## Data Collection and Annotation

To create something like this, we require a reliable and high-quality dataset. I decided to search for a pre-existing dataset from Kaggle, called Road Sign Detection. This was the primary source of images for training and testing the model. This dataset provided a rich set of images containing different road signs, which included speed limit signs and crosswalk signs.

With the dataset having many different images, I decided to sift through the dataset and pick out the images that featured speed limit signs and crosswalk signs. These were to ensure that the model was trained on the right signs. Additionally, any of the images without these signs were excluded. Additionally, with the various lighting conditions, and different resolutions of the image, this allowed for the model to train with different conditions and circumstances. This landed me with a total of 60 photos for each of the road signs.

Additionally, I realised that many of the images struggled to include photos of both signs together. This would not be very good, as it struggled to show the comparison between both signs. I then went online to search through different picture sites to find a few photos of both signs together.

Following data collection, I started to do annotations. I used Roboflow, which helped me to do efficient and precise labelling. Each image was hand-labelled by me, where bounding boxes were drawn around the different signs. With crosswalks, most of them were squares. This meant that I had to just draw bounding boxes around them. With speed limit signs, they were circular. I drew the square bounding boxes around them, reaching to the further part of each circle. Afterwards, I double checked all of them and ensure I did not miss any of the signs out, before exporting the dataset out in a zip format.

My dataset link is <https://github.com/CodexSecret/IT3103-Project/blob/main/Yolo8_Crosswalk_Speedlimit_Train.v2i.yolov8.zip>.

## Finetuning

Looking at my old original run, I saw that the model performed better on speed limit signs but struggled with crosswalk detection based on my precision-recall curve. This meant that it was unable to maintain proper accuracy across the different recall levels.

Looking at my F1-Confidence curve, it fluctuated heavily for crosswalks and showed that the model was unable to balance precision and recall properly. This meant that crosswalks were harder and may have been over-predicted at lower thresholds.

Looking at my Recall-Confidence curve, the recall for crosswalks were significantly dropping beyond the confidence threshold of 0.8. This meant that the model missed many crosswalk detections at higher confidence levels.

Lastly, with Precision-Confidence Curve, the precision was lower by a lot when it came to crosswalks compared to speed limits. All in all, crosswalks were having a hard time with predictions.

To combat this, I first added class weights, which would assign higher weights to the minority class which was crosswalk. I also added augmentations to create new scenarios. Additionally, I decreased the learning rate to help with learning patterns more gradually. I also changed it to AdamW, which is better, and changed the batch size to 32 instead of 16. Next, I added more training epochs, allowing the model to learn more complex patterns. Lastly, I added weight decay which would help to reduce overfitting.

Afterwards, I saw that my crosswalks got better. The precision for both crosswalks and speed limits are now significantly higher than before. The F1 score for both crosswalks and speed limits is smoother and has a better balance between precision and recall. The recall for both crosswalks and speed limits is close to 1.0, up to a confidence threshold of 0.8. Lastly, precision is higher and more consistent across all confidence levels. This shows that the crosswalk class has improved significantly.

## Screenshot of Weights and Biases

Old Run:

A screenshot of a graph

Description automatically generated

Finetuned:

A screenshot of a graph

Description automatically generated

## Link

The link to my HuggingFace space is <https://huggingface.co/spaces/IT3103-2024S2/220227H>.