Knapsack Problem
The "knapsack problem" is a classical OR problem which is simply stated but difficult, with a wide variety of areas of application.

Maximize \[ \sum_{i=1}^{N} V_i X_i \]

subject to \[ \sum_{i=1}^{N} W_i X_i \leq C \]

\[ X_i \geq 0 \text{ & integer} \]

where \( W_i > 0 \)
Given $N$ items, each with known weight $W_i$ and value $V_i$, $i=1,2,\ldots,N$, which items should be included in a knapsack with maximum weight capacity $C$ so as to maximize the value of the knapsack contents without exceeding its capacity?
An important special case is the zero-one knapsack problem, in which each $X$ is restricted to values of either zero or one, e.g., the marginal value of any additional units of an item after the first is zero. (If preparing for a hiking expedition, the value of two boxes of matches is no greater than one box!)
Optimizing algorithms fall into two main categories:

- **Dynamic Programming**
- **Branch-and-Bound**
Applications

- the trim (cutting-stock) problem
- capital budgeting