Evolution of Neural Networks

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Evolution of artificial neural networks has recently emerged as a powerful technique in two areas. First, while the standard value-function based reinforcement learning works well when the environment is fully observable, neuroevolution makes it possible to disambiguate hidden state through memory. Such memory makes new applications possible in areas such as robotic control, game playing, and artificial life. Second, deep learning performance depends crucially on the network architecture and hyperparameters. While many such architectures are too complex to be optimized by hand, neuroevolution can be used to do so automatically. As a result, deep learning can be scaled to utilize more of the available computing power, and extended to domains combining multiple modalities. In this tutorial, I will review (1) neuroevolution methods that evolve fixed-topology networks, network topologies, and network construction processes, (2) ways of combining gradient-based training with evolutionary methods, and (3) applications of these techniques in control, robotics, artificial life, games, image processing, and language.

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