

**New Algorithms for Constrained Rectangular Guillotine Knapsack Problems**

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## **Thesis Summary**

In the Unconstrained Rectangular Guillotine Knapsack Problem (RGKP), also referred to in the literature as the two dimensional guillotine cutting problem, we are given one piece of a stock

Whitlock's algorithm implicitly enumerates all feasible guillotine cutting patterns by constructing a tree with the stock rectangle at its root, and the sets of rectangles obtainable from the stock rectangle by means of a single guillotine cut as the immediate successors of the root, and so on. The implicit enumeration is guided by an upper bounding function that uses dynamic programming coupled with an allocation routine. The search is organized in a depth-first fashion and the bounds calculated are used to avoid further branching from nodes which are known to yield improved solutions and nodes from which further branching is known to be unprofitable.

Wang's approach enumerates all feasible cutting patterns by the reverse process, that is by considering all ways of constructing the stock rectangle starting from the demanded rectangles. Wang's algorithms use certain 'heuristic' measures to restrict the number of patterns constructed. Optimal solutions can be obtained by first generating a good solution manually, and then using either of the algorithms with a suitable heuristic value obtained on the basis of the manually generated solution.

The proposed approach also seeks to construct the stock rectangle starting from the demanded rectangles. However the decision of whether or not to include a given rectangle in a pattern is guided by a measure of desirability of that rectangle. Thus, at any point, the two most promising rectangles are joined together to build a new rectangle. This approach resembles certain heuristic search algorithms studied in the Artificial Intelligence literature. Three measures of attractiveness of rectangles have been suggested and all of them lead to optimal solutions. Two of the measures are dynamic programming and the third measure is derived from the first two. The algorithm can be seen as a "best-first" approach, and is designed to terminate as soon as is possible after an optimal pattern has been constructed.

The approach employed is applicable to one dimensional knapsack problem, and new algorithms which yield optimal solutions to both constrained and unconstrained one dimensional knapsack problems are also presented. However, in their present form, these algorithms are not as efficient as the best known algorithms for these problems.

An extension of the approach employed for CRGKP to the case of multiple stock sheets has also been developed. An application of the proposed algorithm to the general two dimensional cutting stock problems has been suggested.