Today’s topics

Java Language
    Inheritance

Upcoming
    Electric Circuits
        (not in text)

Reading
    Great Ideas, Chapters 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, it 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 *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?

<table>
<thead>
<tr>
<th>Location</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Fill/NoFill</td>
</tr>
<tr>
<td>Color</td>
<td>Fill Color</td>
</tr>
<tr>
<td>Orientation</td>
<td></td>
</tr>
</tbody>
</table>
Subclasses of subclasses

- Which of our Specific shapes might have subclasses?
  - Oval circle
  - Line
  - Triangle equilateral-triangle
  - Rectangle square
  - Polygon pentagon, hexagon, ...
  - 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:
  ```java
  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
    ```java
    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](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
  ```java
  public class oval extends shape
  ```
  - In order to implement our oval class and
  ```java
  public class circle extends oval
  ```
  - To make circle a subclass (special case of) oval
- So, if the 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”