Home Exercise 1: Combinatorics, O-notation, and Data Structures

Algorithms and Complexity lecture
at Ecole Centrale Paris

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Abstract

Please send your solutions by email to Dimo Brockhoff (preferably in PDF format) with a clear indication of your full name until the submission deadline on September 16, 2019 (a Monday). Groups of 2 students are explicitly allowed and even encouraged. In the case of group submissions, please make sure that you submit maximally four times with the same partner!

1 Matrix Multiplication (5 points)

How many additions and how many multiplications does the well-known algorithm from linear algebra needs to multiply a matrix of size $m \times n$ with another one of size $n \times l$?

2 Tennis Event (5 points)

Propose a game plan with as little games as possible for a tennis tournament in which the first and second place are given fairly to the actual best and second best players. We assume that in each game, the better player always wins. How many games are needed when there are n players in the tournament?

3 Tennis Event II (5 points)

What changes for the numbers of matches needed if in the above tennis event, we are only interested in finding out the second-best player?

4 O notation (5 points)

Which of the following "equations" hold? Please give either a proof or a counter example. Note that $O(f_1) \circ O(f_2)$ denotes the set $\{g_1 \circ g_2 \,|\, g_1 \in O(f_1), g_2 \in O(f_2)\}$.

1. $O(f_1) + O(f_2) = O(f_1 + f_2)$
2. $O(f_1) - O(f_2) = O(f_1 - f_2)$