

# ARRAYS

## classnote

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What is an Array?

An **array** is a collection of elements of the *same data type* stored in *contiguous memory locations*.

It allows you to store multiple values under a single variable name.

### Example:

If you want to store 5 integers —

instead of writing `int a1, a2, a3, a4, a5;`

you can write `int a[5];`

### Basic Problems on Arrays

*Input and Output of an Array*

*Sum of All Elements*

*Maximum and Minimum Element*

*Reverse the Array*

*Count Even and Odd Numbers*

## 1D Array (One-Dimensional Array)

### Syntax:

```
data_type array_name[size];
```

### Example:

```
#include <stdio.h>

int main() {
    int marks[5] = {85, 90, 78, 92, 88};

    for(int i = 0; i < 5; i++) {
        printf("marks[%d] = %d\n", i, marks[i]);
    }
    return 0;
}
```

### Explanation:

1. `marks[5]` declares an array with 5 elements.
2. `marks[0]` is the first element.
3. You can access or modify elements using their **index** (starting from 0).

## 2D Array (Two-Dimensional Array)

A **2D array** is like a table with rows and columns.

Think of it as an array of arrays.

### Syntax:

```
data_type array_name[rows][columns];
```

### Example:

```
#include <stdio.h>

int main() {
    int matrix[2][3] = { {1, 2, 3}, {4, 5, 6} };

    for(int i = 0; i < 2; i++) {
        for(int j = 0; j < 3; j++) {
            printf("%d ", matrix[i][j]);
        }
        printf("\n");
    }
    return 0;
}
```

### Explanation:

`matrix[2][3]` means 2 rows and 3 columns.

Elements are accessed using two indices:

- ❑ `matrix[0][0] → 1`
- ❑ `matrix[1][2] → 6`

### Memory Concept

- ❑ 1D array stores elements sequentially in memory.
- ❑ 2D array stores elements **row-wise**

Example layout for `int a[2][3] = {{1,2,3},{4,5,6}}`:

Memory stores as → 1 2 3 4 5 6

## Basic Problems on Arrays

**Problem:** Take 5 integers from the user and print them.

```
#include <stdio.h>

int main() {
    int arr[5];
    for(int i = 0; i < 5; i++) {
        scanf("%d", &arr[i]);
    }
    for(int i = 0; i < 5; i++) {
        printf("%d ", arr[i]);
    }
    return 0;
}
```

### *Sum of All Elements*

**Problem:** Find the sum of elements in an array.

```
#include <stdio.h>

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

### *Maximum and Minimum Element*

**Problem:** Find the largest and smallest element in an array.

```
#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 max = a[0], min = a[0];
    for(int i = 1; i < n; i++) {
        if(a[i] > max) max = a[i];
        if(a[i] < min) min = a[i];
    }
    printf("Max = %d\nMin = %d", max, min);
    return 0;
}
```

### *Reverse the Array*

**Problem:** Print an array in reverse order.

```
#include <stdio.h>

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

    for(int i = n - 1; i >= 0; i--) {
        printf("%d ", a[i]);
    }
    return 0;
}
```

### *Count Even and Odd Numbers*

**Problem:** Count how many even and odd numbers are in an array.

```
#include <stdio.h>

int main() {
    int n, even = 0, odd = 0;
    scanf("%d", &n);
    int a[n];
    for(int i = 0; i < n; i++) {
        scanf("%d", &a[i]);
        if(a[i] % 2 == 0) even++;
        else odd++;
    }
    printf("Even = %d\nOdd = %d", even, odd);
    return 0;
}
```

## Basic Problems on 2D Arrays

### *Input and Output of a Matrix*

**Problem:** Take input for a matrix and print it in normal form.

```
#include <stdio.h>

int main() {
    int rows, cols;
    scanf("%d %d", &rows, &cols);
    int a[rows][cols];

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

    for(int i = 0; i < rows; i++) {
        for(int j = 0; j < cols; j++) {
            printf("%d ", a[i][j]);
        }
        printf("\n");
    }
    return 0;
}
```

### *Sum of All Elements in a Matrix*

**Problem:** Find the total sum of all elements.

```
#include <stdio.h>

int main() {
    int r, c, sum = 0;
    scanf("%d %d", &r, &c);
    int a[r][c];
```

```

    for(int i = 0; i < r; i++) {
        for(int j = 0; j < c; j++) {
            scanf("%d", &a[i][j]);
            sum += a[i][j];
        }
    }
    printf("Sum = %d", sum);
    return 0;
}

```

### *Row-wise and Column-wise Sum*

**Problem:** Print the sum of each row and each column separately.

```

#include <stdio.h>

int main() {
    int r, c;
    scanf("%d %d", &r, &c);
    int a[r][c];

    for(int i = 0; i < r; i++)
        for(int j = 0; j < c; j++)
            scanf("%d", &a[i][j]);

    for(int i = 0; i < r; i++) {
        int rowSum = 0;
        for(int j = 0; j < c; j++)
            rowSum += a[i][j];
        printf("Row %d Sum = %d\n", i + 1, rowSum);
    }

    for(int j = 0; j < c; j++) {
        int colSum = 0;
        for(int i = 0; i < r; i++)
            colSum += a[i][j];
        printf("Col %d Sum = %d\n", j + 1, colSum);
    }
}

```



```
    }

    return 0;
}
```

### *Transpose of a Matrix*

**Problem:** Convert rows into columns (swap indices).

```
#include <stdio.h>

int main() {
    int r, c;
    scanf("%d %d", &r, &c);
    int a[r][c], t[c][r];

    for(int i = 0; i < r; i++)
        for(int j = 0; j < c; j++)
            scanf("%d", &a[i][j]);

    for(int i = 0; i < r; i++)
        for(int j = 0; j < c; j++)
            t[j][i] = a[i][j];

    for(int i = 0; i < c; i++) {
        for(int j = 0; j < r; j++)
            printf("%d ", t[i][j]);
        printf("\n");
    }
}
```

### *Addition of Two Matrices*

**Problem:** Add two matrices of same size and display the result.

```
#include <stdio.h>

int main() {
    int r, c;
    scanf("%d %d", &r, &c);
    int a[r][c], b[r][c], sum[r][c];

    for(int i = 0; i < r; i++)
        for(int j = 0; j < c; j++)
            scanf("%d", &a[i][j]);

    for(int i = 0; i < r; i++)
        for(int j = 0; j < c; j++)
            scanf("%d", &b[i][j]);

    for(int i = 0; i < r; i++) {
        for(int j = 0; j < c; j++) {
            sum[i][j] = a[i][j] + b[i][j];
            printf("%d ", sum[i][j]);
        }
        printf("\n");
    }
    return 0;
}
```