Machine Learning Engineer Nanodegree

Capstone Proposal

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Proposal

Plant Disease Detection using Pytorch and Fastai

Domain Background

As the world grows in population every year the demand for food is also rising, however a growing threat in the form of plant diseases threatens to worsen the already strained food supply.

Pest and disease induced crop losses have devasted farms across the world but thanks to advances in machine learning farmers can detect diseases early through the use of computer vision in the browser or on a mobile device. Convolutional Neural Networks which a class of deep neural networks for analysis visual imagery have been widely used in image classification problems and their applications have been promising.

Problem Statement

The goal of this project is to fit a Convolutional Neural Network on the data using the Fastai library and Pytorch. I am going to use transfer learning with ResNet, a deep residual learning framework developed at Microsoft in order to achieve accurate classification of the plant images. Transfer learning focuses on storing knowledge gained while solving one problem and applying it to a different but related problem. Resnets have been trained on the imagenet dataset which contains millions of images so their knowledge of those features will be very help in this case.

Datasets and Inputs

The PlantVillage dataset consists of 54303 healthy and unhealthy leaf images divided into 38 categories by species and disease.

The images span 14 crop species: Apple, Blueberry, Cherry, Grape, Orange, Peach, Bell Pepper, Potato, Raspberry, Soybean, Squash, Strawberry, and Tomato. It contains images of 17 fundal diseases, 4 bacterial diseases, 2 mold (oomycete) diseases, 2 viral diseases, and 1 disease caused by a mite. 12 crop species also have images of healthy leaves that are not visibly affected by a disease.

Solution Statement

The solution will be a fastai classification model capable of correctly identifying whether an image contains a specfic plant disease or not with a high accuracy. The model will also be deployed in a web application developed using python and flask for farmers to use.

Benchmark Model

For this problem, the benchmark model will be a resnet-152 pytorch classifier developed by Viridiana Romero Martinez as referenced in her medium article https://medium.com/datadriveninvestor/creating-an-ai-app-that-detect-diseases-in-plants-using-facebooks-deep-learning-platform-pytorch-15faaeb6bec3. The model produced a high accuracy score, 96.1% and the goal is to see if fastai and another resnet can improve on that.

Evaluation Metrics

The model will evaluated on accuracy a common metric for classification problems; it takes into account both true positives and true negatives with equal weight.

Project Design

The project is expected to follow the steps below:

- **Data exploration and preprocessing:** Explore the data by looking at the number of classes and then preprocess it to make it easier for train by resizing every image to (224, 224) and then use the .normalize(imagenet_stats) method from fastai to normalise the dataset based on the stats of the RGB channels from the ImageNet dataset
- **Model selection:** Choose a pretrained model starting with Resnet34 and Resnet50
- **Training and validation:** Train the convolutional neural network on the training set and then fit it on the test/validation set.
- **Summarisation of the results:** Calculate the accuracy and construct a confusion matrix
- **Develop and deploy a web application:** Use python and flask to develop a simple web application for a user to input images which will be classifed by the model and return the results to the user

References

- Original crowdai dataset https://github.com/MichaelGerhard/PlantDiseaseData
- Resnet, https://neurohive.io/en/popular-networks/resnet/
- David Hughes paper, https://arxiv.org/ftp/arxiv/papers/1604/1604.03169.pdf
- Viridiana Romero Martinez's medium article https://medium.com/datadriveninvestor/creating-an-ai-app-that-detect-diseases-in-plants-using-facebooks-deep-learning-platform-pytorch-15faaeb6bec3