TBMI26 – Computer Assignment Reports
Deep Learning

Deadline – March 14 2021

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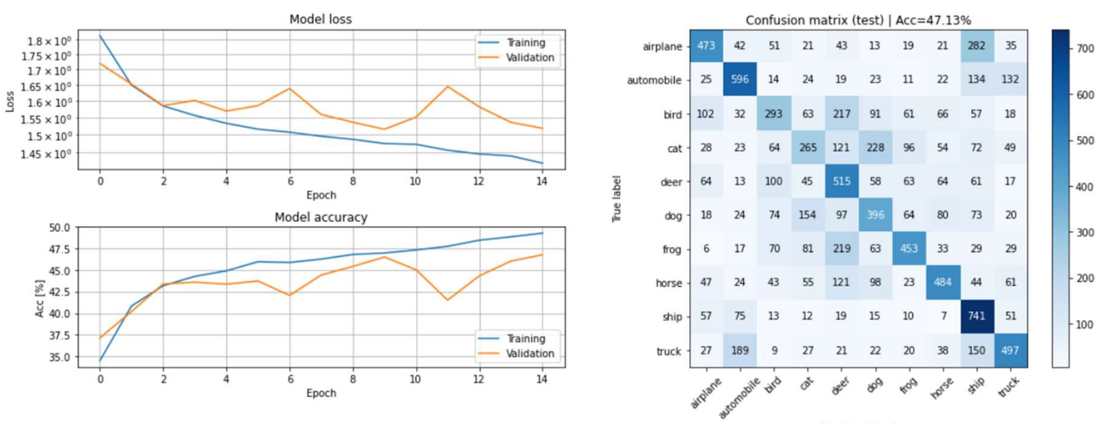
In order to pass the assignment you will need to answer the following questions and upload the document to LISAM. Please upload the document in PDF format. **You will also need to upload the Jupyter notebook as an HTML-file (using the notebook menu: File -> Export Notebook As…)**. We will correct the reports continuously so feel free to send them as soon as possible. If you meet the deadline you will have the lab part of the course reported in LADOK together with the exam. If not, you'll get the lab part reported during the re-exam period.

1. **The shape of X_train and X_test has 4 values. What do each of these represent?**
   The first is number of samples, the second and the third are number of pixels together defining the dimensions of frame for each sample, the fourth is the number of frames in each sample, in this case one for green, blue and red.

2. **Train a Fully Connected model that achieves above 45% accuracy on the test data. Provide a short description of your model and show the evaluation image.**

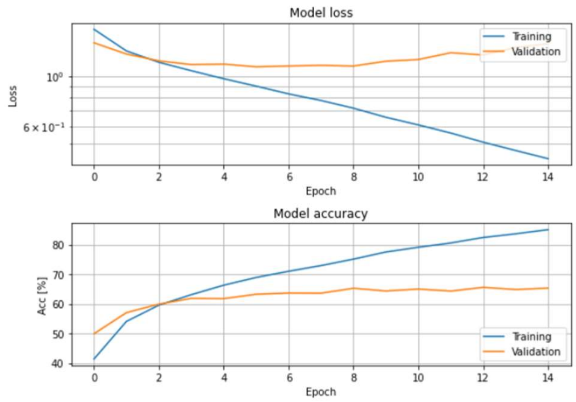


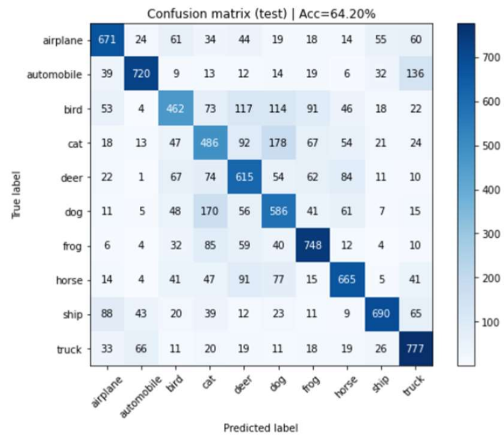
   Our model has one input layer, three hidden layers and the output layer. The hidden layers has 256 nodes each and uses the tanh activation function. The output layer has 10 nodes and uses the softmax activation function.

3. **Compare the model from Q2 to the one you used for the MNIST dataset in the first assignment, in terms of size and test accuracy. Why do you think this dataset is much harder to classify than the MNIST handwritten digits?**
   In terms of size our model is much bigger and more complex than the MNIST data set, and the accuracy is much lower for our model compared to the MNIST model. We think this is

because the larger amount of features in the CIFAR and more complexity and variation in patterns in the CIFAR data set compared to the MNIST.

4. **Train a CNN model that achieves at least 62% test accuracy. Provide a short description of your model and show the evaluation image.**

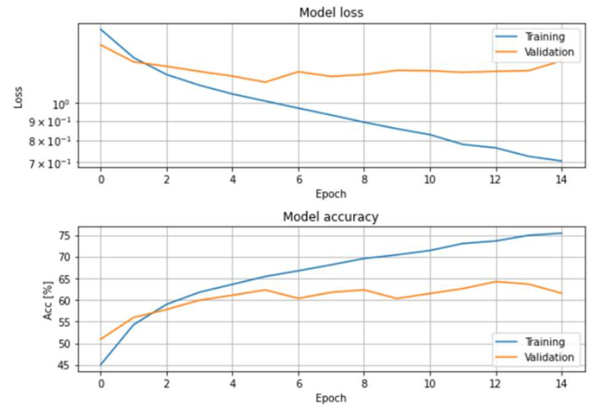


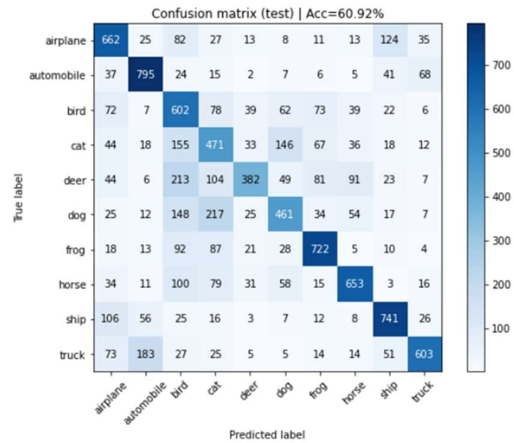


The input layer is of dimension 3x32x32.
Then we have two blocks of layers containing one convolution layer with activation relu, one pooling layer, and for the last block we flatten the layer blocks to enable classification at the end of the network. The output layer is a dense layer of 10 nodes and a softmax activation function.

5. **Compare the CNN model with the previous Fully Connected model. You should find that the CNN is much more efficient, i.e. achieves higher accuracy with fewer parameters. Explain in your own words how this is possible.**
The fully connected model has 50% more parameters than the CNN and achieves higher accuracy. We think this is because the CNN takes into consideration the locality of features in the context of the pictures. The locality makes it easier to find patterns to identify.

6. **Train the CNN-model with added Dropout layers. Describe your changes and show the evaluation image.**

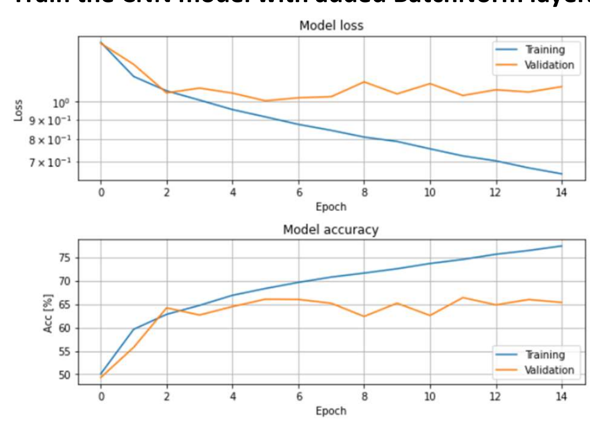


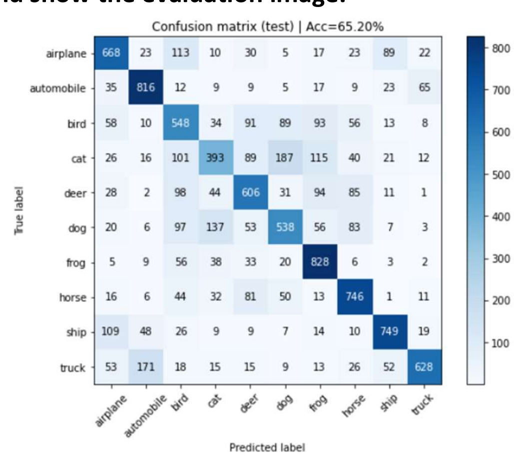


We added a dropout layer before the output layer.

7. **Compare the models from Q4 and Q6 in terms of the training accuracy, validation accuracy, and test accuracy. Explain the similarities and differences (remember that the only difference between the models should be the addition of Dropout layers).**
   Hint: what does the dropout layer do at test time?
   This resulted in a slightly less overfitted model. This is because the model cannot rely on specific nodes to make the prediction and must improve the overall network. The validation training accuracy did go down slightly while the validation accuracy remained almost the same. The Test accuracy went slightly down as well.

8. **Train the CNN model with added BatchNorm layers and show the evaluation image.**

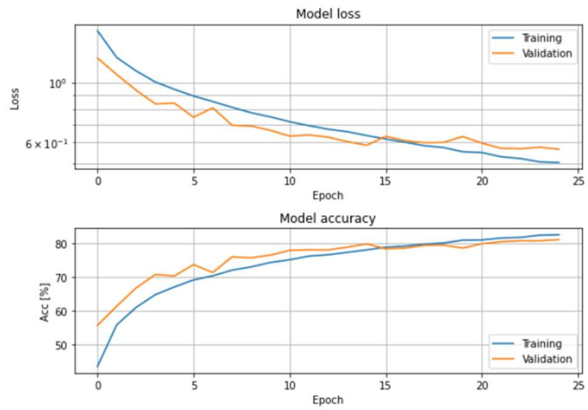


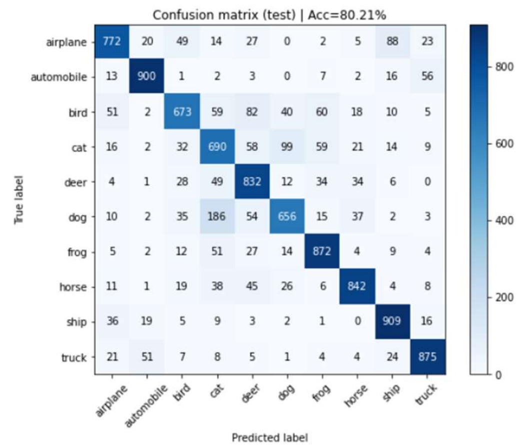


9. **When using BatchNorm one must take care to select a good minibatch size. Describe what problems might arise if the wrong minibatch size is used.**
   You can reason about this given the description of BatchNorm in the Notebook, or you can search for the information in other sources. Do not forget to provide links to the sources if you do!
   If a large mini batch size is used the batch statistics will probably be more alike the true statistics for the data set, but it will take longer time to converge. While the small mini batch size will result in a shorter time to converge, but the statistics might be off, resulting which

could add more noise in the model.

10. Design and train a model that achieves at least 75% test accuracy in at most 25 epochs. Explain your model and motivate the design choices you have made and show the evaluation image.





Our model has the architecture of three blocks in sequence. Each block contains Convolution(with activation)->Convolution(without activation)->Batch Normalization->Activation->Pooling->dropout. After the three blocks we flatten the result and then we do a Dense(128, with activation)->Dropout->Dense(10)->Batch Normalization->Activation which is the output of the net.