

# **RAJALAKSHMI ENGINEERING COLLEGE**

## **(Autonomous)**

RAJALAKSHMI NAGAR, THANDALAM, CHENNAI-602105



**CS23331 – DESIGN AND ANALYSIS OF ALGORITHMS**

### **LABORATORY RECORD NOTEBOOK**

**Register Number** : 241801197

**Name of the Student** : C. Parveenah

**Year / Semester** : II / III

**Branch** : Artificial Intelligence and Data Science

**Academic Year** : 2025 – 2026 (ODD)

# RAJALAKSHMI ENGINEERING COLLEGE

[AUTONOMOUS]

RAJALAKSHMI NAGAR, THANDALAM – 602 105

## **BONAFIDE CERTIFICATE**

Name: ..... C. PARVENDHAN .....

Academic Year: 2025-2026 (ODD)

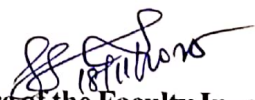
Semester: III

Branch: AIDS

Register Number:

2116 241801197

Certified that this is the bonafide record of work done by the above student  
in the **CS23331 – DESIGN AND ANALYSIS OF ALGORITHMS  
LABORATORY** during the year 2025 - 2026.

  
Signature of the Faculty In-charge

Submitted for the Practical Examination held on .....

Internal Examiner



**RAJALAKSHMI ENGINEERING COLLEGE**  
(An Autonomous Institution affiliated to Anna University)  
**DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**









**Subject: CS23331 – DESIGN AND ANALYSIS OF ALGORITHMS**



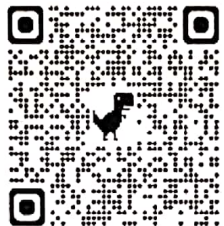

**Reg No: 241801197**

**Name: PARVENDHAN C**

**Department: AIDS**

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| S.NO | Date      | Name of the Experiment                | GitHub QR Code  | Marks Awarded | Signature   |
|------|-----------|---------------------------------------|---|---------------|---|
| 1.   | 26/7/2025 | Basic C Programming                   |   | 9             |    |
| 2.   | 21/8/25   | Finding Time Complexity of Algorithms |  | 8             |  |
| 3.   | 19/9/25   | Greedy Algorithms                     |  | 8             |  |
| 4.   | 26/9/25   | Divide and Conquer                    |  | 9             |  |

| S.NO | Date     | Name of the Experiment  | GitHub QR Code   | Marks Awarded | Signature   |
|------|----------|-------------------------|--|---------------|---|
| 5.   | 24/10/25 | Dynamic Programming     |  | 8             |  |
| 6.   | 31/10/25 | Competitive Programming |  | 8             |  |

**NAME: PARVENDHAN C**

**REG NO: 241801197**

## **COMPETITIVE PROGRAMMING**

### **PROGRAM 1: Finding Duplicates- $O(n^2)$ Time Complexity, $O(1)$ Space Complexity**

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

**For example:**

| Input     | Result |
|-----------|--------|
| 5         | 1      |
| 1 1 2 3 4 |        |

**Answer:** (penalty regime: 0 %)

```
1 #include <stdio.h>
2 int main()
3 {
4     int n;
5     scanf("%d", &n);
6     int arr[n];
7     for (int i = 0; i < n; i++)
8     {
9         scanf("%d", &arr[i]);
10    }
11    int duplicate = -1;
12    for (int i = 0; i < n; i++)
13    {
14        for (int j = i + 1; j < n; j++)
15        {
16            if (arr[i] == arr[j]) {
17                duplicate = arr[i];
18                break;
19            }
20        }
21        if (duplicate != -1)
22            break;
23    }
24    if (duplicate != -1)
25        printf("%d\n", duplicate);
26    else
27        printf("No duplicate found\n");
28    return 0;
29 }
30
31
```

|   | Input                        | Expected | Got |   |
|---|------------------------------|----------|-----|---|
| ✓ | 11<br>10 9 7 6 5 1 2 3 8 4 7 | 7        | 7   | ✓ |
| ✓ | 5<br>1 2 3 4 4               | 4        | 4   | ✓ |
| ✓ | 5<br>1 1 2 3 4               | 1        | 1   | ✓ |

Passed all tests! ✓

**Correct**

Marks for this submission: 1.00/1.00.

## PROGRAM 2: Finding Duplicates- $O(n)$ Time Complexity, $O(1)$ Space Complexity

---

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

**For example:**

| Input          | Result |
|----------------|--------|
| 5<br>1 1 2 3 4 | 1      |



**Answer:** (penalty regime: 0 %)

```
1 #include <stdio.h>
2 int main()
3 {
4     int n;
5     scanf("%d", &n);
6     int arr[n];
7     for (int i = 0; i < n; i++)
8         scanf("%d", &arr[i]);
9     int slow = arr[0];
10    int fast = arr[0];
11    do
12    {
13        slow = arr[slow];
14        fast = arr[arr[fast]];
15    } while (slow != fast);
16    slow = arr[0];
17    while (slow != fast)
18    {
19        slow = arr[slow];
20        fast = arr[fast];
21    }
22    printf("%d\n", slow);
23    return 0;
24 }
25
```

|   | Input                        | Expected | Got |   |
|---|------------------------------|----------|-----|---|
| ✓ | 11<br>10 9 7 6 5 1 2 3 8 4 7 | 7        | 7   | ✓ |
| ✓ | 5<br>1 2 3 4 4               | 4        | 4   | ✓ |
| ✓ | 5<br>1 1 2 3 4               | 1        | 1   | ✓ |

Passed all tests! ✓



## **PROGRAM 3: Print Intersection of 2 sorted arrays- $O(m*n)$ Time Complexity, $O(1)$ Space Complexity**

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  $N_1$ , followed by  $N_1$  integers of the first array
2. Line 2 contains  $N_2$ , followed by  $N_2$  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

**Answer:** (penalty regime: 0 %)

```
1  #include <stdio.h>
2  int main()
3  {
4      int t;
5      scanf("%d", &t);
6      while (t-->0)
7      {
8          int n1, n2;
9          scanf("%d", &n1);
10         int arr1[n1];
11         for (int i = 0; i < n1; i++)
12             scanf("%d", &arr1[i]);
13         scanf("%d", &n2);
14         int arr2[n2];
15         for (int i = 0; i < n2; i++)
16             scanf("%d", &arr2[i]);
17         for (int i = 0; i < n1; i++)
18         {
19             for (int j = 0; j < n2; j++)
20             {
21                 if (arr1[i] == arr2[j])
22                 {
23                     printf("%d ", arr1[i]);
24                     break;
25                 }
26             }
27         }
28         printf("\n");
29     }
30     return 0;
31 }
32
```

|   | Input                                    | Expected | Got   |   |
|---|--|----------|-------|---|
| ✓ | 1<br>3 10 17 57<br>6<br>2 7 10 15 57 246 | 10 57    | 10 57 | ✓ |
| ✓ | 1<br>6 1 2 3 4 5 6<br>2<br>1 6           | 1 6      | 1 6   | ✓ |

Passed all tests! ✓

**Correct**

Marks for this submission: 1.00/1.00.

## **PROGRAM 4:Print Intersection of 2 sorted arrays- $O(m+n)$ Time Complexity, $O(1)$ Space Complexity**

**Question 1** | Correct Mark 1.00 out of 1.00 [Flag question](#)

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  $N_1$ , followed by  $N_1$  integers of the first array
  2. Line 2 contains  $N_2$ , followed by  $N_2$  integers of the second array

Output Format

The intersection of the arrays in a single line

Answer: (penalty regime: 0 %)

```
1 #include <stdio.h>
2 int main()
3 {
4     int t;
5     scanf("%d", &t);
6     while (t--)
7     {
8         int n1, n2;
9         scanf("%d", &n1);
10        int arr1[n1];
11        for (int i = 0; i < n1; i++)
12            scanf("%d", &arr1[i]);
13        scanf("%d", &n2);
14        int arr2[n2];
15        for (int i = 0; i < n2; i++)
16            scanf("%d", &arr2[i]);
17        int i = 0, j = 0;
18        while (i < n1 && j < n2)
19        {
20            if (arr1[i] < arr2[j])
21                i++;
22            else if (arr2[j] < arr1[i])
23                j++;
24            else {
25                printf("%d ", arr1[i]);
26                i++;
27                j++;
28            }
29        }
30        printf("\n");
31    }
32    return 0;
33 }
34
```

|   | Input                                    | Expected | Got   |   |
|---|--|----------|-------|---|
| ✓ | 1<br>3 10 17 57<br>6<br>2 7 10 15 57 246 | 10 57    | 10 57 | ✓ |
| ✓ | 1<br>6 1 2 3 4 5 6<br>2<br>1 6           | 1 6      | 1 6   | ✓ |

Passed all tests! ✓

Correct

Marks for this submission: 1.00/1.00.

## PROGRAM 5: Pair with Difference- $O(n^2)$ Time Complexity, $O(1)$ Space Complexity

Question 1 | Correct | Mark 1.00 out of 1.00 | [Flag question](#)

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.

**Answer:** (penalty regime: 0 %)

```
1  #include<stdio.h>
2  int main()
3  {
4      int n;
5      scanf("%d",&n);
6      int arr[n];
7      for(int i=0;i<n;i++)
8      {
9          scanf("%d",&arr[i]);
10     }
11     int k;
12     scanf("%d",&k);
13     int found=0;
14     for(int i=0;i<n;i++)
15     {
16         for(int j=i+1;j<n;j++)
17         {
18             if(arr[j]-arr[i]==k)
19             {
20                 found=1;
21                 break;
22             }
23         }
24         if(found) break;
25     }
26     printf("%d\n", found);
27     return 0;
28 }
29
```

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

Passed all tests! ✓

**Correct**

Marks for this submission: 1.00/1.00.

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

**Question 1** | Correct Mark 1.00 out of 1.00 [Flag question](#)

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.

**For example:**

| Input | Result |
|-------|--------|
| 3     | 1      |
| 1 3 5 |        |
| 4     |        |



Answer: (penalty regime: 0 %)

```
1 #include <stdio.h>
2 int main()
3 {
4     int n;
5     scanf("%d", &n);
6     int arr[n];
7     for (int i = 0; i < n; i++)
8         scanf("%d", &arr[i]);
9     int k;
10    scanf("%d", &k);
11    int i = 0, j = 1;
12    int found = 0;
13    while (i < n && j < n)
14    {
15        int diff = arr[j] - arr[i];
16        if (i != j && diff == k)
17        {
18            found = 1;
19            break;
20        }
21        else if (diff < k)
22            j++;
23        else
24            i++;
25    }
26    printf("%d\n", found);
27    return 0;
28 }
29
```

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

Passed all tests! ✓

Correct

Marks for this submission: 1.00/1.00.