Genetic Programming Project Documentation

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1 Project Overview

This project consists of four Python code files and multiple text files, each containing 1 to 100 matrices generated by `generate_matrix.py`. The matrices are randomly generated in different sizes, such as 4×4, to test the project under varying conditions.

2 Code Files Description

- `generate_matrix.py`: This file generates random matrices and saves them in text files to be used for testing the algorithm at different matrix sizes.
- `main_gp.py`: This file contains all the Genetic Programming (GP) algorithms developed for the project. We implemented GP from scratch without using any external libraries.
- `read_matrices.py`: This file reads matrices from the generated text files or from existing matrices, utilizes the functions in `main_gp.py`, runs the GP algorithm, and records the number of generations needed to reduce inconsistency below 0.3 for each matrix. Additionally, it generates a plot to show the fitness function (inconsistency) trend based on generations for the first matrix.
- `bar_chart.py`: This file creates bar charts that display the number of matrices that reach consistency within specific numbers of generations.

3 Execution Instructions

To run the project, follow these steps:

1. Generate random matrices using `generate_matrix.py` or use the existing matrices.
2. Run `read_matrices.py` to read the matrices, execute the GP algorithm, and observe the generations needed to achieve a consistency threshold of 0.3.

3. Execute `bar_chart.py` to visualize the distribution of generations needed for different matrices to reach consistency.

4 Output and Visualizations

- `read_matrices.py` provides a plot showing the fitness function trend for the first matrix, illustrating how inconsistency decreases with each generation.
- `bar_chart.py` generates bar charts that represent the count of matrices reaching consistency within specific generation ranges.