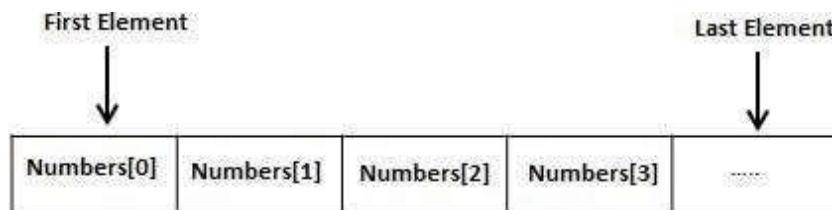


C Arrays

C programming language provides a data structure called the array, which can store a fixed-size sequential collection of elements of the same type. An array is used to store a collection of data, but it is often more useful to think of an array as a collection of variables of the same type.

Instead of declaring individual variables, such as `number0`, `number1`, ..., and `number99`, you declare one array variable such as `numbers` and use `numbers[0]`, `numbers[1]`, and ..., `numbers[99]` to represent individual variables. A specific element in an array is accessed by an index.

All arrays consist of contiguous memory locations. The lowest address corresponds to the first element and the highest address to the last element.



Declaring Arrays

To declare an array in C, a programmer specifies the type of the elements and the number of elements required by an array as follows:

```
type arrayName [ arraySize ];
```

This is called a single-dimensional array. The `arraySize` must be an integer constant greater than zero and `type` can be any valid C data type. For example, to declare a 10-element array called `balance` of type `double`, use this statement:

```
double balance[10];
```

Now `balance` is a variable array which is sufficient to hold up-to 10 double numbers.

Initializing Arrays

You can initialize array in C either one by one or using a single statement as follows:

```
double balance[5] = {1000.0, 2.0, 3.4, 17.0, 50.0};
```

The number of values between braces { } can not be larger than the number of elements that we declare for the array between square brackets []. Following is an example to assign a single element of the array:

If you omit the size of the array, an array just big enough to hold the initialization is created. Therefore, if you write:

```
double balance[] = {1000.0, 2.0, 3.4, 17.0, 50.0};
```

You will create exactly the same array as you did in the previous example.

```
balance[4] = 50.0;
```

The above statement assigns element number 5th in the array a value of 50.0. Array with 4th index will be 5th i.e. last element because all arrays have 0 as the index of their first element which is also called base index. Following is the pictorial representation of the same array we discussed above:

	0	1	2	3	4
balance	1000.0	2.0	3.4	7.0	50.0

Accessing Array Elements

An element is accessed by indexing the array name. This is done by placing the index of the element within square brackets after the name of the array. For example:

```
double salary = balance[9];
```

The above statement will take 10th element from the array and assign the value to salary variable. Following is an example which will use all the above mentioned three concepts viz. declaration, assignment and accessing arrays:

```
#include <stdio.h>

int main ()
{
    int n[ 10 ]; /* n is an array of 10 integers */
    int i,j;

    /* initialize elements of array n to 0 */
    for ( i = 0; i < 10; i++ )
```

```

{
    n[ i ] = i + 100; /* set element at location i to i + 100 */
}

/* output each array element's value */
for (j = 0; j < 10; j++ )
{
    printf("Element[%d] = %d\n", j, n[j] );
}

return 0;
}

```

When the above code is compiled and executed, it produces the following result:

```

Element[0] = 100
Element[1] = 101
Element[2] = 102
Element[3] = 103
Element[4] = 104
Element[5] = 105
Element[6] = 106
Element[7] = 107
Element[8] = 108
Element[9] = 109

```

Multi-dimensional Arrays

C programming language allows multidimensional arrays. Here is the general form of a multidimensional array declaration:

```
type name[size1][size2]...[sizeN];
```

For example, the following declaration creates a three dimensional 5 . 10 . 4 integer array:

```
int threedim[5][10][4];
```

Two-Dimensional Arrays

The simplest form of the multidimensional array is the two-dimensional array. A two-dimensional array is, in essence, a list of one-dimensional arrays. To declare a two-dimensional integer array of size x, y you would write something as follows:

```
type arrayName [ x ][ y ];
```

Where type can be any valid C data type and arrayName will be a valid C identifier. A two-dimensional array can be think as a table which will have x number of rows and y number of columns. A 2-dimentional array a, which contains three rows and four columns can be shown as below:

	Column 0	Column 1	Column 2	Column 3
Row 0	a[0][0]	a[0][1]	a[0][2]	a[0][3]
Row 1	a[1][0]	a[1][1]	a[1][2]	a[1][3]
Row 2	a[2][0]	a[2][1]	a[2][2]	a[2][3]

Thus, every element in array a is identified by an element name of the form a[i][j], where a is the name of the array, and i and j are the subscripts that uniquely identify each element in a.

Initializing Two-Dimensional Arrays

Multidimensional arrays may be initialized by specifying bracketed values for each row. Following is an array with 3 rows and each row has 4 columns.

```
int a[3][4] = {
    {0, 1, 2, 3}, /* initializers for row indexed by 0 */
    {4, 5, 6, 7}, /* initializers for row indexed by 1 */
    {8, 9, 10, 11} /* initializers for row indexed by 2 */
};
```

The nested braces, which indicate the intended row, are optional. The following initialization is equivalent to previous example:

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

Accessing Two-Dimensional Array Elements

An element in 2-dimensional array is accessed by using the subscripts, i.e., row index and column index of the array. For example:

```
int val = a[2][3];
```

The above statement will take 4th element from the 3rd row of the array. You can verify it in the above diagram. Let us check below program where we have used nested loop to handle a two dimensional array:

```
#include <stdio.h>

int main ()
{
    /* an array with 5 rows and 2 columns*/
```

```

int a[5][2] = { {0,0}, {1,2}, {2,4}, {3,6},{4,8}};
int i, j;

/* output each array element's value */
for ( i = 0; i < 5; i++ )
{
    for ( j = 0; j < 2; j++ )
    {
        printf("a[%d][%d] = %d\n", i,j, a[i][j] );
    }
}
return 0;
}

```

When the above code is compiled and executed, it produces the following result:

```

a[0][0]: 0
a[0][1]: 0
a[1][0]: 1
a[1][1]: 2
a[2][0]: 2
a[2][1]: 4
a[3][0]: 3
a[3][1]: 6
a[4][0]: 4
a[4][1]: 8

```

As explained above, you can have arrays with any number of dimensions, although it is likely that most of the arrays you create will be of one or two dimensions.

Passing Arrays as Function Arguments

If you want to pass a single-dimension array as an argument in a function, you would have to declare function formal parameter in one of following three ways and all three declaration methods produce similar results because each tells the compiler that an integer pointer is going to be received. Similar way you can pass multi-dimensional array as formal parameters.

Way-1

Formal parameters as a pointer as follows. You will study what is pointer in next chapter.

```

void myFunction(int *param)
{
    .
    .
    .
}

```
