Why

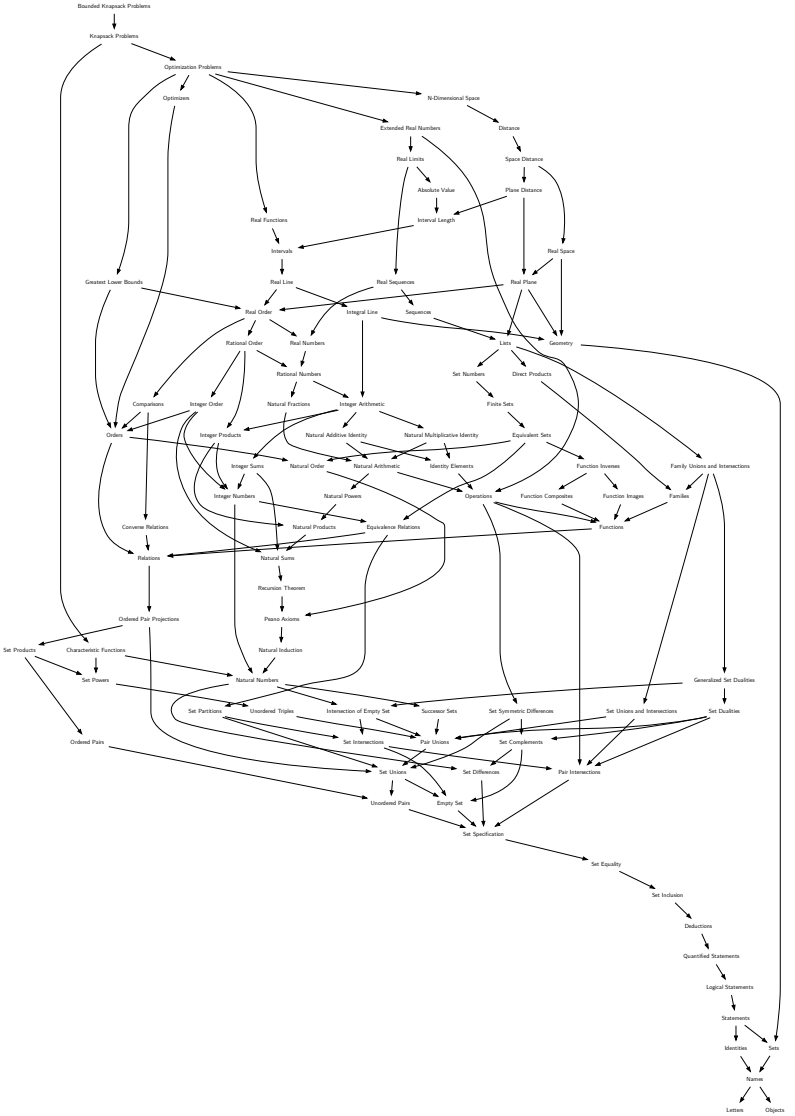
We consider the knapsack problem in which the n items are considered to be types of items and we have a certain quantity of each.

Definition

Suppose we have zero-one knapsack problem data (p, w, c) where $p : [n] \to \mathbf{R}$ is the profit function, $w : [n] \to \mathbf{R}_+$ is the weight function, and $c \in \mathbf{R}_+$ is the capacity constraint. Given *budgets* $b_1, \ldots, b_n \in \mathbf{Z}_+$, find $x \in \mathbf{Z}_+^n$ to

$$\begin{aligned} \text{minimize} \quad & \sum_i p_i x_i \\ \text{subject to} \quad & \sum_i w_i x_i \leq c \\ & 0 \leq x_i \leq b_i, \quad i = 1, \ldots, n, \\ & x_i \in \mathbf{Z} \quad i = 1, \ldots, n \end{aligned}$$

The above is called the *bounded knapsack problem.* The problem above *without* the budget constraints, is called the *unbounded knapsack problem.*


Bounded Knapsack Problems
Knapsack Problems
Optimization Problems
Optimizers
N-Dimensional Space
Extended Real Numbers
Distance
Real Limits
Space Distance
Absolute Value
Plane Distance
Interval Length
Real Functions
Intervals
Real Space
Greatest Lower Bounds
Real Line
Real Sequences
Real Plane
Real Order
Integral Line
Sequences
Rational Order
Real Numbers
Lists
Geometry
Rational Numbers
Set Numbers
Direct Products
Comparisons
Integer Order
Natural Fractions
Integer Arithmetic
Finite Sets
Orders
Integer Products
Natural Additive Identity
Natural Multiplicative Identity
Equivalent Sets
Function Inverses
Family Unions and Intersections
Integer Sums
Natural Order
Natural Arithmetic
Identity Elements
Integer Numbers
Natural Powers
Operations
Function Composites
Function Images
Families
Converse Relations
Natural Products
Equivalence Relations
Functions
Relations
Natural Sums
Recursion Theorem
Ordered Pair Projections
Peano Axioms
Set Products
Characteristic Functions
Natural Induction
Set Powers
Natural Numbers
Generalized Set Dualities
Set Partitions
Unordered Triples
Intersection of Empty Set
Successor Sets
Set Symmetric Differences
Set Unions and Intersections
Set Dualities
Ordered Pairs
Set Intersections
Pair Unions
Set Complements
Set Unions
Set Differences
Pair Intersections
Unordered Pairs
Empty Set
Set Specification
Set Equality
Set Inclusion
Deductions
Quantified Statements
Logical Statements
Statements
Identities
Sets
Names
Letters
Objects