ECBE 329 Final Project Report

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## Introduction

In this report, a Convolutional Neural Network, or (CNN) is used to classify images from the provided data set. Image classification is an important field of image processing. CNNs are often applied to solve recognition problems, and have been shown to provide improved performance and accuracy in previous models. The data utilised for this implementation consisted of a series of images of various materials, those being plastic, metal, paper and glass. The objective being to effectively distinguish between these four materials. Image pre-processing was available for use in order to greater allow easys distinguishing by the network.

## Methods

The network used was a CNN composed of 8 layers, the size of the images was rescaled to 380 X 508, and as such the input for the first layer was of this dimension, the network had two convolution layers, and two pooling layers. A flattening layer was also used to convert the output into a one dimensional format, finally two dense layers were used to acquire the final result. All of the convolution layers and the first dense layer used a ‘ReLu’ activation function, designed to return a binary output. The second, and final, dense layer used a softmax activation function; the final dense layer had 5 outputs, corresponding to the 5 category labels to be distinguished.

Prior to training, the images in the dataset were converted to grayscale to allow for faster training, the images were also resized to 384 X 512. A vertical flip was performed on the data, and these modifications improved the performance of the model. In order to test the model, the dataset was split into validation and training datasets. This allows us to train our model to a high accuracy on our training dataset, and then see how it fares against the validation dataset, which would be new to our network. We allotted 20% of the dataset to validation data, meaning our data had five ‘folds’. We also found that a sparse categorical loss compiler outperformed the categorical loss compiler in our models.

## Results

Upon completion of testing, final results for the optimal model were produced. While training accuracy was found to be very high, the best validation accuracy was approximately 55%. This level of accuracy suggests that while the model does not reliably distinguish between the 5 materials, its ability to distinguish is far better than random chance. For a random selection between the 5 classes of data, one would expect an accuracy of approximately 20%, the models validation accuracy of ~55% outperformed this, as well as the two other models we included in our testing.

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Figure 1. Results from the final models testing showing training and validation accuracy and loss.

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## Conclusion

While the final network created does not provide a definitive classification of data, it clearly has the ability to distinguish between materials with some level of competency, far above that of random chance. Incremental improvements to successive models yielded this final result, however, further optimisation and changes to the network architecture would likely improve its accuracy. Even a network that does not provide absolute certainty can give useful insight into a dataset. This model could also provide a basis for future improvements, and demonstrates the utility of a CNN for image recognition applications.