English

B^2 Model: A Browsing Behavior Model Based on High-Level Petri Nets To Generate Behavioral Patterns for E-Learning

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The Internet use has promptly proliferated in these years, causing e-learning systems to become increasingly popular. Developing an e-learning system with high quality, such as with intelligence and/or adaptive, has become a trend. In general, to verify or test the effect of an e-learning system, the researchers need to collect large amounts of learners' browsing behavioral patterns. However, collecting sufficient behavioral patterns usually takes a great deal of time and effort. This paper has proposed the browsing behavioral model, B^2 model (Fig. 1), to model and to generate students' behavioral patterns. The experimental results have confirmed that the generated behavioral patterns based on the B^2 model are similar to the browsing behaviors of actual students. In terms of practicability, the generated behavioral patterns based on the B^2 model can serve as test data to validate the accuracy of an intelligent tutoring system. Therefore, the B^2 model can facilitate the verification process of an intelligent tutoring system. In this purpose, since the B^2 model is used to generate the behavioral patterns for system verification, the parameters which contain the average and variation values of the browsing time a student remains in a learning unit (BT), the time that a student undertakes an assessment (AT), and the score that a student is assigned for an assessment (AS), which are defined in the equations proposed in the paper, can be randomly set or be assigned according to the requirement of verification. For application, the B^2 model is capable of predicting learning content that enables students to thrive in adaptive learning environments. For the purpose of prediction, the behavior of a few students needs to be collected to simply analyze the characteristics of students. The simply analyzed result can be used as a reference for which the average and variation values of BT, AT and AS defined in our proposed equations can be assigned. To verify the feasibility and practicability of the B^2 model a tool was accompanied to develop in this research (Fig. 2).

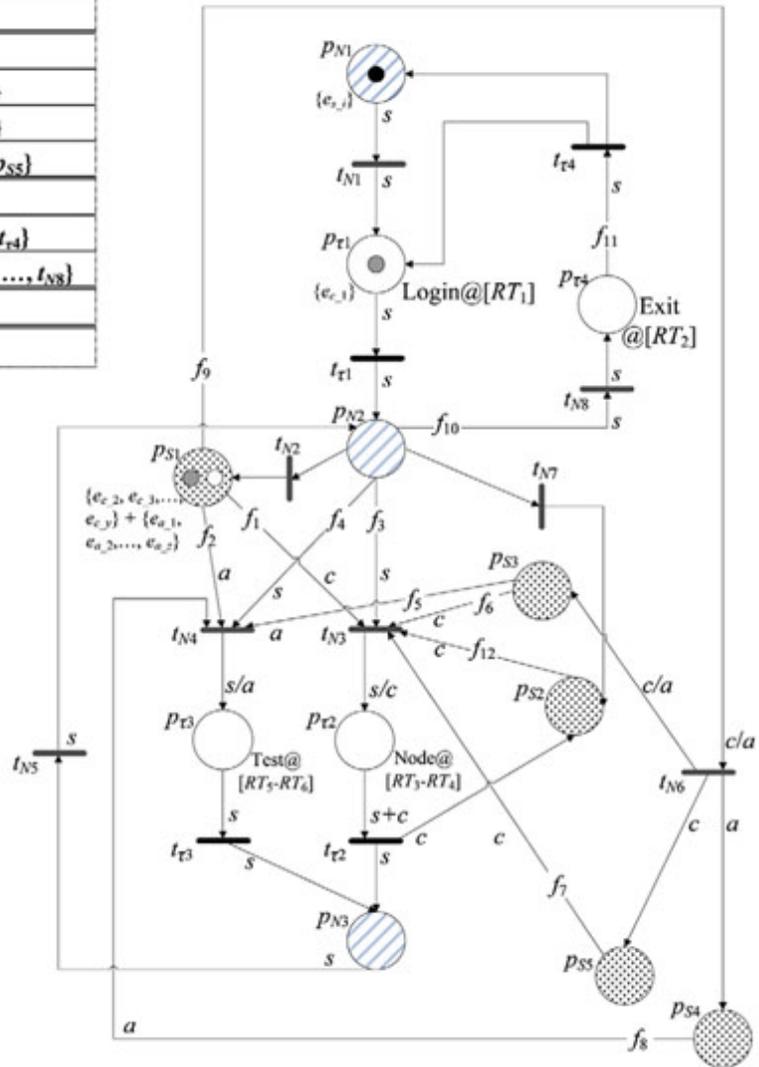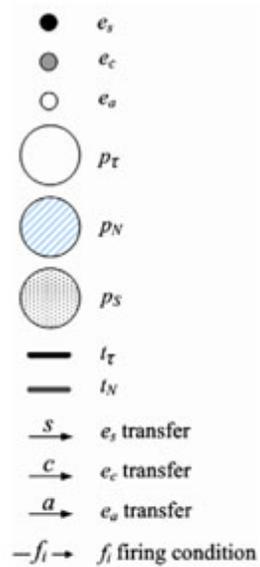| The Components of the B^2 Model |
|---|
| 1. Color set $\Sigma=\{e_s, e_c, e_a\}$ |
| 2. Place set $P = \{P_\tau, P_N, P_S\}$ |
| 2.1 Time place set $P_\tau = \{p_{\tau 1}, p_{\tau 2}, p_{\tau 3}, p_{\tau 4}\}$ |
| 2.2 Normal place set $P_N = \{p_{N1}, p_{N2}, p_{N3}\}$ |
| 2.3 Source place sets $P_S = \{p_{S1}, p_{S2}, ..., p_{S5}\}$ |
| 3. Transition set $T=\{T_\tau, T_N\}$ |
| 3.1 Time transition set $T_\tau = \{t_{\tau 1}, t_{\tau 2}, t_{\tau 3}, t_{\tau 4}\}$ |
| 3.2 Normal transition set $T_N = \{t_{N1}, t_{N2}, ..., t_{N8}\}$ |
| 4. Weight functions $\{s, c, a\}$ |
| 5. Firing conditions $F=\{f_1, f_2, ..., f_{12}\}$ |

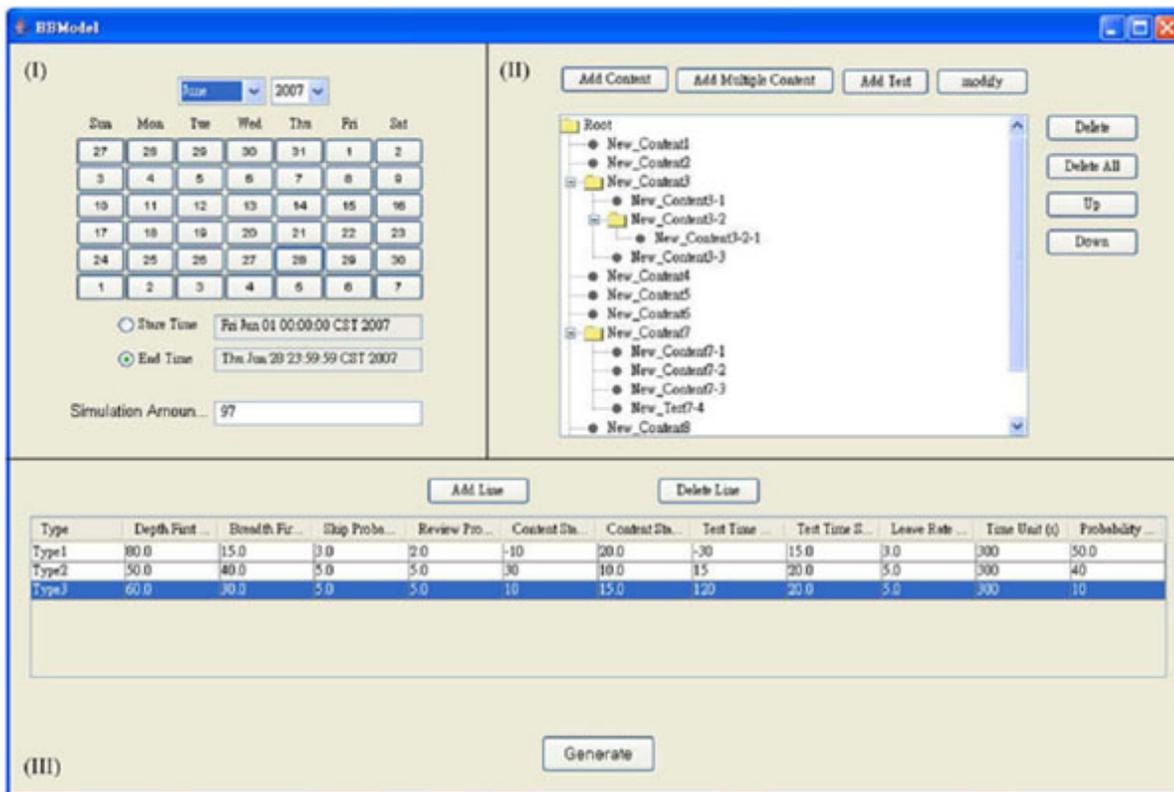Legend:
- e_s
- e_c
- e_a
- p_τ
- p_N
- p_S
- t_τ
- t_N
- $\xrightarrow{s}$ e_s transfer
- $\xrightarrow{c}$ e_c transfer
- $\xrightarrow{a}$ e_a transfer
- $-f_i\rightarrow$ f_i firing condition

Fig. 1

Fig. 2