Human Consciousness in Machines

Breaking down the Human Consciousness:

Google defines consciousness as a state of being awake and aware of ones surroundings. This is a very fluid concept and science itself hasn't been able to understand it completely. Hence, trying to make a machine do something that we our self don't have full grasp over is a considerable feet and can only be achieved by taking a few approximations and shortcuts.

For now we are going to just restrict consciousness to being aware of ones surroundings. This makes the entire implementation of the consciousness machines a little easier.

Making Machines Smart:

This is easier said then done. Even actions that we take for granted like picking a book or writing your name take a great deal of effort and code to be implemented in a machine. Let us take one such problem and try and break it down. In doing so I hope to offer you a better understanding of to model consciousness in machines and what their limitations are.

Picking up a book:

Learning what a book is:

The first step in creating a machine that can pick a book would be to describe what a book is to the machine.

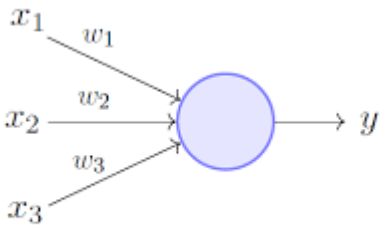
Now this is easier said than done as books can be in various form factors. They can be hard bound, paper back, have font on the front, fat, thin, light, heavy etc. I hope you have already seen how this might be a problem.

Firstly, lets understand how you and I interpret a book. How are we so good at understanding and being able to discern a book from say a can of soda or a loaf of bread? To put it simply it's the sample size that you have been exposed to. You have seen a great many number of books, soda cans or loaf of breads. This has given you the ability to uniquely classify what a bread or a book is. You have a set of features attributed to each of these items that help you classify them properly. Now this is a concept that we need to implement in our machine consciousness to make it to be able to understand what a book is and then move it to the next step of picking it up. Now how do we do this?

The first step moving forward now will be to collect a large enough dataset that consists of all the features or at least a large majority of the features of the a book. With this dataset we will try and do something that our mind so well does FIND PATTERS. We will now create a neural network that will use this data set to become aware of what a book is or not.

Now here in lies our second problem. How do we create this neural network? Once again let's take look at how the best computer in the world, our brain, achieves. Our brain is made of small cells called neurons, and there are millions in fact billions of these neurons in our head and each neuron is connected to its neighbors with dendrites. Dendrites help carry electrical impulses from one neuron to another. This network of cells form a synapse. Each synapse is nothing but a patter. A patter than when excited channels the electric impulses in a specific fashion to give a corresponding output. Well simple right? So now lets try and model this in out book picking up machine.

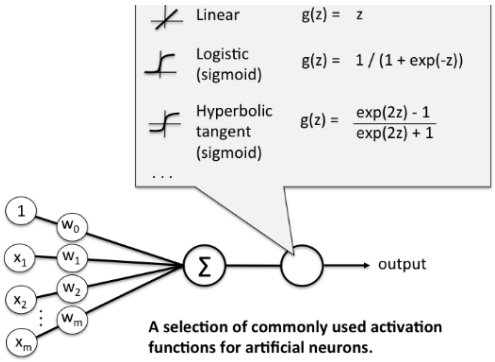
Based on our understanding of the human mind we are now going to construct a artificial neural network. Lets first start by making one neuron. Each neuron has an input and an output.



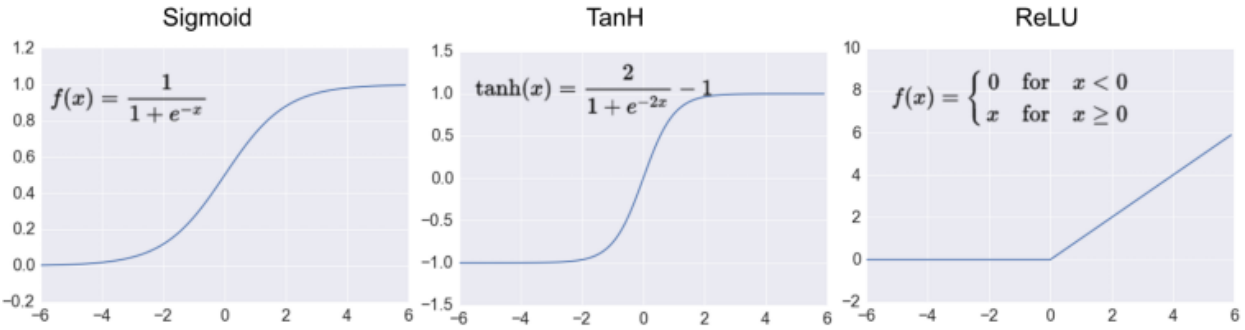
Perceptron Model (Minsky-Papert in 1969)

In the above diagram the input for the neuron is x1,x2,.. each of these values can be coming from multiple sources. We will get to the weights denoted by the Ws later. Now the neuron behaves differently for different set of inputs. That is for a set of inputs it may give 0 as an output for others it make give 1 etc. How do we achieve this? We use something known as an activation function. This is where our third problem lies. How do you pick this activation function?

Well there is no one activation function. Its only through a trial and error method that we can choose the right one. What does an activation function do? For now, lets think of it like a black box (with a mathematical function inside). A box that takes in a set of inputs and gives a corresponding output.



A selection of commonly used activation functions for artificial neurons.



(Here z is nothing but the sigma or the summation of the product of all the inputs and their corresponding weights).

Usually the output of a neuron oscillates between 1 and 0. 1 meaning that it has been activated for a set of inputs and vise-versa.

Now as promised let's get back to what the weights are. Weights are something that determine the significance of each of each of the input. The smaller the weight the lesser of a role the input plays in the output of the neuron.

Now lets apply this knowledge to out book picking up machine. We first create a bunch of these neurons that accept all the features of the book as input and we then pass our dataset through them. Now for each set of input the neural network predicts a output. Is it a book or not? Now if the network predicts the output incorrectly we send a feedback to the network. The network then reassigns the weights to try and repeat the process until it is able to predict the correct output consistently.

$$E = \frac{1}{2} * \sum (t_j - o_j)^2 \text{ (with log-sig or softmax)}$$

$$\frac{\partial E}{\partial w_{ij}}$$

$$\Delta w_{ij} = \alpha * [x_i * (o_j - t_j) * o_j * (1 - o_j)]$$

learning rate — outer — inner

Voila, we have now made a machine aware of one aspect of its surrounding, no matter how minuscule, this is an example of how we can expand this to other aspects of the surrounding and expand the consciousness of the machine.

Now let's pick up the book:

In this step of the project we will learn what it takes for our machine to pick up the book once it has identified it. First, we need to fit our robot with actuator (motors that give a degree of motion to the

robot). Now we need to understand the second part of awareness, apart from the machine being aware of the surroundings the machine need to be made aware of its own existence in space and time. That is it should know where its actuators are in space and time. This the where we encounter the fourth, problem. We need to write the code to integrate the machine consciousness with the all it actuators. There are software that can help us with this but it is a laborious and time consuming effort. We will not be dwelling into this for the scope of this paper. But for references you can look into ROS (Robot operating systems).

We need to write programs that will help us in controlling all the actuators and also help the machine understand where the book that it has just detected is in relation to all these actuators and how it can approach to picking up this book.

Need for such a machine:

Now no one can deny the fact that need is the driving factor for innovation. Here in lies our fifth and final hurdle. We need to find a proper use for the machines we create. Because, making a machine is a complex and expensive endeavor. Without a use case there is no way to fund such a project.

There is more but let's stop here for the scope of this paper. Hope we can discuss further on how we can bridge the gap between human and machine intelligence.