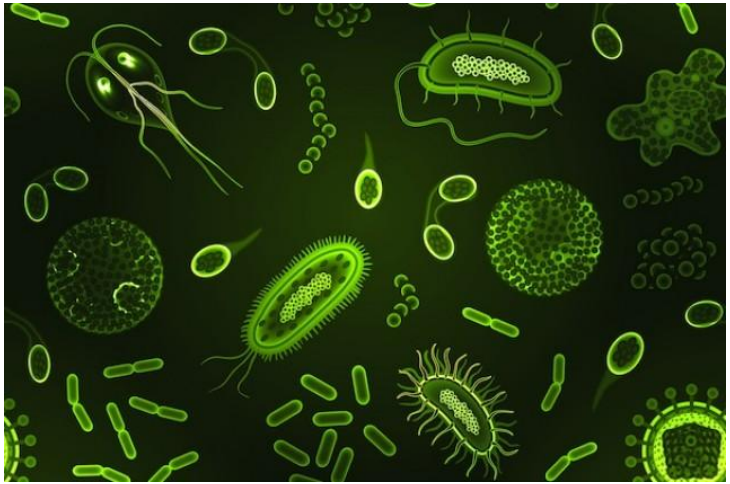
Natural Selection Simulation



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Project Goals

- Simulate a simple example of natural selection using the Unity Engine and generate a large set of evolutionary data.
- The data generated by the simulation will be analyzed with R to examine the evolutionary trends.
- Draw conclusions about the meaning of the simulation data.

Simulation Description

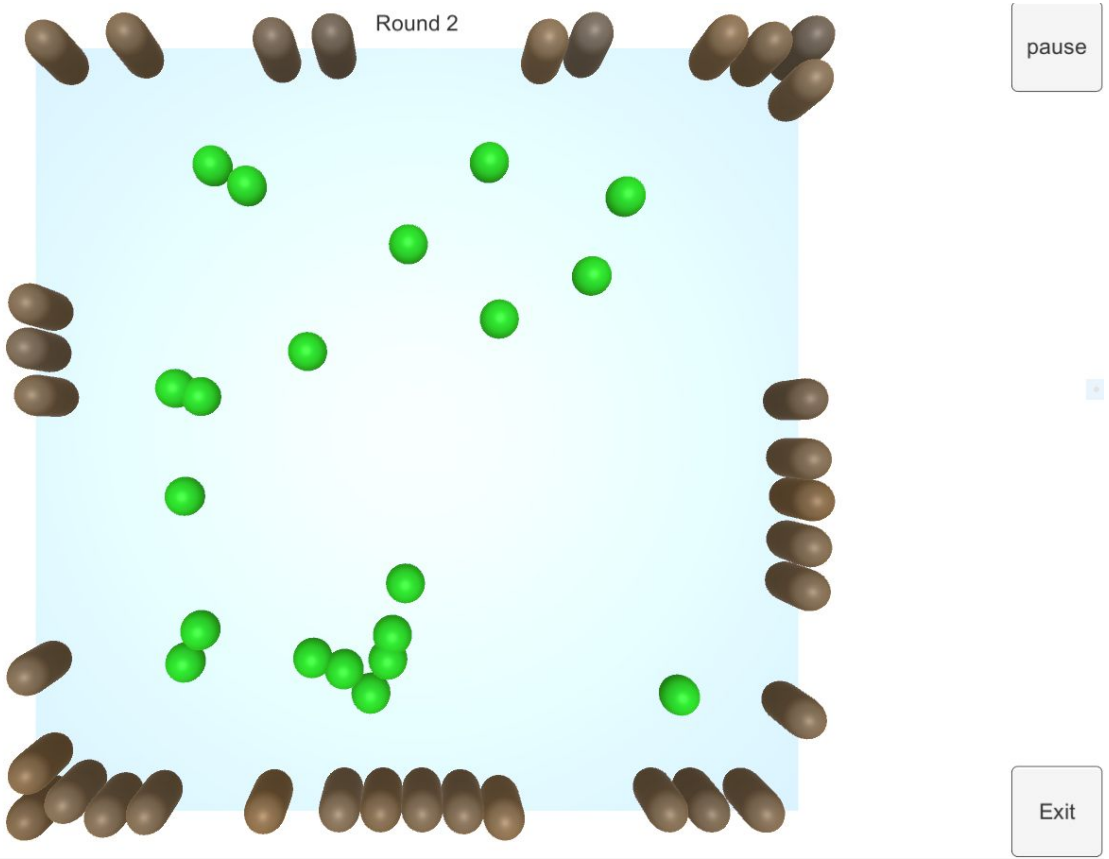
The simulation is divided into a series of “rounds” or “generations”. In the first round the simulation spawns a group of organisms with the exact same starting traits. Organisms that can obtain food will survive to the next round and will be allowed to generate a single offspring that is included in the next round as well. Offspring mostly inherit the traits of their parents, but they are allowed to mutate at most by plus or minus ten percent of their parents’ evolutionary traits. Also, in every subsequent round the supply of food in the environment is restored.

Organisms possess two evolutionary traits: speed and awareness (food detection range). Organisms have a limited amount of energy that is depleted at a rate of ($speed^2$ + awareness) per second. If an organism runs out of energy before finding food it will die and fail to create offspring. Also, rounds end when either there is no more food or all the organisms who have not found food are out of energy.

Simulation Screenshot

Description: The multicoloured capsules are organisms and the green spheres are food. Any organism in this image is either looking for food or chasing after it.

A sample video of the simulation can be found here: https://youtu.be/hKzIOTxdbF0

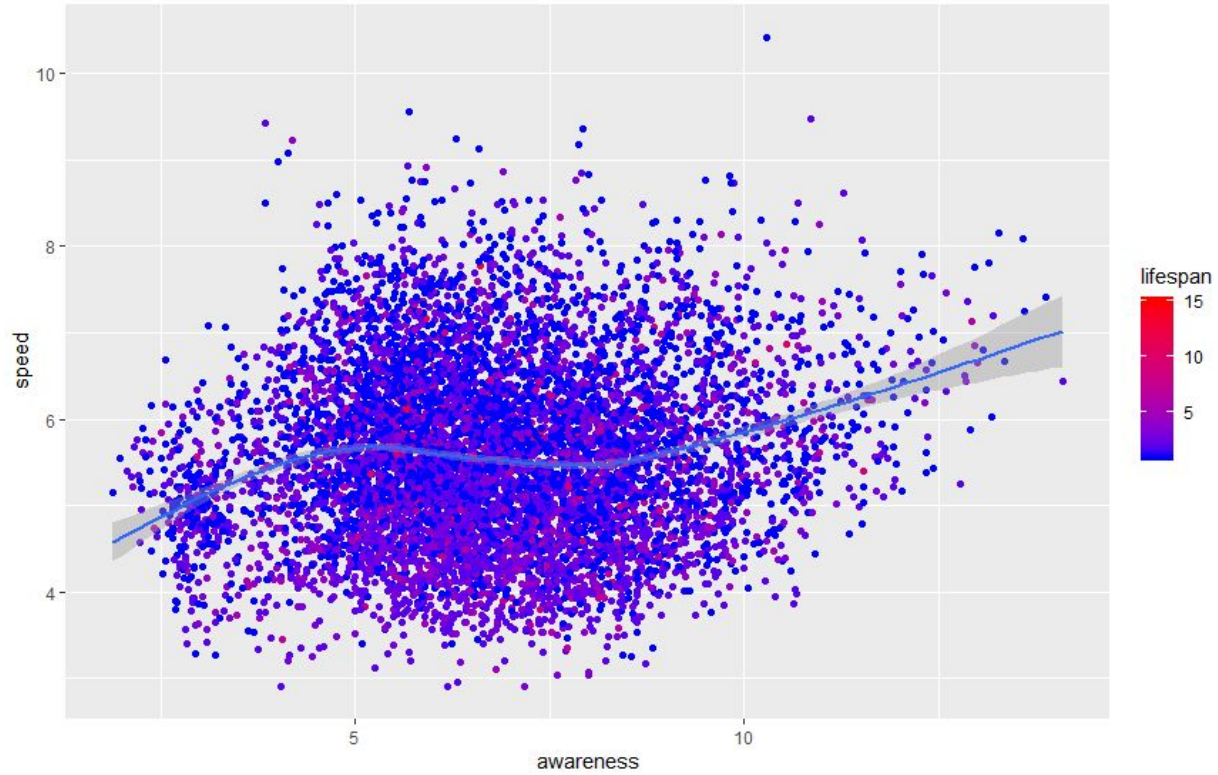


R

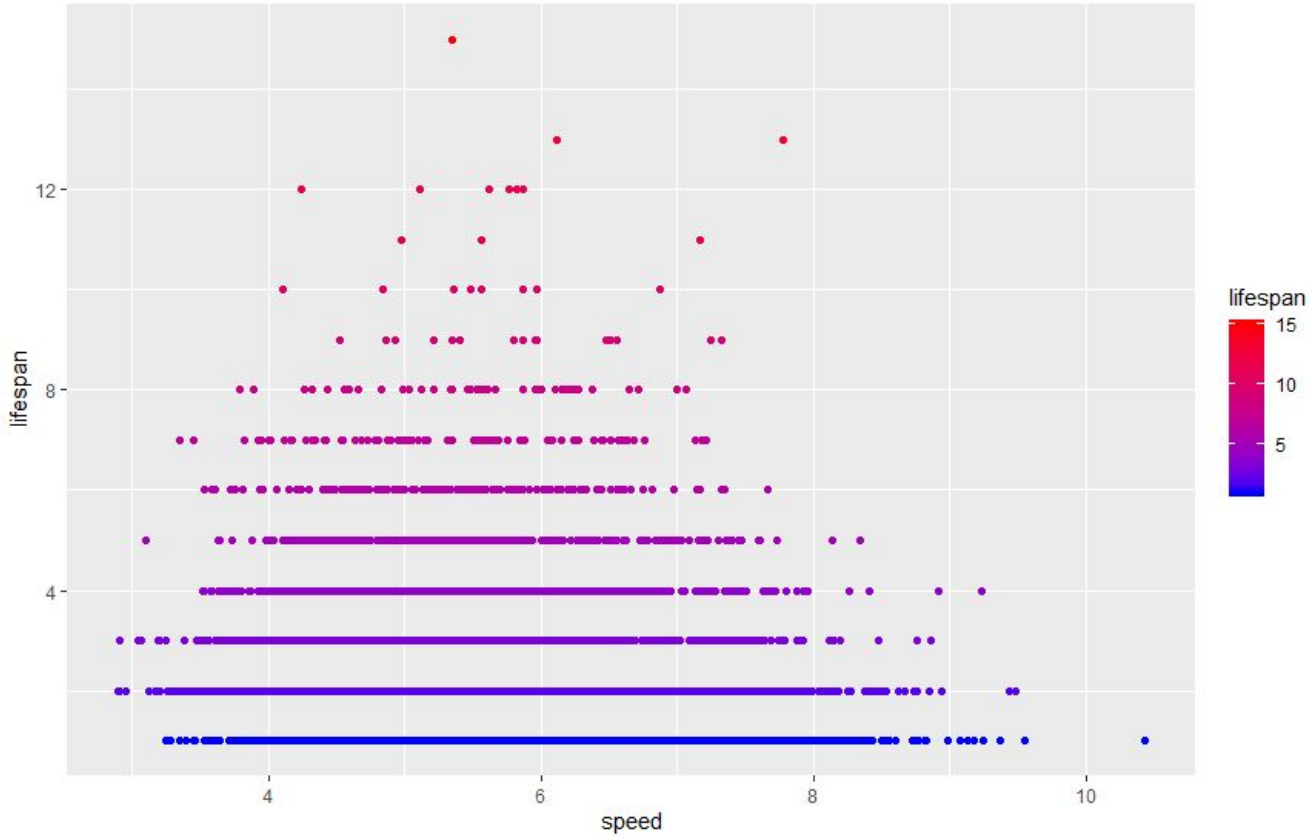
To analyze the simulation data, choose the simData.txt to load into a dataframe. An example file is attached in the same branch as the R code. For newly generated data, access the Assets folder to select the new simData.txt file. Ensure that the necessary R packages are installed: dplyr, readr, ggplot2, plot3D, and plot3Drgl

The graphical models generated in R can be observed in the subsequent slides.

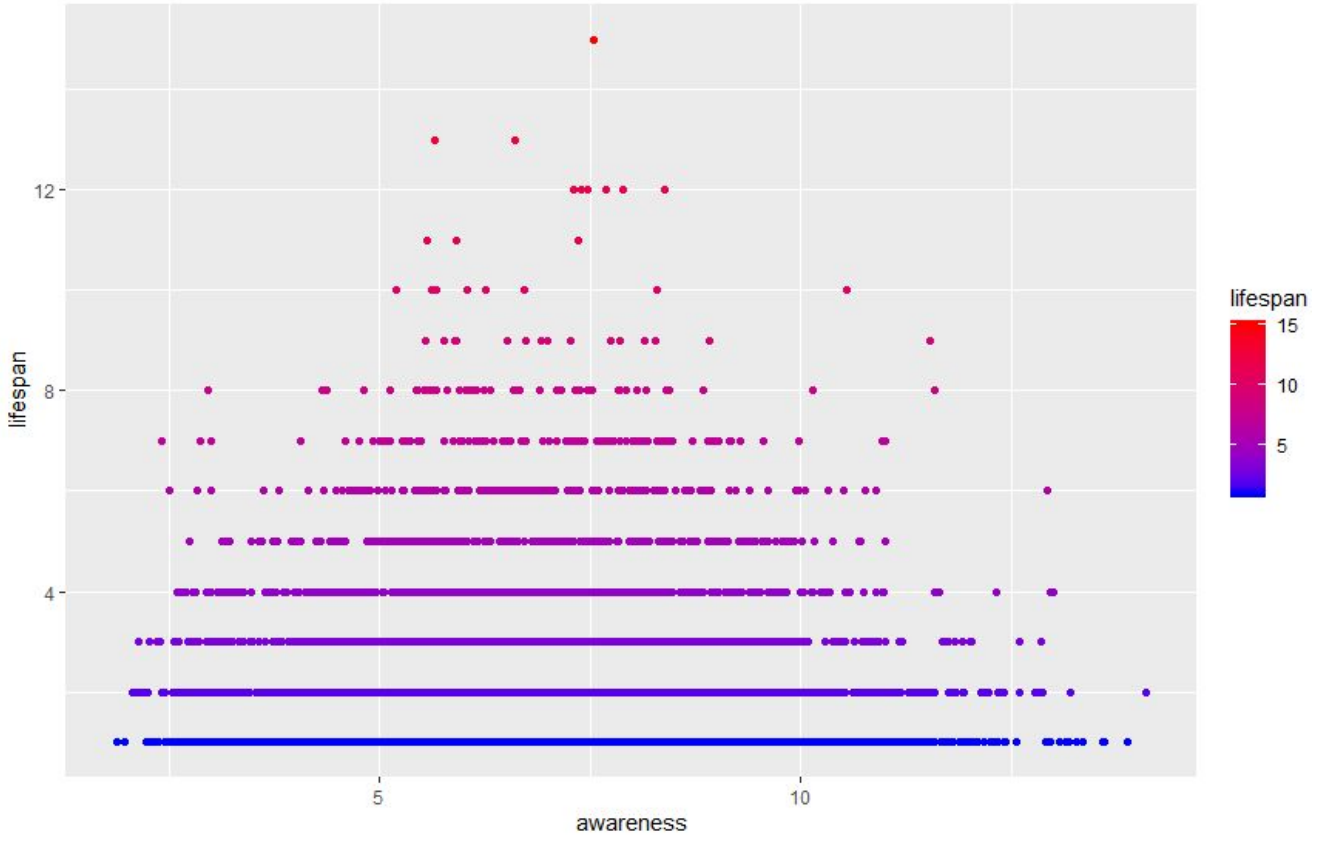
Graphs (1) - Speed and Awareness



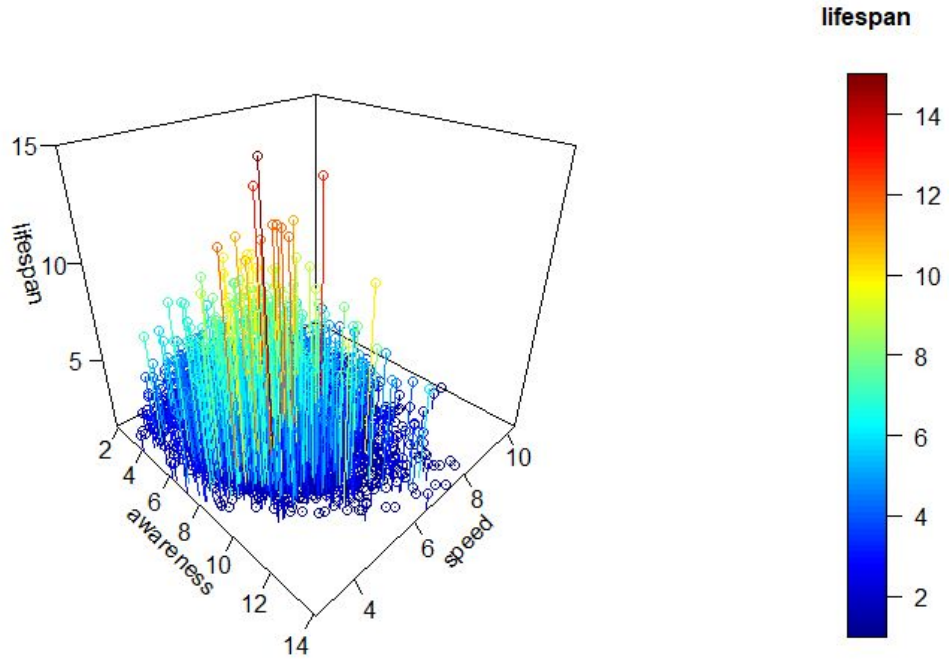
Graphs (2) - Lifespan and Speed



Graphs (3) - Lifespan and Awareness



Graphs (4) - Lifespan, Awareness, and Speed



Note that “lifespan” refers to the number of rounds that an organism survived. The above graph shows that the most successful organisms possessed a speed of around five to six and an awareness of six to eight.

Simulation Results

After simulating hundreds of generations of organisms the data pointed to an unsurprising conclusion. It can be observed that the awareness trait became highly desirable in the population of the simulation. For all starting organisms in the first round the speed trait started at a value of five and the awareness trait started at a value of three. Over the course of the simulation the most venerable organisms evolved to have awareness values between six and eight while their speed values stayed between five and six. It can be concluded that for the given environment it became more important to see further instead of moving faster.