CSE 143 Java

Inheritance Tidbits

Overview

- An assortment of topics related to inheritance
  - Class Object
  - toString etc.
  - instanceof
  - Overloading and overriding

Inheritance Reviewed

- A class can be defined as an extension another one
  - Inherits all behavior (methods) and state (instance variables) from superclass
  - (But only has direct access to public or protected methods/variables)
- Use to factor common behavior/state into classes that can be extended/specialized as needed
- Useful design technique: find a class that is close to what you want, then extend it and override methods that aren't quite what you need

Class *Object*

- In Java's class model, every class directly or indirectly extends Object, even if not explicitly declared

  class Foo { … }   has the same meaning as   class Foo extends Object { … }
- Class Object
  - is the root of the class hierarchy
  - contains a small number of methods which every class inherits and which can be invoked on any object (mostly...)

    toString( ), equals(Object), clone( ), hashCode( ), …

Implications of *Object*

- Any object can be assigned to a variable of type Object
- Object can be an argument type or a return type
- Arrays and collections of Object are possible
- This is why collections that can hold any object give back things of type Object

More on toString( )

- toString() is a method of Object
- Object provides a default implementation of toString( )

  MyClass#2376ac65
- Most well-designed classes should override toString( ) to return a more useful description of an instance

  Rectangle[height: 10; width: 20; x: 140; y: 300]

  Color[red: 120; green: 60; blue: 240]

  (BankAccount: owner=Bill Gates, Balance = beyond your imagination)
- Called by many system methods whenever a printable version of an object is needed

Comparing Objects

- *Object* defines a boolean function ***equals*** to test whether two objects are the same
- Object's implementation just compares objects for identity, using ==
- This behavior is often undesirable
- More normal concept of equality:
  - *obj1*.equals(*obj2*) should return true if *obj1* and *obj2* represent the same **value**
  - A class that wants this behavior must override equals( )

Comparing The Order of Objects

- Many objects have a natural linear or total order
  - For any two values, one is always <= the other
- A boolean comparison doesn't tell about relative order
- Type *Object* does not have a method for this kind of comparison (why not?)
- The most commonly used order comparison method has this kind of signature:

  int compareTo(Object otherObject)
  - return negative, 0, or positive value in a conventional way
- The Comparable interface requires exactly this method to exist.

Copying Object and clone( )

- Review: what does ***A = B*** mean? (Hint: draw the picture)
- This behavior is not always desirable
- In Java, the **=** operator cannot be overridden
- Instead, a method to copy must be written.
- *obj*.clone( ) should return a copy of *obj* with the same value
  - Object's implementation just makes a new instance of the same class whose instance variables have the same values as *obj*
  - Object's implementation is protected!
  - If a subclass needs to do something different, e.g. clone some of the instance variables too, then it should override clone( )
- clone cannot be used at will...
  - Class must be marked as "Clonable"

instanceof (skip for now)

- The expression

```
<object> instanceof <classOrInterface>
```

  is true if the object is an instance of the given class or interface (or any subclass of the one given)
- One common use: checking types of generic objects before casting

```
Monster m = ...;
if (m instanceof JumpingMonster) {
    JumpingMonster jm = (JumpingMonster) m;
    jm.jump(veryHigh);
}
```

- Often can be replaced by method override and dynamic dispatch

```
Monster m = ...;
m.jumpIfPossible(veryHigh);   // Monster does nothing, JumpingMonster overrides to jump
```

Overriding and Overloading

- In spite of the similar names, these are very different
- **Overriding**: replacing an inherited method in a subclass

```
class One {
    public int method(String arg1, double arg2) { ... }
}
class Two extends One {
    public int method(String arg1, double arg2) { ... }
}
```

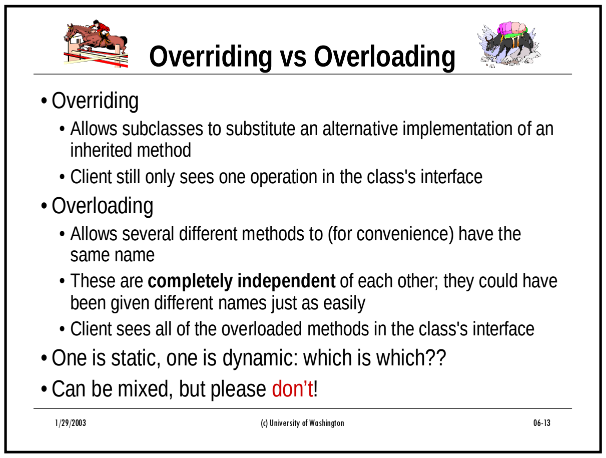
  - Argument lists and results must match **exactly** (number and types)
  - Method called depends on actual (dynamic) type of the receiver

Overloading

- **Overloading**: a class may contain multiple definitions for constructors or methods with the same name, but different argument lists

```
class Many {
    public Many( ) { ... }
    public Many(int x) { ... }
    public Many(double x, String s) { ... }
    public void another(Many m, String s) { ... }
    public int another(String[ ] names) { ... }
```

  - Parameter lists must differ in number and/or type of parameters
    Result types can differ, or not
  - Method calls are resolved automatically depending on number and (static) types of arguments – must be a unique best match



Overriding vs Overloading

- Overriding
  - Allows subclasses to substitute an alternative implementation of an inherited method
  - Client still only sees one operation in the class's interface
- Overloading
  - Allows several different methods to (for convenience) have the same name
  - These are **completely independent** of each other; they could have been given different names just as easily
  - Client sees all of the overloaded methods in the class's interface
- One is static, one is dynamic: which is which??
- Can be mixed, but please don't!

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