3Η MANDATORY WORK
IN THE COURSE "NEURAL NETWORKS - DEEP LEARNING"

Write a program in any programming language that implements a **Radial Basis Function Neural Network** or **a network TRAINED with Hebbian Learning** or **an autoencoder network** that will be trained to solve one of the problems you solved in your previous assignments or a corresponding function approximation or data reconstruction problem (In this case you can use MNIST and the network will construct the next digit, i.e. if it accepts a 3 as input it will construct a 4). Indicatively:

1. Reconstruction digits at decimals digits (0,1,...,9) of MNIST: http://www.cs.toronto.edu/~roweis/data.html
2. Separation of 2 or all classes or reconstruction of samples available in Cifar- 10 or SVHN and located at the following addresses: https://www.cs.toronto.edu/~kriz/cifar.html http://ufldl.stanford.edu/housenumbers/
3. or solve any multi-class categorization or function approximation or data reconstruction problem from the databases on the following pages:

http://archive.ics.uci.edu/ml/
http://www.cs.toronto.edu/~roweis/data.html
http://www.cs.cmu.edu/~cil/v-images.html
https://www.kaggle.com/datasets

Where there is no control set, the base is randomly divided into a training set (60%) and a control set (40%) or a cross-validation technique is followed.

Exporting Features

For sample separation, the dimension of the data can be reduced first using PCA to keep more than 90% of the information.

Results report

A report should be written describing: the algorithm, giving typical examples of correct and incorrect categorisation or reconstruction as well as success rates in the training and testing stages, training time and success rates for different numbers of hidden neurons, training mode (K-means, random selection of centres, etc.) and different values of the training parameters. To compare the performance of RBF against Nearest Neighbor and Nearest Class Centroid categorization and if Hebbian Learning or autoencoder is chosen, compare with PCA reconstruction. In the case of MNIST you could test whether the reconstructed digit can be recognized by a digit recognition neural. Another possible reconstruction project would be to build an adder that takes 2 digits of MNIST as input and outputs 2 digits that are the sum of them. For example 9, 7 will produce 1, 6. Comment on the results and the code.

DELIVERY DATE : 10η January 2024

For each day of late submission of the assignment and for 5 days the mark will be reduced by 10%.

DATE OF PRESENTATION/EXHIBITION : to be determined

After the delivery of the assignment there will be an **oral presentation of the three assignments by each student.** The presentation will consist of 8-10 powerpoint slides:

1η : Student details, databases used, specifics if any.

2η -9η : results for each of the tasks. performance, parameter values, time, etc. 10η : Overall conclusions - Comments.

SLIDES SHOULD BE submitted to elearning no later THAN THE day before the presentation/examination.