LINMA2450 — Project Part 1
Combinatorial Optimization

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Problem 1 — Optimal Boards Cutting

(a) **(1.1) Mathematical Modeling.**

A cutting pattern is feasible if the total length of the pieces cut from a large board does not exceed the length L of the board. This can be expressed as a knapsack constraint:

$$\sum_{j=1}^{n} l_j x_{tj} \leq L \quad \forall t \in P$$

where x_tj is the number of pieces of length lj in pattern t.

(b) **(1.2) Primal Solution and Pattern Generation.**

Let y_t be the number of large boards used with cutting pattern t. The master problem can be formulated as follows:

Minimize:

$$\sum_{t \in P} y_t$$

Subject to:

$$\sum_{t \in P} x_{tj} y_t \geq d_j \quad \forall j = 1, \ldots, n$$

$$y_t \in \mathbb{Z}_{\geq 0} \quad \forall t \in P$$

where d_j is the demand for pieces of length lj.

(c) **(1.3) Implementation and Results.**

To generate new cutting patterns, we can solve a knapsack problem where the objective is to maximize the total length of pieces cut from a large board without exceeding its length L. The items in the knapsack are the different lengths lj, and their values can be set to 1 (indicating that we want to include as many pieces as possible). The knapsack constraint is given by:

Maximize:

$$\sum_{j=1}^{n} x_j$$

Subject to:

$$\sum_{j=1}^{n} l_j x_j \leq L$$

$$x_j \in \mathbb{Z}_{\geq 0} \quad \forall j = 1, \ldots, n$$

Solving this knapsack problem will yield a new cutting pattern that can be added to the master problem.

Problem 2 — Optimal Delivery Assignment

(a) **(2.1) Mathematical Modeling.**

(b) **(2.2) Hungarian Method.**

(c) **(2.3) Implementation and Comparison.**