Domain Background:

VIGIA project [1] is a project based in Mexico aimed to build automatic surveillance of natural areas. With the use of unmanned aircraft such as drones and computer vision based systems, the project aims to protect natural areas and log impacts of climate change and human activities on the flora and fauna.

Specifically in this competition, the task of recognition of cactus from an aerial imagery attempts to lead the way in protecting the flora in natural areas. Aerial imagery taken from unmanned aircraft can be fed into a system which utilizes state-of-the-art computer vision and machine learning methods to assist in the recognition task.

Problem Statement:

Climate change and human encroachment to natural areas especially spread across a vast area of land (often remote) is difficult to be surveyed manually. Such threats in these areas can be recognized and monitored in an efficient and resourceful manner with imagery obtained from unmanned air vehicles and analyzing them.

The problem statement of this competition is to predict whether an image captured from the unmanned aircraft is a columnar cactus species (*Neobuxbaumia tetetz*o) or not. This is a two class problem where the predictions will be whether an image contains the columnar cactus or not.

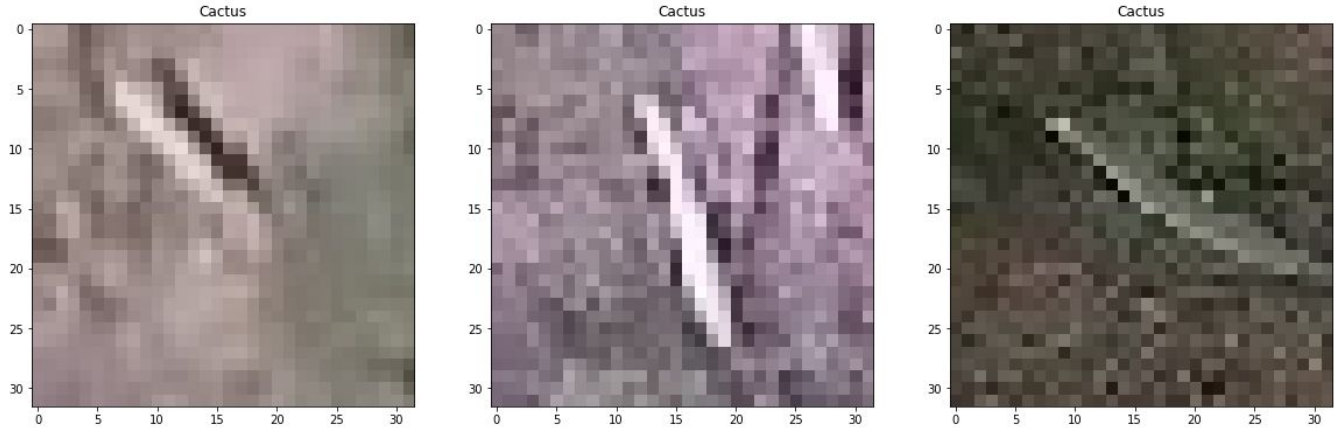
Datasets and Input:

The aerial cactus identification competition [2] contains dataset with large number of 32x32 thumbnail images of aerial photos of cacti. The image dataset has been resized for uniformity. The dataset consists of train and test images in **train** and **test** folders respectively. **Train.csv** contains two columns **id** and **has_cactus**. The **id** column has the image name which can be fetched from the **train** folder. The **has_cactus** column is training image label, 1 if it has a cactus else 0. The dataset in file **train.csv** looks like the following.

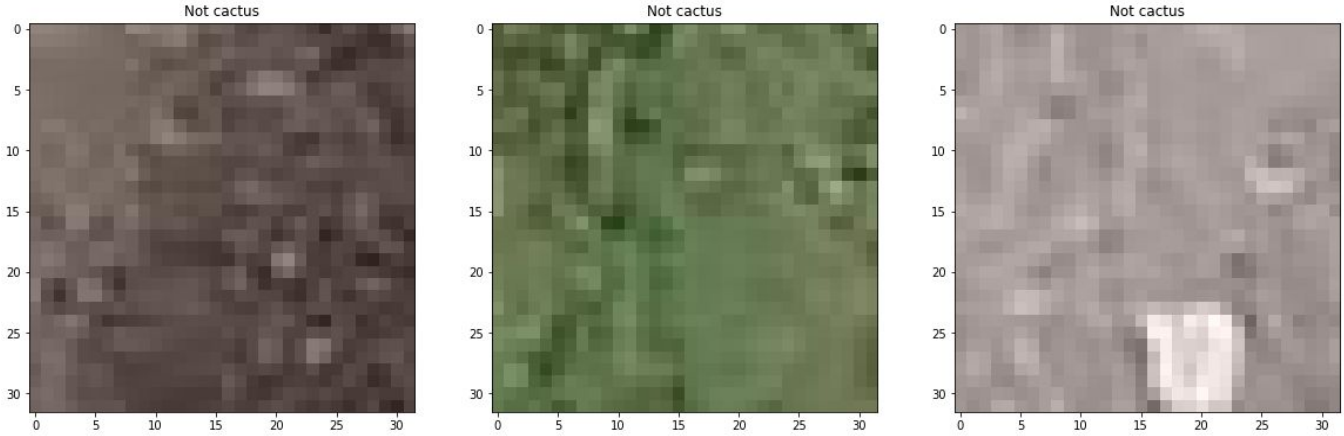
	id	has_cactus
8157	752cac7c99146380d294f6e9a28a5ce8.jpg	1
14994	da6c035fa98200ef8f7b508ce841cacc.jpg	1
698	0a041a57e4e8e5c40b4c72ff115b55c0.jpg	1
13983	cb75a6717a7392b6fe86b5b405dd0861.jpg	1
2034	1c74dcabab5208ed2b8bddbf49ee1d22.jpg	1

The dataset can be downloaded from the link in [3].

Some sample images of images having cactus are shown below:



Some sample images of images having no cactus are shown below:



Solution Statement:

- The classification algorithm will consists of neural network model built using layers of convolution, pooling, dropout ,etc. and applied to image data from the dataset. Model trained on the training images will be used to get prediction accuracy results on the test images.
- To account for shear, rotation of images, the training images will also be augmented.
- In addition, model tuning will be done using batch normalization, L1/L2 regularization methods. Also, well established pre-trained models such as MobileNet will also be explored.

Benchmark Model:

The benchmark model will be a simple CNN (convolutional neural network) model upon which improvements will be done using various processes mentioned in the solution statement. Also, results from [4] show a very high recognition accuracy of 95% on the validation set of columnar

cactus identification tas with an image dataset of more than 10, 000 images. These two models, one a simple CNN and another benchmark of 95% accuracy will be used to assess the quality of the machine learning model.

Evaluation Metrics:

The area under the ROC (Receiver Operating Characteristics) curve (AUC) between the predicted probability of test images and the target labels will be used to evaluate the test data results.

In addition other available metrics such as accuracy, f1-score, precision, recall and confusion matrix will be used to understand the nature of the results.

Project Design:

The project design is as follows:

1. Read the train and test data images
2. Convert the JPEG images to RGB pixel information and convert to floating tensors for use in the neural network (specifically CNN)
3. Re-scale the pixel information from 0-255 to a [0, 1] interval.
4. Apply a simple CNN-based model on the data to get the benchmark model to compare against future improved CNN models.
5. Improved models will optimize on this benchmark model using various measures such as image data augmentation, using batch normalization, regularization techniques, etc.
6. Further well-established image classification models such as VGG16/19, InceptionV3, MobileNet, etc. whichever appropriate will be used to get an even better model.
7. The result to be submitted will be in a *.csv* file and of the format as shown below:
    a. **Id -** *name of the image file in the test folder*
    b. **Has_cactus** - *the predicted class of the image being a cactus (0 or 1)*

References:

[1] https://jivg.org/research-projects/vigia/
[2] https://www.kaggle.com/c/aerial-cactus-identification/data
[3] https://www.kaggle.com/c/13435/download-all
[4] López-Jiménez, Efren, et al. "Columnar cactus recognition in aerial images using a deep learning approach." *Ecological Informatics* 52 (2019): 131-138.