PREDICTING DOG BREEDS USING CONVOLUTIONAL NEURAL NETWORKS

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1.Domain

Image classification is a growing field with recent breakthroughs along with an increase of computing power and new methods developed in Convolutional Neural Networks such as Transfer Learning[1] or models that are developed with huge datasets. For example, ImageNet developed with more than 14 million images for object detection for more than 20.000 categories[2]. Breed classification is a problem that comes from this domain and aims to classify dog breeds. There was even a Kaggle competition about that![3] Certain models that can be used as pre-trained models are behind this breakthrough as state-of-the-art models such as ImageNet, VGG-16, ResNet50 and EfficientNet[4].

I would like to work in this field since I am relatively inexperienced in image classification and see this as a way to improve my skills. The problem is also interested since it is harder to solve than binary problems with two-classes.

2. Problem

The problem I would like to solve is classifying dogs according to their breeds that can be used in an app or website. The end product (our model) has two main tasks: estimate the dog's breed and in the case of a human face, estimate the most similar dog breed to that person. If the image is neither of them, the model will return an error.

3. Dataset

Since the project is suggested by Udacity, datasets are given.

For the dogs' dataset, there are 8351 images with 6680 of them for training, 836 of them for testing and 836 of them for validation. Data is not balanced (with some classes have more than 1% of the observations while others have less than 0.5%) due to the variety of dog breeds and images are not standard with one format. There are also various backgrounds.

For the humans' dataset, we have 13233 images with 250x250 size.

4. Proposed Solution

Besides using pre-trained VGG16 which is required at the project rubric for detecting dog images, I will also try at least one other pre-trained model along with a custom CNN architecture to find the best model.

[1] https://www.tensorflow.org/tutorials/images/transfer_learning
[2] http://www.image-net.org/
[3] https://www.kaggle.com/c/dog-breed-identification/overview
[4] https://github.com/onnx/models#image_classification

I will first try to detect human images using a pre-trained model then detect dog images and lastly classify according to dog breeds.

5. Benchmark to Beat

Our benchmark is surpassing random guess with less than 1% accuracy.

10% accuracy which looks low, however reasonable given the high number of dog breed categories and success comparing to random guess.

6. Evaluation

Different evaluation metrics will be checked such as accuracy, precision, recall and F1 score to find the optimal model. Since this is an imbalanced dataset, I will also consider multi-class log loss.

7. Project Design

a) Import dataset and libraries

b) Load images

c) Pre-processsing: data augmentation, standardizing pixels for RGB values.

c) Detect human faces with a model similar to VGGFace2

d) Detect dogs

e) Classify dog breeds using: VGG-16, ImageNet and one custom model

f) Combine the models to produce the final output