

Applying hierarchical tabu search to an adapted version of the flexible job shop problem

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Introduction

The scheduling departments of batch manufacturing systems have to repeatedly solve a complex scheduling problem for the operation of their production lines. A set of m jobs has to be scheduled on n machines. The goal is to minimize the makespan of the schedule. This can be translated into an adapted version of the flexible job shop problem (FJSP) [1].

Hierarchical tabu has been chosen to solve this problem [3]. This algorithm is performed on problem instances of variable complexity and results are compared to those of a baseline function using mixed integer linear programming (MILP) [2]. This leads to the following research question:

How does hierarchical tabu search perform on an adapted version of FJSP and how does it compare to an MILP approach?

Flexible job shop problem

The flexible job shop problem can be summarized as follows:

- Schedule m jobs on n machines
- Each job consists of n_j operations that have to be executed in sequential order
- An operation can be performed on a subset of machines with a certain corresponding time
- Changeover times might occur between operations on the same machine
- Each machine only supports one type of operations

Hierarchical tabu search

A hierarchical algorithm splits FJSP into two sub-problems: assignment and scheduling. Both these problems are solved using a tabu search approach. An initial schedule is created and in each iteration of the algorithm, a set of new schedules with small changes, called the neighborhood, is created. The best of these schedules is chosen for the next iteration. A tabu list is kept and chosen moves will be stored in there for a set amount of iterations. These moves cannot be chosen again as long as they are in the tabu list. The whole algorithm makes use of a disjunctive graph representations for schedules.

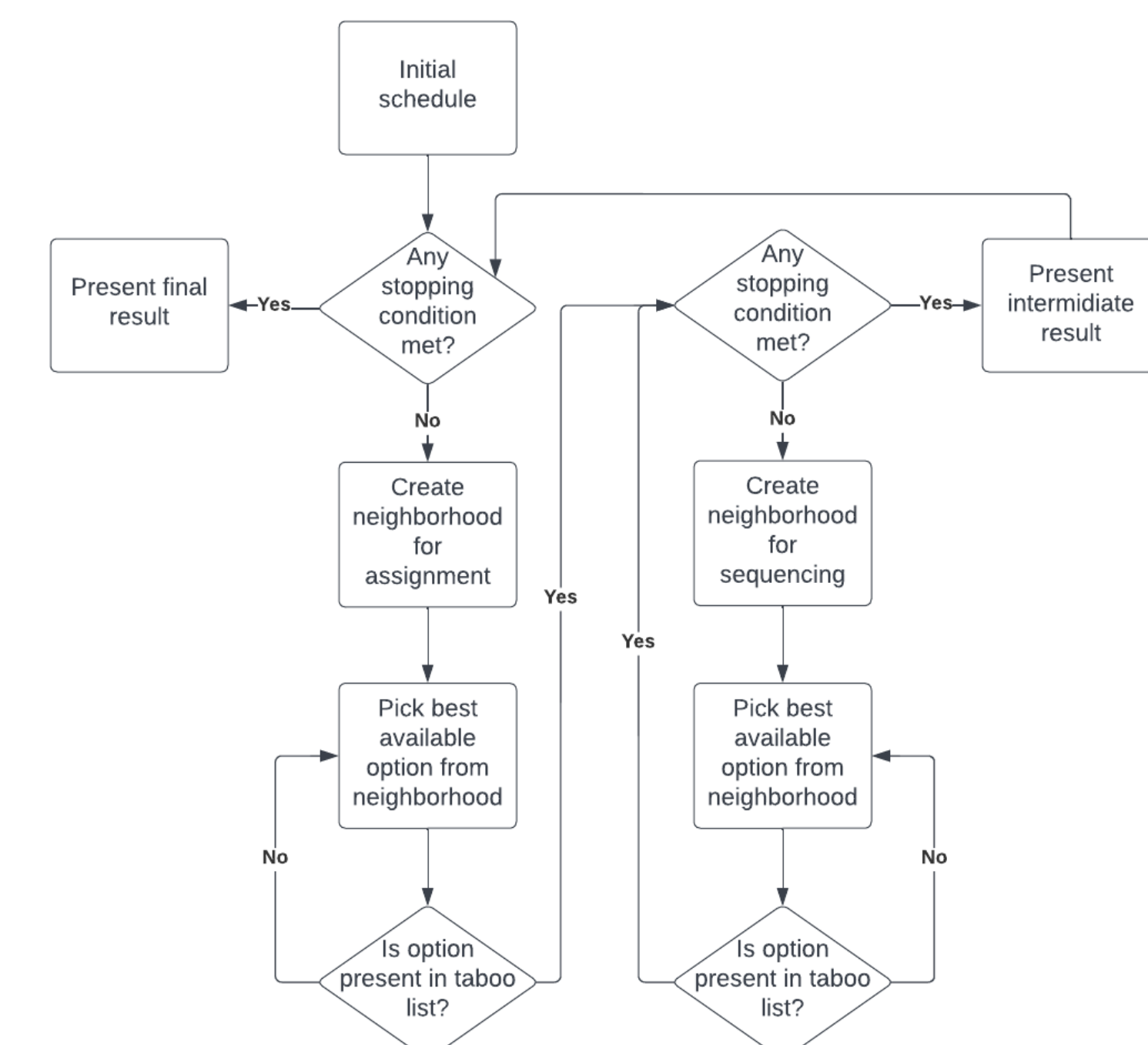


Figure 1: Hierarchical tabu search structure

Results

The initialization procedure using a global selection heuristic [4] performs quite well, surpassing the MILP for more complex instances both in time investment and makespan. The rest of the algorithm only produces results that are worse than the original one. One possible explanation for this would be the added complexity because of the changeover times and the inflexibility of operation assignment.

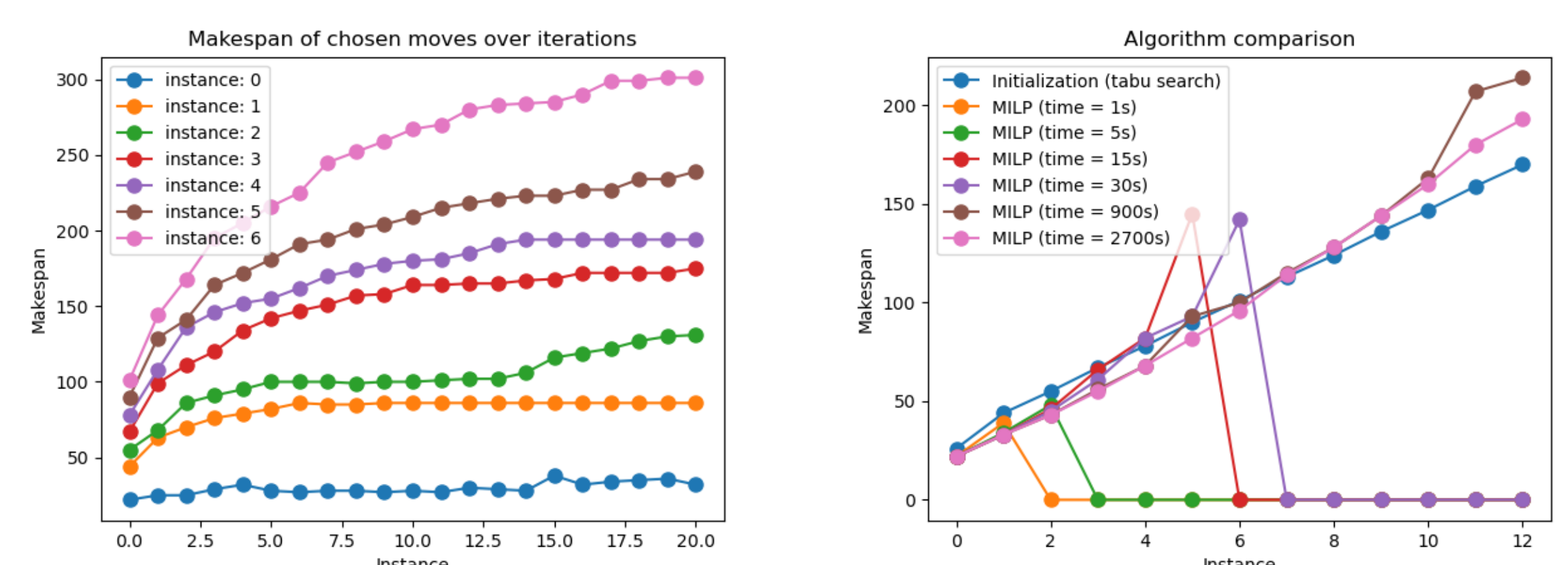


Figure 2: Main results

References

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