

Packing problems in one and more dimensions

The first part of the lecture will provide an overview of models and algorithms for the (one-dimensional) bin packing problem. This is one of the most famous strongly NP-hard problems in combinatorial optimization. Its structure and its applications have been studied since the Thirties (Kantorovich). In the early Sixties Gilmore and Gomory introduced, for this class of problems, the concept of column generation. This is one of the first problems for which, since the early Seventies, the worst-case performance of approximation algorithms was investigated. In the Eighties and Nineties lower bounds were studied and effective exact algorithms were developed. In the following years many heuristic and metaheuristic approaches have been introduced. More recently, branch(-and-cut)-and-price algorithms and pseudo-polynomial formulations have been successfully used for its exact solution

In the second part we will consider extensions of the bin packing problem to the two- and three-dimensional case. In several industrial applications one is required to allocate a set of rectangular items to larger rectangular standardized stock units by minimizing the waste. We will review mathematical models, approximation algorithms, lower bounds, heuristics, and exact methods. Applications arising in transportation (routing problems with loading constraints) will be presented.