New Trends in Fuzzy Sets, Intuitionistic Fuzzy Sets, Generalized Nets and Related Topics Volume II: Applications

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ISBN 83-894-7547-2

Modeling of Electronic Learning Environment with Generalized Nets

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Abstract

Decision making in the process of learning requires careful study of students' behaviour, data analysis and evaluation of the effectiveness of the electronic learning environments. On the basis of GN-models and statistical data it is possible to make evaluation and look for tendencies in the development of the processes relevant to the electronic learning and its maintenance

Keywords: Generalized Nets, e-learning, Learning Management Systems, m-learning (mobile learning), u- learning (ubiquitous learning).

1 Systems for e-learning

The systems for managing the process of e-learning (*Learning Management Systems, LMS*) and the systems for managing the content of the learning process (*Learning Content Management Systems, LCMS)* are known under the common name of *Iinformation Systems for e-learning*. The functions in a system for e-learning are described in [5] as part of the support of the learning process in secondary education. In comparison to the models of these systems which are applied to university education, here a new and specific user appears - the parent or guardian. It is the reason for which a change in the basic functionalities of the system is necessary. The following are the modified functionalities:

- Management of the users – recording and administering of the students and their parents/guardians in the system.

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- Planning of the learning process – determining the learning plan and planning the learning schedule.
- Communication between users (student – student, teacher – student, teacher – parent/guardian etc.) – providing synchronous and asynchronous means of communication. (E-mail, Chat, SMS/MMS, discussion forum, file exchange, environment for group activities.).The parent receives adequate information regarding the learning plan and the learning schedule and is able to take part in discussions with other parents and/or teachers.
- Monitoring the achievements of the students – recording the behaviour of the students and their results as they progress through the learning content and the other learning activities involved. The parent/guardian should have access to this information.
- Access to electronic learning content with possibilities for intelligent search and selection of suitable learning resources, lessons and material for self-testing..
- Examination and evaluation of knowledge – carrying out procedures for examination and evaluation of knowledge and analysis of the results.
- Design of learning content – the learning content can be created inside the system and/or learning content created with other tools or in other systems for learning can be used.

2 GN model of electronic learning environment.

Taking into account the necessity of standardization of the developed learning materials and the specific characteristics that they should possess we see that the alternative solutions should be evaluated on the basis of their quality before they become elements of the learning content of the environment. Our main aim is to represent the model of the process using the generalized nets (GN) as a tool. The basic components of a GN and the algorithms for its functioning are presented in details in [1]. The GN-models of learning presented in [2,10] examine the general case of abstract objects (neuron networks, genetic algorithms, expert systems, intelligent games, abstract systems etc.). -

The GN model in [3] representing the process of e-learning can extended by the subnet from Fig 1. which models the process of generating and updating of the courses taking into account the standards for the learning content.

The set of the generalized net's transitions is:

$$A = \{Z_1, Z_2, Z_3, Z_4\};$$

where

- Z_1 – generation of the educational courses;
- Z_2 – examination of the quality of the courses with regard to the standards ;
- Z_3 – beginning of the work with the environment for e-learning and choosing a course;
- Z_4 – conduction of the learning process.

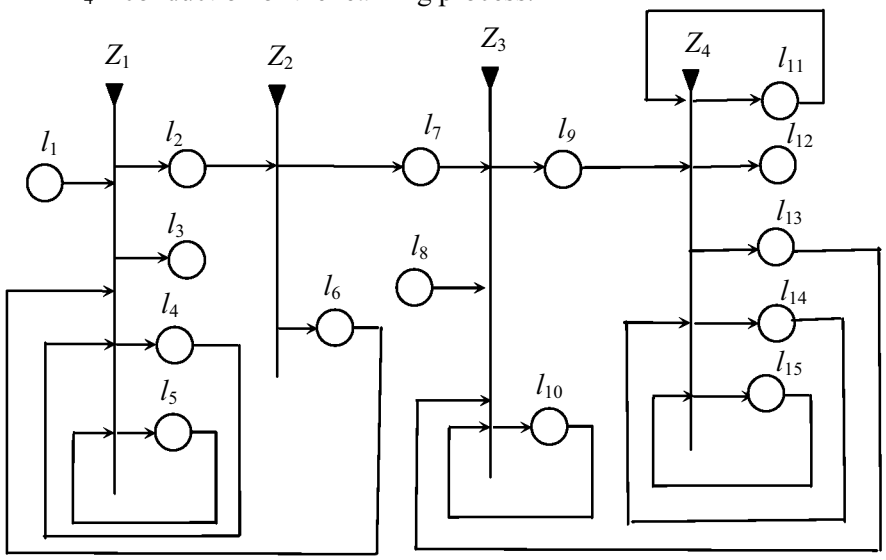

Fig. 1. GN model of the process of generating and updating of the courses taking into account the standards for the learning content.

While in place l_5 there is a σ-token with characteristic:

„*authors(designers) of educational courses*".

$$Z_1 = <\{l_1, l_4, l_5, l_6\}, \{l_2, l_3, l_4, l_5\}, \mathrm{r}_1>;$$

$$r_1 = \begin{array}{c|cccc} & l_2 & l_3 & l_4 & l_5 \\ \hline l_1 & T & F & T & F \\ l_4 & F & F & T & F \\ l_5 & W_{5,2} & F & F & T \\ l_6 & W_{6,2} & W_{6,3} & F & F \end{array}$$

where:
$W_{5,2}$ = „a new educational course is created";
$W_{6,2}$ = „according to the reviewer the course can be improved";
$W_{6,3} = \neg W_{6,2}$;
where ¬P is the negation of the predicate P.

During the functioning of transition Z_1, the σ–token in position l_5 splits into two tokens one of which stays in place l_5, while the other enters position l_2 with characteristic:

„*new educational course*",

In place l_3 the β-token does not obtain any new characteristic.

$$Z_2 = <\{l_2\}, \{l_6, l_7\}, r_2>;$$

$$r_2 = \begin{array}{c|cc} & l_6 & l_7 \\ \hline l_2 & W_{2,6} & W_{2,7} \end{array}$$

where
$W_{2,6}$ = „the new educational course does not meet the standards ";
$W_{2,7} = \neg W_{2,6}$.

In place l_7 the β-token obtains the characteristic:

„*the educational course meets the standards*",

While in place l_6 the β-token obtains the new characteristic:

„*opinion of the reviewer about the possibility for the course to be improved*",

The α–tokens enter the net in place l_8 with initial characteristic:

„user, name and password";

$$Z_3 = <\{l_7, l_8, l_{10}, l_{13}\}, \{l_9, l_{10}\}, r_3>;$$

$$r_3 = \begin{array}{c|cc} & l_9 & l_{10} \\ \hline l_7 & F & T \\ l_8 & T & F \\ l_{10} & W_{10,9} & T \\ l_{13} & T & F \end{array}$$

where
$W_{10,9}$ = „the user has chosen new educational course";

In place l_{10} there is an ε -token with characteristic:

„current list with available courses ".

The ε -token in place l_{10} splits into two tokens: ε and ε'. The ε -token remains in place l_{10}, while the ε' -token merges with the α–token from place l_9.

The α–token in place l_9 obtains the characteristic:

„user, selected educational course ”.

In place l_{15} there is a φ -token, with initial characteristic:

„*database with the current knowledge of the users,(users models)*”;

$$Z_4 = <\{l_9, l_{11}, l_{14}, l_{15}\}, \{l_{11}, l_{12}, l_{13}, l_{14}, l_{15}\}, r_4>;$$

r_4	l_{11}	l_{12}	l_{13}	l_{14}	l_{15}
l_9	T	F	F	F	F
l_{11}	$W_{11,11}$	$W_{11,12}$	$W_{11,13}$	$W_{11,14}$	$W_{11,15}$
l_{14}	T	F	F	F	F
l_{15}	F	$W_{15,12}$	F	F	T

where:
$W_{11,12}$ = „the education on the chosen topic is finished ”;
$W_{11,13}$ = „a new course has been chosen ”;
$W_{11,14}$ = „the user’s profile is modified ”;
$W_{11,11} = \neg W_{11,12}$;
$W_{11,15} = W_{15,12}$=„it is necessary to make an evaluation of the education of the user”.

In place l_{11} the α–token splits into two tokens α and α'. The α–token remains in place l_{11} and does not obtain any new characteristic. The α' –token enters place l_{15}, where it merges with the φ -token.

In place l_{12} the α–token obtains the characteristics:

„*user, evaluation of the knowledge of the user with regard to the educational course ”.*

In place l_{13} the α–token obtains the characteristic:

„*user, new educational course* ”.

In place l_{14} the α–token obtains the characteristic:

„ the user’s profile is modified ”.

3 The evolution of e-learning.

The electronic education (e-learning) is education supported and realized by electronic means and electronic media whose basic components are present-

ed in [6]. Main advantages of e-learning are the individualization of the education, fast and easy access to information, possibility for joint education.. Electronic education evolves and includes the mobile education (m-learning) [4] as a technology for applying the electronic education In order to implement m-learning, three components are necessary: wireless communication technologies, mobile devices for access and educational material in electronic form. Therefore m-learning is education with the help of mobile devices such as mobile phones with access to the Internet through WAP(Wireless Application Protocol) or Radio Service technologies, cellular phones (smartphones), portable computers (notebook, laptop, tablet, pocket), electronic notebooks (PDA – personal digital assistant) etc.

The advantages of m-learning make it interesting environment to work on projects with educational purpose. For that reason new options for education through development of adapted to students projects are sought [7,8]. The aim is to integrate the obtained knowledge and form practical skills for work with modern technological means

U-learning (*ubiquitous learning***)** is a nation-wide and comprehensive education which evolves on the basis of various modern day technologies. It allows the students to use mobile networks and WiFi technologies to record and study educational material of high quality. U-learning makes it possible to implement joint educational and social activities with people from all over the world. The development of e-learning to some extend is connected with the evolution of the methods which use the Web to support learning. [9] If we take an e-learning environment and study its architecture , we will see that it expands including elements of m-learning and, in this way, forming u-learning environment. This can be expressed in the following equation form:

$$u\text{-}Learning = e\text{-}Learning + m\text{-}Learning.$$

The connection to u-learning environment can be realized through the Internet by local (WiFi, cable network, Bluetooth) or mobile network. At present services such as GPRS are relatively expensive and providing them to many consumers is not economically justified. However, a drop in the price of these services may lead to their large-scale use.

If we take into account the specific details when working with different devices in the GN model on Fig. 1, applying the hierarchic operator H_1 [1] we can substitute position l_2 with a new GN E' presented on Fig.2.

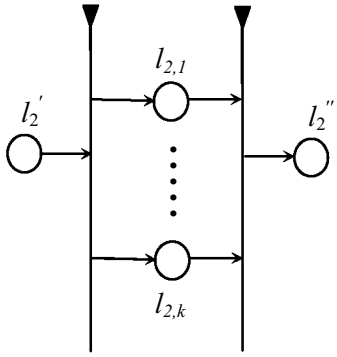

Fig. 2. GN E', preparation of educational content for mobile device

Different web browsers have different limitations on devices such as personal computer, laptop, tablet, pocket computer, smartphone. Different screens and orientation require resizing or restructuring in order to obtain image that is appropriate for mobile screen. These devices are represented by tokens entering places $l_{2,1}$, ..., $l_{2,k}$. In this way, the educational course represented by a token in place l_2' is first prepared for the respective mobile device and only after that it is available to the consumer as a token in place l_2''.

In this way we include the specific characteristics of the u-learning environments which allow the use of intuitive approaches to identification of appropriate content and appropriate services at given place and time depending on the location of the students and their spare time.

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The papers presented in this Volume 2 constitute a collection of contributions, both of a foundational and applied type, by both well-known experts and young researchers in various fields of broadly perceived intelligent systems.
It may be viewed as a result of fruitful discussions held during the Eleventh International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2012) organized in Warsaw on October 12, 2012 by the Systems Research Institute, Polish Academy of Sciences, in Warsaw, Poland, Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences in Sofia, Bulgaria, and WIT - Warsaw School of Information Technology in Warsaw, Poland, and co-organized by: the Matej Bel University, Banska Bystrica, Slovakia, Universidad Publica de Navarra, Pamplona, Spain, Universidade de Tras-Os-Montes e Alto Douro, Vila Real, Portugal, Prof. Asen Zlatarov University, Burgas, Bulgaria, and the University of Westminster, Harrow, UK:

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The Workshop has also been in part technically supported by COST Action IC0806 ``Intelligent Monitoring, Control and Security of Critical Infrastructure Systems'' (INTELLICIS).

The consecutive International Workshops on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGNs) have been meant to provide a forum for the presentation of new results and for scientific discussion on new developments in foundations and applications of intuitionistic fuzzy sets and generalized nets pioneered by Professor Krassimir T. Atanassov. Other topics related to broadly perceived representation and processing of uncertain and imprecise information and intelligent systems have also been included. The Eleventh International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2012) is a continuation of this undertaking, and provides many new ideas and results in the areas concerned.

We hope that a collection of main contributions presented at the Workshop, completed with many papers by leading experts who have not been able to participate, will provide a source of much needed information on recent trends in the topics considered.

ISBN-13 9788389475473