Hybrid AI & Machine Learning Systems

Logan Kearsley
TJHSST Computer Systems Lab 2006-2007

Abstract:

The purpose of this project is to design a set of libraries and demonstration programs that combine the capabilities of multiple AI and machine learning models, such as nervous networks and subsumption architectures, to produce a more flexible and versatile hybrid model.

I will primarily be working with back-propagation neural networks and subsumption architectures.

Two demonstration programs are planned:

- A character recognition systems capable of automatically switching switching between different fonts.
- A robotic AI capable of teaching itself how to navigate and alter its strategies in different environments (such as open hallways vs. classroom with desks).

Procedures & Methods

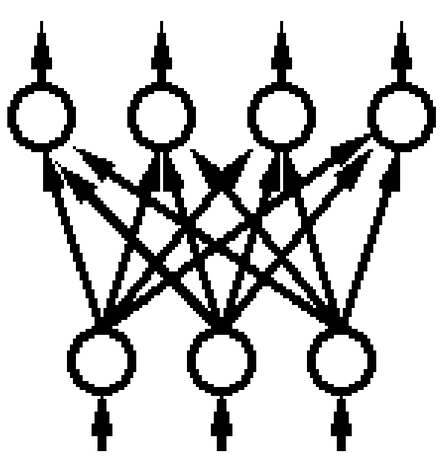
The programming for this project will be done in C, using the gcc compiler. For the neural network programming, I will be using a back-propagation learning algorithm with weight matrices to simulate neuron layers. The project is planned to consist of 3 major stages:

•Model Development- creating the code for the AI algorithms, including a back-propagation learning algorithm and subsumption scheduler/manager. In this stage, I will be testing mostly by feeding test programs random input/output associations to ensure that they learn properly.

•Computer-based testing- for the character recognition program, testing will be similar, but with input data derived from strings of characters rather than randomly generated numbers.

•Robot-based testing- in the final stage, I will be constructing a simple LEGO robot and an AI system to navigate it. Testing will be based on how well and how quickly it learns to properly avoid obstacles, with run-time input coming solely from its interaction with the environment.

Neural Connectivity & Associated Weight Matrix:



In1	In2	In3	
W1,1	W1,2	W1,3	Out1
W2,1	W2,2	W2,3	Out2
W3,1	W3,2	W3,3	Out3
W4,1	W4,2	W4,3	Out4

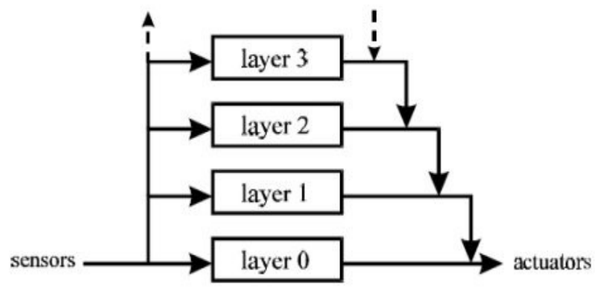
Background:

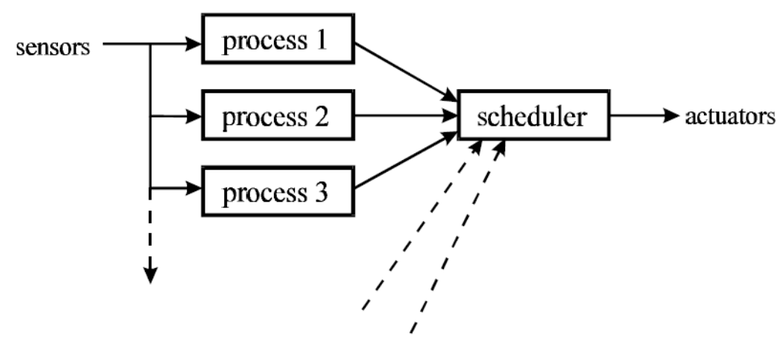
Most AI and Machine Learning research to this point has consisted of pursuing separate single methods, either to maximize utility for a single problem type, or to duplicate biological models.

Comparatively little research has been done in AI models that combine the best aspects of multiple models to produce a more versatile hybrid system. One example, however, is 'hybrid neural networks', incorporating symbolic processing and neural processing into a single model for speed and ease of control while retaining the robustness and generalization capabilities of pure neural nets, which were first proposed in the late 1980s.

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 complex behaviors to be built up from a number of relatively simple components.

Permanent Priority vs. Competitive Subsumption:





Expected Results

The results of the project will be a set of libraries and architecture descriptions for the manipulation and combination of multiple AI models, and a set of demonstration programs. These will be presented in terms of the strengths and weaknesses of the component algorithms and how they have been combined to maximize their net utility, hopefully including data on learning times in various scenarios.

It is intended that these results will provide a starting point for future researchers to work with the same algorithms, and provide inspiration for investigating more combinations of different AI models.