

# IOD\_Capstone\_Project



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# IOD\_Capstone\_Project - Overview

## Overview

### Background & Motivation

- The U.S. apple industry is annually worth \$15 billion USD (~10% of total agriculture export revenue)
- During the growing season, the apple orchards are under constant threats from insects, fungal/bacterial/viral pathogens
- These can result in loss of fruit bearing trees which incurs monetary losses of millions of dollars
- Therefore, early pest and disease detection are critical for prompt deployment of pest and disease management
- Moreover, incorrectly identifying a disease and/or misuse of treatment can even aid in the spreading of the disease, further incurring remedial costs and efforts



# IOD\_Capstone\_Project - Overview

## Overview

### Machine Learning value & Objective

- Fast and accurate diagnosis
  - Mitigate the additional costs and efforts from remedial treatments
  - Mitigate the loss of fruit bearing trees
  - Reduce cost and effort to run diagnosis



# IOD\_Capstone\_Project - Dataset

Source: <https://www.kaggle.com/competitions/plant-pathology-2020-fgvc7/overview>

Columns	Description	Example
image_id	foreign key to images filenames	Train_0.jpg, Train_1.jpg, Train_2.jpg, etc
healthy	Classification category	1 or 0
multiple_diseases	Classification category	1 or 0
rust	Classification category	1 or 0
scab	Classification category	1 or 0

# IOD\_Capstone\_Project - Initial EDA



Healthy



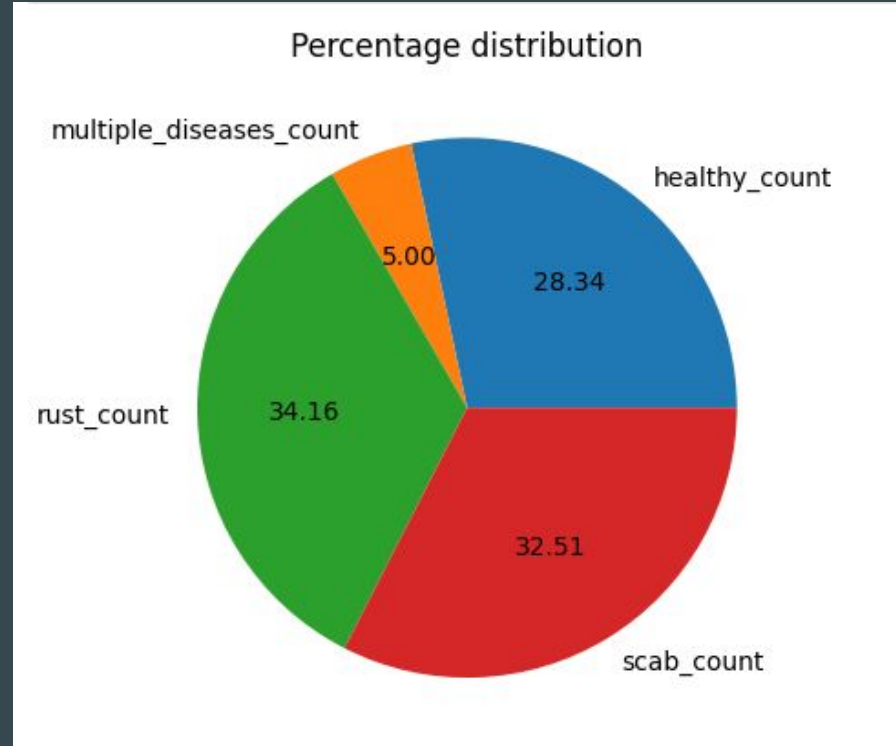
Multiple Diseases



Rust



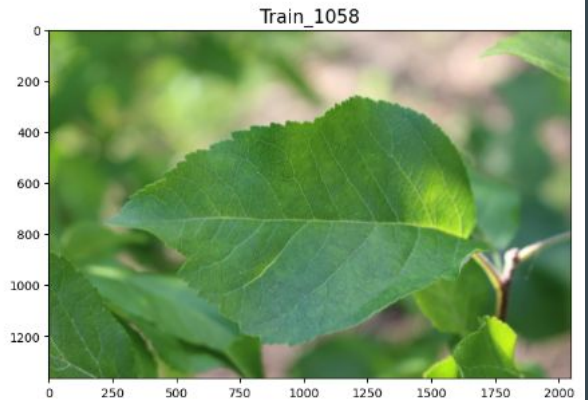
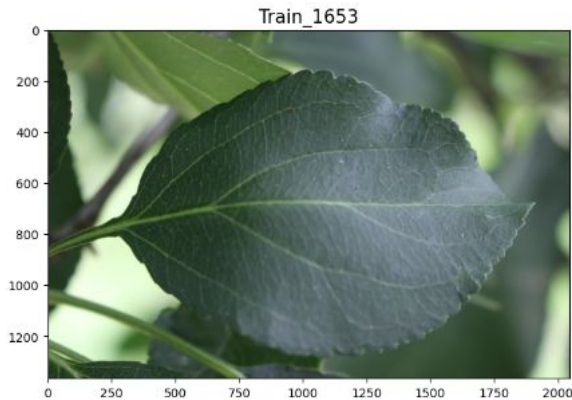
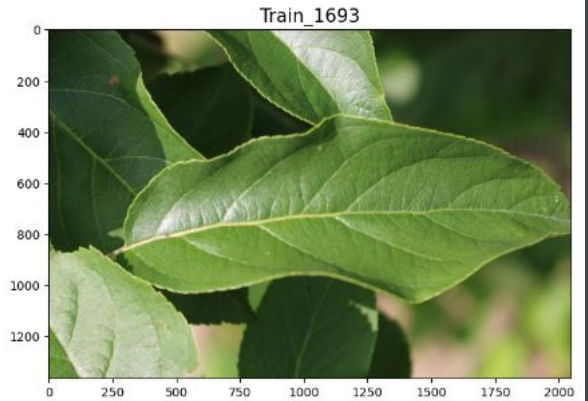
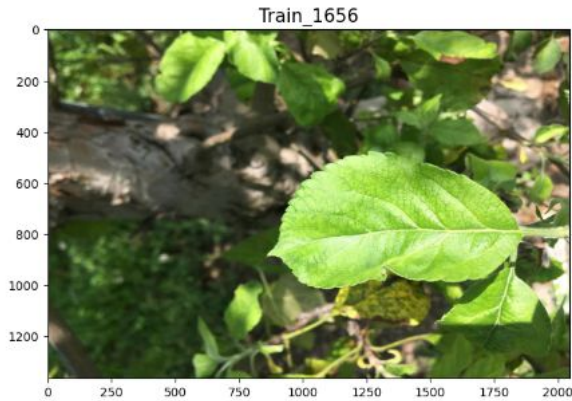
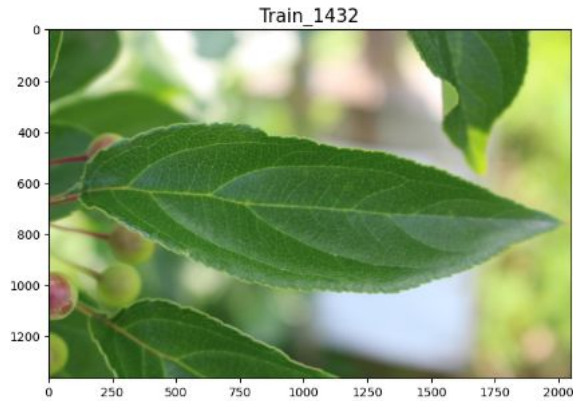
Scab





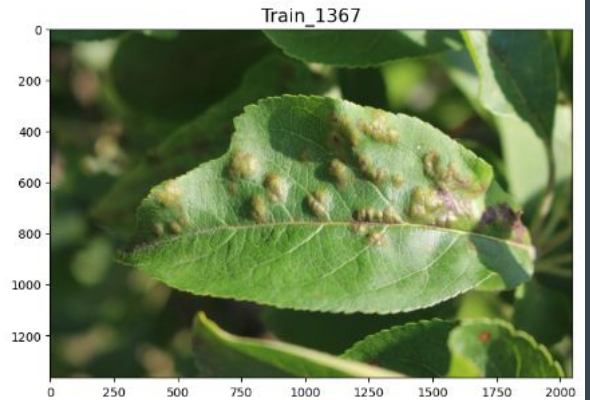
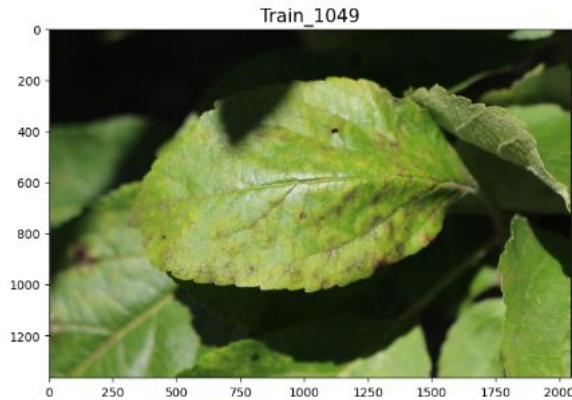
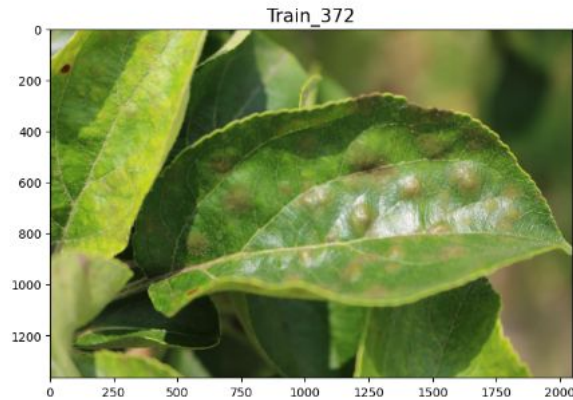
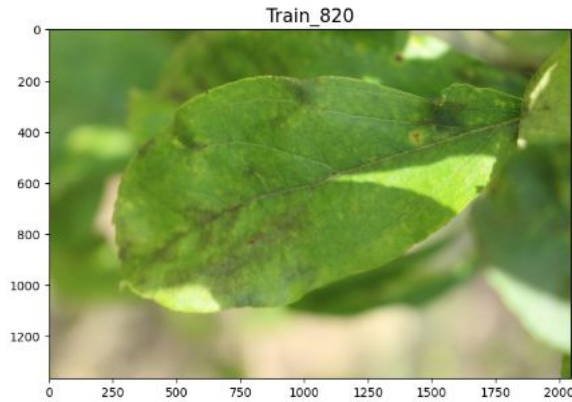
# IOD\_Capstone\_Project - Initial EDA

Healthy Examples



# IOD\_Capstone\_Project - Initial EDA

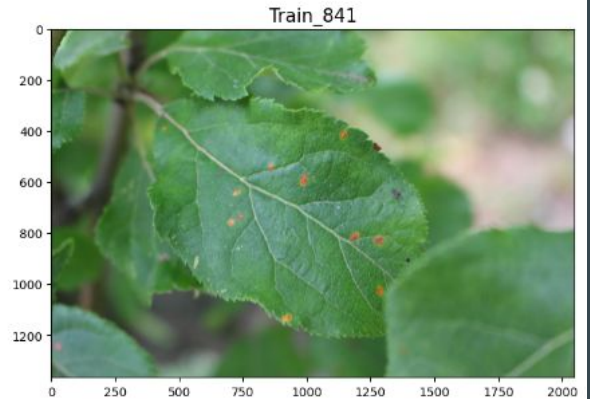
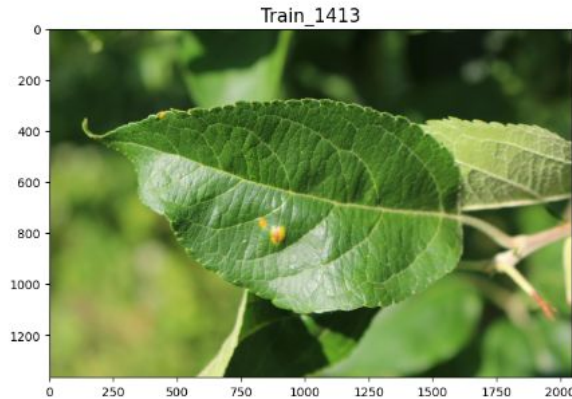
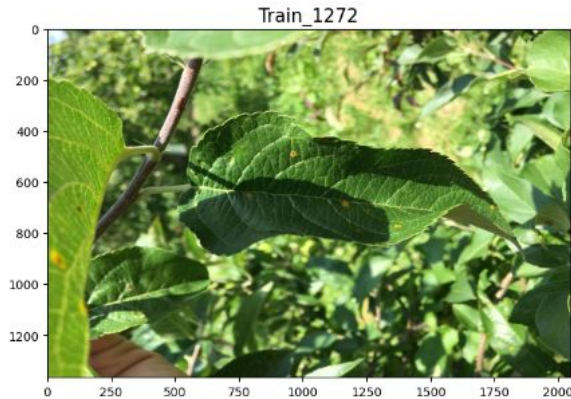
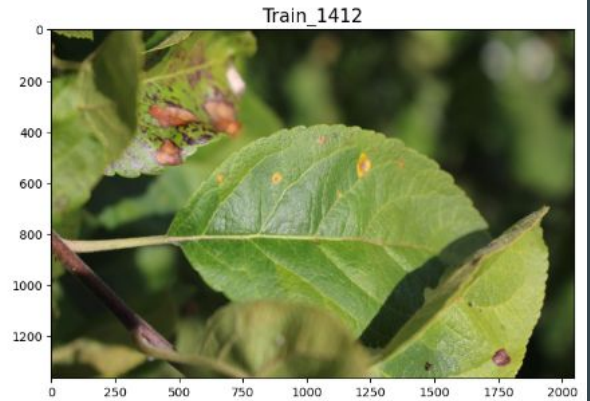
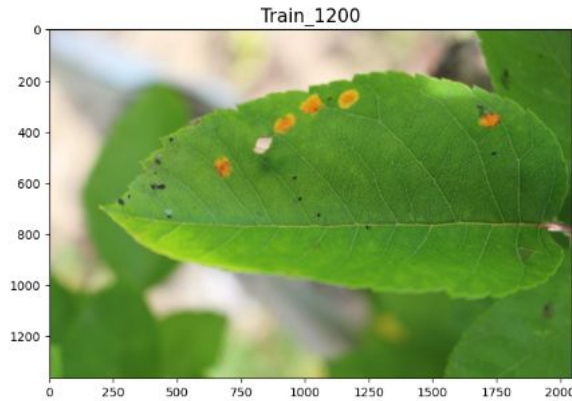
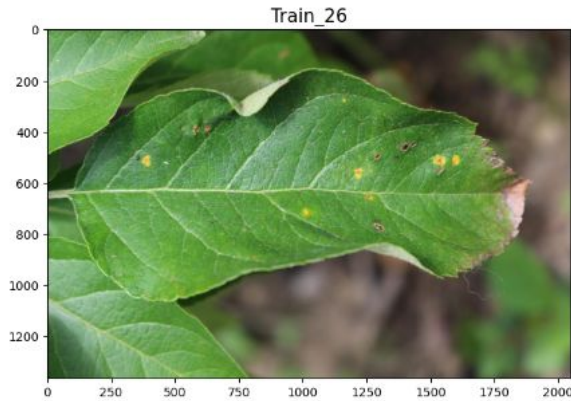
Scab Examples





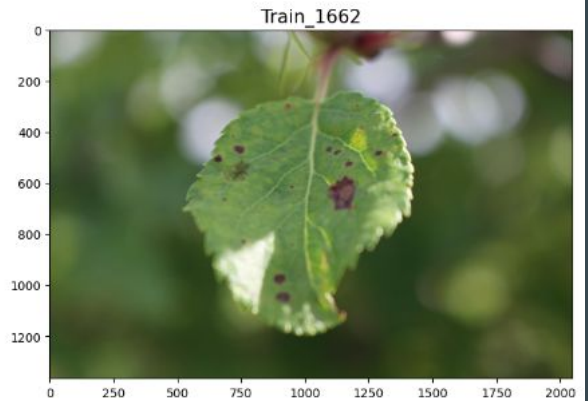
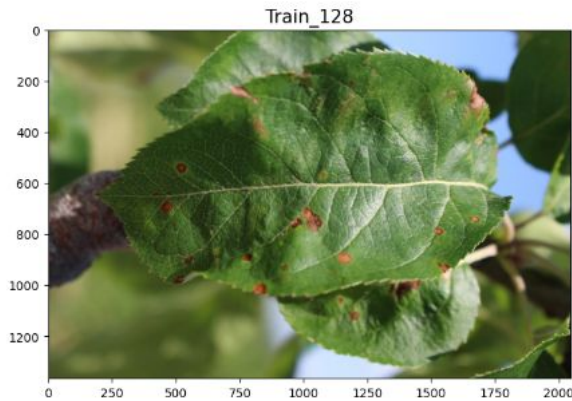
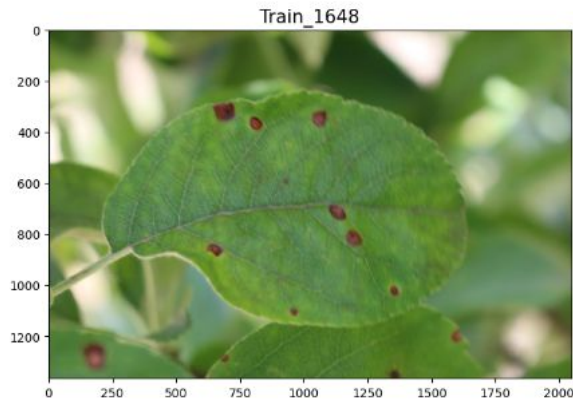
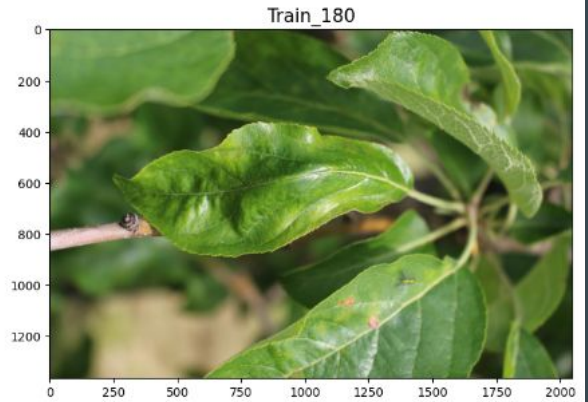
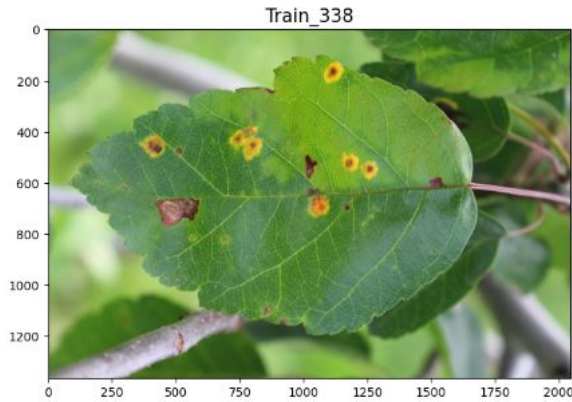
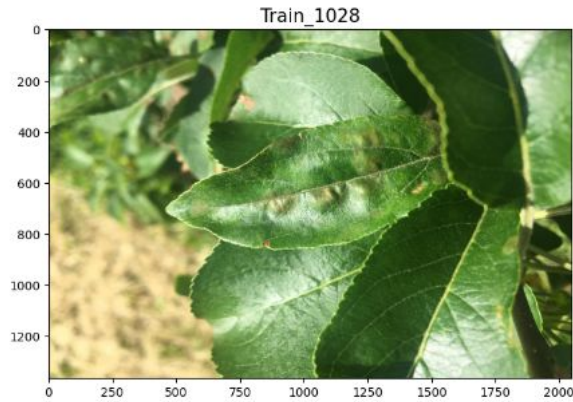
# IOD\_Capstone\_Project - Initial EDA

Rust Examples



# IOD\_Capstone\_Project - Initial EDA

Multiple Diseases Examples

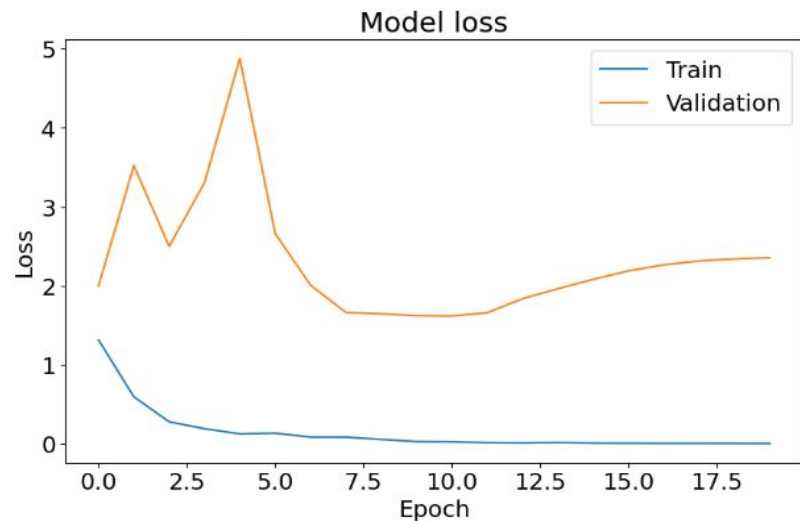
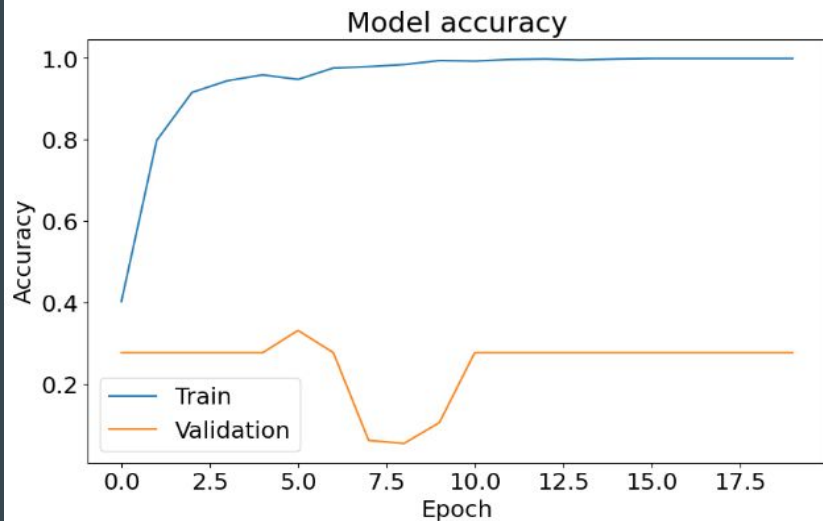


# IOD\_Capstone\_Project - Modeling

Model	Description	Categorical Accuracy	Training Time
ResNet50	Well known and widely used deep learning model for image recognition	0.999	00h:04m:36s
DenseNet121	Better feature use efficiency compared to ResNet50 (e.g. have shown to outperform ResNet50 using fewer parameters)	0.998	00h:06m:20s
EfficientNetB7	Have shown to outperform ResNet50 in accuracy	0.994	00h:12m:24s
Custom	Experimental self made	0.320	00h:03m:40s

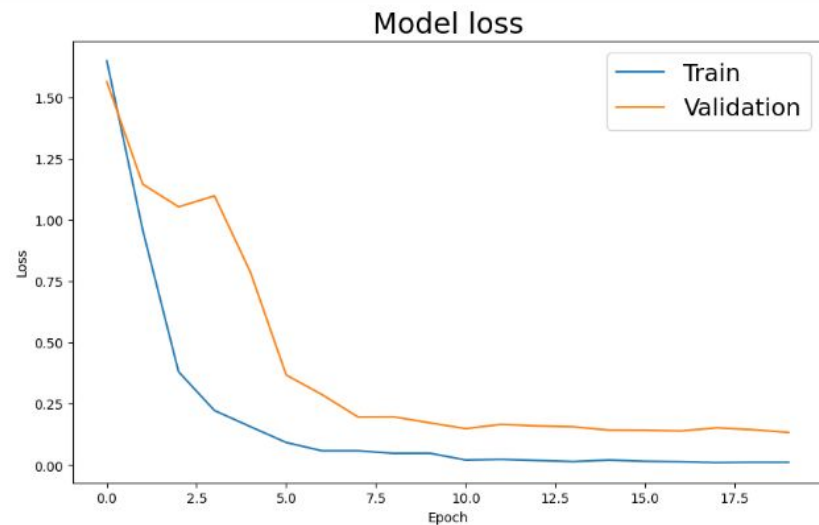
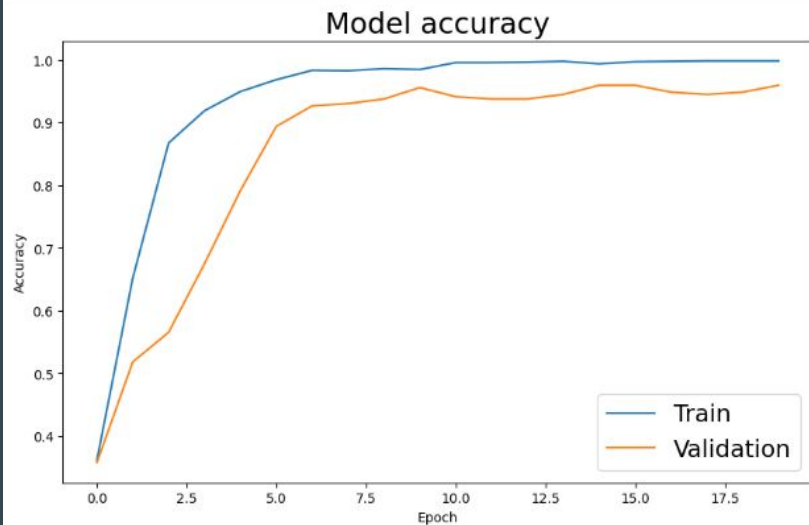
# IOD\_Capstone\_Project - Evaluation

## ResNet50



# IOD\_Capstone\_Project - Evaluation

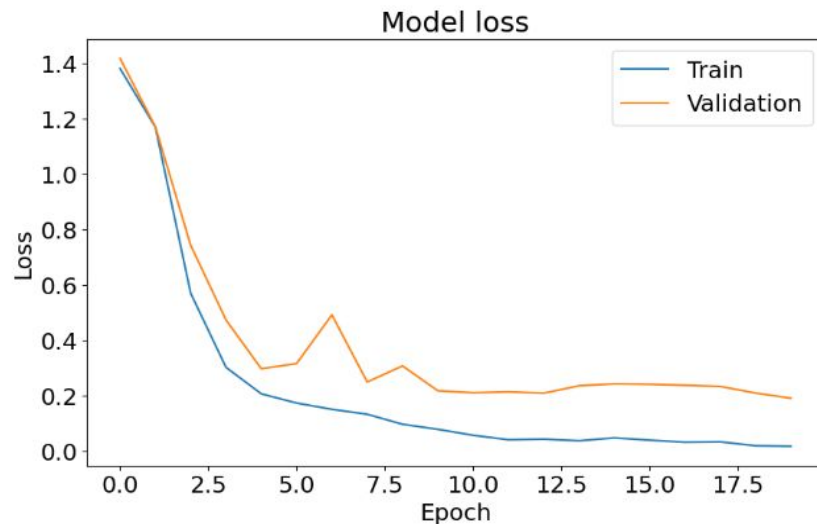
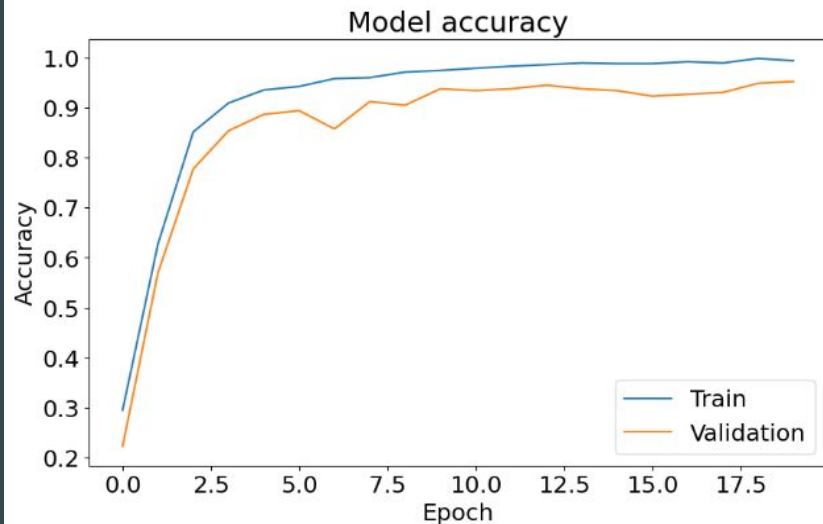
## DenseNet121





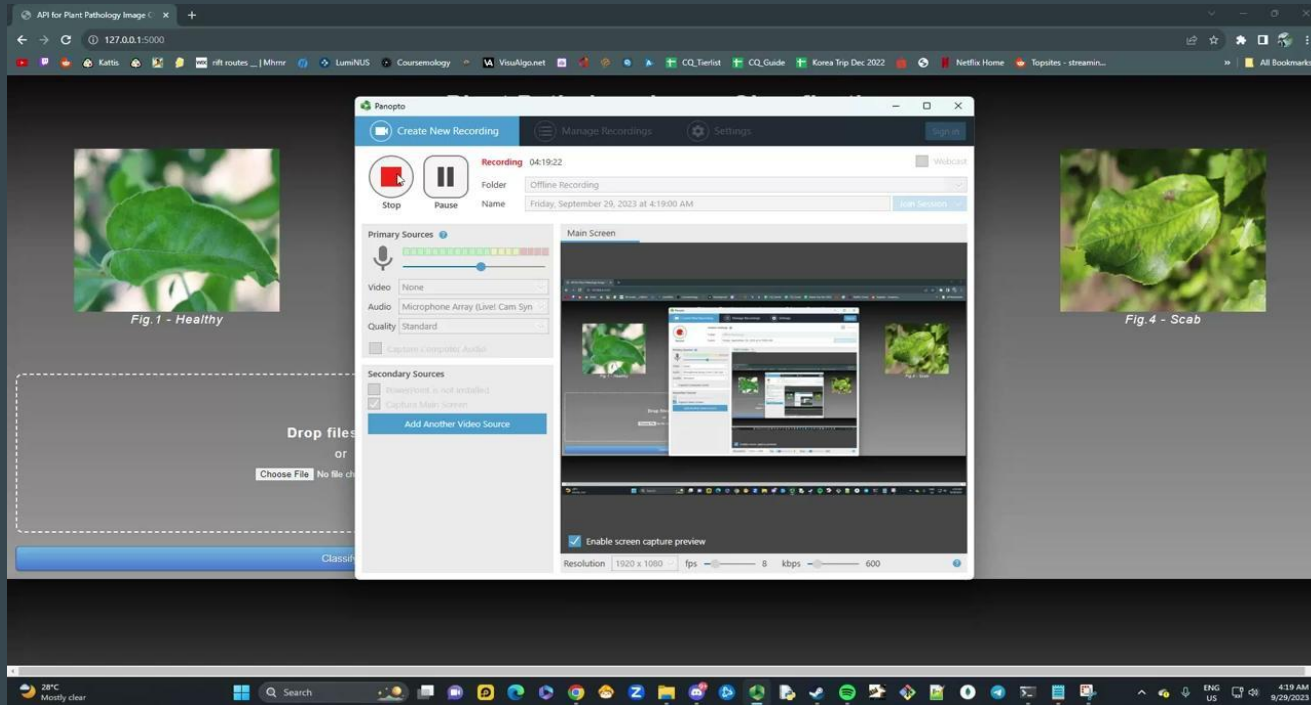
# IOD\_Capstone\_Project - Evaluation

## EfficientNetB7



# IOD\_Capstone\_Project - API Demo

## Demo



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## Findings & future works:

- API:
  - Can be extended as a mobile phone application to be used on the go (Average diagnosis time ~1-2 seconds)
- Objective:
  - Machine learning can add immense value in terms of cost and effort savings by achieving fast and accurate diagnosis of diseases
    - Early diagnosis will prevent loss of fruit bearing trees
    - Accurate diagnosis will prevent rapid spread of resistant pathogens
  - Machine learning can also be applied to other crops and not just apple trees
- Machine Learning Models:
  - Computational resources as a metric (Memory and Time)
  - SOTA model architectures (ResNet,DenseNet,EfficientNet) are able to classify images with high accuracy
  - Improve ResNet evaluation scores