**Assignment 4: Deep Learning**

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**Introduction**

For this assignment, I am developing a face detection convolutional neural network (CNN). This is a binary classifier in which an image is categorized as either containing a face or not. Because my project data set is only of faces, I am combining it with the CIFAR-10 [1], a large data set of 32 x 32 pixel images commonly used in image classification tutorials. I chose the CIFAR-10 because six of the ten categories included are of animals, which should help to ensure that my face detector is specific to human faces and does not detect a single facial feature that might be similar among species (e.g. eyes).

**Methods and Results**

**Data Set**

I am using the FaceScrub [2] data set combined with the CIFAR-10. To standardize the FaceScrub images I ran them through the OpenFace align step to generate square images cropped to the most prominent face in the image. While this means that the images are all aligned and thus the face detector could only detect faces that are positioned in this way, the image augmentation I use in my network should help to prevent this as it randomly transforms the images in various ways. After generating the aligned images I then resized them using the PIL library to be 32 x 32 to match the CIFAR-10 images, and selected 50,000 of the images at random so that the face and no-face sample sizes would match. To use the images with a neural network I then converted the images to numpy arrays with three color channels (RGB), giving an array shape of (32, 32, 3).

**Part A: Deep Learning Model**

https://github.com/keras-team/keras/blob/master/examples/cifar10\_cnn.py

**Part B: Activation Function**

https://keras.io/activations/

<https://towardsdatascience.com/activation-functions-neural-networks-1cbd9f8d91d6>

 Change the activation function. How does it effect the accuracy?

 How does it effect how quickly the network plateaus?

* relu
* sigmoid
* hard\_sigmoid

**Part C: Cost Function**

<https://keras.io/losses/>

### binary\_crossentropy

* categorical\_hinge

### mean\_squared\_error

* Change the cost function. How does it effect the accuracy?
* How does it effect how quickly the network plateaus?

Part D: Epochs

50

100

* Change the number of epochs initialization. How does it effect the accuracy?
* How quickly does the network plateau?

Part E: Gradient Estimation

Part F: Network Architecture

 Change the network architecture. How does it effect the accuracy?

 How does it effect how quickly the network plateaus?

Part G: Network Initialization

 Change the network initialization. How does it effect the accuracy?

 How does it effect how quickly the network plateaus?

ADAM

Stochastic Gradient Descent

RMSProp

**Discussion**

**References**

[1] <http://www.cs.toronto.edu/~kriz/cifar.html>

[2] <http://vintage.winklerbros.net/facescrub.html>