

# **More Inheritance, Polymorphism, and Java Stuff**



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# Opening Discussion



- What did we talk about last class?
- Remember that the code for assignment #1 should be submitted to me today by midnight. Does anyone have any questions about the assignment?
- Let's look at how inheritance is shown in code.
- What is abstract? Why do you use it? Is there an example? Compare to interfaces.

# Difficulties with Inheritance



- One significant problem can be frailty. You have to think about the public interfaces of base classes very carefully because when you have many subclasses it is almost impossible to change them. Also worry about public methods that call other public methods.
- A subclass that doesn't implement everything probably shouldn't be a subclass.
- Finding the methods in superclasses in deep hierarchies. They don't show in UML.

# Inclusion Polymorphism



- The definition of subtyping states that when we have a subtype object, we can use it in a place where we expect a supertype object.
- This implicitly gives us polymorphism because we can write a function that works with the supertype and all subtypes should automatically work as well.

# Why It Works



- The reason this happens is because the subtypes “inherit” the full public interface of the supertypes and possibly other information/code as well. The code using an object can only use the public interface which all subtypes share with the supertype.
- Inclusion polymorphism works well in Java because all objects are stored as references and all methods are virtual.

# Constructors



- I mentioned constructors last time, but we should be more formal about them.
- A constructor is a method with no return type that has the same name as the class. As their name implies, they are used to construct variables and some constructor is called any time new is invoked.
- They can be overloaded with different arguments.

# Quick Code



- Let's do some quick code to demonstrate the use of inheritance, inclusion polymorphism, and constructors in Java.

# The super Keyword



- Sometimes you want to be able to access methods or constructors from the superclass of a given class. In Java this is done with the super keyword.
  - For constructors the first line of a constructor can be `super(arg1,arg2,...)`; to call the constructor of the superclass that takes the given argument list.
  - For other methods, using `super.method(...)` will call that method of the superclass.



# Inner Classes

- Starting with version 1.1, Java introduced inner classes. The simplistic view of inner classes is that they are classes inside of other classes. You can do this in C++.
- The full reality is that inner classes in Java have more complexity than an embedded class in C++. For one thing, unless you state otherwise, inner classes keep track of the instance of the “outer class” that creates them.

# Static Inner Classes



- The construct in Java that is most like an embedded class in C++ is a static inner class.
- The instances of this inner class are associated with the class as a whole.
- Unlike in C++, they have access to all static methods and members of the outer class.
- Make inner classes static unless they need to be otherwise.

# Non-static Inner Classes



- If an inner class is not declared static, it will get a reference to the instance of the outer class in which it is created.
- This gives it access to all methods and members of that instance. The methods of the inner class can access the private data of the outer class.
- This adds some overhead, but can be very handy at times.

# Anonymous Inner Classes



- Java has another construct that has no parallel in C++, the anonymous inner class.
- As the name implies, these classes have no names. Instead, they have to be a subtype of some class or interface. They can then be used as an instance of the supertype.
- They allow you to create a class “inline”, in the code for a method

# More on Anonymous ICs



- They are static or not depending on the type of method they are created in.
- They have access to all the things the named inner classes of their type would have, plus the final variables in the method in which they are declared.
- These are used extensively for event handling in Java GUIs.

# Let's write some code



- Now let's write some code that demonstrates all the major syntactic points of Java that we have talked about and displays inheritance.

# Minute Essay



- Next class is on string processing. This means that we are going to move away from talking about the nature of the language itself. What questions do you still have about the Java language? Do you feel comfortable trying to code assignment #2 and if not what would help?
- Quiz #1 is on Tuesday.