

**Ex. No: 6**

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## **Competitive Programming**

### **6.a. Finding Duplicates- $O(n^2)$ Time Complexity (1) Space Complexity**

**Aim:** Find Duplicate in Array.

Given a read only array of  $n$  integers between 1 and  $n$ , find one number that repeats.

Input Format:

First Line - Number of elements

$n$  Lines -  $n$  Elements

Output Format:

Element  $x$  - That is repeated

**Algorithm:**

```
function main()
{
    initialize n // Number of elements in the array
    read n from user

    initialize arr[n] // Array to hold input values

    // Read values into the array
    for i from 0 to n - 1
    {
```

```

        read arr[i] from user
    }

    flag = 0 // Initialize a flag to indicate if a duplicate is found

    // Search for the first duplicate element
    for i from 0 to n - 1
    {
        el1 = arr[i] // Current element

        for j from 0 to n - 1
        {
            // Check for duplicates and ensure indices are different
            if el1 == arr[j] and i != j
            {
                print el1 // Print the duplicate element
                flag = 1 // Set flag to indicate a duplicate was found
                break // Exit inner loop
            }
        }

        if flag
            break // Exit outer loop if a duplicate was found
    }
}

```

### Program:

```
#include<stdio.h>
```

```
int main(){
    int n;
    scanf("%d",&n);
    int arr[n];
    for(int i=0;i<n;i++){
        scanf("%d",&arr[i]);
    }

    int flag=0;
    for(int i=0;i<n;i++){
        int el1=arr[i];

        for(int j=0;j<n;j++){
            if (el1==arr[j] && i!=j){
                printf("%d",el1);
                flag=1;
                break;
            }
        }
        if(flag)
            break;

    }
}
```

**Output:**

	Input	Expected	Got	
✓	11 10 9 7 6 5 1 2 3 8 4 7	7	7	✓
✓	5 1 2 3 4 4	4	4	✓
✓	5 1 1 2 3 4	1	1	✓

## 6.b. Finding Duplicates- $O(n)$ Time Complexity (1) Space Complexity

**Aim:** Find Duplicate in Array.

Given a read only array of  $n$  integers between 1 and  $n$ , find one number that repeats.

Input Format:

First Line - Number of elements

$n$  Lines -  $n$  Elements

Output Format:

Element  $x$  - That is repeated

**Algorithm:**

```
function main()
{
    initialize n // Number of elements in the array
    read n from user

    initialize a[n] // Array to hold input values

    // Read values into the array
    for i from 0 to n - 1
    {
        read a[i] from user
    }

    initialize b[n] // Array to keep track of seen elements
    for i from 0 to n - 1
    {
```

```

        b[i] = 0 // Initialize the tracking array
    }

    // Search for the first duplicate element
    for i from 0 to n - 1
    {
        // If the element is already present, i.e., b[a[i]] = 1
        if b[a[i]]
        {
            print a[i] // Print the duplicate element
            break // Exit the loop
        }
        else
        {
            b[a[i]] = 1 // Mark the element as seen
        }
    }
}

```

### Program:

```

#include <stdio.h>

int main(){
    int n;
    scanf("%d",&n);
    int a[n];
    for(int i=0;i <n;i++){
        scanf("%d",&a[i]);
    }
}

```

```

int b[n];

for(int i=0;i <n;i++){

    b[i]=0;

}

for(int i=0;i<n;i++){

    //if el already present i.e, b[i]=1

    if(b[a[i]]){

        printf("%d",a[i]);

        break;

    }

    else

        b[a[i]]=1;

}

}

```

**Output:**

	Input	Expected	Got	
✓	11 10 9 7 6 5 1 2 3 8 4 7	7	7	✓
✓	5 1 2 3 4 4	4	4	✓
✓	5 1 1 2 3 4	1	1	✓

## 6.c. Print Intersection of 2 sorted arrays- $O(m*n)$ Time Complexity, $O(1)$ Space Complexity

### Aim:

Find the intersection of two sorted arrays.

OR in other words,

Given 2 sorted arrays, find all the elements which occur in both the arrays.

Input Format

· The first line contains T, the number of test cases. Following T lines contain:

1. Line 1 contains N1, followed by N1 integers of the first array
2. Line 2 contains N2, followed by N2 integers of the second array

Output Format

The intersection of the arrays in a single line

Example

Input:

```
1
3 10 17 57
6 2 7 10 15 57 246
```

Output:

```
10 57
```

Input:

```
1
6 1 2 3 4 5 6
2 1 6
```

Output:

```
1 6
```

### Algorithm:

```
function main()
```



```
{  
    initialize n // Number of test cases  
    read n from user  
  
    for i from 0 to n - 1  
    {  
        initialize n1 // Size of the first array  
        read n1 from user  
  
        initialize arr1[n1] // First array  
  
        // Read values into the first array  
        for j from 0 to n1 - 1  
        {  
            read arr1[j] from user  
        }  
  
        initialize n2 // Size of the second array  
        read n2 from user  
  
        initialize arr2[n2] // Second array  
  
        // Read values into the second array  
        for j from 0 to n2 - 1  
        {  
            read arr2[j] from user  
        }  
    }  
}
```

```

// Check for common elements in both arrays
for j from 0 to n1 - 1
{
    for k from 0 to n2 - 1
    {
        if arr1[j] == arr2[k]
        {
            print arr1[j] // Print the common element
        }
    }
}
}
}

```

### Program:

```

#include<stdio.h>

int main(){
    int n;
    scanf("%d",&n);
    for(int i=0;i<n;i++){
        int n1;
        scanf("%d",&n1);
        int arr1[n1];
        for(int j=0;j<n1;j++){
            scanf("%d",&arr1[j]);
        }
        int n2;
        scanf("%d",&n2);
    }
}

```

```

int arr2[n2];

for(int j=0;j<n2;j++){
    scanf("%d",&arr2[j]);
}

for(int j=0;j<n1;j++){
    for(int k=0;k<n2;k++){
        if(arr1[j]==arr2[k]){
            printf("%d ",arr1[j]);
        }
    }
}
}
}

```

**Output:**

	Input	Expected	Got	
✓	1 3 10 17 57 6 2 7 10 15 57 246	10 57	10 57	✓
✓	1 6 1 2 3 4 5 6 2 1 6	1 6	1 6	✓

## 6.d. Print Intersection of 2 sorted arrays- $O(m+n)$ Time Complexity, $O(1)$ Space Complexity

### Aim:

Find the intersection of two sorted arrays.

OR in other words,

Given 2 sorted arrays, find all the elements which occur in both the arrays.

Input Format

· The first line contains T, the number of test cases. Following T lines contain:

1. Line 1 contains N1, followed by N1 integers of the first array
2. Line 2 contains N2, followed by N2 integers of the second array

Output Format

The intersection of the arrays in a single line

Example

Input:

```
1
3 10 17 57
6 2 7 10 15 57 246
```

Output:

```
10 57
```

Input:

```
1
6 1 2 3 4 5 6
2 1 6
```

Output:

```
1 6
```

### Algorithm:

```
function main()
```

```
{  
    initialize T // Number of test cases  
    read T from user  
  
    while T > 0  
    {  
        // Decrement the test case counter  
        T--  
  
        initialize n1, n2 // Sizes of the two arrays  
        read n1 from user  
        initialize arr1[n1] // First array  
  
        // Read values into the first array  
        for i from 0 to n1 - 1  
        {  
            read arr1[i] from user  
        }  
  
        read n2 from user  
        initialize arr2[n2] // Second array  
  
        // Read values into the second array  
        for i from 0 to n2 - 1  
        {  
            read arr2[i] from user  
        }  
    }  
}
```

```

initialize i = 0, j = 0 // Indices for both arrays

// Iterate through both arrays to find common elements
while i < n1 and j < n2
{
    if arr1[i] < arr2[j]
    {
        i++ // Move to the next element in arr1
    }
    else if arr2[j] < arr1[i]
    {
        j++ // Move to the next element in arr2
    }
    else
    {
        print arr1[i] // Print the common element
        i++ // Move to the next element in arr1
        j++ // Move to the next element in arr2
    }
}

print new line // Move to the next line for output
}
}

```

### Program:

```
#include <stdio.h>
```

```

int main() {
    int T;
    scanf("%d", &T);
    while (T--) {
        int n1, n2;

        scanf("%d", &n1);
        int arr1[n1];
        for (int i = 0; i < n1; i++) {
            scanf("%d", &arr1[i]);
        }

        scanf("%d", &n2);
        int arr2[n2];
        for (int i = 0; i < n2; i++) {
            scanf("%d", &arr2[i]);
        }

        int i = 0, j = 0;
        while (i < n1 && j < n2) {
            if (arr1[i] < arr2[j]) {
                i++;
            }
            else if (arr2[j] < arr1[i]) {
                j++;
            }
            else {

```

```

        printf("%d ", arr1[i]);

        i++;

        j++;

    }

}

printf("\n");

}

}

```

**Output:**

	Input	Expected	Got	
✓	1 3 10 17 57 6 2 7 10 15 57 246	10 57	10 57	✓
✓	1 6 1 2 3 4 5 6 2 1 6	1 6	1 6	✓



## 6.e. Pair with Difference- $O(n^2)$ Time Complexity, $O(1)$ Space Complexity

### Aim:

Given an array A of sorted integers and another non negative integer k, find if there exists 2 indices i and j such that  $A[j] - A[i] = k$ ,  $i \neq j$ .

Input Format:

First Line n - Number of elements in an array

Next n Lines - N elements in the array

k - Non - Negative Integer

Output Format:

1 - If pair exists

0 - If no pair exists

Explanation for the given Sample Testcase:

YES as  $5 - 1 = 4$

So Return 1.

### Algorithm:

```
function main()
{
    initialize n // Number of elements in the array
    read n from user

    initialize arr[n] // Array to hold input values

    // Read values into the array
    for i from 0 to n - 1
    {
        read arr[i] from user
```

```
}
```

```
initialize t // Target difference
```

```
read t from user
```

```
initialize flag = 0 // Flag to indicate if a pair is found
```

```
// Check for pairs with the specified difference
```

```
for i from 0 to n - 1
```

```
{
```

```
    for j from 0 to n - 1
```

```
    {
```

```
        if i != j and abs(arr[i] - arr[j]) == t
```

```
        {
```

```
            flag = 1 // Pair found
```

```
            break
```

```
        }
```

```
    }
```

```
if flag
```

```
{
```

```
    break
```

```
}
```

```
}
```

```
// Output the result based on the flag
```

```
if flag
```

```
{
```

```
    print 1 // Pair found
```

```
}  
  
else  
  
{  
    print 0 // No pair found  
}  
  
return 0  
}
```

### **Program:**

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
int main() {
```

```
    int n;
```

```
    scanf("%d", &n);
```

```
    int arr[n];
```

```
    for (int i = 0; i < n; i++) {
```

```
        scanf("%d", &arr[i]);
```

```
    }
```

```
    int t;
```

```
    scanf("%d", &t);
```

```
    int flag = 0;
```

```
for (int i = 0; i < n; i++) {  
    for (int j = 0; j < n; j++) {  
        if (i!=j && abs(arr[i] - arr[j]) == t) {  
            flag = 1;  
            break;  
        }  
    }  
    if (flag) {  
        break;  
    }  
}  
  
if (flag) {  
    printf("%d\n", 1);  
} else {  
    printf("%d\n", 0);  
}  
  
return 0;  
}
```

**Output:**

	Input	Expected	Got	
✓	3 1 3 5 4	1	1	✓
✓	10 1 4 6 8 12 14 15 20 21 25 1	1	1	✓
✓	10 1 2 3 5 11 14 16 24 28 29 0	0	0	✓
✓	10 0 2 3 7 13 14 15 20 24 25 10	1	1	✓

## 6.f. Pair with Difference - $O(n)$ Time Complexity, $O(1)$ Space Complexity

**Aim:** Given an array A of sorted integers and another non negative integer k, find if there exists 2 indices i and j such that  $A[j] - A[i] = k$ ,  $i \neq j$ .

Input Format:

First Line n - Number of elements in an array

Next n Lines - N elements in the array

k - Non - Negative Integer

Output Format:

1 - If pair exists

0 - If no pair exists

Explanation for the given Sample Testcase:

YES as  $5 - 1 = 4$

So Return 1.

### Algorithm:

```
function main()
{
    initialize n // Number of elements in the array
    read n from user

    initialize arr[n] // Array to hold input values

    // Read values into the array
    for i from 0 to n - 1
    {
        read arr[i] from user
    }
```

initialize t // Target difference

read t from user

initialize flag = 0 // Flag to indicate if a pair is found

initialize i = 0 // First index

initialize j = 1 // Second index

// Loop to find pairs with the specified difference

while i < n and j < n

{

    diff = abs(arr[i] - arr[j]) // Calculate the difference

    if i != j and diff == t

    {

        flag = 1 // Pair found

        break

    }

    else if diff < t

    {

        j++ // Increment second index

    }

    else

    {

        i++ // Increment first index

    }

}

```
// Output the result based on the flag
if flag
{
    print 1 // Pair found
}
else
{
    print 0 // No pair found
}

return 0
}
```

### **Program:**

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
int main() {
```

```
    int n;
```

```
    scanf("%d", &n);
```

```
    int arr[n];
```

```
    for (int i = 0; i < n; i++) {
```

```
        scanf("%d", &arr[i]);
```

```
    }
```



```
int t;

scanf("%d", &t);


int flag = 0;


int i=0;
int j=1;
while(i<n && j<n){
    int diff = abs(arr[i] - arr[j]);
    if(i!=j && diff==t){
        flag=1;
        break;
    }
    else if(diff<t){
        j++;
    }
    else{
        i++;
    }
}
```

```
if (flag) {
    printf("%d\n", 1);
} else {
    printf("%d\n", 0);
}
```

```
}
```

```
return 0;
```

```
}
```

**Output:**

	Input	Expected	Got	
✓	3 1 3 5 4	1	1	✓
✓	10 1 4 6 8 12 14 15 20 21 25 1	1	1	✓
✓	10 1 2 3 5 11 14 16 24 28 29 0	0	0	✓
✓	10 0 2 3 7 13 14 15 20 24 25 10	1	1	✓