

# Solutions **EGMO 2018**

Samuel de Araújo Brandão

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This document contains solutions to the **EGMO 2018** problems, written by me during my preparation for the International Mathematical Olympiad.

The content reflects my own understanding and problem-solving process. Some solutions may have been inspired by the work of others or required external help, in which case proper attribution is given (see [section 3](#)).

If you notice any errors or have suggestions for improvement, I would greatly appreciate hearing from you at [samuelbaraujo19@gmail.com](mailto:samuelbaraujo19@gmail.com).

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# 1 Problems

1. A domino is a  $1 \times 2$  or  $2 \times 1$  tile. Let  $n \geq 3$  be an integer. Dominoes are placed on an  $n \times n$  board in such a way that each domino covers exactly two cells of the board, and dominoes do not overlap. The value of a row or column is the number of dominoes that cover at least one cell of this row or column. The configuration is called balanced if there exists some  $k \geq 1$  such that each row and each column has a value of  $k$ . Prove that a balanced configuration exists for every  $n \geq 3$ , and find the minimum number of dominoes needed in such a configuration.

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## 2 Solutions

### Problem Statement

A domino is a  $1 \times 2$  or  $2 \times 1$  tile. Let  $n \geq 3$  be an integer. Dominoes are placed on an  $n \times n$  board in such a way that each domino covers exactly two cells of the board, and dominoes do not overlap. The value of a row or column is the number of dominoes that cover at least one cell of this row or column. The configuration is called balanced if there exists some  $k \geq 1$  such that each row and each column has a value of  $k$ . Prove that a balanced configuration exists for every  $n \geq 3$ , and find the minimum number of dominoes needed in such a configuration.

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### 3 References