ENHANCEMENT OF ANT SYSTEM ALGORITHM FOR COURSE TIMETABLING PROBLEM

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ENHANCEMENT OF ANT SYSTEM ALGORITHM

FOR COURSE TIMETABLING PROBLEM

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UNIVERSITI UTARA MALAYSIA

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DECLARATION

I declare that all the works described in this thesis was undertaken by myself (unless otherwise acknowledged in the text) and that none of the work has been previously submitted for any academic degree. All sources of quoted information have been acknowledged through references.

Djasli Djamarus

2009

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For my late parents

Djamarus Sutan Sinaro and Mariana

and my family

Iryani, Sigit Setiageni, Setra Ragasta and Oksiadri Abacy

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ABSTRACT

As a member of the NP Problem, an exact algorithm to solve the course scheduling problem is not available to date. It is believe that this kind of problem can not be solved by any deterministic algorithm except with the one that performs checking for all possible solution exhaustedly to find solutions that comply with all mandatory constraints. The running time of this algorithm is usually expressed as a mathematical function that grows very fast with the increment of the input data size. For this kind of problem, researchers believe that it will be better to find an approximate solution that can be delivered by a stochastic algorithm than waiting for an exact solution from the deterministic algorithm.

In order to develop a new algorithm for the course scheduling problem, this research follows the experimental research methodology that consist of problem analysis, designing algorithm, implementing algorithm as a computer program in order to examine the results, analyzing the results, and if necessary improving the algorithm by doing all those activities over and over again.

This research starts with developing an algorithm based on original concept of Ant System Algorithm. As the requirement of the Ant System Algorithm, the problem is modeled as a graph that can be used by the ant to deliver its pheromone. This graph consists of four types of vertices that construct the course schedule element. To direct the ant in the journey, heuristic factors are developed by analyzing the characteristic of the course scheduling problem model. The ant uses this heuristic factor to build its pheromone trail, where the number of pheromone laid on the edge indicates the preference level of the edge to be chosen.

A Two-pass Ant System Algorithm that able to come up with the course schedule without violating any hard constraints has been proposed to cater for the course scheduling problem. The proposed algorithm incorporates a new pheromone update

method that includes the negative value for the pheromone update, failure anticipation, cluster computation and best fit event placement features. These features were tested in conjunction with the proposed Ant System Algorithm either individually or in combination among the features.

Results of the experiments that were conducted using various data sets showed that the proposed algorithm produced better course schedule solution than the Greedy Algorithm, Genetic Algorithm, and other variants of Ant System Algorithm.

CHAPTER I
INTRODUCTION

One of the most important things in an organization is schedule of the organization activities. The schedule will govern the organization to achieve its objectives. This means that organizations have to arrange and coordinate their diverse activities in an organized and integrated manner so that its corporate objectives can be achieve effectively.

In an organization, the activity schedule consists of many events, each of which consumes some organization resources. Almost all integrated activities in an organization are conducted using a proper schedule. Some examples of the activities that required a well prepared schedule are job assignment for medical personnel such as medical doctors and nurses in a hospital, allocating duty of flight attendants and air force crews, and job assignment for teachers in high schools or lecturers in universities. All of these scheduling jobs assign some resources into each of schedule element so that it called as resource allocation job (Gudes, Kuflik, & Meisels, 1990).

In a small organization, constructing a schedule as a series of activities can be done perfectly using a pencil and paper only, but for a large organization with diverse activities that require proper arrangement and coordination, the scheduling task certainly becomes more difficult. The use of simple apparatus usually may no longer be efficient to produce a good schedule. Therefore, it needs to be speed up by using a computer program.

The difficulties of scheduling usually come from its constraint that must be satisfied. There are two types of constraint that must be obeyed by the scheduler. The first is called hard constraint that is mandatory to be followed otherwise the schedule is not workable. The existence of a unique resource, such as a person, in a certain time usually has to be considered as a hard constraint. The second is soft constraint that

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