Chip Happens:

A Machine Learning Approach for Detecting Potato Chip Defects

Nick Hay • 16.02.2024
Capstone Project

Bio

Nicholas Hay
Education: Bachelor of Technology Degree in Food Science (2000)
Professional experience: Food manufacturing, Insurance, Bookkeeping
Data Science learnings: Data Science & AI Bootcamp (IOD)
Link https://www.linkedin.com/in/nicholas-h-2b380910/

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Agenda

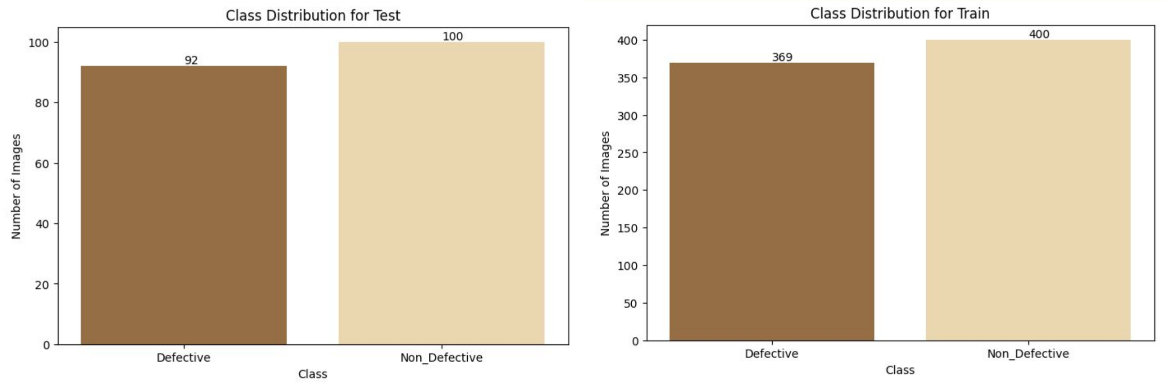
- Opportunity
- Data
- Modelling
- Results
- Deployment

Can image recognition & machine learning classify potato chips as defective (or non defective)

Data Analysis

Data / EDA

- Sourced from Kaggle [1]
- 961 images
- Labelled (Train / Test)
  - Test, Defective - 92 images
  - Test, Not Defective - 100 images
  - Train, Defective - 369 images
  - Train, Non Defective - 400 images
- Size - Original 2976, resized 224
- Manipulated

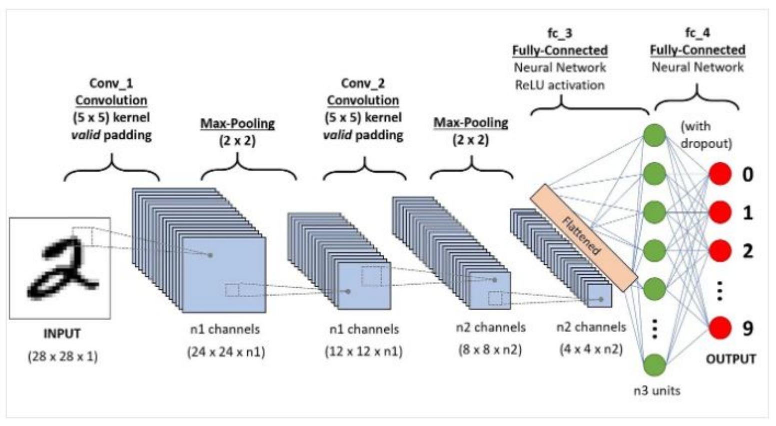


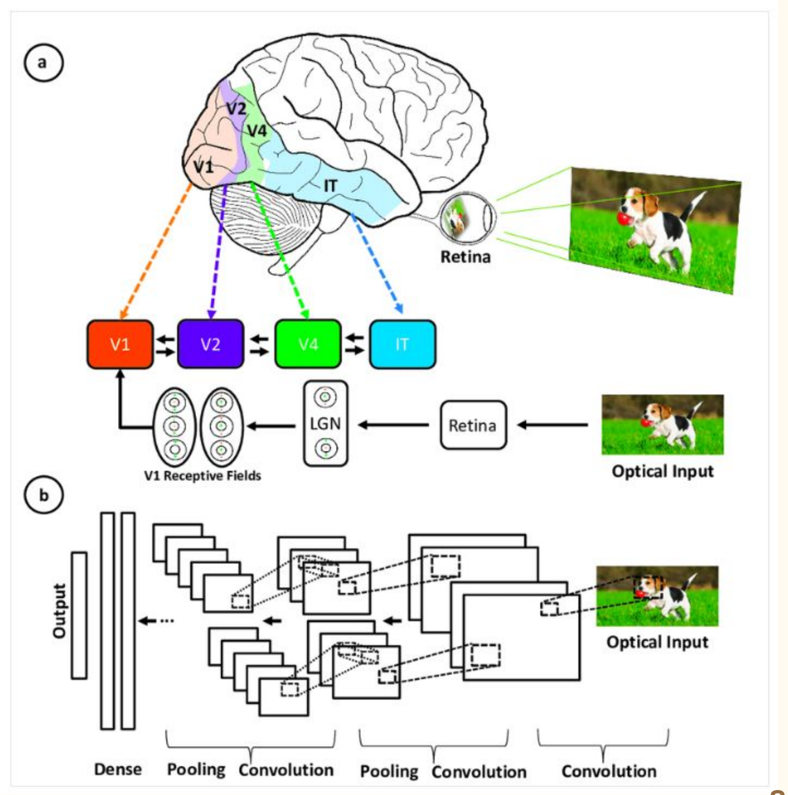
Modelling

Convolutional Neural Network (CNN) [2]

Key Components of CNN:

- Convolutional layers
- Activation function - Rectified Linear Unit (ReLU)
- Pooling layers
- Fully connected layers





Sequential Model (Binary Classification)

- Import the images (Image Data Generator) can augment (transform by flipping, shifts)
- Load Data (flow from directory)
- Normalise image pixels (divide by 255)
- Construct model architecture (add layers)
  - Convolution (2D)
  - Max Pooling
  - Flatten
  - Dense
- Train the model (pre-trained VGG19, ResNet50)
- Evaluate the model
- Made predictions

<u>**Hyperparameters**</u>

Image Size: 224 x 224

Batch Size: 32 images

Epochs: Number of Passes (10 - 30)

Early Stopping: Patience (3) on Validation Loss

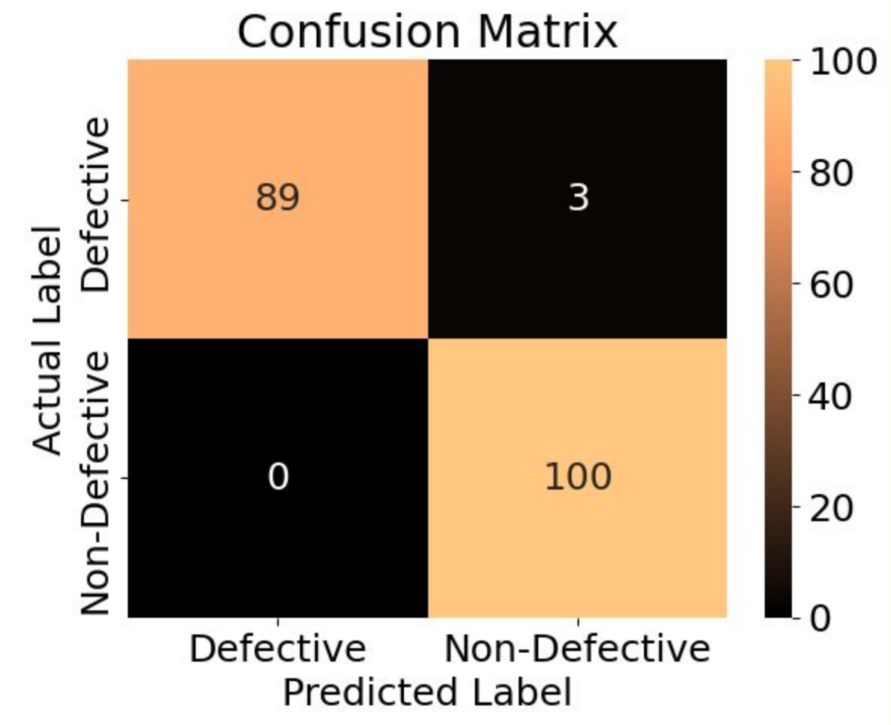
Validation Split: 20% of Training data

Results

Results:

Model	Training Accuracy	Validation Accuracy	Accuracy on Evaluation
First attempt	100%	99%	98.44%
VGG19	100%	99%	98.44%
ResNet50	100%	52%	52.08%
First attempt (Augmented)	100%	100%	98.96%

VGG19 - Confusion Matrix



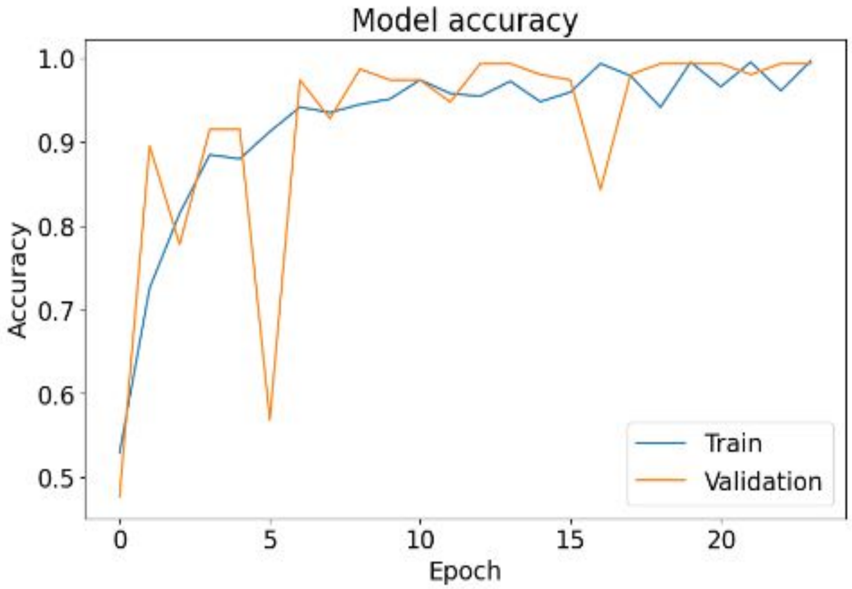
True Positives (TP): The model correctly predicted 89 defective items.

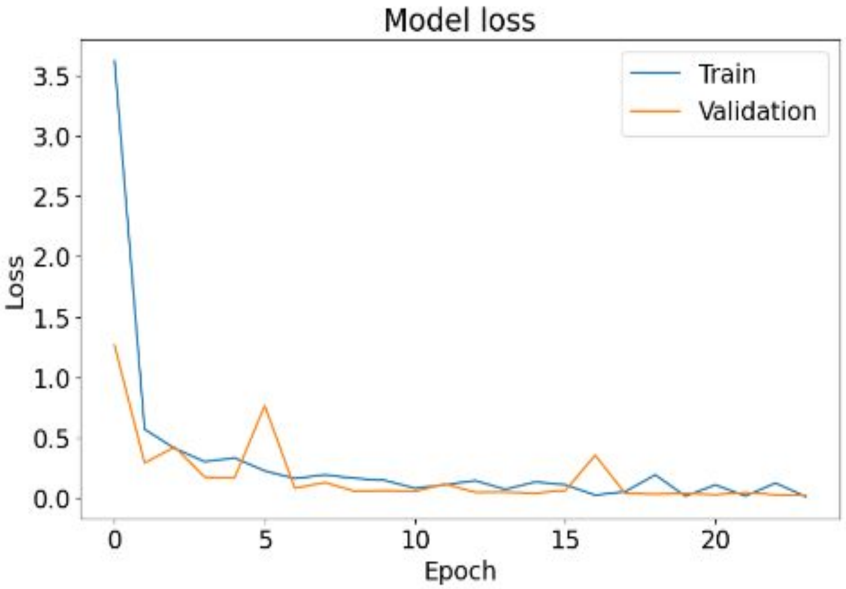
True Negatives (TN): The model correctly predicted 100 non-defective items.

False Negatives (FN): The model incorrectly predicted 3 defective items as non-defective.

False Positives (FP): The model did not make any incorrect predictions of non-defective items as defective.

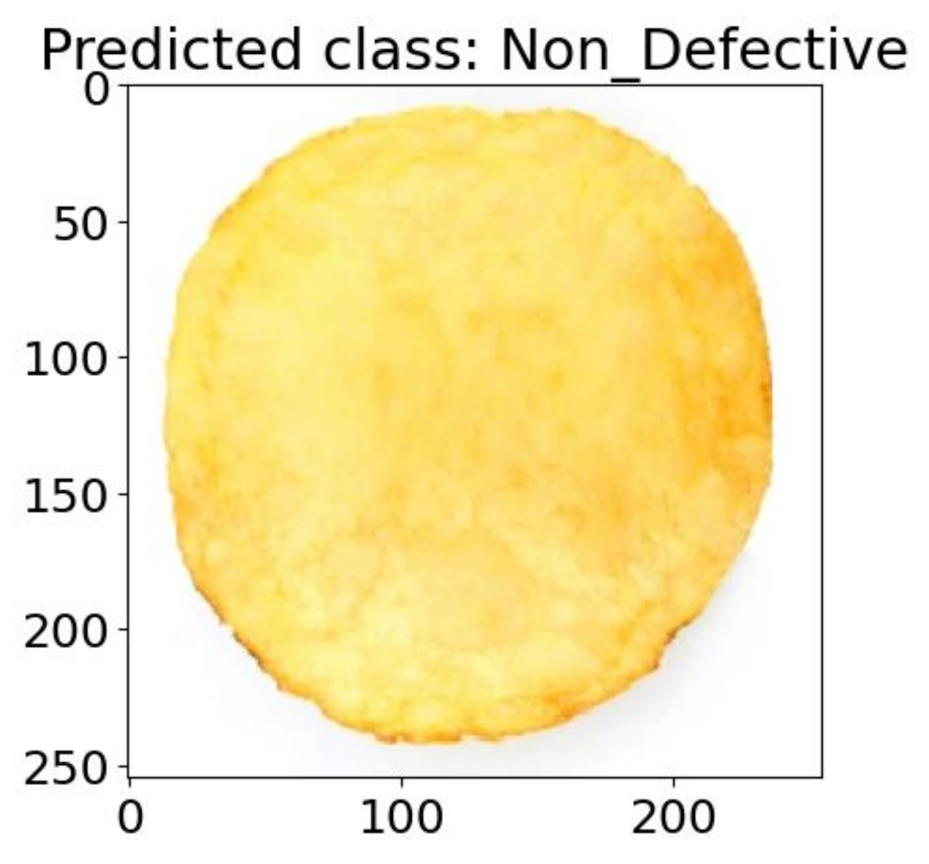
VGG19 - Model Accuracy & Loss

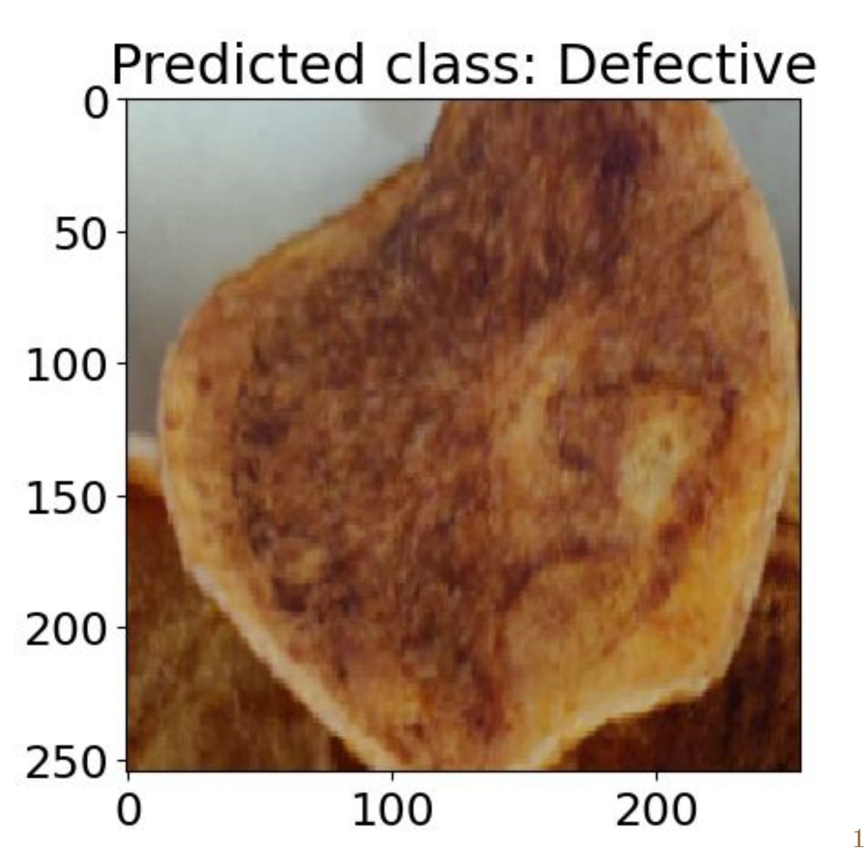




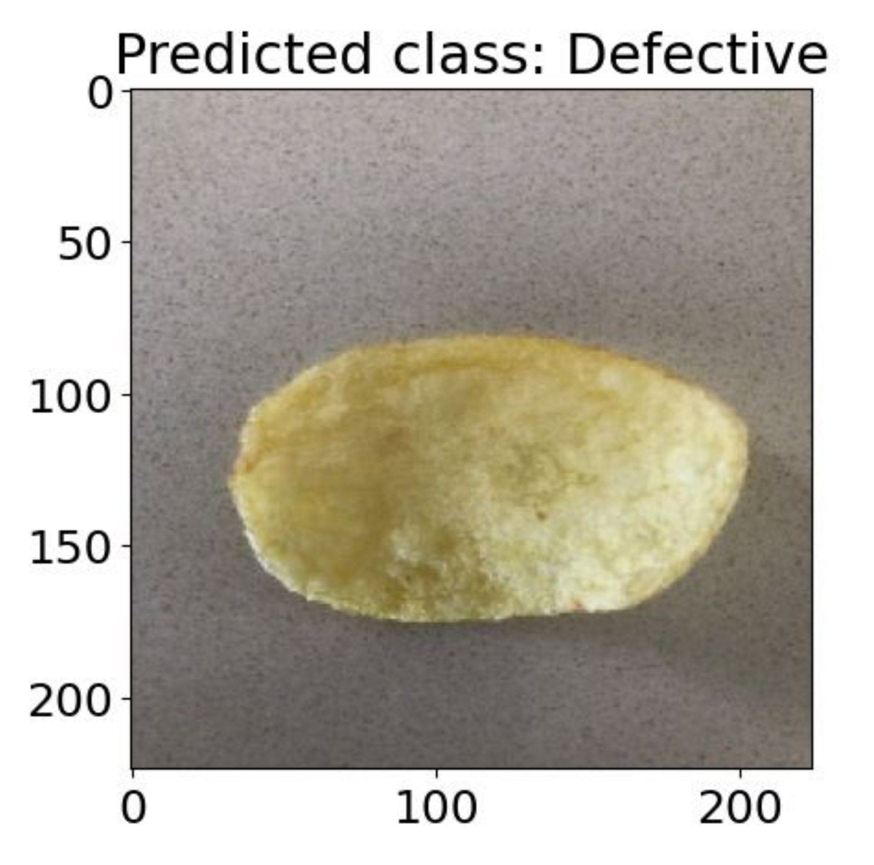
VGG19 Predictions

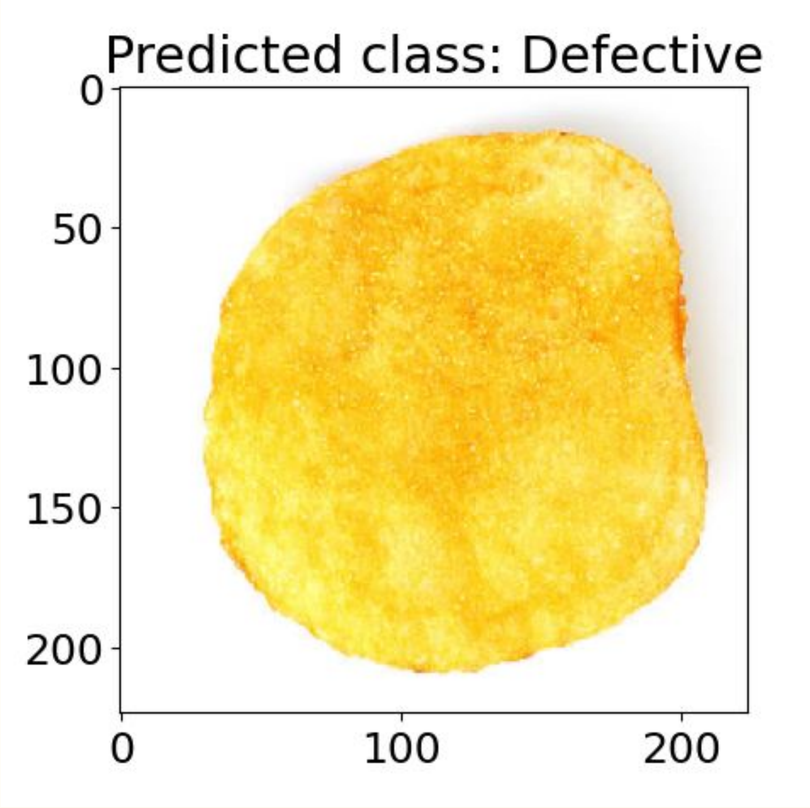
VGG19 - Correct Predictions



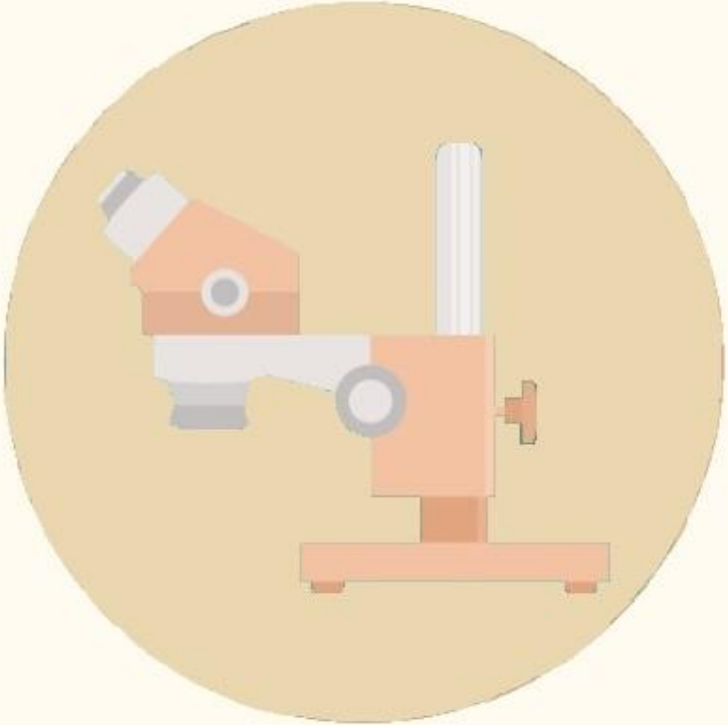


VGG19 - Incorrect Predictions





Implementation



Deployment - Application

Conclusion & Future work

Conclusion & Future Work

- Machine learning can predict defective images
- Application to verify the model is working
- Train the model using more images
- Computing power to run more epochs
- Techniques to minimise overfitting
- Recommend to stakeholders, investigate the practical implications of deploying the model in a manufacturing environment.

Thank you
&
Questions

References:

[1] Navid, Usama. “PepsiCo Lab Potato Chips Quality Control.” *Kaggle*, https://www.kaggle.com/datasets/concaption/pepsico-lab-potato-quality-control

[2] Keita, Zoumana. “An Introduction to Convolutional Neural Networks: A Comprehensive Guide to CNNs in Deep Learning.” *DataCamp*, https://www.datacamp.com/tutorial/introduction-to-convolutional-neural-networks-cnns.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