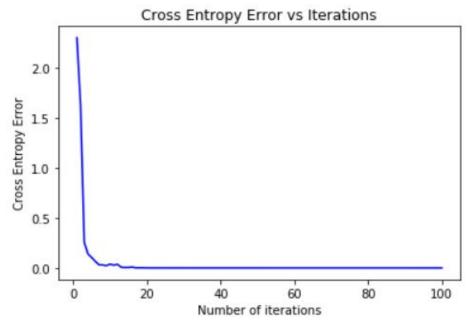
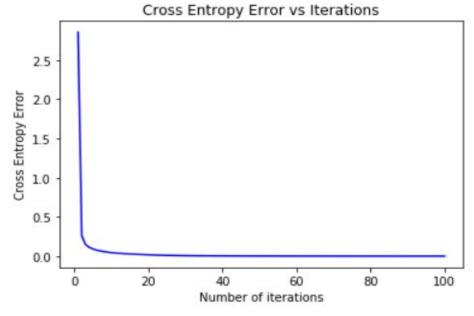
ML Assignment 3

Question 1

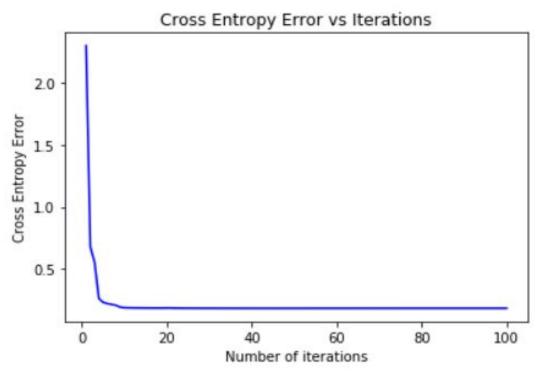
1.1.1 Accuracy of ReLU on implemented Neural Net: 98.06



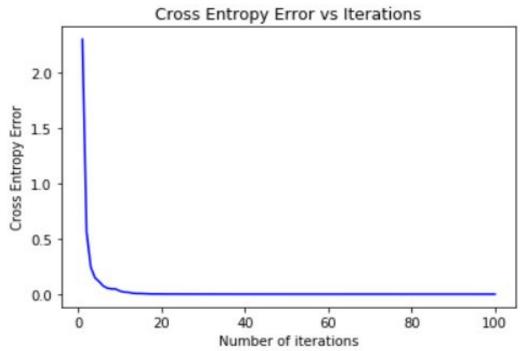
1.1.2 Accuracy of Sigmoid on implemented Neural Net: 97.94



1.1.3 Accuracy of Linear on implemented Neural Net: 90.31



1.1.4 Accuracy of tanh on implemented Neural Net: 97.96



Accuracy of ReLU on inbuilt Neural Net: 97.88 Accuracy of Sigmoid on inbuilt Neural Net: 97.22 Accuracy of Linear on inbuilt Neural Net: 92.08 Accuracy of tanh on inbuilt Neural Net: 97.19

The difference between accuracies of implemented MLP and sklearn's MLP is not much. sklearn's MLP performs quite better as compared to implemented MLP.

Question 2

2.1.1

Accuracy on Train Set: 81.94493865966797 Accuracy on Test Set: 86.11997985839844

Accuracy on Train Set: 87.71170043945312 Accuracy on Test Set: 87.5300064086914

Accuracy on Train Set: 88.876708984375 Accuracy on Test Set: 88.57002258300781

Accuracy on Train Set: 89.59341430664062 Accuracy on Test Set: 88.72998809814453

Accuracy on Train Set: 90.17842102050781 Accuracy on Test Set: 88.62998962402344

Accuracy on Train Set: 90.4217300415039 Accuracy on Test Set: 88.77999114990234

Accuracy on Train Set: 90.80677032470703 Accuracy on Test Set: 89.6100082397461

Accuracy on Train Set: 91.05675506591797

Accuracy on Test Set: 89.0899887084961

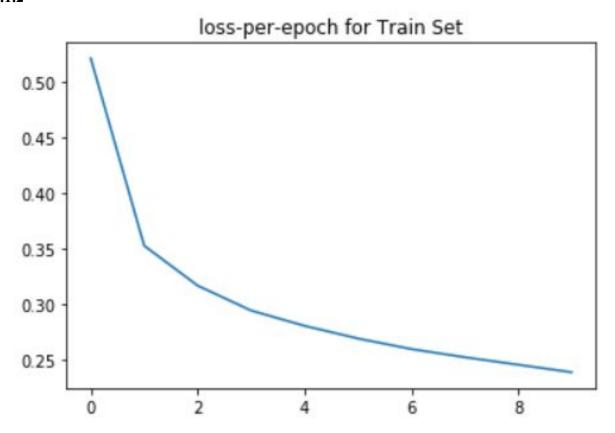
Accuracy on Train Set: 91.2267837524414 Accuracy on Test Set: 89.98002624511719

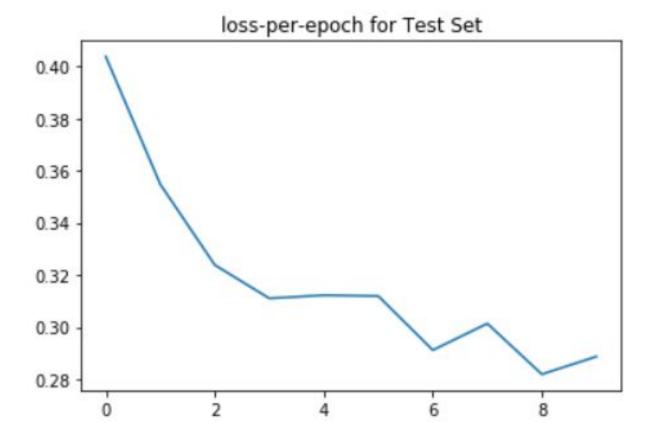
Accuracy on Train Set: 91.47005462646484 Accuracy on Test Set: 89.88999938964844

For SVM, we have considered "RBF" kernel with gamma= "scale" and, probability= "True". For CNN, we have considered a total of 4 layers: Convolutional, ReLU, Max-Pooling and Fully connected Layers.

- Conv2d(1,20,kernel size=(3,3),stride=1)
- MaxPool2d(kernel_size=(3,3),stride=2))
- self.fc_layer=nn.Linear(12*12*20,10)

2.1.2





2.2.1Accuracy of SVM Kernelized CNN on testing Set: 90.47

Accuracy of SVM Kernelized CNN on training Set: 92.7166666666666

Confusion Matrix of Test set:

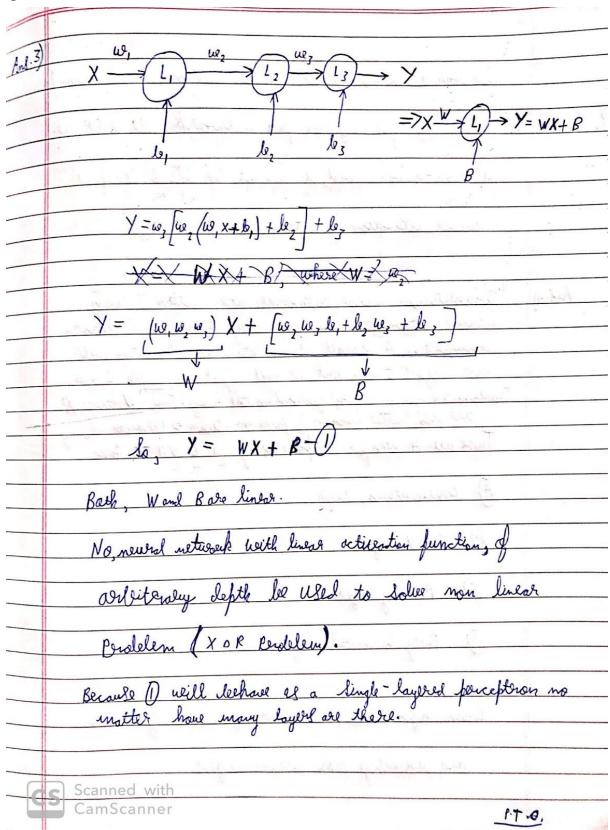
```
[[888, 0, 12, 22, 6, 0, 63, 0, 9, 0],
[ 2, 970, 1, 17, 5, 0, 4, 0, 1, 0],
[ 14, 0, 849, 10, 65, 0, 61, 0, 1, 0],
[ 18, 5, 8, 929, 21, 0, 19, 0, 0, 0],
[ 2, 1, 48, 29, 872, 0, 47, 0, 1, 0],
[ 0, 0, 0, 1, 0, 977, 0, 15, 0, 7],
[ 144, 3, 68, 26, 72, 0, 678, 0, 9, 0],
[ 0, 0, 0, 0, 0, 9, 0, 970, 0, 21],
[ 1, 1, 1, 4, 2, 1, 8, 4, 978, 0],
[ 1, 0, 0, 0, 0, 5, 0, 30, 0, 964]]
```

Confusion Matrix of train set:

```
[[5367, 3, 70, 103, 13, 0, 427, 0, 17, 0],
        [ 5, 5921, 2, 59, 4, 0, 6, 0, 3, 0],
        [ 87, 2, 5217, 38, 370, 0, 281, 0, 5, 0],
        [ 91, 11, 19, 5647, 130, 0, 97, 0, 5, 0],
        [ 7, 7, 259, 137, 5311, 0, 274, 0, 5, 0],
        [ 0, 0, 0, 0, 0, 5918, 0, 53, 6, 23],
        [ 639, 5, 356, 112, 320, 1, 4544, 0, 23, 0],
        [ 0, 0, 0, 0, 0, 32, 0, 5864, 6, 98],
        [ 10, 4, 6, 9, 12, 6, 24, 5, 5923, 1],
        [ 0, 0, 0, 0, 1, 12, 0, 126, 1, 5860]]
```

2.3

From the accuracy reports and loss-per-epoch plots, we can clearly see that the accuracy of kernelized SVM is quite good as compared to Convolutional Neural Network. This is because of the fact that the convolutional neural network has already done the job if feature extraction and SVM simply classified the images.



Question	1
Question	4

This way a constitute layer Newial Notwork well described into a lingle layered few network. As xor is a mon-liner male, it can not be tabled whing a linear activation function. The consolutional Neural Networks are better than neural networks because they (KNN) and more neural networks because they (KNN) and more not affect (KNN). But it will affect the links Neural Touristional No year to load fraterist in the image. Tay 1 Notwork. There are 4 anajor compliments of a CNN > are (a) Consolutional layer. (b) Fooling Layer. (c) Pooling Layer. (d) Consolutional layer. (e) Pooling Layer. (f) Consolutional layer. (g) Fooling Layer. (e) Pooling Layer. (f) Consolutional layer. (g) Scanned with a secondary over other layers.	<u> </u>	4
into a lingle layered per network. As XOR is a mon-linear model, it can not be solved along a linear activation function. Investigation of Neural Networks are letter than neural networks because they (KNN) and more robust. A limit townstation or rotation will not affect (NN. But it will affect the limple Neural Tenditional NN guident the local features in the image. Tray Notucork. are also letter locality of force countrivity = Parameter shoring. Those are 4 snajor components of a CNN > size. (C) Pooling Layer. (D) Ently Connected layer. (Each layer has it's oven functionality weeds and alreading over other layers.		
into a lingle layered per network. As XOR is a mon-linear model, it can not be solved along a linear activation function. Investigation of Neural Networks are letter than neural networks because they (KNN) and more robust. A limit townstation or rotation will not affect (NN. But it will affect the limple Neural Tenditional NN guident the local features in the image. Tray Notucork. are also letter locality of force countrivity = Parameter shoring. Those are 4 snajor components of a CNN > size. (C) Pooling Layer. (D) Ently Connected layer. (Each layer has it's oven functionality weeds and alreading over other layers.		This way a multiple layer Neweral Notwork well decompose
a mon-liner model, it can mode be solved using a linear activation function. Ant.y) Convolutional Neural Networks are better than neural networks because they (CNN) are more robered. A limit toward affect the limite Neural Textesional NN ignores the local features in the image. Tray [Notwoork. are also better because of spone connectivity >> Parameter shoring. There are 4 anajor components of a CNN > are B Re LV Layer. C Pooling Layer. C Pooling Layer. Each layer has it's own functionality, weels and alreadings over other layers.	8 47V	into a lingle loyered per network. As XOR is
And y Consolutional Neural Networks are leather than neural networks belowl they (CNN) are more Prolenet. A Simil tennelation or instation will not appeal CNN. But it will appeal the lumple Neural Tenditional NN ignored the local flatures in the image. Trey Noticear B. are also leater because of spene counciliaty > parameter sharing. There are 4 snajor components of a CNN > are (A) Consolutional layer. (B) Re LV Layer. (C) Pooling Layer. (D) Eully Connected layer. Each layer had it's oven functionality meds and alreatage over other layers.		a mon-liwer model, it can not be solved using a
neural networks Islands they (CNN) are more released. A Small termilation or Instation will not affect CNN. But it will offect the limple Neural Tenditional NN I grown the local features in the image. Trey Notuces of . are also letter because of spens cometricity = Parameter shoring. These are 4 anajor components of a CNN -> save. (a) Conscolutional, layer. (b) Re LV Layer. (c) Pooling Layer. (d) Early Connected layer. (e) Early Connected layer. (e) Early Connected layer.		linear activation function.
neural networks Islands they (CNN) are more released. A Small termilation or Instation will not affect CNN. But it will offect the limple Neural Tenditional NN I grown the local features in the image. Trey Notuces of . are also letter because of spens cometricity = Parameter shoring. These are 4 anajor components of a CNN -> save. (a) Conscolutional, layer. (b) Re LV Layer. (c) Pooling Layer. (d) Early Connected layer. (e) Early Connected layer. (e) Early Connected layer.		THE THE STATE OF A A AND A THE ME
neural networks Islands they (CNN) are more released. A Small termilation or Instation will not affect CNN. But it will offect the limple Neural Tenditional NN I grown the local features in the image. Trey Notuces of . are also letter because of spens cometricity = Parameter shoring. These are 4 anajor components of a CNN -> save. (a) Conscolutional, layer. (b) Re LV Layer. (c) Pooling Layer. (d) Early Connected layer. (e) Early Connected layer. (e) Early Connected layer.	Aus. 4)	Consolutional Neural Networks are letter than
Deally Connected layer. Deally Connected layer. Each layer has it's over functionality needs and alleways over other layer.		neural networks believed they (CNN) are more
Tenditional NN grows the load features in the image. Twey Notucor &. are also letter because of spane connectivity > Parameter shoring. There are 4 anajor components of a c NN > one (A) Consedertional layer. (B) Re LV layer. (C) Pooling Layer. (D) Eully Connected layer. (E) Each layer has it's oven functionality, needs and alreading over other layer.		Indeust. A Small termilation or Instation will
Tenditional NN ignory the local flatured in the image. They Notuce of a see also lecter because of flower connectivity =) Parameter shoring. These are 4 smajor components of a CNN > see (A) Conscolutional layer. (B) Re LV Layer. (C) Pooling Layer. (D) Early Connected layer. Early Connected layer. Early Layer had it's over functionality, weeks and advantage over other layers.		not appet CNN. But it will affect the limber Newson
B Re LV Layer. © Pooling Layer. D Ently Connected layer. Each layer has it's oven functionality, needs and alreadage over other layer.		Topolitional NN ignores the local flatures in the image. They Notnear &.
B Re LV Layer. © Pooling Layer. D Ently Connected layer. Each layer has it's oven functionality, needs and alreadage over other layer.		are also letter because of spone connecticity => Parameter Shair
B Re LV Layer. (C) Pooling Layer. (D) Eully Connected layer. Each layer has it's over functionality, weeds and alreading over other layers.		These are 4 anajor components of a CNN -> one
D Euly Connected layer. Each layer has it's own functionality, weels and alreading over other layer.		(A) Conseolytional layer.
Earl layer has it's over functionality, needs and alreadage over other layers.		B. Re LV Loyer. & Rock Star greater lover of
Earl layer has it's over functionality, weeds and alreadage over other layers.	30 3	6 Pooling Layer.
Earl layer has it's over functionality, weeds and alreadage over other layers.		D Eully Connected layer.
and alcourtage own other layers.	s 436 x3	Beray 17 sall listant of a lines " anger access
Lamscanner Lamscanner	CS	
		CamScanner

A	Consolutional Layer - Cerforums convolution operation to / we flatere clectors and the Kernel or mark. This layer is important leexande it is only leased on local patterns to maintain a small number of network parameters.
	electors and the Kennel or much The land !
	important because it is only leaded on local bitterns
	to maintain a small number of network parameters.
-	9 - 33 1 3
B	Rectified Linear Unit - It is an activation layer. Trip layer
	I important because it persparate oradient without
	Indusing their magnitudes (unlike other activation form).
	Rectified Linear Unit - It is an activation layer. This layer is important because it peropagate genadient without beducing their magnitudes (unlike other activation fx"). This layer is helful in a network with multiple layers.
(6)	Pooling Layer - It Sulesamples the feature of the
	previous layer. It busically does
	down sampling of the features. Tris is useful
	in older to reduce the complexity of the networkas
	il captures more complex patterns. There can be a
	Pooling Layer - It bulesamples the features of the previous layer. It basically dolf down sampling of the features. Tris is useful in conder to reduce the complexity of the networkal is captures more complex patterns. There can be a max-pooling, min-fooling etc, depending upon the problem.
	Eully connected Layer - These are usually last layer in a CNN.
	Their output is feed into the softmax layer,
	Eully connected Layer - These are usually last layer in CNV. Their output is feed into the softmax layer, where higest value is selected as the final
C	Scanned with . CamScandicision.

Question 5