

# Machine Learning Engineer Nanodegree

## Capstone Proposal

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Proposal: Dog Breed Classifier (CNN)

### Domain Background

Dog breed classification is really challenging due to the minimal inter-class variations. A Convolutional Neural Network (CNN) model can be used for this task.

Due to the existence of a huge variety of species and organisms, research on technology to classify them is crucial. Hsu, David from Stanford University published a paper about using convolutional neural networks (CNN) to classify dog breeds.

### Problem Statement

The aim of the project is to build a pipeline to process real-world, user-supplied images. A CNN will be used to predict the breed of a dog from the input image. Given an image of a dog, the model will identify an estimate of the canine's breed. If supplied an image of a human, it will identify the resembling dog breed.

### Datasets and Inputs

The datasets required for this project was provided by Udacity. The dataset is already organized into train, test and validation. There are 13233 human images and 8351 dog images. The dog dataset contains 133 classes i.e. breeds. The data is mostly evenly distributed. We will resize the images to 224x224 pixels to be used in our CNN model. The images in the dog dataset are labelled according to their breed. The images in the LFW dataset are labelled according to the name of the person.

## Solution Statement

At First, we need to detect human faces using OpenCV's Haar feature-based cascade classifiers.

Then we will use a pre-trained VGG-16 model to detect dog images. We will then create a CNN from scratch which must attain a test accuracy of at least 10% since the task is really challenging due to the difficulty in distinguishing certain breeds. Finally, we will use transfer learning with ResNet-50 to improve our CNN. The improved model must attain at least 60% accuracy on the test set.

## Benchmark Model

We will use the ResNet-50 model against the CNN model made from scratch. The ResNet is a state-of-the-art architecture that has been trained on a subset of the ImageNet database which contains 1.2 million images with 1000 classes.

## Evaluation Metrics

Accuracy will be used to evaluate both of the solution model and benchmark model. Accuracy will be calculated with the help of the confusion matrix.

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN}$$

TP: True Positive

TN: True Negative

FP: False Positive

FN: False Negative

## Project Design

The workflow for this project can be described as follows:

1. Import Datasets
2. Detect Humans using OpenCV's Haar feature-based cascade classifiers.
3. Detect Dogs using a pre-trained VGG-16 model.
4. Create a CNN to Classify Dog Breeds (from Scratch)
5. Create a CNN to Classify Dog Breeds (using Transfer Learning)
6. Write an Algorithm to return the breed if a dog is detected or the resembling breed if a human is detected

## 7. Test the Algorithm

## References

1. Hsu, David. *"Using Convolutional Neural Networks to Classify Dog Breeds"*, Stanford University.  
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<https://s3-us-west-1.amazonaws.com/udacity-aind/dog-project/lfw.zip>
3. Dog Image Dataset, Udacity  
<https://s3-us-west-1.amazonaws.com/udacity-aind/dog-project/dogImages.zip>
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