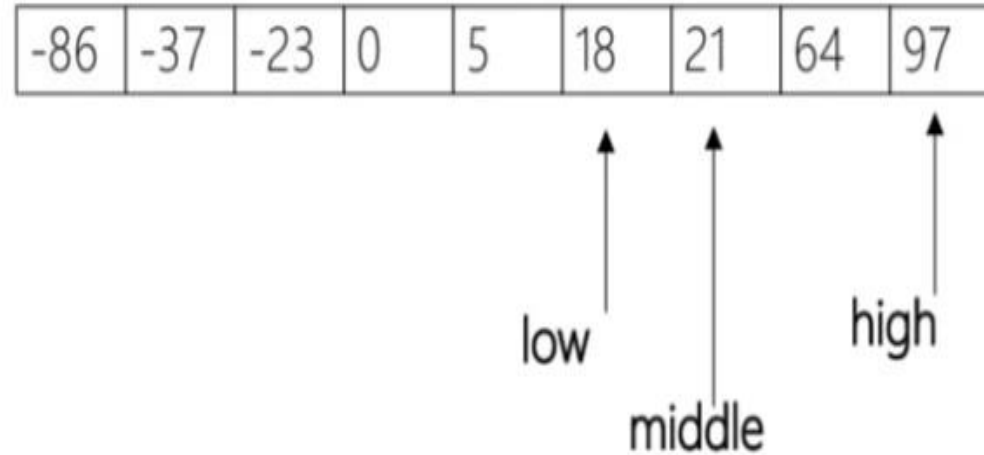
- A binary search is an advanced type of search algorithm that finds and fetches data from a sorted list of items.
- Its core working principle involves dividing the data in the list to half until the required value is located and displayed to the user in the search result.

How binary search works?



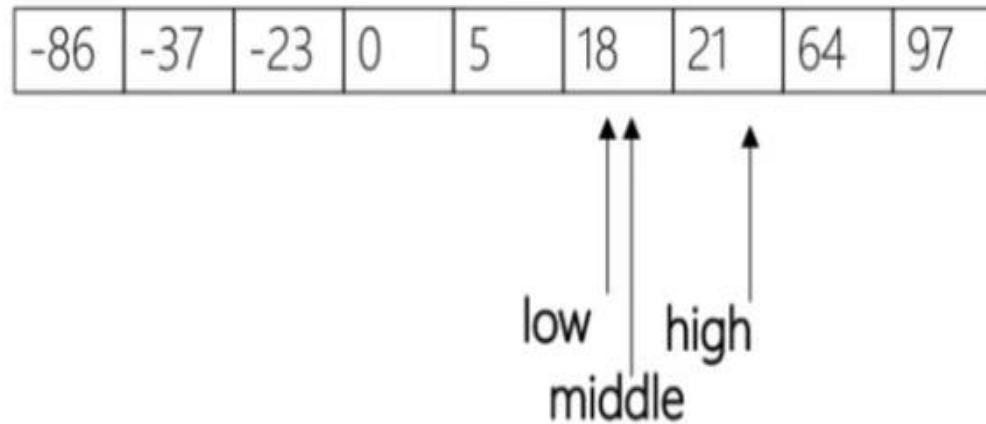
Searching for 18.

How binary search works?



Searching for 18.

How binary search works?



Searching for 18: found!

Time Complexities

- Best case complexity: $O(1)$
- Average case complexity: $O(\log n)$
- Worst case complexity: $O(\log n)$

Space Complexity

The space complexity of the binary search is $O(1)$.

Binary search Implementation:

```
1 #include<stdio.h>
2 int main() {
3     int c, first, last, middle, n, search, array[100];
4     printf("Enter number of elements:\n");
5     scanf("%d",&n);
6     printf("Enter %d integers:\n", n);
7     for (c = 0; c < n; c++)
8         scanf("%d",&array[c]);
9     printf("Enter the value to find:\n");
10    scanf("%d", &search);
11    first = 0;
12    last = n - 1;
13    middle = (first+last)/2;
14    while (first <= last) {
15        if (array[middle] < search)
16            first = middle + 1;
17        else if (array[middle] == search) {
18            printf("%d is present at index %d.\n", search, middle+1);
19            break;
20        }
21        else
22            last = middle - 1;
23        middle = (first + last)/2;
24    }
25    if (first > last)
26        printf("Not found! %d is not present in the list.\n", search);
27
28    return 0;
29 }
30
```

Binary search in C program Output:

```
Enter number of elements:  
5  
Enter 5 integers:  
1  
7  
24  
29  
48  
Enter the value to find:  
24  
24 is present at index 3.
```


Advantages of binary search

- It is better than a linear search algorithm since its run time complexity is $O(\log N)$.
- At each iteration, the binary search algorithm eliminates half of the list and significantly reduces the search space.
- The binary search algorithm works even when the array is rotated by some position and finds the target element.



Thank you!