МАТЕМАТИКА И МАТЕМАТИЧЕСКО ОБРАЗОВАНИЕ, 2008
MATHEMATICS AND EDUCATION IN MATHEMATICS, 2008
Proceedings of the Thirty Seventh Spring Conference of
the Union of Bulgarian Mathematicians
Borovetz, April 2–6, 2008

GENERALIZED NET MODEL OF SYSTEM FOR ELECTRONIC STUDENT – TEACHER INTERACTIONS

Daniela Ananieva Langova-Orozova, Georgi Petkov Petkov

The presented system for electronic consultation is part of a project aimed at creating a system for distance education serving the needs of a university. Following a Generalized Net modelling the real process of communication in the system is created. This net gives us the opportunity to use the implementation of various analysis and statistics in order to generate ideas for enhancing this system.

Introduction. Systems for facilitating the access of information by students and faculty is one of the most evident features of a modern university. Here we present a system for electronic consultation devised by us. The system is realized as interactive web application. In order to use the service, the users first need to register. The registration process creates user profiles that determine the access to the services. Those using the system are of the following two main types:

– Users – in this category fall all users, who can have access to the system via the Web. These may be students, faculty, guests, etc. Users must have the option of updating the data in their profile, to change password, etc.

– Administrators – they have physical access to the resources of the system. They can alter the parameters of the system servers and databases, to register users and to enhance the offered services. They have access to the archive and if necessary they can execute the required modifications.

The service "*communications*" offers direct communication between the students and faculty, through the exchange of messages where the users communicate with each other using their virtual names. The virtual username is the name (pseudonym) which the user has used to register to the system. Behind every virtual name lies the profile of the user, determining his/hers status in the system, the real name and e-mail address. The status defines the rights of the user, that are determined by the group he/she belongs to. The groups are defined in advance by the administrator of the system, and the services available to each of them are also determined. When the user sends a message to another he/she does not know his/hers real e-mail address. He knows only the user's virtual name. The service "communication" provides various opportunities to authorized users (with predefined status), for instance, lecturers or faculty members can use the so-called intelligent filters to sort the messages by criteria specified by them.

To the real e-mail addresses of the faculty are sent only messages notifying the receival of new message. The faculty members have to enter the system to review the received messages. Users with lower status for the service (students) cannot use the filters. They

can only send messages to other users of the system and check online their received messages.

Generalized Net model. Here we construct a Generalized Net (GN, see [1]), shown on Fig. 1, which describes the communication process in the developed system. An opportunity for tracking the changes in the objects parameters, as well as monitoring the state of the system are included.

In [2] GN-models for sending and receiving electronic data in WWW are described. In [3] it is proposed a method for evaluation of the exchanged information in wireless communications, that are used in modern universities, and a GN-model of a server is described, too.

The constructed GN-model has the following tokens α-tokens, representing the users (students, guests, etc.) and their actions; β-tokens, representing the teachers; δ-tokens, representing the information in the databases of the system for online student-teacher interactions. For simplicity we will use the denotations α- and β-tokens instead of α_i- and β_j-tokens, where i, j are the numbers of the respective tokens. Initially α- and β-tokens are in places a_3 and b_3, respectively, with the following characteristics:

$$x_0^{\alpha} = \text{“user's password, name, status, access rights”},$$
$$x_0^{\beta} = \text{“administrator's password, name”}.$$

All α-tokens have equal priorities and all β-tokens have equal priorities but the priority of the β-tokens is higher than the priority of α-tokens.

New users and administrators enter the net through places a_1 and b_1, respectively.

During the functioning of the net the following tokens with current characteristics are always present: δ_S-token in place c_S with characteristic “DB with messages”; δ_R-token in place c_R with characteristic “Trash”; δ_{DB}-token in place c_{DB} with characteristic “DB”; δ_A-token in place c_A with characteristic “archive”. The transitions are of the described below types:

$$Z_1 = < \{a_1, a_3\}, \{a_2, a_3\},$$

	a_2	a_3
a_1	false	true
a_3	$W^a_{3,2}$	$W^a_{3,3}$

$>$,

$W^a_{3,2}$ = “The user will take actions in the system for electronic consultation”,
$W^a_{3,3} = \neg W^a_{3,2}$, where $\neg$P is the negation of the predicate P.
α-tokens do not receive new characteristics in place a_3 and receive the characteristic “list of all possible actions of the user in the system” in place a_2.

$$Z_2 = < \{b_1, b_3\}, \{b_2, b_3\},$$

	b_2	b_3
b_1	false	true
b_3	$W^b_{3,2}$	$W^b_{3,3}$

$>$,

$W^b_{3,2}$ = “The administrator will partake actions in the system for electronic consultation”,

$$W^b_{3,3} = \neg \; W^b_{3,2}.$$

β-tokens do not receive new characteristics in place b_3 and receive characteristic “list of possible administrator actions in the system” in place b_2.

$$Z_3 = < \{a_2\}, \{a_4, a_5, a_6, a_7, a_8\},$$

	a_4	a_5	a_6	a_7	a_8
a_2	$W^a_{2,4}$	$W^a_{2,5}$	$W^a_{2,6}$	$W^a_{2,7}$	$W^a_{2,8}$

$>$,

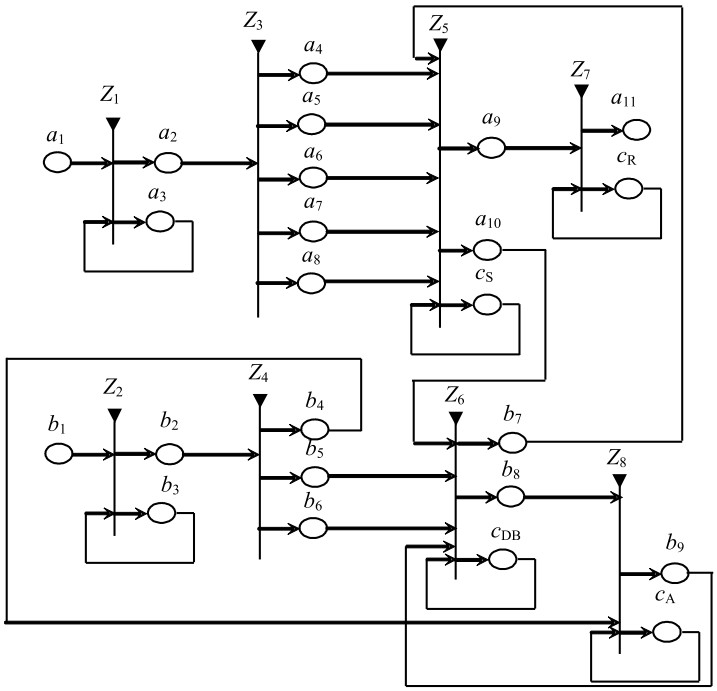

Fig. 1. GN-model of the system for electronic consultation

$W^a_{2,4}$ = "The action Sending a message to another user in the system has been chosen",

$W^a_{2,5}$ = "The action Review online all the received messages has been chosen",

$W^a_{2,6}$ = "The action Deletion of received messages has been chosen",

$W^a_{2,7}$ = "The action Review the messages in Trash has been chosen",

$W^a_{2,8}$ = "The action Filtering messages has been chosen".

α-tokens, entering in places a_4, a_5, a_6, a_7 and a_8 receive the respective characteristics:

"user, action Sending a message to another user in the system", "user, action Review online all the received messages", "user, action Deletion of received messages", "user, action Review the messages in Trash", "user, action Filtering messages".

$$Z_4 =< \{b_2\}, \{b_4, b_5, b_6\}, \quad \begin{array}{c|ccc} & b_4 & b_5 & b_6 \\ \hline b_2 & W^b_{2,4} & W^b_{2,5} & W^b_{2,6} \end{array} >,$$

$W^b_{2,4}$ = "Modifications in the Databases are required",

$W^b_{2,5}$ = "Archivation of the Database is required",

$W^b_{2,6}$ = "The retrieval of information from the archive is required".

β-tokens, entering in places b_4, b_5 and b_6 receive the respective characteristics: "administrator, action Modifications in the Databases", "administrator, action Archivation of the

Database", "administrator, action retrieval of information from the archive".

$$Z_5 =< \{a_4, a_5, a_6, a_7, a_8, b_8, c_S\}, \{a_9, a_{10}, c_1\},$$

	a_9	a_{10}	c_1
a_4	false	false	true
a_5	false	false	true
a_6	false	false	true
a_7	false	false	true
a_8	false	false	true
b_8	false	$W^c_{S,10}$	true
c_S	$W^c_{S,9}$	false	true

$>$,

$W^c_{S,9}$ = "Deleting messages from Trash is required",
$W^c_{S,10}$ = "Access to DB is required".
α-tokens, entering in places a_9 and a_{10} receive characteristics respectively: "user, action Deletion from Trash"; "user, access request".

$$Z_6 =< \{a_{10}, b_5, b_6, b_9, c_{DB}\}, \{b_7, b_8, c_{DB}\},$$

	b_7	b_8	c_{DB}
a_{10}	false	false	true
b_5	$W^b_{5,7}$	false	W^b_{DB}
b_6	false	false	true
b_9	false	false	true
c_{DB}	false	W^b_{DB}	true

$>$,

$W^b_{5,7}$ = "Modifications in the message database are needed",
W^b_{DB} = "Modifications in the database are needed".
β-tokens, entering in places b_7 and b_8 receive characteristics respectively: "administrator, action Modifications in message database", "administrator, action Archivation of database".

$$Z_7 =< \{a_9, c_R\}, \{a_{10}, c_R\},$$

	a_{10}	c_R
a_9	$false$	true
c_R	$W^c_{R,10}$	true

$>$,

$W^c_{R,10}$ = "Deletion of the the information from Trash is required".
α-tokens entering in place a_{10} receive characteristic "user, deleted information".

$$Z_8 =< \{b_4, b_8, c_A\}, \{b_9, c_A\},$$

	b_9	c_A
b_4	false	true
b_8	false	true
c_A	$W^c_{A,9}$	true

$>$,

$W^c_{A,9}$ = "Information retrieved from the archive".

Conclusion. The presented system for electronic consultations is part of a project devoted to the creation of a system for distance education. It is designed for the needs of the Free University of Burgas, where the authors are tutoring. Presently a Java software implementation takes place. The above generalized net model represents the process of communication between the objects, and we call it a system for electronic consultations. The designed model provides the capabilities to apply various analytical and statistical tools in the process of establishment and testing the system with idea of enhancing this process. It uses a large part of the GN components – mainly characteristic and

predicates, which are not present in other Petri nets. The subject of this article represents a continuation of "Generalized Net Modelling of University Processes", KvB Monograph No.7, published in Australia 2005, by a team including the authors.

REFERENCES

[1] K. Atanassov. Generalized Nets, World Scientific, Singapore, 1991.
[2] K. Atanassov, S. Sotirov, V. Kodogiannis. Intuitionistic fuzzy estimations of the Wi-Fi connections, First Int. Workshop on IFSs, GNs, KE, London, 6–7 Sept. 2006, 75–80.
[3] S. Sotirov, V. Kodogiannis, R. Elijah Blessing. Intuitionistic fuzzy estimations for connections with Low Rate Wireless personal area networks, First Int. Workshop on IFSs, GNs, KE, London, 6–7 Sept. 2006, 81–87.

Daniela Ananieva Langova-Orozova
Burgas Free University
Computer Science and
Engineering Sciences Center
62, San Stefano Str.
8001 Burgas, Bulgaria
e-mail: orozova@bfu.bg

Georgi Petkov Petkov
Burgas Free University
Computer Science and
Engineering Sciences Center
62, San Stefano Str.
8001 Burgas, Bulgaria
e-mail: air@airforce-bg.com

МОДЕЛ ЧРЕЗ ОБОБЩЕНА МРЕЖА НА СИСТЕМА ЗА ЕЛЕКТРОННИ ВЗАИМОДЕЙСТВИЯ СТУДЕНТИ – ПРЕПОДАВАТЕЛИ

Даниела Ананиева Лангова-Орозова, Георги Петков Петков

Представената система за електронни взаимодействия "студенти – преподаватели" е част от проект за дистанционно обучение за нуждите на Бургаски свободен университет. Тук чрез обобщена мрежа е конструиран модел на процеса на комуникации в системата. Такъв модел дава възможност за анализ и статистически изследвания, с цел генериране на нови идеи за усъвършенстване и развитие на системата.