

Report on Task 1  
CNN on EuroSAT dataset for Image Classification

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**Directory Structure:**

```
/cnn_21CS60A04_AnkitKumarVerma
  cnn_21CS60A04_AnkitKumarVerma.ipynb
  cnn_21CS60A04_AnkitKumarVerma.pdf
  /logs_cnn
    cnn_best.pth (download from GitHub during execution)
```

**Dependencies:**

Stable Internet Connection	The program downloads the model weights from Github. Link: <a href="https://github.com/ankitverma5859/IIT_KGP/blob/main/SprintSemester2022/Week8/CNN/cnn_best.pth">https://github.com/ankitverma5859/IIT_KGP/blob/main/SprintSemester2022/Week8/CNN/cnn_best.pth</a>  <i>(System must have wget installed for this operation to be successful)</i>
Python	>3, <b>(Recommended: 3.9.6)</b>
Python Libraries	All the libraries mentioned under “ <b>Importing required libraries</b> ” should be installed on the system

**Configurations:**

(Configure the following variables under “*Setting Filepaths and Variables*” section of the .ipynb file before execution):

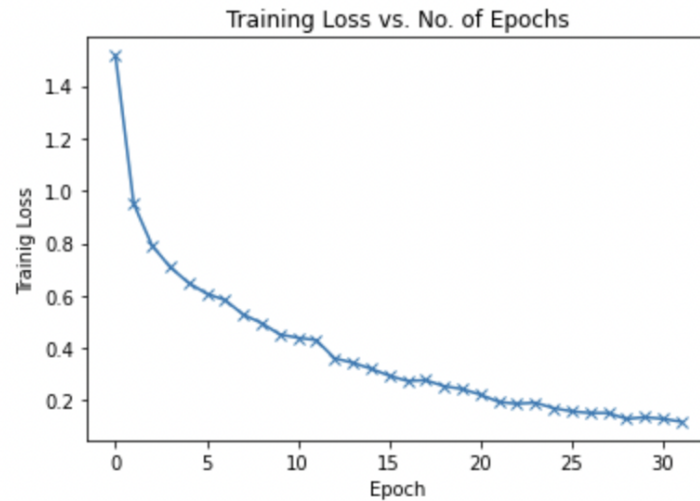
<b>Dataset Filepath</b>	This path should be a local machine path. Internat Link/URL will not work for this configuration.
<b>Hyperparameters</b>	
batch_size	Batch Size

	<p>Default batch size is set to '64'.</p> <p>This model was tested on Google Colab. Since the free version couldn't accommodate more than 64 for batch_size, the config value of used..</p>
num_epochs	<p>Number of Epochs</p> <p>Default value is set to 50.</p> <p>The model was run several times and it was found that the average best accuracy is achieved by the configured number of epochs given the learning rate is 0.001</p>
lr	<p>Learning Rate</p> <p>Default value is set to 0.001</p> <p>Different learning rates were used during the experiment. However, 0.001 gives the best results.</p>
k	<p>Value for Early Stopping</p> <p>Default value is set to 7</p> <p>During the experiment and graph analysis on the validation accuracy it was found that k=7 detects the early stopping best.</p>

## Results/Inferences

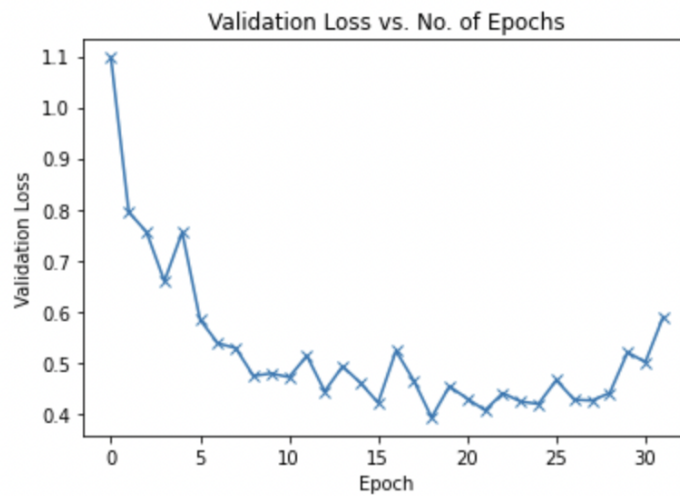
<b>DataSet</b>	<b>Accuracy (%)</b>
Validation Set	86.0819
Test Set	85.725

### Training Loss Graph:



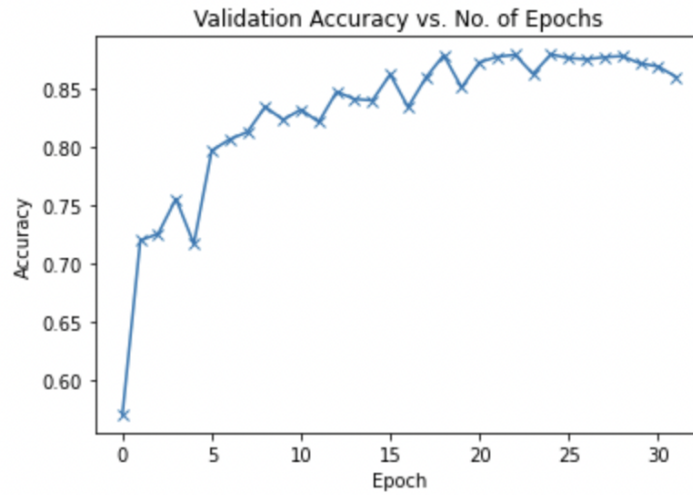
The training loss continuously decreased through the total number of epochs configured except for few cases near (~10, ~24) with the other hyper parameters provided.

### Validation Loss Graph:



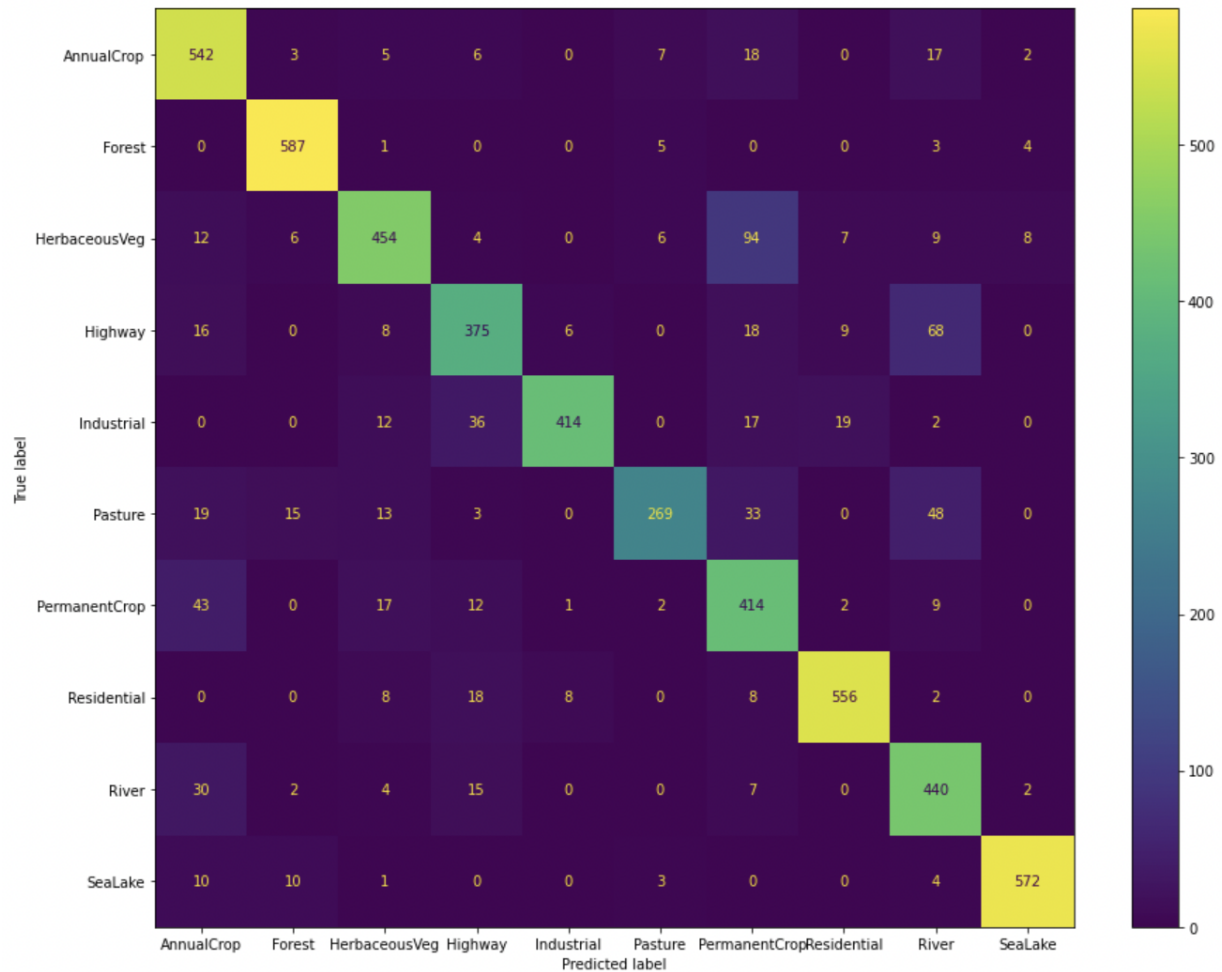
The validation loss continuously decreased until (~26 epochs) except for few cases(#epoch\_4, #epoch\_16, #epoch\_19, etc) for the configured number of epochs. For other experiments when number of epochs was substantially high(>100), validation loss kept fluctuating after a certain number of epochs.

### Validation Accuracy Graph:



The validation accuracy has kept increasing until (#epoch\_27) after which the graph takes a downward trend. The early stopping was not observed for 30 epochs, however, it would have been observed with 70-100 epochs as assumed.

### Confusion Matrix heatmap of Testset:



### Recall Values of each class:

S.No	Class	Recall Value (%)
1	AnnualCrop	90.33
2	Forest	97.83 ( <i>Most Confident Class</i> )
3	Herbaceous Vegetation	75.66
4	Highway	75.00

5	Industrial	82.80
6	Pasture	67.25 ( <i>Least Confident Class</i> )
7	Permanent Crop	82.80
8	Residential	92.66
9	River	88.00
10	SeaLake	95.33

**End of Report**