Dog Identification and Classifier using Pytorch

Machine Learning Engineer Nanodegree Capstone Proposal

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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 difference one to another by a lot of parameters such as high, size, kind of employment, etc...
Automatic image classification is one of the major topics in the research and application field. This category of techniques provides essential components for applications such as auto-pilot systems, product quality control, retail, radiography, other scientific research, etc. Automatic image classification is commonly achieved by a convolutional neural network (CNN), a deep learning framework. The motivation for proceeding with this project is to learn and practice using a convolutional neural network in image classification, starting with dog breeds. The ultimate goal is to develop a modified deep learning model for interpreting seismic reflection maps for auto-identification of natural or artificial features.

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 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 an output that indicates an error.

Datasets and Inputs
The datasets needed are two: dogs dataset and human dataset. The dogs' dataset is composed of :
• Training: 6680 images
• Validation: 835
• Test: 836
• Total images: 8351
• Classes: 133
The human dataset is composed of 13233 human images. All the images are resized to 244x244 and normalized before being used with the model. The majority of the images contain

a single portrait of a dog of the corresponding breed. However, the dataset contains a small portion of images that include both dogs and humans, and other animals like cows and sheep. The challenge is how to successfully detect whether there is a dog in the image and how not to identify other animals or humans like dogs or vice versa.

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 dog's dataset
Fourth, I will create a ResNet like architecture that uses CNN in order to classify the 133 dogs breeds and have an accuracy greater than 10%.
In step five, I will use the transfer learning technique in order to a pre-trained ResNet50 architecture and continue the training with the dog's 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 benchmark for the model can be referenced to the Kaggle leaderboard for dog breed identification competition. The target for this model is to reach a multiclass loss score of less than 0.01, which is in the top 100 of the competition. The other benchmark will be 90% prediction accuracy.

Evaluation Metrics

This project will implement the same evaluation metrics as defined by the Kaggle dog breed identification competition, which is a multi-class log loss between the predicted probability and the observed target. The multi-class log loss measures the performance of a classification model where the prediction input is a probability between 0 and 1. In this proposed dog breed classifier, the output will contain an array with 133 probability values of how likely the supplied image belongs to each of the 133 breeds. Therefore, the multi-class log loss metric is perfect for this project. The goal is to minimize the multi-class log loss, optimally to zero. The other metric is the accuracy of the prediction, which is naturally the most straightforward metric for the nature of this project.

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 pre-trained 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 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.

References

1. https://towardsdatascience.com/an-overview-of-resnet-and-its-variants-5281e2f56035
2. https://docs.opencv.org/3.4/db/d28/tutorial_cascade_classifier.html