Machine Learning Engineer Nanodegree

Capstone Proposal

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Proposal

Domain Background

The target of this proposal is to differentiate a weed from a crop seedling. The ability to do so effectively can mean better crop yields and better stewardship of the environment.
This project will use a deep learning convolutional neural network for classifying multi-class plant species. This project also includes Image preprocessing for noise removal and image features enhancement for better classification.

Problem Statement

Given the Plant Seedling Dataset, containing 960 unique RGB images of 12 species, an algorithm needs to developed to classify each of the 12 species separately. This model will help us in better crop yielding and environment assimilation.

Datasets and Inputs

The Aarhus University Signal Processing group, in collaboration with University of Southern Denmark, has recently released a dataset containing images of approximately 960 unique plants belonging to 12 species at several growth stages. (https://vision.eng.au.dk/plant-seedlings-dataset/). It comprises annotated RGB images with a physical resolution of roughly 10 pixels per mm.

The goal of the competition is to create a classifier capable of determining a plant's species from a photo. The list of species is as follows:

- ⇒ Black-grass
- ⇒ Charlock
- ⇒ Cleavers
- ⇒ Common Chickweed
- ⇒ Common wheat
- ⇒ Fat Hen
- ⇒ Loose Silky-bent
- ⇒ Maize
- ⇒ Scentless Mayweed
- ⇒ Shepherds Purse

⇒ Small-flowered Cranesbill
⇒ Sugar beet.

The following problem has also been hosted as the Kaggle competition in order to give it wider exposure. (https://www.kaggle.com/c/plant-seedlings-classification)

Files descriptor provided in Kaggle competition

- train.zip - the training set, with plant species organized by folder
- test.zip - the test set, you need to predict the species of each image
- sample_submission.csv - a sample submission file in the correct format

Solution Statement

A deep learning solution will be developed using Tensorflow/Keras model and will be trained using training data.

Specifically using Transfer Learning, an already implemented model will be tuned and modified as per our requirement for minimizing multi-class classification loss, which in turn leads to an increased MeanFScore, mentioned as evaluation criteria in Evaluation Metric. Predictions will be made on test data and will be evaluated.

Benchmark Model

The model with the Public Leaderboard Score of 0.99496 will be used as benchmark score. Attempt will be made so that the score obtained will be among the top 20% of the Public Leaderboard submission.

Evaluation Metrics

As mentioned in the Evaluation matrix for Kaggle competition, submissions are evaluated on **MeanFScore**, given positive/negative rates for each class k, the resulting scores are computed.

$$Precision_{micro} = \frac{\sum_{k \in C} TP_k}{\sum_{k \in C} TP_k + FP_k}$$

$$Recall_{micro} = \frac{\sum_{k \in C} TP_k}{\sum_{k \in C} TP_k + FN_k}$$

F1-score is the harmonic mean of precision and recall

$$MeanFScore = F1 = \frac{2Precision_{micro}Recall_{micro}}{Precision_{micro} + Recall_{micro}}$$

The better the MeanFScore, the better our result.

Project Design

From the problem statement and the dataset, it can be inferred that computer vision will be used to arrive to the solution. CNN deep learning models will be employed for this problem.

Initially image pre-processing will be done enhancing the image features and removing the background noises. This will help us in better image predictions.

After this initial pre-processing is done, data will be randomly split into training and validation set and an CNN model will be implemented in Tensorflow/Keras.

Upon analyzing our dataset best suited pre-trained model will be evaluated using Transfer learning (if possible).

Finally, necessary predictions on the test data will be carried out and will be evaluated.