Technische Universität München
Fakultät für Informatik
Lehrstuhl für Algorithmen und Komplexität
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Summer term 2019
Assignment 11
July 8, 2019

Efficient Algorithms and Data Structures II

*Deadline: July 15, 2019, 10:15 am in the **Efficient Algorithms** folder.*

Homework 1 (5 Points)

Suppose there is a polynomial-time approximation algorithm for bin packing with guarantee $\mathrm{OPT}(I)+\log^2(\mathrm{OPT}(I))$, where $\mathrm{OPT}(I)$ is the number of bins used by an optimal packing. Show that then there is a fully polynomial approximation scheme for bin packing

Homework 2 (5 Points)

In the maximum directed cut problem, we are given as input a directed graph $G = (V,A)$. Each directed arc $(i,j) \in A$ has nonnegative weight $w_{ij} \geq 0$. The goal is to partition V into two sets U and $W = V \setminus U$ SO as to maximize the total weight of the arcs going from U to W. Give a $\frac{1}{4}$-approximation algorithm for this problem.
Additional Bonus Question: How can you improve the approximation factor using the ideas by Goemans and Williamson?

Homework 3 (7 Points)

Give a 2-approximation algorithm for the multicut problem in trees. You are given a tree $T = (V,E)$ and k pairs of vertices s_i, t_i, as well as edge costs. The goal is to find a minimum-cost set of edges F such that for all i, s_i and t_i are in different connected components of $(V,E \setminus F)$.
Hint: Construct a (natural) LP and design a primal-dual approximation algorithm.

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If the [Unique Games Conjecture] holds then the
Goemans-Williamson approximation algorithm [for MAX-
CUT] is optimal. Our result indicates that the ge-
ometric nature of the Goemans-Williamson algorithm
might be intrinsic to the MAX-CUT problem.
       - S. Khot, G. Kindler, E. Mossel, R. O'Donnell
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