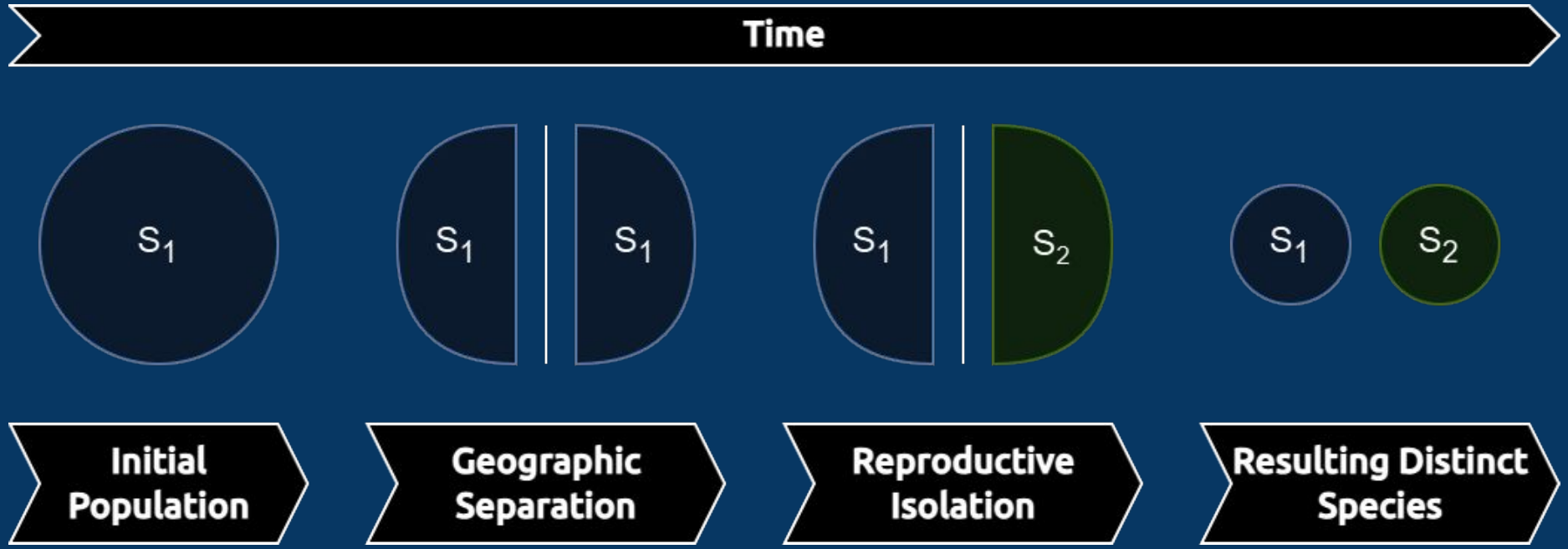
Using Secondary Inherited Characteristics During Reproductive Choice to Replicate Allopatric Speciation

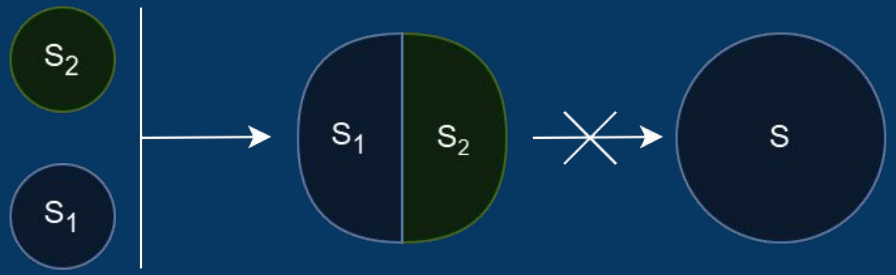
Gary B. Parker, Jay Nash

What is Allopatric Speciation?

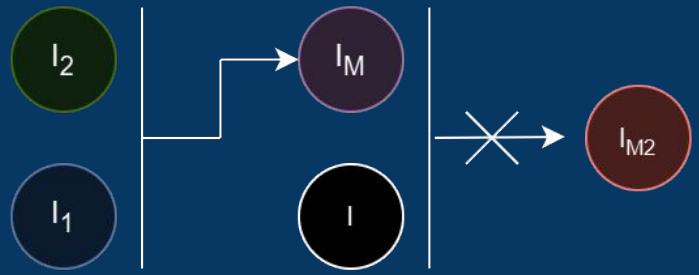


How Do We Define a Distinct Species

Distinct Species Do Not Recombine

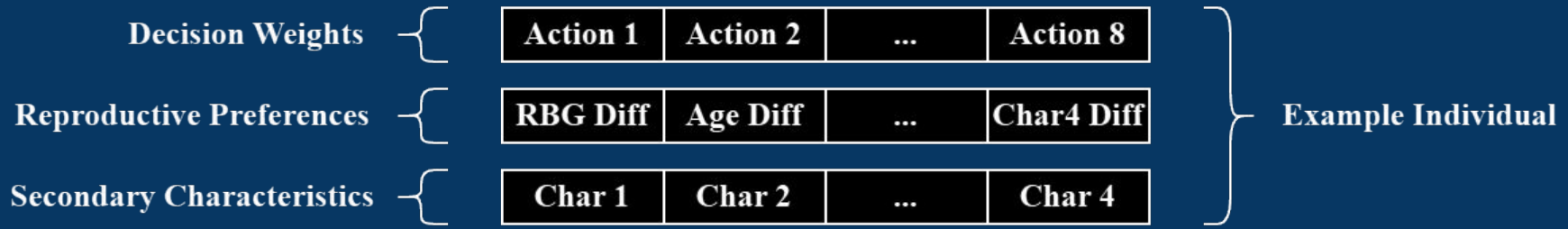


Mutants Should Be Infertile



Genetic Algorithm Overview

- Population:
  - Population size varies
  - Individuals “die” over time and can reproduce multiple times
- Chromosomes:
  - Each individual has three chromosomes for:
    - Decision weights
    - Reproductive Preferences
    - Secondary Characteristics
- Evolutionary Operators:
  - Single-Point Crossover
  - Mutation Rate 0.0033%
  - Selection is done by individuals choosing to reproduce inside the simulated environment
- Fitness:
  - No fitness is calculated as the individuals themselves decide which other individuals to reproduce with



Selection

- Selection is handled entirely by the individuals preferences, without regard to any fitness
  - Individuals can choose to mate with nearby individuals
  - Both individuals decide if they should reproduce
- Individuals consider:
  - Age, RGB color, and secondary characteristics
  - Individuals have a size, but this is not considered

Example of a Successful Reproduction

Agent 1

	Self	Desired
Age	37	27-47
RBG		
Char 1	12	10-14
Char 2	5	4-6
Char 3	2	0-7
Char 4	4	1-7

Agent 2

	Self	Desired
Age	45	25-65
RBG		
Char 1	10	8-12
Char 2	5	3-7
Char 3	4	2-6
Char 4	3	2-4

“Fitness”

- Individuals do not use fitness to evaluate possible mates
  - Characteristics that could imply a fitness are also not considered
- This encourages individuals to only reproduce with other, similar individuals
  - Similar individuals are likely to have the same fitness for the current environment

Example of a Successful Reproduction

Agent 1

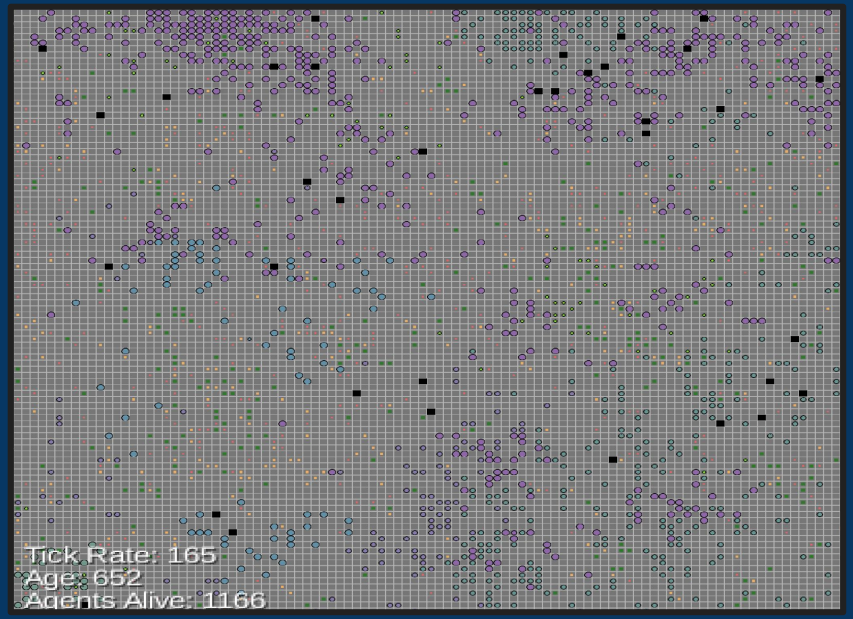
	Self	Desired
Age	37	27-47
RBG		
Char 1	12	10-14
Char 2	5	4-6
Char 3	2	0-7
Char 4	4	1-7

Agent 2

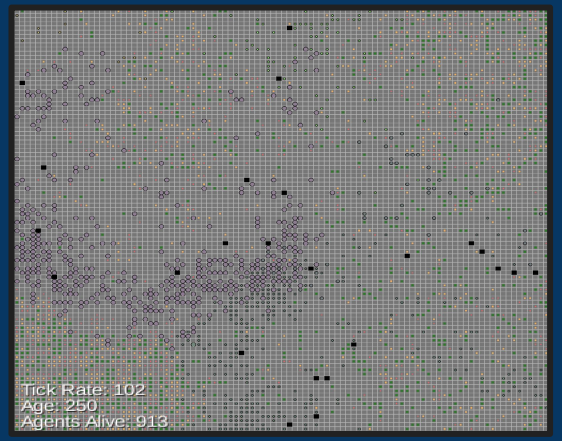
	Self	Desired
Age	45	25-65
RBG		
Char 1	10	8-12
Char 2	5	3-7
Char 3	4	2-6
Char 4	3	2-4

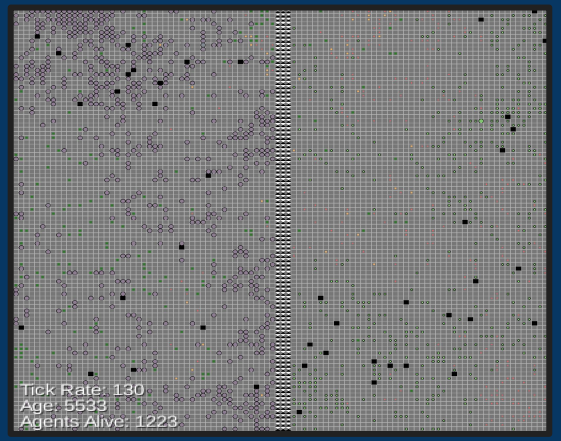
The Environment

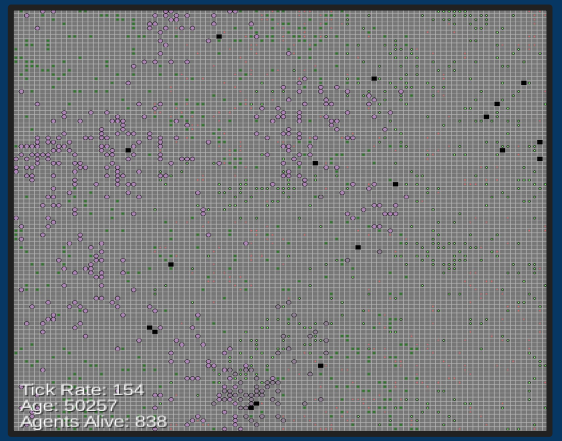
- The environment is a grid the individuals can traverse
  - All individuals inhabit the same environment
  - Food is generated periodically on the grid
    - Individuals must consume food to stay alive
    - Individuals that consume excess food may reproduce
- Individuals traverse the environment by taking decisions prioritized by their decision weights
  - These decisions include movement, eating food, and reproducing



Simulating Allopatric Speciation

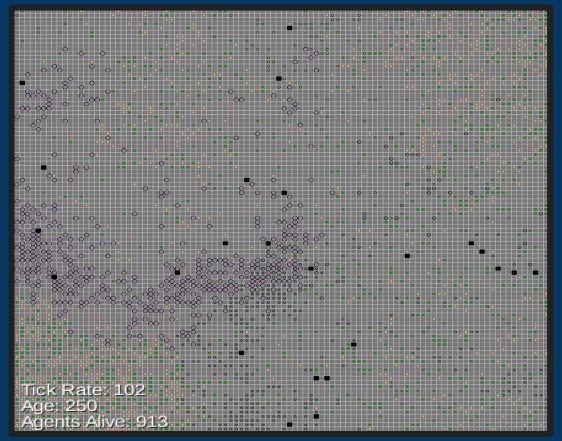


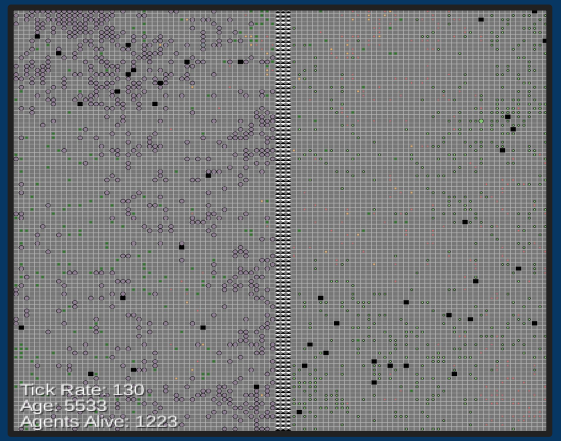


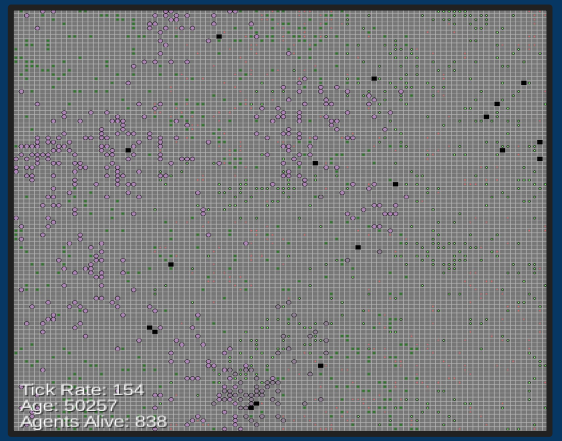


Initial Randomly Generated Population → Geographic Isolation → Reintroduction

Simulating Allopatric Speciation







Initial Randomly Generated Population → Geographic Isolation → Reintroduction

Results

- When individuals considered all allowed characteristics for reproduction:
  - Few or no mutant offspring is produced, with no second degree mutants produced
- When individuals only considered RGB and age:
  - Mutant offspring is produced, with many trials resulting in second degree mutants

Reproductive Considerations	Total Time Steps	Total Reproductive Attempts	Total Reproductions	Total Reproductive Attempts With Mutant Offspring	Total Reproductions with Mutant Offspring
All Characteristics	40,000	24,214,134	586,723	789,205	0
All Characteristics	40,000	26,562,194	644,462	1,386,087	0
RGB and Age Only	40,000	15,191,461	553,952	67,650*	1,358*

Questions