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## INTRODUCTION TO C++

C++ is very similar to the C Language.

- For the input/output stream we use **<iostream>** library (in C it was <stdio>).
- For taking input and out we **cout** and **cin** (in C it was printf and scanf).
  - cout uses **insertion ( << ) operator**.
  - cin uses **extraction ( >> ) operator**.

### Sample C++ Code:

```
#include <iostream>
using namespace std;
int main()
{
    int var = 0;

    cout << "Enter an Integer value: ";
    cin >> var;
    cout << "Value of var is : " << var;
    return 0;
}
```

Sample Run: In this sample run, the user input is shaded.  
Enter an Integer value: 12  
Value of var is : 12

# DIFFERENCE BETWEEN C AND C++

The key differences include:

C	C++
It is a structural or procedural programming language.	It is an object oriented programming language.
Emphasis is on procedure or steps to solve a problem	Emphasis is on objects rather than procedure
Functions are the fundamental building blocks.	Objects are the fundamental building blocks.
In C, the data is not secured.	Data is hidden and can't be accessed by external functions.
C uses scanf() and printf() functions for standard input and output.	C uses cin>> and cout<< functions for standard input and output.
In C, namespace feature is absent.	In C++, namespace feature is present.
C program file is saved with .C extension.	C++ program file is saved with .CPP extension.

## ARRAYS:

- An Array is a collection of fixed number of elements of same data type.

### 1-D ARRAY:

- 1-D Array is a form of array in which elements are arranged in a form of List.
- To declare a 1D array you need to specify the data type, name and array size.

```
dataType arrayName [ arraySize ] ;
```

- Following is the declaration of a 1D array.

```
int numArray[5];
```

- Data Type: Integers
- Name: numArray
- Size: 5

- To access array element you use the array name along with the index in subscript operator "[ ]".

```
numArray[0], numArray[1], numArray[2], numArray[3], numArray[4].
```

- Index of the array starts with **zero '0'**.
- Index of the last element is always **'size - 1'** (in this case it is 4).

## Example Code for 1-D Array:

```
//Program to read five numbers, find their sum, and
//print the numbers in reverse order.

#include <iostream>
using namespace std;
int main()
{
    int item[5]; //Declare an array item of five components
    int sum = 0;
    int counter;

    cout << "Enter five numbers: ";

    for (counter = 0; counter < 5; counter++)
    {
        cin >> item[counter];
        sum = sum + item[counter];
    }

    cout << endl;

    cout << "The sum of the numbers is: " << sum << endl;
    cout << "The numbers in reverse order are: ";

    //Print the numbers in reverse order.
    for (counter = 4; counter >= 0; counter--)
        cout << item[counter] << " ";

    cout << endl;
    return 0;
}
```

Sample Run: In this sample run, the user input is shaded.

Enter five numbers: 12 76 34 52 89

The sum of the numbers is: 263

The numbers in reverse order are: 89 52 34 76 12

## 2-D ARRAY:

- 2-D Array is a collection of fixed collection of elements arranged in **rows and columns**.
- To declare a 2D array you need to specify the data type, name and no. of rows and columns.

```
dataType arrayName [ rowSize ][ columnSize ] ;
```

- Following is the declaration of a 1D array.

```
int numArray[5][5];
```

- Data Type: Integers
  - Name: numArray
  - Rows: 5
  - Columns: 5
- To access array element you use the array name along with the rowIndex and columnIndex in subscript operator “[[]]”.

```
numArray[0][0], numArray[1][1], numArray[2][2], numArray[3][3],
numArray[4][4].
```

- Index for the rows and columns of the array starts with **zero '0'**.
- Index of the last element in rows and columns is always '**sizeofRow - 1**' and '**sizeofColumn - 1**' respectively (in this case it is 4).

## Example Code for 2-D Array:

```
//Program to read a 2D array of size 3x3 find the sum for each row,
//print the sum line by line.
```

```
#include <iostream>
using namespace std;
int main()
{
    int item[3][3]; //Declare an array of size 3x3
    int sum = 0;
    int row, col;

    cout << "Enter array elements: " << endl;

    for (row = 0; row < 3; row++)
    {
        for (col = 0; col < 3; col++)
        {
            cin >> item[row][col];
            sum = sum + item[row][col];
        }

        cout << "The sum of row " << i << " : " << sum <<
endl;
    }

    cout << endl;
    return 0;
}
```

Sample Run: In this sample run, the user input is shaded.  
Enter array elements:

```
12 76 34
```

The sum of row 0 : 122

52 89 48

The sum of row 1 : 189

22 63 99

The sum of row 2 : 184

# POINTERS:

A Pointer is a variable whose content is a memory address.

## Single Pointers:

- To declare a single pointer variable you need to specify the data type, an asterisk symbol ( \* ) and the name of the pointer variable.

```
dataType *ptrName;
```

- Following is the declaration of a Pointer variable.

```
int *ptr;
```

- DataType: Integer
- Name: ptr
- Pointer variable holds the memory address of the variable which is of same data type (integer in this case).
- To assign the memory address of any variable to the pointer variable we use **Address of Operator ( & )**.

```
int intVar = 5;  
ptr = &intVar;
```

- In this statement **ptr** now holds the memory address of an integer variable '**intVar**'.
- To access the value at the memory address (currently stored) in the variable we use **Dereferencing Operator ( \* )**.
  - Do not confuse this with the symbol used for the declaration of a pointer.

```
int intVar2 = *ptr;
```

- In this statement another integer variable '**intVar2**' is now initialized with the value at the memory address which is stored in **ptr** (that is the value of intVar).

## Example Code for Single Pointers:

The following program illustrates how pointer variables work:

```
#include <iostream>
using namespace std;
int main()
{
    int *p;
    int x = 37;
    cout << "Line 1: x = " << x << endl; //Line 1
    p = &x; //Line 2
    //Line 3
    cout << "Line 3: *p = " << *p << ", x = " << x << endl;
    *p = 58; //Line 4
    //Line 5
    cout << "Line 5: *p = " << *p << ", x = " << x << endl;
    cout << "Line 6: Address of p = " <<&p << endl; //Line 6
    cout << "Line 7: Value of p = " << p << endl; //Line 7
    cout << "Line 8: Value of the memory location " << "pointed to
    by *p = " << *p << endl; //Line 8
    cout << "Line 9: Address of x = " <<&x << endl; //Line 9
    cout << "Line 10: Value of x = " << x << endl; //Line 10
    return 0;
}
```

### Sample Run:

```
Line 1: x = 37
Line 3: *p = 37, x = 37
Line 5: *p = 58, x = 58
Line 6: Address of p = 006BFDF4
Line 7: Value of p = 006BFDF0
Line 8: Value of the memory location pointed to by *p = 58
Line 9: Address of x = 006BFDF0
Line 10: Value of x = 58
```

## DYNAMIC VARIABLES:

Variables created during the program execution are called **dynamic variables**.

- To create a dynamic variable we use **new** operator.

```
new dataType;           // to allocate a single variable
new dataType [ size];    // to allocate an array of variables.
```

- The new operator allocates the memory of a designated type.
- It returns a pointer to the allocated memory.
- Following is the declaration of a dynamic variable.

```
int p = new int;
char cArray = new char[5];
```

- Line 01: creates a single variable of integer type.
- Line 02: Creates an array of 5 characters.
- To delete the dynamically allocated memory we use **delete** operator.

```
delete ptrVar;          //to deallocate single dynamic variable
delete [] ptrArray;     //to deallocate dynamically created array
```

- **delete** operator is used to free the memory which is dynamically allocated using **new** operator.

## Example Code for Dynamic Variables:

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

int main()
{
    int* intPtr;

    char* charArray;
    int arraySize;

    intPtr = new int; // allocating memory to single variable

    cout << "Enter an Integer Value: ";
    cin >> *intPtr;
    cout << "Enter the size of the Character Array : ";
    cin >> arraySize;

    charArray = new char[arraySize]; // allocating memory to array

    for (int i = 0; i < arraySize; i++)
        cin >> charArray[i];

    for (int i = 0; i < arraySize; i++)
        cout << charArray[i];
```



```
        return 0;
    }
}
```

Sample Run: In this sample run, the user input is shaded.

Enter an Integer Value: 2

Enter the size of the Character Array : 2

a b

ab

## STRUCTURES:

- A structure is a collection of fixed number of components in which the components are accessed by name. The components may be of different types.
- Components of a structure are called members of the structure.
- To declare a structure you need to use the “**struct**” keyword along with the structure name.
  - The **struct** block then contains all the members, which are variables of different/same type.

```
struct structName
{
    dataType1 varName1;
    dataType2 varName2;
    . . .
    dataTypeN varNameN;
}
```

- To declare an object of the structure you need to use the **name of structure** and then the name of **structure object**.

```
struct studentStruct
{
    string firstName;
    string lastName;
    char courseGrade;
    int testScore;
    double GPA;
};
```

```
studentStruct Obj;
```

## Example Code for Structure:

```
#include<iostream>

using namespace std;

struct studentType
{
    string firstName;
    string lastName;
    char courseGrade;
    int courseScore;
    double GPA;
};

int main()
{
    studentType newStudent;

    cout << "Enter Details for the Student";

    cout << "Enter Student's First Name : ";
    cin >> newStudent.firstName;

    cout << "Enter Student's Last Name : ";
    cin >> newStudent.lastName;

    cout << "Enter Student's Course Grade : ";
    cin >> newStudent.courseGrade;

    cout << "Enter Student's Course Score : ";
    cin >> newStudent.courseScore;

    cout << "Enter Student's GPA : ";
    cin >> newStudent.GPA;

    cout << newStudent.firstName << endl;
    cout << newStudent.lastName << endl;
    cout << newStudent.courseGrade << endl;
    cout << newStudent.courseScore << endl;
    cout << newStudent.GPA << endl;

}
```

Sample Run: In this sample run, the user input is shaded.

```
Enter Details for the Student
Enter Student's First Name : First_Name
Enter Student's Last Name : Last_Name
Enter Student's Course Grade : A
Enter Student's Course Score : 84
Enter Student's GPA : 2.0
```

```
First_Name
Last_Name
A
84
2
```

## LAB TASKS:

### Task - 01:

A car traveled for some hours. The time car traveled is taken at run time of the program, and it must not be negative and must be between one to five hours. The car had not traveled same distance in each hour. The distance that the car covered must not be negative. Write a C++ Program that computes the Average Speed of the Car in miles per hour.

Hint: the restrictions can be displayed in the form of message on the window.  
Format your output with two decimal places.

### Task - 02:

Write a C++ program that accepts an employee's ID, total worked hours of a month and the amount he received per hour. Print the employee's ID and salary (with two decimal places) of a particular month.

Sample Input /Output:

Input the Employees ID: 0342

Input the working hrs: 8

Salary amount/hr: 15000

Expected Output:

Employees ID = 0342

Salary = 120000.00

### Task - 03:

Write C++ program to create a BMI calculator application that reads the user's weight in pounds and height in inches (or, if you prefer, the user's weight in kilograms and height in meters), then calculates and displays the user's body mass index. Also, the application should display the following information from the Department of Health and Human Services/National Institutes of Health so the user can evaluate his/her BMI.

BMI VALUES

Underweight: less than 18.5

Normal: between 18.5 and 24.9

Overweight: between 25 and 29.9

Obese: 30 or greater

### Task - 04:

Write a program that reads a student name followed by five test scores. The program should output the student name, the five test scores, and the average test score. Output the average test score with two decimal places.

#### **Input:**

```
Andrew Miller 87.50 89 65.75 37 98.50
```

#### **Output:**

Student name: Andrew Miller

Test scores: 87.50 89.00 65.75 37.00 98.50

Average test score: 75.55

### Task - 05:

Develop a user-registration system have the following options.

- a. Ask the user for a user-name (5 alphabets).
- b. Password should be 6 characters long with at least 1 numeric, 1 capital and 1 small letter.
- c. Display a "Account Created Successfully".
- d. Login the user with correct username and password.
- e. Display "Welcome username, you are now logged in".

### Task - 06:

Write a structure to store the roll no., name, age (between 11 to 14) and address of students (more than 10). Store the information of the students.

1. Write a function to print the names of all the students having age 14.
2. Write another function to print the names of all the students having even roll no.
3. Write another function to display the details of the student whose roll no is given (i.e. roll no. entered by the user).