

MODELLING SOME ELEMENTS OF THE THE PROCESS IN E-LEARNING WITH PETRY NETS

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Abstract. In the article are represented by Petri nets some significant moments of the use of "Automated system for practical web-based training" that is developed by the author. Such training situations are: solving problems of varying levels of sophistication and student's knowledge development through support. Explained the necessity of the proposed approach.

Key words: Petri net, system for practical learning, modeling process of knowledge.

1. Introduction

Gone is euphoric period of application of e-learning, when relying on the natural interest of students to new technologies. Jay Cross (Mason, Renie 2006) said: "We thought we could take the instructors out of the learning process and let workers gobble up self paced (i.e. do not expect help from us) lessons on their own. We were wrong. The first generation e-learning was a flop." To develop highly effective web-based learning programs is necessary for their design to take into account the psychological characteristics of students. For a better understanding of the necessary elements of training programs of their developers are required appropriate means. One such tool are the Petri nets through which conveniently are represent the parallel processes to develop students' knowledge through the use of Internet-based training tools.

2. Petri nets

Petri nets have the name of its founder Carl Adam Petri. They are specifically designed for modeling of systems with interacting and competitive components (Romanski 2008).

2.1. Formal definition

A Petri net can be defined as an ordered triple PN, involving the sets:

A set of elements, called "places" $P = \{p_1, p_2, \dots, p_m\}$;

A set of elements, called "transitions" $T = \{t_1, t_2, \dots, t_n\}$;

A set of the relations, called "arcs" $F \in (P \times T) \cup (T \times P)$.

The set F includes ordered pairs of type (p, t_j) , defining two functions:

$I: P \rightarrow T$, called input function which defines the input positions for each transition and

$O: T \rightarrow P$, called output function which defines the output positions for each transition.

Example 1:

Let the sets P and T are given, as $P = \{P_1, P_2, P_3, P_4\}$ and $T = \{t_1, t_2\}$.

The input function is: $I(t_1) = \{P_1\}$, $I(t_2) = \{P_2, P_3\}$ The output function is: $O(t_1) = \{P_2, P_3\}$, $O(t_2) = \{P_4\}$.

2.2. Graph definition

For the definition of a Petri net can be used targeted multi-graph with peaks, the elements of the sets P , T , and edges defined depending on the functions I and O . Positions are graphically represented by a circle and transitions are graphically represented by with segment, rectangle or square.

Example 2:

Presented graphically Petri net defined in Example 1 and is given on Fig. 1. The image is from (accessed online 2012).

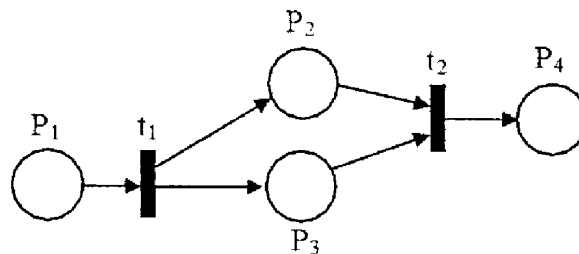


Fig. 1: Petri net defined in Example 1

2.3. Petri nets marking

A mark is a fundamental concept of Petri nets, like positions and transitions. It appears as a point in the circles that represent positions in the net.

The presence of markers in positions reflect the level of implementation of the conditions for occurrence of events.

The implementation of Petri nets is controlled by the number and distribution of markers in the network. Petri nets is implemented by so-called firing of transitions. A transition is enabled (it may fire) only if authorized. Firing consists in moving the markers from input positions for the transition and creating new markers that are distributed in its output positions

3. Modeling by Petri nets of some elements of the Automated system for practical web-based learning

Higher mental functions are represented by the knowledge which are designated as Knowledge from The area for near development of knowledge and Knowledge of the area of the current development of knowledge. It was stated that by action, after

sufficient time, all knowledge from The area for near development of knowledge passes to The area of the current development of knowledge. In Automated systems for practical web-based learning, the activities for development of knowledge are solving tasks. To enable the knowledge from these tasks to consistently come in The zone for near development of knowledge and in The zone of the current development of knowledge they need to be tackled with care, should be given tasks and solved similar problems that include as subtasks already solved.

This concludes that the system of tasks should include:

- Tasks to be applied directly to the properties of the target object (problems from Level 1);
- Tasks, whose decisions are analogous to the solutions of the first group (problems from Level 2);
- The third, highest level of development of the student knowledge correspond with the tasks in which students can purposefully, through reasoning, to reach new knowledge of the target object (problems from Level 3).

Detailed, the implementation of psychological principles to the development of knowledge of students in the system for web-based education is discussed in (Ganchev 1999), (Dimitrova 2001).

3.1. Modeling by Petri Nets of the development process of knowledge when using an Automated system for practical web-based learning

Nodes of the Petri net are:

3BP (ZND) -Zone for Near Development of knowledge;

3AP (ZAD) -Zone for Actual Development of knowledge;

Z1 – Problem 1;

Z2 – Problem 2;

Z3 – Problem 3;

Z4 – Problem 4;

Z5 – Problem 5;

Z6 – Problem 6;

PZ1 – Sub-task 1;

PZ2 – Sub-task 2;

P1 – Problem 1 is solved or the student needs help;

P2 – Help for solving Task 4;

R2 – Problem 5 is solved;

R3 – Problem 4 is solved;

R4 – Problem 6 is solved.

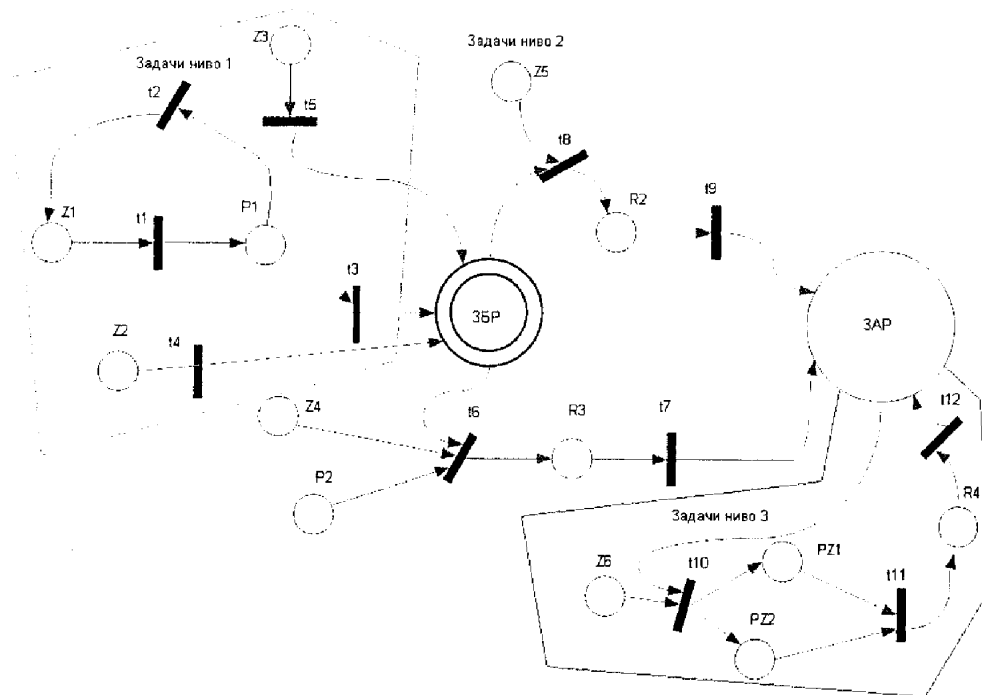


Fig. 2: Petri net for development process of knowledge

Transitions of Petri net are:

- t1 – The student solves Problem 1;
- t2 –Student gets help from an automated training system;
- t3 –Expansion of the Zone for Near Development of knowledge with the knowledge obtained after solving Problem 1;
- t4 - Expansion of the Zone for Near Development of knowledge with the knowledge obtained after solving Problem 2;
- t5 - Expansion of the Zone for Near Development of knowledge with the knowledge obtained after solving Problem 3;
- t6 - Solving Problem 4, using the knowledge of the ZND and the help of P2;
- t7 –Expanding the Zone for Actual Development of knowledge;
- t8 - Solving Problem 4, using the knowledge of the ZND and decision of the analogue Task 3
- t9 - Expanding the Zone for Actual Development of knowledge;
- t10 –Decomposition of decision the Task 6 on components: Sub-task 1 and Sub-task 2
- t11 - Solving Problem 6;
- t12 - Expanding the Zone for Actual Development of knowledge;

3.2. Modeling with Petri Nets the process solving problems from Level 1

The process of solving problems of Level 1 of development of knowledge is presented on Fig.3.

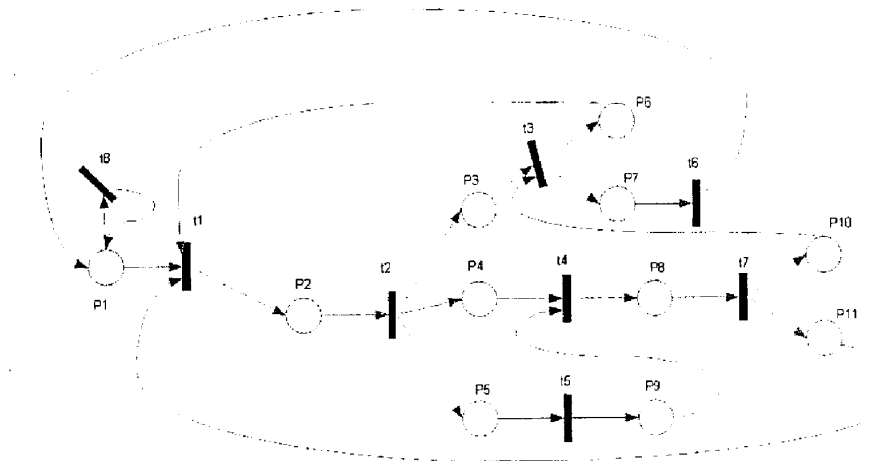


Fig. 3: Petri net for solving problems of Level 1

Nodes of the Petri net are:

- p1 ~ Student - in the page with tasks;
- p2 ~ The student has chosen task;
- p3 ~ The student has chosen to consider the judgment;
- p4 ~ The student has chosen to solve the task;
- p5 ~ The student has chosen to read the help;
- p6 ~ The student has understood the decision;
- p7 ~ The student has not understood the decision;
- p8 ~ The student has solved the problem;
- p9 ~ The student has understood the instructions;
- p10 ~ The student has not decided the task;
- p11 ~ The student has correctly decided the task.

Transitions of Petri net are:

- t1 ~ The student selects a task;
- t2 ~ The student selects the task;
- t3 ~ The student examines the decision;
- t4 ~ The student solves the problem alone;
- t5 ~ The student gets acquainted with the directions;
- t6 ~ Return to the page with tasks;
- t7 ~ The student verifies, that the problem was solved true;
- t8 ~ Study of the theory.

- t6 – The student choose whether to proceed with the task or try to solve new task;
 t7 – Study of the theory.

3.4. Modeling with Petri Nets the process solving problems from Level 3

The process of solving problems of Level 3 of development of knowledge is presented on Fig.5.

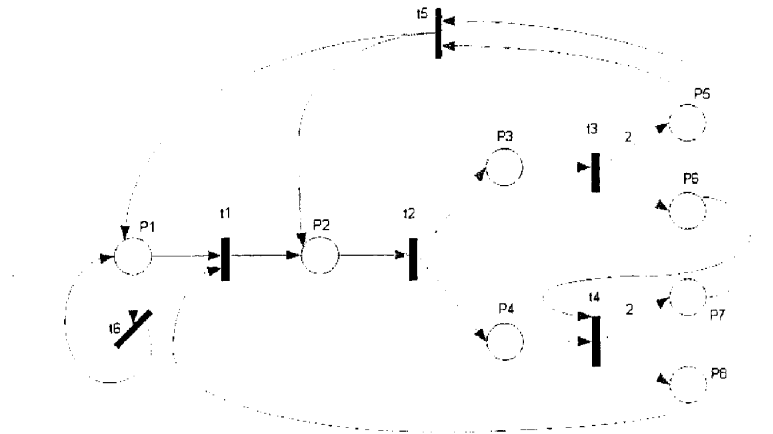


Fig. 5: Petri net for solving problems of Level 3

Nodes of the Petri net are:

- P1 - Student - in the page with tasks;
 P2 – The student has chosen task;
 P3 – The student has chosen to solve the task, but he not so confident in the way, therefore he wants to review interim results;
 P4 - The student has chosen to solve the task;
 P5 – The student has not received intermediate results;
 P6 – The student has received intermediate results;
 P7 – The student has not decided the task;
 P8 – The student has correctly decided the task.

Transitions of Petri net are:

- t1 – The student selects a task;
 t2 - The student choose how to solve the task;
 t3– The student gets acquainted with intermediate results;
 t4 – The student solves the problem alone;
 t5 – Study of the theory.

4. Conclusions

Petri nets can be used for modeling of such processes in which the quantitative accumulations (represented as a sufficient number of markers) lead to qualitative changes (activation transitions). The article gives examples of appropriate modeling of the processes of development of knowledge by solving problems organized into a system of tasks with different difficulty level.

Opportunities for access to training materials via mobile devices poses to developers of training programs, new challenges. The main objective can no longer remain the delivery of content, but must be the development of knowledge and creativity of students.

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