Artificial Life

Using Recurrent Neural Networks and Hebbian Learning

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Organisms

- Behavior decided by a Recurrent Neural Network (RNN)
- RNN derived from a genome
- Organisms have a 360 degree visual system

Gene Encoding

- Direct Encoding (boring)
- Graph Grammar (interesting)
- Cellular Encoding (Interesting)
- Functional Block Problem

Graph Grammar

- Goal is to generate an adjacency matrix
- Each non-terminal generates a 2x2 matrix
- Each 2x2 matrix contains either numbers or other non-terminals.
- The start symbol is used to build up an adjacency matrix

Cellular Encoding

- Fundamental unit of genome is a transformation.
- Transformations act on a particular neuron
- A sequence of transformations defines a neural network.
- This preserves functional blocks better

Grid World

- World is a wrap-around grid
- Each grid can have 1 organism
- Each grid can have food on it for the organisms to eat
- Organisms have a 360 degree visual system
- Organisms use an RNN to decide on their actions

Learning Method

- Recurrent networks
- Hebbian Learning
- Clamping Outputs

Results?

- Grid World difficult to implement
- Two Interesting encodings remain unimplemented
- Interesting extensions to the world model remain unimplemented