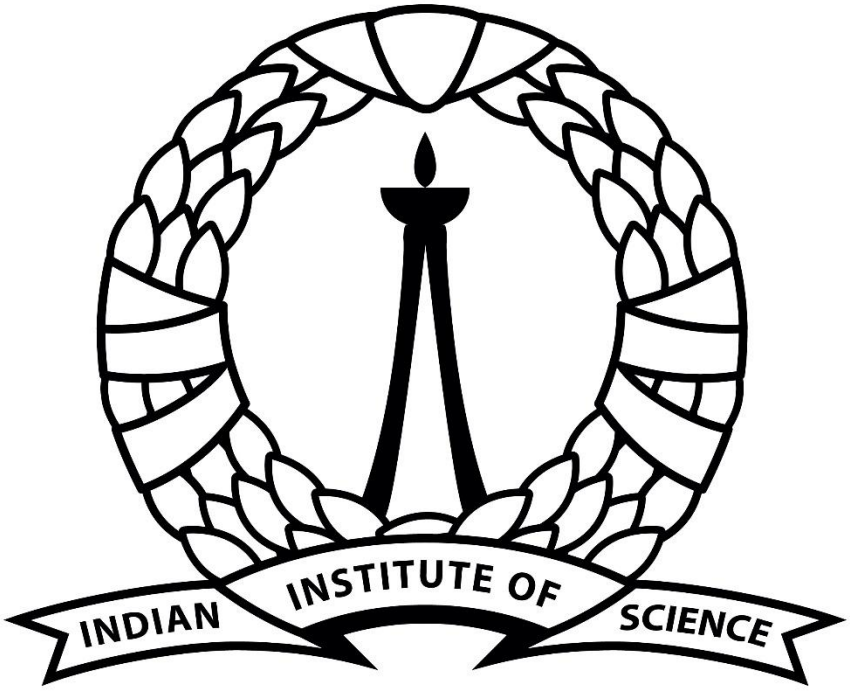

भारतीय विज्ञान संस्थान

Artificial Intelligence

ASSIGNMENT -1

IMAGE FEATURES

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PCA-SIFT

Computation Steps

- **Scale Space Extrema Detection**
- **Key-point Localization**
- **Orientation Assignment**
- **Key-point Descriptor**

IMPLEMENTATION DETAILS

• Number of octaves: 2, 2nd octave created by downsampling image by a factor of 2.

• DOGs per octave: 4, Five scale space per octave leading to 4 DOGs

• Scales per octave : 3, Only 3 DOGs available with lower and higher scale neighbors required for scale space extrema detection.

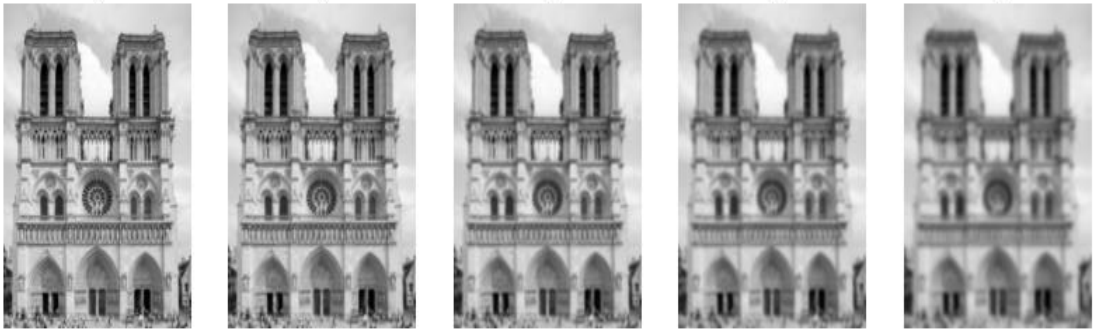
• SIGMA = 0.7, of the base scale of the first octave. Gradually increases by a factor of K after each scale. (K = 2^1/s, where s is no. of

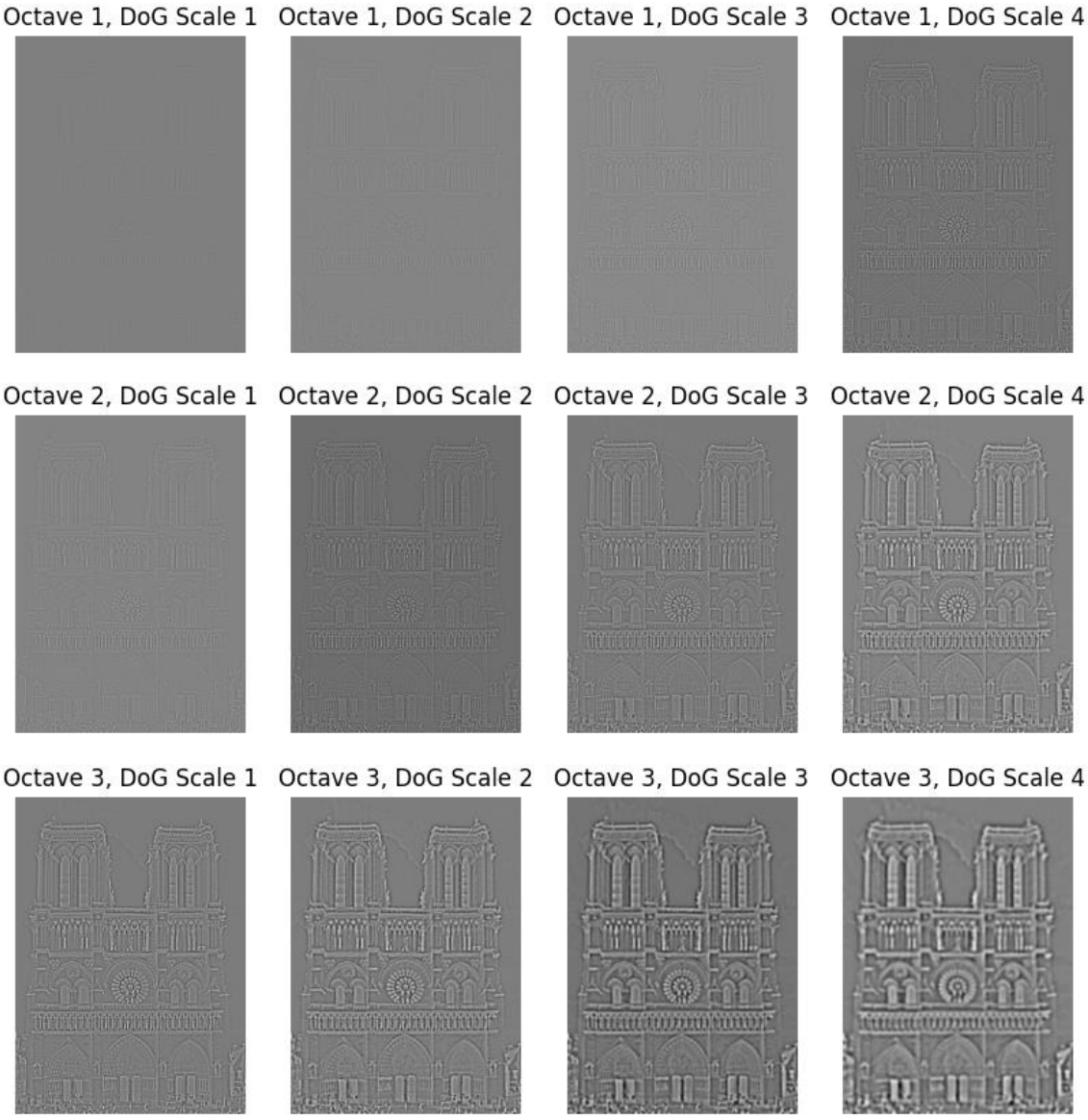
Key-points: Image 1(original)

Octave 1, Scale 1 Octave 1, Scale 2 Octave 1, Scale 3 Octave 1, Scale 4 Octave 1, Scale 5

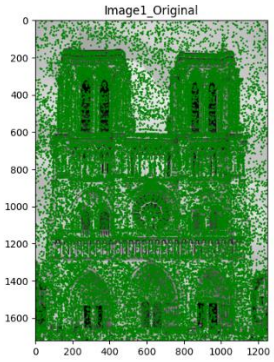
Octave 2, Scale 1 Octave 2, Scale 2 Octave 2, Scale 3 Octave 2, Scale 4 Octave 2, Scale 5

Octave 3, Scale 1 Octave 3, Scale 2 Octave 3, Scale 3 Octave 3, Scale 4 Octave 3, Scale 5

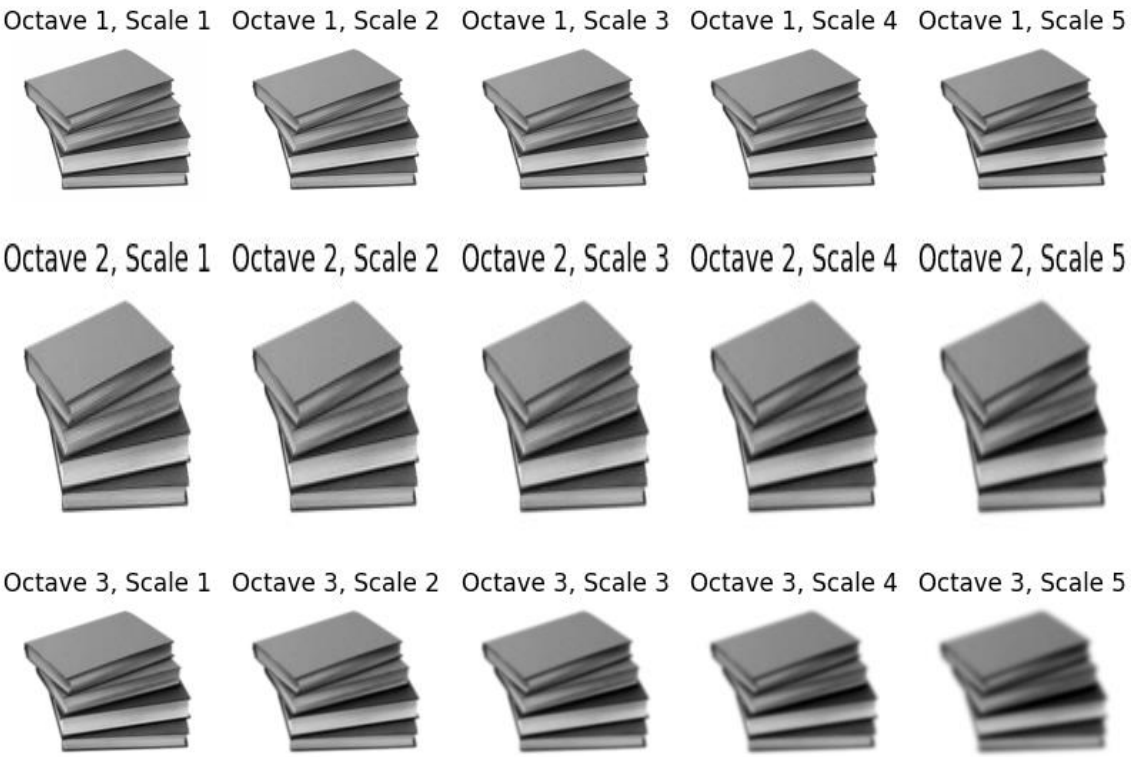


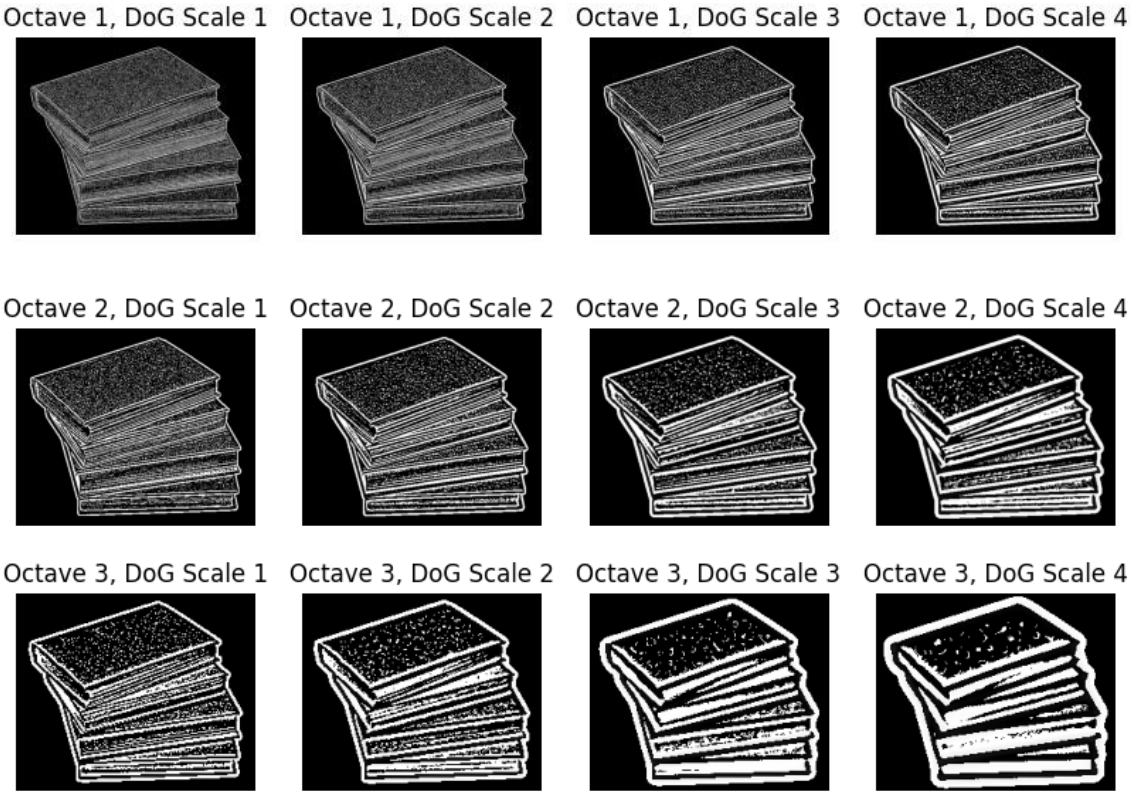


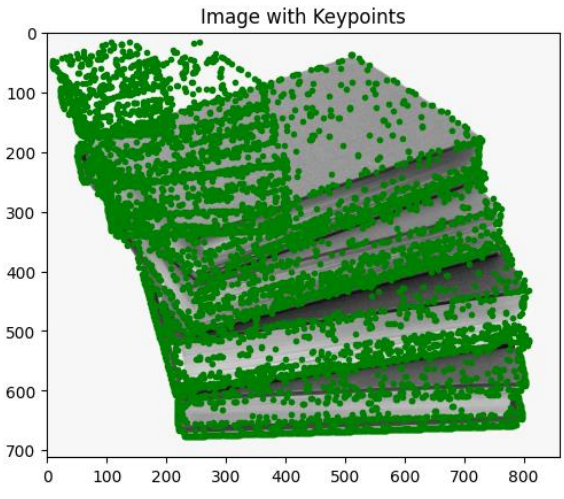
Keypoints:36758



Key points: Image2(Original)







keypoints:7527

Observations:

	ORIGINAL	SCALED(*0.5)	ROTATED(45 deg)	BLURRED				
IMAGE1	36758	27651	36634	32971				
IMAGE 2	7527	5132	7495	5047				

Takeaways:

-The number of key points do not change significantly upon rotation however a slight decrease is observed as the rotation angle is increased.

-The number of key points as expected decreases as the image is downscaled.

-In the case of Gaussian blur the key points drop initially but then stay relatively the same upon higher levels of blur.

Image Classification

Model Architecture:

Dataset: CIFAR10

Training Data : 3 batches of 10000 images each with assigned labels

Test Data: 1 batch of 10000 images with assigned labels

Additional Test Data: 1 batch of 10000 images with assigned labels

. Each batch of train and test dataset contains RGB [32X32] images belonging to one of the 10 specified categories

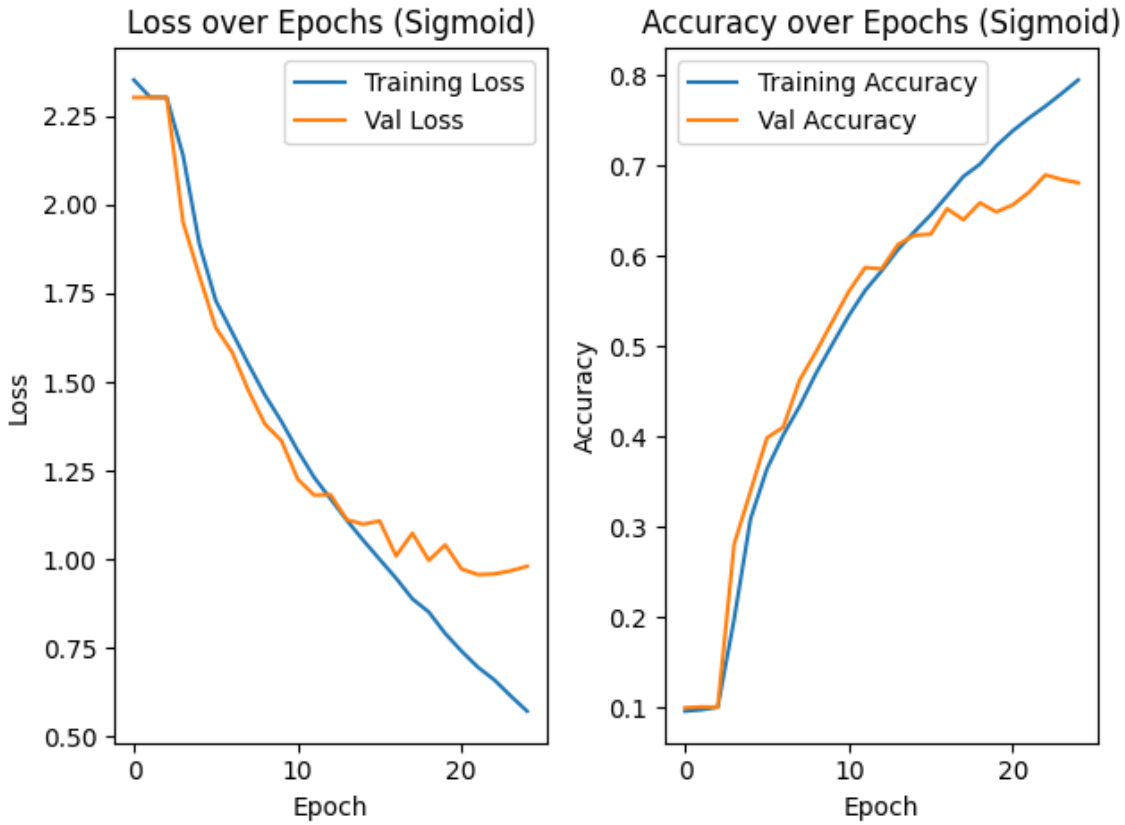
. Number of images belonging to each category are equal in both train and test datasets

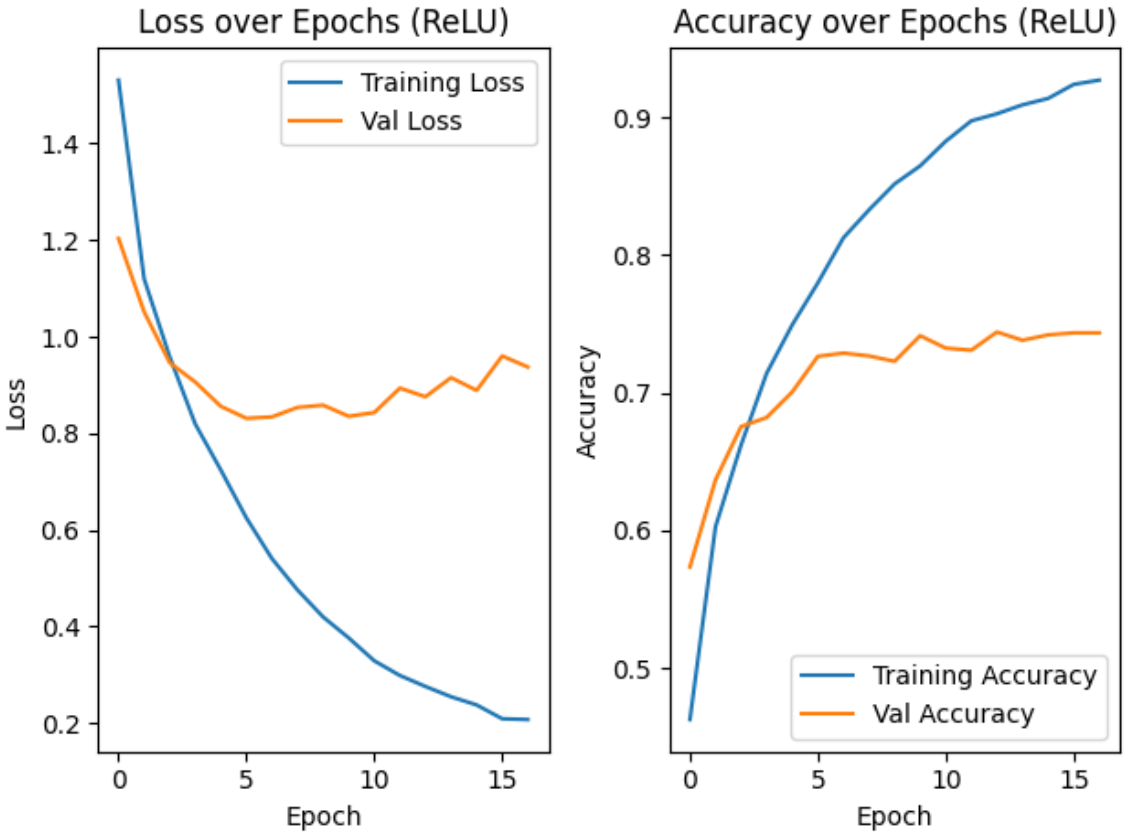
Hyperparameters:

-Number of classes : 10

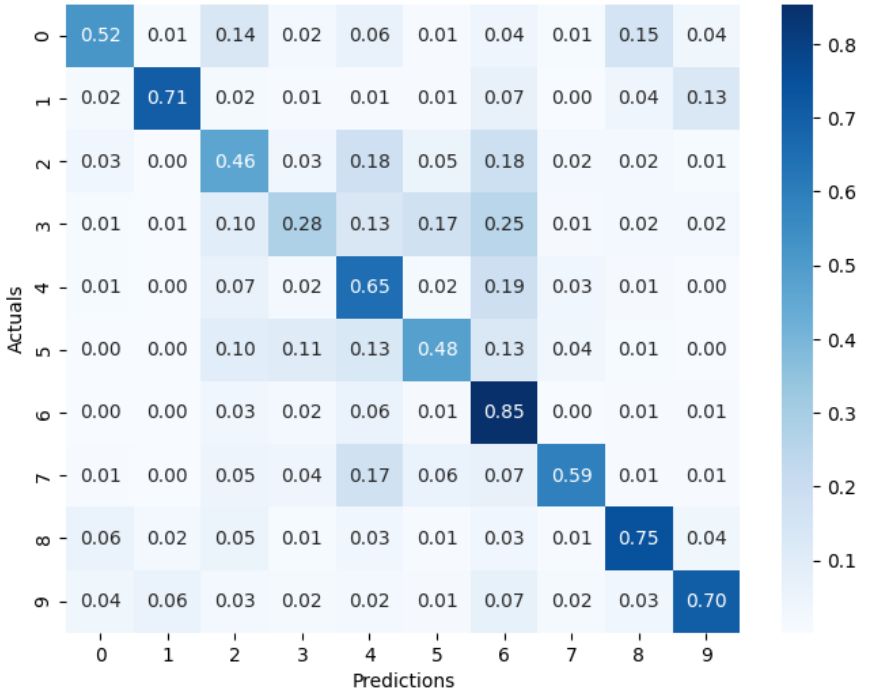
- Batch Size : 100
- Number of Epochs : 10/15/25
- Learning Rate : 0.01/0.001/0.0001
- Loss function: Categorical cross-entropy
- Optimiser : ADAM

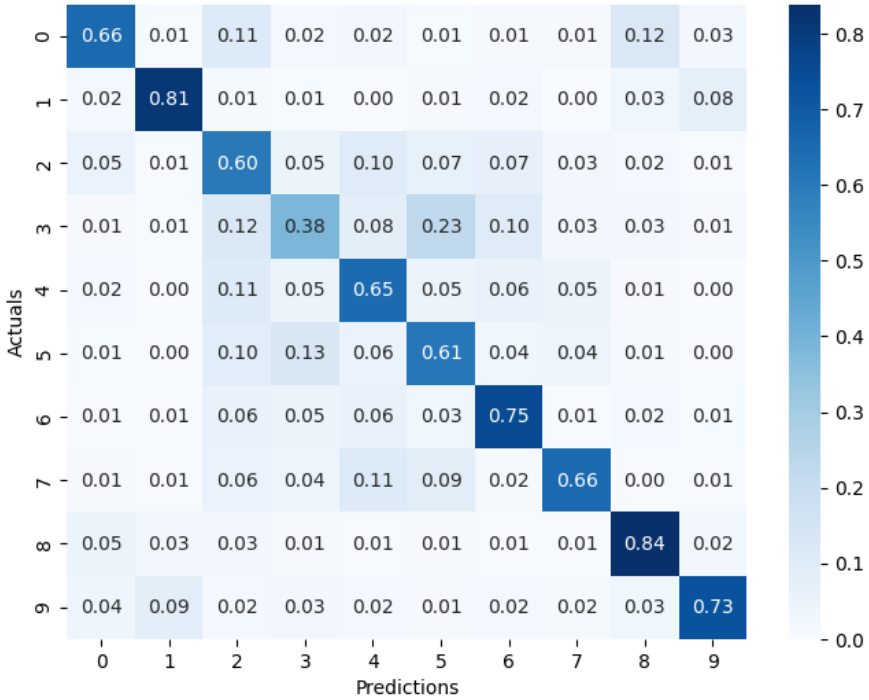
Training Accuracy:

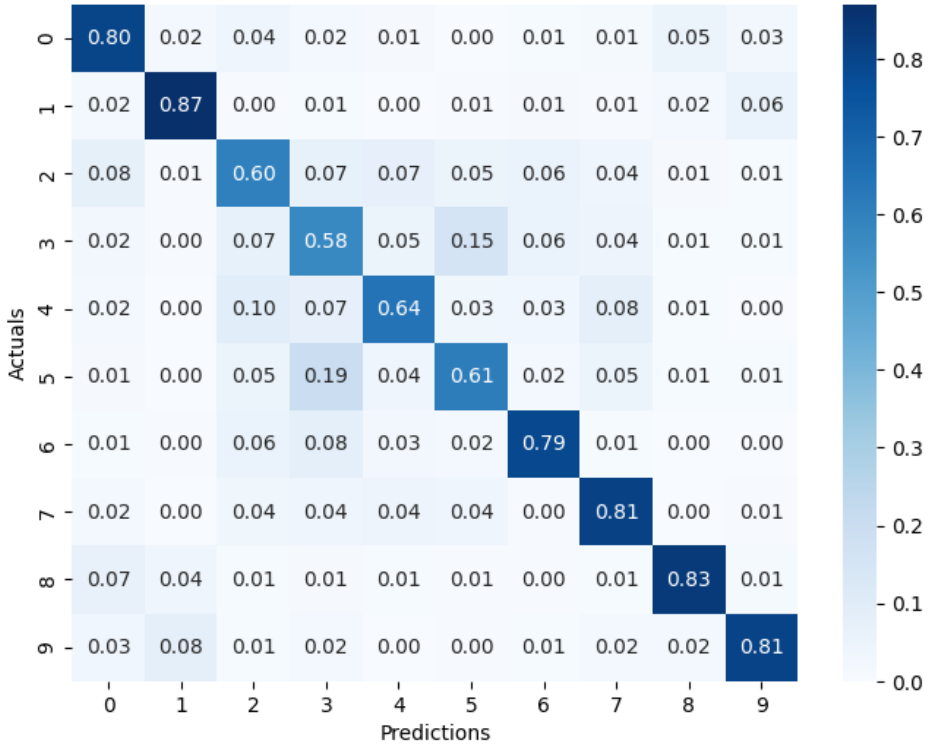


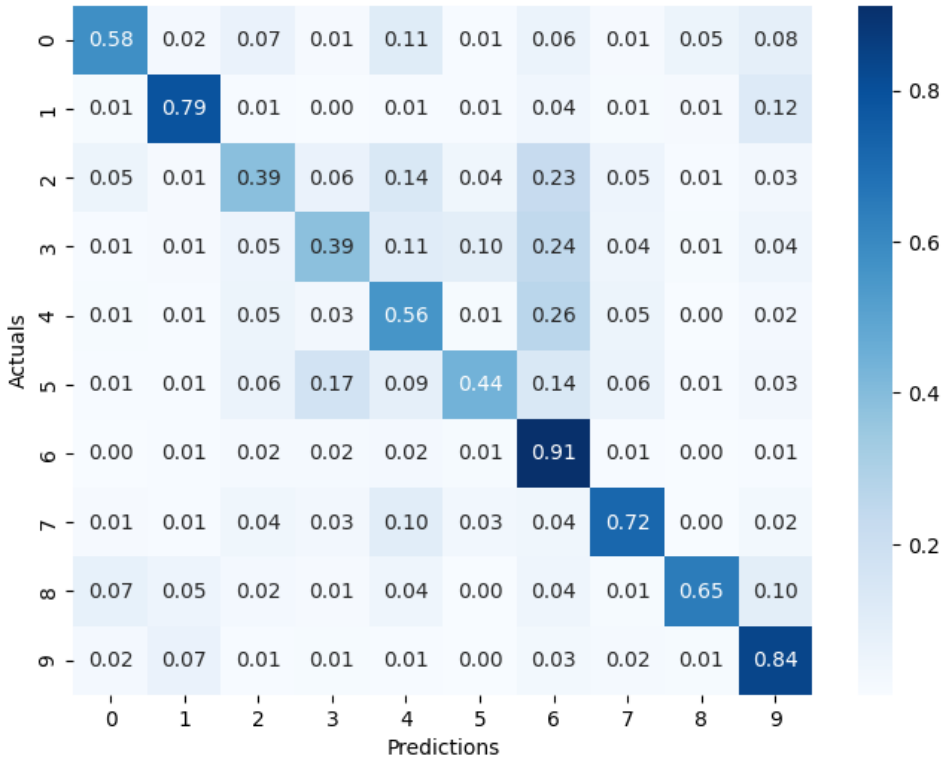

Loss over Epochs (ReLU)
Training Loss
Val Loss
Loss
Epoch
Accuracy over Epochs (ReLU)
Training Accuracy
Val Accuracy
Accuracy
Epoch

Confusion Matrix









Accuracy Observations:

Activation Function	Learning Rate	Eapocs	Accuracy on Train Set	Accuracy on Test Set	Accuracy on the hidden test dataset
Sigmoid	0.001	25	79%	66%	59%
ReLU	0.0001	17	92%	73%	62%

Takeaways:

- 0.1 Learning rate is too high; model is essentially guessing while 0.0005 learning rate is too slow.

- 0.001 seems appropriate learning rate for Sigmoid activation function and 0.0001 for ReLU activation function

- For Test accuracy, 17-25 epochs of training is best; however train accuracy is greatest for 17 and 25 epochs (possibly due to overfitting).

- ReLU activation works better than Sigmoid Activation for the specified task