Algorithms Group **Winter '19/20**
Departement of Computer Science - IBR
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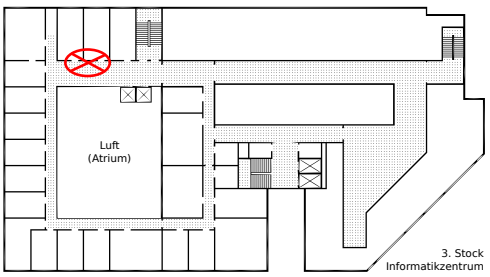
Approximation Algorithms
Exercise 2
12. November 2019

Hand in your solutions until November 27, 11:30 am. You can hand in your solutions at the beginning of the tutorial or via the homework box in front of room IZ337. Please put your name on all pages.



Exercise 1 (Knapsack 1):
Consider the greedy algorithm for the knapsack problem. Sort the objects by decreasing ratio of profit to size, and then greedily pick objects in this order. Show that this algorithm can be made to perform arbitrarily badly. **(5 P.)**

Exercise 2 (Knapsack 2):
Consider the following modification to the algorithm given in Exercise 1. Let the indices of the element match the sorting. Find the lowest k such that the size of the first k objects exceeds B. Now, pick the more profitable of $\{1, \ldots, k-1\}$ and $\{k\}$ (we have assumed that the size of each object is at most B). Show that this algorithm achieves an approximation factor of 2.

(5 P.)

Exercise 3 (Set Cover for limited cardinality):
In the lecture you have seen an H_n approximation algorithm for Set Cover. Show that if the cardinality of each set is limited by l, you can give an H_l approximation algorithm. **(20 P.)**

Exercise 4 (Terms):
Quickly describe in your own words the following terms: NP-hard, NP-complete, strongly NP-hard, PTAS, FPTAS. **(10 P.)**

Remarks

- The first two exercises are taken from *Vazirani, Vijay V. Approximation algorithms. Springer Science & Business Media, 2013.* Chapter 8