OBJECT ORIENTED PROGRAMMING LAB

Lab Manual # 04

Classes and Objects in C++

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OBJECT ORIENTED PROGRAMMING LANGUAGE

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Object Oriented Programming (OOP)

OOP is methodology or paradigm to design a program using class and object.

OOP is paradigm that provides many concepts such as:

- Classes and objects
- Encapsulation (binding code and its data) etc.
- Inheritance
- Polymorphism
- Abstraction
- Overloading

Class

- A Class is a collection of data and functions. The data items and functions are defined within the class. Functions are written to work upon the data items and each function has a unique relationship with data items of the class.
- Classes are defined to create user defined data types. These are similar to built-in data types available in all programming languages.
- Definition of data type does not create any space in the computer memory. When a variable of that data type is declared, a memory space is reserved for that variable.
- Similarly, when a class is defined, it does not occupy any space in the computer memory. It only defines the data items and the member function that can be used to work upon its data items. Thus, defining a class only specifies its data members and the relationship between the data items through it functions.

Defining a class

A class is defined in a similar way as structure is defined. The keyword "**class**" is used to define the class. The general syntax to define a class is:

```
class class_name

{

body of the class;

};
```

class is a keyword that is used to define a class.

class_name It represents the name of the class.

body of classs The body of the class consist of the data items and the functions. These are called members of the class. These are written between braces.

Semicolon (;) The body of a class ends with semicolon.

Members of a class

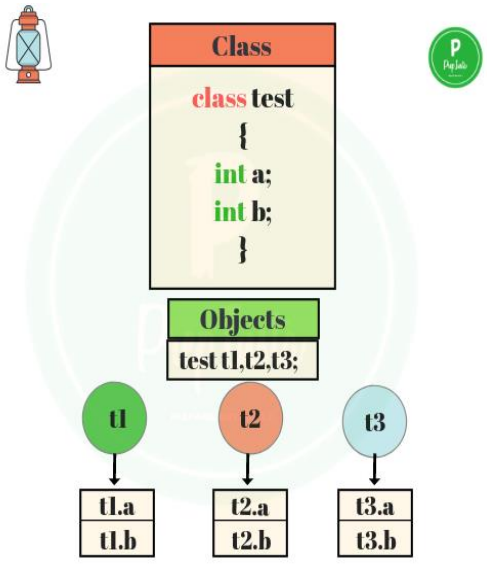
A class contains data items and functions. These are called members of the class. The data items are called data members and the functions are called member functions.

1. Data Members

The data items of a class are called data members of the class. For example, a class that has four integer type and two float type data items is declared as:

```
class abc
{
        int w , x , y , z;
        float a , b;
}
```

In the above class **a, b, w, x, y** and **z** are data members of the class "**abc**".



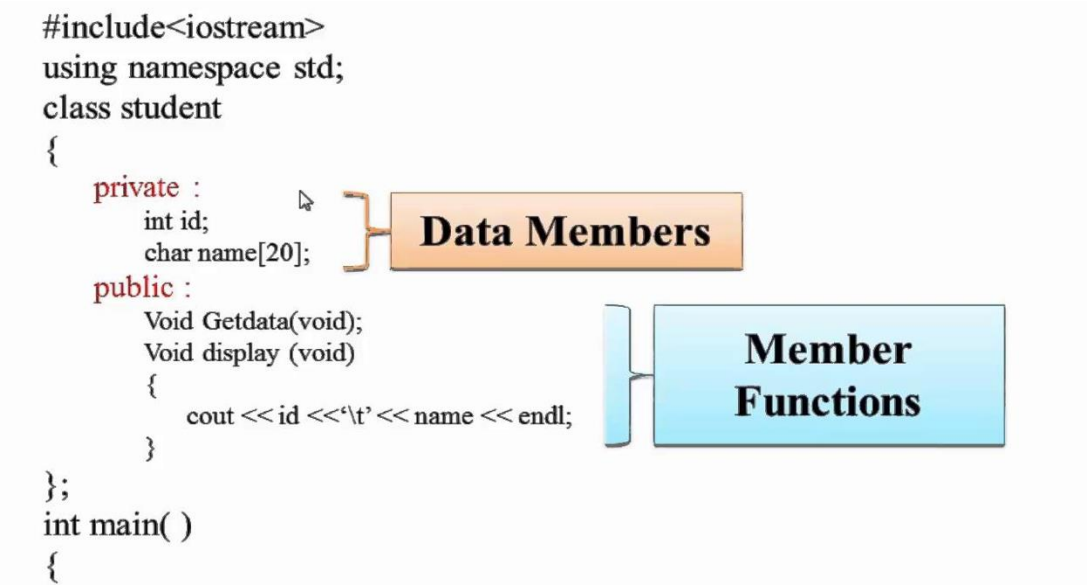
2. Member Functions

The functions of a class that are defined to work on its data members are called member functions of the class. The member functions may be defined within the class or outside it.

For example:

```
class xyz
{
      private:
      int a , b , c;
      public:
      void getData(void)
      {
            cout<<Enter value of a, b and c”;
            cin>>a>>b>>c;
      }
      void printData(void)
      {
            cout<<“a= ”<<a<<endl;
            cout<<“b= ”<<b<<endl;
            cout<<“c= ”<<c<<endl;
      }
} ;
```

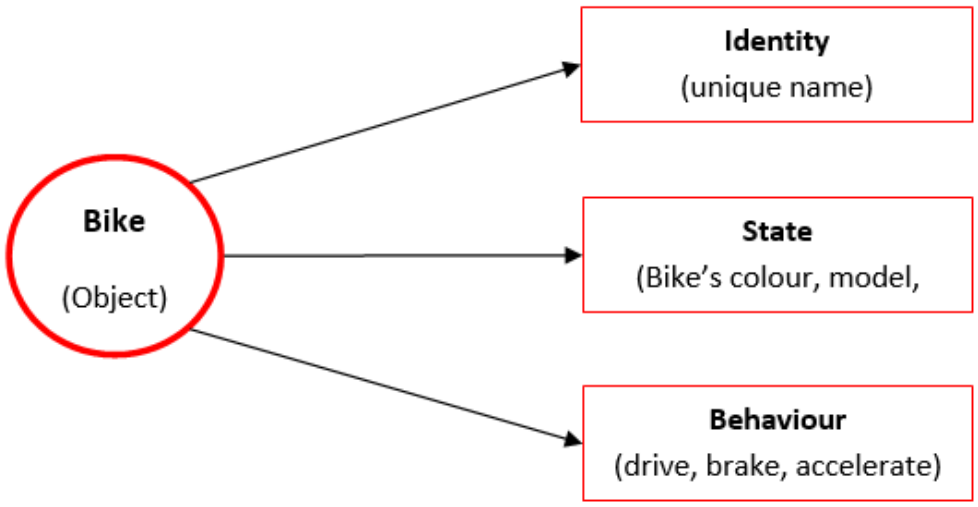
In this class, there are three data members and two member functions. The member functions are “getData” and “printData”. The “getData” function is used to input values into data members a, b and c. The “printData” function is used to print values of the data members on the computer screen.

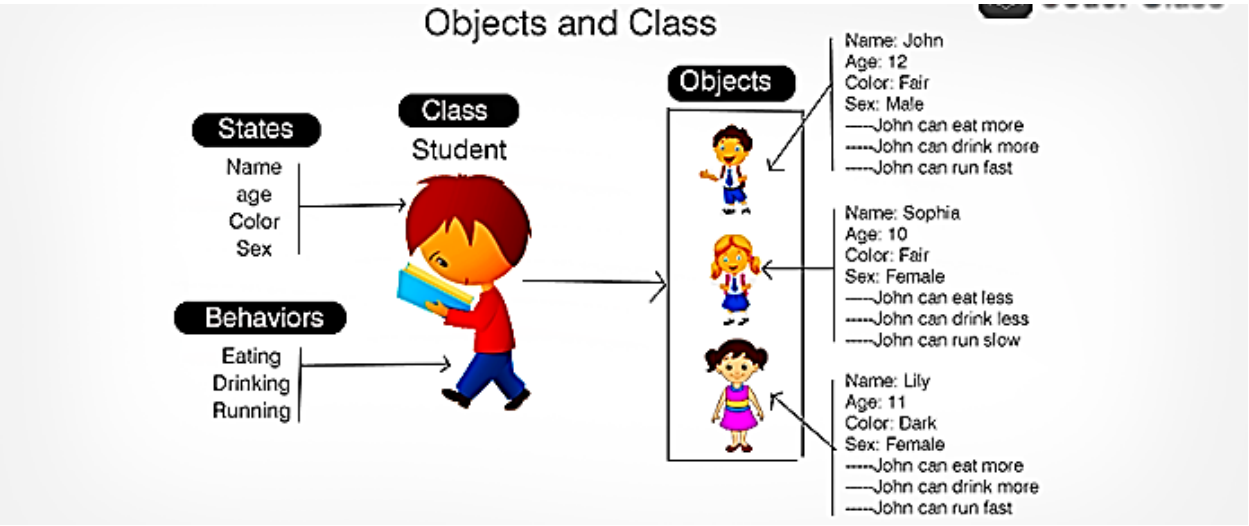


Objects

- A data type is used to declare a variable. A variable of a data type is also known as the instance or case of that data type.
- Each variable has unique name but each variable follows the rules of its data type. When a variable of a data type is declared, some space is reserved for it in the memory.
- A class is also like a data type. It is therefore used to declare variables or instances. The variables or instances of a class are called **objects**.
- A class may contain several data items and functions. Thus, the object of a class consists of both the **data members** and **member functions** of the class.
- The combining of both the data and the functions into one unit is called data **encapsulation**.
- An object represents data members of a class in the memory. Each object of class has unique name. The name of an object differentiates it from other objects of the same class.
- The values of data members of different objects may be different or same. The values of data members in an object are known as the **state** of the object.
- The functions in an object are called the member functions. They are also known as the them **methods**.
- The member functions are used to process and access data of the objects.

Characteristics of Object (Identity, State & Behavior)





Declaring object of a class

- The objects of a class are declared in the similar way as the variables of any data or structure type are declared.
- When a class is defined, no space is reserved for it in the memory. It only provides information how its object will look like.
- When an object of a class is declared, a memory space is reserved for that object.
- The syntax to create objects of a class type is:
  - **class_name object_name separated by commas;**
- For example, to define an objects of Student class, the statement is written as:
  - **Student s1;**
- In the above statement one object namely **s1** is declared of Students class. It is the declaration of an object that actually creates an object in the memory.

A Class is a Full-Fledged Type

- A class is a type just like int and double. You can have variables of a class type, you can have parameter of class type, a function can return a value of a class type, and more generally, you can use a class type like any other type.

  For example: Student s1,s2,s3;

Accessing data members and member functions

- The data members and member functions of class can be accessed using the dot('.') operator with the object.
- For example if the name of object is *obj* and you want to access the member function with the name *printName()* then you will have to write *obj.printName()* .

Accessing Data Members

- The public data members are also accessed in the same way given however the private data members are not allowed to be accessed directly by the object.
- Accessing a data member depends solely on the access control of that data member. This access control is given by Access modifiers in C++.
- There are three access modifiers: public, private and protected.

Example

```
// C++ program to demonstrate accessing of data members
#include <iostream>
using namespace std;

class Student
{
   // Access specifier
    public:

   //Data members
   int id;
   string name;
   double salary;
}; // end of class body

int main () {

// Declare an object of class Student
    Student s1;
// accessing data members
    s1.id=144;
    s1.name="Aisha";
    s1.salary=60000;

    cout<<"Student Id is:"<<s1.id<<endl;
    cout<<"Student Name is:"<<s1.name<<endl;
    cout<<"Student Salary is:"<<s1.salary<<endl;
   return 0;
}
```

```
/*
Output
Student Id is:144
Student Name is:Aisha
Student Salary is:60000
*/
```

Accessing Member Functions

- The member functions of a class is called or accessed in similar way as member or data item of a structure is called.
- The member function is called/accessed through an object of the class.
- The dot operator is used. The dot operator connects the **object name** and **member function**.
- For example, if "**add**" is the name of the object and "**pdate()**" is the member function then the member function is called as shown below:

  add.pdate();

- The **dot operator** is also called the class member **access operator**.
- Only those member functions can be accessed from outside the class with dot operator that have been declared as public.

Examples

```
class Student
{
   // Access specifier
    public:
   //Data members
   int id;
   string name;
   double salary;
// Member Functions
   void setData(int i, string n, double s)
    {
       id=i;
       name=n;
       salary=s;
    }

    void printData()
    {
```

```
        cout<<"Student Id is:"<<id<<endl;
        cout<<"Student Name is:"<<name<<endl;
        cout<<"Student Salary is:"<<salary<<endl;
    }
}; // end of class body
int main () {

    // Declare an object of class Student
    Student s1;

    // accessing member function
    s1.setData(144, "Aisha", 60000);

    s1.printData();

   return 0;
}

/*
Output
Student Id is:144
Student Name is:Aisha
Student Salary is:60000
*/
```

Program 01: Write a program to input a date and print on the screen using class.

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

class Date
{
   // Access specifier
    private:
   //Data members
   int y,m,d;
  public:
   void getDate()
    {
       cout<<"Enter Year: "; cin>>y;
       cout<<"Enter Month: "; cin>>m;
       cout<<"Enter Day: "; cin>>d;
    }

    void printDate()
```

```
    {
        cout<<"Date is :";
        cout<<d<<"/" <<m<<"/"<<y;
    }
}; // end of class body

int main () {

    // Declare an object of class Date
    Date date;

    // accessing member function
    date.getDate();
    date.printDate();
   return 0;
}


/*
Output
Enter Year: 1995
Enter Month: 12
Enter Day: 12
Date is :12/12/1995
*/
```

Program 02: Write a program by using class to input values using a member functions of a class. Display the sum of two values by using another member function of the class.

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

class Sum
{
   // Access specifier
    private:
   //Data members
   int n , m;

   public:
   void getDate(int x, int y)
    {
```

```
       n=x;
       m=y;
    }

    void displayData()
    {
        cout<<"Sum is: "<<(n+m);
    }
}; // end of class body
int main () {

    // Declare an object of class
    Sum sum;

    int x, y;
    cout<<"Enter first No. :"; cin>>x;
    cout<<"Enter second No. :"; cin>>y;

    // accessing member function
    sum.getDate(x,y);
    sum.displayData();
   return 0;
}

/*
Output
Enter first No. :4
Enter second No. :4
Sum is: 8
*/
```

Program 03: Write a program to input the name of student and marks of three subjects, calculate the total marks and average marks. Each subject has maximum of 100 marks.

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

class StudentRecord
{
   private:
    char name[15];
    float s1,s2,s3, total, avg;
```

```
public:
    void getRecord()
    {
       cout<<"Enter Name of the student: "; cin>>name;
       cout<<"Enter marks of 1st subject: "; cin>>s1;
       cout<<"Enter marks of 2nd subject: "; cin>>s2;
       cout<<"Enter marks of 3rd subject: "; cin>>s3;
       total= s1+s2+s3;
       avg= total/3.0;
    }
 void displayRecord()
    {
       cout<<"Name of the student : "<<name<<endl;
       cout<<"Marks of 1st subject : "<<s1<<endl;
       cout<<"Marks of 2nd subject : "<<s2<<endl;
       cout<<"Marks of 3rd subject : "<<s3<<endl;
       cout<<"Total Marks : "<<total<<endl;
       cout<<"Average Marks : "<<avg<<endl;
    }
}; // end of class body

int main () {

    // Declare an object of class
    StudentRecord stdRecord;

    // accessing member function
    stdRecord.getRecord();
    stdRecord.displayRecord();
    return 0;
}

/*
Output
Enter Name of the student: Aousaf
Enter marks of 1st subject: 55
Enter marks of 2nd subject: 77
Enter marks of 3rd subject: 88
Name of the student : Aousaf
Marks of 1st subject : 55
Marks of 2nd subject : 77
Marks of 3rd subject : 88
Total Marks : 220
Average Marks : 73.3333
*/
```

Program 04: Write a program by using class Employee to input the record of employees.

Program 04: Write a program by using class Employee to input the record of employees.

Define the data members for Name, basic pay, house rent, medical allowance, gross pay

- name, bpay, h_rent, ma, gpay

Define the following member functions:

- to input data in name and bpay
- to calculate h_rent, ma, gpay
- to print complete record on the computer Screen.

Where

h-rent = house rent= 60 %

ma = medical allowance = 20 %

Gpay = bpay + h_rent + ma

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

class EmployeeRecord
{
   private:
    char name[15];
    float bpay, h_rent, ma, gpay;

    public:
    void getRecord()
    {
       cout<<"Enter Name of the employee: "; cin>>name;
       cout<<"Enter basic pay of employee: "; cin>>bpay;
    }
void allow()
    {
       h_rent =bpay*60/100;
       ma= bpay*20/100;
       gpay=bpay+h_rent+ma;
```

```
    }
    void displayRecord()
    {
       cout<<"Name of the Employee : "<<name<<endl;
       cout<<"Basic Pay            : "<<bpay<<endl;
       cout<<"House Rent           : "<<h_rent<<endl;
       cout<<"Medical Allowance    : "<<ma<<endl;
       cout<<“Net Pay              : "<<gpay<<endl;
    }
}; // end of class body
int main () {

    // Declare an object of class
    EmployeeRecord empRecord;

    // accessing member function
    empRecord.getRecord();
    empRecord.allow();
    empRecord.displayRecord();
    return 0;
}

/*
Output
Enter Name of the employee: Aisha
Enter basic pay of employee: 30000
Name of the Employee   : Aisha
Basic Pay              : 30000
House Rent             : 18000
Medical Allowance      : 6000
Net Pay                : 54000
*/
```

Defining Member Functions outside class

- Members functions of a class can also be defined outside the class. In this case, only the prototype of the member function is declared inside the class.

- The member functions are defined outside the class in the similar way as user defined functions are defined. However, the scope resolution operator (**::**) is used in the member function declarator to define the function of the class outside the class.

- The general syntax of member function definition outside the class is:

  type class_name :: function_name (arguments)

  { body of function }

- **Note:** The member function is defined outside its class if the body of the function definition is large. Otherwise the function definition should be defined inside the class.
- To define a member function outside the class definition we have to use the scope resolution :: operator along with class name and function name.

Program 05: Write a program by using class Employee to input the record of employee by defining the function member outside the class.

```
#include <iostream>
using namespace std;
class EmployeeRecord
{
   private:
    char name[15];
    float bpay, h_rent, ma, gpay;

    public:
     void getRecord(void);
     void allow(void);
     void displayRecord(void);
}; // end of class

int main () {

    // Declare an object of class
    EmployeeRecord empRecord;

    // accessing member function
    empRecord.getRecord();
    empRecord.allow();
    empRecord.displayRecord();
    return 0;
}
// Definition of getRecord using scope resolution operator ::
   void EmployeeRecord::getRecord()
    {
       cout<<"Enter Name of the employee: "; cin>>name;
       cout<<"Enter basic pay of employee: "; cin>>bpay;
    }

    // Definition of allow using scope resolution operator ::

   void EmployeeRecord::allow()
    {
       h_rent =bpay*60/100;
       ma= bpay*20/100;
```

```
        gpay=bpay+h_rent+ma;
    }
// Definition of displayRecord using scope resolution operator ::
    void EmployeeRecord::displayRecord()
    {
        cout<<"Name of the Employee : "<<name<<endl;
        cout<<"Basic Pay            : "<<bpay<<endl;
        cout<<"House Rent           : "<<h_rent<<endl;
        cout<<"Medical Allowance    : "<<ma<<endl;
        cout<<"Net Pay              : "<<gpay<<endl;

    }

/*
Output

Enter Name of the employee: Aisha
Enter basic pay of employee: 30000
Name of the Employee : Aisha
Basic Pay                : 30000
House Rent               : 18000
Medical Allowance        : 6000
Net Pay                  : 54000

*/
```

Storage of Object in Memory

- When an object of a class is created, a space is reserved in the computer memory to hold its data members. Similarly, separate memory spaces are reserved for each class object.
- The member functions of a class are, however, stored at only one place in the computer memory.
- All objects of the class use the same member functions to process data.
- Therefore while, each object has separate memory space for data members, the member functions of a class are stored in only one place and are shared by all objects of the class.

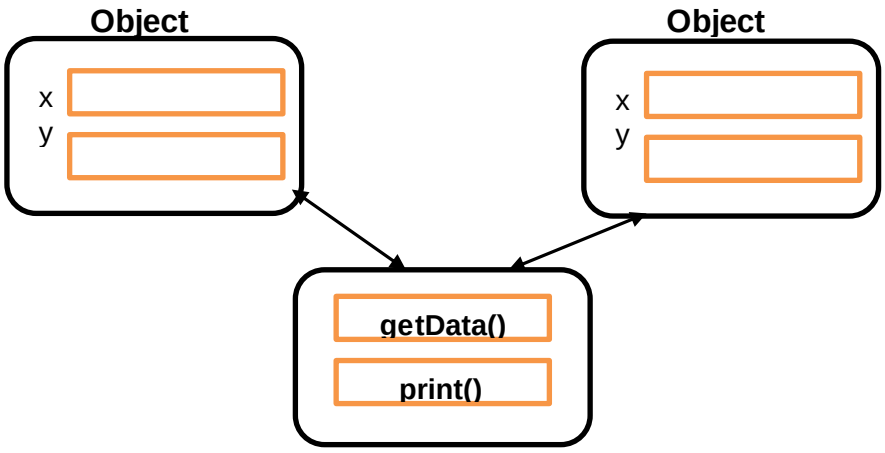
Program 06:

```
#include <iostream>
using namespace std;
class Temp
{
   private:
    int x;
```

```
    float y;

    public:
     void getData(void)
     {
        cout<<"Enter value of x : "; cin>>x;
        cout<<"Enter value of y : "; cin>>y;
     }
 void print(void)
     {
        cout<<"Entered value of x = "<<x<<endl;
        cout<<"Entered value of y = "<<y<<endl;

     }
}; // end of class body
int main () {

    // Declare an object of class
    Temp a, b;

    cout<<"Get data in object a"<<endl;
    a.getData();
    cout<<"Get data in object b"<<endl;
    b.getData();

    cout<<"Data in object a is : "<<endl;
    a.print();
    cout<<"Data in object b is : "<<endl;
    b.print();

    return 0;
}
/*
Output
Get data in object a
Enter value of x : 44
Enter value of y : 5
Get data in object b
Enter value of x : 66
Enter value of y : 66
Data in object a is :
Entered value of x = 44
Entered value of y = 5
Data in object b is :
Entered value of x = 66
Entered value of y = 66
```

```
*/
```

❖ The storage of object **a** and **b** as mentioned in the above program example is shown below. These objects use the same member functions.



Functions vs Methods

Function — a set of instructions that perform a task.

Method — a set of instructions that are associated with an object.

METHODS

A method, like a function, is a set of instructions that perform a task. The difference is that a method is associated with an object, while a function is not.

Access Specifiers / Modifiers in C++

❖ It specifies that member of a class is accessible outside or not.

❖ Access modifiers are used to implement an important aspect of Object-Oriented Programming known as **Data Hiding.**

❖ Access Modifiers or Access Specifiers in a class are used to assign the accessibility to the class members. That is, it sets some restrictions on the class members not to get directly accessed by the outside functions.
There are 3 types of access modifiers available in C++:

1. Public
2. Private
3. Protected

Note: If we do not specify any access modifiers for the members inside the class then by default the access modifier for the members will be **Private**.

1. Public Access Specifier

- All the class members declared under the public specifier will be available to everyone.
- The data members and member functions declared as public can be accessed by other classes and functions too.
- The public members of a class can be accessed from anywhere in the program using the direct member access operator (.) with the object of that class.

Example 1: Public Access Specifier

```
// C++ program to demonstrate public access modifier
#include<iostream>
using namespace std;

// class definition
class Circle
{
    public:
        double radius;

        double compute_area()
        {
            return 3.14*radius*radius;
        }

};

// main function
int main()
{
    Circle obj;

    // accessing public data member outside class
    obj.radius = 5.5;

    cout << "Radius is: " << obj.radius << "\n";
    cout << "Area is: " << obj.compute_area();
    return 0;
}


/*
Output
```

```
Radius is: 5.5
Area is: 94.985
*/
```

In the above program the data member *radius* is declared as public so it could be accessed outside the class and thus was allowed access from inside main().

2. Private Access Specifier

- The class members declared as *private* can be accessed only by the member functions inside the class.
- They are not allowed to be accessed directly by any object or function outside the class.
- Only the member functions or the friend functions are allowed to access the private data members of a class.
- friend functions will be discussed later

Example 1: Private Access Specifier

```
// C++ program to demonstrate private access modifier
#include<iostream>
using namespace std;
class Circle
{
    // private data member
    private:
        double radius;
    // public member function
    public:
        double compute_area()
        { // member function can access private
            // data member radius
            return 3.14*radius*radius;
        }
}; //end of class
// main function
int main()
{
    Circle obj;  // creating object of the class
    // trying to access private data member
    // directly outside the class
    obj.radius = 1.5;
    cout << "Area is:" << obj.compute_area();
    return 0;
}
/*
Output
```

```
In function 'int main()': 11:16: error: 'double Circle::radius' is
private double radius; ^ 31:9: error: within this context obj.radius =
1.5; ^
*/
```

The output of above program is a compile time error because we are not allowed to access the private data members of a class directly outside the class. Yet an access to obj.radius is attempted, radius being a private data member we obtain a compilation error.

Example 2: Private Access Specifier

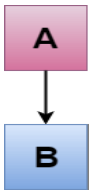
However, we can access the private data members of a class indirectly using the public member functions of the class.

```
// C++ program to demonstrate private access modifier
#include<iostream>
using namespace std;
class Circle
{
    // private data member
    private:
        double radius;
// public member function
    public:
        void compute_area(double r)
        { // member function can access private
            // data member radius
            radius = r;
            double area = 3.14*radius*radius;
            cout << "Radius is: " << radius << endl;
            cout << "Area is: " << area;
        }
};  //end of class

// main function
int main()
{
    // creating object of the class
    Circle obj;

    // trying to access private data member
    // directly outside the class
    obj.compute_area(1.5);
    return 0;
}

/*
Output
```

```
Radius is: 1.5
Area is: 7.065
*/
```

3. Protected Access Specifier

- Protected access modifier is similar to private access modifier in the sense that it can't be accessed outside of its class unless with the help of friend class.
- The difference is that the class members declared as Protected can be accessed by any subclass (derived class) of that class as well.
- **Note**: This access through inheritance can alter the access modifier of the elements of base class in derived class depending on the **modes of Inheritance**.
- Where 'A' is the base class, and 'B' is the derived class.



Example 1: Protected Access Specifier

```
// C++ program to demonstrate protected access modifier
#include <iostream>
using namespace std;
// base class
class Parent
{
    // protected data members
    protected:
    int id_protected;

}; //parent class ends
// sub class or derived class from public base class
class Child : public Parent
{
    public:
    void setId(int id)
    {
        // Child class is able to access the inherited
        // protected data members of base class

        id_protected = id;

    }
```

```
    void displayId()
    {
        cout << "id_protected is: " << id_protected << endl;
    }
};  // child class ends

// main function
int main() {

    Child obj1;
    // member function of the derived class can
    // access the protected data members of the base class
    obj1.setId(81);
    obj1.displayId();
    return 0;
}  // end of main() function

/*
Output
id_protected is: 81

*/
```

Summary: public, private, and protected

public elements can be accessed by all other classes and functions.

private elements cannot be accessed outside the class in which they are declared, except by friend classes and functions.

protected elements are just like the private, except they can be accessed by derived classes.

Note: By default, class members in C++ are **private**, unless specified otherwise.

Specifiers	Same Class	Derived Class	Outside Class
Public	Yes	Yes	Yes
Private	Yes	No	No
protected	Yes	Yes	No

Constructor in C++

- Special method that is implicitly invoked.
- Used to create an object (an instance of the class) and initialize it.
- Every time an object is created, at least one constructor is called.
- It is special member function having same name as class name and is used to initialize object.
- It is invoked/called at the time of object creation.
- It constructs value i.e. provide data for the object that is why it called constructor.
- Can have parameter list or argument list. Can never return any value (no even void).
- Normally declared as public.
- At the time of calling constructor, memory for the object is allocated in the memory.
- It calls a default constructor if there is no constructor available in the class.

Note: It is called constructor because it constructs the values at the time of object creation.

There can be two types of constructors in C++.

1. Default constructor (no-argument constructor)
2. Parameterized constructor.

1. Default constructor

- A constructor is called "Default Constructor" when it doesn't have any parameter.
- It is also called non-parameterized constructor.
- A constructor which has no argument is known as default constructor. It is invoked at the time of creating object.
- Note: If we have not defined a constructor in our class, then the C++ compiler will automatically create a default constructor with an empty code and no parameters.
- Let's see the simple example of C++ default Constructor.

```
#include <iostream>
using namespace std;
class Employee
 {
   public:
        Employee()
        {
            cout<<"Default Constructor Invoked/Called"<<endl;
        }
};
int main(void)
```

```
{
    Employee e1; //creating an object of Employee
    Employee e2;
    return 0;
}
/*
Output
Default Constructor Invoked/Called
Default Constructor Invoked/Called
*/
```

```
#include<iostream>
#include<string.h>
using namespace std;
class Student
    {
        int Roll;
        char Name[25];
        float Marks;
        public:
        Student()           //Default Constructor
            {
                Roll = 1;
                strcpy(Name,"Kumar");
                Marks = 78.42;
            }
void Display()
       {
            cout<<"\n\tRoll : "<<Roll;
            cout<<"\n\tName : "<<Name;
            cout<<"\n\tMarks : "<<Marks;
       }
    };  // end of class
int main()
    {
        Student S;          //Creating Object

        S.Display();        //Displaying Student Details
        return 0;
    }

/*
Output
Roll : 1
Name : Kumar
```

```
Marks : 78.42
*/
#include <string>
#include <iostream>
using namespace std;
class ClassRoom {
private:
int roomID;
int numberOfChairs;
char boardType; // C for chalk and M for marker
string multimedia;
string remarks;
public:
	ClassRoom();
	void setroomID(int);
	void setnumberOfChairs(int);
	void setboardType(char);
	void setmultimedia(string);
	void setremarks(string);
	int getroomID();
	int getnumberOfChairs();
	char getboardType();
	string getmultimedia();
	string getremarks();
	void display();
};
int main ()
{
	ClassRoom CR0;
	CR0.display();
	system("PAUSE");
	return 0;
}
//-------------------------------------Constructors
ClassRoom::ClassRoom()
{
	this->roomID=0;
	this->numberOfChairs=0;
	this->boardType='M';
	this->multimedia="New";
	this->remarks="Default Constructor";
}
//-------------------------------------Getter Functions
int ClassRoom::getroomID()
{
	return this->roomID;
}
int ClassRoom::getnumberOfChairs()
{
	return this->numberOfChairs;
```

```
}
char ClassRoom::getboardType()
{
	return (this->boardType);
}
string ClassRoom::getmultimedia()
{
	return this->multimedia;
}

string ClassRoom::getremarks()
{
	return this->remarks;
}
//-----------------------------------Printing Functions
void ClassRoom::display()
{
	cout<<"Room ID \t: "<<this->getroomID()<<endl;
	cout<<"N.O. Chairs \t: "<<this->getnumberOfChairs()<<endl;
	cout<<"Board Type \t: "<<this->getboardType()<<endl;
	cout<<"Multimedia \t: "<<this->getmultimedia()<<endl;
	cout<<"Remarks \t: \n"<<this->getremarks()<<endl;
	cout<<"---------------------------------"<<endl;
}

/*
Room ID         : 0
N.O. Chairs     : 0
Board Type      : M
Multimedia      : New
Remarks         :
Default Constructor
--------------------------------
Press any key to continue . . .
*/
```

2. Parameterized Constructor

❖ A constructor which has a specific number of parameters is called a parameterized constructor.

Why use the parameterized constructor?

- The parameterized constructor is used to provide different values to distinct objects. However, you can provide the same values also.
- Used to initialize objects with different values.
- This is the preferred method to initialize member data.

❖ Let's see the simple example of C++ Parameterized Constructor.

```
#include <iostream>
using namespace std;
class Employee {
   public:
       int id; //data member (also instance variable)
       string name; //data member(also instance variable)
       float salary;

     Employee(int i, string n, float s)
        {
            id = i;
            name = n;
            salary = s;
        }
void display()
        {
            cout<<id<<"  "<<name<<"  "<<salary<<endl;
        }
};
int main(void) {
  Employee e1 =Employee(101, "Ali", 890000); //creating an object of E
mployee
    Employee e2=Employee(102, "Saad", 59000);
    e1.display();
    e2.display();
    return 0;
}

/*
Output
101  Ali  890000
102  Saad  59000
*/
```

```
#include<iostream>
#include<string.h>
using namespace std;

class Student
    {
        int Roll;
        char Name[25];
        float Marks;
```

```
        public:
        Student(int r,char nm[],float m)    //Parameterize Constructor
        {
            Roll = r;
            strcpy(Name,nm);
            Marks = m;
        }
void Display()
        {
            cout<<"\n\tRoll : "<<Roll;
            cout<<"\n\tName : "<<Name;
            cout<<"\n\tMarks : "<<Marks;
        }
    };

int main()
    {
        Student S(2,"Sumit",89.63);
        //Creating Object and passing values to Constructor

        S.Display();
        //Displaying Student Details
        return 0;
    }

/*
Output
Roll : 2
Name : Ali
Marks : 89.63
*/
```

```
#include <string>
#include <iostream>
using namespace std;
class ClassRoom {
private:
int roomID;
int numberOfChairs;
char boardType; // C for chalk and M for marker
string multimedia;
string remarks;
public:
      ClassRoom(int id,int NOC,char,string mul, string rmks);
```

```
	void setroomID(int);
	void setnumberOfChairs(int);
	void setboardType(char);
	void setmultimedia(string);
	void setremarks(string);
	int getroomID();
	int getnumberOfChairs();
	char getboardType();
	string getmultimedia();
	string getremarks();
	void display();
};
int main ()
{
	ClassRoom CR(11,25,'M',"Repairing..","Remarks added from Main");
	CR.display();
	system("PAUSE");
	return 0;
}
//---------------------------------------Constructors
ClassRoom::ClassRoom(int id,int NOC,char c,string mul, string remks)
{
	this->roomID=id;
	this->numberOfChairs=NOC;
	this->boardType=c;
	this->setmultimedia(mul);
	this->setremarks(remks+"\nConstructor with All(5)Parameters
(ID,NOC,BoardType,Multimedia,Remarks)");
}
//---------------------------------------Setter Functions
void ClassRoom::setroomID(int id)
{
	this->roomID=id;
}
void ClassRoom::setnumberOfChairs(int NOC)
{
	this->numberOfChairs=NOC;
}
void ClassRoom::setboardType(char c)
{
	this->boardType=c;
}
void ClassRoom::setmultimedia(string str)
{
	this->multimedia=str;
}
void ClassRoom::setremarks(string str)
{
	this->remarks=str;
}
```

```
//-------------------------------------Getter Functions
int ClassRoom::getroomID()
{
	return this->roomID;
}
int ClassRoom::getnumberOfChairs()
{
	return this->numberOfChairs;
}
char ClassRoom::getboardType()
{
	return (this->boardType);
}
string ClassRoom::getmultimedia()
{
	return this->multimedia;
}

string ClassRoom::getremarks()
{
	return this->remarks;
}
//-------------------------------------Printing Functions
void ClassRoom::display()
{
	cout<<"Room ID \t: "<<this->getroomID()<<endl;
	cout<<"N.O. Chairs \t: "<<this->getnumberOfChairs()<<endl;
	cout<<"Board Type \t: "<<this->getboardType()<<endl;
	cout<<"Multimedia \t: "<<this->getmultimedia()<<endl;
	cout<<"Remarks \t: \n"<<this->getremarks()<<endl;
	cout<<"---------------------------------"<<endl;
}
/*
Room ID         : 11
N.O. Chairs     : 25
Board Type      : M
Multimedia      : Repairing..
Remarks         :
Remarks added from Main
Constructor with All(5)Parameters (ID,NOC,BoardType,Multimedia,Remarks)
---------------------------------
*/
```

The Default Copy Constructor

- We've seen two ways to initialize objects. A no-argument constructor can initialize data members to constant values, and a multi-argument constructor can initialize data members to values passed as arguments.

- Let's mention another way to initialize an object: you can initialize it with another object of the same type.
- Surprisingly, you don't need to create a special constructor for this; one is already built into all classes. It's called the default copy constructor. It's a one argument constructor whose argument is an object of the same class as the constructor.
- Initialization of an object through another object is called **copy constructor**.
- In other words, copying the values of one object into another object is called **copy constructor.**

Example of The Default Copy Constructor

```
#include<iostream>
#include<string.h>
using namespace std;

class Student
    {
        int Roll;
        string Name;
        float Marks;

        public:
        Student(int r,string nm,float m)   //Parameterized Constructor
        {
            Roll = r;
            Name=nm;
            Marks = m;
        }

        // Student(Student &S)
        // {
        //    Roll=S.Roll;
        //    Name=S.Name;
        //    Marks =S.Marks;
        // }

        void Display()
        {
            cout<<"\n\tRoll : "<<Roll;
            cout<<"\n\tName : "<<Name;
            cout<<"\n\tMarks : "<<Marks;
        }
    };  // end of class
```

```
int main()
    {
        Student S1(2,"Ali",89.63);

        Student S2(S1);    //Copy S1 to S2
        Student S3=S1;    //copy S1 to S3

        cout<<"\n\tValues in object S1";
        S1.Display();

        cout<<"\n\tValues in object S2";
        S2.Display();

        cout<<"\n\tValues in object S3";
        S3.Display();
    }  // end of main() function


/*
Output
 Values in object S1
 Roll : 2
 Name : Ali
 Marks : 89.63
 Values in object S2
 Roll : 2
 Name : Ali
 Marks : 89.63
 Values in object S3
 Roll : 2
 Name : Ali
 Marks : 89.63
*/
```

- We initialize S1 to the value of "**2,"Ali",89.63**" using the three-argument constructor. Then we define two more objects of type Student Class, S2 and S3, initializing both to the value of S1.
- You might think this would require us to define a one-argument constructor, but initializing an object with another object of the same type is a special case. These definitions both use the default copy constructor.
- The object S2 is initialized in the statement

  Student S2(S1);

- This causes the default copy constructor for the Student class to perform a member-by-member copy of S1 into S2.
- Surprisingly, a different format has exactly the same effect, causing S1 to be copied member-by-member into S3:

```
Student S3 = S1;
```

Constructor Overloading

- More than one constructor functions can be defined in one class. When more than one constructor functions are defined, each constructor is defined with a different set of parameters.
- Defining more than one constructor with different set of parameters is called constructor overloading.
- Constructor overloading is used to initialize different values to class objects.
- When a program that uses the constructor overloading is compiled, C++ compiler checks the number of parameters, their order and data types and marks them differently.
- When an object of the class is created, the corresponding constructor that matches the number of parameters of the object function is executed.
- In the following example two constructor functions are defined in the class "**Sum**".

```
using namespace std;
#include<iostream>
class Sum
{
 public:
   Sum(int l, int m, int n)
   {
       cout<<"Sum of three integer is= "<<(l+m+n)<<endl;
   }
Sum(int l, int m)
   {
       cout<<"Sum of two integer is= "<<(l+m)<<endl;
   }
}; // end of class body

int main () {

    Sum s1=Sum(3,4,5);
    Sum s2=Sum(2,4);
```

```
    //Sum s1(3,4,5), s2(2,4);

   return 0;
}

/*
Output
Sum of three integer is= 12
Sum of two integer is= 6
*/
```

- When the above program is executed, the object s1 is created first and then the Sum constructor function that has only three integer type parameters is executed.
- Then the s2 object is created. It has two parameters of integer type, So the constructor function that has two arguments of integer type is executed.

Write a program to define two constructors to find out the maximum values.

```
using namespace std;
#include<iostream>
class Find
{
   private:
   int max;
public:
   Find(int x, int y, int z)
   {
       if (x>y)
        {
            if(x>z)
            {
                max=x;
            }
            else
            {
                max=z;
            }
        }
        else if(y>z)
            max=y;
        else
            max=z;
       cout<<"Maximum between three numbers is= "<<max<<endl;
   }
```

```
 Find(int x, int y)
   {
       if (x>y)
       {
           max=x;
       }
       else
       {
           max=y;
       }
       cout<<"Maximum between two numbers is= "<<max<<endl;
   }
}; // end of class body


int main () {

    int a=9, b=56, c=67;
    Find f1=Find(a,b,c);
    Find f2=Find(a,b);
    //Find f1(a,b,c), f2(a,b);

   return 0;
}

/*
Output
Maximum between three numbers is = 67
Maximum between two numbers is = 56
*/
```

```
//Given example demonstrates the concept of overloaded constructor
#include <string>
#include <iostream>
using namespace std;
class ClassRoom {
private:
int roomID;
int numberOfChairs;
char boardType; // C for chalk and M for marker
string multimedia;
string remarks;
public:
ClassRoom();
ClassRoom(int id);
```

```
ClassRoom(int id,int NOC);
ClassRoom(int id,int NOC,char c);
ClassRoom(int id,int NOC,char,string mul);
ClassRoom(int id,int NOC,char,string mul, string rmks);

void setroomID(int);
    void setnumberOfChairs(int);
    void setboardType(char);
    void setmultimedia(string);
    void setremarks(string);
    int getroomID();
    int getnumberOfChairs();
    char getboardType();
    string getmultimedia();
    string getremarks();
    void display();

};
int main ()
{
ClassRoom CR0,CR1(1),CR2(2,30),CR3(3,35,'M'),
CR4(4,40,'M',"Repairing.."),CR5(5,40,'M',"Repairing..","Remarks added
from Main");
CR0.display();
CR1.display();
CR2.display();
CR3.display();
CR4.display();
CR5.display();
return 0;
}
//-------------------------------------Constructors
ClassRoom::ClassRoom()
{
    this->roomID=0;
    this->numberOfChairs=0;
    this->boardType='M';
    this->multimedia="New";
    this->remarks="Default Constructor";
}
ClassRoom::ClassRoom(int id)
{
this->roomID=id;
this->setnumberOfChairs(0);
this->setboardType('M');
this->setmultimedia("New");
```

```
this->remarks="Constructor with 1-Parameter (ID) ";
}

ClassRoom::ClassRoom(int id,int NOC)
{
this->roomID=id;
this->numberOfChairs=NOC;
this->setboardType('M');
this->setmultimedia("New");
this->remarks="Constructor with 2-Parameters (ID,NOC) ";
}
ClassRoom::ClassRoom(int id,int NOC,char c)
{
this->roomID=id;
this->numberOfChairs=NOC;
this->boardType=c;
this->setmultimedia("New");
this->remarks="Constructor with 3-Parameters (ID,NOC,BoardType) ";
}
ClassRoom::ClassRoom(int id,int NOC,char c,string mul)
{
this->setroomID(id); //this->roomID=id;
this->setnumberOfChairs(NOC); //this->numberOfChairs=NOC;
this->setboardType(c); //this->boardType=c;
this->setmultimedia(mul); //this->multimedia=str;
this->setremarks("Constructor with 4-
Parameters (ID,NOC,BoardType,Multimedia)");
}
ClassRoom::ClassRoom(int id,int NOC,char c,string mul, string remks)
{
this->setroomID(id); //this->roomID=id;
this->setnumberOfChairs(NOC); //this->numberOfChairs=NOC;
this->setboardType(c); //this->boardType=c;
this->setmultimedia(mul); //this->multimedia=str;
this-
>setremarks(remks+"\nConstructor with All(5)Parameters (ID,NOC,BoardTy
pe,Multimedia,Remarks)");
}

//--------------------------------------Setter Functions
void ClassRoom::setroomID(int id)
{
    this->roomID=id;
}
void ClassRoom::setnumberOfChairs(int NOC)
{
```

```
    this->numberOfChairs=NOC;
}
void ClassRoom::setboardType(char c)
{
    this->boardType=c;
}
void ClassRoom::setmultimedia(string str)
{
    this->multimedia=str;
}
void ClassRoom::setremarks(string str)
{
    this->remarks=str;
}
//-------------------------------------Getter Functions
int ClassRoom::getroomID()
{
    return this->roomID;
}
int ClassRoom::getnumberOfChairs()
{
    return this->numberOfChairs;
}
char ClassRoom::getboardType()
{
    return (this->boardType);
}
string ClassRoom::getmultimedia()
{
    return this->multimedia;
}

string ClassRoom::getremarks()
{
    return this->remarks;
}
//-----------------------------------Printing Functions
void ClassRoom::display()
{
    cout<<"Room ID \t: "<<this->getroomID()<<endl;
    cout<<"N.O. Chairs \t: "<<this->getnumberOfChairs()<<endl;
    cout<<"Board Type \t: "<<this->getboardType()<<endl;
    cout<<"Multimedia \t: "<<this->getmultimedia()<<endl;
    cout<<"Remarks \t: \n"<<this->getremarks()<<endl;
    cout<<"--------------------------------"<<endl;
}
```

```
/*
Output:
Room ID : 0
N.O. Chairs : 0
Board Type : M
Multimedia : New
Remarks :
Default Constructor
---------------------------------
Room ID : 1
N.O. Chairs : 0
Board Type : M
Multimedia : New
Remarks :
Constructor with 1-Parameter (ID)
---------------------------------
Room ID : 2
N.O. Chairs : 30
Board Type : M
Multimedia : New
Remarks :
Constructor with 2-Parameters (ID,NOC)
---------------------------------
Room ID : 3
N.O. Chairs : 35
Board Type : M
Multimedia : New
Remarks :
Constructor with 3-Parameters (ID,NOC,BoardType)
---------------------------------
Room ID : 4
N.O. Chairs : 40
Board Type : M
Multimedia : Repairing..
Remarks :
Constructor with 4-Parameters (ID,NOC,BoardType,Multimedia)
---------------------------------
Room ID : 5
N.O. Chairs : 40
Board Type : M
Multimedia : Repairing..
Remarks :
Remarks added from Main
Constructor with All(5)Parameters (ID,NOC,BoardType,Multimedia,Remarks)
---------------------------------
Press any key to continue . . .
*/
```

Defining Constructor Outside Class

```
class class_name {

public:
   //Constructor declaration
   class_name();
   //... other Variables & Functions
}; // Class body ends

// Constructor definition outside Class
class_name::class_name()
{
   // Constructor code
}
```

Defining Constructor Outside Class Example

```
using namespace std;
#include<iostream>
class Sum
{
   //Constructor declaration
   public:
   Sum(int l, int m, int n);
   Sum(int l, int m);

}; // end of class body
int main () {
    Sum s1=Sum(3,4,5);
    Sum s2=Sum(2,4);
    //Sum s1(3,4,5), s2(2,4);

   return 0;
}  //end of main() function
// Constructor definition outside Class
Sum::Sum(int l, int m, int n)
   {
       cout<<"Sum of three integer is= "<<(l+m+n)<<endl;
   }
Sum::Sum(int l, int m)
   {
       cout<<"Sum of two integer is= "<<(l+m)<<endl;
   }
```

C++ this pointer

In C++ programming, **this** is a keyword that refers to the current instance of the class. There can be 3 main usage of this keyword in C++.

- It can be used **to pass current object as a parameter to another method.**
- It can be used **to refer current class instance variable.**
- It can be used **to declare indexers.**

```
#include <iostream>
using namespace std;
class Employee {
   public:
       int id; //data member (also instance variable)
       string name; //data member(also instance variable)
       float salary;
       Employee(int id, string name, float salary)
        {
            this->id = id;
            this->name = name;
            this->salary = salary;
        }
void display()
        {
            cout<<id<<"  "<<name<<"  "<<salary<<endl;
        }
};   // class body ends

int main(void) {
Employee e1 =Employee(101, “Ali", 890000); //creating an object of Emp
loyee
Employee e2=Employee(102, “Sania", 59000); //creating an object of Emp
loyee

e1.display();
e2.display();
    return 0;
}

/*
Output
101  Ali  890000
102  Sania  59000
*/
```

Constructor with Default Parameters

Given example demonstrates the concept of constructor with default values

```
#include <string>
#include <iostream>
using namespace std;
class ClassRoom {
private:
    int roomID;
    int numberOfChairs;
    char boardType; // C for chalk and M for marker
    string multimedia;
    string remarks;
public:
    ClassRoom(int id=0,int NOC=25,char c='C',string mul="New",string r
emks="Defaut Value")
    {
        //this->roomID=id;
    this->setroomID(id);
    this->numberOfChairs=NOC;
    this->boardType=c;
    this->setmultimedia(mul);
    this->setremarks(remks);
    }

    void setroomID(int);
    void setnumberOfChairs(int);
    void setboardType(char);
    void setmultimedia(string);
    void setremarks(string);
    int getroomID();
    int getnumberOfChairs();
    char getboardType();
    string getmultimedia();
    string getremarks();
    void display();
};
int main ()
{
    ClassRoom CR0,CR1(1),CR2(2,30),CR3(3,35,'M'),
    CR4(4,40,'M',"Repairing.."),CR5(5,40,'M',"Repairing..","Remarks ad
ded from Main");
    CR0.display();
    CR1.display();
    CR2.display();
    CR3.display();
```

```
    CR4.display();
    CR5.display();
    return 0;
}

//--------------------------------------Setter Functions
void ClassRoom::setroomID(int id)
{
    this->roomID=id;
}
void ClassRoom::setnumberOfChairs(int NOC)
{
    this->numberOfChairs=NOC;
}
void ClassRoom::setboardType(char c)
{
    this->boardType=c;
}
void ClassRoom::setmultimedia(string str)
{
    this->multimedia=str;
}
void ClassRoom::setremarks(string str)
{
    this->remarks=str;
}
//--------------------------------------Getter Functions
int ClassRoom::getroomID()
{
    return this->roomID;
}
int ClassRoom::getnumberOfChairs()
{
    return this->numberOfChairs;
}
char ClassRoom::getboardType()
{
    return (this->boardType);
}
string ClassRoom::getmultimedia()
{
    return this->multimedia;
}

string ClassRoom::getremarks()
{
```

```
    return this->remarks;
}
//-----------------------------------Printing Functions
void ClassRoom::display()
{
    cout<<"Room ID \t: "<<this->getroomID()<<endl;
    cout<<"N.O. Chairs \t: "<<this->getnumberOfChairs()<<endl;
    cout<<"Board Type \t: "<<this->getboardType()<<endl;
    cout<<"Multimedia \t: "<<this->getmultimedia()<<endl;
    cout<<"Remarks \t: \n"<<this->getremarks()<<endl;
    cout<<"---------------------------------"<<endl;
}

/*
Room ID         : 0

N.O. Chairs     : 25

Board Type      : C

Multimedia      : New

Remarks         :

Defaut Value

---------------------------------

Room ID         : 1

N.O. Chairs     : 25

Board Type      : C

Multimedia      : New

Remarks         :

Defaut Value

---------------------------------

Room ID         : 2

N.O. Chairs     : 30

Board Type      : C

Multimedia      : New

Remarks         :

Defaut Value
```

```
---------------------------------

Room ID          : 3

N.O. Chairs      : 35

Board Type       : M

Multimedia       : New

Remarks          :

Defaut Value

---------------------------------

Room ID          : 4

N.O. Chairs      : 40

Board Type       : M

Multimedia       : Repairing..

Remarks          :

Defaut Value

---------------------------------

Room ID          : 5

N.O. Chairs      : 40

Board Type       : M

Multimedia       : Repairing..

Remarks          :

Remarks added from Main

---------------------------------*/
```

The new Operator

The new operator is an **operator** which denotes a request for memory allocation on the Heap. If sufficient memory is available, new operator initializes the memory and returns the address of the newly allocated and initialized memory to the pointer variable. When you create an object of class using new keyword (normal new).

- The memory for the object is allocated using **operator new** from heap.
- The constructor of the class is invoked to properly initialize this memory.

```
// CPP program to illustrate use of new keyword

#include<iostream>
using namespace std;
class car
{
      string name;
      int num;
      public:
            car(string a, int n)
            {
                  cout << "Constructor called" << endl;
                  this ->name = a;
                  this ->num = n;
            }
            void enter()
            {
                  cin>>name;
                  cin>>num;
            }
            void display()
            {
                  cout << "Name: " << name << endl;
                  cout << "Num: " << num << endl;
            }
};
int main()
{
      // Using new keyword
      car *p = new car("Honda", 2017);
      p->display();
}

/*
Output
Constructor called
Name: Honda
Num: 2017
*/
```

Destructors

- When an object is destroyed, a special member function of that class is executed automatically. This member function is called **destructor function** or **destructor**.

- The destructor function has the same name as the name of a class but a tilde sign (**~**) is written before its name. It is executed automatically when an object comes to end of its life.
- Like constructors, destructor do not return any value. They also do not take any arguments.
- **For example**, a local object is destroyed when all the statements of the function in which it is declared are executed. So, at the end of the function, the destructor function is executed.
- Similarly, global objects (objects that are declared before main function) or static objects are destroyed at the end of main function. The life time of these objects end when the program execution ends.
- So, at the end of program the destructor function is executed. The destructor functions are commonly used to free the memory that was allocated for objects.
- Constructor is invoked automatically when the object created.
- Destructor is invoked when the object goes out of scope. In other words, Destructor is invoked, when compiler comes out from the function where an object is created.
- The following example explains the concept of constructors and destructors.

```
using namespace std;
#include<iostream>
class Prog
{
    public:
    Prog()
    {
        cout<<"This is constructor function "<<endl;
    }

    ~Prog()
    {
        cout<<"This is destructor function "<<endl;
    }

}; // end of class body

int main () {

    Prog x;
    int a, b;
    a=10;
    b=20;
    cout<<"Sum of two numbers is = "<<(a+b)<<endl;
```

```
    return 0;
}

/*
Output
This is constructor function
Sum of two numbers is = 30
This is destructor function
*/
```

C++ Objects and Functions

- In this tutorial, we will learn to pass objects to a function and return an object from a function in C++ programming.
- In C++ programming, we can pass objects to a function in a similar manner as passing regular arguments.

Passing Objects as Arguments to Function

Objects can also be passed as arguments to member functions. When an object is passed as an argument to a member function:

- only the name of the object is written in the argument.
- The number of parameters and their types must be defined in the member function which the object is to be passed. The objects that are passed are treated local for the member functions and are destroyed when the control returns to the calling function.

Example 1: C++ Pass Objects to Function

```
using namespace std;
#include<iostream>
class Test
{
   private:
   char name[20];

   public:
   void get()
   {
      cout<<"Enter your name: ";
      cin.get(name, 20);
   }
 void print(Test s)
   {
```

```
    cout<<"Name is: "<<s.name<<endl;
  }

}; // end of class body

int main () {

  Test test1,test2;
  test1.get(); // calling get() function for object initialization

  test2.print(test1);  //Passing object as argument to function

 return 0;
}

/*
Output
Enter your name: Nouman Yousaf
Name is: Nouman Yousaf
*/
```

- In the above program, the class "Test" has one data member "name" of string type and two member functions "get()" and "print()". The print() function has parameter of class Test type.

- The objects test1 and test2 are declared of class Test. The member function gets the name in object test1, and store it into the data member "name". The member function "print()" for objects "test2" is called by passing argument of object "test1". When the control shifts to member function "print()", a copy of "test1" is created as a local object in the print function with name "s".

Example 2: C++ Pass Objects to Function

```
// C++ program to calculate the average marks of two students
#include <iostream>
using namespace std;

class Student {

   public:
    double marks;

    // constructor to initialize marks
    Student(double m) {
        marks = m;
    }
};  // class body ends
// function that has objects as parameters
```

```
void calculateAverage(Student s1, Student s2) {

    // calculate the average of marks of s1 and s2
    double average = (s1.marks + s2.marks) / 2;

   cout << "Average Marks = " << average << endl;

}
int main() {
    Student student1(88.0), student2(56.0);

  // pass the objects as arguments
   calculateAverage(student1, student2);

    return 0;
}

/*
Output
Average Marks = 72
*/
```

Here, we have passedtwo Student objects student1 and student2 as arguments to

```
#include<iostream>

class Student {...};

void calculateAverage(Student s1, Student s2) {
    // code
}

int main() {
    ... ...
    calculateAverage(student1, student2);
    ... ...
}
```

the calculateAverage() function.

Example 3: C++ Return Object from a Function

```
#include <iostream>
using namespace std;
class Student {
   public:
    double marks1, marks2;
};  //class body ends
// function that returns object of Student
Student createStudent() {
    Student student;

    // Initialize member variables of Student
    student.marks1 = 96.5;
    student.marks2 = 75.0;
    // print member variables of Student
    cout << "Marks 1 = " << student.marks1 << endl;
    cout << "Marks 2 = " << student.marks2 << endl;

    return student;
}
int main() {
    Student student1;
    // Call function
    student1 = createStudent();
    return 0;
}
/*
Output
Marks 1 = 96.5
Marks 2 = 75
*/
```

Arrays as Class Members in C++

- Arrays can be declared as the members of a class. The arrays can be declared as private, public or protected members of the class.
- To understand the concept of arrays as members of a class, consider this example.

Example: A program to demonstrate the concept of arrays as class members.

```
#include<iostream>
using namespace std;
const int size=5;
class Student
{
  int roll_no;
  int marks[size];

  public:
    void getdata ();
    void tot_marks ();
};  // end of clas body

int main()
{
   Student s1;
   s1.getdata() ;
   s1.tot_marks() ;
   return 0;
} //ends of main() function
//function definitions
void Student :: getdata ()
{
      cout<<"\nEnter roll no: ";
      cin>>roll_no;
      for(int i=0; i<size; i++)
      {
        cout<<"Enter marks in subject"<<(i+1)<<": ";
        cin>>marks[i] ;
      }
}
//calculating total marks
void Student :: tot_marks ()
{
      int total=0;
      for(int i=0; i<size; i++)
      {
          total=total+marks[i];
      }
      cout<<"\nTotal marks "<<total;
}

/*
Output
```

```
Enter roll no: 333
Enter marks in subject1: 56
Enter marks in subject2: 88
Enter marks in subject3: 77
Enter marks in subject4: 66
Enter marks in subject5: 88
Total marks 375
*/
```

In this example, an array marks is declared as a private member of the class student for storing a student's marks in five subjects. The member function tot_marks () calculates the total marks of all the subjects and displays the value.

Similar to other data members of a class, the memory space for an array is allocated when an object of the class is declared. In addition, different objects of the class have their own copy of the array. Note that the elements of the array occupy contiguous memory locations along with other data members of the object. For instance, when an object s1 of the class student is declared, the memory space is allocated for both rollno and marks.

Ways to initialize object

There are 3 ways to initialize object in C++.

- By directly accessing data members of class using object
- By member functions of the class
- By constructors of class

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