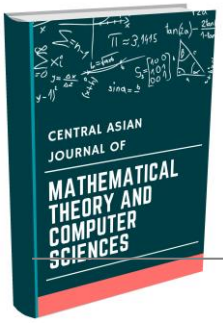

CENTRAL ASIAN JOURNAL OF MATHEMATICAL THEORY AND COMPUTER SCIENCES

https://cajmtcs.centralasianstudies.org

Volume: 04 Issue: 2 | Feb 2023 ISSN: 2660-5309

TRAINING A SINGLE – LAYER NEURAL NETWORK IN THE PYTHON PROGRAMMING LANGUAGE

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Absract

This article describes the training of artificial neural network. A program for training a single – layer neural network is created and the result is shown.

ARTICLEINFO

Article history:
Received 6 Dec 2022
Revised form 5 Jan 2023
Accepted 8 Feb 2023

Key words: *Dendrite, soma, axon, synapse, biological neuron, perceptron, artificial intelligence, neural network, training of neural networks, one-layer neural network.*

The structure of nerve cells: dendrite, soma, axon, synapse. A biological neuron is a nerve cell consisting of a neuron body (otherwise called a soma), dendrites and axons. Neurons are structural and functional units of the brain, and are special cells that perform the function of processing information coming to the brain. Soma (or cell body) is a place where signals from dendrites are collected, processed and then transmitted. The body of the neuron is surrounded by many short and thick projections called dendrites. This is the point of entry of information into the neuron body, and this information comes from the neurons that are ahead of this neuron in the neural network. Some neurons have many dendrites. There is also a neuron that has only one dendrite. The point of contact between nerve cells that transmit impulses or signals is called synapses that transmit chemical or electrical signals. The next member of a biological neuron is called an axon. It is longer than dendrites. It transmits the electrochemical impulse from the neuron body to the next neurons in the network. Thus, a neuron receives an input signal from many dendrites, processes them in the neuron body, and transmits them through a single axon to subsequent neurons in the neuron network. At the end of the axon, the output signal can be divided into several parts (branches) and transmitted to several neurons located next to it.

A perceptron is a building block of artificial neural networks, which is a simplified model of biological neurons in our brain. A perceptron is the simplest neural network, which consists of only one neuron. A perceptron is a simple model of a biological neuron in an artificial neural network. Perceptron is also the name of an early algorithm for supervised learning of binary classifiers. Every artificial neural network has three layers - input layer, hidden layer and output layer. A perceptron works by accepting some numerical data along with what are known as weights and biases. It then multiplies these inputs by their respective weights (called weighted summation). These products are then added together with bias. Perceptron networks have several limitations. First, the output values of the perceptron can take only one of two values (0 or 1) due to the hard – bounded transfer function. Second, perceptrons can only classify a set of linearly separable vectors. The goal of perceptron learning is to adjust the weights along with class detection. A

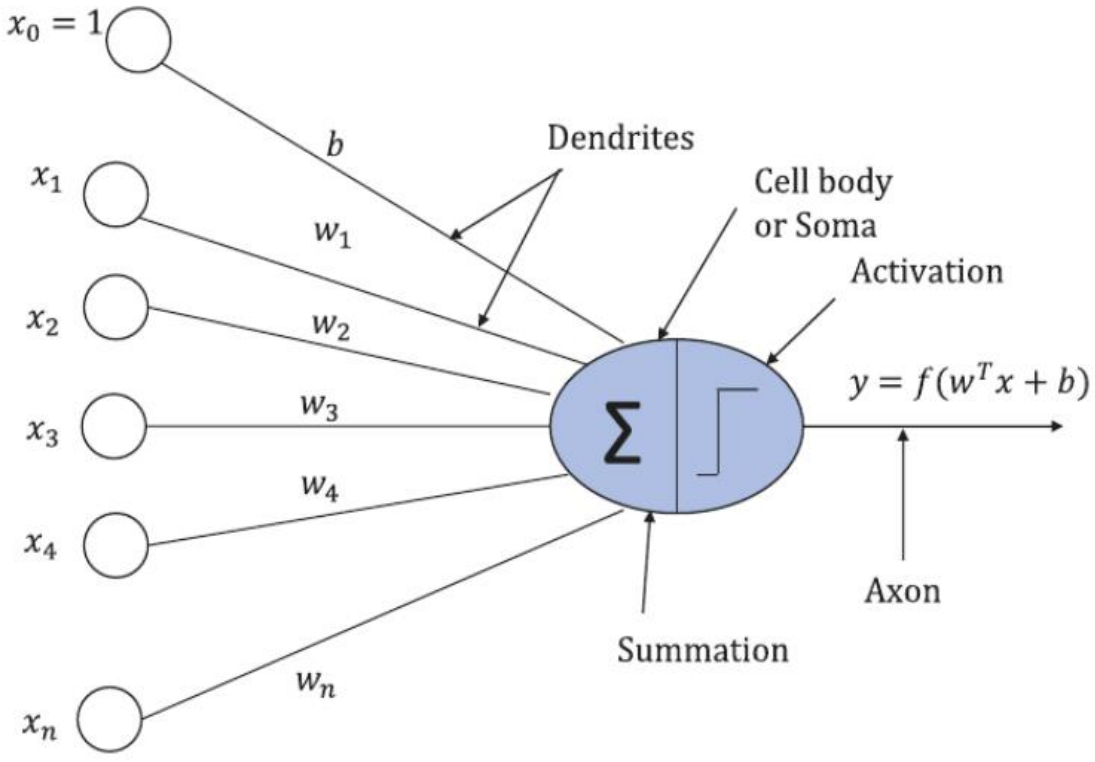
perceptron is a single-layer neural network, and a multi-layer perceptron is called a neural network. In addition, it is used in supervised teaching. This helps categorize the input data.

The nervous system of the human body is made up of highly differentiated neurons and neurons that support, protect and feed them. Each neuron is connected with many other neurons forming synapses. Nervous tissue connects all organs with each other and with the external environment.

Artificial intelligence is a system of programs that reflect human thoughts on a computer. Artificial intelligence (AI) allows computers to learn from their experiences, adapt to given parameters, and perform tasks previously only possible for humans. In many AI implementations — from computer chess players to unmanned vehicles — deep learning and natural language processing capabilities are essential. Thanks to these technologies, computers can be "taught" to perform certain tasks by processing large amounts of data and identifying patterns in them.

To solve practical problems, it is important to find a set of values for weights of interneuron connections. In this case, the output signals of artificial neural networks change in a certain way depending on the presented values of the input signals. The process of adjusting the weights of interneuron connections is called neural network training.

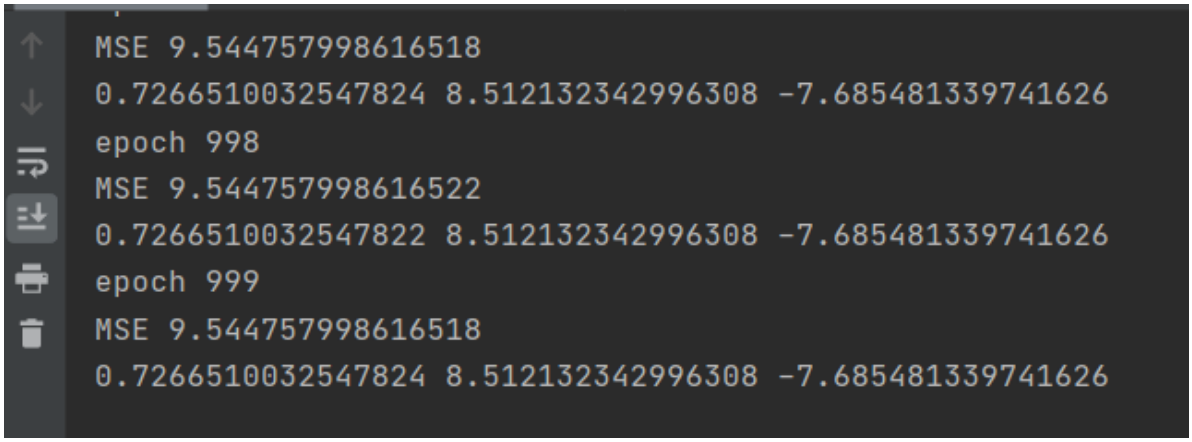
The structural structure of a single-layer neural network is as follows:

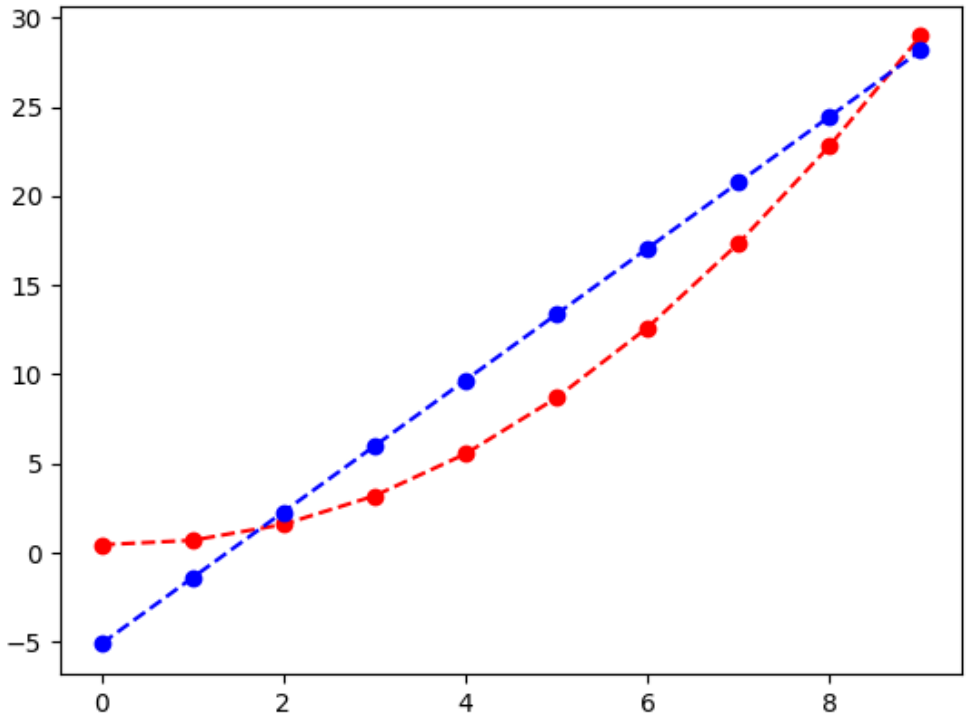


Let's look at training a single-layer neural network in the Python programming language and environment:

```
import matplotlib.pyplot as plt
x1 = [1.2, 1.6, 2, 2.4, 2.8, 3.2, 3.6, 4, 4.4, 4.8]
x2 = [0.2, 0.6, 1, 1.4, 1.8, 2.2, 2.6, 3, 3.4, 3.8]
y = [0.442, 0.691, 1.584, 3.183, 5.538, 8.682, 12.62, 17.35, 22.81, 28.97]
w1, w2 = 0.1, 0.2
b=0
alfa = 0.01
```

```
for epoch in range (1000):
s = 0
for x1_in, x2_in, y_in in zip(x1, x2, y):
y_pred = x1_in * w1 + x2_in * w2 + b
E_error = (y_pred - y_in)**2
grad_w1 = 2 * (y_pred - y_in) * x1_in
w1 = w1 - alfa*grad_w1
grad_w2 = 2 * (y_pred - y_in) * x2_in
w2 = w2 - alfa*grad_w2
grad_b = 2 * (y_pred - y_in)*1
b = b - alfa*grad_b
s = s + E_error
MSE = s / len(y)
print("epoch", epoch)
print("MSE", MSE)
print(w1, w2, b)
y_pArr = []
for x1_in, x2_in in zip(x1,x2):
y_input = x1_in * w1 + x2_in * w2 + b
y_pArr.append(y_input)
plt.plot(y,'o--r')
plt.plot(y_pArr,'o--b')
plt.show()
```





It can be seen that the error difference is significant. To reduce (minimize) this error, hidden layers are added to it, that is, it is achieved by training a multi-layer neural network. Because multi-layer neural networks work more efficiently than single-layer ones.

Conclusion: python is clearly the best language for artificial intelligence. Python provides high-level data structures and simple yet efficient object-oriented programming styles. In this article, the main concepts of artificial intelligence were mentioned, a program for training a single-layer neural network was created, and its result was clearly shown. In the current developing period, it is important to study information technologies, including the field of artificial intelligence, which is rapidly entering our social life.

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