Research Institute for Discrete Mathematics
Approximation Algorithms
Summer term 2012

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Exercise Set 7

Exercise 1:
Describe a $\frac{3}{4}$-approximation algorithm for the KNAPSACK problem with running time $\mathcal{O}(n^3)$ and give a proof of the approximation ratio.
Provide an example to show that the performance bound is tight.
Hint: The basic idea is to run, for every pair of items, a 2-approximation algorithm on the remaining elements.

(6 points)

Exercise 2:
An algorithm for the BIN PACKING problem is called monotonic if for inputs S and T with $S \subseteq T$ the algorithm needs at least as many bins for T as for S. Show:

(a) Next Fit is monotonic.

(b) First Fit is not monotonic.

(2+2 points)

Exercise 3:
Consider the following algorithm for the MINIMUM MAKESPAN SCHEDULING problem: Sort the jobs by decreasing processing times. Schedule the jobs in this order. Assign each job to the machine which has the smallest total processing time at this point.
Show that this is a $\frac{4}{3}$-approximation algorithm. Provide an example to show that the bound is tight.

(5 points)

Please return the exercises until Tuesday, **May 22nd, at 2:15 pm**.