DLSD -
Deep Learning Solutions Development

PROJECT PRESENTATION

21-FEB-2019

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Application Name

- The name of the application is **Plant Disease Identifier**

Description

- Purpose
  - To provide a seamless interface using a mobile/web app interface to facilitate identification of plant related diseases and access to relevant information
- Capabilities
  - Identifies plant disease via image taken using smartphone camera or uploaded to web application
  - Displays related plant disease information
- Justification
  - To facilitate early treatment and diagnosis of diseased plant

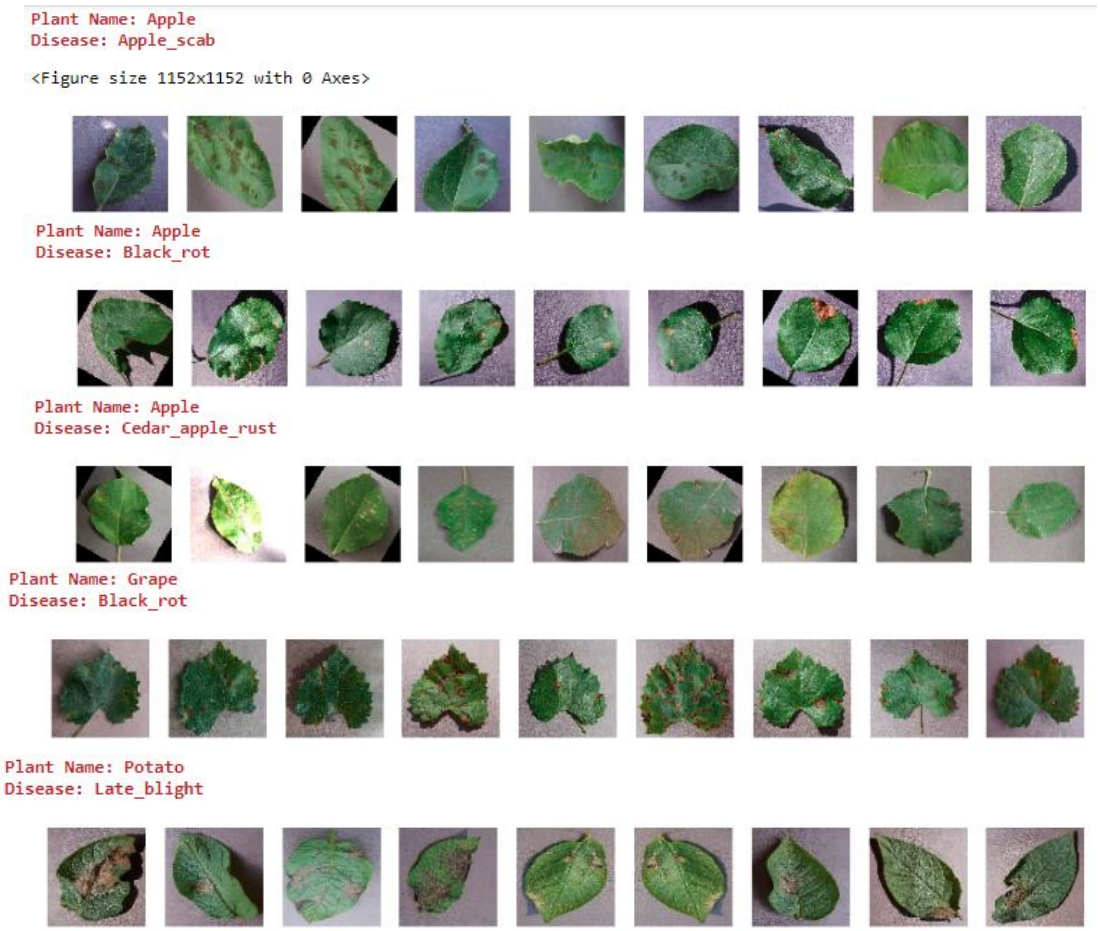
Dataset Collection - 1

- The dataset used for training/ testing is referenced from:
  - https://www.kaggle.com/vipoooool/plant-diseases-classification-using-alexnet/data
- Dataset is based on original expertly curated images on healthy and infected leaves of crops plants made available at an online platform PlantVillage (www.plantvillage.org), an online platform dedicated to crop health and crop diseases.
- Dataset consists of 250 images (256 x 256) each for 38 classes of plant disease categories

Apple	Apple_scab
Apple	Black_rot
Apple	Cedar_apple_rust
Apple	healthy
Blueberry	healthy
Cherry_(including_sour)	healthy
Cherry_(including_sour)	Powdery_mildew
	Cercospora_leaf_spot
Corn_(maize)	Gray_leaf_spot
Corn_(maize)	Common_rust_
Corn_(maize)	healthy
Corn_(maize)	Northern_Leaf_Blight
Grape	Black_rot
Grape	Esca_(Black_Measles)
Grape	healthy
Grape	Leaf_blight_(Isariopsis_Leaf_Spot)
Orange	Haunglongbing_(Citrus_greening)
Peach	Bacterial_spot
Peach	healthy
Pepper	Bacterial_spot
Pepper	healthy
Potato	Early_blight
Potato	healthy
Potato	Late_blight
Raspberry	healthy
Soybean	healthy
Squash	Powdery_mildew
Strawberry	healthy
Strawberry	Leaf_scorch
Tomato	Bacterial_spot
Tomato	Early_blight
Tomato	healthy
Tomato	Late_blight
Tomato	Leaf_Mold
Tomato	Septoria_leaf_spot
Tomato	Spider_mites Two-spotted_spider_mite
Tomato	Target_Spot
Tomato	Tomato_mosaic_virus
Tomato	Tomato_Yellow_Leaf_Curl_Virus

Dataset Collection - 2

- Sample images from selected plant disease classes



Model Training - 1

- Transfer learning (using pre-trained Inception/ MobileNet models) were used for model training and testing.

- Dataset

  - Train:
    https://drive.google.com/open?id=1JFOenFkqGUub7LilMbb-gJZlpuSAN_qQ

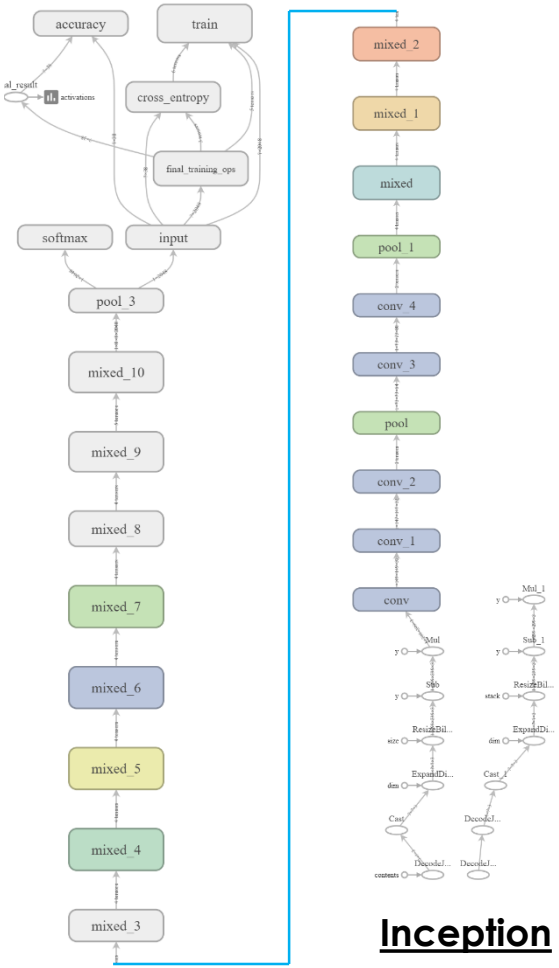
  - Test:
    https://drive.google.com/open?id=1njUuI7UuOcElwj3w29W1AEs4UTaQ2MUw

  - Test (All categories):
    https://drive.google.com/open?id=1y6OY5CXBsNhGLiwNBogOBmzFjiQJrKGw

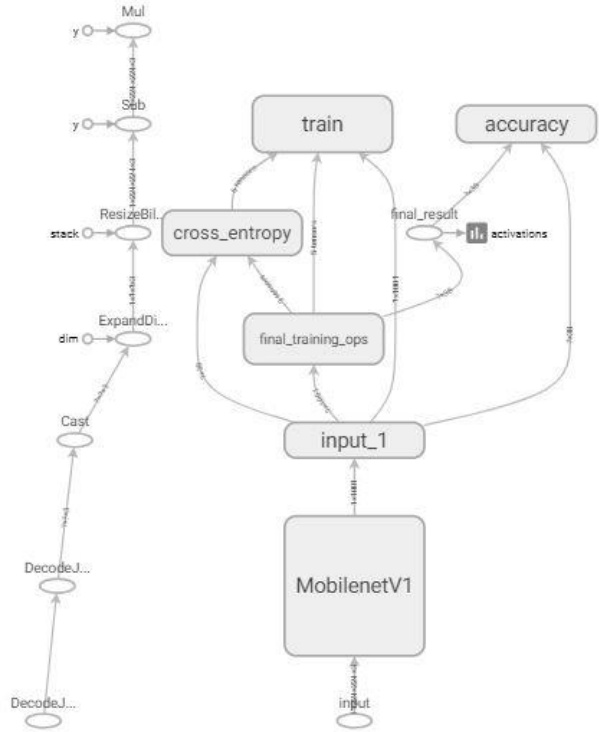
- Assessment criteria is based on minimum confidence level of 50% achieved and minimum accuracy of 90%.

Model Training - 2

- Inception and MobileNet were used for model training and evaluation



Inception

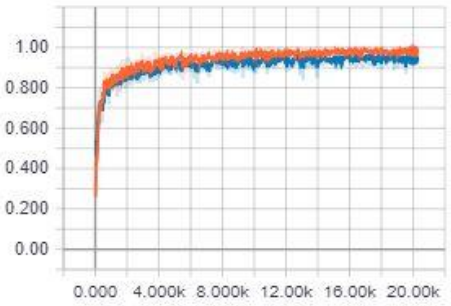


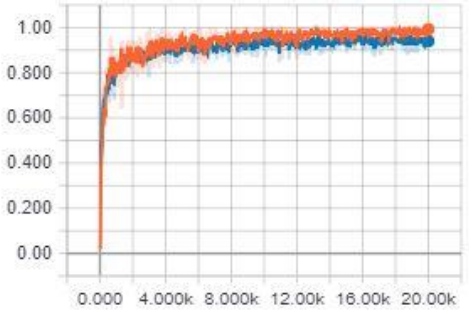
MobileNet

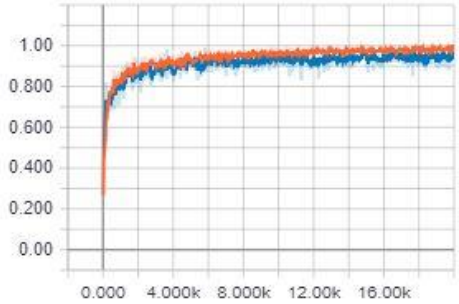
Model Evaluation - 1

- Inception

Accuracy



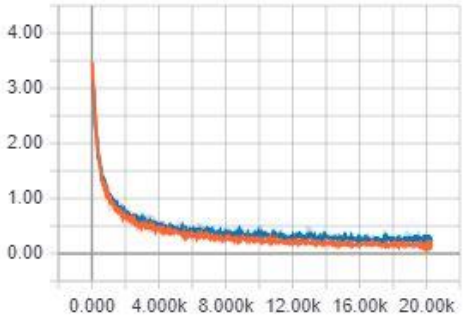


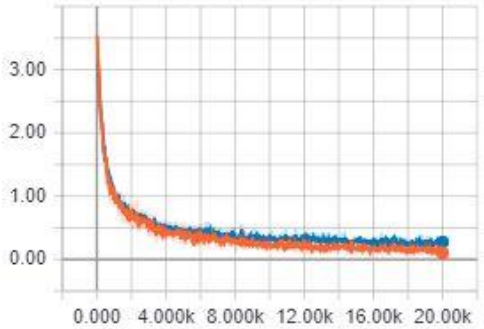


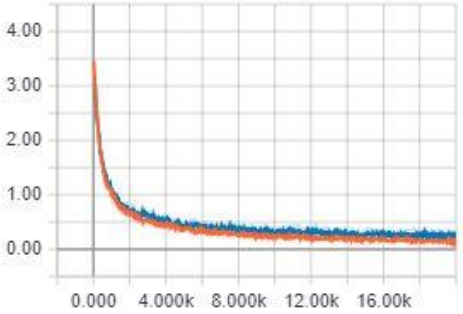
Validation Accuracy

92.4% | **92.3%** | **92.2%**

Entropy



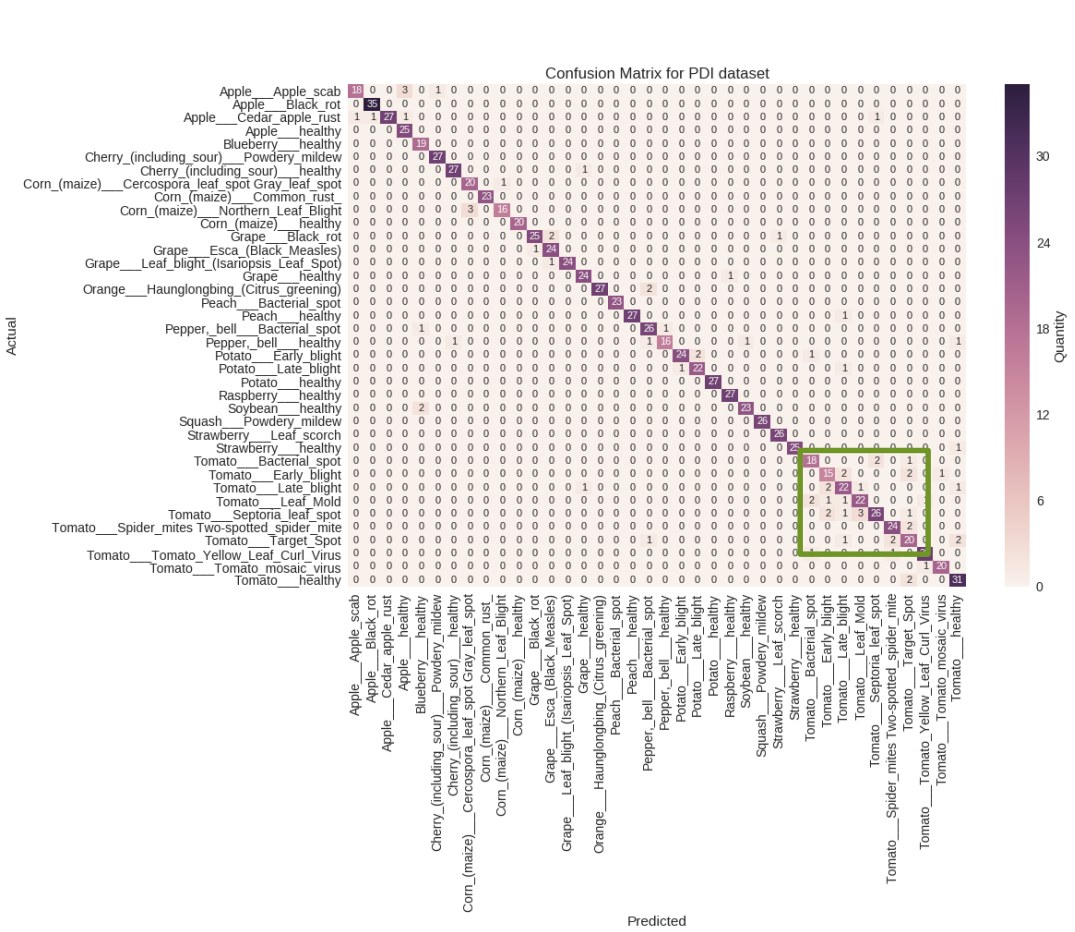


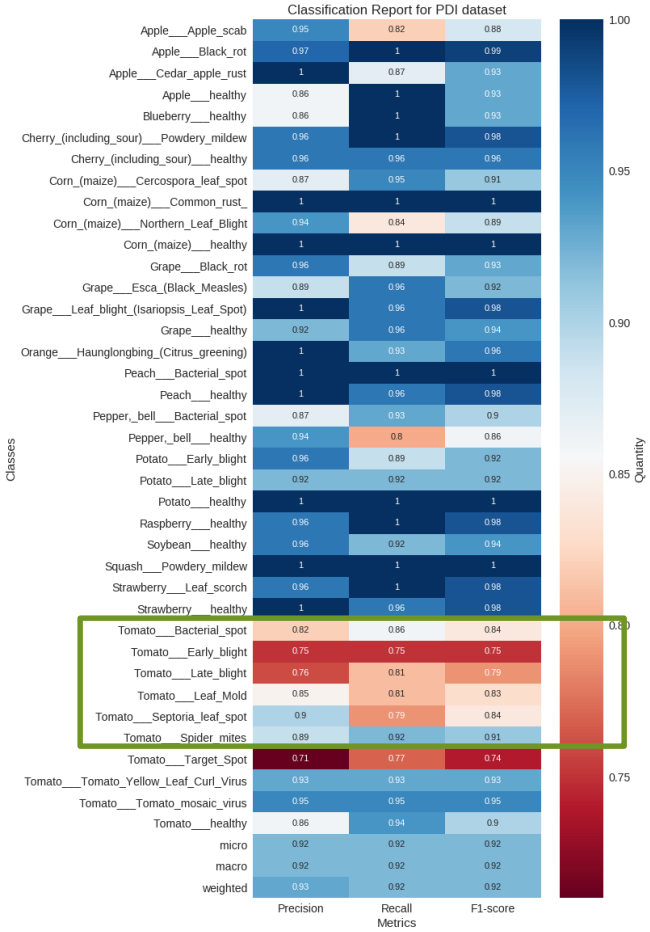


Batch Size = 100 | **Batch Size = 50** | **Batch Size = 200**

Model Evaluation - 2

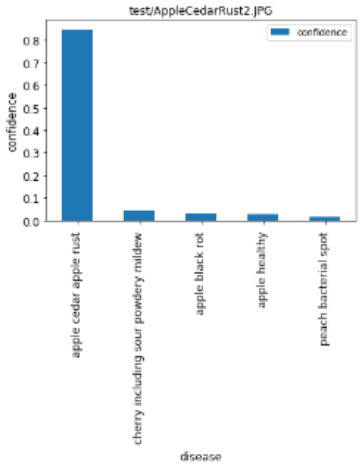
- Confusion Matrix and Classification Plots for Inception

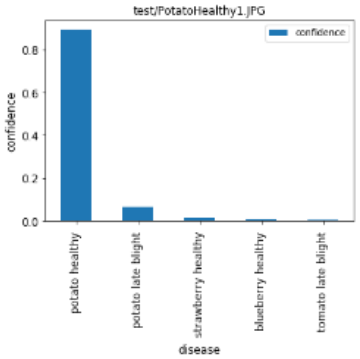


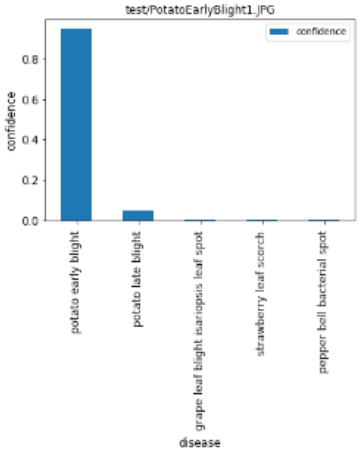


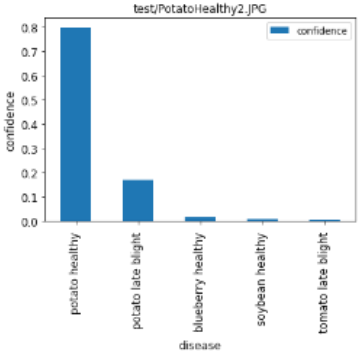
Model Evaluation - 3

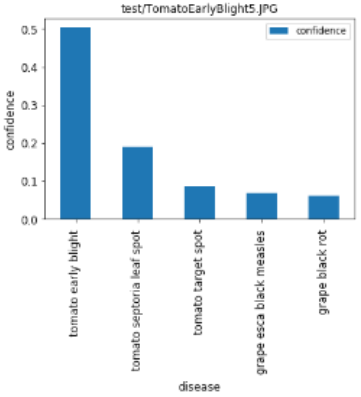
- Inception –Test Data

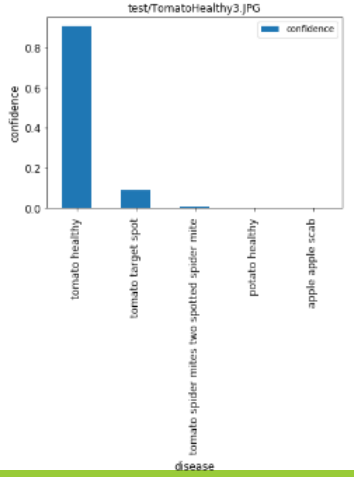








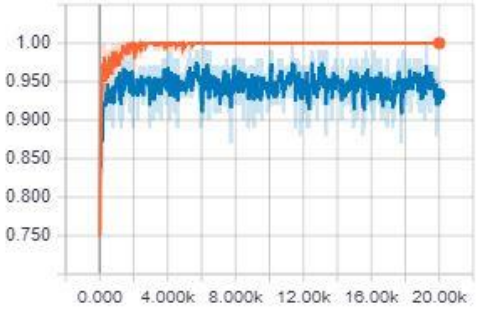


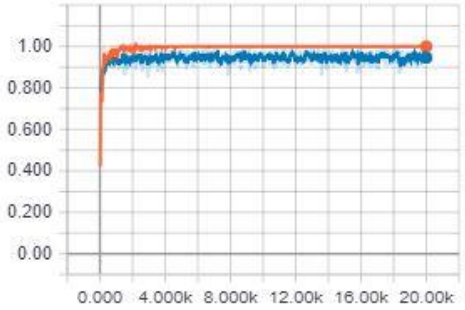


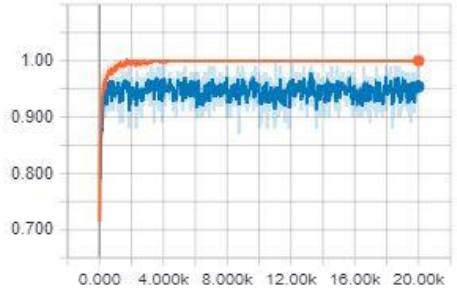
Model Evaluation - 4

- MobileNet

Accuracy







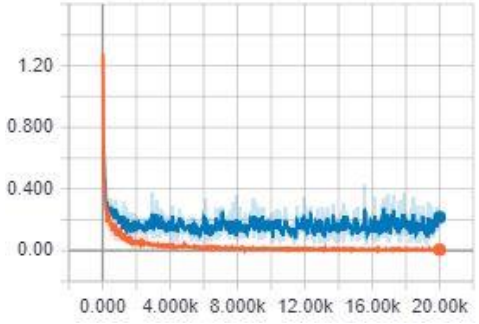
Validation Accuracy

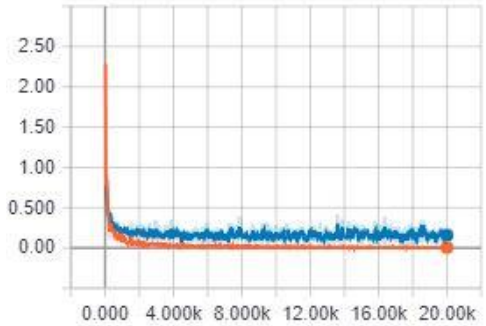
94.5%

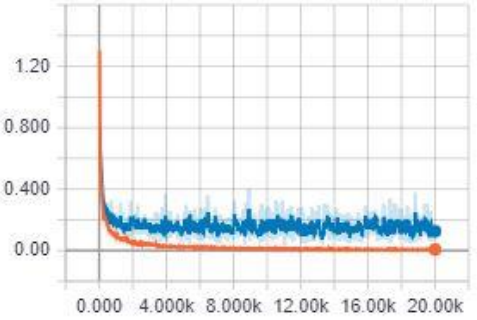
94.1%

94.3%

Entropy







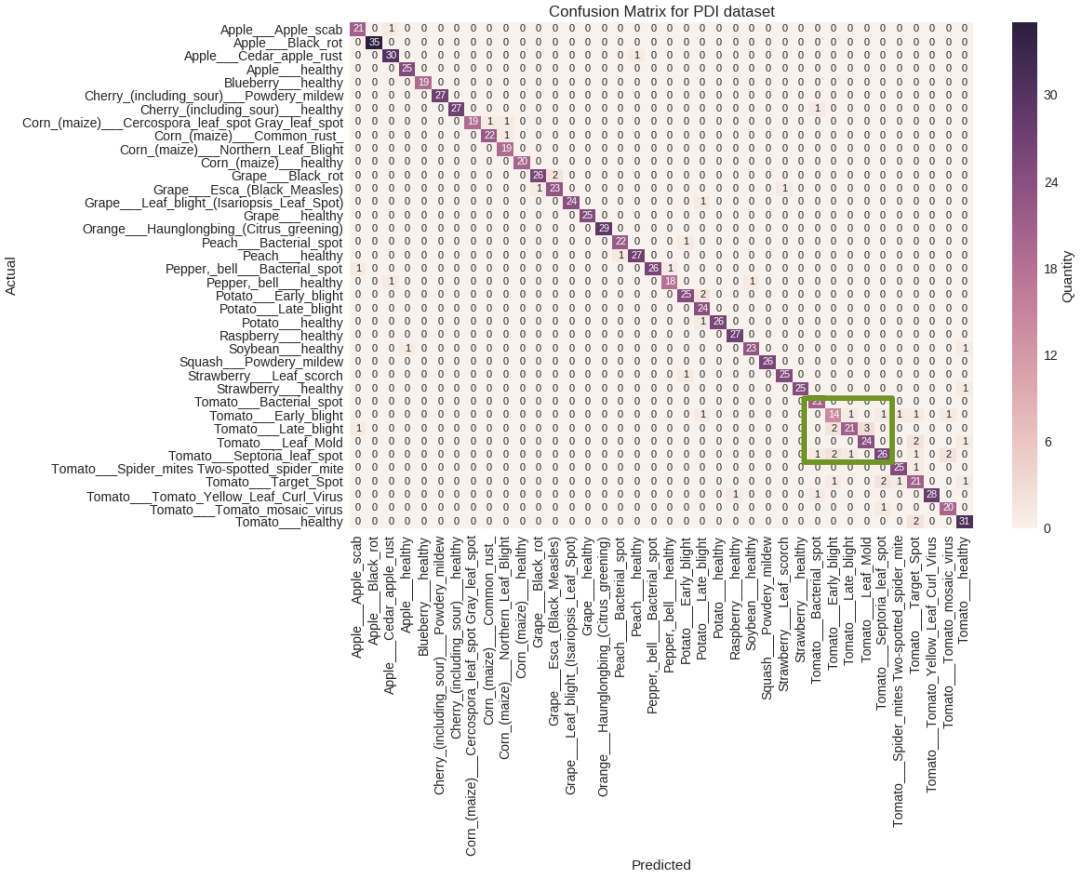
Batch Size = 100

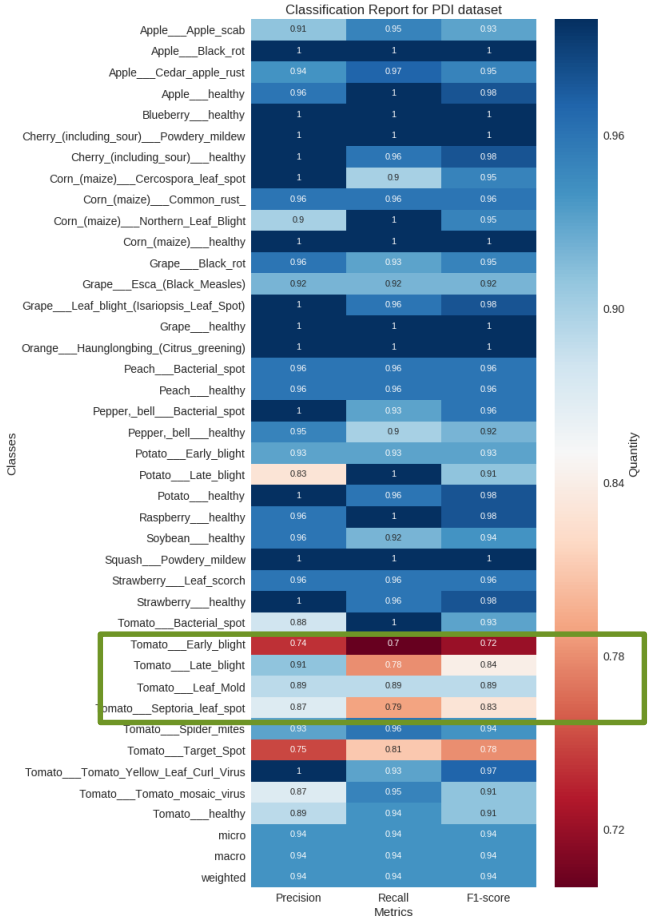
Batch Size = 50

Batch Size = 200

Model Evaluation - 5

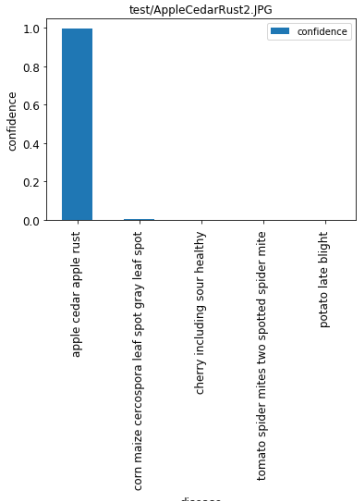
- Confusion Matrix and Classification Plots for MobileNet

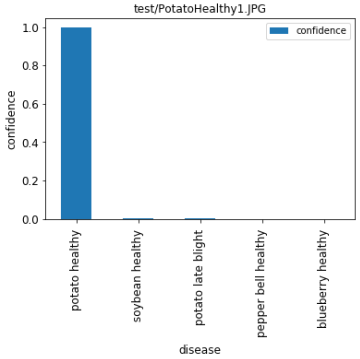


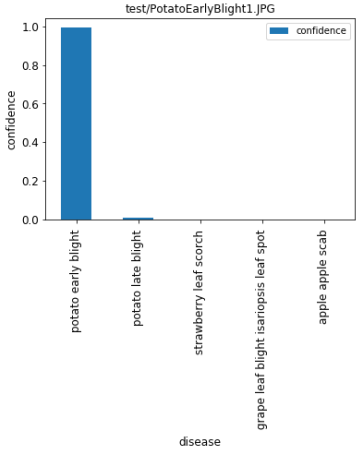


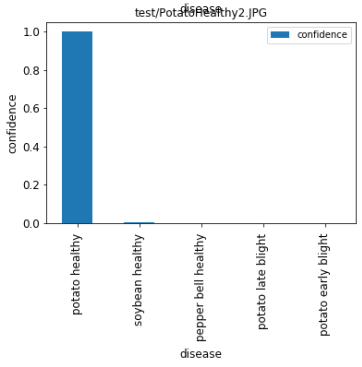
Model Evaluation - 6

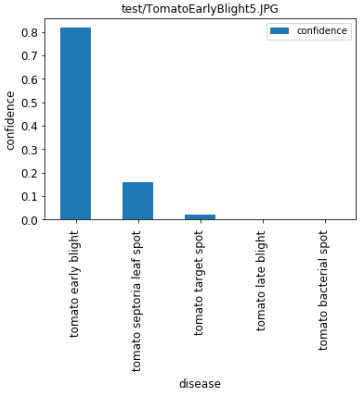
- MobileNet –Test Data

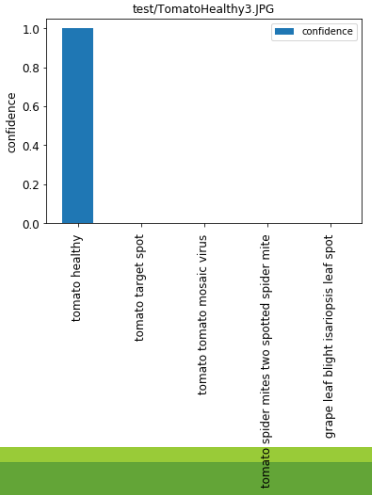






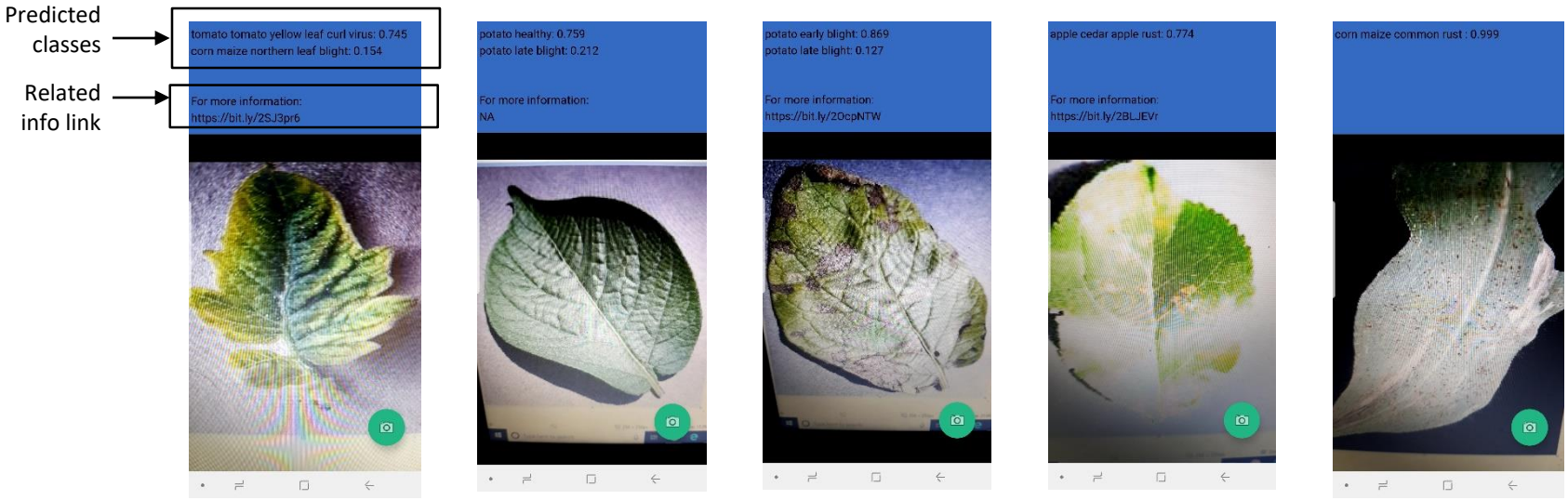






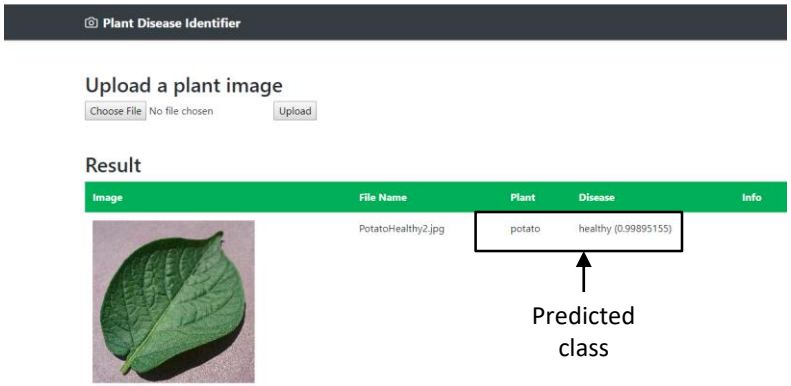
Model Deployment - 1

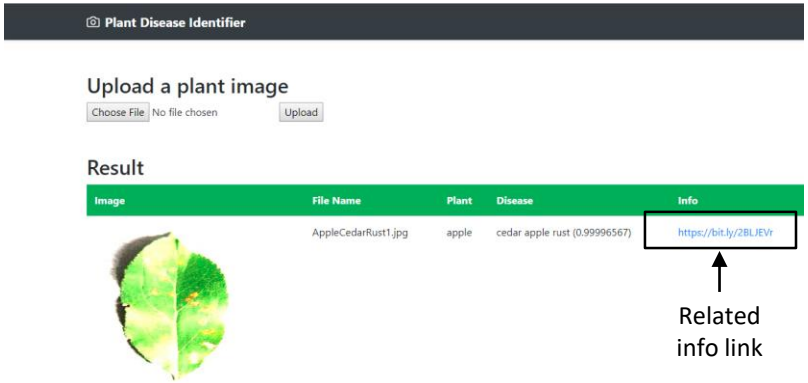
- The trained model is deployed to an android mobile app using TensorFlow
- Using the smartphone camera, the user can take a picture of the plant and the app will display the predicted plant disease (top 3 with highest confidence levels) and provide relevant link for the plant disease predicted with highest confidence level



Model Deployment - 2

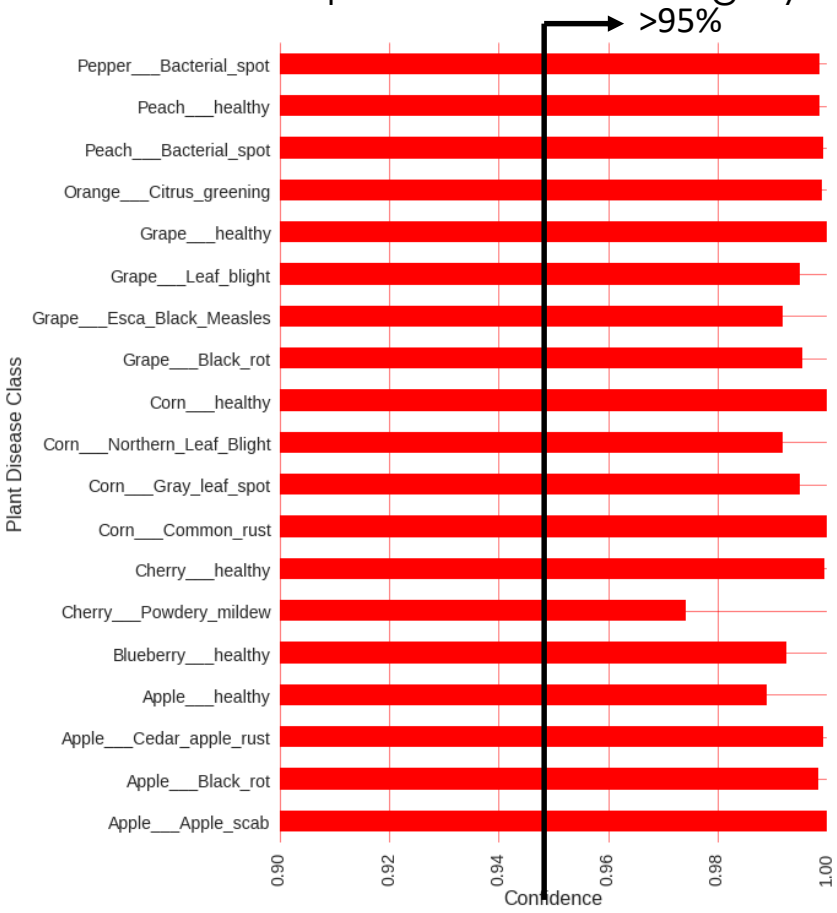
- Alternate option is to deploy the trained model to a flask web application
- Using the web application, the user uploads an image file of the plant and the web application will display the predicted plant disease (with highest confidence levels) and provide a web hyperlink to relevant information about the plant disease

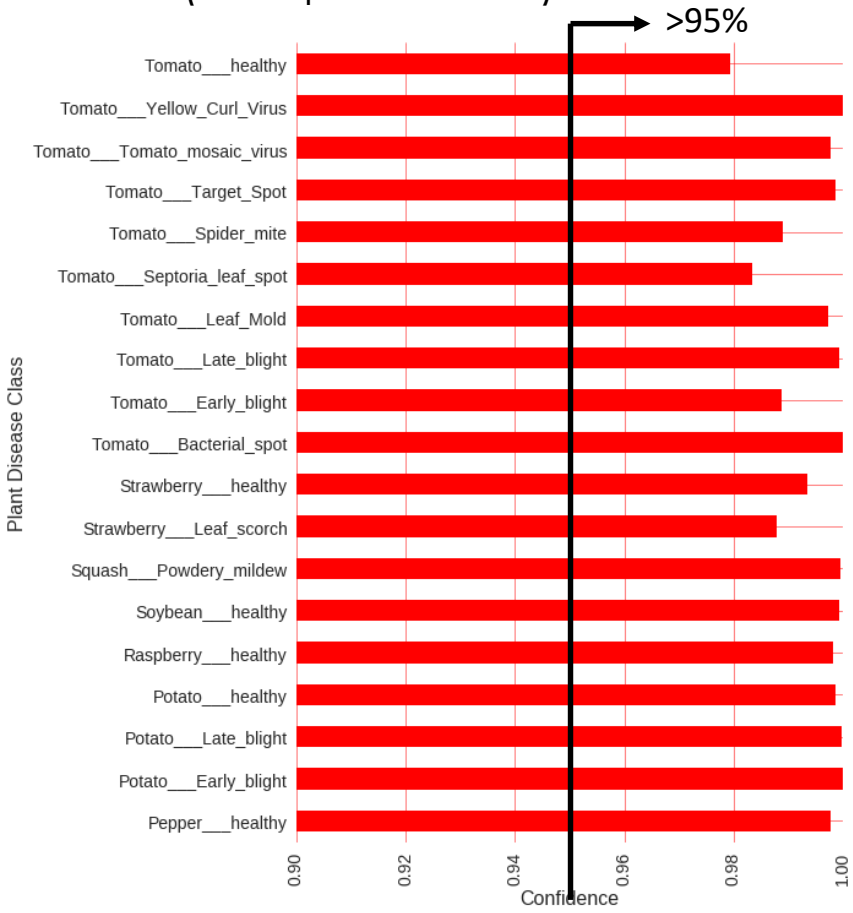




Selected Deployed Model Test Evaluation

- Trained model (*MobileNet (Batchsize=50)*) achieved **94.1% model validation accuracy** and **minimum confidence level of 95%** for each plant disease category of test data (refer plots below)





Conclusion

- Transfer learning was used to train a model for plant disease classification.
- Inception and MobileNet was evaluated with MobileNet achieving **2%** improvement in validation accuracy for trained model
- Selected model for deployment was **MobileNet trained with batchsize of 50**:
  - Achieved **94.1%** model validation
  - Achieved minimum confidence level of **95%** for each plant disease category of test data
- Trained model deployed to both an android mobile app and flask web application

References - 1

- Dataset
  - Train:
    https://drive.google.com/open?id=1JFOenFkqGUub7LilMbb-gJZlpuSAN_qQ
  - Test:
    https://drive.google.com/open?id=1njUuI7UuOcElwj3w29W1AEs4UTaQ2MUw
  - Test (All categories) – for deployed model testing:
    https://drive.google.com/open?id=1y6OY5CXBsNhGLiwNBogOBmzFjiQJrKGw
- Training Scripts:
  - retrain.py
    https://drive.google.com/open?id=1tA6YBGr8VliC2G5qXBoVn4-o-TpWPsde
  - label_image.py
    https://drive.google.com/open?id=1DJ2R9A9A9KAYI2DY-3k2_LFs6wLVgoKN
  - quantize_graph.py
    https://drive.google.com/open?id=161umWXzThIyShsy9HcNWwfIRqU4cFMh-
- Jupyter Notebook:
  https://drive.google.com/open?id=1U_rJiQvZSPpvHa1n4XjPrOleYyRHR6Uj

References - 2

- Deployed Model
  - retrained_graph.pb:
    https://drive.google.com/open?id=1zFKciI1DQ2BZ0b4_4Y6NahcmKY753ifB
  - optimized_graph.pb:
    https://drive.google.com/open?id=13S5YoTTwgp0bxMjxiGKMfVmvj9oVXvwp
  - retrained_labels.txt:
    https://drive.google.com/open?id=1c9-12W1wERxTQ6LXWqGk6viNGgyysN4t
  - Miscellaneous Trained Models:
    https://drive.google.com/open?id=1Vn_nycdtIfiSASwuZIeeLXA7qaK1gyDD
- Deployment Source Files:
  - Mobile (Android):
    https://drive.google.com/open?id=1FAntzP6OXRpSc9DWG_Qz70Not2Rai3p-
  - apk file:
    https://drive.google.com/open?id=1oekq8ejtZ4-6KpFZ5B1rpxB3Ro4qy6K-
  - Web:
    https://drive.google.com/open?id=1mJ499998vtQXqbi3-1FTVfohqe0JSP_J
- Test Screenshots:
  https://drive.google.com/open?id=1qkt6JGAIk5yNyDOIfZcso6I3CTpDbhhJ

References - 3

- Samir Bhattarai, *Plant Diseases Classification Using AlexNet*
  - https://www.kaggle.com/vipoooool/plant-diseases-classification-using-alexnet
- David. P. Hughes, Marcel Salathe, *An open access repository of images on plant health to enable the development of mobile disease diagnostics*
  - https://arxiv.org/ftp/arxiv/papers/1511/1511.08060.pdf
- Alex Krizhevsky, Ilya Sutskever, Geoffrey E. Hinton, *ImageNet Classification with Deep Convolutional Neural Networks*
  - https://papers.nips.cc/paper/4824-imagenet-classification-with-deep-convolutional-neural-networks.pdf