CS577 Assignment 4: Cifar10 report

Theo Guidroz
Department of Computer Science
Illinois Institute of Technology

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Abstract

This is a report for the second part of Assignment 4. The goal of this question is to gain a better understanding of inception and residual blocks.

Problem Statement

Build three models to classify the cifar10 dataset. Each model will be different:

1. No blocks
2. Inception blocks
3. Residual blocks

Evaluate and compare the performance of the three models.

Implementation details

This implementation question was divided into 3 main parts:

1. Loading the dataset
2. Building the models using various techniques
3. Evaluating the models and comparing the results

The first model was built using a combination of convolution, drop out and max pooling. The second model was similar but inception blocks were added after the last convolution. For the last model, residual blocks were implemented in between the convolution, drop out and max pooling branches.

Loading the dataset

Since it is already available in the Keras package, the dataset was imported using a Keras function. This made it easier to load the training, validation and testing sets. Furthermore, the data was normalized (divided each pixel by 255) and the labels were transformed into one-hot encoding. Once these steps were completed, we were able to start building the different models.

Building the model with no blocks

A simple architecture was implemented to prevent the model from overfitting. The model is made of 2 layers of convolution, dropout, batch normalization and max pooling. Then, we flatten the output of the last layer and used softmax activation since it is a multi classification problem. The model was trained on 80 epochs.

Building the model with inception blocks

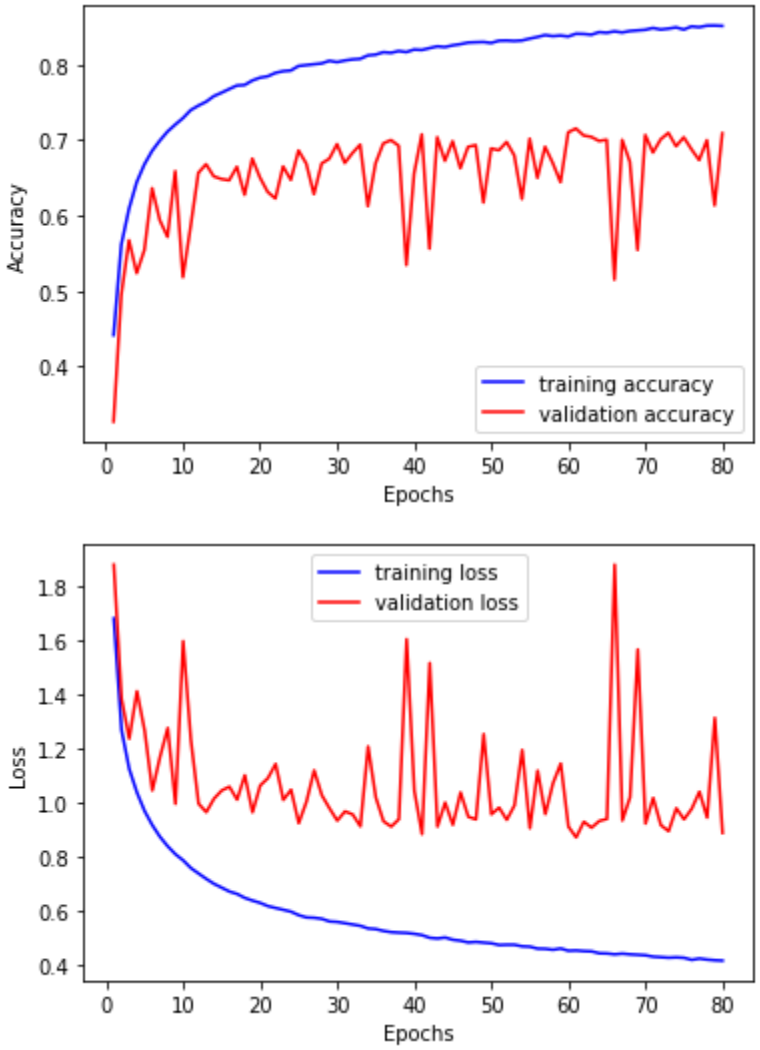
Inception blocks allow for us to use multiple types of filter size, instead of being restricted to a single filter size, in a single image block, which we then concatenate and pass onto the next layer. This became a very common technique for image classification. In our model, We have two layers of convolution, dropout, batch normalization and max pooling followed by 4 branches in parallel. These 4 branches are then concatenated and flattened before our last activation function, softmax. The model was trained on 80 epochs.

Building the model with residual blocks

Residual blocks allow the flow of or information from initial layers to last layers. This can be very useful to avoid loss of information. In our model, we have two residual blocks. This is done using the layers.add() function. Softmax is used as the last activation function and we then train the model on 80 epochs.

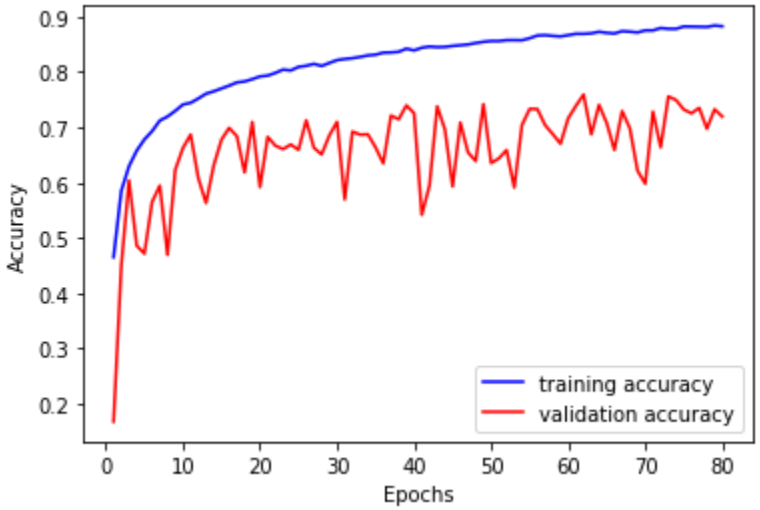
Results and discussion

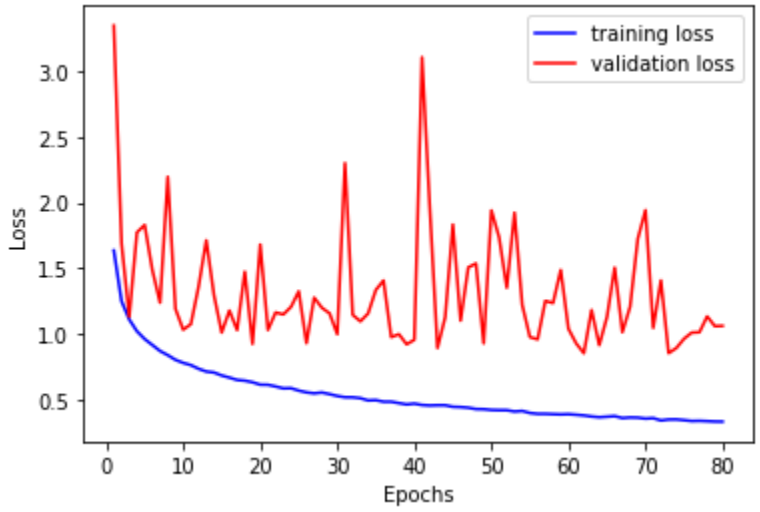
No blocks



The graphs above show the loss and accuracy of the model against the number of epochs. The model converges but there are signs of overfitting since training loss is decreasing but validation loss is increasing.

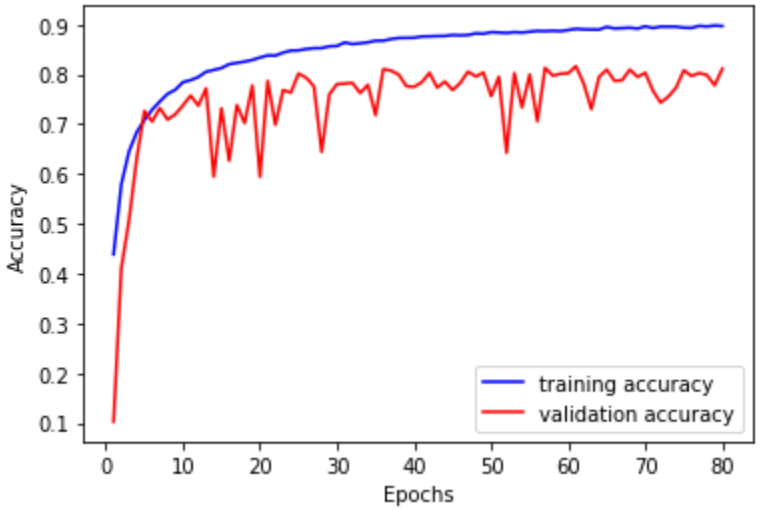
Inception blocks

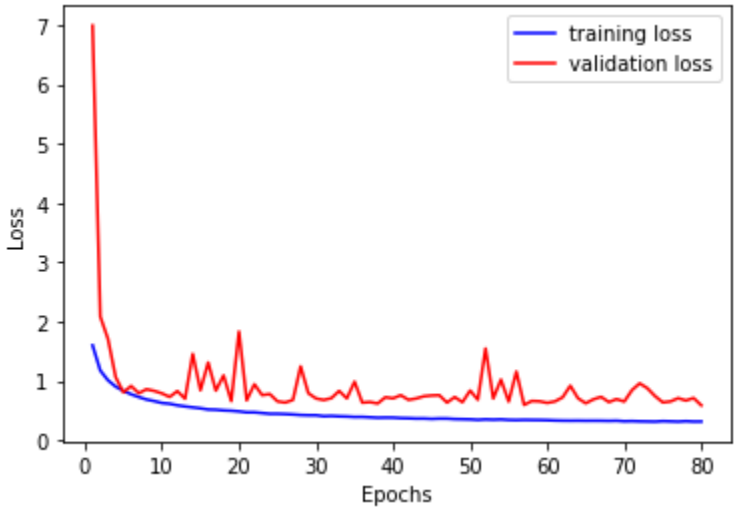




The graphs above show the loss and accuracy of the model against the number of epochs for the model with inception block. It converges but there are signs of overfitting since training loss is decreasing but validation loss is increasing.

Residual blocks





The graphs above show the loss and accuracy of the model against the number of epochs for our model with residual blocks. The model converges and generalizes well.

Comparing the models

	No block	Inception	Residual
0	0.326900	0.168000	0.102700
5	0.636200	0.565200	0.705300
10	0.585600	0.687000	0.757500
15	0.646600	0.699100	0.626600
20	0.631200	0.682800	0.786900
25	0.668900	0.712800	0.793300
30	0.669500	0.569600	0.781600
35	0.695400	0.634800	0.810500
40	0.707500	0.541700	0.784200
45	0.662600	0.708700	0.783000
50	0.686400	0.643900	0.795200
55	0.649800	0.733100	0.705700
60	0.715200	0.738900	0.816500
65	0.514900	0.659100	0.787100
70	0.683400	0.728500	0.767200
75	0.687700	0.725400	0.796900
79	0.708800	0.719500	0.811400

The table above shows the validation accuracy of all three models at each five epochs. The left column is the number of epochs. The model with the highest accuracy is highlighted in green. From this table it is clear that the ResNet is the best model for this image classification problem. Here are the results when the models were evaluated on the test dataset:

```
Test acc for No Block:           71.069997549057%
Test acc for Inception Block:    72.14000225067139%
Test acc for Residual Block:     80.39000034332275%
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Conclusion

Overall, this assignment showed the benefits of inception blocks and residual blocks. The results of the models are also satisfactory.

References

- Professor’s slides
- https://arxiv.org/pdf/1409.4842v1.pdf