Udacity Machine Learning Nanodegree

Capstone Proposal

Classifying Dog Breeds

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March 2020

1 Domain Background

Convolutional neural networks (CNNs) is a technique that analyses visual imagery with the help of multiple (deep) neural layers. It can be used to classify images, recognize objects, or detect anomalies in speech waveforms. In any case, the input should be an image in some way. In this project, we will be looking at image classification, in particular, classification of dog breeds. On one hand, this classification sounds simple (especially to a dog lover), however, there are several breeds that are closely related and the differences are subtle, difficult even for the human eye. Since the beginning of the ImageNet competition, CNNs have been become better than humans at classification problems. Now, CNNs are applied to more and more narrow fields to see if the network can find even the most benign features in an image.

2 Problem Statement

Image classification means returning a single class for an input image. In contrast, object recognition, which sounds similar, returns a list of all object classes found in the image. In our case, we have a list of classes of dogs and upon an input of a random dog/human/non-dog image, we would like to return the correct class of dog breed. In the case of human image, we would like to return a class of dog breed lookalike. In the case of non-dog/non-human image we should return an error.

3 Datasets and Inputs

We are using two separate datasets for dogs [1] and humans [2] provided by Udacity and The University of Massachusetts, respectively.

The dog dataset contains 133 folders each corresponding to a different dog breed.

4 Solution Statement

The aim is to create a CNN-based classifier that can correctly classify each of the 133 dog breeds. In order to classify the dog breeds properly, I am designing a deep neural network and then training the network on the supplied datasets. In the end, the classifier can differentiate between dog breeds as well as dogs and humans and non-human/non-dogs.

We will use the evaluation metrics to compare the the performance of the classifier against the benchmark models in the next section.

5 Benchmark Model

For the benchmark model, we will use models that have performed well on a similar dataset of dog breeds from Stanford [3].

Table 1: Summary of Benchmarks of Stanford Dogs [4]

Method	Top - 1 Accuracy
SIFT + Gaussian Kernel	22%
Unsupervised Learning Template	38%
Gnostic Fields	47%
Selective Pooling Vectors	52%

6 Evaluation Metrics

The evaluation metric for this problem is simply the accuracy score.

7 Project Design

- **Data Preprocessing:** Before we can begin with the model design/training, we first have to import the datasets and process the datasets so we can work with it.

- **Data Splitting:** Next, we split the data into train, validation and test sets.

- **Model Design/Training:** We will build two models: one from scratch and one with transfer learning from a pre-trained model. Training is done with the train set and validated with the validation set

- **Model Evaluation:** We evaluate the classifier against the test set.

- **Model Testing:** Finally, we will test the model on completely new images of humans, dogs, and non-humans/non-dogs.

8 References

[1] https://s3-us-west-1.amazonaws.com/udacity-aind/dog-project/dogImages.zip

[2] http://vis-www.cs.umass.edu/lfw/lfw.tgz

[3] http://vision.stanford.edu/aditya86/ImageNetDogs/main.html

[4] Hsu, David (2015), "Using Convolutional Neural Networks to Classify Dog Breeds", http://cs231n.stanford.edu/reports/2015/pdfs/fcdh_FinalReport.pdf