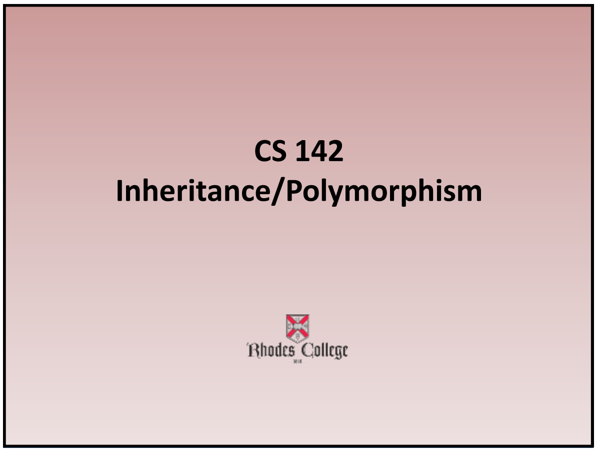
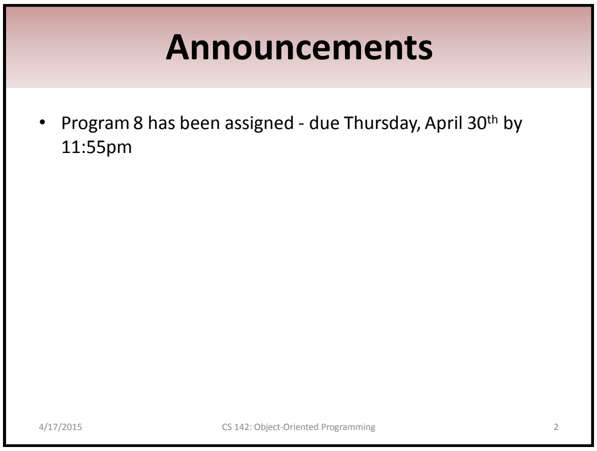


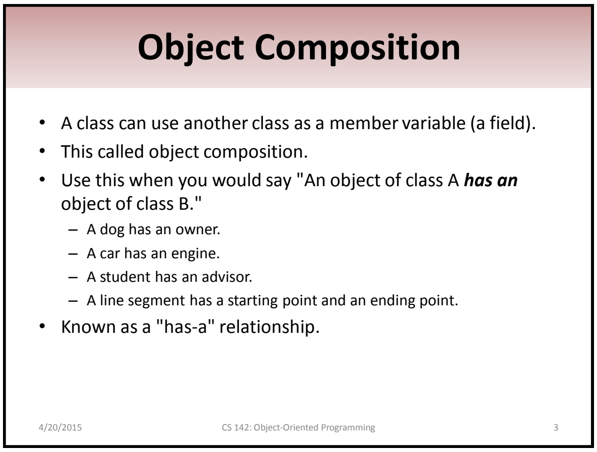
CS 142 Inheritance/Polymorphism

Rhodes College



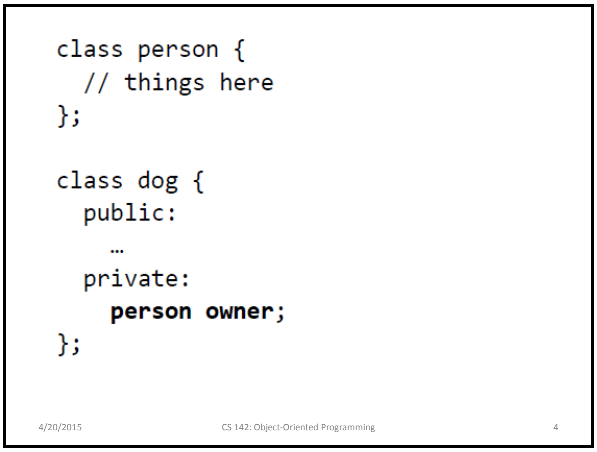
Announcements

- Program 8 has been assigned - due Thursday, April 30th by 11:55pm

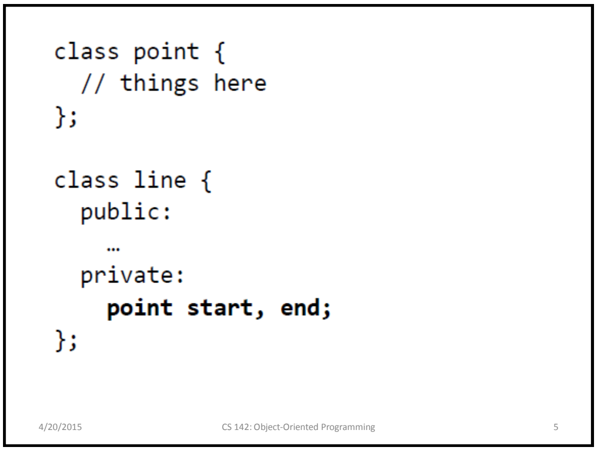


Object Composition

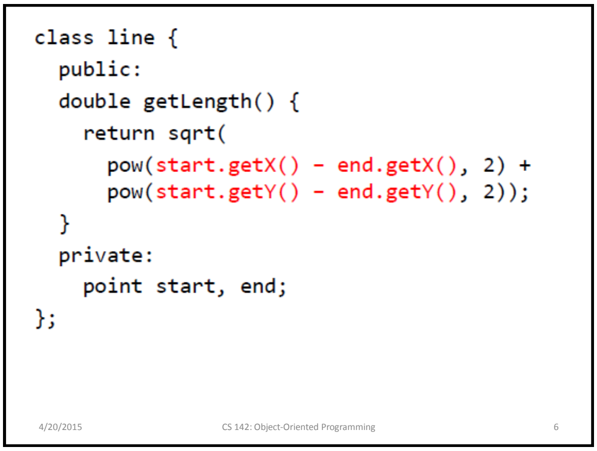
- A class can use another class as a member variable (a field).
- This called object composition.
- Use this when you would say "An object of class A ***has an*** object of class B."
  - A dog has an owner.
  - A car has an engine.
  - A student has an advisor.
  - A line segment has a starting point and an ending point.
- Known as a "has-a" relationship.



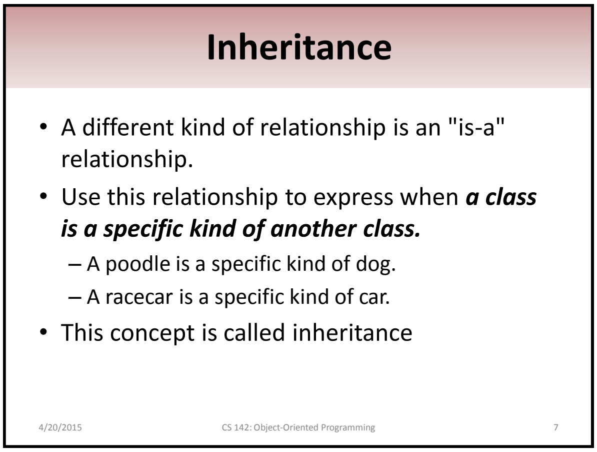
```
class person {
  // things here
};

class dog {
  public:
    …
  private:
    person owner;
};
```



```
class point {
  // things here
};

class line {
  public:
    …
  private:
    point start, end;
};
```

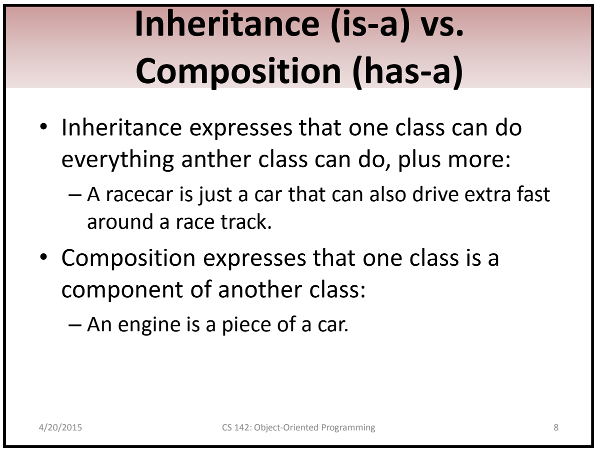


```
class line {
  public:
  double getLength() {
    return sqrt(
      pow(start.getX() – end.getX(), 2) +
      pow(start.getY() – end.getY(), 2));
  }
  private:
    point start, end;
};
```



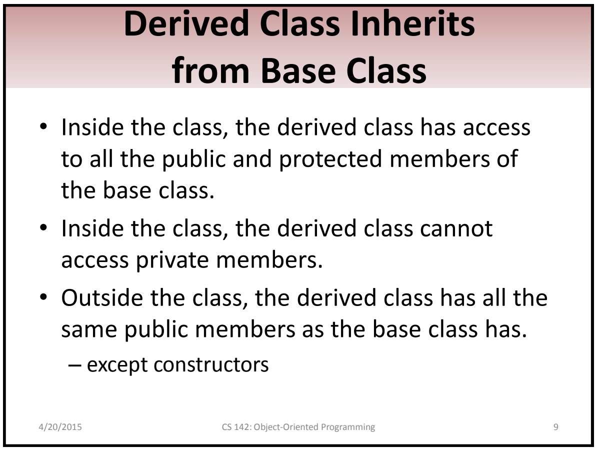
Inheritance

- A different kind of relationship is an "is-a" relationship.
- Use this relationship to express when ***a class is a specific kind of another class.***
  - A poodle is a specific kind of dog.
  - A racecar is a specific kind of car.
- This concept is called inheritance



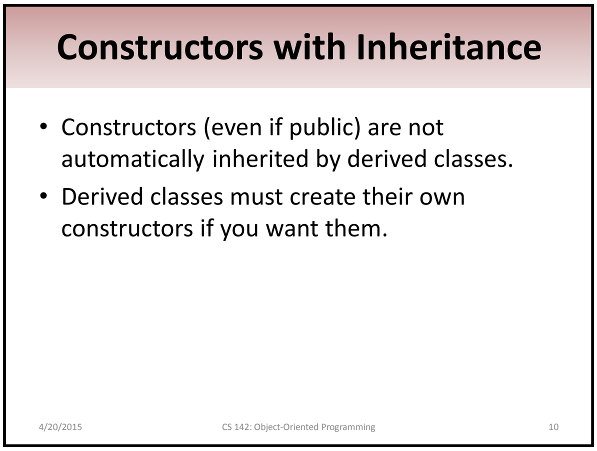
Inheritance (is-a) vs. Composition (has-a)

- Inheritance expresses that one class can do everything anther class can do, plus more:
  - A racecar is just a car that can also drive extra fast around a race track.
- Composition expresses that one class is a component of another class:
  - An engine is a piece of a car.



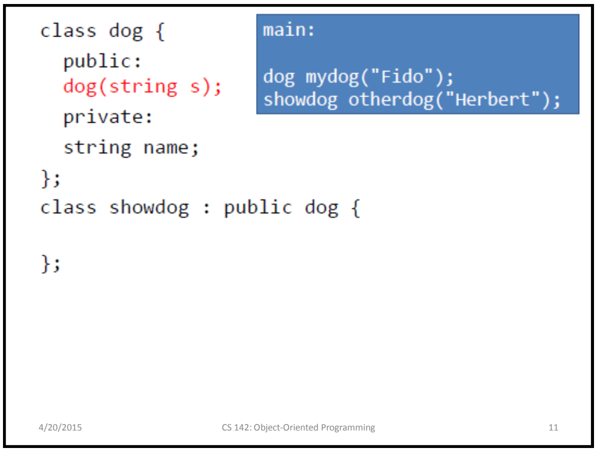
Derived Class Inherits from Base Class

- Inside the class, the derived class has access to all the public and protected members of the base class.
- Inside the class, the derived class cannot access private members.
- Outside the class, the derived class has all the same public members as the base class has.
  - except constructors



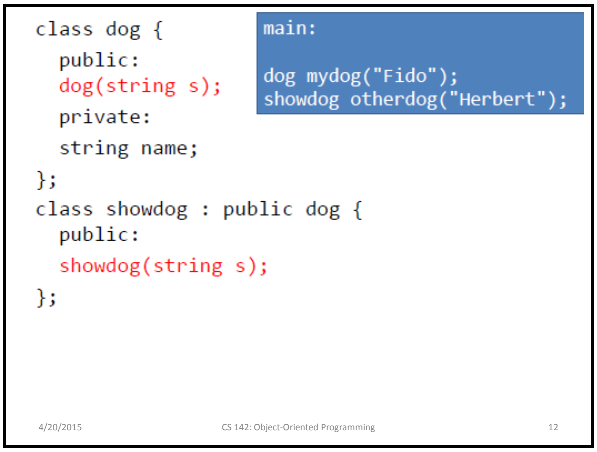
Constructors with Inheritance

- Constructors (even if public) are not automatically inherited by derived classes.
- Derived classes must create their own constructors if you want them.



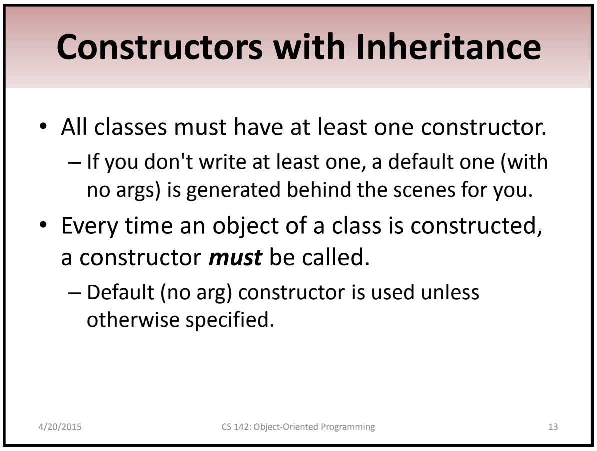
```
class dog {
  public:
  dog(string s);
  private:
  string name;
};
class showdog : public dog {

};
```

```
main:

dog mydog("Fido");
showdog otherdog("Herbert");
```



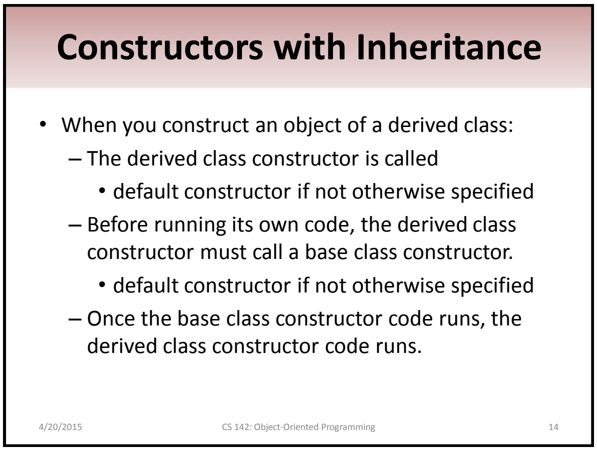
```
class dog {
  public:
  dog(string s);
  private:
  string name;
};
class showdog : public dog {
  public:
  showdog(string s);
};
```

```
main:

dog mydog("Fido");
showdog otherdog("Herbert");
```



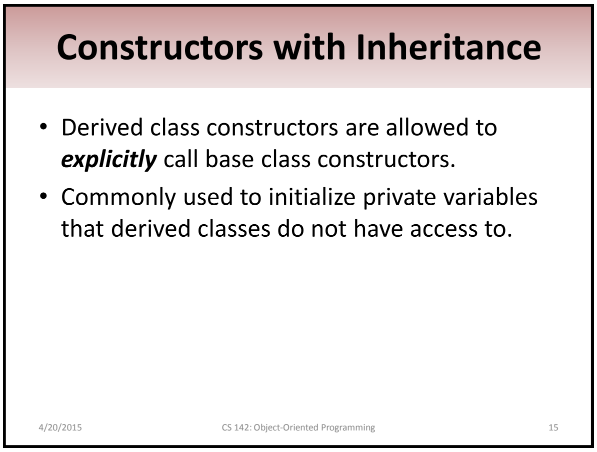
Constructors with Inheritance

- All classes must have at least one constructor.
  - If you don't write at least one, a default one (with no args) is generated behind the scenes for you.
- Every time an object of a class is constructed, a constructor ***must*** be called.
  - Default (no arg) constructor is used unless otherwise specified.



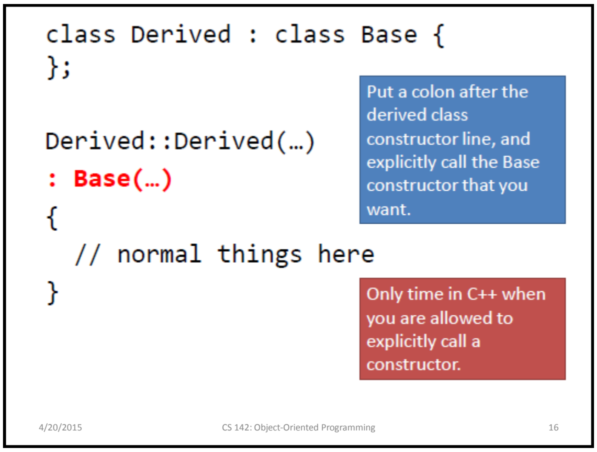
Constructors with Inheritance

- When you construct an object of a derived class:
  - The derived class constructor is called
    - default constructor if not otherwise specified
  - Before running its own code, the derived class constructor must call a base class constructor.
    - default constructor if not otherwise specified
  - Once the base class constructor code runs, the derived class constructor code runs.



Constructors with Inheritance

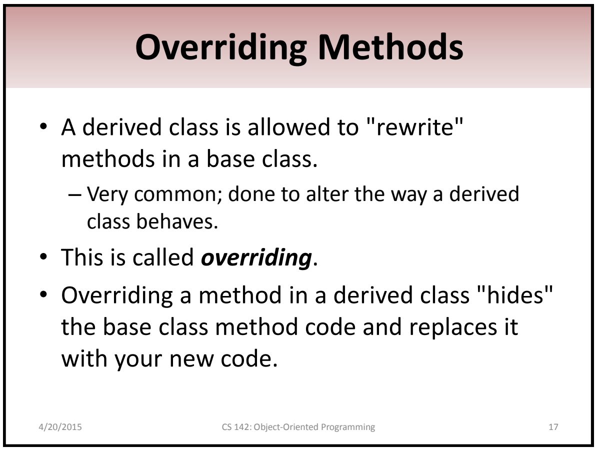
- Derived class constructors are allowed to ***explicitly*** call base class constructors.
- Commonly used to initialize private variables that derived classes do not have access to.



```
class Derived : class Base {
};

Derived::Derived(…)
: Base(…)
{
  // normal things here
}
```

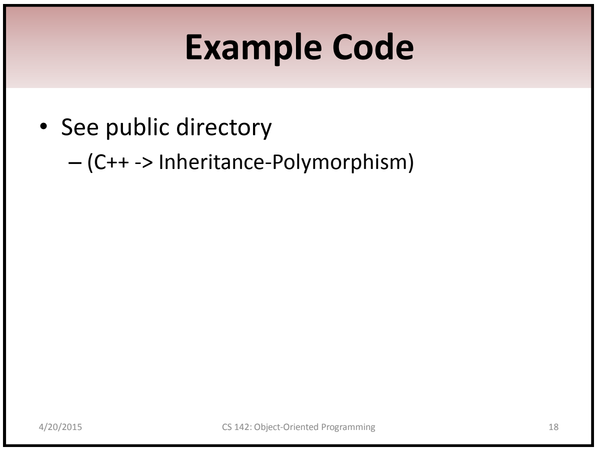
Put a colon after the derived class constructor line, and explicitly call the Base constructor that you want.

Only time in C++ when you are allowed to explicitly call a constructor.



Overriding Methods

- A derived class is allowed to "rewrite" methods in a base class.
  - Very common; done to alter the way a derived class behaves.
- This is called ***overriding***.
- Overriding a method in a derived class "hides" the base class method code and replaces it with your new code.



Example Code

- See public directory
  - (C++ -> Inheritance-Polymorphism)