The Effect of Speed on Simulated Cars

Aim:

To observe the effect of speed on cars within a machine learning simulation.

Introduction:

Speed has always been a topic of discussion in regards to safety. Using this simulation to measure the survivability of AI cars we will be able to determine whether speed allows cars to outperform — in terms of safety — their slower or faster counterparts. Currently the belief — both general and personal — is that slower cars will complete tracks with a higher degree of safety. This experiment will attempt to measure this by using an array of speeds and measuring their fitness. This will be measured after 30 generations with an average fitness, the best fitness of the set and the average time taken for each generation. The goal of this experiment is to determine the effects of speed on simulated cars' ability to both learn to drive and steer.

Hypothesis:

If a car has a slower starting speed, then its fitness and survivability will be greater.

Prediction:

After a large number of generations the initially slower cars will outperform the faster cars in terms of fitness but will lose in terms of overall speed.

Variables:

Independent Variable:

- Speed

Dependant Variable:

- Fitness
    - Average Fitness
    - Best Fitness
- “True Speed”:
    - The average time of generations

Controlled:

- Size of the cars.
- Resolution.
- Reward calculations.
- Movement calculations.
- Neural network used.
- Car sprite.
- Map pool (although the map does randomly change, this remains consistent across the simulations).
- The program and parameters used to direct the car.
- Colour of the track and colour used to destroy the cars.
- The number of trials performed for each speed.

Method:

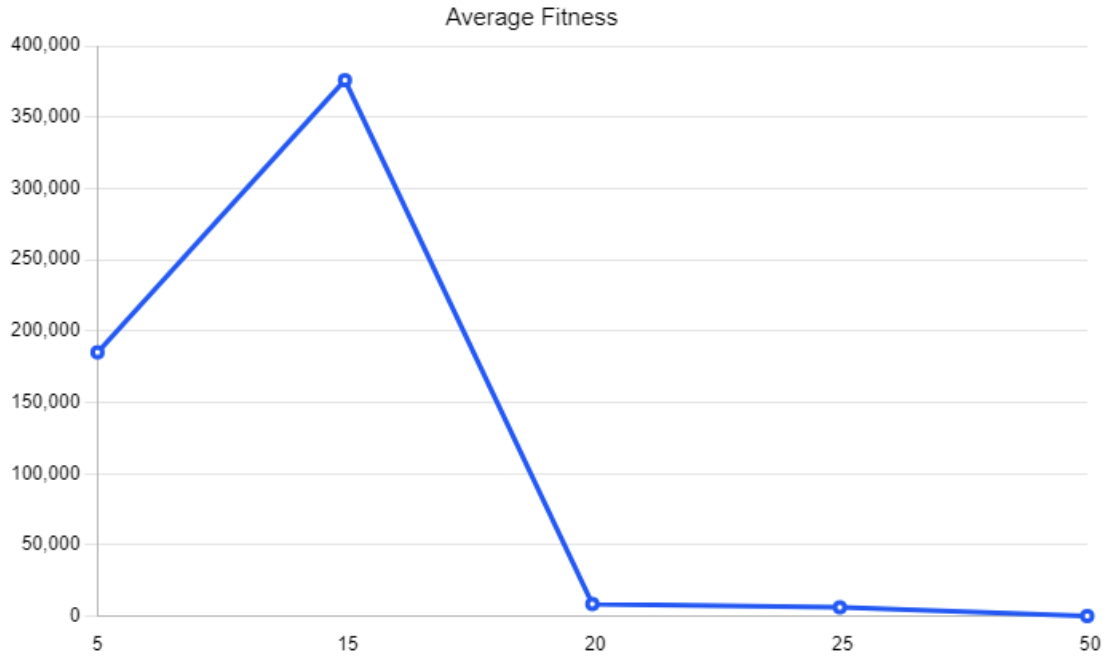
1. Adjust the value of the speed.
2. Run the program for 30 generations.
3. Extract the fitness and average time for each generation.
4. Repeat steps 2-4 3 times.

This method will be performed for the speed values 5, 15, 20, 25, 50.

Data:

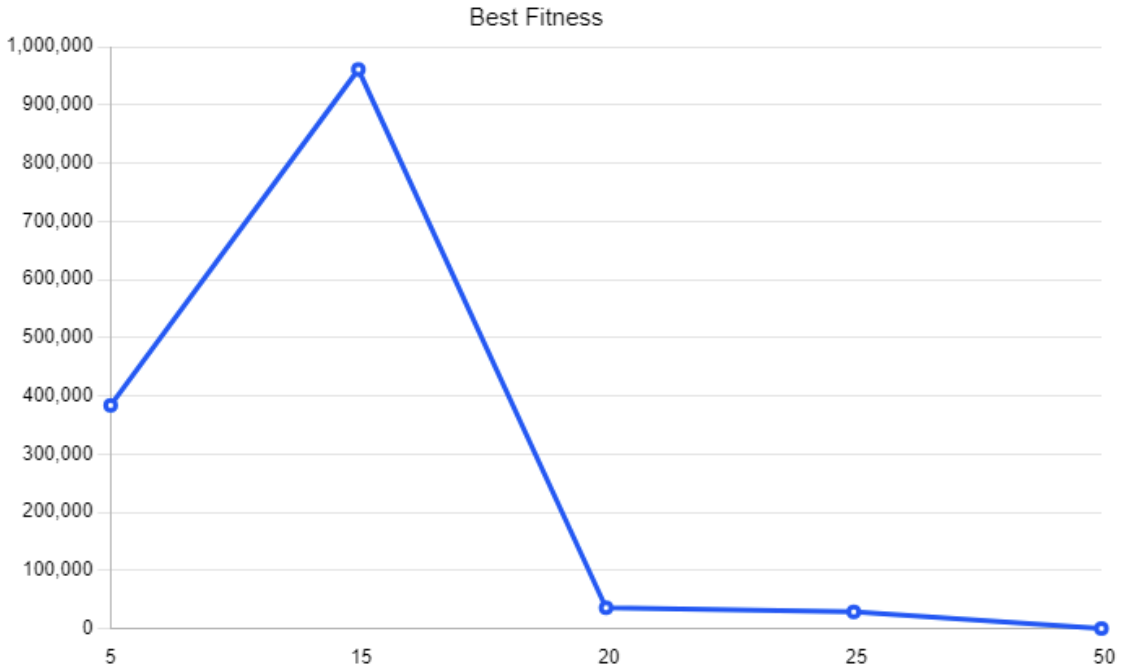
Average Fitness

	Trial 1	Trial 2	Trial 3	Average
5	180934.28148	183072.95407	191142.83259	185050.022713
15	320459.75111	469783.99407	337473.05481	375905.599997
20	8378.89778	7776.55704	9468.53926	8541.33136
25	5053.77491	5703.68296	7903.35704	6220.27163667
50	226.79111	16.45630	175.01037	139.41926



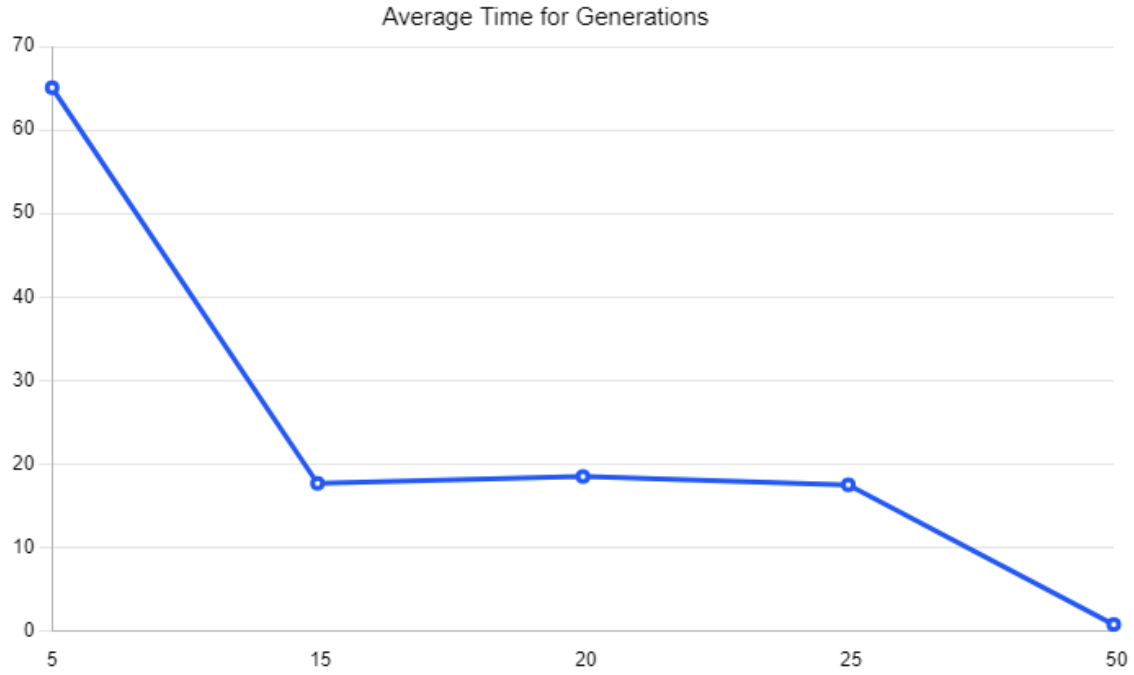
Best Fitness

	Trial 1	Trial 2	Trial 3	Average
5	440389.86667	320266.66667	390272.62222	383643.051853
15	960800.00000	960800.00000	960800.00000	960800.00000
20	36155.37778	35616.17778	35880.88889	35884.14815
25	18625.60000	33931.91111	33883.73333	28813.7481467
50	346.31111	26.84444	315.55556	229.57037



Average Time for Generations (True Speed)

	Trial 1	Trial 2	Trial 3	Average
5	65.648	71.151	58.345	65.048
15	16.088	24.705	12.273	17.6886666667
20	17.790	20.584	17.141	18.505
25	12.019	23.270	17.251	17.5133333333
50	0.679	0.904	0.785	0.78933333333



Observation:

Throughout the experiment I observed that the slower cars performed better, being reflected by the data. This proves that if a car has a slower starting speed, then its fitness and survivability will be greater. Contrary to the initial hypothesis fitness does not directly scale by decreasing its speed, but as a collective the slower cars performed better. I noticed during the experiment that slower cars would have generations with both better average fitness and best fitness while faster cars would have faster average generations. On the slowest setting (5) the cars started to develop interesting methods to gain distance. This included spinning in a circle on certain tracks without actually crossing the finish line to gain greater distance. This increased both their overall fitness and survivability at the cost of slower generations. Another trend I observed was that the best fitness would not often change as the generations increase, only occasionally increasing by a marginal amount. What did change consistently was the average fitness which would see a sporadic rise.

Discussion and Conclusion:

The data presented shows that speed affects fitness but exists in a range rather than scaling directly with it. This is due to slower runs not reaching the distance required to achieve a high fitness (although still performing better than their faster counterparts) with faster runs having a higher chance of instantly or quickly dying. The experiment proves my initial hypothesis and prediction to an extent. The second slowest speed (15) far outperformed the other cars with the faster cars having a faster average time for generations. The slowest time did perform the second best overall in terms of fitness, showing that while the slower cars had the best results the car requires a mix between the speeds to perform at an optimal level. The starting speed of 50 showed that the faster cars would have shorter average times (although this was most likely due to the fact that they would instantly die but the other “slower” fast cars showed this trend. Although, the

decreasing average time for generations scaling directly with the speed of the cars do directly prove this theory.) The experiment was reliable but could still be improved, the successful use of controlled variables and the methods used to measure the cars fitness proved consistent. Increasing the amount and range of the speeds used and measured would be of course a way to increase the reliability of the tests. The changing maps — while it may initially seem to skew the results of such an experiment — allowed for the AI to be better tested against a variety of tracks and situations rather than simply acclimating to a single track and gaining a true or general intelligence. A problem with the experiment was the constantly changing average and best fitness as some generations having an unlucky run would cause incredible outliers making the data near unusable, adjusting how the fitness is calculated and displayed would fix this issue and would be done if I were to repeat this experiment. The best fitness proved to be the most reliable way of measuring their fitness overall but the trends still presented themselves across both sets of data. Overall the experiment was reliable, proved the predictions set out and showed a trend regarding how speed affects the fitness of the simulated cars. From this we can conclude that speed directly affects how simulated cars develop and their survivability and fitness.