A Farewell to Structural Rigidity: Generating the starting state of autencoders with NEAT

Christopher Ross, Jonathan Brant, Zak Roessler

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# Project Overview and Initial scope

Autoencoders play an important role in learning efficient, compressed encodings and have been experimentally shown to be effective at compressed feature extraction and artificial neural network pre-training. However, the vast majority (if not all) autoencoders have a rigid, manually designed structure, leaving the often baffling task of designing the network topology in the hands of a human architect; a task that has proven to be better suited to NEAT.

Given NEAT’s success in generating successful ANNs, our group wishes to test the hypothesis that NEAT will yield similar benefits for the evolution of the topology and starting weights for autencoders. To test this hypothesis, we will have NEAT generate autoencoders, and then train them with backpropagation. We will use a dataset typically used in image recognition and each ANN generated will go through the following stages:

1. Generate an autoencoder with NEAT.
2. Optimize the autoencoder’s weights using standard backpropagation (which will need to be implemented to backpropagate over arbitrary topologies) using a training dataset.
3. Present a validation set to the autoencoder and score.
   1. This score will be the fitness function for NEAT to produce the next generation of autoencoders.

Evaluation criteria for the experiment will be focused on:

1. Quantitative assessments
   1. To what magnitude of error does the autoencoder approximate the identity function
   2. How well does the autoencoder generalize given the validation set
2. Qualitative assessments
   1. Does the autoencoder learn interesting, salient features about the image presented
   2. How well does the autoencoder reproduce the image
   3. Looking at the ANNs created, and attempting to assess how they work

# Initial Tasking

In general, tasking will be allocated as follows:

* Christopher Ross
  + Overall project vision and guidance
  + Experiment Design (primary)
  + Backpropagation implementation
  + Paper authoring (secondary)
  + Experiment execution (secondary)
  + Results analysis (primary)
* Jonathan Brant
  + Experiment implementation (secondary)
  + Experiment design (secondary)
  + Evolution implementation
  + Results analysis (secondary)
  + Paper authoring (primary)
  + Presentation development (secondary)
* Zak Roessler
  + Experiment implementation (secondary)
  + Experiment execution (primary)
  + Results analysis (secondary)
  + Presentation development (primary)
  + Paper authoring (secondary)

# Project Milestones

