CDS-230-001 - FALL 2023

PROBLEM SET 1

8/31/23

Instructions: Use the PS template provided in class to write your answers. When you are done run your script and make sure it executes without syntax errors. Note: You will need the **math** module to access math functions. Make sure you import it once at the top of your script.

Exercise 1.1: Expressions (10 points)

Convert the following mathematical expressions into Python code. Use string formatting to print the values up to 4 decimal places.

(a)

$$4 + \frac{5}{4} \tag{1}$$

(b)

$$19 \times 48^{-4} \tag{2}$$

(c)

$$cos^2(\pi) + sin^2(\pi) \tag{3}$$

(d)

$$\frac{1}{\sqrt{2\pi}} e^{1.5} \tag{4}$$

(e)

$$\frac{-(4 + 5^3 - .39)}{2^4 \times 17.26} \tag{5}$$

Exercise 1.2: Variable names (10 points)

Which of the following variable names are legal versus illegal? Of the illegal ones, how would you fix the names? Of the legal ones, are these good names to use, and why or why not? Use a "docstring" to submit your answers.

a) data4analysis

b) 7mac11

c) iHeartData!

d) j

e) data-set

f) data set

g) len

h) thisOldVariable

i) variablesRgr8

j) this_is_a_variable_i_will_use_for_analysis_results

How to submit your answer using a doc string:

```
# Answer in a doc string:
print("""
a) this is my explanation for part (a)
b) this is my explanation for part (b)
c) etc...
...
""")
```

Exercise 1.3: Understanding Strings (10 points)

Consider the string

```
s = "Computers are good at following instructions, but not at
   reading your mind."
```

Use string functions to do the following:

a) Print the length of *s*

b) Count and print the number of times 'o' occurs

c) Determine (save to a variable) and print the index of 'g'

d) Use the answer from (d) combined with string slicing to print the word 'good'.

e) Without creating a new string, replace the 'C' with 'c', then print *s*

You may use ipython (or Jupyter) to browse the documentation for the **str** type or look at the official documentation Common string operations

Exercise 1.4: Statements (10 points)

If the statements

```
x = 3
y = 9
z = "2.4"
a = True
```

have been executed, then use print() to evaluate the following expressions. If an error occurs, use print() to state why:

a) x/y

b) x//y

c) x%y

d) y/x*z

e) float(x)/float(z)

f) int(x)/int(z)

g) a+x

h) a + a

i) x/y < 0.3

j) str(3) > z

Exercise 1.5: Altitude of a satellite (10 points)

A satellite is to be launched into a circular orbit around the Earth so that it orbits the planet once every T seconds. The altitude h above the Earth's surface that the satellite must have is

$$h = \left(\frac{GMT^2}{4\pi^2}\right)^{1/3} - R,$$

where $G = 6.67 \times 10^{-11}\,\mathrm{m^3\,kg^{-1}\,s^{-2}}$ is Newton's gravitational constant, $M = 5.97 \times 10^{24}\,\mathrm{kg}$ is the mass of the Earth, and $R = 6371\,\mathrm{km}$ is its radius.

a) Use your program to calculate the altitudes in *meters* of satellites that orbit the Earth once a day (so-called "geosynchronous" orbit), once every 90 minutes, and once every 45 minutes. What can you conclude from these calculations?

b) Technically a geosynchronous satellite is one that orbits the Earth once per *sidereal day*, which is 23.93 hours, not 24 hours. How much difference will it make to the altitude of the satellite?