

**MINING STUDENT'S PERFORMANCE IN SPM USING
STATISTICS AND NEURAL NETWORKS FOR TECHNICAL
SUBJECT**

**A thesis submitted to college Arts & Sciences
in partial fulfillment of requirements for the degree
Master of Science (Intelligent Systems)
University of Utara Malaysia**

**By
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**KOLEJ SASTERA DAN SAINS
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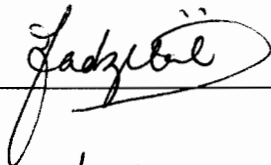
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ABSTRAK (BAHASA MELEYU)

Pencapaian pelajar di dalam peperiksaan menjadi penanda aras yang penting dalam menentukan kualiti pendidikan di Malaysia. Data-data peperiksaan telah dikumpul mulai ujian-ujian bulanan yang telah dijalankan sehingga ke percubaan SPM untuk diuji dengan peperiksaan SPM yang sebenar. Ini juga melibatkan data-data lain yang berkaitan seperti latar belakang keluarga dan maklumat berkenaan persekolahan pelajar. Data mentah diproses serta dianalisa menggunakan kaedah Statistik. Kaedah Statistik memberikan analisis yang bernilai kepada model pencapaian. Kemudian, kombinasi unit input, unit tersembunyi dan unit output diuji untuk meramal pencapaian sebenar pelajar. 7 model diuji berdasarkan 7 matapelajaran teras untuk mengaitkannya dengan faktor-faktor lain menggunakan analisis diskriptif. Justeru, hubungan itu dikaji dengan teliti untuk mengukuhkan model jangkaan. Keputusan yang telah diperolehi menunjukkan Rangkaian Neural mempunyai potensi yang tinggi untuk meramal pencapaian pelajar di masa hadapan.

ABSTRACT (ENGLISH)

Academic performance has become an important evidence of determining the quality in Malaysia's education system. The examination data is collected on the previous students' examinations yet to be tested for their coming SPM. The other related data such as family background and schooling information are also involved. The raw data is preprocessed and analyzed using statistical method. The results from the statistical analysis indicate the significant contribution of these attributes to the achievement model. The combinations of input variables, hidden layer and output nodes are explored to predict the students' performance. Seven models are constructed based on seven subjects to relate them with other factors for the purpose of descriptive analysis. The relationship between examination results and other factors are investigated thoroughly to enhance the prediction model. The result indicates that Neural Networks has high potential to be used in predicting students' performance.

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DEDICATION

*To my parents Abdul Latiff and Jainamboo, my wife Zubaidah, and to my children
Basyirah, Muhammad Arif and Muhammad Amran.*

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LIST OF ABBREVIATIONS

| | |
|--------------|-----------------------------|
| AI | Artificial Intelligence |
| ANN | Artificial Neural Networks |
| BP | Backpropagation Algorithm |
| FF | Feed Forward Algorithm |
| MLP | Multilayer Perceptrons |
| NC | Neural Connection |
| NN | Neural Networks |
| SPM | Sijil Pelajaran Malaysia |
| BM | Bahasa Melayu |
| BI | Bahasa Inggeris |
| MAT | Mathematics |
| SCI | Science |
| SEJ | Sejarah |
| PI | Pendidikan Islam |
| PENDO | Pendawaian Domestik |
| SMK | Sekolah Menengah Kebangsaan |
| SMM | Sistem Maklumat Murid |
| BMM | Borang Maklumat Murid |
| HMM | Hampan Markah Murid |

CHAPTER 1

INTRODUCTION

This section discusses the background of the study that consists of general overview on data mining techniques, which have been used in this study. A brief description on selected domain, education domain is also reviewed. The section also consists of the problem statement, list of project objectives, significance of the study conducted and the study scope. Finally, this section presents the thesis organization that describing the structure of this report.

1.1 Background

The word mining has been used to describe the activity of digging coal or other essential substances out of the ground. The Cambridge Advanced Learner's Dictionary defines the word mining in several ways. As an information technology jargon, mining commonly implies data mining, and is defined as applying a specific algorithm for the discovery of hidden knowledge, unexpected patterns and new rules in large databases, (Dunham, 2003). Fayyad et al. (1996) defined data mining as "the use of algorithms to

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REFERENCES

- Larose D., (2006). *Data Mining Methods and Models*. New Jersey: John Wiley & Sons Inc, 93-149.
- Hand D., Mannila H., Smyth P., (2001). *Principles of Data Mining*. Cambridge: MIT Press.
- Haykin S., (2007). *Neural Networks: A Comprehensive Foundation*. New York: Macmillan Publishing, 156-175.
- Khoa N., Sakakibara K., Nishikawa I., (2006). Stock Price Forecasting Using Back Propagation Neural Networks with Time and Profit Based Adjusted Weight Factors. *Electronics & Communication Engineering Journal*, 5484 – 5488.
- Fung C., Iyer V., Brown W., Wong K., (2005). Comparing The Performance of Different Neural Networks Architectures for The Prediction of Mineral Prospectivity. *Electronics & Communication Engineering Journal*, vol. 1, 394 – 398.
- Wang T., Mitrovic A., (2002). Using Neural Networks to Predict Student's Performance. *Electronics & Communication Engineering Journal*, 969 – 973.
- Huisken G., Coffa A., (2000). Short-term Congestion Prediction: Comparing Time Series with Neural Networks. *Electronics & Communication Engineering Journal*, 66 – 69.
- Cripps A., (1996). Using Artificial Neural Nets to Predict Academic Performance. *American Psychological Association Journal*, 33 – 37.
- Hostetler T., (1996). Predicting Student Success in An Introductory Programming Course. *American Psychological Association Journal*, pp. 40 – 49.
- Butcher D., Muth W., (1985). Predicting Performance in An Introductory Computer Science Course. *American Psychological Association Journal*, 263 – 268.
- Bae, Yupin, Smith, Thomas M., (1997). Women in Mathematics and Science. *Education Resources Information Center Journal*.
- Gibson, Margaret A., (2003). Improving Graduation Outcomes for Migrant Students. *Education Resources Information Center Journal*.
- Terry E., Spradlin, Kirk R., Walcott C., Kloosterman P., Zaman K., McNabb S., Zapf J. & associates, (2005). Is The Achievement Gap in Indiana Narrowing. *Education Resources Information Center Journal*.

- Hayek, John C., Kuh, George D., (1999). College Activities and Environmental Factors Associated with The Development of Life Long Learning Competencies of College Seniors. *Education Resources Information Center Journal*.
- Erbe, Mach B., (2000). Correlates of School Achievement in Chicago Elementary Schools. *Education Resources Information Center Journal*.
- Henchey, Norman, (2002). Schools That Make A Difference : Final Report. Twelve Canadian Secondary Schools in Low Income Settings. *Education Resources Information Center Journal*.
- Dai, Huang, (2006). Data Mining Used in Rule Design for Active Database Systems. *Electronics & Communication Engineering Journal*.
- Young, Ho, Il., Ok, Suk, (2003). The Reliability of Pollution with Regression Analysis and The Possibility of Dispersion and Receptor Models. *Electronics & Communication Engineering Journal*.
- Yusof & Syed Hassan, (2000). Regression Analysis of Consonant Frequency over Number of Turn of Normal Mode Helical Antenna. *Electronics & Communication Engineering Journal*.
- Bon, Ogier, Razali, (2007). Modelling in Manufacturing Industry : Parameters Selection Using Regression Analysis. *Electronics & Communication Engineering Journal*.
- Perez, Gonzalez, Salinas, (2000). Neural versus Difference Equation Modeling for 2D Pattern Recognition Problems. *Electronics & Communication Engineering Journal*.
- Fausett, Elwasif, (1994). Predicting Performance From Test Scores Using Backpropagation and Counterpropagation . *Electronics & Communication Engineering Journal*.
- Burtner, (2004). Critical-To-Quality Factors Associated with Engineering Student Persistence: The Influence of Freshman Attitudes. *Electronics & Communication Engineering Journal*.
- Han, Cheng, Meng, (2003). Application of Four-layer Neural Network on Information Extraction. *Electronics & Communication Engineering Journal*.
- Walczak, (1994). Categorizing University Student Applicants with Neural Networks. *Electronics & Communication Engineering Journal*.
- Mahmoud E., (2004). Accuracy in Forecasting: A Survey. *Journal of Forecasting*.

- Friedman D., Montgomery D., (1985). Evaluation of The Predictive Performance of Biased Regression Estimators. *Journal of Forecasting*.
- Tsukamoto Y., Namatame A., (1996) Evolving Neural Network Models. *Electronics & Communication Engineering Journal*.
- Phua C., Alahakoon D., Lee V. (2000). Minority Report in Fraud Detection: Classification of Skewed Data. *Sigkdd Explorations*.
- Schultz R., (1984). The Implementation of Forecasting Models. *Journal of Forecasting*.
- Klein L., (1984). The Importance of The Forecast. *Journal of Forecasting*.
- Huss W., (1985). The Teachers/Practitioners Corner Comparative Analysis of Load Forecasting Techniques at a Southern Utility. *Journal of Forecasting*.
- Gruca T., Klemz B., Petersen E., (1999). Mining Sales Data Using A Neural Network Model of Market Response. *SIGKDD Explorations*.
- Lu C., Brabanter J., Huffel S., Vergote I., Timmeman D. (2001). Using Artificial Neural Networks To Predict Malignancy of Ovarian Tumors. *Proceedings of the 23rd Annual EMBS International Conference*.
- Atiya A., El-Shoura S., Shaheen S., El-Sherif M. (1999). "A Comparison Between Neural-Network Forecasting Techniques – Case Study: River Flow Forecasting" *Electronics & Communication Engineering Journal*.
- Ringwood J., Galvin G. (2002). Computer-Aided Learning in Artificial Neural Networks. *Electronics & Communication Engineering Journal*.
- Burke H., Rosen D., Goodman P., (1994). Comparing Artificial Neural Networks To The Other Statistical Methods For Medical Outcome Prediction. *Electronics & Communication Engineering Journal*.
- Sitte R., Sitte J. (2000). Analysis Of The Predictive Ability Of Time Delay Neural Networks Applied To The S&P 500 Time Series. *Electronics & Communication Engineering Journal*.
- Jiuzhen L., Jiaqing Z., (2002). Procedure Neural Networks With Supervised Learning. *Proceeding of the 9th International Conference on Neural Information Processing*.
- Ritschel, Pfeifer W., Grob (1994). Rating of Pattern Classifications in Multi-layer Perceptrons: Theoretical Background And Practical Results. *ACM*.

- Mahamud K., Bakar A., Norwawi N. (1998). Neural Network Modelling To Predict House Prices Performance. *Research Report*.
- Roy A., (2000). Artificial Neural Networks – A Science in Trouble. *SIGKDD Explorations*, 33.
- Chamillard A., (2006). Using Student Performance Predictions in A Computer Science Curriculum. *ACM*.
- Spradlin T., Kirk R., Walcott C., Kloosterman P., Zaman K., McNabb S., Zapf J., (2005). Is The Achievement Gap in Indiana Narrowing? *Center for Evaluation & Education Policy*.
- Sweet J., Rasher S., Abromitis B., Johnson E., (2004). Case Studies of High-Performing, High-Technology Schools. *North Central Regional Educational Laboratory*.
- Williams, Bugg D., (1998). Parent Involvement Gender Effects On Preadolescent Student Performance. *American Educational Research Association*.
- Verna, Ann M., Spina, Maria, (2002). Parental Processes and Self-Concepts Effect The Academic Achievement of Italian Students. *American Educational Research Association*.
- Sengupta S., (1995). A Comparative Study of Neural Network and Regression Analysis As Modelling Tools. *Electronics & Communication Engineering Journal*.
- Li Y., (1994). A General Linear-Regression Analysis Applied To The 3-Parameter Weibull Distribution. *Electronics & Communication Engineering Journal*.
- Itsuki R., Yajima H., Mizuno H., Kinukawa H. (1996). Application and Verification of Using Statistical Analysis Tool and Expert System Together in Multiple Regression Analysis. *Electronics & Communication Engineering Journal*.
- Fukuda T., Shibata T., Tokita M., Mitsuoka T. Neural Network Application for Robotic Motion Control. *Research Report*
- Wong K., (1993). Artificial Intelligence and Neural Network Applications In Power Systems. *Electronics & Communication Engineering Journal*.
- Means R., (1994). High Speed Parallel Hardware Performance Issues for Neural Network Applications. *Electronics & Communication Engineering Journal*.
- El-Sharkawi M., Huang S., (1994). Ancillary Techniques for Neural Network Applications. *Electronics & Communication Engineering Journal*.

- Vonk E., Jain L., Veelenturf L., (1995). Neural Network Applications. *Electronics & Communication Engineering Journal*.
- Sugiyama S, A Neural Network Application To Semantic and Logistic Recognition. *Electronics & Communication Engineering Journal*, 1995.
- Bershad N., Ibnkahla M., Castanie F., (1997). Statistical Analysis of A Two-Layer Backpropagation Algorithm Used For Modelling Nonlinear Memoryless Channels: The Single Neuron Case. *Electronics & Communication Engineering Journal*.
- Hansen J., Nelson R., (1997). Neural Networks and Traditional Time Series Methods: A Synergistic Combination in State Economic Forecasts. *Electronics & Communication Engineering Journal*.
- Ye Q., Liang B., Li Y., (2005). Amnesic Neural Network for Classification: Application on Stock Trend Prediction. *Electronics & Communication Engineering Journal*.
- Lisboa P., Taylor M., (1993). Workshop on Neural Network Applications and Tools. *Electronics & Communication Engineering Journal*.
- Tal B., (2003). Background Information On Our Neural Network – Based System of Leading Indicators. *CIBC World Markets*.
- Bojkovic Z., Milovanovic D., Mastorakis N., (2000). Neural Networks Applications For Multimedia Processing. *Electronics & Communication Engineering Journal*.
- Chowdhury F., Wahi P., Raina R., Kaminedi S., (2001). A Survey of Neural Networks Applications in Automatic Control. *Electronics & Communication Engineering Journal*.
- Rajagopalan R., Rajagopalan P., (1996). Applications of Neural Network in Manufacturing. *Electronics & Communication Engineering Journal*.
- Bose B., (2007). Neural Network Applications in Power Electronics and Motor Drives – An Introduction and Perspective. *Electronics & Communication Engineering Journal*.
- Wikipedia, (2008). Statistics. <http://en.wikipedia.org/wiki/Statistics>.
- Deberard, M. S, Spielmans, (2004). Predictors of Academic Achievement and Retention Among College Freshman: A Longitudinal Study. *College student journal* 38 (1), 66 – 80.
- Golding, P. & Donaldson, (2006). Predicting Academic Performance. 36 th asee/ieee frontiers in education conference, October 28-31, 2006, San Diego

Golding, P. & Mcnamarah, (2005). Predicting Academic Performance in the school of computing & information technology (scit). 35 th asee/ieee frontiers in education conference, October 19-22, Indianapolis

Hendrich, (2007). The prediction of first year academic achievement at a south african university of technology: the important of english language proficiency. Unpublished paper