Image based Plant Disease Detection

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Introduction

Farmers face several challenges due to plants being affected by diseases which leads to a dip in crop production. Early detection of the disease can aid the farmers in taking the right action.

Problem Statement

- Plant health is important for high yield crop production.
- Farmers face several challenges due to plants being affected by diseases which leads to a dip in crop production.
- Early detection of the disease can aid the farmers in taking the right action.
- Our goal is to detect the right disease based on the plant leaf images.

Methodology

- Dataset : PlantVillage dataset
  - 38 classes of healthy and diseased crop leaf images.
  - Preprocessed according to the architecture.

- Papers on the problem used Support Vector Machines and CNNs to detect and classify the images based on the type of disease and the type of plant leaf in the picture.

- We used AlexNet and GoogleNet to replicate the current state-of-the-art results and compare with them.

Methodology

- Earlier implementations are based on the classical image processing techniques like SIFT, HoG features of the image.

- We used SVM as baseline model.
  - Used RBF kernel with OVR method.
  - Trained different preprocessed data.

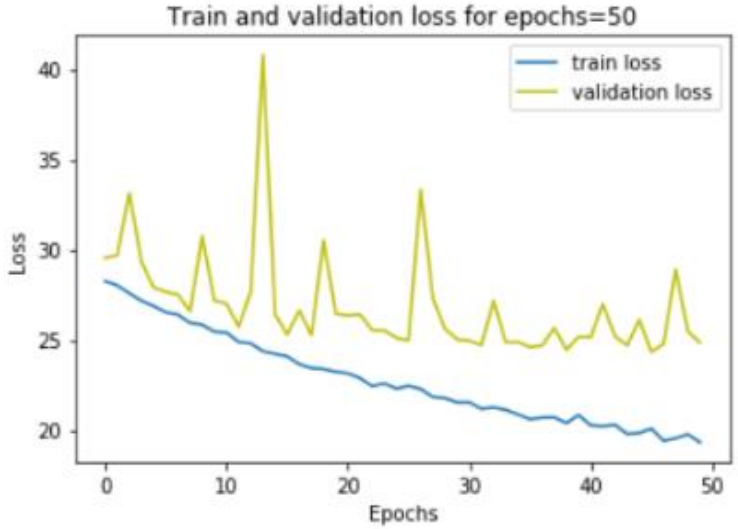
- and experimented on different deep learning architectures like CNNs-AlexNet, GoogLeNet and tried GAN.

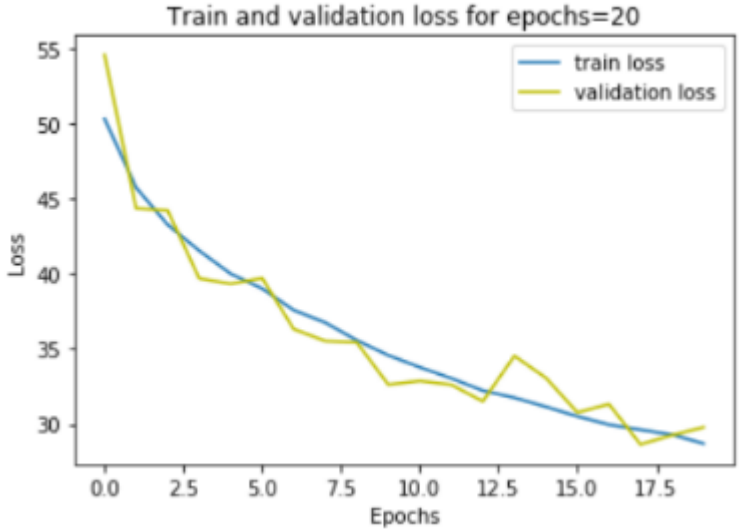
Results

- SVM
  - Trained using RBF kernel
  - Pre-processed dataset
- For 28x28 image:
  - Accuracy: 0.8316
  - Precision : 0.84, Recall: 0.83, F1-Score: 0.84
- For 128x128 image:
  - Accuracy:0.94
  - Precision: 0.94, Recall:0.92 , F1-score:0.93

Results

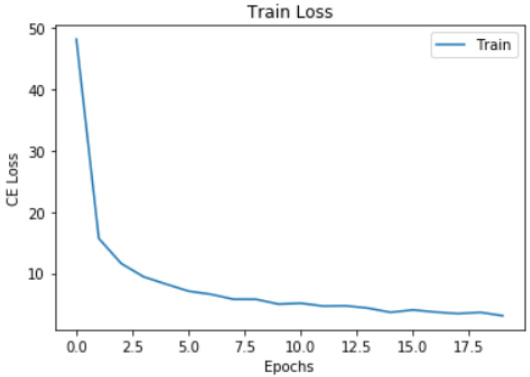
- CNN with dataset without augmentation Test Accuracy = 0.92
- with augmentation Test Accuracy = 0.93

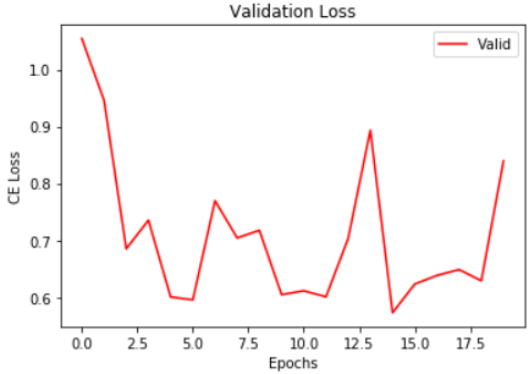




Results

- AlexNet with Transfer learning: changed the classifier and trained for 20 epochs.





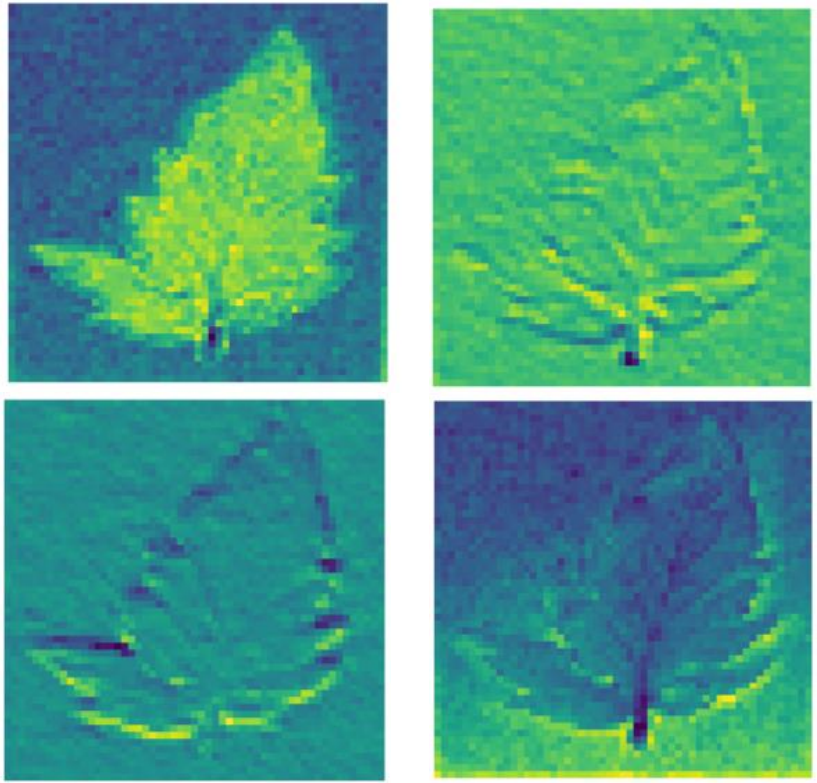
Accuracy: 0.91

- AlexNet from Scratch: loss is not converged as fast as pretrained model.

Accuracy: 0.87

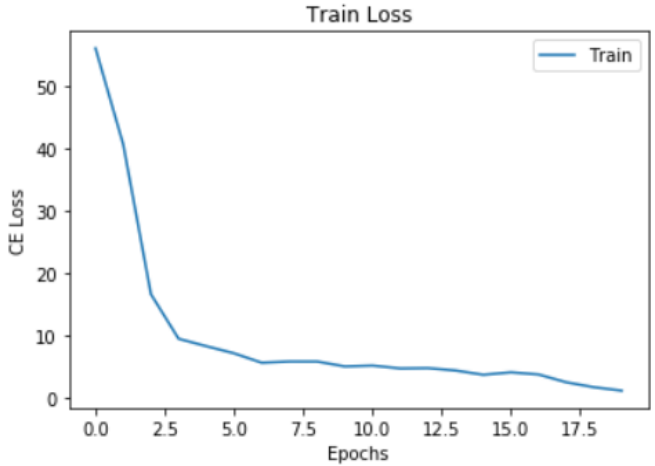
Results

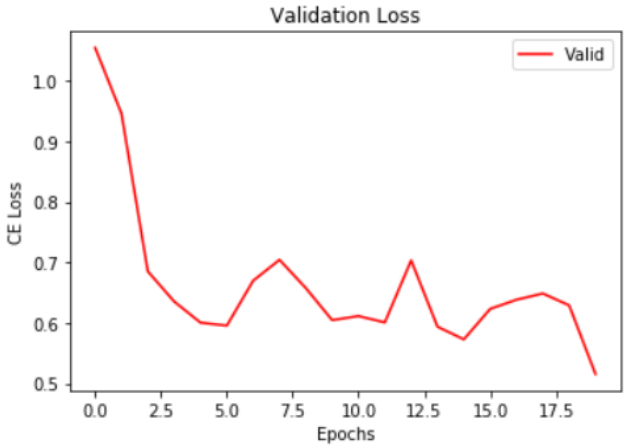
- Visualizing Activation map of first convolution layer in AlexNet architecture.



Results

- GoogLeNet with Transfer learning: changed the classifier and trained for 20 epochs.



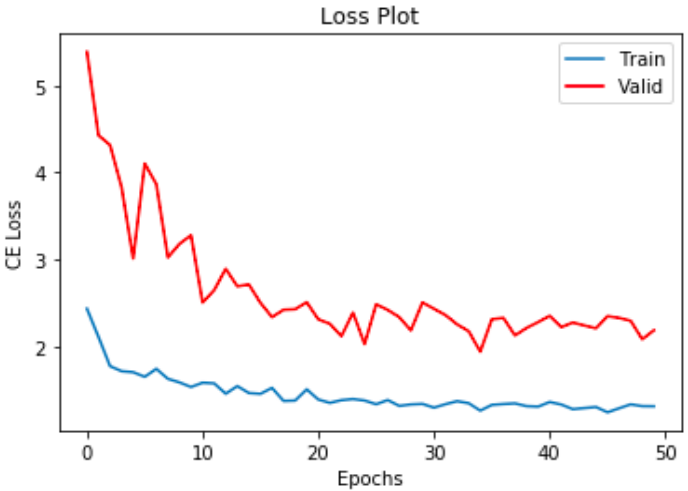


Accuracy: 0.92

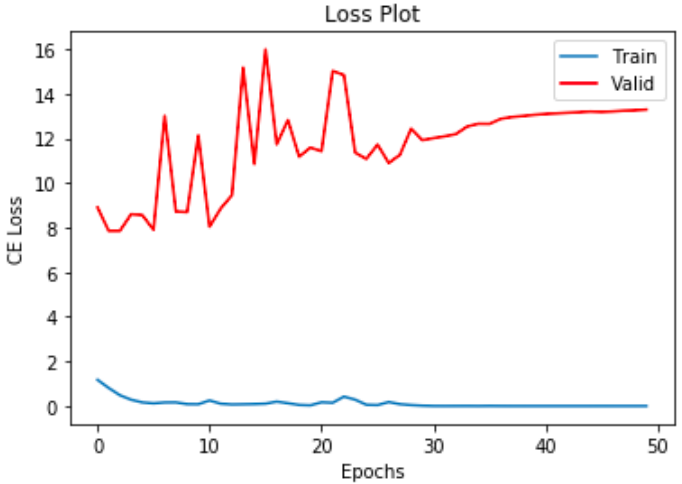
- GoogLeNet from Scratch: loss is not converged as fast as pretrained model.
  Accuracy: 0.89

Results

- Multi-tasking :



Leaf + Disease classification



Disease classification

Conclusion

Given the number of diseases that can occur to a plant and leaf structure being identical it can be difficult to classify. Our experiments showed that it would be better to use a multi-task network to classify leaves first and then the type of diseases.

With a lot of training, although we could achieve better performance, it can be done in less training iterations if multi-task learning is used.

Thank You