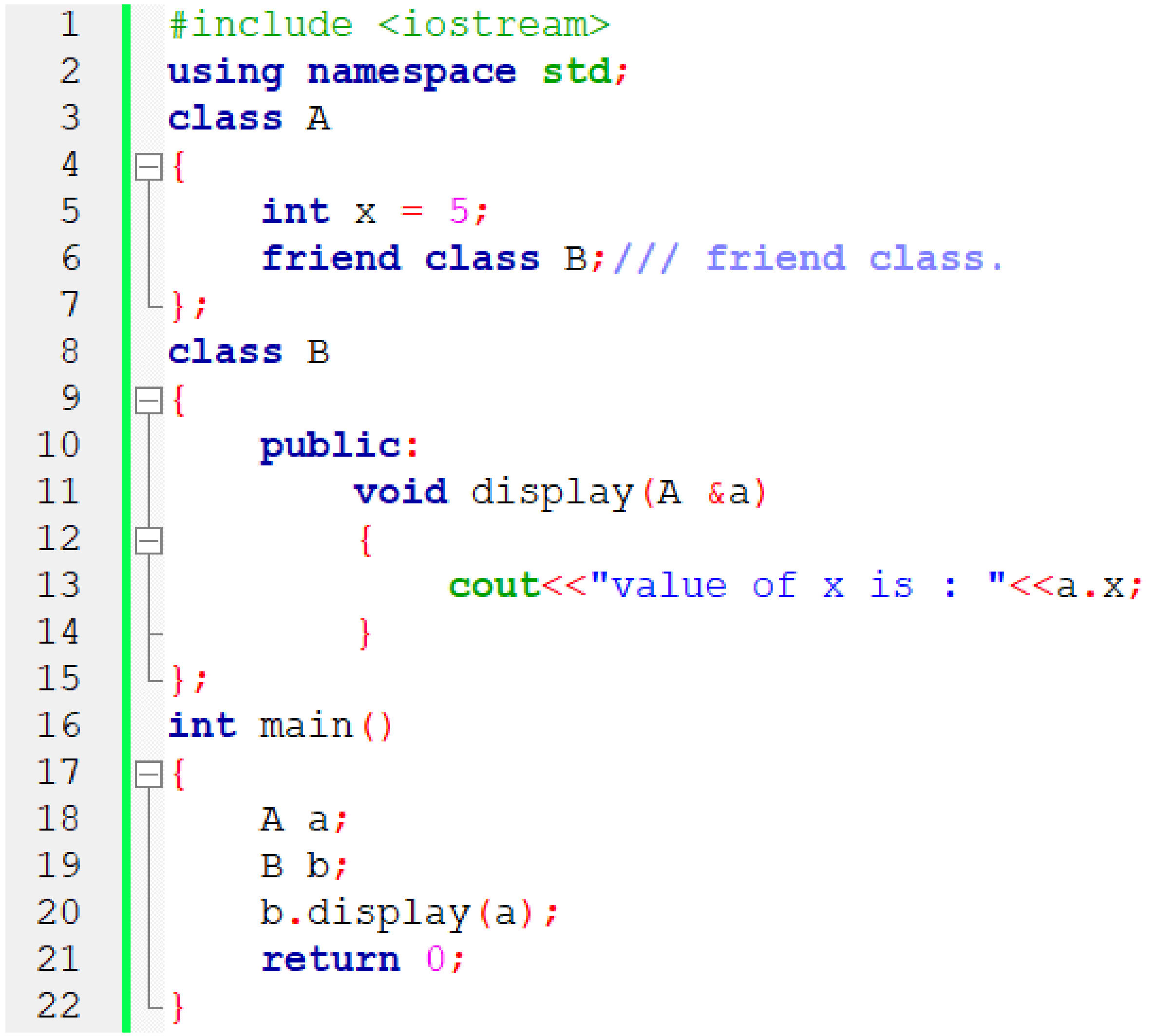
Friend Class and Function in C++

Friend Class

- **Friend Class** ***can access private and protected members of other class in which it is declared as friend***.
- It is sometimes useful to allow a particular class to access private members of other class.
- For example; a LinkedList class may be allowed to access private members of Node.

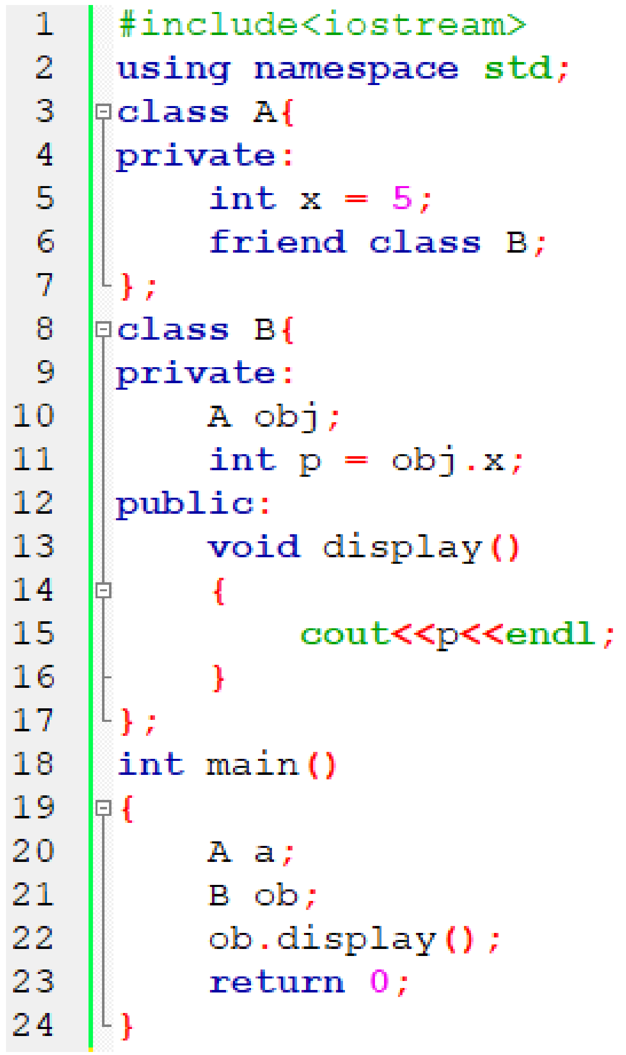
```
... .. ...
class B;
class A
{
    /// class B is a friend class of class A
    friend class B;
    ... .. ...
}

class B
{
    ... .. ...
}
```

Example of Friend Class



```cpp
#include <iostream>
using namespace std;
class A
{
    int x = 5;
    friend class B;/// friend class.
};
class B
{
    public:
        void display(A &a)
        {
            cout<<"value of x is : "<<a.x;
        }
};
int main()
{
    A a;
    B b;
    b.display(a);
    return 0;
}
```

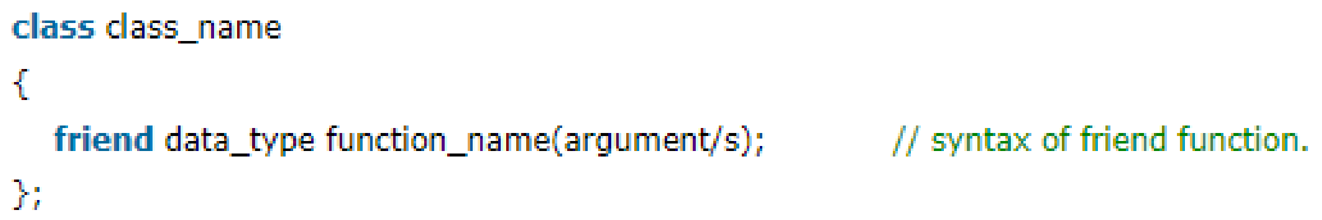
Example-02 of Friend Class



```cpp
#include<iostream>
using namespace std;
class A{
private:
    int x = 5;
    friend class B;
};
class B{
private:
    A obj;
    int p = obj.x;
public:
    void display()
    {
        cout<<p<<endl;
    }
};
int main()
{
    A a;
    B ob;
    ob.display();
    return 0;
}
```

Friend Function

- If a function is defined as a friend function in C++, then the protected and private data of a class can be accessed using the function.
- By using the keyword friend compiler knows the given function is a friend function.
- For accessing the data, the declaration of a friend function should be done inside the body of a class starting with the keyword friend.



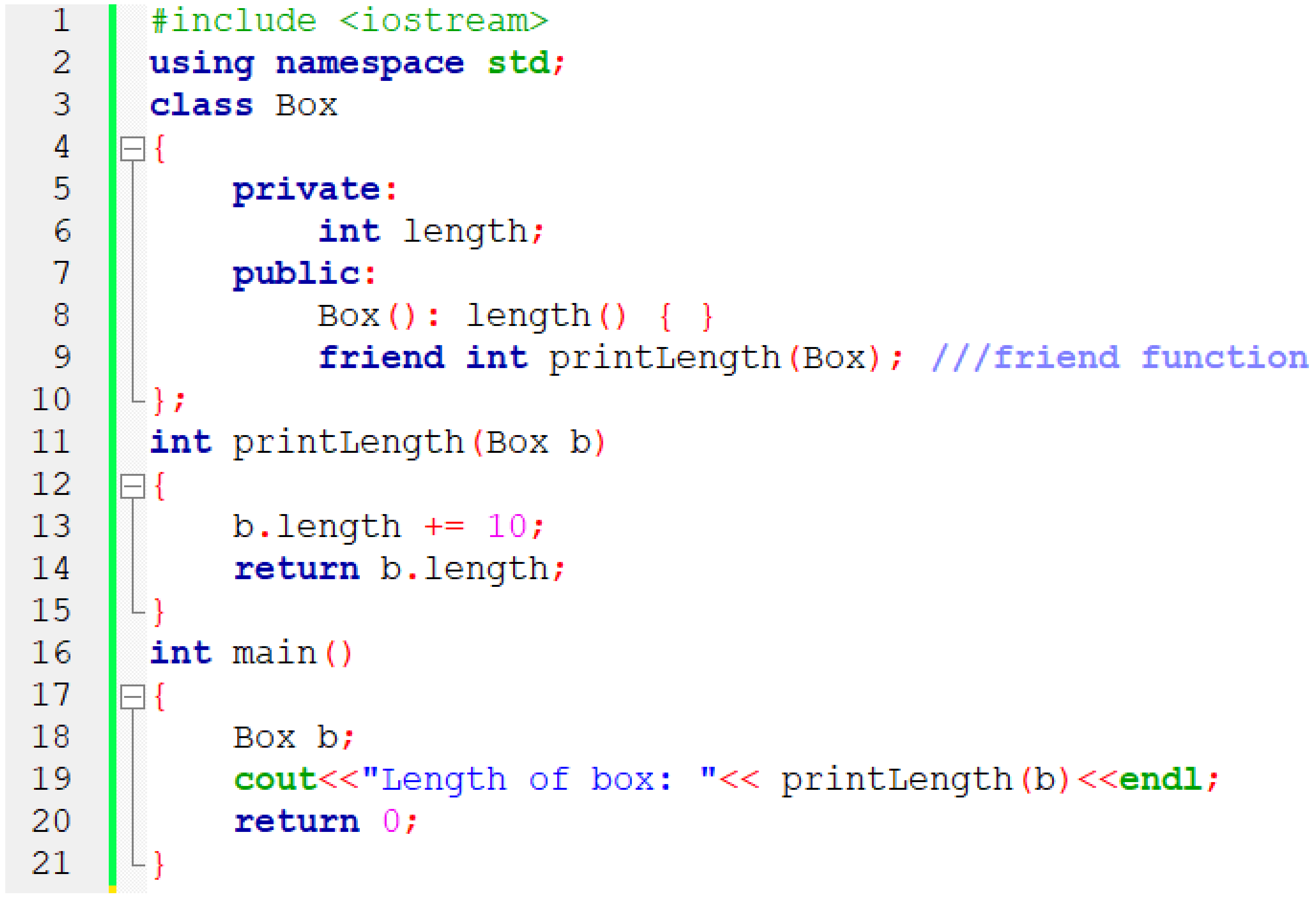
```
class class_name
{
   friend data_type function_name(argument/s);          // syntax of friend function.
};
```

- In the above declaration, the friend function is preceded by the keyword friend. The function can be defined anywhere in the program like a normal C++ function. The function definition does not use either the keyword **friend or scope resolution operator**.

Characteristics of Friend Function

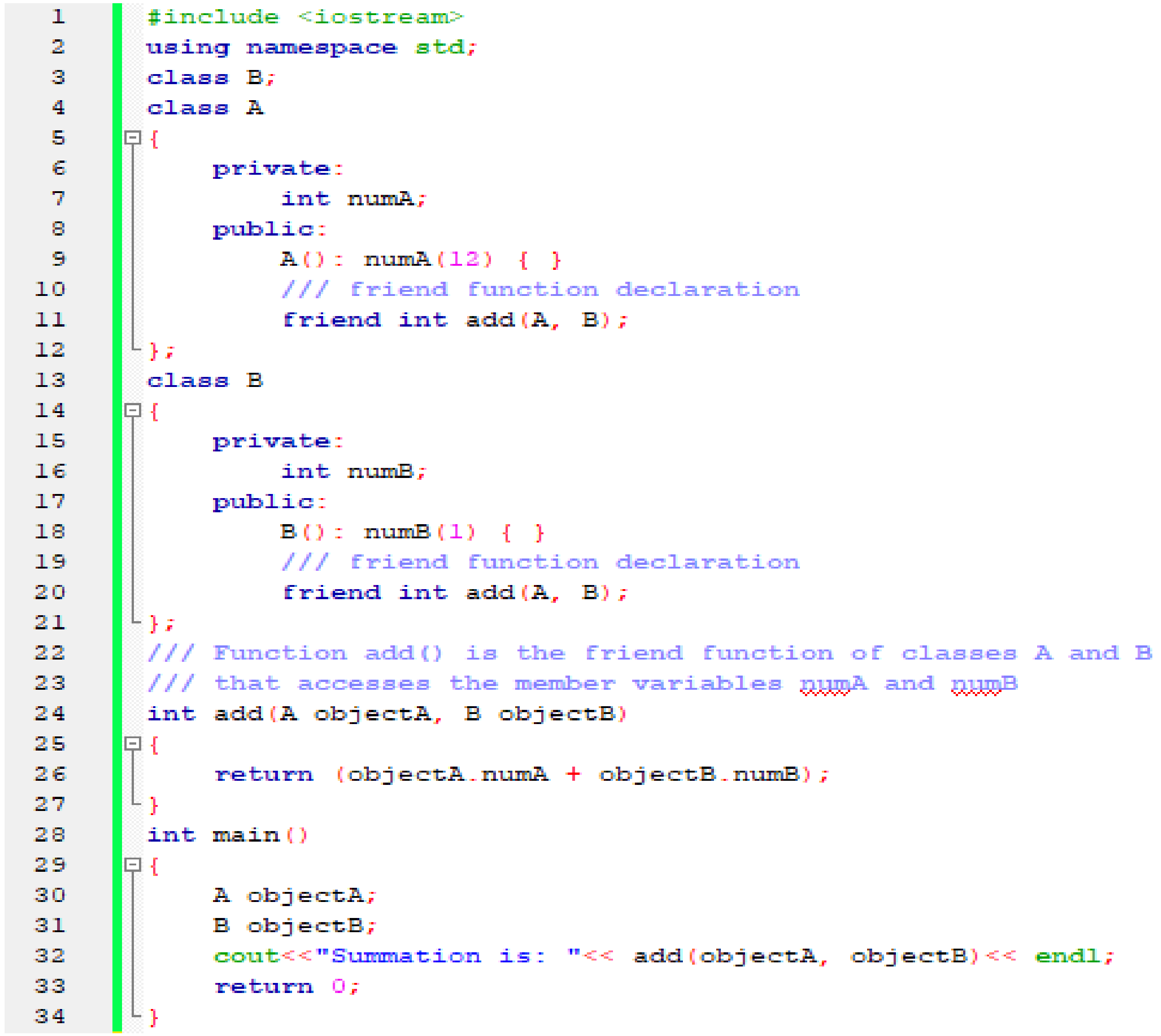
- The function is not in the scope of the class to which it has been declared as a friend.
- It cannot be called using the object as it is not in the scope of that class.
- It can be invoked like a normal function without using the object.
- It cannot access the member names directly and has to use an object name and dot membership operator with the member name.
- It can be declared either in the private or the public part.

Example of Friend Function



```cpp
#include <iostream>
using namespace std;
class Box
{
    private:
        int length;
    public:
        Box(): length() { }
        friend int printLength(Box); ///friend function
};
int printLength(Box b)
{
    b.length += 10;
    return b.length;
}
int main()
{
    Box b;
    cout<<"Length of box: "<< printLength(b)<<endl;
    return 0;
}
```

Addition of members of two different classes using friend Function



```
#include <iostream>
using namespace std;
class B;
class A
{
    private:
        int numA;
    public:
        A(): numA(12) { }
        /// friend function declaration
        friend int add(A, B);
};
class B
{
    private:
        int numB;
    public:
        B(): numB(1) { }
        /// friend function declaration
        friend int add(A, B);
};
/// Function add() is the friend function of classes A and B
/// that accesses the member variables numA and numB
int add(A objectA, B objectB)
{
    return (objectA.numA + objectB.numB);
}
int main()
{
    A objectA;
    B objectB;
    cout<<"Summation is: "<< add(objectA, objectB)<< endl;
    return 0;
}
```

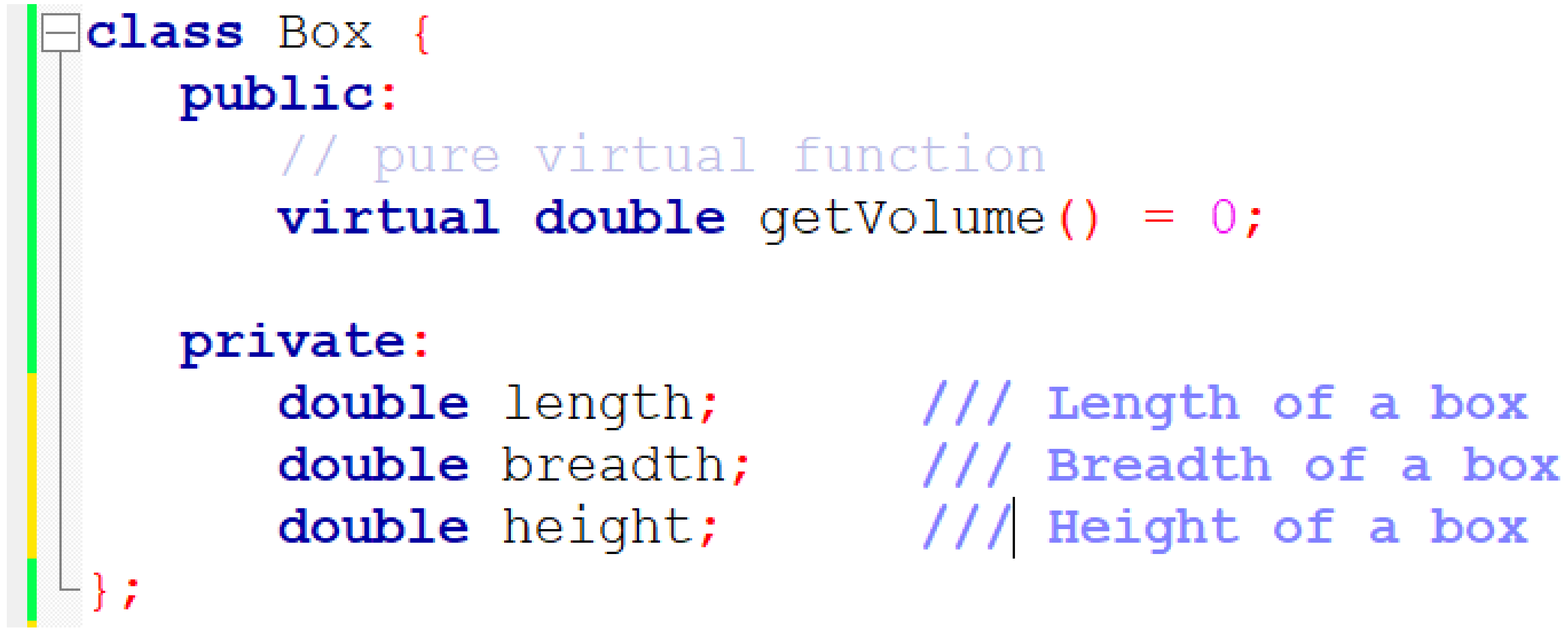
Interfaces in C++ (Abstract Classes)

- ***Abstract classes are the way to achieve abstraction in C++.*** Abstraction in C++ is the process to hide the internal details and showing functionality only. Abstraction can be achieved by two ways:
  - ✓Abstract class
  - ✓Interface
- Abstract class and interface both can have abstract methods which are necessary for abstraction.
- In C++ class is made abstract by declaring at least one of its functions as <strong>pure virtual function. A pure virtual function is specified by placing ***"function = 0"*** in its declaration. Its ***implementation must be provided by derived classes.***

Interfaces

- An interface describes ***the behavior or capabilities of a C++ class without committing to a particular implementation*** of that class.
- The C++ interfaces are implemented using **abstract classes** and these abstract classes should not be confused with data abstraction which is a concept of keeping implementation details separate from associated data.

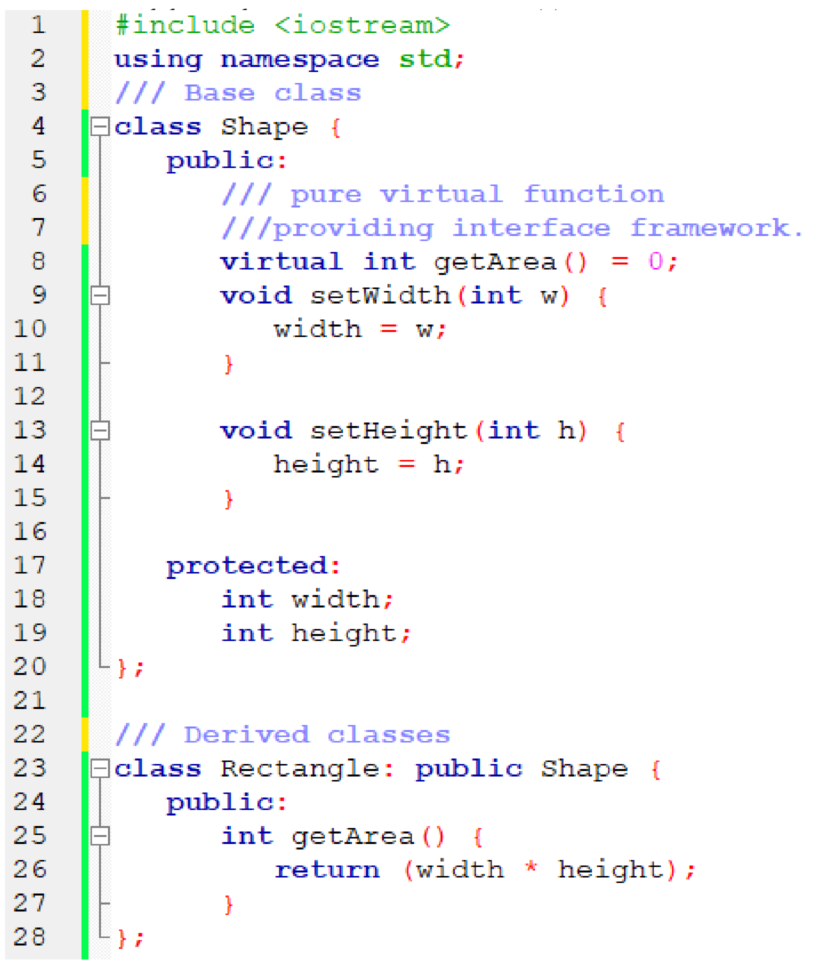
Interfaces



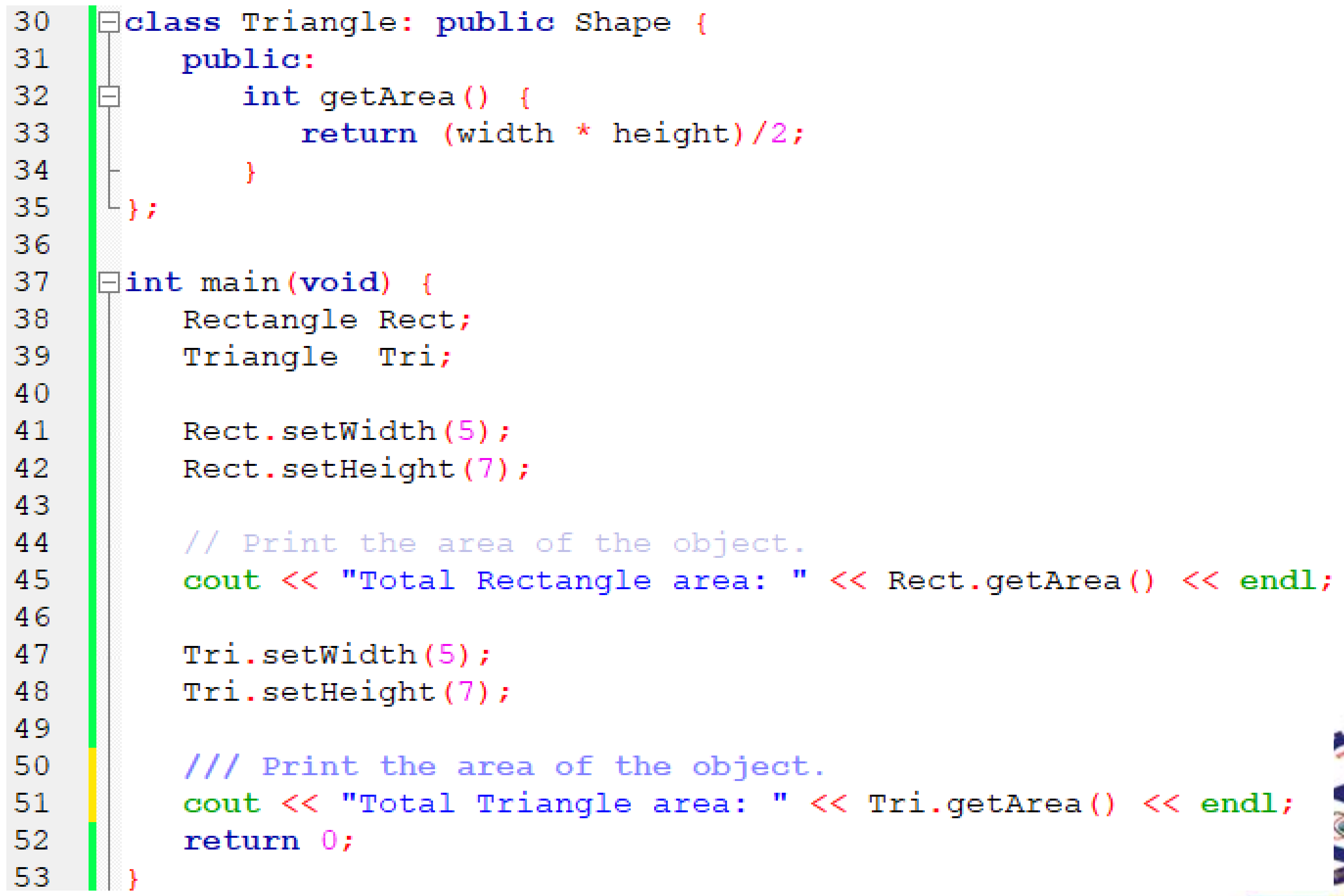
```
class Box {
   public:
      // pure virtual function
      virtual double getVolume() = 0;

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

Example of Abstract Class

➢Consider the following example where parent class provides an interface to the base class to implement a function



```
#include <iostream>
using namespace std;
/// Base class
class Shape {
    public:
        /// pure virtual function
        ///providing interface framework.
        virtual int getArea() = 0;
        void setWidth(int w) {
            width = w;
        }

        void setHeight(int h) {
            height = h;
        }

    protected:
        int width;
        int height;
};

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



```
class Triangle: public Shape {
    public:
        int getArea() {
            return (width * height)/2;
        }
};

int main(void) {
    Rectangle Rect;
    Triangle  Tri;

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

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

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

    /// Print the area of the object.
    cout << "Total Triangle area: " << Tri.getArea() << endl;
    return 0;
}
```

Practice Problem

- Perform the addition operation of different members of two/three/four different classes using friend function in C++.
- Perform the multiplication operation of different members of two/three/four different classes using friend function in C++.

Practice Problem

- Create a base class in C++ called shape. Use this class to store two double type values that could be used to compute the area of different shapes. Derive two specific classes called triangle and rectangle from the base shape. Add to the base class a member function get_data () to initialize base class data members and another member function display_area () to compute and display the area of figures. Make display_area () a pure virtual function and redefine this function in the derived classes to suit their requirements. Using these classes, design a program that will accept the dimensions of a triangle or a rectangle interactively and display the area.

Practice Problem

- If we do not override the pure virtual function in a derived class, then the derived class also becomes an abstract class. Justify your answer with a proper coding example in C++.

Thank You