1 Administrative Topics

• Go over great projects
• I sent out a HW last night. Did you all get it?
• Office hours: M:1-4, T:1-5, F: 12-2 (note change on Fri)

2 Lab 9

2.1 Dictionaries

I need to tell you about a very neat data structure that Python supports, that is similar to a list, but doesn’t require the indexing to use numbers. It is called a dictionary and it maps “keys” to values.

Suppose we want to build a dictionary mapping names to phone numbers.

| George | 555-1212 |
| Jorge  | 555-1313 |
| Joerg  | 555-1414 |

Here is the code to do it:

```python
In [1]: d = {}  # make empty dictionary
In [2]: d['George'] = '555-1212'
```
We can explicitly test to see if certain values are in the dictionary. And we can access values.

```python
# Is there a number for Stephanie?
print 'Stephanie' in d

# Is there a number for George?
print 'George' in d

# What is George's number?
print d['George']
```

### 2.2 Inheritance with Shapes

Let's look at the `drawString` method in Interpreter. It takes a distance, an angle, and a string. It does not mandate that the string is generated by an L-system. That means we can use this class to draw non-L-system shapes (modularity at work!). For example.

```python
terp = interpreter.Interpreter()
terp.drawString(dstring='F−F−F', distance=100, angle=90)
```

And we draw a square.

Let's design a `Shape` class that can draw the shape specified by a string field.

```python
def __init__(self, distance=100, angle=90, color=(0, 0, 0), istring=' '):
    self.distance = distance
    self.angle = angle
    self.color = color
    self.string = istring

def draw(self, xpos, ypos, scale=1.0, orientation=0):
    terp = interpreter.Interpreter()
    terp.place(xpos, ypos, orientation)
    terp.drawString(self.string, distance=self.distance*scale, angle=self.angle, color=self.color)
```
We have a draw method that uses methods in the Interpreter to place, orient, and draw the given string. We should have accessor and mutator methods for the data fields, but we won’t take the time to do that now.

Now we can make specific shapes by deriving a subclass the the Shape class (it is a super class). For example a Square:

```python
class Square(Shape):
    def __init__(self, distance=100, color=(0, 0, 0)):
        Shape.__init__(self, distance=distance, angle=90, 
                       color=color, istring='−F−F−F−F')
```

We use the parentheses in the class definition to indicate that the Square is derived from a Shape. Another way of putting it is “A Square is a Shape”. The Square class inherits all of the methods from the Shape class. That means its symbol table has an entry for each method in Shape, and that its value is an arrow directing you to the corresponding entry in Shape’s symbol table. With one exception... Square has an __init__ method that overrides the __init__ method of the Shape class. That means the entry for __init__ in Square’s symbol table contains an arrow pointing to this new method.

When a new Square is instantiated using the code `s = Square()`, a new object of type Square is created, and then Square’s __init__ method is called on that new object. The body of Square.__init__ then, in turn, calls Shape.__init__ because we still want to run that code. Notice that the Class.method(obj) notation is used. This is the only way to force the overridden method to run.

When a the line `s.draw(xpos=0,ypos=0)` is executed, python goes to s’s symbol table and looks up draw. It finds a pointer to the draw entry in the Square class symbol table, which in turn contains a pointer to the draw entry in the Shape class. Finally, the draw entry in the Shape class contains a method, and that method is executed. In other words, a chain of arrows leads us from the instance object to the method. It may lead us all the way up the inheritance hierarchy, or it may stop at the first class it encounters (as it does with the __init__ method).

We created a Triangle as well. Here is code:

```python
class Triangle(Shape):
    def __init__(self, distance=100, color=(0, 0, 0)):
        Shape.__init__(self, distance=distance, angle=120, 
                       color=color, istring='F−F−F')
```

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We also tested the new shapes:

```python
if __name__ == '__main__':
    s = Square(distance=50, color=(0,1,0))
    d = Diamond(distance=65, color=(1,1,0))
    s.draw(0,0)
    d.draw(100, -100)
    terp = interpreter.Interpreter()
    terp.hold()
```

There are a couple of ways we can add fill to the shapes. Assuming we have updated the Interpreter code to turn fill on when it encounters `{` and to turn fill off when it encounters `}`.

I include code, but not an explanation here, because I don’t want to contradict what is taught in lab.