

# Computer Vision- Based Coffee Disease Detection

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EE-490



# Overview

- Climate change impact on coffee production
  - Rising temperatures
  - Shorter disease latency period
  - Stronger epidemics and faster spread
- Impact on Central American economies
  - Contributing 20% of total exports





# Leaf Rust

- Effects of coffee leaf rust
  - Stunts plant growth
  - Reduces yields and bean quality
  - Guatemala's exports down 4-5%
- The issue:
  - Difficult to detect
  - Rapid spread once detected
  - Decline in agricultural labor



Figure: Leaf infested with leaf rust

# Why is it difficult to detect?



I. Merle, P. Tixier, Elias, C. Cilas, and J. Avelino, "Forecast models of coffee leaf rust symptoms and signs based on identified microclimatic combinations in coffee-based agroforestry systems in Costa Rica," *Crop Protection*, vol. 130, pp. 105046–105046, Apr. 2020, doi: <https://doi.org/10.1016/j.cropro.2019.105046>.

# Solution: Computer Vision

- Computers learn to recognize images
  - Series of activation functions
  - Image transformations
- New problem:
  - Lack of training data
  - Time-intensive collection process

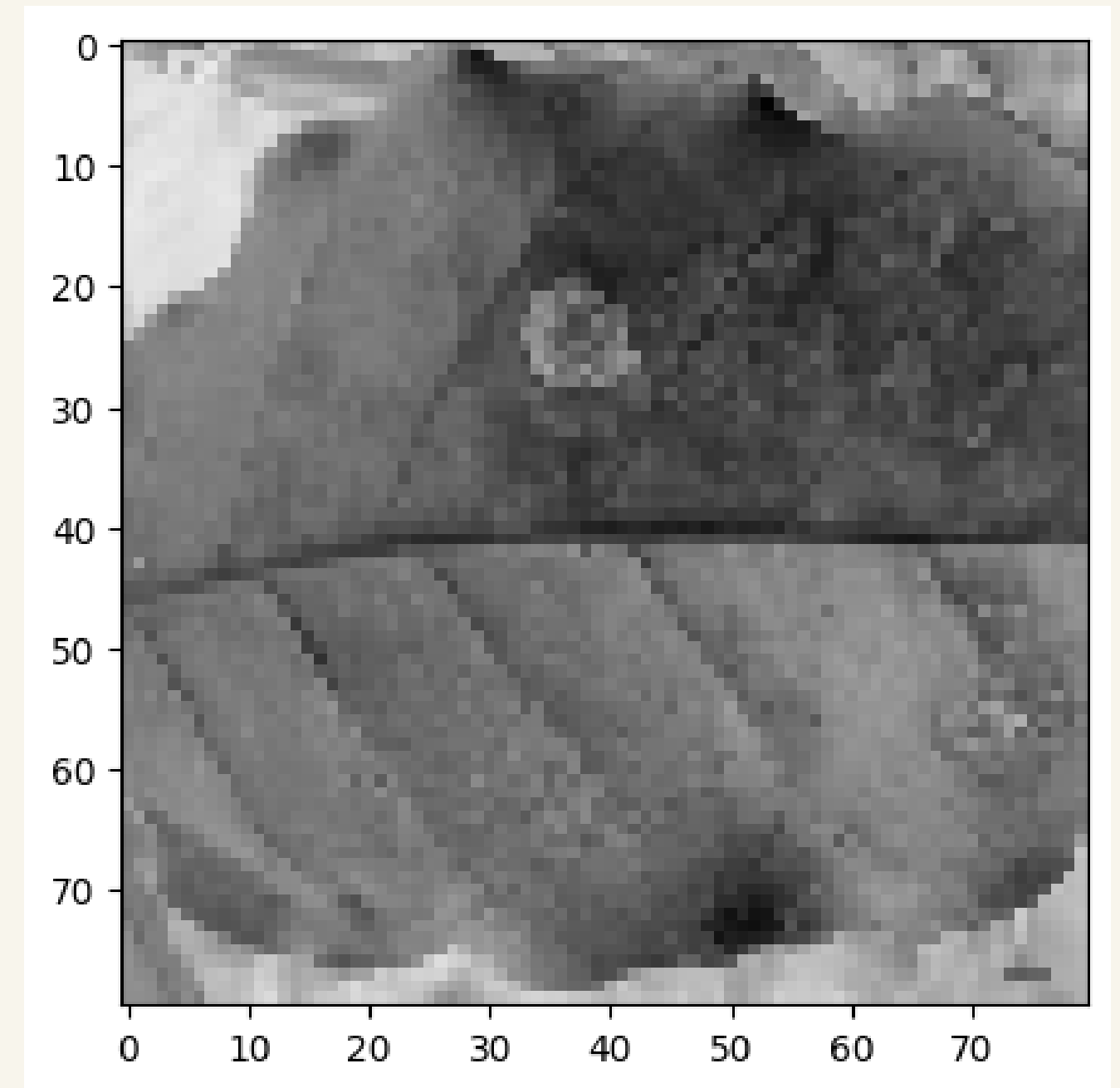
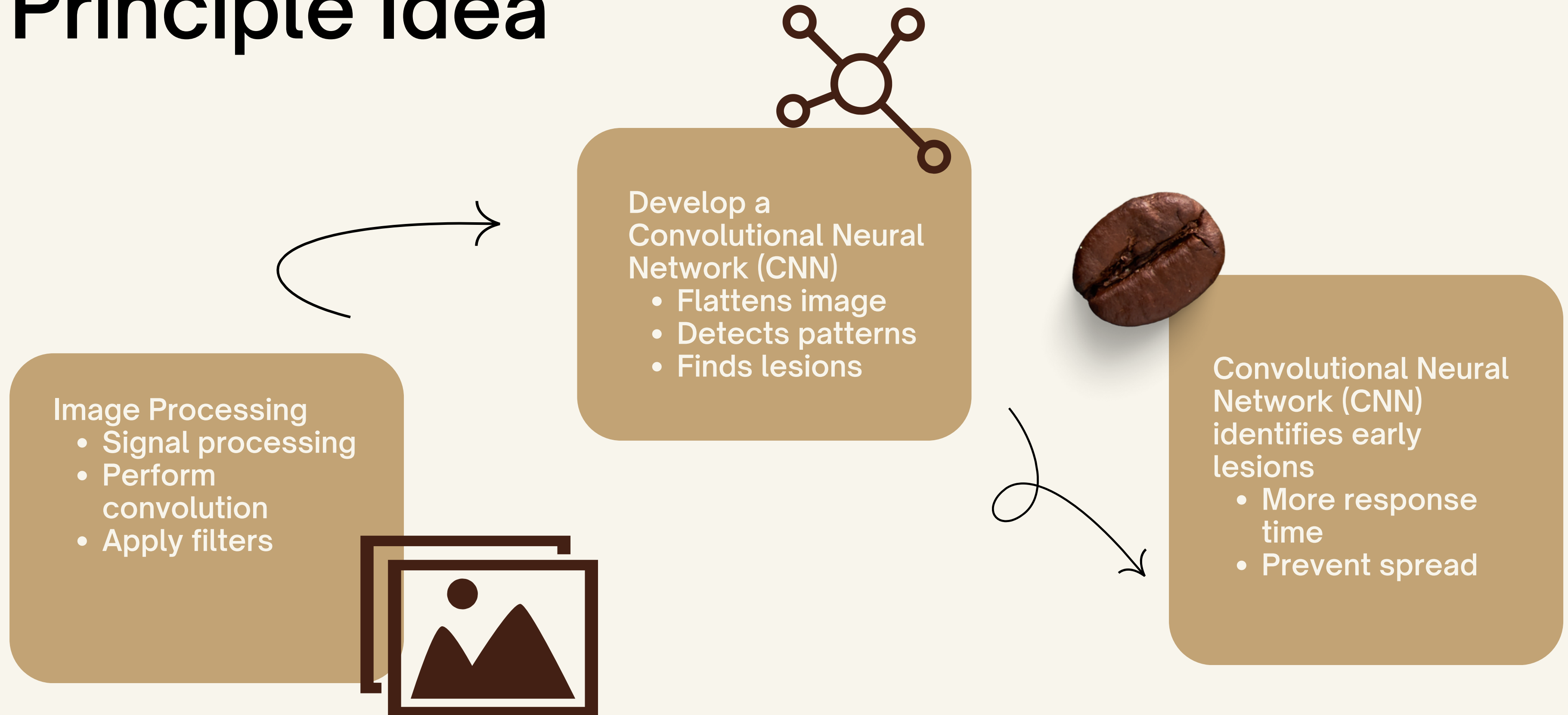


Figure: Train batch image post-convolution



# Principle Idea



# Convolution

- Finds Patterns:
  - Shapes, Edges, Textures
- Filters to highlight features
  - Simplifies image for analysis
- Pixel values range  $[0, 255]$

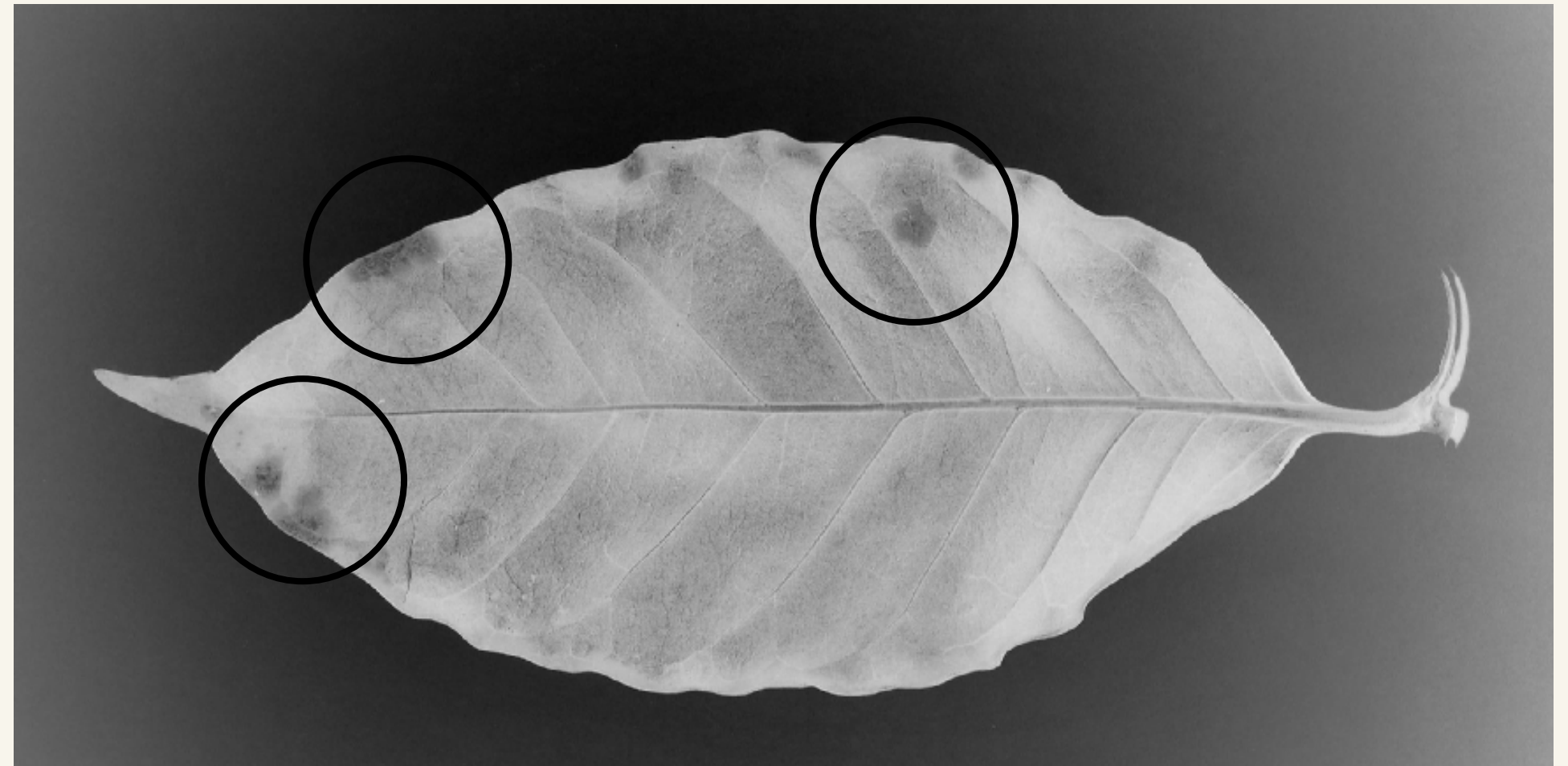


Figure: Sample image post-convolution. Leaf rust marked with circles.

# What does convolution look like?

Original Image



Grayscale Image



Convolved Image



High-pass kernel --> brightness difference



# Dataset

- Using the Coffee Leaf Disease dataset
  - Extracted images of healthy and rusted leaves
- Over 600 images
  - Healthy leaves: 284 images
  - Rusted leaves: 325 images
- Performed convolution on each image
- Flattened images and converted to numpy arrays

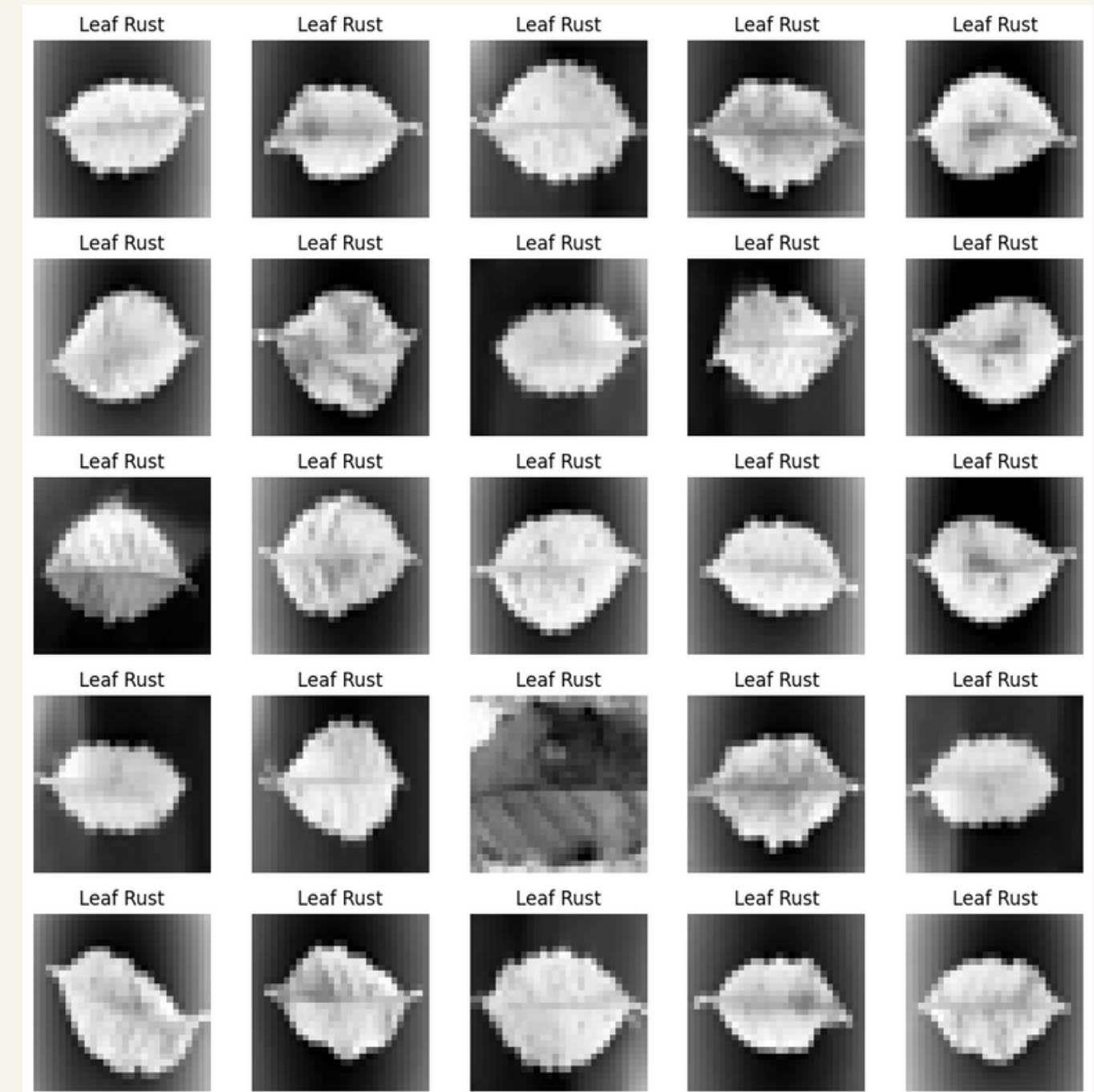


Figure: Sample data post-convolution

# Model Selection

- Examined quality of data with a simple MLP Classifier
  - Achieving 80% accuracy
  - Shows potential for improvement
- Future development:
  - Developing CNN
  - Potential for backpropagation

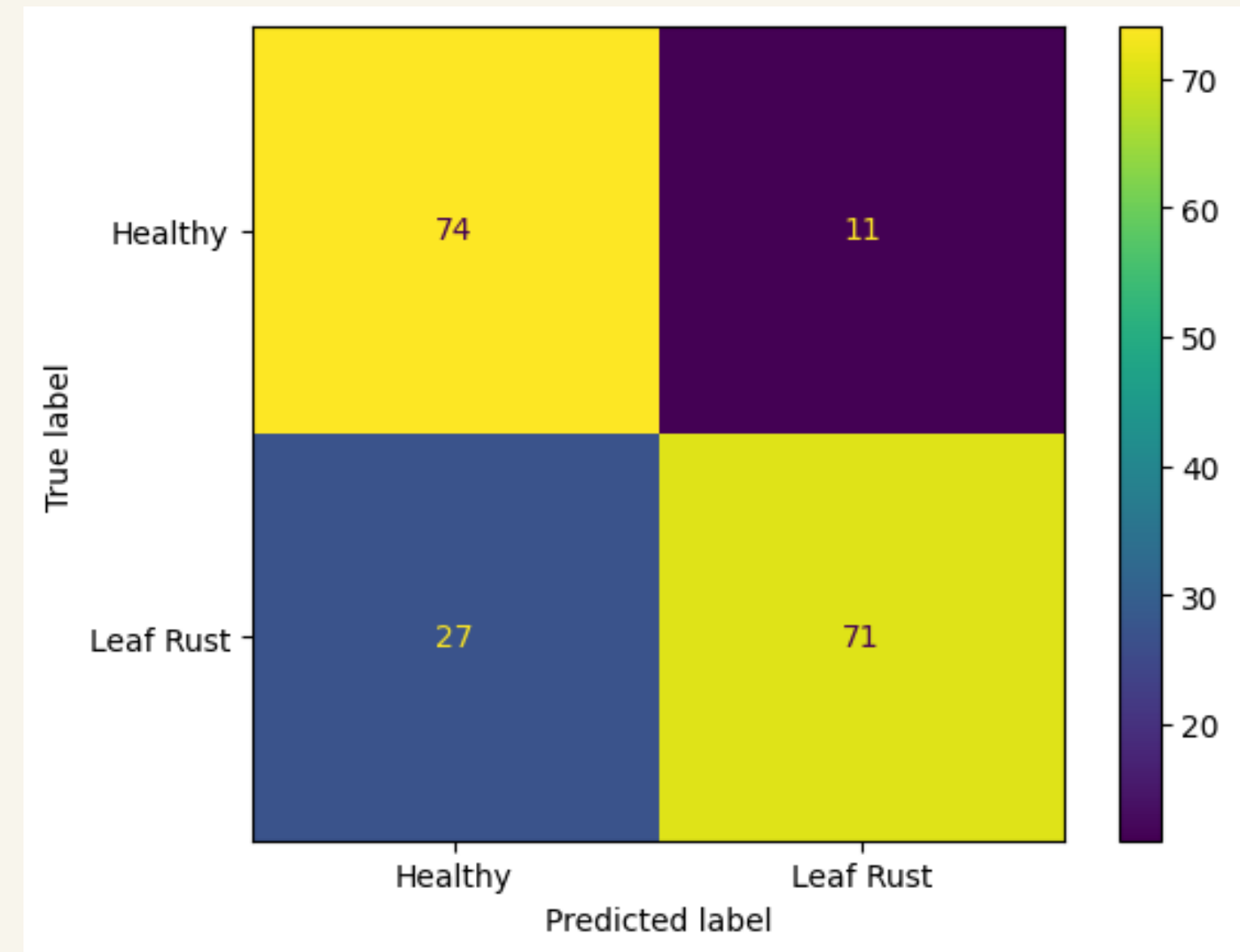
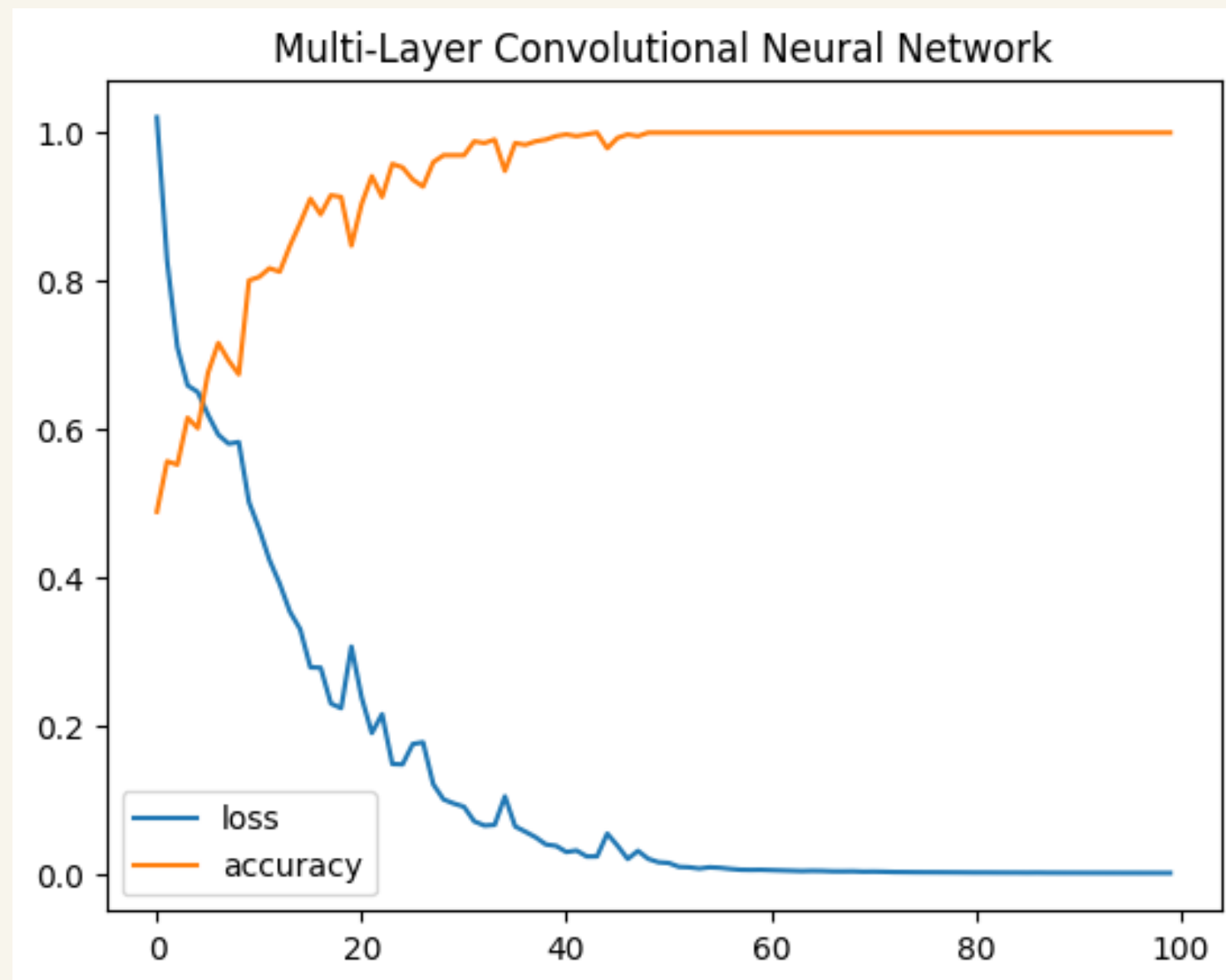


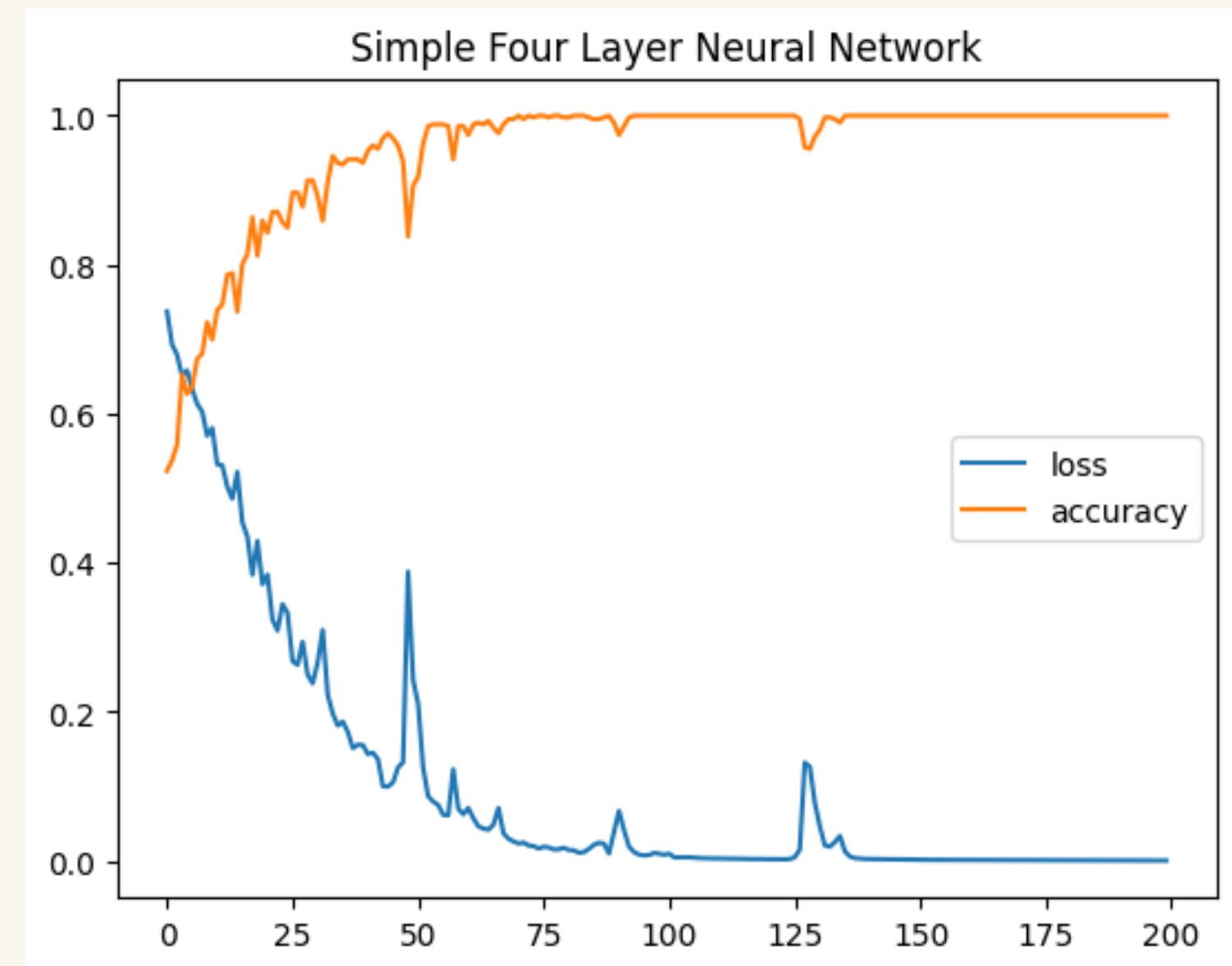
Figure: Model confusion matrix

# Preliminary Model Evaluation

Testing Convolutional Neural Network against a Neural Network made only of dense layers



Accuracy: 84%



Accuracy: 82%



# Thank You!

**Slideshow last updated: November 2023**