Assignment 05: part-b

Deep Learning – Spring 2020

Muhammad Rauf Tabassam
MSCS18030

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Information Technology University, Lahore

Focal Loss for Handling Class Imbalance in Detecting Coronavirus Infections through Chest X-Ray images

Detecting Coronavirus infections through chest X-ray images is a computer vision problem by applying deep learning algorithms on it. The details of dataset provided for this assignment is as follows:

Dataset Details:
This dataset contains X-Ray images from 2 classes:

Class	# of images in training set	# of images in validation set
Covid - 19	200	28
Pneumonia	2000	200
Normal	4000	400

GitHub Repository Link:

https://github.com/rauftabassam/MSCS18030_FocalLoss_DLSpring2020

Task 1: Finetune pre-trained CNN models

1. VGG16 without focal loss

I use the pre-trained VGG16 model on Image Net and change the out_features by 3for this task. I did various experiments by changing hyper-parameters (e.g. learning rate, epochs, fc layers, weight decay etc.) and achieve accuracy of 90% on training dataset. Later, on last day, I realize that my accuracy function is not correct. It is not calculating the accurate accuracy. Then I change the accuracy function on last day and perform the following experiment with the following hyper parameters:

Experimental Setup

- Learning Rate = 0.001
- Epochs = 30
- Momentum = 0.9
- Block size = 32

I used `nn.BCEWithLogitsLoss()` as loss function that used sigmoid (as mentioned in assignment).

Confusion Matrix of Training Data

		Predicted Values			F1 Score
		Covid - 19	Pneumonia	Normal	
Actual Values	Covid - 19	84	58	55	0.59
	Pneumonia	0	3939	55	0.95
	Normal	1	307	1672	0.88

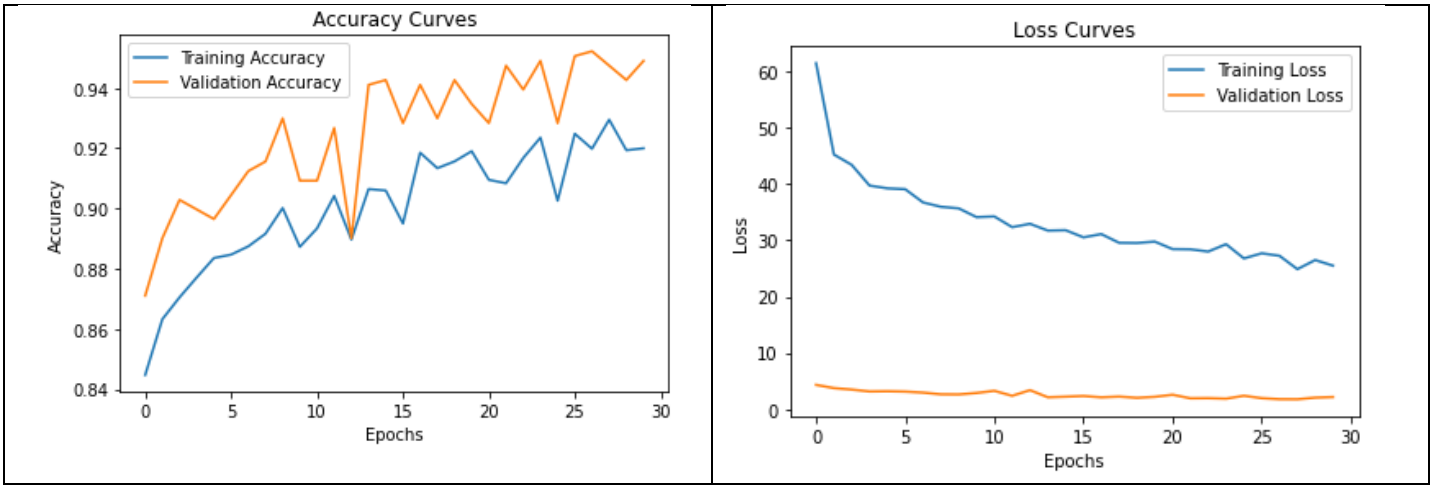
This table is filled with the labels in ground truth. Output of 3 covid19, 6 of pneumonia and 20 of normal images were different to the provided ground truths (e.g. predicted both normal and covid19 or normal and pneumonia etc.) **Accuracy on Training Data is 92%.**

Confusion Matrix of Validation Data

		Predicted Values			F1 Score
		Covid - 19	Pneumonia	Normal	
Actual Values	Covid - 19	14	11	3	0.65
	Pneumonia	1	393	4	0.96
	Normal	0	15	184	0.94

This table is filled with the labels in ground truth. Output of 2 of pneumonia and 1 normal image were different to the provided ground truths (none of covid19, pneumonia and normal). **Accuracy on Validation Data is 94.9%.**

Loss and Accuracy Curves



Testing Data CSV

- Training data CSV is attached with the submission named as "MSCS18030_results_vgg16_without_focal_loss.csv"

All the parameters of the models are saved named as "vgg16_without_focal_loss.pth"

2. RES18 without focal loss

I use the pre-trained VGG16 model on Image Net and add 3 fc layers with 256, 128, 3 neurons respectively. I did various experiments by changing hyper-parameters (e.g. learning rate, epochs, fc layers, weight decay etc.) and achieve accuracy of 90% on training dataset. Later, on last day, I realize that my accuracy function is not correct. It is not calculating the accurate accuracy. Then I change the accuracy function on last day and perform the following experiment with the following hyper parameters:

Experimental Setup

- Learning Rate = 0.001
- Epochs = 30
- Momentum = 0.9
- Block size = 32

I used `nn.BCEWithLogitsLoss()` as loss function that used sigmoid (as mentioned in assignment).

Confusion Matrix of Training Data

		Predicted Values			F1 Score
		Covid - 19	**Pneumonia**	**Normal**	
Actual Values	**Covid - 19**	7	145	42	0.07
	Pneumonia	0	3860	119	0.93
	Normal	2	283	1702	0.88

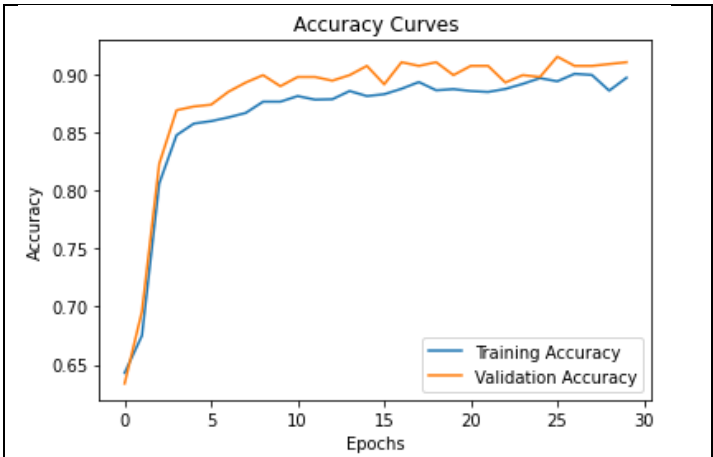
This table is filled with the labels in ground truth. Output of 6 covid19, 21 of pneumonia and 13 of normal images were different to the provided ground truths (e.g. predicted both normal and covid19 or normal and pneumonia etc.) **Accuracy on Training Data is 89.74%.**

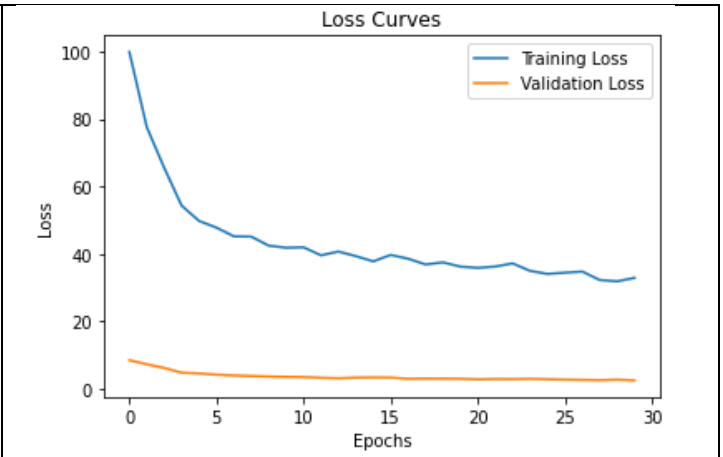
Confusion Matrix of Validation Data

		Predicted Values			F1 Score
		Covid - 19	**Pneumonia**	**Normal**	
Actual Values	**Covid - 19**	0	26	1	0
	Pneumonia	0	393	6	0.94
	Normal	0	20	178	0.92

This table is filled with the labels in ground truth. Output of 1of covid19, 1 of pneumonia and 2 normal images were different to the provided ground truths (none of covid19, pneumonia and normal). **Accuracy on Validation Data is 91.08%.**

Loss and Accuracy Curves





Testing Data CSV

- Training data CSV is attached with the submission named as "MSCS18030_results_res18_without_focal_loss.csv"

All the parameters of the models are saved named as "res18_without_focal_loss.pth"

Challenges & Problems

Reading Test data was a big problem in this assignment. Using PIL and cv2 libraries does not help in feed forwarding or maybe I was unable to crack how to use them to pass in network. Almost I waste my whole day to testing. Then I create a folder named "Test2" and copy the test folder in it and read it. I set the shuffle=False while creating loader for test.

Loading weights was a hectic task that I could not able to done. After loading weights, whenever I called accuracy function it predicted zero accuracy. Don't know why but It did this. Now on last day, I had to retrain all models again that waste a lot of time.

Conclusion

After doing various experiments without focal loss, I conclude that the precision of covid19 class was too bad because of class imbalances. It fails in predicting covid19 class that is very dangerous and serious case according to the problem. Focal loss somehow solves this problem and gives better results than without focal loss.

Future Work

I was not having much time to do all experiments again that is why I submit experiments of without focal loss. The results and notebook of focal loss experiments will be shared soon on github link provided above.