📘 Understanding Class Inheritance in C++

🧠 What is Inheritance?

Inheritance is a fundamental concept in **Object-Oriented Programming (OOP)** that allows a class (called the **derived** class or **subclass**) to inherit attributes and behaviors (fields and methods) from another class (called the **base class** or superclass).

🔑 Key Benefits:

- **Code reuse**: Avoids duplication by reusing existing class functionality.
- **Extensibility**: Allows new functionality to be added with minimal changes.

🧱 Basic Syntax

```
class Base {
  // base class members
};

class Derived : access_modifier Base {
  // derived class members
};
```

🔐 Access Modifiers in Inheritance

Modifier	Description
`public`	Public and protected members of the base class retain their access levels in the derived class.
`protected`	Public and protected members of the base class become protected in the derived class.
`private`	Public and protected members of the base class become private in the derived class.

```
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
};

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

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

🧪 Example: Basic Inheritance

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

class Animal {
  public:
    void eat() {
        cout << "This animal eats food." << endl;
    }
};

class Dog : public Animal {
  public:
    void bark() {
        cout << "The dog barks." << endl;
    }
};

int main() {
    Dog myDog;
    myDog.eat();  // Inherited from Animal
    myDog.bark(); // Defined in Dog

    return 0;
}
```

Class Diagram

🔍 Explanation:

- `Dog` inherits from `Animal` using `public` inheritance.
- `Dog` can access `eat()` because it is a public member of `Animal`.

🧵 Constructor Calls in Inheritance

🔍 How Constructors Work in Inheritance

When a derived class object is created, **constructors are called in the order of inheritance hierarchy**:

1. **Base class constructor** is called first.
2. Then the **derived class constructor** is executed.

This ensures that the base part of the object is properly initialized before the derived part.

🧪 Example: Constructor Call Order

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

class Animal {
  public:
    Animal() {
        cout << "Animal constructor called." << endl;
    }
};

class Dog : public Animal {
  public:
    Dog() {
        cout << "Dog constructor called." << endl;
    }
};

int main() {
    Dog d;
    return 0;
}
```

Output:

```
Animal constructor called.
Dog constructor called.
```

📩 Using Initialization Lists in Derived Constructors

You can explicitly call a base class constructor using an **initialization list** in the derived class:

```
class Animal {
  public:
    Animal(string type) {
        cout << "Animal: " << type << endl;
    }
};

class Dog : public Animal {
  public:
    Dog() : Animal("Dog") {
        cout << "Dog constructor called." << endl;
    }
};
```

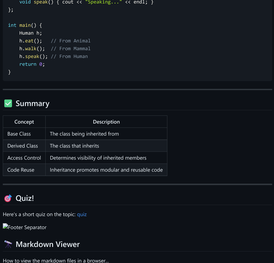
⚠️ Notes

- If the base class only has a **parameterized constructor**, the derived class **must** explicitly call it.
- If the base class has a **default constructor**, it is called automatically unless specified otherwise.

🧬 Types of Inheritance

Type	Description
Single	One base class, one derived class
Multiple	One derived class inherits from multiple base classes
Multilevel	A class is derived from a derived class
Hierarchical	Multiple classes inherit from a single base class
Hybrid	Combination of multiple types (can lead to ambiguity)

Here is an example of a multilevel inheritance structure.



🧪 Example: Multilevel Inheritance

```
class Animal {
  public:
    void eat() { cout << "Eating..." << endl; }
};

class Mammal : public Animal {
  public:
    void walk() { cout << "Walking..." << endl; }
};

class Human : public Mammal {
  public:
    void speak() { cout << "Speaking..." << endl; }
};

int main() {
    Human h;
    h.eat();  // From Animal
    h.walk(); // From Mammal
    h.speak(); // From Human
    return 0;
}
```

✅ Summary

Concept	Description
Base Class	The class being inherited from
Derived Class	The class that inherits
Access Control	Determines visibility of inherited members
Code Reuse	Inheritance promotes modular and reusable code

🧠 Quiz!

Here's a short quiz on the topic: quiz

🪶 Markdown Viewer

How to view the markdown files in a browser...

- Markdown Viewer

🧠 Lecture Practices

Here are the lecture Practices...

- Day 7
- Day 8
- Day 9

🔍 Lecture Quizzes

Here are the lecture quizzes...

- Day 7
- Day 8
- Day 9

Weekly Topics

Here are the topics for the week...

- Classes
- Structs
- Fields
- Getters and Setters
- Constructors
- Instances
- Inheritance
- Polymorphism
- Pointers
- Upcasting
- Misc. Concepts
- 4 Pillars of OOP