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GENERALIZED NET MODEL OF INTRANET IN AN ABSTRACT UNIVERSITY WITH CURRENT ESTIMATIONS

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Abstract

We apply estimations of the intuitionistic fuzzy sets on the basis of which some amendments may be undertaken.

Key words : GN-net, Abstract University, Intranet

1. Introduction

The generalized net model, described in [1] models the informational streams in a local area network in an abstract university, rendering an account of the hierarchical structure of the organization. The model, proposed in [3] shapes the various services – e-mail, WWW, administrative informational system in an abstract university on the basis of an Internet protocol. In the framework of the present model we include some possibilities of e-mail evaluation of the correctness of the exchanged information. We can apply estimations of the intuitionistic fuzzy sets on the basis of which some amendments may be undertaken.

Defining the necessary amendments uses criteria for determining the type of information flaw: virus infection, unreadable messages, spam. The unrecoverable messages shall be deleted, and the recovered and edited ones shall be sent to the proper addressee.

The estimations, signifying the degree of correctness (μ) and incorrectness (ν) of the obtained information, are represented by ordered pairs $<\mu,\nu>$ of real numbers from the set $[0,1]\times[0,1]$. The degree of uncertainty $\pi = 1-\mu-\nu$ appears in the cases when the obtained information has incomplete, unreadable or inadequate form. The ordered pairs have been everywhere defined in the sense of the theory of the intuitionistic fuzzy sets [2].

At the beginning, when still no information is derived, all estimations obtain values $<0,0>$. When $k \geq 0$, the current (k+1)-st estimation is calculated on the basis of the previous estimations according to the formula $<\mu_{k+1},\nu_{k+1}> = <\frac{\mu_k k+m}{k+1}, \frac{\nu_k k+n}{k+1}>$,

where $<\mu_k,\nu_k>$ is the previous estimation, and $<\mu,\nu>$ is the estimation of the latest message, for m, n $\in$ [0, 1] and m + n $\leq$ 1. Thus the server forms the final estimation of the correctness of the exchanged information on the basis of the previous and the latest events.

2. A GN-model

The so constructed generalized net model on Fig. 1 describes the process of exchange of the e-mail messages, as well as the possibilities of evaluation of the correctness of the information exchanged.

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The places in the generalized net fall in five categories:

- L-places standing for the separate objects in the net, which are able to exchange information (clients);
- S-places describing the mail server;
- V-places denoting the e-mail messages;
- R-places standing for the corrective techniques; and
- K-places defining the criteria for estimating the correctness of the transferred messages.

On the other hand the clients – Rector, Vice-rectors, Deans (Directiors), Head of Departments (Sections), Lecturers and Students and etc. – are interpreted in the Intranet exchange information in an electronic way (via e-mail) by means of the α-tokens in the L-places. The e-mails from / to the Client and Mail Server are described by γ- and β-tokens at places S and V. The estimation criteria and the corrective techniques are interpreted by a δ- and ε-token at places K and R, respectively.

Initially, one or more α-tokens enter place L, so that the i-th object α_i has an initial characteristic: "Client's identifier".

In a certain moment of time, the α-tokens produce β-tokens, which transfer via transition Z_2 and merge with the γ-token in place S.

Also initially, there is one γ-token located at place S with characteristic "Mail Server".

Again initially, there is one δ-token located at place K with characteristic "estimation criteria". In the next time moment this δ-token splits into two new tokens. One of them – let it be the original δ-token – will continue its stay in place K, while the other token will pass via transition Z_3 to the place K_1.

Also initially, there is one ε-token located at place R with the characteristic "corrective techniques and estimation of their efficiency". In the next time moment this ε-token splits into two tokens. One of them – let it be the original ε-token – will continue its stay in the place R, while the other token will transfer to the place R_1 via transition Z_4.

The Generalized net contains the following set of transitions:

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

where the following transitions represent:

- sending and receiving information among the clients – transitions Z_1 and Z_2;
- defining the estimations, which signify the degrees of correctness μ and incorrectness ν of the information received, on the basis of preliminary set criteria – transitions Z_3;
- determining and performing of corrective actions over the obtained information, on the basis of certain corrective techniques – transitions Z_4, Z_5 and Z_6.

Here and below m_i will stand for the arc capacities corresponding to the number of exchanged messages in the framework of the modelled process, according to the physical restrictions.

The transitions have the following forms.

$$Z_1 = < \{V_1, V_2, V_4, V_7\}, \{L\}, R_1, M_1, \vee(V_1, V_2, V_4, V_7) >,$$

The index matrices of the transition conditions and the capacities of the transition arcs are:

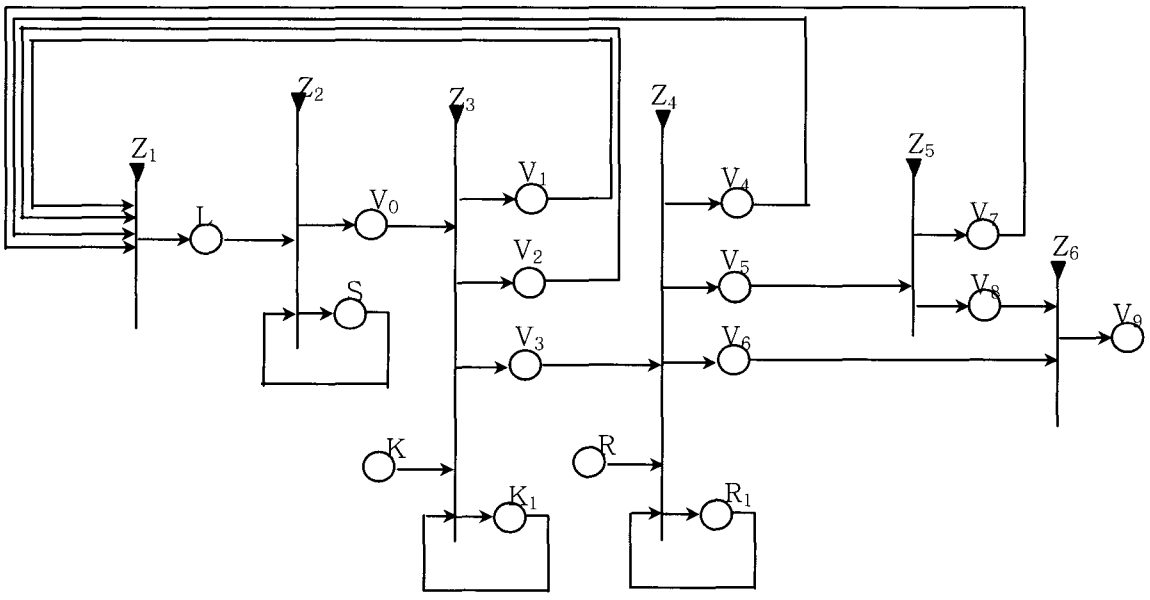

Fig. 1

$$R_1 = \begin{array}{c|c} & L \\ \hline V_1 & W_1 \\ V_2 & W_2 \\ V_4 & W_3 \\ V_7 & W_4 \end{array}, \qquad M_1 = \begin{array}{c|c} & L \\ \hline V_1 & m_1 \\ V_2 & m_2 \\ V_4 & m_3 \\ V_7 & m_4 \end{array},$$

where:

W_1 = "there is a new message",

W_2 = "there is a returned message",

W_3 = "there is a virus infected message",

W_4 = "there is a coded message".

The β_j-tokens (j =1, 2,..., m), entering place L obtain the characteristics:

"sender, receiver, e-mail, estimations (β_j)",

where estimations

$$(\beta_j) = \left\{ < \mu_j, \nu_j > \mid (\forall j : 1 \le j \le m)(\mu_j, \nu_j \in R^+ \,\&\, \mu_j + \nu_j \le 1) \right\}$$

i.e. these are the estimations of the intuitionistic fuzzy set for each associated criterion, where $R^+ = \{x \mid x \in R \,\&\, x \ge 0\}$. To simplify the calculations, we will reduce this set of estimations to a single intuitionistic fuzzy estimation of the correctness of the obtained information.

$$Z_2 = < \{L,S\}, \{V_0,S\}, R_2, M_2, \vee(L,S) >,$$

The index matrices of the transition conditions and the capacities of the transition arcs are:

$$R_2 = \begin{array}{c|cc} & V_0 & S \\ \hline L & \text{false} & W_L \\ S & W_L & \text{true} \end{array}, \qquad M_2 = \begin{array}{c|cc} & V_0 & S \\ \hline L & 0 & m_5 \\ S & m_5 & 0 \end{array},$$

where:

W_L = "there is a sent message".

The β_j-tokens (j =1, 2,..., m), entering place S obtain the characteristics:

"sender, receiver, e-mail, estimations (β_j)".

The tokens entering place V_0 stand for the messages generated at the current moment and they receive characteristic

"list: sender, receiver, e-mail, estimations (β_j)",

where estimations$(\beta_j) = < 0,0 >$.

$$Z_3 = < \{V_0, K, K_1\}, \{V_1, V_2, V_3, K_1\}, R_3, M_3, \vee(\wedge(V_0, K), K_1) >,$$

The index matrices of the transition conditions and the capacities of the transition arcs are:

$$R_3 = \begin{array}{c|cccc} & V_1 & V_2 & V_3 & K_1 \\ \hline V_0 & \text{false} & \text{false} & \text{false} & W_L \\ K & \text{false} & \text{false} & \text{false} & W_K \\ K_1 & W_{1,1} & W_{1,2} & W_{1,3} & \text{true} \end{array}, \qquad M_3 = \begin{array}{c|cccc} & V_1 & V_2 & V_3 & K_1 \\ \hline V_0 & 0 & 0 & 0 & m_6 \\ K & 0 & 0 & 0 & m_7 \\ K_1 & m_8 & m_9 & m_{10} & \infty \end{array},$$

where:

W_K = "there are criteria for defining of the estimations",

$W_{1,1}$ = "the obtained estimations have determined the correct messages",

$W_{1,2}$ = "the obtained estimations have determined the messages that shall be returned to the addressee",

$W_{1,3}$ = "the obtained estimations have determined the messages to be amended".

The β-tokens in places V_1, V_2 and V_3 obtain characteristics:

"sender, receiver, e-mail, $< \mu, \nu >$",

where μ and ν are the estimations of the technical correctness and incorrectness of the obtained information. These estimations are calculated according to the respective number of tokens in V_1 and V_2. The degree of uncertainty is determined by the number of tokens in place V_3.

The characteristic of the δ-token from place K_1 containes four threshold values: M_{max}, M_{min}, N_{max}, N_{min}. If ($\mu > M_{max}$ & $\nu < N_{min}$), then token β in place V_1 obtains characteristic

"the message is correct: sender, receiver, e-mail, estimations (β)".

If ($\mu < M_{min}$ & $\nu > N_{max}$), then the β-token at place V_2 obtains characteristic

"the message shall be returned to the sender: sender, sender, e-mail, estimations (β)".

In the rest cases the β-token at place V_3 obtains the characteristic

"the message shall be amended: sender, receiver, e-mail, estimations (β)".

Hence, on the basis of the characteristic of the δ_1-token at place K_1 the system is able to prepare statistical data about the correctness of the exchanged information according to the number of messages and other factors.

$$Z_4 = < \{V_3, R, R_1\}, \{V_4, V_5, V_6\}, R_4, M_4, \vee(\wedge(V_3, R), R_1) >,$$

The index matrices of the transition conditions and the capacities of the transition arcs are:

$$R_4 = \begin{array}{c|cccc} & V_4 & V_5 & V_6 & R_1 \\ \hline V_3 & \text{false} & \text{false} & \text{false} & W_{3,1} \\ R & \text{false} & \text{false} & \text{false} & W_R \\ R_1 & W_{1,4} & W_{1,5} & W_{1,6} & \text{true} \end{array}, \qquad M_4 = \begin{array}{c|cccc} & V_4 & V_5 & V_6 & R_1 \\ \hline V_3 & 0 & 0 & 0 & m_{11} \\ R & 0 & 0 & 0 & m_{12} \\ R_1 & m_{13} & m_{14} & m_{15} & \infty \end{array},$$

where:

$W_{3,1}$ = "there are messages needing correction",

W_R = "there are present corrective techniques",

$W_{1,4}$ = "the message has been antivirus amended",

$W_{1,5}$ = "the message is unreadable",

$W_{1,6}$ = "the message is spam".

The β-tokens, entering places V_4, V_5 and V_6 do not obtain any new characteristics.

Each ε-token that enters place R_1 obtains the characteristic:

"corrective technique, $<\mu^\varepsilon, \nu^\varepsilon>$".

The intuitionistic fuzzy estimation $<\mu^\varepsilon, \nu^\varepsilon>$ determined the degree of effectiveness μ^ε and the degree of ineffectiveness ν^ε

of the certain corrective algorithm, and again the inequality $\mu^{\varepsilon} + \nu^{\varepsilon} \leq 1$ holds for $\mu^{\varepsilon}, \nu^{\varepsilon} \in [0, 1]$.

$$Z_5 = <\{V_5\}, \{V_7, V_8\}, R_5, M_5, \vee(V_5)>$$

The index matrices of the transition conditions and the capacities of the transition arcs are:

$$R_5 = \begin{array}{c|cc} & V_7 & V_8 \\ \hline V_5 & W_{5,7} & W_{5,8} \end{array}, \qquad M_5 = \begin{array}{c|cc} & V_7 & V_8 \\ \hline V_5 & m_{16} & m_{17} \end{array},$$

where:

$W_{5,7}$ = "the coding has been changed",

$W_{5,8}$ = "recovery is impossible".

The β-tokens entering V_7 и V_8 do not obtain any new characteristic.

$$Z_6 = <\{V_6, V_8\}, \{V_5\}, R_6, M_6, \vee(V_6, V_8)>$$

The index matrices of the transition conditions and the capacities of the transition arcs are:

$$R_6 = \begin{array}{c|c} & V_5 \\ \hline V_6 & W_{6,5} \\ V_8 & W_{6,5} \end{array}, \qquad M_5 = \begin{array}{c|c} & V_5 \\ \hline V_6 & m_{18} \\ V_8 & m_{19} \end{array},$$

where:

$W_{6,5}$ = "need of message deletion".

The β-tokens that enter place V_9 obtain the characteristic "deleted message".

3. Conclusin

The present generalized net model may be considered one of the possible models of the process of e-mail exchange in the abstract university Intranet. Usage of hierarchical operators, which model the same transition ot place in more details, will make the model more concrete. Most of the model parameters can also be regarded as characteristics of tokens from an additional contour, thus reaching optimization in respect to the given aim, or statistical information can be collected in order to make prognosis of the prcess development.

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