Improved Filtering for the Bin-Packing with Cardinality Constraint

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Previous research[2, 3] shows that a cardinality reasoning can improve the pruning of the bin-packing constraint, even when cardinalities are not involved in the original model. Our contribution is two-fold.

We first introduce a new algorithm, called BPCFlow, that filters both load and cardinality bounds on the bins, using a flow reasoning similar to the one used for the Global Cardinality Constraint.

Moreover, we detect impossible assignments of items by combining the load and cardinality of the bins using a new reasoning method called "too-big/too-small". This new method attempts to construct for each bin with load and cardinality bounds $[\underline{L}, \overline{L}]$ and $[\underline{C}, \overline{C}]$ a maximum-weighted set of $\overline{C} - 1$ items. Once this set is constructed, we detect that items with weight $w < \underline{L} - \sum_{i \in S} w_i$ cannot be assigned to the current bin. Similar arguments can be used to detect a maximum weight. The "too-big/too-small" reasoning is then adapted to the existing propagators, namely SimpleBPC[3], Pelsser's method[2] and BPCFlow.

We then experiment our four new algorithms on Balanced Academic Curriculum Problem and Tank Allocation Problem instances.

BPCFlow is shown to be indeed stronger than previously existing filtering, and more computationally intensive. We show that the new filtering is useful on a small number of hard instances, while being too expensive for general use.

Our results show the introduced "too-big/too-small" filtering can most of the time drastically reduce the size of the search tree and the computation time. This method is profitable in 88% of the tested instances.

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References

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