Classification of waste materials into biodegradable and nonbiodegradable using machine learning

An experiment by Aarav Balaji

Statement of Problem

Can I use artificial Neural Networks that specialize in image classification to train an AI model to classify waste materials into Biodegradable and Nonbiodegradable?

Hypothesis

I hypothesize that I can use artificial neural networks that specialize in image recognition such as MobileNetV2, ResNet50, and VGG16 to classify waste materials into Biodegradable and Nonbiodegradable.

Variables

Independent Variable:

Hyperparameters of the AI models (Epochs and Learning Rate)

Dependent Variable:

The Accuracy

Control

Platform used for coding(Google Colab)

Dataset for training the models

Number of images used to train each model

Materials

Materials:

A PC with Google Colab Pro on it

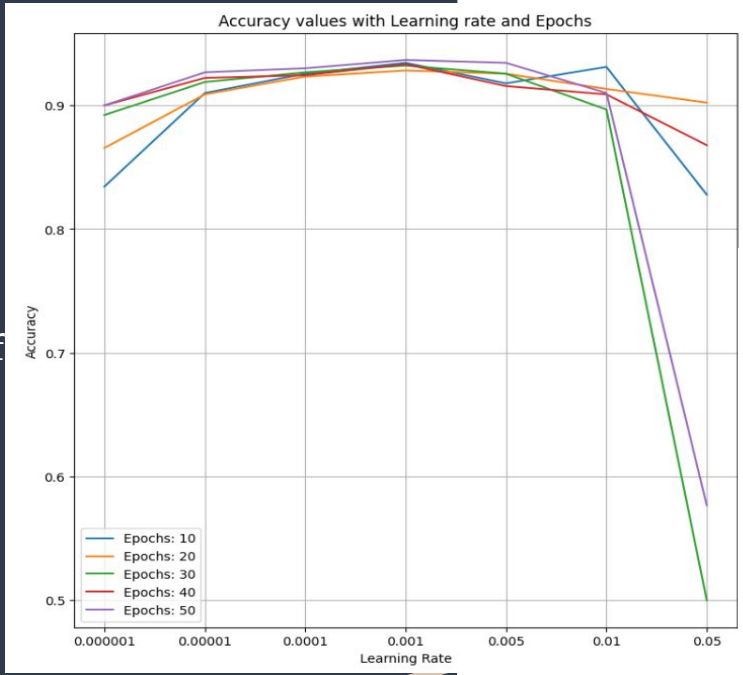
Procedure

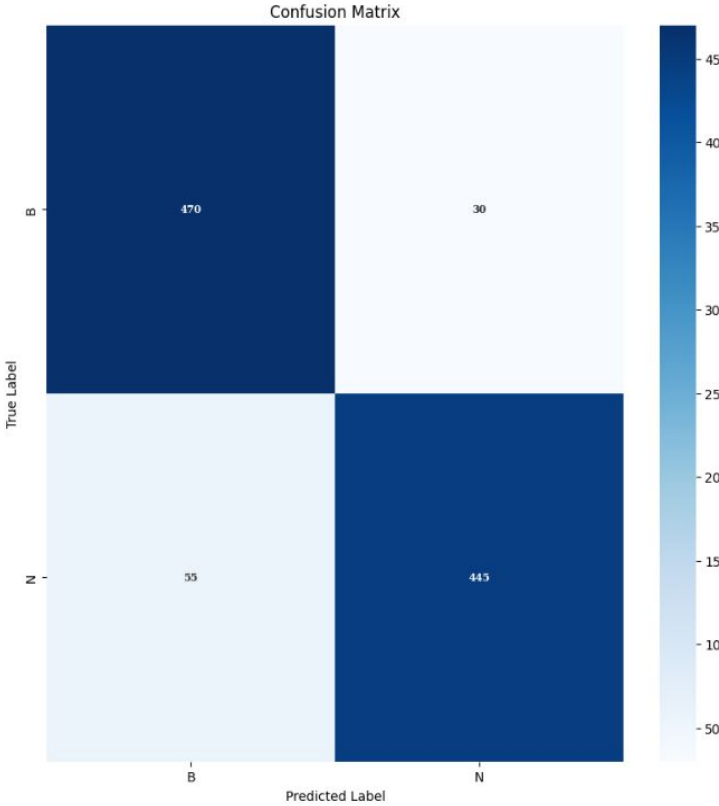
Epochs/Learning Rate	0.000001	0.00001	0.0001	0.001	0.005	0.01	0.05
10	0.8344	0.91	0.9256	0.9344	0.9178	0.9311	0.8278
20	0.8656	0.9089	0.9233	0.9282	0.9256	0.9133	0.9022
30	0.8922	0.9189	0.9267	0.9322	0.9256	0.8967	0.5
40	0.9	0.9222	0.9244	0.9333	0.9156	0.9089	0.8678
50	0.9	0.9267	0.93	0.9367	0.9344	0.91	0.5767

1. Download [Non and Biodegradable Material Dataset] from Kaggle.
2. Split dataset into 3 categories: 80% train data, 10% test data, and 10% validation data using python code on a coding platform called google colab .
3. Use the train data and the validation data to run experiments with MobileNetV2 and change the hyperparameters as shown in the chart on the left using Google Colab for coding. Then, record the accuracy of each model in a chart similar to the one on the left.
4. Repeat step #3 with the algorithms VGG16 and Resnet50
5. Generate graphs with the data you recorded using python code for each Algorithm.
6. Find the best model of each algorithm and save them in a file
7. Generate a confusion matrix showing how many images the AI predicted right and wrong for each algorithm
8. Find which model works the best and come up with a conclusion

Data: MobileNetV2

B = Biodegradable
N = Non-biodegradable
Zoom in to see data clearly
Confusion Matrix:
Shows number of images of the test data that the AI predicted correctly and incorrectly.
Multiline plot:
Shows on a line graph the results of hyper parameter tuning(changing the epochs and learning rate)

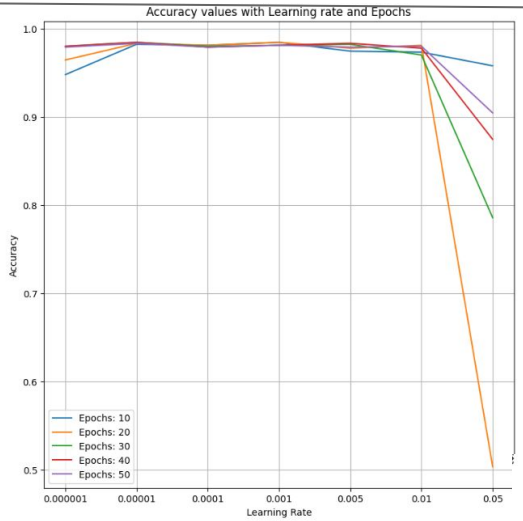




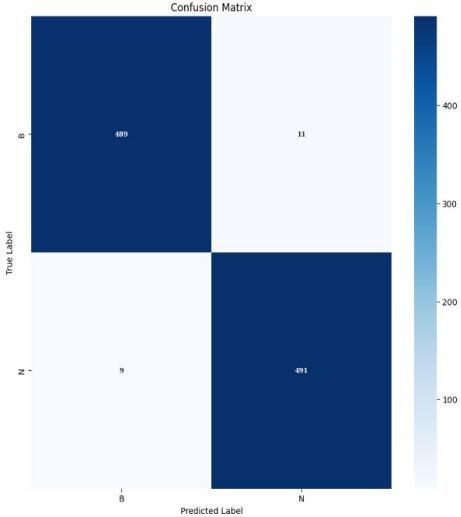
Data: Resnet50

B = Biodegradable
N = Non-biodegradable
Zoom in to see data clearly
Confusion Matrix:
Shows number of images of the test data that the AI predicted correctly and incorrectly.
Multiline plot:
Shows on a line graph the results of hyper parameter tuning(changing the epochs and learning rate)

Multiline plot



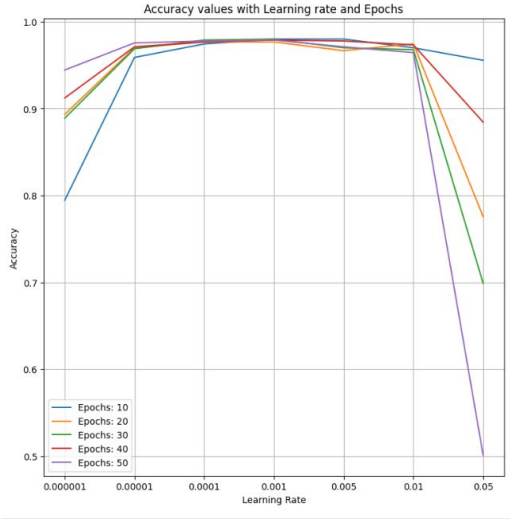
Confusion Matrix



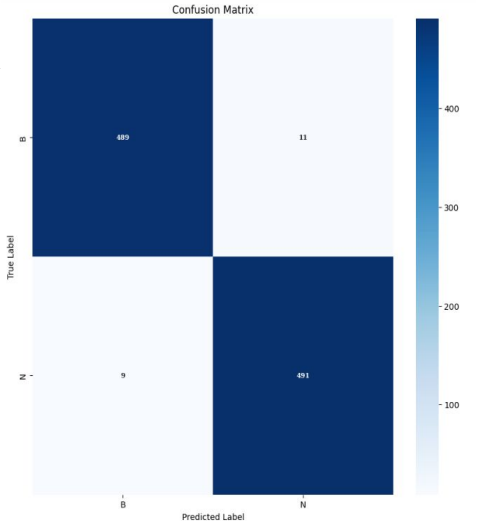
Data: VGG16

B = Biodegradable
N = Non-biodegradable
Zoom in to see data clearly
Confusion Matrix:
Shows number of images of the test data that the AI predicted correctly and incorrectly.
Multiline plot:
Shows on a line graph the results of hyper parameter tuning(changing the epochs and learning rate)

Multiline plot



Confusion Matrix



Conclusion and Analysis of Data

In conclusion, my hypothesis is proven correct: I hypothesize that I can use artificial neural networks that specialize in image recognition such as MobileNetV2, Resnet50, and VGG16 to classify waste materials into Biodegradable and Nonbiodegradable. Based on my data I collected, I found that the best epochs, learning rate and algorithm that resulted in the most accurate model was the Epochs 20, learning rate 0.001, and the best algorithm was Resnet50. This combination resulted in an accuracy of 98.44%, and was the one I used for creating a AI that can classify waste material into Biodegradable and Nonbiodegradable.