

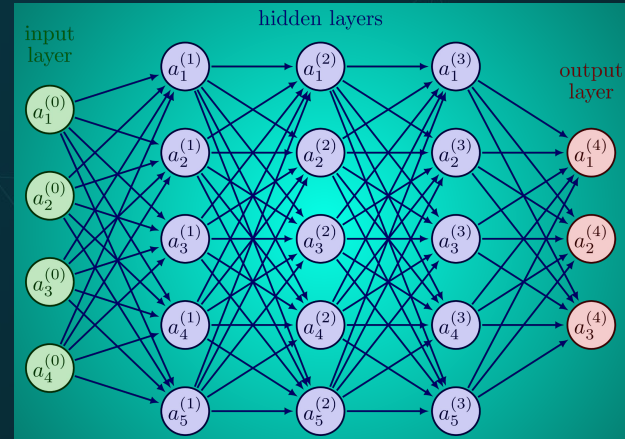
# Evolutionary Algorithms To Train Neural Networks

Angelo Rosso



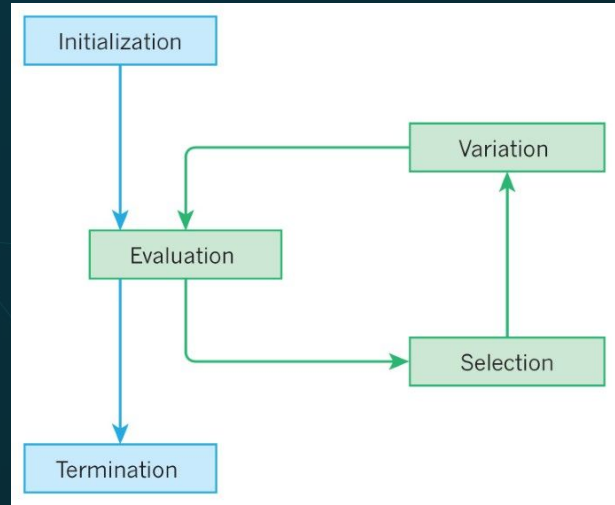
# Neural Networks

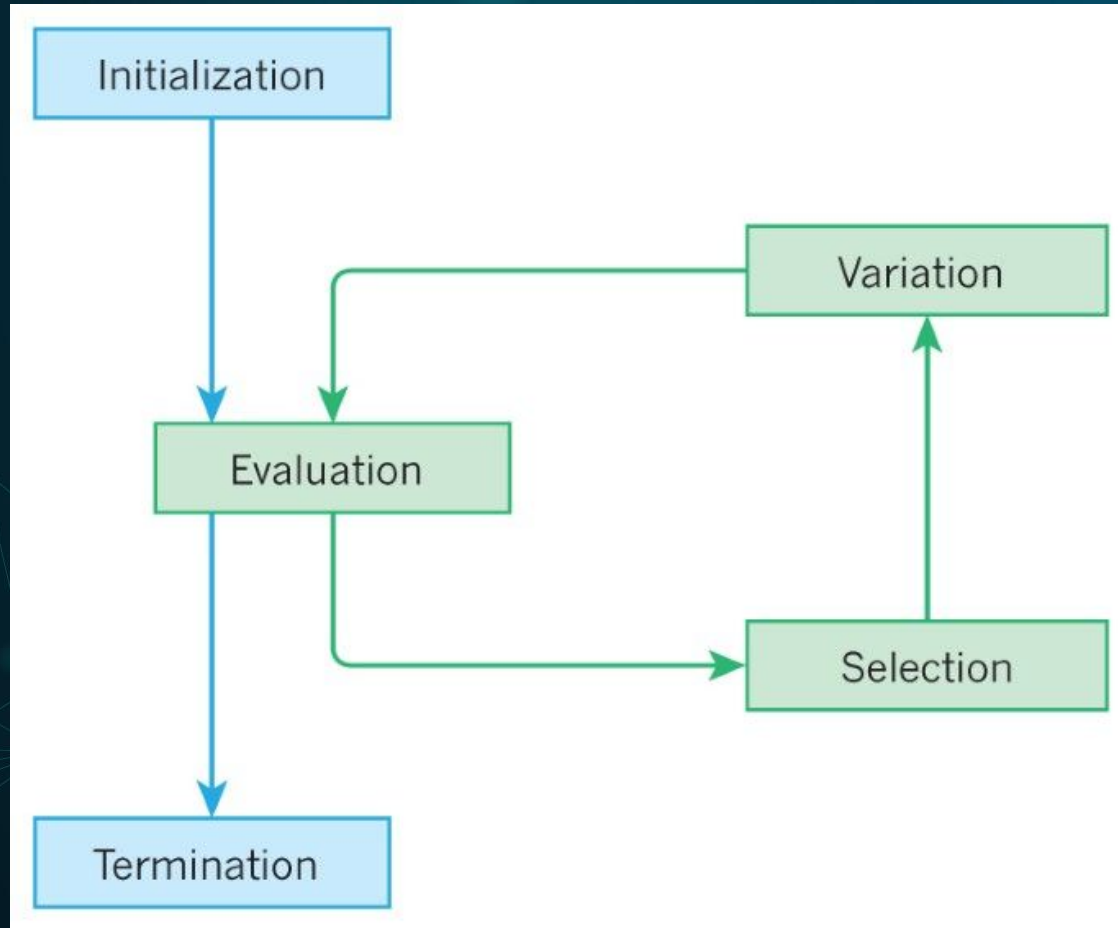
- Network of “neurons”
- Layers of nodes with biases and weights
- Predictions and classifications
- Maps inputs to outputs



# Evolutionary Algorithms

- Based on biological evolution
- Trial and error
- Starts with random sample









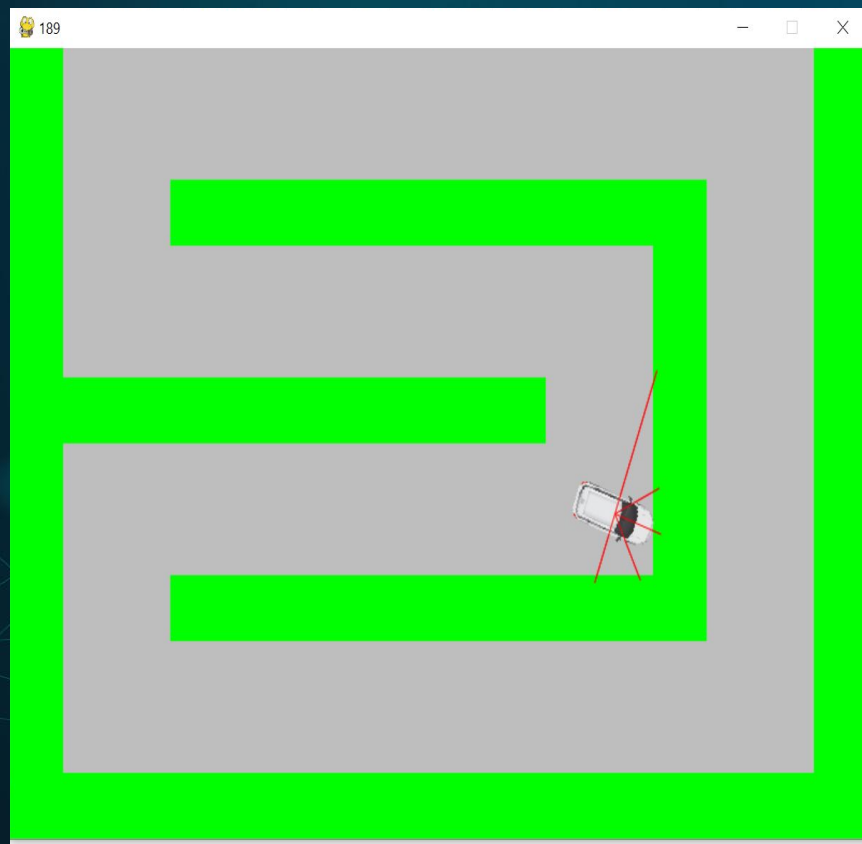
# **Evolving Cars Project**



# Setup

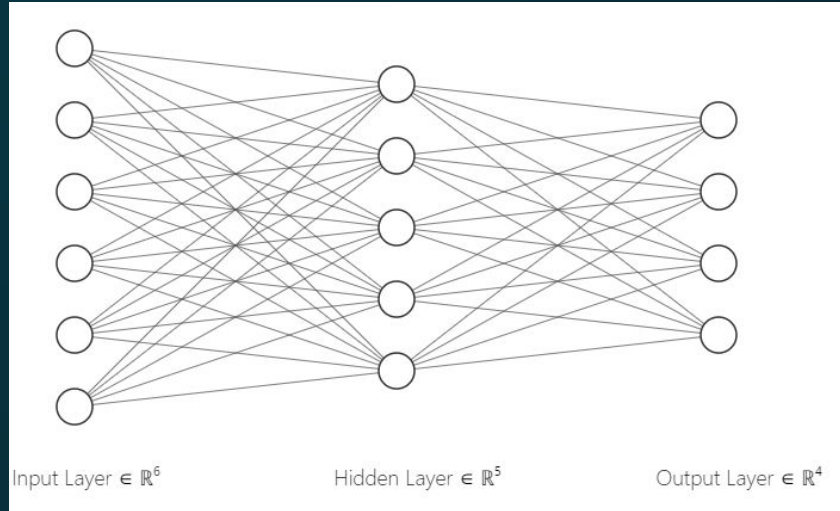
- P - 100 for each “checkpoint” passed
- E - world with track, grass, and car
- A - accelerate, turn, brake
- S - speed, distance to walls at 5 angles





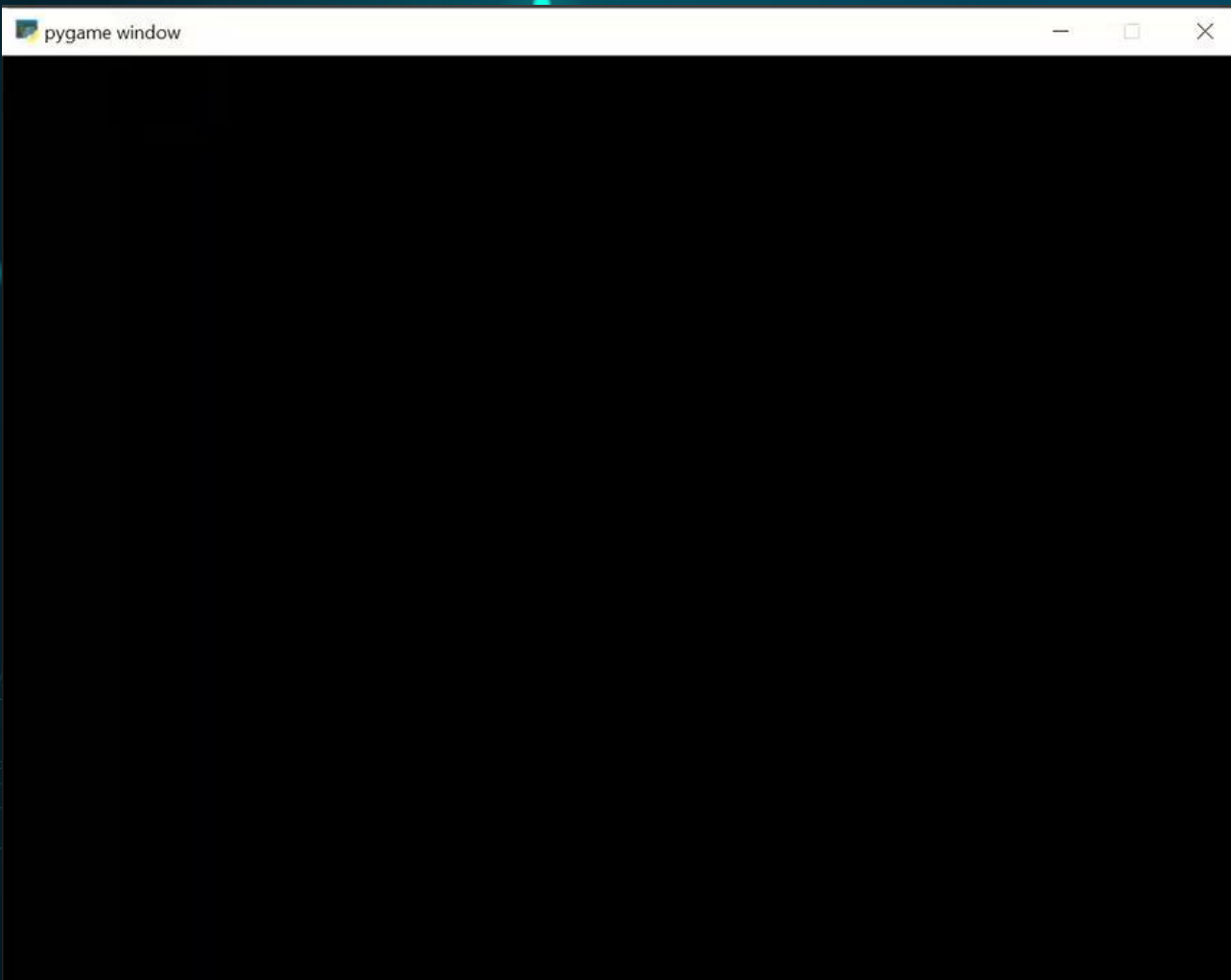
# Setup cont.

- 6 inputs, 5 node hidden layer, 4 outputs
  - arbitrary
- Sigmoid activation
- Dense connections



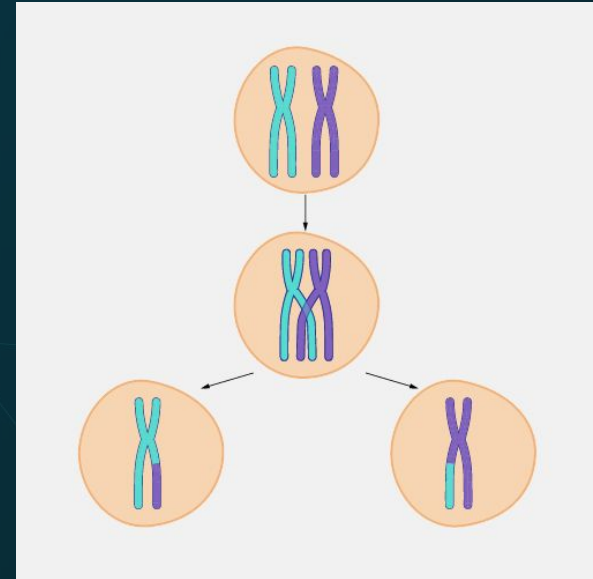
<http://alexlenail.me/NN-SVG/index.html>



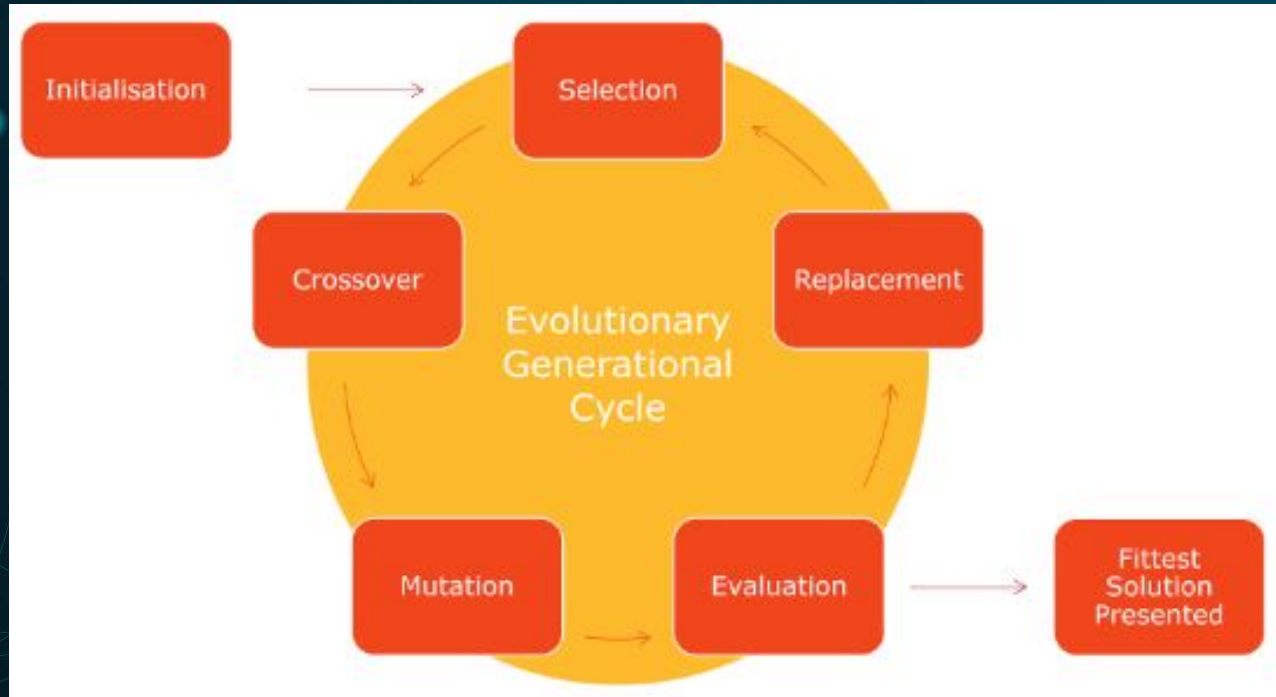


# Genetic Algorithms\*

- Subset of evolutionary algorithms
- Requires genetic representation
- Includes crossover
- Maintains greater diversity



\*This is one interpretation of the terminology because it is not very consistent within the literature





# Comparison

## No crossing over

Mean: 22.7

Standard Deviation: 15.7

Min: 1

Max: 67

Median: 17

## With crossing over

Mean: 16.7

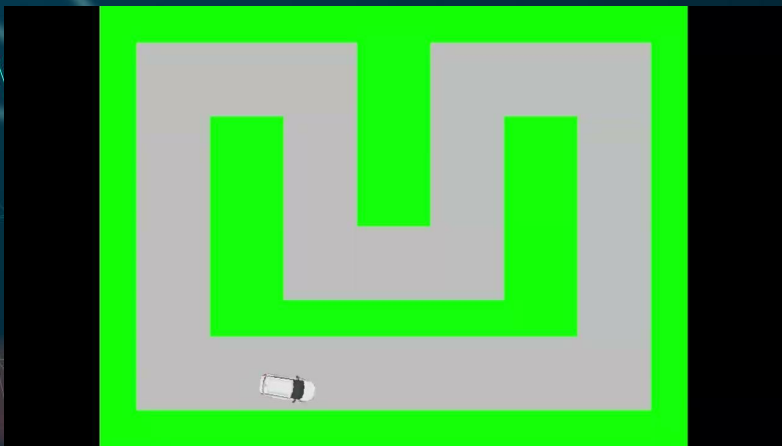
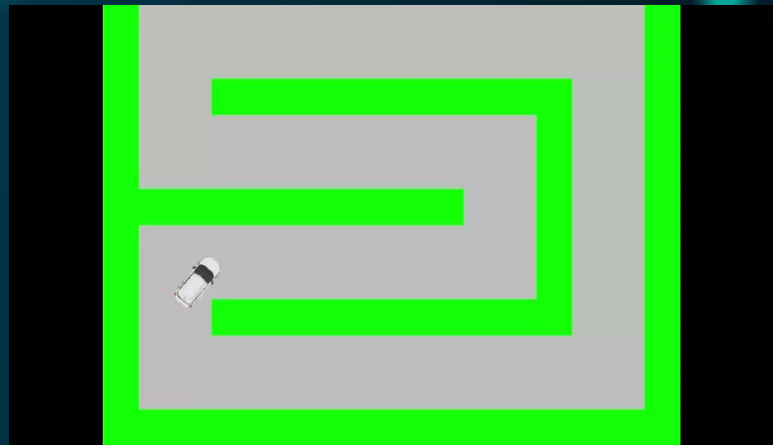
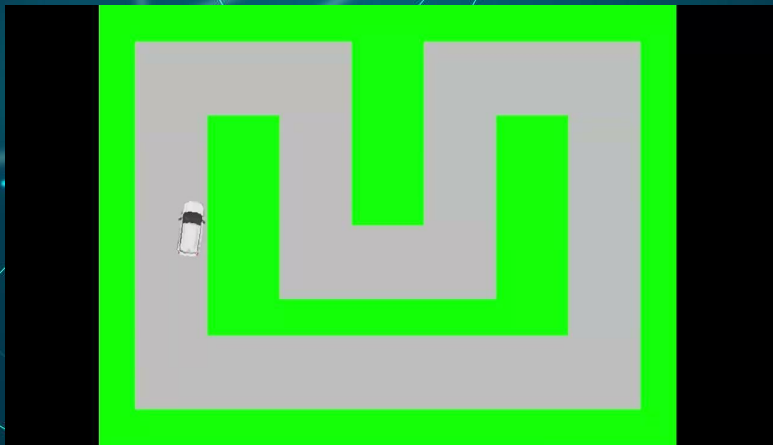
Standard Deviation: 14.0

Min: 1

Max: 70

Median: 12

Unit is generations taken before car could complete two full laps without crashing



# Advantages and Disadvantages

## Advantages

- Not as susceptible to local mins/maxs
- Relatively easy to implement
- Does not require loss function to be differentiable

## Disadvantages

- Can be slower than traditional methods in certain cases
- Sensitive to parameters

Dichotomy between applicability and efficiency



# References

[Advantages and Disadvantages of Evolutionary Computation Over Other Approaches](https://www.researchgate.net/publication/237129070)

[Genetic algorithm](https://en.wikipedia.org/wiki/Genetic_algorithm)

[Evolutionary algorithm](https://en.wikipedia.org/wiki/Evolutionary_algorithm)

[Evolutionary Computation: An Introduction to the Field of Computational Intelligence](https://link.springer.com/content/pdf/10.1007/BF00113894.pdf)

[Evolutionary Computation: An Introduction to the Field of Computational Intelligence](https://d1wqtxts1xzle7.cloudfront.net/31138276/10.11.56.8965-with-cover-page-v2.pdf?Expires=1669654602&Signature=WW-iBZWt9Y3-8BEXwPlhzTdXHjEqTeobcCrud3LD2v~pThXrfjFZV60ofTeGYKKODOAB7~c4HFdt2po hoY-Nqam0iloOT7iBU sM3JNIs4djXFFxnuzwiBiiyjMmKPRRF9qWiL8RGvyvf7N--Z4kE3EomMvGsDQqtZrnLI6GBFW6~oWYnDPR1ds3ugiePBdFC8nxSsE1ClhmoTLFoA0l7sA3Kwr9aALjHF2dR-iXVIK4MZ98aCA2-XISEUaa-q4Z6-e4mBYRqMqEFR~sZPnONUnj06Bp3HG4q9MOMpiC4avOSaKiP6s-XWyr-VWY4TXSvL-oxlblCixMUx4ECbs4JyGg_&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA)