

CMPSC 623 Problem Set 7.
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Out: November 30, 2006
Due: December 7, 2006, before class.

Problem. In this problem, we consider some generalizations of the knapsack problem.

1. Describe how to change the knapsack algorithm described in class to deal with the case where the value of an item can be different from its weight.
2. Consider a knapsack problem where each item, in addition to having a weight w_i and a value v_i , also has a size s_i . The knapsack has a weight capacity W and also a size capacity S . Give an algorithm that runs in time $O(nWS)$ for determining the maximum value subsets of the items that can be placed in the knapsack without violating the weight capacity or the size capacity.
3. Consider a scenario where the items to be stolen by the thief are partitioned into types (i.e., stereos, computers, necklaces...). Every item belongs to exactly one type. In addition to the weight capacity of the knapsack, the thief is further constrained to be able to steal at most one item of each type. Give an algorithm, that runs in time $O(nW)$, that determines the optimal subset of items that the thief is able to steal. You can assume that each item comes with an indication of which type it belongs to, and that the items start off sorted by item type. For this subproblem, there is no longer the size consideration introduced in part (b).