Capstone Project Injeti Ravi Varma

Machine Learning Engineer Nanodegree April 21th, 2020

Dog Breed Classifier Using CNN

1. Domain Background

The Dog breed classifier is a well-known problem in Machine Learning. The task is to identify a breed of dog if dog image is given as input, even if supplied an image of a human, we have to identify the resemblance of dog breed in the image. The idea is to build and develop a pipeline that can process real-world, user-supplied images and identify an estimate of the canine's breed. This is a multi-class classification problem where we can use supervised machine learning to solve this problem. After completing this model, I am planning to build a web app where user can input an image and obtain prediction from this model. This project gives me an opportunity to build and deploy ML models, so I have chosen this as my capstone project.

2. Problem Statement

The main aim of this project is to build and develop a Machine learning model that can be used within the webapp to process real world and user supplied images. Here, the algorithm performs two different tasks:

***Dog face detector*:** After giving the image of dog as input the algorithm must identify an estimate of the canine's breed.

***Human Face Detector*:** after giving the image of human, the algorithm must identify the resemblance of the dog breed.

3. Datasets & Inputs

For this project, the input must be in the image format, because using the image as input and identification of the dog breed will be estimated. To do this the Dataset was provided by Udacity which contains the dogs and human's dataset.

So, in total the Dog image dataset has 8351 images where it was splitted in to 6680 images for training, 836 images for testing and 835 images for validation are saved into directories. Each

of this directory (train, test, valid) have 133 folders corresponding to dog breeds. The images are of different sizes and different backgrounds, some images are not full-sized. The data is not balanced because the number of images provided for each breed varies. Few have 4 images while some have 8 images. And, Human images dataset consists of 13233 images which were sorted with names in 5750 folders with the image size of 250x250 and different background and different angles i.e., data is not balanced.

4. Solution Statement

For performing this multiclass classification, we can use Convolutional Neural Network to solve the problem. A Convolutional Neural Network (CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The solution involves three steps. First, to detect human images, we can use existing algorithm like OpenCV's implementation of Haar feature based cascade classifiers. Second, to detect dog-images we will use a pretrained VGG16 model. Finally, after the image is identified as dog/human, we can pass this image to an CNN which will process the image and predict the breed that matches the best out of 133 breeds.

5. Benchmark Model

The CNN model created from scratch must have accuracy of at least 10%. This can confirm that the model is working because a random guess will provide a correct answer roughly 1 in 133 times, which corresponds to an accuracy of less than 1%.

The CNN model created using transfer learning must have accuracy of 60% and above.

6. Evaluation Metrics

Evaluation Metric includes the accuracy, and speed of the training. Where the data is unbalanced, we are also going to consider F1 score as a metric.

7. Project Design

For this project we will explore the required dataset and libraries, pre-process the dataset and create train, test and validation dataset by performing the image augmentation on training data. We will use OpenCV's Implementation of Haar feature based cascade classifiers to detect the human faces and apply VGG16 to dog detection. We will create a CNN to classify the dog breeds from scratch, train, validate and test the model and create a CNN to classify the Dog Breeds using the Transfer Learning with resnet101architecture. Train and Test the model.

Reference

- Udacity Repo for project: https://github.com/udacity/deep-learning-v2-pytorch/blob/master/project-dog-classification/
- Explanation of CNN(cs231n): https://cs231n.github.io/convolutional-networks/#layers
- Imagenet Training : https://github.com/pytorch/examples/blob/97304e232807082c2e7b54c597615dc0ad8f6173/imagenet/main.py#L197-L198
- Pytorch Documentation: https://pytorch.org/docs/master/