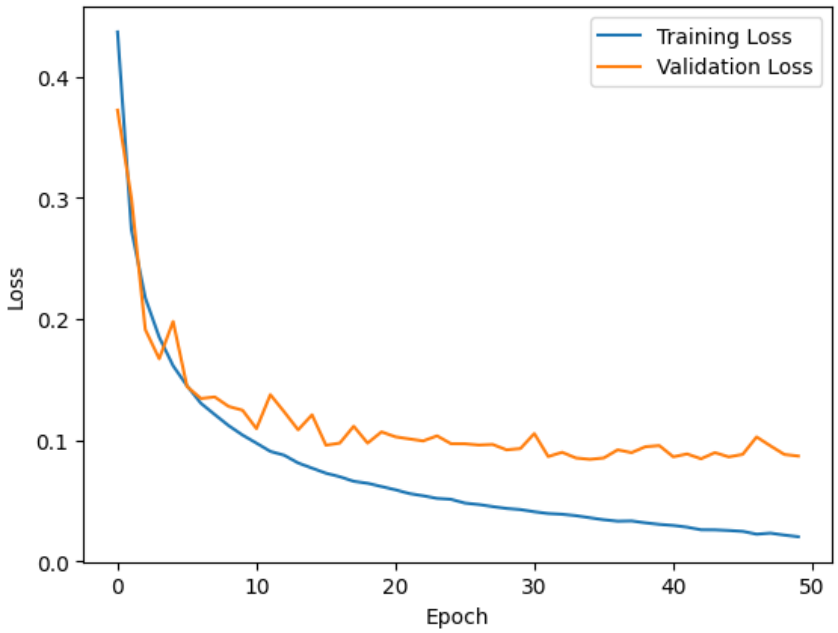
NEURAL NETWORK AND DEEP LEARNING COURSEWORK 2023

IMAGE CLASSIFICATION OF CIFAR-10 DATASET USING CONVOLUTIONAL NEURAL NETWORK

Training the CIFAR-10 dataset is performed in the following way:

1. ***Setting the random seed:*** The first few lines of the code set a random seed to ensure that the results of the training process can be reproduced.
2. ***Defining the data loaders***: The next step is to define the data loaders for the training and validation sets. The data loader is responsible for loading the data in batches and passing it to the model for training or evaluation. Here, two data loaders are defined, one for the training set and one for the validation set. The batch size and number of workers for data loading are also defined.
3. ***Setting the training parameters***: The number of epochs, print frequency, and other training parameters are defined.
4. ***Storing the loss and accuracy entries:*** Four lists are created to store the training and validation loss and accuracy at each epoch.
5. ***Training loop:*** The model is trained using a for loop that iterates over each epoch. For each epoch, the model is set to train mode and the running loss, correct predictions, and total predictions are initialized to zero. Then, the training data is loaded in batches, the model is trained on each batch, and the loss and accuracy are calculated. After each epoch, the model is set to evaluation mode, and the validation loss and accuracy are calculated.
6. ***Learning rate scheduler:*** A learning rate scheduler is used to adjust the learning rate at each epoch. The learning rate is an important hyperparameter that controls the speed and quality of the training process.
7. ***Storing the loss and accuracy details:*** The loss and accuracy details of the training and validation sets are stored in the previously created lists.
8. ***Printing the progress:*** The progress of the training process is printed at regular intervals. The training loss, training accuracy, validation loss, and validation accuracy are printed at every fifth epoch.
9. ***Calculating the average loss and accuracy:*** After all epochs are completed, the average loss and accuracy over all epochs are calculated.
10. ***Printing the results***: The final results of the training process are printed, including the average training loss, average training accuracy, average validation loss, and average validation accuracy. These results indicate the quality of the trained model and can be used to compare different training processes or models.

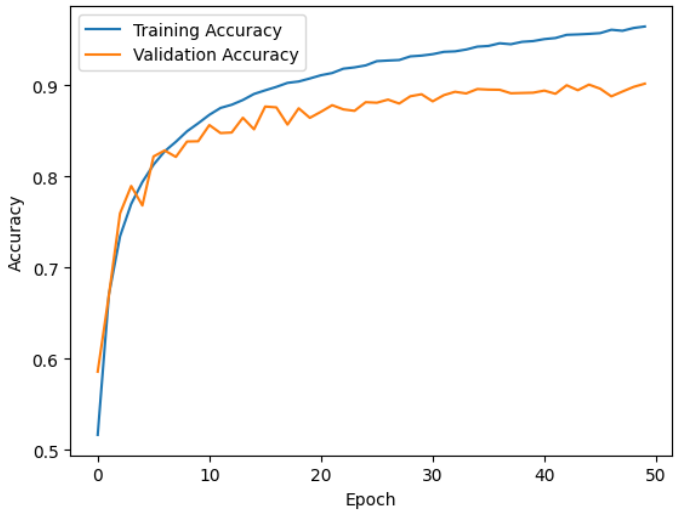
The curve for evolution of loss:



- The evolution of the loss curve shows that the training loss and validation loss both decrease as the number of epochs increases. This indicates that the model is learning and improving its performance on the training and validation sets.
- It is worth noting that the validation loss appears to level off towards the end of training, while the training loss continues to decrease.
- This may suggest that the model is starting to overfit the training data, as it becomes too specialized to the training set and loses the ability to generalize to new data.
- However, the fact that the validation accuracy (below) continues to increase even as the validation loss levels off suggests that the model is still able to improve its ability to classify new data, even if it is starting to overfit the training set.

Overall, the evolution of the loss curve suggests that the model has been trained effectively and is able to generalize well to new data.

The curve for the evolution of training and validation (test) accuracies:



- The evolution of training and validation accuracies can give us an idea of how well the model is learning to classify the data.
- The curves suggest that the model is improving its ability to correctly classify both the training and validation data as training progresses. Additionally, the fact that the validation accuracy increases as well indicates that the model is generalizing well to new data and not just memorizing the training set.
- It is worth noting that the validation accuracy appears to level off towards the end of training, while the training accuracy continues to increase. This may suggest that the model is starting to overfit the training data as it becomes too specialized to the training set and loses the ability to generalize to new data.
- However, the fact that the validation loss and accuracy are both relatively stable at the end of training suggests that the model is still performing well on new data despite potentially overfitting the training set.

Overall, the evolution of the training and validation accuracies suggests that the model has been trained effectively and is able to classify new data with a high degree of accuracy.

Final model accuracy on CIFAR-10 Validation set:

The final model accuracy on the CIFAR-10 validation set is 90.17% as indicated by the validation accuracy (Val Acc) value in the last epoch with an average validation accuracy of 86.01%. This means that the model correctly classified 90.17% of the images in the validation set, which is a relatively good performance on this task.