Ex. No: 6 **Date: 17.09.24**

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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:

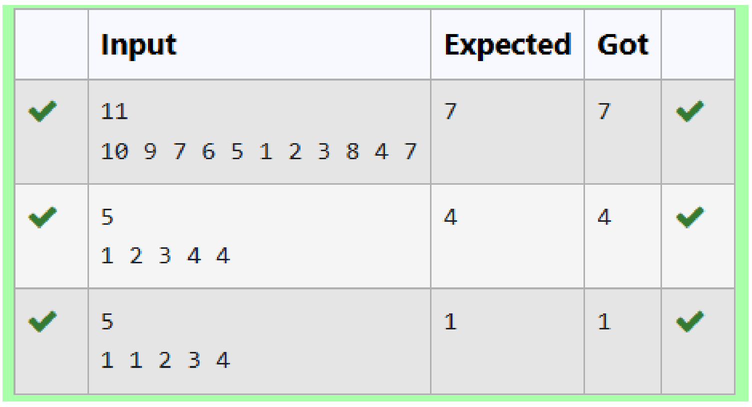
```
function main()
{
    initialize n  // Number of elements in the array
    read n from user

    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,val,j=0;
    scanf("%d",&n);
    int arr[n];

    for(int i=0; i<=n;i++){
        scanf("%d",&val);
        arr[i] = val;
    }
    for (int i=1; i<=n; i++){
        if(arr[j] == arr[i]){
             printf("%d",arr[i]);
             break;
        }
        else{
            j++;
        }
    }
}
```

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

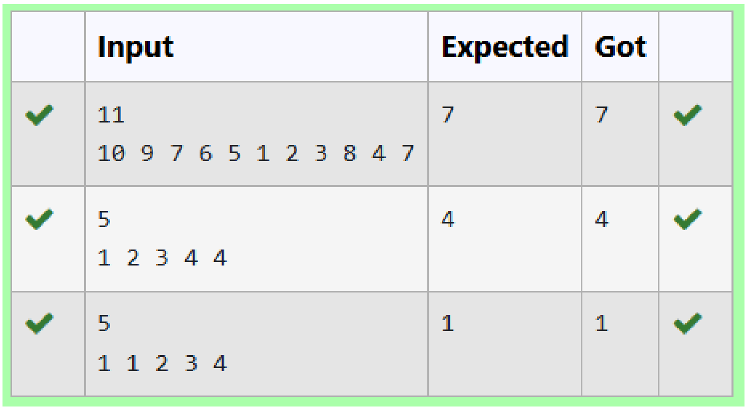
Algorithm:

```
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,val,j=0;


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

        scanf("%d",&val);

        arr[i] = val;

    }


    for (int i=1; i<=n; i++){

        if(arr[j] == arr[i]){

            printf("%d",arr[j]);

            break;

        }

        else{

            j++;

        }

    }

}
```

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:

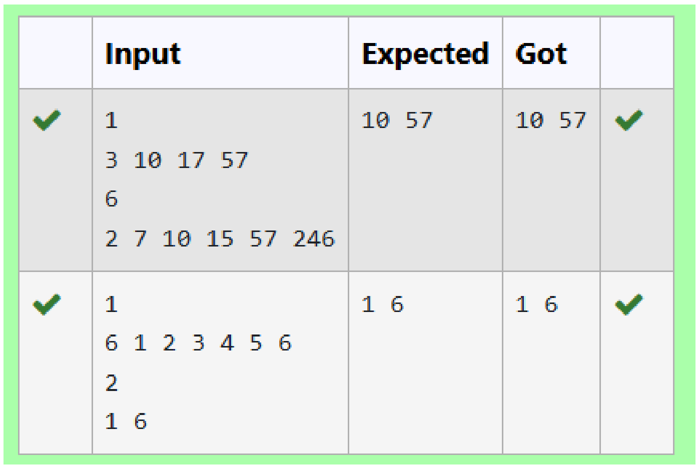
function main()

```
{
    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>

void findIntersection(int *arr1, int n1, int *arr2, int n2) {
    int i = 0, j = 0;
    int first = 1;

    while (i < n1 && j < n2) {
        if (arr1[i] == arr2[j]) {
            if (!first) {
                printf(" ");
            }
            printf("%d", arr1[i]);
            first = 0;
            i++;

            j++;

        } else if (arr1[i] < arr2[j]) {

            i++;

        } else {

            j++;

        }

    }

    printf("\n");

}


int main() {

    int T;

    scanf("%d", &T);


    while (T--) {

        int N1;

        scanf("%d", &N1);

        int arr1[N1];

        for (int i = 0; i < N1; i++) {

            scanf("%d", &arr1[i]);

        }


        int N2;

        scanf("%d", &N2);

        int arr2[N2];

        for (int i = 0; i < N2; i++) {

            scanf("%d", &arr2[i]);
        }


        findIntersection(arr1, N1, arr2, N2);
    }


    return 0;
}
```

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()

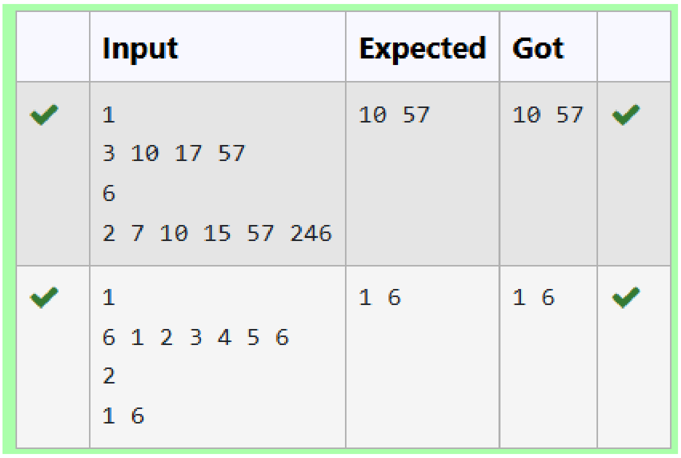
```
{
    initialize T  // Number of test cases
    read T from user

    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>
```

```
void findIntersection(int *arr1, int n1, int *arr2, int n2) {
    int i = 0, j = 0;
    int first = 1;

    while (i < n1 && j < n2) {
        if (arr1[i] == arr2[j]) {
            if (!first) {
                printf(" ");
            }
            printf("%d", arr1[i]);
            first = 0;
            i++;
            j++;
        } else if (arr1[i] < arr2[j]) {
            i++;
        } else {
            j++;
        }
    }
    printf("\n");
}

int main() {
    int T;
    scanf("%d", &T);

    while (T--) {
        int N1;
        scanf("%d", &N1);
        int arr1[N1];
        for (int i = 0; i < N1; i++) {
            scanf("%d", &arr1[i]);
        }

        int N2;
        scanf("%d", &N2);
        int arr2[N2];
        for (int i = 0; i < N2; i++) {
            scanf("%d", &arr2[i]);
        }

        findIntersection(arr1, N1, arr2, N2);
    }

    return 0;
}
```

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 != 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:

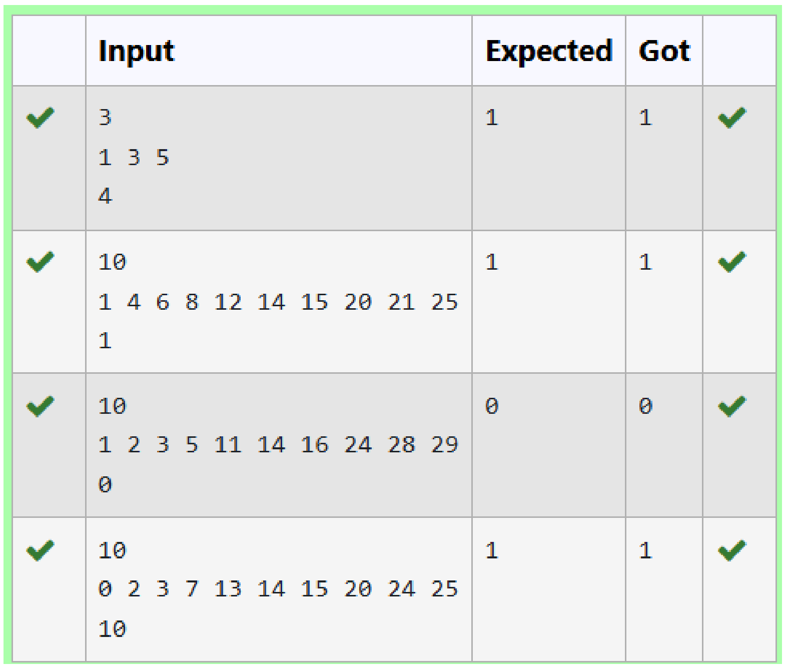
```
function main()

{

    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>

int findPairWithDifference(int *arr, int n, int k) {
    int i = 0, j = 1;

    while (j < n) {
        int diff = arr[j] - arr[i];

        if (diff == k) {
            return 1;
        }
        if (diff < k) {
            j++;
        } else {
            i++;
            if (i == j) {
                j++;
            }
        }
    }
    return 0;
}
int main() {
    int n, k;
    scanf("%d", &n);
    int arr[n];
    for (int i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
    }
    scanf("%d", &k);
    int result = findPairWithDifference(arr, n, k);
    printf("%d\n", result);
    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 != 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
  }
```

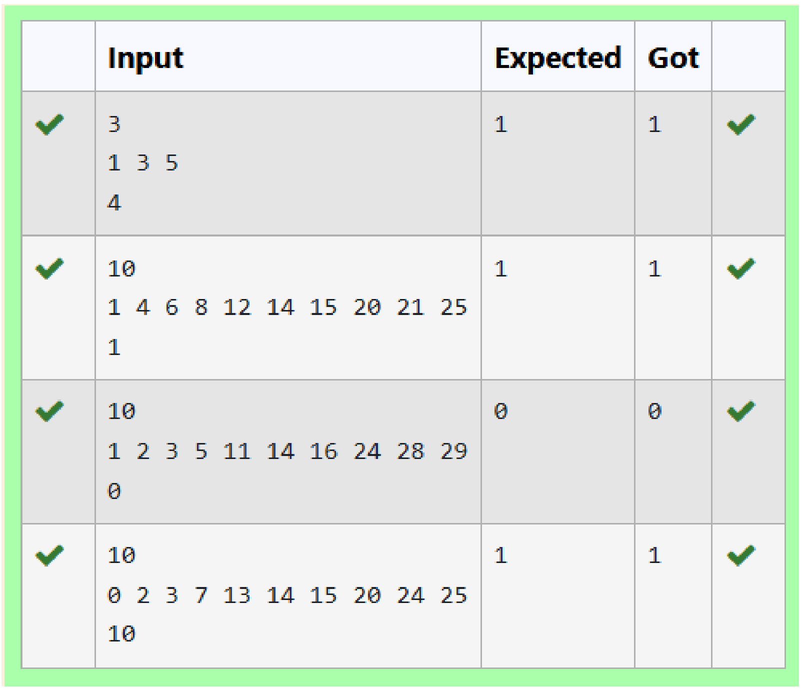
```
initialize t  // Target difference
read t from user

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:

```c
#include <stdio.h>

int findPairWithDifference(int *arr, int n, int k) {
    int i = 0, j = 1;

    while (j < n) {
        int diff = arr[j] - arr[i];

        if (diff == k) {
            return 1;
        }
        if (diff < k) {
            j++;
        } else {
            i++;
            if (i == j) {
                j++;
            }
        }
    }
    return 0;
}

int main() {
    int n, k;
    scanf("%d", &n);
    int arr[n];

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

    scanf("%d", &k);

    int result = findPairWithDifference(arr, n, k);
    printf("%d\n", result);

    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	✓