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GENERALIZED NET OF THE PROCESS OF CLASSIFICATION OVER SOCIAL NETWORKS

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Abstract: Social networks have become a very important part of nowadays life. Many people proposed social network models in the recent years, and most of them focus on classification coefficient. Social networks have been central to some of the most influential theories in sale marketing. For researchers interested in exploring social networks and their relationship to markets, the network analysis provides the leverage to answer questions in a more refined way than nonrelational analyses do. In this paper, the authors propose a neural network approach to link people who have no explicit relation with the network despite potential common interests.
Keywords: Social networks, Generalized networks, Neural networks.

1. Introduction

In the multilayered neural networks, one layer's exits become entries for the next one. The equations describing this operation are:

$$a^3 = f^3(w^3 f^2(w^2 f^1(w^1 p+b^1)+b^2)+b^3), \tag{1}$$

where:

- a^m is the exit of the m^{th} layer of the neural network for $m = 1, 2, 3$;
- w is a matrix of the weight coefficients of each of the entries;
- b is the neuron's entry bias;
- f^m is the transfer function of the m^{th} layer.

The neuron in the first layer receives external entries p.

The neurons' exits from the last layer determine the network's exits a.

Since the backpropagation algorithm belongs to the supervised learning methods, pairs of numbers are submitted to the algorithm, corresponding to the entry value and the target for achievement on the network's exit:

$$\{p_1, t_1\}, \{p_2, t_2\}, \ldots, \{p_Q, t_Q\}, \tag{2}$$

where $Q \in \{1, ..., n\}$, n is the number of training pairs. Every network's entry is determined in advance and constant, and the exit has to match the target. The difference between the entry values and the aim is the error $e = t - a$.

The backpropagation algorithm [4] uses the least-quarter error:

$$\hat{F} = (t - a)^2 = e^2. \tag{3}$$

While learning the neural network, the algorithm recalculates the network's parameters (W and b), in order to achieve the least-square error.

On the $(k+1)^{\text{-st}}$ iteration, the backpropagation algorithm usesthe following equations for the $i^{\text{-th}}$ neuron:

$$w_i^m(k+1) = w_i^m(k) - \alpha \frac{\partial \hat{F}}{\partial w_i^m}; \tag{4}$$

$$b_i^m(k+1) = b_i^m(k) - \alpha \frac{\partial \hat{F}}{\partial b_i^m}, \tag{5}$$

where:

- α is the learning rate for neural network;
- $\frac{\partial \hat{F}}{\partial w_i^m}$ is the relation between the changes of the square error and the changes of the weights;
- $\frac{\partial \hat{F}}{\partial b_i^m}$ is the relation between the changes of the square error and the changes of the biases.

The network is considered learnt when

$$e^2 < E_{max}, \tag{6}$$

where E_{max} is maximum square error.

2. Generalized Network model

The Generalized Net (GNs [1, 2]) model is presented in Figure 1. Initially the following tokens enter in the net:

- In place L_{1A} one token with characteristics "Data base with customer data";
- In place L_{2A} one token with characteristics "Data base with questions";
- In place L_{3A} one token with characteristics "Data base with the already clustered polls [3], and their user";
- In place L_{4A} one token with characteristics "Data base with structures to MLP";
- In place L_{11} one token with characteristics "Initial weight coefficients";
- In place L_{12} one token with characteristics "Initial biases";
- In place L_{13} one token with characteristics "Transfer functions";
- In place L_{15} one token with characteristics "Least squared error".
- In place L_{18} one token with characteristics "Learning rate – α".

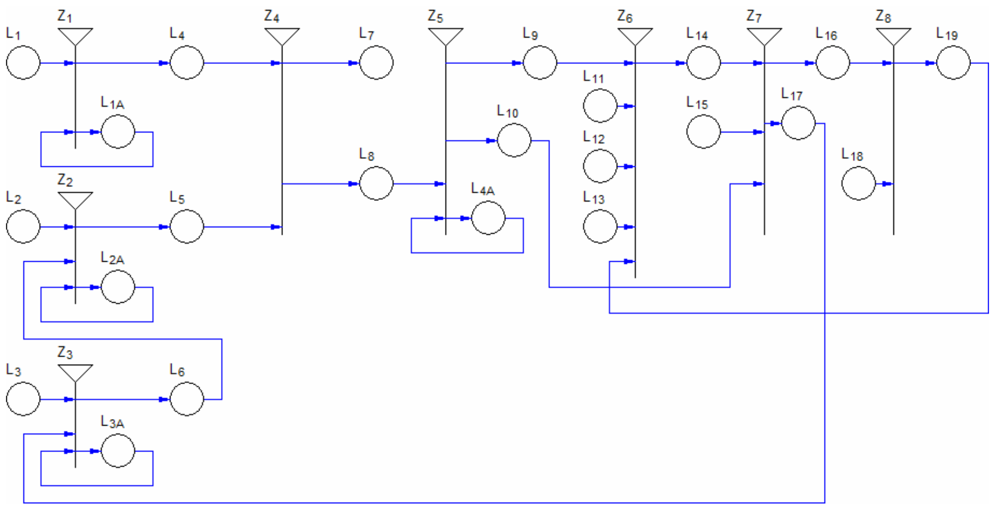

Figure 1. Generalized net of the process of classification over social networks

The generalized net model contains the following set of transitions A:

$$A = \{Z_1, Z_2, Z_3, Z_4, Z_5, Z_6, Z_7, Z_8\},$$

where the transitions describe these process:

- Z_1 – Activity of the social network;
- Z_2 – Compilation of polls;
- Z_3 – Activity of user survey;
- Z_4 – Completing the questionnaire;
- Z_5 – Choosing the structure of Neural network;
- Z_6 – Calculating of output a^2 according (1);
- Z_7 – Checking for trained Neural network;
- Z_8 – Update of weight coefficients and biases using (3), (4) and (5).

The transitions of the GN-model have the following form. The token entering in place L_1 enter with characteristics "New user".

$$Z_1 = \langle \{L_1, L_{1A}\}, \{L_4, L_{1A}\}, R_1, \vee (L_1, L_{1A})\rangle,$$

where:

$$R_1 = \begin{array}{c|cc} & L_4 & L_{1A} \\ \hline L_1 & true & true \\ L_{1A} & false & true \end{array}.$$

The tokens that enter places L_2 and L_6 obtain the characteristics, respectively: "New question in the polls" and "Request for questions to be added to the poll".

$$Z_2 = \langle \{L_2, L_6, L_{2A}\}, \{L_5, L_{2A}\}, R_2, \wedge (\vee(L_2, L_6), L_{2A})\rangle,$$

where:

$$R_2 = \begin{array}{c|cc} & L_5 & L_{2A} \\ \hline L_2 & false & true \\ L_6 & false & true \\ L_{2A} & W_{2A,5} & true \end{array},$$

where $W_{2A,5}$ = "It is necessary to prepare the survey".

The tokens that enter place L_3 obtain the characteristic "New user survey".

$$Z_3 = \langle \{L_3, L_{17}, L_{3A}\}, \{L_6, L_{3A}\}, R_3, \wedge(\vee(L_3, L_{17}), L_{3A})\rangle,$$

where:

$$R_3 = \begin{array}{c|cc} & L_6 & L_{3A} \\ \hline L_3 & false & true \\ L_{17} & false & true \\ L_{3A} & W_{3A,6} & true \end{array},$$

where $W_{3A,6}$ = "It is necessary to prepare data survey".

The token that enter place L_6 obtain the characteristic "Ready poll".

$$Z_4 = \langle \{L_4, L_5\}, \{L_7, L_8\}, R_4, \wedge (L_4, L_5)\rangle,$$

where:

$$R_4 = \begin{array}{c|cc} & L_7 & L_8 \\ \hline L_4 & true & false \\ L_5 & true & true \end{array}.$$

The token that enter place L_7 obtain the characteristic "Left client". The token that enters place L_8 obtains the characteristic "Accomplished survey".

$$Z_5 = \langle \{L_8, L_{4A}\}, \{L_9, L_{10}, L_{4A}\}, R_5, \vee (L_8, L_{4A})\rangle,$$

where:

$$R_5 = \begin{array}{c|ccc} & L_9 & L_{10} & L_{4A} \\ \hline L_8 & false & false & true \\ L_{4A} & W_{4A,9} & W_{4A,10} & true \end{array},$$

where:

- $W_{4A,9} = \neg W_{4A,10} =$ "MLP structure is chosen".

The tokens', entering in places L_9 и L_{10}, receives the characteristic "MLP structure; Completed survey" and "Survey answers".

$$Z_6 = \langle \{L_9, L_{11}, L_{12}, L_{13}, L_{19}\}, \{L_{14}\}, R_6, \wedge(L_9, L_{13}, \vee(L_{11}, L_{12}), L_{19})\rangle,$$

where:

$$R_6 = \begin{array}{c|c} & L_{14} \\ \hline L_9 & true \\ L_{11} & true \\ L_{12} & true \\ L_{13} & true \\ L_{19} & true \end{array}.$$

The tokens that enter place L_{14} merge in a new token with characteristic "Structure of the MLP, output a^2, transfer functions, weight coefficients and biases".

$$Z_7 = \langle \{L_{14}, L_{15}, L_{10}\}, \{L_{16}, L_{17}\}, R_7, \wedge(L_{14}, L_{15}, L_{10})\rangle,$$

where:

$$R_7 = \begin{array}{c|cc} & L_{16} & L_{17} \\ \hline L_{14} & W_{14,16} & W_{14,17} \\ L_{15} & W_{15,16} & W_{15,17} \\ L_{10} & W_{10,16} & W_{10,17} \end{array},$$

where:

- $W_{14,16} = W_{15,16} = W_{10,16} =$ "$e^2 > E_{max}$".
- $W_{14,17} = W_{15,17} = W_{10,17} = \neg W_{14,16}$.

The token entering place L_{16} obtains the characteristic "Structure of Neural network, weight coefficients and biases, error, transfer functions".

$$Z_8 = \langle \{L_{16}, L_{18}\}, \{L_{19}\}, R_8, \wedge(L_{16}, L_{18})\rangle,$$

where:

$$R_8 = \begin{array}{c|c} & L_{19} \\ \hline L_{16} & true \\ L_{18} & true \end{array}.$$

The token, entering place L_{19}, obtains characteristic "Updated weight coefficients and biases".

3. Conclusion

In this paper the authors present generalized net of the process of classification over social networks. The MLP is one of traditional tools that can obtain possibilities for classification of some properties of the social networks. The survey answers gives MLP necessary numerical values for the preparing "learning couples" for the neural network.

This paper is a part of one investigation of the tools for analyzing the social networks. The generalized nets are very useful tools for describing all the process for preparing the survey, filling it and classification, and allow as changing all components of the process.

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