

Evolutionary algorithm for the Game of Nim

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Best strategies

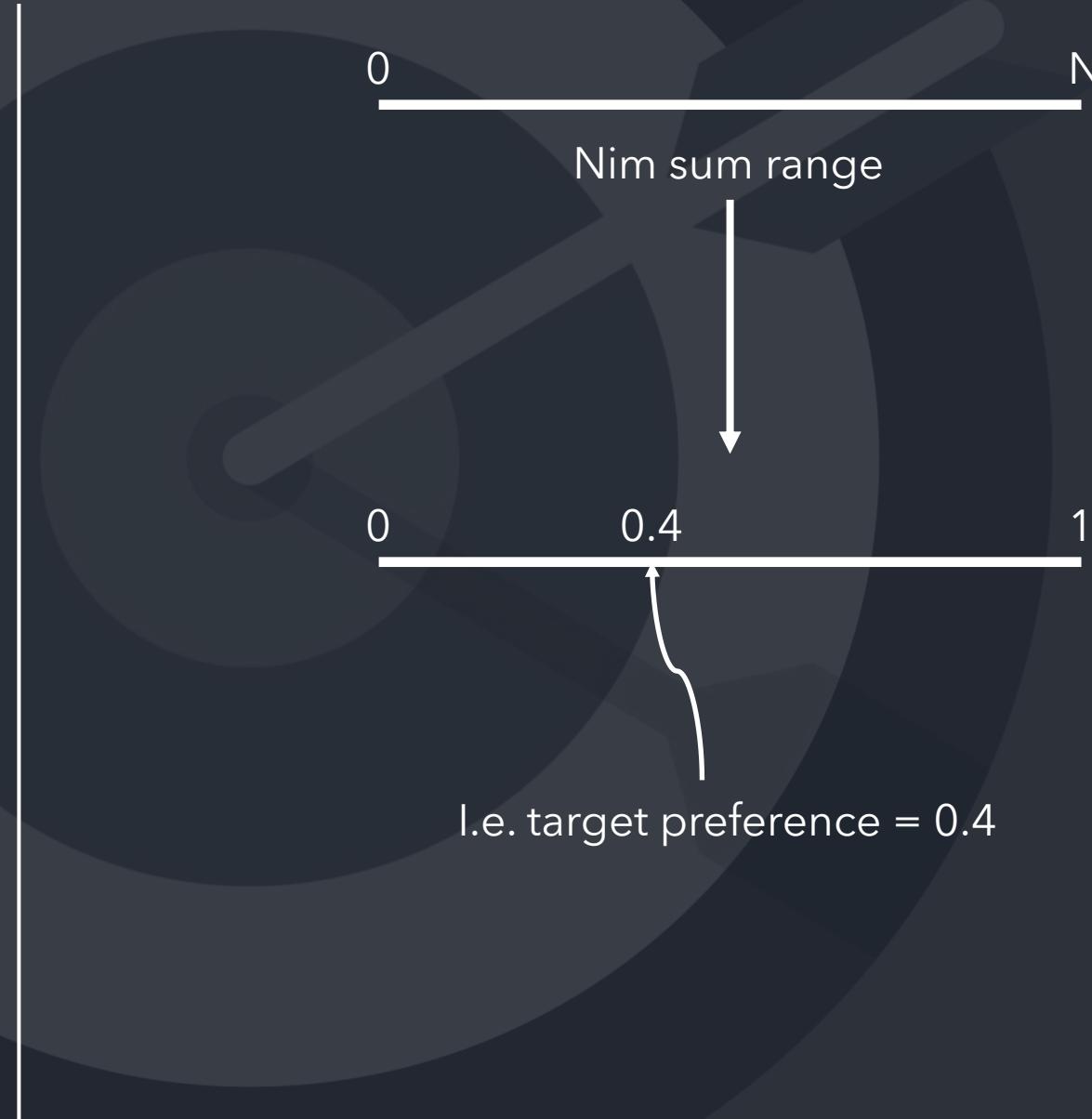
- **Key Concept:** The winning strategy for Nim revolves around the concept of "Nim Sum", calculated using the bitwise XOR operation.
- **Nim Sum Calculation:** Convert the number of items in each pile to binary, and then perform a bitwise XOR (exclusive or) operation across all piles.
- **Winning Move:**
 - If the Nim Sum is zero, your position is currently losing, and any move will leave a winning position for the opponent unless they make a mistake.
 - If the Nim Sum is non-zero, make a move that results in a new state where the Nim Sum is zero. This is always possible if the Nim Sum is non-zero.

Genome definition

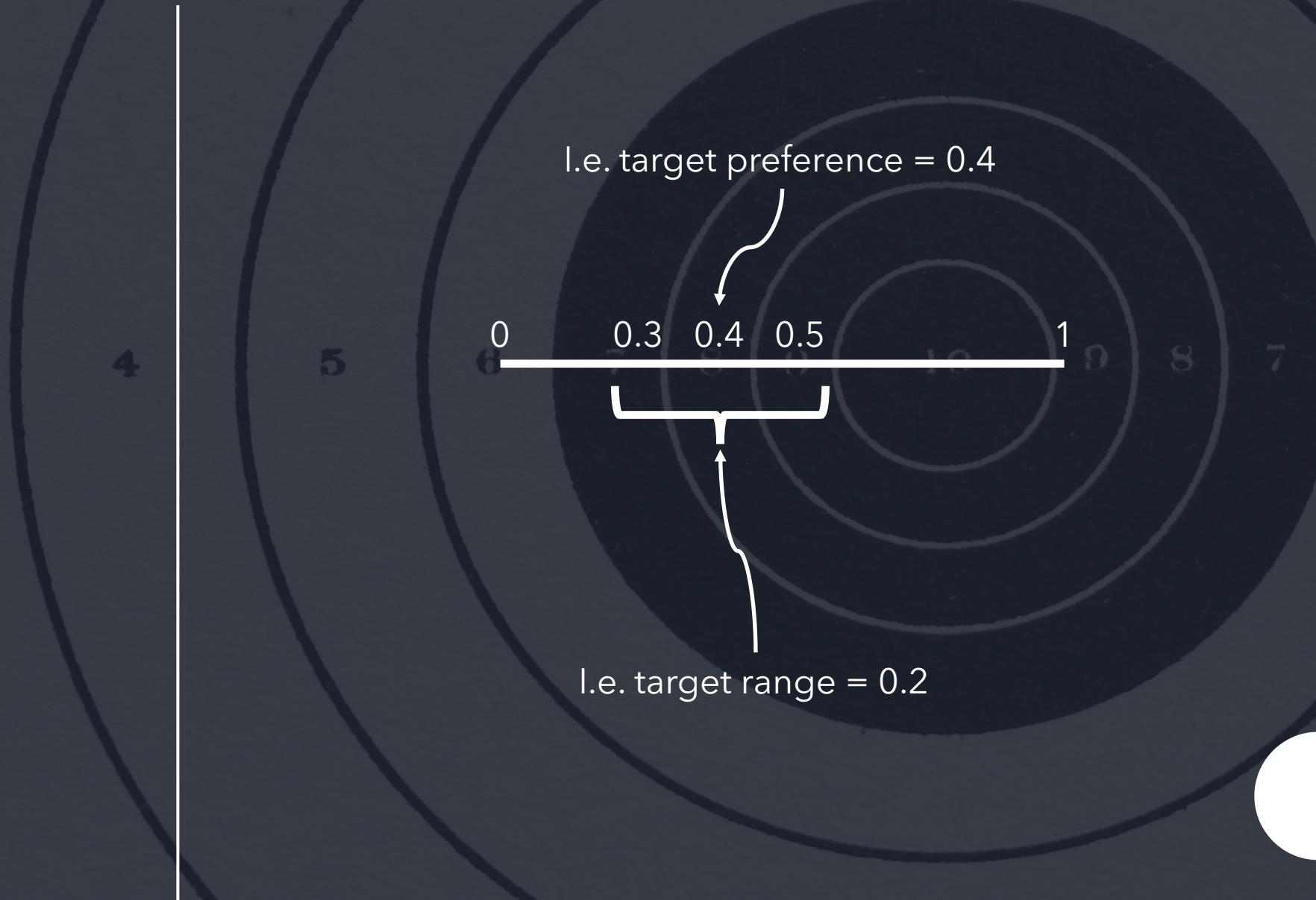
The genome is made of 2 parts: target_preference and target_range.

- The **target_preference** in the genome represents an individual's tendency to aim for a specific nim_sum value after making a move, expressed as a random float between 0 and 1
- The **target_range** in the genome defines the proportion of the total nim_sum range that an individual is willing to consider as acceptable for making a move, with the value being a float between 0 and 1 to represent the size of this acceptable subset relative to the game's full range of nim_sum possibilities.

Target Preference



Target range





Parent selection

Two selection methods were implemented and compared

- Roulette Wheel Selection
- Tournament Selection

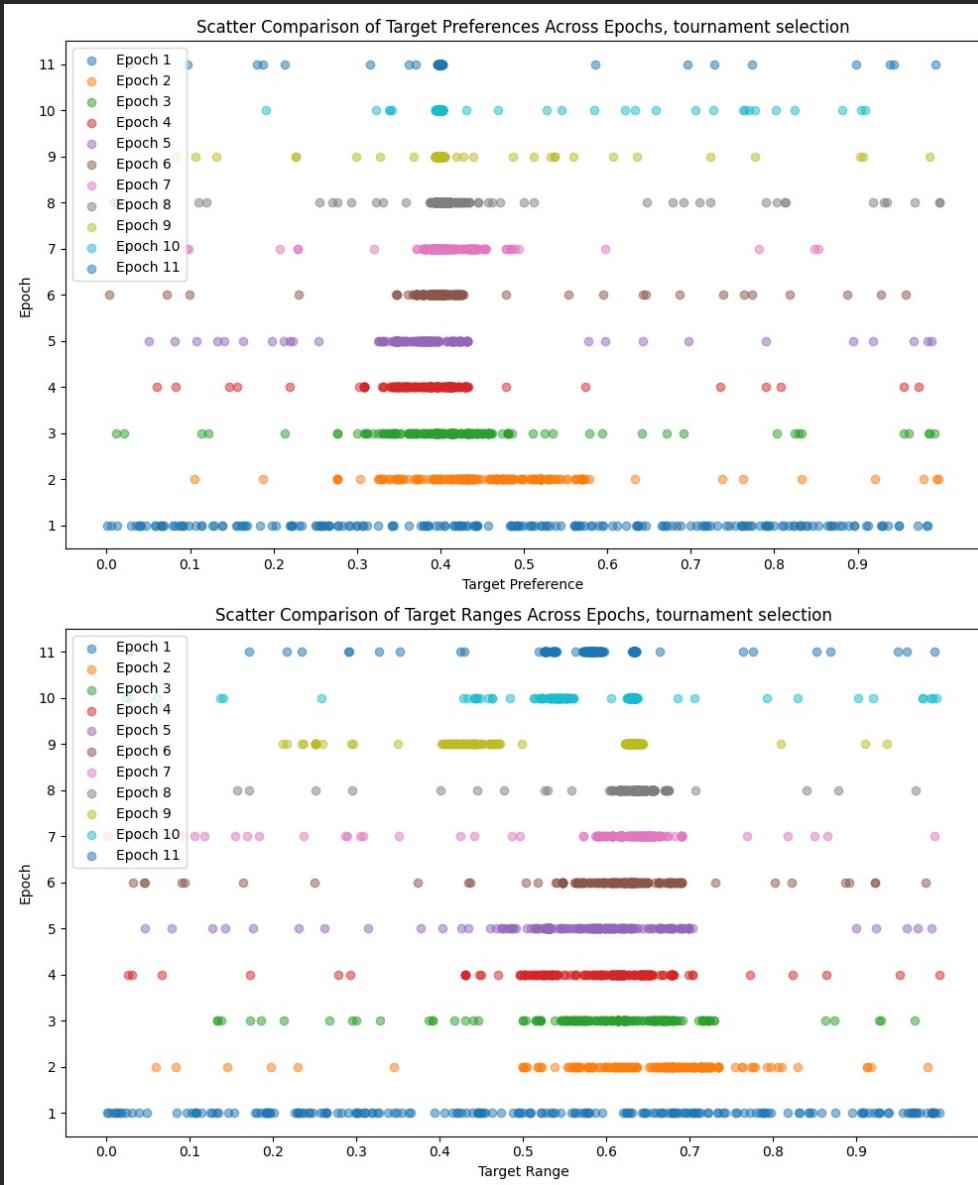
Simulation

- **10 Epochs:** Represents the total number of generations the simulation will run through. Each epoch sees the creation of a new generation of individuals.
- **30 Number of Games per Individual:** Indicates the number of games each individual in the population will play. It's crucial for determining the fitness of each individual.
- **Population (200):** The total number of individuals in each generation. A larger population size allows for more genetic diversity.
- **100 Parents :**The number of individuals selected as parents to create the next generation. This selection is key to passing successful traits forward.
- **Tournament Size (50):** Used in tournament selection method. It's the size of the group from which one parent is selected based on fitness.
- **Mutation Rate (0.1) :** The probability of a random mutation occurring in an individual's genome. Mutation introduces new genetic variations into the population.

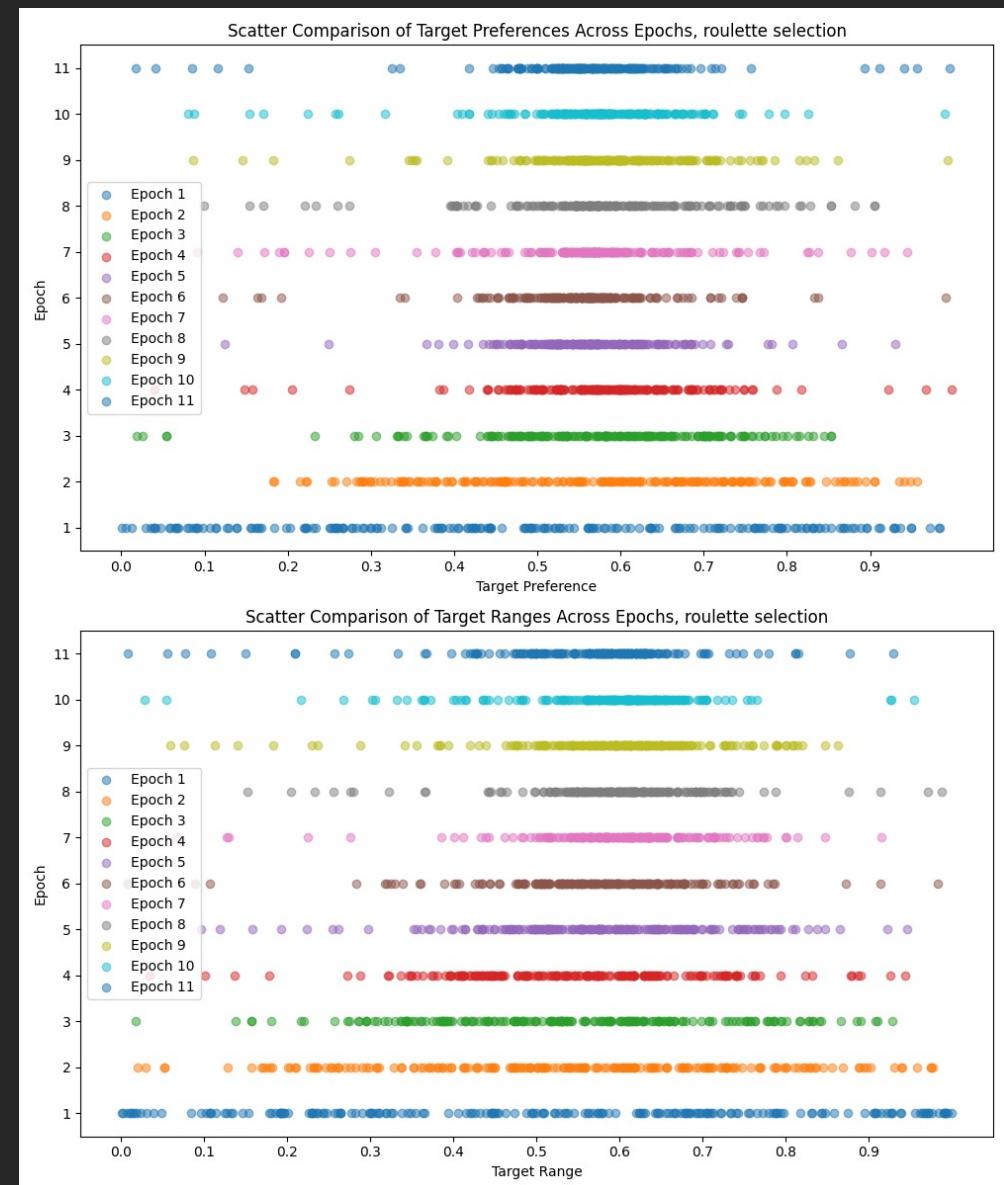
Result



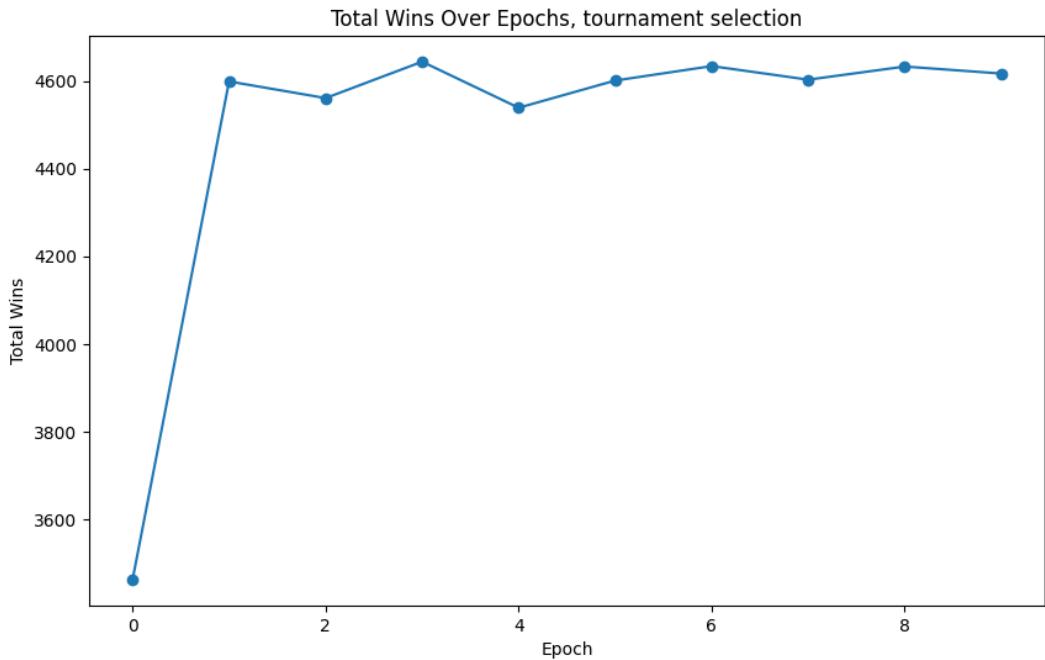
Tournament selection



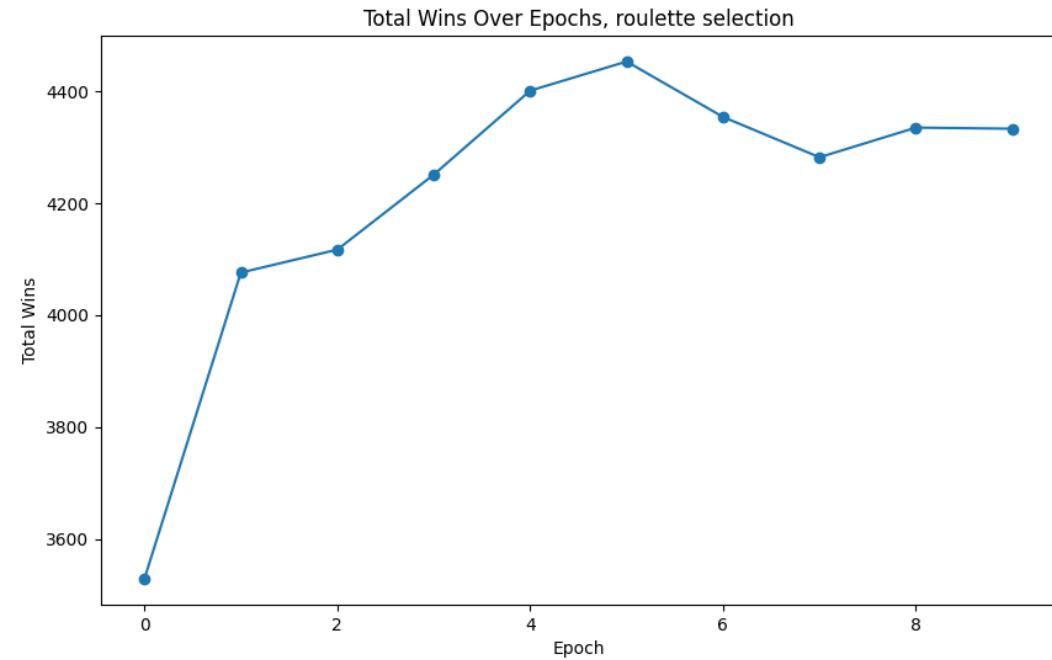
Roulette wheel selection



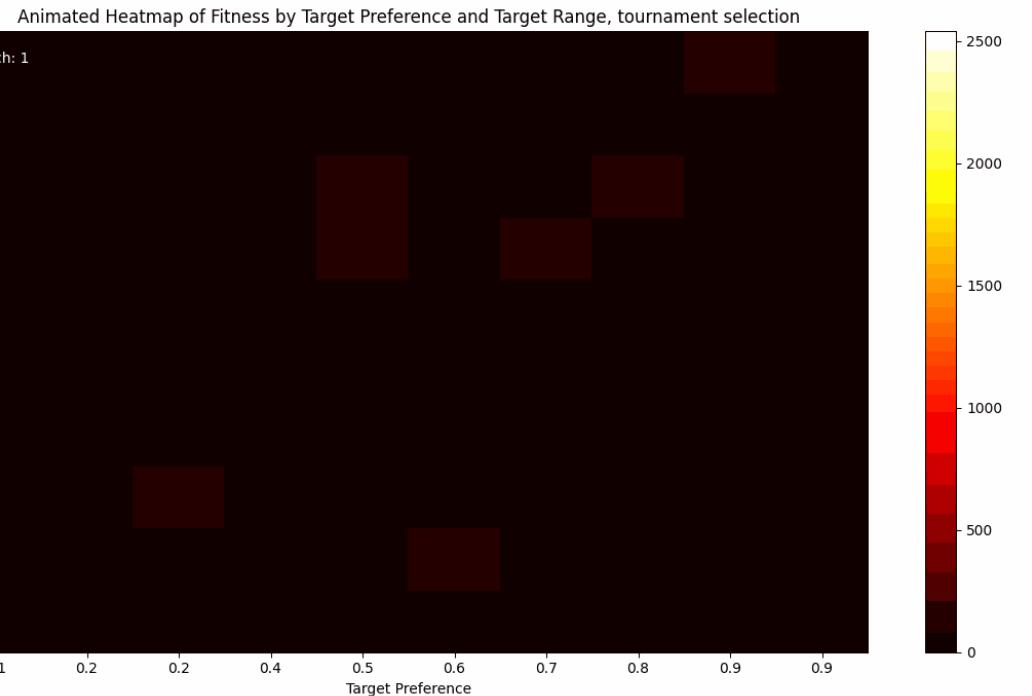
Tournament selection



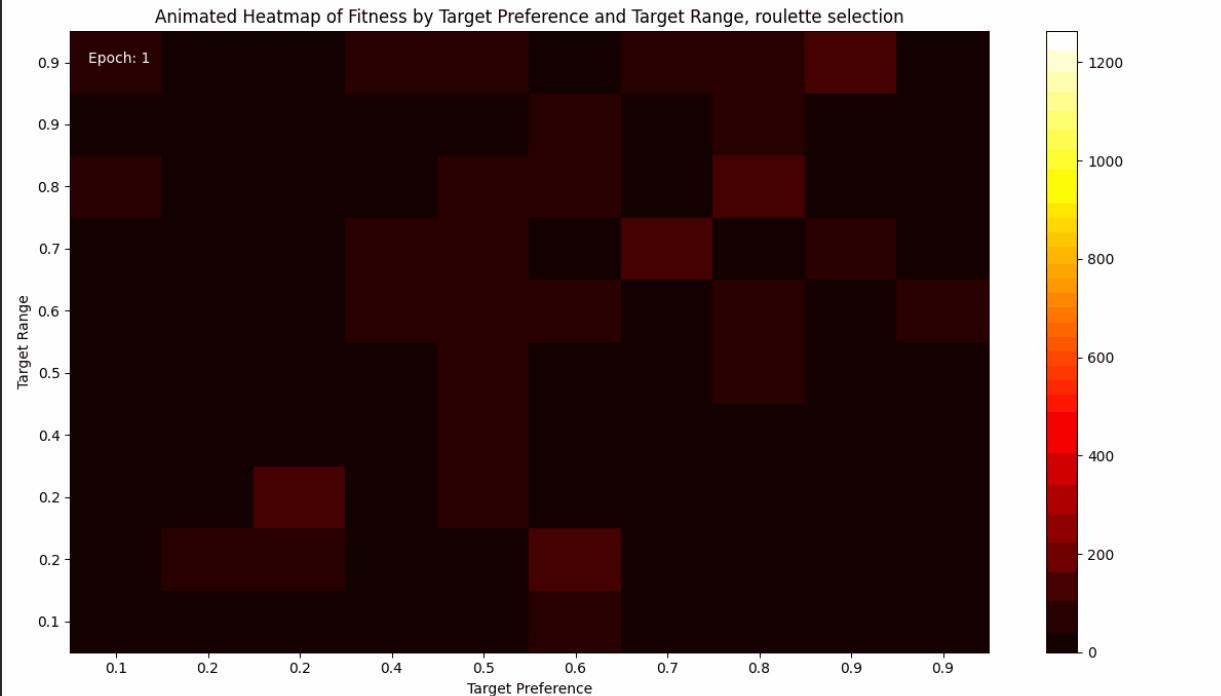
Roulette wheel selection



Tournament selection



Roulette wheel selection



*Thanks for the
attention*

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