# 0-1 GOAL LINEAR PROGRAMMING FOR NURSE ROSTER

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,

## YEAP JIA JUN

## UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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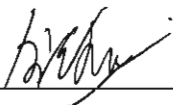Saya _____ <u>YEAP JIA JUN</u> _____.

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# 0-1 GOAL LINEAR PROGRAMMING FOR NURSE ROSTER

YEAP JIA JUN

The report is submitted in partial fulfillment of the requirements for the
Bachelor of Computer Science (Artificial Intelligence)

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2011

# DECLARATION

I hereby declare that this project report entitled

**NURSE ROSTERING SYSTEM**

is written by me and is my own effort and that no part has been plagiarized without citation.

STUDENT   :  _____    Date: _05/07/2011_

                 (YEAP JIA JUN)

SUPERVISOR : _____    Date: _____

             (MISS NUZULHA KHILWANI BINTI IBRAHIM)

# DEDICATION

To my beloved parents, Mr. Yeap Kean Hoe and Mrs. Goh Beng Choo, for their expression of love and fully support...

To my supervisor, Miss Nuzulha Khilwani Binti Ibrahim, for making it all worthwhile...

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Thanks a lot.

# ABSTRACT

The continuous pattern of working 24 hours a day, 7 days a week, needs a working shift environment that could affect the working conditions of the nurses. This involves social life and nurses' level of health. Therefore the development of a nurse scheduling model that can be accepted well by all parties is necessary to enable it to be applied in the nurse scheduling system. This nurse scheduling considers policy imposed by the hospital and demand from the nurses so that there is more balance, quality and fairness in the production of the nurse scheduling model. Hence, in this research, 0-1 goal programming approach is applied in the development of nurse scheduling model because of its ability to produce a model with multiple objectives. Approach to the problem was illustrated on the general hospital. The result obtained by the system shows that the developed model of nurse scheduling using 0-1 goal programming approach performs better than the manual method. This is because it was successful in meeting the hospital policy and nurses' preferences.

# ABSTRAK

Corak bekerja yang berterusan iaitu selama 24 jam sehari 7 hari seminggu, memerlukan waktu kerja mengikut syif yang boleh memberi kesan yang mendalam ke atas keadaan kerja jururawat. Ini melibatkan kehidupan sosial dan tahap penjagaan kesihatan jururawat. Oleh itu pembangunan sebuah model penjadualan jururawat yang dapat diterima baik oleh semua pihak adalah perlu bagi membolehkan ia digunapakai dalam sistem penjadualan jururawat. Penjadualan jururawat ini mempertimbangkan polisi yang dikenakan oleh pihak hospital dan permintaan daripada jururawat agar model penjadualan jururawat yang dihasilkan lebih adil, berkualiti dan seimbang. Justeru, dalam kajian ini, pendekatan pengaturcaraan gol 0-1 diaplikasikan di dalam pembangunan model penjadualan jururawat ini kerana keupayaannya menghasilkan sebuah model dengan pelbagai matlamat. Pendekatan ke atas masalah ini diilustrasikan ke atas jururawat di hospital awam kerajaan. Daripada hasil penyelesaian menggunakan perisian ini, didapati model penjadualan jururawat secara pengaturcaraan gol 0-1 adalah lebih baik berbanding kaedah secara manual. Ini kerana ia berjaya memenuhi polisi pihak hospital dan permintaan jururawat.

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF ABBREVIATIONS

MCDA -    Multi-criteria decision analysis

AI -    Artificial Intelligent

MCDM -    Multi-criteria decision making

MIGP -    Mix Integer Goal Programming

ME -    Marketing executive

GP -    Goal programming

IT -    Internet Technology

LGP -    Linear goal programming

NP -    Non-deterministic polynomial-time

# LIST OF ATTACHMENTS

| TITLE | | PAGE |
|---|---|---|

# BAB I

# INTRODUCTION

## 1.1    Project Background

This project is mainly used for the nurse rostering in general hospital Malaysia because every hospitals will face the Nurse Rostering Problems (NRP) or NP (Nondeterministic Polynomial time) problems based on the hard and soft constraints that cannot be avoided. The reason is that hospitals need to be staffed 24 hours a day over seven days a week in 365 days a year which has no holiday. In addition, many hospitals nurses are allowed to request preset shifts, while other nurses are scheduled around these pre-set shifts. Shift arrangement becomes a significance task in nursing administration for the purpose of providing a stable and secured nursing service to patients because human has limited energy to work for a very long period especially for the nurses that have many shifts, they need time to rest so that they are able to work in the good condition. To ensure the quality and image of a hospital, the nursing service is very important to the patient therefore they always need to be alert and focus to do their work. Therefore in order to make the nurse's duty more efficient and fair, we need to build a system to schedule the time roster for them because fairness of shift arrangement plays a key role for nurses

Besides that, mostly roster is created by the head nurse of the wad. The roster is done manually in a piece of paper without using computer system or software. This is

not a good solution for them because the roster may not be perfect to every nurse in term of fairness and not secure. Some nurse may not get a fair roster and it will cause the nurse lack of rest and cannot focus in doing their job. On the other hand, there is no database to keep the roster of the nurse and that is not secure. It is hard for the head nurse to retrieve back the previous roster and maybe the roster already lost if there is no a proper way to keep the database. Therefore, they need a system that will keep the entire roster and generate a perfect roster for the nurse.

There are some systems that been used to solve this problems using many different approach and it shown artificial intelligence approach can solve the NRP efficiently. By using 0-1 Goal Linear Programming it also can solve the NRP efficiently. BOA is one of the artificial intelligence approaches that can be use to solve the problems. 0-1 Goal Linear Programming will base on the dataset of the nurse to generate a roster to solve NRP by using its algorithm. It will schedule the shifts and working time for the nurse effectively to ensure the nurse will have comfortable working time and fair to every nurse in the hospital start form Sunday to Saturday in a month. It will make the head nurse job easier, flexible and produce a better roster for the nurse.

## 1.2    Problem Statement(s)

There are some problems that can be found in the nurse roster. To build and plan a nurse roster is a very complicated process because it has to base on some constraints which are soft and hard constraints. The roster has to fit to all those constraints in order to produce a perfect roster. It is a difficult task for the head nurse to create the roster for nurse and face some problems regarding the constraints while creating the roster. The head nurse might not produce the best roster to the nurse.

Besides that, the roster will be not very efficient if it is build by manually by the head nurse. As we are human, we will make some mistakes sometimes and it may has some effect to the work we produce. This will cause unbalance roster for the nurse and not fair among the nurse. Mostly head nurse will create the roster in a piece of paper. It is actually not a good way to create a roster because the paper might be lost and it is not safe. If the paper is lost, the head nurse has to redo the roster again and could not retrieve back the previous roster. It will waste time to redo the roster. Therefore, the problems have to be solved by create a system using artificial intelligence approach.

## 1.3 Objective

- To investigate 0-1 Goal Linear Programming in NRP.
- To model the 0-1 Goal Linear Programming in NRP.
- To apply and implement the 0-1 Goal Linear Programming in NRP.
- To generate a roster for the nurse.

## 1.4 Scope

The scopes of the project are listed as follows:
- The intelligent approach that will use in the system is 0-1 Goal Linear Programming to the nurse rostering.
- The target user is the head nurse for the particular wad that will handle the nurse roster.
- The roster is built for the general hospital in Malaysia.
- The system will generate the nurse roster automatically based on the hard and soft constraints.

- The system is built with Visual Studio 2010 and Microsoft Office Excel 2003 The output will be save as an excel (.xls) file.

## 1.5    Project Significance

The research is mainly for the nurse rostering problems. It will use an artificial intelligence approach to solve the problems. It is important to help the head nurse to prepare the roster as there are many constraints to be considered to produce a perfect roster. The system will automatically generate the roster for the nurse in the wad by using 0-1 Goal Linear Programming concept.

## 1.6    Expected Output

The system will be a standalone application that will be used for the wad roster. It apply artificial technique to automatic generate the roster for the nurse. The output for the roster is the first half in a month or the first 14 days in a month. Then the roster will save as a excel file so that it is easy to retrieve back the roster and easy to manage.

Besides that, there is a function that will read the text from the system. It is a text to speech system. The output will be the speech that read by the system, it actually converts the text to speech.

Lastly, the objective function will be calculated based on the generated roster where the roster meets penalties by the soft and hard constraints. Weighted average is the method that use in the objective function to calculate the result for the roster that generated by the system. The lowest the value show by the objective function, the accurate the roster that meets the soft constraints.

## 1.7    Conclusion

As a conclusion, the nurse rostering system is using 0-1 Goal Linear Programming to expect to produce a better nurse roster. The system will help the head nurse to automatically generate the nurse roster based on the constraints.

For the next chapter, there is a literature review of the project that will include the topic by finding facts and comparing the existing systems. Besides that, the project methodology will also be discussed in Chapter 2.

# BAB II

## LITERATURE REVIEW AND PROJECT METHODLOGY

### 2.1 Introduction

In this chapter, the literature part of this research study will be presented and discussed. This includes the study on the nurse rostering system based on the domain of the project and the technique that will be use for the project. Besides that, the project methodology will also be determined and justified its selection. Then followed by the requirement needed to build the proposed system will also be stated. Lastly, the project schedule and milestones are planned in order the system can finished in time by following them.

Project methodology is an approach that tells user what he/she has to do and manage the project from start to finish. It describes every step in the project life cycle in deep, so users know exactly what tasks to complete, when and how. The details in this topic will be discussed later.