



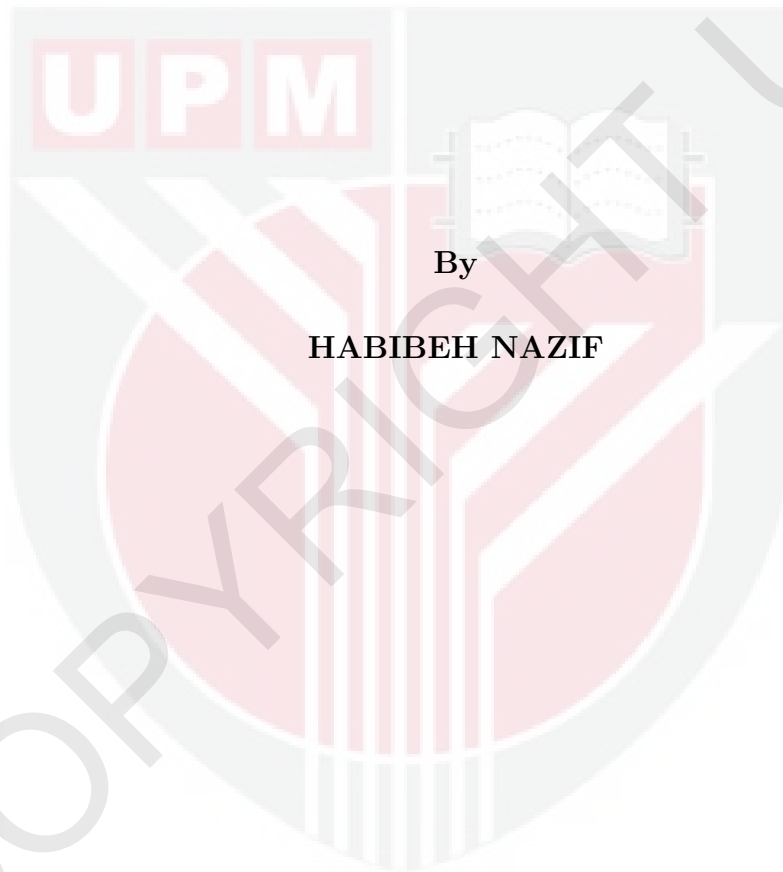
UNIVERSITI PUTRA MALAYSIA

**OPTIMISED CROSSOVER GENETIC ALGORITHMS FOR
COMBINATORIAL OPTIMISATION PROBLEMS**

HABIBEH NAZIF

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**OPTIMISED CROSSOVER GENETIC ALGORITHMS FOR
COMBINATORIAL OPTIMISATION PROBLEMS**



By

HABIBEH NAZIF

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

July 2010

DEDICATION

To

My Sweetheart, Akbar

and

My Lovely Son, Kiarash



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in
fulfilment of the requirement for the degree of Doctor of Philosophy

**OPTIMISED CROSSOVER GENETIC ALGORITHMS FOR
COMBINATORIAL OPTIMISATION PROBLEMS**

By

HABIBEH NAZIF

Julai 2010

Chair: Dr. Lee Lai Soon, PhD

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A Genetic Algorithm is successful in generating near-optimal solutions if it is able to produce offspring during crossover that is better than the parent solutions. Most of the current methods of crossover determine offspring by using a stochastic approach and without reference to the objective function with the result being that a potentially optimal solution could be lost through incorrect choices being made in the randomisation process.

This thesis focuses on the development of a new stream of crossover within genetic algorithms, called Optimised Crossover Genetic Algorithm (OCGA) for solving combinatorial optimisation problems, which takes into account the objective function in finding the best offspring solution among an exponentially large number of potential offspring. Using the optimised crossover scheme, the two parents produce the two new children: the O-child (Optimum child) and the E-child (Exploratory child). The O-child is constructed in a way so as to have the best objective function value from the feasible set of children, while the E-child is constructed so as to maintain the diversity of the search space.

In this thesis, the OCGA is applied to some combinatorial optimisation problems, specifically on single machine scheduling problems and vehicle routing problems. We particularly focus on four problems: single machine family scheduling problem with maximum lateness, single machine family scheduling problem with total weighted completion time, capacitated vehicle routing problem and vehicle routing problem with time windows. These problems are motivated by the manufacturing organisations where decisions involve a trade-off between the manufacturer's efficiency and customers' satisfaction.

Extensive computational experiments are carried out to assess the effectiveness of the OCGA compared to other local search methods proposed in the literature. The results shown the OCGA is competitive and capable of generating near optimal solutions.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**ALGORITMA GENETIK LINTASAN TEROPTIMUM UNTUK
MASALAH PENGOPTIMUMAN KOMBINATORIK**

Oleh

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Jun 2010

Pengerusi: Dr. LEE LAI SOON, PhD

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Algoritma Genetik telah berjaya dalam menjana penyelesaian hampir optimum sekiranya ia mampu menghasilkan zuriat yang lebih baik semasa lintasan dari penyelesaian ibubapa. Kebanyakan kaedah-kaedah lintasan terkini menentukan zuriat dengan menggunakan pendekatan stokastik dan tanpa rujukan kepada fungsi objektif dengan keputusan yang berpotensi untuk penyelesaian optimum akan gagal menerusi pilihan tidak tepat yang telah dibuat dalam proses perawakan.

Tesis ini memfokuskan pembangunan strim lintasan yang baru di dalam algoritma genetik, dipanggil Algoritma Genetik Lintasan Teroptimum (OCGA) untuk menyelesaikan masalah pengoptimuman kombinatorik, yang mengambil kira fungsi objektif dalam mencari penyelesaian zuriat terbaik diantara zuriat berpotensi yang berjumlah besar secara eksponen. Dengan menggunakan skim

lintasan teroptimum, kedua-dua ibubapa menghasilkan dua kanak-kanak baru: anak-O (anak optimum) dan anak-E (anak jelajahan). Anak-O dibina sedemikian rupa untuk mendapatkan nilai fungsi objektif terbaik dari set tersaur bagi kanak-kanak, sementara anak-E dibina untuk mengekalkan perbezaan ruang gelintaran.

Dalam tesis ini, OCGA digunakan untuk masalah pengoptimuman kombinatorik, secara spesifiknya dalam masalah penjadualan mesin tunggal dan masalah perjalanan kenderaan. Kami secara khususnya memfokuskan empat masalah: masalah penjadualan keluarga mesin tunggal dengan kelewatan maksimum, masalah penjadualan keluarga mesin tunggal dengan masa siap berpemberat keseluruhan, masalah perjalanan kenderaan yang berkapasiti tetap dan masalah perjalanan kenderaan dengan tettingkap masa. Masalah dimotiuasikan oleh organisasi pembuatan di mana keputusan membabitkan keseimbangan diantara kecekapan pengeluaran dan kepuasan pelanggan.

Eksperimen berkomputer telah dijalankan dengan meluas untuk menilai keberkesanan OCGA berbanding kaedah carian lain yang dicadangkan dalam literatur. Keputusannya menunjukkan OCGA adalah kompetitif dan berupaya menjanakan penyelesaian yang hampir optimum.

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I certify that an Thesis Examination Committee has met on **18 June 2010** to conduct the final examination of **Habibeh Nazif** on her thesis entitled “**Optimised Crossover Genetic Algorithms For Combinatorial Optimisation Problems**” in accordance with Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the **Doctor of Philosophy**.

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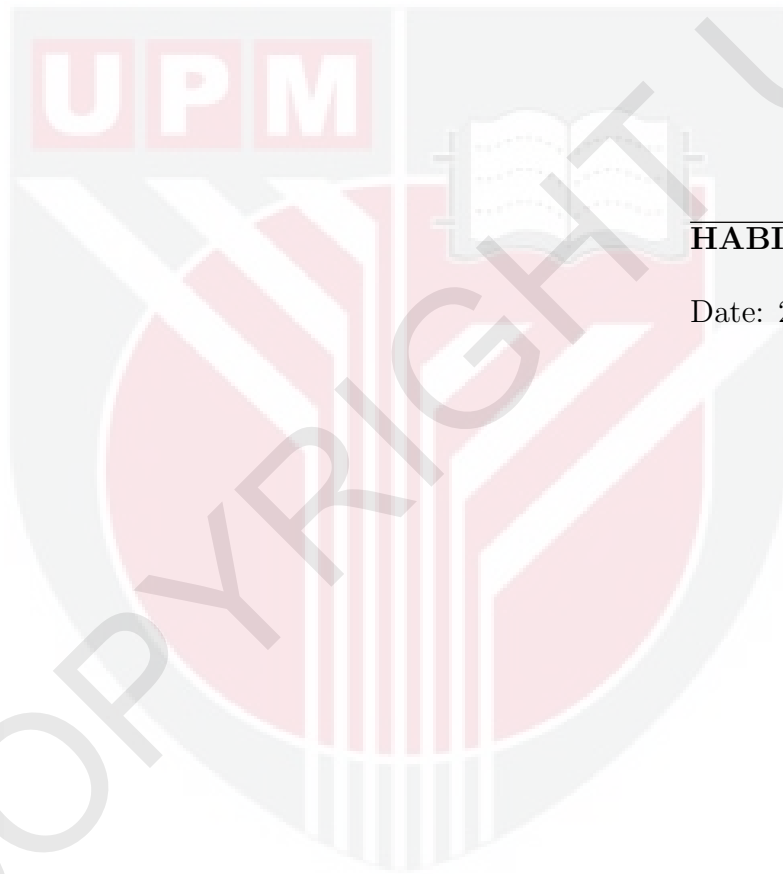
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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.



HABIBEH NAZIF

Date: 23 July 2010

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