



## Introduction

In this project, the Lights Out puzzle game is extended from two-state to multistate grids using HTML, CSS, and JavaScript. By integrating linear algebra concepts, a novel approach to puzzle game design is introduced, addressing a gap in existing research. The extension presents new challenges in both puzzle design and solver implementation, offering users a distinctive gaming experience. Through the fusion of web development and linear algebra concepts, the boundaries of traditional puzzle game design are pushed, showcasing innovative applications of technology and mathematics in gaming.

## Objective

Our objective was to develop and integrate a web-based implementation of the Lights Out game, encompassing both two-state and multi-state variants, using principles of linear algebra. This project will involve analyzing solvability conditions and implementing a minimal solution algorithm to ensure optimal efficiency and functionality of the game on the website.

## Methodology

### Mathematics

We applied advanced mathematical concepts from linear algebra to develop a web-based Lights Out game capable of handling puzzles in higher dimensions (4 and 5) where free variables are present. Utilizing the null space basis of larger matrices, we identified all potential solutions to these complex puzzles. Through careful exploration of the matrix's null space, we efficiently determined the minimum solution based on predefined criteria.

	Invertible Cases	Non-InvertibleCases
Use of Pseudo Inverse	✗	✓
NULL Space	✗	✓

### Development

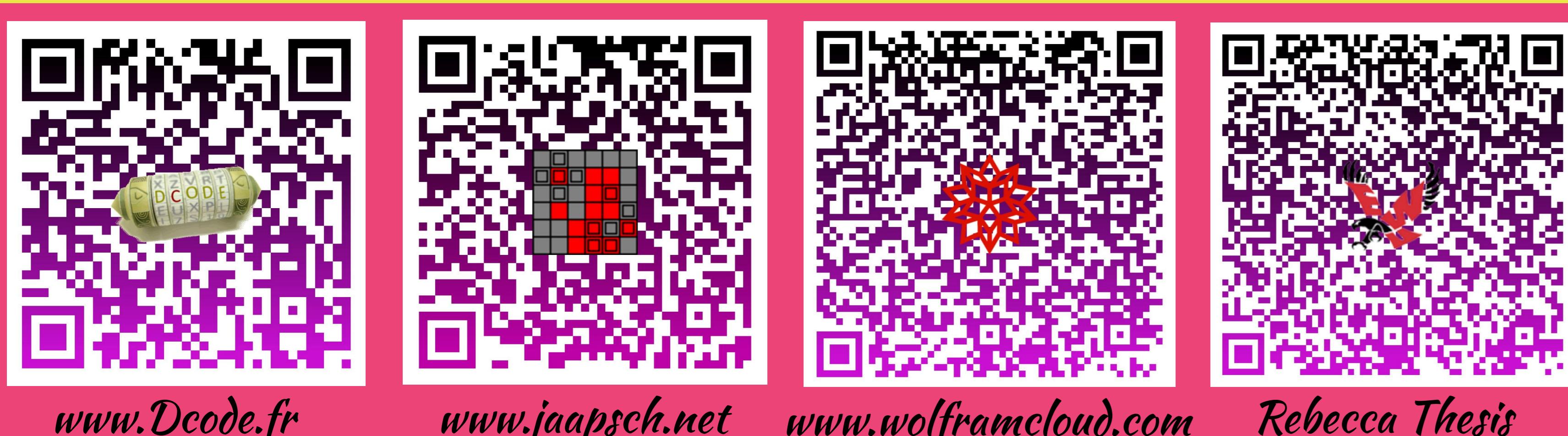
The development process involved defining the scope and target audience of the game. We selected appropriate web technologies, including HTML, CSS, JavaScript, and frameworks such as Tailwind CSS, to create an engaging and interactive user interface. Our user interface design prioritized intuitiveness and accessibility, ensuring a seamless gaming experience across various devices, rigorous testing and optimization.

## Future Work

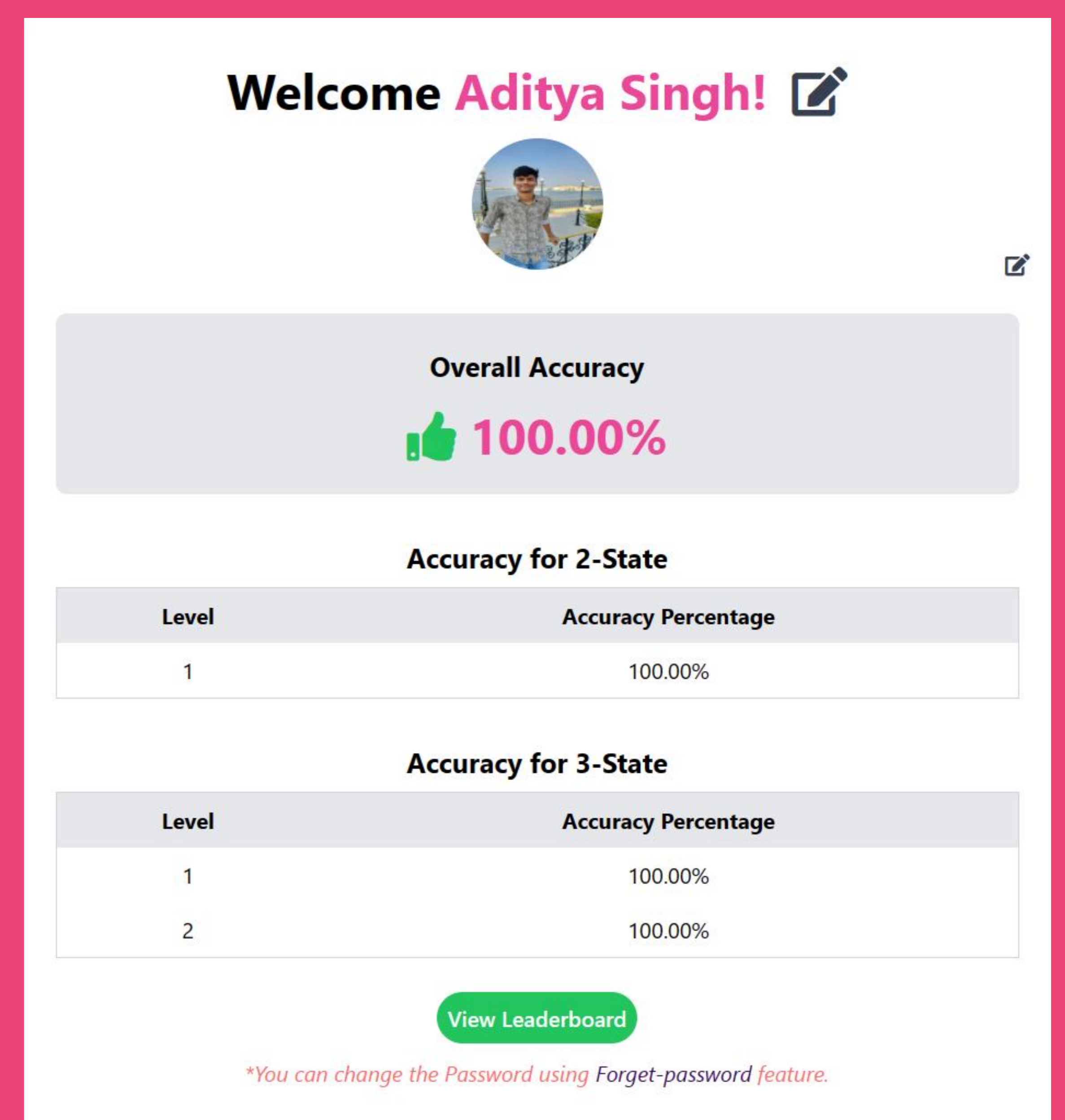
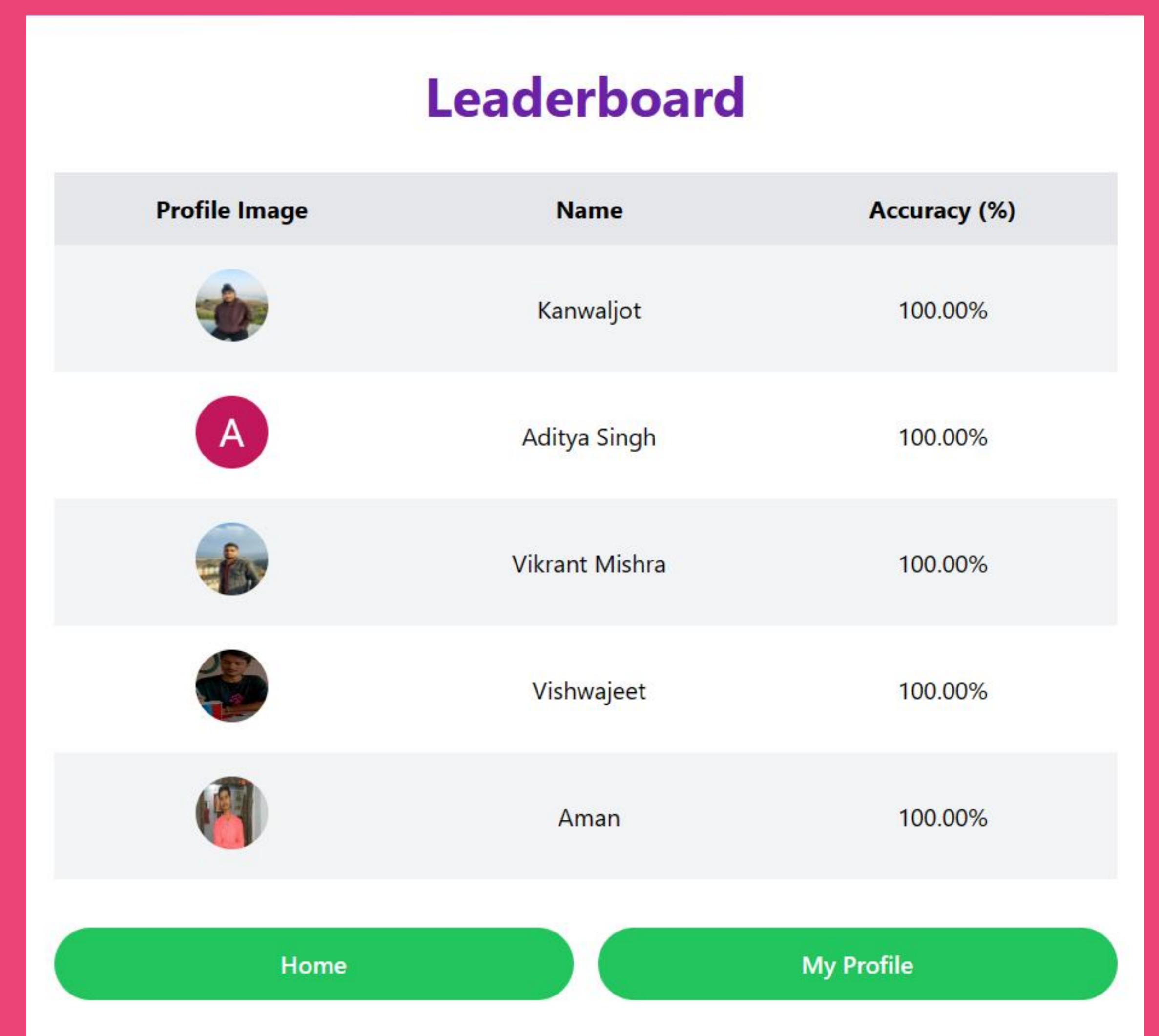
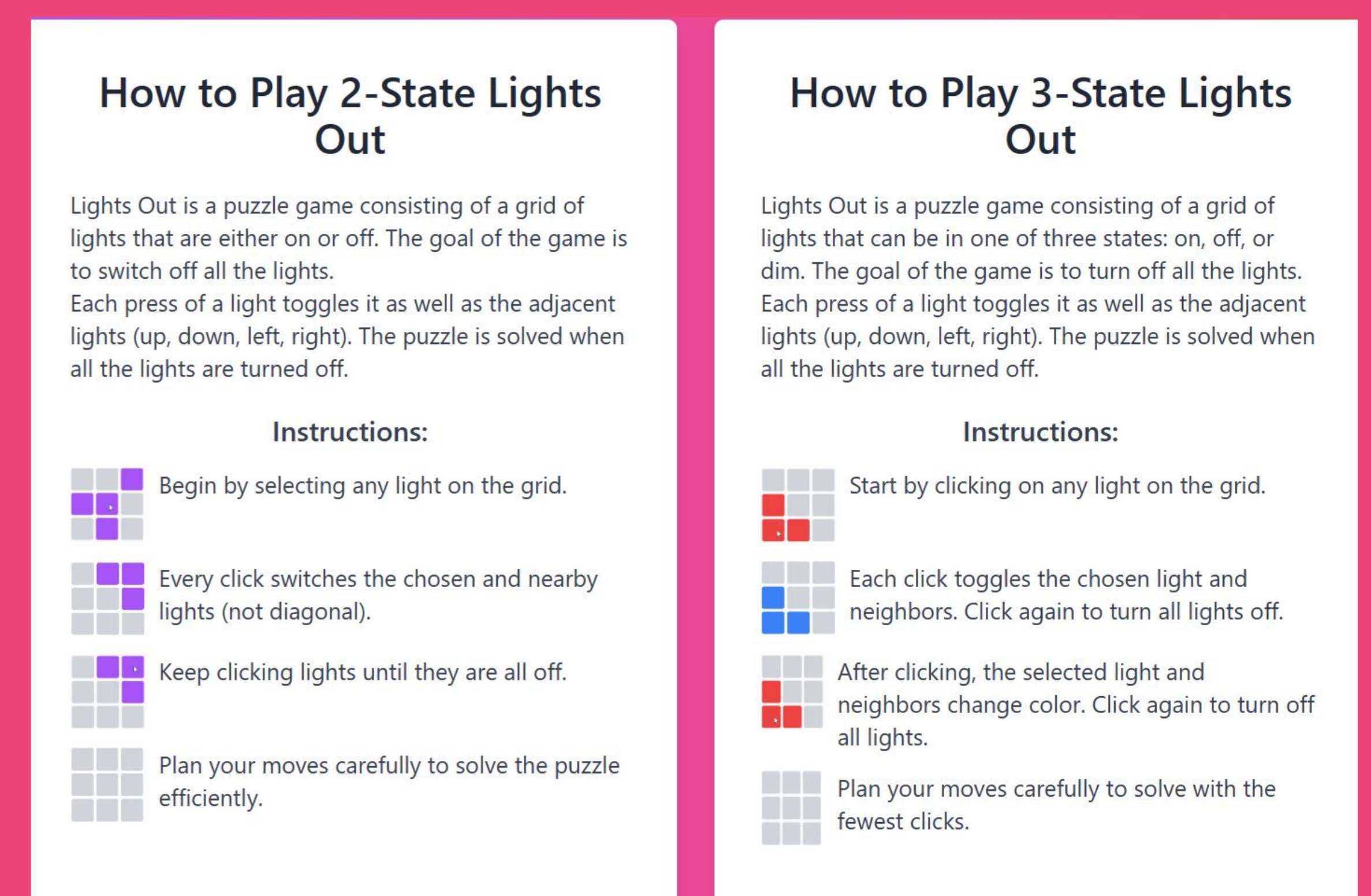
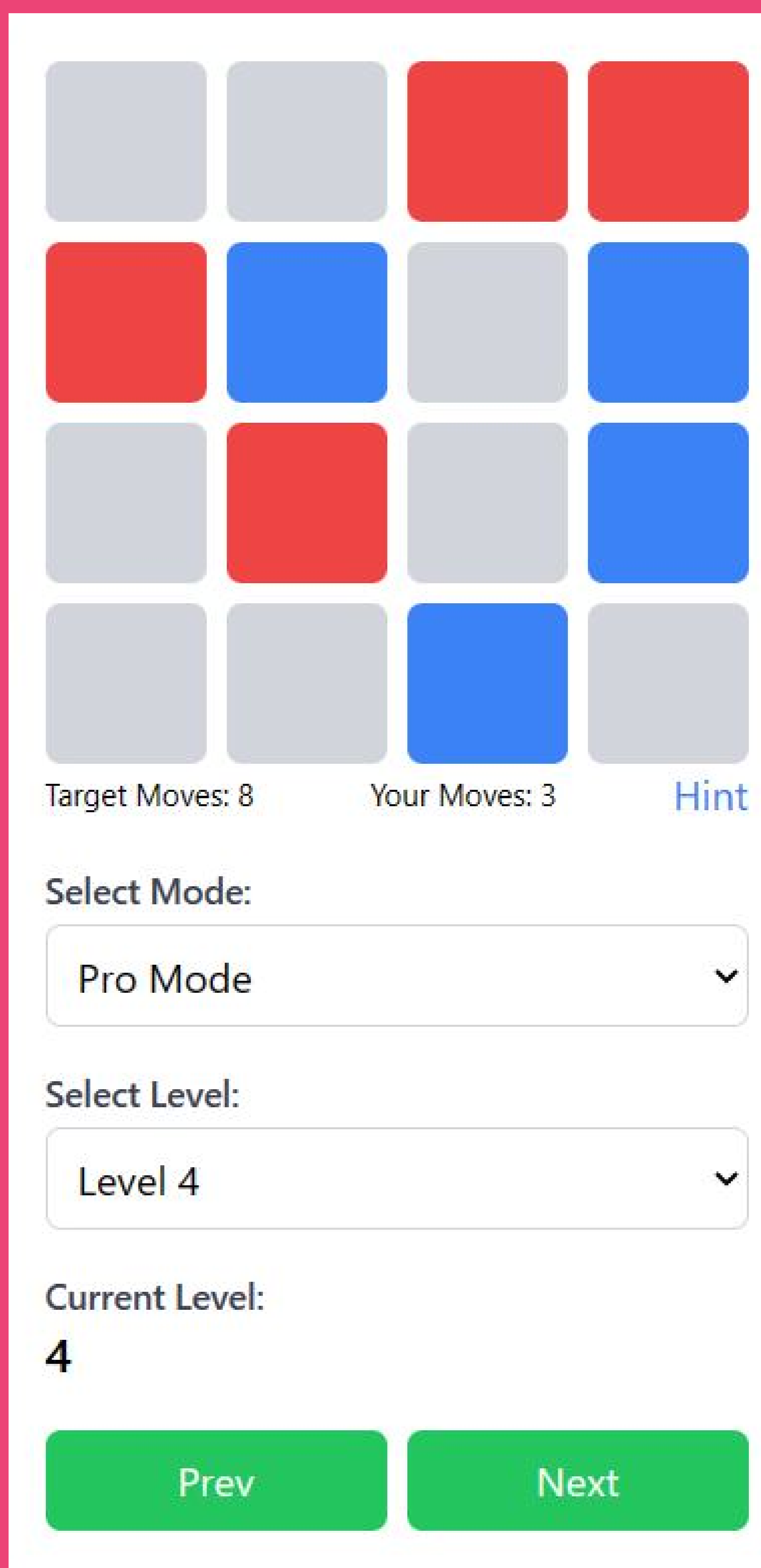
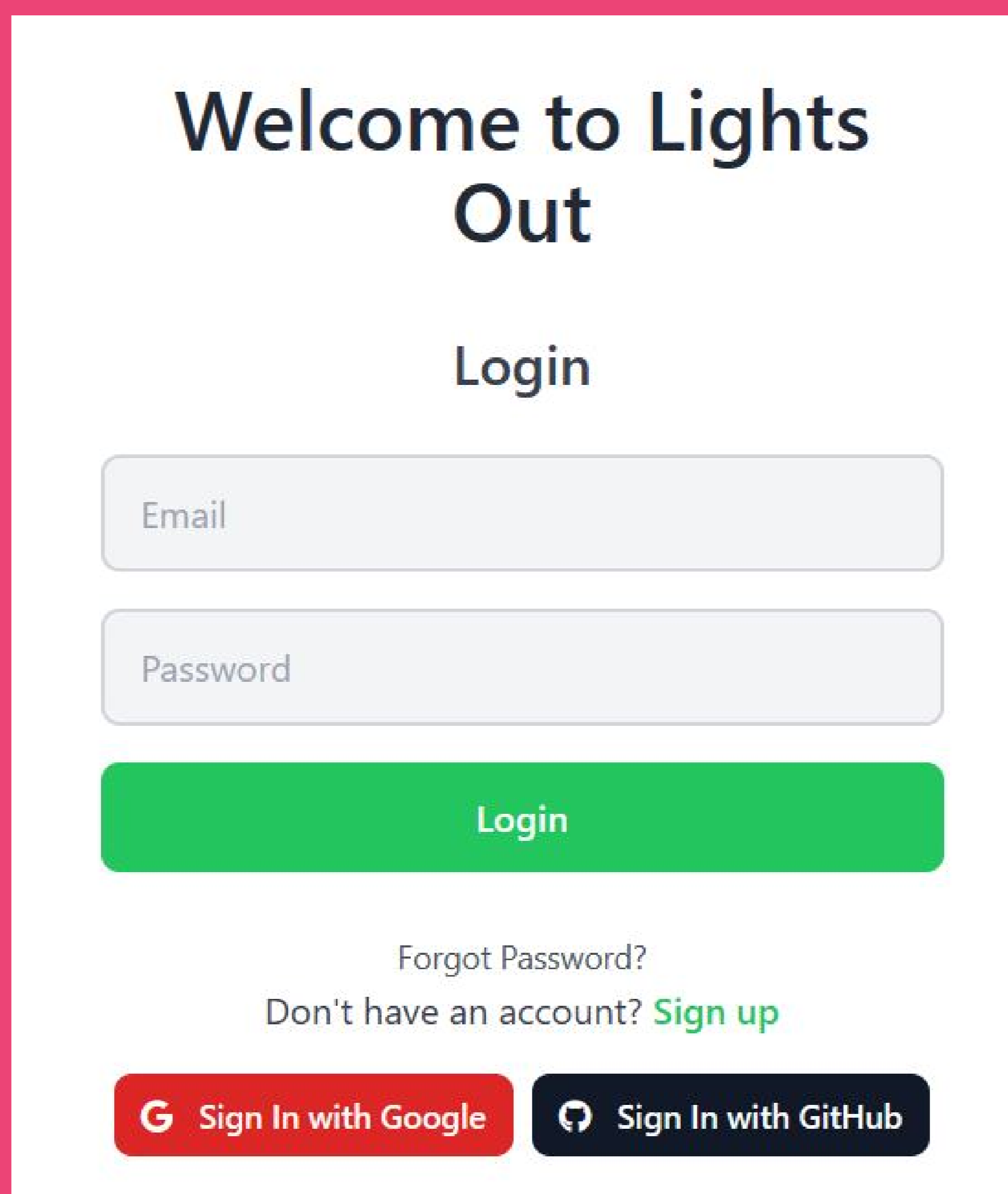
There are several exciting opportunities to expand and enhance the Lights Out game:

- Organising Contests:** Hosting regular contests or tournaments where players can compete against each other for prizes and recognition.
- Extensive Analysis Tool:** Developing an advanced analysis tool that provides insights into gameplay strategies, patterns, and optimal moves. This tool could be offered as a paid service, allowing users to analyse their gameplay and learn the game faster.

## References



## Results



## Conclusions

The development of the Lights Out game was a collaborative and iterative process that required careful planning, implementation, and testing. By leveraging a diverse range of technologies, mathematical concepts and adopting an agile approach, we successfully brought the game from concept to reality. In the following chapters, we explore the deployment, user experience, and future prospects of the Lights Out game.

## Appendix



## Tech Stack

