Parallel Hybrid Meta Heuristic Algorithm for University Course Timetabling Problem (PHACT)

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Abstract: *The scheduling of courses in universities is known to be a highly constraint NP-hard problem, that is a class of optimization problems attracted by many researchers. Our solution uses hybrid algorithm for solving polynomial with satisfying all problem constraints. Of the many researches have been applied to solving the problem automatically, Meta-heuristic techniques have shown better results. In this paper we present a method based on Hybrid Meta-heuristic approach to solve university course timetabling problem. This approach has two sequential phases with overall parallel implementation; it has a main algorithm that employed prescheduling structure and overall high performance MPI algorithm. This algorithm shows 92% speedup over serial implementation. The system is tested with real data from Islamic Azad University of Iran.*

Keywords: Timetabling, Constraint Problem, Hybrid Meta-heuristic, MPI.

1. Introduction

University timetabling problems are difficult, time consuming and multi variable tasks faced by educational institutions. In order to provide automated support for human-related timetables and to find optimal answers different research has been invested over the years. In recent years, meta-heuristic methods are being used more frequently for solving this problem. University timetabling is an allocation of given resources to a timeslot with satisfying given constraints [1].

The university-timetabling problem can be grouped in two main categories: course timetabling and examination timetabling. The web-based system is presented for solving course timetable problem with a hybrid method called PHACT. Course timetabling is a NP-hard problem assignment with many constraints in which teacher and students are assigned to courses and classrooms; each event (meeting between specific teacher and group of students) is assigned to one classroom in a time slot [2].

A practical schedule problem like *University Course Timetabling Problem* (UCTP) usually includes different parts, some goals and series of constraints related to resources. Techniques applied to the course timetabling are mainly divided into eight categories [3]. Including: graph based approach, constraint based approach, meta-heuristic approaches, multi-criteria approaches, hyper-heuristic/self-adaptive approaches, case-based reasoning, knowledge-based and fuzzy-based approaches.

A major aspect for solving scheduling problems by using the Artificial Intelligence (AI) is Constraint Programming (CP). CP helps us clarify many problems so they can be easily solved.

Other Algorithms from researchers are available [4,5,6], but many of them for solving this problem in high density of data needed a lot time. Answering in a long time in this kind of problem for real implementation is not acceptable. So for solving problem, this hybrid meta-heuristic method applies a pre-scheduling structure and two phases approach that they are running sequential each after another. This algorithm has a body of a parallel implementation that uses Message Passing Interface (MPI). In the first phase, initial feasible timetable is generated using Greedy algorithm. Improvement is made in second phase using backtracking. A Particle Swarm Optimization algorithm with MPI implementation is main algorithm. Our proposed approach introduces optimized method for resolving UCTP, which prevent people from wasting their time at web environment.

System based on problem implemented with Visual Basic.net and uses MPI.NET. Cause of using MPI.Net instead other implementations is that system developed for web. Base platform considered for this was windows and its High performance computation (HPC). This system is established for the collection of Islamic Azad Universities with Web environment implementation.

This article deals in details with CP approach. The main advantage of CP method is its straightforward and clear solutions for small domestic searches. Finally, an optimizing approach is needed.

This paper is organised as follows. In section 2 we review the criteria for University timetable problem and