IT 166 Lab 4

Loops in Python

Objectives

- Be able to write Python programs that solve problems using loops.

Preparation

- Launch the Jupyter notebook.
- Rename the notebook page as “lab4”.
- Solution to one problem should occupy one cell.

Please provide solutions to the problems below.

Problem 1

Mean and standard deviation

Mean (μ) and standard deviation (σ) are two important statistical measures for a group of data, where mean shows the average of the data and standard deviation shows the amount of variation of the data. In this problem, you will firstly use list comprehension to create a list of fifty positive randomly generated integers, which have values that are in between 0 and 1000. Given the formula below, you will then calculate the mean and the standard deviation for the list of data.

$$\mu = \frac{\sum_{i=1}^{50} x_i}{50}$$

$$\sigma = \sqrt[2]{\frac{\sum_{i=1}^{50} (x_i - \bar{x})^2}{50}}$$

Hint:

To randomly generate an integer between 1 and 500, you need to use Python’s random library:

```
import random
a_random_number = random.randint(1,500)
```

Requirement:

Only keep two significant digits for the standard deviation’s decimal places.

Sample output:

```
The list is:  [212, 481, 391, 90, 159, 469, 260, 342, 117, 209, 360, 245, 379, 11, 49
8, 63, 316, 344, 195, 411, 181, 318, 346, 371, 208, 99, 328, 49, 280, 162, 8, 91, 284,
 148, 356, 87, 205, 243, 226, 166, 384, 320, 470, 324, 250, 471, 43, 186, 299, 200]
Mean:  253.1
Standard deviation:  129.75
```

Problem 2

The computation of e^x

e^x can be computed using the Maclaurin series, which the formula is given as:

$$e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!} = 1 + \frac{x^1}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots + \frac{x^n}{n!}$$

Where:

- x is the exponential.
- n is the number of steps of the series' expansion.

Write a Python program that computes e^{10} using the Maclaurin series. There should be a way for the program to control the number of expansion steps.

Sample output with three different steps of expansion:

```
The exponential is 10
There are 10 steps of expansions.
The ground truth for e**10 is 22026.465794806703
Our result is 12842.305114638448

The exponential is 10
There are 20 steps of expansions.
The ground truth for e**10 is 22026.465794806703
Our result is 21991.482025665064

The exponential is 10
There are 100 steps of expansions.
The ground truth for e**10 is 22026.465794806703
Our result is 22026.46579480671
```

Given the results above, the more the steps of expansions, the better the precision.

Hint:

- To compute the ground truth, import the math library to retrieve the natural base, e.
- Example to compute e^{10} using the math library: math.e ** 10

Problem 3

Write a Python program that solves the equation below:

$$x_1 + 13 \cdot x_2 \div x_3 + x_4 + 12 \cdot x_5 - x_6 - 11 + x_7 \cdot x_8 \div x_9 - 10 = 66$$

Where:

- $x_1, x_2 \ldots x_9$ are numbers from 1 to 9.
- The numbers can be used more than once.
- The computation should follow the arithmetic precedence.

Hint:

- The solution is not unique.

Expected outcome:

```
One of the solutions is: [3, 8, 8, 7, 5, 1, 5, 7, 7]
```