Self-Paced Cognitive System

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We propose a cognitive system that manifests all the behaviors of biological systems to be declared a true AGI. Also discussed are the parts of biological systems that are not necessary to cognition. Included is a discussion of the code implementation of the system and the ongoing results.

# Algorithm

The algorithm is an interplay between a few systems. First the environment of the AI. Second is the processor that generates representations of aspects of the environment. Third is the cortex, a homogeneous block of neurons that is constantly pattern matching itself. In addition, the cortex is always learning, and always forgetting and rewiring at a low rate.

The processor is constantly taking the raw environment and creating sets of values representing some concept of the environment at various levels of abstraction. At the same time the processor is also taking various abstract concepts of output to the environment and driving the output (robotics or game style simulation mechanics). The abstractions are paired with the lowest layer of the cortex and stimulate the cortex for inputs and read the cortex for outputs.

In the cortex we use a simplified model of the neuron. It is simply a charge with N input source pointers, N weights, and one output pointer, the target. The target is some other neuron in the cortex. The neuron is trying to predict the next state of the target given the continually changing state of all the inputs.

The system free-runs with no central control. There is a chaotic and asynchronous interplay of a loop between environment and the concepts, and a constant interplay between the cortex and the concepts.

The system then operates in one of two modes, imagined and concrete, yet is always partly in both modes, with one mode dominating.

‘Concrete’ mode is if we imagine the system with no cortex, and we have just a stimulus-reflex system hardwired in the abstraction processing and no learning. This is in effect a simplistic reptilian or insect brain minus the cerebellum.

‘Imagine’ mode is if we have the system, after learning for a lengthy time, and we disconnect the Input/Output processing. Now the lone cortex will be only pattern matching on itself and oscillate in an endless cycle of match-stimulate-match-stimulate… It is simulating (imagining) the environment and processor in an unending chain of states.

With the whole system connected the lowest layer of the cortex becomes a partially imagined and partially concrete representation of the environment. If there are rapid large changes in the environment, then concrete will dominate. If there is a very strong match among a large percentage of the cortex, then imagination dominates. This balance is constantly moving and may not be the same across all areas of the processor-cortex interface.

Self-Paced Cognitive System Diagram

Output Stimulus

Input with weight

Input with weight

Input with weight

Target Neuron

Neuron

Neuron

Neuron

Neuron

External Environment

**Processor**

Input concept abstraction processing

Output concept de-abstraction processing.

Input concepts neurons Output concepts neurons

**Cortex**

Large array of neurons

# Processor

The processor component is hard coded to grab the environment from the camera, screen, mouse, keyboard, microphone, chat text area, and a whiteboard. The processor is also hard coded to drive the drawing whiteboard, speakers, type into the text area, and move the attention spots in the camera view around.

The processor then uses many algorithms to extract abstract concepts about the inputs. For example, it takes the camera view and compares successive frames getting the changes in the view. For output the processor does very little de-abstraction but in the future may do so.

The processor then takes all the abstract concepts and adds them neuron by neuron (e.g. pixel by pixel) to a matching set of neurons in the cortex. For output the processor reads the matching set of cortex neurons and sets the output hardware to match.

The setup of the processor is in the style of a subsumptive system and is defined as a set of concept maps. A concept map is simply the start and end address and some other information about where the corresponding locations in the cortex are. Each concept map has a unique set of neurons in the cortex.

In general, most input is processed as changes over time. The system is interested in what is changing in the environment.

# Cortex

The cortex has a goal of predicting the future state of the environment.

The cortex is made up of a 3D array of neurons all the same type.

# Neurons

The neuron model is a simple charge-based model. Every neuron has N inputs and weights, and one stimulus target neuron. The neurons are not pulse based. They assume a slightly courser granularity such that the charge represents the integration over a short time.

Neurons also keep track of how often they have fired and how old they are.

On a short time period the weights of the inputs to the neuron are constantly adjusted according to a simplified spike timing dependent plasticity (STDP) model. As the neuron ages over long time periods the weights are adjusted less and less.

Over a long time period neurons that have very low use rate get chosen to be retargeted. A low usage rate is when the neuron is almost never fired, and all the weights are near zero.

# Discussion