Machine Learning Engineer Nanodegree
Capstone Proposal

Samuele Buosi
May 11th, 2020

Dog Breed Classifier

Domain Background

The purpose of this project is to classify the different dog breeds. In the world, exists a lot of breeds of dogs that differences one to another by a lot of parameters such as high, size, kind of employment, etc...

For this project, the classification is totally based on images and the goal will be to classify 133 dog breeds using state of art deep learning algorithms to teach the computer how to give an estimation of a particular dog breed from an dog image.

Image classification is one of the most important field in machine learning/computer vision and one other most important challenge is the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) where each year review the new classification algorithms[1].

Problem Statement

The final purpose of this project is to write an algorithm that accepts a file path to an image and first determines whether the image contains a human, dog, or neither.

In general, after a detection, we could have:

- dog detection in the image, return the predicted breed.
- human detection in the image, return the resembling dog breed.
- neither detection in the image, provide output that indicates an error.

Datasets and Inputs

The datasets needed are two: dogs dataset and human dataset.

The dogs dataset is composed by:

- Training: 6680 images
- Validation: 835
- Test: 836
- Total images: 8351
- Classes: 133

The human dataset is composed by 13233 human images.

All the images are resized to 244x244 and normalized before being used with the model.

Solution Statement

The solution of the project follows six main steps.

First, we need to explore the datasets in order to understand how to use them and choose the proper algorithms.

Second, implement a Haar feature-based cascade classifier using OpenCV in order to detect faces in the human dataset.

In the third step, I will use a pre-trained VGG16 model in order to detect dogs in the dogs dataset

Fourth, I will create a LeNet[2] like architecture that uses CNN in order to classify the 133 dogs breeds and have an accuracy greater than 10%.

In the step five, I will use the transfert learning tecquinque in order to a pre-trained ResNet50 architecture and continue the training with the dogs dataset. The minimum accuracy required is 60% on the test set.

Seventh, I will write a custom algorithm that accepts a file path to an image and first determines whether the image contains a human, dog, or neither.

In the last step, I will Test the Algorithm with some random images found online.

Benchmark Model

The model will be compared with different benchmark models in a Kaggle competition (https://www.kaggle.com/c/dog-breed-identification/discussion)

Evaluation Metrics

In order to deal with a multi class classification problem, the evaluation metric that will be used is the negative log- likelihood loss function.

Using this matric, the algorithm will calculate each iteration the distance of a predicted output to the corresponding label.

In this way, the algorithm will learn from it and will adjust the predictions in order to minimize this distance (loss).

Project Design

The solution designed for this project will follow these steps:

- Step 0: Datasets exploration
- Step 1: Detect Humans using a Haar feature-based cascade classifiers
- Step 2: Detect Dogs using a pretrained network
- Step 3: Create a CNN to Classify Dog Breeds (from Scratch) using a LeNet like architecture.
- Step 4: Create a CNN to Classify Dog Breeds using Transfer Learning and a using a ResNet50 architecture.
- Step 5: Write a custom Algorithm that accepts a file path to an image and first determines whether the image contains a human, dog, or neither.
- Step 6: Test the Algorithm with some random images found online.

Reference

1. Olga Russakovsky*, Jia Deng*, Hao Su, Jonathan Krause, Sanjeev Satheesh, Sean Ma, Zhiheng Huang, Andrej Karpathy, Aditya Khosla, Michael Bernstein, Alexander C. Berg and Li Fei-Fei. (* = equal contribution) ImageNet Large Scale Visual Recognition Challenge. IJCV, 2015.
2. https://en.wikipedia.org/wiki/LeNet