

# Machine Learning Engineer Nanodegree - Capstone Proposal

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## Dog Breed Classifier

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### Domain Background

The automatic classification of images is a fascinating problem, the objective is to generate a fully automated process to add metadata to digital images to group them based on common features, the process is also known as automatic image annotation. This kind of classification tasks were usually assigned to humans but with the advent of new and more powerful technologies like machine learning and deep learning and almost infinite computer power provided by cloud computing we can automate this kind of tasks in an scalable way.

One field of interest is the classification of dog breeds, the Fédération Cynologique Internationale officially recognizes 360 breeds officially. However for non specialized people can be somewhat difficult to distinguish one from another. Have an automatic application to classify a dog by their breed can potentially uncover if is or not a pure breed and even can help to identify his ancestry. One interesting thing about data analysis and classification using AI is that it can uncover relationships or causation, let's say for example that analyzing the picture of a dog we can infer their ancestry or breed and predict how easy or hard to train is.

### Problem Statement

Pets and especially dogs are an essential part of our lives, however how well we know our furry partners? Are we able to identify the breed of our dogs? or their ancestry just by seeing them? It can be difficult for a regular person because it is not easy to differentiate and associate the different visual characteristics of a dog. What about seeing the pictures of different dogs? Are we able to identify if they are of the same breed or related to some degree? This kind of analysis could take time and resources if we do it manually. With machine learning, this could be done in milliseconds in a repeatable and scalable manner. We can establish metrics to measure the predictions' accuracy based on the number of right guesses and potentially measure the degree of relationship between dogs.

### Datasets and Inputs

We will be using two datasets of images, the first one filled with dog images and the second one with people photos. The objective is to not only classify dog breeds but differentiate between persons and pets. Udacity provided the human dataset. While it shows their real names and faces, they are from public figures and easily available for anyone, to avoid privacy concerns.

- [Dog dataset] (<https://s3-us-west-1.amazonaws.com/udacity-aind/dog-project/dogImages.zip>) 8351 images (train: 6680, test: 836, valid: 835)
- [Human dataset] (<https://s3-us-west-1.amazonaws.com/udacity-aind/dog-project/lfw.zip>) 13234 images

### Solution Statement

The problem is a multiclass classification problem. Artificial neural networks are very effective solutions for high dimensionality problems; they are theoretically complex; however, frameworks like TensorFlow and others can help ease the development of solution models. The solution algorithm will use Convolutional neural networks, and it would be structured in two main parts:

- Feature learning. This part consist of the convolutional layers and pooling layers
- Classification. This part is in charge of classifying the images on categories extracted by the features layer

### Benchmark Model

It is required that the CNN model has an accuracy of at least 10% based on our test data set; we should require at least 83 right guesses. Also, comparative data about the scratch and transfer learning model would be collected.

### Evaluation Metrics

For this project, Categorical Crossentropy will be used to evaluate the effectiveness of the model. This approach is better suited to multiclass problems since it assigns a probability to each class. It is a good fit for this specific case.

### Project Design

The project would generate the model using the following steps:

- Step 1: Import the datasets into the Jupyter environment.
- Step 2: Implement human image recognition.
- Step 3: Implement dog image recognition.
- Step 4: Create a CNN from scratch, and train, validate and test that model.
- Step 5: Create a CNN to classify dog breeds using transfer learning.
- Step 6: Implement an algorithm combining those models.
- Step 7: Evaluate the following test cases:
  - If a human is detected, return a resembling dog breed.
  - If a dog photo is detected, return their breed.
  - If the image cannot be classified, return an error.

### References

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