

Senior Project – Computer Science - 2010

Training a Neural Network to Sail a Virtual Sailboat

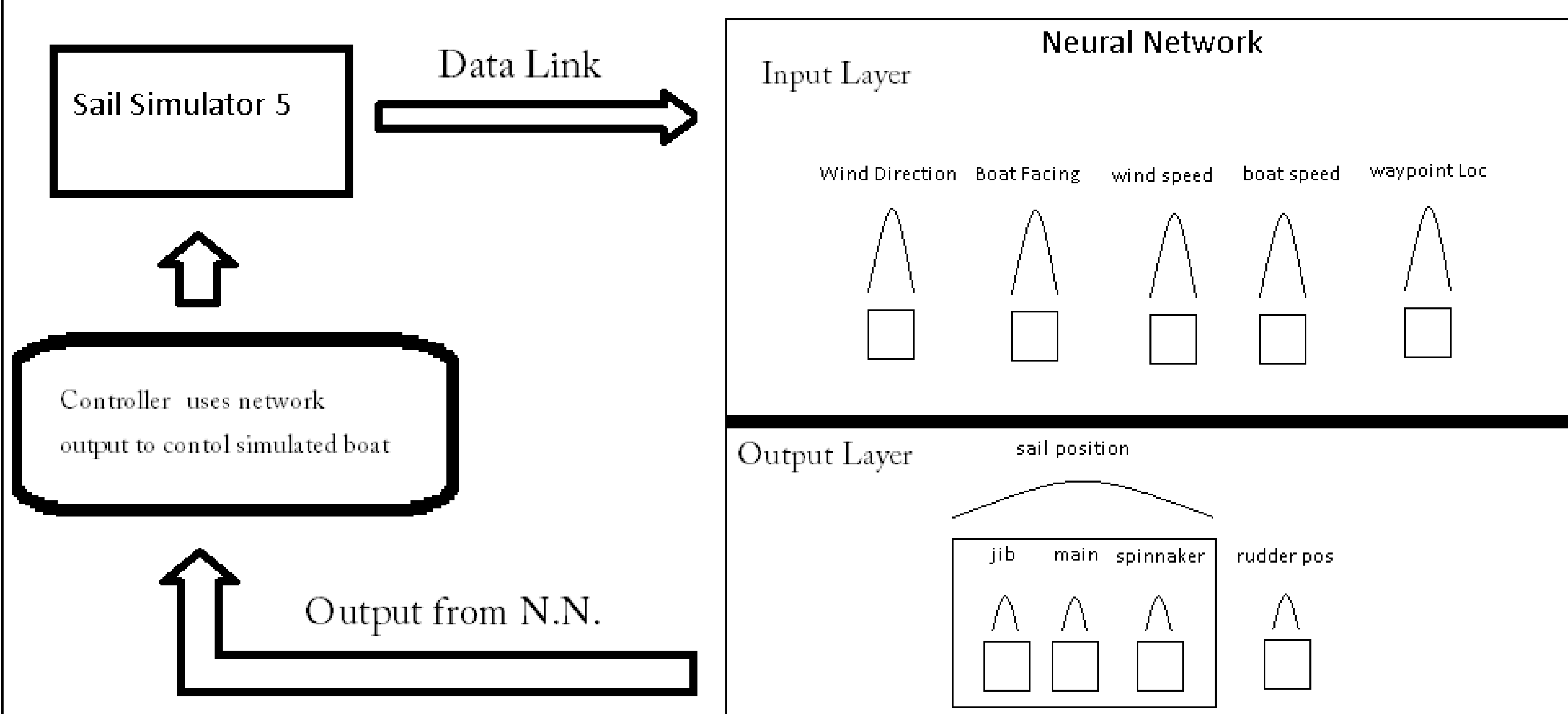
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My Project

The goal of my project is to train an Artificial Neural Network to pilot a small sail boat. Due to the difficulties and expense of a real world implementation, I decided to train the network with a virtual sailing simulator.

I chose to use Sail Simulator 5 as the simulator in my project, because it is sufficiently realistic and the information about the state of the boat and environment is easily accessible to external programs.

My Neural network is fully connected, with one input layer, one hidden layer and one output layer and it uses the back propagation algorithm for learning.



My Neural Network (Overlord)

The Neural Network I constructed is a 3 layer, fully connected neural network that uses a back propagation algorithm to facilitate synaptic learning.

It takes the following information: wind speed, wind direction, boat speed, boat direction, boat latitude and longitude and waypoint latitude and longitude. It uses this information to produce sail and rudder positions that will be passed back into the simulator.

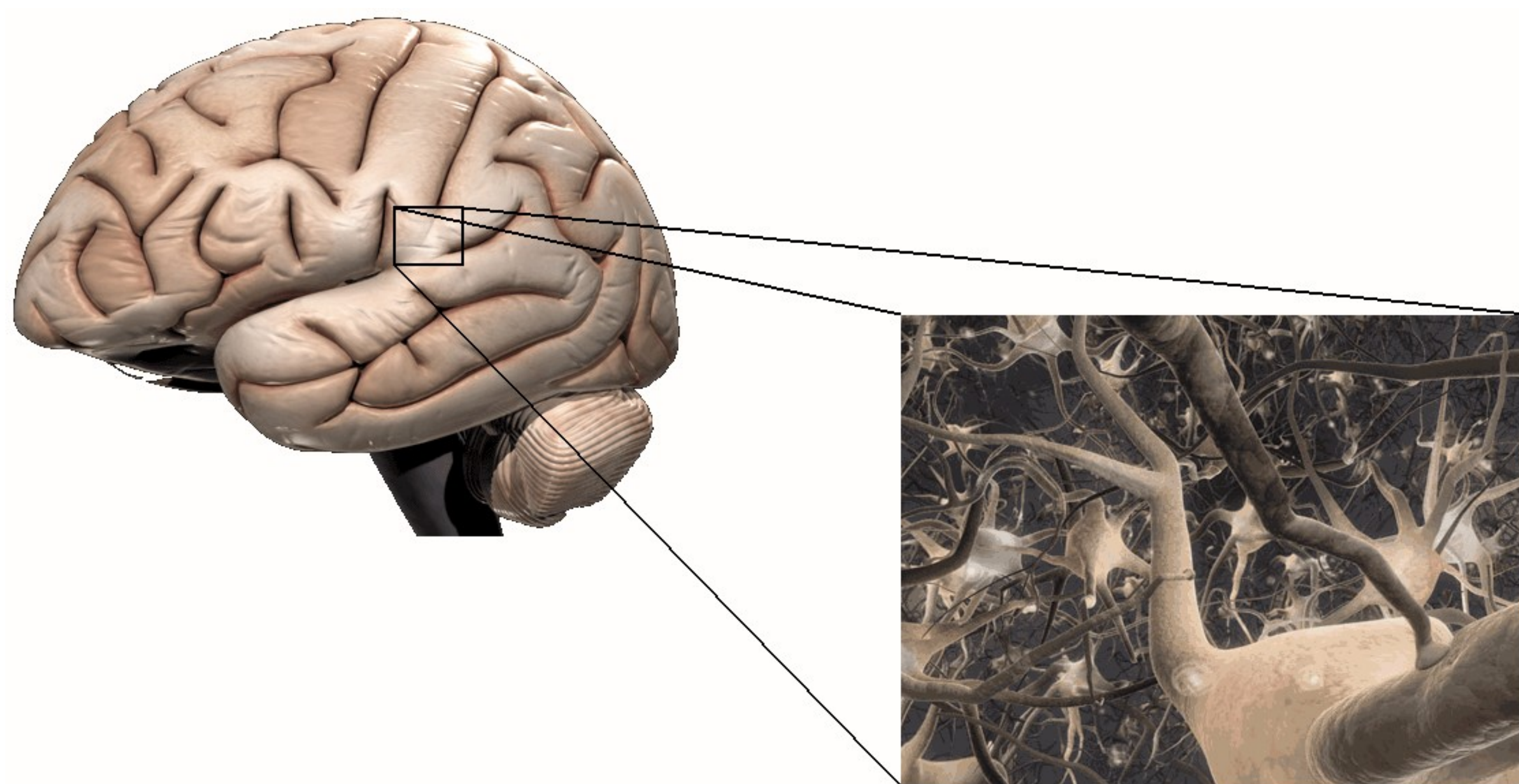
Controller

As of right now I have a program that reads the output stream from the Sail Simulator, runs the data through the Neural Network and uses the output to tell the controller to turn the rudder left or right and to tighten or loosen the main sheet But I don't have a controller program, so the controller is me.

Sail Simulator 5

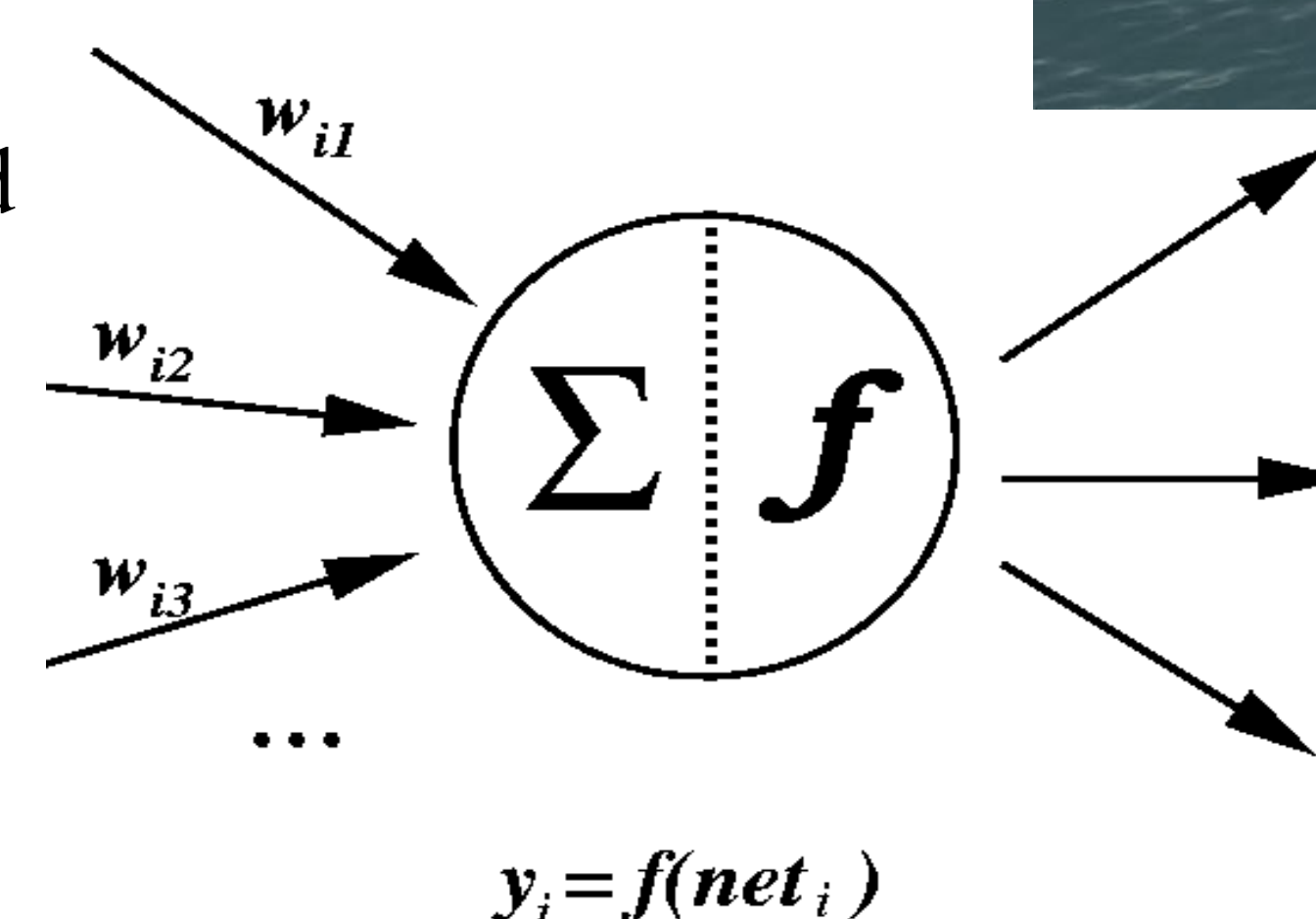
Developed by Stentec Software.

The developers of this software have been a great help in the course of this project. They modified their simulator so that it would output the information that I required. Sends information via serial port connection. That is read by a translator program that passes information to the neural network



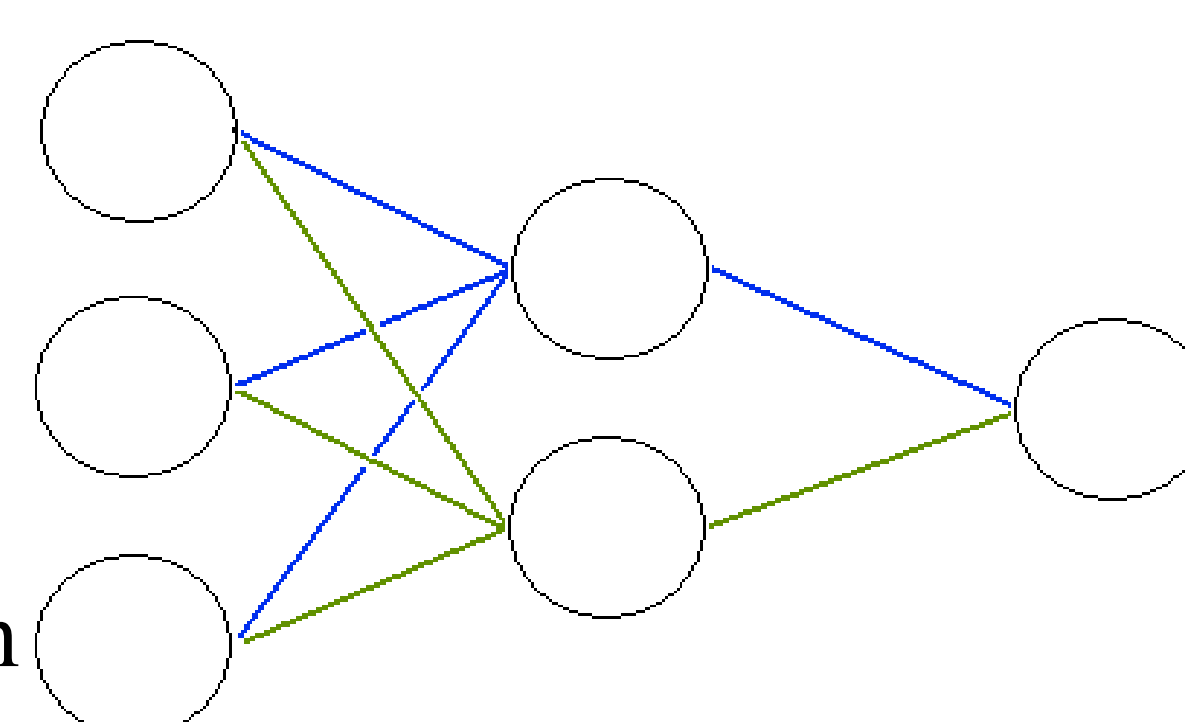
The Artificial Neuron

The basic computational element in a neural network is the artificial neuron. Each neuron has connections for both input and output. Each neuron can receive input either from other artificial neurons or from external sources. Each connection has an associated weight, which can be modified in order to model synaptic learning. The neuron contains an activation function that takes the weighted sum of its inputs and calculates the output for the neuron. The most commonly used activation function is the sigmoid function.



Artificial Neural Networks

An Artificial Neural Network is implemented as a set of interconnected Artificial Neurons. The patterns of interconnection vary greatly but all Neural networks contain a layer of input neurons and a layer of output neurons and use some algorithm to adjust the weights of the connections between the neurons in order to facilitate learning



Future Work

- Collaboration with Stentec Software to incorporate a neural network into their simulator
- Using the Neural Network to sail a real boat