Machine learning Engineer

Capstone proposal

Title: Dog Breed Classifier

1. Domain Background:

This project uses machine learning, computer vision and deep learning techniques to predict the correct dog breed in the image. This is a classification problem. There are various breeds of dogs and classifying them just by looking is a tedious task. Hence the goal here is to predict what breed of the dog species the dog in the image belongs to.

A convolutional neural network (CNN, or ConvNet) is a class of deep, feed-forward artificial neural networks that has successfully been applied to analyzing visual imagery. Convolutional networks were inspired by biological processes in which the connectivity pattern between neurons is inspired by the organization of the animal visual cortex. Convnets can be essentially used in image recognition of most of the world problems because of the accuracy and standard of the results it provides.

Earlier research and academic works included:

1. Stanford - https://web.stanford.edu/class/cs231a/prev_projects_2016/output%20(1).pdf

2. O. M. P. et al. Cats and dogs. 2012 IEEE Conference on Computer Vision and Pattern Recognition, 2012.

2. Problem Statement:

The main objective of the project is to find the breed of the dog in the image. Dogs have similar features and appearances making it a tough task for their classification. Moreover, there are locally bred and cross breeds which are totally unaccounted for in the species chart. Hence this is more challenging when providing an image that is totally not in the species' list.

Furthermore, solving this challenge opens the way for more fine grained classification problems to be solved (i.e.) breeds of cats, horses etc. or any other problem involving a vast range of variations also can be classified. In the real world, this sort of classifying and identifying can be a game changer with newer recognition services coming every day. This sort of classification finds applications in healthcare, industries, security services etc. Breed classification moreover helps veterinarians to correctly identify the breed and provide ailments and treatment in case of an injury.

This particular problem is taken from Kaggle. Competition is open as of 02-18-2018.

Competition link: https://www.kaggle.com/c/dog-breed-identification

Summarizing:

Task: Classifying dog breed in the image

Target: Correctly identified dog breed.

3. Datasets and inputs

Dataset obtained from Kaggle competition:

Training: https://www.kaggle.com/c/dog-breed-identification/download/train.zip

Training labels: https://www.kaggle.com/c/dog-breed-identification/download/labels.csv.zip

Testing: https://www.kaggle.com/c/dog-breed-identification/download/test.zip

The dataset is a subset from Stanford's ImageNet competition focusing purely on the class of canines. The dataset contains 10222 training images and 10357 testing images each belonging to one of the 120 dog breeds.

The training set consists of images with unique ids. Each image has a label linked to it.

Each image is a RGB coded and is of variable size which we can resize in the course of solving the problem.

4. Solution Statement:

To solve the above problem of image classification, a convolutional network is best applicable in terms of accuracy and reliability. Unlike traditional machine learning algorithms, convolutional neural network looks for individual pixel information and hence it promotes to the correctness of the classification and prediction. Various predefined models are available for a convolutional network. The famous one being AlexNet (Alex Krizhevsky), VGGNet etc. The state of the art network is the ResNet by Microsoft. For competition purposes, let us consider building our own network from scratch for this problem. A sequential model with Keras using Tensorflow background can be implemented for the problem.

5. Benchmark model

A 2012 paper by Liu et. Al[2] attempted dog breed identification using a similar approach. They first use an SVM regressor to isolate the face of the dog. This helped them create a sliding window with all the essential features to make a classification model. With this approach, Liu et. al is able to classify their test dataset with an accuracy of about 90%.

Stanford research team used a convolutional neural network for facial key-point detection on dogs and multinomial logistic regression for classification. Doing so resulted in an accuracy of 50%.

6. Evaluation Metrics:

Kaggle has provided that the evaluation metric for this competition be multi-class log loss.

Log loss:

Log loss measures the performance of a classification model where the prediction input is a probability value between 0 and 1. The goal of our machine learning models is to minimize this value. A perfect model would have a log loss of 0. Log loss increases as the predicted probability diverges from the

actual label. So predicting a probability of .012 when the actual observation label is 1 would be bad and result in a high log loss.

Apart from this other metrics such as accuracy can also be used for evaluation.

7. Project Design

Programming language and libraries

1. Python
2. Tensorflow
3. Keras

Workflow:

1. Data visualization

   Visual representation of the data to find valuable insights.

2. Data preprocessing

   Resizing images to a common width and height, say 32x32x3, do that the model can have similar window for the convolution process.

3. Model engineering

   Creating a new sequential model using Keras, probably with 3 or 4 layers of convolution.

4. Model tuning

   Fine tuning the model on an evaluation test set to improve model accuracy.

5. Testing

   Testing the model on the test set.

7. References

1. Kaggle competition: https://www.kaggle.com/c/dog-breed-identification
2. Stanford CS231a research: https://web.stanford.edu/class/cs231a/prev_projects_2016/output%20(1).pdf
3. J. L. et al. Dog breed classification using part localization. Computer Vision: ECCV 2012, pages 172–185, 2012.
4. O. M. P. et al. Cats and dogs. 2012 IEEE Conference on Computer Vision and Pattern Recognition, 2012.