

Name : AKHIL

Roll no : 18CS10070

# Assignment-2 Report

## **Task:**

To train and test Convolutional Neural Networks for image classification on the CIFAR10 dataset using PyTorch Module.

## **Data:**

Train\_images, train\_labels, test\_images and test\_labels

## **Labels:**

Each training and test image is classified into one of 10 categories

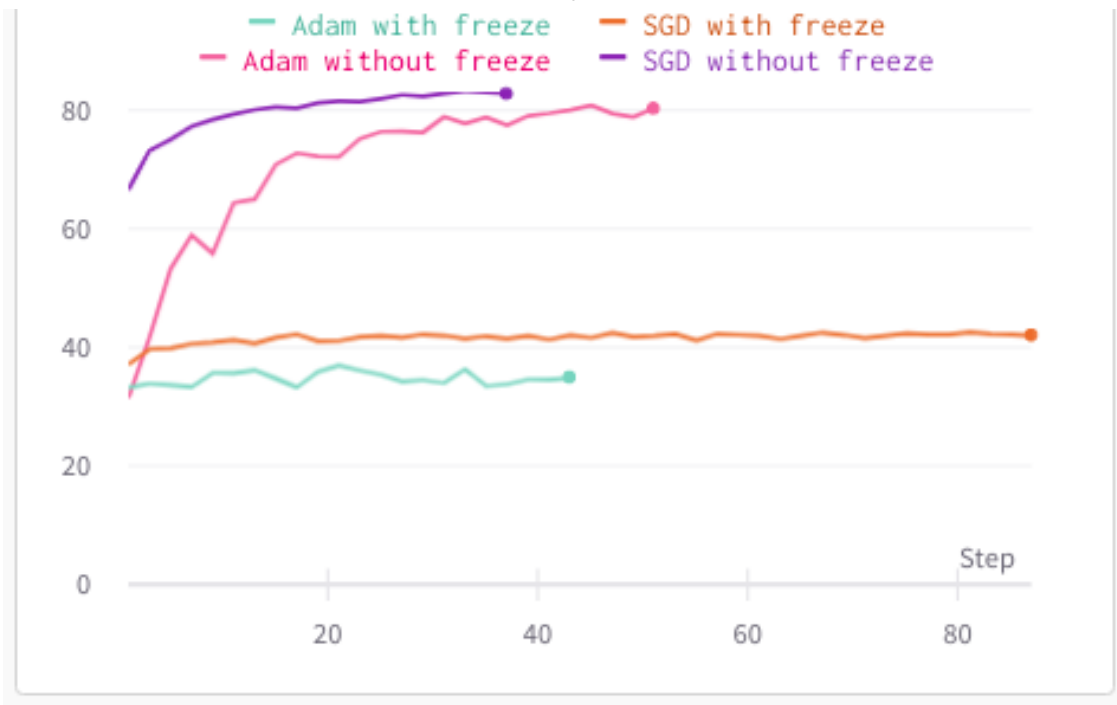
## **Runs:**

This report is generated for the experimental run with the following variations:

1. SGD without Freeze (lr=0.001, m=0.9)
2. Adam without Freeze (lr=0.001, m=0.9)
3. SGD with Freeze (lr=0.01)
4. Adam with Freeze (lr=0.01)

# Plots for Accuracy and Loss

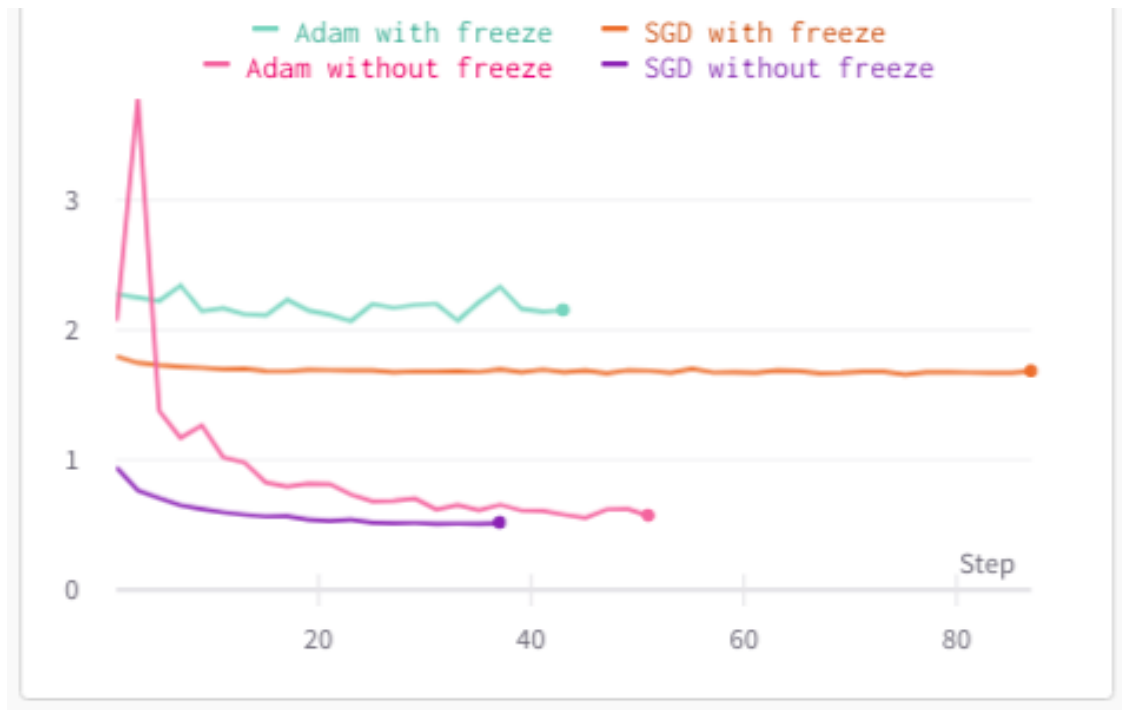
Test Accuracy vs Epochs



Train Loss vs Epochs



## Test Loss vs Epochs



## Prediction Samples:


Examples

ethereal-waterfall-7

fast-disco-6

likely-feather-5

cosmic-haze-4




Pred: 3 Truth: 3


Pred: 3 Truth: 3


Pred: 3 Truth: 3


Pred: 3 Truth: 3

Selected Runs Without Media (6)

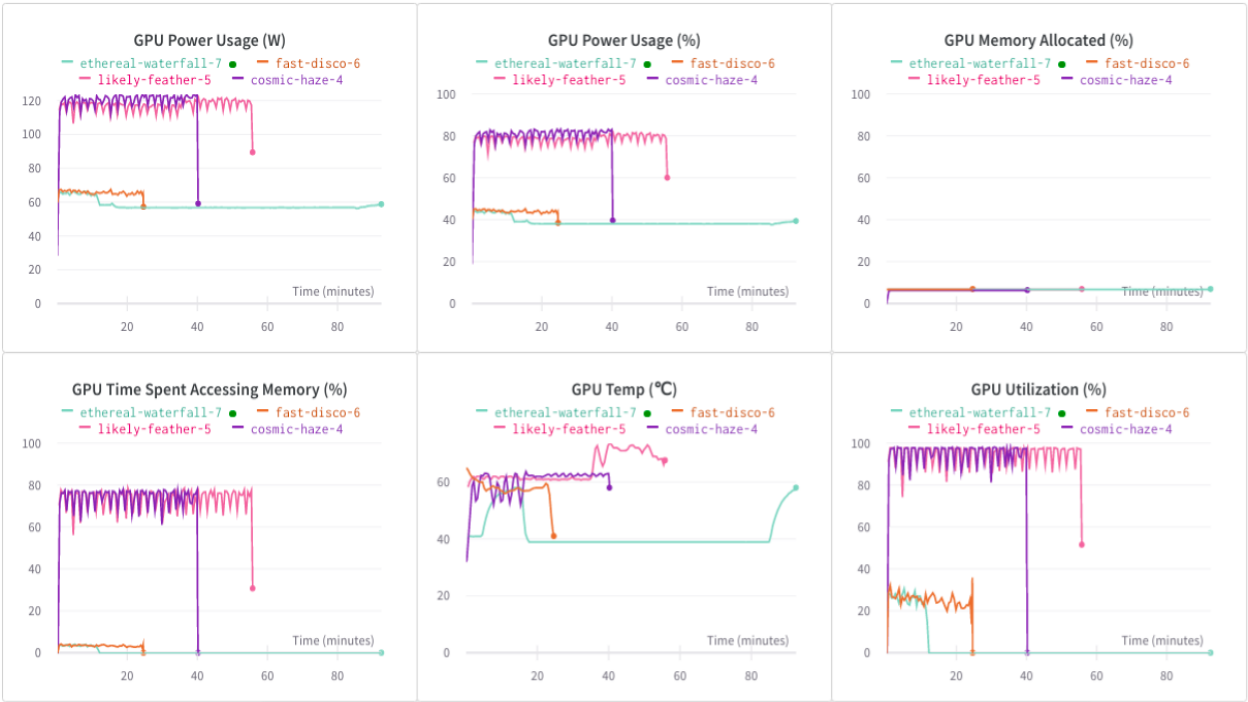
Step 

87 

Index 0 

99 

# System Resource Utilization:



# Confusion Matrices:

The classes with the best and worst number of correct predictions for each run are indicated below:

## 1. SGD without Freeze

	plane	car	bird	cat	deer	dog	frog	horse	ship	truck
plane	873	13	28	12	7	2	1	6	48	10
car	19	911	1	4	0	4	6	0	11	44
bird	36	3	771	28	58	37	41	21	4	1
cat	14	4	52	588	59	177	53	31	10	12
deer	16	2	57	38	809	14	20	35	8	1
dog	8	6	32	85	31	766	19	50	1	2
frog	7	4	20	36	18	10	898	6	1	0
horse	20	1	12	31	28	32	5	859	0	12
ship	33	23	4	5	3	2	7	3	910	10
truck	30	59	4	9	0	3	3	5	22	865

- 
- Best = Car (911)
- Worst = Cat (588)

## 2. Adam without Freeze

	plane	car	bird	cat	deer	dog	frog	horse	ship	truck
plane	882	18	29	13	9	1	5	5	20	18
car	9	928	2	6	2	1	6	0	7	39
bird	44	0	808	30	47	14	39	10	2	6
cat	23	10	74	666	51	80	56	26	11	3
deer	13	2	68	23	812	13	31	36	1	1
dog	13	5	58	184	40	630	32	32	3	3
frog	6	1	36	36	15	3	897	4	2	0
horse	23	5	26	40	33	24	7	832	2	8
ship	55	44	4	8	8	1	2	1	867	10
truck	21	69	7	10	2	1	6	6	16	862

- 
- Best = Car (928)
- Worst = Dog (630)

## 3. SGD with Freeze

	plane	car	bird	cat	deer	dog	frog	horse	ship	truck
plane	525	33	83	13	29	14	13	34	217	39
car	82	395	24	47	17	72	20	45	104	194
bird	117	34	337	58	141	111	83	44	52	23
cat	39	53	76	338	68	198	73	70	42	43
deer	41	8	119	63	492	66	96	55	29	31
dog	25	53	81	134	66	441	40	90	26	44
frog	27	35	97	63	151	89	448	32	41	17
horse	51	29	54	79	125	125	23	399	38	77
ship	274	48	48	33	24	35	20	18	444	56
truck	123	123	18	37	30	81	16	62	103	407

-

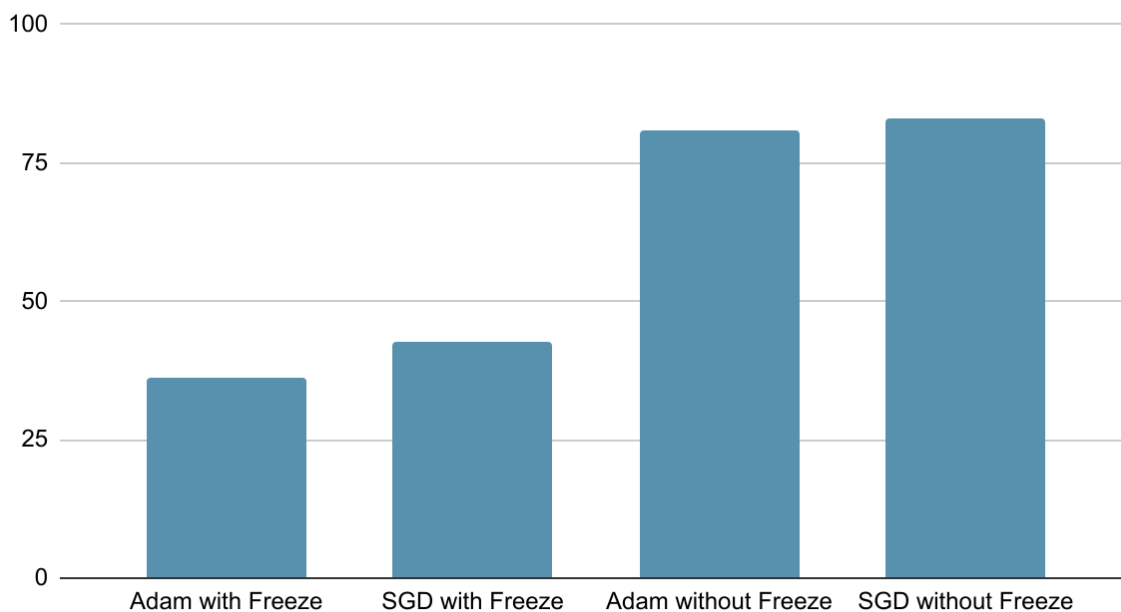
- Best = Plane (525)
- Worst = Bird (337)

#### 4. Adam with Freeze

	plane	car	bird	cat	deer	dog	frog	horse	ship	truck
plane	532	68	33	45	29	8	8	51	184	42
car	93	497	22	69	18	12	10	59	98	122
bird	145	71	245	114	148	30	56	87	78	26
cat	44	81	73	423	56	72	41	103	58	49
deer	67	22	83	115	431	24	71	119	42	26
dog	44	112	80	295	70	167	16	120	52	44
frog	53	74	84	176	149	27	292	81	34	30
horse	55	47	46	148	109	36	21	410	44	84
ship	308	95	35	52	22	13	8	21	399	47
truck	108	233	13	78	36	30	8	73	126	295

- 
- Best = Plane (532)
- Worst = Dog (167)

## Best accuracy for each variation



Name	Accuracy %
Adam with Freeze	36.35
SGD with Freeze	42.61
Adam without Freeze	80.85
SGD without Freeze	82.86

## Observations and reason of different accuracies

### Comparison of SGD and Adam :

- It is easy to observe that with number of epochs of training, train loss and test loss is reducing in general for all 4 experiments which means that the model is able to generalize well.
- It can be observed that as a consequence of the decrease in loss, test accuracy increases with more epochs of training and stabilizes after 15-20 epochs.
- The SGD optimizer is able to converge really fast in less no of epochs as compared to the Adam optimizer, also the best test accuracy is highest in the case of SGD optimizer. When all layers are frozen except for the final layer, the test accuracy is significantly lower.

### Conclusion:

- It can be inferred that the accuracy with using SGD optimizer is highest as SGD optimizer gives slightly better results than if Adam optimizer is used in this case.
- Also, when all layers are free to be trained, the accuracy reaches about much higher than if only the last layer is free to be finetuned. From this, we concluded that the pre-trained ResNet-18 model is not able to Generalize well with Cifar-10 dataset as all other layers do not carry enough information to classify the sample only using a final linear layer.
- This means that the common 512 features obtained after passing through the fixed pre-trained neural network are very confusing for differentiating between some classes as evident from the confusion matrix

Made from :

[https://wandb.ai/akhilchoudhary/SDM\\_Assignment\\_2/reports/Assignment-2-Report--VmlldzoxMDM4MzM1](https://wandb.ai/akhilchoudhary/SDM_Assignment_2/reports/Assignment-2-Report--VmlldzoxMDM4MzM1)



