

TJHSST Senior Research Project

Hybrid AI and Machine Learning Systems

2006-2007

Logan Kearsley

September 13, 2006

1 Introduction - Problem Statement and Purpose

The purpose of this project is to combine the capabilities of multiple types of AI and machine learning systems, such as nervous networks and subsumption architectures, to produce a more flexible and versatile hybrid system.

The end goal would be to produce an AI system capable of teaching itself how to complete tasks specified by a human-defined heuristic via trial-and-error and inference, and of altering learned behaviors to cope with changes in its operational environment without human intervention.

2 Background

Most AI and Machine Learning research to this point has consisted of pursuing separate single methods, either to maximize utility for a single problem type, or to duplicate biological models. The two AI/ML systems I'll be starting with are simulated nervous networks making use of matrix mathematics to represent simple collections of neurons, and subsumption architectures.

To my knowledge, little research has been done in hybrid systems that combine the best aspects of multiple other methods to produce a highly versatile AI/ML system without necessarily trying to model biological nervous system functions, although 'hybrid neural networks' have been studied

which incorporate symbolic representations into neural network programs for, among other things, speed and ease of control while retaining the robustness and generalization capabilities of pure neural nets since the late '80s.

The subsumption architecture model was first used in 1984 and invented by Alexandre Parodi. Subsumption architectures make use of multiple 'behavior layers' which process inputs and produce outputs independently, with some layers capable of temporarily overriding or 'subsuming' the actions of others. This allows for low-level, high-priority 'reflex' layers to deal with immediate problems, while higher layers control the mid-term and global goals of the agent.

3 Procedure and Methodology

I intend to work primarily in C, although other languages may prove to have more utility for specific problems as the project goes on. Testing will likely involve the construction of a simple virtual world (for example, a 2D maze, topological map, etc.) in which to operate an agent running the AI/ML program.

The project is easily segmentable by introducing new layers or types of AI and learning algorithms in stages.

4 Expected Results & Value to Others

The results of the project will be a final, or multiple final, AI/ML programs and data detailing their learning curves in various scenarios. These will be presented in terms of the strengths and weaknesses of various AI and ML methods used, with an attempt to extrapolate the best types of further applications for the final program(s) based on the test scenarios.