From Scramble to Solution: Harnessing Genetic Algorithms for Pyraminx

Team Members

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Term Project Status

Currently, our project has evolved from its original focus on the traditional 3x3 Rubik's Cube to exploring the Pyraminx—a puzzle shaped like a triangular pyramid. This decision was made to offer a fresh perspective and contribute new insights to the field, as research on solving the Pyraminx with genetic algorithms remains largely unexplored. We are in the initial stages of algorithm design and have refined our approach to incorporate multi-phase solving and structured moves, which aim to emulate human solving techniques more closely.

Discussion on Project Status

Our project shifted focus based on the professor's feedback and our own analysis of existing research, which heavily covers the standard Rubik's Cube. We believe that by addressing a less-studied puzzle, our project will provide unique contributions. In addition, we've encountered some challenges as we moved to this new focus, particularly in adapting genetic algorithm structures. Unlike the 3x3 Rubik's Cube, the Pyraminx has different properties, such as rotational symmetry and fewer pieces, which necessitated a revised approach for encoding moves and designing fitness functions.

Moreover, rather than viewing each face turn as an individual step, we've decided to treat meaningful sequences of moves as steps within our evolutionary algorithm. For example, a step might involve swapping two pieces, which simplifies the complexity of potential solutions and could align more closely with human strategies. Additionally, we are structuring our algorithm to solve the Pyraminx in phases: small corners, larger corners, bottom layer, and top

layer. These phases are designed to improve efficiency and increase the likelihood of finding an optimal solution.

Miscellaneous Items

- **Interest:** Our project has become more engaging due to these adjustments, and we are optimistic about creating an algorithm that brings new insights to solving non-standard puzzles.
- **Current Focus:** We are currently finalizing the structural definition of the Pyraminx, including the systematic naming of faces and moves. Additionally, we are concentrating on designing each phase's genotype representation, establishing precise fitness functions, and defining gene characteristics such as sequence length and variability.
- **Next Steps:** Our immediate priorities include finalizing the phased approach and refining our genetic operators, selection methodologies, and fitness functions to accommodate the unique attributes of the Pyraminx.

Summary

Overall, we believe these modifications will improve our project's success potential and offer valuable contributions to both the study of evolutionary algorithms and puzzle-solving methodologies.