CS 142
Inheritance

Rational Class

- Monday's lab

Composition

- Combining Objects
  - A class can use another class as a member variable
  - This is called object composition.
  - Use this when you would say "An object of class A has-an object of class B"
    - A dog has an owner
    - A car has an engine.
    - A student has an advisor.
    - A line segment has a starting point and an ending point.

Composition in Python

```
class Person(object):

    def __init__(self, name):
        self.__name = name

class Dog(object):
    def __init__(self, owner, dogsName):
        self.__owner = owner
        self.__name = dogsName

p = Person("Sally")
d = Dog(p, "Spot")
```

More Composition in Python

```
class Point(object):
    def __init__(self, x=0, y=0):
        self.__x = x
        self.__y = y

    #Other Point class code here

class LineSegment(object):
    def __init__(self, startPoint, endPoint):
        self.__startPt = startPoint
        self.__endPt = endPoint

    #More LineSegment class code here

startPt = Point(2, 4)
endPt = Point(5, 6)
lineSeg1 = LineSegment(startPt, endPt)
```



```
import math

class Point(object):
    def __init__(self, x=0, y=0):
        self.__x = x
        self.__y = y

    def getX(self):
        return self.__x

    def getY(self):
        return self.__y

    #Other Point class code here

class LineSegment(object):
    def __init__(self, startPoint, endPoint):
        self.__startPt = startPoint
        self.__endPt = endPoint

    def getLineLength(self):
        dx = math.fabs(self.__startPt.getX() - self.__endPt.getX())
        dy = math.fabs(self.__startPt.getY() - self.__endPt.getY())
        return math.sqrt(dx * dx + dy * dy)

    #More LineSegment class code here

startPt = Point(1, 3)
endPt = Point(5, 6)
lineSeg1 = LineSegment(startPt, endPt)
print(lineSeg1.getLineLength()) #outputs 5.0
```


Inheritance

- Object composition is also known as a **“has-a”** relationship
- Another type of relationship between objects is a **“is-a”** relationship.
- Use the “is-a” relationship to express when **a class is a specific kind of another class**
  - A German Shepherd is a specific kind of dog.
  - An SUV is a specific kind of automobile.
- This concept is called ***inheritance***.

New Definitions

Inheritance- The concept that one class can inherit traits from another class, much like you and your parents.

Composition- The concept that a class can be composed of other classes as parts, much like how a car has wheels.

Attribute- A property classes have that are from composition and are usually variables.

is-a - A phrase to say that something inherits from another, as in a "salmon" is-a "fish.“

has-a - A phrase to say that something is composed of other things or has a trait, as in "a salmon has-a mouth.“

Rhodes College

Inheritance (is-a) vs. Composition (has-a)

- Inheritance expresses that one class can do everything another class can do, plus more:
  - A racecar is just a car that can drive extra fast around a race track. (A racecar is-a car).
- Composition expresses that one class is a component of another class.
  - An engine is a piece of a car. (A car has-an engine)

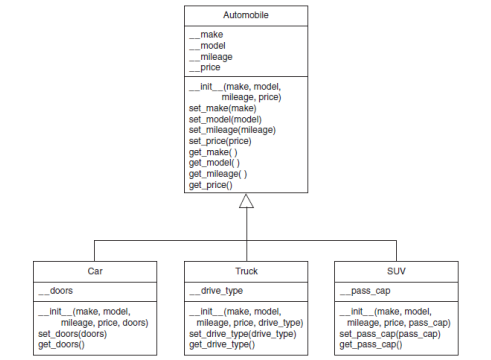
Inheritance (is-a)

- Superclass (base class): a general class **(car)**
- Subclass (derived class): a specialized class **(racecar)**
  - An extended version of the superclass
    - Inherits attributes and methods of the superclass
    - New attributes and methods can be added

Inheritance Example

- Need to create classes for cars, pickup trucks, and SUVs
- All are automobiles
  - Have a make, year model, mileage, and price
  - This can be the attributes for the base class
- In addition:
  - Car has a number of doors
  - Pickup truck has a drive type
  - SUV has a passenger capacity

Figure 12-2 UML diagram showing inheritance



Writing a Subclass

- To indicate inheritance, the superclass name is placed in parentheses after subclass name
  - Example: `class Car(Automobile):`
- The initializer method of a subclass calls the initializer method of the superclass and then initializes the unique data attributes
- Add method definitions for unique methods