

Object-Oriented Programming in C++

Classes and Objects

A C++ *class* is a user-defined data type that encapsulates information and behavior about an object.

A class can have two types of *class members*:

- *Attributes*, also known as member data, consist of information about an instance of the class.
- *Methods*, also known as member functions, are functions that can be used with an instance of the class.

An *object* is an instance of a class and can be created by specifying the class name.

```
#include <iostream>

class Dog {
public:
    int age;

    void sound() {
        std::cout << "woof\n";
    }
};

int main() {
    Dog buddy;

    buddy.age = 5;

    buddy.sound();
    // Outputs:woof
}
```

Access Specifiers

Access specifiers are C++ keywords that determine the scope of class components:

- `public` : Class members are accessible from anywhere in the program.
- `private` : Class members are only accessible from inside the class.

Encapsulation is achieved by declaring class attributes as `private` :

- Accessor functions: return the value of `private` member variables.
- Mutator functions: change the value of `private` member variables.

```
#include <iostream>

class Computer {
private:
    int password;

public:
    int getPassword() {
        return password;
    }
}
```

```
void setPassword(int new_password) {  
    password = new_password;  
}  
};  
  
int main()  
{  
    Computer dell;  
  
    dell.setPassword(12345);  
    std::cout << dell.getPassword();  
  
    return 0;  
}
```

Constructors

For a C++ class, a *constructor* is a special kind of method that enables control regarding how the objects of a class should be created. Different class constructors can be specified for the same class, but each constructor signature must be unique. A constructor can have multiple parameters as well as default parameter values.

In order to initialize const or reference type attributes, use *member initializer lists* instead of normal constructors.

```
#include <iostream>  
  
using namespace std;  
  
class House {  
private:  
    std::string location;  
    int rooms;  
  
public:  
    // Constructor with default  
parameters  
    House(std::string loc = "New York",  
int num = 5) {  
        location = loc;  
        rooms = num;  
    }  
  
    // Destructor  
    ~House() {  
        std::cout << "Moved away from " <<  
location << "\n";  
    }  
}
```

```
};

int main()
{
    House default_house; // Calls
House("New York", 5)

    House texas_house("Texas");    //
Calls House("Texas", 5)

    House big_florida_house("Florida",
10);    // Calls House("Florida", 10)

    return 0;
}
```

Inheritance

In C++, a class can inherit attributes and methods from another class. In an inheritance relationship, there are two categories of classes:

- *Base class*: The class being inherited from.
- *Derived class*: The class that inherits from the base class.

It's possible to have multi-level inheritance where classes are constructed in order from the “most base” class to the “most derived” class.

```
#include <iostream>

class Base {
public:
    int base_id;

    Base(int new_base) :
base_id(new_base) {}
};

class Derived: public Base {
public:
    int derived_id;

    Derived(int new_base, int
new_derived)
        : Base(new_base),
derived_id(new_derived) {}

    void show() {
        std::cout << base_id << " " <<
derived_id;
    }
};
```

```
int main() {
    Derived temp(1, 2);

    temp.show(); // Outputs: 1 2

    return 0;
}
```

Polymorphism

In C++, *polymorphism* occurs when a derived class overrides a method inherited from its base class with the same function signature.

Polymorphism gives a method many “forms”.

Which form is executed depends on the type of the caller object.

```
#include <iostream>

class Employee {
public:
    void salary() {
        std::cout << "Normal salary.\n";
    }
};

class Manager: public Employee {
public:
    void salary() {
        std::cout << "Normal salary and
bonus.\n";
    }
};

int main() {
    Employee newbie;
    Manager boss;

    newbie.salary(); // Outputs: Normal
salary.
    boss.salary(); // Outputs: Normal
salary and bonus.

    return 0;
}
```

A class is comprised of class members:

- *Attributes*, also known as member data, consist of information about an instance of the class.
- *Methods*, also known as member functions, are functions that can be used with an instance of the class.

```
class City {  
  
    // Attribute  
    int population;  
  
public:  
    // Method  
    void add_resident() {  
        population++;  
    }  
  
};
```

Constructor

For a C++ class, a *constructor* is a special kind of method that enables control regarding how the objects of a class should be created. Different class constructors can be specified for the same class, but each constructor signature must be unique.

```
#include "city.hpp"  
  
class City {  
  
    std::string name;  
    int population;  
  
public:  
    City(std::string new_name, int  
        new_pop);  
  
};
```

Objects

In C++, an *object* is an instance of a class that encapsulates data and functionality pertaining to that data.

```
City nyc;
```

Class

A C++ class is a user-defined data type that encapsulates information and behavior about an object. It serves as a blueprint for future inherited classes.

```
class Person {  
  
};
```

Access Control Operators

C++ classes have access control operators that designate the scope of class members:

- public
- private

public members are accessible everywhere;

private members can only be accessed from within the same instance of the class or from friends classes.

```
class City {  
  
    int population;  
  
public:  
    void add_resident() {  
        population++;  
    }  
  
private:  
    bool is_capital;  
  
};
```



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