UNIVERSITI PUTRA MALAYSIA

UNIVERSITY ENTRY SELECTION FRAMEWORK USING RULE-BASED AND BACK-PROPAGATION

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UNIVERSITY ENTRY SELECTION FRAMEWORK USING RULE-BASED AND BACK-PROPAGATION

By

SITTI SYARAH BINTI MAHARANI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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DEDICATIONS

In the name of Allah, Most Gracious, Most Merciful This thesis is dedicated to:

Husband & Son
Father & Mother
Family & Friends

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the Degree of Master of Science

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October 2015

Chair : Razali Yaakob, PhD
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Processing thousands of applications can be a challenging task, especially when the applicant does not consider the university requirements and their qualification. The selection officer will have to check the program requirements and calculate the merit score of the applicants. This process is based on rules determined by the Ministry of Education and the institution will have to select the qualified applicants among thousands of applications.

In recent years, several student selection methods have been proposed using the fuzzy multiple decision making and decision trees. These approaches have produced high accuracy and good detection rates on closed domain university data. However, current selection procedure requires the admission officers to manually evaluate the applications and match the applicants' qualifications with the program they applied. Because the selection process is tedious and very prone to mistakes, a comprehensive approach to detect and identify qualified applicants for university enrollment is highly desired.

In this work, a student selection framework using rule-based and back-propagation neural network is presented. Two processes are involved in this work; the first phase known as pre-processing uses rule-based for checking the university requirements, merit calculation and data conversion to serve as input for the next phase. The second phase uses back-propagation neural network model to evaluate the qualified candidates for admission to particular programs. This means only selected data of the qualified applicants from the first phase will be sent to the next phase for further processing. The dataset consists of 3,790 datasets from Universiti Pendidikan Sultan Idris.

The experiments have shown that the proposed method of ruled-based and back-propagation neural network produced better performance, where the framework has successfully been implemented and validated with the average

performance of more than 95% accuracy for student selection across all sets of the test data.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

KERANGKA KERJA PEMILIHAN KEMASUKAN UNIVERSITI MENGGUNAKAN KAEDAH BERASASKAN PERATURAN DAN PERAMBATAN-BALIK

Oleh

SITTI SYARAH BINTI MAHARANI

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Pengerusi : Razali Yaakob, PhD
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Memproses beribu-ribu permohonan boleh menjadi tugas yang mencabar, terutamanya apabila pemohon tidak mengambil kira syarat am universiti dan kelayakan mereka. Pegawai pendaftaran akan menyemak syarat khas program dan mengira skor merit pemohon. Proses ini adalah berdasarkan kepada peraturan yang ditetapkan oleh Kementerian Pelajaran Malaysia dan institusi yang akan memilih pemohon yang layak di kalangan beribu-ribu permohonan.

Pada tahun-tahun kebelakangan ini, beberapa kaedah pemilihan pelajar telah dicadangkan menggunakan kaedah pembuat keputusan kabur pelbagai dan pepokok keputusan. Pendekatan ini menghasilkan ketepatan yang tinggi dan kadar pengesanan yang baik pada data dari domain tertutup universiti tertentu. Walau bagaimanapun, prosedur pemilihan yang digunakan kini memerlukan pegawai kemasukan untuk menilai secara manual permohonan dan cuba untuk menyesuaikan kelayakan pemohon dengan program yang mereka mohon. Oleh kerana ia adalah satu proses yang rumit dan sangat terdedah kepada kesilapan, pendekatan yang menyeluruh untuk mengesan dan mengenal pasti pemohon yang layak untuk pendaftaran universiti amat diinginkan.

Dalam kajian ini, kerangka kerja pemilihan pelajar menggunakan kaedah berasaskan peraturan dan rangkaian neural perambatan-balik dibentangkan. Dua proses terlibat dalam kerja ini; fasa pertama menggunakan kaedah berasaskan -peraturan untuk memeriksa syarat am universiti, pengiraan merit dan penukaran nilai data sebagai input bagi fasa seterusnya. Fasa kedua menggunakan kaedah rangkaian neural perambatan-balik untuk menilai caloncalon yang layak untuk kemasukan ke program-program tertentu. Ini bermakna hanya data pemohon yang layak daripada fasa pertama sahaja akan dihantar ke fasa seterusnya. Set data mengandungi 3,790 dataset dari Universiti Pendidikan Sultan Idris.

Hasil kajian telah menunjukkan bahawa kaedah yang dicadangkan iaitu kaedah berasaskan peraturan dan rangkaian perambatan-balik menghasilkan prestasi yang lebih baik, di mana rangka kerja ini telah berjaya dilaksanakan dan disahkan dengan purata ketepatan melebihi 95% bagi pemilihan pelajar bagi semua set pengujian data.

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Lastly, I would like to thank to all those who had lent me a helping hand in allowing me to materialize this study.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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Declaration by graduate student

I hereby confirm that:

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Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ABE	Agent Building Environment
AI	Artificial Intelligent
ANN	Artificial Neural Network
CASCEP	Computer-Aided in Choosing Education Program
EST	English Language for Science and Technology
IPTA	Institusi Pengajian Tinggi Awam
IPTS	Institute Pengajian Tinggi Swasta
KPT	Kementeriam Pengajian Tinggi
MADM	Multiple Attribute Decision Making
MCE	Malaysian Certificate of Education
MLP	MultiLayer Perceptron
MOE	Ministry of Education
MOHE	Ministry of Higher Education
PMR	Penilaian Menengah Rendah
RAISE	Reusable Agent Software Environment
RSAU	Recommender System of Admission to University
SMJK	Sekolah Menengah Jenis Kebangsaan
SMK	Sekolah Menengah Kebangsaan
SMKA	Sekolah Menengah Kebangsaan Agama
SPM	Sijil Pelajaran Malaysia
SRP	Sijil Rendah Pelajaran
STPM	Sijil Tinggi Pelajaran Malaysia
UITM	Universiti Teknologi Mara
UKM	Universiti Kebangsaan Malaysia
UNET	University Entry Selection Framework Using Rule-Based and Back-Propagation
UNITAR	Universiti Tun Abd Razak
UNITEN	Universiti Tenaga Nasional
UPM	Universiti Putra Malaysia
UPSI	Universiti Pendidikan Sultan Idris
UPSR	Ujian Penilaian Sekolah Rendah
UPU	Unit Pusat Universiti
UTM	Universiti Teknologi Malaysia

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CHAPTER 1

INTRODUCTION

This chapter forms the introduction to the thesis. Discussions begin with the overview of tertiary education in Malaysia with highlights in generic problems of student selection in university admission.

1.1 Background

Education has always been highly valued and is often regarded as a secure passport for promising future. Education is also viewed as a critical factor in contributing to the long-term economic well-being of a country. The government of any country has long realized the importance of maximizing the potential of each individual future graduate in an educational system.

In Malaysia, the young adults are eligible to pursue tertiary education after finishing their secondary education at the age of 17 (Yassin, 2015). At this juncture, they have two choices to pursue their studies, whether to enrol in a public higher education institutions (IPTA) such as Universiti Putra Malaysia (UPM) and Universiti Perguruan Sultan Idris (UPSI) or in a private higher education institutions (IPTS) such as Universiti Tun Abdul Razak (UNITAR) and Universiti Tenaga Nasional (UNITEN).

Since 2011, the intakes for all IPTA across Malaysia have been standardized to commence in September of every year (Nordin, 2011). The universities, nonetheless, all have their own standards in selecting applicants to enroll in their respective institution. Because of the wide range of programs and programs offered, coupled with the enormous number of applicants, it is difficult for officers in the admission department to conduct a transparent and consistent selection.

Applications to universities in Malaysia are coordinated by the Ministry of Higher Education (MOHE), whereby all applications will go through Unit Pusat Universiti (UPU) (MOHE, 2011). The final decision on the university selection is made by UPU based on the applicants' qualification and their choice of place of study. UPU is known to place the applicant in one of the university in the applicants' list based on their academic eligibility.

In order to enrol in the public university, the applicants should have at least a credit in Bahasa Melayu and at least credits in four other subjects (Mustafah, 2011). For instance, applicants who wish to pursue the Diploma in Science is required to meet the minimum requirements of the university as well as the specific subject requirements for the program. The additional requirements are set to ensure applicants will be able to perform well throughout the program. The requirements are shown in Figure 1.1 and Figure 1.2 (MOE, 2014).

Figure 1.1: University Requirement

(i) Program Education (ii) Code Program (iii) Duration of Study	Minimum Requirements
DIPLOMA OF SCIENCE **A2000** 06 Semester **Open to Category A : Science Stream** **Diploma Program at UPSI**	**Fulfill the University Requirements and Program Requirement** Obtain at least a credit (Grade C) at SPM level in any two (2) of the following subjects: • Chemistry • Biology • Physics • Mathematics • Additional Mathematics • Engineering of Drawings • School of Electrical and • Electronic Engineering • School of Civil Engineering • Mechanical of Engineering **and** At least pass or Grade E at SPM level in the following subjects: English Language

1.2: Program Requirement for Diploma in Science

Although the list of applicants being considered for admission is ranked based on their merit (Mustafah, 2011), the process of selecting the most qualified candidates for a particular program is carried out manually due to additional criteria to be considered in programs selected. In this research, Universiti Perguruan Sultan Idris (UPSI) has been chosen as the case study to validate a framework on student selection and focus on diploma level only. UPSI also offers tertiary education at the diploma level, hence the applicants have just completed the *SijilPelajaranMalaysia* (SPM). SPM holders carry a variety of subjects at the SPM level. Appendix A detail out the complete requirements of the programs offered by UPSI.

1.1 Problem Statement

Selecting qualified applicants to enter one educational institution is not an easy task because it involves a lot of processes and requirements. The selection committee has to consider several things including the applicants' qualifications, the programs requirements and the quota for each program. In fact, each institute and faculty also have their own quota.

Since 2003, the intake of students to universities will no longer be based on the 55 per cent quota places allocated to Bumiputera while the other 45 percent to non-Bumiputera (Mustafah, 2011). This method does not have a category of grades for excellent candidates and difficult to select suitable applicants among them because the aggregate A in SPM result increasing every year.

The similar issue encountered by selection officer each university, if allocating applicants for one program in a faculty from a particular university is difficult enough; imagine if it involves hundreds of programs from several faculties and universities. It will definitely involve many people and will take a very long time, not to mention the labour cost. Sometimes the selection officer overlook the qualification of applicants. In addition, there are high chances for the applicants to overlook or even ignore the minimum requirements of each program, therefore making the selection process more cumbersome.

Based on this situation, the government introduced the meritocracy system that opens equal opportunities to students of various races based on student ability. The system of meritocracy use 90% academic marks and 10% cocurriculum marks. The determination of the merits carried out regardless of religion, race, descent, land, town and so on (Mustafah, 2011).

Several techniques have been proposed to facilitate the selection process in order to identify the most suitable programs for each applicant. The techniques include the fuzzy MADM (Mohamad et al., 2005) and rule-based reasoning (Mohd et al., 2009) developed to assist applicant for selecting a university program based on academic results. The fuzzy method (Mokhtar et al., 2011) also used to recommend suitable programs based on high school results. The neural network model (Adewale et al., 2007) and (Wabwoba and Mwakondo, 2011) used for student selection based on applicants' qualification and programs requirements. Lei et al. (2015) examines parameters based on academic

performance, personal Information and socio-Economic. In Fong et al. (2009) paper, neural network with decision tree classifier used to assist selection officer to analyze data from secondary school result.

Nonetheless, there are still room for improvement to enhance the accuracy in selection of the right program for each applicant. This is because to date, none of the related works have considered the meritocracy marks at the secondary school level, while the extra curricula involvement is known to be a strong indication for a qualified applicant (MOE, 2014). The calculation of merit is based on two components; 90% Academic Marks and 10% Co-curriculum Marks from school assessment (Nordin, 2011). The academic merit and cocurriculum merit will be combined for the final merit score with a total mark of 100%. In this study, the process only focuses in the calculation of academic marks while the co-curriculum marks (Appendix C) has been evaluated by their secondary schools.

1.2 Objectives of the Study

The main objective of this research is to **propose a framework for student selection in university admission to assist the selection officer in verifying and selecting student application**. The detailed framework is as follow:

1. To include the ruled-based method for pre-processing phase to check the university requirements, merit calculation and data conversion.

2. To use the back-propagation algorithm to evaluate the qualified candidates for admission to a particular programs.

1.3 Scope of the Study

This research focuses only on admission process by analyzing candidates' applications in programs offered by Universiti Pendidikan Sultan Idris (UPSI). It is developed using a rule-based and back-propagation neural network method and is able to list suitable programs for diploma level based on SPM results and co-curriculum marks.

1.4 Organization of Thesis

This thesis is organized in accordance to the standard structure of thesis dissertations for Universiti Putra Malaysia. The thesis is inherently divided into six chapters as follows:

Chapter 1 – Introduction. This chapter introduces the degree of importance on student selection and its impact to the public. Awareness on current selection issues forms the problem statement and the research objective.

Chapter 2 – Literature Review. This chapter reviews related studies on the fundamental knowledge related to the subject such as the selection systems, criteria of selection, university requirements, machine learning techniques such as hybrid, neural network and other related techniques.

Chapter 3 – Research Methodology. This chapter presents an overview of research steps, which comprise of problem identification, dataset preparation, design of the proposed method, implementation of proposed method, and finally experiment and analysis.

Chapter 4 – University Entry Selection (UNET). This chapter introduces the back-propagation neural network to evaluate student applications for university admission. The output of the proposed approach is a list of all programs qualified by the applicants with ranking merits for each student application.

Chapter 5 – Experiments and Results. This chapter presents the data source, metric of performance evaluation, as well as the experimental process flow that formed the experiments. In addition, this chapter also presents a analysis between the proposed technique other approaches.

Chapter 6 – Conclusion and Future Works. This chapter concludes the research with some recommendations for future development.

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