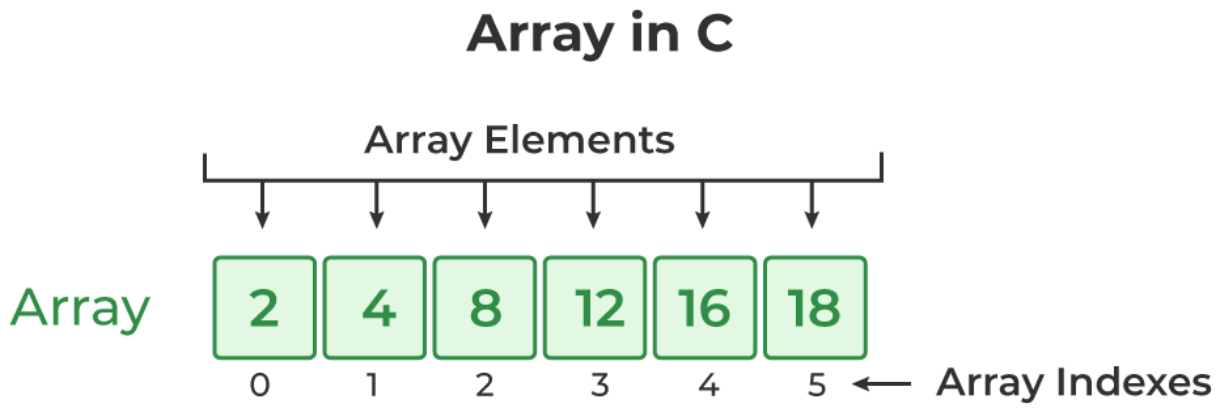
C Arrays

Difficulty Level : Easy • Last Updated : 06 Apr, 2023

Array in C is one of the most used data structures in C programming. It is a simple and fast way of storing multiple values under a single name. In this article, we will study the different aspects of array in C language such as array declaration, definition, initialization, types of arrays, array syntax, advantages and disadvantages, and many more.

What is Array in C?

An array in C is a fixed-size collection of similar data items stored in contiguous memory locations. It can be used to store the collection of primitive data types such as int, char, float, etc., and also derived and user-defined data types such as pointers, structures, etc.



C Array Declaration

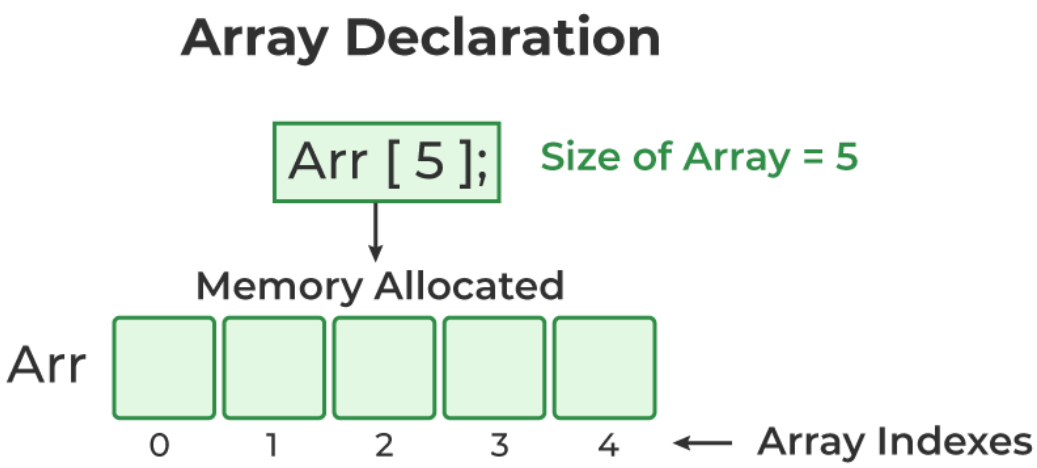
In C, we have to declare the array like any other variable before using it. We can declare an array by specifying its name, the type of its elements, and the size of its dimensions. When

we declare an array in C, the compiler allocates the memory block of the specified size to the array name.

Syntax of Array Declaration

```
data_type array_name [size];
        or
data_type array_name [size1] [size2]...[sizeN];
```

where N is the number of dimensions.



The C arrays are static in nature, i.e., they are allocated memory at the compile time.

Example of Array Declaration

C

```
// C Program to illustrate the array declaration
#include <stdio.h>
```

```
int main()
{

    // declaring array of integers
    int arr_int[5];
    // declaring array of characters
    char arr_char[5];

    return 0;
}
```

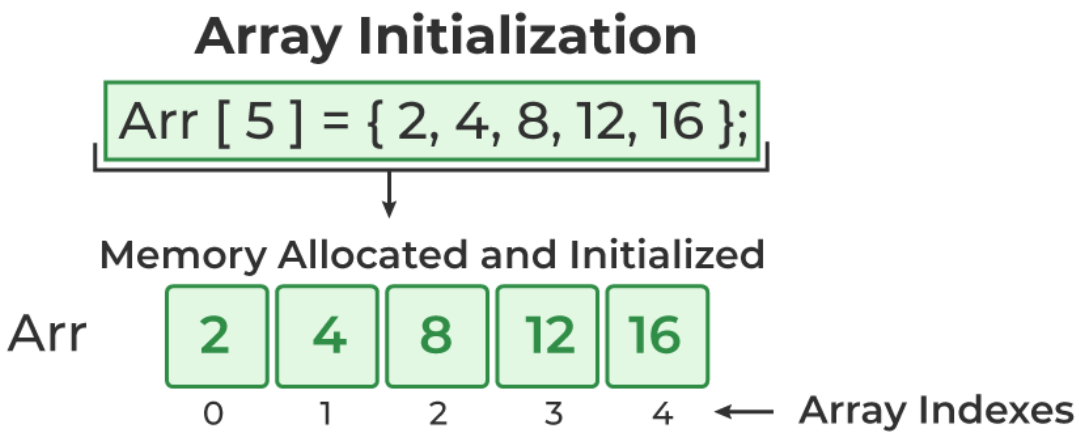
C Array Initialization

Initialization in C is the process to assign some initial value to the variable. When the array is declared or allocated memory, the elements of the array contain some garbage value. So, we need to initialize the array to some meaningful value. There are multiple ways in which we can initialize an array in C.

1. Array Initialization with Declaration

In this method, we initialize the array along with its declaration. We use an initializer list to initialize multiple elements of the array. An initializer list is the list of values enclosed within braces **{ }** separated b a comma.

```
data_type array_name [size] = {value1, value2, ... valueN};
```



2. Array Initialization with Declaration without Size

If we initialize an array using an initializer list, we can skip declaring the size of the array as the compiler can automatically deduce the size of the array in these cases. The size of the array in these cases is equal to the number of elements present in the initializer list as the compiler can automatically deduce the size of the array.

```
data_type array_name[] = {1,2,3,4,5};
```

The size of the above arrays is 5 which is automatically deduced by the compiler.

3. Array Initialization after Declaration (Using Loops)

We initialize the array after the declaration by assigning the initial value to each element individually. We can use for loop, while loop, or do-while loop to assign the value to each element of the array.

```
for (int i = 0; i < N; i++) {
    array_name[i] = valuei;
}
```

Example of Array Initialization in C

C

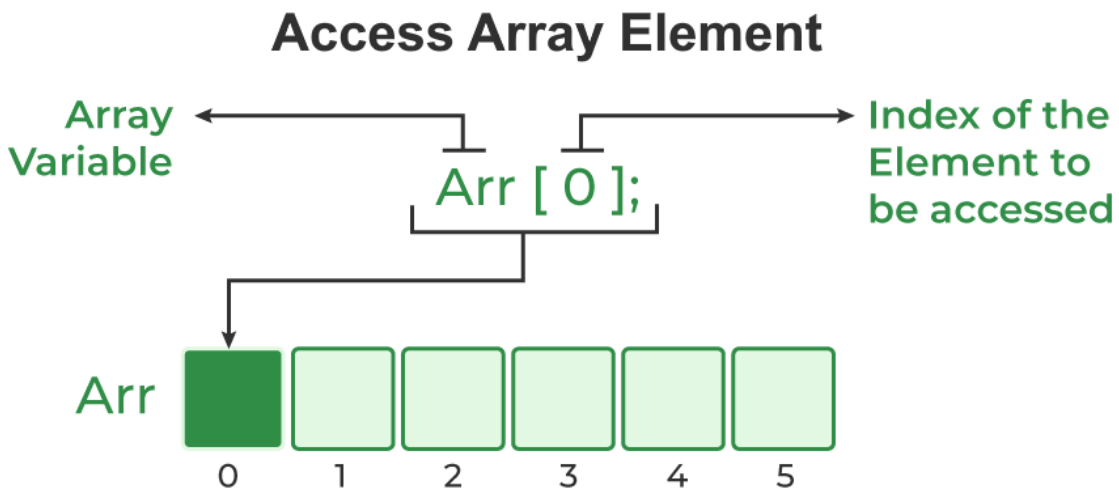
```c
// C Program to demonstrate array initialization
#include <stdio.h>

int main()
{

    // array initialization using initialier list
    int arr[5] = { 10, 20, 30, 40, 50 };

    // array initialization using initializer list without
    // specifying size
    int arr1[] = { 1, 2, 3, 4, 5 };

    // array initialization using for loop
    float arr2[5];
    for (int i = 0; i < 5; i++) {
        arr2[i] = (float)i * 2.1;
    }
    return 0;
}
```

Access Array Elements

We can access any element of an array in C using the array subscript operator **[ ]** and the index value ***i*** of the element.

```
array_name [index];
```

One thing to note is that the indexing in the array always starts with 0, i.e., the **first element** is at index **0** and the **last element** is at **N – 1** where **N** is the number of elements in the array.



Example of Accessing Array Elements using Array Subscript Operator

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C

```c
// C Program to illustrate element access using array
// subscript
#include <stdio.h>

int main()
{

    // array declaration and initialization
    int arr[5] = { 15, 25, 35, 45, 55 };

    // accessing element at index 2 i.e 3rd element
    printf("Element at arr[2]: %d\n", arr[2]);

    // accessing element at index 4 i.e last element
    printf("Element at arr[4]: %d\n", arr[4]);

    // accessing element at index 0 i.e first element
    printf("Element at arr[0]: %d", arr[0]);
```

```
    return 0;
}
```

Output

```
Element at arr[2]: 35
Element at arr[4]: 55
Element at arr[0]: 15
```

Update Array Element

We can update the value of an element at the given index i in a similar way to accessing an element by using the array subscript operator **[ ]** and assignment operator **=**.

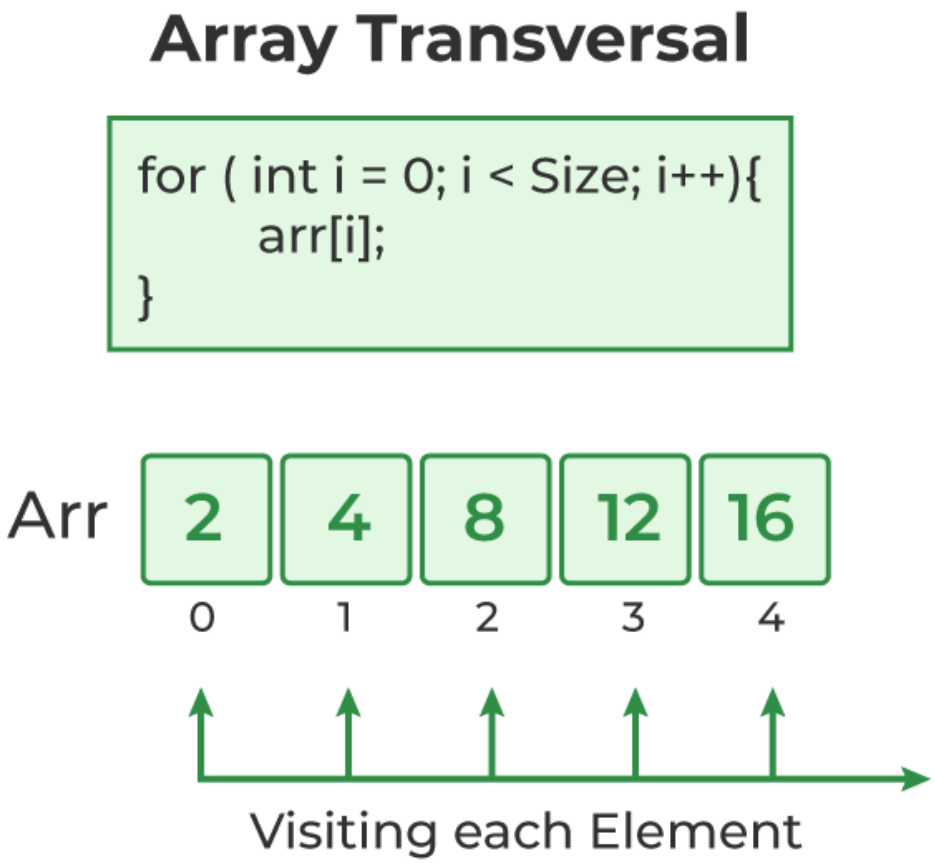
```
array_name[i] = new_value;
```

C Array Traversal

Traversal is the process in which we visit every element of the data structure. For C array traversal, we use loops to iterate through each element of the array.

Array Traversal using for Loop

```
for (int i = 0; i < N; i++) {
    array_name[i];
}
```



How to use Array in C?

The following program demonstrates how to use an array in the C programming language:

C

```
// C Program to demonstrate the use of array
#include <stdio.h>

int main()
{
    // array declaration and initialization
    int arr[5] = { 10, 20, 30, 40, 50 };

    // modifying element at index 2
    arr[2] = 100;

    // traversing array using for loop
  printf("Elements in Array: ");
    for (int i = 0; i < 5; i++) {
        printf("%d ", arr[i]);
    }

    return 0;
```

```
}
```

Output

```
Elements in Array: 10 20 100 40 50
```

Types of Array in C

There are two types of arrays based on the number of dimensions it has. They are as follows:

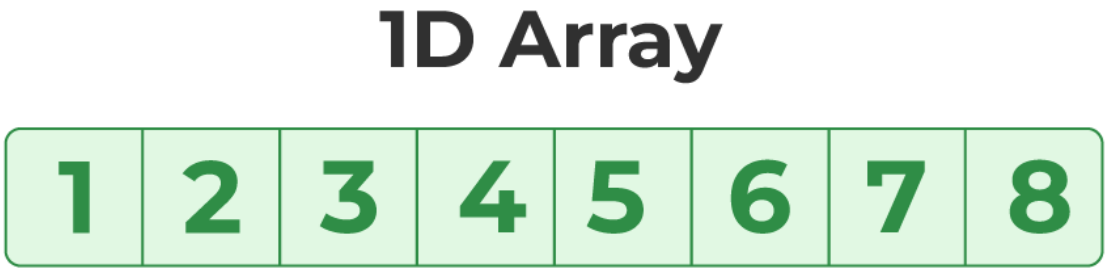
1. One Dimensional Arrays (1D Array)
2. Multidimensional Arrays

1. One Dimensional Array in C

The One-dimensional arrays, also known as 1-D arrays in C are those arrays that have only one dimension.

Syntax of 1D Array in C

```
array_name [size];
```



Example of 1D Array in C

C

```c
// C Program to illustrate the use of 1D array
#include <stdio.h>

int main()
{

    // 1d array declaration
    int arr[5];

    // 1d array initialization using for loop
    for (int i = 0; i < 5; i++) {
        arr[i] = i * i - 2 * i + 1;
    }

    printf("Elements of Array: ");
    // printing 1d array by traversing using for loop
    for (int i = 0; i < 5; i++) {
        printf("%d ", arr[i]);
    }

    return 0;
}
```

Output

```
Elements of Array: 1 0 1 4 9
```

Array of Characters (Strings)

In C, we store the words, i.e., a sequence of characters in the form of an array of characters terminated by a NULL character. These are called strings in C language.

C

```c
// C Program to illustrate strings
#include <stdio.h>

int main()
{

    // creating array of character
    char arr[6] = { 'G', 'e', 'e', 'k', 's', '\0' };

    // printing string
    int i = 0;
    while (arr[i]) {
        printf("%c", arr[i++]);
    }
    return 0;
}
```

Output

```
Geeks
```

To know more about strings, refer to this article – Strings in C

2. Multidimensional Array in C

Multi-dimensional Arrays in C are those arrays that have more than one dimension. Some of the popular multidimensional arrays are 2D arrays and 3D arrays. We can declare arrays with more dimensions than 3d arrays but they are avoided as they get very complex and occupy a large amount of space.

A. Two-Dimensional Array in C

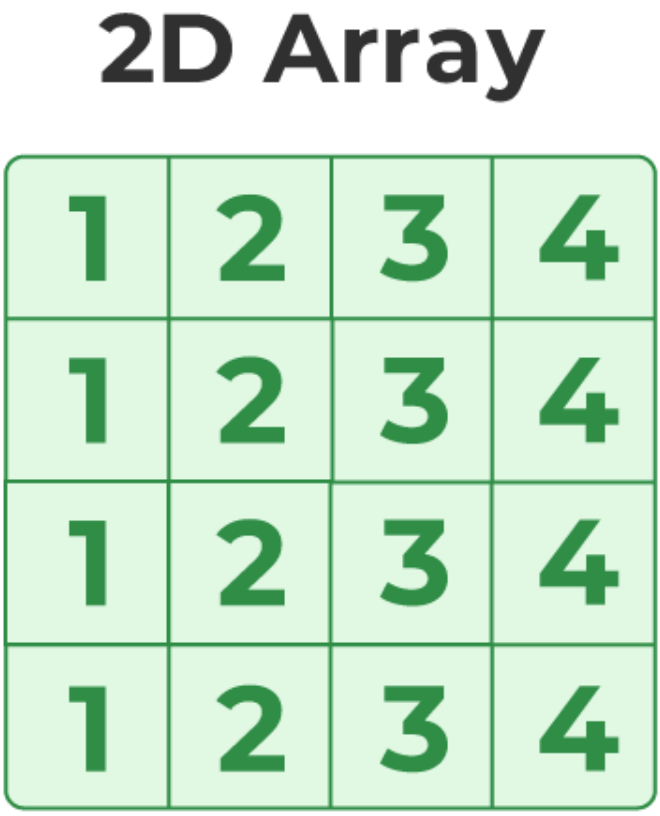
A Two-Dimensional array or 2D array in C is an array that has exactly two dimensions. They can be visualized in the form of rows and columns organized in a two-dimensional plane.

Syntax of 2D Array in C

```
array_name[size1] [size2];
```

Here,

- **size1:** Size of the first dimension.
- **size2:** Size of the second dimension.



Example of 2D Array in C

C

```c
// C Program to illustrate 2d array
#include <stdio.h>

int main()
{

    // declaring and initializing 2d array
    int arr[2][3] = { 10, 20, 30, 40, 50, 60 };

  printf("2D Array:\n");
    // printing 2d array
    for (int i = 0; i < 2; i++) {
        for (int j = 0; j < 3; j++) {
            printf("%d ",arr[i][j]);
        }
        printf("\n");
    }

    return 0;
}
```

Output

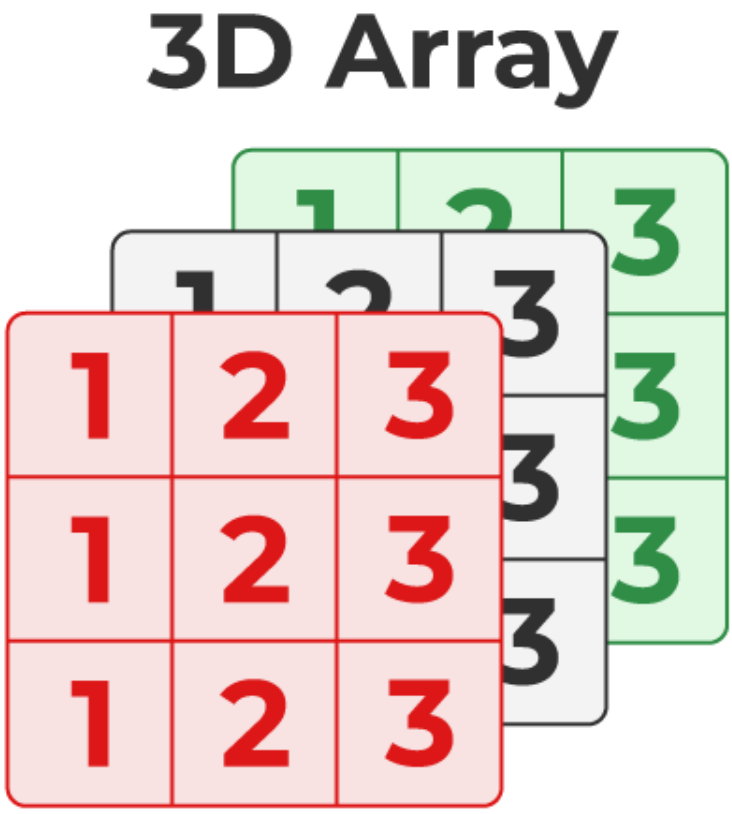
```
2D Array:
10 20 30
40 50 60
```

B. Three-Dimensional Array in C

Another popular form of a multi-dimensional array is Three Dimensional Array or 3D Array. A 3D array has exactly three dimensions. It can be visualized as a collection of 2D arrays stacked on top of each other to create the third dimension.

Syntax of 3D Array in C

```
array_name [size1] [size2] [size3];
```



Example of 3D Array

C

```c
// C Program to illustrate the 3d array
#include <stdio.h>

int main()
{

    // 3D array declaration
    int arr[2][2][2] = { 10, 20, 30, 40, 50, 60 };

    // printing elements
    for (int i = 0; i < 2; i++) {
        for (int j = 0; j < 2; j++) {
            for (int k = 0; k < 2; k++) {
                printf("%d ", arr[i][j][k]);
            }
            printf("\n");
        }
        printf("\n \n");
    }
    return 0;
}
```

Output

```
10 20
30 40



50 60
0 0
```

To know more about Multidimensional Array in C, refer to this article – Multidimensional Arrays in C

Relationship between Arrays and Pointers

Arrays and Pointers are closely related to each other such that we can use pointers to perform all the possible operations of the array. The array name is a constant pointer to the first element of the array and the array decays to the pointers when passed to the function.

C

```c
// C Program to demonstrate the relation between arrays and
```

```c
// pointers
#include <stdio.h>

int main()
{

    int arr[5] = { 10, 20, 30, 40, 50 };
    int* ptr = &arr[0];

    // comparing address of first element and address stored
    // inside array name
    printf("Address Stored in Array name: %p\nAddress of "
           "1st Array Element: %p\n",
           arr, &arr[0]);

    // printing array elements using pointers
    printf("Array elements using pointer: ");
    for (int i = 0; i < 5; i++) {
        printf("%d ", *ptr++);
    }
    return 0;
}
```

Output

```
Address Stored in Array name: 0x7ffce72c2660
Address of 1st Array Element: 0x7ffce72c2660
Array elements using pointer: 10 20 30 40 50
```

To know more about the relationship between an array and a pointer, refer to this article – Pointer to an Arrays | Array Pointer

Passing an Array to a Function in C

An array is always passed as pointers to a function in C. Whenever we try to pass an array to a function, it decays to the pointer and then passed as a pointer to the first element of an array.

We can verify this using the following C Program:

C

```c
// C Program to pass an array to a function
#include <stdio.h>

void printArray(int arr[])
{
    printf("Size of Array in Functions: %d\n", sizeof(arr));
    printf("Array Elements: ");
    for (int i = 0; i < 5; i++) {
        printf("%d ",arr[i]);
```

```
    }
}

// driver code
int main()
{

    int arr[5] = { 10, 20, 30, 40, 50 };

    printf("Size of Array in main(): %d\n", sizeof(arr));
    printArray(arr);
    return 0;
}
```

Output

```
Size of Array in main(): 20
Size of Array in Functions: 8
Array Elements: 10 20 30 40 50
```

Return an Array from a Function in C

In C, we can only return a single value from a function. To return multiple values or elements, we have to use pointers. We can return an array from a function using a pointer to the first element of that array.

C

```
// C Program to return array from a function
#include <stdio.h>

// function
int* func()
{
    static int arr[5] = { 1, 2, 3, 4, 5 };

    return arr;
}

// driver code
int main()
{

    int* ptr = func();

    printf("Array Elements: ");
    for (int i = 0; i < 5; i++) {
        printf("%d ", *ptr++);
    }
    return 0;
}
```

Output

```
Array Elements: 1 2 3 4 5
```

> ***Note:*** *You may have noticed that we declared static array using static keyword. This is due to the fact that when a function returns a value, all the local variables and other entities declared inside that function are deleted. So, if we create a local array instead of static, we will get segementation fault while trying to access the array in the main function.*

Properties of Arrays in C

It is very important to understand the properties of the C array so that we can avoid bugs while using it. The following are the main properties of an array in C:

1. Fixed Size

The array in C is a fixed-size collection of elements. The size of the array must be known at the compile time and it cannot be changed once it is declared.

2. Homogeneous Collection

We can only store one type of element in an array. There is no restriction on the number of elements but the type of all of these elements must be the same.

3. Indexing in Array

The array index always starts with 0 in C language. It means that the index of the first element of the array will be 0 and the last element will be N – 1.

4. Dimensions of an Array

A dimension of an array is the number of indexes required to refer to an element in the array. It is the number of directions in which you can grow the array size.

5. Contiguous Storage

All the elements in the array are stored continuously one after another in the memory. It is one of the defining properties of the array in C which is also the reason why random access is possible in the array.

6. Random Access

The array in C provides random access to its element i.e we can get to a random element at any index of the array in constant time complexity just by using its index number.

7. No Index Out of Bounds Checking

There is no index out-of-bounds checking in C/C++, for example, the following program compiles fine but may produce unexpected output when run.

C

```c
// This C program compiles fine
// as index out of bound
// is not checked in C.

#include <stdio.h>

int main()
{
    int arr[2];

    printf("%d ", arr[3]);
    printf("%d ", arr[-2]);

    return 0;
}
```

Output

```
 211343841 4195777
```

In C, it is not a compiler error to initialize an array with more elements than the specified size. For example, the below program compiles fine and shows just a Warning.

C

```c
#include <stdio.h>
int main()
{

    // Array declaration by initializing it
```

```
    // with more elements than specified size.
    int arr[2] = { 10, 20, 30, 40, 50 };

    return 0;
}
```

Warnings:

```
prog.c: In function 'main':
prog.c:7:25: warning: excess elements in array initializer
  int arr[2] = { 10, 20, 30, 40, 50 };
                         ^
prog.c:7:25: note: (near initialization for 'arr')
prog.c:7:29: warning: excess elements in array initializer
  int arr[2] = { 10, 20, 30, 40, 50 };
                             ^
prog.c:7:29: note: (near initialization for 'arr')
prog.c:7:33: warning: excess elements in array initializer
  int arr[2] = { 10, 20, 30, 40, 50 };
                                 ^
prog.c:7:33: note: (near initialization for 'arr')
```

Examples of Array in C

Example 1: C Program to perform array input and output.

In this program, we will use scanf() and print() function to take input and print output for the array.

C

```
// C Program to perform input and output on array
#include <stdio.h>

int main()
{

    // declaring an integer array
    int arr[5];

    // taking input to array elements one by one
    for (int i = 0; i < 5; i++) {
        scanf("%d", &arr[i]);
    }

    // printing array elements
    printf("Array Elements: ");
```

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

Input

```
5 7 9 1 4
```

Output

```
Array Elements: 5 7 9 1 4
```

Example 2: C Program to print the average of the given list of numbers

In this program, we will store the numbers in an array and traverse it to calculate the average of the number stored.

C

```
// C Program to the average to two numbers
#include <stdio.h>

// function to calculate average of the function
float getAverage(float* arr, int size)
{

    int sum = 0;
    // calculating cumilative sum of all the array elements
    for (int i = 0; i < size; i++) {
        sum += arr[i];
    }

    // returning average
    return sum / size;
}

// driver code
int main()
{

    // declaring and initializing array
    float arr[5] = { 10, 20, 30, 40, 50 };
    // size of array using sizeof operator
    int n = sizeof(arr) / sizeof(float);

    // printing array elements
    printf("Array Elements: ");
    for (int i = 0; i < n; i++) {
```

```
        printf("%.0f ", arr[i]);
    }

    // calling getAverage function and printing average
    printf("\nAverage: %.2f", getAverage(arr, n));
    return 0;
}
```

Output

```
Array Elements: 10 20 30 40 50
Average: 30.00
```

Example 3: C Program to find the largest number in the array.

C

```
// C Program to find the largest number in the array.
#include <stdio.h>

// function to return max value
int getMax(int* arr, int size)
{
    int max = arr[0];
    for (int i = 1; i < size; i++) {
        if (max < arr[i]) {
            max = arr[i];
        }
    }
    return max;
}

// Driver code
int main()
{

    int arr[10]
        = { 135, 165, 1, 16, 511, 65, 654, 654, 169, 4 };

    printf("Largest Number in the Array: %d",
           getMax(arr, 10));

    return 0;
}
```

Output

```
Largest Number in the Array: 654
```

Advantages of Array in C

The following are the main advantages of an array:

1. Random and fast access of elements using the array index.
2. Use of fewer lines of code as it creates a single array of multiple elements.
3. Traversal through the array becomes easy using a single loop.
4. Sorting becomes easy as it can be accomplished by writing fewer lines of code.

Disadvantages of Array in C

1. Allows a fixed number of elements to be entered which is decided at the time of declaration. Unlike a linked list, an array in C is not dynamic.
2. Insertion and deletion of elements can be costly since the elements are needed to be rearranged after insertion and deletion.

Conclusion

The array is one of the most used and important data structures in C. It is one of the core concepts of C language that is used in every other program. Though it is important to know about its limitation so that we can take advantage of its functionality.

FAQs on C Array

1. Define Array in C.

An array is a fixed-size homogeneous collection of elements that are stored in a contiguous memory location.

2. How to declare an array in C?

We can declare array in C using the following syntax:

```
datatype array_name [size];
```

3. How do you initialize an array in C?

We can initialize an array using two methods:

- Using Initializer list
- Using Loops

Using Initializer List

We can use an initializer list to initialize the array with the declaration using the following syntax:

```
datatype array_name [size] = {value1, value2,...valueN};
```

Using Loops

We can initialize an Array using Loops in C after the array declaration:

```
for (int i = 0; i < N; i++) {
    array_name[i] = valuei;
}
```

4. Why do we need Arrays?

We can use normal variables (v1, v2, v3, ..) when we have a small number of objects, but if we want to store a large number of instances, it becomes difficult to manage them with normal variables. The idea of an array is to represent many instances in one variable.

5. How can we determine the size of the C array?

We can determine the size of the Array using sizeof Operator in C. We first get the size of the whole array and divide it by the size of each element type.

6. What is the difference between Arrays and Pointers?

The following table list the differences between an array and a pointer:

Pointer	Array
A pointer is a derived data type that can store the address of other variables.	An array is a homogeneous collection of items of any type such as int, char, etc.
Pointers are allocated at run time.	Arrays are allocated at runtime.
The pointer is a single variable.	An array is a collection of variables of the same type.
Dynamic in Nature	Static in Nature.

Multidimensional Arrays in C

Difficulty Level : Easy • Last Updated : 21 Mar, 2023

Prerequisite: Arrays in C

A multi-dimensional array can be termed as an array of arrays that stores homogeneous data in tabular form. Data in multidimensional arrays is generally stored in row-major order in the memory.

The ***general form of declaring N-dimensional arrays*** is shown below.

Syntax:


```
data_type array_name[size1][size2]....[sizeN];
```

- **data_type**: Type of data to be stored in the array.
- **array_name**: Name of the array.
- **size1, size2,..., sizeN**: Size of each dimension.

Examples:

```
Two dimensional array: int two_d[10][20];
```

```
Three dimensional array: int three_d[10][20][30];
```

Size of Multidimensional Arrays:

The total number of elements that can be stored in a multidimensional array can be calculated by multiplying the size of all the dimensions.
For example:

- The array **int x[10][20]** can store total (10*20) = 200 elements.
- Similarly array **int x[5][10][20]** can store total (5*10*20) = 1000 elements.

To get the size of the array in bytes, we multiply the size of a single element with the total number of elements in the array.
For example:

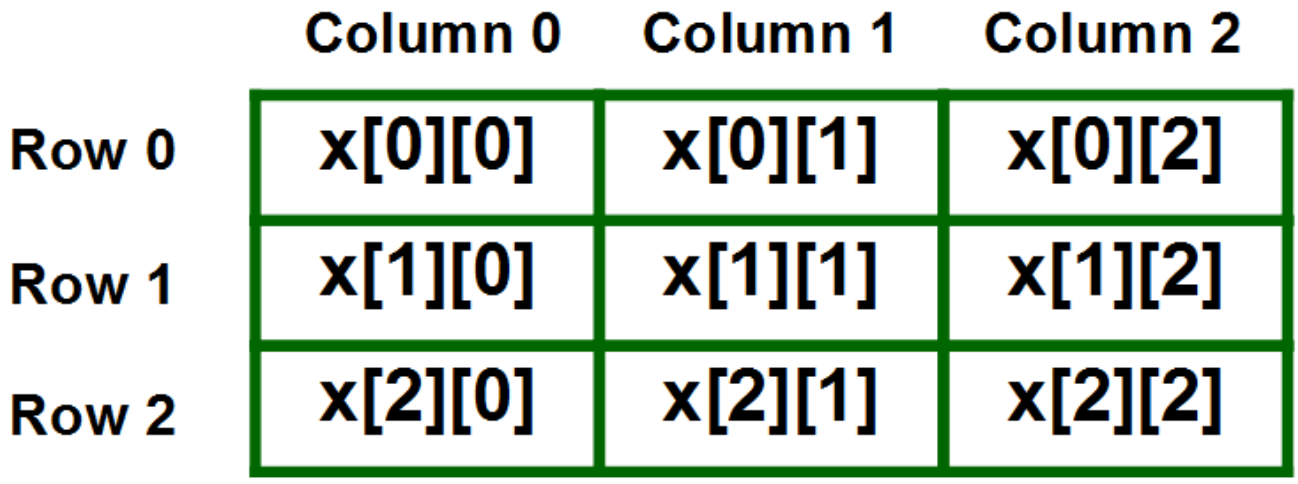
- Size of array **int x[10][20]** = 10 * 20 * 4 = 800 bytes. (where int = 4 bytes)
- Similarly, size of **int x[5][10][20]** = 5 * 10 * 20 * 4 = 4000 bytes. (where int = 4 bytes)

The most commonly used forms of the multidimensional array are:

1. **Two Dimensional Array**
2. **Three Dimensional Array**

Two-Dimensional Array in C

A **two-dimensional array** or **2D array** in C is the simplest form of the multidimensional array. We can visualize a two-dimensional array as an array of one-dimensional arrays arranged one over another forming a table with 'x' rows and 'y' columns where the row number ranges from 0 to (x-1) and the column number ranges from 0 to (y-1).



Graphical Representation of Two-Dimensional Array of Size 3 x 3

Declaration of Two-Dimensional Array in C

The basic form of declaring a 2D array with **x** rows and **y** columns in C is shown below.

Syntax:

```
data_type array_name[x][y];
```

where,

- **data_type:** Type of data to be stored in each element.
- **array_name:** name of the array
- **x:** Number of rows.
- **y:** Number of columns.

We can declare a two-dimensional integer array say 'x' with 10 rows and 20 columns as:

Example:

```
int x[10][20];
```

> *Note: In this type of declaration, the array is allocated memory in the stack and the size of the array should be known at the compile time i.e. size of the array is fixed. We can also create an array dynamically in C by using methods mentioned here.*

Initialization of Two-Dimensional Arrays in C

The various ways in which a 2D array can be initialized are as follows:

1. **Using Initializer List**
2. **Using Loops**

1. Initialization of 2D array using Initializer List

We can initialize a 2D array in C by using an initializer list as shown in the example below.

First Method:

```
int x[3][4] = {0, 1 ,2 ,3 ,4 , 5 , 6 , 7 , 8 , 9 , 10 , 11}
```

The above array has 3 rows and 4 columns. The elements in the braces from left to right are stored in the table also from left to right. The elements will be filled in the array in order:

the first 4 elements from the left will be filled in the first row, the next 4 elements in the second row, and so on.

Second Method (better):

```
int x[3][4] = {{0,1,2,3}, {4,5,6,7}, {8,9,10,11}};
```

This type of initialization makes use of nested braces. Each set of inner braces represents one row. In the above example, there is a total of three rows so there are three sets of inner braces. The advantage of this method is that it is easier to understand.

> *Note: The number of elements in initializer list should always be less than or equal to the total number of elements in the array.*

2. Initialization of 2D array using Loops

We can use any C loop to initialize each member of a 2D array one by one as shown in the below example.

Example:

```
int x[3][4];

for(int i = 0; i < 3; i++){
    for(int j = 0; j < 4; j++){
        x[i][j] = i + j;
    }
}
```

This method is useful when the values of each element have some sequential relation.

Accessing Elements of Two-Dimensional Arrays in C

Elements in 2D arrays are accessed using row indexes and column indexes. Each element in a 2D array can be referred to by:

Syntax:

```
array_name[i][j]
```

where,

- **i:** The row index.

- **j:** The column index.

Example:

```
int x[2][1];
```

The above example represents the element present in the third row and second column.

> ***Note**: In arrays, if the size of an array is N. Its index will be from 0 to N-1. Therefore, for row index 2 row number is 2+1 = 3. To output all the elements of a Two-Dimensional array we can use nested for loops. We will require two 'for' loops. One to traverse the rows and another to traverse columns.*

For printing the whole array, we access each element one by one using loops. The order of traversal can be row-major order or column-major order depending upon the requirement. The below example demonstrates the row-major traversal of a 2D array.

Example:

C

```c
// C Program to print the elements of a
// Two-Dimensional array

#include <stdio.h>

int main(void)
{
    // an array with 3 rows and 2 columns.
    int x[3][2] = { { 0, 1 }, { 2, 3 }, { 4, 5 } };

    // output each array element's value
    for (int i = 0; i < 3; i++) {
        for (int j = 0; j < 2; j++) {
            printf("Element at x[%i][%i]: ", i, j);
            printf("%d\n", x[i][j]);
        }
    }

    return (0);
}

// This code is contributed by sarajadhav12052009
```

Output

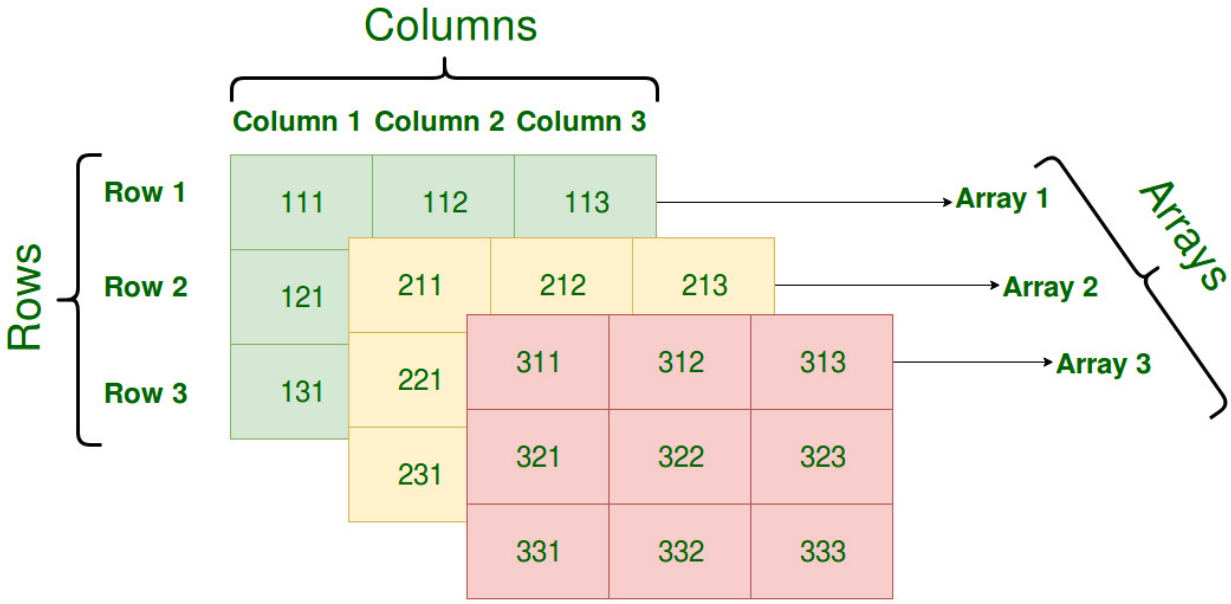
```
Element at x[0][0]: 0
Element at x[0][1]: 1
Element at x[1][0]: 2
Element at x[1][1]: 3
Element at x[2][0]: 4
Element at x[2][1]: 5
```

Time Complexity: O(N*M) ,where N(here 3) and M(here 2) are number of rows and columns repectively.

Space Complexity:O(1)

Three-Dimensional Array in C

A **Three Dimensional Array** or **3D** array in C is a collection of two-dimensional arrays. It can be visualized as multiple 2D arrays stacked on top of each other.



Graphical Representation of Three-Dimensional Array of Size 3 x 3 x 3

Declaration of Three-Dimensional Array in C

We can declare a 3D array with **x** 2D arrays each having **y** rows and **z** columns using the syntax shown below.

Syntax:

```
data_type array_name[x][y][z];
```

- **data_type:** Type of data to be stored in each element.
- **array_name:** name of the array

- **x:** Number of 2D arrays.
- **y:** Number of rows in each 2D array.
- **z:** Number of columns in each 2D array.

Example:

```
int array[3][3][3];
```

Initialization of Three-Dimensional Array in C

Initialization in a 3D array is the same as that of 2D arrays. The difference is as the number of dimensions increases so the number of nested braces will also increase.

A 3D array in C can be initialized by using:

1. **Initializer List**
2. **Loops**

Initialization of 3D Array using Initializer List

Method 1:

```
int x[2][3][4] = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10,
                  11, 12, 13, 14, 15, 16, 17, 18, 19,
                  20, 21, 22, 23};
```

Method 2(Better):

```
int x[2][3][4] =
 {
   { {0,1,2,3}, {4,5,6,7}, {8,9,10,11} },
   { {12,13,14,15}, {16,17,18,19}, {20,21,22,23} }
 };
```

Initialization of 3D Array using Loops

It is also similar to that of 2D array with one more nested loop for accessing one more dimension.

```
int x[2][3][4];

for (int i=0; i<2; i++) {
    for (int j=0; j<3; j++) {
        for (int k=0; k<4; k++) {
            x[i][j][k] = (some_value);
```

```
        }
    }
}
```

Accessing elements in Three-Dimensional Array in C

Accessing elements in 3D Arrays is also similar to that of 3D Arrays. The difference is we have to use three loops instead of two loops for one additional dimension in 3D Arrays.

Syntax:

```
array_name[x][y][z]
```

where,

- **x:** Index of 2D array.
- **y:** Index of that 2D array row.
- **z:** Index of that 2D array column.

C

```c
// C program to print elements of Three-Dimensional Array

#include <stdio.h>

int main(void)
{
    // initializing the 3-dimensional array
    int x[2][3][2] = { { { 0, 1 }, { 2, 3 }, { 4, 5 } },
                       { { 6, 7 }, { 8, 9 }, { 10, 11 } } };

    // output each element's value
    for (int i = 0; i < 2; ++i) {
        for (int j = 0; j < 3; ++j) {
            for (int k = 0; k < 2; ++k) {
                printf("Element at x[%i][%i][%i] = %d\n", i,
                       j, k, x[i][j][k]);
            }
        }
    }
    return (0);
}
```

Output

```
Element at x[0][0][0] = 0
Element at x[0][0][1] = 1
```

```
Element at x[0][1][0] = 2
Element at x[0][1][1] = 3
Element at x[0][2][0] = 4
Element at x[0][2][1] = 5
Element at x[1][0][0] = 6
Element at x[1][0][1] = 7
Element at x[1][1][0] = 8
Element at x[1][1][1] = 9
Element at x[1][2][0] = 10
Element at x[1][2][1] = 11
```

In similar ways, we can create arrays with any number of dimensions. However, the complexity also increases as the number of dimensions increases. The most used multidimensional array is the Two-Dimensional Array.

Arrays are also closely related to pointers in C language. To know more about the Relationship of Arrays with Pointers in C, refer to this article.

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How to print size of array parameter in C++?

Difficulty Level : Medium • Last Updated : 10 Mar, 2023

How to compute the size of an array CPP?

C++

```
// A C++ program to show that it is wrong to
// compute size of an array parameter in a function
#include <iostream>
using namespace std;

void findSize(int arr[])
{
  cout << sizeof(arr) << endl;
}

int main()
{
    int a[10];
    cout << sizeof(a) << " ";
    findSize(a);
    return 0;
}
```

Output

```
 40 8
```

Time Complexity: O(1)
Auxiliary Space: O(n) where n is the size of the array.

The above output is for a machine where the size of an integer is 4 bytes and the size of a pointer is 8 bytes.

The **cout** statement inside main prints 40, and **cout** in findSize prints 8. The reason is, arrays are always passed pointers in functions, i.e., findSize(int arr[]) and findSize(int *arr) mean exactly same thing. Therefore the cout statement inside findSize() prints the size of a pointer. See this and this for details.

How to find the size of an array in function?

We can pass a 'reference to the array'.

CPP

```cpp
// A C++ program to show that we can use reference to
// find size of array
#include <iostream>
using namespace std;

void findSize(int (&arr)[10])
{
    cout << sizeof(arr) << endl;
}

int main()
{
    int a[10];
    cout << sizeof(a) << " ";
    findSize(a);
    return 0;
}
```

Output

```
40 40
```

Time Complexity: O(1)

Space Complexity: O(n) where n is the size of array.

The above program doesn't look good as we have a hardcoded size of the array parameter.

We can do it better using templates in C++**.**

CPP

```cpp
// A C++ program to show that we use template and
// reference to find size of integer array parameter
#include <iostream>
using namespace std;

template <size_t n>
void findSize(int (&arr)[n])
{
    cout << sizeof(int) * n << endl;
}

int main()
{
    int a[10];
    cout << sizeof(a) << " ";
    findSize(a);
    return 0;
}
```

Output

```
 40 40
```

Time Complexity: O(1)

Space Complexity: O(n) where n is the size of array.

We can make a generic function as well:

CPP

```cpp
// A C++ program to show that we use template and
// reference to find size of any type array parameter
#include <iostream>
using namespace std;

template <typename T, size_t n>
void findSize(T (&arr)[n])
{
    cout << sizeof(T) * n << endl;
}
```

```
int main()
{
    int a[10];
    cout << sizeof(a) << " ";
    findSize(a);

    float f[20];
    cout << sizeof(f) << " ";
    findSize(f);
    return 0;
}
```

Output

```
40 40
80 80
```

Time Complexity: O(1)

Space Complexity: O(n)

Now the next step is to print the size of a dynamically allocated array.

It's your task man! I'm giving you a hint.

CPP

```
#include <iostream>
#include <cstdlib>
using namespace std;

int main()
{
    int *arr = (int*)malloc(sizeof(int) * 20);
    return 0;
}
```

This article is contributed by **Swarupananda Dhua** Please write comments if you find anything incorrect, or you want to share more information about the topic discussed above

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