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Neural network for defining intuitionistic fuzzy sets in e-learning

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Abstract

It is exposed neural network evaluating the students' answers based on in preliminary set criterions in electronic learning. To be involved in practice there are used intuitional intuitionistic fuzzy sets about the students' knowledge.

Key words: Neural networks, Intuitionistic Fuzzy Sets, e-Learning, University.

Introduction

E-learning is one of the newest directions in university students' education.
It reveals an information exchange between educational system from the one hand and the learner from the other and this exchange is performed in electronic way. The student receives the information about assign theme on his/her local computer and he/she has to be assessed after setting the proper questions and tasks.
The main aim of the neural network is to be received fuzzy set for assimilated material level. This set is based on students' answers and previously given criterion for assessing of each question.
The second, not less important aim is to be realized neural network, which could replace separate fragments of summarized network [2] using for assessing learners' knowledge with intuitionistic fuzzy sets.
To obtain clearer notion about the learner's knowledge it is used intuitionistic fuzziness [1]. It gives the possibility to be defined not only the of knowledge digestion degree but and not digested knowledge, too. In some cases are used summarized-network models to be modeled the process of electronic learning in the local network at a university and to be assessed the students' knowledge by respective themes. The sets showing the degree of knowledge digestion μ and not digested ν for one-piece knowledge, are arranged pairs $<\mu, \nu>$ of real numbers from the set [0, 1] x [0, 1] [2]. The degree of incertitude $\pi = 1-\mu-\nu$ present the cases when the student cannot answer the asked question at the current stage and he/she needs an additional information. Arranged pairs have been defined according to the theory of intuitionistic fuzzy sets [1].

In works [3, 4, 5] are described many types of neural networks. Many of them are used for class recognizing (symbols, injuries' types, knowledge etc.). Analogically they could be used for fuzzy sets defining in electronic learning.
In general, the neural network realizing the set purpose has got the image of fig.1. In the neural network entrances are placed the examinee answers and the positive criterions for assessing the respective question (the true answers for it).

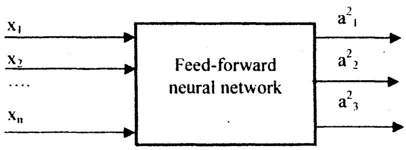

Fig.1

In this case, intuitionistic fuzzy sets about the learner's knowledge are received on the networks' exits.
The first of the exits gives set for the degree of a knowledge digestion μ. The second - degree of a non digested knowledge ν, and the third - degree of incertitude $\pi = 1-\mu-\nu$.

When the examinee gives true answers, maximal degree of knowledge digest and minimum of non digested knowledge appear on the exit of the neural network. Analogically when is given absolutely no true answers by the examinee, maximum degree of not digested knowledge and minimal digestion appear on the exit of the neural network. If the examinee refuses to give an answer, maximum degree of incertitude and low degree of digested and non digested knowledge receive on the exit of the neural network.

Realization

For the accomplishment it has been used tree-layer neural network (fig.2). Tree answer's aspects of the current question are given in tree of its entries. Information about the criterions (the true answers) is given in the next tree entries. The second layer of the neural network consists 8/ eight neurons and it uses standard logical function (logsig) for a transfer function. The exit of the second layer is defined by the equation a^1=logsig(pw^1+b). The exit's layer has linear transfer function and is defined by the equation a^2=purelin ((logsig (pw^1+b^1)w^2+b^2).

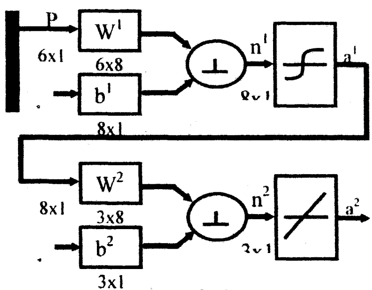

Fig.2

The network training has accomplished in the MATLAB environment with Levenberg-Marquard algorithm where is set average square error 1.10^{-5}. The graphic of the error alteration in the education process is shown in fig. 3.

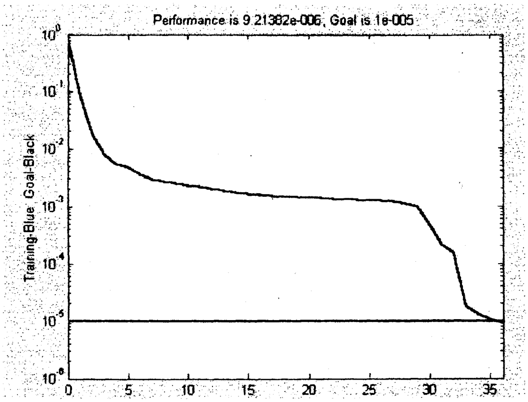

fig.3

The weight's coefficients W^1, W^2 and the displacing $b^1$and b^2 are:

$$W^1=\begin{bmatrix} -0.3380 & 1.9520 & 0.4815 & -0.7077 & -0.4620 & -0.9502 \\ 0.7527 & -1.0214 & -1.2297 & -0.9441 & 1.3111 & 1.9291 \\ 1.4263 & 1.3425 & -0.4544 & -1.4887 & -0.7551 & -0.4975 \\ 0.3261 & 2.2382 & 0.6776 & -0.5138 & -1.3473 & -1.3184 \\ -0.9172 & 0.8959 & 1.0257 & 0.0978 & -2.1925 & -0.9082 \\ -0.8218 & -0.8622 & 0.2231 & 1.3552 & -0.4421 & -0.0268 \\ 1.1690 & -0.2948 & 0.7482 & 0.1796 & -1.9218 & -0.2200 \\ -0.0267 & 0.5858 & 0.3725 & 0.3760 & -0.0950 & -0.3091 \end{bmatrix}$$

b^{1t}= [-4.1147 -3.2572 2.3874 -1.1986 -0.0561 1.7507 2.4294 3.9962]

$$W^2=\begin{bmatrix} -1.7189 & 0.6534 & 1.8473 & -1.5456 & -0.4052 & 1.2034 & -1.3779 & -0.2072 \\ 1.1016 & 0.3706 & -1.1414 & 1.6709 & 0.8327 & -0.1037 & 0.8320 & -0.4481 \\ 0.6212 & -1.0069 & -0.7047 & -0.1176 & -0.4190 & -1.0872 & 0.5393 & 0.5131 \end{bmatrix}$$

b^{2t}= [0.6966 -0.0787 0.5116]

It is accepted the true answers of question 1 to have numeral value/cost – 1 3 4, for question 2 they are 2 2 -1, for question 3 – 1 2 and for question 4 they are 9 5 3. The neural network is trained in that way – when the answers for the all 4 questions are true is given set for knowledge digestion μ=1, non digested ν=0 and incertitude $\pi = 1-\mu-\nu=0$.

During the neural network's test not only correct answers are given but and different of them (table 1).

Table 1

№	The answers of each different question			digestion μ	non digested ν	incertitude π
1	-1	3	4	1.0009	-0.0008	0.0004
2	-1.3	3	4	0.7999	0.1002	0.0983
3	-1	3.3	4	0.6008	0.2991	0.1038
4	8	5	3	0.7998	0.1001	0.0995
5	9	4.5	3	0.8010	0.0998	0.1016
6	9	6	2	0.3586	0.5093	0.1324
7	9	5	4	0.5992	0.2988	0.0997

Inferences

- When on the neural network's entry is given correct answer coinciding with precursory set criterion, the degree of digestion is unity/1, and the rank/stage of non digestion is approximately equal on zero/0.
- Because of the error, which trains the network, μ can be bigger than 1 and ν can be negative number.
- When is given an answer very close to the correct one, the costs/values of μ, ν and π are broken numbers giving high degree of digestion, low degree of non digestion and a little degree of incertitude (because of non full knowledge). They are showed in table 1, rows 2 and 3.
- For the rest tests there are results very close to the incertitude $\mu = 1$;
- The examinee needs additional learning when the degree of the non digestion criterion is $\nu > 0.5$ or incertitude is $\pi > 0.5$ (row 6 of table1).

Conclusion:

The exposed neural network determine the degree of digestion, none digestion and incertitude in the students answers' assessing. The assessing is based on precursory set criterions in electronic learning. The network shows very good assessing ability (table 1) and could be used in the exam's answers assessing where the questions have got precursory trained criterions. This is proper to be used as a basic element for learning systems' building.

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