

C++

程式語言（二）

Introduction to Programming (II)

Inheritance

Joseph Chuang-Chieh Lin

Dept. CSE, NTOU

Platform/IDE

- Dev-C++



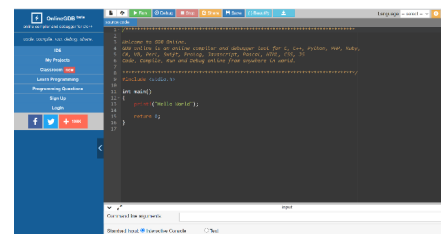
<https://www.pngegg.com/en/search?q=Dev-C>

- Codeblocks

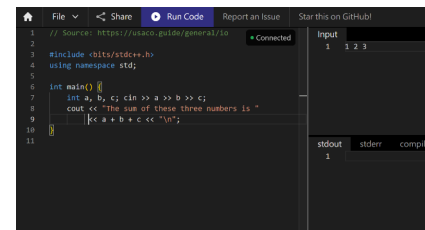


<https://icons8.com/icons/set/code-blocks>

- OnlineGDB (<https://www.onlinegdb.com/>)



- Real-Time Collaborative Online IDE (<https://ide.usaco.guide/>)



Textbooks (We focusing on C++11)

- ***Learn C++ Programming by Refactoring* (由重構學習 C++ 程式設計). Pang-Feng Liu (劉邦鋒). NTU Press. 2023.**
- ***C++ Primer. 5th Edition.* Stanley B. Lippman, Josée Lajoie, Barbara E. Moo. 2019.**
- *Effective C++*. Scott Meyers. O'Reilly. 2016.
- *Thinking in C++. Vol. 1: Introducing to Standard C++*. 2nd Edition. Bruce Eckel. Prentice Hall PTR. 2000.

Useful Resources

- Tutorialspoint
 - <https://www.tutorialspoint.com/cplusplus/index.htm>
 - Online C++ Compiler
- Programiz
 - <https://www.programiz.com/cpp-programming>
- LEARN C++
 - <https://www.learncpp.com/>
- MIT OpenCourseWare - Introduction to C++
 - <https://ocw.mit.edu/courses/6-096-introduction-to-c-january-iap-2011/pages/lecture-notes/>
- Learning C++ Programming
 - <https://www.programiz.com/cpp-programming>
- GeeksforGeeks
 - <https://www.geeksforgeeks.org/c-plus-plus/>

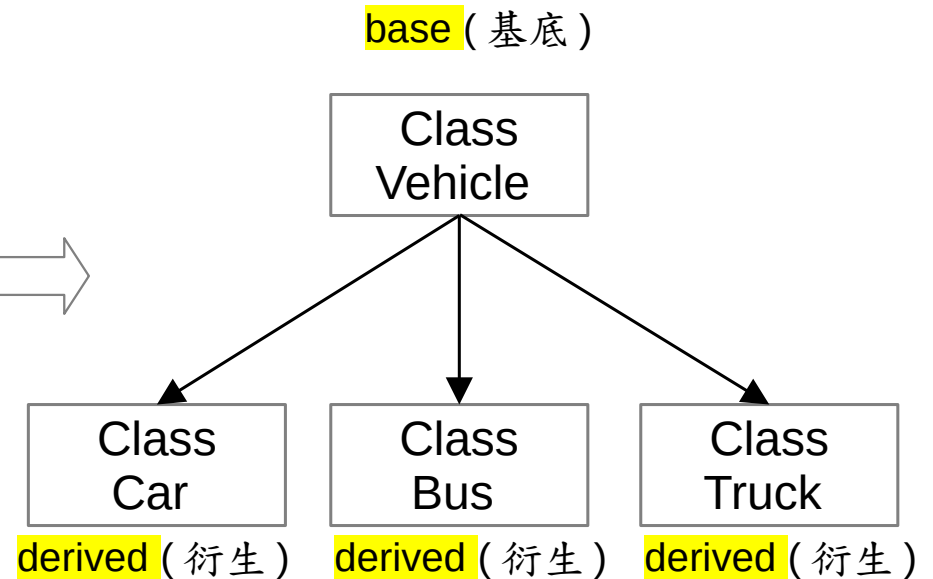
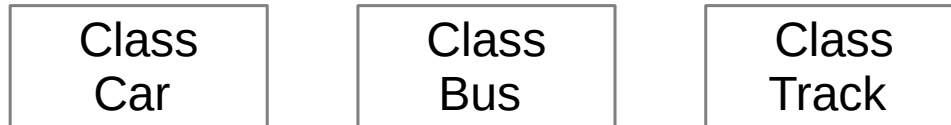


Inheritance

Inheritance

<https://www.geeksforgeeks.org/inheritance-in-c/?ref=lbp>

- Get rid of duplication of the same codes.
- Decrease the chance of error.
- Increase code and data reusability.
- Abstraction + Hierarchy



An Easy Illustrating Example

```
class A
{
    public:
        int x;
    protected:
        int y;
    private:
        int z;
};

class B : public A
{
    // x is public
    // y is protected
    // z is not accessible from B
};
```

access mode

```
class C : protected A
{
    // x is protected
    // y is protected
    // z is not accessible from C
};

class D : private A
// 'private' is default for classes
{
    // x is private
    // y is private
    // z is not accessible from D
};
```

Modes of Inheritance

Just like going through a mask...

- Public

Example: <https://onlinegdb.com/Z7tf4BU0x>

- **public** member of the base class => **public** in the derived class.
- **protected** members of the base class => **protected** in derived class.
- **private** members of the base class => not accessible.

- Protected

- **public** member of the base class => **protected** in the derived class.
- **protected** members of the base class => **protected** in derived class.
- **private** members of the base class => not accessible.

- Private

- **public** member of the base class => **private** in the derived class.
- **protected** members of the base class => **private** in derived class.
- **private** members of the base class => not accessible.

Single Inheritance

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

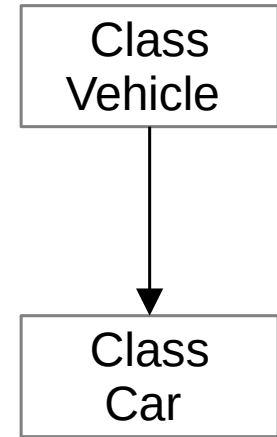
class Vehicle {
public:
    Vehicle() {
        cout << "This is a Vehicle.\n";
    }
};

class Car : public Vehicle {
// nothing to do here so far...
};
```

```
int main()
{
    // invoke the constructors
    Car obj;
    return 0;
}
```

Output:

```
This is a Vehicle.
```



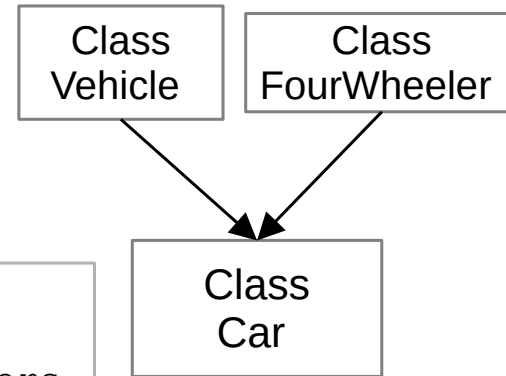
Multiple Inheritance

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

class Vehicle {
public:
    Vehicle() {
        cout << "This is a Vehicle.\n";
    }
};

class FourWheeler {
public:
    FourWheeler() {
        cout << "This is a 4 wheeler
                Vehicle.\n";
    }
};
```

```
class Car : public Vehicle, public FourWheeler {
    // nothing to do here so far...
};
```



```
int main()
{
    // invoke the constructors
    Car obj;
    return 0;
}
```

Output:

```
This is a Vehicle.
This is a 4 wheeler Vehicle.
```

Multilevel Inheritance

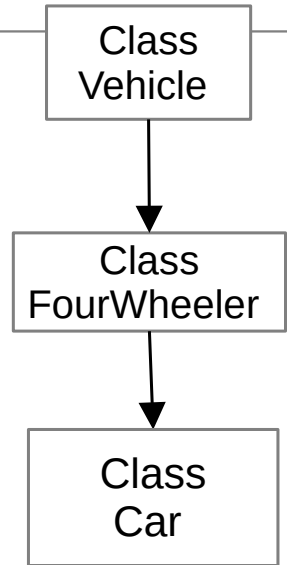
```
#include<iostream>
using namespace std;

class Vehicle {
public:
    Vehicle() {
        cout << "This is a Vehicle.\n";
    }
};

class FourWheeler: public Vehicle {
public:
    FourWheeler() {
        cout << "A 4 wheeler Vehicle.\n";
    }
};
```

```
class Car: public FourWheeler {
public:
    Car() {
        cout << "A Car has 4 Wheels.\n";
    }
};
```

```
int main()
{
    // invoke the constructors
    Car obj;
    return 0;
}
```



Output:

```
This is a Vehicle.
A 4 wheeler Vehicle.
A Car has 4 Wheels.
```

More Details in Examples

- <https://www.programiz.com/cpp-programming/public-protected-private-inheritance>

Class Exercise (1%)

```
class Shape {  
public:  
    string type;  
protected:  
    double parameter;  
};
```

```
class Circle : protected Shape {  
private:  
    double area = 0.0;  
public:  
    void compute_area() {  
/* please implement this member function */  
    }  
    void setRadius() {  
/* please implement this member function */  
    }  
    double getArea() {  
/* please implement this member function */  
    }  
};
```

```
int main()  
{  
    Circle obj;  
    obj.setRadius();  
    obj.compute_area();  
    cout << "Area: " << obj.getArea();  
    return 0;  
}
```

Sample Input & Output:

```
3.2  
Area: 32.1699
```


Exercise

```
class A {  
public:  
    int x = 0;  
    int get_pvt() { return z; }  
protected:  
    int y = 1;  
private:  
    int z = 2;  
};  
  
class B : public A {  
    // x is public  
    // y is protected  
    // z is not accessible from B  
};
```

Please modify the code here by “adding appropriate member functions” in the classes B, C, and D.

```
class C : protected A {  
    // x is protected  
    // y is protected  
    // z is not accessible from C  
};  
  
class D : private A {  
    // 'private' is default for classes  
    // x is private  
    // y is private  
    // z is not accessible from D  
};
```

```
int main () {  
    B obj1;  
    C obj2;  
    D obj3;  
    cout << obj1.x << obj2.y << obj3.y;  
    // try to print these values  
    // by adding appropriate member  
    // functions  
}
```



Discussions & Questions