DATS6203 - Machine Learning – II

Multi-Label Classification

Individual Project Report

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12/13/2022

Overview of the Project

The goal of this project was to implement Multi-Label Image Classification using Convoluted Neural Network. We used various other pretrained models such ResNet101, EffecientNet-B3 and RegNet_x_800.

The data consists of approximately 10,000 images, with each image having between 0 to 16 different labels. Its taken from the IDD (Indian Driving Dataset) dataset, which is a dataset for road scene understanding in unstructured environments used for semantic segmentation and object detection for autonomous driving.

We use different fine-tuning methods such as data augmentation, changes in model definition, changes in optimization algorithm, changes in batch size and other parameters.

For metrics, we use Accuracy Score and Hamming Loss.

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Roles and Responsibilities

In this project, my role was to improve Convoluted Neural Network model definition and fine tune the EfficientNet-B3 model.

I used different data augmentation techniques such as Random Rotation, Affine transformation, Normalization and resizing of the image to improve the model. While defining the Convoluted Neural Network, I tried to improve the model by adding multiple Convoluted Layers and MaxPooling layers and also make changes and add Dense layers to the model definition.

In addition to this, I implemented different fine-tuning techniques to improve the EfficientNet Pretrained Model. With changes in Learning Rate, Batch Size, Number of Epochs and Optimization algorithms.

I was also involved in preparing the Group Project Report while my team members managed other aspects of the submission requirements.

The results were as follows from Fine-Tuning:

Epoch	Batch Size	Augmentation	Optimazation	Learning Rate	CNN Layers	Pretrained Model	Accuracy
10	32	RandomRotation(degrees=45 Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225])]	Adam	0.0001		efficient_netb3	0.2
10	32	RandomRotation(degrees=45 Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225])]	Adam	**0.001**		efficient_netb3	0.39
10	32	RandomRotation(degrees=45 Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225])] RandomFlip	Adam	0.0001	(with 2 dense layers)	FALSE	0.05
10	32	RandomRotation(degrees=45 Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225])] RandomAffine(30, 70)	Adam	**0.001**	(with 3 dense layers)	FALSE	0.05

Metrics on 40 Epochs:

Test Accuracy: 46% and Test Hamming: 0.06681
Average Individual Class – F1: 0.68


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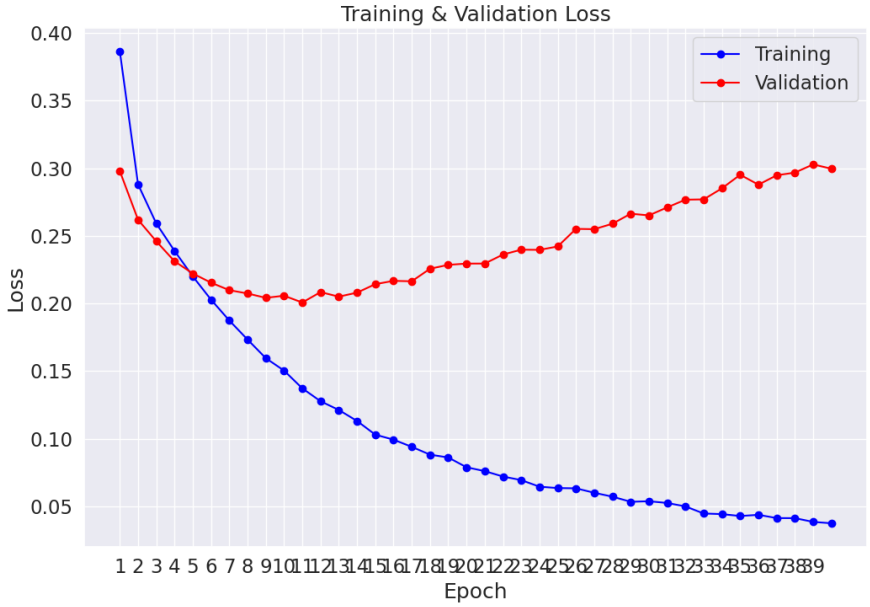
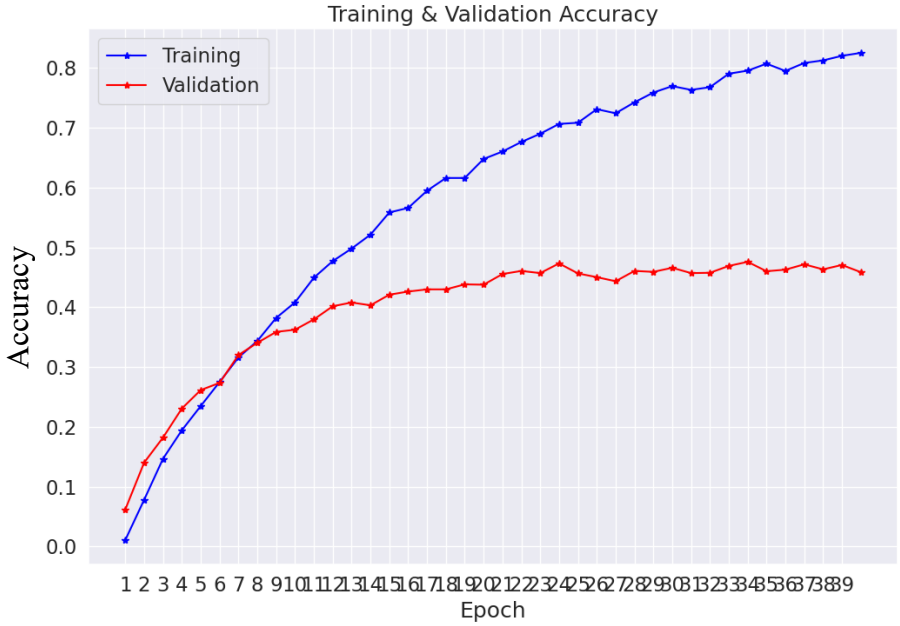
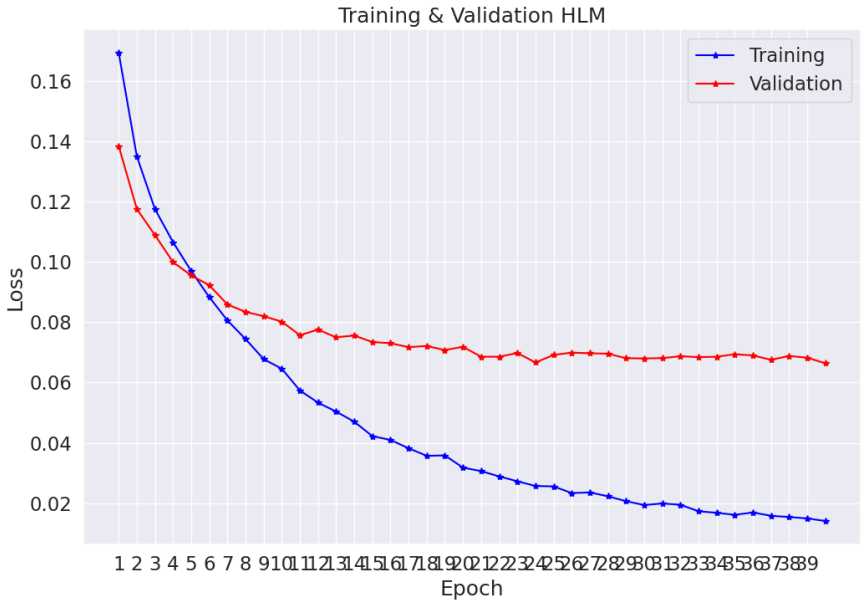

Training & Validation Loss
Training
Validation
Loss
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Epoch


Training & Validation Accuracy
Training
Validation
Accuracy
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Epoch


Training & Validation HLM
Training
Validation
Loss
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39
Epoch

Conclusion

In conclusion, the project gave me the opportunity to work on CNN model architecture, learn the limitations of it and also work on fine-tuning the EfficientNet pretrained model.

Appendix

GitHub Link - https://github.com/IshanKuchroo/IDD-Indian-Driving-Dataset

Datasource:

https://paperswithcode.com/dataset/idd

References

Dr. Amir Jafari, George Washington University

https://ai.googleblog.com/2019/05/efficientnet-improving-accuracy-and.html

https://pytorch.org/vision/stable/transforms.html