Part: 41

Multiple Inheritance Deep Dive with Code Example in C++

In this tutorial, we will discuss multiple inheritances in C++

Multiple Inheritances in C++

Multiple inheritances are a type of inheritance in which one derived class is inherited with more than one base class. For example, we have three classes **“employee”**, **“assistant”** and **“programmer”**. If the **“programmer”** class is inherited from the **“employee”** and **“assistant”** class which means that the **“programmer”** class can now implement the functionalities of the **“employee”** and **“assistant”** class. The syntax of inheriting multiple inheritances is shown below.

```
// class DerivedC: visibility-mode base1, visibility-mode base2
// {
//      Class body of class "DerivedC"
// };
```

Code Snippet 1: Multiple inheritances syntax

As shown in a code snippet 1,

- After writing the class keyword we have to write the derived class name and then put a **“:”** sign.
- After **“:”** sign we have to write the visibility mode and then write the base class name and again we have to write the visibility mode and write another base class name.

An example program is shown below to demonstrate the concept of multiple inheritances in C++.

```
class Base1{
protected:
    int base1int;

public:
    void set_base1int(int a)
    {
        base1int = a;
    }
};

class Base2{
protected:
    int base2int;

public:
    void set_base2int(int a)
    {
        base2int = a;
    }
};

class Base3{
protected:
    int base3int;

public:
    void set_base3int(int a)
    {
        base3int = a;
    }
};
```

Code Snippet 2: Base Classes

As shown in Code snippet 2,

- 1st we created a **"Base1"** class which consists of protected data member integer **"base1int"**.
- 2nd the **"Base1"** class consists of a public function **"set_base1int"**. This function will set the value of the data member **"base1int"**.
- 3rd we created a **"Base2"** class which consists of protected data member integer **"base2int"**.
- 4th the **"Base2"** class consists of a public function **"set_base2int"**. This function will set the value of the data member **"base2int"**.
- 5th we created a **"Base3"** class which consists of protected data member integer **"base3int"**.
- 2nd the **"Base3"** class consists of a public function **"set_base3int"**. This function will set the value of the data member **"base3int"**.

The code for the "Derived" class is shown below. "Derived" class will inherit all the base classes.

```
class Derived : public Base1, public Base2, public Base3
{
    public:
        void show(){
            cout << "The value of Base1 is " << base1int<<endl;
            cout << "The value of Base2 is " << base2int<<endl;
            cout << "The value of Base3 is " << base3int<<endl;
            cout << "The sum of these values is " << base1int + base2int + base3int 
<< endl;
        }
};
```

Code Snippet 3: Derived Class

As shown in a code snippet 3,

- 1st we created a **"Derived"** class which is inheriting **"Base1"**, **"Base2"**, and **"Base3"** classes in public mode.
- 2nd the **"Derived"** class consists of the public member function **"show"**.
- 4th the function **"show"** will first print the values of **"base1int"**, **"base2int"**, and **"base3int"** individually and then print the sum of all three values.

It can be clearly seen that the class **"Derived"** is inheriting class "**Base1"**, **"Base2"**, and **"Base3"**. This is an example of multiple inheritances. The code main program is shown below.

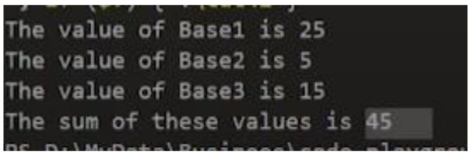
```
int main()
{
    Derived harry;
    harry.set_base1int(25);
    harry.set_base2int(5);
    harry.set_base3int(15);
    harry.show();

    return 0;
}
```

Code Snippet 4: Main Program

As shown in Code snippet 4,

- 1st object **“`harry`”** is created of the **“`Derived`”** data type.
- 2nd the function **“`set_base1int`”** is called by the object **“`harry`”** and the value **“`25`”** is passed.
- 3rd the function **“`set_base2int`”** is called by the object **“`harry`”** and the value **“`5`”** is passed.
- 4th the function **“`set_base3int`”** is called by the object **“`harry`”** and the value “15” is passed.
- 4th the function **“`show`”** is called by the object **“`harry`”**.

The output for the following program is shown in figure 1.



```
The value of Base1 is 25
The value of Base2 is 5
The value of Base3 is 15
The sum of these values is 45
```

Figure 1: Program Output

Part: 42

Exercise on C++ Inheritance

Exercise on C++ Inheritance

As we have discussed a lot about inheritance and its types; we have also seen its working with example programs. In this tutorial, I will give an exercise on C++ inheritance to be solved.

Questions

You have to create 2 classes:

1. **`SimpleCalculator`** - Takes input of 2 numbers using a utility function and performs +, -, *, / and displays the results using another function.
2. **`ScientificCalculator`** - Takes input of 2 numbers using a utility function and performs any four scientific operation of your choice and displays the results using another function.
3. Create another class **`HybridCalculator`** and inherit it using these 2 classes

Also, answer the questions given below.

- What type of Inheritance are you using?
- Which mode of Inheritance are you using?
- Create an object of **`HybridCalculator`** and display results of simple and scientific calculator.
- How is code reusability implemented?

Code file tut42.cpp as described in the video

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

Create 2 classes:

1. **`SimpleCalculator`** - Takes input of 2 numbers using a utility function and performs +, -, *, / and displays the results using another function.
2. **`ScientificCalculator`** - Takes input of 2 numbers using a utility function and performs any four scientific operations of your choice and displays the results using another function.

Create another class **`HybridCalculator`** and inherit it using these 2 classes:

Q1. What type of Inheritance are you using?

Q2. Which mode of Inheritance are you using?

Q3. Create an object of **`HybridCalculator`** and display results of the simple and scientific calculator.

Q4. How is code reusability implemented?

```
*/
int main(){

    return 0;
}
```

Part: 43

Ambiguity Resolution in Inheritance in C++

In this tutorial, we will discuss ambiguity resolution in inheritance in C++

Ambiguity Resolution in Inheritance

Ambiguity in inheritance can be defined as when one class is derived for two or more base classes then there are chances that the base classes have functions with the same name. So it will confuse derived class to choose from similar name functions. To solve this ambiguity scope resolution operator is used **“`::`”**. An example program is shown below to demonstrate the concept of ambiguity resolution in inheritance.

```
class Base1{
    public:
        void greet(){
            cout<<"How are you?"<<endl;
        }
};

class Base2{
    public:
        void greet()
        {
            cout << "Kaise ho?" << endl;
        }
};
class Derived : public Base1, public Base2{
   int a;
   public:
    void greet(){
        Base2 :: greet();
    }
};
```

Code Snippet 1: Ambiguity Resolution in Inheritance Example Program 1

As shown in a code snippet 1,

1. We have created a **“`Base1`”** class which consists of public member function **“`greet`”**. The function **“`greet`”** will print **“`how are you?`”**
2. We have created a **“`Base2`”** class which consists of public member function **“`greet`”**. The function **“`greet`”** will print **“`kaise ho?`”**
3. We have created a **“`Derived`”** class which is inheriting **“`Base1`”** and **“`Base2`”** classes. The **“`Derived`”** class consists of public member function **“`greet`”**. The function **“`greet`”** will run the **“`greet`”** function of the **“`Base2`”** class because we have used a scope resolution operator to let the compiler know which function should it run otherwise it will cause ambiguity.

The code of the main function is shown below

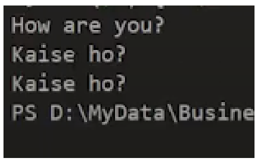
```
int main(){
  // Ambibuity 1
    Base1 base1obj;
    Base2 base2obj;
    base1obj.greet();
    base2obj.greet();
    Derived d;
    d.greet();

    return 0;
}
```

Code Snippet 2: Main program 1

As shown in code snippet 2,

1. Object **“base1obj”** is created of the **“Base1”** data type.
2. Object **“base3obj”** is created of the **“Base2”** data type.
3. The function **“greet”** is called by the object **“base1obj”**.
4. The function **“greet”** is called by the object **“base2obj”**.
5. Object **“d”** is created of the **“Derived”** data type.
6. The function **“greet”** is called by the object **“d”**.

The main thing to note here is that when the function **“greet”** is called by the object **“d”** it will run the **“greet”** function of the **“Base2”** class because we had specified it using scope resolution operator **“::”** to get rid ambiguity. The output for the following program is shown in figure 1.



```
How are you?
Kaise ho?
Kaise ho?
PS D:\MyData\Busine
```

Figure 1: Output

Another example of ambiguity resolution in inheritance is shown below.

```
class B{
    public:
        void say(){
            cout<<"Hello world"<<endl;
        }
};

class D: public B{
    int a;
    // D's new say() method will override base class's say() method
    public:
        void say()
        {
            cout << "Hello my beautiful people" << endl;
        }
};
```

Code Snippet 3: Ambiguity Resolution in Inheritance Example Program 2

As shown in a code snippet 3,

1. We have created a **“B”** class which consists of public member function **“say”**. The function **“say”** will print **“hello world”**
2. We have created a **“D”** class that is inheriting the **“B”** class. The **“D”** class consists of the public member function **“say”**. The function **“say”** will print **“Hello my beautiful people”**

The main thing to note here is that both **“B”** and **“D”** classes have the same function **“say”**, So if the class **“D”** will call the function **“say”** it will override the base class **“say”** method because compiler by default run the method which is already written in its own body. But if the function **“say”** was not present in the class **“D”** then the compiler will run the method of the class **“B”**.

The code of the main function is shown below,

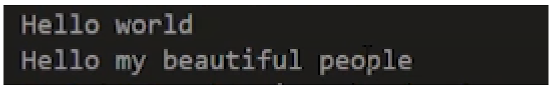
```
int main(){
    // Ambibuity 2
    B b;
    b.say();

    D d;
    d.say();

    return 0;
}
```

Code Snippet 4: Main Program 2

As shown in code snippet 4,

1. Object **“`b`”** is created of the **“`B`”** data type.
2. The function **“`say`”** is called by the object **“`b`”**.
3. Object **“`d`”** is created of the **“`D`”** data type.
4. The function **“`say`”** is called by the object **“`d`”**.

The output for the following program is shown in figure 2.



```
Hello world
Hello my beautiful people
```

Figure 2: Output

Part: 44

Virtual Base Class in C++

In this tutorial, we will discuss virtual base class in C++

Virtual Base Class in C++

The virtual base class is a concept used in multiple inheritances to prevent ambiguity between multiple instances. For example: suppose we created a class **“A”** and two classes **“B”** and **“C”**, are being derived from class **“A”**. But once we create a class **“D”** which is being derived from class **“B”** and **“C”** as shown in figure 1.

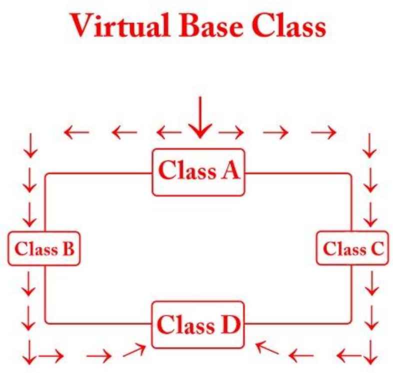


Figure 1: Virtual Base Class Example Diagram

As shown in figure 1,

1. Class **“A”** is a parent class of two classes **“B”** and **“C”**
2. And both **“B”** and **“C”** classes are the parent of class **“D”**

The main thing to note here is that the data members and member functions of class **“A”** will be inherited twice in class **“D”** because class **“B”** and **“C”** are the parent classes of class **“D”** and they both are being derived from class **“A”**.

So, when the class **“D”** will try to access the data member or member function of class **“A”** it will cause ambiguity for the compiler and the compiler will throw an error. To solve this ambiguity, we will make class **“A”** as a virtual base class. To make a virtual base class **“virtual”** keyword is used.

When one class is made virtual then only one copy of its data member and member function is passed to the classes inheriting it. So, in our example when we will make class “A” a virtual class then only one copy of the data member and member function will be passed to the classes “B” and “C” which will be shared between all classes. This will help to solve the ambiguity.

The syntax of the virtual base class is shown in the code snippet below,

```
#include <iostream>
using namespace std;
class A {
public:
    void say()
    {
        cout << "Hello
world"<<endl;
    }
};
class B : public virtual A {
};
class C : public virtual A {
};
class D : public B, public C {
};
```

Code Snippet 1: Virtual Base Class Syntax Example Code

Part: 45

Code Example Demonstrating Virtual Base Class in C++

In this tutorial, we will discuss demonstrating of virtual base class in C++

Virtual Base Class in C++

The virtual base class is a concept used in multiple inheritances to prevent ambiguity between multiple instances. For example: suppose we created a class **`“Student”`** and two classes **`“Test”`** and **`“Sports”`**, are being derived from class **`“Student”`**. But once we create a class **`“Result”`** which is being derived from class **`“Test”`** and **`“Sports”`** as shown in figure 1.

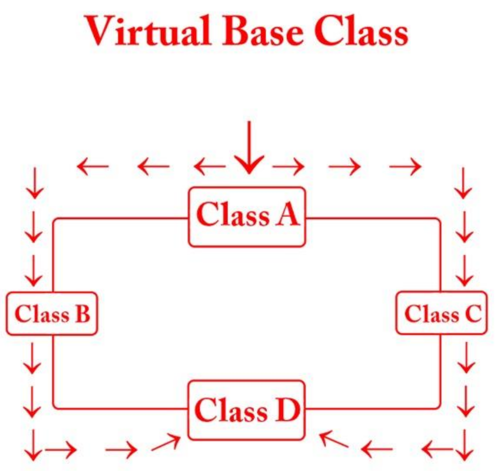


Figure 1: Virtual Base Class Example Diagram

As shown in figure 1,

1. Class **`“Student”`** is a parent class of two classes **`“Test”`** and **`“Sports”`**
2. And both **`“Test”`** and **`“Sports”`** classes are the parent of class **`“Result”`**

The main thing to note here is that the data members and member functions of class **`“Student”`** will be inherited twice in class **`“Result”`** because class **`“Test”`** and **`“Sports”`** are the parent classes of class **`“Result”`** and they both are being derived from class **`“Student”`**.

So when the class **`“Result”`** will try to access the data member or member function of class **`“Student”`** it will cause ambiguity for the compiler and the compiler will throw an error. To solve this ambiguity, we will make class **`“Student”`** as a virtual base class. To make a virtual base class **`“virtual”`** keyword is used.

When one class is made virtual then only one copy of its data member and member function is passed to the classes inheriting it. So in our example when we will make class **`“Student`”** a virtual class then only one copy of data member and member function will be passed to the classes **`“Test”`** and **`“Sports”`** which will be shared between all classes. This will help to solve the ambiguity.

An example program of the following diagram is shown in a code snippet below,

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

class Student{
    protected:
        int roll_no;
    public:
        void set_number(int a){
            roll_no = a;
        }
        void print_number(void){
            cout<<"Your roll no is "<< roll_no<<endl;
        }
};

class Test : public Student{
    protected:
        float maths, physics;
        public:
            void set_marks(float m1, float m2){
                maths = m1;
                physics = m2;
            }

            void print_marks(void){
                cout << "You result is here: "<<endl
                     << "Maths: "<< maths<<endl
                     << "Physics: "<< physics<<endl;
            }
};

class Sports: public Student{
    protected:
        float score;
    public:
        void set_score(float sc){
            score = sc;
        }

        void print_score(void){
            cout<<"Your PT score is "<<score<<endl;
        }

};

class Result : public Test, public Sports{
    private:
        float total;
    public:
        void display(void){
            total = maths + physics + score;
            print_number();
            print_marks();
            print_score();
            cout<< "Your total score is: "<<total<<endl;
        }
};
```
Code Snippet 1: Virtual Base Class Example Program

As shown in a code snippet 1,

1. We have created a **"Student"** class that consists of protected data member **"roll_no"** and member functions **"set_number"** and **"print_number"**. The function **"set_number"** will assign the value to the protected data member **"roll_no"** and the function **"print_number"** will print the value of data member **"roll_no"**.

2. We have created a **“Test”** class that is inheriting the virtual base class **“Student”**. The **“Test”** consists of protected data members **“maths”** and **“physics”** and member functions **“set_marks”** and **“print_marks”**. The function **“set_number”** will assign the values to the protected data members **“maths”** and **“physics”** and the function **“print_marks”** will print the value of data members **“maths”** and **“physics”**.
3. We have created a **“Sports”** class that is inheriting the virtual base class **“Student”**. The **“Sports”** consists of protected data member **“score”** and member functions **“set_score”** and **“print_score”**. The function **“set_score”** will assign the values to the protected data members **“score”** and **“physics”** and the function **“print_score”** will print the value of data members **“score”**.
4. We have created a **“Result”** class which is inheriting base classes **“Test”** and **“Sports”**. The **“Result”** consists of protected data member **“total”** and member functions **“display”**. The function **“display”** will first add the values of data members **“math”**, **“physics”**, and **“score”** and assign the value to the protected data members **“total”** and second the **“display”** function will call the functions **“print_number”**, **“print_marks”**, and **“print_score”** and also print the value of the data member **“total”**.

The code of the main function is shown below,

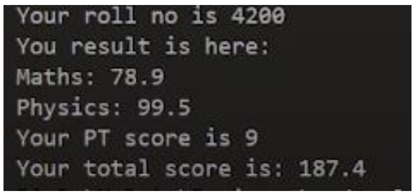
```
int main(){
    Result harry;
    harry.set_number(4200);
    harry.set_marks(78.9, 99.5);
    harry.set_score(9);
    harry.display();
    return 0;
}
```

Code Snippet 2: Main Program

As shown in code snippet 2,

1. Object **“harry”** is created of the **“Result”** data type.
2. The function **“set_number”** is called by the object **“harry”** and the value **“4200”** is passed.
3. The function **“set_marks”** is called by the object **“harry”** and the values **“48.9”** and **“99.5”** are passed.
4. The function **“set_score”** is called by the object **“harry”** and the value **“9”** is passed.
5. The function **“display”** is called by the object **“harry”**.

The main thing to note here is that there will be no ambiguity because we have made the **“Student”** class as a virtual base class but if we remove the **“virtual”** keyword then the compare will throw an error. The output of the following program is shown below.



```
Your roll no is 4200
You result is here:
Maths: 78.9
Physics: 99.5
Your PT score is 9
Your total score is: 187.4
```

Figure 2: Program Output

Part: 46

Constructors in Derived Class in C++

In this tutorial, we will discuss constructors in derived class in C++

Constructors in Derived Class in C++

- We can use constructors in derived classes in C++
- If the base class constructor does not have any arguments, there is no need for any constructor in the derived class
- But if there are one or more arguments in the base class constructor, derived class need to pass argument to the base class constructor
- If both base and derived classes have constructors, base class constructor is executed first

Constructors in Multiple Inheritances

- In multiple inheritances, base classes are constructed in the order in which they appear in the class deceleration. For example, if there are three classes **`“A”`**, **`“B”`**, and **`“C”`**, and the class **`“C”`** is inheriting classes **`“A”`** and **`“B”`**. If the class **`“A”`** is written before class **`“B”`** then the constructor of class **`“A”`** will be executed first. But if the class **`“B”`** is written before class **`“A”`** then the constructor of class **`“B”`** will be executed first.
- In multilevel inheritance, the constructors are executed in the order of inheritance. For example, if there are three classes **`“A”`**, **`“B”`**, and **`“C”`**, and the class **`“B”`** is inheriting classes **`“A”`** and the class **`“C”`** is inheriting classes **`“B”`**. Then the constructor will run according to the order of inheritance such as the constructor of class **`“A”`** will be called first then the constructor of class **`“B”`** will be called and at the end constructor of class **`“C”`** will be called.

Special Syntax

- C++ supports a special syntax for passing arguments to multiple base classes
- The constructor of the derived class receives all the arguments at once and then will pass the call to the respective base classes
- The body is called after the constructors is finished executing

Syntax Example:

```
Derived-Constructor (arg1, arg2, arg3….): Base 1-Constructor (arg1, arg2), Base 2-
Constructor(arg3, arg4)
{
….
} Base 1-Constructor (arg1, arg2)
```

Special Case of Virtual Base Class

- The constructors for virtual base classes are invoked before a non-virtual base class
- If there are multiple virtual base classes, they are invoked in the order declared
- Any non-virtual base class are then constructed before the derived class constructor is executed

Part: 47

Solution to Exercise on Cpp Inheritance

A solution to Exercise on Inheritance in C++

As I have given you an exercise on inheritance to solve in the previous tutorial. In this tutorial, we will see the solution to that exercise. So the question was to make three classes **“SimpleCalculator”**, **“ScientificCalculator”** and **“HybridCalculator”**.

- In **“SimpleCalculator”** class you have to take input of 2 numbers and perform function (+, -, *, /)
- In **“ScientificCalculator”** class you have to take input of 2 numbers and perform any 4 scientific operations
- You have to inherit both **“SimpleCalculator”** and **“ScientificCalculator”** classes with the **“HybridCalculator”** class. You have to make an object of the **“HybridCalculator”** class and display the results of **“SimpleCalculator”** and **“ScientificCalculator”** classes.

The solution to the above Question is shown below,

```
class SimpleCalculator {
    int a, b;
    public:
        void getDataSimple()
        {
            cout<<"Enter the value of a"<<endl;
            cin>>a;
            cout<<"Enter the value of b"<<endl;
            cin>>b;
        }

        void performOperationsSimple(){
            cout<<"The value of a + b is: "<<a + b<<endl;
            cout<<"The value of a - b is: "<<a - b<<endl;
            cout<<"The value of a * b is: "<<a * b<<endl;
            cout<<"The value of a / b is: "<<a / b<<endl;
        }
};
```

Code snippet 1: Simple Calculator Class

As shown in a code snippet 1,

1. We created a class **“SimpleCalculator”** which contains two private data members **“a”** and **“b”**
2. The class **“SimpleCalculator”** contains two members functions **“getDataSimple”** and **“performOperationsSimple”**
3. The function **“getDataSimple”** will take 2 numbers as input
4. The function **“performOperationsSimple”** will perform the operations **“+, -, *, /”**

```
class ScientificCalculator{
    int a, b;

    public:
        void getDataScientific()
        {
            cout << "Enter the value of a" << endl;
            cin >> a;
            cout << "Enter the value of b" << endl;
            cin >> b;
        }

        void performOperationsScientific()
        {
            cout << "The value of cos(a) is: " << cos(a) << endl;
            cout << "The value of sin(a) is: " << sin(a) << endl;
            cout << "The value of exp(a) is: " << exp(a) << endl;
            cout << "The value of tan(a) is: " << tan(a) << endl;
        }
};
```

Code Snippet 2: Scientific Calculator Class

As shown in code snippet 2,

1. We created a class **“ScientificCalculator”** which contains two private data members **“a”** and **“b”**
2. The class **“ScientificCalculator”** contains two members functions **“getDataScientific”** and **“performOperationsScientific”**
3. The function **“getDataScientific”** will take 2 numbers as input
4. The function **“performOperationsScientific”** will perform the operations **“cos, sin, exp, tan”**

```
class HybridCalculator : public SimpleCalculator, public ScientificCalculator{

};
```

Code Snippet 3: Hybrid Calculator Class

As shown in code snippet 3, we created a **“HybridCalculator”** class which is inheriting the **“SimpleCalculator”** class and **“ScientificCalculator”** class.

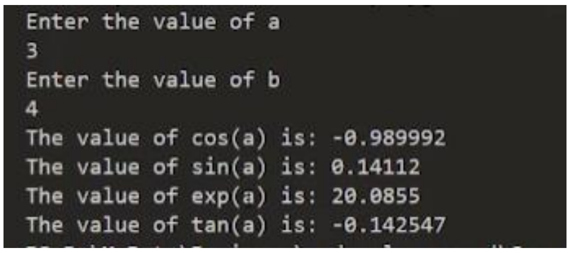
```
int main()
{
    HybridCalculator calc;
    calc.getDataScientific();
    calc.performOperationsScientific();
    calc.getDataSimple();
    calc.performOperationsSimple();

    return 0;
}
```

Code Snippet 4: Main Program

As shown in code snippet 4,

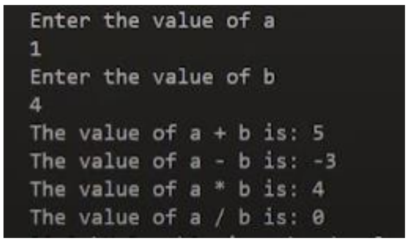
1. We created an object **“calc”** of the data type **“hybridCalculator”**
2. The function **“getDataScientific”** is called using the object **“calc”**
3. The function **“performOperationsScientific”** is called using the object **“calc”**
4. The function **“getDataSimple”** is called using the object **“calc”**
5. The function **“performOperationsSimple”** is called using the object **“calc”**

The output of the following program is shown in the figure below,



```
Enter the value of a
3
Enter the value of b
4
The value of cos(a) is: -0.989992
The value of sin(a) is: 0.14112
The value of exp(a) is: 20.0855
The value of tan(a) is: -0.142547
```

Figure 1: Program Output 1



```
Enter the value of a
1
Enter the value of b
4
The value of a + b is: 5
The value of a - b is: -3
The value of a * b is: 4
The value of a / b is: 0
```

Figure 2: Program Output 2

Q1. What type of Inheritance are you using?

Ans. Multiple inheritances

Q2. Which mode of Inheritance are you using?

Ans. public SimpleCalculator, public ScientificCalculator

Part: 48

Code Example: Constructors in Derived Class in Cpp

In this tutorial, we will discuss constructors in derived class with code example in C++

Constructors in Derived Class in C++

As we have discussed before about the constructors in derived class in a code snippet below three cases are given to clarify the execution of constructors.

```
/*
Case1:
class B: public A{
   // Order of execution of constructor -> first A() then B()
};

Case2:
class A: public B, public C{
    // Order of execution of constructor -> B() then C() and A()
};

Case3:
class A: public B, virtual public C{
    // Order of execution of constructor -> C() then B() and A()
};

*/
```

Code Snippet 1: Constructors Execution Example Cases

As shown in Code Snippet 1,

1. In case 1, class **"B"** is inheriting class **"A"**, so the order of execution will be that first the constructor of class **"A"** will be executed and then the constructor of class **"B"** will be executed.
2. In case 2, class **"A"** is inheriting two classes **"B"** and **"C"**, so the order of execution will be that first constructor of class **"B"** will be executed and then the constructor of class **"C"** will be executed and at the end constructor of class **"A"** will be executed.
3. In case 3, class **"A"** is inheriting two classes **"B"** and virtual class **"C"**, so the order of execution will be that first constructor of class **"C"** will be executed because it is a virtual class and it is given more preference and then the constructor of class **"B"** will be executed and at the end constructor of class **"A"** will be executed.

To demonstrate the concept of constructors in derived classes an example program is shown below.

```
class Base1{
    int data1;
    public:
        Base1(int i){
            data1 = i;
            cout<<"Base1 class constructor called"<<endl;
        }
        void printDataBase1(void){
            cout<<"The value of data1 is "<<data1<<endl;
        }
};

class Base2{
    int data2;
```

```
        public:
            Base2(int i){
                data2 = i;
                cout << "Base2 class constructor called" << endl;
            }
            void printDataBase2(void){
                cout << "The value of data2 is " << data2 << endl;
            }
    };

    class Derived: public Base2, public Base1{
        int derived1, derived2;
        public:
            Derived(int a, int b, int c, int d) : Base2(b), Base1(a)
            {
                derived1 = c;
                derived2 = d;
                cout<< "Derived class constructor called"<<endl;
            }
            void printDataDerived(void)
            {
                cout << "The value of derived1 is " << derived1 << endl;
                cout << "The value of derived2 is " << derived2 << endl;
            }
    };
```

Code Snippet 2: Constructors in Derived Class Example Program

As shown in code snippet 2,

1. We have created a **"Base1"** class which consists of private data member **"data1"** and parameterized constructor which takes only one argument and set the value of data member **"data1"**. The **"Base1"** class also contains the member function **"printDataBase1"** which will print the value of data member **"data1"**.
2. We have created a **"Base2"** class which consists of private data member **"data2"** and parameterized constructor which takes only one argument and set the value of data member **"data2"**. The **"Base2"** class also contains the member function **"printDataBase2"** which will print the value of data member **"data2"**.
3. We have created a **"Derived"** class that is inheriting base classes **"Base1"** and **"Base2"**. The **"Derived"** class consists of private data members **"derived1"** and **"derived2"**. The **"Derived"** class contains parameterized constructor which calls the **"Base1"** and **"Base2"** class constructors to pass the values, it also assigns the values to the data members **"derived1"** and **"derived2"**. The **"Derived"** class also contains member functions **"printDataDerived"**. The function **"printDataDerived"** will print the values of the data member **"derived1"** and **"derived2"**.

The main thing to note here is that the constructors will be executed in the order in which the classes are being inherited. As in the example program above the **"Base2"** class is being inherited first and then **"Base1"** class is being inherited, so the constructor of **"Base2"** class will be executed first. The main program of the following example code is shown below.

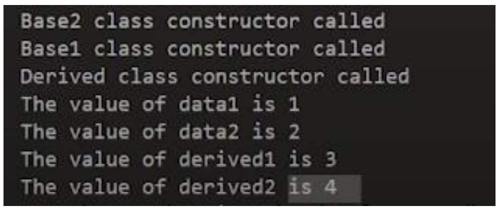
```
int main(){
    Derived harry(1, 2, 3, 4);
    harry.printDataBase1();
    harry.printDataBase2();
    harry.printDataDerived();
    return 0;
}
```

Code Snippet 3: Main Program

As shown in code snippet 3,

1. Object **“harry”** is created of the **“Derived”** data type and the values (1, 2, 3, 4) are passed.
2. The function **“printDataBase1”** is called by the object **“harry”**.
3. The function **“printDataBase2”** is called by the object **“harry”**.
4. The function **“printDataDerived”** is called by the object **“harry”**.

The output of the following program is shown below,



```
Base2 class constructor called
Base1 class constructor called
Derived class constructor called
The value of data1 is 1
The value of data2 is 2
The value of derived1 is 3
The value of derived2 is 4
```

Figure 1: Program Output

Part: 49

Initialization list in Constructors in C++

In this tutorial, we will discuss the Initialization list in Constructors in C++

Initialization list in Constructors in C++

The initialization list in constructors is another concept of initializing the data members of the class. The syntax of the initialization list in constructors is shown below.

```
/*
Syntax for initialization list in constructor:
constructor (argument-list) : initilization-section
{
    assignment + other code;
}
```

Code Snippet 1: Initialization list in Constructors Syntax

As shown in a code snippet 1,

1. A constructor is written first and then the initializations section is written
2. In the initialization section, the data members are initialized

To demonstrate the concept of Initialization list in Constructors an example program is shown below,

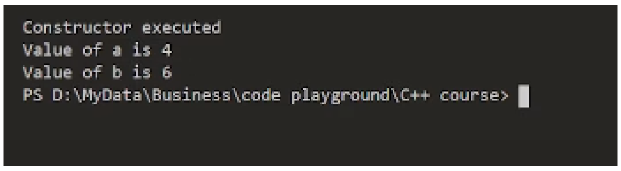
```
class Test
{
    int a;
    int b;
public:
    Test(int i, int j) : a(i), b(j)
    {
        cout << "Constructor executed"<<endl;
        cout << "Value of a is "<<a<<endl;
        cout << "Value of b is "<<b<<endl;
    }
};

int main()
{
    Test t(4, 6);
    return 0;
}
```

Code Snippet 2: Initialization list in Constructors Example Program 1

As shown in code snippet 2,

1. We have created a **"test"** class that consists of private data member **"a"** and **"b"** and parameterized constructor which takes two arguments and sets the value of data member **"a"** and **"b"** by using the initialization list. The constructor will also print the value of data member **"a"** and **"b"**.
2. In the main program object **"t"** is created of the **"test"** data type and the values (4, 6) are passed.

The output of the following program is shown below,



```
Constructor executed
Value of a is 4
Value of b is 6
PS D:\MyData\Business\code playground\C++ course>
```

Figure 1: Program Output

Main Points

The main thing to note here is that if we use the code shown below to initialize data members the compiler will throw an error because the data member **“a”** is being initialized first and the **“b”** is being initialized second so we have to assign the value to **“a”** data member first.

```
Test(int i, int j) : b(j), a(i+b)
```

Code Snippet 3: Initialization list in Constructors Example 1

But if we use the code shown below to initialize data members the compiler will not throw an error because the data member **“a”** is being initialized first and we are assigning the value to the data member **“a”** first.

```
Test(int i, int j) : a(i), b(a + j)
```

Code Snippet 4: Initialization list in Constructors Example 2

Part: 50

Revisiting Pointers: new and delete Keywords in CPP

In this tutorial, we will discuss pointers and new, delete keywords in C++

Pointers in C++

Pointers are variables that are used to store the address. Pointers are created using "*". An example program of pointers is shown below

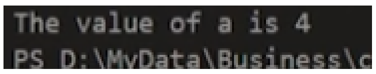
```
#include<iostream>
using namespace std;

int main(){
    // Basic Example
    int a = 4;
    int* ptr = &a;
    cout<<"The value of a is "<<*(ptr)<<endl;

    return 0;
}
```

Code Snippet 1: Pointer Example Program 1

As shown in a code snippet 1,

1. We created an integer variable **"a"** and assign the value **"4"** to it
2. We created an integer pointer **"ptr"** and assign the address of variable **"a"**
3. And printed the value at the address of pointer **"ptr"**

The output of the following program is shown below,



```
The value of a is 4
PS D:\MyData\Business\c
```

Figure 1: Pointer Program 1 Output

As shown in figure 1, we get the output value **"4"** because pointer **"ptr"** is pointing to the variable **"a"** and the value of the variable **"a"** is **"4"** that is why we get the output **"4"**.

New Keyword

Another example program for pointers and the use of a "new" keyword is shown below.

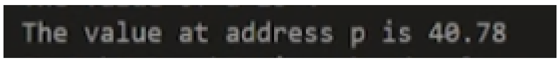
```
#include<iostream>
using namespace std;

int main(){

    float *p = new float(40.78);
    cout << "The value at address p is " << *(p) << endl;

    return 0;
}
```

Code Snippet 2: Pointer Example Program 2

As shown in code snippet 2,

1. We created a float pointer **"p"** and dynamically created a float which has value **"40.78"** and assigned that value to pointer **"p"**
2. And printed the value at the address of pointer **"p"**

The output of the following program is shown below,



```
The value at address p is 40.78
```

Figure 2: Pointer Program 2 Output

As shown in figure 2, we get the output value **“40.78”** because pointer **“p”** is pointing to an address whose value is **“40.78”**.

Another example program for pointers array and the use of a **“new”** keyword with an array is shown below.

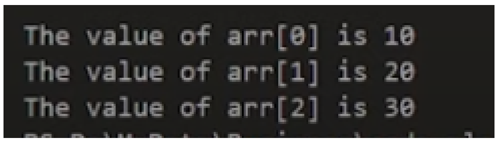
```
#include<iostream>
using namespace std;

int main(){

    int *arr = new int[3];
    arr[0] = 10;
    arr[1] = 20;
    arr[2] = 30;
    cout << "The value of arr[0] is " << arr[0] << endl;
    cout << "The value of arr[1] is " << arr[1] << endl;
    cout << "The value of arr[2] is " << arr[2] << endl;

    return 0;
}
```

Code Snippet 3: Pointer Example Program 3

As shown in a code snippet 3,

1. We created an integer pointer **“arr”** and dynamically created an array of size three which is assigned to the pointer **“arr”**
2. The values **“10”**, **“20”**, and **“30”** are assigned to the **“1”**, **“2”**, and **“3”** indexes of an array
3. And printed the value at the array indexes **“1”**, **“2”**, and **“3”**

The output of the following program is shown below,



```
The value of arr[0] is 10
The value of arr[1] is 20
The value of arr[2] is 30
```

Figure 3: Pointer Program 2 Output

As shown in figure 3, we get the output values **“10”**, **“20”**, and **“30”**.

Delete Keyword

Another example program for pointers array and the use of the **“delete”** keyword with an array is shown below.

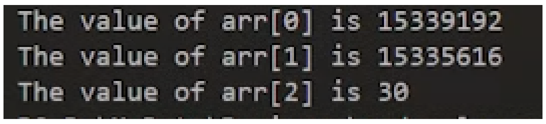
```
#include<iostream>
using namespace std;
int main(){
    int *arr = new int[3];
    arr[0] = 10;
    arr[1] = 20;
    arr[2] = 30;
    delete[] arr;
    cout << "The value of arr[0] is " << arr[0] << endl;
    cout << "The value of arr[1] is " << arr[1] << endl;
    cout << "The value of arr[2] is " << arr[2] << endl;
    return 0;
}
```

Code Snippet 4: Pointer Example Program 4

As shown in code snippet 4,

1. We created an integer pointer **“`arr`”** and dynamically created an array of size three which is assigned to the pointer **“`arr`”**
2. The values **“`10`”**, **“`20`”**, and **“`30`”** are assigned to the **“`1`”**, **“`2`”**, and **“`3`”** indexes of an array
3. Before printing the values, we used the **“`delete`”** keyword
4. And printed the value at the array indexes **“`1`”**, **“`2`”**, and **“`3`”**

The output of the following program is shown below,



```
The value of arr[0] is 15339192
The value of arr[1] is 15335616
The value of arr[2] is 30
```

Figure 4: Pointer Program 2 Output

As shown in figure 2, we get the garbage value in the output instead of **“`10`”**, **“`20`”**, and **“`30`”** because we have used **“`delete`”** keyword before printing the values due to which the space used by an array gets free and we get the garbage value in return.