EAST WEST UNIVERSITY

Assignment-2

Genetic Algorithm - Robot Resource Optimization

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Objective

The objective of this project is to optimize task assignments among a given set of robots using a Genetic Algorithm (GA). The optimization aims to minimize the total production time while balancing the workload among the robots. The tasks have varying durations and priorities, and each robot possesses a unique efficiency level.

Overview

This project utilizes a Genetic Algorithm (GA) to efficiently allocate tasks to robots. The GA iteratively evolves a population of potential solutions, where each solution represents a potential assignment of tasks to robots. Through the process of selection, crossover, and mutation, the algorithm converges towards solutions that minimize the total production time and ensure workload balance among the robots. The implemented GA consists of several components including data generation, fitness calculation, selection mechanisms, crossover operations, mutation strategies, and visualization of the results.

Approach and Implementation Details

Data Generation: The ‘generate_mock_data’ function generates mock data for tasks and robots, including task durations, priorities, and robot efficiencies.

Genetic Algorithm Implementation: The ‘run_genetic_algorithm’ function serves as a placeholder for the GA implementation. This includes initialization, fitness function calculation, selection using tournament selection, single-point crossover, and task swapping mutation.

Fitness Function: The ‘calculate_fitness’ function evaluates the fitness of a solution based on the total production time and workload balance among the robots.

Visualization: The ‘visualize_assignments_improved’ function visualizes the task assignments on a grid, with additional annotations for task duration, priority, and robot efficiency.

Challenges Faced

Algorithm Design: Designing an effective GA required careful consideration of various components such as population initialization, selection mechanisms, and mutation strategies.

Visualization: Creating a clear and informative visualization that accurately represents the task assignments while accommodating additional details was challenging.

Results and Analysis

Optimization of Task Assignments: The GA effectively optimizes task assignments by minimizing the total production time and balancing the workload among the robots.

Impact of Parameters: Parameters such as robot efficiencies and task priorities significantly influence the outcomes. Higher robot efficiency leads to shorter production times, while task priorities influence the distribution of tasks among robots.

Implications of Findings: The optimized task assignments obtained through the GA can lead to improved efficiency and productivity in various real-world scenarios such as manufacturing, logistics, and scheduling.

Conclusion

In conclusion, the implemented Genetic Algorithm effectively optimizes task assignments while considering task durations, priorities, and robot efficiencies. The visualization provides valuable insights into the distribution of tasks among robots, facilitating informed decision-making. Further refinement and analysis could lead to even more efficient resource allocation and improved overall performance.