RC Research Fellowship Proposal: OpenBrain

William Guss
26793499
wguss@berkeley.edu

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1 Background

Machine learning research in the past decade has had a large focus on derivatives of the artificial neural network, a biologically inspired algorithm created from the neuron model proposed by McCulloch and Pitts [2]. Artificial Intelligence research in the past decade has focused heavily on derivatives of the artificial neural network, a machine learning algorithm derived from the network structure of biological neurons. The biological inspiration has been heavily abstracted, leading to the question of whether some key component of intelligence has been left out of the model. Furthermore, there is the notion that learning in the neural network algorithm occurs along a centralized platform, while the biological analog to learning, a combination of synaptogenesis and axon hillock strengthening, operates at the level of the individual neuron.

Additionally, the neural structure of the brain passes information asynchronously, whereas the McCullough-Pitts model

2 Goals

There are essentially four goals of the OpenBrain project.

- Build a massiveley parallel Beowulf cluster of parallela computers controlled using MPI on ArchLinux.
- Create an always online, turing complete modification to the recursive neural network algorithm whose fitness is determined by the Universal Intelligence Measure described in (Legg and Veness, 2011). The algorithm must have the following constraints:
  - In the spirit of John Conway's turing complete Game of Life, the individual neural nodes must follow arbitrarily simple rules in a decentralized fashion.
  - *Training* is unsupervised and occurs over the lifetime of an *instance* of the open brain, such that the aforementioned governing rules are modified with respect to the fitness of the instance.
- Implement each neural node as an Erlang process distributed across the Beowulf cluster asynchronously.
- Provide always on input/output to the OpenBrain cluster in similar fashion to that done in Google DeepMind's Deep Reinforcement Learning.

References

[1] Nicolaos Karayiannis and Anastasios N. Venetsanopoulos *Artificial Neural Networks: Learning Algorithms, Performance Evaluation, and Applications* 2013: Springer Science Business Media

[2] Warren S. McCulloch and Walter Pitts *A Logical Calculus of the Ideas Immanent in Nervous Activity* 1943.