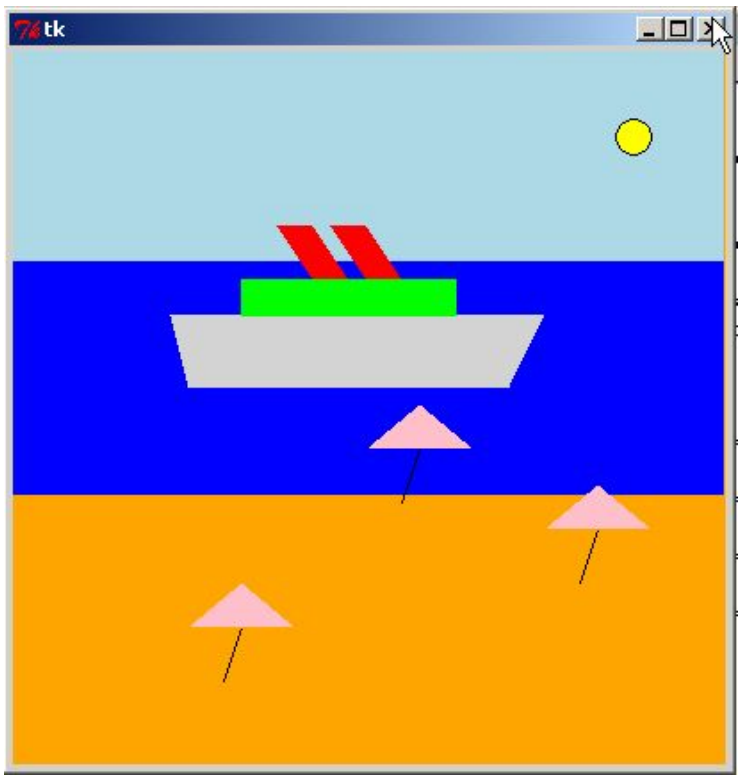
CSC 110 – Lab 12
Graphics and Objects

Names: _____

Introduction
The purpose of this lab is to understand how to use object-oriented programming to create graphics objects to draw simple images in Python.

Exercises

In this lab we are going to use the `graphics.py` library to draw this scene:



Before we start, be sure to save `graphics.py` in the folder where you will be creating your Python programs. Download it from here:

http://www.cs.uri.edu/~cingiser/csc110/handouts/python/graphics.py

Once you save it, run it.

1) Let's start by creating an umbrella. It is made from two simple shapes – a triangle (polygon) and a line.

Suppose you are given an initial point at the top of the umbrella triangle, how would you create the other two points on the triangle if the height of the triangle is 15 and the width of the triangle is 40?

In the Python shell, type the following:

```
from graphics import *

top_point = Point(50,50)
```

Now we will create a triangle with the dimensions mentioned above with top_point as the top of the triangle. Start with this:

```
p2 = Point(top_point.getX() + 20, top_point.getY() + 15)
```

See if you can create the third point on the triangle, `p3`, in a similar way. Once you have done so, you can create the triangle using the Polygon class:

```
triangle = Polygon(top_point, p2, p3)
```

Open the a window so you can draw this triangle:

```
win = GraphWin("Beach", 400, 400)
triangle.draw(win)
```

You have drawn the top part of the umbrella. Now lets draw the handle. It is a simple line. See if you can define the handle as a line. Remember a line requires that you specify two points. Use the given point, `top_point`, as a reference to define the line.

Once you have defined the handle, draw it along with the triangle. Color the triangle whatever color you want your umbrella to be.

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2) So we have drawn a single umbrella in the window. If we want to be able to draw multiple umbrellas, it would be nice to have a class that defines an umbrella. Then we can create as many umbrella objects as we want based on that class.

   We will start with the following skeleton code:

```
from graphics import *

class Umbrella(GraphicsObject):
    def __init__(self, top_point):
        GraphicsObject.__init__(self, ["outline", "fill"])
        # The init method is given the top point of the triangle

        # Insert the code to create the other two points of the
          triangle using the top_point


        # top is an attribute of the umbrella - it is the triangle
          part of the umbrella

        # Initialize self.top by creating the Polygon object
        self.top = Polygon(top_point, left_point, right_point)

        # Insert the code to create the handle of the umbrella by
          specifying the two points of the line

        # Initialize self.handle by creating the Line object

    def draw(self, canvas):
        self.top.draw(canvas)
        self.top.setFill("hot pink")
        self.handle.draw(canvas)

    def undraw(self, canvas):
        self.top.undraw()
        self.handle.undraw()
```

Finish the definition of this class by inserting the code to create the other two points on the triangle, and to create the handle. Once you create the class, save it in a file called `beach.py`. You can test it by running it, and then creating an Umbrella object with the following instruction:

```
umbrella = Umbrella(Point(100,100))
```

And then create a graphics window and draw the umbrella in the window.

Now let's draw another umbrella. One way to do this is to create a new umbrella with this instruction:

```
umb2 = Umbrella(Point(50,50))
umb2.draw(win)
```

You can create a third Umbrella object by cloning one of the existing ones and then moving it to the desired location:

```
umb3 = umbrella.clone()
umb3.move(50, 80)
umb3.draw(win)
```

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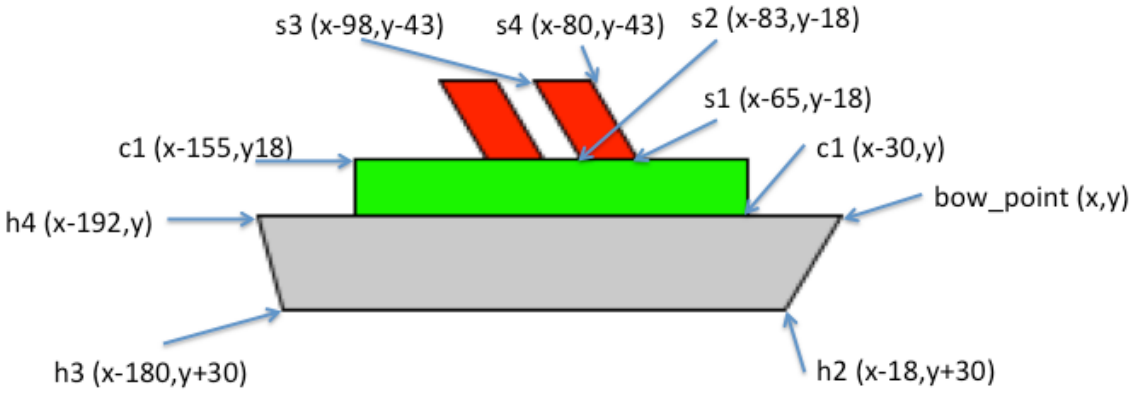
3) Now let's create a class to define the boat in the picture. The boat is made up of three basic shapes: a trapezoid for the hull, a rectangle for the cabin, and two parallelograms for the smoke stacks. We will define the boat given one point, the bow of the hull, and we will compute all of the other points from that one.

   The following are the dimensions that define the boat:



   We will start by creating the class and just including the hull. Use the following skeleton code:

```
class Boat(GraphicsObject):
    def __init__(self, bow_point):
        GraphicsObject.__init__(self, ["outline", "fill"])

        # Create the hull of the boat
        h1 = bow_point
        h2 = Point(h1.getX()-18, h1.getY()+30)
        # Insert the code to create the other two points on the hull
        self.hull = Polygon(h1, h2, h3, h4)
```

```
    def draw(self, canvas):
        self.hull.draw(canvas)
        self.hull.setFill("grey")

    def undraw(self):
        self.hull.undraw()
```

Fill in the code to create the other two points on the hull. Once you have done this, add this code to the file you created and run it. From the Python shell create a boat object and draw it in a window. Of course, this should only draw the hull.

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Now add code to the Boat class to define the cabin as a Rectangle, and one smoke stack as a Polygon. Be sure you add the necessary code in the `__init__` method as well as in the `draw` and `undraw` methods.

Once you have done this, test it by saving the file and running it.

The last step to drawing the boat is to draw the second smoke stack. You can create the second one by cloning the first one and moving it left 30 units.

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4) Let's finish the drawing by writing the main() function of the program that creates the objects and draws them. Your main will start with this skeleton code:

```
def main():
    # Create rectangles to color the background
    sky = Rectangle(Point(0,0), Point(400, 130))
    water = Rectangle(Point(0,130), Point(400, 260))
    sand = Rectangle(Point(0,260), Point(400, 400))

    # Insert code to create a Boat object with the bow
    # point at Point(200,140)

    # Insert code to create three umbrellas wherever you
```

```
# want - as long as the handle is in the sand

# Insert code to create the sun in the sky

# Create the graphics window
win = GraphWin("beach", 400, 400)
# Draw and color the objects in the scene
# The order in which you draw these object is
# important because they overlay each other
sky.draw(win)
sky.setFill("light blue")
# Draw and color the
sun.draw(win)
sun.setFill("yellow")
water.draw(win)
water.setFill("blue")
sand.draw(win)
sand.setFill(color_rgb(244,164,96))
boat.draw(win)
umbrella1.draw(win)
umbrella2.draw(win)
umbrella3.draw(win)
```

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Challenge Problems

1) Take the scene that you drew above, and modify it to animate it. Make the sun set behind the horizon, and make the boat move across the water until it goes off the screen. This will require a few lines of code in the `main` function, and the definition of a `move` method in the `Boat` class.

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2) Add a few people to the scene lying down on towels on the beach. You can use stick figures if you want, or you can be creative with how you draw them. To do this you should create a new class called Person and a new class called Towel. Then draw a few people and towels in the scene.

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