Research of the Model Characteristics of the Knowledge Dynamic aimed at Increasing the Effectiveness of the Educational Process

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***Abstract**: The basic quantity characteristics of the knowledge dynamic models are presented in this article.A specific kind of net has been chosen – closed net. The determinations of the characteristics of a homogeneous closed net and inhomogeneous net, describing the knowledge dynamic are examined. The purpose of this paper is to research the possibilities for analyze system's behaving by using the instruments of the Petri nets.*

***Key words:** Model characteristic, Education, Petri nets, Knowledge dynamic*

INTRODUCTION

In the educational process students assimilate various parts of the subject matter. Therefore it's very important to manage this process. The more efficient it is the bigger part of the subject is assimilated. According to an author the level of the student training is changing continuously [4]. Because of this, different important characteristics of the knowledge dynamic will be researched.

The educational process is very important and so is his efficiency. In connection with that quantity evaluations of the basic characters have to be created. Design of the macrographs of Petri nets has been offered to make the evaluation process easier. The grouping macro positions correspond to the separate themes that construct the relevant subject.

The purpose of this paper is to offer an easy accessible way for gathering impressions about the quantity dimension of the educational process and discovering potentional opportunities for increasing it's effectiveness.

QUANTITY CHARACTERISTICS OF THE KNOWLEDGE DYNAMIC

The analysis of the quantity characteristics of the knowledge dynamic allows the management of the school process to be optimized. The management optimization is examined this way: assimilation, forgetting and repeating of the school material are forming a casual process. The space of its realizations can be characterized with a certain possibility measure. To take into account the priorities of separate obligatory or additional terms in assimilation of certain topics, weight coefficients of the arcs in the Petri nets showing the school process on this topic are initiated. The next stage represents the learning of several topics from the school material in one school subject. Determining the steps in learning the topics must take into account the succession of some knowledge parts from one topic to another. This forces the introducing of one more kind of weight coefficient, which is the volume of inherited knowledge from the previous to current topics. The character of these weight coefficients is probability, of course. Because of the condition that it is obligatory to assimilate a term during a given stage from a previous topic, these possibilities can be only conditional.

Each combination of realizations of the casual process and the corresponding control have a quality parameter (stage of usefulness). Therefore, the task for optimization of the school process management is reduced to syntheses of the strategy of obligatory process management, which can guarantee extreme value of the quality parameter.

ASSIGNMENT THE PERFORMANCES OF A HOMOGENOUS CLOSED NET, DESCRIBING THE KNOWLEDGE DYNAMIC

The homogenous closed net describes studying on a topic from a current school subject. Such system is previewed in [2] and the corresponding Petri net /with weight factors of the arcs/ is given on Figure 1.

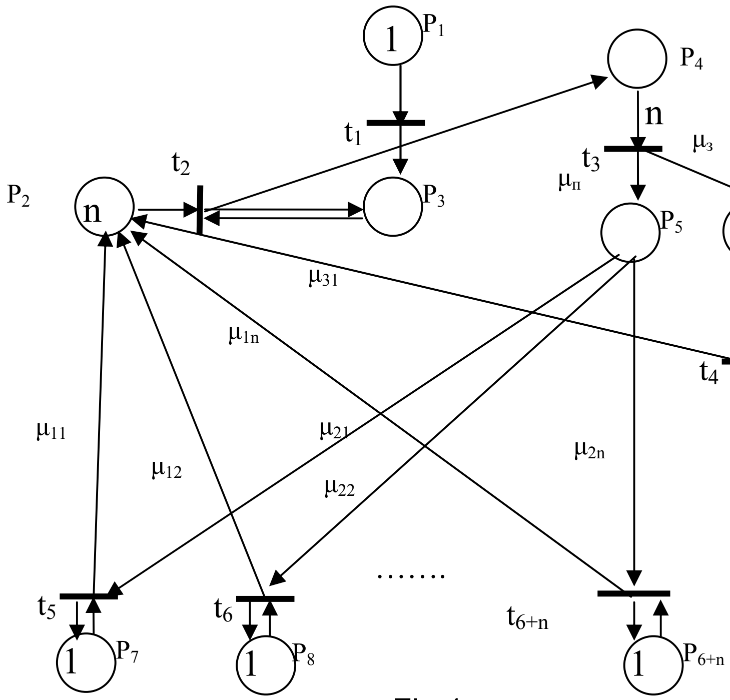

Fig.1

With p is registered the current number of the terms that have to be assimilated. The coefficient μ with first index 2 has to be with lowest possible value for the most obligatory term that has to be assimilated. Its value increases with decreasing the importance of the term in this school subject. Assigning values to the coefficients μ with first index 1 is in a reciprocal way, because it's about an opposite process – forgetting. With $\mu_{п}$ and μ_3 are registered respectively the probabilities for once more assimilating and for forgetting the terms that have to be assimilated. To ensure correct input conditions to working the net instead of the values of r, $\mu_{п}$ and μ_3 it's necessary only a mark to be marked in all positions from p_7 up.

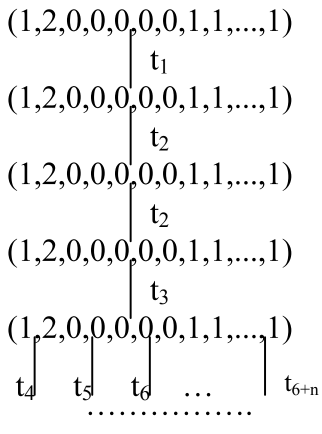

Fig.2.

On Figure 2. the reachability tree for the status when r=2 and the initial marking is M_0=(1,2,0,0,0,0,0,1,1,...,1). is shown.

In the net analyses for evaluation of the knowledge dynamic usage of the normalizing coefficient is also recommended. For opened nets this constant has a simple layout, and for the closed nets because of the complexity of the knowledge dynamics it is the sum of a product. The number of the addends in this sum is equal to the dimension of the status space of the net. For example, for the case of homogenous closed net the size H is:

$$H(N,M) = C_{N+M-1}^{M-1}, \text{ where}$$

(t)= $(n_1(t), n_2(t), \dots, n_M(t))^T$ is a multidimensional vector of the casual process, consisting of the number of the terms on the stage S1 at a moment t.

Increasing the number of the stages M increases the dimension of the status space very fast. As a result from all this the immediate definition of the normalizing coefficient can turn out practically impossible. Because of this a necessity appears for special methods for defining the stationary possibility of the status vector and other properties of the closed nets. They can be based on the usage of the Buzen recursive algorithm. This algorithm is reduced to consecutive filling of a table, containing M columns and N+1 rows. The decision of the system based on equations is as accurate as the constants assigned in advance. Because of this the value of the normalizing constant is calculated by taking into account the specific for the assigned case conditions.

When using different stages of knowledge dynamic detailing at separate students or a group of students different net models can be used and because of this the characteristics of these net models can vary in the borders of an error.

When working with knowledge dynamic describing models the concepts of equivalence and tolerance are introduced. Two models are called equivalent if their properties are identical. If the differences between the properties of two models are not bigger than the admissible error tolerances, then such models are called tolerant or similar.

DEFINING THE PROPERTIES OF AN INHOMOGENEOUS NET WHICH IS DESCRIBING THE KNOWLEDGE DYNAMIC

An inhomogeneous closed system describes the education of one discipline, which includes several topics. Such a system is previewed in [2]. The specific characteristics here are:

- the graph of the net is a macrograph
- every position is a macroposition and represents the graph for assimilation of each topic.

The accepted symbols are not about the concepts, but about the separate topics, constructing the discipline. The closed net allows the system to be examined on a different surface as well. For example, let Pij(r) be the possibility the terms from class r of the school material to finish the process of the stage Si and pass to stage Sj, and nir is the count of the terms from r-th class of the stage Si of the net.

Then the quantity n_{ir} is influenced by different conditions, which are reflecting the status of the system. Some of those conditions can be obligatory, and some – not. For example, when the transfering from one stage to another the term class can be changed, then in the general case the number of the terms in the r-th class in the net can be changed. The nets with possibilities of changing the term class can be led down to equivalent ones with lack of this kind of possibilities.

For this purpose the set of classes is broken down to unintercepting subsets.

If in the net the term class is not changed, then everything from the mentioned subsets has identical term class.

Until now it was supposed that all N terms are equally important for the student. In the basic case this is not true. Depending on the importance stage, the terms can own different priorities as in assimilating and as in knowledge recovering.

Let there be two classes of priorities– 1 and 2, and the terms from the first class are with higher priority than these from the second class (the lower number corresponding to a higher). Besides, the first class consists N1 terms, but the second – N2. Therefore, the total number of terms is N = N1 + N2. In the terms of Petri nets this will lead to realization of this branch of the net, which arc possesses a lower weight coefficient.

If we examine a case of a two class system, then when a term with higher priority from first class is input, the assimilation of the lower priority, can be cancelled (this is the so called absolute priority), and to be put in the beginning of the row with terms from the second class.

The student can be in one of (N1 +1)(N2 +1) $E_{i,j}$ statuses,where (i=0,N1, j=0, N2), and $E_{i,j}$ is a status, when the student doesn't know i number of terms from the first class and j number of terms from the second class.

If $\mathbf{z_{11}}$ and $\mathbf{z_{12}}$ represent the intensity of the forgetting term from first and second class respectively, and $\mathbf{z_{21}}$ and $\mathbf{z_{22}}$ represent the intensity of the knowledge recovering respectively, then the change in the student knowledge can be represented with a markov process (in zij the first index i shows the stage number, and the second – j – the term class number). From here a schedule for the student transitions from one status to another can be composed, and on it to compose a differential equation system. From this system there can be found, for example, the stationary possibilities $\mathbf{l_{ij}}$

From this system, for example, the stationary probabilities $\mathbf{l_{ij}}$ for staying of the student into different situations are expected to be found. Later, quantity characteristics about the quality of the training can be found.

If the mathematical expectation about the number of the forgotten terms in the first class is L_1, and the second one – L_2 , than for all the forgotten terms we get $L = L_1 + L_2$. The intensity of the terms streams who enter and exit the S_1 stage are equal. As a result, the average amount of the terms processing during the S_1 stage can be found.

CONCLUSIONS

The advantage of using Petri net is the opportunity of analyzing the system's behavior and researching it.

The quantity valuation of the characters for the quality of the teaching process has always been serving to determinate the student's position depending on the level of the assimilated knowledge. On the other side, it can also serve to show the direction that the work must be done to, in order to correct or to upgrade the level of the student's qualification. That is why he can be continued to be taught or not.

REFERENCES

[1] Filipova, K., Sv. Stefanova, Defining the Performances of the Knowledge Dynamic Models, Annual School.Lectures- 2003, 3-5, vol.23, number 1, Sept 2001/2003.

[2] Filipova, K., Sv. Stefanova, Net Models of Knowledge Dynamic, Annual School.Lectures- 200,; 29-32, vol.23, number 1, Sept 2001/2003.

[3] Stefanova, Sv., K. Filipova, I. Zheliazkova, A Technology for Teaching by Means of an Intelligent Animation Environment, Annual School.Lectures- 2003, 17-19, vol.23, number 1, Sept 2001/2003.

[4] Sviridov A.P., I.A. Shalobina, Net models of knowledge dynamic, Moskva, MEI, 1992.

[5] Yulin Y. A Petri net model for temporal knowledge representation and reasoning, IEEE. Trans. On Systems, Man. And Cybernetics, v. 24, 9, 1994.

[6] Кр.Филипова, Св. Стефанова, Методът на Свиридов за ефективна организация на учебния процес, First International Conf. "Challenges in Higher Education in the 21st Century", pp.48-50, may, Sozopol, 2003

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