WASTE CLASSIFICATION

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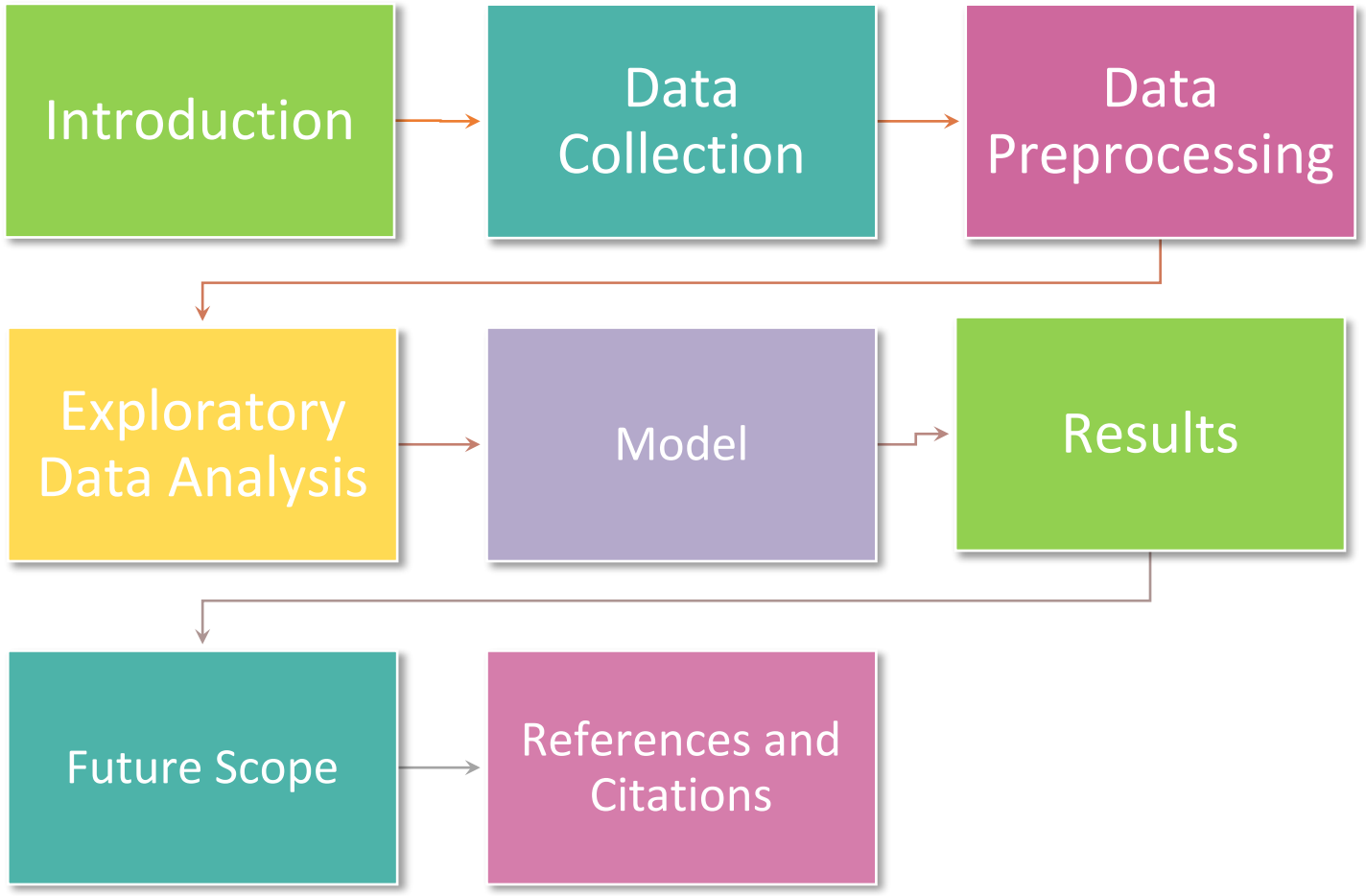
AGENDA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INTRODUCTION

🎯 **OBJECTIVE:** To create a waste classification system that helps in solving environmental issues using machine learning techniques.

The segregated waste is further divided into recyclable and non-recyclable

Why Is Waste Classification Important?

- Reduces risk of secondary pollution in air, water and land
- Helps Garbage disposal issues and saves land area
- Helps turn trash to treasure by recycling, composting, etc.

DATA COLLECTION

Examples of Input Images

DATA PREPROCESSING

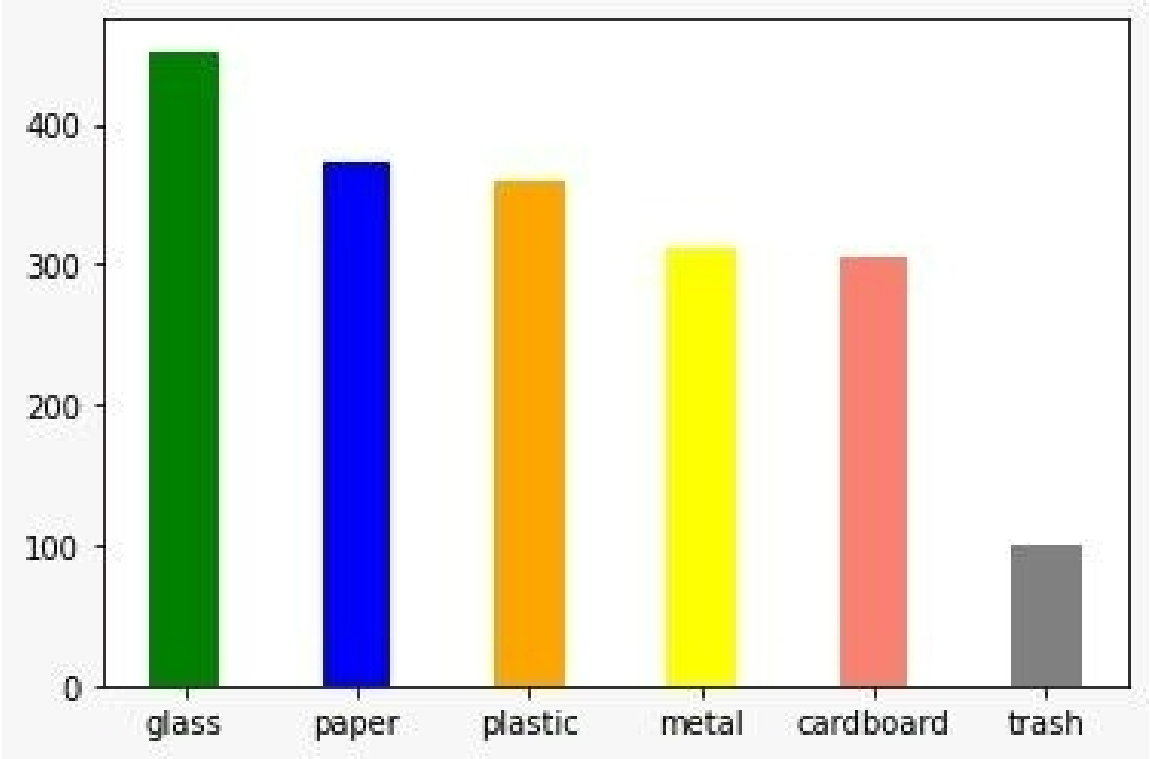
Why Data Processing?

- To convert raw .jpg data into the machine-readable form and help in improving the efficiency and overall accuracy of the model.
- To apply transformations such as resizing and scaling into tensor format.

Gathering garbage images and dividing them into different class folders → Resizing images to a standard image size, i.e. 256 x 256 → Reading the image and Label → Setting the batch size to 48 with 16 in each row

EXPLORATORY DATA ANALYSIS

FREQUENCY OF CLASS



Type of Waste

Total Number of Images Given For Training: 1900

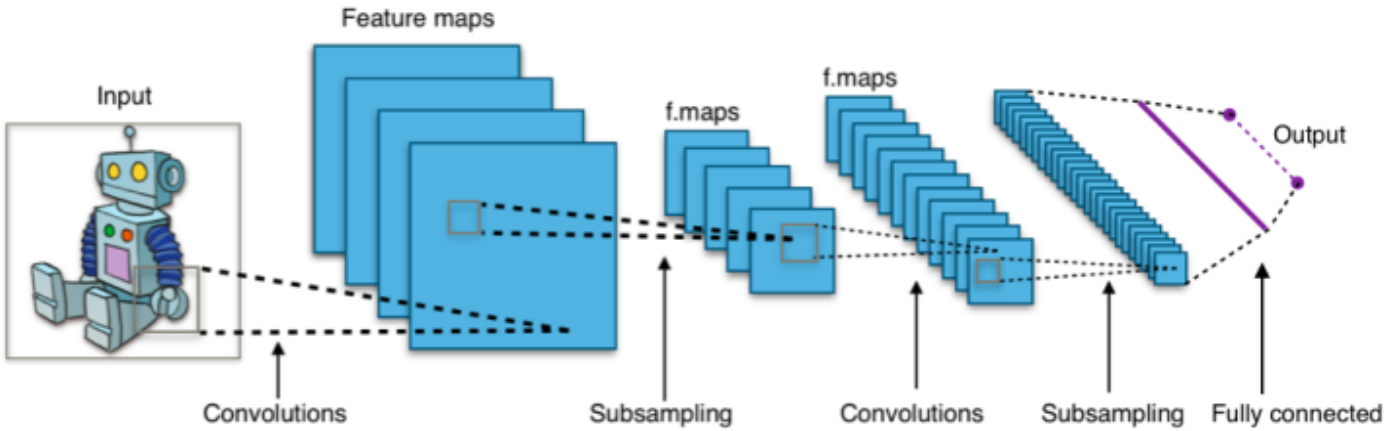
Ratio Split of Classes of training data : 452, 373, 359, 311, 305, 100

Data is Imbalanced

More amount of data for glass images

Less amount of data for Trash

Model



Split Size: 80:20

Model used: RESNET34

Framework used: Pytorch

What is a convolutional network?

It takes pixels of an image as input and returns a feature map as output.

What is RESNET?

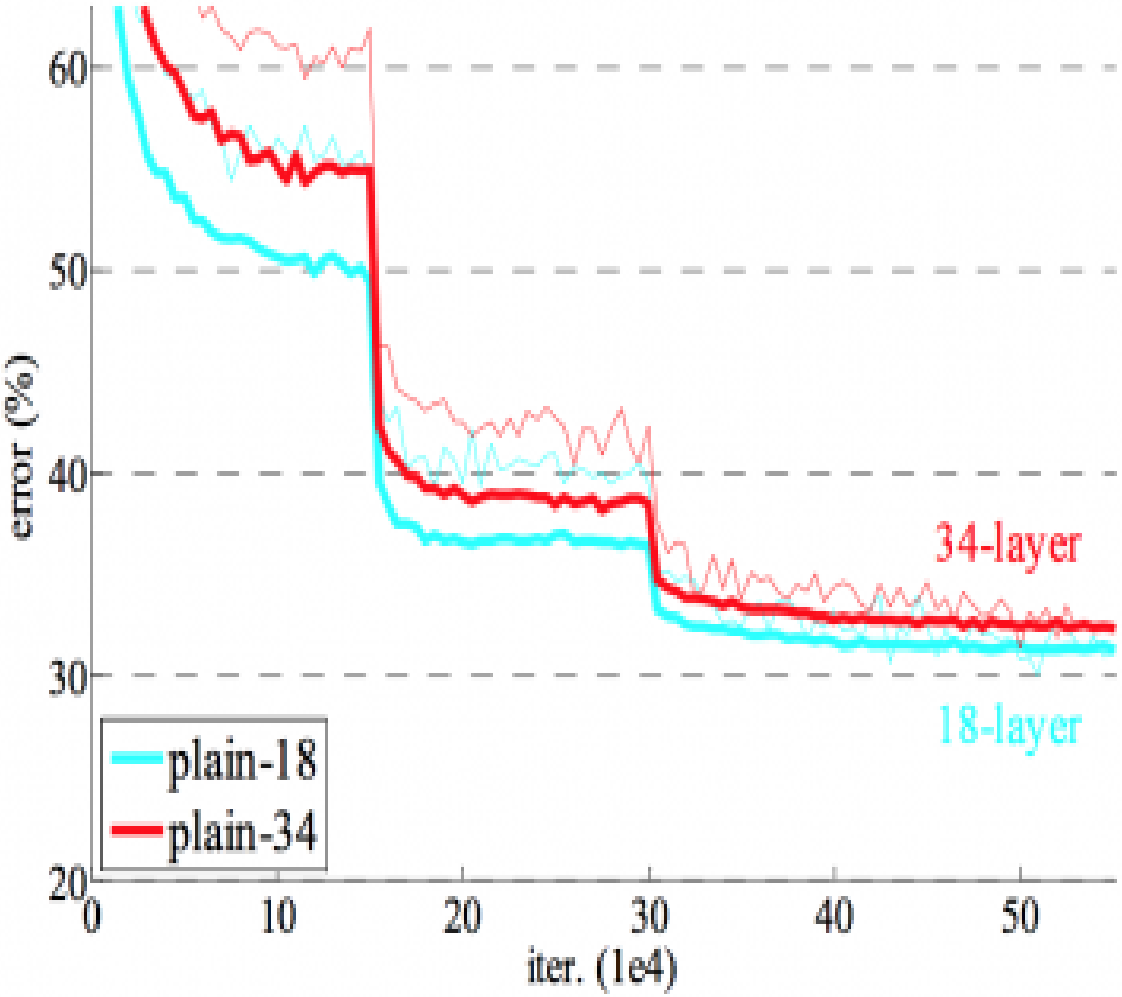
It is a 34 layer convolutional network.

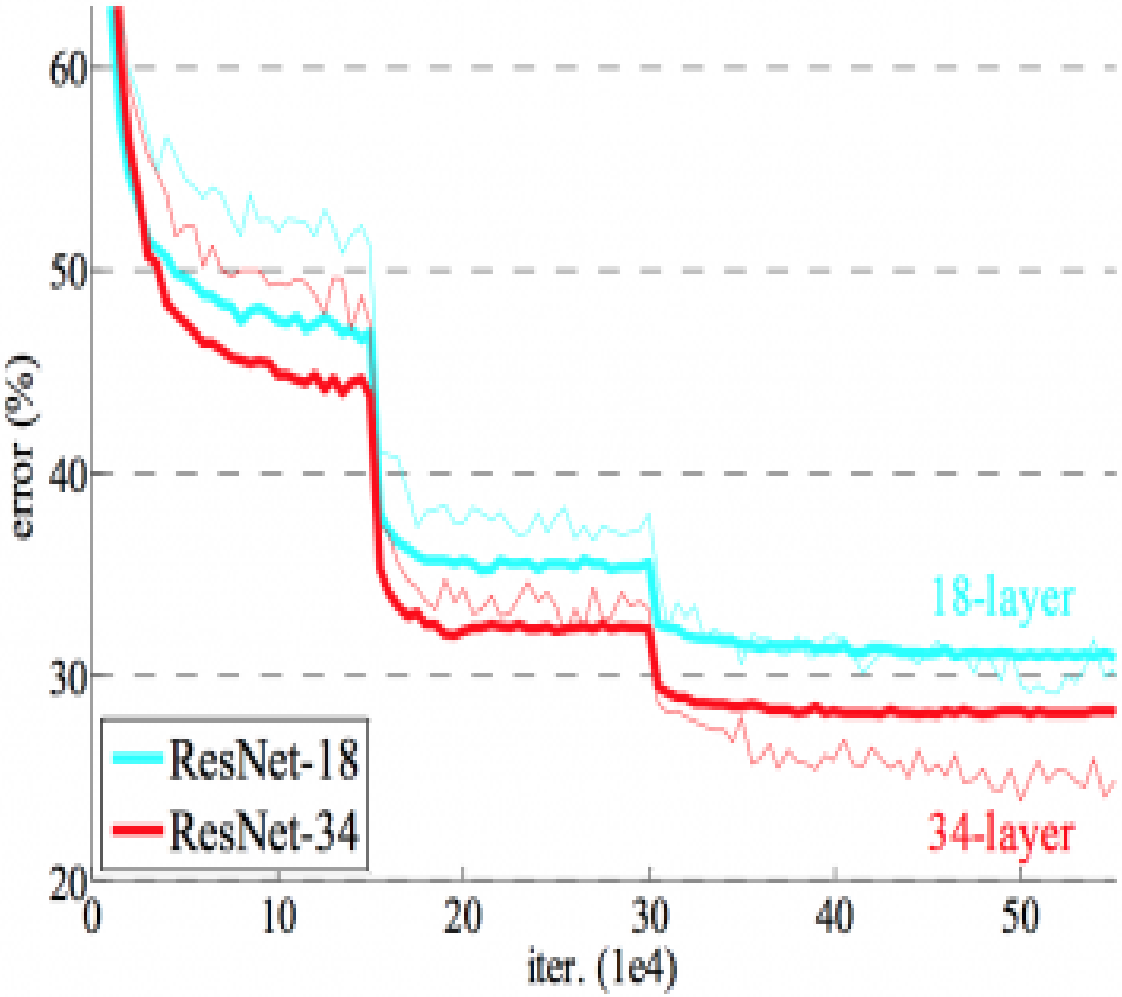
It is a sophisticated and commonly used model in image classification.

The model is pre-trained on a dataset that has 100,000+ images across 200 different classes and since our project consists of 6 (nonbinary) classes, Resnet34 seems to be the best option.

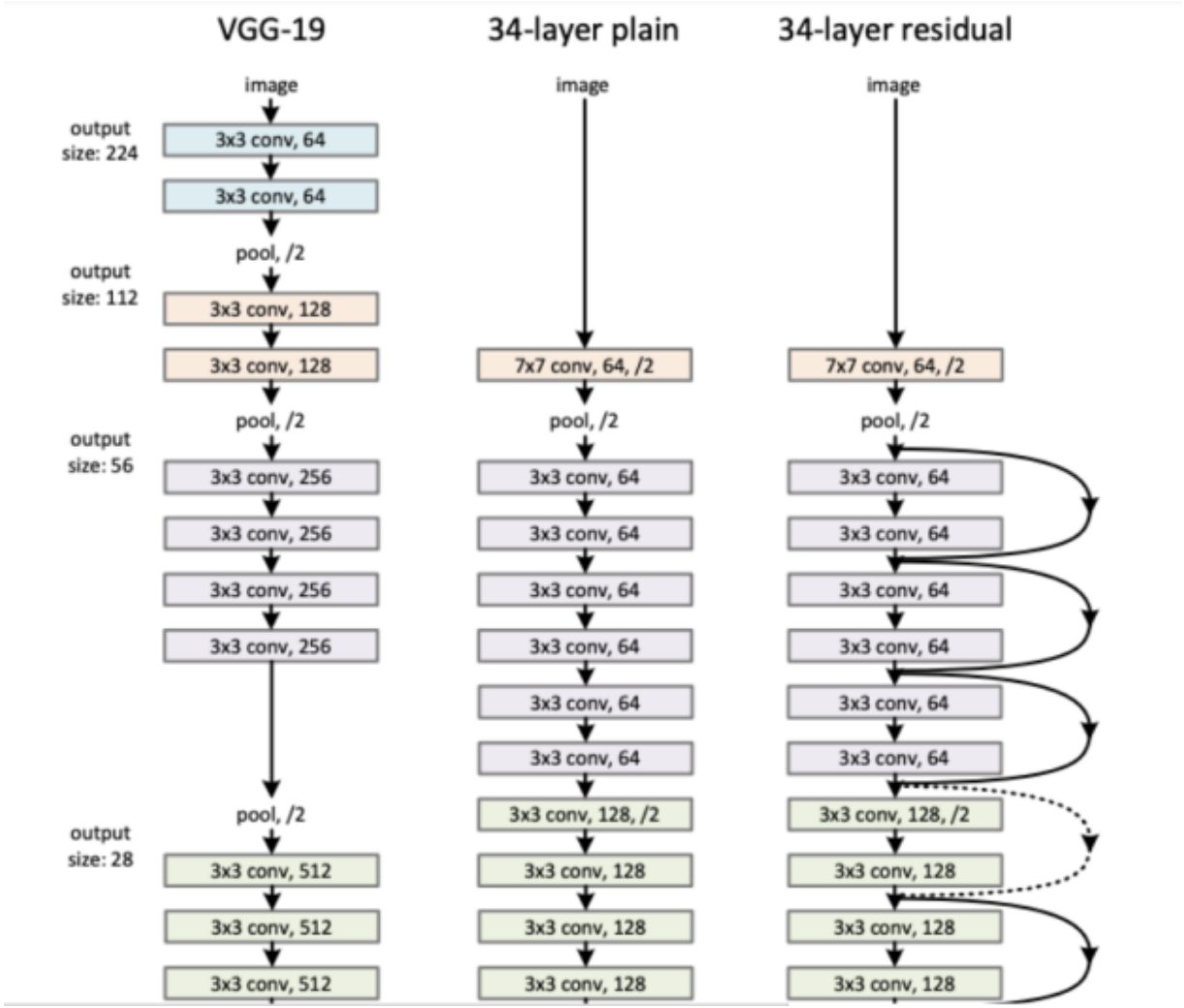
This model is different from the traditional neural networks. This is because it takes residuals from each layer and uses them in the subsequent connected layers.

Increasing the Layers





Click on the link for full architecture: https://blog.roboflow.com/content/images/2020/09/image.png



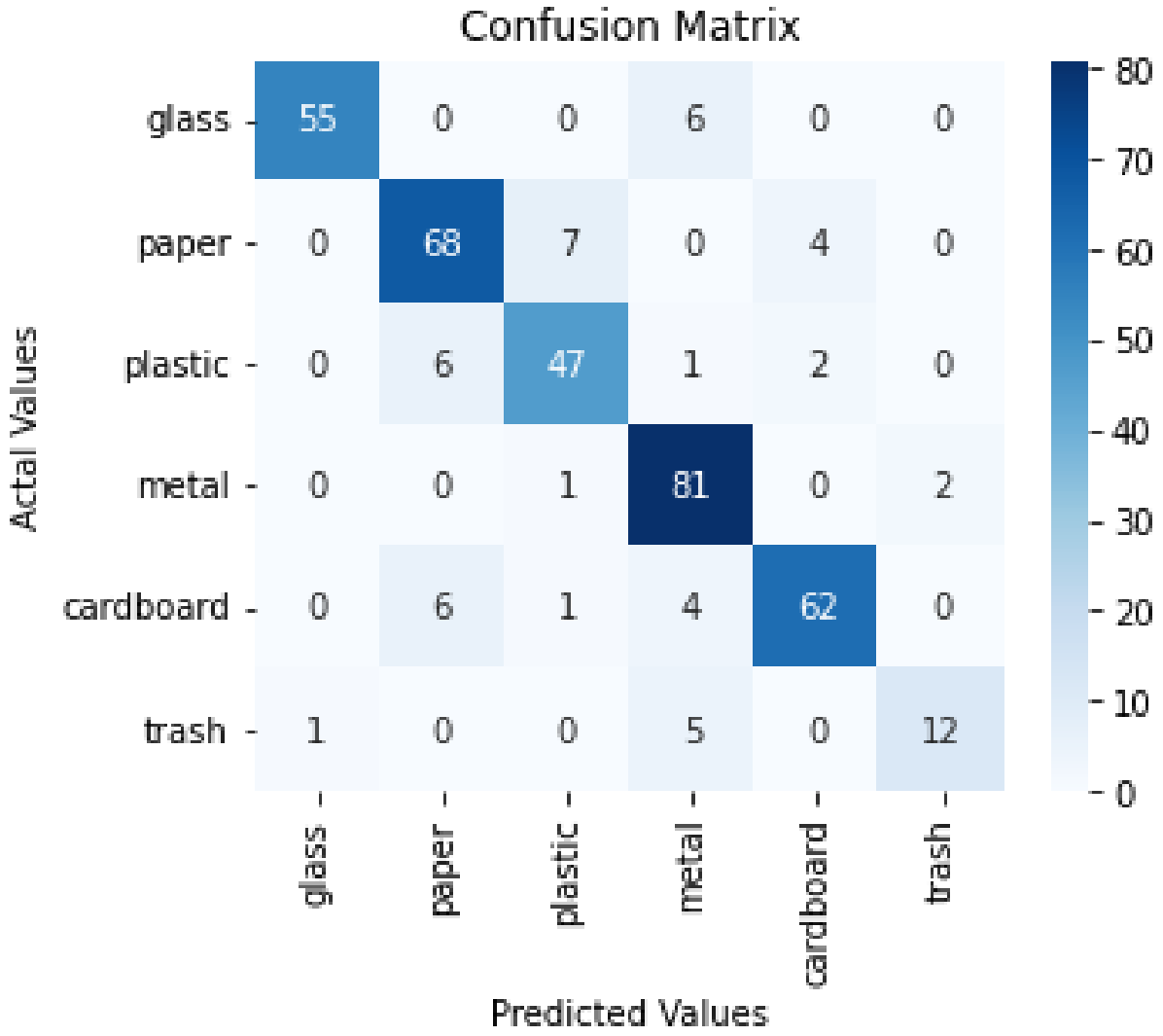
Why use PyTorch?

After implementing in different libraries (like Keras) Pytorch proved to be more effective while using Resnet.

Pytorch is also handy for resizing and changing pixels of an image.

RESULTS AND ACCURACY

Heat map of test data



Training and Testing Split: 80:20

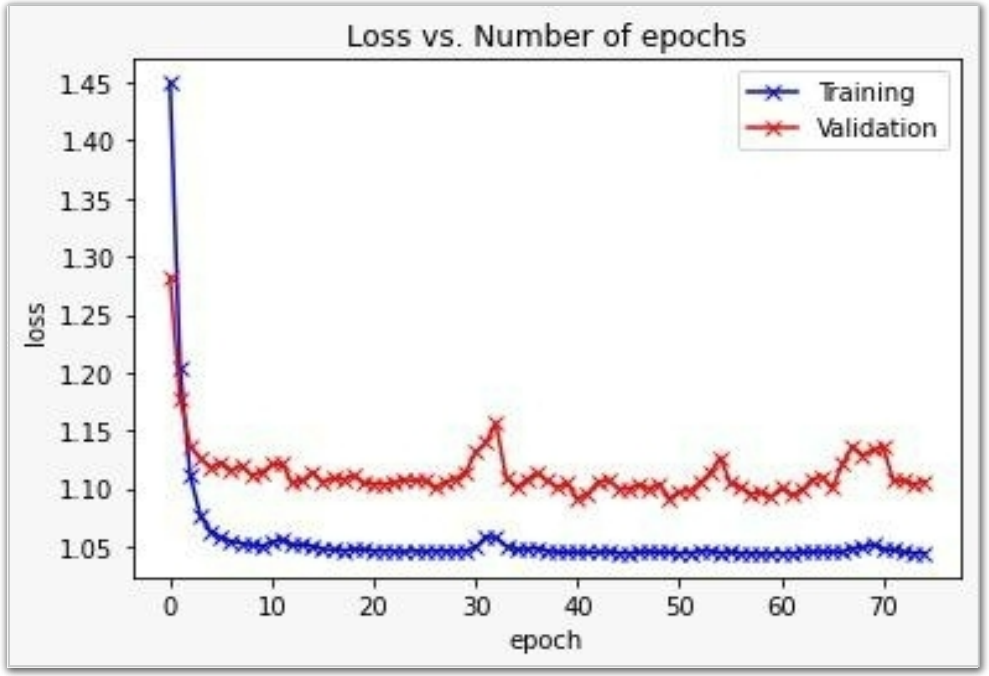
Decent Recall and Precision Values

Accuracy Score of test data: 0.892

Precision and Recall of Test Data

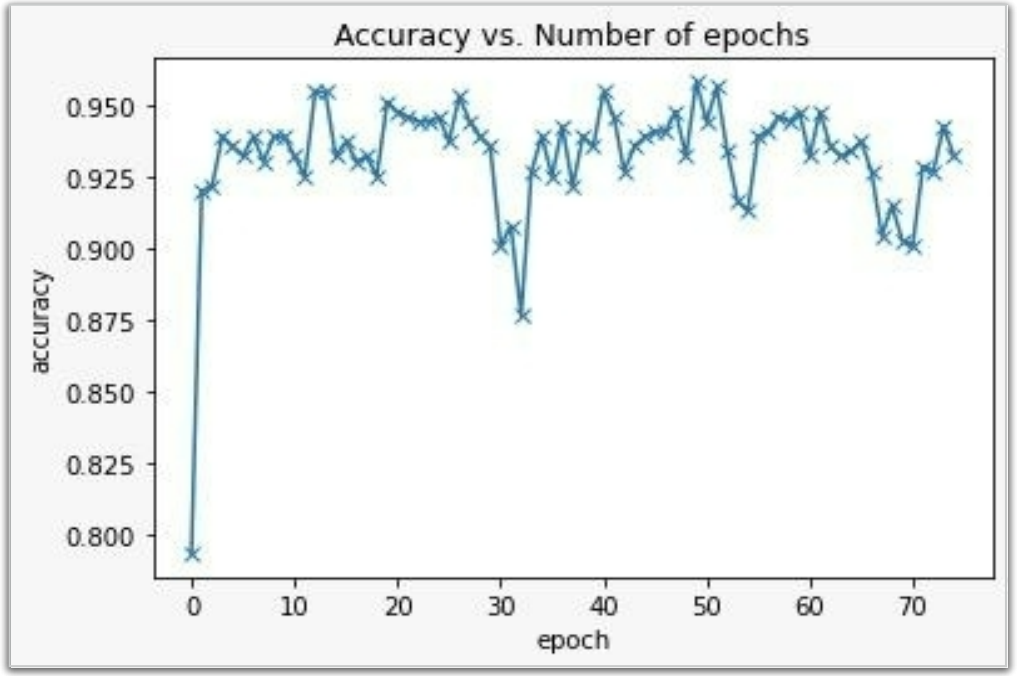
Class	Precision	Recall
Glass	90.2%	98.2%
Paper	86.1%	85%
Plastic	83.9%	83.9%
Metal	96.4%	83.5%
Cardboard	84.9%	91.2%
Trash	66.6%	84.7

IMPORTANT GRAPHS



The Loss vs Epoch graph plotted shows that the learning rate of the model is high.

IMPORTANT GRAPHS
Accuracy of Validation data:

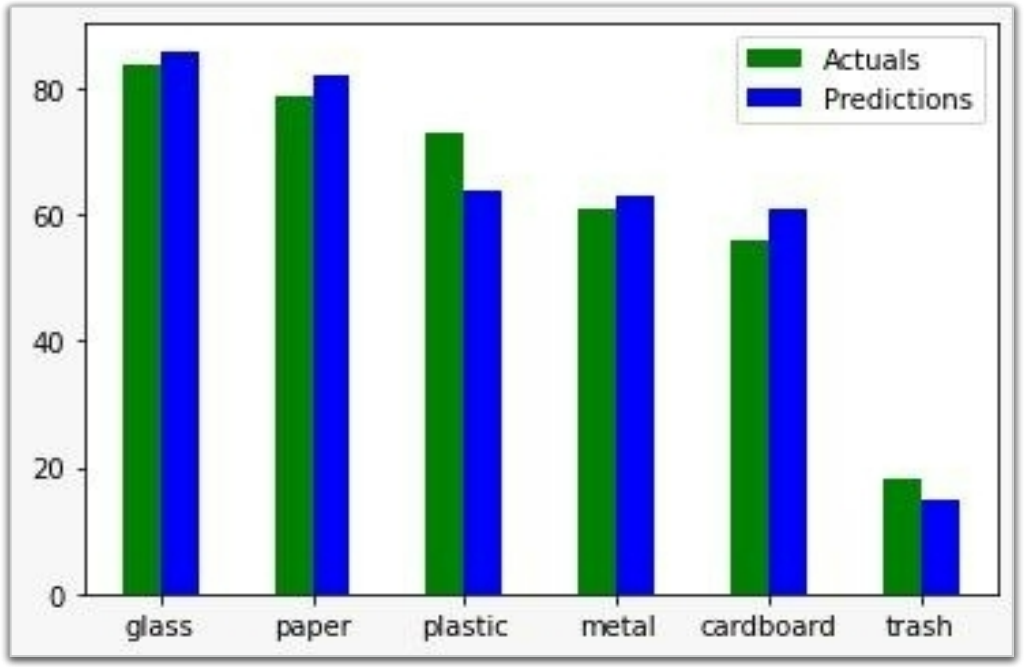


Accuracy increased drastically after 2nd Epoch.

Accuracy drops significantly at 30 Epoch.

At 75th Epoch, validation data had 93.2% accuracy

ACTUAL DATA VS PREDICTED DATA



- There is a very slight difference between the count of actual and prediction values.
- For Trash and Plastic, actual value is Higher than its prediction
- The highest difference between actual and predicted can be observed for plastic.

FUTURE SCOPE

Improve the accuracy of the model by using more image transformation techniques.

Create an Application to recognize type of waste.

Create an intelligent waste management system to help protect environment.

Train the model using balanced data, i.e. add more trash images and equal number of images for each class.

Reference Links

https://models.roboflow.com/classification/resnet34

https://towardsdatascience.com/advanced-waste-classification-with-machine-learning-6445bff1304f

https://www.kaggle.com/datasets/asdasdasasdas/garbage-classification

https://pytorch.org/docs/stable/index.html

https://gist.github.com/Gladiator07/c6c9fba479a1cf35db844ed58dd0ba22

https://colab.research.google.com/github/divya-r-kamat/PyTorch/blob/master/MNIST_CNN_(Fine_Tuning).ipynb

THANK YOU