Announcements/Follow-ups

- Lab09 tomorrow
  - Practice with generics and inheritence
- P6 due + P7 posted on Wednesday
- Quiz5 Thursday (last one!)
  - Study questions posted today
- Follow-ups
  - MutableDouble example
  - HashTable example
  - Generics and new

Inheritance

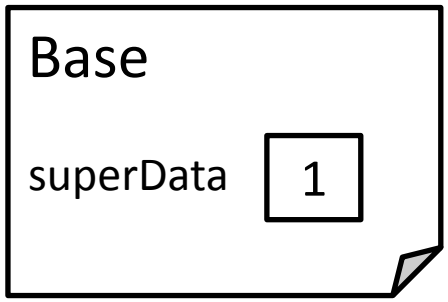
- What is it?
  - The ability to define a new class that automatically possesses the properties of an existing class
    - Fields
    - Methods
    - Nested classes
- What is it good for?
  - Conceptually organizing code
  - Reusing code
    - RedundantInterfacing example

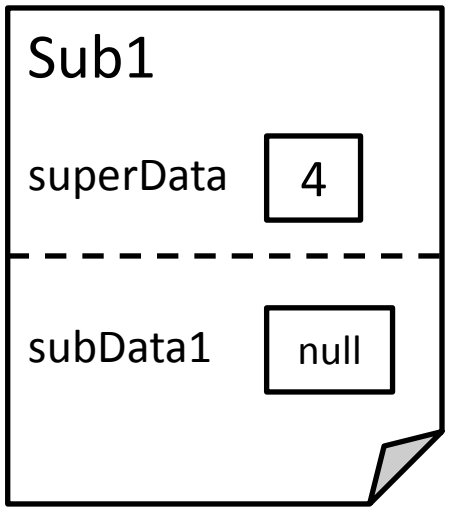
Basic terminology

- Any of the following refer to the existing class:
  - “Base” class
  - “Super” class
  - “Parent” class
- Any of the following refer to the new class:
  - “Derived” class
  - “Sub” class
  - “Child” class
- The derived class “inherits” the members of the base class.
- mySubObject “Is-a” mySuperObject

Inheritance

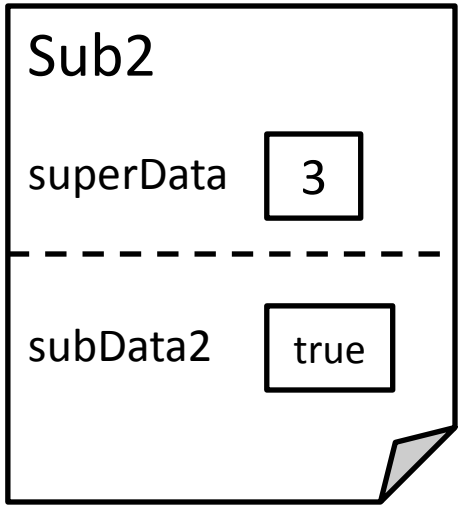
An instance of the base class





An instance of a one sub class

An instance of a different sub class



Basic syntax and usage

- The `extends` keyword:

```
public class SubClass extends SuperClass {…}
```

  - Mother/Child example
  - ReusableExtending example
  - MyBigInt example
- `Object` is the default super-class when `extends` is omitted
- Interfaces can extend other interfaces as well

Basic syntax and usage

- The final keyword (for classes):
  - Prevents extension by any other class
  - Truly immutable classes (String, Integer, etc.) are final
    - Otherwise MyMutableString could extend String, and violate the “is-a” relationship
  - Final children are leaves in the tree of inheritance
- Casting rules: based on the “is-a” relationship again
  - Mother/Child example

Protected access level

- There is one more access modifier: `protected`.
- A sub-class can only access its *own* copy of a protected field.
  - Mommy/Daddy/Baby example

Access Levels

Modifier	Class	Package	Subclass	World
`public`	Y	Y	Y	Y
`protected`	Y	Y	Y	N
no modifier	Y	Y	N	N
`private`	Y	N	N	N

http://docs.oracle.com/javase/tutorial/java/javaOO/accesscontrol.html

Overriding instance methods

- Instance methods with identical declarations in a sub-class and super-class
  - sub-class version “overrides” super-class version
  - `String toString()`
  - `boolean equals(Object other)`
  - Mommy/Baby `void invest()`
- The analogy to static methods is called “hiding”.
- The `final` keyword (for methods): If the class is not final, sub-classes may exist, but they cannot override final methods.

The super keyword

- `super` is like `this`, but it refers to inherited members.
- `super` and `this` can also be used in one constructor to call another constructor
  - `this(…)` calls another constructor in the sub-class (with a different signature)
  - `super(…)` calls a constructor in the super-class (potentially with the same signature).
    - Must be the first line of constructor body
    - If omitted, `super()` without arguments is called by default. In this case, a zero-parameter constructor must be defined in the base-class, or there is a compile-time error
- Super example

The `abstract` keyword

- A middle-ground between inheritance and interfaces. Useful in the following situation:
  - Some members will be identical for all sub-classes, so they should be implemented in the base class.
  - Other members must exist, but their implementations will depend entirely on the sub-classes. So they cannot be implemented in the base class.
- The `abstract` keyword identifies the second category.
- A class with abstract members must be declared abstract itself.
- Abstract example

The `instanceof` operator

- Similar concept to getClass(), but with important differences
  - Usage: `ref1 instanceof MyClass`
  - True when the run-time type of ref1 is MyClass *or any sub-class of* MyClass
  - Mommy/Baby inheritance tests example