PRE-GENERATION OF STUDENT MODULE IN INTELLIGENT TUTORING SYSTEM

SAFDAR ALI

UNIVERSITY UTARA MALAYSIA
2009

PRE-GENERATION OF STUDENT MODULE IN INTELLIGENT TUTORING SYSTEM

A thesis submitted to College Arts & Sciences
in partial fulfillment of the requirement for the degree
Master of Science (Intelligent System)
University Utara Malaysia

By

Safdar Ali

KOLEJ SASTERA DAN SAINS
(College of Arts and Sciences)
Universiti Utara Malaysia

PERAKUAN KERJA KERTAS PROJEK
(Certificate of Project Paper)

Saya, yang bertandatangan, memperakukan bahawa
(I, the undersigned, certify that)

SAFDAR ALI
(801245)

calon untuk Ijazah
(candidate for the degree of) **MSc. (Intelligent System)**

telah mengemukakan kertas projek yang bertajuk
(has presented his/her project paper of the following title)

PRE-GENERATION OF STUDENT MODULE IN INTELLIGENT TUTORING SYSTEM

seperti yang tercatat di muka surat tajuk dan kulit kertas projek
(as it appears on the title page and front cover of project paper)

bahawa kertas projek tersebut boleh diterima dari segi bentuk serta kandungan dan meliputi bidang ilmu dengan memuaskan.
(that the project paper acceptable in form and content, and that a satisfactory knowledge of the field is covered by the project paper).

Nama Penyelia Utama
(Name of Main Supervisor): **DR. YUHANIS YUSOF**

Tandatangan
(Signature) : _____

Tarikh
(Date) : 17 nov 2009

PERMISSION TO USE

In presenting this thesis in partial fulfillment of the requirements for a Master of Science in Intelligent System degree from University Utara Malaysia, I agree that the University Library may make it freely available for inspection. I further agree that permission for copying of this thesis in any manner, in whole or in part, for scholarly purpose may be granted by my supervisor or, in their absence by the Academic Dean College of Arts and Sciences. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to University Utara Malaysia for any scholarly use which may be made of any material from my thesis.

Requests for permission to copy or to make other use of materials in this thesis, in whole or in part, should be addressed to

Dean (Academic) College of Art and Sciences
University Utara Malaysia
06010 UUM Sintok
Kedah Darul Aman.

ABSTRACT

An intelligent tutoring system (ITS) is a system that provides direct modified instruction or feedback to students without the interference of human beings. Most of the researches in ITS have been in assessment, reforming of the learning objects and change of the learning object finding path. To make an ITS as efficient as expert human tutors, this research aims at identifying the user understanding level of a user prior to using an ITS by conducting a pre-test. Upon completing the test, user will be presented with a teaching session that is based on his/her performance in the undertaken pre-test. The system is intended for undergraduate students to learn knowledge representation. Two systems were developed for the purpose of evaluation and namely Version A and Version B. Version A adopts the existing approach that assumes all students have the same background knowledge, while Version B conducted the teaching session according to students existing knowledge. A pilot test was performed on the BIT undergraduate students. The results showed that by using Version B, students obtained a better result compared to using Version A.

ACKNOWLEDGEMENTS

First and foremost, all praise to ALLAH (SWT), the Almighty, the most gracious and most merciful, without whose divine guidance and blessing, I would not have been able to even begin, let alone complete, such a complex and confounding undertaking.

I would like to express my deepest appreciation to a number of people by giving up their valuable time and energy, and their precious thoughts and comments. I owe my heartfelt thanks to my supervisor Dr. Yuhanis binti Yusof and my consultant Mr. Mohammad Tarmidi Mahli for their advice, knowledge and word of encouragement during this study. I feel much honored to extend my thanks to my evaluator during defense for critical ideas and suggestions. I'll always be thankful to all, Terima kasih!

Special thanks to all my lecturers Assoc. Prof Fadzilah Siraj, Dr. Yuhanis binti Yusof, Dr. Faudziah Ahmad, Assoc. Prof Dr. Norita Md Norwawi, Assoc. Prof Azizi Zakaria, Nur Azzah bt Abu Bakar, Aniza binti Mohamed Din, Zhamri Che Ani and other UUM staffs.

I must acknowledge the immeasurable contributions of my friends and colleagues who have shown great love and care during my study especially Taha, Abdullatif, Ali Abadi, Yunis, Hossam, and Khalil, a big Thank you!

This acknowledgment won't be complete without mentioning my family. Profound gratitude goes to my parents G. Shabir and Saeeda who have never failed to give me the best in life. May Allah reward your efforts! To my grand father Bashir, my Uncle Imtiaz and his wife and also my younger brothers Shafqat, Sumair and Salman, you guys are great, love you all. The Other's, who have shown me love, love you all.

DEDICATION

A very special dedication if this piece of myself to the two people who meant the most to me (my great father and my lovely mom).To my mom, who was so amazed at the way of my life turned out. To my father, who was my biggest cheerleader. Who, over the years, modeled compassion and caring of others. Who was always there with the advice when I needed it and sometimes I even took it? Who worked hard, to make sure me and support me, even when he may not agreed with the directions I took. I was richly blessed with the two of you in my life. Special thanks to my brothers and my sisters, whom supporting and caring me all the time and never hide any efforts to encourage and consolidate my study.

TABLE OF CONTENT

PERMISSION TO USE i
ABSTRACT ii
ACKNOWLEDGEMENTS iii
DEDICATION iv
TABLE OF CONTENT v
LIST OF TABLES vii
LIST OF FIGURES viii
LIST OF ABBREVIATIONS ix

CHAPTER ONE : INTRODUCTION 1
1.1 PROBLEM STATEMENT 4
1.2 RESEARCH QUESTION 5
1.3 RESEARCH OBJECTIVE 5
1.4 SCOPE OF THE STUDY 6
1.5 ORGANIZATION OF THE THESIS 6

CHAPTER TWO : LITERATURE REVIEW 7
2.1 INTELLIGENT TUTORING SYSTEM (ITS) 7
2.2 OTHERS WORK 10
2.2.1 TUTOR MODULE 11
2.2.2 INTERFACE MODULE 13
2.2.3 STUDENT MODEL 14
2.3 INTELLIGENCE QUOTA (IQ) TEST IN EDUCATION 19
2.4 OTHERS WORK ON PEDAGOGY 21
2.4 SUMMARY 22

CHAPTER THREE : METHODOLOGY 23
3.1 INTRODUCTION 23
3.2 PHASE 1: *SELECTION OF PROBLEM* 24
3.3 PHASE 2: *REVIEW OF EXISTING RESEARCH AND THEORY* 24
3.4 PHASE 3: *STATEMENT OF HYPOTHESIS OR RESEARCH QUESTION* 25
3.5 PHASE 4: *DETERMINATION OF APPROPRIATE METHODOLOGY* 25

3.6 PHASE 5: *DATA COLLECTION* 30
3.7 PHASE 6: *SYSTEM DESIGN AND ANALYSIS* 30
3.7.1 SNAP SHOTS OF VERSION A 31
3.7.2 SNAP SHOTS OF VERSION B 35

CHAPTER FOUR : RESULTS 38

4.1 RESULTS OF AI STUDENTS USING VERSION A AND VERSION B 39
4.2 RESULTS OF NON-AI STUDENTS USING VERSION A AND VERSION B 42

CHAPTER FIVE : CONCLUSION AND FUTURE RECOMMENDATION 46

5.1 CONCLUSION 46
5.2 RECOMMENDATION AND FUTURE WORK 48

REFERENCES: 49

APPENDIX A 53

APPENDIX B 74

APPENDIX C 120

LIST OF TABLES

Table 3.1:	Range, Level and Question type	27
Table 4.1:	Final Exam Results (using Version A) for Students with AI Background	39
Table 4.2:	Final Exam Results (using Version B) for Students with AI Background	40
Table 4.3:	Final Exam Results (using Version A) for Students with non-AI background	42
Table 4.4:	Final Exam Results (using Version A) for Students with non-AI background	43

LIST OF FIGURES

Figure 1.1:	The general architecture of ITS	1
Figure 3.1:	General Methodology of Design Research	23
Figure 3.2:	General Architecture of ITS with generation of Student module	24
Figure 3.3:	Flow Chart of ITS Version A	28
Figure 3.4:	Flow Chart of ITS Version B	29
Figure 3.5:	New User	31
Figure 3.6:	Login Screen	31
Figure 3.7:	Version A Main Menu	32
Figure 3.8:	Question	32
Figure 3.9:	Show Why Message	33
Figure 3.10:	Show Message when user select incorrect answer	33
Figure 3.11:	Final Exam request	34
Figure 3.12:	Final Exam Result	34
Figure 3.13:	Version B Main Menu	35
Figure 3.14:	Pre-Test IQ Question	36
Figure 3.15:	Pre-Test Result	36
Figure 4.1:	Graph of Final Exam Results (AI Students)	41
Figure 4.2:	Graph of Final Exam Results (Non-AI Students)	44
Figure 4.3:	Graph of Final Exam Results (AI and Non AI Students)	45

LIST OF ABBREVIATIONS

UUM	Universiti Utara Malaysia
ITS	Intelligent Tutoring System
AI	Artificial Intelligence
WBT	Web-Based Training
ITG	Intelligent Tutor Generator
EGIP	Explanation Generation for Integration Problem
NL	Natural Language
IITS	Integrated Intelligent Tutoring System
BN	Bayesian Networks
CBR	Case-Based Reasoning
KSE	Knowledge Scoring Engine
SM	Student Module
IQ	Intelligence Quota

CHAPTER ONE

INTRODUCTION

An intelligent tutoring system (ITS) is any computer system that provides direct customized instruction or feedback to students, i.e. without the intervention of human beings, while performing a learning task. However, ITS systems are more narrowly considered as artificial intelligence systems, more specifically expert systems made to simulate aspects of a human tutor. A system as shown in Figure 1.1 consists of four subsystems or modules, namely; the interface module, the expert module, the student module, and the tutor module.

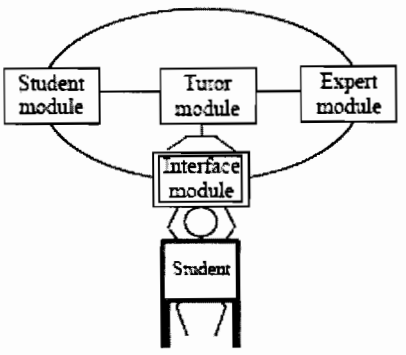

Figure 1.1: The general architecture of ITS. (Htaik & Amnuaisuk, 2003)

The contents of the thesis is for internal user only

REFERENCES:

Bond, M. (2009). Clever Fools: Why a high IQ doesn't mean you're smart. Retrieved 10th November, 2009 from http://www.newscientist.com/article/mg20427321.000-clever-fools-why-a-high-iq-doesnt-mean-youre-smart.html

Brusilovsky, P. (1993). Student as user: Towards an adaptive interface for an Intelligent Learning Environment. *World Conference on Artificial Intelligence in Education Edinburgh, Scotland; 23-27.*

Burguillo, J. C., Gonzalez, C., Llamas, M., & Mikic, F. A. (2008). A Case-Based Peer-to-Peer Framework for Managing Student Models in Itelligent Tutoring Systems. Proceedings of the *38th ASEE/IEEE Frontiers in Education Conference S3A-1.*

Butz, C. J., Hua, S., & Maguire, R. B. (2002). *Bits: a Bayesian Intelligent Tutoring System For Computer Programming.*

Ceponis, P. J. M., Chan, D., Boorman, R. S., Hutchison, C., & Mohtadi, N. G. H. (2007). A randomized pilot validation of educational measures in teaching shoulder arthroscopy to surgical residents. *Canadian Medical Association, Can J Surg,* 50 (5).

Corbett, A. T., Koedinger, K.R., & Anderson, J. R. (1997). *Intelligent Tutoring Systems.* Original pp 849-874.

Crowley, R., Medvedeva, O., & Jukic, D. (2004). *SlideTutor: A model-tracing Intelligent Tutoring System for teaching microscopic diagnosis.*

Chien, T. C., Md.Yunus, A. S., Ali, W. Z. W., & Bakar, A. R. (2008). The Effect Of An Intelligent Tutoring System (ITS) On Student Achievement In Algebraic Expression. *International Journal of Instruction July 2008. 1(2).*

Di Eugenio, B., Fossati, D., Yu, D., Haller, S. and Glass, M. (2005). Aggregation Improves Learning: Experiments In Natural Language Generation For Intelligent Tutoring Systems. *The 42nd Meeting of the Association for Computational Linguistics, Ann Arbor, MI.*

Driscoll, D. (2009). Improving Student Performance with the TI-NavigatorSystem: A Pedagogical Journey. *Case Study 20.*

Durkin, J. (1994). *Expert Systems.* U.S.A: Prentice-Hall International Press.

Errico, B., & Micarelli, A. (1994). *From Student Modeling to User Modeling.*

Fox, B. (1993). The Human Tutorial Dialogue Project. *Lawrence Erlbaum Associates, Hillsdale, NJ.*

Garlick, D. (2002). *Understanding the Nature of the General Factor of Intelligence:*

The Role of Individual Differences in Neural Plasticity as an Explanatory Mechanism.

Gonzalez, C., Burguillo, J. C., & Llamas, M. (2006). A Qualitative Comparison of Technologies for Student Modeling in Intelligent Tutoring Systems. *36th ASEE/IEEE Frontiers in Education Conference T1F-13*

Htaik, T.T., & Amnuaisuk, P.S. (2003). *Intelligent Tutoring System for Mathematical Problems: Explanation Generations for Integration Problem (EGIP).*

Huang, H. S., Huang, M. J., & Chen, M. Y. (2006). Constructing a personalized e-learning system based on genetic algorithm and case-based reasoning approach. *Expert Systems with Applications.*

Huda, K., and Keith, M. (2006). Teaching Box Builder: Customizing Pedagogical Contexts for Use of Digital Library Resources in Classrooms. *Proceedings of the 6th ACM/IEEE-CS joint conference on Digital Libraries JCDL*

Jackson, B. G. (2002). Intelligent Tutoring Systems. *TechKnowLogia, January - March 2002, Knowledge Enterprise, Inc.*

Jackson, P. (1999). *Introduction to Expert Systems* (3rd ed.). London: ADDISON-WESLEY Press.

Jodlowski, M. T., & Doane, S. M. (2004). A Knowledge Scoring Engine (KSE) for Real-Time Knowledge Base Generation Used in Intelligent Tutoring Systems. Proceedings of the *37th Hawaii International Conference on System Sciences*

Lane, C.H. (2006). *Intelligent Tutoring Systems: Prospects for Guided Practice and Efficient Learning.*

Legg, S. & Hutter, M. (2007). *Universal Intelligence: A Definition of Machine Intelligence.*

Lilly, E. (2009). Tailored Learning – Overview. *Lilly University Learning Services*

Linton, S. (2003). *Knowledge Representation and Acquisition for Intelligent Tutoring Systems.*

Liu, H., Tang, S., & Ma, L. (2008). A Rule-Based Approach for Student Modeling. *Fifth International Conference on Fuzzy Systems and Knowledge Discovery.*

Ljubomir, J., & Vladan, D. (2000). The friendly Intelligent Tutoring Environment. *ACM SIGCHI Bulletin, Volume 32 Issues 1.* Publisher: ACM Press.

Lu, X. (2007). *Expert Tutoring and Natural Language Feedback in Intelligent Tutoring Systems.*

Maciejewski, A. A., & Kang, Y. S. (1994). A Student Model of Katakana Reading Proficiency for a Japanese Language Intelligent Tutoring System. *IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS, Vol. 24, 9.*

Matsuda, N., Cohen, W. W., & Koedinger, K. R. (2005). Building Cognitive Tutors with Programming by Demonstration. *In Proceedings of the International Conference on Inductive Logic Programming: Springer-Verlag.*

Mithal, B., Mirjana, I., & Zoran, B. (1997). Intelligent Tutoring System as Multi-agent System. *IEEE International conference on Intelligent Processing Systems.*

Nkambou, R. (1999). *Managing Inference Process in Student Modeling for Intelligent Tutoring Systems.*

Ong, J., & Ramachandran, S. (2003). Intelligent Tutoring Systems: Using AI to Improve Training Performance and ROI. *Stottler Henke Associates, Inc.*

Pauline, C., & Rammohan, R. (1995). Using Simulation to Aid in the Design of an Inelligent Tutoring System. *ACM SIGSIM Simulation Digest, volume 24, Issue 3.* Publisher: ACM Press

Rasmussen, K. (2006). *Developing A Cognitive Rule-Based Tutor For The Assistment System.* PhD Thesis. Worcester Polytechnic Institute.

Roger, N., & Froduald, K. (2001). Designing Intelligent Tutoring Systems: A multi-agent Planning Approach. *ACM SIGCUE Outlook, Volume 27 Issue 2.* Publisher: ACM Press

Russell, K., & Carter, P. (2005). *Book of IQ Tests.* London: Kogan Page Press.

Samuelis, L. (2007). Notes on the Components for Intelligent Tutoring Systems. Technical University of Košice. *Vol. 4, 2*

Schreiber, G., Akkermans, H., Anjewierden, A., Hoog, R. D., Shadbolt, N., Velde, W. V. D., & Wielinga, B. (2000). *Knowledge Engineering and Management The CommonKADS Methodology.* London: MIT Press.

Salgueiro, F., Costa, G., Cataldi, Z., Lage, F., & Martinez, R. G. (2004). *Redefinition of Basic Modules of an Intelligent Tutoring System: The Tutor Module.*

Shah, F. (1997). *Recognizing And Responding To Student Plans In An Intelligent Tutoring System: CIRCSIM-Tutor.* PhD Thesis. Illinois Institute of Technology, Chicago.

Siddappa, M., & Dr.Manjunath, A. S. (2008). Intelligent Tutor Generator for Intelligent Tutoring System. *World Congress on Engineering and Computer Science, October 22 - 24, 2008, San Francisco, USA.*

Spearman, C. E. (1927). The abilities of man, their nature and measurement. *Macmillan, NewYork.*

Tan, Z., Weiling, L., Liu, L., & Yang, Z. (2008). The Application of Ontology Model in Intelligent Tutoring System. *International Conference on Computer Science and Software Engineering.*

Thompson, J. E. (1996). Student Modeling in an Intelligent Tutoring System. *Air Force Institute of Technology, Ohio.*

Tom, W. (2005). Constructivist Approaches for Teaching Computer Programming. *Proceedings of the 6th conference on Information Technology Education SIGITE '05. Publisher: International Society of the learning Sciences.*

Tuaksubun, C., & Mungsing, S. (2007). Design of an Intelligent Tutoring System that Comprises Individual Learning and Collaborative Problem-Solving Modules. *Fourth International Conference on eLearning for Knowledge-Based Society, November 18-19, 2007, Bangkok, Thailand.*

Tuaksubun, C., & Mungsing, S. (2008). *Design of Intelligent Tutoring System for Collaborative Problem Based Learning.*

Tsovaltzi, D., McLaren, B. M., Rummel, N., Scheuer, O., Harrer, A., Pinkwart, N., & Braun, I. (2008). Using an Adaptive Collaboration Script to Promote Conceptual Chemistry Learning. *B. Woolf et al. (Eds.): ITS 2008, LNCS 5091, pp. 709–711.*

Ueno, M. (2001). *Student Models Construction by Using Information Criteria.*

Vanlehn, K., Lynch, C., Schulze, K., Shapiro, J. A., Shelby, R., Taylor, L., Treacy, D., Weinstein, A., & Wintersgill, M. (2005). The Andes Physics Tutoring System: Lessons Learned. *International Journal of Artificial Intelligence in Education.*

Valentin, R., and Richard, A. (2006). Pedagogical Techniques Supported by the Use of Student Devices in Teaching Software Engineering. *ACM SIGCSE Bulletin, Proceedings of the 37th SIGCSE technical symposium on computer science education SIGCSE 38 (1).*

Wei, F. (2007). *A Student Model For An Intelligent Tutoring System Helping Novices Learn Object-Oriented Design.* PhD Thesis. Lehigh University.

Wu, Y. W., Liu, W., & Wang, J. B. (2008). Application of Emotional Recognition in Intelligent Tutoring System. *Workshop on Knowledge Discovery and Data Mining.*