Assignment 1 Artifacts:

1. Actual notebook with all the cells run indicating the outputs present in the Notebooks Folder
2. PDF version of the above Notebooks can be found in pdf_files Folder
3. final report gives the Brief summary of the above experiments

Multi layered Feedforward Neural Network

Layers:

a. Image of size 3 X 32 X 32
b. 3 - Hidden layers:
   i. h1 of size 500
   ii. h2 of size 250
   iii. h3 of size 100

   Activation used: ReLU

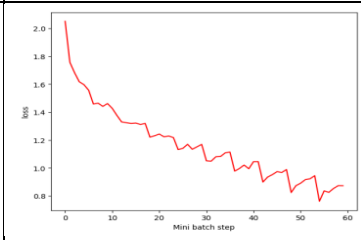
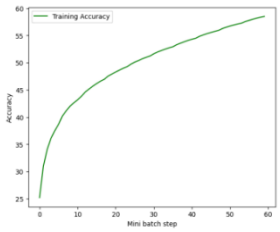
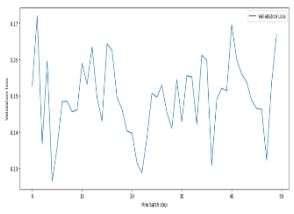
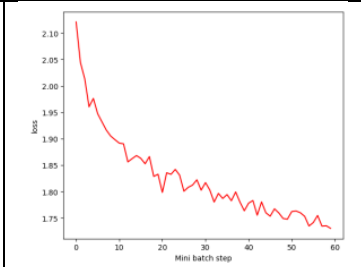
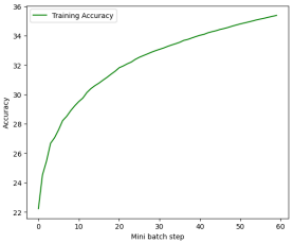
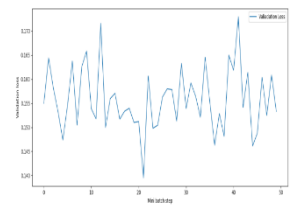
c. output layer with 10 Units
   Activation used: SoftMax

Loss: Cross-Entropy

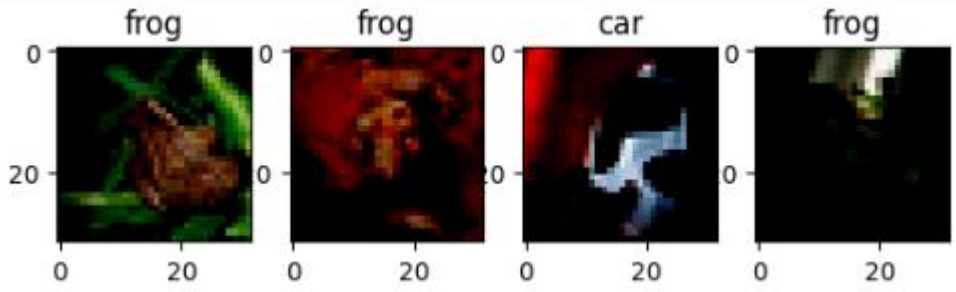
Optimizer: SGD (Stochastic Gradient Descent)

Hyperparameters:

a. Learning rate: 0.001
b. Epochs: 10
c. Momentum: 0.9
d. Batch Size: 4

Serial Number	Batch Norm Present	Training Accuracy	Validation Accuracy	Training Accuracy Plot	Training Loss plot	Validation Loss
1	No	58%	53%			
2	Yes	35%	46%			

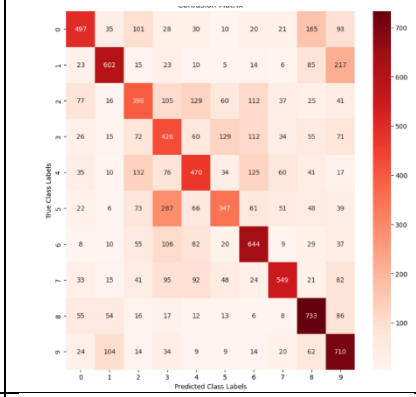
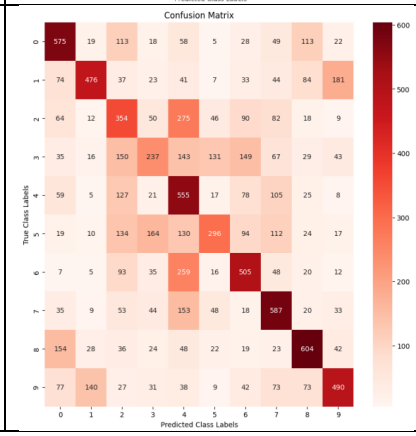
3.Ground Truth data of some random Images from the dataset:



The Trained model predictions for the same Without Batch Norm: ['dog', 'cat', 'frog', 'horse']

The Trained model predictions for the same With Batch Norm: ['frog', 'bird', 'car', 'horse']

4.Confusion Matrix:

Serial Number	Batch Norm Enabled	Confusion Matrix
1	No	
2	Yes	

5.Batch Normalization Effect:

Batch Normalization Decreased the Training Accuracy and Validation Accuracy, in general Applying Batch Normalization must result in faster convergence.

Question-2: C.N.N

2.1 Experimental Settings

Loss Function used: Cross-entropy

Optimization Method: SGD (Stochastic Gradient Descent)

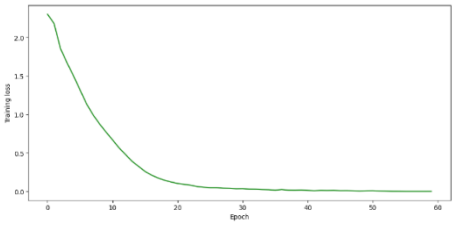
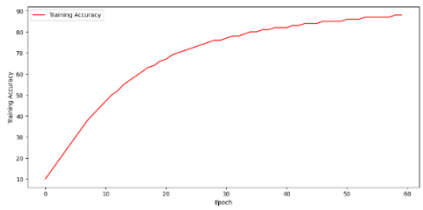
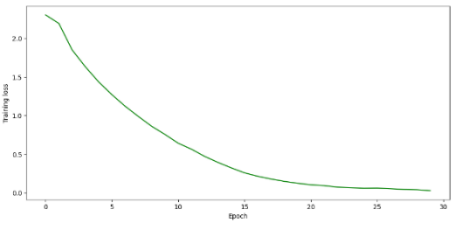
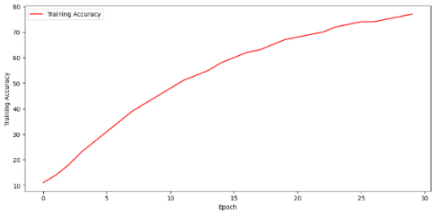
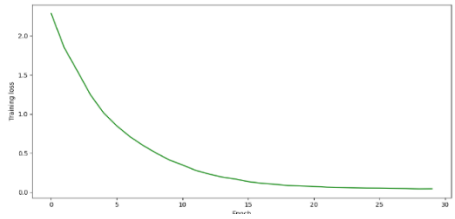
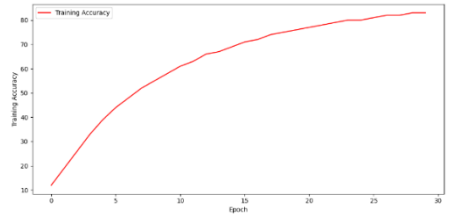
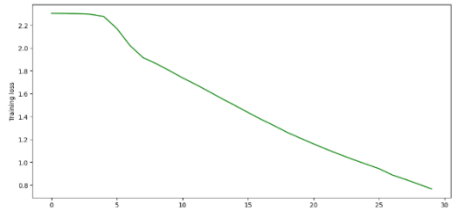
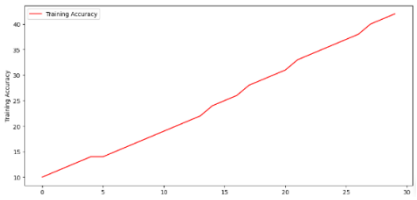
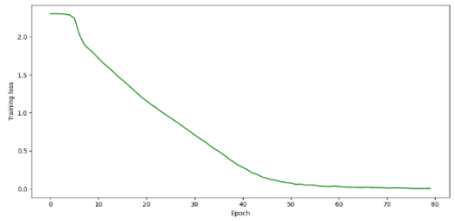
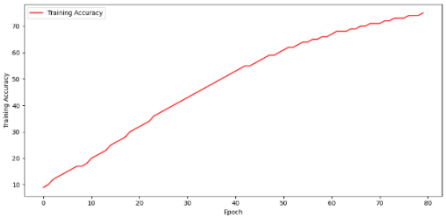
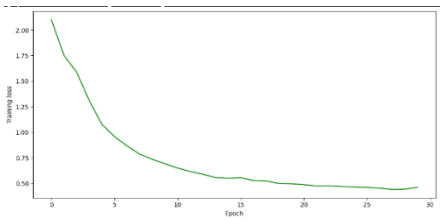
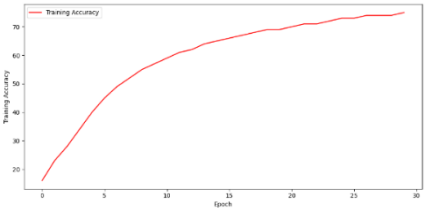
2.1.1

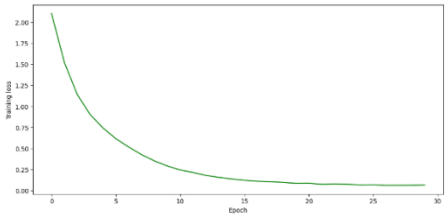
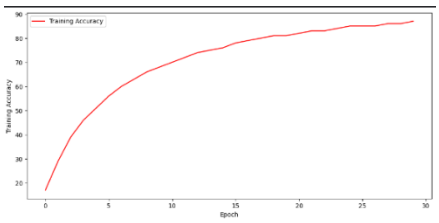
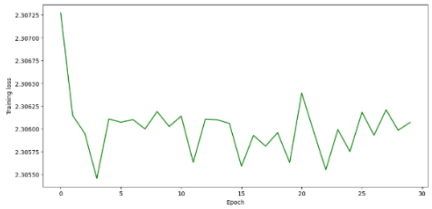
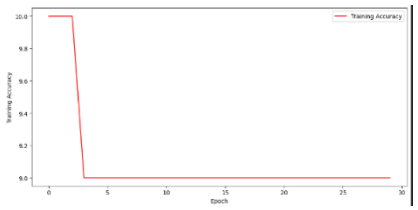
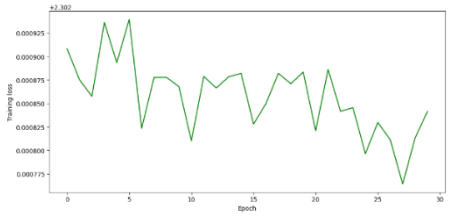
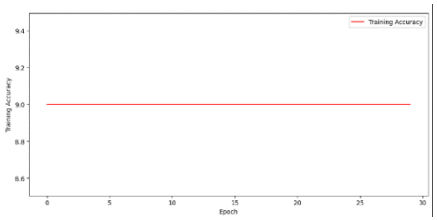
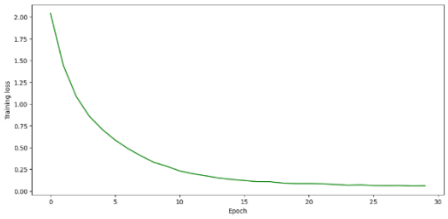
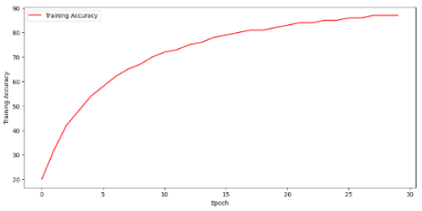
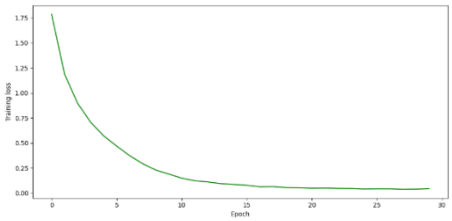
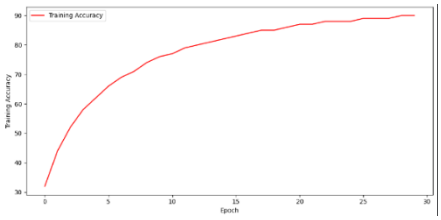
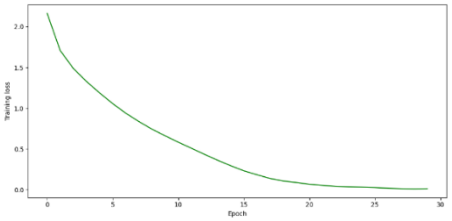
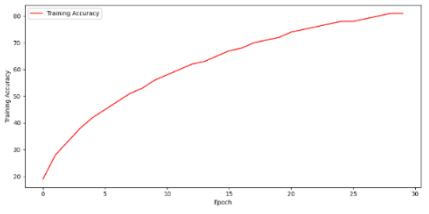
Serial Num	Learn-ing rate	Batch Size	Epoch	Momentum	weights and Bias initialization	Max pool layer at the end	Modify the number of neurons in a FC layer	Increase/ Decrease FC count	Training accuracy (in %)	Accuracy On Test data (in %)
1	0.01	256	60	0.9	Yes	Yes	No	No	88%	79%
2	0.01	256	30	0.9	Yes	Yes	No	No	76%	77%
3	0.01	128	30	0.9	Yes	Yes	No	No	83%	79%
4	0.001	128	30	0.9	Yes	Yes	No	No	42%	68%
5	0.001	128	80	0.9	Yes	Yes	No	No	75%	73%
6	0.1	128	30	0.9	Yes	Yes	No	No	75%	76%
7	0.01	64	30	0.9	Yes	Yes	No	No	87%	80%
8	0.1	64	30	0.9	Yes	Yes	No	No	9%	10%
9	0.01	128	30	0.9	No	Yes	No	No	9%	10%
10	0.01	64	30	0.9	Yes	No	No	No	87%	79%
11	0.01	64	30	0.9	Yes	No	Yes	Yes, Two Fully connected layer used	90%	80%
12	0.01	64	30	0.5	Yes	No	Yes	Yes, Two Fully connected layer used	81%	77%

2.1.3 Plots:

Serial Number	Training loss plots	Training accuracy	Remarks

ASSIGNMENT-1

1			
2			
3			Accuracy improved on reducing the batch size for the same learning rate and same epochs
4			Slow learning rate resulted in less accuracy for 30 epochs
5			More number of epochs required as learning rate is decreased
6			

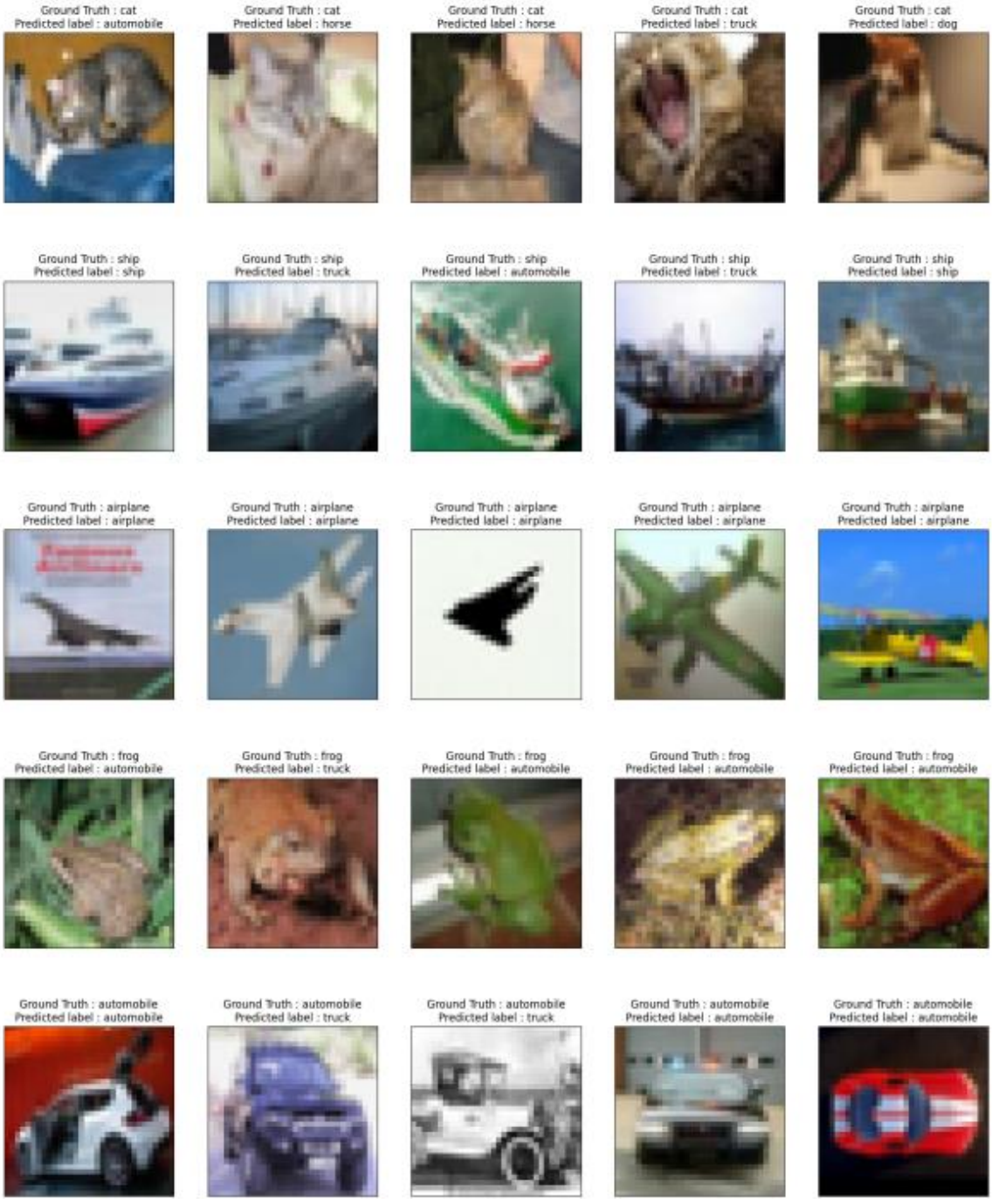
7			
8			Convergence did not take place due to high learning rate with small batch size
9			Due to uninitialization of weights, there might be a problem of gradient vanishing which resulting in non-convergence of model
10			Removed the last max pool layer
11			Has only 2 Fully connected layers. Training time has been reduced.
12			

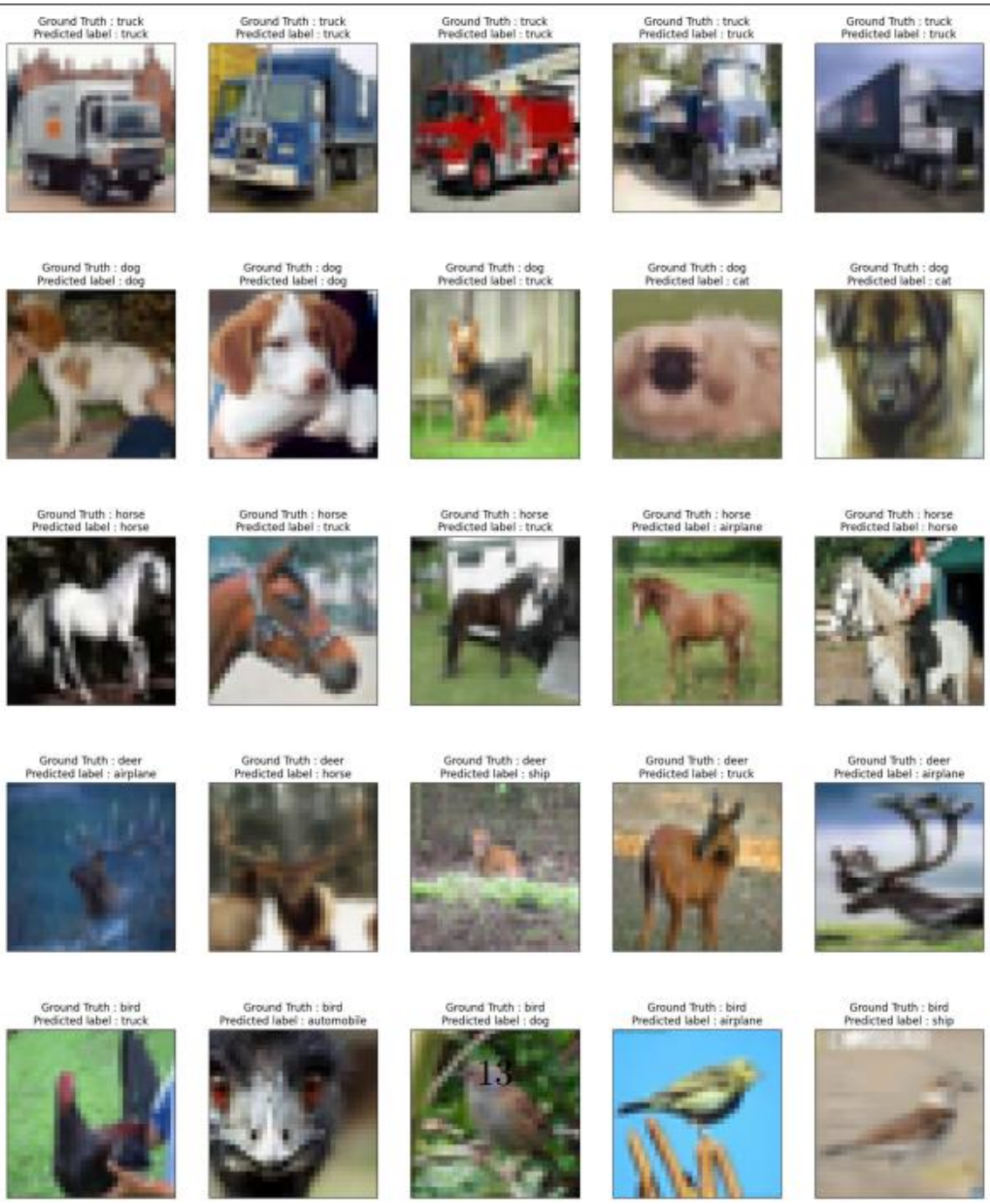
2.1.2 Challenges Faced:

- Did not initialize the weights initially for the model initially, which resulted in the vanishing gradient problem or gradients exploding problem

2.1.5

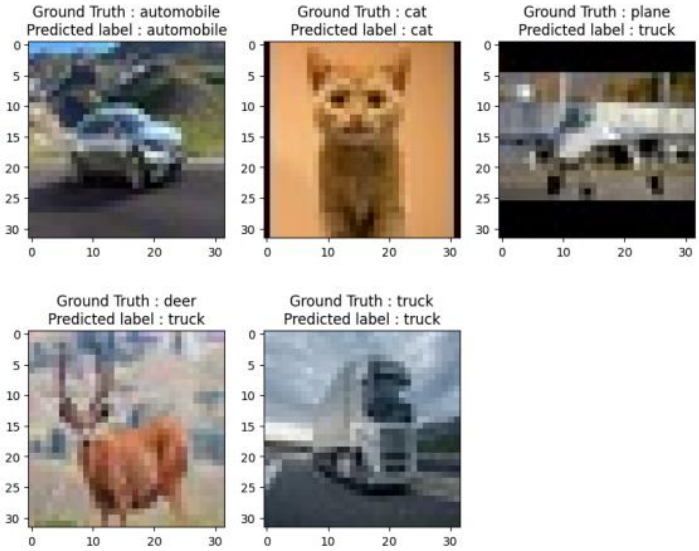
- Images respective to each class has been recorded in the appropriate PDF. Experimental-1 result has been attached for reference.





2.1.6

- For Question-6, Random image classification has been done to each experimental setting. Experimental-1 result has been attached for reference.



Question-3

1. For Training and Testing Hindi Language has been chosen for the models mentioned in both Question-2 and Question-3
2. Detailed Training and Testing has been recorded in notebook as well as pdf.