Journal of Theoretical and Applied Information Technology
10th August 2014. Vol. 66 No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

AN ADAPTIVE WEB-BASED INTELLIGENT TUTORING USING MASTERY LEARNING AND LOGISTIC REGRESSION TECHNIQUES

[1]KUNYANUTH KULARBPHETTONG
[1]Suan Sunandha Rajabhat University, Computer Science Program, Thailand
E-mail: [1]kunyanuth.ku@ssru.ac.th

ABSTRACT

In this paper, we present an Adaptive Web-Based Intelligent Tutoring System using Mastery Learning, Logistic Regression and rule-based Techniques. To create a model for analysis programming skills in each level as specified in the curriculum, Logistic Regression approach was used to predict the probability of pass or the probability of fail of student enrolling in a JAVA Programming Language Course. According to the level of student knowledge, the main function of the system is the ability to automatically adapt and change content by the ability of the learner and also to organize learning contents in order to suit with the learner until he/she can have in terms of required skills. The experimental results showed that rule-based and Logistic Regression approaches can help student learning and reduce time consuming. To evaluate the preliminary prototype system, Black Box Testing and questionnaires were used to measure system performance and user satisfaction respectively. The results were satisfactory as followed: Means for teacher and students were 4.15 and 4.23, and standard deviations were 0.64 and 0.71.

Keywords: *Adaptive; Tutoring System, Mastery Learning* Technique*, Logistic Regression And Rule-Based Technique*

1. INTRODUCTION

Nowadays, with no longer barrier by space and time, a web-based educational system has been increasingly used to support students and teachers. Students can study their interested topics and selected courses though a web-based class to enhance their knowledge at any time and any place and also teachers can easily manage their online classes and monitor student's performance through Internet as well. Although there are many benefits to use web-based educational systems to support in student learning, like information sharing and collaboration between students and teachers in a course, most web-based educational systems can rarely support interactive and adaptive abilities.

To enhance students' learning, intelligent tutoring systems (ITS) are computer programs that are widely implemented so as to support and customized classes automatically without intervention from a human teacher [1]. During the rapid grown of the web technology, Web Intelligence is a promising channel of Artificial Intelligent issues and there are many ITS applications which are developed and applied to use in various educational level. For instance, a web based learning system, ActiveMath, was adapted in Mathematics to enhance long distance learning [2]. Moreover, Mastery learning is termed by Benjamin Bloom. It was based on differentiated and individualized practices, progress monitoring, assessment, and feedback to improve the process of classroom practice [3]-[4].

Therefore, the purpose of this research aims to develop an Adaptive Web-Based Intelligent Tutoring System using Mastery Learning Technique Logistic Regression and rule-based Techniques to support students in learning computer programming courses in case of Suan Sunandha Rajabhat University. Rule based approach and student information were conducted in this project to classify and suggest student's learning. Moreover, this proposed system handled the problems in adjustment learning classes and materials for each student according to student's performance.

The remainder of this paper is organized as follows. Section 2 presents related works used in this work. Section 3 we describe the system architecture based on the purposed model and section 4 shows the results of this experiment.

Journal of Theoretical and Applied Information Technology
10th August 2014. Vol. 66 No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Finally, the conclusion and future research are presented in section 5.

2. RELATED WORKS

A literature search shows that most of the related researchers have developed Adaptive Web-Based Intelligent Tutoring Systems to support learners in different courses by following this: A Web-based intelligent tutoring system, called BITS, was implemented by using a Bayesian network approach to support students in learning computer programming at the University of Regina [5]. E-TCL (an Expert tutoring system for teaching computer programming languages) can support teachers so as to cooperate computer programming language courses together and use agent approach in the project [6]. DEPTHS [7] collected track of every activity performed both by the student and the system to observe activities in the student model and UZWEBMAT [8] was designed, developed and implemented at secondary school level and implemented to teach subjects of probability unit. E. R. Sykes and F. Franek [9] presented "JavaTM Intelligent Tutoring System" (JITS) which was designed for students in their first programming course in JavaTM at the College and University level. According to Biplab Kanti Das and Saurabh Pal [10], the framework of intelligent tutorial system was presented as layered architecture which was assessed the relative performance of adaptive learning system over general classroom learning. The web-based learning system was adopted a hybrid technique with Bayesian Networks, Fuzzy Logic, and Neural Networks and composed in to three layers: the learning management, the learner modeling, and the user interface [11]. There are many models of a web-based intelligent tutoring system which are purposed and implemented [12][13]. The most of related research works concentrate on student's learning knowledge than enhance and analyze student's cognition. Hence, this research was adapted mastery technique with this system.

3. THE PROPOSED APPROACHES

To develop this prototype, Rapid application development (RAD) and Object-oriented principle were applied for using minimal planning in favor of rapid prototyping and users' requirements were used as the significant issue to implement this project based on the needs of users.

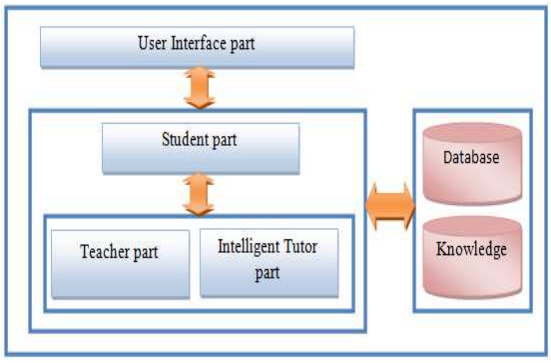

Figure 1: The System Architecture

The architecture of the system consists of 5 parts: the User Interface part, the Student part, the Teacher part and the Intelligent Tutor part, as shown in Figure.1.In the user interface part is consisted of two main functions: providing information to users and displaying diagnostic information. It receives input from the user and sends the information to the related parts for processing. For instance, student can register his/her profile through the user interface module, such as personnel information, email address, username and password, and etc., and he/she is assigned to take pre-test so as to initialize the student profile. According to Z. Jeremić and et al, the performance and learning pattern of student were represented in the Student part and also Comprehension–ability and Problem-solving skill was used to measure in this project [14].

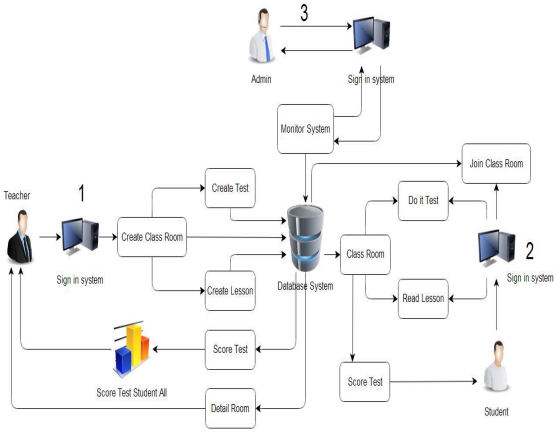

Figure 2: The Overview Of System

The Teacher part allows teachers to set and determine teaching objectives and strategies. Besides, it allows teachers to indicate pre-test, post-

Journal of Theoretical and Applied Information Technology
10th August 2014. Vol. 66 No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

test and tutorial. The questions in this system are both multi-choice quiz and subjective quiz. Pre-test includes the groups of questions to assess prerequisite student's knowledge. Post-test is evaluated the effectiveness of student's knowledge after learning related tutorial. Furthermore, teacher can view students' activities in his/her course. The intelligent tutor part interacts with students and teachers in pedagogy view and teaching strategies. It determines student's individual characteristics and learning styles based on the result score of pre-test. After that the system evaluates his/her comprehensive by the result score of post-test. The repository is composed of database and knowledge as an important pool of learning and testing materials and Fig 2 was shown the overview of system.

To determine the model of student, the analysis of test-taking students was used to choose student into 2 groups: pass and fail.

$$P_r(y=1) = \frac{1}{1+e^{-X}} \quad (1)$$

$$P_r(y=0) = \frac{1}{1+e^{-X}} \quad (2)$$

$P_r(y=1)$ = probability of student pass the content

$P_r(y=0)$ = probability of student fail the content

x = Independent variables

e = 2.17828

and

$$\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n = X$$

When

β= is the intercept and

$\beta_1 \ldots \beta_n$ are the coefficients of interest.

then

$$P_r(y=1) = \frac{1}{1+e^{-X'\beta}} \quad (3)$$

$$P_r(y=0) = 1 - \left(\frac{1}{1+e^{-X'\beta}}\right) \quad (4)$$

$$= \frac{e^{-X'\beta}}{1+e^{-X'\beta}}$$

4. EXPERIMENTAL RESULTS

In this section, experimental results were separated to 2 parts: developing the Adaptive Web-Based Intelligent Tutoring System and evaluating the performance and satisfaction of the application.

4.1 Developing the Adaptive Web-Based Intelligent Tutoring System

The experiment of this system was conducted at Computer Science Program, Suan Sunandha Rajabhat University, with freshman 120 students in Java Programming course I. Figure 3shows the main page of this prototype. In this system, a teacher can create classroom and content. Student can registers in to the system and sends a request to the classroom until a teacher approves. After that student can learn the lesson, view materials and take a test divided in to 2 parts multi-choices and subjective quiz.

Figure 3: The Main Page Of Application

In subjective quiz for testing programming skill, student sends an answer file and the system will compile the answer file and check scores base on ruled base approach. In figure 4 displayed how teacher indicate the model of subjective quiz and figure 5 shown the result of the subjective quiz

Journal of Theoretical and Applied Information Technology
10th August 2014. Vol. 66 No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

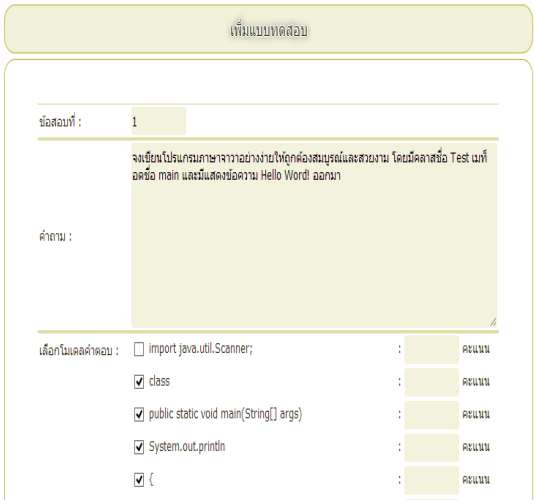

Figure 4: The Example Of Subjective Quiz Page

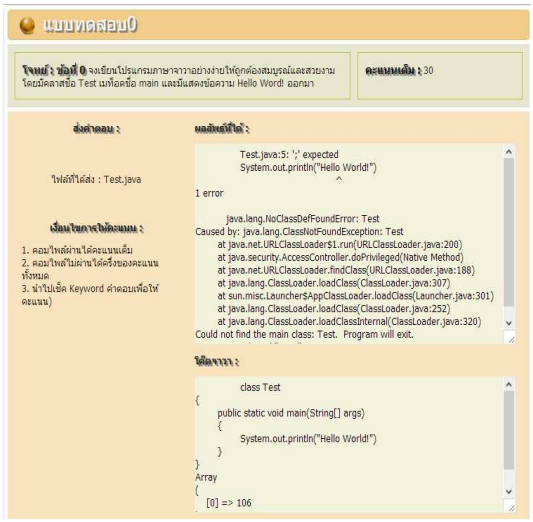

Figure 5: The Example Of Answer Subjective Quiz Page

4.2 Evaluating The Performance And Satisfaction Of The Application

Black box Testing and Questionnaires by teachers and students were used to test and evaluate the qualities of this application. Black Box testing was assessed in the error of the project as following: functional requirement test, Function test, Usability test, Performance test and Security test. The ability of this application was evaluated by Functional Requirement test in needs of the users and Functional test was used to evaluate the accuracy of the system. Usability test was tested the suitability of the system. Performance test was used the processing speed of the system. Finally, Security test was evaluated the security of the system and Table 1 and Fig 5 were shown the results of Black box testing.

Table 1: The Results Of Black Box Testing

	Teachers		Students	
	$\bar{x}$	SD	$\bar{x}$	SD
1.Function Requirement Test	3.71	0.66	4.12	0.71
2. Functional Test	3.96	0.41	3.71	0.66
3. Usability Test	4.23	0.61	3.97	0.64
4.Performance Test	4.02	0.43	3.98	0.54
5. Security Test	4.15	0.61	4.06	0.65
Summary	4.05	0.56	3.97	0.64

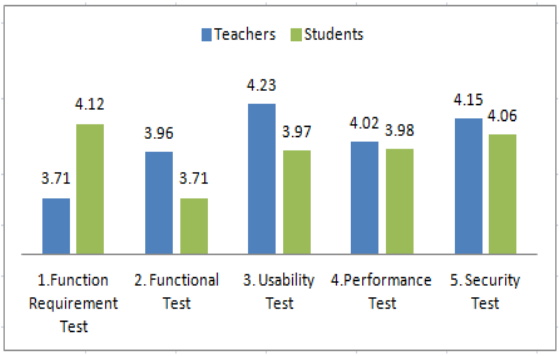

Figure 5: The Results Of Black Box Testing

Means for teachers and students were 4.05 and 3.97, and standard deviation for teachers and students were 0.563 and 0.644 respectively.

4. CONCLUSION AND FUTURE WORKS

This paper presents the preliminary result showing a promising progress in this prototypes model for the ongoing improvement of an Adaptive Web-Based Intelligent Tutoring System. The proposed system can well manage at three stages: pretest, learning, and posttest stages according to student's performance and students can enhance and improve their programming ability and also this system supports teachers in handle and manages their programming course. However, in term of the future experiments, we are looking forward to research about other techniques to enhance this project and the student's learning behavior data will be analyzed to explore the learning behavior pattern so as to suggest the possible direction for improvement student's performance.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

5. ACKNOWLEDGEMENT

The authors gratefully acknowledge the financial subsidy provided by Suan Sunandha Rajabhat University.

REFRENCES:

[1] Joseph Psotka, L. Dan Massey, and Sharon A. Mutter, *Intelligent Tutoring Systems: Lessons Learned*, Lawrence Erlbaum Associates, ISBN 0-8058-0192-81988.

[2] Melis, E. and Siekmann, J., "Activemath: An Intel- ligent Tutoring System for Mathematics", *Proceeding of 7th International Conference Artificial Intelligence and Soft Computing*, Lecture Notes in AI LNAI, Springer-Verlag pp.91-101, 2004.

[3] Bloom, B. S., "Mastery learning", *In J. H. Block (Ed.), Mastery learning: Theory and practice*. Rinehart & Winston, New York, 1971, pp. 47–63.

[4] Zimmerman, B. J., and Dibenedetto, M. K., "Mastery learning and assessment: Implications for students and teachers in an era of high-stakes testing", *Psychology in the Schools*, Vol. 45 Issue 3, March 2008, pp. 206-216.

[5] C.J.Butz, S.Hua, R.B.Maguire., "A web-based bayesian intelligent tutoring system for computer programming", *Web Intelligence and Agent Systems*, Vol. 4 Issue 1, January 2006, pp. 77-97.

[6] El-Khouly, M.M., Far, B.H. and Koono, Z., "Expert tutoring system for teaching computer programming languages", *Expert Systems with Applications*, Vol. 18 Issue 1, January 2000, pp. 27–32.

[7] Z. Jeremic´, J. Jovanovich´, and D. Gaševic´ b, "Student modeling and assessment in intelligent tutoring of software patterns", *Expert Systems with Applications*, Vol. 39, January 2012, pp. 210–222.

[8] Ozcan Ozyurt, Hacer Ozyurt, and Adnan Baki, "Design and development of an innovative individualized adaptive and intelligent e-learning system for teaching–learning of probability unit: Details of UZWEBMAT", *Expert Systems with Applications* Vol. 40, 2013, pp. 2914–2940.

[9] E. R. Sykes and F. Franek., "A prototype for an Intelligent Tutoring System for students learning to program in Java", *Proceedings of CATE2003, IASTED International Conference on Computers and Advanced Technology in Education*, June 30 - July 2, 2003, Rhodes, Greece, pp. 78-83.

[10] Biplab Kanti Das, Saurabh Pal, "A framework of Intelligent Tutorial System to incorporate adaptive learning and assess the relative performance of adaptive learning system over general classroom learning", *International Journal of Multimedia and Ubiquitous Engineerin*g, Vol. 6, No. 1, January, 2011, pp3 43-54.

[11] Burak Galip Aslan, Mustafa Murat Inceoglu, "Machine Learning Based Learner Modeling for Adaptive Web-Based Learning", *Lecture Notes in Computer Science*, Vol. 4705, 2007, pp. 1133-1145.

[12] Neelu Jyothi Ahuja, Roohi Sille, "A Critical Review of Development of Intelligent Tutoring Systems: Retrospect, Present and Prospect", *International Journal of Computer Science Issues*, Vol. 10 Issue 4, July 2013, pp 39-48.

[13] Lamia Mahnane, Mohamed Tayeb Laskri and Philippe Trigano, "A Model of Adaptive e-learning Hypermedia System based on Thinking and Learning Styles", *International Journal of Multimedia and Ubiquitous Engineering*, Vol. 8 No. 3, May 2013, pp. 336-350.

[14] Sunandan Chakraborty, Devshri Roy, and Anupam Basu, "Development of Knowledge Based Intelligent Tutoring System", *Advanced Knowledge Based Systems: Model, Applications & Research* (Eds. Sajja & Akerkar) Vol. 1, 2010, pp. 74-100.