Fourteenth Int. Conf. on IFSs, Sofia, 15-16 May 2010
NIFS 16 (2010), 2, 50-56

Generalized net model of the process of administrative servicing in a digital university with intuitionistic fuzzy estimations

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Abstract

The present paper describes the process of the administrative servicing in a digital university. For the purpose we use Generalized Nets. The opportunity to use GNs as a tool for modelling such processes is also analyzed. The model utilizes the theory of intuitionistic fuzzy sets.
Keywords: Intuitionistic fuzzy estimations, Generalized nets, Modelling, Digital university, E-learning.

1 Introduction

In a series of papers collected in the book [5] the processes of the functioning of the ideal (abstract university) have been described using the apparatus of Generalized Nets [1,2]. In [6,7]

different processes related to the information systems in a university were discussed. The present paper is based on [8] and describes the process of the administration servicing in a digital university using intuitionistic fuzzy estimations [3, 4] for the evaluation of the efficiency of the process.

The administrative servicing in a digital university is based on requests from and to the various departments within the university. These requests can be received by e-mail, by telephone or via the web. If the request is received by e-mail, the applicant receives the auto-respond answer from the E-mail server. Each request is transferred to the Data Base server for validation. If the request is duplicated or if spam is retained, a correction is made by the applicant. The approved requests are passed for resolution and response.

In the context of the present model we include some possibilities for the possible ways for evaluating of the efficiency of the university administration servicing system. To do this we can apply estimations of the intuitionistic fuzzy sets. The estimations, which signify the degree of efficiency (μ) and non efficiency (ν) of the university administrative servicing system, are represented by ordered pairs $<\mu, \nu>$ of real numbers from the set [0,1]x[0,1]. The degree of uncertainty $\pi = 1 - \mu - \nu$ appears in those cases when the obtained queries are not resolved.

Initially, when no information has been derived, all estimations take on initial values of <0, 0>. When $k \geq 0$, the current $(k+1)$-st estimation is calculated on the basis of the previous estimations according to the recursive 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 model forms the final estimation of the efficiency of the university administration servicing system that performs the student's queries on the basis of the previous and the latest events.

2 A GN-model

The GN-model [1, 2] (see Fig. 1) contains 6 transitions and 20 places.

In the first time-moment, there is one α_D-token that is located in place l_9 with initial characteristic

"DataBase Server".

In the next time-moments this token can generate two or more new tokens. One of them, let it be the original α_D-token, will continue to stay in place l_9, while the other tokens will pass via transition Z_3.

Initially, there is one α_E-token that is located in place l_{12} with initial characteristic

"E-mail Server".

In the next time-moments this token can generate two or more new tokens. One of them, let it be the original α_E-token, will continue to stay in place l_{12}, while the other tokens will move to transitions Z_1 or Z_3.

All tokens that enter transitions Z_3 or Z_4 will unite with the original tokens, that stay in places l_9 and l_{12}. All information generated by the respective subject (DataBase Server or E-mail Server) will be put as an initial characteristic of a token, generated by the respective original token.

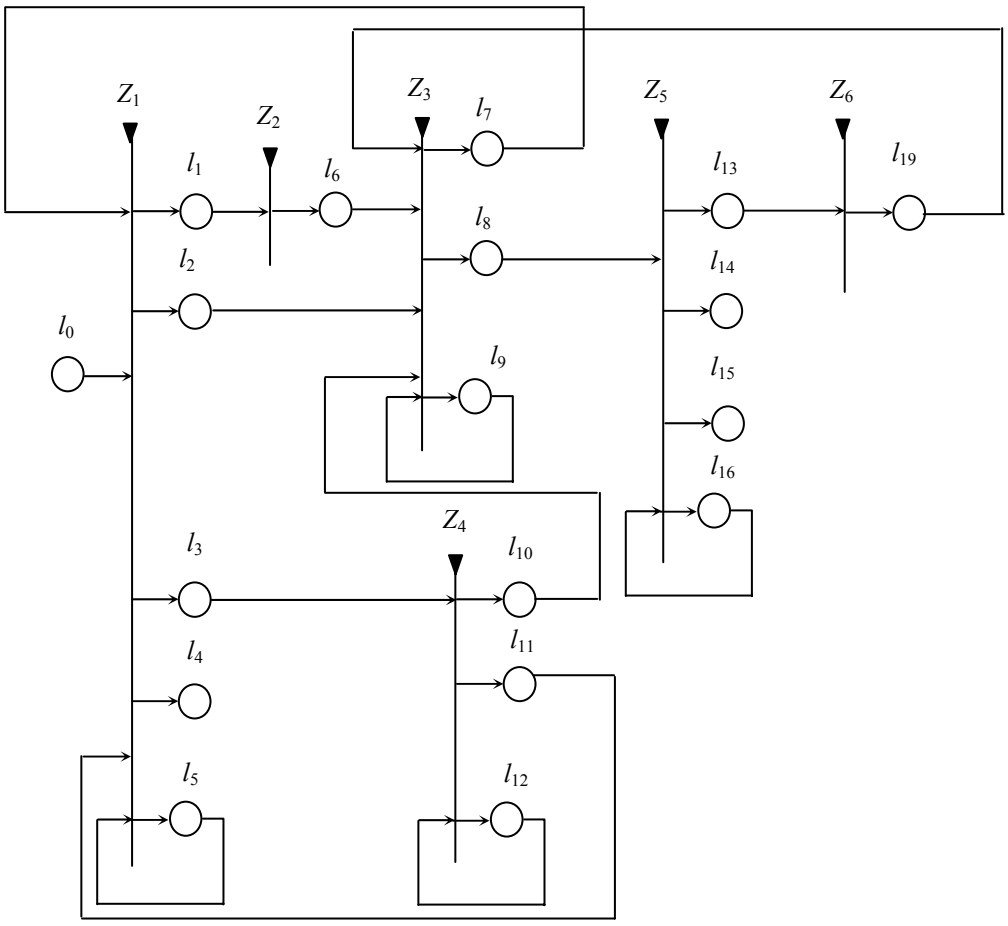

Figure 1: GN model of process of the administration servicing in a digital university

The new $\beta_1, \beta_2, \ldots, \beta_n$ -tokens enter the net via places l_0 with characteristics

"request, name and specialty of a student".

Also initially at place l_{16} there is one χ-token with initial characteristic

"current estimation of the efficiency of the process of the administration servicing in a digital university $<\mu_k, \nu_k>$".

The GN contains the following set of transitions:

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

where the following transitions represent:

Z_1 – The activity of the students;
Z_2 – Work of the telephone operator;
Z_3 – Work of the data base server;
Z_4 – Work of the e-mail server;
Z_5 – Calculating of the intuitionistic fuzzy estimations;
Z_6 – Resolving of the requests.

The forms of the transitions are the following.

$$Z_1 = <\{l_0, l_5, l_7, l_{11}\}, \{l_1, l_2, l_3, l_4, l_5\}, r_1, \vee(l_0, l_5, l_7, l_{11})>$$

where:

$$r_1 = \begin{array}{c|ccccc} & l_1 & l_2 & l_3 & l_4 & l_5 \\ \hline l_0 & False & False & False & False & True \\ l_5 & W_{5,1} & W_{5,2} & W_{5,3} & W_{5,4} & True \\ l_7 & False & False & False & False & True \\ l_{11} & False & False & False & False & True \end{array},$$

and:
$W_{5,1}$ = "There is a telephone request",
$W_{5,2}$ = "There is a Web request",
$W_{5,3}$ = "There is an e-mail request",
$W_{5,4}$ = "The query is performed".

The tokens that enter place l_5 do not have new characteristics.

The tokens entering places l_1, l_2, l_3 and l_4 take on characteristics, respectively:

"Telephone request, name and specialty of a student"
"Web request, name and specialty of a student",
"E-mail request, name and specialty of a student",
"Performed query, name and specialty of a student".

$$Z_2 = <\{l_1\}, \{l_6\}, r_2, \vee(l_1)>$$

where:

$$r_2 = \begin{array}{c|c} & l_6 \\ \hline l_1 & True \end{array}.$$

The token entering place l_6 has characteristic

"Request from telephone operator, name and specialty of a student".

$$Z_3 = <\{l_2, l_6, l_9, l_{10}, l_{19}\}, \{l_7, l_8, l_9\}, r_3, \vee(l_2, l_6, l_9, l_{10}, l_{19})>$$

where:

$$r_3 = \begin{array}{c|ccc} & l_7 & l_8 & l_9 \\ \hline l_2 & False & False & True \\ l_6 & False & False & True \\ l_9 & W_{9,7} & W_{9,8} & True \\ l_{10} & False & False & True \\ l_{19} & False & False & True \end{array},$$

$W_{9,7}$ = “There is a respond for the applicant”;
$W_{9,8}$ = “There is an accepted request”.

The tokens entering places l_7 and l_8 obtain characteristics, respectively:

“Message, name and specialty of a student”;
“Accepted request, name and specialty of a student”.

$$Z_4 = <\{l_3, l_{12}\}, \{l_{10}, l_{11}, l_{12}\}, r_4, \vee (l_3, l_{12})>$$

where:

$$r_4 = \begin{array}{c|ccc} & l_{10} & l_{11} & l_{12} \\ \hline l_3 & False & False & True \\ l_{12} & W_{12,10} & W_{12,11} & True \end{array},$$

$W_{12,10}$ = “There is an e-mail”;
$W_{12,11}$= $W_{12,10}$.

The tokens entering places l_{10} and l_{11} gain characteristics, respectively:

“Email request, name and specialty of a student”;
“Confirmation for email request, name and specialty of a student”.

$$Z_5 = <\{l_8, l_{16}\}, \{ l_{13}, l_{14}, l_{15}, l_{16}\}, r_4, \vee (l_8, l_{16})>$$

where:

$$r_5 = \begin{array}{c|cccc} & l_{13} & l_{14} & l_{15} & l_{16} \\ \hline l_8 & False & False & False & True \\ l_{16} & W_{16,13} & W_{16,14} & W_{16,15} & W_{16,16} \end{array},$$

$W_{16,13}$ = “There is a request for Academic staff, Accounting, Library, Educational department or Stipends/Hostel department”;
$W_{16,14}$ = “There is a performed request”;
$W_{16,15}$ = “There is a duplicated or retained request”;
$W_{16,16}$ = “The intuitionistic fuzzy estimation for the obtained request is evaluated”.

The tokens entering places $l_{13,}$ l_{14} and l_{15} obtain characteristic

“Request, name and specialty of a student”.

The χ-token in place l_{16} l_{14} obtains characteristic:

"current estimation $<\mu_k, \nu_k>$",

where μ_k and ν_k are the estimations of the performed requests and duplicated or retained requests. These estimations are calculated according to the respective number of tokens in l_{14} and l_{15}. The degree of uncertainty is determined by the number of tokens in place l_{13}.

Hence, on the basis of the characteristic of the χ-token at place l_{16} the system is able to prepare statistical data about the effectively of the system according to the number of performed queries and duplicated or retained request.

$$Z_6 = <\{l_{13}\},\{l_{19}\},\ r_6, \vee (l_{13})>$$

where:

$$r_6 = \frac{\left| l_{19} \right.}{l_{13} \left| True \right.},$$

The token entering place l_{19} obtains the characteristic

"Performed request, name and specialty of a student".

3 CONCLUSION

The Generalized Net model of the process of the administrative servicing system in a digital university constructed in this way is the latest in a series of research papers which the authors are currently preparing. The model has as its purpose the optimization of the functioning of the university by the creation of a reliable information environment for monitoring and for the management of the quality of university education.

ACKNOWLEDGEMENTS

Krassimir Atanassov would like to thank for the support provided by Grant Bin-2/09 *"Design and development of intuitionistic fuzzy logic tools in information technologies"* of the National Science Fund of the Ministry of Education, Youth and Science of Bulgaria.

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