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:

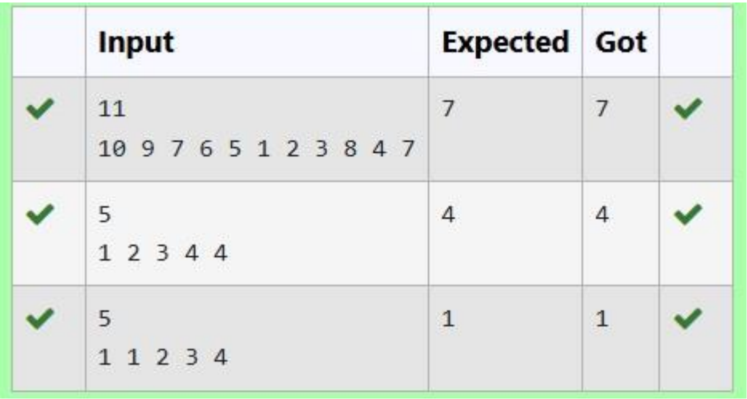
```
1. Read the integer n (size of array)
2. Initialize array a[] of size n
3. For i = 0 to n-1 do:
      a[i] = input value (read each
element of the array)
4. For i = 0 to n-1 do:
      For j = i+1 to n-1 do:
          If a[i] == a[j] then:
```

```
        Print a[i]
```

Program:

```
#include<stdio.h>
int main()
{
    int n,b;
    scanf("%d",&n);
    int a[n];
    for(int i=0;i<n;i++)
    {
        scanf("%d",&b);
        a[i]=b;
    }
    for(int i=0;i<n;i++)
    {
        for(int j=i+1;j<n;j++)
        {
            if(a[i]==a[j])
            {
                printf("%d",a[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
```

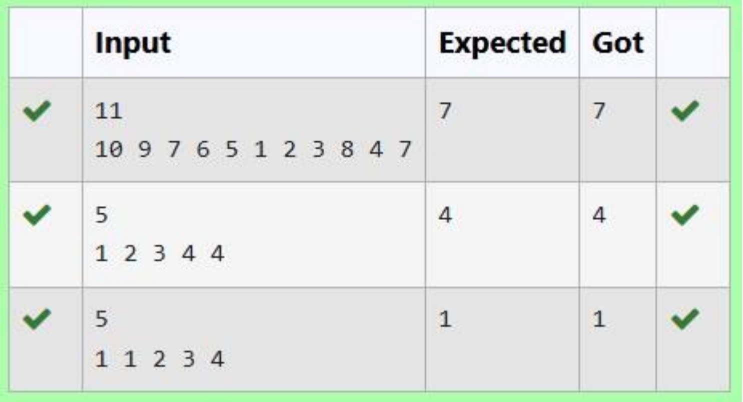
```
   }

   // 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;
   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

1. Read the integer

n (size of array)

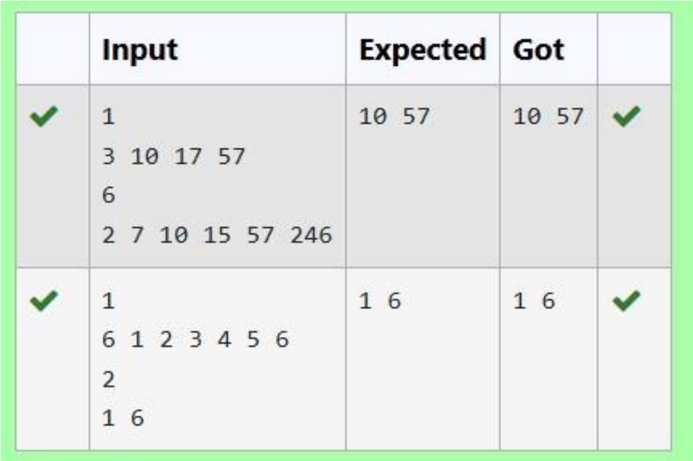
```
2. Initialize array a[] of size n
3. For i = 0 to n-1 do:
    Read a[i] from input
4. For i = 0 to n-2 do:
    If a[i] == a[i+1] then:
        Print a[i]
        Break the loop
5. If no duplicate is found, do nothing or handle it as needed
```

Program:

```c
#include<stdio.h>
int main()
{
   int n,b;
   scanf("%d",&n);
   int a[n];
   for(int i=0;i<=n;i++)
```

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

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:

1. Read the integer T

(number of test

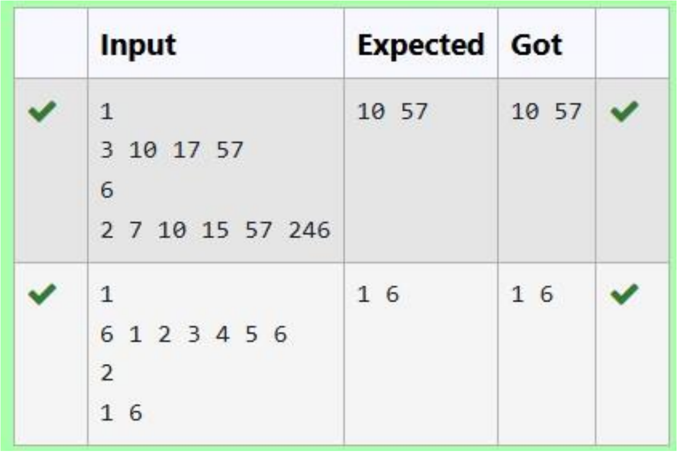
cases).

```
2. For each test case (T times):
    a. Read n1 (size of arr1) and n2 (size of arr2).
    b. Initialize array arr1[] of size n1.
    c. Read n1 integers into arr1[].
    d. Initialize array arr2[] of size n2.
    e. Read n2 integers into arr2[].

    f. Initialize indices i = 0 and j = 0.
    g. While i < n1 and j < n2:
        i. If arr1[i] < arr2[j], increment i.
        ii. If arr1[i] > arr2[j], increment j.
        iii. If arr1[i] ==
arr2[j], print arr1[i],
increment both i
and j.

    h. Print newline
after the results of
each test case.


3. End.
```

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 != 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:

1. Read the integer n (size of array).

2. Initialize array arr[] of size n.

3. For i = 0 to n-1:

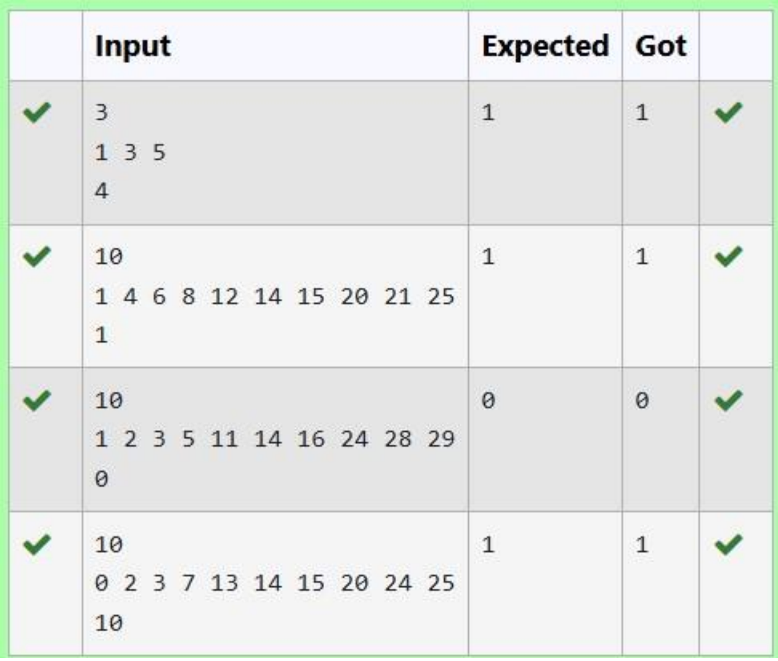
```
    a. Read arr[i] from input.
4. Read the integer t (target absolute difference).
5. Initialize flag = 0.
6. Initialize i = 0 and j = 1.
7. While i < n and j < n:
    a. Compute diff = abs(arr[i] - arr[j]).
    b. If i != j and diff == t:
        i. Set flag = 1.
        ii. Break the loop.
    c. Else if diff < t, increment j.
    d. Else, increment i.
8. If flag is set to 1:
    a. Print 1.
9. Else:
    a. Print 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	✓

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.

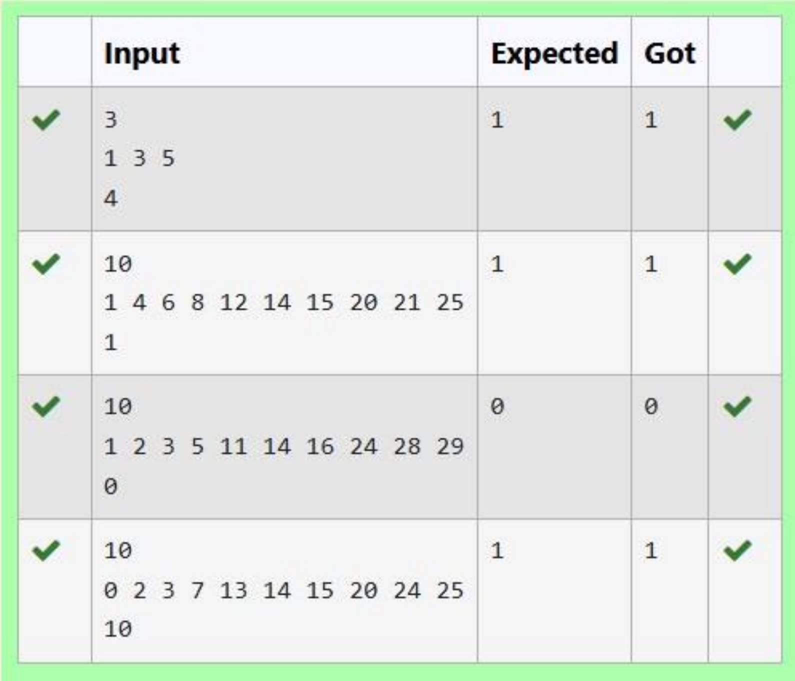
Algorithm:

```
1. Read the integer n (size of array).
2. Initialize array arr[] of size n.
3. For i = 0 to n-1:
    a. Read arr[i] from input.
4. Read the integer t (target absolute difference).
5. Initialize flag = 0.
6. For i = 0 to n-1:
    a. For j = 0 to n-1:
        i. If i != j and abs(arr[i] - arr[j]) == t:
            A. Set flag = 1.
            B. Break the inner loop.
    b. If flag = 1, break the outer loop.
7. If flag is set to 1:
    a. Print 1.
8. Else:
    a. Print 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	✓