Towards stable co-evolution of Deep Neural Networks and Fitness Predictors

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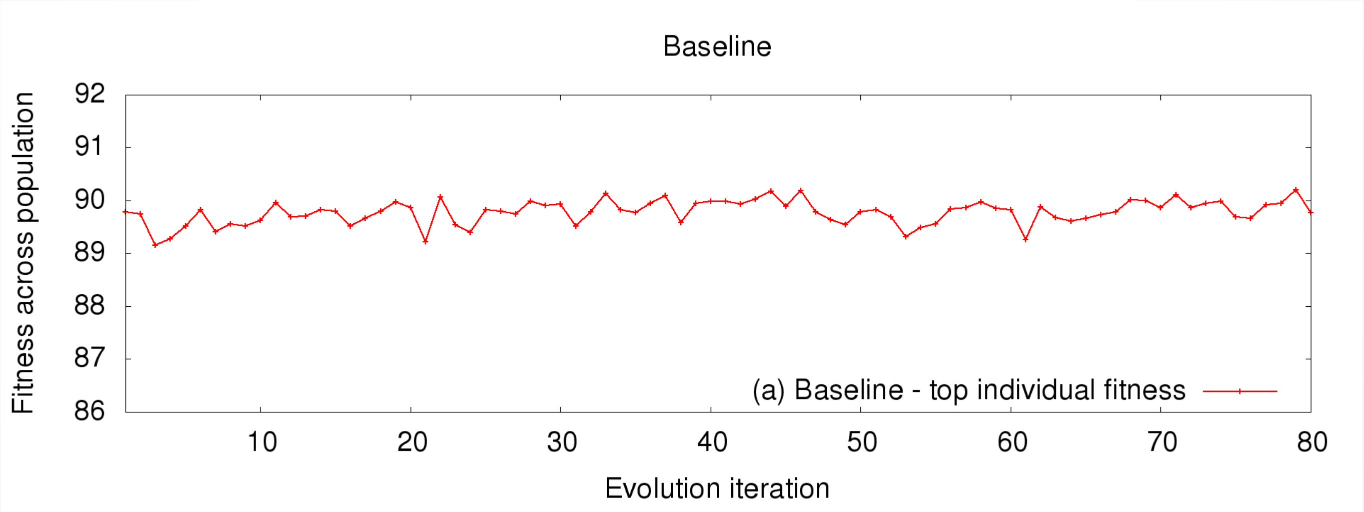
Research motivation

- Deep Neural Network topology design is a challenging task.
- Automated approach – evolving topologies
  - Can potentially speed up this process.
  - Improves overall model performance and quality.
  - It would also help to discover new types of structures.
- Co-evolution in this setup provides promising results
  - Challenge: fitness does not always increase monotonically.



Research objective

Objective:

stabilize improvements of the co-evolutionary process

- Evaluating three hypotheses
  - Fitness predictors are not able to find the most representative subset of the full training set.
  - Evolution objective might change in every iteration because of the trainer individual update.
  - Fitness predictors are aligned to the best individual from the main population. They favorize particular, non-optimal architectures.

Results

- Introduced a new metric to measure stability improvements

$$D = \sum_{i \in [1;N]} \begin{cases} 0 & \text{when} \quad F(i) >= 0 \\ -F(i) & \text{when} \quad F(i) < 0 \end{cases}$$

- None of the presented methods was able to completely eliminate the instability of evolution.
- Instability can be significantly reduced by increasing the number of trainers used in both (Fitness Predictor and Deep Neural Network) populations.
- Introducing too many trainers (5 in any population) slows down the progress of evolution and may result in decreasing fitness over time.