

Inheritance in Java

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Opening Discussion

- What did we talk about last class?
- How many of you have looked in the book at the chapters I have asked you to read? Did you have problems writing the code for assignment #1? It isn't due until midnight tonight and I would like you to e-mail me your source code for this one. I'm working on a different method of submission but it isn't complete yet.

Immutability

- From the minute essay answers last time it seemed that about 50% of the class had some problems with what immutability means. An immutable class is not a class that can't be changed, all classes are like that in a Java execution, it is a class where the objects of that type can't be changed.
 - Good: prevents bugs
 - Bad: lots of allocations

Projects

- Some of the project descriptions seemed a little “bigger” than what you might want to tackle. This doesn’t mean you can’t do them. We can find ways around almost any limitations you might find in the framework, but it will require more work on your part.
- Having a “doable backup” is always suggested especially if it is part of your full design.

Inheritance

- We have mentioned inheritance in each of the last two classes.
- As I said two classes ago, normal inheritance plays two roles in programming.
 - When class B inherits from class A, it “reuses” all the non-private methods and members of class A.
 - B also becomes a subtype of A.

Inheritance Hierarchies

- The standard way of drawing out inheritance is through a tree-like hierarchy.
- In UML the arrows point from the subclass to the superclass. This is because the superclass doesn’t generally know of all of its subclasses but the subclasses know of the superclass.

Inheritance for Code Reuse

- The first side effect of inheritance is gaining "copies of" non-private members.
- This means that if A had a public method foo() then B will also have a public method foo().
- In the assignment I mentioned that MainFrame inherits from javax.swing.JFrame and gets the show() method from it.

Virtual Functions

- One of the powers of Java is that you don't always have to use the methods defined by the superclass. You can override them in the subclass.
- Methods that can be overridden are called virtual methods. By default all methods in Java are virtual.
- A method invocation uses the definition "closest" to the actual class.

Final Keyword

- If you have a method that you don't want to ever be overridden, you can declare it as final.
- You can also declare an entire class to be final in which case no subclasses can ever be written to inherit from it.

Inheritance for Subtyping

- Inheritance also provides subtyping. This is in part because the subclass has all the public methods and members of the superclass.
- Formally, when we say that B is a subtype of A, what we are saying is that any place in the code where an A is expected, a B can be used, or a B can always take the place of an A.

Inclusion Polymorphism

- This ability to substitute subtypes in place of supertypes is what leads to inclusion polymorphism.
- Inclusion polymorphism is a form of “universal polymorphism” because there is an infinite number of possible subclasses for any given class (assuming it isn’t final).

Inclusion Polymorphism in the Project

- Inclusion polymorphism is what allows my code to work with what you are going to be writing.
- You are going to create subtypes of the types I have defined. My code works with the supertypes and through inclusion polymorphism it will work with your subtypes as well.

Single Inheritance of Classes

- Java only allows single inheritance of classes. That is to say that a class can only inherit from one superclass.
- This greatly simplifies code by reducing ambiguity. C++ has multiple inheritance which causes one to frequently need to specify which superclass of a given class a method should be called through.

Interfaces

- Of course, C++ has multiple inheritance for a reason, there are many times when you want one type to be a subtype of several supertypes.
- To deal with this Java has interfaces. An interface is much like a class, but contains only method signatures. They have no implementations and no member data.

Interfaces Continued

- Java allows multiple inheritance from interfaces because they can never create ambiguity.
- Implementing an interface only provides subtyping, not code reuse.
- Subtypes of interfaces need to implement all of the methods of that interface or they will be abstract.

Abstract Keyword

- Just as methods and classes can be final, they can also be abstract. In some ways abstract is the opposite of final.
- Final implies you can't override or inherit, abstract implies that you must.
- An abstract method of a class has no implementation.
- Any class that contains an unimplemented method must be declared abstract.

Let's Write Code

- Now we will use the rest of the time to write some code in Together that demonstrates a bit more about Java and inheritance as well as Together and what you can do in it.

Minute Essay

- Inheritance is a very powerful tool, but it does have pitfalls. Can you think of what some of the problems might be with using inheritance? If not don't worry, they can be subtle so then write any questions you have about inheritance or how it is done in Java.
- Read the description of assignment #2 and think about it. The desing is due in 1.5 weeks.
