PROGRAMMING FOR PROBLEM SOLVING -- PPS

SUBJECT CODE- BTPS-101-18

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PPS SYLLABUS

Unit 4

Basic Algorithms (6 lectures)

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

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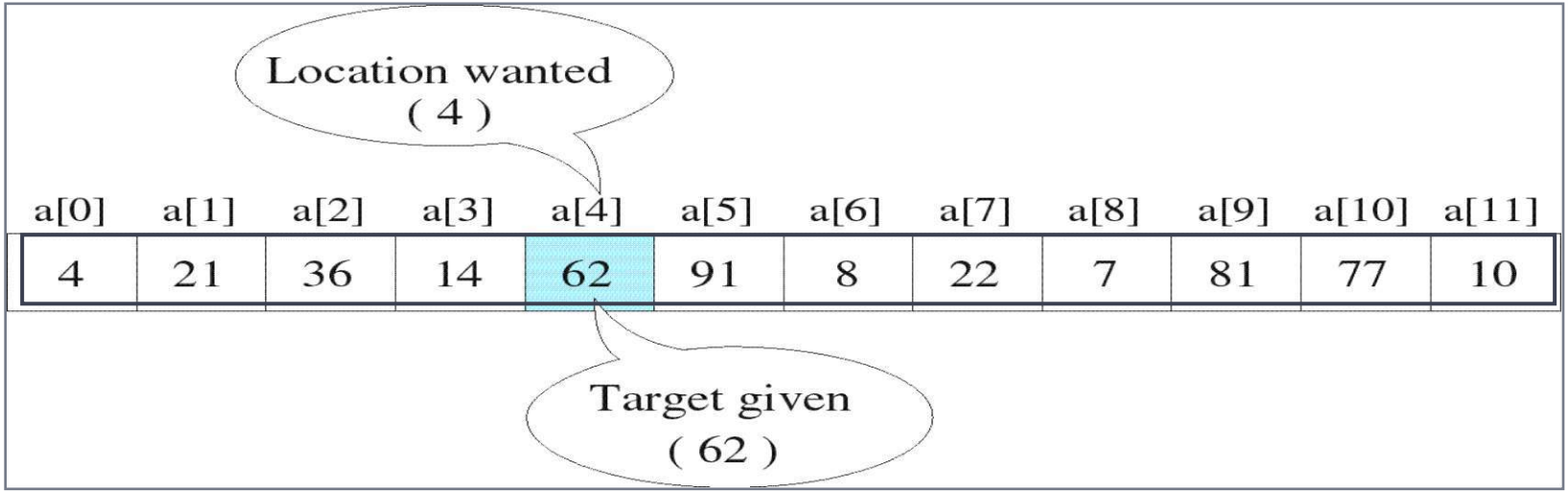
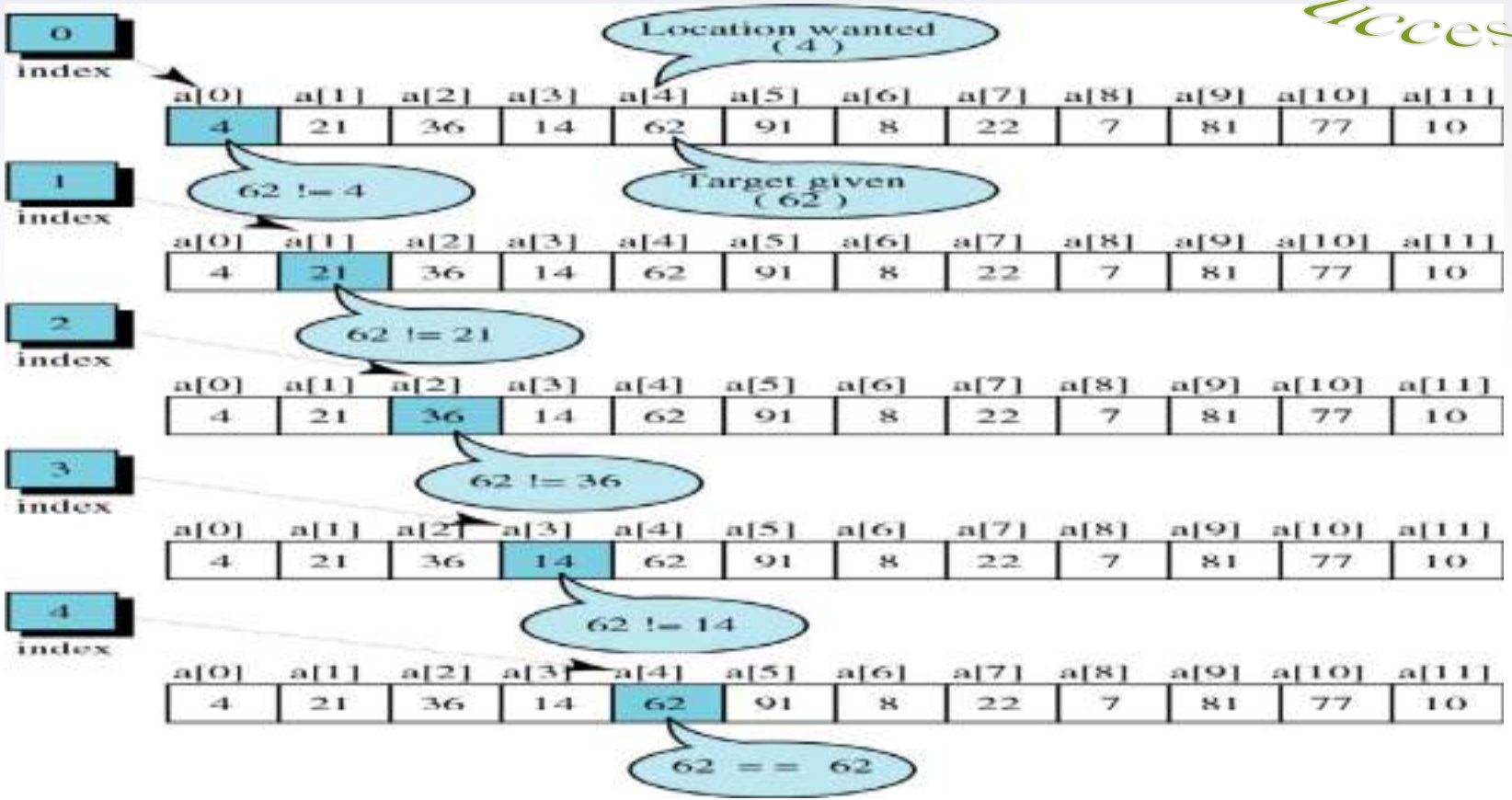
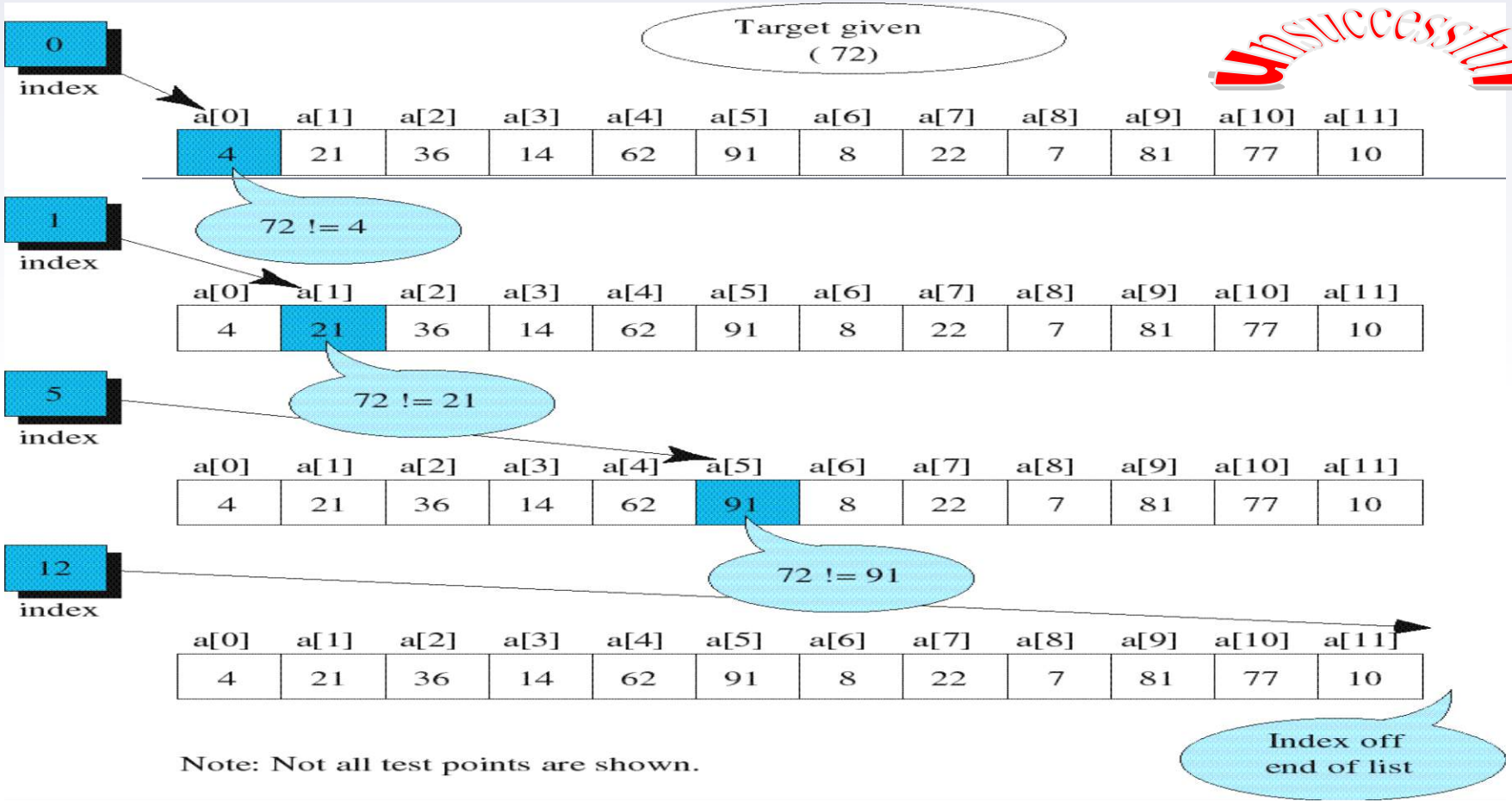
Searching

- The process used to find the location of a target among a list of objects
- Searching an array finds the index of first element in an array containing that value




0
index
Location wanted
(4)
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 21 36 14 62 91 8 22 7 81 77 10
1
index
62 != 4
Target given
(62)
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 21 36 14 62 91 8 22 7 81 77 10
2
index
62 != 21
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 21 36 14 62 91 8 22 7 81 77 10
3
index
62 != 36
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 21 36 14 62 91 8 22 7 81 77 10
4
index
62 != 14
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 21 36 14 62 91 8 22 7 81 77 10
62 == 62


Target given
(72)
Unsuccessful
0
index
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 21 36 14 62 91 8 22 7 81 77 10
72 != 4
1
index
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 21 36 14 62 91 8 22 7 81 77 10
72 != 21
5
index
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 21 36 14 62 91 8 22 7 81 77 10
72 != 91
12
index
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 21 36 14 62 91 8 22 7 81 77 10
Index off
end of list
Note: Not all test points are shown.

Unordered Linear Search

- Search an unordered array of integers for a value and return its index if the value is found. Otherwise, return -1.
- A[0] A[1] A[2] A[3] A[4] A[5] A[6] A[7]

14	2	10	5	1	3	17	2

- **Algorithm:**

Start with the first array element (index 0)

while(more elements in array){

if value found at current index, **return index**;

Try next element (increment index);

}Value not found, return -1;

Unordered Linear Search

```
// Searches an unordered array of integers
int search(int data[],  //input: array
          int size,    //input: array size
           int value){  //input: search value
    // output: if found, return index;
    //         otherwise, return –1.
    for(int index = 0; index < size; index++){
        if(data[index] == value)
            return index;
        }    return -1;}
```

Linear Search Algorithm

- LINEAR_SEARCH(A, N, VAL)
- Step 1: [INITIALIZE] SET POS = -1 Step 2: [INITIALIZE] SET I = 1
- Step 3: Repeat Step 4 while I<=N
- Step 4: IF A[I] = VAL
- SET POS = I
- PRINT POS
- Go to Step 6
- [END OF IF]
- SET I = I + 1
- [END OF LOOP]
- Step 5: IF POS = –1
- PRINT VALUE IS NOT PRESENT IN THE ARRAY
- [END OF IF]
- Step 6: EXIT

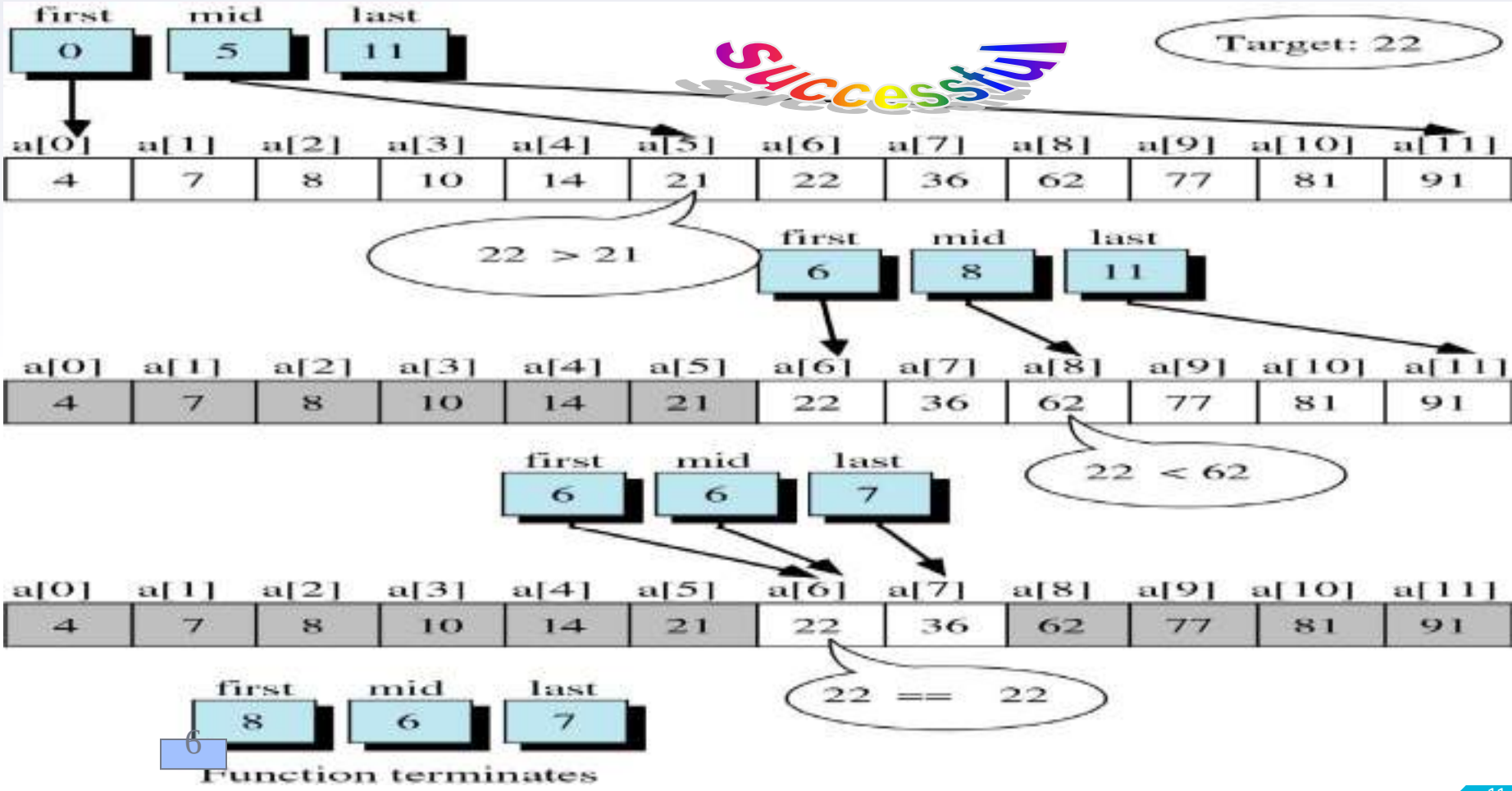
Program to perform Linear Search

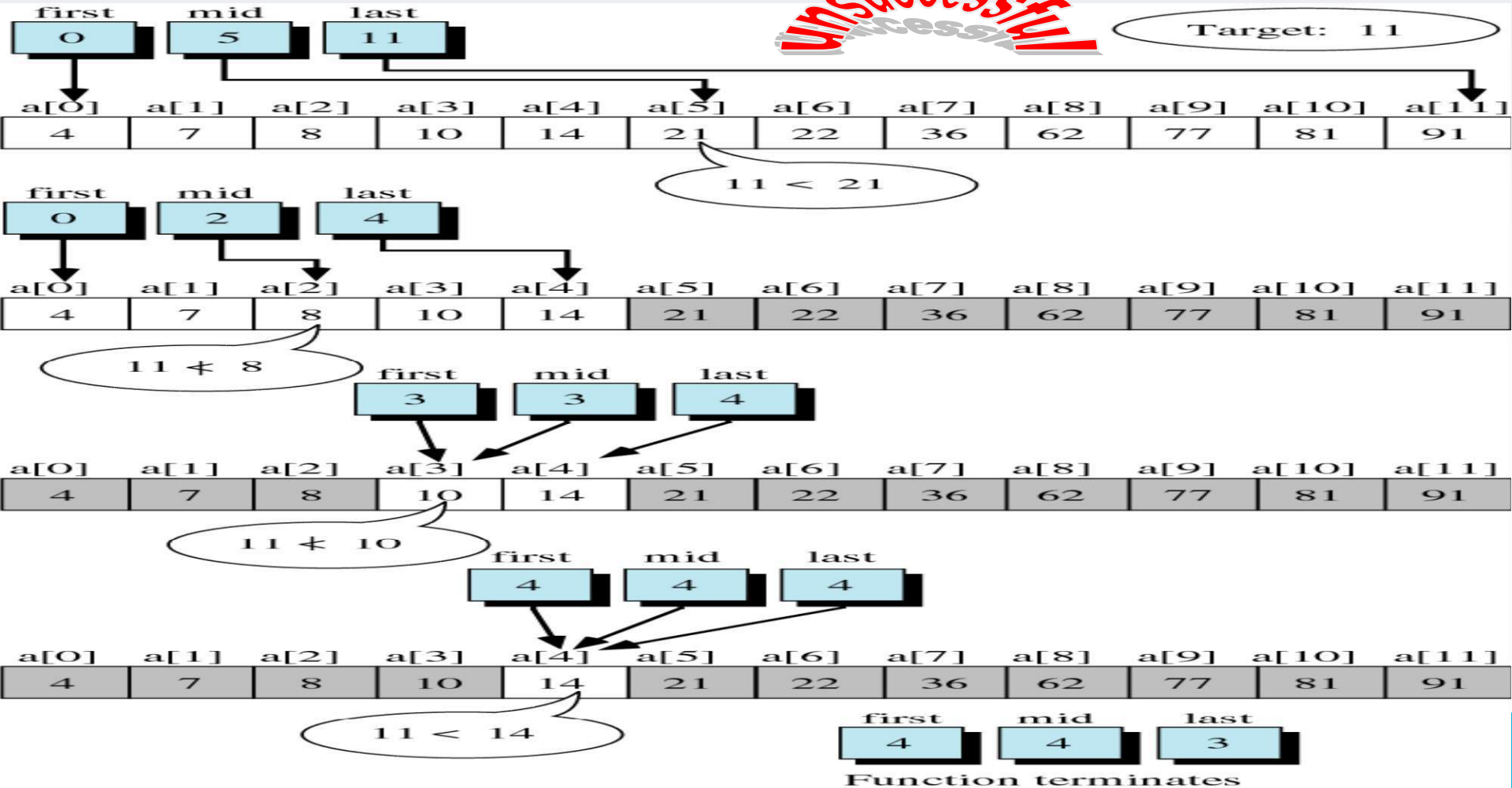
```
#include<stdio.h>
#include<conio.h>
void main()
{
 int a[11],b,c;
 clrscr();
 printf("Enter an array  ");
 for(b=0;b<11;b++)
 {
   scanf("%d",&a[b]);
 }
 printf("\nWhich value you want to search");
 scanf("%d",&c);
 for(b=0;b<11;b++)
 {
 if(a[b]==c)
  {
   printf("\nLocation of that value is %d",b+1);
   break;
  }
 }
 if(b==11)
 printf("\nValue not found in array");
 getch();
}
```

Binary Search

- Search an ordered array of integers for a value and return its index if the value is found. Otherwise, return -1.

- Binary search skips over parts of the array if the search value cannot possibly be there.


first
mid
last
0
5
11
Target: 22
Successful
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 7 8 10 14 21 22 36 62 77 81 91
22 > 21
first
mid
last
6
8
11
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 7 8 10 14 21 22 36 62 77 81 91
22 < 62
first
mid
last
6
6
7
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 7 8 10 14 21 22 36 62 77 81 91
22 == 22
first
mid
last
8
6
7
6
Function terminates


Unsuccessful
Target: 11
first
mid
last
0
5
11
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 7 8 10 14 21 22 36 62 77 81 91
11 < 21
first
mid
last
0
2
4
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 7 8 10 14 21 22 36 62 77 81 91
11 ≠ 8
first
mid
last
3
3
4
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 7 8 10 14 21 22 36 62 77 81 91
11 ≠ 10
first
mid
last
4
4
4
a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] a[8] a[9] a[10] a[11]
4 7 8 10 14 21 22 36 62 77 81 91
11 < 14
first
mid
last
4
4
3
Function terminates

Binary Search Algorithm

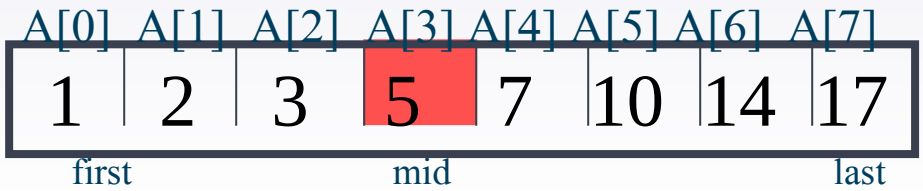
- Step 1: [INITIALIZE] SET BEG = lower_bound
- END = upper_bound, POS = - 1
- Step 2: Repeat Steps 3 and 4 while BEG <= END
- Step 3: SET MID = (BEG + END)/2
- Step 4: IF A[MID] = VAL SET POS = MID PRINT POS Go to Step 6
- ELSE IF A[MID] > VAL
- SET END = MID - 1
- ELSE
- SET BEG = MID + 1
- [END OF IF]
- [END OF LOOP]
- Step 5: IF POS = -1
- PRINT "VALUE IS NOT PRESENT IN THE ARRAY"
- [END OF IF] Step 6: EXIT

Binary Search

- Binary search is based on the “divide-and-conquer” strategy which works as follows:
  - Start by looking at the middle element of the array
    - 1. If the value it holds is lower than the search element, eliminate the first half of the array from further consideration.
    - 2. If the value it holds is higher than the search element, eliminate the second half of the array from further consideration.
  - Repeat this process until the element is found, or until the entire array has been eliminated.

Example: binary search

- 14 ?

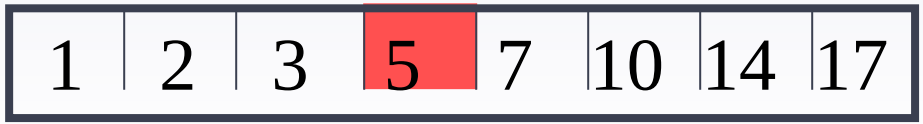


In this case,
(data[middle] == value)
return middle;

Example: binary search

A[0] A[1] A[2] A[3] A[4] A[5] A[6] A[7]

- 8 ?



first mid last

A[4] A[5] A[6] A[7]

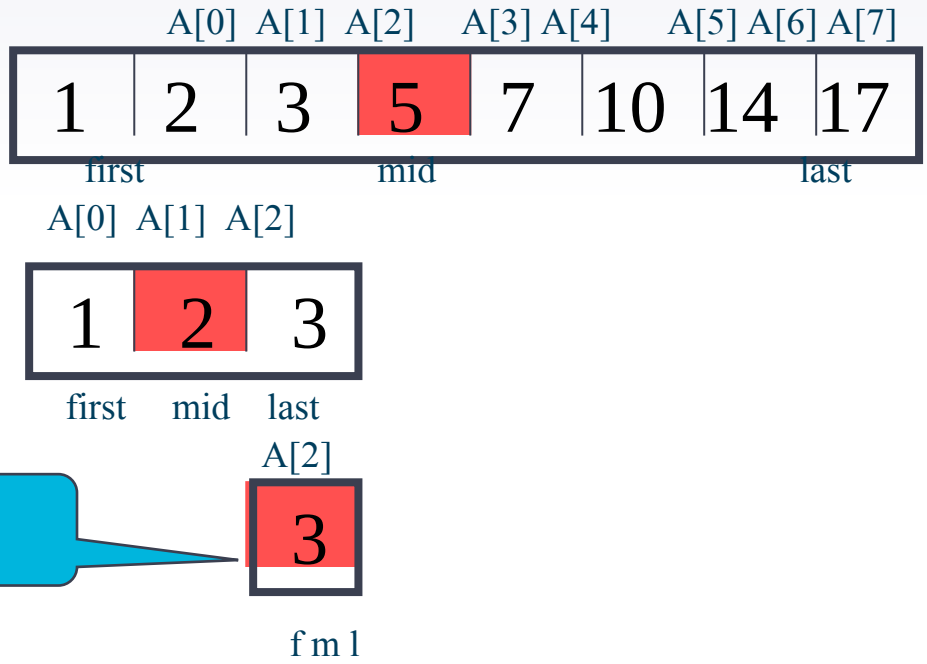
first mid last

```
In this case, (first == last)
    return -1;
```

A[4] f m l

Example: binary search

- 4 ?




```
In this case, (first == last)
    return -1;
```

Thank You

Queries????