Introduction to Programming
Arrays

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Summary

- Array's definition
- Arrays declaration
- Arrays declaration (manual assignment of elements)
- Programs
- Two-dimensional arrays.
- Some programs

Arrays

- In C++, an array is a variable that can store multiple values of the same type.

or

- An array is a structured collection of elements of the same data type, stored in contiguous (adjacent) memory locations. The total number of elements in an array determines its size.

But why do we need arrays?

Let us consider an example about the calculation of the average marks of 59 students. At first, we will declare 59 variables (One for each) to store the grade of each student, and then sum up all the grades and divide this by 59 (The Number of total students) to get the average.

And Arrays are the possible solution to the problem.

Instead of creating 59 separate variables, we can simply create an array:

int grade[59]; dataType arrayName[arraySize];

C++ Array

```
int grade     [59] ;
dataType arrayName[arraySize];
```

- In C++, every array has a data type i.e., name and size.
- The rules of variable naming conventions apply to array names.
- The size of the array tells how many elements are there in the array.
- The size of the array should be a precise number.
- An element of an array accessed by its subscript value also called index.

Array are divided into two types. These are:

i. One-dimensional arrays
ii. Multi-dimensional arrays

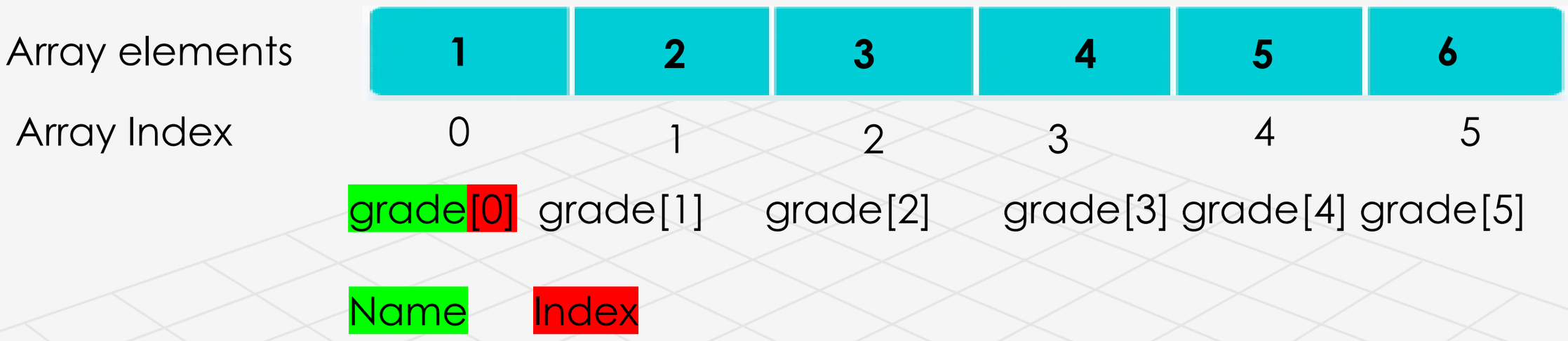
One-dimensional Array |Array Declaration

- One-dimensional array is also known as a list or a linear array. It consists of only one row or column. as the following array:
- Declaring one-dimensional array, like any other variable declaration, defining the name of the array, its type, and total number of element of an array or size | |of an array as following.

int grade [6] ;

- int - type of element to be stored
- grade - name of the array
- 6 - size of the array

Memory image/Digram of an array



Program

Write a program to declare one-dimensional array and retrieve the first element of an array

```
#include <iostream>
using namespace std;
int main()
{
    int first_Array [5];
    first_Array[0]=1;
    first_Array[1]=2;
    first_Array[2]=3;
    first_Array[3]=4;
    first_Array[4]=5;
    cout <<"The first element of an array is : "<<first_Array[0];
    return 0;
}
```

Index

```
The first element of an array is : 1
Process returned 0 (0x0)   execution time : 0.105 s
Press any key to continue.
```

Program

Write a program to declare a one-dimensional array for all subjects' marks, count the, Subjects and find the average marks.

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

int main() {
    int length = 6;
    int marks[length] = {23, 20, 27, 28, 29,19};
    float sum = 0.0;

    for (int i = 0; i < length; i++) {
        sum += marks[i];
    }

    float avg = sum / length;

    cout << "Number of subjects: " << length << endl;
    cout << "Sum: " << sum << endl;
    cout <<"Average: " << avg;
    return 0;
}
```

```
Number of subjects: 6
Sum: 146
Average: 24.3333
Process returned 0 (0x0)   execution
Press any key to continue.
```

Program

Write a program to declare a string type array and return all the stings in that array.

```
Subjects: ITP, Calculus, English, ITC, Physics, Islamyat
Process returned 0 (0x0)   execution time : 0.089 s
Press any key to continue.
```

```cpp
#include <iostream>
#include <string>
using namespace std;

int main() {
    const int length = 6;
    string subjects[length] = {"ITP", "Calculus", "English",
                               "ITC", "Physics", "Islamyat"};

    cout << "Subjects: ";
    for (int i = 0; i < length; i++) {
        cout << subjects[i];
        // Add comma except after last subject
        if (i < length - 1) {
            cout << ", ";
        }
    }

    return 0;
}
```

Program

Write a program to declare an int type array and find the largest number in a given array

```
Largest number is : 99

Process returned 0 (0x0)   execution time :
Press any key to continue.
```

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

int main() {
    int length =5;
    int grades[length] = {99, 78, 96, 88,92};
    int large = grades[0];

    for (int i = 0; i < length; i++) {
        if (grades[i] > large)
            large = grades[i];
    }

    cout << "Largest number is : " << large << endl;
    return 0;
}
```

Program

'''

```cpp
#include <iostream>
#include <iomanip> // For setw() formatting
using namespace std;

int main() {
    // Arrays for subjects and corresponding marks
    int length = 5;
    string subjects[length] = {"Calculas", "Physics", "English", "Islamiyat", "ITP"};
    int marks[length] = {22, 20, 27, 28, 19};
     // Number of subjects/marks

    cout << "Student Grade Report"<<endl;
    cout << "--------------------\n";
    // Print each subject with its mark
    for(int i = 0; i < length; i++) {
       cout << setw(12) << left << subjects[i] << ": " << marks[i] << endl;

        //cout << subjects[i] << ": " << marks[i] << endl;
    }
    // Find and print the highest mark
    int maxIndex = 0;
    for(int i = 1; i < length; i++) {
        if(marks[i] > marks[maxIndex]) {
            maxIndex = i;
        }
    }
    cout << "\nHighest Grade:\n";
    cout << subjects[maxIndex] << ": " << marks[maxIndex] << endl;

    return 0;
}
```

```
Student Grade Report
--------------------
Calculas    : 22
Physics     : 20
English     : 27
Islamiyat   : 28
ITP         : 19

Highest Grade:
Islamiyat: 28
```

Program

Write a two-dimensional 2x2 array and retrieve all the elements of the array.

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

int main() {
    int myarray[2][3] = {{1, 2, 3},
                         {4, 5, 6}};
    for (int i = 0; i < 2; i++){
        for (int j = 0; j < 3; j++){
            cout << myarray[i][j]<<" ";
    }
        //cout <<endl;
    }
    return 0;
}
```

```
1 2 3 4 5 6
Process returned 0 (0x0)   execution
Press any key to continue.
```

Program

Write a two-dimensional 3x3 array and retrieve all the elements of the array.

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

int main() {
    int myarray[3][3] = {{1, 2, 3},
                         {4, 5, 6},
                         {7, 8,9}};
    for (int i = 0; i < 3; i++){
        for (int j = 0; j < 3; j++){
            cout << myarray[i][j]<<" ";
    }
        //cout <<endl;
    }
    return 0;
}
```

```
1 2 3 4 5 6 7 8 9
Process returned 0 (0x0)   execution
Press any key to continue.
```

C++ for loop to find factorial of a given number

Write a C++ for loop to find factorial of a given number.

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

int main() {
    cout << "Enter a number to find factorial: ";
    int number;
    cin >> number;

    int factorial = 1;

    for (int i = 1; i <= number; i++) {
        factorial *= i;
    }

    cout << "Factorial of " << number << " is: " << factorial << endl;
    return 0;
}
```

```
Enter a number to find factorial: 4
Factorial of 4 is: 24

Process returned 0 (0x0)   execution
Press any key to continue.
```

Continue when to use???

Write a C++ for loop to iterate over the following array and retrieve only the odd numbers.

```
Odd numbers from 1 to 10:
1 3 11 41
Process returned 0 (0x0)   execution time : 0.015 s
Press any key to continue.
```

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

int main() {
    cout << "Odd numbers from 1 to 10:" <<endl;
int arr[8]= {1,2,3,4,11,6,41,8};
    for (int i : arr) {
        if (i % 2 == 0) {
            continue; // Skip even numbers
        }
        cout << i << " ";
    }
    return 0;
}
```

Continue when to use???

```
Odd numbers from 1 to 10:
1 3 11 41
Process returned 0 (0x0)   execution time : 0.015 s
Press any key to continue.
```

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

int main() {
    cout << "Odd numbers from 1 to 10:" << endl;
    int arr[8] = {1, 2, 3, 4, 11, 6, 41, 8};

    for (int i = 0; i < 8; i++) {
        if (arr[i] % 2 != 0) {
            cout << arr[i] << " ";
        }
    }

    return 0;
}
```

Assignment # 3

1) Briefly explain Two-dimensional arrays, with an example, and write some built-in function for arrays.
2) Write a program to return the following results. Hints as follows.

NOTE: MUST BE HAND WRITTEN AND AT LEAST 3 PAGES

Deadline Submit in next class

```
string subjects[length] = {"Calculas", "Physics", "English", "Islamiyat", "ITP"};
int marks[length] = {22, 20, 27, 28, 19};
```

```
Student Grade Report
--------------------
Calculas    : 22
Physics     : 20
English     : 27
Islamiyat   : 28
ITP         : 19

Highest Grade:
Islamiyat: 28
```

Thanks