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How Various Activation Functions Affect the Loss and Output of a Neural Network.

A. As society begins to implement machine learning algorithms into all modern devices, it's important to grasp an idea of the basic technicalities of how these models learn. By doing this, we can obtain a surface level understanding of the technologies we'll be using in the future.

Additionally, when developing such technologies, it's important to know how to optimize them. Doing so will save computational time and resources.

In the case of my experiment, I will program a basic neural network called a "perceptron". Neural networks like these require what's called an "activation function," an activation function determines the final output of each node (also called a neuron) and whether or not it should "fire/activate/synapse". This terminology comes from the same terminology used to describe communication between real neurons in the brain, this is because neural networks are inspired by the brain! So, when a neuron in a neural network fires, that means that its output value can move onto the next neuron, and the next neuron, and the next neuron until it reaches the end of the network to spit out an output value. Each time a neuron takes an input, it computes the dot product (The dot product is the operation that multiplies each element in the two vectors together and adds up their products to create a single number) of that input (And its corresponding weight value). It then inputs that into the given activation function.

My neural network will be a "classification neural network," and it will be used to classify pixelated slashes and the letter O. **B. Research Question:** How do various activation functions affect the accuracy of a classification neural network? **Hypothesis:** I hypothesize that the sigmoid activation will be the most accurate because it suppresses data between 0 and 1, this is useful because the classifier will label data using only 1s and 0s. **Engineering Goal:** My main goal with this is to develop a graphical interface that renders a detailed graph of what's happening under the hood so that it's easy to identify the benefits and drawbacks of each activation function in more detail. Additionally, I will program both the neural network and the interface in the Python programming language for its ability to abstract vector arithmetic. **Expected Outcomes:** I expect to generate a visual matrix of pixels that allows the user to provide input. Additionally the interface will render a loss graph to demonstrate the performance of each activation function.

C. I will conduct an experiment that measures percent% error (AKA: loss) of the neural network's output compared to the preferred output according to the activation function in use. My goal with this is to figure out which activation function works best for the task i'm trying to complete.

Procedures: I will be implementing the standard scientific method in my project.
Risk: No Risk
Data Analysis: The efficiency of each activation function will be rendered on a graph.

D. In this experiment, I will be referring to a neural network series from Grant Sanderson that explains the learning process of neural networks at a theoretical level.