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CPS 499

Report for Assignment 3

The purpose of this assignment is to evaluate two deep learning models, ResNet and CNN. To compare them, we use the Intel Image Classification dataset. The goal is to compare their performance in multi-class classification.

ResNet:

Used a ResNet50 model. Modified the top layer and changed it to a 256 unit dense layer. I added a softmax output for the 6 classes.

CNN:
The architecture is three convolutional blocks, 32 then 64 then 128 filters using 3x3 kernels, ReLu, and BatchNorm. I used MaxPooling and progressive Dropout for regularization. The classifier is a 256 unit dense layer with dropout.

The data was 70% train, 15% validation, and 15% test. I used the Adam optimizer with a learning rate of 0.001. I used dropout for the CNN and L2 weight decay for the ResNet model.

Results:

Metric	ResNet	CNN
Accuracy	50.1%	81.4%
F1	49.4%	81.4%
Precision	49.5%	81.6%
Recall	50.6%	81.6%

Examples:

ResNet50 Predictions

True: buildings
Pred: sea
(0.27)

True: buildings
Pred: forest
(0.43)

True: buildings
Pred: buildings
(0.47)

True: buildings
Pred: street
(0.28)

True: buildings
Pred: buildings
(0.43)
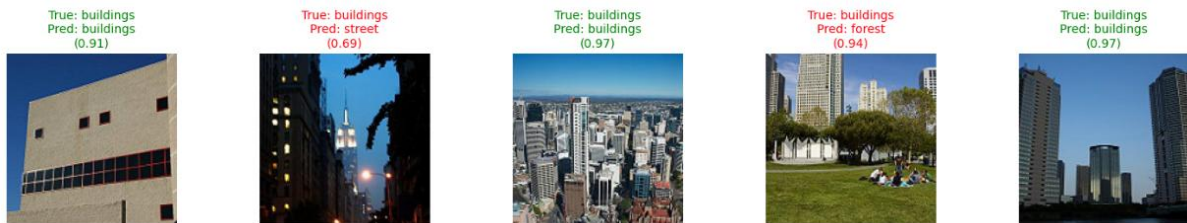
The ResNet model had trouble classifying the images. As you can see the guesses are quite low, eg. 0.43, which shows that the model was not very definitive in picking which class the image belonged to.

Custom CNN Predictions

True: buildings
Pred: buildings
(0.91)

True: buildings
Pred: street
(0.69)

True: buildings
Pred: buildings
(0.97)

True: buildings
Pred: forest
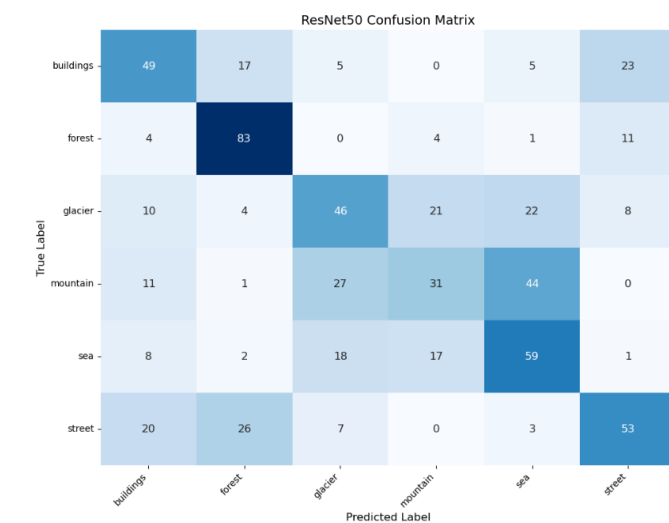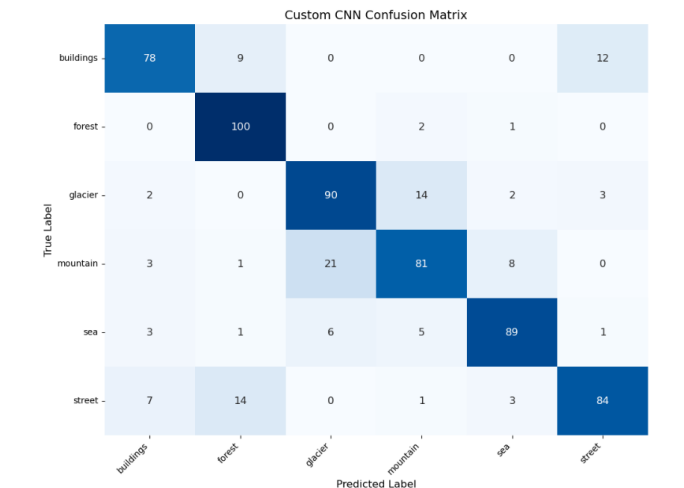(0.94)

True: buildings
Pred: buildings
(0.97)

The CNN model was much more confident in its answers. Its mistakes are not terrible, in this example, it misclassifies a park in a city as a forest.

Conclusion:

The CNN model outperformed the ResNet model in classifying images. I believe that its dropout helped the model significantly and prevented overfitting. The CNN is better at discriminating textures in the image, for example it can tell the difference between the sea and a blue sky. ResNet was able to train faster. To improve the ResNet model I could unfreeze the top layer. For the CNN I could test different kernel sizes and try to optimize that. One limitation that I faced was training time. I had to cut the data size into a fourth of its original size just so the epochs would not take 20 minutes and so my computer would not overheat.

Appendix:

Custom CNN Confusion Matrix

ResNet50 Confusion Matrix

*For ResNet model

Model Accuracy

Model Loss