Queens College, CUNY, Department of Computer Science

Object Oriented Programming in C++

CSCI 211 / 611

Summer 2018

Instructor: Dr. Sateesh Mane

June 28, 2018

Inheritance: Part III

- This lecture contains advanced topics about **inheritance**.
- The material in this lecture is **not for examination**.

1 Non-public inheritance

- There are actually three types of inheritance: **public**, **private** and **protected**.

```
class B1 : public A;
class B2 : private A;
class B3 : protected A;
```

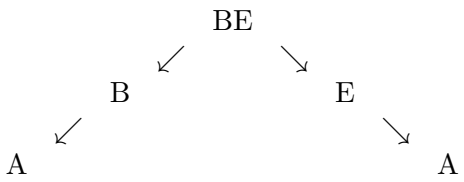
- **I have never used private or protected inheritance, and I have never seen them used in any project in my career.**
- The textbooks also state that private or protected inheritance are rarely used.
- We shall employ public inheritance exclusively. ***It is by far the most common.***

2 Multiple inheritance

- A C++ class can inherit from more than one base class.
- Suppose there are two base classes `A1` and `A2`.
- A class `B12` can derive from both `A1` and `A2`.

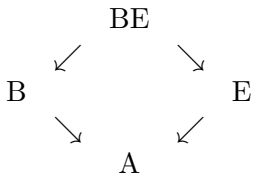
```
class A1;
class A2;
class B12 : public A1, A2;
```

- This is called **multiple inheritance.**
- What we have studied up to now is called **single inheritance.**
- Multiple inheritance can lead to terrible complications.
  1. Suppose both `A1` and `A2` have a method "`f1()`" in their declarations.
  2. Which of the two "`f1()`" methods does an object of type `B12` invoke?
  3. To avoid ambiguity, the class `B12` must override `f1()`, even though the class `B12` may have nothing of its own to add to the method.
  4. This is the most obvious example of many complications with multiple inheritance.
- Recall the base class `A` and the derived classes `B` and `E` which both inherit from `A`.
- Now declare a class `BE` which inherits from **both `B` and `E`**.
- The structure of the inheritance tree (or chain) now looks like this.



- The above tree causes terrible problems.
  1. `B` "IS-A" `A` hence it contains an `A` object.
  2. `E` "IS-A" `A` hence it contains an `A` object.
  3. `BE` "IS-A" `B` and also `E`.
  4. Hence `BE` contains both a `B` object and an `E` object.
  5. However, *both of those* `B` *and* `E` *objects contain their own* `A` *objects*, **and the `A` objects in `B` and `E` are not the same.**
  6. Hence `BE` it contains **two copies of `A` objects.**
  7. It is undefined which of the `A` objects should be used, for example to access data (accessors) or to set data values (mutators).
  8. The compiler generates a warning, although it does not prevent compilation of the code.

- There is a mechanism to resolve the ambiguity so that the implicit `A` objects in the `B` and `E` components are the same object.



- However, in general multiple inheritance leads to a mess.
- Multiple inheritance is such a bad feature that it is **not supported in the Java language.**
- That is to say, Java supports only single inheritance.
- This was a deliberate design decision in Java because of the problems caused by multiple inheritance in C++.