

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

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요 약

우리는 수업시간에 이루어질 수 있는 내용을 기본으로 intuitionistic 퍼지집합의 평가방법을 이용하고자 한다. 특히, 본 논문에서는 대학 수업을 이해해 가는 과정을 서술하고 있다.

Abstract

We apply estimations of the intuitionistic fuzzy sets on the basis of which some amendments may be undertaken. In particular, this paper describes the process of working out a university classes schedule.

Key words : Sealed-bid auction, secure auction, security protocols, multiagent systems, electronic commerce

1. INTRODUCTION

The generalized net model, described in 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 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.

Working out the university classes schedule is a complicated and time-consuming task. A multitude of parameters takes part in this process - students, lecturers, halls, subjects, etc. A number of binding

requirement and restrictions has to be observed.

This paper describes the process of working out a university classes schedule. Training in a definite number of subjects is carried out every semester. For every subject D_i the groups that study it have to be defined; as well as the number of the weeks during which the subject has to be presented; the lecturers who can present it; the rooms where it can be carried out. Respectively the distribution of the subject classes has to comply with the schedule of the students, lecturers and rooms.

Generalized nets have been used to build up models of the described processes. They offer a powerful set of instruments for working out models of parallel real time processes.

2. GN-model

The model, describing the organization of the university classes schedule at the university, is shown

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on Figure 1.

The generalized network consists of the following tokens: α -tokens – stand for the subjects, σ -tokens – show the duration of presenting the subjects, β -tokens – show the university subject curriculum, δ -tokens – represent the students groups, ξ -tokens – stand for the lecture rooms, ρ -tokens – represent the lecturers in the university, ϵ -tokens – a certain subject classes schedule.

Initially the following tokens take place in the network:

- in place B_0 – α_0 -token with characteristic “list of the subjects”,
- in place B_1 – β -token with characteristic “archives with the subjects curriculum”,
- in place B_2 – δ_0 -token with characteristic “group, semester, subject”, it gives the available subject groups at the present moment,
- in place B_3 – σ -token with characteristic “subjects duration list: subject D_i – duration ($i = 1, \dots, n$)”,
- in place B_4 – ξ -token with characteristic “lists of the rooms where a certain subject can be presented: room number: subject D_i – type of hall (for lectures, seminars, laboratory work) ($i = 1, \dots, n$)”,
- in place B_5 – ρ' -token with characteristic “list of lecturers who can present a certain subject: lecturer’s name, subject D_i – lectures / seminars / laboratory work ($i = 1, \dots, n$)”,
- in place B_6 – ξ -token with characteristic with the form room schedule:

room number:		8h.-9h.	9h.-10h.	...	19h.-20h.
Monday					
...					
Friday					

- in place B_7 – δ - token with characteristic with the form group schedule:

group number, semester, specialty:		8h.-9h.	9h.-10h.	...	19h.-20h.
Monday					
...					
Friday					

- in place B_8 – ρ - token with characteristic with the form lecturer schedule:

lecturer's name:		8h.-9h.	9h.-10h.	...	19h.-20h.
Monday					

...				
Friday				

In the next time moment each token splits into two ones. One of them – let it be the original token – will continue its stay in respective place B_j , while the other tokens will move via respective transitions for each place B_j , ($j=0, \dots, 8$).

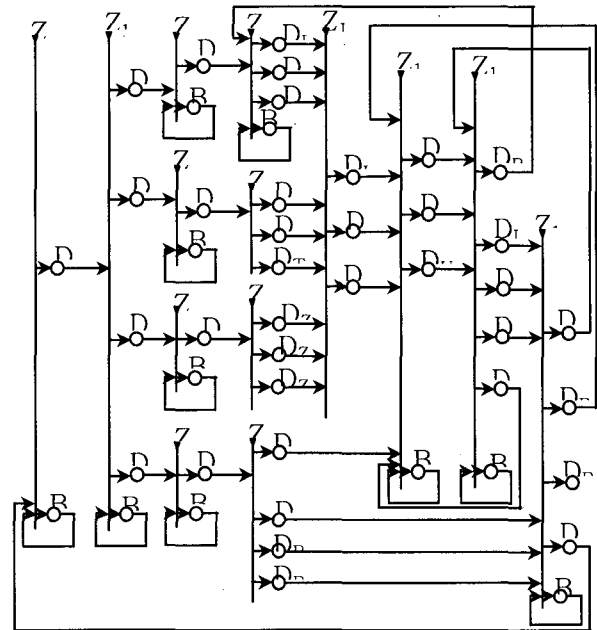


Figure 1

The Generalized net is a block of transitions:

$$A = \{ Z_0, Z_1, Z_2, Z_3, Z_4, Z_5, Z_6, Z_7, Z_8, Z_9, Z_{10}, Z_{11}, Z_{12} \},$$

where transitions represent:

Z_0 and Z_1 – choice of subject and giving information about its parameters,

Z_2 – defining the groups which will learn the chosen subject during the semester,

Z_3 – forming lecture stream groups, seminar and laboratory work groups (if there are any) for the chosen subject,

Z_4 – defining the number of the weeks necessary for lecturing the chosen subject,

Z_5 – defining the number of the classes per week for lectures, seminars and laboratory work for the chosen subject,

Z_6 – defining the rooms where the chosen subject can be presented,

Z_7 – defining the lecture rooms, seminar rooms and laboratory work rooms where the chosen subject can be presented,

Z_8 – defining the lecturers who can present the chosen subject,

Z₉ – defining the number of the lecturers who can present respectively lectures, seminars and laboratory work in the chosen subject,

Z₁₀ – defining the necessary week occupation for the chosen subject for lectures, seminars and laboratory work,

Z₁₁ – defining the week schedule of the rooms where the chosen subject will be presented,

Z₁₂ – co-ordination of the week schedule of the rooms with the student groups' schedule,

Z₁₃ – co-ordination of the drawn week schedule for the rooms and student groups with the lecturer's schedule.

The GN transitions have the following form:

$$Z_0 = \langle \{B_0, D_Q\}, \{B_0, D\}, R_0, M_0, \vee (B_0, D_Q) \rangle.$$

The transition's condition and the index matrices of the capacities of transition arcs are:

$$R_0 = \begin{array}{c|cc} & B_0 & D \\ \hline B_0 & \text{true} & W_0 \\ D_Q & W_Q & \text{false} \end{array}, \quad M_0 = \begin{array}{c|cc} & B_0 & D \\ \hline & \infty & 3 \\ & 1 & 0 \end{array},$$

where:

W₀ = "A subject has been chosen",

W_Q = "A choice of new subject is necessary"

The α-token obtains the characteristic "subject D_i" in place D_i (i = 1, ..., n).

$$Z_1 = \langle \{D, B_1\}, \{D_1, D_2, D_3, D_4, B_1\}, R_1, M_1, \vee (D, B_1) \rangle.$$

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

$$R_1 = \begin{array}{c|ccccc} & D_1 & D_2 & D_3 & D_4 & B_1 \\ \hline D & \text{false} & \text{false} & W_3 & W_4 & W_5 \\ B_1 & W_1 & W_2 & \text{false} & \text{false} & \text{true} \end{array},$$

$$M_1 = \begin{array}{c|ccccc} & D_1 & D_2 & D_3 & D_4 & B_1 \\ \hline D & 0 & 0 & 1 & 1 & 1 \\ B_1 & 1 & 1 & 0 & 0 & \infty \end{array},$$

where:

W₁ = "The specialties which learn the chosen subjects are defined",

W₂ = "The lectures, seminars and laboratory work classes for the specialties which will learn the chosen subject have been defined",

$$W_3 = W_4 = W_0,$$

W₅ = "Specialty t learns the chosen subject" (t=1, ..., w).

The α₁-token which enters place D₁ obtains the characteristics "subject D_i: specialty t, semester v" (t=1, ..., w), w-number of specialties (v=1, ..., s_t), s_t-number of semesters for specialty t. The α₂-token which enters place D₂ obtains the characteristics "subject D_i: specialty t, semester v, l_i – lectures, s_i – seminars, u_i – laboratory work classes". The α-tokens which enter place D₃ and D₄ do not get new characteristics.

$$Z_2 = \langle \{D_1, B_2\}, \{B_2, D_G\}, R_2, M_2, \vee (D_1, B_2) \rangle.$$

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

$$R_2 = \begin{array}{c|cc} & B_2 & D_G \\ \hline D_1 & W_{1,2} & \text{false} \\ B_2 & \text{true} & W_G \end{array}, \quad M_2 = \begin{array}{c|cc} & B_2 & D_G \\ \hline D_1 & 1 & 0 \\ & \infty & 1 \end{array},$$

where:

W_{1,2} = "The specialties that study the chosen subject have been defined",

W_G = "The groups that study the chosen subject are defined".

The δ_G-token which enters place D_G and obtains the characteristic "list of the groups: group q, specialty t, semester v, subject D_i" (q=1, ..., g_t), g_t-number of the group in the specialty t, (t=1, ..., w, v=1, ..., s_t).

$$Z_3 = \langle \{D_G, B_G, D_{pr1}\}, \{D_L, D_S, D_U, B_G\}, R_3, M_3, \vee (D_G, B_G, D_{pr1}) \rangle.$$

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

$$R_3 = \begin{array}{c|cccc} & D_L & D_S & D_U & D_{Gr} \\ \hline D_G & \text{false} & \text{false} & \text{false} & W_{DG} \\ B_G & W_{G,L} & W_{G,S} & W_{G,U} & \text{true} \\ D_{pr1} & \text{false} & \text{false} & \text{false} & W_{Gr} \end{array},$$

$$M_3 = \begin{array}{c|cccc} & D_L & D_S & D_U & D_{Gr} \\ \hline D_G & 0 & 0 & 0 & 1 \\ B_G & 1 & 1 & 1 & \infty \\ D_{pr1} & 0 & 0 & 0 & 1 \end{array},$$

where:

$$W_{DG} = W_G,$$

W_{G,L} = "The lecture stream groups in the chosen subject are defined",

W_{G,S} = "The seminar groups in the chosen subject are defined",

$$W_{G,U} = W_G,$$

W_{Gr} = "A change is necessary in the lecture stream groups or in the seminar groups in the chosen subject".

In place D_L and D_S δ_L- δ_S-token get the characteristic: "list of the lecture stream groups in subject D_i: stream group number, list of the groups in the stream" and "list of the seminar groups in subject D_i: seminar group number, list of the groups in the seminar group". δ' and δ_U-tokens, which enter in place B_G and D_U (from place D_G and B_G) do not get new characteristics.

$$Z_4 = \langle \{D_2, B_3\}, \{B_3, D_T\}, R_4, M_4, \vee (D_2, B_3) \rangle.$$

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

$$R_4 = \begin{array}{c|cc} & B_3 & D_T \\ \hline D_2 & W_{2,3} & \text{false} \\ B_3 & \text{true} & W_T \end{array}, \quad M_4 = \begin{array}{c|cc} & B_3 & D_T \\ \hline D_2 & 1 & 0 \\ & \infty & 1 \end{array},$$

where:

$W_{2,3}$ = “The specialties that study the chosen subject, as well as the number of the lecture, seminar and laboratory classes are defined”,

W_T = “The duration of studying the chosen subject is defined”.

The σ_T -token which enters place D_T obtains the characteristic “subject D_i ; duration t_i (specialty t , semester v , l_i -lectures, s_i -seminars, u_i - laboratory work classes)”.

$$Z_5 = \langle \{D_T\}, \{D_{TL}, D_{TS}, D_{TU}\}, R_5, M_5, v(D_T) \rangle.$$

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

$$R_5 = \frac{D_T}{D_T} \left| \begin{array}{ccc} D_{TL} & D_{TS} & D_{TU} \\ W_{GL} & W_{GS} & W_{GU} \end{array} \right., \quad M_5 = \frac{D_T}{D_T} \left| \begin{array}{ccc} D_{TL} & D_{TS} & D_{TU} \\ 1 & 1 & 1 \end{array} \right.,$$

where:

W_{GL} = “The week number of lecture classes in the chosen subject is defined”,

W_{GS} = “The week number of seminar classes in the chosen subject is defined”,

W_{GU} = “The week number of laboratory work classes in the chosen subject is defined”.

The σ_{L-} , σ_{S-} and σ_{U-} tokens, which enter places D_{TL} , D_{TS} and D_{TU} obtains the respective characteristics: “subject D_i , lecture classes: l/t_i ”, “subject D_i , seminar classes: l/s_i ” and “subject D_i , laboratory work classes: l/u_i ”, $\forall i = 1, \dots, n$.

$$Z_6 = \langle \{D_3, B_4\}, \{B_4, D_Z\}, R_6, M_6, v(D_3, B_4) \rangle.$$

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

$$R_6 = \frac{D_3}{D_3} \left| \begin{array}{cc} B_4 & D_Z \\ W_{3,4} & \text{false} \end{array} \right., \quad M_6 = \frac{D_3}{D_3} \left| \begin{array}{cc} B_4 & D_Z \\ 1 & 0 \end{array} \right., \\ B_4 \left| \begin{array}{cc} \text{true} & W_Z \end{array} \right. \quad B_4 \left| \begin{array}{cc} \infty & 1 \end{array} \right.,$$

where:

$W_{3,4}$ = “The chosen subject can be presented in room z ” ($z=1, \dots, y$) (y -number of the rooms in the university),

W_Z = “The rooms’ numbers where the chosen subject can be presented are defined”.

The ξ_Z -token which comes in place D_Z gets characteristic “room number, type of room, (for lectures / seminars / laboratory work), subject D_i ”.

$$Z_7 = \langle \{D_Z\}, \{D_{ZL}, D_{ZS}, D_{ZU}\}, R_7, M_7, v(D_Z) \rangle.$$

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

$$R_7 = \frac{D_Z}{D_Z} \left| \begin{array}{ccc} D_{ZL} & D_{ZS} & D_{ZU} \\ W_{ZL} & W_{ZS} & W_{ZU} \end{array} \right., \quad M_7 = \frac{D_Z}{D_Z} \left| \begin{array}{ccc} D_{ZL} & D_{ZS} & D_{ZU} \\ 1 & 1 & 1 \end{array} \right.,$$

where for $i = 1, \dots, n$:

W_{ZL} = “The lecture rooms’ numbers in the chosen

subject are defined”,

W_{ZS} = “The seminar rooms’ numbers in the chosen subject are defined”,

W_{ZU} = “The laboratory work rooms’ numbers in the chosen subject are defined”.

The ξ_{L-} , ξ_{S-} and ξ_{U-} tokens which come in places D_{ZL} , D_{ZS} and D_{ZU} obtain the respective characteristics: “lecture rooms’ numbers in subject D_i ”, “seminar rooms’ numbers in subject D_i ” and “laboratory work rooms’ numbers in subject D_i ”.

$$Z_8 = \langle \{D_4, B_5\}, \{B_5, D_P\}, R_8, M_8, v(D_4, B_5) \rangle.$$

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

$$R_8 = \frac{D_4}{D_4} \left| \begin{array}{cc} B_5 & D_P \\ W_{4,5} & \text{false} \end{array} \right., \quad M_8 = \frac{D_4}{D_4} \left| \begin{array}{cc} B_5 & D_P \\ 1 & 0 \end{array} \right., \\ B_5 \left| \begin{array}{cc} \text{true} & W_P \end{array} \right. \quad B_5 \left| \begin{array}{cc} \infty & 1 \end{array} \right.,$$

where for $i = 1, \dots, n$:

$W_{4,5}$ = “The chosen subject can be presented by a lecturer p ” ($z=1, \dots, r$), r - number of lecturers in the university,

W_P = “The lecturers who can present the chosen subject are defined”.

The ρ_P -token which enter place D_P obtain the characteristic “name of lecturer in subject D_i (lecture / seminar / laboratory work classes)”.

$$Z_9 = \langle \{D_P\}, \{D_{PO}, D_{PL}, D_{PS}, D_{PU}\}, R_9, M_9, v(D_P) \rangle.$$

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

$$R_9 = \frac{D_P}{D_P} \left| \begin{array}{cccc} D_{PO} & D_{PL} & D_{PS} & D_{PU} \\ W_{PO} & W_{PL} & W_{PS} & W_{PU} \end{array} \right., \\ M_9 = \frac{D_P}{D_P} \left| \begin{array}{cccc} D_{PO} & D_{PL} & D_{PS} & D_{PU} \\ 1 & 1 & 1 & 1 \end{array} \right.,$$

where:

W_{PO} = “The number of the lecturers in the chosen subject is defined”,

W_{PL} = “The lecturers who will read lectures in the chosen subject are defined”,

W_{PS} = “The lecturers who will have seminars in the chosen subject are defined”,

W_{PU} = “The lecturers who will deliver laboratory work classes in the chosen subject are defined”.

The ρ_{O-} , ρ_{L-} , ρ_{S-} and ρ_U tokens which enter places D_{PO} , D_{PL} , D_{PS} and D_{PU} and obtain the following characteristics, respectively: “number of the lecturers in subject D_i ; for lectures / seminar / laboratory work”, “a list of the names of the lecturers in the subject D_i ”, “a list of the names of the lecturers who will deliver seminars in the subject D_i ”, “a list of the names of the lecturers who will deliver laboratory work classes in the subject

D_i ”, for $i = 1, \dots, n$.

$$Z_{10} = \langle \{D_L, D_S, D_U, D_{TL}, D_{TS}, D_{TU}, D_{ZL}, D_{ZS}, D_{ZU}\}, \{D_L, D_S, D_U\}, R_{10}, M_{10}, \vee (\wedge (D_L, D_{TL}, D_{ZL}), \wedge (D_S, D_{TS}, D_{ZS}), \wedge (D_U, D_{TU}, D_{ZU})) \rangle$$

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

$$R_{10} = \begin{matrix} & D_L & D_S & D_U \\ D_L & W_{LL} & \text{false} & \text{false} \\ D_S & \text{false} & W_{SS} & \text{false} \\ D_U & \text{false} & \text{false} & W_{UU} \\ D_{TL} & W_{TL} & \text{false} & \text{false} \\ D_{TS} & \text{false} & W_{TS} & \text{false} \\ D_{TU} & \text{false} & \text{false} & W_{TU} \\ D_{ZL} & W_{ZL} & \text{false} & \text{false} \\ D_{ZS} & \text{false} & W_{ZS} & \text{false} \\ D_{ZU} & \text{false} & \text{false} & W_{ZU} \end{matrix}, M_{10} = \begin{matrix} & D_L & D_S & D_U \\ D_L & 1 & 0 & 0 \\ D_S & 0 & 1 & 0 \\ D_U & 0 & 0 & 1 \\ D_{TL} & 1 & 0 & 0 \\ D_{TS} & 0 & 1 & 0 \\ D_{TU} & 0 & 0 & 1 \\ D_{ZL} & 1 & 0 & 0 \\ D_{ZS} & 0 & 1 & 0 \\ D_{ZU} & 0 & 0 & 1 \end{matrix}$$

where:

W_{LL} = “The lecture stream groups in the chosen subject are defined”,

W_{SS} = “The seminar groups in the chosen subject are defined”,

W_{UU} = “The laboratory work groups in the chosen subject are defined”,

W_{TL} = “The lectures week duration in the chosen subject is defined”,

W_{TS} = “The seminars week duration in the chosen subject is defined”,

W_{TU} = “The laboratory work week duration in the chosen subject is defined”,

W_{ZL} = “The lecture rooms in the chosen subject are defined”,

W_{ZS} = “The seminar rooms in the chosen subject are defined”,

W_{ZU} = “The laboratory work rooms in the chosen subject are defined”,

The ϵ_{L1} -, ϵ_{S1} - and ϵ_{U1} -tokens which enter places D_L , D_S and D_U obtain characteristics: “week occupation of the lecture rooms in subject D_i ; number of stream groups (lists of the group numbers in every stream), number of the classes, room numbers”, “week occupation of the seminar rooms in subject D_i ; number of seminar groups (lists of the group numbers in every group), number of the classes, room numbers”, “week occupation of the laboratory work rooms in subject D_i ; number of the classes, room numbers”.

$$Z_{11} = \langle \{D_L, D_S, D_U, D_{PO}, B_6, D_{pr2}, D_{pr4}\}, \{D_L, D_S, D_U, B_6\}, R_{11}, M_{11}, \vee (\wedge (\vee (D_L, D_S, D_U), D_{PO}), B_6, D_{pr2}, D_{pr4}) \rangle$$

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

$$R_{11} = \begin{matrix} & D_{L_2} & D_{S_2} & D_{U_2} & B_6 \\ D_{L_1} & \text{false} & \text{false} & \text{false} & W_{BL_1} \\ D_{S_1} & \text{false} & \text{false} & \text{false} & W_{BS_1} \\ D_{U_1} & \text{false} & \text{false} & \text{false} & W_{BU_1} \\ D_{PO} & \text{false} & \text{false} & \text{false} & W_{PO_6} \\ B_6 & W_{BL_2} & W_{BS_2} & W_{BU_2} & \text{true} \\ D_{pr2} & \text{false} & \text{false} & \text{false} & W_{pr2} \\ D_{pr4} & \text{false} & \text{false} & \text{false} & W_{pr4} \end{matrix}, M_{11} = \begin{matrix} & D_{L_2} & D_{S_2} & D_{U_2} & B_6 \\ D_{L_1} & 0 & 0 & 0 & 1 \\ D_{S_1} & 0 & 0 & 0 & 1 \\ D_{U_1} & 0 & 0 & 0 & 1 \\ D_{PO} & 0 & 0 & 0 & 1 \\ B_6 & 1 & 1 & 1 & \infty \\ D_{pr2} & 0 & 0 & 0 & 1 \\ D_{pr4} & 0 & 0 & 0 & 1 \end{matrix}$$

where:

W_{BL_1} = “The necessary week occupation of the lecture rooms is defined”,

W_{BS_1} = “The necessary week occupation of the seminar rooms is defined”,

W_{BU_1} = “The necessary week occupation of the laboratory work rooms is defined”,

W_{PO_6} = “The number of the lecturers in the chosen subject is defined”,

W_{BL_2} = “The lecture rooms schedule in the chosen subject is worked out”,

W_{BS_2} = “The seminar rooms schedule in the chosen subject is worked out”,

W_{BU_2} = “The laboratory work rooms schedule in the chosen subject is worked out”,

W_{pr2} = “A change in the rooms schedule is necessary”,

$$W_{pr4} = W_{pr2}$$

The ϵ_{L2} -, ϵ_{S2} - and ϵ_{U2} -tokens which enter places D_{L_2} , D_{S_2} and D_{U_2} obtain characteristics respectively: “sample lecture schedule in subject D_i ; stream group’s number (list of groups), classes (from-to), room number” “sample seminar schedule in subject D_i ; seminar group number (list of the groups), classes (from-to), room’s number” and “sample laboratory work schedule in subject D_i ; group number, classes (from-to), room number”.

$$Z_{12} = \langle \{D_{L_2}, D_{S_2}, D_{U_2}, B_7, D_{pr3}\}, \{D_{L_2}, D_{S_2}, D_{U_2}, B_7, D_{pr1}, D_{pr2}\}, R_{12}, M_{12}, \vee (D_{L_2}, D_{S_2}, D_{U_2}, B_7, D_{pr3}) \rangle$$

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

	D_{L_3}	D_{S_3}	D_{U_3}	B_7	Dpr_1	Dpr_2	
$R_{12} =$	D_{L_2}	false	false	false	W_{BL_2}	false	false
	D_{S_2}	false	false	false	W_{BS_2}	false	false
	D_{U_2}	false	false	false	W_{BU_2}	false	false
	B_7	W_{L_3}	W_{S_3}	W_{U_3}	true	W_{Bpr1}	W_{Bpr2}
	Dpr_3	false	false	false	W_{Bpr3}	false	false

	D_{L_3}	D_{S_3}	D_{U_3}	B_7	Dpr_1	Dpr_2	
$M_{12} =$	D_{L_2}	0	0	0	1	0	0
	D_{S_2}	0	0	0	1	0	0
	D_{U_2}	0	0	0	1	0	0
	B_7	1	1	1	∞	1	1
	Dpr_3	0	0	0	1	0	0

where:

W_{BL_2} = "The lecture rooms schedule in the chosen subject is worked out",

W_{BS_2} = "The seminar rooms schedule in the chosen subject is worked out",

W_{BU_2} = "The laboratory work rooms schedule in the chosen subject is worked out",

W_{Bpr1} = "A change in the lectures tream groups or in the seminar groups in the chosen subject is necessary",

W_{Bpr2} = "A change in the room schedule in the chosen subject is necessary",

W_{L_3} = "The lecture schedule in the chosen subject is worked out",

W_{S_3} = "The seminar schedule in the chosen subject is worked out",

W_{U_3} = "The laboratory work schedule in the chosen subject is worked out",

W_{Bpr3} = "A change in the group schedule is necessary".

The ϵ_{L_3} -, ϵ_{S_3} - and ϵ_{U_3} -tokens which enter places D_{L_3} obtain characteristics: "lecture schedule in subject D_i ; stream number (list of the groups), classes (from-to), room number", "seminar schedule in subject D_i ; group number (list of the groups), classes (from-to), room number", "laboratory work schedule in subject D_i ; group number, classes (from-to), room number". In places Dpr_1 and Dpr_2 the tokens obtain characteristics "lecture stream group number, group numbers / seminar groups number, group numbers" and "stream group / seminar group / laboratory group - classes (from-to), room number".

$Z_{13} = \langle \{ D_{L_3}, D_{S_3}, D_{U_3}, D_{PL}, D_{PS}, D_{PU}, B_8, \{ Dpr_3, Dpr_4, Dpr_5, D_Q, B_8 \}, R_{13}, M_{13}, \vee (\wedge (\vee(D_{PL}, D_{PS}, D_{PU}), Dpr_2), B_8, D_{L_3}, D_{S_3}, D_{U_3},) \rangle$.

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

	Dpr_3	Dpr_4	Dpr_5	D_Q	B_8	
$R_{13} =$	D_{L_3}	false	false	false	false	W_{BL_3}
	D_{S_3}	false	false	false	false	W_{BS_3}
	D_{U_3}	false	false	false	false	W_{BU_3}
	D_{PL}	false	false	false	false	W_{PL}
	D_{PS}	false	false	false	false	W_{PS}
	D_{PU}	false	false	false	false	W_{PU}
	B_8	W_{Bpr3}	W_{Bpr4}	W_{Bpr5}	W_Q	true

	Dpr_3	Dpr_4	Dpr_5	D_Q	B_8	
$M_{13} =$	D_{L_3}	0	0	0	0	1
	D_{S_3}	0	0	0	0	1
	D_{U_3}	0	0	0	0	1
	D_{PL}	0	0	0	0	1
	D_{PS}	0	0	0	0	1
	D_{PU}	0	0	0	0	1
	B_8	1	1	1	1	∞

where for $i = 1, \dots, n$:

W_{BL_3} = "The room and lecture stream group schedule in subject D_i is worked out",

W_{BS_3} = "The room and seminar group schedule in subject D_i is worked out",

W_{BU_3} = "The room and laboratory group schedule in subject D_i is worked out",

$W_{PL} = W_{PL}, W_{PS} = W_{PS}, W_{PU} = W_{PU}$,

W_{Bpr3} = "A change in the group schedule is necessary in subject D_i ",

$W_{Bpr4} = W_{Bpr2}$,

W_{Bpr5} = "The D_i subject schedule is ready",

W_Q = "A choice of new subject is necessary".

The δ_3 - and ξ_4 -tokens which enter places Dpr_3 and Dpr_4 obtain characteristic: "laboratory work group number / seminar group number / stream group number - laboratory work / seminars/ lectures- classes (from-to), room number". In place D_Q α_Q -tokens get the characteristic "new subject". In place Dpr_5 ξ_5 -tokens get characteristic: "The subject D_i ; lectures: stream group number (list of the groups in the stream), classes (from-to), room number, name of the lecturer; seminars: group number (list of the groups), classes (from-to), room number, name of the lecturer; laboratory work: group number, classes (from-to), room number, name of the lecturer".

3. Conclusion

The above presented model can be applied for analysis and management in the process of working out the semester schedule for university classes. The token's characteristics in places B_6 , B_7 and B_8 can be used to gain information from the model about the

schedule of every room, the week schedule of every group and the schedule of every lecturer in the university.

4. References

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