

# **Advanced Scheduling Techniques**

## **ABSTRACT**

This Ph.D. dissertation considers the scheduling problem as it is faced in the companies where a good schedule is needed for all the activities that must be executed. The models that represent these scheduling problems require the solution of combinatorial optimization problems that belong to the category of NP-hard problems and there is no known polynomial time algorithm to solve them. Moreover, the size of practical scheduling problems is very big that makes it impractical to attempt solving them using general purpose exact algorithms for integer programming. In order to find acceptable solutions for practical scheduling problems at reasonable computational time, the use of some modern heuristic techniques for the solution of combinatorial problems is suggested. The implementation of these techniques considers also the specific characteristics of the problems.

An algorithm based on the column generation approach, was designed and developed for the combined bus and driving scheduling problem of the Greek bus companies. Firstly developed a quick heuristic scheduling procedure for the solution of the problem, using minimum cost matching, set partitioning and shortest path algorithms. Then a column generation procedure that uses an LP-solver and the previous heuristic as its integer solution finder is presented. A scheduling system based on this algorithm is in daily use by a number of Greek bus companies.

Also, a detailed model and an efficient solution methodology for the monthly workshift and rest assignment problem, is presented. A hybrid methodology that utilizes the strengths of operations research and artificial intelligence was used for the solution of the problem. In particular, an approximate integer linear programming model is firstly solved and its solution is further improved using local search and tabu search techniques.

Finally, the timetabling problem for a typical Greek high school environment is modeled and solved using a constraint programming approach. Operations Research sensitivities and local search algorithms are included in the solution process in order to calculate lower bounds of the solution for specific subproblem instances and to effectively guide the search process. The strategy used for choosing variables and the values assigned to them depends on the characteristics of the cost function.