



MATH-GA.2711 Machine Learning & Computational Statistics

Homework 1

Profs. Ivailo Dimov
Due: Sunday Feb 1, 2026

Instruction

This homework is to be done individually. No collaboration and/or code sharing permitted.

Objective

In this assignment, you will:

- install Anaconda and Python on your own machine, and
- practice writing some simple code in Python.

Methodology and Deliverables

1. Installation of the environment

You will install Python and Anaconda on your computer.

- (a) Download and install Anaconda and Python.
- (b) Read through and run the Jupyter notebook demoed in class as a prerequisite for answering the question(s) below. Submit your answers in a separate Jupyter notebook named "HW1-answers.ipynb". Make sure this notebook is self-contained, i.e. runs on its own.

2. Basic Python

Solve the following problems using Python. You may use standard Python libraries and NumPy where indicated.

- (a) Write a function `reverse_words(s)` that takes a string and returns the string with the *order of words reversed*.
- (b) Write a function `is_even_and_positive(x)` that returns `True` if x is even and positive, otherwise `False`.

- (c) Given a list of numbers, write a function `second_largest(lst)` that returns the second largest element. Assume the list has at least two unique values.
- (d) Write a function `count_chars(s)` that returns a dictionary counting how many times each character appears in a string.
- (e) Write a function `squares_of_evens(lst)` that returns a list of squares of the even numbers in `lst`.
- (f) Define a class `BankAccount` with:
 - an attribute `balance`,
 - a method `deposit(amount)`,
 - a method `withdraw(amount)` that only withdraws if there is enough balance.

Test your class by creating an account and performing a few operations.

3. Numpy

- (a) Create a NumPy array containing the integers from 1 to 100. Reshape it into a 10×10 matrix.
- (b) Given a 2D array A of shape 5×5 , extract the first row, the last column, the central 3×3 submatrix.
- (c) Given an array x , return all elements that are greater than 0 and less than 1.
- (d) Given two arrays x and y of the same shape, compute:

$$z_i = x_i^2 + \sin(y_i)$$

without using any Python loops.

- (e) Given a matrix $X \in \mathbb{R}^{n \times d}$ and a vector $v \in \mathbb{R}^d$, subtract v from every row of X .
- (f) Generate a random matrix $A \in \mathbb{R}^{3 \times 3}$ and a vector $b \in \mathbb{R}^3$. Solve the linear system:

$$Ax = b.$$