On Some Realizations of Solving the Resource Constrained Project Scheduling Problems

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We consider the resource constrained project scheduling problem (RCPSP) with precedence and resource constraints. The RCPSP can be defined as a combinatorial optimization problem, i.e. in terms of decision variables, constraints and objective functions, as follows. A set of activities and a set of resources of known characteristics (activity durations, activity resource demands, resource availabilities, precedence restrictions) are given. The decision variables are the activity start times defined on integer time periods. The objective function which has to be minimized is the makespan, i.e. the largest activity completion time, assuming the project starts at time 0. There are two types of constraints. The precedence constraints prevent each activity from starting before the completion of its predecessors. The resource constraints ensure that, at each time period and for each resource, the total activity demand does not exceed the resource availability. Once started, an activity cannot be interrupted.

The RCPSP belongs to the class of NP-hard optimization problems and is actually one of the most intractable classical problems in practice.

We propose two methods for solving the problem. One of them is the exact branch and bound algorithm. For another, we use metaheuristics – genetic algorithm. Both of the proposed algorithms use the solution of the relaxed problem where all constrained resources being accumulative as an auxiliary problem.

We present results of numerical experiments illustrating quality of proposed algorithm. The test instances were used from the library of test problems PSPLIB. Numerical experiments demonstrated algorithm's competitiveness. We have found the best solutions for a few instances from the dataset j120, and the best average deviation from the critical path lower bound for the datasets j60 (50000 and 500000 iterations) and j120 (500000 iterations).

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