MODAPTO [101091996]: Modular Manufacturing and Distributed Control via Interoperable Digital Twins

5.4.1 Exact Methods Overview

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Exact methods are mathematical approaches that search systematically for the optimal solution in optimization problems. Unlike heuristic methods, which stop at good-enough results, exact methods continue until they can prove that no better solution exists. This makes them ideal for benchmarking or for applications where decision quality is a top priority.

Some of the most widely used exact methods include branch and bound algorithms, dynamic programming, linear or integer programming and constraint programming. Branch and bound works by exploring the solution space in a structured way and eliminating paths that cannot lead to optimal solutions. Dynamic programming breaks down a problem into smaller subproblems and combines their solutions to find the best overall outcome. Integer and linear programming models use mathematical formulations to represent constraints and objectives precisely. In more complex frameworks, constraint programming provides a declarative approach to scheduling, where problems are specified in terms of variables, domains, and constraints.

While these methods can be too slow for very large problems, they are well-suited for small to medium-sized scheduling scenarios, especially when accuracy is more important than speed.

References

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