

Games with perfect information

Exercise sheet 1

Sebastian Muskalla

TU Braunschweig
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Out: April 4

Due: April 11

Submit your solutions on Wednesday, April 11, during the lecture.

Please submit in groups of three persons.

Exercise 1

Complete the tree from Example 2.3 from the lecture notes, i.e. draw the full tree of plays for the initial state $(2, 2, 1)$, where we assume that player 1 is active. For every node, write down the Nim sum. Furthermore, mark all winning states in the tree.

Exercise 2

Prove Lemma 2.9 from the lecture notes: Let (c_1, \dots, c_k) be an unbalanced state. There is a successor state (i.e. a state to which we can go with one single move) that is balanced.

Hint: Consider the smallest index j such that $\text{Nim}\Sigma(c_1, \dots, c_k)_j$ is odd. (Note that "smallest" means that the corresponding bit is most significant.) Prove that there is an index i with $c_{ij} = 1$ that can be modified to get to a balanced state.