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A Generalized Net Model for Analysis of Students Evaluations by Data Mining Techniques in the Digital University

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Abstract: A generalized net is used to construct a model which describes the applying the data mining techniques to analysis of students evaluations in the digital university. The model can be used to simulate some processes, related to estimation of students' background.

Keywords: Data mining, Digital university, e-Learning, Generalized nets.

1 Introduction

In a series of research, the authors study some of the most important processes of functioning of universities (see [5, 6, 7, 8, 9, 10, 16]). Generalized nets (GNs, see [1, 2]) are used to describe the process of student assessment (see [5, 9, 10]). The evaluations to cope with the varying student's background on different themes are represented in intuitionistic fuzzy form; (for the concept of intuitionistic fuzzy sets (IFS, see [3, 4]).

In [5] the process of evaluation of the problems solved by students is described by Generalized Nets. The paper [8] describes the process of evaluation by lecturers of the tasks presented by students. In [9] a generalized net is used to construct a model which describes of the process of evaluation by lecturers. In [10] is constructed a generalized net that corresponds to a model which describes the standardization of the process of evaluation by lecturers. In [11] the process of evaluation of lecturer's course is described by Generalized Nets. The evaluation of lecturer is a function of the averaged student's evaluations from the examination of the course, averaged evaluation from the student's investigation of the lecturer and the scientific activity of a lecturer.

In the present paper the process of evaluation the applying the data mining techniques (see [12, 13, 14, 15]) for analysis of a student's evaluations in the e-learning university is described by generalized nets. Let us have i students that have to solve j problems related to a current lecture course, and let us have s lecturers, and l data mining techniques, for $i = 1, 2,\ldots, m$, $j = 1, 2,\ldots, n$, $s = 1, 2,\ldots, q$, $l = 1, 2,\ldots, k$. Once a lecturer has evaluated the student's solutions from the different courses, the data mining techniques is used for discovering hidden patterns and dependencies in data.

2 A GN-model

The GN-model for this section (Figure 1) contains 8 transitions and 23 places, collected in four groups and related to the four types of the tokens that will enter respective types of places:

- α-tokens and *a*-places represent the lecturers and their activities,
- β-tokens and *b*-places represent the courses and connected with them problems,
- γ-tokens and *c*-places represent the students and their solutions of the problems,
- φ-tokens and *d*-places represent the data mining techniques.

For brevity, we shall use the notation α-, β-, γ- and φ-tokens instead of α_s-, β_j-, γ_i-, and φ_l-tokens, where *s, j, i, l* are numerations of the respective tokens.

Initially the α-, β-, γ-, and δ-tokens remain, respectively, in places a_5, b_3, c_3 and d_3 with initial characteristics:

x_0^{α} = *"Name and specialty of a lecturer"*,

x_0^{β} = *"Name of the course, text of a problem, theme, level of difficulty"*,

x_0^{γ} = *"Name, specialty and current evaluations of a student"*,

x_0^{φ} = *"Name and current status of a data mining technique"*.

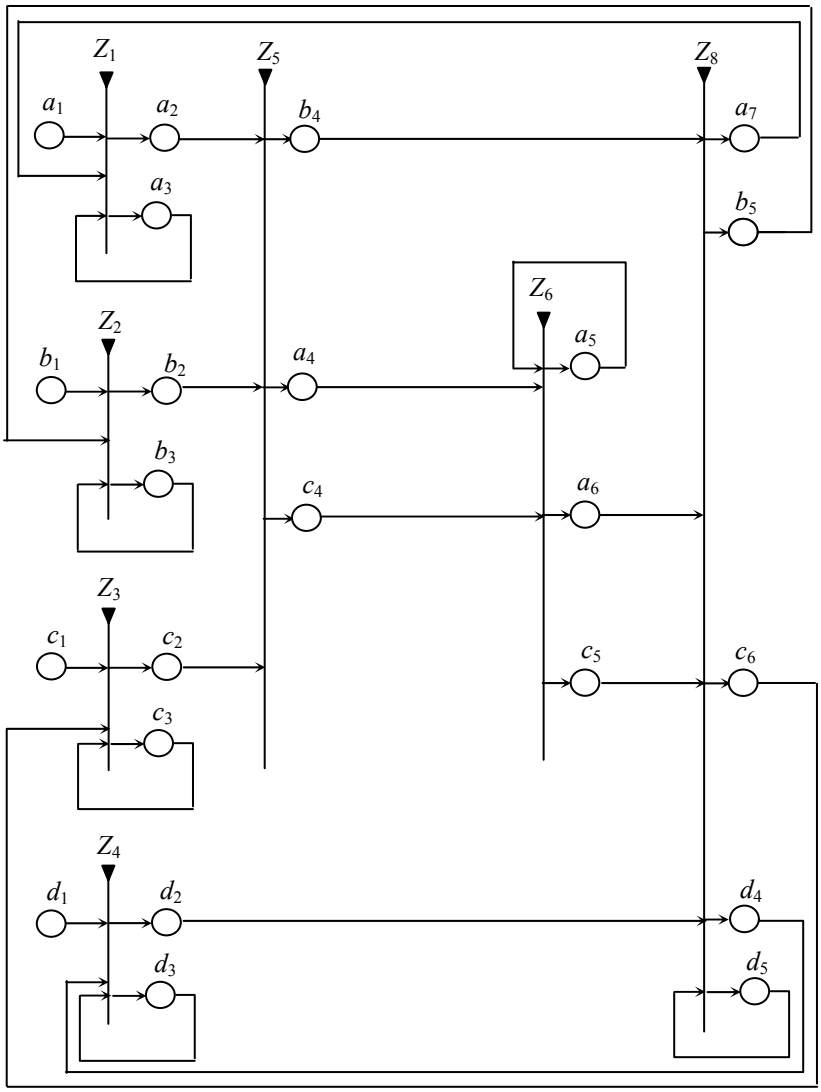

Figure 1: GN Model for analysis of a student's evaluations by data mining techniques

If we would like the model to be more detailed, the first and the latest characteristics can have, e.g., the following larger forms

x_0^{α} = *"Name, specialty and score of a teacher, variant of assessment of the course"*,

x_0^{γ} = *"Name, specialty and current evaluations of a student, name of the student's teacher who will give the problems and/or examine the student, name of the course"*.

All α-tokens, all β-tokens, all γ-tokens, and all φ-tokens have equal priorities, but the priority of α-tokens is higher than the priority of β-tokens, that is higher than the priority of γ-tokens, that is higher than the priority of φ-tokens. Let x_{cu}^{α}, x_{cu}^{β}, x_{cu}^{γ} and x_{cu}^{φ} be the current characteristics of the α-, β-, γ- and φ- tokens, respectively. The forms of the transitions are the following.

$$Z_1 = <\{a_1, a_3, a_7\}, \{a_2, a_3\}, \begin{array}{c|cc} & a_2 & a_3 \\ \hline a_1 & false & true \\ a_3 & W_{3,2}^a & W_{3,3}^a \\ a_7 & false & true \end{array} >,$$

where:

- $W_{3,2}^a$ = *"The lecturer must examine"*,
- $W_{3,3}^a = \neg W_{3,2}^a$.

The α-tokens do not obtain new characteristic in place a_3 and they obtain the characteristic

$$x_{cu}^{\alpha} = \text{"Lecturer, list of the problems that the student must solve"}$$

in place a_2.

$$Z_2 = <\{b_1, b_3, b_5\}, \{b_2, b_3\}, \begin{array}{c|cc} & b_2 & b_3 \\ \hline b_1 & false & true \\ b_3 & W_{3,2}^b & W_{3,3}^b \\ b_5 & false & true \end{array} >,$$

where:

- $W_{3,2}^b$ = *"The problem is included in* x_{cu}^{α} *"*,
- $W_{3,3}^b = \neg W_{3,2}^b$.

The β-tokens do not have new characteristic in place b_3 and they take on the characteristic

$$x_{cu}^{\beta} = \text{"Current course, texts of the problems that the student must solve"}$$

in place b_2.

$$Z_3 = <\{c_1, c_3, c_6\}, \{c_2, c_3\}, \begin{array}{c|cc} & c_2 & c_3 \\ \hline c_1 & false & true \\ c_3 & W_{3,2}^c & W_{3,3}^c \\ c_5 & false & true \end{array} >,$$

where:

$W_{3,2}^c$ = *"The student must have examination"*,

$W_{3,3}^c = \neg W_{3,2}^c$.

The γ-tokens do not obtain new characteristic in places d_2 and d_3.

$$Z_4 = <\{ d_1, d_3, d_4\}, \{d_2, d_3\},$$

	d_2	d_3
d_1	*false*	*true*
d_3	$W^d_{3,2}$	$W^d_{3,3}$
d_4	*false*	*true*

$>$,

where:

- $W^d_{3,2}$ = "The students' evaluation must be evaluated by Data mining technique",
- $W^d_{3,3} = \neg W^d_{3,2}$.

The γ-tokens do not obtain new characteristic in places d_2 and d_3. The φ-tokens do not have any characteristic in place d_3 and they take on the characteristic

$$x^{\varphi}_{cu} = \textit{"Data mining technique"}$$

in place d_2.

$$Z_5 = <\{a_2, b_2, c_2 \}, \{a_4, b_4, c_4 \},$$

	a_4	b_4	c_4
a_2	*true*	*false*	*false*
b_2	*false*	*true*	*false*
c_2	*false*	*false*	*true*

$>$.

The α- and β-tokens do not have new characteristic in places a_4 and b_4, respectively, while γ-tokens obtain characteristic

"Lecture course, student's solutions of the problems for the course"

in place c_4.

$$Z_6 = <\{a_4, a_5, c_4 \}, \{a_5, a_6, c_5\},$$

	a_5	a_6	c_5
a_4	$W^a_{4,5}$	$W^a_{4,6}$	*false*
a_5	$W^a_{5,5}$	$W^a_{5,6}$	*false*
c_4	*false*	*false*	*true*

$>$,

where:

$W^a_{4,5} = W^a_{5,5}$ = *"There are students whose research must be evaluated by the current teacher"*,

$W^a_{4,6} = W^a_{5,6} = \neg W^a_{4,5}$.

The α- and γ-tokens do not obtain new characteristic in places a_5 and c_5. The α-tokens that enter place a_6 obtain characteristics

"Lecturer, course, estimation of the current student's problems for the course".

$$Z_7 = <\{a_6, b_4, c_5, d_2, d_5\}, \{a_7, b_5, c_6, d_4, d_5\},$$

	a_7	b_5	c_6	d_4	d_5
a_6	*true*	*false*	*false*	*false*	*false*
b_4	*false*	*true*	*false*	*false*	*false*
c_5	*false*	*false*	*true*	*false*	*false*
d_2	*false*	*false*	*false*	$W^d_{2,4}$	$W^d_{2,5}$
d_5	*false*	*false*	*false*	$W^d_{5,4}$	$W^d_{5,5}$

$>$,

where:

$W^d_{2,5} = W^d_{5,5}$ = *"There are estimation who must be evaluated by the current data mining technique"*,

$W^d_{2,4} = W^d_{5,4} = \neg W^d_{2,5}$.

The α-, β-, γ- and φ-tokens do not obtain new characteristic in places a_7, b_5, c_6 and d_5. The φ-tokens that enter place d_6 obtain characteristics

"Lecturer, course, estimation of the current student's problems for the course, results from the data mining evaluation".

3 Conclusions

The GN-model so-constructed offers the opportunity to simulate many of the processes which need to be considered when carrying out summative assessments of the students' progress and also it provides a compact representation of the discovered patterns and allows the model application to new amounts of data. The present model is thus an important element of a more general model describing the different information flows within a university.

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