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Exercise Set 6

Exercise 6.1. Recall the version of KNAPSACK from Exercise 5.2, where items can be used multiple times.

Give an FPTAS for this problem.

(4 points)

Exercise 6.2. Let $A = (a_i)_{1 \le i \le p}$ and $B = (b_j)_{1 \le j \le q}$ be two inputs of the BIN PACKING problem. We write $A \subseteq B$ if there are indices $1 \le k_1 < k_2 < \cdots < k_p \le q$ with $a_i \le b_{k_i}$ for $1 \le i \le p$. An algorithm for the BIN PACKING problem is called monotone if for inputs A and B with $A \subseteq B$ the algorithm needs at least as many bins for B as for A. Prove or disprove:

(i) NEXT FIT is monotone.

(ii) FIRST FIT is monotone.

(2+2 points)

Exercise 6.3. Show that the BIN-PACKING PROBLEM restricted to instances $a_1, \ldots, a_n$ with $a_i > \frac{1}{3}$ for $i = 1, \ldots, n$ can be solved in $O(n \log n)$ time.

(4 points)

Exercise 6.4. Show that if all item sizes are of the form $a_i = k \cdot 2^{-b_i}$ for some $b_i \in \mathbb{N}$, $i = 1, \ldots, n$ and some fixed $k \in \mathbb{N}$ then the FIRST FIT DECREASING algorithm always finds an optimum solution.

(4 points)

Deadline: Thursday, June 11th 14:15, via eCampus. LaTeX submissions are highly encouraged, however, you can also submit a scan (e.g. obtained with a mobile phone). The websites for lecture and exercises can be found at:

`http://www.or.uni-bonn.de/lectures/ss20/appr_ss20_ex.html`

In case of any questions feel free to contact us at approx-ss20@or.uni-bonn.de.