SOFTMAX CLASSIFIER USING TENSOR FLOW ON MNIST DATA

Information about data:

```
-> The dataset inbuilt in Tensor Flow and also available in Kaggle

-> The dataset contains of hand written digits and their
corresponding class labels
```

Objective:

```
-> Getting started with the Tensor Flow, to get some hands on practi
se

-> To implement Tensor Flow toolkit on the MNIST dataset

-> To understand the functionality of each observation

-> Training the Neural nets and to check the loss with each Epoch
```

-> Importing the required Libraries

-> Importing data set

In [62]:

```python
from tensorflow.examples.tutorials.mnist import input_data
data = input_data.read_data_sets("MNIST_data/",one_hot=True)
```

```
Extracting MNIST_data/train-images-idx3-ubyte.gz
Extracting MNIST_data/train-labels-idx1-ubyte.gz
Extracting MNIST_data/t10k-images-idx3-ubyte.gz
Extracting MNIST_data/t10k-labels-idx1-ubyte.gz
```

Train and Test Data Shape

In [63]:

```python
print(data.train.images.shape)
print(data.test.images.shape)
print(data.train.labels.shape)
print(data.test.labels.shape)
```

```
(55000, 784)
(10000, 784)
(55000, 10)
(10000, 10)
```

In [64]:

```python
print('The number of data point in training are:',data.train.images.shape[0
],"and number of features for each data point are",data.train.images.shape[
1])
print('The number of data point to test  are:',data.test.images.shape[0],"a
nd number of features for each data point are",data.test.images.shape[1])
```

```
The number of data point in training are: 55000 and number of features for
each data point are 784
The number of data point to test  are: 10000 and number of features for eac
h data point are 784
```

In [65]:

```
print("The shape of the class labels in the train and test dataset after ap
pling One Hot Encoding on the class labels")
print("The number of class labels in training are:",data.train.labels.shape
[0],"and each class label is of:",data.train.labels.shape[1],"dimensions")
print("The number of class labels in training are:",data.test.labels.shape[
0],"and each class label is of:",data.test.labels.shape[1],"dimensions")
```

```
The shape of the class labels in the train and test dataset after appling O
ne Hot Encoding on the class labels
The number of class labels in training are: 55000 and each class label is o
f: 10 dimensions
The number of class labels in training are: 10000 and each class label is o
f: 10 dimensions
```

To check the system requirements availble for Tensor Flow Operations

In [66]:

```
from tensorflow.python.client import device_lib
print(device_lib.list_local_devices())
```

```
[name: "/device:CPU:0"
device_type: "CPU"
memory_limit: 268435456
locality {
}
incarnation: 5524967967427380823
]
```

Placeholders and Variables

In [80]:

```
x = tf.placeholder(tf.float32, [None,784])
w = tf.Variable(tf.zeros([784,10]))
b = tf.Variable(tf.zeros([10]))
```

Predicted and the Actual Class labels

In [81]:

```
y_ = tf.placeholder(tf.float32, [None,10])
y = tf.nn.softmax(tf.matmul(x,w)+b)
```

-> Defining the loss function

-> Defining the Optimizer algorithm as Gradient Descent Optimizer

-> Defining the Optimizer algorithm as Gredient Descent Optimizer

In [82]:

```
entropy = tf.reduce_mean(-tf.reduce_sum(y_ * tf.log(y),reduction_indices=[1
]))
train_step = tf.train.GradientDescentOptimizer(0.03).minimize(entropy)
```

-> Starting the Session

-> Initializing the Variables

In [83]:

```
sess = tf.InteractiveSession()
tf.global_variables_initializer().run()
```

```
C:\Users\Anil Chowdary\Anaconda3\lib\site-
packages\tensorflow\python\client\session.py:1711: UserWarning: An interact
ive session is already active. This can cause out-of-memory errors in some
cases. You must explicitly call `InteractiveSession.close()` to release res
ources held by the other session(s).
  warnings.warn('An interactive session is already active. This can '
```

-> Implementing on subset of data which conatins 5000 data points

-> Creating batches of size 100

In [110]:

```
for _ in range(5000):
    batch_xs,batch_ys = data.train.next_batch(100)
    sess.run(train_step, feed_dict={x: batch_xs, y_: batch_ys})
```

In [111]:

```
prediction = tf.equal(tf.argmax(y,1),tf.argmax(y_,1))
accuracy = tf.reduce_mean(tf.cast(prediction,tf.float32))
print(sess.run(accuracy,feed_dict = {x:data.test.images,y_:data.test.labels
}))
```

```
0.9195
```

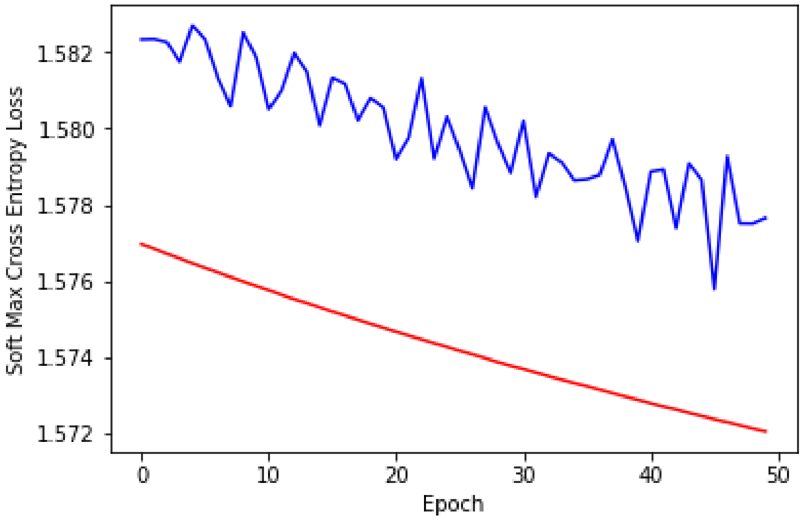
In [114]:

```
def dynamic_plot(x, y, y_1, ax, colors=['b']):
    ax.plot(x, y, 'b', label='Train loss')
    ax.plot(x, y_1, 'r', label='Test loss')
    if len(x)==1:
        plt.legend()
    fig.canvas.draw()
```

In [115]:

```
Number_of_epochs = 50
batch_size = 1000
display_step = 1
log_loss = tf.reduce_mean(tf.nn.softmax_cross_entropy_with_logits(logits =
y, labels = y_))
training = tf.train.GradientDescentOptimizer(0.03).minimize(log_loss)
training = tf.train.GradientDescentOptimizer(0.05).minimize(log_loss)
epchs,ytrainloss,ytestloss = [],[],[]
fig,ax = mp.subplots(1,1)
ax.set_xlabel('Epoch')
ax.set_ylabel("Soft Max Cross Entropy Loss")
for epoch in range(Number_of_epochs):
    training_loss = 0
    test_loss = 0
    number_of_batches = int(data.train.num_examples/batch_size)
    for i in range(number_of_batches):
        xs_batch,ys_batch = data.train.next_batch(batch_size)
        _,c=sess.run([training,log_loss], feed_dict={x: xs_batch, y_: ys_bat
ch})
        training_loss += c/number_of_batches
        c = sess.run(log_loss,feed_dict = {x:data.test.images,y_:data.test.l
abels})
        test_loss += c/number_of_batches
    epchs.append(epoch)
    ytrainloss.append(training_loss)
    ytestloss.append(test_loss)
dynamic_plot(epchs,ytrainloss,ytestloss,ax)
correct_prediction = tf.equal(tf.argmax(y,1),tf.argmax(y_,1))
accuracy = tf.reduce_mean(tf.cast(correct_prediction,tf.float32))
print("Accuracy:",accuracy.eval({x:data.test.images,y_:data.test.labels}))
```

```
Accuracy: 0.9202
```



CONCLUSION:

-> Have gone through different teminologies like Epochs, Batch size, Cross Entropy Loss, Optimizers

-> The accuracy with subset of 5000 points is 91.95

-> The accuracy on the whole data is 92.02