# Machine learning scientific inquiry:

# Introduction:

## Aim:

The aim of this experiment is to explore the effects of changing the population size on the evolutionary process of autonomous cars in navigating a predefined track using NEAT.

## Hypothesis:

Altering the population size in the NEAT-based autonomous car evolution will impact the speed in which the neural network evolves, meaning that the larger the population the higher the probability cars completing the track in less generations.

## Background:

Finding an optimal population size for a machine learning algorithm like a NEAT-based neural network is crucial in optimising the process of computational learning. Having a larger population size allows for more enhanced exploration, increasing the chances of discovering optimal solutions in complex problem spaces.

# Method:

1. Fork and download the code from JetScholar/ML_Task2
2. Go into config.txt and change ‘pop_size’ between 30, 100, 200, 300, 1000
3. Record results
4. Repeat five times

# Results:

What was measured was the amount of generations it took to complete map three when changing the population between 30, 100, 200, 300, 1000

## All results:

| Trial Number: | Population: | Generations: | Map: |
|---|---|---|---|
| 1 | 30 | 11 | 3 |
| | 100 | 9 | 3 |
| | 200 | 4 | 3 |
| | 300 | 9 | 3 |
| | 1000 | 2 | 3 |
| 2 | 30 | 14 | 3 |
| | 100 | 3 | 3 |

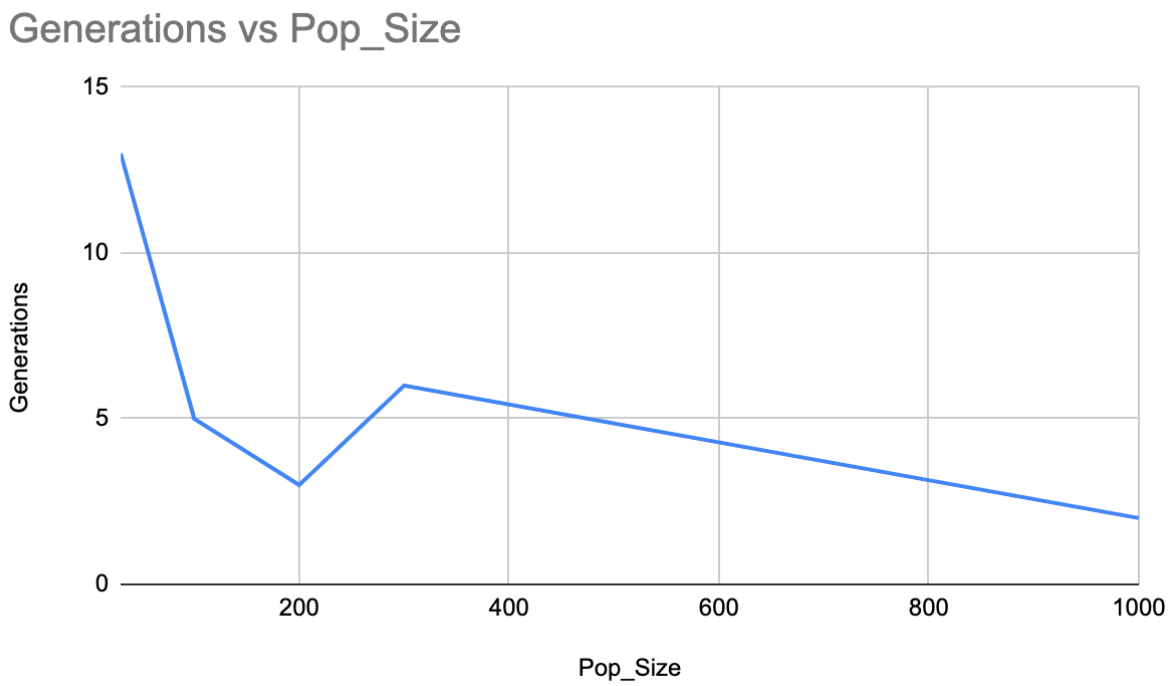
| | | | |
|---|---|---|---|
| | 200 | 3 | 3 |
| | 300 | 5 | 3 |
| | 1000 | 2 | 3 |
| 3 | 30 | 12 | 3 |
| | 100 | 3 | 3 |
| | 200 | 4 | 3 |
| | 300 | 7 | 3 |
| | 1000 | 3 | 3 |
| 4 | 30 | 15 | 3 |
| | 100 | 6 | 3 |
| | 200 | 2 | 3 |
| | 300 | 5 | 3 |
| | 1000 | 2 | 3 |
| 5 | 30 | 11 | 3 |
| | 100 | 4 | 3 |
| | 200 | 4 | 3 |
| | 300 | 5 | 3 |
| | 1000 | 2 | 3 |

## Averages:

The average amount of Generations it took to to complete track 3

| Average amount of Gens before completing track | 30 | 100 | 200 | 300 | 1000 |
|---|---|---|---|---|---|
| | 13 | 5 | 3 | 6 | 2 |

## Graph:




## Evaluation:

From looking at the data what can be seen is that the NEAT-based neural network learned and evolved quicker with a larger population. Meaning that the machine learning process was better optimised to computational learning with a larger population. When running the program with a larger population the track was completed on average in less generations then with a low population, as seen when the population was 30. As it took 13 generations on average to complete the track compared to just two generations when the population was 1000. As such the larger the population the quicker the algorithm can learn.

## Conclusion:

In this experiment I explored the effects of changing the population size on the evolutionary process of autonomous cars in navigating a predefined track using NEAT. Finding that the machine learning algorithm greatly improved when the number of the population was raised. Allowing the algorithm to learn quicker and reducing odd behaviour, making the process more stable. Ultimately proving my hypothesis correct that the larger the population the quicker the machine learning process.

# Bibliography:


- Www-Liby@waikato.ac.nz (no date) Writing a scientific report, Write Scientific Reports - The Library: University of Waikato. Available at: https://www.waikato.ac.nz/library/guidance/guides/write-scientific-reports (Accessed: 11 September 2023).
- Saturn Cloud (2023). Using the NEAT Algorithm: Understanding Genetic Diversity and Structure in Evolutionary Neural Networks | Saturn Cloud Blog. [online] saturncloud.io. Available at: https://saturncloud.io/blog/using-the-neat-algorithm-understanding-genetic-diversity-and-structure-in-evolutionary-neural-networks/ [Accessed 11 May 2023].