Knapsack Problem

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

$$\text{Maximize} \quad \sum_{i=1}^{N} V_i X_i$$

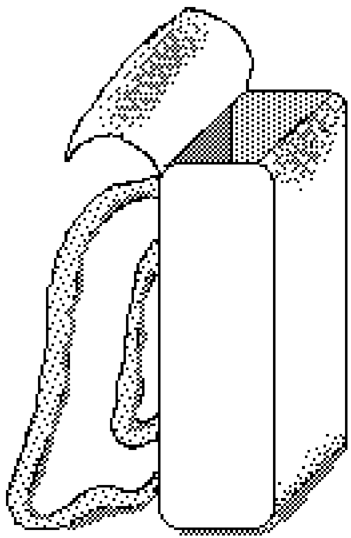
$$\text{subject to} \quad \sum_{i=1}^{N} W_i X_i \leq C$$

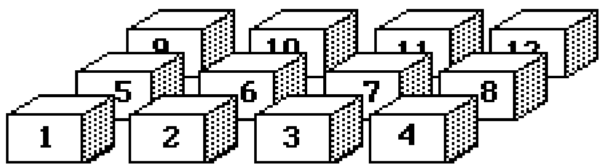
$$X_i \geq 0 \text{ \& integer}$$

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