Performance Analysis of Different Approaches

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In this project, I classified what breed a dog is based off an image of the dog. I accomplished this using deep learning with TensorFlow and Keras. The first neural network that I built uses a simple sequential model and consists solely of Dense hidden layers. The second neural network I built is a Convolutional Neural Network (CNN) that has Convolutional hidden layers. The third neural network that I built relies on transfer learning from a pre-trained model known as MobileNetV2.

Let's take a deeper look at the architectures of each model.

- The first neural network has two inner Dense layers with 512 nodes each and one outer Dense layer with 8 nodes (one for each dog breed classification). The hidden layers have a relu activation function and the outer layer has a softmax activation function. The loss function used to compile the model was the sparse_categorical_crossentropy function and the optimizer was the root means-squared back propagation.
- The second neural network has three inner Convolutional layers (the first with 16 filters, the second with 32 filters, and the third with 64 filters), one inner Dense layer with 128 nodes, and one outer Dense layer with 8 nodes (one for each dog breed classification). The hidden layers have a relu activation function and the outer layer has a softmax activation function. The loss function used to compile the model was the sparse_categorical_crossentropy function and the optimizer was the Adam algorithm.
- The third neural network was built on a base model of a pre-trained model known as MobileNetV2. I trained a couple of layers on top of the base model.

These three neural networks performed with different accuracies. Prior to building the models, our image data was divided into an 80%/20% split between training and validation. Some of the validation data was used to create a test dataset as well. After training the model with the training dataset and then performing validation with the validation dataset, the test data was fed into the model to see if the model could accurately classify it. The first model had an accuracy rate of around 16%, the second model had an accuracy rate of around 59% and the third model had an accuracy rate of around 94%.

Each subsequent neural network was able to classify more accurately what breed a dog is based off an image. The second neural network performed better than the first neural network because CNNs work quite well with image data due to the fact that a densely connected sequential layer will learn global patterns from the input data, whereas a CNN learns patterns in

small 2D windows with the input data. This gives CNNs two advantages. Firstly, once a pattern is recognized in one location, it can be applied to another location. Secondly, a CNN can learn spatial hierarchies that allow it to identify more complex things such as faces. While the CNN performed well in classifying dog breeds, it did not perform as well as the third neural network. The reason that the third neural network performed so well is because it is built on a pre-trained model and learning new tasks relies on previously learned tasks. The dataset that I used for the training of these models is quite small because I don't have a powerful laptop. By relying on a pre-trained model that has been trained on millions of images, I didn't need a large dataset to achieve a high level of accuracy.

Personal Note:

The whole reason I chose the dataset that I did is because I wanted to classify what breed my dog is. My family adopted Buddy when he was a puppy, but since he was a stray, we don't know what breed he is. The vet guessed that he is a Lhasa Apso and Poodle mix.

Consequently, I included Lhasa Apso and Poodle as two out of the eight categories my models could classify a dog's breed as. If one of my models could either classify Buddy as either a Lhasa Apso or a Poodle, I feel like I would have succeeded with this project.

Here is a picture of Buddy:

The first model classified Buddy as a Samoyed.

The second model classified Buddy as a Siberian Husky.

The third model classified Buddy as a Traditional Poodle. Yay!