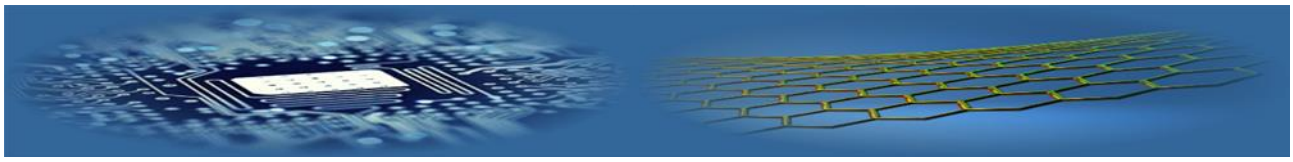


Research of neural network simulators through two training data sets

E Zdravkova, N Nenkov*

Faculty of Mathematics and Informatics, University of Shumen "Episkop Konstantin Preslavsky"
115, Universitetska St., Shumen 9712, Bulgaria

**Corresponding author's e-mail: elitca_spasova@abv.bg, naydenv@shu-bg.net*

Received 1 March 2016, www.cmnt.lv

Abstract

In the present study our aims is to analyze and test two neural networks simulators - Joone and NeuroPh. This will be accomplished by establishing a neural network of 4 layers constituting a multilayer perceptron with sigmoid links. For the purpose of the study were selected two test data sets, which contain integers. Through sequential training the neural network with each of them and subsequently the test results will be obtained for analysis. The study seeks to show how much these two simulators are similar and how different in their characteristics, what neural networks is suitable to be made by them, what are their advantages and disadvantages, how they can be used interchangeably to give certain desired result.

Keywords:

neural network
neural network simulator
data set
training set
neural network architecture

1 Introduction

Both the simulator selected for the study are Java - based and object - oriented simulators. The used simulators are Joone 4.5.2 and NeuroPh 2.92. Joone is object - oriented frameworks allows to build different types of neural networks. As of 2010 Joone, NeuroPh and Encog are main component - based environments for neural networks of java - platforms. [1, 2] Joone can be considered not only as a simulator of neural networks such frameworks were, but as a fully integrated development environment. Unlike its trading partners, it has a strong focus on the code, building a neural network, but not on the visual design. In theory Joone can be used to build a wide range of adaptive systems (including those with maladaptive elements) but generally his focus is on building backpropagation - neural networks.

NeuroPh is lightweight frameworks allowed to simulate neural networks. It is java - based and can be use basic for the development of standard types of neural network architectures. It contains well designed open source library and a small number of core classes that correspond to basic concepts in neural networks. There is a good graphics editor to quickly build java - based components of neural networks [3].

2 Methodology

At the beginning we will present two test sets, which is based on study.

Two training sets selected for the study are:

TABLE 1 Data set 1

Input 1	Input 2	Input 3	Input 4	Output
1.0	1.0	1.0	1.0	1.0
3.0	3.0	2.0	3.0	2.0
2.0	2.0	3.0	4.0	3.0
7.0	7.0	5.0	2.0	4.0
4.0	8.0	7.0	5.0	5.0
11.0	6.0	8.0	6.0	6.0
10.0	9.0	4.0	17.0	7.0
6.0	5.0	14.0	38.0	8.0
26.0	4.0	32.0	37.0	9.0
8.0	10.0	10.0	10.0	10.0
5.0	11.0	26.0	25.0	11.0
13.0	12.0	11.0	28.0	12.0
19.0	13.0	17.0	8.0	30.0
14.0	16.0	21.0	29.0	29.0
25.0	15.0	12.0	36.0	28.0
17.0	20.0	9.0	27.0	27.0
18.0	22.0	22.0	7.0	26.0
15.0	21.0	13.0	24.0	25.0
22.0	18.0	20.0	20.0	24.0
20.0	19.0	38.0	15.0	23.0
31.0	14.0	27.0	9.0	22.0
12.0	23.0	37.0	14.0	21.0
16.0	25.0	16.0	31.0	20.0
35.0	27.0	6.0	33.0	40.0
9.0	28.0	31.0	35.0	39.0
21.0	26.0	39.0	16.0	38.0
39.0	24.0	24.0	22.0	37.0
40.0	17.0	15.0	26.0	36.0
38.0	29.0	18.0	18.0	35.0
27.0	31.0	30.0	34.0	34.0
34.0	30.0	35.0	12.0	33.0
28.0	32.0	36.0	13.0	32.0
23.0	36.0	33.0	39.0	31.0
32.0	33.0	25.0	23.0	30.0
36.0	35.0	23.0	11.0	50.0
37.0	34.0	34.0	40.0	49.0
24.0	36.0	40.0	21.0	48.0
29.0	37.0	29.0	32.0	47.0
30.0	39.0	28.0	30.0	46.0
33.0	40.0	19.0	19.0	45.0

TABLE 2 Data set 2

Input 1	Input 2	Input 3	Input 4	Output
2.0	3.0	1.0	1.0	1.0
4.0	5.0	3.0	4.0	2.0
6.0	4.0	7.0	2.0	3.0
9.0	6.0	2.0	3.0	4.0
1.0	1.0	5.0	18.0	5.0
13.0	8.0	10.0	5.0	6.0
5.0	2.0	9.0	23.0	7.0
11.0	12.0	8.0	8.0	8.0
16.0	9.0	14.0	6.0	9.0
8.0	11.0	12.0	14.0	10.0
19.0	7.0	13.0	13.0	11.0
7.0	10.0	11.0	34.0	12.0
15.0	13.0	15.0	7.0	13.0
14.0	22.0	4.0	10.0	20.0
18.0	19.0	6.0	17.0	21.0
10.0	16.0	20.0	11.0	22.0
24.0	17.0	21.0	9.0	23.0
22.0	14.0	17.0	19.0	24.0
3.0	32.0	35.0	16.0	25.0
17.0	30.0	16.0	12.0	26.0
23.0	15.0	23.0	29.0	27.0
12.0	25.0	36.0	21.0	28.0
20.0	18.0	22.0	28.0	29.0
30.0	24.0	28.0	15.0	30.0
25.0	21.0	18.0	27.0	40.0
33.0	20.0	32.0	20.0	39.0
21.0	26.0	19.0	26.0	38.0
29.0	23.0	30.0	24.0	37.0
26.0	28.0	27.0	33.0	36.0
32.0	27.0	24.0	30.0	35.0
34.0	29.0	25.0	31.0	34.0
28.0	33.0	26.0	32.0	33.0
27.0	35.0	31.0	25.0	32.0
35.0	34.0	29.0	22.0	31.0
36.0	31.0	33.0	35.0	30.0
31.0	36.0	34.0	36.0	50.0

These data sets are used by Mahmoud Iskandarani in "Disparity in Intelligent classification of Data Sets Due to Dominant Pattern Effect "(Mahmoud, 2015).

In the tables are shown input values and the corresponding output.

Now we have to realize neural network through simulators NeuroPh and Joone.

The neural network that we will use for the study is multilayered perceptron with sigmoid relations and consists of four layers - entry (4 neurons) hidden layer (9 neurons), 2 hidden layer (6 neurons) and output layer (one neuron).

In each of the simulators we will conduct training with the first test set (in this case, the learning set) and then we test with the first data set and with the second data set. We will then conduct training with the second test set (in this case, the learning set) and then re-test with the first data set and with a second data set.

- NeuroPh

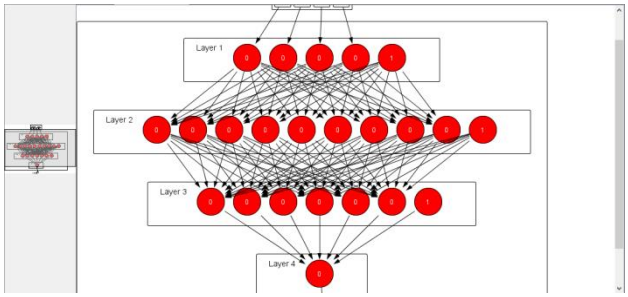


FIGURE 1 Neural Network in NeuroPh

Neural networkis trained with training set 1 (learning set in this example) and then tested it on the two test sets.

Then neural networkis trained with training set 2 (learning set in this example) and then tested it on the two test sets.

In the following tables are shown the results from tests on two training sets - its been described input values for each example (1 - 4), complying with him output, and the actual output of the system - NeuroPh. In the last column is the error on the system - the difference between actual and desired output.

Learning with the training set 1

TABLE 3 Result by testing with the training test 1

Inputs				Outputs		Error
1	2	3	4	Actual	Desired	
1	1	1	1	1	1	0
3	3	2	3	1	2	-1
2	2	3	4	1	3	-2
7	7	5	2	1	4	-3
4	8	7	5	1	5	-4
11	6	8	6	1	6	-5
10	9	4	17	1	7	-6
6	5	14	38	1	8	-7
26	4	32	37	1	9	-8
8	10	10	10	1	10	-9
5	11	26	25	1	11	-10
13	12	11	28	1	12	-11
19	13	17	8	1	30	-29
14	16	21	29	1	29	-28
25	15	12	36	1	28	-27
17	20	9	27	1	27	-26
18	22	22	7	1	26	-25
15	21	13	24	1	25	-24
22	18	20	20	1	24	-23
20	19	38	15	1	23	-22
31	14	27	9	1	22	-21
12	23	37	14	1	21	-20
16	25	16	31	1	20	-19
35	27	6	33	1	40	-39
9	28	31	35	1	39	-38
21	26	39	16	1	38	-37
39	24	24	22	1	37	-36
40	17	15	26	1	36	-35
38	29	18	18	1	35	-34
27	31	30	34	1	34	-33
34	30	35	12	1	33	-32
28	32	36	13	1	32	-31
23	36	33	39	1	31	-30
32	33	25	23	1	30	-29
36	35	23	11	1	50	-49
37	34	34	40	1	49	-48
24	36	40	21	1	48	-47
29	37	29	32	1	47	-46
30	39	28	30	1	46	-45
33	40	19	19	1	45	-44

Total Mean Square Error: 819.225

TABLE 4 Result by testing with the training test 2

Inputs				Outputs		Error
1	2	3	4	Actual	Desired	
2	3	1	1	1	1	0
4	5	3	4	1	2	-1
6	4	7	2	1	3	-2
9	6	2	3	1	4	-3
1	1	5	18	1	5	-4
13	8	10	5	1	6	-5
5	2	9	23	1	7	-6
11	12	8	8	1	8	-7
16	9	14	6	1	9	-8
8	11	12	14	1	10	-9
19	7	13	13	1	11	-10
7	10	11	34	1	12	-11
15	13	15	7	1	13	-12
14	22	4	10	1	20	-19
18	19	6	17	1	21	-20
10	16	20	11	1	22	-21
24	17	21	9	1	23	-22
22	14	17	19	1	24	-23
3	32	35	16	1	25	-24
17	30	16	12	1	26	-25
23	15	23	29	1	27	-26
12	25	36	21	1	28	-27
20	18	22	28	1	29	-28
30	24	28	15	1	30	-29
25	21	18	27	1	40	-39
33	20	32	20	1	39	-38

21	26	19	26	1	38	-37
29	23	30	24	1	37	-36
26	28	27	33	1	36	-35
32	27	24	30	1	35	-34
34	29	25	31	1	34	-33
28	33	26	32	1	33	-32
27	35	31	25	1	32	-31
35	34	29	22	1	31	-30
36	31	33	35	1	30	-29
31	36	34	36	1	50	-49

Total Mean Square Error: 620.0833333333334

Learning with the training set 2

TABLE 5 Result by testing with the training test 1

Inputs				Output		Error
1	2	3	4	Actual	Desired	
1	1	1	1	1	1	0
3	3	2	3	1	2	-1
2	2	3	4	1	3	-2
7	7	5	2	1	4	-3
4	8	7	5	1	5	-4
11	6	8	6	1	6	-5
10	9	4	17	1	7	-6
6	5	14	38	1	8	-7
26	4	32	37	1	9	-8
8	10	10	10	1	10	-9
5	11	26	25	1	11	-10
13	12	11	28	1	12	-11
19	13	17	8	1	30	-29
14	16	21	29	1	29	-28
25	15	12	36	1	28	-27
17	20	9	27	1	27	-26
18	22	22	7	1	26	-25
15	21	13	24	1	25	-24
22	18	20	20	1	24	-23
20	19	38	15	1	23	-22
31	14	27	9	1	22	-21
12	23	37	14	1	21	-20
16	25	16	31	1	20	-19
35	27	6	33	1	40	-39
9	28	31	35	1	39	-38
21	26	39	16	1	38	-37
39	24	24	22	1	37	-36
40	17	15	26	1	36	-35
38	29	18	18	1	35	-34
27	31	30	34	1	34	-33
34	30	35	12	1	33	-32
28	32	36	13	1	32	-31
23	36	33	39	1	31	-30
32	33	25	23	1	30	-29
36	35	23	11	1	50	-49
37	34	34	40	1	49	-48
24	36	40	21	1	48	-47
29	37	29	32	1	47	-46
30	39	28	30	1	46	-45
33	40	19	19	1	45	-44

Total Mean Square Error: 819.225

TABLE 6 Result by testing with the training test 2

Inputs				Output		Error
1	2	3	4	Actual	Desired	
2	3	1	1	1	1	0
4	5	3	4	1	2	-1
6	4	7	2	1	3	-2
9	6	2	3	1	4	-3
1	1	5	18	1	5	-4
13	8	10	5	1	6	-5
5	2	9	23	1	7	-6
11	12	8	8	1	8	-7
16	9	14	6	1	9	-8
8	11	12	14	1	10	-9
19	7	13	13	1	11	-10
7	10	11	34	1	12	-11
15	13	15	7	1	13	-12
14	22	4	10	1	20	-19
18	19	6	17	1	21	-20
10	16	20	11	1	22	-21
24	17	21	9	1	23	-22
22	14	17	19	1	24	-23
3	32	35	16	1	25	-24
17	30	16	12	1	26	-25
23	15	23	29	1	27	-26
12	25	36	21	1	28	-27
20	18	22	28	1	29	-28
30	24	28	15	1	30	-29
25	21	18	27	1	40	-39
33	20	32	20	1	39	-38
21	26	19	26	1	38	-37
29	23	30	24	1	37	-36
26	28	27	33	1	36	-35
32	27	24	30	1	35	-34
34	29	25	31	1	34	-33
28	33	26	32	1	33	-32
27	35	31	25	1	32	-31
35	34	29	22	1	31	-30
36	31	33	35	1	30	-29
31	36	34	36	1	50	-49

Total Mean Square Error: 620.0833333333334

- Joone

The neural network is showed on the figure bellow.

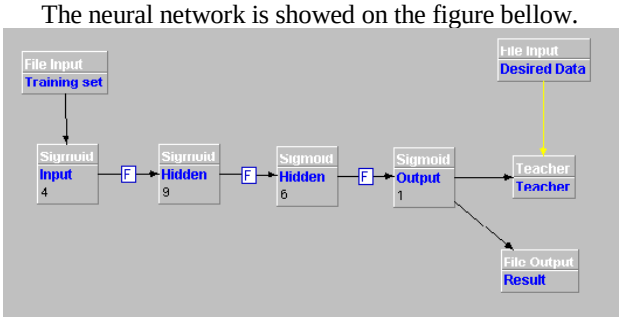


FIGURE 2 Neural network in Joone

Neural networkis trained with training set 1(learning set in this example) and then tested it on the two test sets.

Then neural networkis trained with training set 2 (learning set in this example) and then tested it on the two test sets.

In the following tables are shown the results from tests on two training sets - its been described input values for each example (1 - 4), complying with him output, and in the last column the actual output of the system - Joone.

Learning with the training set 1

TABLE 7 Result by testing with the training test 1

Inputs				Output	
1	2	3	4	Desired	Actual
1.0	1.0	1.0	1.0	1.0	0.9999999744607189
3.0	3.0	2.0	3.0	2.0	0.9999999745996135
2.0	2.0	3.0	4.0	3.0	0.9999999745929045
7.0	7.0	5.0	2.0	4.0	0.9999999746185853
4.0	8.0	7.0	5.0	5.0	0.9999999746359067
11.0	6.0	8.0	6.0	6.0	0.9999999746386214
10.0	9.0	4.0	17.0	7.0	0.9999999746368382
6.0	5.0	14.0	38.0	8.0	0.9999999746380515
26.0	4.0	32.0	37.0	9.0	0.999999974636465
8.0	10.0	10.0	10.0	10.0	0.9999999746394257
5.0	11.0	26.0	25.0	11.0	0.9999999746386334
13.0	12.0	11.0	28.0	12.0	0.9999999746394863
19.0	13.0	17.0	8.0	30.0	0.999999974639435
14.0	16.0	21.0	29.0	29.0	0.9999999746394899
25.0	15.0	12.0	36.0	28.0	0.999999974639489
17.0	20.0	9.0	27.0	27.0	0.9999999746394719
18.0	22.0	22.0	7.0	26.0	0.9999999746393415
15.0	21.0	13.0	24.0	25.0	0.999999974639489
22.0	18.0	20.0	20.0	24.0	0.9999999746394899
20.0	19.0	38.0	15.0	23.0	0.9999999746394899
31.0	14.0	27.0	9.0	22.0	0.9999999746394697
12.0	23.0	37.0	14.0	21.0	0.999999974639489
16.0	25.0	16.0	31.0	20.0	0.9999999746394899
9.0	28.0	31.0	35.0	39.0	0.9999999746394743
21.0	26.0	39.0	16.0	38.0	0.9999999746394899
39.0	24.0	24.0	22.0	37.0	0.9999999746394901
40.0	17.0	15.0	26.0	36.0	0.9999999746394899
38.0	29.0	18.0	18.0	35.0	0.9999999746394899
27.0	31.0	30.0	34.0	34.0	0.9999999746394901
34.0	30.0	35.0	12.0	33.0	0.999999974639489
28.0	32.0	36.0	13.0	32.0	0.9999999746394896
23.0	36.0	33.0	39.0	31.0	0.9999999746394901
32.0	33.0	25.0	23.0	30.0	0.9999999746394901

36.0	35.0	23.0	11.0	50.0	0.9999999746394872
37.0	34.0	34.0	40.0	49.0	0.9999999746394901
24.0	36.0	40.0	21.0	48.0	0.9999999746394901
29.0	37.0	29.0	32.0	47.0	0.9999999746394901
30.0	39.0	28.0	30.0	46.0	0.9999999746394901
33.0	40.0	19.0	19.0	45.0	0.9999999746394899

Result by testing with the training test 2:

0.9999999745277177

0.9999999746261485

0.9999999746163228

Learning with the training set 1

TABLE 8 Result by testing with the training test 1

Inputs				Output	
1	2	3	4	**Desired**	**Actual**
2.0	3.0	1.0	1.0	1.0	0.9999999856334327
4.0	5.0	3.0	4.0	2.0	0.9999999857114681
6.0	4.0	7.0	2.0	3.0	0.9999999857077682
9.0	6.0	2.0	3.0	4.0	0.9999999857221205
1.0	1.0	5.0	18.0	5.0	0.9999999857318369
13.0	8.0	10.0	5.0	6.0	0.9999999857333697
5.0	2.0	9.0	23.0	7.0	0.9999999857323729
11.0	12.0	8.0	8.0	8.0	0.9999999857330646
16.0	9.0	14.0	6.0	9.0	0.9999999857321902
8.0	11.0	12.0	14.0	10.0	0.9999999857338417
19.0	7.0	13.0	13.0	11.0	0.9999999857334032
7.0	10.0	11.0	34.0	12.0	0.999999985733889
15.0	13.0	15.0	7.0	13.0	0.9999999857338677
18.0	19.0	6.0	17.0	21.0	0.9999999857339166
10.0	16.0	20.0	11.0	22.0	0.9999999857339192
24.0	17.0	21.0	9.0	23.0	0.9999999857338597
22.0	14.0	17.0	19.0	24.0	0.9999999857339577
3.0	32.0	35.0	16.0	25.0	0.9999999857339741
17.0	30.0	16.0	12.0	26.0	0.9999999857339912
23.0	15.0	23.0	29.0	27.0	0.9999999857339978
12.0	25.0	36.0	21.0	28.0	0.9999999857340278
20.0	18.0	22.0	28.0	29.0	0.9999999857340482
30.0	24.0	28.0	15.0	30.0	0.9999999857338666
25.0	21.0	18.0	27.0	40.0	0.9999999857340818
33.0	20.0	32.0	20.0	39.0	0.9999999857341153
21.0	26.0	19.0	26.0	38.0	0.99999998573414
29.0	23.0	30.0	24.0	37.0	0.9999999857341697
26.0	28.0	27.0	33.0	36.0	0.9999999857341979
32.0	27.0	24.0	30.0	35.0	0.9999999857342261
34.0	29.0	25.0	31.0	34.0	0.9999999857342536
28.0	33.0	26.0	32.0	33.0	0.9999999857342818
27.0	35.0	31.0	25.0	32.0	0.9999999857343091
35.0	34.0	29.0	22.0	31.0	0.999999985734336
36.0	31.0	33.0	35.0	30.0	0.9999999857343604
31.0	36.0	34.0	36.0	50.0	0.9999999857343873

TABLE 9 Result by testing with the training test 2

Inputs				Output	
1	2	3	4	**Desired**	**Actual**
2.0	3.0	1.0	1.0	1.0	0.999999985670389
4.0	5.0	3.0	4.0	2.0	0.9999999857257089
6.0	4.0	7.0	2.0	3.0	0.9999999857202295
9.0	6.0	2.0	3.0	4.0	0.9999999857187547
1.0	1.0	5.0	18.0	5.0	0.9999999856848016
13.0	8.0	10.0	5.0	6.0	0.9999999857325841
5.0	2.0	9.0	23.0	7.0	0.9999999857213497
11.0	12.0	8.0	8.0	8.0	0.9999999857331825
16.0	9.0	14.0	6.0	9.0	0.9999999857330106
8.0	11.0	12.0	14.0	10.0	0.9999999857332278
19.0	7.0	13.0	13.0	11.0	0.999999985733175
7.0	10.0	11.0	34.0	12.0	0.9999999857331963
15.0	13.0	15.0	7.0	13.0	0.9999999857331912
14.0	22.0	4.0	10.0	20.0	0.9999999857318056
18.0	19.0	6.0	17.0	21.0	0.9999999857330908
10.0	16.0	20.0	11.0	22.0	0.9999999857333006
24.0	17.0	21.0	9.0	23.0	0.9999999857333339
22.0	14.0	17.0	19.0	24.0	0.999999985729922
3.0	32.0	35.0	16.0	25.0	0.9999999857333666
17.0	30.0	16.0	12.0	26.0	0.9999999857333852
23.0	15.0	23.0	29.0	27.0	0.9999999857334039
12.0	25.0	36.0	21.0	28.0	0.9999999857334243
20.0	18.0	22.0	28.0	29.0	0.9999999857334452
30.0	24.0	28.0	15.0	30.0	0.9999999857334667
25.0	21.0	18.0	27.0	40.0	0.9999999857334914
33.0	20.0	32.0	20.0	39.0	0.999999985733518
21.0	26.0	19.0	26.0	38.0	0.9999999857335458
29.0	23.0	30.0	24.0	37.0	0.999999985733574
26.0	28.0	27.0	33.0	36.0	0.9999999857336022
32.0	27.0	24.0	30.0	35.0	0.9999999857336304
34.0	29.0	25.0	31.0	34.0	0.9999999857336581
28.0	33.0	26.0	32.0	33.0	0.9999999857336854
27.0	35.0	31.0	25.0	32.0	0.9999999857337121
35.0	34.0	29.0	22.0	31.0	0.999999985733738
36.0	31.0	33.0	35.0	30.0	0.9999999857337634
31.0	36.0	34.0	36.0	50.0	0.999999985733738

3 Conclusions

After the conducted tests it shows that both the simulator for neural networks have some peculiarities. At the same architecture of the neural network (the same number of layers and neurons) and identical sets of test data, the both simulator give different results.

In testing, it appears that the simulator Joone gives a little - good results in the training with both data sets. The simulator NeuroPh gives a less - poor output through education.

It can be argued in this case that Joone is suitable for the realization of any neural network to implement a certain number of test data. So it can be used by programmers of neural networks to create new types of neural network architectures as well as new algorithms for learning.

As the results, NeuroPh can be used in the implementation of standard architectures of neural networks and standard algorithms. Novice programmers can be familiar by him with the basics of neural networks.

References

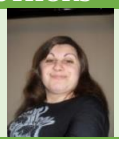
[1] Heaton J T 2005 *Introduction to Neural Network with Java*

[2] David J *Artificial Neural Network. Methods and Applications*

[3] Suzuki K *Artificial Neural Networks. Industrial and control engineering applications*

[4] Iskandarani M 2015 Disparity in Intelligent classification of Data Sets Due to Dominant Pattern Effect (DPE) *Journal of Intelligent learning systems and applications*

AUTHORS



Elitsa Spasova, 15.02.1988, Bulgaria

Current position, grades: assistant in Shumen University
University studies: Master in Artificial Intelligence
Scientific interest: Artificial Intelligence, Neural Networks, Genetic Algorithms
Publications: 3

Nayden Nenkov, 22.08.1957, Novi Pazar, Shumen region, Bulgaria

Current position, grades: Vice Dean, Faculty of Mathematics and Computer Science
University studies: Shumen University
Scientific interest: Artificial Intelligence, E-learning, Data mining; Logic Programming
Publications: 63
Experience: 28 years university lecturer