Machine Learning Engineer Nanodegree
Capstone Project

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Domain Background

There are more than 100 breeds of dogs. It is not an easy task for an average person to be able to identify the dog breed of a given dog. Further there can be minimal inter class variation between two breeds(for example Brittany and Welsh Springer Spaniel). Within the same breed there can be different coat colors.

So there is a good opportunity to employ CNN for image classification. The project also uses Transfer Learning and some state-of-the-art CNN models to classify a dog into one of 133 breeds.

Problem statement

A data processing pipeline needs to be built which takes input from the user as an image and returns the dog breed if the supplied image is of a dog. If the image of a human is detected then the resembling dog breed needs to be returned. If neither human nor dog is detected then an error needs to be shown.

Datasets and Inputs

The human and dog breed dataset has been provided by Udacity.

- There are a total of 13233 human images with their names.
- There are a total of 8351 dog images.

(The links to datasets have been provided at the end)

All the images are resized to 244*244 then normalized.

Solution Statement

The project will use OpenCV's implementation of Haar feature-based cascade classifiers to detect human faces in images.

A VGG-16 model that has been trained on ImageNet, a very large, very popular dataset used for image classification will be used . ImageNet contains over 10 million URLs, each linking to an image containing an object from one of 1000 categories.

Input to an image is given. If the supplied image is of a dog then the dog breed is shown. If the image is of a human then a resembling breed is shown. Error is shown when the input image is neither dog or human.

Benchmark Model

The CNN model that is to be created as a result of transfer learning based on the VGG-16 model should have 60% or greater accuracy.
The model created without transfer learning should have an acceptable accuracy that is better than a random guess.

Evaluation Metrics

Accuracy will be the main metric used to test both benchmark model and solution model

$$\text{Accuracy} = \frac{\text{True Positives} + \text{True Negatives}}{\text{All Samples}}$$

Project Design

The 7 steps to be followed in this project are:

1. Import Datasets - The dataset containing human and dog images are imported and their count is noted.

2. Detect Humans - OpenCV's implementation of Haar feature-based cascade classifiers is used to detect human faces in images.

3. Detecting dogs - A pre-trained model, VGG-16 is used to detect dogs in images.

4. Create a CNN to Classify Dog Breeds (from Scratch) - A CNN model is developed from scratch using Pytorch.

5. Create a CNN to Classify Dog Breeds (using Transfer Learning) - Now CNN is developed using transfer learning. This yields better performance than the one developed from scratch.

6. Write your Algorithm - An algorithm is written that accepts a file path to an image and first determines whether the image contains a human, dog, or neither.
    a. if a dog is detected in the image, the predicted breed will be returned.
    b. If a human is detected in the image, the resembling dog breed is returned.
    c. if neither is detected in the image, indicate error.

7. Test your Algorithm - Finally! The model is checked by providing our own image.

Resources

1. https://s3-us-west-1.amazonaws.com/udacity-aind/dog-project/dogImages.zip
2. https://s3-us-west-1.amazonaws.com/udacity-aind/dog-project/lfw.zip
3. http://docs.opencv.org/trunk/d7/d8b/tutorial_py_face_detection.html
4. http://pytorch.org/docs/master/torchvision/models.html