

# Machine Learning Assignment

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## Building a Classifier

The plots in Figure ?? are for the best CNN architecture implmeneted for the classifier. The best accuracy for the test data was 59%. Figure ?? show the architecture of this network. A key feature for this classifier was the inclusion of randomnization for the training dataset. The data was randomly rotated, cropped and flipped, this had significantly improved the results as shown in Figure ??. It is clear from the plots that without randomnising the dataset the test accuracy quickly converges although the training accuracy is improving and reaching a value close to 98%. With randomnisation the test accuracy was continuesly improving along with the training accuracy although at a much slower pace.

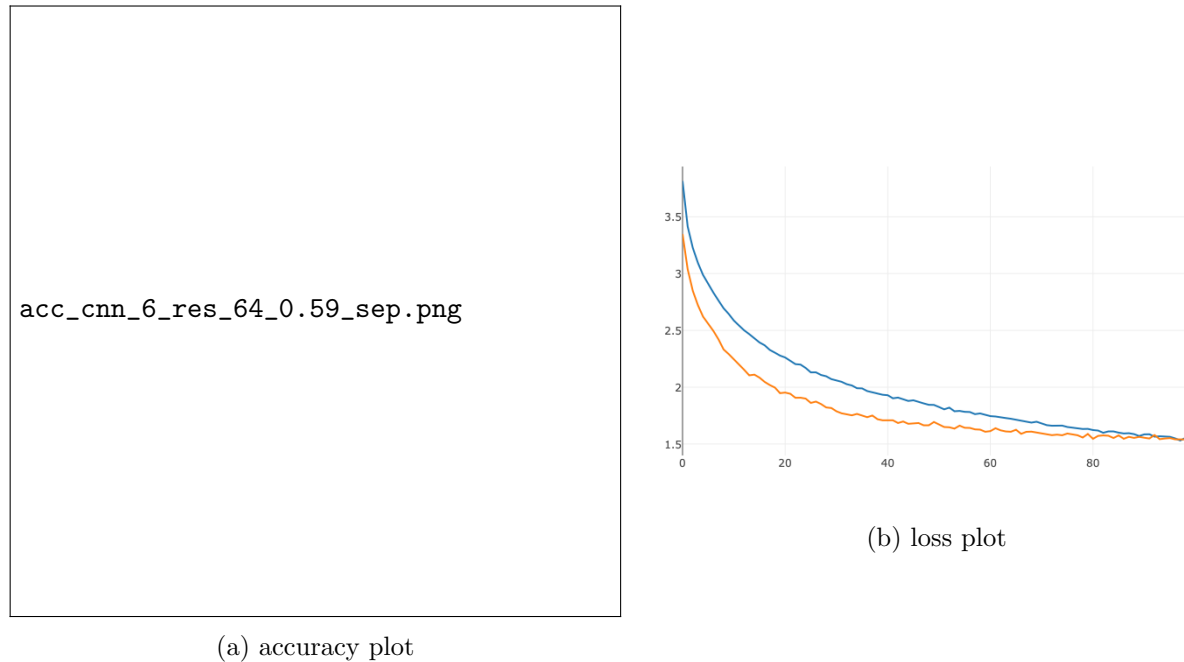


Figure 1: Best CNN results

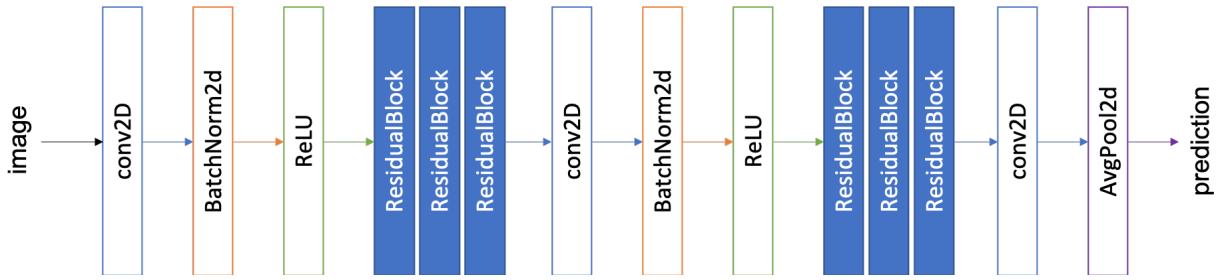
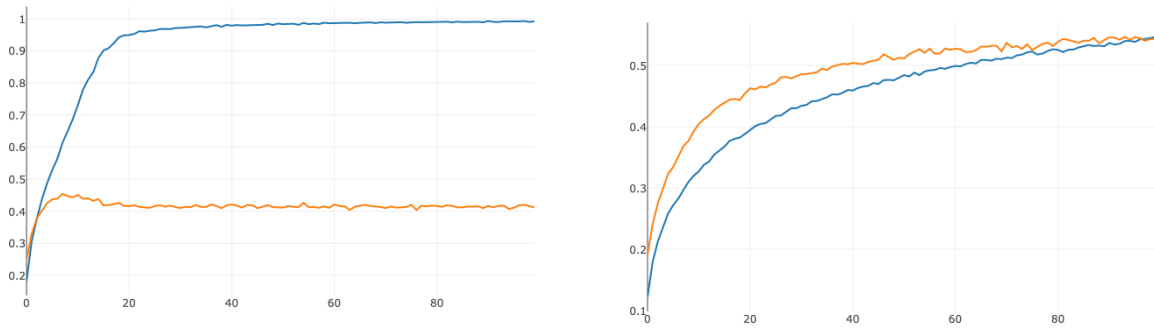


Figure 2: Best CNN architecture

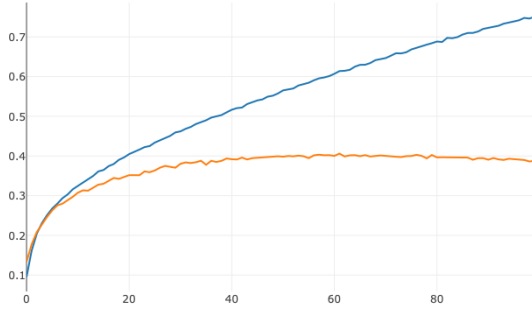


(a) accuracy plot for non-randomized training dataset (b) accuracy plot for randomized training dataset

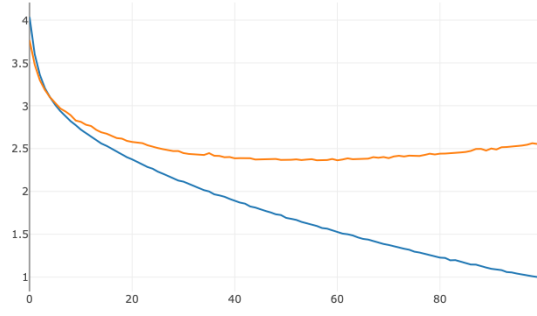
Figure 3: The network accuracy with and without randomising the training dataset

## Other Architectures Tested

As first steps, the CNN discussed in this module lectures was tested. The code of this CNN was taken from the provided material and modified accordingly to fit the purpose of this assignment. The first modification included was adding rescaling and normalizing both training and testing datasets. The batch size was increased to 64 as well. The number of epochs was also increased to 100. The results for those modifications included in Figure ???. The accuracy obtained for this CNN was 39%. The architecture of this network is shown in Figure ??.



(a) accuracy plot



(b) loss plot

Figure 4: CNN with 3 convolutional network layers, training dataset was not randomized

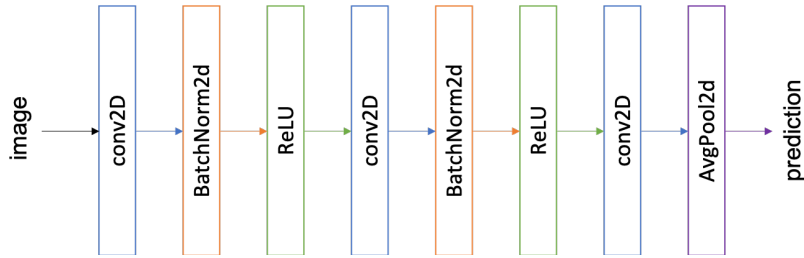
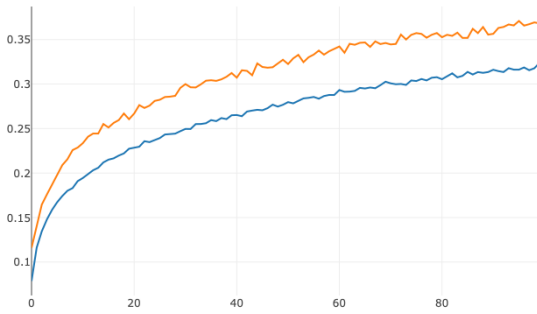
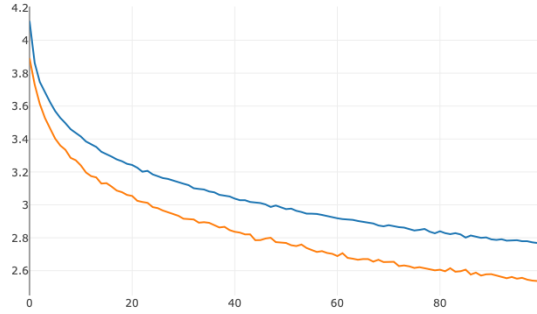


Figure 5: Basic CNN architecture

After that randomisation was included to the training dataset; Figure ?? . The resulted test accuracy, 37% was not better than the previous test accuracy, however the convergence of the accuracy was significantly slowed and thus with more complex network architecture and increased epochs this setup could provide better results than the previous setup.



(a) accuracy plot



(b) loss plot

Figure 6: CNN with 3 convolutional network layers, training dataset was randomized

As randomisation of the training dataset proved to be promising however this came at the cost of an increased training time; from around 30 minutes to 1 hour. The CNN architecture

was improved next. Residual blocks were added to the network; Figure ?? . Figure ?? shows the accuracy and loss plots for this network. The test accuracy reached 54% a big improvement from the previous network.

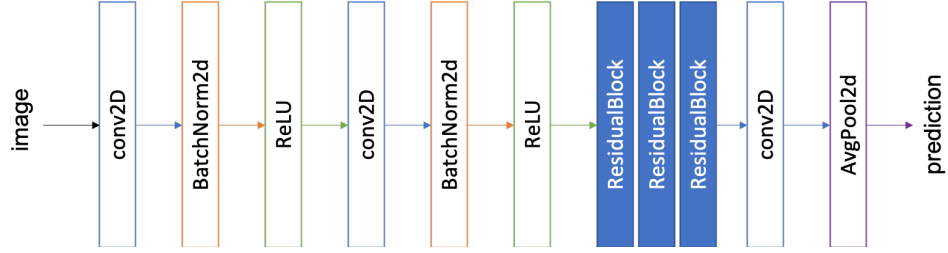
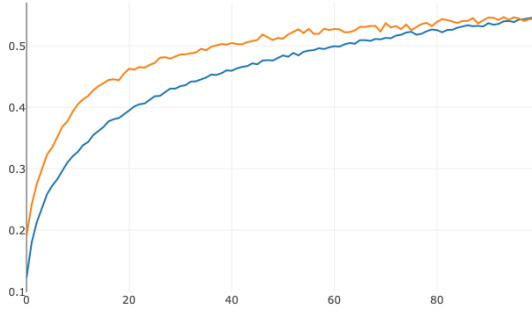
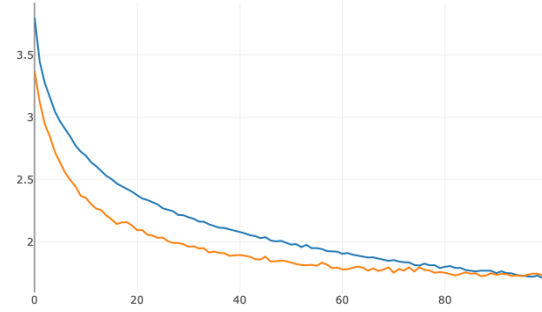


Figure 7: CNN with Residual Blocks architecture



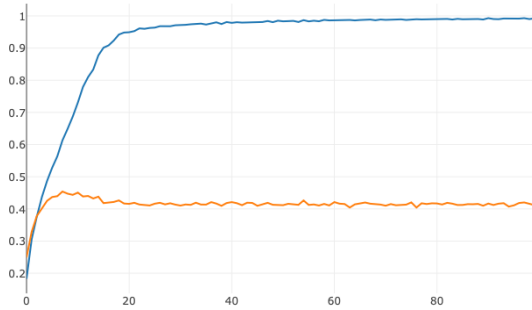
(a) accuracy plot



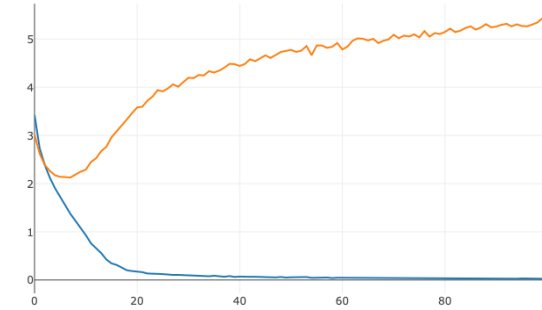
(b) loss plot

Figure 8: CNN with 3 Residual Blocks included, training dataset was randomized

As a contrast, for non-randomised dataset Figure ?? shows the accuracy and loss plots. The test accuracy was 41% and the loss for the test dataset seemed to be getting worst with each epoch.



(a) accuracy plot



(b) loss plot

Figure 9: CNN with 3 Residual Blocks included, training dataset was not randomized

The following architectures were tested next:

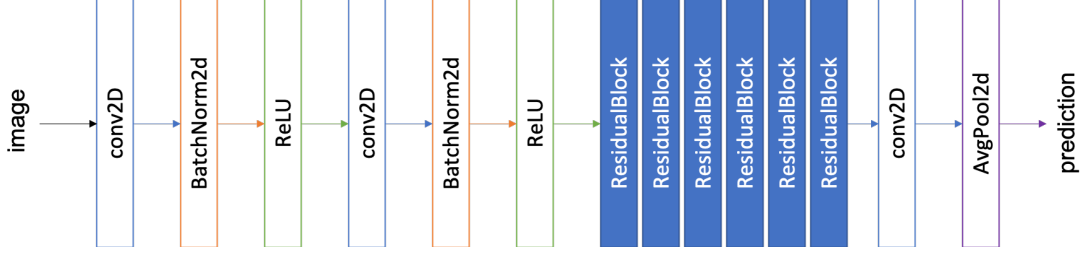


Figure 10: CNN with 6 consecutive Residual Blocks architecture

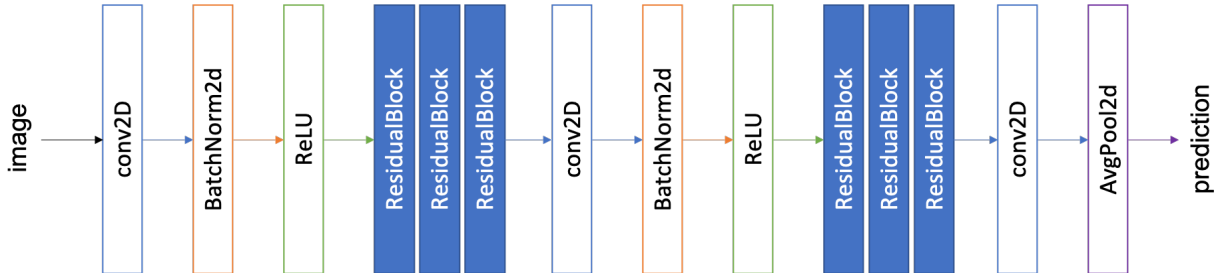


Figure 11: CNN with 3 consecutive Residual Blocks between the convolutional layers architecture

The architecture in Figure ?? resulted in a slightly improved test accuracy 56%, Figure ??. Also, the test accuracy converged at a much earlier epoch, around epoch 60, than the previous network.

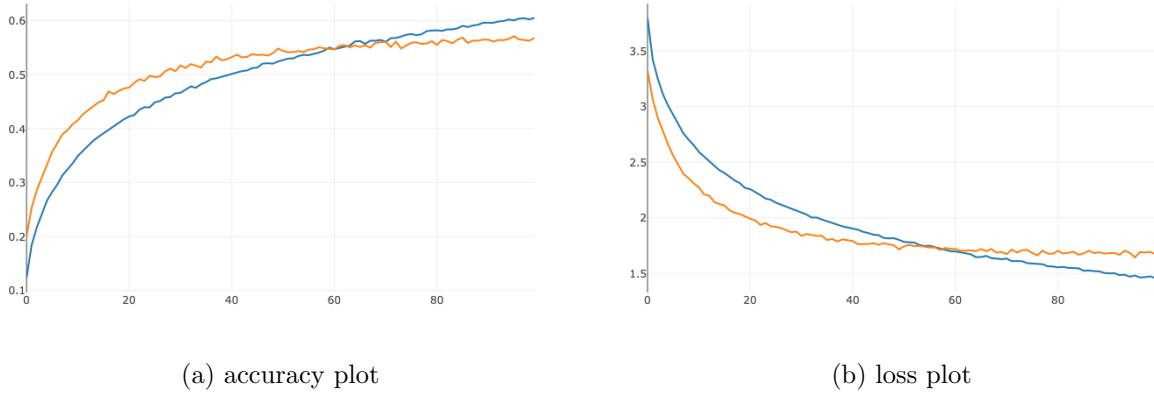


Figure 12: CNN with 6 Residual Blocks included, training dataset was randomized

On the other hand for the architecture in Figure ?? which is the best architecture for this task, the test accuracy improved to 59%, Figure ??. Unlike the previous architecture the test accuracy did not converge around epoch 60 and kept improving along with the training accuracy. The parameters used of those networks were tested as well, however changing those parameters did not result in a much better performing classifier. The batch size was also modified however a smaller batch size did not improve the learning and an increase batch size did not provide a greater improvement.

## Generating a Pegasus