HOMEWORK 5

1)

Here is the screenshot which shows the gradient updates

```
Epoch 1/10
860/860 [==============================] - ETA: 0s - loss: 0.5649 - accuracy: 0.7933
Epoch 1: val_loss improved from inf to 0.35580, saving model to model.weights.best.hdf5
860/860 [==============================] - 147s 169ms/step - loss: 0.5649 - accuracy: 0.7933 - val_loss: 0.3558 - val_accuracy: 0.8724
Epoch 2/10
860/860 [==============================] - ETA: 0s - loss: 0.3928 - accuracy: 0.8571
Epoch 2: val_loss improved from 0.35580 to 0.33175, saving model to model.weights.best.hdf5
860/860 [==============================] - 121s 140ms/step - loss: 0.3928 - accuracy: 0.8571 - val_loss: 0.3317 - val_accuracy: 0.8730
Epoch 3/10
860/860 [==============================] - ETA: 0s - loss: 0.3458 - accuracy: 0.8735
Epoch 3: val_loss improved from 0.33175 to 0.27342, saving model to model.weights.best.hdf5
860/860 [==============================] - 118s 137ms/step - loss: 0.3458 - accuracy: 0.8735 - val_loss: 0.2734 - val_accuracy: 0.8970
Epoch 4/10
860/860 [==============================] - ETA: 0s - loss: 0.3166 - accuracy: 0.8816
Epoch 4: val_loss improved from 0.27342 to 0.26447, saving model to model.weights.best.hdf5
860/860 [==============================] - 121s 141ms/step - loss: 0.3166 - accuracy: 0.8816 - val_loss: 0.2645 - val_accuracy: 0.8996
Epoch 5/10
860/860 [==============================] - ETA: 0s - loss: 0.2969 - accuracy: 0.8918
Epoch 5: val_loss improved from 0.26447 to 0.24558, saving model to model.weights.best.hdf5
860/860 [==============================] - 119s 138ms/step - loss: 0.2969 - accuracy: 0.8918 - val_loss: 0.2456 - val_accuracy: 0.9068
Epoch 6/10
859/860 [==========================>.] - ETA: 0s - loss: 0.2804 - accuracy: 0.8965
Epoch 6: val_loss improved from 0.24558 to 0.23302, saving model to model.weights.best.hdf5
860/860 [==============================] - 124s 144ms/step - loss: 0.2804 - accuracy: 0.8965 - val_loss: 0.2330 - val_accuracy: 0.9114
Epoch 7/10
860/860 [==============================] - ETA: 0s - loss: 0.2682 - accuracy: 0.9008
Epoch 7: val_loss improved from 0.23302 to 0.22831, saving model to model.weights.best.hdf5
860/860 [==============================] - 121s 140ms/step - loss: 0.2682 - accuracy: 0.9008 - val_loss: 0.2283 - val_accuracy: 0.9094
Epoch 8/10
860/860 [==============================] - ETA: 0s - loss: 0.2557 - accuracy: 0.9054
Epoch 8: val_loss improved from 0.22831 to 0.22232, saving model to model.weights.best.hdf5
860/860 [==============================] - 118s 137ms/step - loss: 0.2557 - accuracy: 0.9054 - val_loss: 0.2223 - val_accuracy: 0.9162
Epoch 9/10
860/860 [==============================] - ETA: 0s - loss: 0.2449 - accuracy: 0.9092
Epoch 9: val_loss improved from 0.22232 to 0.21655, saving model to model.weights.best.hdf5
860/860 [==============================] - 122s 142ms/step - loss: 0.2449 - accuracy: 0.9092 - val_loss: 0.2166 - val_accuracy: 0.9186
Epoch 10/10
860/860 [==============================] - ETA: 0s - loss: 0.2359 - accuracy: 0.9123
Epoch 10: val_loss improved from 0.21655 to 0.20714, saving model to model.weights.best.hdf5
860/860 [==============================] - 115s 134ms/step - loss: 0.2359 - accuracy: 0.9123 - val_loss: 0.2071 - val_accuracy: 0.9208
<keras.callbacks.History at 0x7ff8e1c2a8b0>
```

The accuracy of test set is shown below

```
Test accuracy: 0.9171000123023987
```

2)

```
Epoch 15: val_loss did not improve from 10.50167
169/169 [==============================] - 44s 263ms/step - loss: 4.6111 - accuracy: 0.0052 - val_loss: 11.9929 - val_accuracy: 0.0017
Epoch 16/20
169/169 [==============================] - ETA: 0s - loss: 4.7043 - accuracy: 0.0052
Epoch 16: val_loss did not improve from 10.50167
169/169 [==============================] - 45s 264ms/step - loss: 4.7043 - accuracy: 0.0052 - val_loss: 11.1477 - val_accuracy: 0.0033
Epoch 17/20
169/169 [==============================] - ETA: 0s - loss: 4.3783 - accuracy: 0.0052
Epoch 17: val_loss did not improve from 10.50167
169/169 [==============================] - 44s 263ms/step - loss: 4.3783 - accuracy: 0.0052 - val_loss: 11.7559 - val_accuracy: 0.0033
Epoch 18/20
169/169 [==============================] - ETA: 0s - loss: 4.0709 - accuracy: 0.0052
Epoch 18: val_loss did not improve from 10.50167
169/169 [==============================] - 44s 263ms/step - loss: 4.0709 - accuracy: 0.0052 - val_loss: 10.8569 - val_accuracy: 0.0033
Epoch 19/20
169/169 [==============================] - ETA: 0s - loss: 3.9866 - accuracy: 0.0052
Epoch 19: val_loss improved from 10.50167 to 10.39119, saving model to final_model.weights.best.hdf5
169/169 [==============================] - 45s 266ms/step - loss: 3.9866 - accuracy: 0.0052 - val_loss: 10.3912 - val_accuracy: 0.0033
Epoch 20/20
169/169 [==============================] - ETA: 0s - loss: 3.9043 - accuracy: 0.0052
Epoch 20: val_loss did not improve from 10.39119
169/169 [==============================] - 45s 263ms/step - loss: 3.9043 - accuracy: 0.0052 - val_loss: 10.8695 - val_accuracy: 0.0033
Test Score: [10.803643226623535, 0.004000000189989805]
girivaasan@Giri:~$
```