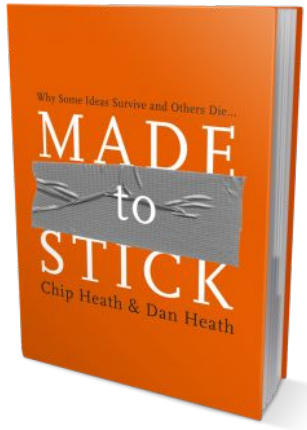
Evaluation of Genetic Algorithms and Evolutionary Strategy for Training DNN Models

A Presentation by Afnan Gurung

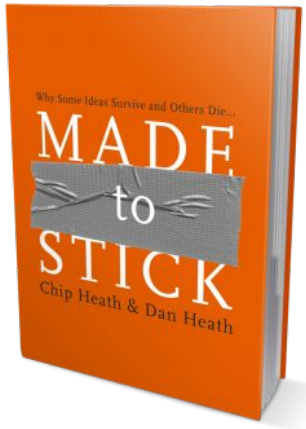
Motivation

- Niche
- Not heavily explored
- Interesting concepts
- Expand on Y2 Studies



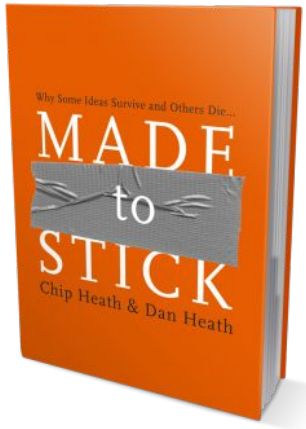
Genetic Algorithm

- Developed by John Holland in 1960s
- Simulate process of natural selection
- Idea of evolving a population via functions of mutation, crossovers, fitness and selection
- “Fittest” solutions combined using crossover function to reflect biological process of reproduction
- “Fittest” individual at end reflects most optimal solution to problem



Evolutionary Strategies

- Developed by Ingo Rechenberg and Hans-Paul Schwefel in the 1960s
- Similar to genetic algorithms but heavier focus on the idea of mutation
- Deterministic -> Only strongest solutions survive to next generation



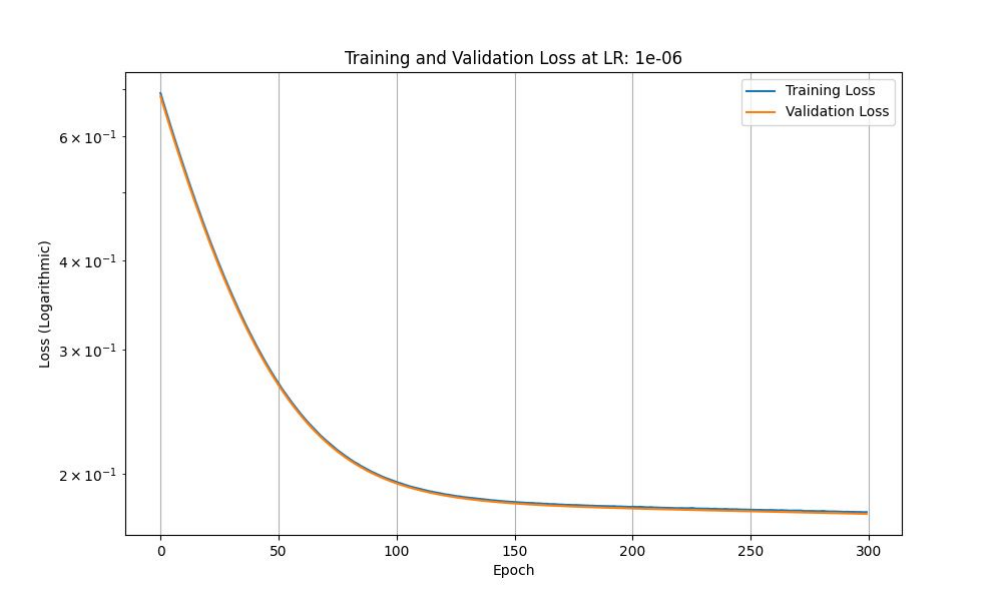
Objectives

- **Showcase Potential**
  Show there is benefit to using this alternative
- **Robust**
  Show that it can work with large amounts of data
- **Test in a real world scenario**
  Show these algorithms can be used in the real world

Methodology

- **Stock Market Prediction**
  Time series forecasting problem
- **Train with 3 methods**
  One control group
- **Record results**
  Loss curves and final values

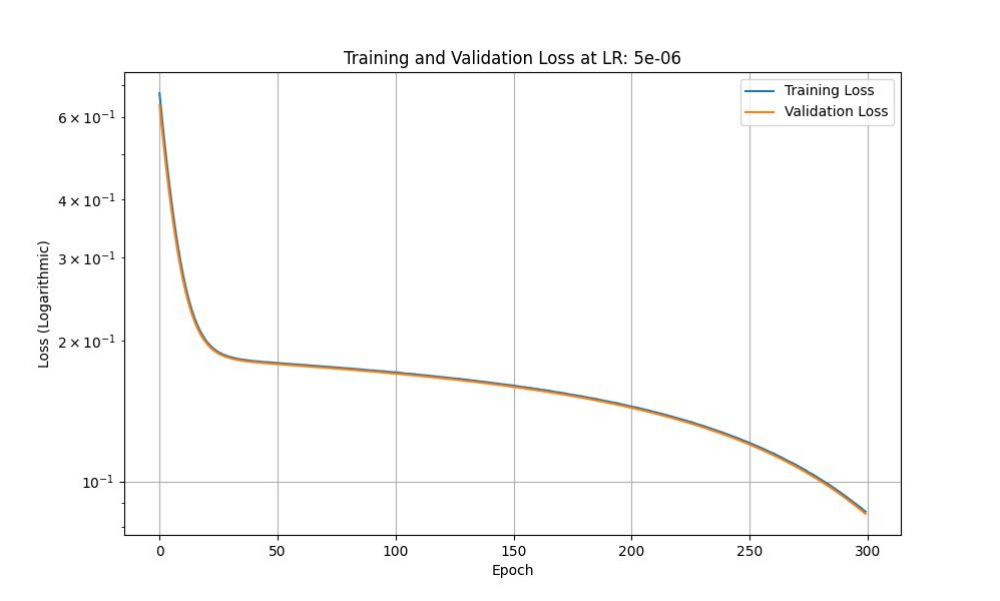
Results.



Stochastic Gradient Descent

- Steady Convergence
- High Training and Validation Loss
  - 0.177 and 0.176
- Runtime of 962 seconds

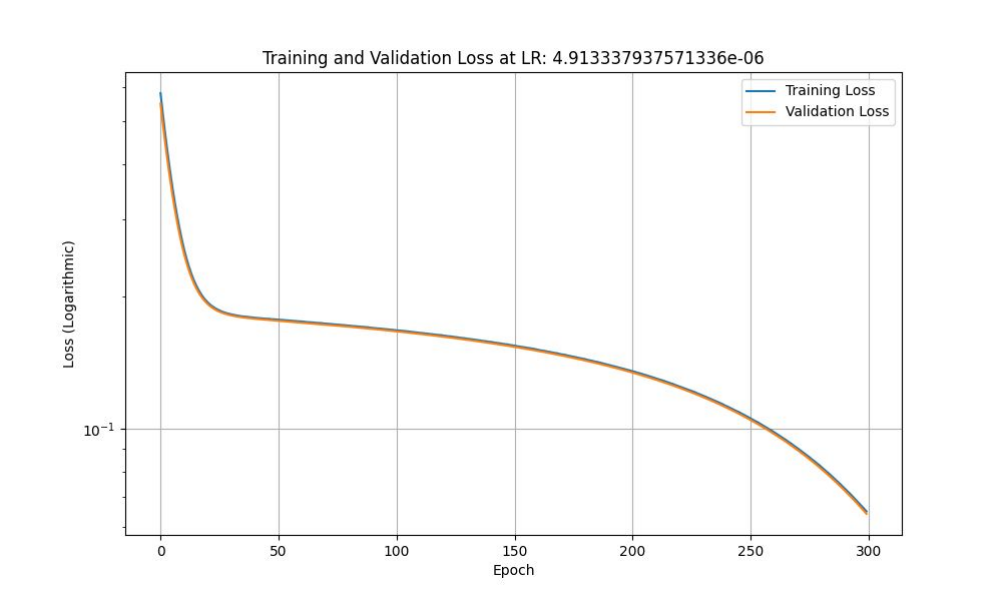
Results continued.



Genetic Algorithm

- Much lower Training and Validation Loss
  - 0.0907 and 0.0901
- Nearly a 50% improvement!
- Runtime increased to 1556 seconds
  - 62% increase

Results continued.



Evolutionary Strategy

- Even Lower Training and Validation Loss
- 0.0767 and 0.0759
  - 57% compared to benchmark
  - 15.7% compared to GA
- Even More Computationally Expensive
  - 81.5% compared to benchmark
  - 15% compared to GA

Conclusion.

- Clear to see improvement in accuracy
- Allows automation
- Only downside is computational cost
- Become more viable as tech improves

The Future

- **More extensive testing**
  Test with more hyperparameters
- **Test in different applications**
  Test performance in different fields i.e Image Classification.

Link to video

- https://universityofexeteruk-my.sharepoint.com/:v:/g/personal/ag811_exeter_ac_uk/EaGROB2L-35OqHemMSx6bPcBnmj5qt7o-bR5FudDh4sDiQ?e=jiQcAl