**Traffic Sign Recognition Machine Learning**

**Project Report**

## Introduction

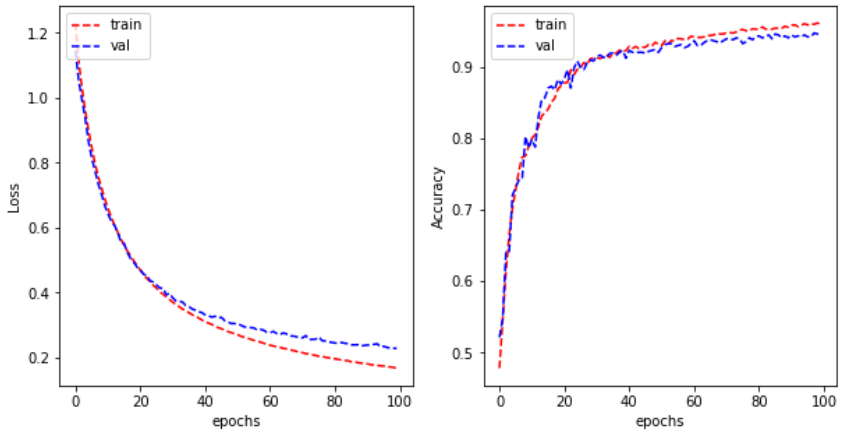
In this project I will classify images of road traffic signs. For this project using the dataset that has been provided to me I will need to train a machine learning model to classify road traffic signs based on shape and type. After this I will conduct independent evaluation with this adjusted model on my own independent data.

## Investigation

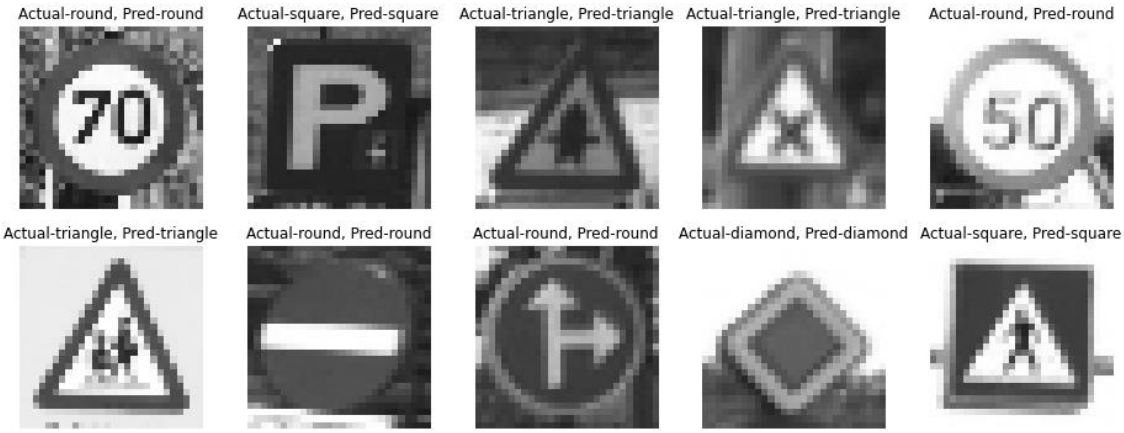
The database used for this assignment comes in a zipped file. It would take a lot of time for the data to be pre-processed manually in the extracted file. In order for the data to be pre-processed a CSV file will be created for the data. This CSV has 3 main columns ImgPath, Shape and Type. ImgPath will have the path to the images used for the machine learning models, Shape will be the shape of the traffic signs in the image and type is the type of traffic signs in the image.

## Multilayer Perception Model

The first model I used was MLP for classifying the traffic signs shape and type was MLP. The reason why I chose MLP was because it's a very flexible model which can be applied to various data types such as images. After training and adjusting the model for classifying sign shapes, the learning curve of the training process is plotted below.

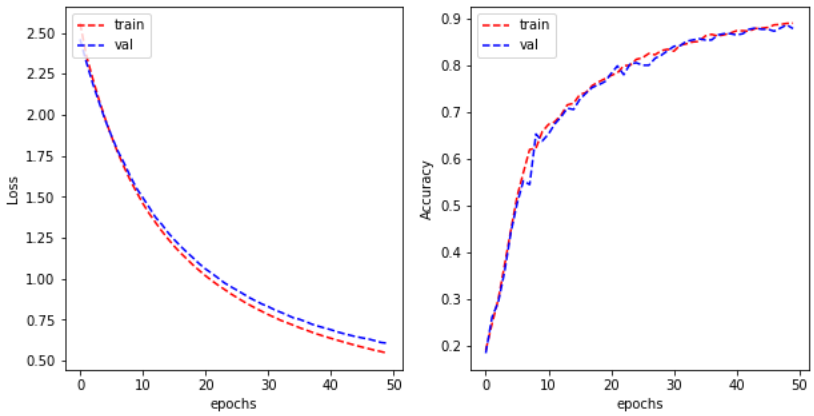



Judging from the learning curve plotted above, it shows that this model is balanced and is very accurate with minimal loss. After evaluating the model with the testing data frame an accuracy of 91.35% was yielded. Some of the results of the model used on the testing data frame are plotted below.

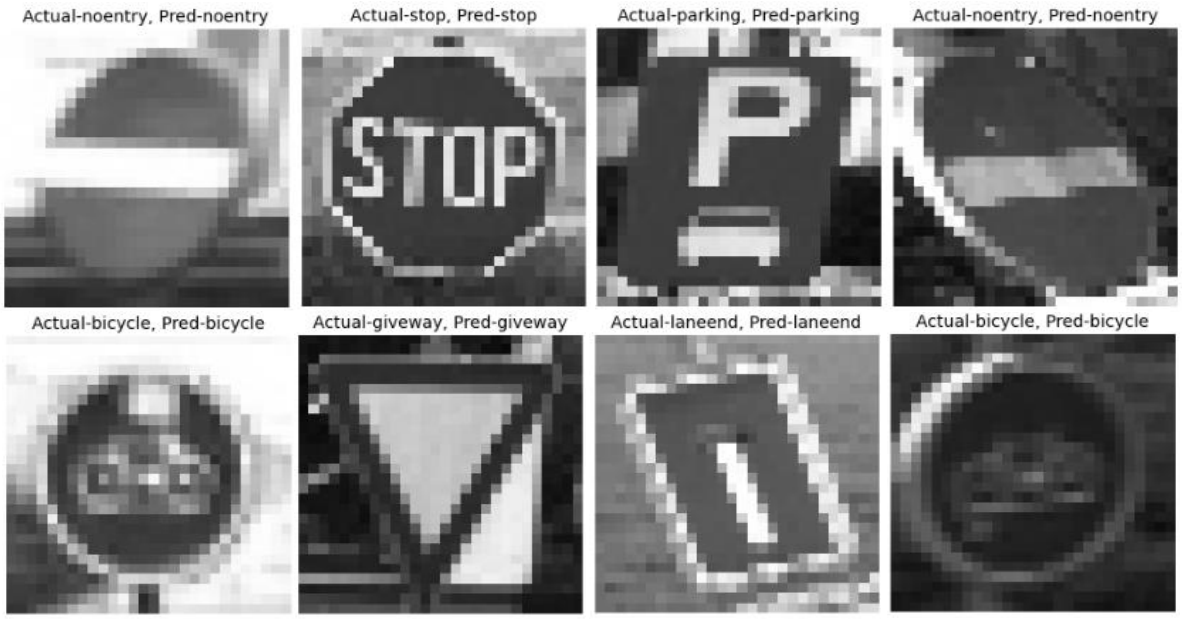



From these samples above, it is shown that the model has classified these samples correctly.

A similar MLP model with slightly different parameters is then developed for classifying the traffic signs type. The learning curve of the training process is plotted below.




Similar to the model used for classifying sign shapes. This learning curve shows that this model is balanced, even more balanced than the model for the sign shapes. It can also be judged that this model is also accurate with minimal loss. After evaluating the model with the testing data frame an accuracy of 87.16% was yielded which is not as high as the model used for the sign shapes but it makes sense because there are more classification outputs for classifying the sign type. Some of the results of the model used on the testing data frame are plotted below.

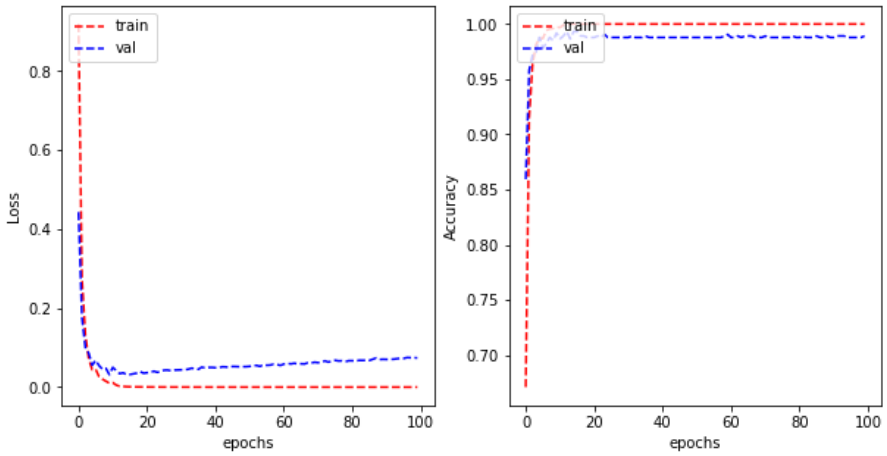


**Convolutional Neural Network**

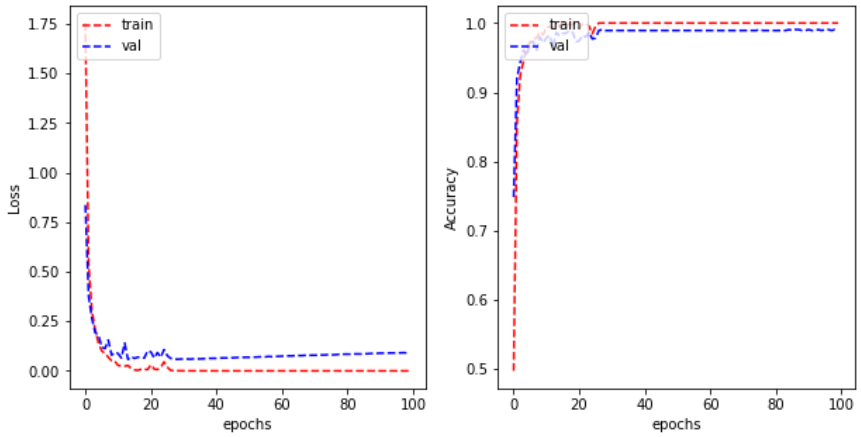
I then decided to create a CNN model to classify the traffic signs shape and type to compare it with MLP. I've decided to use CNN this time because CNN is more complicated than MLP which means it should yield better performance results. CNN is also often used for classifying images.

Here are the learning curves for the performance of the CNN models for classifying sign shape and type after it was trained and adjusted.

Classifying Shape Model

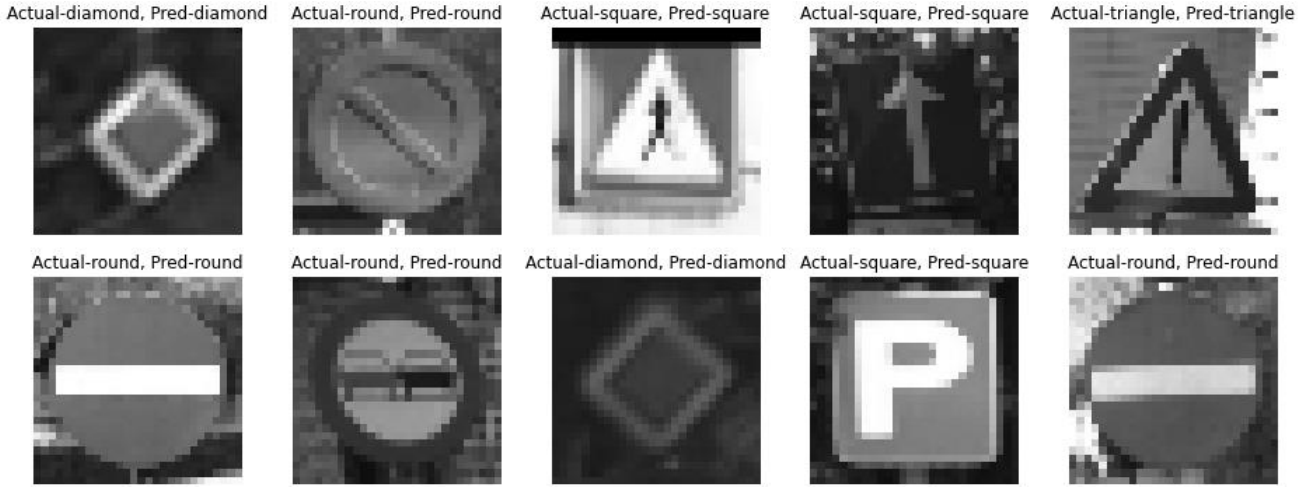



Classifying Type Model

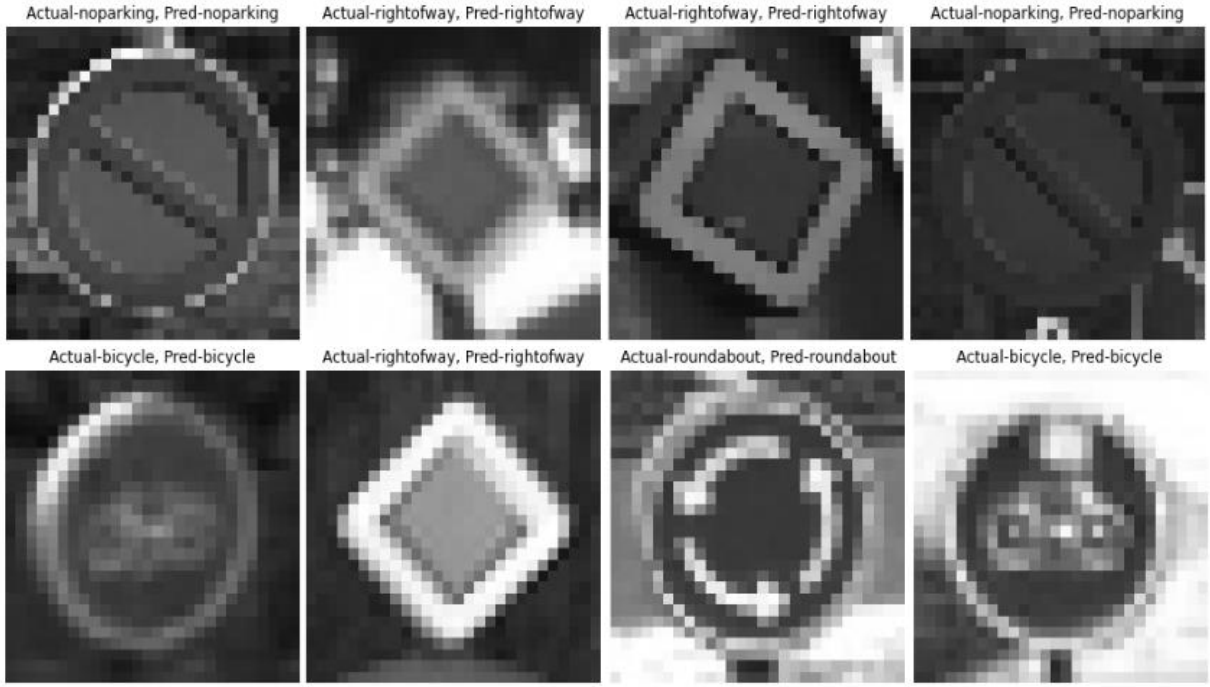



The learning curves for both shape and type classification show that both of these models are balanced and are very accurate with minimal loss. From running evaluating for both the shape and type model with the testing data frame, it yields an accuracy score of 99.05% for the shape model and 98.38%. These scores are higher than the MLP models for both shape and type. Some of the results of the CNN model are plotted below for both shape and type classification.

Shape Classification




Type Classification



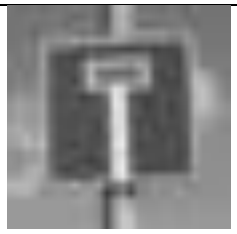
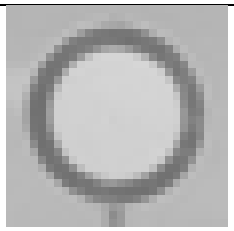
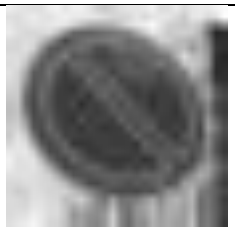
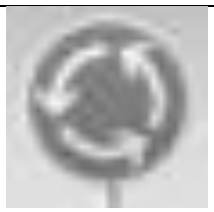
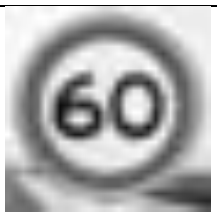
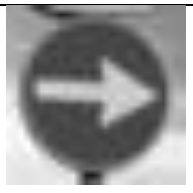

**Ultimate Judgement**

After testing, analysis, and evaluations, it is shown that the best model to be used for classifying traffic sign shape and types is CNN. CNN is the better model over MLP is because for both shape and type classification it scored higher accuracy scores which are 99.05% for shape classification and 98.38% for type classification compared to 91.35% and 87.16% respectively. The shape classification models have a higher score than the type of classification for both models is because there are less shapes to classify than types, nonetheless CNN is the best model for both cases.

**Independent Evaluation**

For my independent evaluation I have collected 16 images of different types of traffic signs on the internet to test these models on. The images were pre-processed so they can be used for the CNN model which is the model I will be using. How the images were pre-processed was that they were cropped to a 1:1 resolution then downscaled to 28x28 pixels and grey scaled. The source for these images will be linked on the last page. After running evaluation the accuracy scores for shape and type classification are 93.75% and 68.75% respectively. The type classification only scored 68.75%, this could be because I only used 16 images and all

the sign types in the images are different. Otherwise, this means the model can be retrained and adjusted to perform better. The results of this evaluation are plotted below.

| | | | |
|---|---|---|---|
|  |  |  |  |
| **Actual:** Round | **Actual:** Square | **Actual:** Square | **Actual:** Triangle |
| **Pred:** Round | **Pred: R**ound | **Pred:** Square | **Pred:** Triangle |
| **Actual:** Bicycle | **Actual:** Continue | **Actual:** Crossing | **Actual:** Giveway |
| **Pred:** Pred-parking | **Pred:** Pred-traveldirection | **Pred:** Warning | **Pred:** Giveway |
|  |  |  |  |
| **Actual:** Square | **Actual:** Round | **Actual:** Round | **Actual:** Round |
| **Pred:** Square | **Pred:** Round | **Pred:** Round | **Pred:** Round |
| **Actual:** Lane end | **Actual:** Limited traffic | **Actual:** No entry | **Actual:** No parking |
| **Pred:** Continue | **Pred:** Limited traffic | **Pred:** No entry | **Pred:** No parking |
|  |  |   |   |
| **Actual:** Diamond | **Actual:** Round | **Actual:** Round | **Actual:** Hex |
| **Pred:** Diamond | **Pred:** Round | **Pred:** Round | **Pred:** Hex |
| **Actual:** Right of way | **Actual:** Roundabout | **Actual:** Speed | **Actual:** Stop |
| **Pred:** Right of way | **Pred:** Roundabout | **Pred:** Speed | **Pred:** Stop |
|   |  |  |  |
| **Actual:** Square | **Actual:** Round | **Actual:** Round | **Actual:** Triangle |
| **Pred:** Square | **Pred:** Round | **Pred:** Round | **Pred:** Triangle |
| **Actual:** Parking | **Actual:** Traffic directive | **Actual:** Travel direction | **Actual:** Warning |
| **Pred:** Parking | **Pred:** Parking | **Pred:** Travel direction | **Pred:** Warning |

**Source of the images:**

Bicycle: https://www.pikist.com/free-photo-isvwc

Continue: https://www.shutterstock.com/search/%E0%B8%95%E0%B8%A3%E0%B8%87%E0%B8%94%E0%B8%B4%E0%B9%88%E0%B8%87

Crossing: https://www.canstockphoto.com.au/road-sign-warning-pedestrian-crossing-43792871.html

Give way: https://www.arnoldclark.com/newsroom/435-what-s-going-to-happen-to-uk-traffic-signs

Lane end: https://www.alamy.com/international-traffic-sign-dead-end-of-street-or-road-blue-sky-with-small-clouds-are-on-background-image425263580.html

Limited traffic: https://www.masterfile.com/search/en/german+road+signs

No entry: https://www.shutterstock.com/search/no+stopping+road+sign

No parking: https://www.dreamstime.com/photos-images/dormitory-district.html

Parking: https://www.dreamstime.com/traffic-signs-prohibition-parking-parking-lot-reserved-staff-embassy-hague-image176236232

Right of way: https://www.masterfile.com/search/en/european+sign+post

Roundabout: https://www.limburger.nl/cnt/dmf20181119_00081030

Speed: https://www.dreamstime.com/photos-images/european-speed-limit-sign.html

Stop: https://study.com/academy/lesson/identifying-geometric-shapes-in-the-real-world.html

Traffic directive: https://www.shutterstock.com/search/dont+turn

Travel direction: https://www.dreamstime.com/photos-images/one-way-europe-traffic-sign.html

Warning: https://www.fineartstorehouse.com/collections/imagebroker-collection-nils-kramer-landscapes/moose-warning-sign-norway-scandinavia-europe-12550369.html