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BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS

An analysis of the game *Lights Out!* and its generalizations

In this thesis we study the board game *Lights Out!*, along with its generalization to any arbitrary simple, finite graph G. We study the possibility to beat the game, using graph theory and linear algebra.

We also show the evolution of methods to find a solution to this game, from the existence of a solution, an exponential algorithm to find a solution, and finally a polynomial algorithm.

The game *Lights Out!* can also be considered as a game played on the finite field $\mathbb{F}_2$. We also explore a generalization of the game where we play over $\mathbb{Z}_n$, for any natural number n.

We then also consider a refinement of a brute force (integer linear program) approach to find a solution of the game, applying a technique from modulo optimization, using Hermite normal forms.

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