Computer Programming Lab # 12

Virtual Functions and Virtual Classes and Abstract Classes

Virtual Functions and Polymorphism:

Virtual means *existing in appearance but not in reality*. When virtual functions are used, a program that appears to be calling a function of one class may in reality be calling a function of a different class. Why are virtual functions needed? Suppose you have a number of objects of different classes but you want to put them all in an array and perform a particular operation on them using the same function call.

Program # 01

```
#include<iostream>
using namespace std;
class shape
{
    int size;
public:
        void draw()
       {
          cout<<"Shape Class"<<endl;
       }
};
class circle : public shape
{
   int raduis;
   public:
          void draw()
          {
            cout<<"Circle"<<endl;
          }

};
class rectangle : public shape
{
   int raduis;
   public:
          void draw()
          {
            cout<<"Rectangle"<<endl;
          }

};
void main()
{
   shape* ptrarr[2];
       ptrarr[0]=new circle;
       ptrarr[1]=new rectangle;
for(int i=0;i<3;i++)
      ptrarr[i]->draw();

 system("pause");
}
```

Program # 02

```
#include<iostream>
using namespace std;
class shape
{
    int size;
public:
       virtual void draw()
       {
          cout<<"Shape Class"<<endl;
       }
};
class circle : public shape
{
   int raduis;
   public:
          void draw()
          {
            cout<<"Circle"<<endl;
          }

};
class rectangle : public shape
{
   int raduis;
   public:
          void draw()
          {
            cout<<"Rectangle"<<endl;
          }

};
void main()
{
   shape* ptrarr[2];
       ptrarr[0]=new circle;
       ptrarr[1]=new rectangle;


for(int i=0;i<3;i++)
      ptrarr[i]->draw();

 system("pause");
}
```

Program # 03

```
#include<iostream>
using namespace std;
class shape
{
    int size;
public:
       virtual void draw()
       {
          cout<<"Shape Class"<<endl;
       }
};
class circle : public shape
{
   int raduis;
   public:
          void draw()
          {
            cout<<"Circle"<<endl;
          }

};
class rectangle : public circle
{
   int raduis;
   public:
          void draw()
          {
            cout<<"Rectangle"<<endl;
          }

};
void main()
{
   shape* ptrarr[2];
       ptrarr[0]=new circle;
       ptrarr[1]=new rectangle;


for(int i=0;i<2;i++)
      ptrarr[i]->draw();

 system("pause");
}
```

This is an amazing capability: Completely different functions are executed by the same function call. If the pointer in ptrarr points to a rectangle, the function of rectangle is called; if it points to a circle, the circle-drawing function is called. This is called *polymorphism*, which means *different forms*.

Abstract Classes and Pure Virtual Functions:

Think of the shape class in the above programs. We'll never make an object of the shape class; we'll only make specific shapes such as circles and rectangles. When we will never want to instantiate objects of a base class, we call it an *abstract class*. Such a class exists only to act as a parent of derived classes that will be used to instantiate objects.

How can we make it clear to someone using our family of classes that we don't want anyone to instantiate objects of the base class? How can we can do that? By placing at least one *pure virtual function* in the base class. A pure virtual function is one with the expression =0 added to the declaration.

Here the virtual function draw () is declared as

virtual void draw() = 0; // pure virtual function

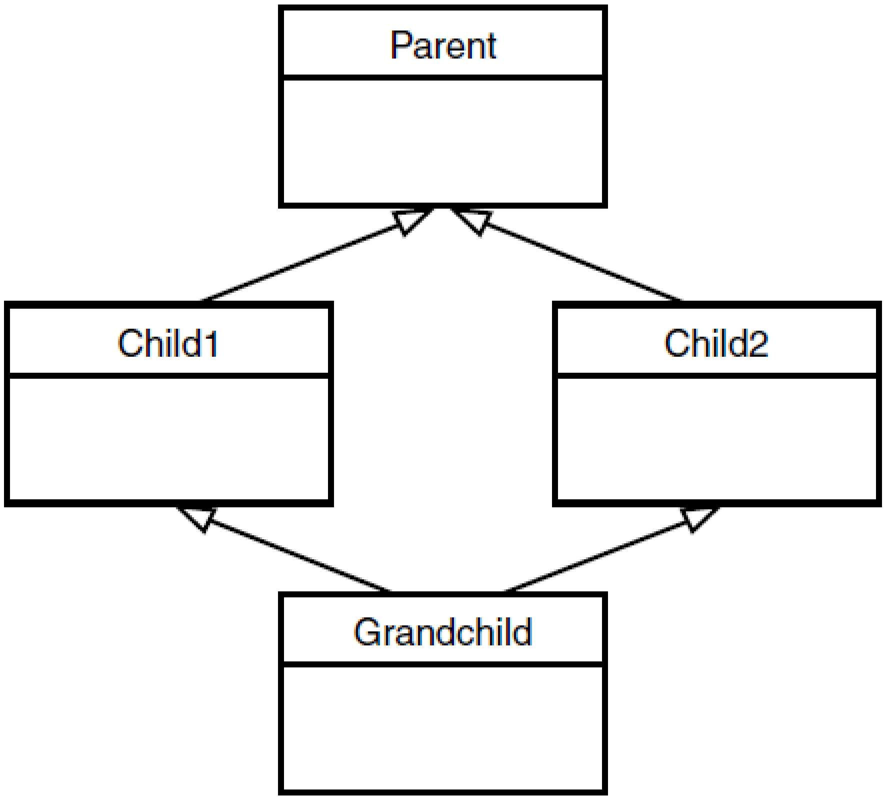
The equal sign here has nothing to do with assignment; the value 0 is not assigned to anything. The =0 syntax is simply how we tell the compiler that a virtual function will be pure. Now if in main () you attempt to create objects of class Base, the compiler will complain that you're trying to instantiate an object of an abstract class. It will also tell you the name of the pure virtual function that makes it an abstract class.

Once you've placed a pure virtual function in the base class, you must override it in all the derived classes from which you want to instantiate objects. If a class doesn't override the pure virtual function, it becomes an abstract class itself, and you can't instantiate objects from it (although you might from classes derived from it).

Program # 04

```
#include<iostream>
using namespace std;
class shape
{
    int size;
public:
       virtual void draw()=0;
};
class circle : public shape
{
   int raduis;
   public:
          void draw()
          {
            cout<<"Circle"<<endl;
          }

};
class rectangle : public shape
{
   int raduis;
   public:
          void draw()
          {
            cout<<"Rectangle"<<endl;
          }

};
void main()
{
   shape* ptrarr[2];
       ptrarr[0]=new circle;
       ptrarr[1]=new rectangle;


for(int i=0;i<2;i++)
      ptrarr[i]->draw();

 system("pause");
}
```

Virtual Base Classes:



Program # 05

```
#include<iostream>
using namespace std;
class shape
{
protected:
    int size;
public:
        void draw(int x)
        {
           size=x;
        }
};
class circle : public shape
{
   public:
          void draw()
          {
           shape::draw(5);
          }
};
class rectangle : public shape
{
   public:
          void draw()
          {
                 shape::draw(6);
          }
};
class abc : public circle, public rectangle
{
   public:
          void print()
          {
            cout<<size<<endl;
          }

};
void main()
{


 system("pause");
}
```

Program # 06

```
#include<iostream>
using namespace std;
class shape
{
protected:
    int size;
public:
        void draw(int x)
        {
           size=x;
        }
};
class circle : virtual public shape
{
   public:
          void draw()
          {
           shape::draw(5);
          }
};
class rectangle : virtual public shape
{
   public:
          void draw()
          {
                shape::draw(6);
          }
};
class abc : public circle, public rectangle
{
   public:
          void print()
          {
            cout<<size<<endl;
          }

};
void main()
{


 system("pause");
}
```

friend Classes:

Program # 07

```
#include<iostream>
using namespace std;
class shape;
class circle
{
private:
       int radius;
public:
          void draw()
          {
                radius=3;
          }
          friend shape;
};
class shape
{
private:
    int size;
public:
        void print(circle obj)
        {
           cout<<obj.radius;
        }
};


void main()
{
 circle obj;
 obj.draw();
 shape obj1;
 obj1.print(obj);

 system("pause");
}
```

Static Functions:

Program # 08

```
#include <iostream>
using namespace std;
class gamma
{
private:
static int total;
int id;
public:
gamma()
{
total++;
id = total;
}
~gamma()
{
total--;
cout << "Destroying ID number " << id << endl;
}
static void showtotal()
{
cout << "Total is " << total << endl;
}
void showid()
{
cout << "ID number is" << id << endl;
}
};
```

```
//--------------------------------------------------------------
int gamma::total = 0; //definition of total
void main()
{
gamma g1;
gamma::showtotal();
gamma g2, g3;
gamma::showtotal();
g1.showid();
g2.showid();
g3.showid();
system("pause");
}
```

The this Pointer:

Program # 09

```
#include<iostream>
using namespace std;
class shape
{
private:
    int size;
public:
        shape fun()
        {
               this->size=3;
            return *this;
        }
};


void main()
{
 shape obj,obj1;
 obj1=obj.fun();
 system("pause");
}
```