

# DAILY ASSESSMENT FORMAT

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Course:	C++ PROGRAMMING	USN:	4AL17EC068
Topic:	C++	Semester & Section:	6 <sup>TH</sup> B
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## FORENOON SESSION DETAILS

### Image of session

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**Course content**

- Section 6: Inheritance (3 / 3 | 34min)
  - 53. Inheritance (9min) [Resources]
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- Section 7: Odds and Ends: Twos Complement and Static Variables (2 / 2 | 38min)
- Section 8: Developing a Program: The Particle Fire Simulation (18 / 18 | 4hr 58min)
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- Section 10: Bonus (4 / 4 | 50min)
- Section 11: Advanced C++! (1 / 1 | 1min)

**About this course**

How to program in the popular (and tricky!) C++ programming language, for complete beginners.

By the numbers: Skill level: Beginner Level Lectures: 82

### Report – Report can be typed or hand written for up to two pages.

One of the most important concepts in object-oriented programming is that of inheritance. Inheritance allows us to define a class in terms of another class, which makes it easier to create and maintain an application. This also provides an opportunity to reuse the code functionality and fast implementation time.

When creating a class, instead of writing completely new data members and member functions, the programmer can designate that the new class should inherit the members of an existing class. This existing class is called the **base** class, and the new class is referred to as the **derived** class.

The idea of inheritance implements the **is a** relationship. For example, mammal IS-A animal, dog IS-A mammal hence dog IS-A animal as well and so on.

## Base and Derived Classes

A class can be derived from more than one classes, which means it can inherit data and functions from multiple base classes. To define a derived class, we use a class derivation list to specify the base class(es). A class derivation list names one or more base classes and has the form –

```
class derived-class: access-specifier base-class
```

Where access-specifier is one of **public**, **protected**, or **private**, and base-class is the name of a previously defined class. If the access-specifier is not used, then it is private by default.

Consider a base class **Shape** and its derived class **Rectangle** as follows –

```
#include <iostream>

using namespace std;

// Base class
class Shape {
public:
    void setWidth(int w) {
        width = w;
    }
    void setHeight(int h) {
        height = h;
    }

protected:
    int width;
    int height;
};

// Derived class
class Rectangle: public Shape {
public:
    int getArea() {
        return (width * height);
    }
};

int main(void) {
    Rectangle Rect;

    Rect.setWidth(5);
    Rect.setHeight(7);

    // Print the area of the object.
    cout << "Total area: " << Rect.getArea() << endl;
```

```
    return 0;
}
```

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

Total area: 35

## Access Control and Inheritance

A derived class can access all the non-private members of its base class. Thus base-class members that should not be accessible to the member functions of derived classes should be declared private in the base class.

We can summarize the different access types according to - who can access them in the following way –

Access	public	protected	private
Same class	yes	yes	yes
Derived classes	yes	yes	no
Outside classes	yes	no	no

A derived class inherits all base class methods with the following exceptions –

- Constructors, destructors and copy constructors of the base class.
- Overloaded operators of the base class.
- The friend functions of the base class.

## Type of Inheritance

When deriving a class from a base class, the base class may be inherited through **public**, **protected** or **private** inheritance. The type of inheritance is specified by the access-specifier as explained above.

We hardly use **protected** or **private** inheritance, but **public** inheritance is commonly used. While using different type of inheritance, following rules are applied –

- **Public Inheritance** – When deriving a class from a **public** base class, **public** members of the base class become **public** members of the derived class and **protected** members of the base class become **protected** members of the derived class. A base class's **private** members are never accessible directly from a derived class, but can be accessed through calls to the **public** and **protected** members of the

base class.

- **Protected Inheritance** – When deriving from a **protected** base class, **public** and **protected** members of the base class become **protected** members of the derived class.
- **Private Inheritance** – When deriving from a **private** base class, **public** and **protected** members of the base class become **private** members of the derived class.

## Multiple Inheritance

A C++ class can inherit members from more than one class and here is the extended syntax

–

```
class derived-class: access baseA, access baseB....
```

Where access is one of **public**, **protected**, or **private** and would be given for every base class and they will be separated by comma as shown above. Let us try the following example

–

```
#include <iostream>

using namespace std;

// Base class Shape
class Shape {
public:
    void setWidth(int w) {
        width = w;
    }
    void setHeight(int h) {
        height = h;
    }

protected:
    int width;
    int height;
};

// Base class PaintCost
class PaintCost {
public:
    int getCost(int area) {
        return area * 70;
    }
};

// Derived class
class Rectangle: public Shape, public PaintCost {
public:
    int getArea() {
        return (width * height);
    }
};
```

```

    }
};

int main(void) {
    Rectangle Rect;
    int area;

    Rect.setWidth(5);
    Rect.setHeight(7);

    area = Rect.getArea();

    // Print the area of the object.
    cout << "Total area: " << Rect.getArea() << endl;

    // Print the total cost of painting
    cout << "Total paint cost: $" << Rect.getCost(area) << endl;

    return 0;
}

```

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

```

Total area: 35
Total paint cost: $2450

```

All C++ programs are composed of the following two fundamental elements –

- **Program statements (code)** – This is the part of a program that performs actions and they are called functions.
- **Program data** – The data is the information of the program which gets affected by the program functions.

Encapsulation is an Object Oriented Programming concept that binds together the data and functions that manipulate the data, and that keeps both safe from outside interference and misuse. Data encapsulation led to the important OOP concept of **data hiding**.

**Data encapsulation** is a mechanism of bundling the data, and the functions that use them and **data abstraction** is a mechanism of exposing only the interfaces and hiding the implementation details from the user.

C++ supports the properties of encapsulation and data hiding through the creation of user-defined types, called **classes**. We already have studied that a class can contain **private**, **protected** and **public** members. By default, all items defined in a class are private. For example –

```

class Box {
    public:
        double getVolume(void) {
            return length * breadth * height;
        }

    private:

```

```
double length;    // Length of a box
double breadth;   // Breadth of a box
double height;    // Height of a box
};
```

The variables `length`, `breadth`, and `height` are **private**. This means that they can be accessed only by other members of the `Box` class, and not by any other part of your program. This is one way encapsulation is achieved.

To make parts of a class **public** (i.e., accessible to other parts of your program), you must declare them after the **public** keyword. All variables or functions defined after the public specifier are accessible by all other functions in your program.

Making one class a friend of another exposes the implementation details and reduces encapsulation. The ideal is to keep as many of the details of each class hidden from all other classes as possible.

## Data Encapsulation Example

Any C++ program where you implement a class with public and private members is an example of data encapsulation and data abstraction. Consider the following example –

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

class Adder {
public:
    // constructor
    Adder(int i = 0) {
        total = i;
    }

    // interface to outside world
    void addNum(int number) {
        total += number;
    }

    // interface to outside world
    int getTotal() {
        return total;
    };

private:
    // hidden data from outside world
    int total;
};

int main() {
    Adder a;

    a.addNum(10);
    a.addNum(20);
}
```

```
a.addNum(30);

cout << "Total " << a.getTotal() << endl;
return 0;
}
```

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

```
Total 60
```

Above class adds numbers together, and returns the sum. The public members **addNum** and **getTotal** are the interfaces to the outside world and a user needs to know them to use the class. The private member **total** is something that is hidden from the outside world, but is needed for the class to operate properly.

## Designing Strategy

Most of us have learnt to make class members private by default unless we really need to expose them. That's just good **encapsulation**.

This is applied most frequently to data members, but it applies equally to all members, including virtual functions.