Bin Packing and Related Problems: General Arc-flow Formulation with Graph Compression

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We present an exact method, based on an arc-flow formulation with side constraints, for solving bin packing and cutting stock problems – including multi-constraint variants – by simply representing all the patterns in a very compact graph. Our method includes a graph compression algorithm that usually reduces the size of the underlying graph substantially without weakening the model.

Our formulation is equivalent to Gilmore and Gomory’s, thus providing a very strong linear relaxation. However, instead of using column-generation in an iterative process, the method constructs a graph, where paths from the source to the target node represent every valid packing pattern.

The same method, without any problem-specific parameterization, was used to solve a large variety of instances from several different cutting and packing problems. We deal with vector packing, bin packing, cutting stock, cardinality constrained bin packing, cutting stock with cutting knife limitation, bin packing with conflicts, and other problems.

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