Evolving simple organisms and their behaviour

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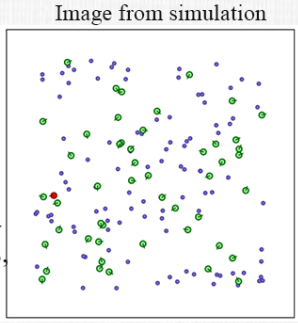
Introduction

Generations of organisms are created that fight for food in a simulation[1]. While competing for food with each other, they also have to avoid getting infected by a virus. Strongest individuals are used to populate further generations. Infected individuals have lowest fitness scores, meaning they are most likely not getting selected for next generations. Fitness score can be increased by gathering food in the simulation. Individuals also mutate and crossover with each other. Organisms move by deep neural network and parameters of this network are changed by natural selection described above. In ideal conditions organisms learn over multiple generations, to avoid sick individuals and still focus on gathering food.

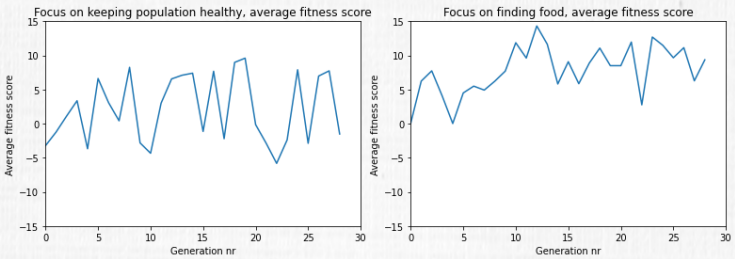
Image from simulation



Red - infected organism
Green - healthy organism
Blue - food

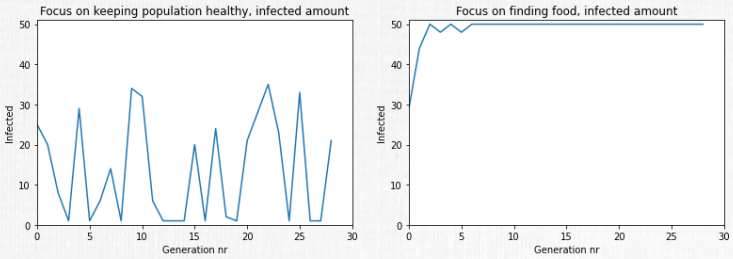
Organism behaviour

Two deep neural networks were tested. One focuses on learning how to keep themselves healthy and another tries to maximize on gathering food. Later outputs from these two networks are put together to create one big network. That should allow learning both behaviors while trying to maximize fitness score. As seen from graphs below, network that focuses only on finding food performs better when comparing fitness scores.



When organisms learn how to gather food their chance of getting sick also increases. This is caused by multiple organisms moving towards same food source and causing more collisions. When one of these colliding individuals are infected, they all become infected.

While food finding network was able to get better average in fitness score, it also got highly infected as seen from graph below. Because of the exponential nature how viruses spread, network that tries to avoid getting infected has high variation in the data.



Combining networks

Gathering 1 food gave 1 fitness score and getting infected decreased that same score by 10. This becomes important when combining both network results, because this can cause one network dominating over another. It is because fitness score from one network can be altered many times more than from other network. I think that is the main reason combining both networks was not full success. Combined network gave better results than random behavior, but was not able to learn much with genetic selection.

Summary

Because sick organisms are less likely to give their genes to further generations, food gathering network starts to dominate. Even when increasing the amount infection decreases fitness score results do not change much. While both networks performed well separately, combining them requires more research and testing.

References

[1] https://nathanrooy.github.io/posts/2017-11-30/evolving-simple-organisms-using-a-genetic-algorithm-and-deep-learning/