Programming Fundamentals Using Python

2018

Problem Set 2 (for Day 1)

Last update: July 11, 2018

Objectives:

1. define and call functions

2. state the difference between functions with return values and no return values

3. state the difference between formal argument and actual arguments

4. explain the difference between local and global variables

5. import function from another module

Note: Solve the programming problems listed below using your favourite text editor. Make sure you save your programs in files with suitably chosen names, **and try as much as possible to write your code with good style (see the style guide for python code)**. In each problem find out a way to test the correctness of your program. After writing each program, test it, debug it if the program is incorrect, correct it, and repeat this process until you have a fully working program. Show your working program to one of the cohort instructors.

Problems: Cohort sessions

1. *Functions: multivalued:* Recall the following equation that gives the height of a ball at time t when it is thrown with an initial velocity of v_0.

$$y(t) = v_0 t - \frac{1}{2}gt^2$$

   Write a function named `position_velocity()` that takes v_0 and t as inputs and returns $y(t)$ and $y'(t)$, where $y'(t)$ is the first derivative of $y(t)$ with respect to t. Use your knowledge of calculus to find the formula to calculate $y'(t)$. Define the gravitational constant g, where appropriate? **Round the output to two decimal places** using `round(n,d)`. Use $g = 9.81 \ m \ s^{-2}$.

```
>>>print(position_velocity(5.0, 10.0))
(-440.5, -93.1)
>>>print(position_velocity(5.0, 0.0))
(0.0, 5.0)
>>>print(position_velocity(0.0, 5.0))
(-122.62, -49.05)
```

2. *Functions: Number of years and days:* Write a function `minutes_to_years_days` that takes in minutes as its input parameter, and returns the number of years and days for the minutes. For examploe, if the function takes in 527040 minutes, it is equivalent to 366 days, and so it will return 1 year and 1 day. For simplicity, assume a year has 365 days. For example,

```
>>>print(minutes_to_years_days(1000000000))
(1902, 214)
>>>print(minutes_to_years_days(2000000000))
(3805, 63)
```

   Test the function by writing a test program that prompts the user, using `input`, to enter the minutes and print the output of the function. Here is a sample run:

```
Enter the number of minutes: 1000000000
1000000000 minutes is approximately 1902 years and 214 days.
```

3. *Functions: Area of a Triangle:* Write a function that takes in the three points (x1,y1), (x2,y2), and (x3,y3) of a triangle and returns its area. The formula for computing the area of a triangle is

$$
\begin{aligned}
s &= (side_1 + side_2 + side_3)/2 \\
area &= \sqrt{s(s - side_1)(s - side_2)(s - side_3)}
\end{aligned}
$$

where $side_n$ is the length of one of the sides of a triangle. The three points are of the type Coordinate defined as:

```
class Coordinate:
    pass
```

See the figure below. **Round your answer to two decimal places**. To test the function,
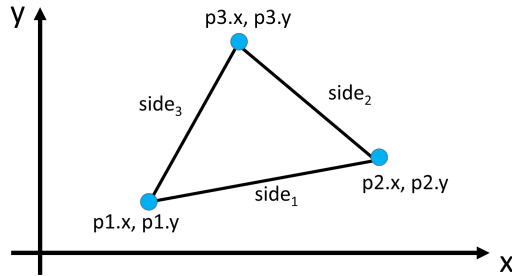
you can use the following code:

```
print("Test Case 1")
p1=Coordinate()
p1.x=1.5
p1.y=-3.4
p2=Coordinate()
p2.x=4.6
p2.y=5
p3=Coordinate()
p3.x=9.5
p3.y=-3.4

ans=area_of_triangle(p1,p2,p3)
print(ans)

print("Test Case 2")
p1=Coordinate()
p1.x=2.0
p1.y=-3.4
p2=Coordinate()
p2.x=4.6
p2.y=5
p3=Coordinate()
p3.x=9.5
p3.y=-1.4

ans=area_of_triangle(p1,p2,p3)
print(ans)

print("Test Case 3")
p1=Coordinate()
p1.x=1.5
p1.y=3.4
p2=Coordinate()
p2.x=4.6
p2.y=5
p3=Coordinate()
p3.x=-1.5
```

```
            p3.y=3.4

            ans=area_of_triangle(p1,p2,p3)
            print(ans)

            print("Test Case 4")
            p1=Coordinate()
            p1.x=-1.5
            p1.y=3.4
            p2=Coordinate()
            p2.x=4.6
            p2.y=5
            p3=Coordinate()
            p3.x=4.3
            p3.y=-3.4

            ans=area_of_triangle(p1,p2,p3)
            print(ans)
```

The expected output should be:

```
Test Case 1:
33.6
Test Case 2:
28.9
Test Case 3:
2.4
Test Case 4:
25.38
```

Write a test program that prompts the user to enter the coordinates of the three sides and display the area. Here is a sample run:

```
Enter x coordinate of the first point of a triangle: 1.5

Enter y coordinate of the first point of a triangle: -3.4

Enter x coordinate of the second point of a triangle: 4.6

Enter y coordinate of the second point of a triangle: 5

Enter x coordinate of the third point of a triangle: 9.5

Enter y coordinate of the third point of a triangle: -3.4

The area of the triangle is 33.6
```

End of Problem Set 2.