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Machine Learning

Practical Sheet 1: Google Colab + Python Essentials

1. Implement one Python function that obtains the sum of the elements in one matrix, according to two different dimensions.

2. Implement one Python function that counts the number of elements in a matrix inside the [a,b] interval.

3. Implement one Python function that plots (using Matplotlib) the value of $y=x^2*\cos(2x)$ in the [a,b] interval.

4. **Gradient Descent.** Implement one Python script that optimize the function defined in 3, according to the gradient descent algorithm (with a "learning rate" parameter, received as input).

5. Compare the results obtained in 4., using different learning rates and different input functions.

6. ***Google* Colab** – This is a free service, based in *Jupyter Notebooks,* that supplies free GPU processing. It can be used, in a web browser, in the development of Python projects related to Artificial Intelligence, Machine Learning and Data Science domains, using tools/libraries such as *Keras*, *PyTorch*, *TensorFlow*,....

   Using one of the many resources (tutorials) available at the web (e.g., https://towardsdatascience.com/getting-started-with-google-colab-f2fff97f594c), the first task is to configure the *Google Colab* service and execute a simple "Hello World" notebook, using Python.

7. Create a function that takes two numbers as arguments (num, length) and returns an array of multiples of num until the array length reaches length.

   Example: (7, 5) ➞ [7, 14, 21, 28, 35].

8. In mathematics, a matrix (plural matrices) is a rectangular array or table of numbers, symbols, or expressions, arranged in rows and columns. A square matrix is a matrix with the same number of rows and columns. The trace of a square matrix A is defined to be the sum of elements on the main diagonal (from the upper left to the lower right).

   Example: A= [
   [0, 1, 0, 0],
   [1, 1, 1, 1],
   [0, 1, 0, 1],

```
  [0, 1, 1, 5]
]
```

tr(A)=6

Implement a Python function that obtains the trace of a matrix.

9. In mathematics, primorial, denoted by "#", is a function from natural numbers to natural numbers similar to the factorial function, but rather than successively multiplying positive integers, the function only multiplies **prime numbers**. Create a function that takes an integer n and returns its **primorial**.

   Example: primordial(2) = 6 (the product of the first two prime numbers)

10. The number of rabbits banded at a series of sampling sites has been counted and entered into the following list. The first item in each sublist is an alphanumeric code for the site and the second value is the number of rabbits banded. Cut and paste the list into your assignment and then answer the following questions by printing them to the screen.

```
data = [['A1', 28], ['A2', 32], ['A3', 1], ['A4', 0],
      ['A5', 10], ['A6', 22], ['A7', 30], ['A8', 19],
                ['B1', 145], ['B2', 27], ['B3', 36], ['B4', 25],
                ['B5', 9], ['B6', 38], ['B7', 21], ['B8', 12],
                ['C1', 122], ['C2', 87], ['C3', 36], ['C4', 3],
                ['D1', 0], ['D2', 5], ['D3', 55], ['D4', 62],
                ['D5', 98], ['D6', 32]]
```

   a. How many sites are there?

   b. How many rabbits were counted at the 7th site?

   c. How many rabbits were counted at the last site?

   d. What is the total number of rabbits counted across all sites?

   e. What is the average number of rabbits seen on a site?

   f. What is the total number of rabbits counted on sites with codes beginning with 'C'?