

D7041E “Applied artificial intelligence”

(Please report any found inconsistencies to Evgeny as soon as you find them)

LAB 4: Unsupervised learning with Self-Organized Maps

1. Introduction

In this lab we will work with Self-Organized Maps. A Self-Organizing Map, or SOM, falls under the rare domain of unsupervised learning in Neural Networks. It is essentially a grid of neurons, which is used for projecting multidimensional data onto a meaningful coordinates revealing the class structure.

2. Fundamentals of data pre-processing and basic skills in Jupyter

Following the example of SOM implementation in the Jupyter notebook from the class, extend it to learn the SOM topology of the MNIST dataset. Study the effect of SOM hyperparameters.

Task 1.1 Unsupervised learning of hand-written digits with SOM:

1. Load the MNIST dataset
2. Use the flattened (that is 1D) array of pixels of each image as a feature vector.
3. Initializing the weights in the SOM network randomly, train SOM with grid 20x20, 40x40, 80x80.
4. Display the initial, intermediate (at 50% of iterations) and the final learned weights of SOM neurons as a grid of 28x28 images.

5. Now by passing the TRAINING examples through the trained SOM and recording the statistics of matching in each node assign labels to the neurons.
 - Display the confusion matrix of classification of the TRAINING SET
 - Display the confusion matrix of classification of the TEST SET
6. For a fixed number of iterations increase and decrease the learning rate of SOM:
 - What is the resulting effect?
7. For a fixed number of iterations and the best learning rate increase and decrease the exponential decay of the neighbourhood parameter.
8. What is the effect?
9. What is a biological neuron? How does it relate to the concept of neurons in SOM?

Congrats, you have just become familiar with a very powerful tool for unsupervised learning - Self-Organized Networks. Well done!