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Using Genetic Algorithm for Single Machine Scheduling with Earliness/Tardiness Penalties and Setup Cost

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***Abstract*-Analysis of single machine scheduling problems, taking earliness and tardiness penalties into consideration, is one of the most applicable problems in the field of scheduling. In just in time (JIT) production systems, the objective is to sequence and schedule all the jobs so that the total earliness and tardiness be minimized. Scheduling based on the due date is an important and competitive task in the production plants. This paper addresses the one-machine scheduling problem with earliness and tardiness penalties. We propose integer nonlinear programming model (INLP) that can solve instances with up to 30 jobs and genetic algorithm that can solve instances more than 50 jobs.**

Keywords-Genetic Algorithm, Integer Nonlinear Program, Earliness and Tardiness, Single Machine Scheduling, Setup Cost.

I. INTRODUCTION

A useful but difficult criterion in scheduling theory is the minimization of both earliness and tardiness costs. It comes from the "just-in-time" philosophy in management and production theory: an item should be delivered when it is required by the customer. Therefore earliness and tardiness delivery of a task with respect to its due date is penalized.

The study of scheduling dates back to 1950s. In the 1970s, many scheduling problems were shown to be NP-hard. Baker and Scudder present a review on scheduling problems with earliness and tardiness penalties [2]. They discern two major classes of problems. The first class involves a common due date for all jobs. This problem is in the second class, which permits the due dates to differ. Ow and Morton examine the problem of minimizing total earliness and tardiness costs and present some interesting heuristic methods [20]. However, they do not allow idle time, which is inconsistent with the earliness/tardiness criterion of Baker and Scudder. Garey also consider the problem of minimizing the total earliness and tardiness, and they do allow idle time [9]. For problems with all tasks having the same length as well as for problems with a fixed sequence they discuss efficient algorithms to find an optimal solution. As is recognized in Baker and Scudder, the search for optimal schedules may be decomposed in two sub-problems: finding a good job sequence and scheduling inserted idle time [2]. Fry et al consider the problem of minimizing weighted total earliness and tardiness [8]. They present a method to optimally insert idle time, and give empirical results for some heuristics. Yano and Kim consider the problem of minimizing weighted earliness and tardiness [31]. They present a dynamic programming approach. They compare the solutions of a number of heuristic methods with the optimal solutions, which are found by a Branch and Bound procedure.