Today's topics

Java Language
Inheritance

Upcoming
Language Translation
(Great Ideas, Chapter 9)

Reading
Great Ideas, Chapter 5

Inheritance in Everyday Life

- Inheritance kind of ideas are not strange in today's world
- When you order a new car you:
  - Pick model
    - That implies certain standard features
  - Pick a color
  - Choose engine
    - Often have several choices
  - Choose other options
    - Often many packages to choose from
- Whatever you choose will have lots in common with other cars
  - We would say these common things are inherited from the model
  - Many of the things you chose might have sub-options
  - Thus, there would be another level of inheritance

Inheritance in O. O. Programming

- Object Oriented Programming
- Basic Ideas is Don’t Reinvent the Wheel!
- Wherever possible, build on the work of others
- Reuse as much as possible
  - Modify only where necessary
  - Delete where not appropriate
- Vocabulary
  - Parent Class or super-class
  - Child Class or sub-class
  - Child class inherits from parent class

Inheritance in Graphics

- Assume we want to write a simple drawing package
- A basic feature might be a shape
  - What functions might be associated with shape?
  - I.e., what does every shape have?
  - Also, what do most shapes have?
- Every:
  - Location
  - Size
  - Color
  - Orientation
- Most:
  - Area
  - Fill/NoFill
  - Fill Color
Shape Subclasses

- What are the obvious shapes?
  - Oval
  - Line
  - Triangle
  - Rectangle
  - Polygon
  - Pie
  - Arc

- How do these mesh with some of the methods suggested?

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<thead>
<tr>
<th>Location</th>
<th>Area</th>
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<td>Orientation</td>
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Subclasses of subclasses

- Which of our Specific shapes might have subclasses?
  - Oval  Circle
  - Line  EquilateralTriangle
  - Triangle  Square
  - Rectangle  Polygon, Hexagon, ...
  - Polygon
  - Pie
  - Arc

- Still leaves many things to deal with
  - Parallelogram
  - Arbitrary polygons
  - Various line shapes
  - Use composites...

Inheritance in Java

- We say a subclass extends a parent class
- Remember:
  ```
  public class classname extends java.applet.Applet
  ```
  - This means our class is a subclass of java.applet.Applet
- Some of the other classes we've used also invoked inheritance
  - Button inherits from Component
  - Label inherits from Component
  - All of these classes include the words extends Component
- Both TextField and TextArea are subclasses of a class called a TextComponent which, in turn, is a Component
- Look at http://java.sun.com/j2se/1.4.2/docs/api/index.html
  - Shows the inheritance hierarchy

Inheritance in Java

- Let's think of our graphic/drawing problem
- If we had a class Shape, then we would write
  ```
  public class Oval extends Shape
  ```
  - In order to implement our Oval class and
  ```
  public class Circle extends Oval
  ```
  - To make Circle a subclass (special case of) Oval
- So, if class Shape had the method setColor, then it
  - could be used by Oval and
  - could also be used by Circle
Inheritance in Java

- Sometimes, this inheritance doesn’t work quite that easily
- Take a method such as `getArea` which might be considered for the class `Shape`
  - It is unlikely that one could come up with an area calculation that works for all shapes
  - This means we need to write specialized versions of `getArea` for each shape
  - This is called *overriding* a method
  - We simply write a new `getArea` in the subclass
- On the other hand, `getArea` for oval *will* work for circle
  - We might still override for efficiency reasons. Formula for circle is simpler.

Access Control

- Methods and data may have restricted access
- Use `public`, `private`, or `protected` to specify
- For methods:
  - `public` means: anyone can use
  - `private` means: can only use within class
  - `protected` means: only class and subclasses can use
- For data fields:
  - `public` means: anyone can access or modify
  - `private` means: can only access or modify within class
  - `protected` means: only class and subclasses access or modify
- Helps support *Information Hiding*

Polymorphism

- When you have inheritance hierarchy, can be more general
- Just as we can say it’s a Ford, for all models and variations, we can say something is a `Shape` and then *allow* Ovals, Circles, etc.
- This ability to be more general is called *polymorphism*

- In Java everything, *by default*, inherits from the class `Object`
  - Thus you have a hierarchy containing *all* classes
  - `Object` is at the “peak”