Introduction to computational models

Lab Assignment 1. Implementation of the multilayer perceptron

Pedro Antonio Gutiérrez

pagutierrez@uco.es

Module "Introduction to computational models"
4th year of "Grado en Ingeniería Informática"
Especialidad Computación
Escuela Politécnica Superior
(Universidad de Córdoba)

22nd September 2021

Objectives of the lab assignment

- To familiarise the student with neural networks, in particular, with the multilayer perceptron.
- To implement the basic backpropagation algorithm for multilayer perceptrons.
- To check the effect of different parameters:
  - Network architecture.
  - Learning rate.
  - Momentum factor.
  - Early stopping by a validation set.
  - etc.

Backpropagation algorithm

- Please, read and analyse the theory notes.
- Pay special attention to the pseudo-code.
- Only two elements will be specified differently: the stop condition and a special decrement factor on the learning rate.

Stop condition

- Standard version, the algorithm stops if:
  - Training error does not decrease more than 0,00001 or increases, during 50 iterations (external loop).
- Validation version, the algorithm stops if:
  - Training error does not decrease more than 0,00001 or increases, during 50 iterations (external loop).
  - Validation error does not decrease more than 0,00001 or increases, during 50 iterations (external loop).

Decrementing learning rate in every layer

- It is interesting to include a different learning rate in every layer.
- Given that the weights in the first layers are more sensitive, the closer we are to the input layer the lower the learning rate can be.
- This can be done using the following equation

$$\eta_h = F^{-(H-h)}\eta, h \in \{1, \ldots, H\}$$

where F if a decrement factor given by the user and η is the original learning rate.

- The learning rate only needs to be calculated once for every layer.

Decrementing learning rate in every layer

- For $H = 2$ y $F = 2$:

$$\eta_1 = 2^{-(2-1)}\eta = 2^{(-1)}\eta = \frac{\eta}{2}$$
$$\eta_2 = 2^{-(2-2)}\eta = 2^{(0)}\eta = \eta$$

- For $H = 3$ y $F = 2$:

$$\eta_1 = 2^{-(3-1)}\eta = 2^{(-2)}\eta = \frac{\eta}{4}$$
$$\eta_2 = 2^{-(3-2)}\eta = 2^{(-1)}\eta = \frac{\eta}{2}$$
$$\eta_3 = 2^{-(3-3)}\eta = 2^{(0)}\eta = \eta$$

Introduction to computational models

Lab Assignment 1. Implementation of the multilayer perceptron

Pedro Antonio Gutiérrez

pagutierrez@uco.es

Module "Introduction to computational models"
4th year of "Grado en Ingeniería Informática"
Especialidad Computación
Escuela Politécnica Superior
(Universidad de Córdoba)

22nd September 2021