**Machine Learning Engineer Nanodegree**

## Capstone Proposal

Ahmed Abdelmalek

Jun 1st, 2018

## Proposal

### Domain Background

Ornithology is a branch of zoology that concerns the study of birds. Several aspects of ornithology differ from related disciplines, due partly to the high visibility and the aesthetic appeal of birds. The science of ornithology has a long history and studies on birds have helped develop several key concepts in evolution, behavior and ecology such as the definition of species, the process of speciation, instinct, learning, ecological niches, guilds, island biogeography, phylogeography and conservation.

### Each species' seasonal movements become evident when comparing its distribution from various times throughout the year. We can discover the precise migratory paths followed by Neotropical migrants, Manual observation is very costly and time consuming, So automatic alternatives should solve these problems

### Problem Statement

Classifying organisms, such as specific bird species, is a challenging task and active machine learning research field. Current [state-of-the-art](https://www.researchgate.net/publication/300717574_Improved_Bird_Species_Recognition_Using_Pose_Normalized_Deep_Convolutional_Nets) computer vision algorithms can achieve a maximum of 85% accuracy with most around 60%. Our objective was to try to implement our own machine learning and computer vision algorithms to correctly distinguish and classify 200 bird species using Caltech dataset, I will try Softmax regression, an SVM, and a CNN with transfer learning to see what accuracy we could achieve in classifying bird species and whether we could identify specific features on the birds.

### Datasets and Inputs

I will use a dataset from caltech competition [here](http://www.vision.caltech.edu/visipedia/CUB-200.html), It contains:

* 200 categories of bird species
* 6,033 total number of images
* Other information: labeled visible bird parts (in pixels), binary attributes, bounding box of bird

**Solution Statement**

I will try to solve this problem using various deep learning techniques and machine learning algorithms, I’ll focus on the deep neural networks like CNN and MLP also I may try using SVM

### Benchmark Model

I will try **Random choice** where we predict probability for a fish to blong to any classof the eight classes for the naïve benchmark.

I may try also **K-nearest neighbor classification** where model was trained on the color histogram of the images with Euclidean distance as distance metric.

### Evaluation Metrics

We will use **multi-class logarithmic loss**(aka categorical cross entropy) as our evaluation metric

### Project Design

I will start with the simple Work Flow for image classification and species detection problems

1. Data input
2. Bird detection

* I will search for a good bird detection technique

1. Crop the bird pixels

* I will do image segmentation for the part that contains the bird

1. Extract features
2. Train model

* I will use some models like CNN and MLP with different architecture
* I will try to use transfer learning

1. Evaluation

* I will use categorical crossentropy as evaluation metric

**References**

* <http://www.vision.caltech.edu/visipedia/CUB-200.html>
* <https://www.kaggle.com/c/multilabel-bird-species-classification-nips2013/discussion>
* <http://cs229.stanford.edu/proj2017/final-posters/5124475.pdf>
* <https://en.wikipedia.org/wiki/Ornithology>