

# Convolutional Neural Network for Dog Breed Classification

## Udacity Machine Learning Engineer Nanodegree Capstone Proposal

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### 1 Domain Background

For computer vision tasks, such as a dog breed classification, an algorithm mostly used is a Convolutional Neural Network, or CNN for short, which is a model that extracts features, like texture and edges, from spatial data.

The history behind this algorithm started during the 1950s, but it is around the year 2012 that CNNs saw a huge surge in popularity after a CNN called AlexNet achieved state-of-the-art performance labeling pictures in the [ImageNet](#) challenge. Alex Krizhevsky et al. published the paper "ImageNet Classification with Deep Convolutional Neural Networks" describing the winning AlexNet model.

### 2 Problem Statement

The purpose of this project is to use a Convolutional Neural Network to classify dog breeds using images as input. For images that contain a human instead of a dog, the algorithm should display which dog breed resembles the human in the picture.

### 3 Datasets and Inputs

There are two datasets for this project: one is a dog dataset containing 8351 images of 133 different dog breeds, and the other is a human dataset consisting of 13233 photos of 5749 different people. The dog dataset is divided in train, validation and test datasets.

### 4 Solution Statement

Three main algorithms will be used for this project: a human face detector, a dog detector, and a dog breed classifier. More about each of these algorithms is described below.

- Human Face Detector: an OpenCV's implementation of Haar feature-based cascade classifier to detect human faces in images. The pre-trained face detector is stored as XML file on [GitHub](#).
- Dog Detector: a pre-trained VGG-16 model with weights that have been trained on [ImageNet](#), a very popular dataset used for image classification and other vision tasks.
- Dog Breed Classifier: a pre-trained VGG-11 model on which the last layer is altered to output 133 classes and trained further using the dog dataset mentioned earlier.

## 5 Benchmark Model

The benchmark for the dog breed classifier will be a simple CNN model designed from scratch that will be compared to the final CNN obtained from transfer learning using a pre-trained VGG-11 model.

## 6 Evaluation Metrics

The metric to evaluate the quality of the classifier is the accuracy of the dog breed predictions.

## 7 Project Design

The workflow for this project is as follows:

- Data exploration: verify the information contained in the datasets.
- Preprocessing: crop images to make sure all have the same size and normalize the input data.
- Training and testing: create algorithms to train all three models mentioned earlier.
- Refinement: use transfer learning to improve accuracy of dog breed classifier.
- Performance evaluation: observe classification accuracy as the performance metric.