REPORT JUNE 25

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Course:	**Solo Learning**	**USN:**	**4AL16EC409**
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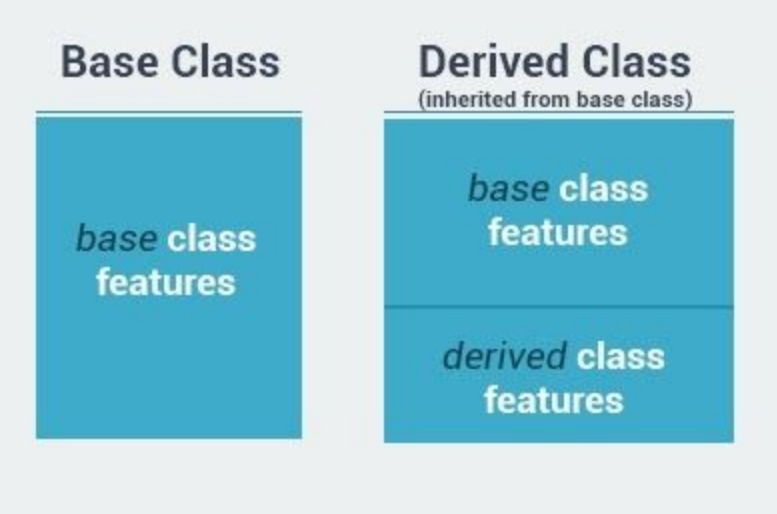
FORENOON SESSION DETAILS
Image of session
Report – **Inheritance** **Inheritance is one of the most important concepts of object-oriented programming.** **Inheritance allows us to define a class based on another class. This facilitates greater ease in creating and maintaining an application.** **The class whose properties are inherited by another class is called the Base class. The class which inherits the properties is called the Derived class. For example, the Daughter class (derived) can be inherited from the Mother class (base).** **The derived class inherits all feature from the base class, and can have its own additional features.**



Inheritance

This syntax derives the Daughter class from the Mother class.

```
class Daughter : public Mother
{
public:
 Daughter() {};
};
```

As all public members of the Mother class become public members for the Daughter class, we can create an object of type Daughter and call the sayHi() function of the Mother class for that object:

```
#include <iostream>
using namespace std;
class Mother
{
public:
 Mother() {};
 void sayHi() {
  cout << "Hi";
 }
};

class Daughter: public Mother
{
public:
 Daughter() {};
};

int main() {
 Daughter d;
 d.sayHi();
}
```

```
//Outputs "Hi"
```

Access Specifiers

Up to this point, we have worked exclusively with public and private access specifiers.
Public members may be accessed from anywhere outside of the class, while access to private members is limited to their class and friend functions.

Protected

There is one more access specifier - protected.
A protected member variable or function is very similar to a private member, with one difference - it can be accessed in the derived classes.

```
class Mother {
public:
 void sayHi() {
  cout << var;
 }
private:
 int var=0;
protected:
 int someVar;
};
```

Type of Inheritance

Access specifiers are also used to specify the type of inheritance.
Remember, we used public to inherit the Daughter class:

class Daughter: public Mother

private and protected access specifiers can also be used here.

Public Inheritance: 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: public and protected members of the base class become protected members of the derived class.

Private Inheritance: public and protected members of the base class become private members of the derived class.

Inheritance

When inheriting classes, the base class' constructor and destructor are not inherited.
However, they are being called when an object of the derived class is created or deleted.

To further explain this behavior, let's create a sample class that includes a constructor and a destructor:

```
class Mother {
public:
Mother()
{
 cout <<"Mother ctor"<<endl;
}
~Mother()
{
 cout <<"Mother dtor"<<endl;
}
};
```

Inheritance

Next, let's create a Daughter class, with its own constructor and destructor, and make it a derived class of the Mother:

```
class Daughter: public Mother {
public:
Daughter()
{
 cout <<"Daughter ctor"<<endl;
}
~Daughter()
{
 cout <<"Daughter dtor"<<endl;
}
};
```

Polymorphism

The word polymorphism means "having many forms".
Typically, polymorphism occurs when there is a hierarchy of classes and they are related by inheritance.

C++ polymorphism means that a call to a member function will cause a different implementation to be executed depending on the type of object that invokes the function.

Polymorphism can be demonstrated more clearly using an example:
Suppose you want to make a simple game, which includes different enemies: monsters, ninjas, etc. All enemies have one function in common: an attack function. However, they each attack in a different way. In this situation, polymorphism allows for calling the same attack function on different objects, but resulting in different behaviors.

The first step is to create the Enemy class.

```
class Enemy {
protected:
 int attackPower;
```

```
public:
 void setAttackPower(int a){
  attackPower = a;
 }
};
```

Polymorphism

Our second step is to create classes for two different types of enemies, Ninjas and Monsters. Both of these new classes inherit from the Enemy class, so each has an attack power. At the same time, each has a specific attack function.

```
class Ninja: public Enemy {
public:
 void attack() {
  cout << "Ninja! - "<<attackPower<<endl;
 }
};

class Monster: public Enemy {
public:
 void attack() {
  cout << "Monster! - "<<attackPower<<endl;
 }
};
```

Virtual Functions

The previous example demonstrates the use of base class pointers to the derived classes. Why is that useful? Continuing on with our game example, we want every Enemy to have an attack() function.

To be able to call the corresponding attack() function for each of the derived classes using Enemy pointers, we need to declare the base class function as virtual.

Defining a virtual function in the base class, with a corresponding version in a derived class, allows polymorphism to use Enemy pointers to call the derived classes' functions.

Every derived class will override the attack() function and have a separate implementation:

```
class Enemy {
public:
 virtual void attack() {
 }
};
class Ninja: public Enemy {
public:
 void attack() {
  cout << "Ninja!"<<endl;
 }
};
class Monster: public Enemy {
public:
 void attack() {
```

```
  cout << "Monster!"<<endl;
 }
 };
```

Pure Virtual Functions

The pure virtual function in the Enemy class must be overridden in its derived classes.

```
class Enemy {
public:
 virtual void attack() = 0;
};

class Ninja: public Enemy {
public:
 void attack() {
  cout << "Ninja!"<<endl;
 }
};
class Monster: public Enemy {
public:
 void attack() {
  cout << "Monster!"<<endl;
 }
};
```

Function Templates

Functions and classes help to make programs easier to write, safer, and more maintainable. However, while functions and classes do have all of those advantages, in certain cases they can also be somewhat limited by C++'s requirement that you specify types for all of your parameters.

For example, you might want to write a function that calculates the sum of two numbers, similar to this:

```
int sum(int a, int b) {
 return a+b;
}
```

Function Templates

We can now call the function for two integers in our main.

```
int sum(int a, int b) {
 return a+b;
}
int main () {
 int x=7, y=15;
 cout << sum(x, y) << endl;
}
// Outputs 22
```

It becomes necessary to write a new function for each new type, such as doubles.

```
double sum(double a, double b) {
 return a+b;
}
```

Wouldn't it be much more efficient to be able to write one version of sum() to work with parameters of any type?
Function templates give us the ability to do that!
With function templates, the basic idea is to avoid the necessity of specifying an exact type for each variable. Instead, C++ provides us with the capability of defining functions using placeholder types, called template type parameters.

To define a function template, use the keyword template, followed by the template type definition:

```
template <class T>
```

Now we can use our generic data type T in the function:

```
template <class T>
T sum(T a, T b) {
 return a+b;
}

int main () {
  int x=7, y=15;
  cout << sum(x, y) << endl;
}
```

Template functions can save a lot of time, because they are written only once, and work with different types.

Template functions reduce code maintenance, because duplicate code is reduced significantly.

In our main, we can use the function for different data types:

```
template <class T, class U>
T smaller(T a, U b) {
 return (a < b ? a : b);
}
int main () {
 int x=72;
 double y=15.34;
 cout << smaller(x, y) << endl;
}
```

Class Templates

Just as we can define function templates, we can also define class templates, allowing classes to have members that use template parameters as types.

The same syntax is used to define the class template:

```
template <class T>
class MyClass {
};
```

As an example, let's create a class Pair, that will be holding a pair of values of a generic type.

```
template <class T>
class Pair {
private:
 T first, second;
public:
 Pair (T a, T b):
  first(a), second(b) {
 }
};
```

A specific syntax is required in case you define your member functions outside of your class - for example in a separate source file.

You need to specify the generic type in angle brackets after the class name.

For example, to have a member function bigger() defined outside of the class, the following syntax is used:

```
template <class T>
class Pair {
private:
 T first, second;
public:
 Pair (T a, T b):
  first(a), second(b){
 }
 T bigger();
};
template <class T>
T Pair<T>::bigger() {
```

```
    // some code
    }
```

Template Specialization

In case of regular class templates, the way the class handles different data types is the same; the same code runs for all data types.

Template specialization allows for the definition of a different implementation of a template when a specific type is passed as a template argument.

For example, we might need to handle the character data type in a different manner than we do numeric data types.

To demonstrate how this works, we can first create a regular template.

```
    template <class T>
    class MyClass {
    public:
     MyClass (T x) {
      cout <<x<<" -  not a char"<<endl;
     }
    };
template <class T>
class MyClass {

public:

 MyClass (T x) {

  cout <<x<<" -  not a char"<<endl;

 }

};

template < >

class MyClass<char> {

public:
```

```
MyClass (char x) {

 cout <<x<<" is a char!"<<endl;

}

};
```

Exceptions

Problems that occur during program execution are called exceptions.

In C++ exceptions are responses to anomalies that arise while the program is running, such as an attempt to divide by zero.

Working with Files

Another useful C++ feature is the ability to read and write to files. That requires the standard C++ library called fstream.

Three new data types are defined in fstream:

ofstream: Output file stream that creates and writes information to files.

ifstream: Input file stream that reads information from files.

fstream: General file stream, with both ofstream and ifstream capabilities that allow it to create, read, and write information to files.

To perform file processing in C++, header files <iostream> and <fstream> must be included in the C++ source file.

```
#include <iostream>
#include <fstream>
```

File Opening Modes

An optional second parameter of the open function defines the mode in which the file is opened. This list shows the supported modes.

Mode Parameter	Meaning
ios::**app**	append to end of file
ios::**ate**	go to end of file on opening
ios::**binary**	file open in binary mode
ios::**in**	open file for reading only
ios::**out**	open file for writing only
ios::**trunc**	delete the contents of the file if it exists

All these flags can be combined using the bitwise operator OR (|).

For example, to open a file in write mode and truncate it, in case it already exists, use the following syntax:

```
ofstream outfile;
outfile.open("file.dat", ios::out | ios::trunc );
```

Reading from a File

You can read information from a file using an ifstream or fstream object.

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

int main () {
 string line;
 ifstream MyFile("test.txt");
 while ( getline (MyFile, line) ) {
  cout << line << '\n';
 }
 MyFile.close();
}
```