Dog Breed Classifier

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Domain Background

Every day more and more people get familiar with the power of image classification and subsequent alterations, whether they are aware of it or not. Using snapchat and/or instagram A.R. filters require complex underlying neural networks built upon training on millions, and in somes cases **billions**, of images. Humans have integrated these tools to achieve things such as dog filters, recognition of faces in photo galleries.

Problem Statement

The Fédération Cynologique Internationale (FCI) [1], also known as the World Canine Organization, states there are at least 360 officially recognized dog breeds around the globe. With this many breeds, a human can't possibly be able to keep up with most dog breeds. Of course most people are able to recognize the Poodles and Chihuahuas, but what about the American Staffordshire Terriers? And the Lancashire Heelers? And what about the Kintamani-Bali dogs? That's too much for our monkey brains to remember. This is where A.I. can help us.

Project Outline (Goal)

The goal of the project will be to build an image classification model, in which images of dogs are classified based on their breeds. If the image of a human is provided instead, it will approximate the dog breed that looks the most similar. It will be using CNNs (Convolutional Neural Networks) to achieve this purpose (Fig. 1).

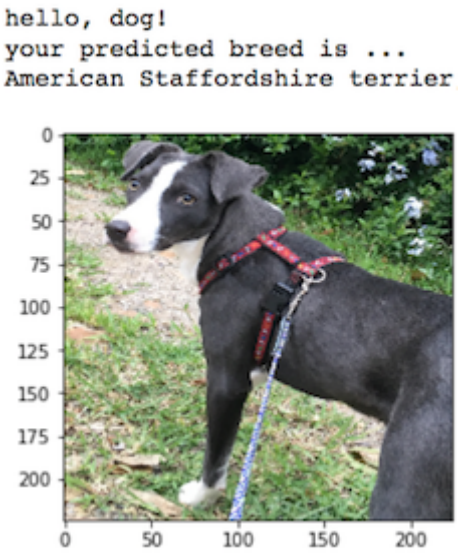


Fig. 1. Dog breed classification example.

Datasets and Inputs

The base human and dog datasets are also provided in the project's repository, consisting of **13233 samples** of image data for the human dataset and **8351 samples** for the dog dataset. Each image consists of one or more of the species it is supposed to portray. For example, an image may contain more than one human face for the human dataset.

There is a relatively high amount of class imbalance in the dog dataset, as shown by the graph below (Fig. 2). Although the average of class sizes (number of images in a class) is around 50, there are still classes with as high as 77 and as low as 26 images:

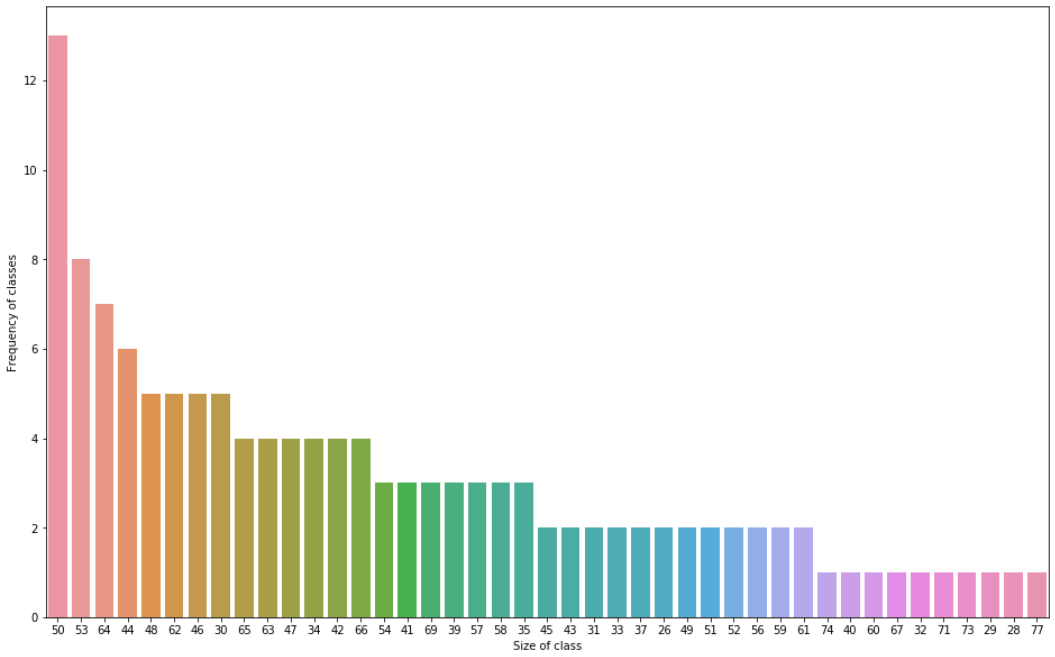
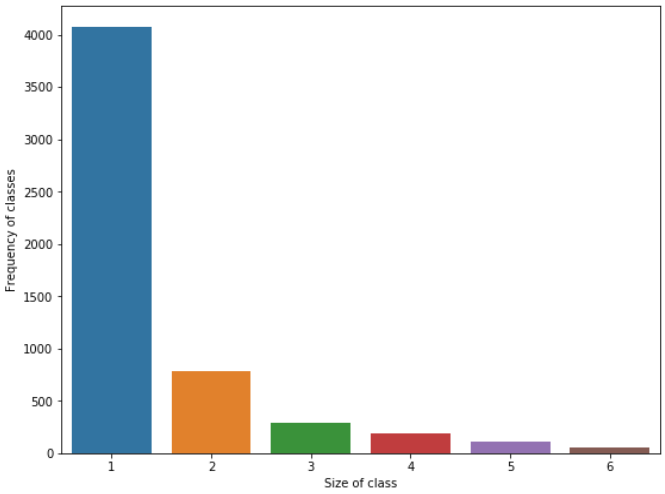


Fig. 2. Graph showing class imbalance in the dog dataset

The human dataset also presented a relatively high amount of class imbalance, but in a less significant manner. Here, classes are represented by names of people, and most people only have one picture in the dataset. So there is almost an insignificant amount of distribution between other classes.



The dog dataset can be obtained via the following link:
https://s3-us-west-1.amazonaws.com/udacity-aind/dog-project/dogImages.zip

The human dataset can be obtained via the following link:
http://vis-www.cs.umass.edu/lfw/lfw.tgz

Project Design

This project will be built by following the steps provided in this github repository. The final goal will be to have a working prediction model that can accurately classify dog breeds from different images of dogs, as well as approximate dog breeds to human faces.

Given an image, the model will first try to verify if the image is a dog or a human. It will try to detect a human face with the OpenCV Haar feature-based cascade pre-trained classifier [2]. The algorithm will then operate under the following rules:

- If a dog is detected in the image, it will return the predicted breed.
- If a human is detected in the image, it will return the resembling dog breed.
- If neither is detected in the image, it will provide output that indicates an error.

The project notebook will contain a model built from scratch using PyTorch convolutional neural networks, and a transfer learning model, using the pre-built CNN VGG-16 [3] for image recognition (Fig. 3).

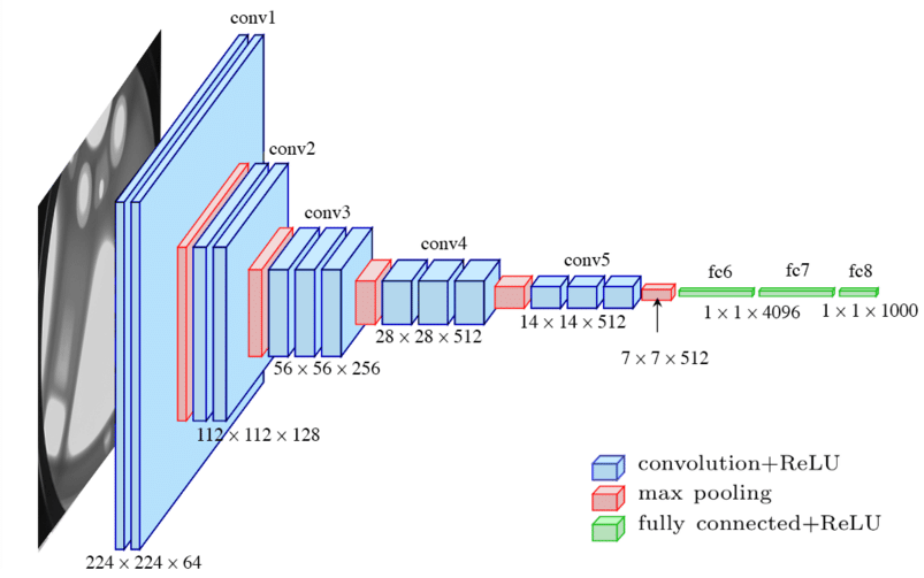


Fig. 3. The standard VGG-16 network architecture

Benchmark Model

The model will be evaluated and compared to the model created by Whitney LaRow, Brian Mittl, Vijay Singh, documented in the Stanford article Dog Breed Identification [4]. Their model achieved a top accuracy of 90% in identifying dog breeds, which is already a pretty high score for such a complex problem.

Evaluation Metrics

The model will be tested on a section of the initial dataset, reserved for testing. Accuracy will be calculated by dividing the number of correct guesses of breeds by the number of total guesses within the testing set.

Another way in which the model will be tested is by selecting images randomly and running detection on them. The project notebook will contain these tests, along with their expected outcomes. The following image contains an example of a test and its respective output (Fig. 4):

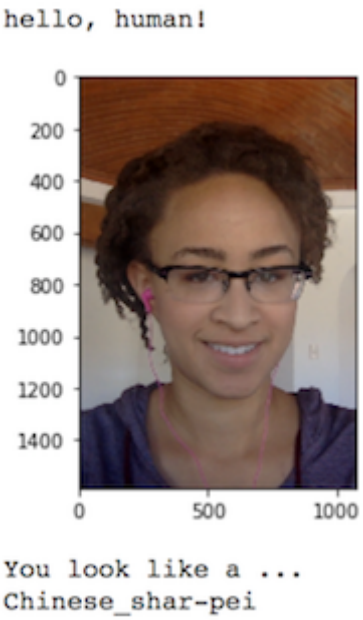


Fig. 4. This is an example of a test and its respective output:

References

[1] Fédération Cynologique Internationale (FCI): http://www.fci.be/en/

[2] Haar feature-based cascade classifiers:
https://docs.opencv.org/master/db/d28/tutorial_cascade_classifier.html

[3] VGG16 – Convolutional Network for Classification and Detection :
https://neurohive.io/en/popular-networks/vgg16/

[4] Dog Breed Identification:
https://web.stanford.edu/class/cs231a/prev_projects_2016/output%20(1).pdf