

# Approximation Algorithms, exercise sheet 4

November 7, 2013

Next Tuesday we will discuss the exercises from the third sheet. The exercises on this sheet we will discuss Friday the 15th of November.

## 1. Harmonic numbers

In the lecture it was proven that the greedy algorithm for the Set Cover Problem gives an approximation factor  $\log(n)$ . In the analysis it was used that the function  $H(n) := \sum_{i=1}^n \frac{1}{i}$  belongs to  $O(\log(n))$ . Can you prove that?

## 2. Special case where FFD finds optimal solution

Prove that if on an input  $I$  the FFD algorithm puts in every bin at least one element with weight  $> \frac{1}{3}B$  then it has actually found an optimal solution.

## 3. Lower bounds

- a) What is the largest lower bound for  $R_{FFD}^\infty$  you can find?
- b) The problem PARTITION is NP-complete. An instance of this problem is a sequence of natural numbers  $(a_1, \dots, a_n)$  and the question is whether there exist  $b_1, \dots, b_n \in \{-1, 1\}$  such that  $\sum_{i=1}^n a_i b_i = 0$ . Under the assumption that  $P \neq NP$ , what is the best lower bound you can find for  $R_A$  for any bin packing algorithm A?