Chapter 65
EvoWebReg:
Web-Based Course Registration and Optimization of Student Personal Schedules with Evolutionary Algorithms

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ABSTRACT

This article presents a complete course registration system through the web (EvoWebReg). The system consists of three parts. The first one is a web application which allows the students to submit their course preferences to the system's database, through Internet. The second part is an administrative tool which controls the whole system and allows its smooth operation, and the third part is an evolutionary algorithm which is responsible for the optimization of the student course schedules according to their submitted preferences, and taking into consideration the constraints imposed by the department. The results of the experimental tests of the evolutionary algorithm prove that our initial objectives to provide an open generic and effective tool, which can satisfactory implement the course registration procedure, were achieved. The proposed system is quite general and can be easily adapted to incorporate the needs of other departments.

INTRODUCTION

Course timetabling and student scheduling are two important activities of institutes in tertiary education worldwide. In some of them, students are requested to select courses, taking into consideration a pre-constructed timetable, while in other institutes the selection process proceeds, and the timetable construction follows. The Department of Informatics at the Alexander Technological Educational Institute of Thessaloniki (ATEITh) applies the first approach. Both approaches have been extensively studied by numerous researchers using several scientific techniques ranging from applied mathematics and operational research to computational intelligence.

At the same time, a remarkable progress happened at the field of telecommunications, starting from a small 4-node network at 1969 which evolved to ARPANET with 213 nodes at 1981

when the protocol TCP/IP appeared. Its further development led to the WWW with millions of users and the web playing an important role to every human activity.

The successful solution of complex problems with computational intelligence techniques, and the prevalence of the web were the reasons to start the implementation of the system "EvoWebReg." The target is the exploitation of these technologies in order to optimize the student course schedules and facilitate the course registration procedure.

The system consists of the registration website, the management application and the scheduling algorithm responsible for the optimization of the student course schedules. The website provides students an easy to use GUI to submit their course preferences to the system's database via the Internet. The management application is a useful tool for the staff of the Department, since it provides numerous choices to access and control the system and certify its smooth operation. The scheduling algorithm is an evolutionary algorithm (EA) which implements the constraints imposed by the Department. The constraints are either hard-coded in the EA, or they are taken into consideration by its fitness function.

In the next sections we describe the problem of course registration at the Dept. of Informatics at ATEITh, give a review of relevant literature, present a brief description of the web application and an extensive one of the scheduling and optimization application through the evolutionary algorithm. Finally we present some results and discuss future extensions and results.

PROBLEM DESCRIPTION: CASE STUDY

According to Carter and Laporte (1998) the course scheduling problem can be decomposed into the following sub-problems: course timetabling (assign courses or course sections to time periods satisfying some requirements and/or constraints),

teacher assignment (assign teachers to courses maximizing a preference function), classroom assignment (events must be assigned to specific rooms to satisfy some criteria), and student scheduling (arises when courses are taught in multiple sections). The course timetabling systems are also distinguished as *Master Timetables* or *Demand Driven*, with their primary difference lying in the sequence in which the various sub-problems are being solved.

In this paper we consider the student scheduling problem with the Master Timetable approach, adapted to the requirements and characteristics of the Dept. of Informatics of ATEITh. Although we discuss a specific case study, most methods are general enough and should be applicable to modeling and solving other instances of the problem.

In our case study, a semester is the academic time unit. Course timetables and student sectioning must be done in the beginning of every semester. Studies last for 8 semesters. In the first seven semesters, the students have to pass a number of courses. In the eighth semester students have to elaborate a thesis and also complete a six month practice at a company (industrial placement).

A course can be either *simple* or *mixed*. A course is considered *simple* when it is taught only by lectures in big enough lecture rooms, and *mixed* when it is taught by lectures (theoretical part) and laboratory exercises (lab part). When a course is mixed, in order for a student to pass the course he/she must enrol in both parts of the course and succeed a passing mark in both parts. A simple course or the theoretical part of a mixed course is taught by lectures in rooms that are large enough to accommodate all enrolled students. It's very rare to have two sections of a simple course. On the other hand, all laboratory rooms have limited capacity which is usually much smaller than the number of students registered in the theoretical part of the course. So the students of most mixed courses must be separated into lab groups (course sections for the lab part). The available number of lab groups for each mixed course is decided before

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