

# 2023-August-Mathematics of Network Algorithms

## Assignment 3

(Last Updated September 6, 2023)

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- Deadline: 5 pm on 11<sup>th</sup> September, 2023. Please submit your assignment in the specified format [here](#) (The form will close at the mentioned time.)
  - You can only use numpy python library for math related functions.
  - You **must** submit python file named as: *enrolment-nr-assignment-nr-question-nr-student-name.py*  
For example, for the student XYZ with enrolment number 20251010, a solution for the first question should be in the file 20251010-03-01-XYZ.py.
  - Your code will be evaluated with the command `$ python3 20251010-03-01-XYZ.py`.
  - Any deviation from these instructions related to submission will adversely affect the number of test cases your algorithm can solve.
  - The points for each question will be determined by the quality of the output.
  - Some test cases for the problem are available on [the web-page](#).
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1. ( 5 pts) [Cleaning Data] We have two files viz `asst-3-Q1.txt` that describes the data and `asst-3-Q1.xlsx` file that contains actual data. The first line of file `asst-3-Q1.txt` contains two integers  $m$  (denoting the number of data points), and  $n$  (denoting dimension of each data point). The next  $n$  lines has three entries: type of data (int or float), lower range, upper range. The file `asst-3-Q1.xlsx` contains  $m$  many rows, each containing  $n$  entries.

Write a python program that reads these two files and cleans the data. Your program should be able to do the following cleaning:

- Fix wrong types of values if they are fixable (i.e. covert float to int is such conversion is valid. For example, it should convert 4.0000 to 4 but it should *not* convert 4.0001 to 4)
- Omit the data point (i.e. the row) if it contains missing values, wrong types of values (which are not fixable), or values that are outside the range.
- Remove duplicate rows.

The output should be a single line containing your roll number and the nr of useful rows. For example, the output for the `asst-3-Q1.txt` is as follows:

20251010 2

2. ( 10 pts) File `asst-3-Q2.xlsx` contains matrix  $A$  of dimension  $m \times n$  where each row corresponds to a data point. Write a program to compress  $A$  to another matrix  $B$  of dimension  $m \times 2$ <sup>1</sup>. Your program should also be able to recover the data and store it as matrix  $A'$  (of the dimension  $m \times n$ ).

The output should be a single line containing your roll number, followed by  $\|A - A'\|_F / (m * n)$  and then  $\|B\|_F$ . For example, the output for the `asst-3-Q1.txt` is as follows:

20251010 0.6313 5.9326

3. ( 15 pts) File `asst-3-Q3.xlsx` contains details of a bank's customers. All of these fields are self-explanatory except the last field called 'churn'. This is the target variable that takes a binary value reflecting the fact whether the customer has closed his/her account (denoted by 0) or he/she continues to be a customer (denoted by 1).

Write a python code that creates a neural network and fits the above data. It should be able to predict the values of churn for data in `asst-3-Q3-test.xlsx`.<sup>2</sup> Please submit your code **after** it had learned all the values to your satisfaction. Also, modify your code so that it **does not** re-learn the network when it is run on my machine but only evaluates values of churn for data in `asst-3-Q3-test.xlsx`.

The output should be a single line containing your roll number, the number of perceptrons in each layer, the number of data points in `asst-3-Q3-test.xlsx` on which the neural network correctly predicts the churn value, total number of data points in `asst-3-Q3-test.xlsx`

For example, if your neural network uses four layers with 20, 5, 10, and 1 perceptrons in these layers, and it solves 955 out of 1000 cases, then the output should be

20251010 20 5 10 1 955 1000

It will be good idea to keep building your code based on the program we discussed in Lecture-12. You are allowed to use the same dependencies required to run that program.

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<sup>1</sup>Here, you can hardcode 2 in your program

<sup>2</sup>Since you do not have this file, you need to split data in `asst-3-Q3.xlsx` into training set and test set.