

Developing a Learning Notification Express Delivery Service for Students based on Petri-Net

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Abstract

This paper designs a learning notification express delivery service for providing students information about their learning status, their next learning activities, and even reminder notes. The learning notification express delivery service uses Petri-net for modeling learning activities. In order to make students knowing what status they are and what activities they need to do during the learning process, a learning planner is also developed to make teachers feel more comfortable in planning their teaching schedule.

Keywords: Petri-net, Computer Assisted Learning, Learning Feedback

Petri-net is a directed, bipartite graph in which nodes are either transitions or states and could be defined as:

$$P(\text{Petri-net}) = (T, S, A)$$

S is defined as a set of states (s_i) presenting as a state or a condition. The state number in a Petri-net P can be denoted as n . When a state is transformed from one state to another, the transformation event is called as a transition, which is denoted as

$$t_{n+k} \in T, \text{ where } k > 0$$

The last part, A , is a set of arc connecting states and transitions.

This paper develops a learning notification delivery service to give students useful information about when and what learning activity they should do. Figure 1 shows a practical learning activity example, "Delivering Homework", based on Petri-net modeling. When a token is at s_1 , the student has no homework. After teacher assigns a homework (t_5), the token would

be transited to s_2 (have homework). If the student delivers his/her homework on time (t_8), the token would go to s_4 (homework finished). Otherwise, if the student could not finish it before the deadline (t_6), the token would go to s_3 , "Homework Tardiness" state.

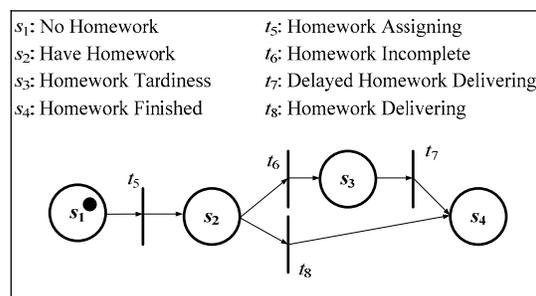


Figure 1. Using Petri-net to analyze the "Delivering Homework" learning activity

Some additional states and transitions are added into the original Petri-net-based learning activity to make the learning notification express delivery service get knowing what kind of information should be used to inform the student. Figure 2 shows additional two states and three transitions are added into the original Petri-net and insert between the transition t_{n+k} and the destination state s_j , where s_{n+k}^r is a state to check the notification rule used by the transition t_{n+k} .

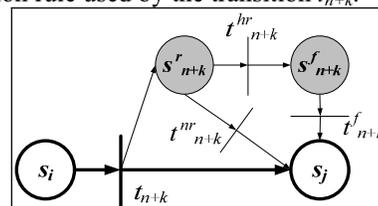


Figure 2. Decision process example of the learning notification express delivery service

If there is no rule here, the token would be able to go to the destination state s_j through the transition t_{n+k} . If there is any rule for the transition t_{n+k} , the

token would be sent to the state s_{n+k}^f through the transition t_{n+k}^{hr} (has notification rule(s) for the transition t_{n+k}). s_{n+k}^f is a decision state to decide which the notification rule for t_{n+k} should be fired. After the learning notification express delivery service sends a short message to the student via mobile phone, the token then transfer to the destination state s_j automatically through the transition t_{n+k}^f .

To make teachers feel comfortable to use the service, a learning planner is also implemented. For this reason, some additional variables should be considered. Figure 3 is a complete Petri-net-based learning notification express delivery service. The bold lines represent the main learning process. Each transition (from t_5 to t_8) would cause additional related states and transitions with normal line. A variable, f_{n+k} , is used to indicate whether the notification action should be activated or not (just like $f_5 \sim f_8$ in Figure 3). Other useful variables such as check point (c_x) is also added in the learning planner marked as blocks with dotted line. This variable is used for teacher setting the triggering-time of each feedback function.

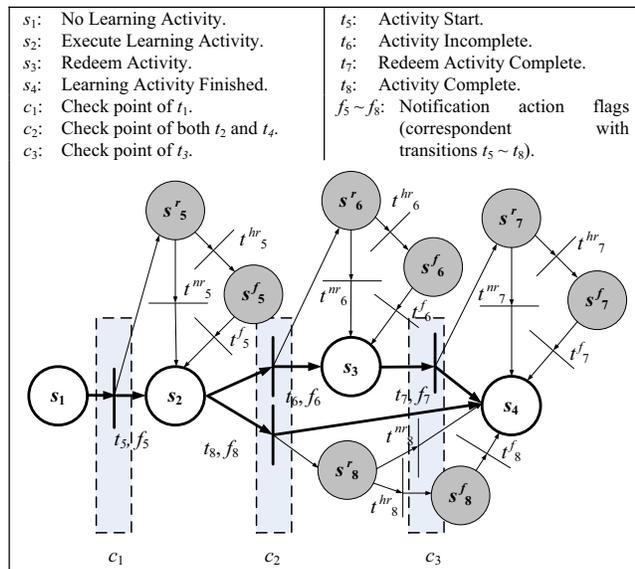


Figure 3. Learning Process Model

Figure 4 is a learning plan example according to Figure 3. The first column is the parameters needed in the learning process model and the second column is an example. The first two parameters (title and content) are the learning plan descriptions. The learning flow controller uses the three check point settings inside the bold table frame. The rest parameters are notification action flags. If teachers do not want the service delivers learning notification to students at a transition,

they could dis-check the correspondent notification action flag.

Parameters	Value
Title	Homework 1
Content	Finds out three types of notebook.
Start Time (c_1)	2006/01/10
End Time (c_2)	2006/01/13
Redeem Deadline (c_3)	2006/01/16
Activity Start Notification (f_5)	<input checked="" type="checkbox"/>
Activity Incomplete Notification (f_6)	<input checked="" type="checkbox"/>
Redeem Notification (f_7)	<input type="checkbox"/>
Activity Complete on time Notification (f_8)	<input type="checkbox"/>

Figure 4. Parameters example of learning activity in "Homework" learning plan

In the end of this paper, Figure 5 shows an example for two students passing through different ways after the teacher creating a new learning process based on Figure 4 and Figure 5 on 2006/1/7. Both Alex and Buddy stayed at the state - "No Learning Activity (s_1)" from 2006/1/7 to 2006/1/9. When the date 2006/1/10 came, Alex and Buddy passed through the transition "Activity Start (t_5)" and stayed in the state - "Execute Learning Activity (s_2)". Because the "Activity Start Notification (f_5)" is checked, students would receive a notification notes from the system. On 2006/1/13, Alex had already delivered his homework and went to the state - "Learning Activity Finished (s_4)" through the transition "Activity Complete (t_8)" without any notification, because the notification action flag f_8 was dis-checked according to Figure 4.

Date	1/7 ~ 1/9	1/10 ~ 1/12	1/13 ~ 1/15	1/16
Student	s_1	t_5	s_2	t_8, s_4
Alex	s_1	t_5	s_2	t_6, s_3, t_7, s_4
Buddy	s_1	t_5	s_2	t_6, s_3, t_7, s_4

Figure 5. Example of two students' learning processes based on the predefined learning plan

Buddy didn't finish the homework on time, so he would be forced to go to the state - "Redeem Activity (s_3)" through the transition "Activity Incomplete (t_6)". He would also receive a remind message from the service, because the notification action flag f_6 ("Activity Incomplete Notification") was checked. After Buddy delivered his homework, the system would check the homework delivering status on 2006/1/16 and transferred him to the state - "Learning Activity Finished (s_4)" through the transition - "Redeem Activity (t_7)".