EXAMINATION TIMETABLE SCHEDULING USING TABU SEARCH

A thesis sumitted to the College of Arts & Sciences in partial

fulfilment pf the requirement for degree Master

of Science (Information Technology),

University Utara Malaysia

by

Mohammed Saad Almabrok

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)

MOHAMMED SAAD ALMABROK

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

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

EXAMINATION TIMETABLES SCHEDULING USING TABU SEARCH

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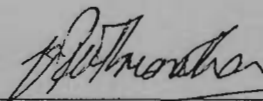*(as it appears on the title page and front cover of project paper)*

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. MOHD. SYAZWAN BIN ABDULLAH**

Tandatangan
(Signature) :

Tarikh
(Date) : 25/05/2008

CENTER FOR GRADUATE STUDIES UNIVERSITI UTARA MALAYSIA

PERMISSION TO USE

In presenting this thesis in fulfillment of the requirements for the postgraduate degree from the Universiti Utara Malaysia, I agree that the Universiti Library may take it freely available for inspection. I further agree that the 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 his absence, by the Dean of the Center for Graduate Studies. It is understood that any copy 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 the Universiti Utara Malaysia for any scholarly use which may be made of any material from my thesis.

Request for permission to copy or make other use of material in this thesis in whole or in part should be addressed to:

Dean of the Center for Graduate Studies
Universiti Utara Malaysia
06010 UUM Sintok
Kedah Darul Aman
Malaysia

i

ABSTRACT

Examination Timetables are utilized to schedule exam-timeslots in field of Applied Science .It involved assigning times and places to suitable events by creating use of available resource. Badly designed examination timetables are not just inconvenient but proved high-priced in terms of wasting time and money. Hence, the major aim of this research is to investigate the internal method of Tabu Search in solving and improving exam-timetable problem. The research have targeted on class examination timetabling problem. Hence, Tabu search is an iterative search method. It uses a local search algorithm at every iteration to search for the finest solution in some subset of the neighborhood, which came from the finest solution obtained at the last iteration. This paper reports the powerful techniques using Tabu Search in scheduling. Examination Timetabling problem is one of the applications in scheduling. In one aspect, it deals with courses such that it executes the process time slot. These aspects are important for the examination timetabling so it can be done in a smooth way and no student can sit more than one exam in a same time slot.

Keyword: Tabu Search, FAS Examination Timetabling

ACKNOWLEDGEMENTS

Praise and gratitude be given to Allah the Almighty for putting forward me such a great strength, patience, courage, and ability to complete this project.

My excessive gratefulness to my supportive and helpful supervisor, Dr.Mohd Syazwan Abdullah for assessing and guiding me in the completion of the research. With all truthfulness, without him, the project would not have been a complete one. He has really been for me a center of motivation and guidance. I am truly grateful to him continual support and cooperation, to assist me all along the completion of the project.

I would like to present my thanks to my father who has always been there for me, my mother and all my family. My demonstrative appreciations to all my friends, colleagues, all College of Arts & Sciences staff, and every one who has helped either directly or indirectly to the completion of this thesis.

Especially, I would like to give my special thanks to my friends Naser Alamrone and Majde Adme whose patient love enabled me to complete this work.

TABLE OF CONTENTS

v

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

1.0 INTRODUCTION

The aim of this report is to discuss on the project background that was conducted at the Field Applied Science (FAS), for generating examination timetabling using Tabu Search (TS). The problem statement, the objective and the significance of the study and scope are discussed in this section.

1.1 Background to the study:

In achieving Malaysia's aspiration to become a developed nation by year 2020, the government has put a greater emphasis on technology-based industries as the catalyst to improve the nation's economic growth. Thus, a well trained lab our force is essential to lead and manage these high technology industries. To meet the abovementioned demand, University Utara Malaysia (UUM) has taken the initiative by officially establishing the Faculty of Information Technology.

Field of applied sciences was formally known as the School of Information Technology (SIT) before the faculty system was officially launched in September 2003. SIT was established on March 1, 1990 and was the first school to offer Information Technology programmes in Malaysia. It has since expanded its programmes from just one bachelor degree program to three bachelor degree programmes, four master programmes, PhD and collaboration programmes with local

1

The contents of the thesis is for internal user only

References

Abdullah Konak & Sadan Kulturel-Konak ,2005 . SIMULATION OPTIMIZATION USING TABU SEARCH: AN EMPERICAL STUDY . Proceedings of the 2005 Winter Simulation Conference M. E. Kuhl, N. M. Steiger, F. B. Armstrong, and J. A. Joines, eds.

Alvarez, R., Crespo, E. and Tamarit, (2002) J.M. Design and implementation of a course sched- uling system using tabu search, European Journal of Operational Research 137, 512–523,.

Abdennadher, S. & Marte, M. (2000). *University Course Timetabling Using Constraint Handling Rules*. Retrieved January, 2005, from http://www.pms.informatik.uni-muenchen.de/mitarbeiter/ marte/publications/Abdennadher-Marte-JAAI-2000.pdf

Baggio, G. Wainer, J. & Ellis, C. (2004). Applying Scheduling Techniques To Minimize The Number Of Late Jobs In Workflow Systems. *SAC '04, March 14-17, 2004, Nicosia, Cyprus. 2004 ACM Symposium on Applied Computing, pp. 1396-1403.*

Brown, D. E. & Scherer, W. T. (1995). *Intelligent Scheduling Systems.* Kluwer Academic Publishers, 101 Philip Drive, Assinippi Park, Norwell, Massachusetts 02061, USA, ISBN 0-7923-9515-8.

Burke, E. K. & Newall, J. P. (2002). Enhancing Timetable Solutions With Local Search. PATAT 2002 Proceedings of the 4th International Conference on the Practice and Theory of Automated Timetabling. Retrieved February, 2005, from http://ingenieur.kahosl.be/vakgroep/IT/Patat2002/ExaminationTT/newall.pdf

Clark D. (1993). Exam scheduling by Tabu Search . Australian Soc. Ops Res.

Bulletin, 12, 5–9.

Cagdas Hakan Aladag & Gulsum Hocaolu, 2007. A TABU SEARCH ALGORITHM
TO SOLVE A COURSE TIMETABLING PROBLEM . Hacettepe Journal of
Mathematics and Statistics Volume 36 (1) (2007), 53 – 64

Carter, M. W. (2000). A Comprehensive Course Timetabling And Student Scheduling
System at the University of Waterloo. PATAT 2000 Proceedings of the 3rd
International Conference on the Practice and Theory of Automated
Timetabling.Retrieved January, 2005,
frohttp://www.mie.utoronto.ca/staff/profiles/carter.html

Di Gaspero L. and Schaerf A. (2003), "Multi-neighbourhood Local Search with
Application to Course Timetabling". In: Burke, E.K. and De Causmaecker, P.
(eds.): Practice and Theory of Automated Timetabling IV (PATAT 2002),
Lecture Notes in Computer Science 2740, Springer-Verlag 2003, pp 262--275.

De Werra D., Hertz A. -Tabu Search Techniques, (1989),: A tutorial and an
application to neural networks - OR Spektrum ,pp. 131-141.

EVEN, S., ITAI, A., AND SHAMIR, A. 1976. On the complexity of timetabling and
multicommodity , flow problems. SIAM Journal on Computing 5, 691–703.

Enric Crespo.(1997).   Department of Financial and Mathematical Economy.
Universitat de Val`encia

Fang, H. L. (1992). Investigating Genetic Algorithms for Scheduling. Unpublished
Thesis: MSc. University of Edinburgh.

Frank Dammeyer, and Stefan Voß ,(2005). Technische Hochschule Darmstadt,
FB1/FG Operations Research, Hochschulstrasse 1, D-6100 Darmstadt,
Germany

Faigle U., Kern W. (1992), Some Convergence Results for Probabilistic Tabu Search
– ORSA Journal on Computing 4, pp. 32-37.

Fox B.L 1993. -Integrating and accelerating tabu search, simulated annealing and geneticalgorithms - Annals of Operations Research 41, (1993) pp. 47-67.

Filho, G. R. & Lorena, L. A. N. (2000). A Constructive Evolutionary Approach To School Timetabling. Retrieved December, 2004, from www.lac.inpe.br/~marcos/arsig2/CGA-timet-EVOCOP.pdf

Ghazali, N. H. & Ramli, R. (2004). Past Solutions Of Driver Scheduling And A Promising Path Via Genetic Algorithm. Seminar Kebangsaan Sains Pemutusan 2004, pp. 385-392.

Glover, F. and Laguna, M. 1997. Tabu Search. Norwell, MA: Kluwer Academic Publishers.

Grajcar, M. (2000). Conditional Scheduling for Embedded Systems Using Genetic List Scheduling. University of Passau. ISSS 2000, Madrid, Spain. IEEE 2000, pp. 123-128.

Glover, F. (1986). Future Paths for Integer Programming and Links to Artificial Intelligence. Computers and Operations Research. Vol. 13, pp. 533-549.

Glover, F. Kelly, J. P & Laguna, M. (1995). Genetic Algorithms and Tabu Search: Hybrids for Optimization. Computers and Operations Research. Vol. 22, No. 1, pp 111 – 134.

Ghaith Mohammad Hasan Jaradat (2006), Improving Secondary School Examination Timetabling using Genetic Algorithm , Universiti Utara Malaysia

Glover F. and Laguna M. (1997), "Tabu search", Boston : Kluwer Academic Publishers.

Hertz A. (1991). Tabu search for large scale timetabling problems . Eur . J. Opl Res., 54, 39–47.

Hertz, A., Taillard, E. and Werra, D. (2005) A Tutorial on Tabu Search. Accessed on April 14: http://www.cs.colostate.edu/whitley/CS640/hertz92tutorial.pdf

Hansen, P. 1986. The Steepest Ascent Mildest Descent Heuristic for Combinatorial Programming.Congress on Numerical Methods in Combinatorial Optimization, Capri, Italy.

Hansen P 1999. -The Steepest Ascent Mildest Descent Heuristic for Combinatorial Programming - Presented at the Congress on Numerical Methods in Combinatorial Optimization, Capri, Italy, (1986) .

Helm, T. M. Painter, S. W. & Oakes, W. R. (2002). A Comparison Of Three Optimization Methods For Scheduling Maintenance Of High Cost, Long-Lived Capital Assets. *Proceedings of the 2002 Winter Simulation Conference, pp. 1880-1884.*

Lalescu, L. & Badica, C. (2003). Timetabling Experiments Using Genetic Algorithms. Timetabling Experiments Using Genetic Algorithms, prezentata la TAINN'03, Canakkale, Turcia, 2003. Retrieved February, 2005, from http://software.ucv.ro/Cercetare/Inginerie_ Software/inginerie_software.html

Khaled Ahmad Eltayf ,(2007) Time table Scheduling for BIT Program. Universiti Utara Malaysia.

Mushi ,2004 A. R. tabu search heuristic for university course timetabling problem Department of Mathematics, University of Dar es salaam, Box 35062, Tanzania

Malek Rahoual & Rachid Saad (2006) .Solving Timetabling Problems by Hybridizing Genetic Algorithm and Tuba Search . Department informatique , University Bougara, Boumerdes Algeria .

Melicio, F. Caldeira, J. P & Ruso, A. (2004). Two Neighbourhood Approaches To The Timetabling Problem. PATAT 2004 Proceedings of the 5th International Conference on the Practice and Theory of Automated Timetabling.

Melicio, F. Caldeira, J. P & Ruso, A. (2004). Two Neighborhood Approaches To The Timetabling Problem. PATAT 2004 Proceedings of the 5th International Conference on the Practice and Theory of Automated Timetabling. Technische Hochschule

Ozcan, E. & Alkan, A. (2002). Timetabling Using A Steady State Genetic Algorithm. Yeditepe University, Department of Computer Engineering, Istanbul/Turkey. RetrievedDecember,2004,from http://cse.yeditepe.edu.tr/~eozcan/research/papers/PATAT2002.pdf

Pham, D.T. and Karaboga, D. (2000). Intelligent Optimisation Techniques – Genetic Algorithms, Tabu Search, Simulated Annealing and Neural Networks. London: Springer-Verlag.

Pinedo, M. (2002). Scheduling Theory, Algorithms, and Systems Second Edition, Prentice Hall, Upper Saddle River, New Jersey 07458, ISBN 0-13-028138-7.

Ramon Alvarez-Valdes . Enric Crespo . Jose m. Tamarit (1997) a tabu search algorithm to schedule university examinations Universitat de Val`encia

Rubio, R. G. & Munoz, D. P. (2004). A Timetable Production System Architecture For Courses And Exams. PATAT 2004 Proceedings of the 5th International Conference on the Practice and Theory of Automated Timetabling.

Rubio, R. G. & Munoz, D. P. (2004). A Timetable Production System Architecture For Courses And Exams. PATAT 2004 Proceedings of the 5th International Conference on the Practice and Theory of Automated Timetabling.

Reeves, C.R. (1993). Modern Heuristic Techniques for Combinatorial Problems. John Wiley & Sons, Inc.

63

Rossi-Doria, O. & Paechter, B. (2004). A Memetic Algorithm For University Course Timetabling. School of Computing, Napier University, Edinburgh, Scotland. Retrieved December, 2004, from http://iridia.ulb.ac.be/~meta/newsite/downloads/co2004_dam.pdf

Schaerf A. and Schaerf M. (1995), "Local Search Techniques for High School st Timetabling", . Proceedings of the 1 International Conference on the The Practice and Theory of Automated Timetabling (PATAT 1995), Burke E.K. and Ross P. (eds).

Sheibani, 2002. An evolutionary approach for the examination timetabling problems . University of Victoria Victoria, BC, Canada

Santos, H.G. Ochi, L. Z. & Souza, M. J. F. (2004). A Tabu Search Heuristic With Efficient Diversification Strategies For The Class/Teacher Timetabling Problem. PATAT 2004 Proceedings of the 5th International Conference on the Practice and Theory of Automated Timetabling.

Thompson J. and DowslandK. (1993). Multi-objective university examination scheduling . Working paper EBMS/1993/12.

Tariq Riaz, Yi Wang, Kuo-Bin Li (2001). Multiple Sequence Alignment Using Tabu Search. Bioinformatics Institute, 30 Biopolis Street, Singapore 138671.

Yang, Y. & Petrovic, S. (2004). A Novel Similarity Measure For Heuristic Selection In Examination. PATAT 2004 Proceedings of the 5th International Conference on the Practice and Theory of Automated Timetabling.