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Exercise Set 7

Exercise 7.1. Show that if all item sizes are of the form $a_i = k \cdot 2^{-b_i}$ for some $b_i \in \mathbb{N}$, $i = 1, \dots, n$ and some fixed $k \in \mathbb{N}$ then the First Fit Dcreasing algorithm always finds an optimum solution.

(4 points)

Exercise 7.2. Give an algorithm for Bin Packing restricted to instances with a constant number of different item sizes whose running time is polynomially bounded in the number n of items.

Hint: Use dynamic programming.

(4 points)

Exercise 7.3.

(i) Prove that for any fixed $\varepsilon > 0$ there exists a polynomial-time algorithm which for any instance $I = (a_1, \dots, a_n)$ of the Bin Packing problem finds a packing using the optimum number of bins but possibly violating the capacity constraints by ε, i. e. an $f : \{1, \dots, n\} \to \{1, \dots, \mathrm{OPT}(I)\}$ with $\sum_{f(i)=j} a_i \leq 1 + \varepsilon$ for all $j \in \{1, \dots, \mathrm{OPT}(I)\}$.

Hint: Use Exercercise 7.2.

(ii) Use (i) to show that the Multiprocessor Scheduling Problem (see Exercise 6.3) has an approximation scheme.

(4+4 points)

Deadline: Thursday, May 23$^{\text{th}}$, before the lecture. The websites for lecture and exercises can be found at:

`http://www.or.uni-bonn.de/lectures/ss19/appr_ss19_ex.html`

In case of any questions feel free to contact me at rockel@or.uni-bonn.de.