# Machine Learning Engineer Nanodegree

## Capstone Proposal

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## Proposal

### Domain Background

Nearly half of the world depends on seafood for their main source of protein. In the Western and Central Pacific, where 60% of the world's tuna is caught, illegal, unreported, and unregulated fishing practices are threatening marine ecosystems, global seafood supplies and local livelihoods. The Nature Conservancy is working with local, regional and global partners to preserve this fishery for the future.

The Conservancy is looking to the future by using cameras to dramatically scale the monitoring of fishing activities to fill critical science and compliance monitoring data gaps. Although these electronic monitoring systems work well and are ready for wider deployment, the amount of raw data produced is cumbersome and expensive to process manually.

The Nature Conservancy starts a competition on Kaggle to develop algorithms to automatically detect and classify species of tunas, sharks and more that fishing boats catch, which will accelerate the video review process. Faster review and more reliable data will enable countries to reallocate human capital to management and enforcement activities which will have a positive impact on conservation and our planet.

### Problem Statement

For this competition, we have to detect which species of fish appears on a boat, based on images captured from boat cameras of various angles.
Our goal is to predict the likelihood of fish species in each picture from the given Eight categories: 1. Albacore tuna 2. Bigeye tuna 3. Yellowfin tuna 4. Mahi Mahi 5. Opah 6. Sharks 7. Others (meaning that there are fish present but not in the above categories) 8. No Fish (meaning no fish in the picture).

Each image has only one fish category, expect that there are sometimes very small fish in the pictures that are used as bait.

## Datasets and Inputs

For this competition we are given around 4000 images for training and 1000 images for testing captured from boat cameras of various angles.

Eight target categories are available in the dataset
1. Albacore tuna
2. Bigeye tuna
3. Yellowfin tuna
4. Mahi Mahi
5. Opah
6. Sharks
7. Others (meaning that there are fish present but not in the above categories)
8. No Fish (meaning no fish in the picture).

The dataset was compiled by The Nature Conservancy in partnership with Satlink, Archipelago Marine Research, the Pacific Community, the Solomon Islands Ministry of Fisheries and Marine Resources, the Australia Fisheries Management Authority, and the governments of New Caledonia and Palau.

## Solution Statement

In this project we use deep learning approach to tackle the problem of classifying the fish in the given image. Here, for this problem we train a Convolutional Neural Network using transfer learning. Transfer learning is a process that focuses on storing knowledge gained while solving one problem and applying it to a different but related problem.
There are some pretrained network on imagenet dataset such as Inception-V3, RESNET 50, VGG-16, VGG-19 whose weights can be used for developing the solution of this problem.

## Benchmark Model

For the Benchmark, we will use a CNN created from scratch using Conv2D layers with increasing numbers of filters to progressively detect more complex patterns. Between the Conv2D layers, we will insert MaxPooling and dropout layers to reduce the input dimensions and finally the fully connected Dense layer(s).
We train this model on the training set and then evaluate the predictions made by the model on the test set using the log-loss function.

## Evaluation Metrics

The Evaluation Metrics used for this Kaggle competition is multi class logarithmic loss.

$$logloss = -\frac{1}{N}\sum_{i=1}^{N}\sum_{j=1}^{M} y_{ij}\, log(p_{ij})$$

Where N is the number of images in the test set, M is the number of image class labels, log is the natural logarithm, $y_{ij}$ is 1 if observation $i$ belongs to class $j$ and 0 otherwise, and $p_{ij}$ is the predicted probability that observation $i$ belongs to class $j$ .

The submitted probabilities for a given image are not required to sum to one because they are scaled prior to being scored (each row is divided by the row sum). In order to avoid the extremes of the log function, predicted probabilities are replaced with $max(min(p,\ 1-10^{-15}),\ 10^{-15})$ .

## Project Design

### Steps:-

1.First, we import the required datasets for the fish classification.

2. Made some visualization like the distribution of various categories of fishes over the training dataset, the quality of images, color distribution in various images etc.

3.Separate the dataset into training, testing and validation sets and do some required preprocessing like converting the images into tensors, normalization etc.

4.We create a benchmark model from scratch, using a mixture of Conv2D, MaxPooling2D, Dropout and Dense layers.

5.Train the benchmark model on training set and then evaluate its predictions using log-loss.

6.Then, we create other model(s) with transfer learning approach using the pretrained models like Inception-V3, RESNET 50, VGG-16, VGG-19 (We create one or more models as computationally feasible). We extract the features from the images using pretrained network(s) and the use a fully connected dense layer with 8 nodes in the end (as there are 8 categories of fishes).

7.We fine tune the model using different optimizers and adjusting the various parameters.

8.Finally we compare our results with the result of benchmark model and decide whether our model made improvements or not.

**References:**


- https://www.kaggle.com/c/the-nature-conservancy-fisheries-monitoring
- https://www.conserveca.org
- Udacity's Deep Learning Lessons - MLND
- https://www.nature.org
- https://en.wikipedia.org/wiki/Transfer_learning