Seventh Int. Workshop on GNs, Sofia, 14-15 July 2006, 25-29

Generalized net model of the process of ordering of university subjects

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1. Introduction

The precise distribution of the order of the university subjects is very important for the quality of the training process. Usually, development of a new training plan and even changes in already existing plans cost a lot of time and resources. The process takes into consideration different conditions and restrictions. Students undertake a range of various disciplines corresponding to their university specialty. In the course of their education they are to be trained as on the respective subjects, as well as given premises for future training subjects, based of the current ones. The courses are strictly connected in an order that only makes their learning effective.

In the present paper we construct a GN representing the process of logical ordering of the study subjects, accounting on the needs of the students' university training.

Let us assume that students be trained over w university disciplines D_1, D_2,…., D_w. Let discipline D_t be represented by token α_t (t 1, 2, …, w) and let it have as parameters:

1. a list of previous disciplines (that should have been taught before the current one),

2. duration H_{D_t} of the training process over discipline D_t.

3. a list of modules that D_t contains. Each module is characterized by a topic and duration (i.e., number of lection hours).

Let training at the university be done over q in number specialties S_1, S_2,…., S_q. scpeciality S_r is interpreted in the GN by token β_r *(r = 1, 2, …, q)*. The following conditions should be considered in the course of training in specialty S_r.

1. The education takes N_{S_r} semesters;
2. k_r in number disciplines are being taught: D_1, D_2,…., D_{k_r}, $k_r \le w$;
3. In the course of education in specialty S_r there have to be undertaken no less than $H_{S_r}^{\min}$ hours and no more than $H_{S_r}^{\max}$.

2. GN model

All definitions related to the concept of Generalized nets (GN) are taken from [1]. The GN, representing the process of ordering of university subjects is shown on Fig.1.

Initially, the GN consist the following tokens:

- w in number α_t-token (in place l_{11}) whit initial and current characteristic

$x_0^{\alpha_t}$ = "D_t; list of previous disciplines; H_{D_t}; list of modules", t = 1, 2, …, w;

- q in number β-token (in place l_3) whit initial and current characteristic

$x_0^{\beta_r}$ = "S_r; N_{S_r}; $H_{S_r}^{\min}$; $H_{S_r}^{\max}$; list of disciplines", r = 1, 2, …, q.

α- and β-tokens will be at their places during the whole time of GN functioning. While they may split into two or more tokens, the original one of those will always remain at its place. Below, we shall omit these characteristics in descriptions of the separate transitions.

Token δ with initial characteristric

$x_0^{\delta_t}$ = "the name of the specialty for which the disciplines will be ordered"

enters place l_1.

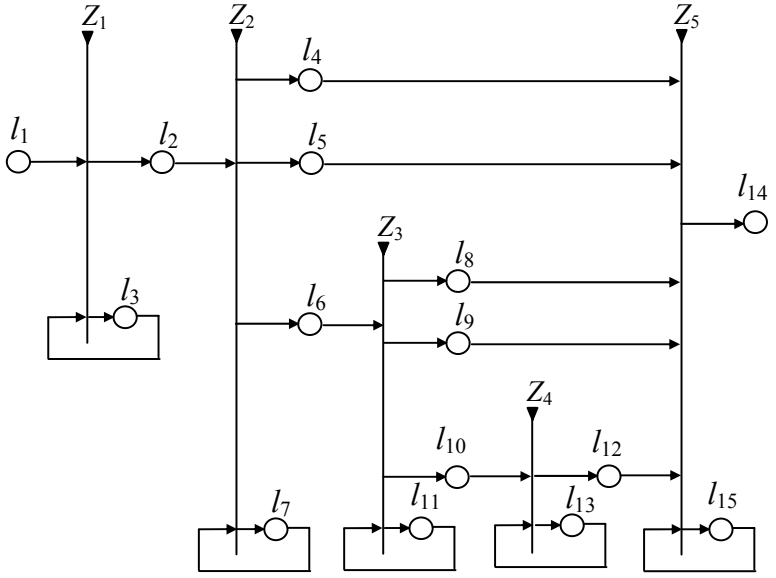

Fig.1. The GN model

Generalized net is presented by a set of transitions:

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

where transitions describe the following processes:

Z_1 and Z_2 – determining of the parameters of specialty S_r *(*$r = 1, 2, \ldots, q$*)* and its parameters.
Z_3 and Z_4 – determining of the disciplines for the respective specialty and their parameters.
Z_5 – order of the disciplines in the semesters.

Transitions of GN-model have the following form. Everywhere r is the specialty's number ($r = 1, 2, \ldots, q$); and t is the discipline's number ($t = 1, 2, \ldots, w$).

$$Z_1 = <\{l_1, l_3\}, \{l_2, l_3\}, R_1, \vee(l_1, l_3)>,$$

where

$$R_1 = \begin{array}{c|cc} & l_2 & l_3 \\ \hline l_1 & false & true \\ l_3 & W_{3,2} & true \end{array},$$

and
$W_{3,2}$ = "Specialty S_r *is determined*".

Tokens that enter place l_2 obtain characteristic

$$x_{cu}^{\beta_r} = "S_r; N_{S_r}; H_{S_r}^{\min}; H_{S_r}^{\max}; \text{list of disciplines}".$$

$$Z_2 = <\{l_2, l_7\}, \{l_4, l_5, l_6, l_7\}, R_2, \vee(l_2, l_7)>,$$

where

$$R_2 = \begin{array}{c|cccc} & l_4 & l_5 & l_6 & l_7 \\ \hline l_2 & false & false & false & true \\ l_7 & W_{7,4} & true & true & true \end{array},$$

and
$W_{7,4}$ = "The minimum and maximum lecture hours per semester are determined".

Tokens that enter places l_4, l_5 and l_6 obtain characteristic respectively:

$$x_{cu}^{\beta'_r} = "\frac{H_{S_r}^{\min}}{N_{S_r}}",$$

$$x_{cu}^{\beta''_r} = "\frac{H_{S_r}^{\max}}{N_{S_r}}"$$

and

$$x_{cu}^{\beta'''_r} = "\mathrm{pr}_3 x_{cu}^{\beta_r}".$$

For each semester $C_{S_r}^1, C_{S_r}^2, \ldots, C_{S_r}^{N_{S_r}}$ of the training over specialty S_r, there must be provided at least $[\frac{H_{S_r}^{\min}}{N_{S_r}}]$ lecture hours and no more than $[\frac{H_{S_r}^{\max}}{N_{S_r}}] + 1$ lecture hours, where $[x]$ is the integer part of real positive number x.

The token that enters place l_7 does not obtain a new characteristic.

$$Z_3 = <\{l_6, l_{11}\}, \{ l_8, l_9, l_{10}, l_{11}\}, R_3, \vee(l_6, l_{11}) >,$$

where

R_3	l_8	l_9	l_{10}	l_{11}
l_6	*false*	*false*	*false*	*true*
l_{11}	$W_{11,8}$	$W_{11,9}$	$W_{11,10}$	*true*

and

$W_{11,8}$ = "There are disciplines which need no premise disciplines to be taught";

$W_{11,9}$ = "Determined are the disciplines, whose premise disciplines have already been ordered";

$W_{11,8}$ = "Determined are the disciplines that are dependant on one another".

The tokens that enter in places l_8, l_9 and l_{10} obtain characteristic respectively:

$$x_{cu}^{\alpha_t'} = " D_1^{S_r}, D_2^{S_r}, ..., D_v^{S_r} ",$$

$$x_{cu}^{\alpha_t''} = " D_{v+1}^{S_r}, D_{v+2}^{S_r}, ..., D_{v+u}^{S_r} "$$

$$\text{and } x_{cu}^{\alpha_t'''} = " D_{v+u+1}^{S_r}, D_{v+u+2}^{S_r}, ..., D_{v+u+z}^{S_r} ",$$

where:

v – number of disciplines that do not have previous ones,

u – number of disciplines whose premise disciplines have already been ordered,

z – number of disciplines, dependant on one another .

The token that enters place l_{11} (from place l_6) does not obtain a new characteristic.

$$Z_4 = <\{l_{10}, l_{13} \}, \{ l_{12}, l_{13} \}, R_4, \vee(l_{10}, l_{13}) >,$$

where

R_4	l_{12}	l_{13}
l_{10}	*false*	*true*
l_{13}	$W_{13,12}$	*true*

and

$W_{13,12}$ = "The disciplines, dependant on one another, are divided into groups".

The token that enters places l_{12} obtains characteristic

"list: group, disciplines".

Disciplines from one and the same group have to be learnt in parallel in one and the same semester.

$$Z_5 = <\{l_4, l_5, l_8, l_9, l_{12}, l_{15} \}, \{ l_{14}, l_{15} \}, R_5, \vee(\wedge(l_4, l_5, l_8, l_9, l_{12}), l_{15})>,$$

where

R_5	l_{14}	l_{15}
l_4	*false*	*true*
l_5	*false*	*true*
l_8	*false*	*true*
l_9	*false*	*true*
l_{12}	*false*	*true*
l_{15}	$W_{15,14}$	*true*

and

$W_{15,14}$ = "The disciplines, dependant on one another, are divided into groups".

The token that enters place l_{14} does not obtain new characteristic.
The token that enters place l_{15} obtains characteristic

"specialty S_r:

semester $C_{S_r}^1$	disciplines
semester $C_{S_r}^2$	disciplines
...	...
semester $C_{S_r}^{N_{S_r}}$	disciplines

".

Conclusion

The GN-model is a next step of the authors' research in the area of university activities modeling (see [2]). It can be extended with subnets representing the processes of training.

References:

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