

PH227: AI and Data Science
Tutorial Sheet 2: Python/Data-Science Part

Note: Each tutorial sheet is worth 20 marks, and you have to submit the codes corresponding to the starred (*) problems to the TAs. The marks of the starred problems are indicated next to them.

1. * Write a Python program which:
 - (a) asks the user for an integer $n > 0$
 - (b) generates a 1D array (i.e. a vector) with n elements, and fills those with n random numbers
 - (c) Calculates and prints out the mean and variance of those n random numbers. (6 marks)

2. * Consider the series

$$S = \sum_{i=1}^n \frac{(-1)^i x^{\frac{i}{2}}}{i(i+1)}$$

Write a Python program that will ask the user for the values of n and x , and will calculate and print out the value of S using a: (a) for loop, and (b) while loop. Both the loops should be part of the same program. (7 marks)

3. Consider the infinite series

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} + \dots - \frac{(-1)^m x^{2m}}{2m!} + \dots$$

Write a Python program which will ask the user for a value of x , and a convergence tolerance, and then sum this series accurate up to that tolerance using a: (a) for loop, and (b) while loop.

4. Write a Python program which will read a decimal number and then print out its binary digits in the correct order. For example, if the decimal number is 6, the output should be 110.
5. * Consider the functions

$$\begin{aligned} f(x) &= \frac{(x^2 + 2x + 3)}{(x + 20)} \\ &= x^3 - 6x^2 + 4x - 1 \\ &= e^x - 1 + x^2 - x^3 \\ &= 2 \sin x + x/3 - 4 \end{aligned}$$

Write a Python program which will ask the user for (a) which function to plot, (b) x_{min}, x_{max} (with $x_{max} > x_{min}$), and n , and (c) compute the value of the chosen function for n equispaced values of $x \in [x_{min}, x_{max}]$. The program should:

- (a) plot the chosen function using suitable functions of matplotlib
- (b) Output $(x, f(x))$ in a csv file in the two-column format, with the first column being values of x , and second those of $f(x)$, with a comma separating the two in each row. (7 marks)