Exercise 2 – Fundamental Variables

Objective

To experiment with some of the basic variable types within Python and some of their operations.

Questions

1. This exercise carries out some basic operations on variables.
   a) Create a new script called ex2.py
   b) Create two variables, one containing your first name and another containing your last name. Display them using print.
   c) Now transfer these variable values into a list and display the list.
   d) Take the variables and now store the values in a dictionary, using keys 'first' and 'last'. Display the dictionary values.

   ...and execute the script ex2.py.

2. Now we'll try some object methods. Create a Python script (call it ex2_2.py if you like) with the following line:

   ```
   var = input("Please enter a value: ")
   ```

   This is an easy way of outputting a prompt to the console and getting a reply. The variable var is a reference to that reply, which is a *string*.

   Now print the following:

   a) The value of var as upper case.
   b) The number of characters in var (this does not require a method).
   c) Does it contain numeric characters? (try the isdecimal() method).

If time allows...

3. The height of a projectile (*y*) from a gun (ignoring air resistance) is given as:

$$y = y_0 + x \tan \theta - \frac{gx^2}{2(v_0 \cos \theta)^2}$$

where:

g : Acceleration due to gravity: 9.81 m/s squared

v_0 : the initial velocity m/s

θ : (theta) elevation angle in radians

x : the horizontal distance travelled

y_0 : height of the barrel (m)

Write a Python program to answer the following question:

At a barrel height of 1m, after a horizontal distance of 0.5m, an elevation of 80 degrees, and an initial velocity of 44 m/s, what is the height of the projectile?

To convert degrees (deg) to radians use:

```
theta = deg * (pi/180)
```

You will need to import some math methods:

```
from math import pi, tan, cos
```

There will be a further *if time allows* question which expands on this code after the Collections chapter.

4. Create a new program called F1.py, it will explore some of the mathematics involved in managing a Formula 1 racing car.

   The task of this program (at first), is to answer a question:

   Q. "During a race of 45 laps, what is the minimum fuel requirement?"

   You will need to know the fuel consumption found during the race qualifying, which is 2.25 kg for each lap.

5. In this exercise, we'll make a few more modifications to F1.py. First, we'll add an extra fuel load, and then we're going to calculate the lap time based on the weight of fuel, which naturally decreases each lap.

a. In the previous exercise, we worked out the minimum fuel requirement for a 45-lap race and stored this in a variable named fuel_requirement. To fill the tank with the absolute minimum amount of fuel would be foolhardy, and not allow the drivers any margin for manoeuvre. Typically, a car will carry an extra 50% for contingency (multiply the minimum by 1.5). So what fuel will be carried by our fictional F1 car at the start of the race?

   Modify your F1.py program to calculate this.

b. You might think it odd that fuel is measured in kilograms rather than litres or gallons. This is because the weight of fuel is critical to the way a Formula One car performs.

   The qualifying lap time was 80.45 seconds, but that was with only 5kg of fuel: each 10 kg of fuel increases the lap time by 0.35 seconds.

   What will be the lap time for the first lap with all the required fuel on board?

Solutions

Question 1

```
# Create two variables, one containing your first name.
first = 'Fred'
# And another containing your last name.
last = 'Bloggs'
# Display them using print.
print(first, last)

# Now transfer these variable values into a list.
names = [first, last]
# Display the list.
print(names)

# Transfer these variable values into a dictionary,
# using keys 'first' and 'last'.
mydict = {'first': first,
        'last': last
            }

# Display the values.
print(mydict['first'], mydict['last'])
```

Question 2

```
var = input("Please enter a value: ")

# Display the value of var in upper case.
print(var.upper())
# Display the number of characters in var.
print(len(var))
```

```
# Display whether it contains numeric characters?
print(var.isdecimal())
```

If time allows...

Question 3

```
from math import pi, tan, cos

# 1 Mile per Hour = 0.44704 Meters per Second

g  = 9.81         # Acceleration due to gravity m/s squared.
v0 = 44                   # The initial velocity m/s.
theta = 80 * (pi/180) # Elevation angle in radians.
x  = 0.5          # The horizontal distance travelled.
y0 = 1            # Height of the barrel in metres.

y  = y0 + x*tan(theta) - (g * x**2)/(2 * ((v0 * cos(theta))**2))

print('Height:', y, 'm')
```

Questions 4 & 5

```
# This race requires 45 laps. How much fuel is required?
fuel_per_lap = 2.25
laps = 45
fuel_requirement = laps * fuel_per_lap

# Typically, a car will carry an extra 50% for contingency.
fuel = fuel_requirement * 1.5
print("Full fuel load:", fuel, "kg")

# The qualifying lap time was 80.45 seconds.
# However, that was with only 5kg of fuel.
# Each 10 kg of fuel decreases the lap time by 0.35 seconds.

q_lap_time = 80.45

# Theoretical initial lap time.
t_lap_time = q_lap_time - (0.35/10) * 5

print("Theoretical initial lap time:", t_lap_time)

lap_one_time = t_lap_time + ((fuel/10) * 0.35)
print("Lap one time:", lap_one_time, "seconds")
```