The Evolution of Neural Plasticity in Digital Organisms

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Abstract:
I extend the Markov Brain framework which consists of evolvable networks of probabilistic and deterministic logic gates to include a novel gate type--feedback gates. Feedback gates use internally generated feedback to learn how to navigate a complex task by learning in the same manner a natural organism would. They gates allow Markov Brains to evolve to learn novel environments by relying solely on their experiences. Further I show that the mechanism generating feedback can be ported to new environments and still successfully complete the task—thus creating autonomously learning machines. Further, once a Markov Brain can generalize, it is able adapt to changing sets of stimuli, i.e. reversal learn. Lastly, I show that the neuro-correlate Phi—which is based on Information Integration Theory and quantifies organism's ability to integrate information--is increased through neural plasticity using Markov Brains augmented with feedback gates.