

Chapter 19

The China Brain Project: An Evolutionary Engineering Approach to Building China's First Artificial Brain Consisting of 10,000s of Evolved Neural Net Minsky–Like Agents

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ABSTRACT

This chapter describes a 4 year research project (2008-2011) to build China's first artificial brain. It takes an "evolutionary engineering" approach, by evolving 10,000s of neural net modules, (or "agents" in the sense of Minsky's "Society of Mind" [Minsky 1988, 2007]), and connecting them to make artificial brains. These modules are evolved rapidly in seconds on a "Tesla" PC Supercomputer, and connected according to the artificial brain designs of human "BAs" (Brain Architects). The artificial brain will eventually contain thousands of pattern recognizer modules, and hundreds of decision modules that when suitably combined will control the hundreds of behaviors of a walking, talking robot.

1. INTRODUCTION

The Artificial Brain Lab (ABL) (see Figure 1), of the School of Information Science and Technology (SIST) of Xiamen University, Fujian Province, China, has embarked upon an ambitious research project to build China's first artificial brain, over

a period of 4 years (2008-2011), with a budget of some 10 million RMB, about 20 people (full and part time), and 250 sq ms of floor space.

The term "artificial brain" is defined here to be a "network of neural networks", where each neural network module (or "agent", to use Minsky's "Society of Mind" terminology [Minsky 1988, 2007]) is evolved in a few seconds in a Tesla PC Supercomputer [NVIDIA], and then

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The China Brain Project

Figure 1. Plaque of the Artificial Brain Lab (ABL) at Xiamen University, Xiamen, Fujian Province, China



downloaded into an ordinary PC or supercomputer. This is done 10,000s of times, with each neural net module (or agent) performing some simple task. Human “BAs” (“Brain Architects”) then specify the connections between these evolved modules to form networks of networks, or “artificial brains” using special (operating system) software, called IMSI (Inter Module Signaling Interface), which has a double function, firstly to store the humanly (i.e. BA) specified connections between the neural signal outputs and the neural signal inputs of modules, and secondly to perform the neural signaling of the whole brain in real time, defined to be 25 output signals per neuron per second.

The artificial brain is then used to control the 100s of behaviors of a robot (or other appropriate device). These neural net modules can be used to evolve visual (and aural) pattern detectors, e.g. object detectors, face detectors, moving line detectors, color detectors, etc. Thousands of these visual detectors can be placed in an artificial brain consisting of 10,000s of modules.

The artificial brain is used to control the hundreds of behaviors (motions) of a French “NAO” (robo cup standard) robot, shown in Figures 2 and 4. The French company Aldebaran [Aldebaran],

Figure 2. The French company Aldebaran’s 58 cm “NAO” Robot that our 10,000s evolved neural net module artificial brain will control



which manufactures this robot also provides motion control software called “Choregraphe”, which sends time dependent “angle vectors” to the motors of the robot. These 25 (time dependent) numbers control the angles of the 25 motors of the NAO robot, causing it to move in a desired fashion, e.g. walking straight, turning, etc.

Initially, we thought we would evolve neural net modules to control the robot’s motors, but decided against the idea once we saw the results of the Choregraphe software.

Hence, the “China Brain Project” is a hybrid, consisting of a mix of evolved neural net modules, Choregraphe motion control models, and simple conventional code modules (subroutines).

Decision type modules are also evolved, so that an appropriate mapping can be made between stimuli coming from both the external world and the internal world of the robot (e.g. boredom, hunger (i.e. low battery)) and motion generators. With hundreds of motions to choose between, and thousands of pattern detectors and decision modules, we expect that an artificial brain ought to be quite interesting for a human observer to watch.

However, in 2008, before any neural net pattern recognition or decision module could be evolved, we needed to decide initially which neural net

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