NeuroEvolution

Neuroevolution is a machine learning technique that applies evolutionary algorithms to construct artificial neural networks, taking inspiration from the evolution of biological nervous systems in nature. Compared to other neural network learning methods, neuroevolution is highly general; it allows learning without explicit targets, with only sparse feedback, and with arbitrary neural models and network structures. Neuroevolution is an effective approach to solving reinforcement learning problems, and is most commonly applied in evolutionary robotics and artificial life.

The neuroevolution approach to artificial intelligence is motivated by the evolution of biological nervous systems. Correspondingly, neuroevolution applies abstractions of natural evolution (i.e. evolutionary algorithms) to construct abstractions of biological neural networks (i.e. artificial neural networks). An overall ambitious objective is to evolve complex artificial neural networks capable of intelligent behavior. As a result, neuroevolution can be seen both as a means to investigate how intelligence evolved in nature, as well as a practical method for engineering artificial neural networks to perform desired tasks.

Similar to natural selection in nature, which is driven only by feedback from reproductive success, neuroevolution is guided by some measure of overall performance. Whereas the most common artificial neural network learning algorithms operate through supervised learning and therefore depend upon a labeled corpus of input-output pairs, a main advantage of neuroevolution is that it allows learning even when such corpora are not available, based only on sparse feedback. For example, in game playing, vehicle control, and robotics, the optimal actions at each point in time are not always known; it is only possible to observe how well a sequence of actions worked, e.g. resulting in a win or loss in the game. Neuroevolution makes it possible to find a neural network that optimizes behavior given only such sparse feedback, without direct information about what exactly it should be doing.