COMP6248 Lab 5 Exercise – A little Linear Regression

Wei Chien Teoh (Eugene)
wct1c16@soton.ac.uk

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Introduction

The results are seeded using `pytorch_lightning.seed_everything(0)` to provide reproducible results. All plots are generated using Weights & Biases.[1]

1 An initial attempt

1.1 A simple CNN baseline

The image-to-vector regression task given is described as a regression problem, thus the Mean Squared Error (MSE) loss function will be used for all models in this exercise. The goal is to predict the coefficients of the regression lines from the images.

The learning curves and performance of all models is illustrated in Figs. 1 to 3. Table 1 shows more properties for the models. Models 1 to 3 corresponds to the models built in Sections 1 to 3.

Model 1 provides the best training performance but gives a high validation and test loss relative to it's training. This is possibly due to the large complexity of the model, 9.8 M parameters. The model is likely overfitting on the training data.

2 A second attempt

2.1 A simple CNN with global pooling

Model 2 provides the worse performances for all train, validation and test loss. This is due to the lower complexity of the model. However, all the losses is relatively close, thus we can conclude that it generalises well to the validation and test set. A benefit of Model 2 is the shorter training time compared to Model 1.

3 Something that actually works?

3.1 Let's regress

Model 3 improves on previous models by adding two interleaved channels of equally spaced values ranging from -0.5 to 0.5. The third channel is the transpose/rotation of the second. The original data channel is sparse. The interleaved channels provide a form of data augmentation that allows the convolutional layers to better learn the structure of the original sparse data.

By introducing the interleaved channels, Model 3 outperforms Model 2 in training loss and Model 1 in validation loss. It also significantly outperforms the previous models in test loss. Hence, it can be concluded that Model 3 provides the best generalisation out of all the models. The training time is reasonable relative to the previous models as the model complexity is similar to Model 2.

Table 1: Runtime and total parameters.

Model	Runtime	Total Parameters
1	7m 13s	9.8 M
2	4m 50s	27.8 K
3	4m 52s	28.7 K

Figure 1: Train loss. Final values: (1) 0.149 (2) 12.859 (3) 1.013.

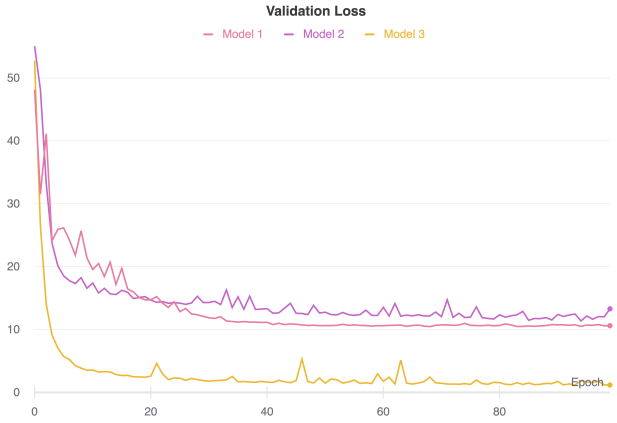

Figure 2: Validation loss. (1) 10.608 (2) 13.287 (3) 1.176.

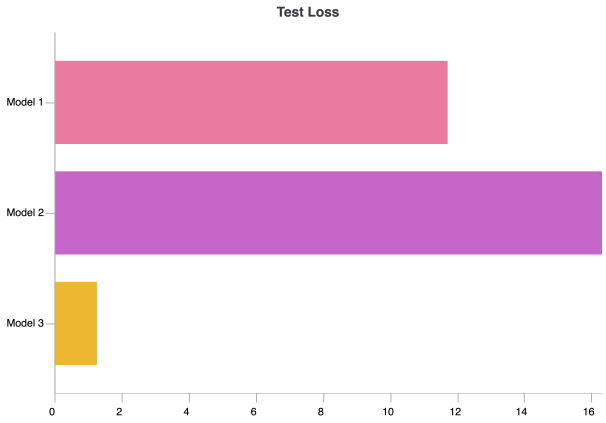

Figure 3: Test loss. (1) 11.697 (2) 16.302 (3) 1.236.

[1] *Weights & Biases*. W&B. URL: `https://wandb.ai/site` (visited on 04/26/2021).