ETGG1801 **Final Exam** **12/16/2016 8:00 – 9:50am**

WARNING: THE TOPICS AND EMPHASIS ARE LIKELY SLIGHTLY DIFFERENT FROM THIS YEAR – THIS IS JUST AN EXAMPLE! ALSO, THIS CLASS DIDN'T HAVE A CHEAT-SHEET, SO YOUR QUESTIONS, MIGHT BE SLIGHTLY DIFFERENT IN TONE / DIFFICULTY.

Name: ____

There are 106 points possible. NO CALCULATORS!!

1. (**16 points**) What is the DEFINITION of each of these (I'm *not* looking for a number answer):
   a. π

the *ratio* of any circle's circumference to its diameter (π = C/D)

   b. Sin (Θ)

the ratio of a right-triangle's opposite side-length to its hypotenuse (sin(Θ) = O / H)

   c. Cos^{-1} (h)

if cos(Θ) = h, then $\cos^{-1}(h) = \Theta$

   d. 1 radian

the angle made by two lines coming from the center of a circle, where the length of the arc is equal to the radius.

2. (**4 points**) How would you convert 137 degrees to the equivalent radian angle? I'm not asking for a number answer (since you don't have a calculator – instead I'm looking for an equation / expression that we *could* enter in python or a calculator).

radians = 137 * 3.1416 / 180

3. (**8 points**) Suppose you are currently storing these python variables:
   a. **x**: the character's current x position
   b. **y**: the character's current y position
   c. **degrees**: the orientation of the character (in degrees)
   d. **speed**: The speed at which the character moves (in pixels / s)
   e. **dt**: the time (in seconds) since the last update.

   Show a python code snippet to show how to update the character's position if they were to move forward at the given rate after dt seconds have passed.

```
rad = math.radians(degrees)

dist = speed * dt
x += dist * math.cos(rad)
y -= dist * math.sin(rad)
```

4. (**8 points**) Suppose you are currently storing these python variables:
    a. **x**: the character's current x position
    b. **y**: the character's current y position
    c. **tx**: The x position of a target
    d. **ty**: The y position of a target

   Show a python code snippet to create two additional variables:
   dist: the distance between the character and the target
   degrees: The angle (in degrees) towards the target (from the character's point-of-view)

```
dist = ((tx – x) ** 2 + (ty – y) ** 2) ** 0.5
degrees = math.degrees(math.atan2(-(ty – y), tx – x)
```

5. (**20 points**) Show me what must be in the foo module for this main program to produce the output shown in comments:

```
import foo

f = foo.Blah(4, 15)         # Yarg! 19
g = foo.Blah(3, 2)          # Yarg! 5
print(f)                    # 15-15-15-15
print(g)                    # 2-2-2
f.toot()                    # Toot!
print(f)                    # 15-15-15-15-15
f.toot()                    # Toot!
print(f)                    # 15-15-15-15-15-15
g.toot()                    # Toot!
print(g)                    # 2-2-2-2
```

```
# this is in foo.py
class Blah:
     def __init__(self, a, b):
          self.a = a
          self.b = b
          print(“Yarg! “, a + b)

     def __str__(self):
          s = “”
          for i in range(self.a):
               s += str(self.b)
               if i < self.a – 1:
                    s += “-“

          return s


     def toot(self):
          print(“Toot!”)
          self.a += 1
```

6. (**10 points**) Write a function called **move** that takes a parameter **L**, which is a list of lists, where each sub-list is of this form [**x**, **y**, **velX**, **velY**, **rad**]. The function also takes a parameter **dt** (the change in time, in seconds) and **accX**, **accY**, which is the acceleration these objects are being subjected to. The function should apply acceleration on all the objects and change their position. Any objects that go completely off-screen (in an 800x600 window) should be removed from the list. The function should return a new list of any objects that were removed. **(Note: We didn't do acceleration in the fall2017 semester. Basically, you do velX += accX * dt every frame and also posX += velX * dt)**

```
def move(L, dt, accX, accY):
      for item in L:
            item[2] += accX * dt
            item [3] += accY * dt
            item [0] += item [2] * dt
            item [1] += item [3] * dt
            if item[0] < -item[4] or item[1] < -item[4] or
               item[0] > 800 + item[4] or item[1] > 600 + item[4]:
                  L.remove(item)
```

7. (**8 points**) Write a function named **ptInRect** which takes two arguments: **p** (a position tuple) and **r** (a pygame rectangle) and returns a Boolean indicating whether the point is within the rectangle.

```
def ptInRect(p, r):
      return p[0] >= r[0] and p[0] <= r[0] + r[2] and p[1] >= r[1] and p[1] >= r[1] + r[3]
```

8. (**8 points**) Suppose we have a sprite sheet being stored in a python (pygame.Surface) variable called **img**. Each frame of the animation is 100x100 pixels. Further suppose we have these variables:
   a. **frame**: an integer (0 – 7) that indicates what frame of animation we're on
   b. **direction**: a string (one of "w", "ne", "n", "nw", "w", "sw", "s", "se")
   c. **x**, **y**: a position
   d. **rows**: a dictionary which contains {"w":4, "se":7, and so on}

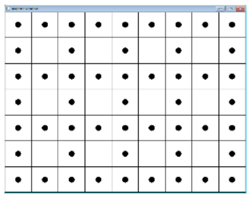
   Show a python blit command to center the *current* frame of animation at the given position to the screen. To get full points, use the dictionary.

```
    rect = (frame * 100,
            rows[direction] * 100, 100, 100)

    screen.blit(img, (x – 50, y – 50), rect)
```

9. (**13 points**) Write a python code snippet which will draw a grid using black lines. For even rows *or* even columns (or both), draw a small circle in the middle of the square. You have 3 variables to work with:
   a. **screen**: The surface to draw to (you can assume it is 800 x 600)
   b. **numCols**: The number of circles to draw horizontally
   c. **numRows**: The number of circles to draw vertically

   For example: if numCols were 9 and numRows were 7, the screen would look like:



```
square_width = screen.get_width() / numCols
square_height = screen.get_height() / numRows
for i in range(numRows):
     y = square_height * i
     for j in range(numCols):
          x = square_width * j
          pygame.draw.rect(scree, (0,0,0), (x, y, square_width, square_height), 1)
          if i % 2 == 0 or j % 2 == 0:
               cx = int(x + square_width / 2)
               cy = int(y + square_height / 2)
               pygame.draw.circle(screen, (0,0,0), (cx, cy), 3)
```

10. (**5 points)** Convert this while loop to an equivalent for loop (using range). Use / create the same variables

```
i = 0
while i < 20:
     c = data[i]
     print("i = " + str(c))
     i += 1
```

```
for i in range(20):
     c = data[i]
     print(“i = “ + str(c))
```

11. (**6 points**) What is the output of this python snippet? If there errors, indicate them, but continue with the rest of the program.

```
G = (4, 7.2, "abc", [9, 3, 11], [14, 18, 19], "qrs")
print(len(G))
print(G[1])
print(G[-1])
print(G[2:4])
print(G[2][1])
```

```
6
7.2
qrs
[“abc”, [9, 3, 11]]
b
```

Have a great break! I know this has been a tough semester – thank you for all your hard work!