Combinatorial Dominance Analysis of Some Algorithms for the Knapsack problem

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Abstract

A measure of *quality* of an algorithm enables us to compare and evaluate algorithms. For exact algorithms we compare mainly running time, but for approximation algorithms we first check the solution quality.

Let P be an optimization problem, and let A be an approximation algorithm for P. The *domination ratio*, $\text{domn}(A, n)$, is the maximum real q such that the solution $x(I)$ obtained by A for any instance I of P of size n is not worse than at least a fraction q of the feasible solutions of I. Clearly, exact algorithms are of domination ratio 1.

In the talk, we will overview and analyze some simple algorithms for the Knapsack problem. In this problem, we are given a multi-set of non-negative integers $S = \{s_1, \ldots, s_n\}$ and a capacity T. We seek a subset $S' \subseteq S$ maximizing $\sum_{s \in S'} s$ subject to the constraint $\sum_{s \in S'} s \leq T$.

In particular, we shall see a simple greedy-type algorithm for Knapsack, showing (extending the result in [2]) that the algorithm domination ratio is $1 - o(1)$.

References

[1] G. Gutin, A. Vainshtein and A. Yeo. Domination Analysis of Combinatorial Optimization Problems. *Discrete Applied Mathematics* 129 (2003) 513-520.

[2] N. Alon, G. Gutin and M. Krivelevich. Algorithms with large domination ratio. Submitted to *J. Algorithms*.