NATURAL SELECTION SIMULATION

01416305 - ARTIFICIAL INTELLIGENCE TECHNOLOGY

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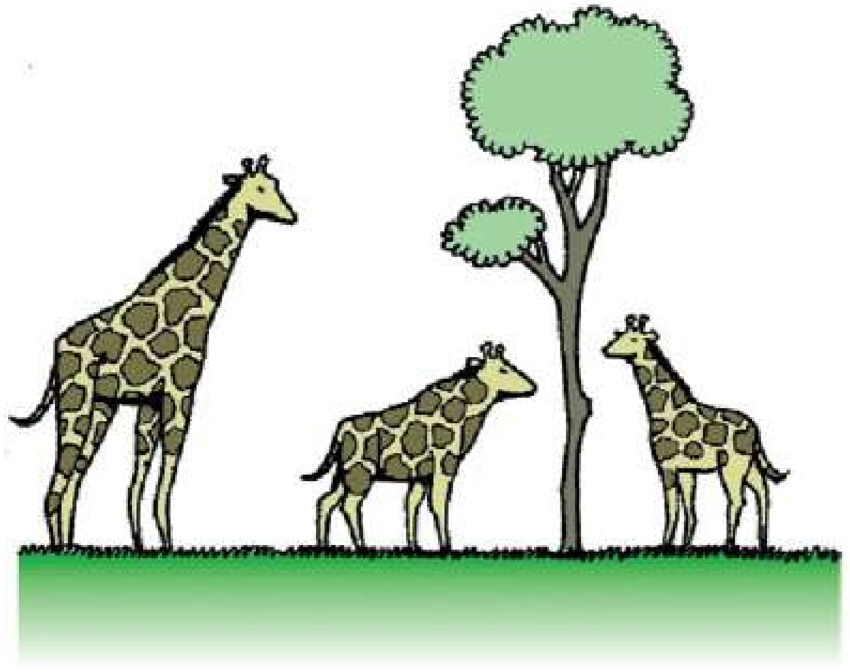
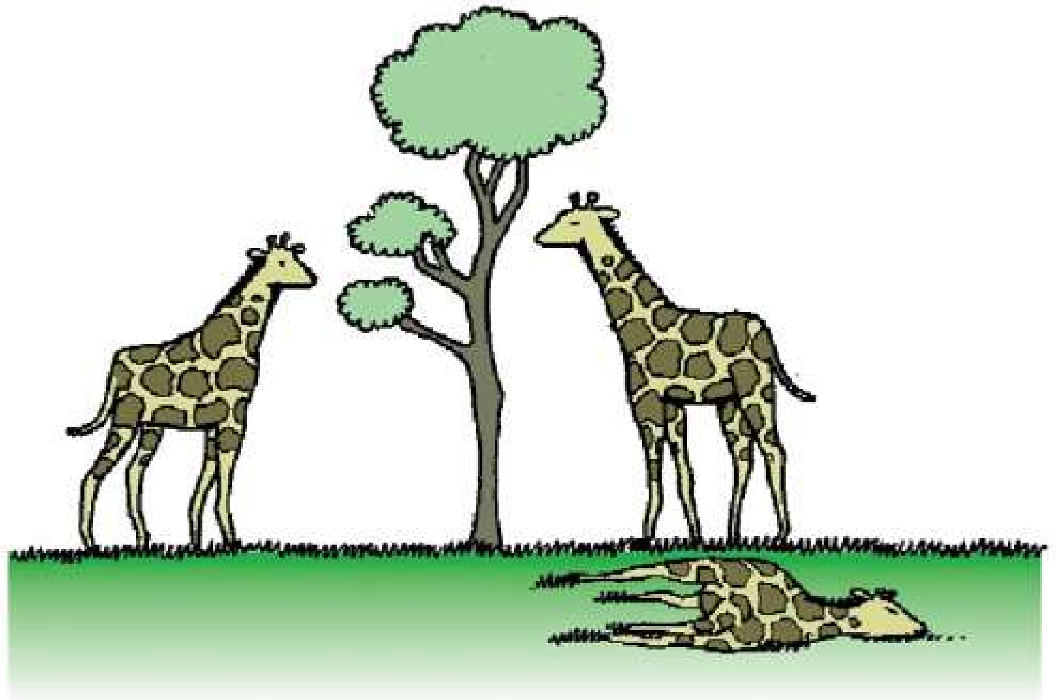
ARTIFICIAL INTELLIGENCE MINOR PROGRAM

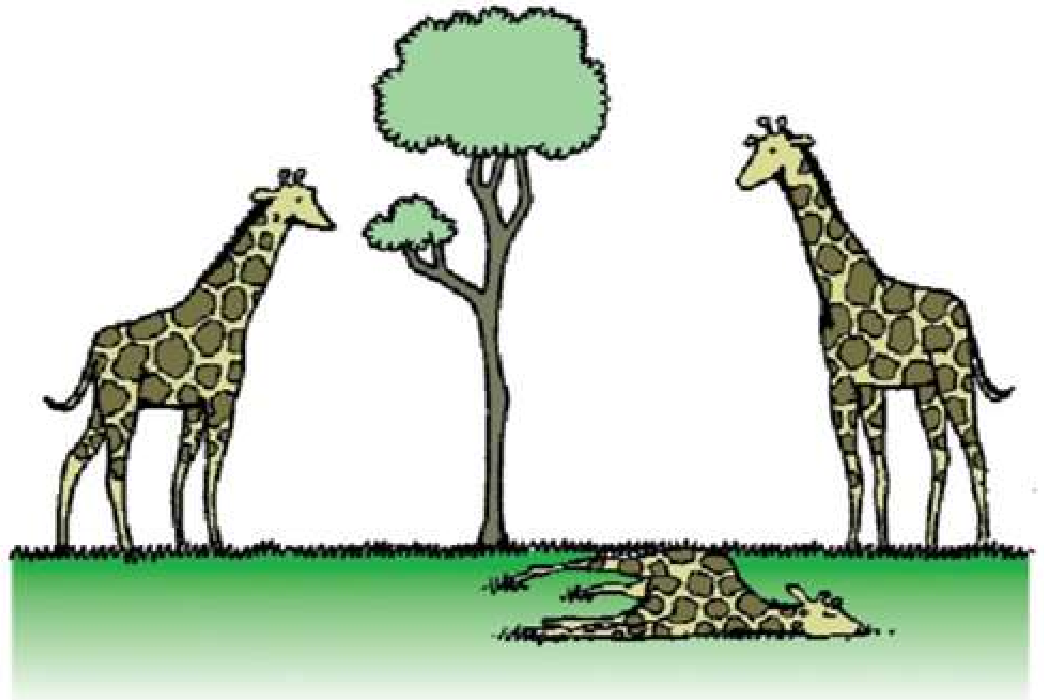
INTRODUCTION



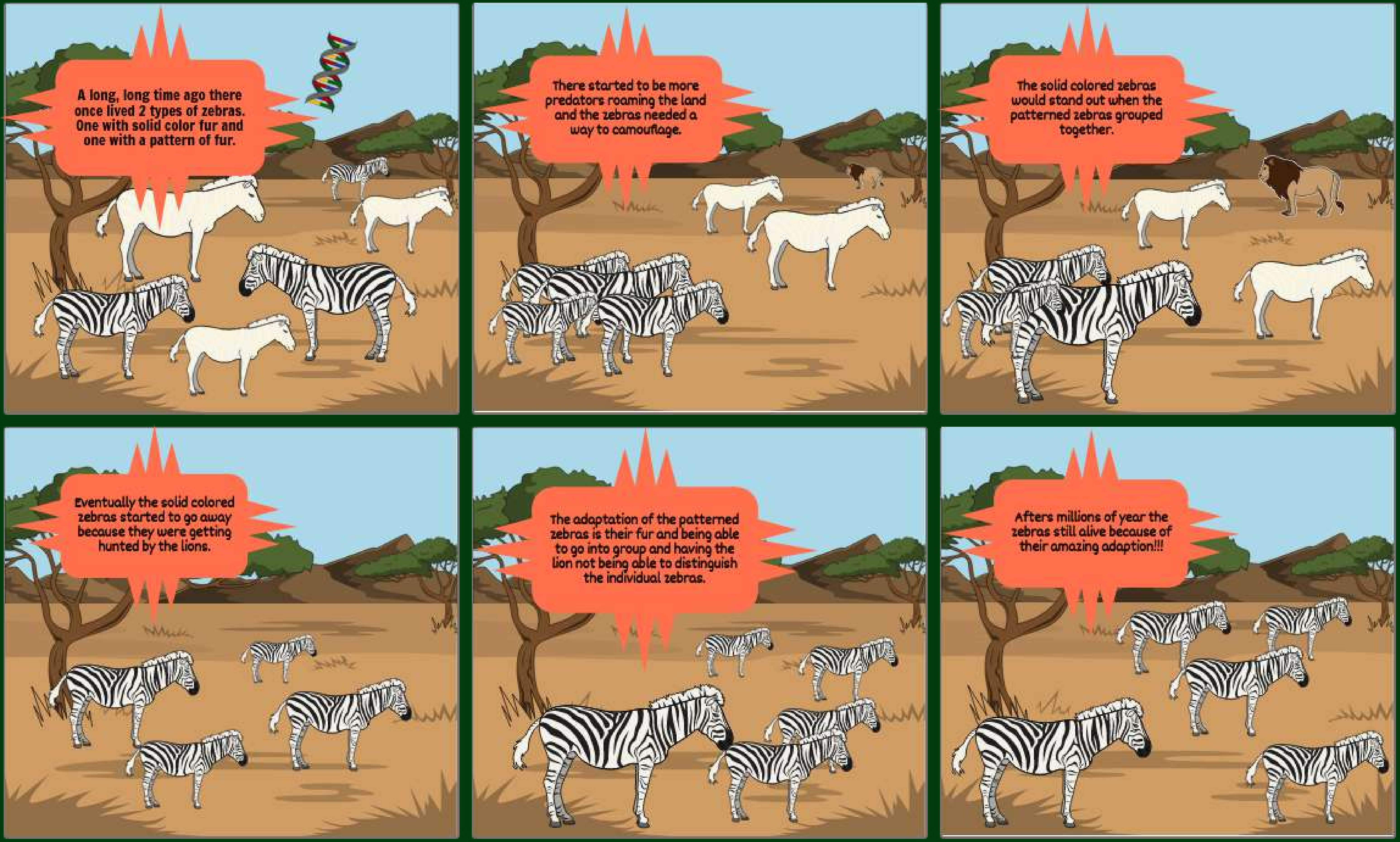
Not all giraffes have equally long necks. Giraffes inherit their neck length from their parents. It is largely fixed by genes.



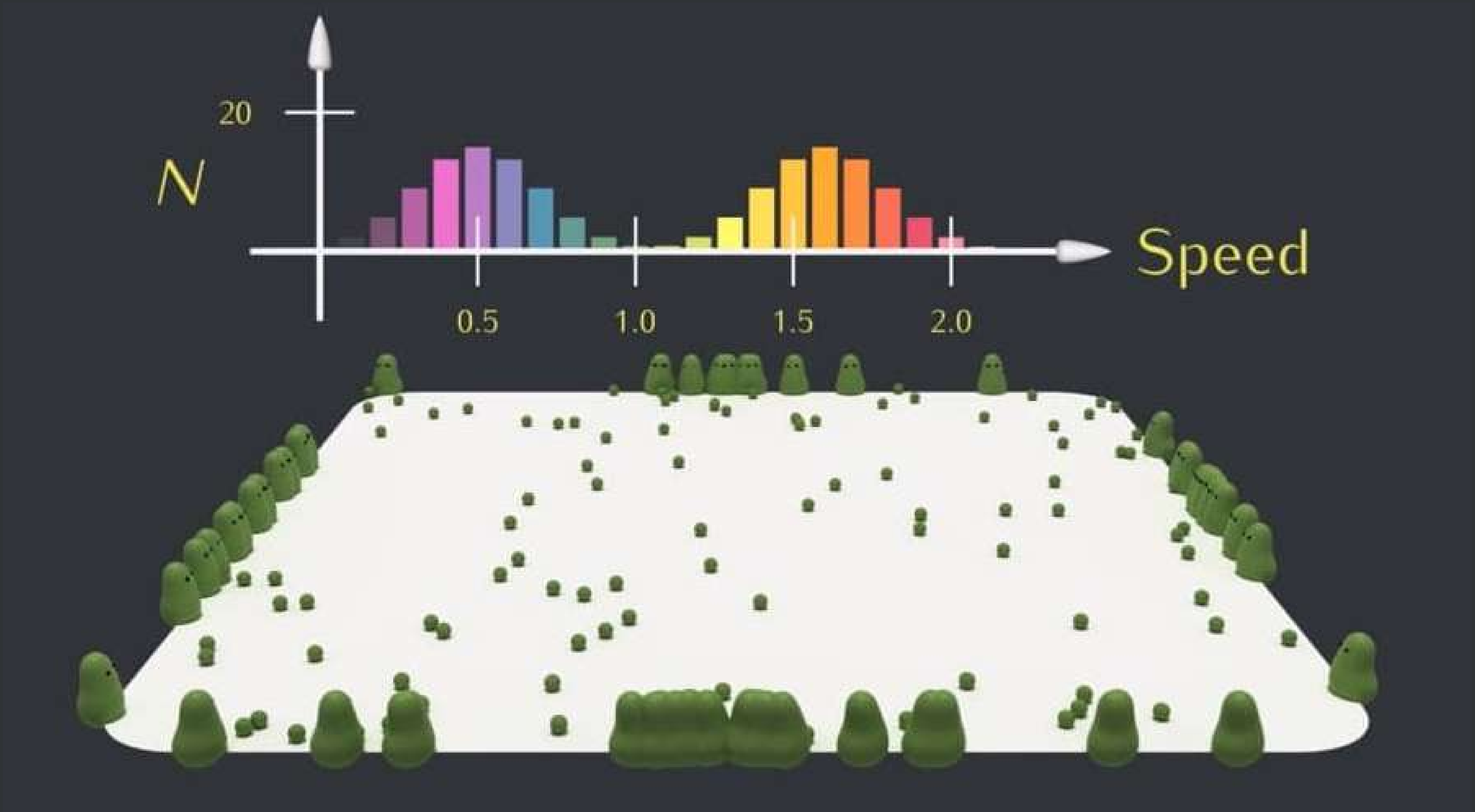
Food that are easily accessed will be eaten by many animal species, and is therefore easily gone. If this happens, giraffes with longer neck are more likely to survive. They can reach food that few other can reach.



Over time, more and more of the giraffes came to have long necks (the short ones never made it to reproduction). This is what we call natural selection and evoluationary adapation.


A long, long time ago there once lived 2 types of zebras. One with solid color fur and one with a pattern of fur.
There started to be more predators roaming the land and the zebras needed a way to camouflage.
The solid colored zebras would stand out when the patterned zebras grouped together.
Eventually the solid colored zebras started to go away because they were getting hunted by the lions.
The adaptation of the patterned zebras is their fur and being able to go into group and having the lion not being able to distinguish the individual zebras.
Afters millions of year the zebras still alive because of their amazing adaption!!!

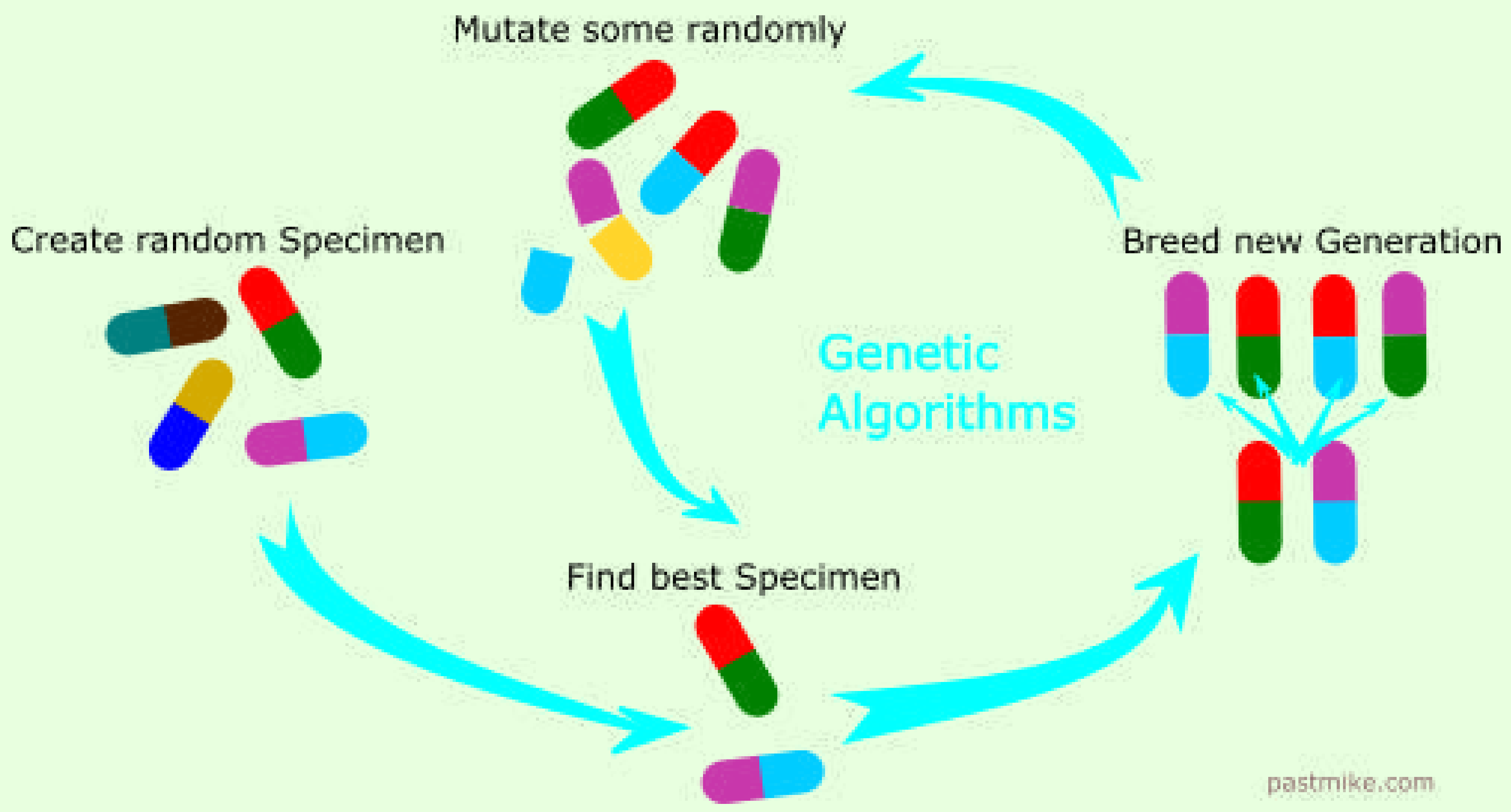
PRIMER



ref : youtube.com/c/PrimerLearning

GENETIC ALGORITHM

In computer science and operations research, a genetic algorithm (GA) is a metaheuristic inspired by the process of natural selection that belongs to the larger class of evolutionary algorithms (EA). Genetic algorithms are commonly used to generate high-quality solutions to optimization and search problems by relying on biologically inspired operators such as mutation, crossover and selection. Some examples of GA applications include optimizing decision trees for better performance, automatically solve sudoku puzzles, hyperparameter optimization, etc.



OBJECTIVE

- To make a simulation in python by creating my own environmental rules.

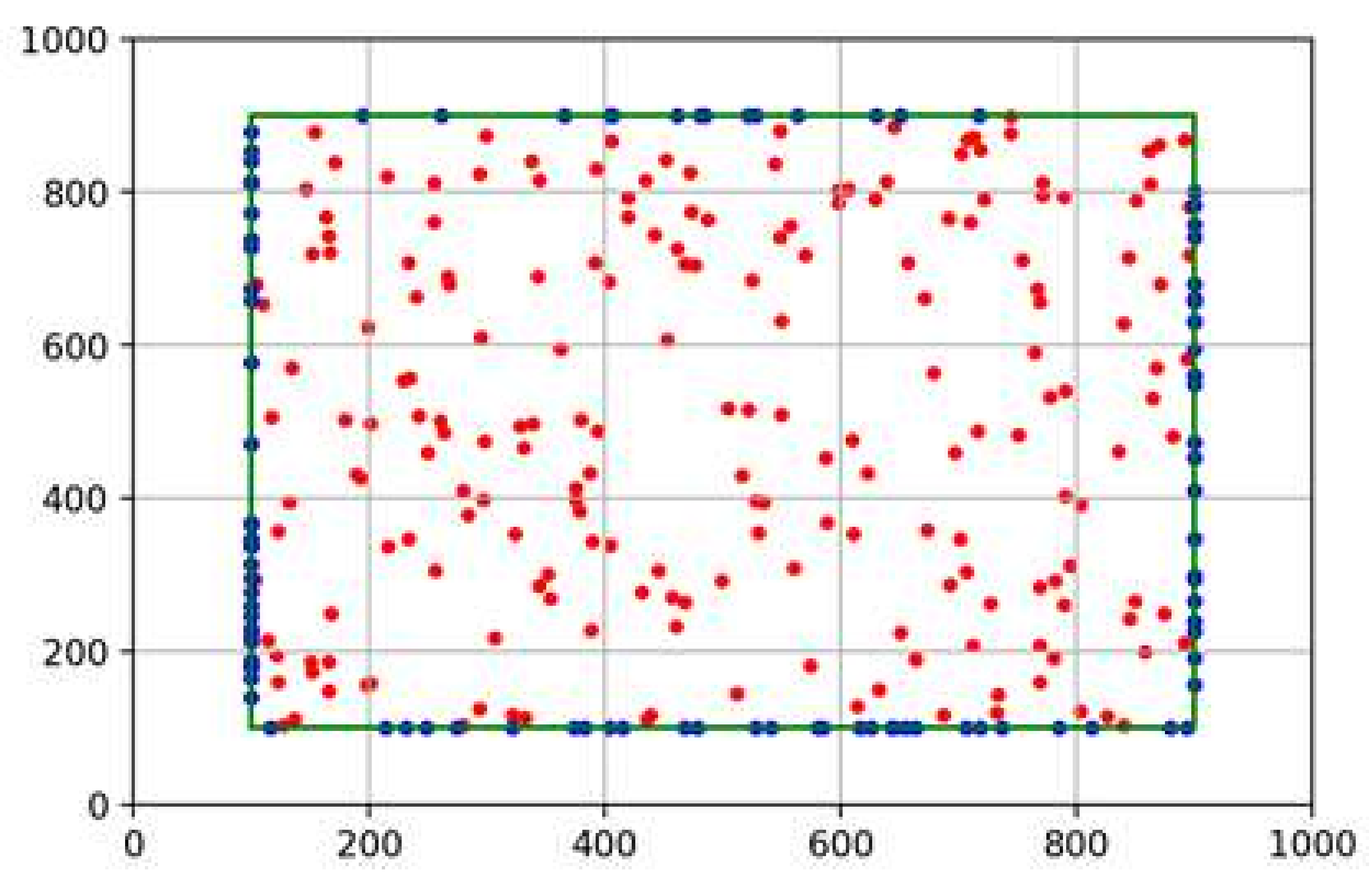
- Using the concept of genetic algorithm to find the way how creature evolve after time and using it to optimize how to run the simulation.

- Proves the real-world theories. (That was already proved.)

- Gain experience using Python and matplotlib in general.

METHODOLOGY

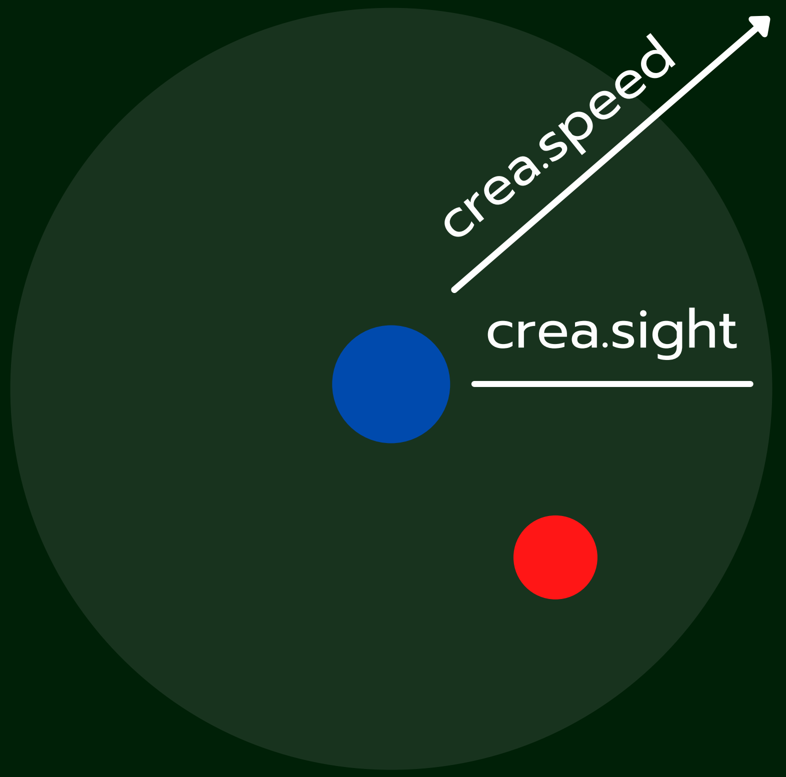
ENVIRONMENT RULES



- Map size 1000 * 1000 sq.unit with food only generate in between [100,800]
both x and y axis (64% area in the map).

- Creatures can only random spawn on the green line.

4 TRAITS OF CREATURES



MUTATION RATE

The children will have a chane to mutate their sight and speed from their parent.

SIGHT

If there is a food in creature sight, they will be able to eat it.

SPEED

Ability to move randomly direction with speed.

LIFESPAN

How long it take for creature to die even if they can get the food.

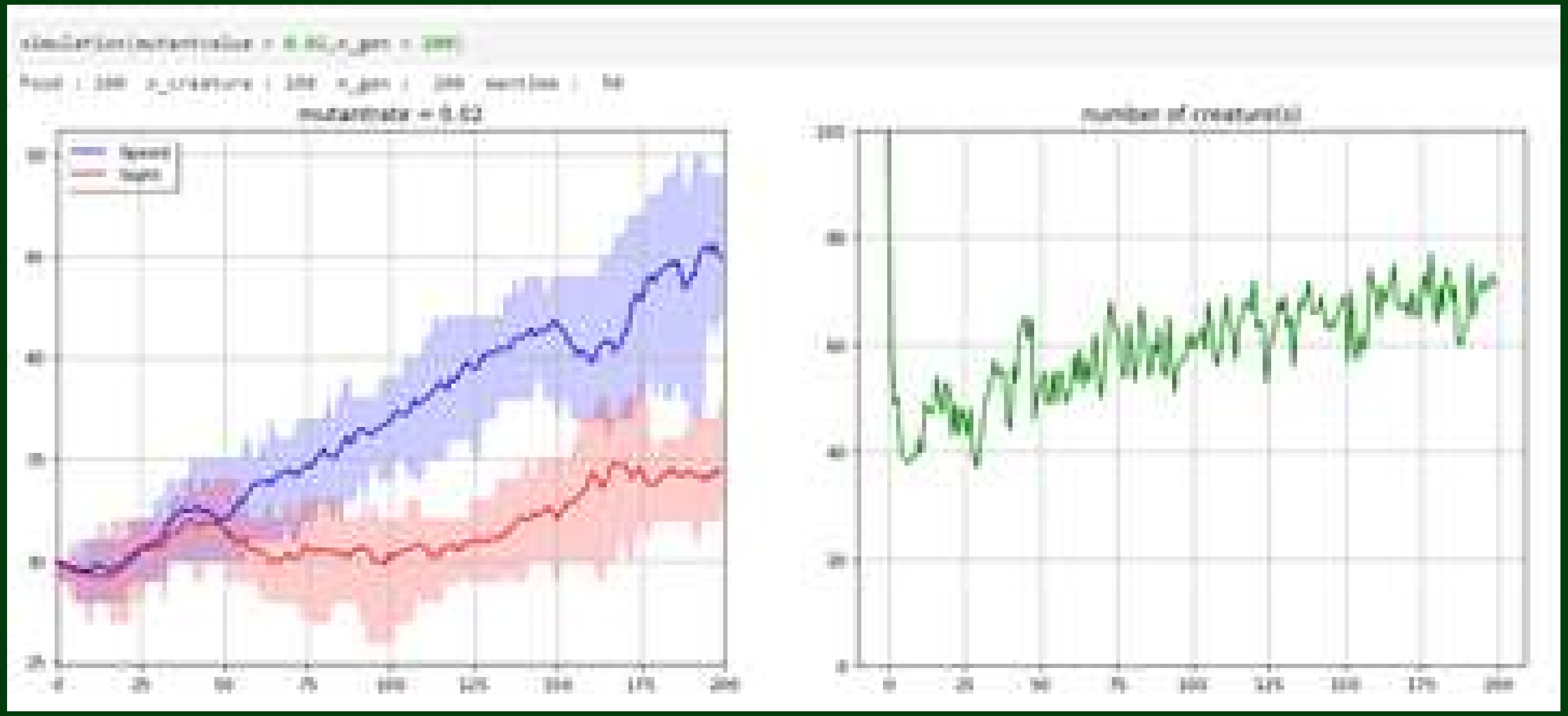
=

=

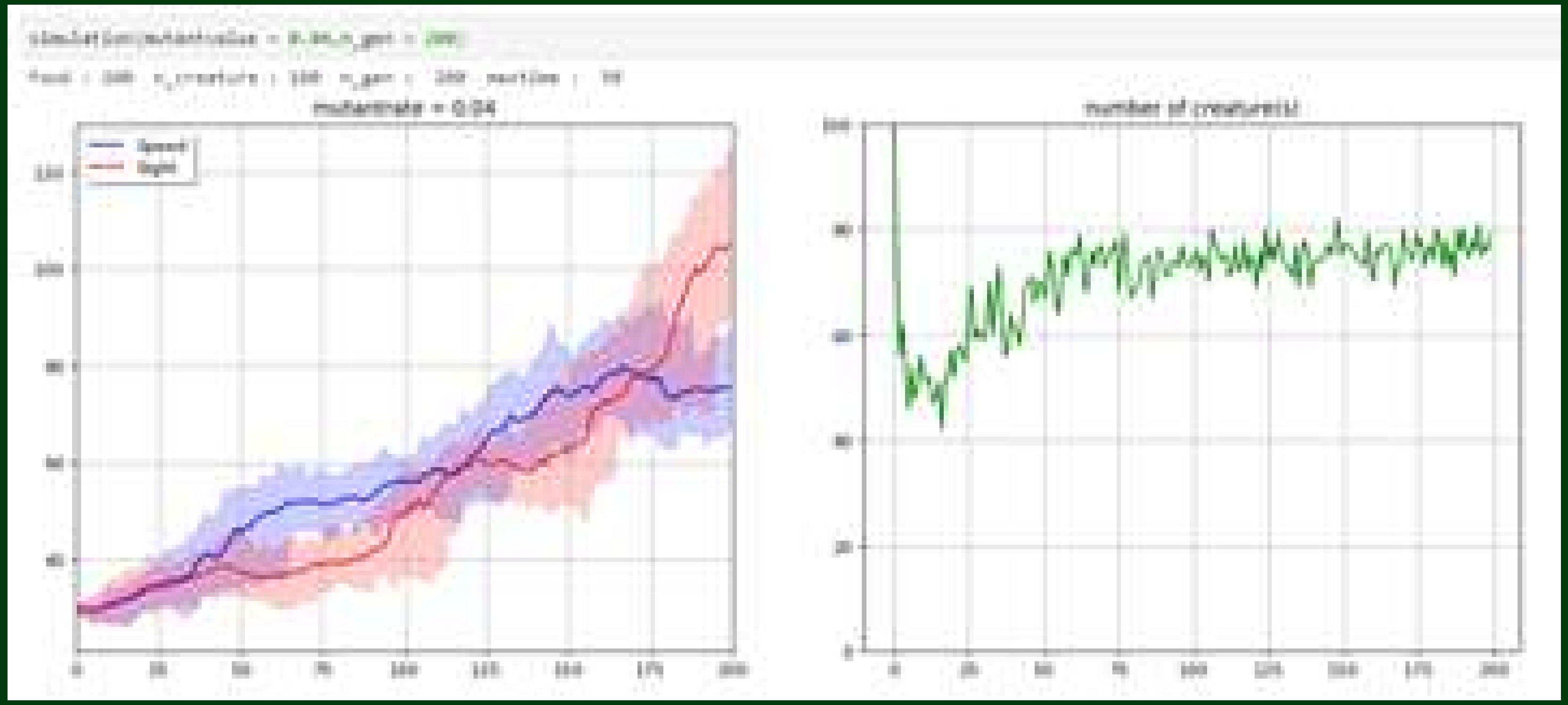
SURVIVE TO THE NEXT GENERATION IF THERE IS A LIFETIME LEFT.

EXPERIMENT 1 :

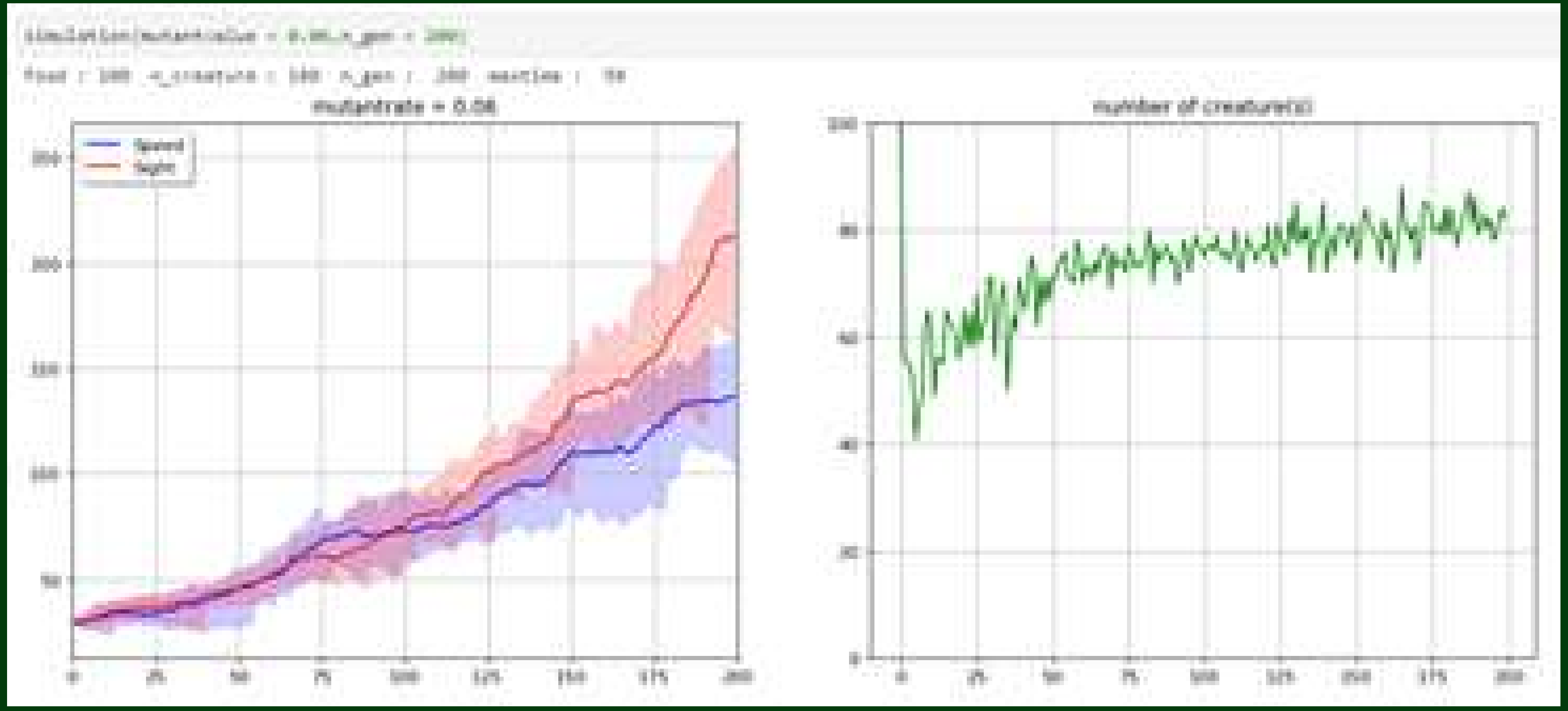
- One type of creatures.
- Having difference mutation rate across the simulation.
- 200 Generations / Simulation.
- 1000 * 1000 sq.unit with 100 foods (64% of the area).
- Total 100 creatures at the start.



Mutantation Rate = 0.02 (?)

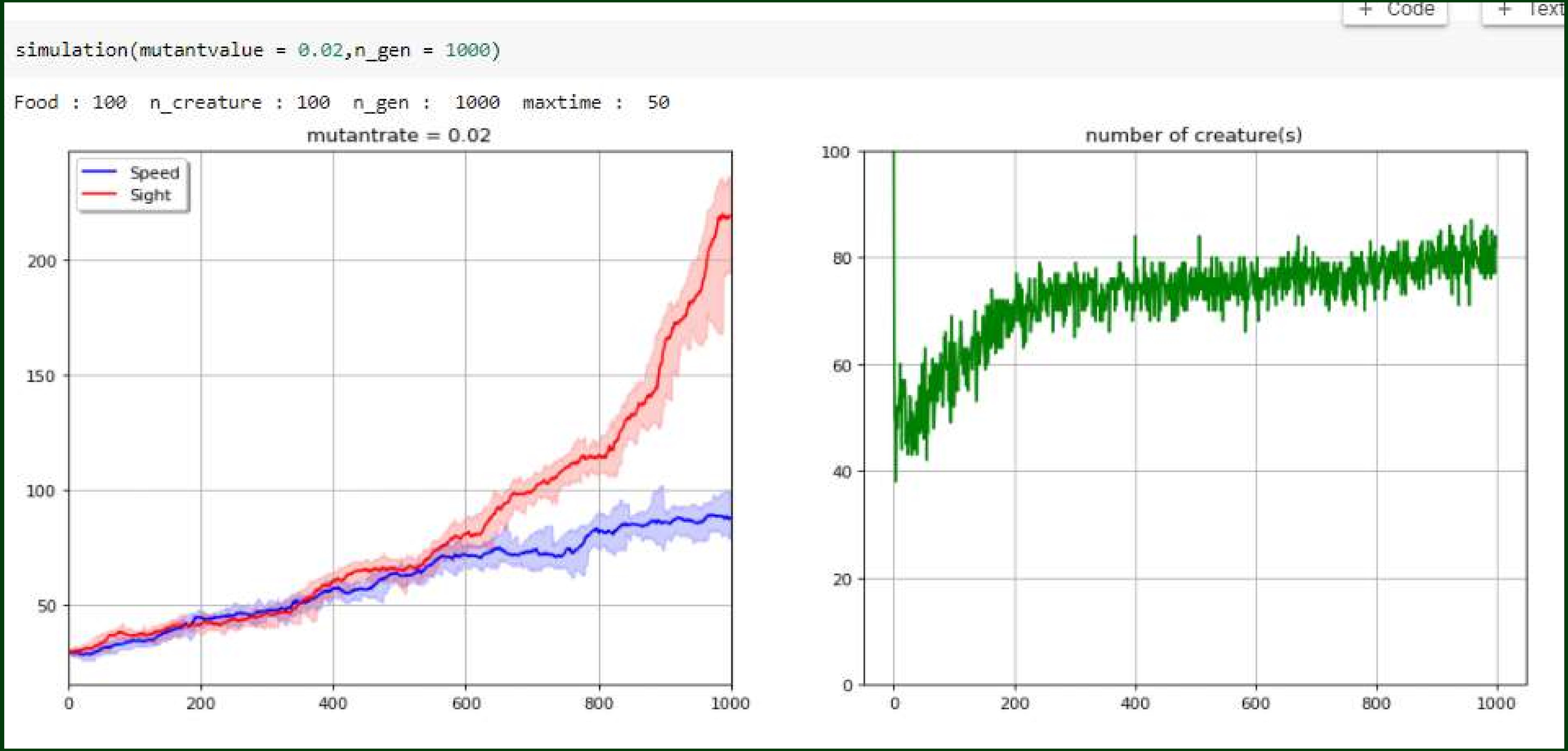


Mutantation Rate = 0.04



Mutantation Rate = 0.06

Mutantation Rate = 0.08



1000 GENERATIONS

Mutation Rate 0.02 Finally reach an equilrium of the environment !!!

The result is true If there is only one type of creature that lives in the environment. They will eventually reach the equilibrium point of the environment, a number of generations will depend on the mutant rate.

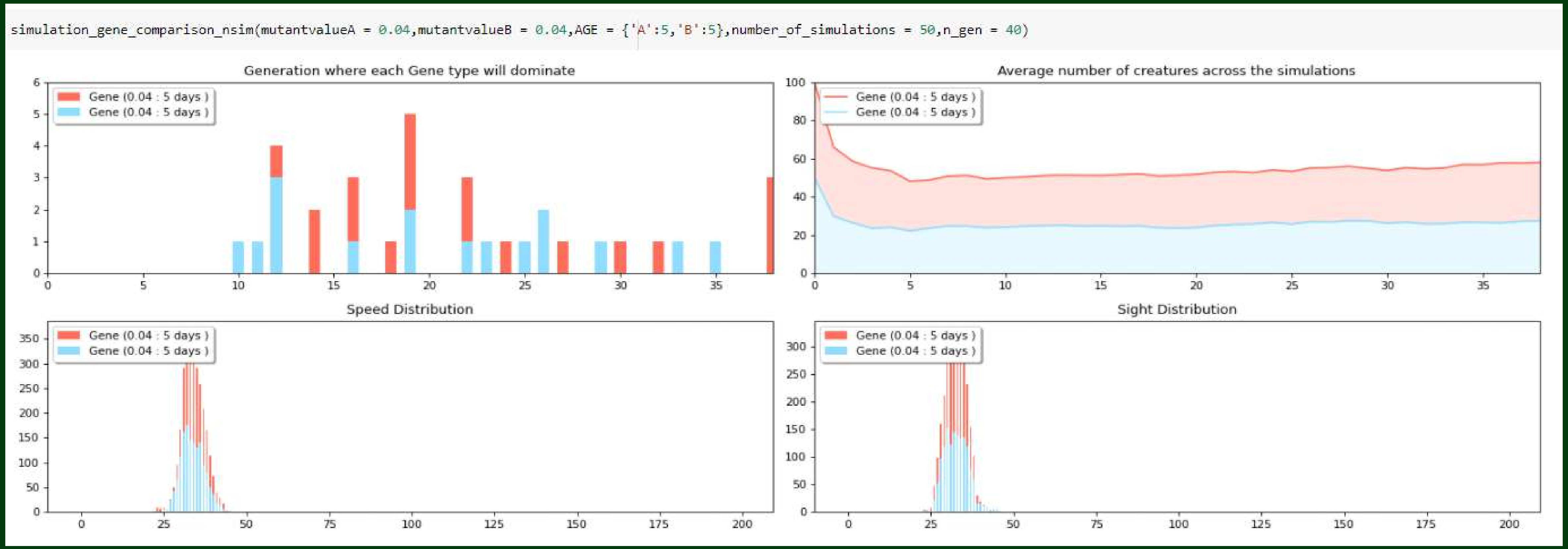
Another main point in this experiment is the environment can reach its equilibrium even though the creatures' performance in speed and sight are different across the mutation rate. It can be assumed that when they only need to compete with other creatures that have the same mutation rate and can be survived in the environment because there are no other creatures that can survive better to compete with them.

TLDR : HIGHER MUTATION RATE -> REACHING EQUILIBRIUM FASTER

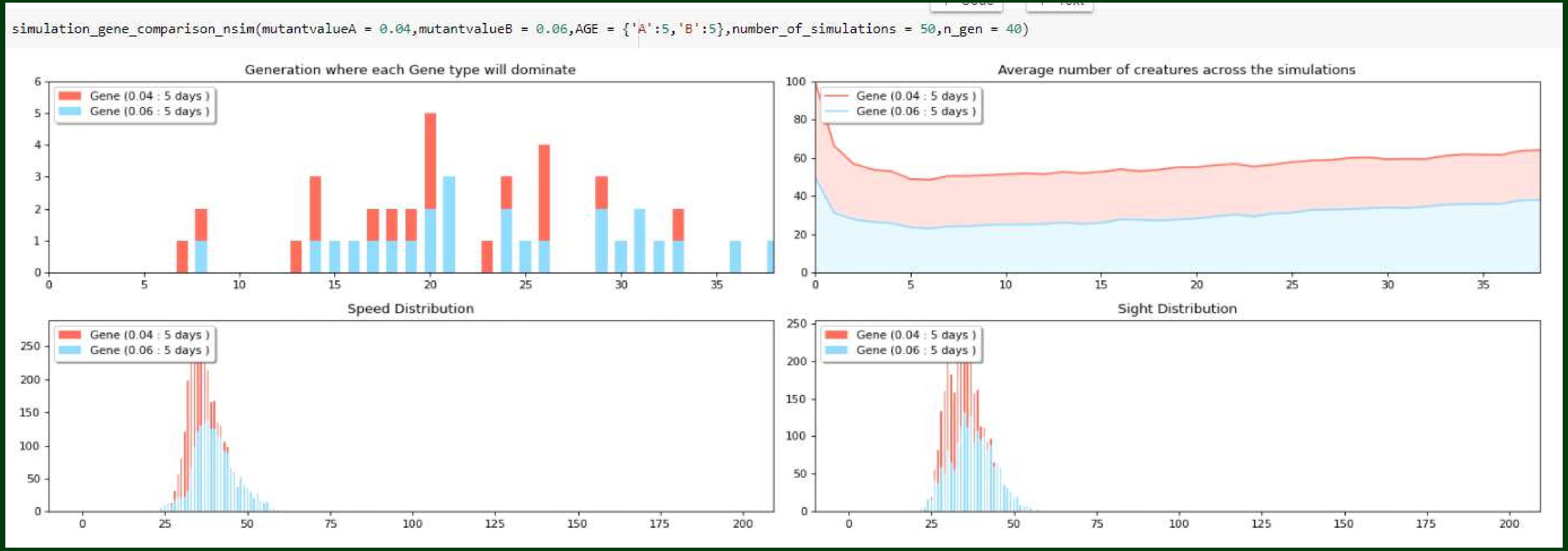
(ALSO HIGHER CHANCE TO EXTINCT)

EXPERIMENT 2 :

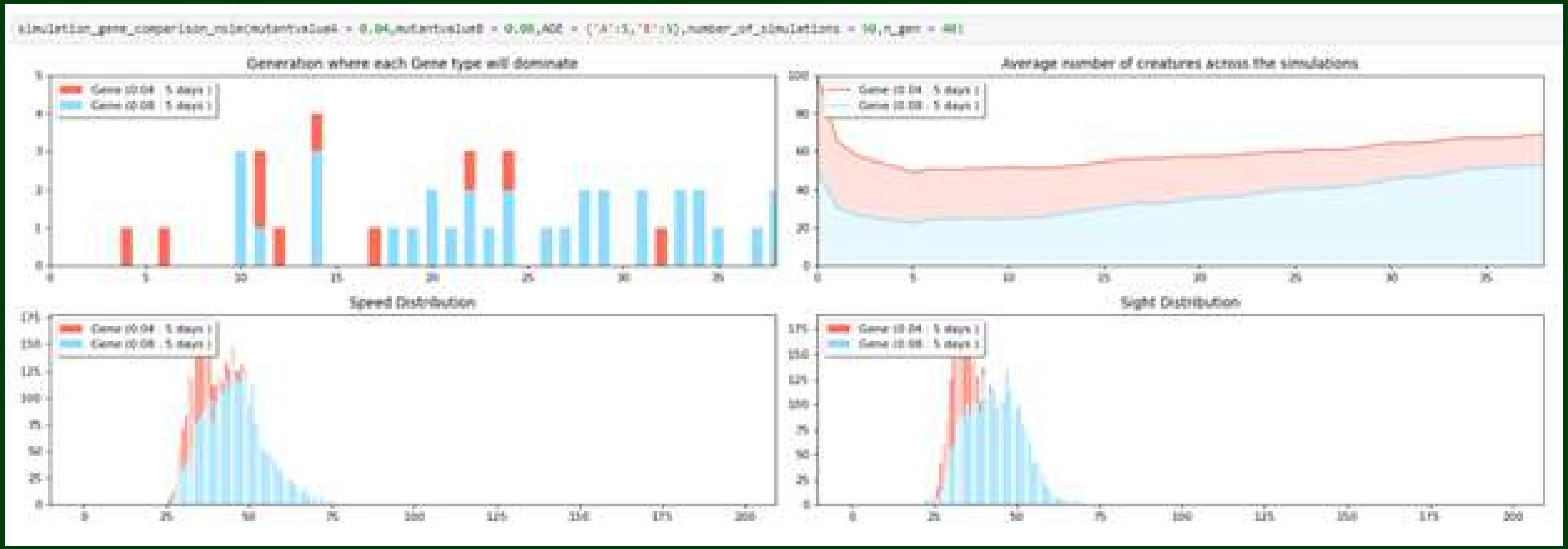
- Two types of creatures, the difference in mutation rate, 50 creatures for each type.
- 40 Generations / Simulation , 50 Simulation for each run.
- 1000 * 1000 sq.unit with 100 foods (64% of the area).
- Total 100 creatures at the start.
- 5 generations lifespan for every creatures.



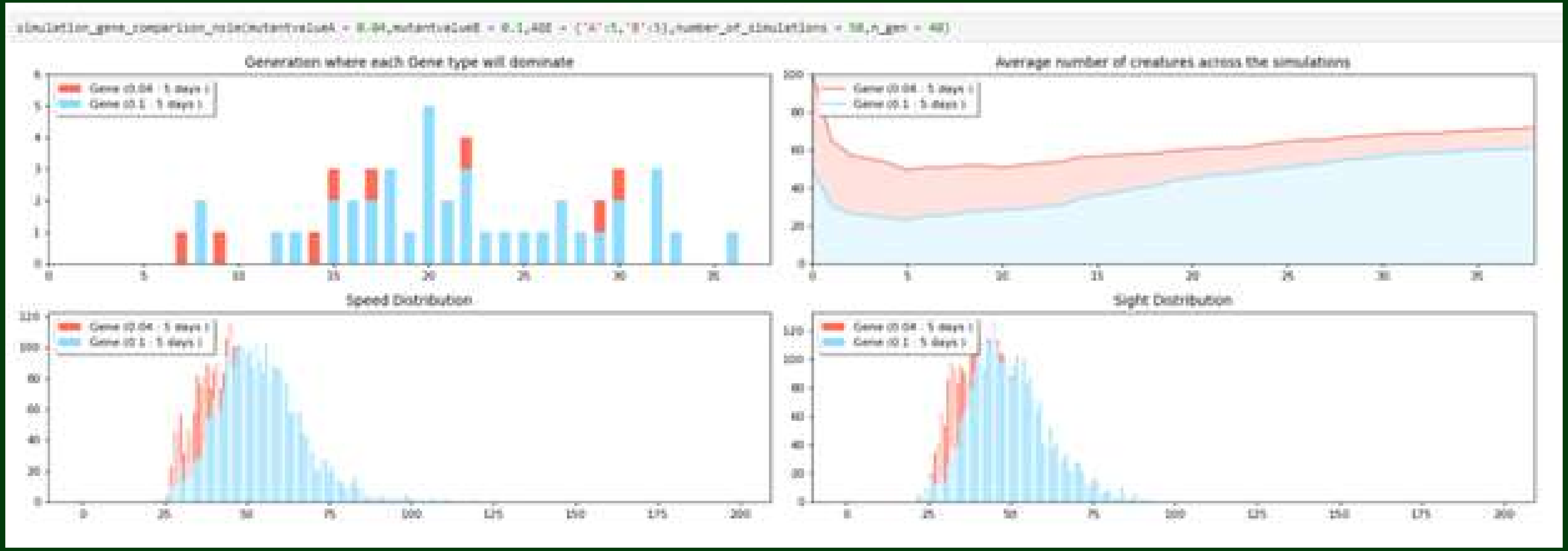
0.04 vs 0.04 Mutation Rate



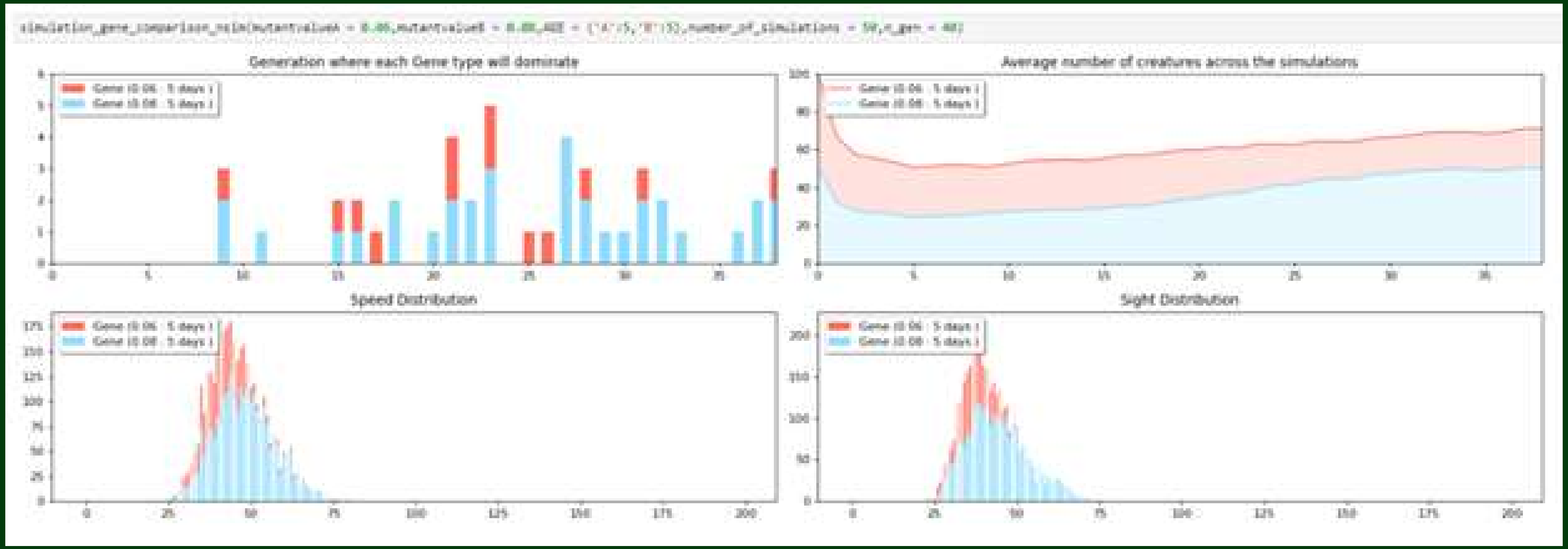
0.04 vs 0.06 Mutation Rate



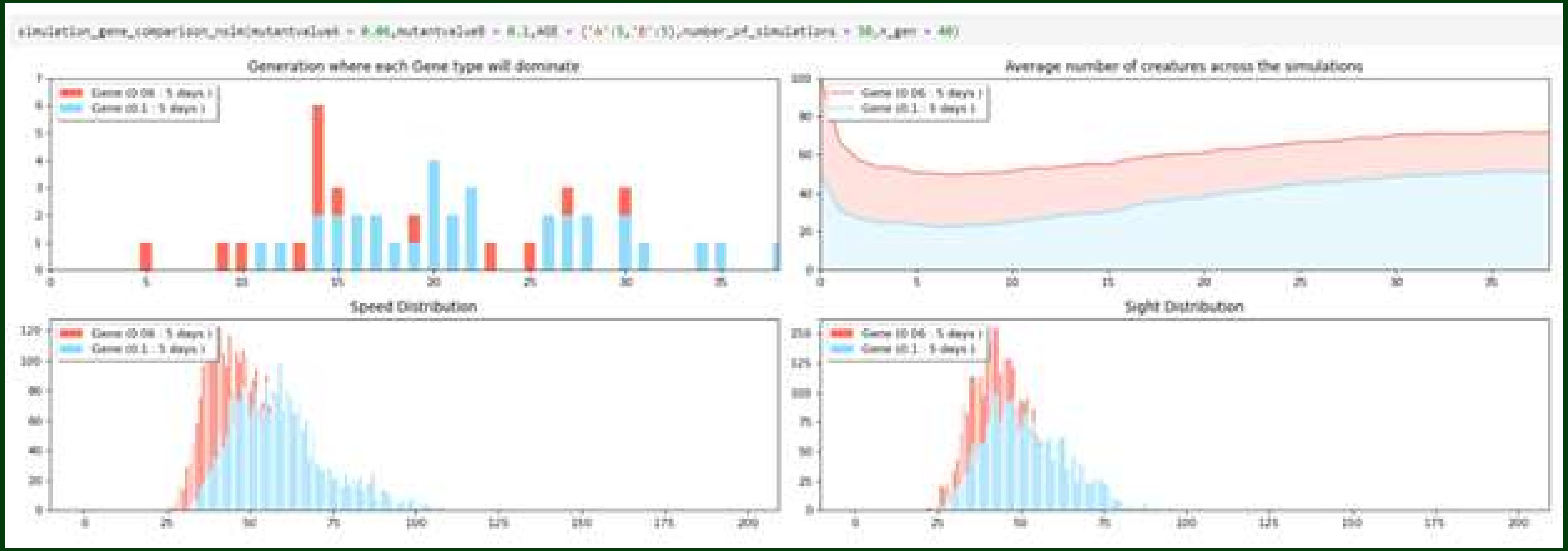
0.04 vs 0.08 Mutation Rate



0.04 vs 0.1 Mutation Rate



0.06 vs 0.08 Mutation Rate



0.06 vs 0.1 Mutation Rate

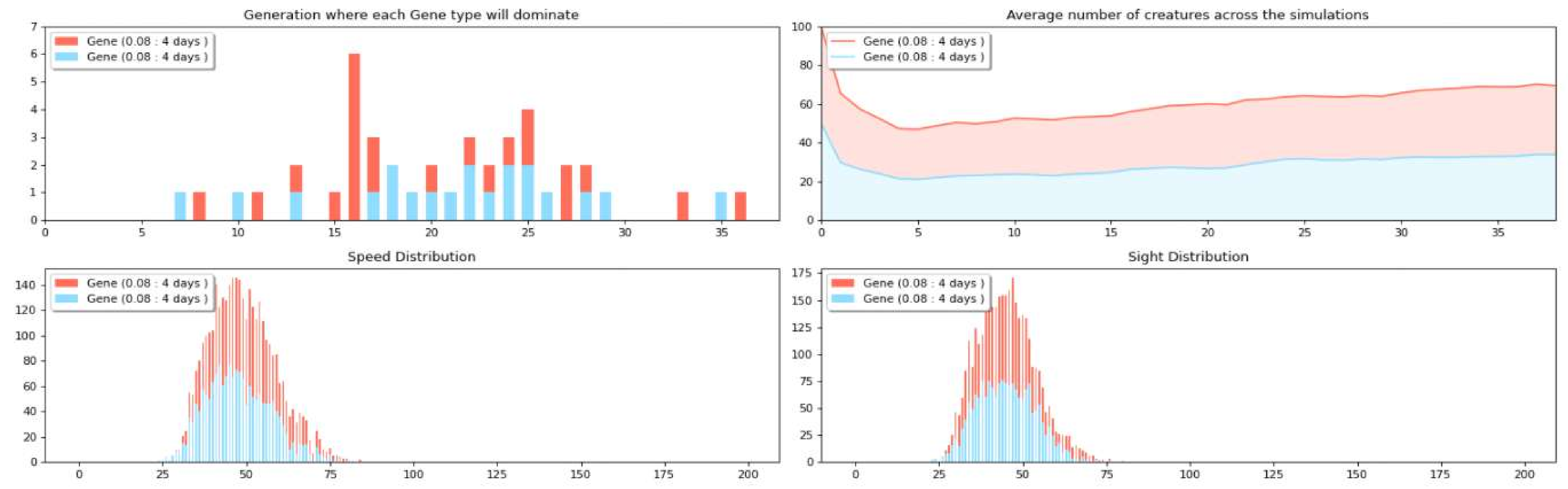
The result shows that creatures with a higher mutation rate will have a higher chance of surviving in this environment. The chance of dominating the environment will depend on the gap between creatures' mutation rate which also means that to survive in this environment, every creature needs to produce a child that has better traits to be able to survive, and even if the lower mutation rate creatures can survive, they also have relatively high phenotypic traits because they need to outperform higher mutation creatures in order to dominate an environment.

TLDR : BIGGER MUTATION RATE GAP -> HIGER CHANCE TO DOMINATE
(ALSO HIGHER CHANCE TO EXTINCT)

EXPERIMENT 3 :

- Two types of creatures, the difference in lifespan, 50 creatures for each type.
- 40 Generations / Simulation , 50 Simulation for each run.
- 1000 * 1000 sq.unit with 100 foods (64% of the area).
- Total 100 creatures at the start.
- 0.08 mutation rate for every creatures.

```
simulation_gene_comparison_nsim(mutantvalueA = 0.08,mutantvalueB = 0.08,AGE = {'A':4,'B':4},number_of_simulations = 50,n_gen = 40)
```



4 Days vs 4 Days

```
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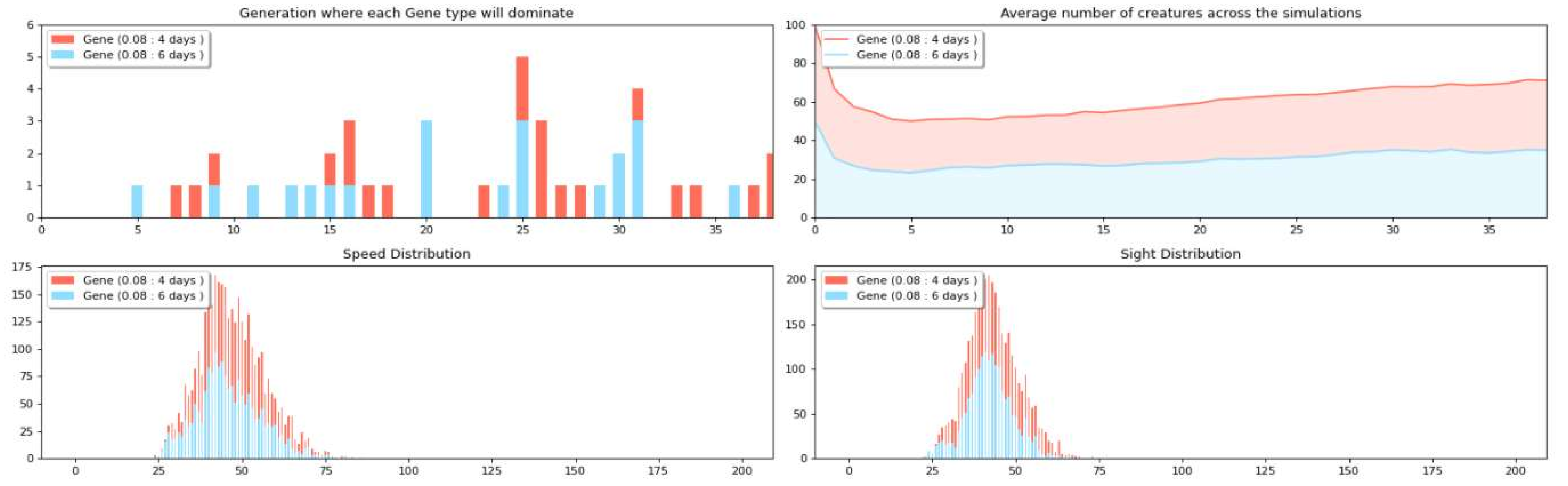

4 Days vs 6 Days

```
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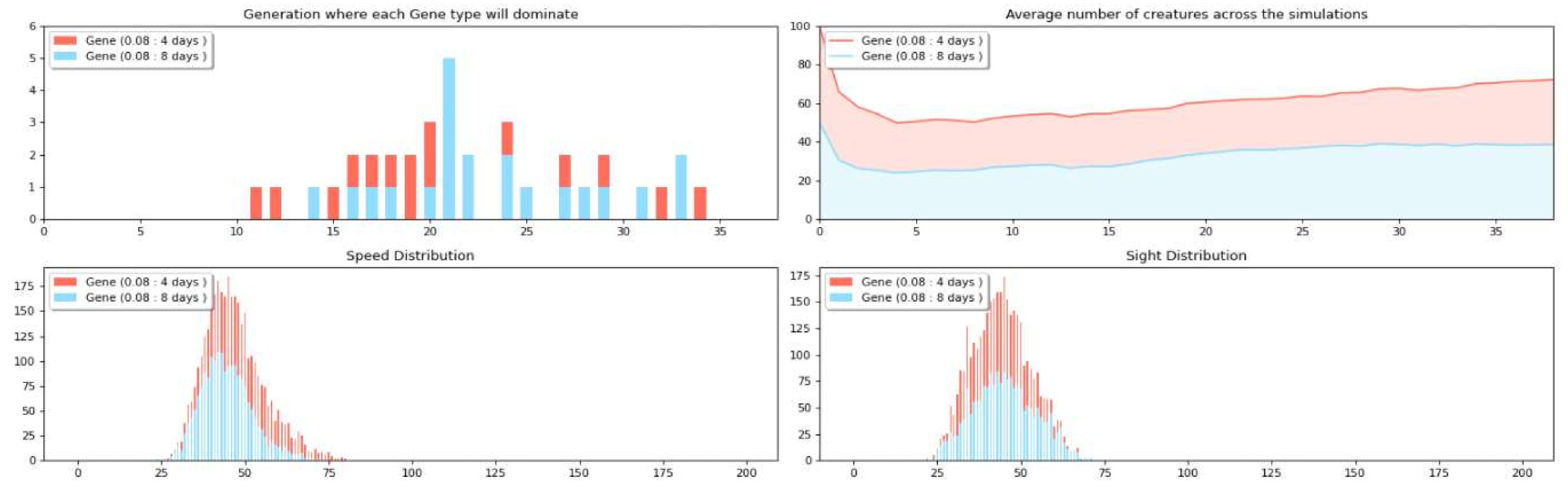

4 Days vs 8 Days

```
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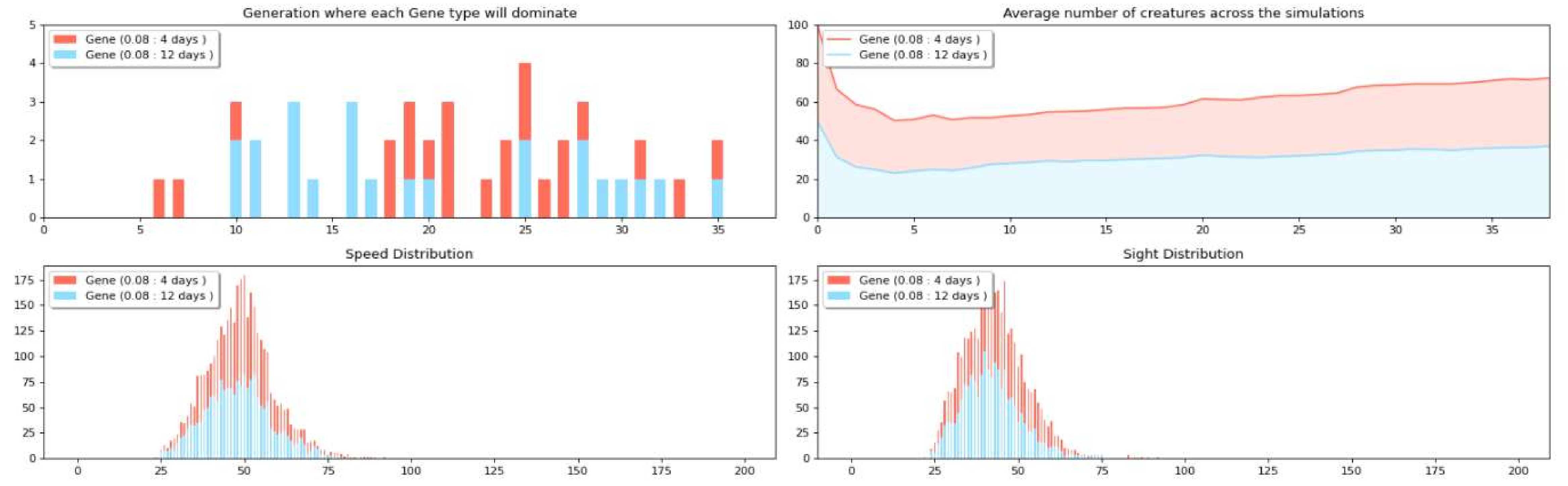

4 Days vs 12 Days

```
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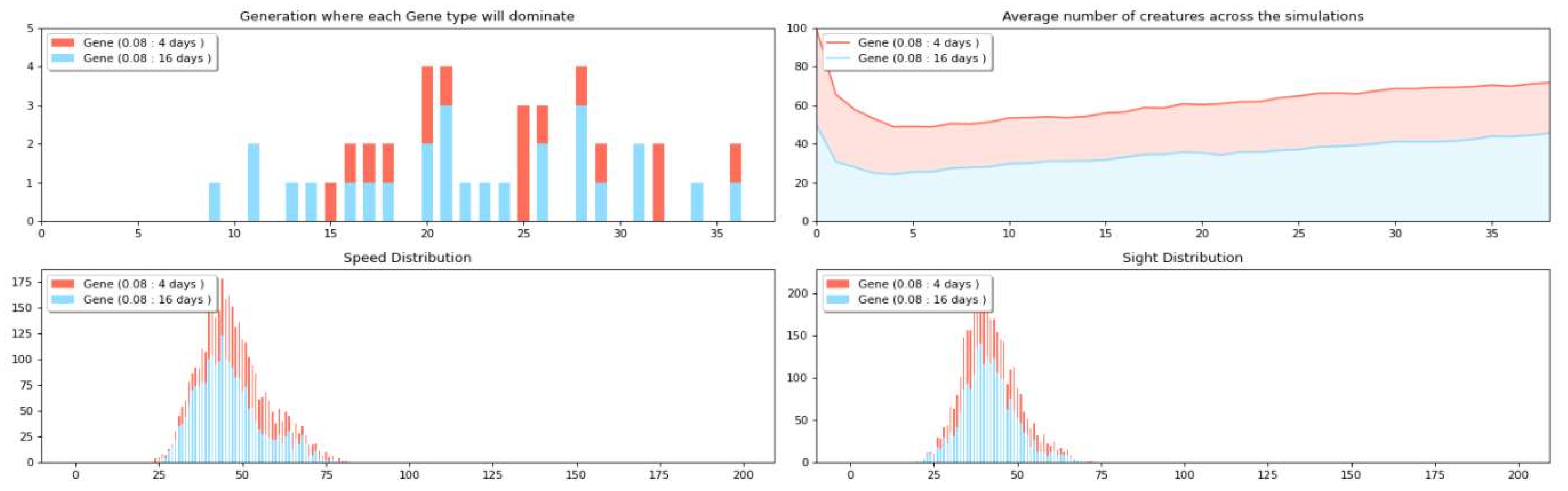

4 Days vs 16 Days

```
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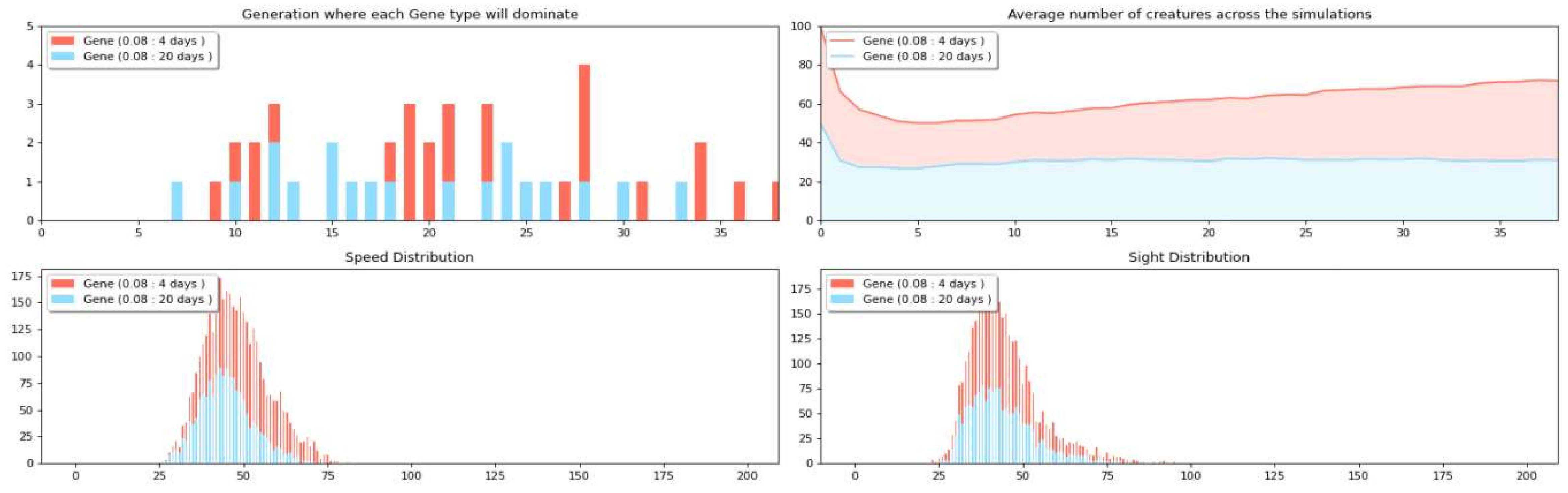

4 Days vs 20 Days

Results of the experiments show that life-span has a co-relation with how creatures will perform when they have to compete with another type of creature. Longer lifespans help the creature to survive better because they only need to get one food in order to survive and have a longer chance of booking their spot in this environment until they are defunct. But it isn’t the only parameter that affects the environment because if other creatures make a new generation creature that performs better, other creatures that only have a longer lifespan but worse traits in comparison will eventually die.

TLDR : LONGER LIFESPAN -> HIGER CHANCE TO SURVIVE

(TOO LONG IS UNNECESSARY)

CONCLUSION

In order to survive in this environment for creatures that have speed, sight, mutation rate, and lifespan as their phenotypic traits. There are several rules that can be assumed after the experiments.

1. In an environment that only has one type of creature, it will reach equilibrium after time unless if the first generation can survive. Period of taken by stabilizing state depends on mutation rate which will be faster if the mutation rate is higher.

2. Creatures with a higher mutation rate will have a better chance of dominating the environment because when creatures have to compete with other creatures, They need better phenotypic traits (speed and sight) in order to survive, so having a higher mutation rate means that they will have a better chance to get better in phenotypic traits and be able to survive.

3. Longer lifespan can contribute to a creature having a higher chance to survive in an environment but is not linearly dependent because a longer lifespan can help the creature to survive by only eating one piece of food but after time where other creatures have developed, they will eventually lose the competition and die.

TLDR

- HIGHER MUTATION RATE -> REACHING EQUILIBRIUM FASTER (NOT EVERYTIME)
- BIGGER MUTATION RATE GAP BETWEEN CREATURES -> HIGER CHANCE TO DOMINATE THE ENVIRONMENT
- LONGER LIFESPAN -> HIGER CHANCE TO SURVIVE (TOO LONG IS UNNECESSARY)

WITH THAT BEING SAID, ALL OF THE PHENOTYPIC TRAITS ARE AFFECT HOW CREATURES SURVIVE IN THE ENVIRONMENT AS CHARLES DARWIN SAID IN NATURAL SELECTION RULES.

POSSIBLE IMPROVEMENT

- USING THIS KNOWLEDGE TO FIND OPTIMAL TRAITS OF CREATURES THAT ARE MOST LIKELY TO SURVIVE THE ENVIRONMENT.
- ADD MORE TYPE OF CREATURE IN ONE ENVIRONMENT TO FIND HOW ITS PERFORM AGAINST EACH OTHER.
- USING CHANGEABLE MUTANT RATE TO FIND THE BEST MUTANT RATE IN THE ENVIRONMENT INSTEAD OF OTHER TRAITS OF CREATURES. (BECAUSE MUTANT RATE WILL LEAD TO OTHER TRAITS ANYWAY)
- ADD TRAITS ABOUT ENERGY CONSUMPTION OF CREATURES TO MAKE IT MORE REALISTIC.


THANK YOU FOR LISTENING