Lecture 4.2

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The goal of the knapsack problem is to select a set of items whose **total weight is *not* too large**, and whose **total value is maximized**.

More formally, the input is given as

- $X = \{x_1, \dots, x_n\}$
- $weight(x_i)$ is a positive number
- $value(x_i)$ is a positive number
- W is a positive number

and the goal is described as: 'Compute subset $S \subseteq X$ whose total value is maximized under the condition that its total weight is at most W.'

The global strategy of the PTAS we construct is as follows:

1. Replace the value of each item x_i by a new value, $value^*(x_i)$, which is a "small" integer;
   - The optimal solution for the new values should be a good approximation of the optimal solution for the original values.
2. Solve the problem optimally for the new values;
   a. The exact algorithm should run in polynomial time when items have "small" integer values.
3. Return the subset computed in step 2 as a solution for the original problem.