

# CS\_228\_DL\_HW\_1

April 22, 2023

## 0.0.1 Imports

```
[1]: import torch
import torchvision.datasets as datasets
import torchvision.transforms.functional as F
import torchvision.transforms as transforms
import matplotlib.pyplot as plt
plt.rcParams["figure.figsize"] = (5, 5)
import time
import pandas as pd
import math
```

## 0.0.2 Import and preprocess dataset

```
[2]: # Transform the images from PIL to tensor and normalize them
transform = transforms.Compose([
    transforms.ToTensor(),
    transforms.Normalize((0.5,), (0.5,))
])
```

```
[3]: # Download the Dataset
mnist_trainset = datasets.MNIST(root='./data', train = True, download= True,
    ↪transform=transform)
mnist_testset = datasets.MNIST(root='./data', train = False, download= True,
    ↪transform=transform)
print (len(mnist_trainset))
print (len(mnist_testset))
```

Downloading <http://yann.lecun.com/exdb/mnist/train-images-idx3-ubyte.gz>  
Downloading <http://yann.lecun.com/exdb/mnist/train-images-idx3-ubyte.gz> to  
./data/MNIST/raw/train-images-idx3-ubyte.gz

100%| | 9912422/9912422 [00:00<00:00, 401934582.16it/s]

Extracting ./data/MNIST/raw/train-images-idx3-ubyte.gz to ./data/MNIST/raw

Downloading <http://yann.lecun.com/exdb/mnist/train-labels-idx1-ubyte.gz>

Downloading <http://yann.lecun.com/exdb/mnist/train-labels-idx1-ubyte.gz> to  
./data/MNIST/raw/train-labels-idx1-ubyte.gz

100%| | 28881/28881 [00:00<00:00, 102051974.58it/s]

Extracting ./data/MNIST/raw/train-labels-idx1-ubyte.gz to ./data/MNIST/raw

Downloading <http://yann.lecun.com/exdb/mnist/t10k-images-idx3-ubyte.gz>

Downloading <http://yann.lecun.com/exdb/mnist/t10k-images-idx3-ubyte.gz> to  
./data/MNIST/raw/t10k-images-idx3-ubyte.gz

100%| | 1648877/1648877 [00:00<00:00, 163720737.57it/s]

Extracting ./data/MNIST/raw/t10k-images-idx3-ubyte.gz to ./data/MNIST/raw

Downloading <http://yann.lecun.com/exdb/mnist/t10k-labels-idx1-ubyte.gz>

Downloading <http://yann.lecun.com/exdb/mnist/t10k-labels-idx1-ubyte.gz> to  
./data/MNIST/raw/t10k-labels-idx1-ubyte.gz

100%| | 4542/4542 [00:00<00:00, 26793992.64it/s]

Extracting ./data/MNIST/raw/t10k-labels-idx1-ubyte.gz to ./data/MNIST/raw

60000

10000

```
[4]: # Visualize 1 sample
x = mnist_trainset
print ('length of dataset', len(x))

x = mnist_trainset[0][1]
print ('Label of first data sample', x)

x = mnist_trainset[0][0]

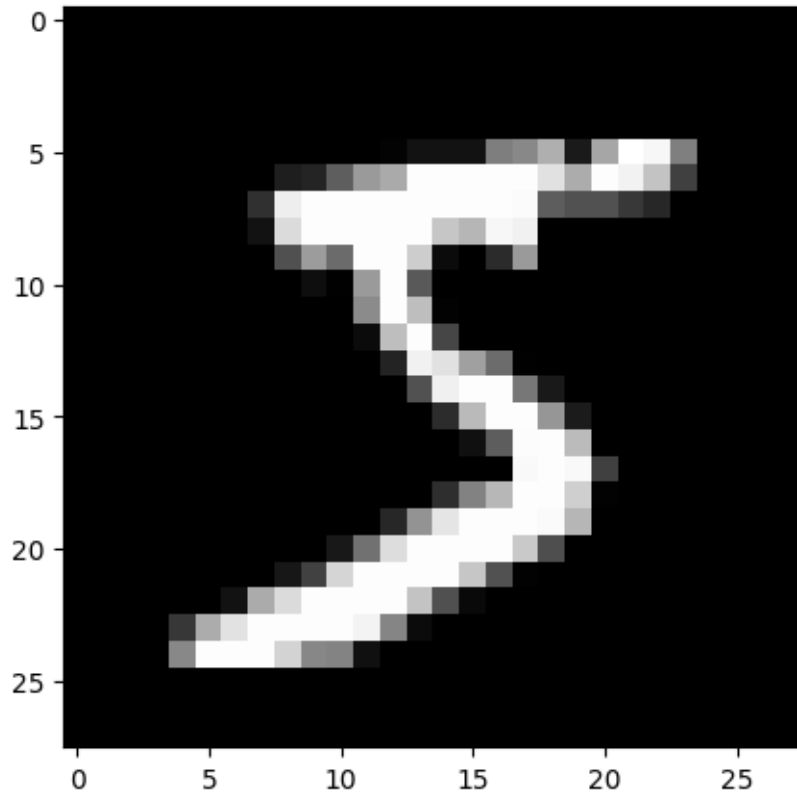
print ('visualize first data vector')
plt.imshow(x.squeeze(), cmap='gray')
```

length of dataset 60000

Label of first data sample 5

visualize first data vector

```
[4]: <matplotlib.image.AxesImage at 0x7fa0c3010700>
```



```
[5]: # Iterate over the train dataset to create x data matrix and y output vector of
      ↳ shapes n,784 and n,1 respectively
x_train = []
y_train = []

t0 = time.time()
for img, label in mnist_trainset:
    x_train.append(img.squeeze().view(-1))
    y_train.append(int(label))

t1 = time.time()

print ('time for train_Set', t1 - t0)
x_train = torch.stack(x_train, dim=0)
y_train = torch.Tensor(y_train)
```

time for train\_Set 27.307374715805054

```
[6]: # Iterate over the test dataset to create x data matrix and y output vector of
      ↳ shapes n,784 and n,1 respectively
x_test = []
```

```

y_test = []

t0 = time.time()

for img, label in mnist_testset:
    x_test.append(img.squeeze().view(-1))
    y_test.append(int(label))

t1 = time.time()

print ('time for test_Set', t1 - t0)
x_test = torch.stack(x_test, dim=0)
y_test = torch.Tensor(y_test)

```

time for test\_Set 2.8875644207000732

```
[7]: print (x_train.shape, y_train.shape, x_test.shape, y_test.shape)
```

torch.Size([60000, 784]) torch.Size([60000]) torch.Size([10000, 784])  
torch.Size([10000])

```
[8]: # function to convert y output vector of size n,1 to onhot vector of size n,10
def convert_to_one_hot(labels):
    unique = torch.unique(labels)
    onehot = torch.zeros((labels.shape[0], unique.shape[0]))
    onehot[torch.arange(labels.shape[0]), labels.int()] = 1.
    return onehot

```

```
[9]: # Visualize the onehot vector
y_test_one_hot = convert_to_one_hot(y_test)
print (y_test_one_hot.shape)

y_test[:10], y_test_one_hot[:10]

```

torch.Size([10000, 10])

```
[9]: (tensor([7., 2., 1., 0., 4., 1., 4., 9., 5., 9.]),
      tensor([[0., 0., 0., 0., 0., 0., 0., 0., 1., 0.],
              [0., 0., 1., 0., 0., 0., 0., 0., 0., 0.],
              [0., 1., 0., 0., 0., 0., 0., 0., 0., 0.],
              [1., 0., 0., 0., 0., 0., 0., 0., 0., 0.],
              [0., 0., 0., 0., 1., 0., 0., 0., 0., 0.],
              [0., 1., 0., 0., 0., 0., 0., 0., 0., 0.],
              [0., 0., 0., 0., 1., 0., 0., 0., 0., 0.],
              [0., 0., 0., 0., 0., 0., 0., 0., 0., 1.],
              [0., 0., 0., 0., 0., 1., 0., 0., 0., 0.],
              [0., 0., 0., 0., 0., 0., 0., 0., 0., 1.])))

```

### 0.0.3 SGD on Dataset

```
[10]: def accuracy(y_true, y_out_oh):
        return torch.sum(torch.argmax(y_out_oh, dim=1) == y_true)/y_true.shape[0]

def predict(X, w, b):
    return torch.matmul(X, w.T) + b

def loss(y_pred_oh, y_true_oh):
    return torch.sum(0.5*(y_pred_oh - y_true_oh)**2)/y_pred_oh.shape[0]

def plot_loss(loss_array):
    with torch.no_grad():
        plt.figure(1)
        plt.plot(torch.arange(0, len(loss_array)), loss_array)
        plt.title('Train Loss vs iters')
        plt.xlabel('iters')
        plt.ylabel('loss')
        plt.grid()
        plt.show()

def plot_accuracy(train_accuracy, test_accuracy):
    with torch.no_grad():
        plt.figure(2)
        plt.plot(torch.arange(0, len(train_accuracy)), train_accuracy,
        ↪label='train')
        plt.plot(torch.arange(0, len(test_accuracy)), test_accuracy,
        ↪label='test')
        plt.title('Accuracy vs iters')
        plt.xlabel('iters')
        plt.ylabel('Accuracy')
        plt.legend()
        plt.grid()
        plt.show()
```

```
[11]: # Linear classifier to predict correct labels for mnist dataset
        # Takes in input x_train, the input matrix of size, n,784, n = 60000 here
        # Takes in input y_train, the output vector of size, n,1, n = 60000 here
        # Takes in input y_train_oh, the one hot encoded output vector of size, n,10, n
        ↪= 60000 here

        # Takes in input x_test, the input matrix of size, n,784, n = 10000 here
        # Takes in input y_test_true, the output vector of size, n,1, n = 10000 here
        # Takes in input y_test_oh, the one hot encoded output vector of size, n,10, n
        ↪= 10000 here

        # lr is learning rate
        # n_iters is number of iterations
```

```

# batch_size is required for minibatch SGD
def linear_model(x_train, y_train_true, y_train_oh, x_test, y_test_true,
    y_test_oh, lr = 0.001, n_epochs=50, n_iters=100, batch_size = 4096,
    verbose=False):

    # create weights and bias matrix
    # weights has a shape of 10, 784
    # biases has a shape of 1,1

    input_dim = x_train.shape[1]
    output_dim = y_train_oh.shape[1]

    # weights and biases have been initialized as 0
    w = torch.zeros(output_dim, input_dim)
    b = torch.zeros(1,1)

    # store train loss, train accuracy and test accuracy
    loss_array = []
    train_accuracy_array = []
    test_accuracy_array = []

    for epoch in range(n_epochs):

        for iter in range(n_iters):
            # generate random indices from 0 - len(input vector), 60000 in this
            case,
            # generate a total of batch_size indices
            # indices are generated with replacement, so we can have multiple
            of same index
            random_batch_indices = torch.randint(x_train.shape[0], (batch_size,))

            # get y_pred that is one hot encoded
            # ypred = X.W + b
            out = predict(x_train[random_batch_indices], w, b)

            # calculate loss mse loss
            # loss = 1/2 * (ypred_oh - ytrue_oh)**2 / N
            l = loss(out, y_train_oh[random_batch_indices])

            # calculate gradients for weights and bias
            # dl/dw = ((ypred_oh - ytrue_oh).T).X / N
            w_grad = torch.matmul((out - y_train_oh[random_batch_indices]).T,
            x_train[random_batch_indices]) / out.shape[0]
            # dl/dw = sum(ypred_oh - ytrue_oh) / N
            b_grad = torch.sum(out - y_train_oh[random_batch_indices]) / out.
            shape[0]

```

```

        # update gradients
        w -= lr*w_grad
        b -= lr*b_grad

    # loss for entire dataset
    out = predict(x_train, w, b)
    l = loss(out, y_train_oh)
    loss_array.append(l.item())

    # train accuracy in entire dataset
    train_acc = accuracy(y_train_true, out)
    train_accuracy_array.append(train_acc.item())

    # test accuracy in entire dataset
    out_test = predict(x_test, w, b)
    test_acc = accuracy(y_test_true, out_test)
    test_accuracy_array.append(test_acc.item())

    # print stats if required
    if verbose and (epoch+1) % 10 == 0:
        print ('epoch = {}, train_loss = {}, train_acc = {}, test_acc = {}'.
        ↪format(epoch+1, l, train_acc, test_acc))

    # if loss is not defined due to poor lr selection, break the loop
    if l.item() == torch.inf or math.isnan(l.item()):
        print ('--- loss explodes ---')
        break

    return w, b, loss_array, train_accuracy_array, test_accuracy_array

# convert y to one hot encoded
y_train_oh = convert_to_one_hot(y_train)
y_test_oh = convert_to_one_hot(y_test)

w,b,loss_arr,train_acc, test_acc = linear_model(x_train, y_train,
↪y_train_oh,x_test, y_test, y_test_oh, verbose=True)

# plot graphs
plot_loss(loss_arr)
plot_accuracy(train_acc, test_acc)

```

```

epoch = 10, train_loss = 0.2119123786687851, train_acc = 0.8489500284194946,
test_acc = 0.857699990272522

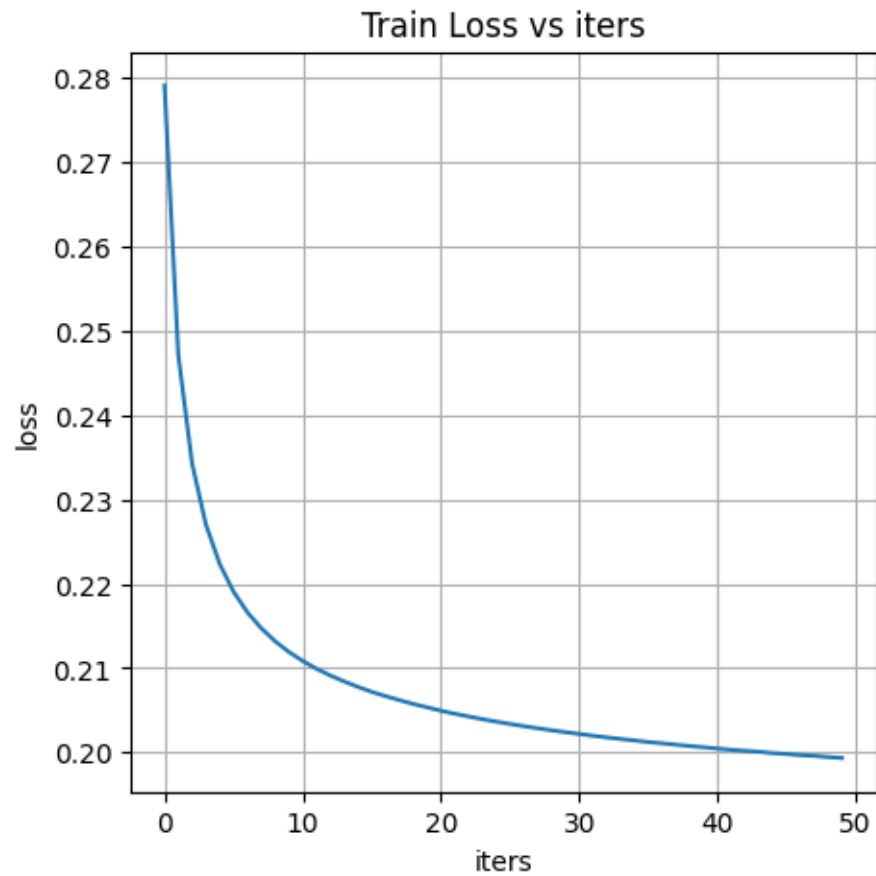
```

```

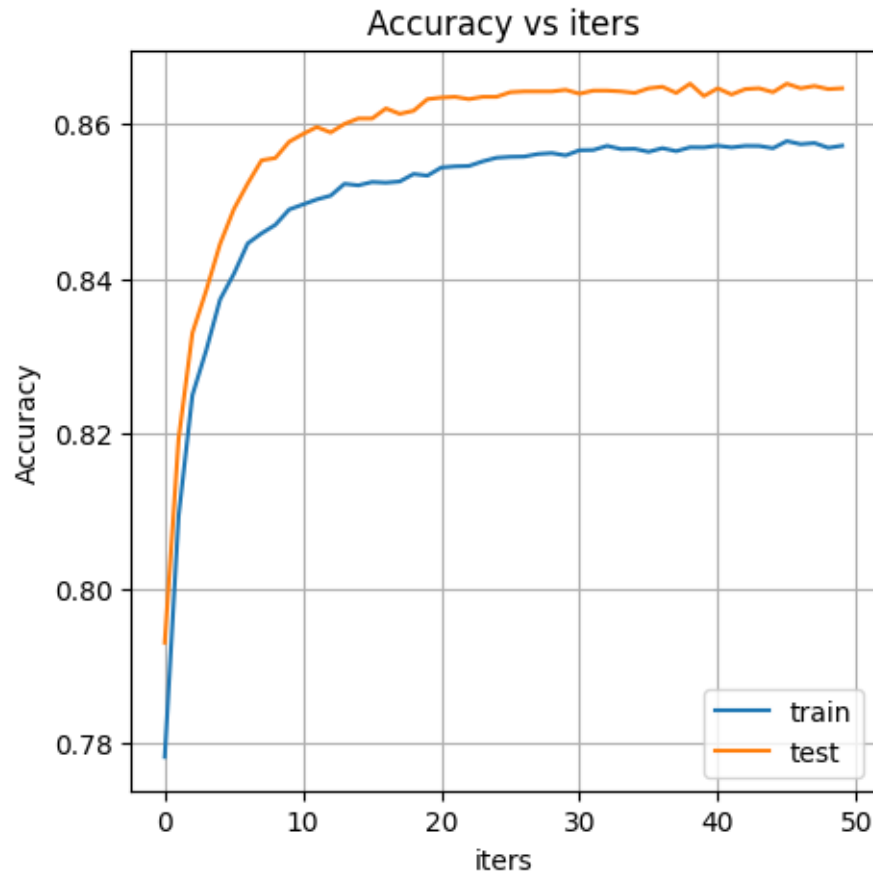
epoch = 20, train_loss = 0.20535032451152802, train_acc = 0.8533166646957397,

```

```
test_acc = 0.8632000088691711
epoch = 30, train_loss = 0.20240749418735504, train_acc = 0.8559333086013794,
test_acc = 0.8644000291824341
epoch = 40, train_loss = 0.2006262093782425, train_acc = 0.8569666743278503,
test_acc = 0.8636000156402588
epoch = 50, train_loss = 0.19934695959091187, train_acc = 0.8571833372116089,
test_acc = 0.8646000027656555
```







#### 0.0.4 Choice of Learning Rate

```
[12]: # # This takes approximately 3 hrs to run, it is used to find the best_
      ↳ combination of iterations for SGD, total epochs, batchsize and learning rate
      # # In case only the results need be validated, comment this part and move with_
      ↳ next section.
      # # store all the training data and stats to tabulate and compare later
      # summary_object = []

      # # test variety of batches and learning rates
      # for epoch in [20,40,60,80, 100]:
      #     for iter in [25,50,75,100]:
      #         for batch in [1,10,100,1000,10000]:
      #             for lr in [0.1,0.01,0.001,0.0001, 0.00001]:

      #                 print ()
      #                 print (' ----- ')
      #                 print ('epoch:{}, iter:{}, batchsize: {} and learning rate:_
      ↳ {}'.format(epoch, iter, batch, lr))
```

```

#                               # time before training start
#                               t0 = time.time()

#                               # convert y to one hot encoded
#                               y_train_oh = convert_to_one_hot(y_train)
#                               y_test_oh = convert_to_one_hot(y_test)
#                               w,b,train_loss, train_acc, test_acc = linear_model(x_train,
↪y_train, y_train_oh, x_test, y_test, y_test_oh, lr=lr, n_epochs= epoch,
↪n_iters=iter, batch_size=batch)

#                               # time after train end
#                               t1 = time.time()

#                               # plot graphs
#                               plot_loss(train_loss)
#                               plot_accuracy(train_acc, test_acc)

#                               temp_summary = {
#                               'epoch': epoch,
#                               'iter': iter,
#                               'batch_size': batch,
#                               'learning_rate': lr,
#                               'test_acc': max(test_acc),
#                               'train_acc': max(train_acc),
#                               'time': t1-t0
#                               }

#                               summary_object.append(temp_summary)

```

```

[13]: # # create dataframe of the generated data stats and compare results
# df = pd.DataFrame.from_records(summary_object)
# print('--- Effect of Learning_rate ---')
# print(df.sort_values(by=['learning_rate', 'batch_size']))
# print()
# print ('-----')
# print('--- Sort by accuracy ---')
# print(df.sort_values(by=['test_acc', 'train_acc']))
# df.to_csv('summary.csv')

```

```

[14]: # I have already run this once and results can be loaded from S3
from urllib import request
request.urlretrieve('https://d1u36hdvoy9y69.cloudfront.net/cs-228-intro-to-dl/
↪summary.csv', 'summary.csv')
df = pd.read_csv('summary.csv')
df

```

```
[14]: Unnamed: 0 epoch iter batch_size learning_rate test_acc train_acc \
0 0 20 25 1 0.10000 0.0980 0.098717
1 1 20 25 1 0.01000 0.1010 0.102183
2 2 20 25 1 0.00100 0.7194 0.712667
3 3 20 25 1 0.00010 0.6987 0.688800
4 4 20 25 1 0.00001 0.4759 0.458017
.. ...
495 495 100 100 10000 0.10000 0.0980 0.098717
496 496 100 100 10000 0.01000 0.0980 0.098717
497 497 100 100 10000 0.00100 0.8653 0.857700
498 498 100 100 10000 0.00010 0.8575 0.848650
499 499 100 100 10000 0.00001 0.7907 0.777867

time
0 0.300203
1 0.248212
2 2.121936
3 2.221480
4 2.596230
.. ...
495 4.171421
496 3.924819
497 368.458464
498 368.516162
499 368.411054

[500 rows x 8 columns]
```

From the above dataframe, we can see that the best learning rate is **0.001**

### 0.0.5 Role of batch Size

```
[15]: # create summary object to store stats
summary_objects = []

# fix the learning rate, n_iters and n_epochs as computed from experimentation
# above
learning_rate = 0.001
n_epoch = 40
n_iter = 100

# Test the variety of batch sizes
for batch in [1,10,100,1000,10000]:

    print ()
    print (' ----- ')
    print ('batch size: {} and learning rate: {}'.format(batch, learning_rate))
```

```

# time before train start
t0 = time.time()

# convert y to one hot encoded
y_train_oh = convert_to_one_hot(y_train)
y_test_oh = convert_to_one_hot(y_test)
w,b,train_loss, train_acc, test_acc = linear_model(x_train, y_train,
↪y_train_oh, x_test, y_test, y_test_oh, lr=learning_rate, n_epochs= n_epoch,
↪n_iters=n_iter, batch_size=batch)

# time after train end
t1 = time.time()

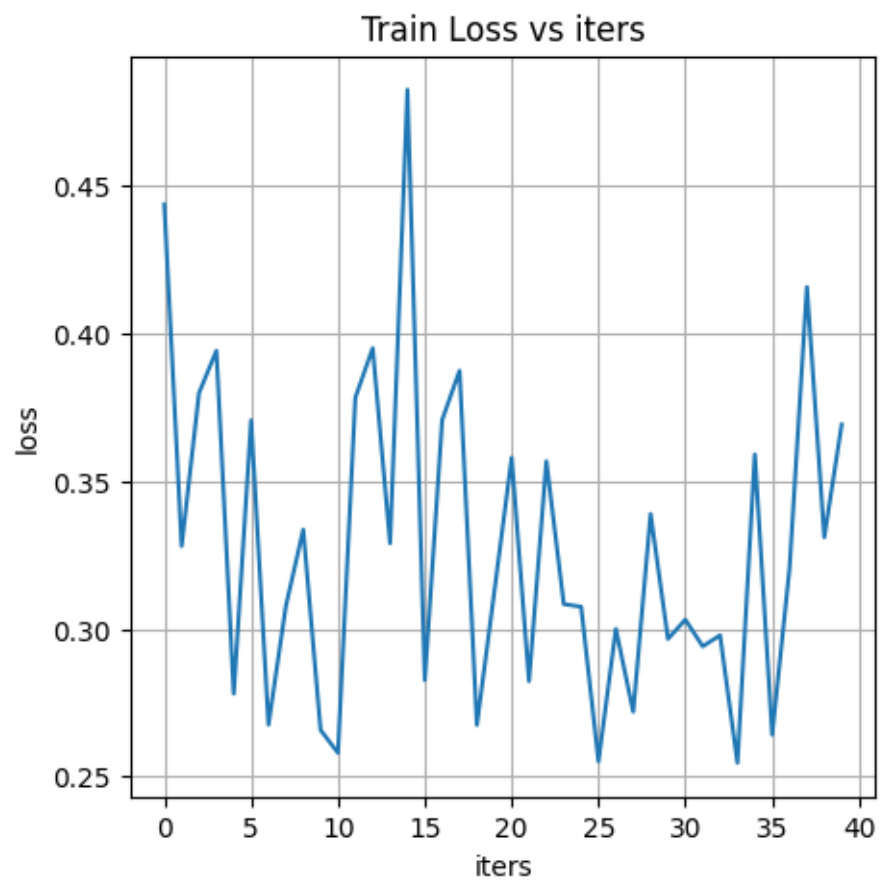
# plot graphs
plot_loss(train_loss)
plot_accuracy(train_acc, test_acc)

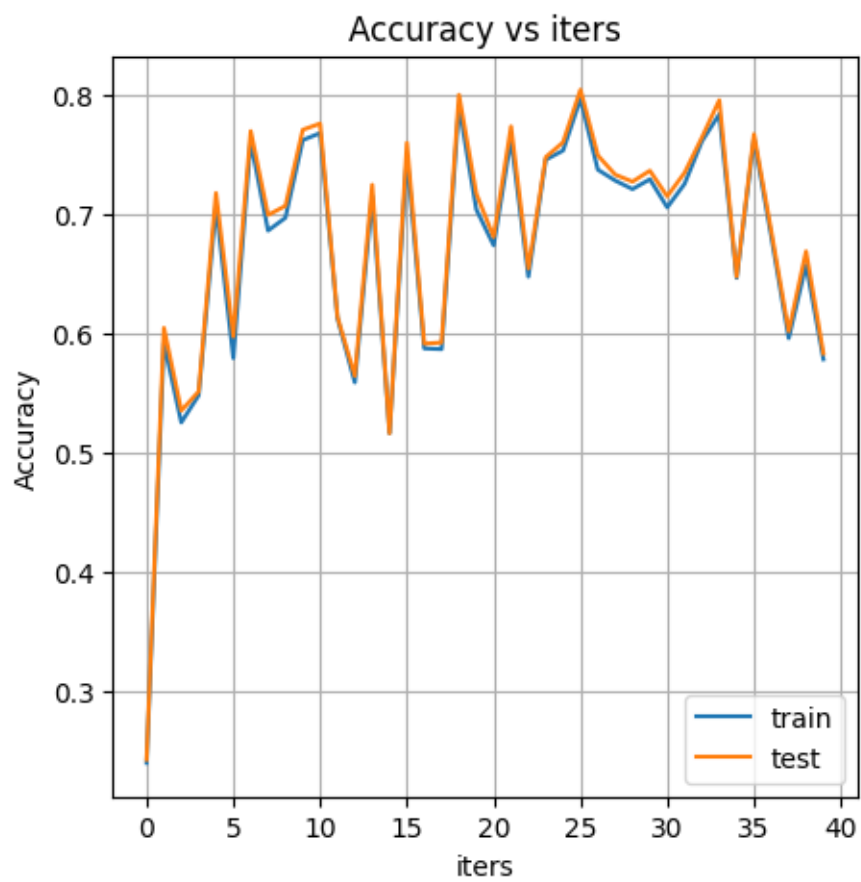
temp_summary = {
    'batch_size': batch,
    'learning_rate': learning_rate,
    'test_acc': max(test_acc),
    'train_acc': max(train_acc),
    'time': t1-t0
}

summary_objects.append(temp_summary)

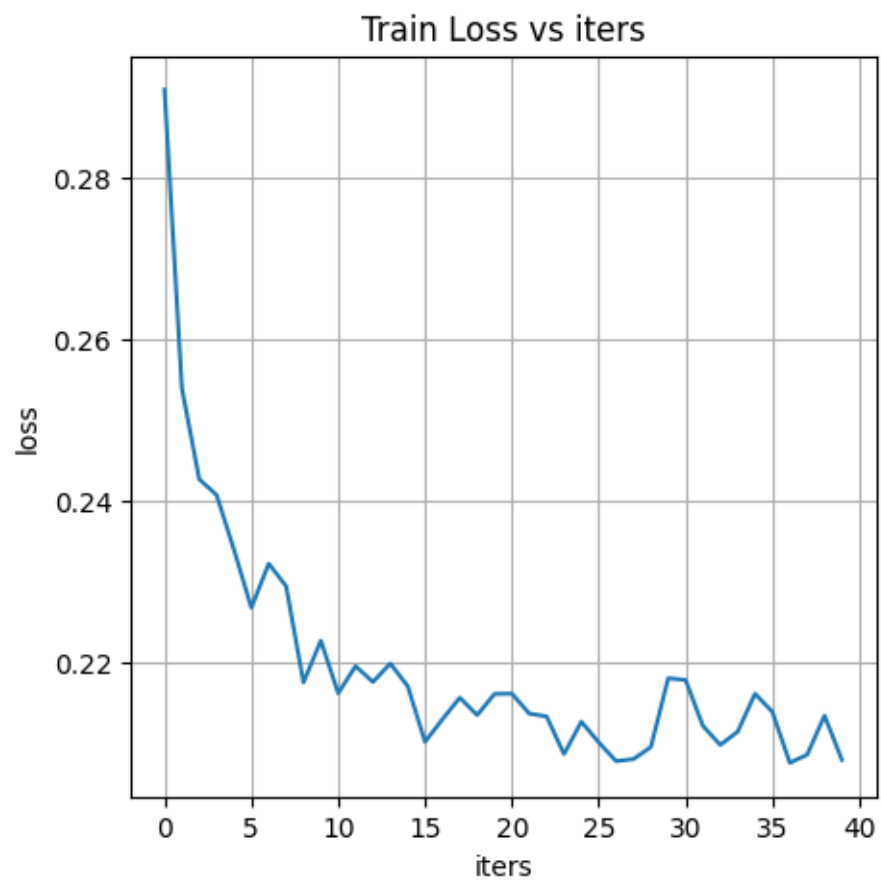
```

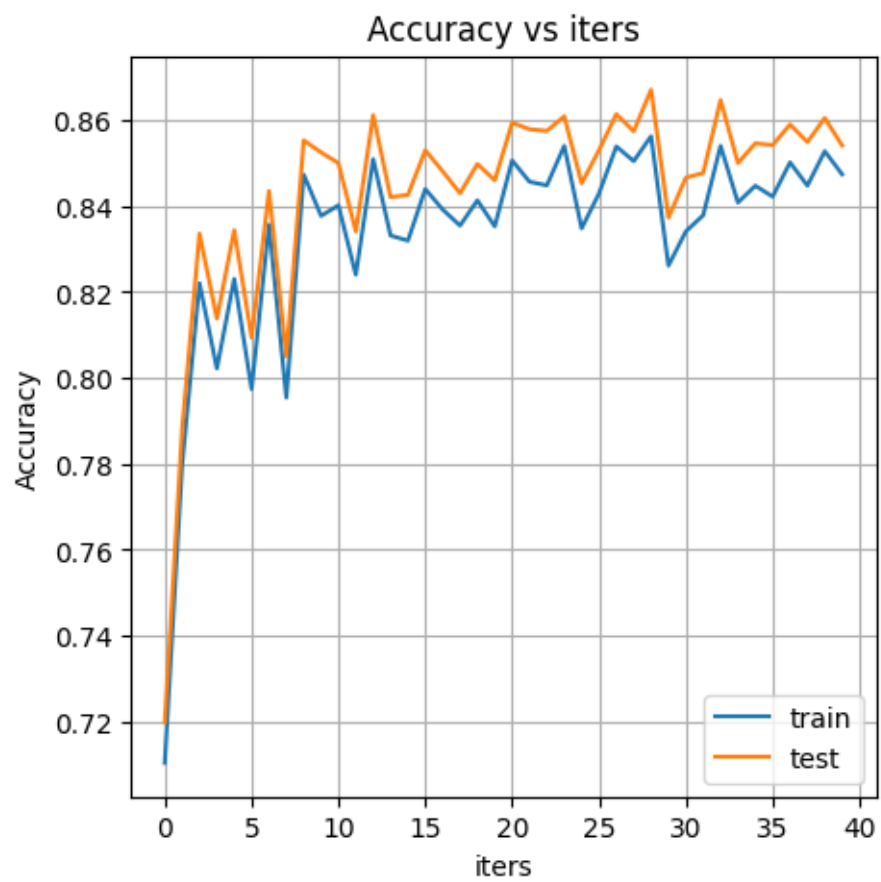
-----  
batch size: 1 and learning rate: 0.001





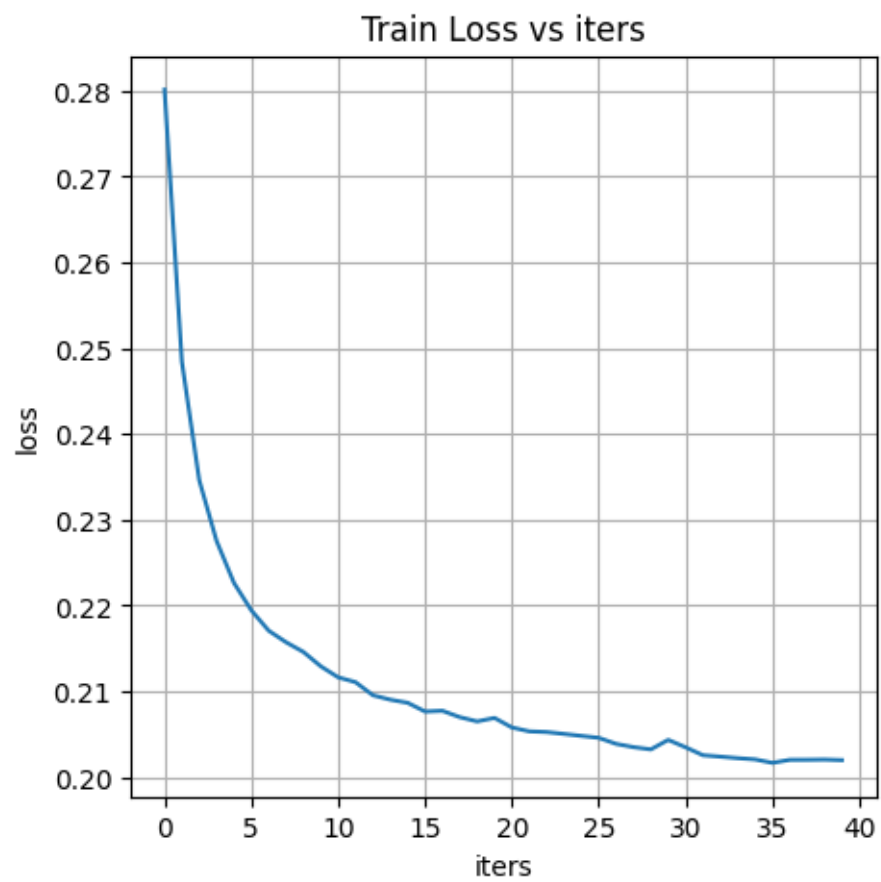
-----  
batch size: 10 and learning rate: 0.001

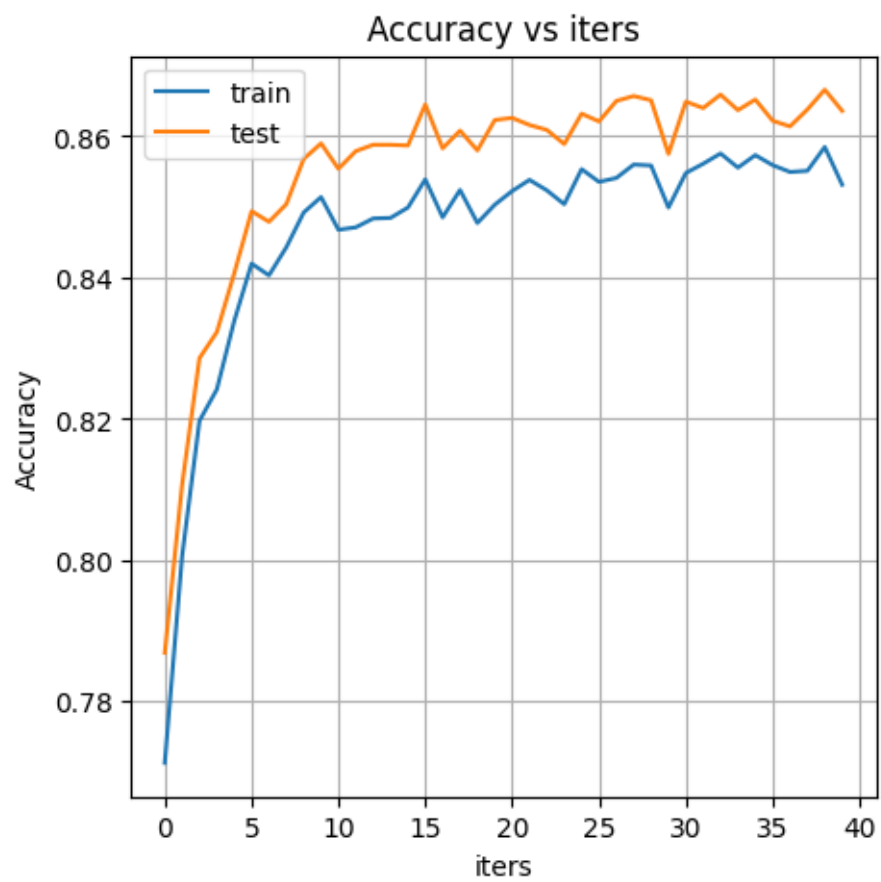




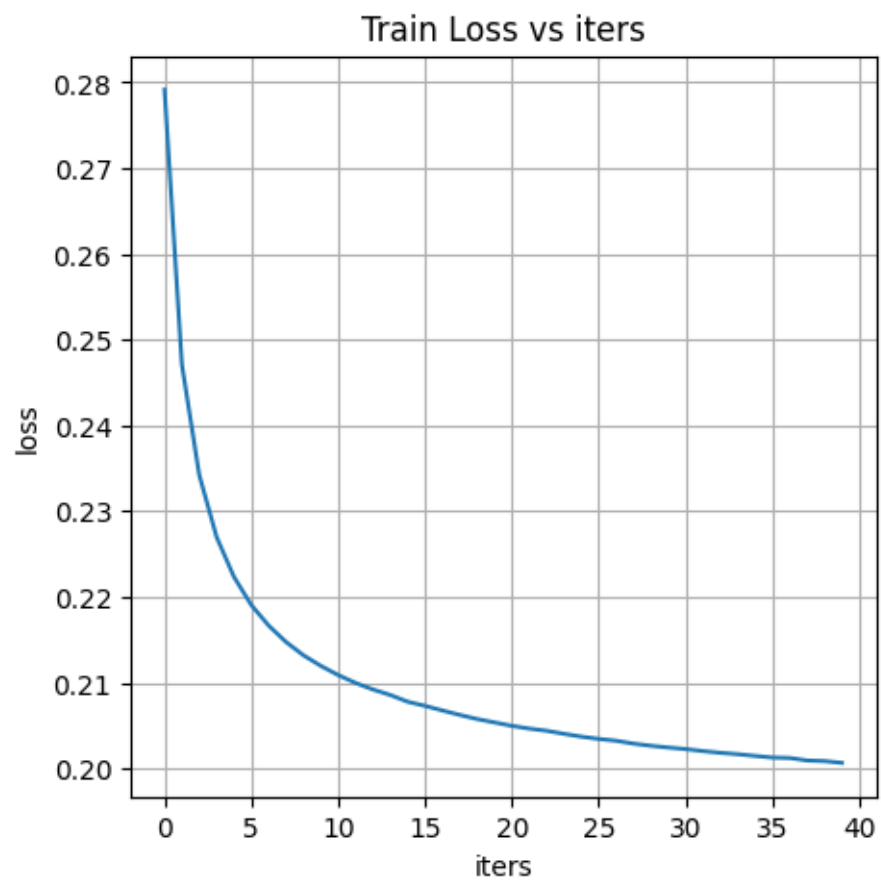
-----  
batch size: 100 and learning rate: 0.001

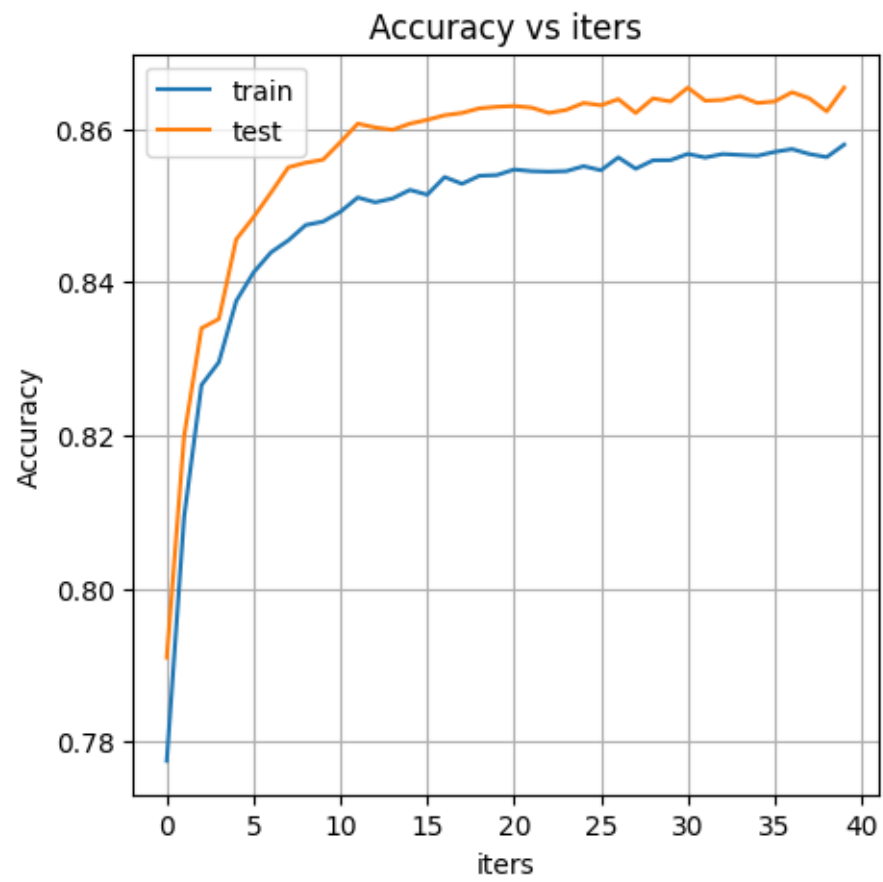




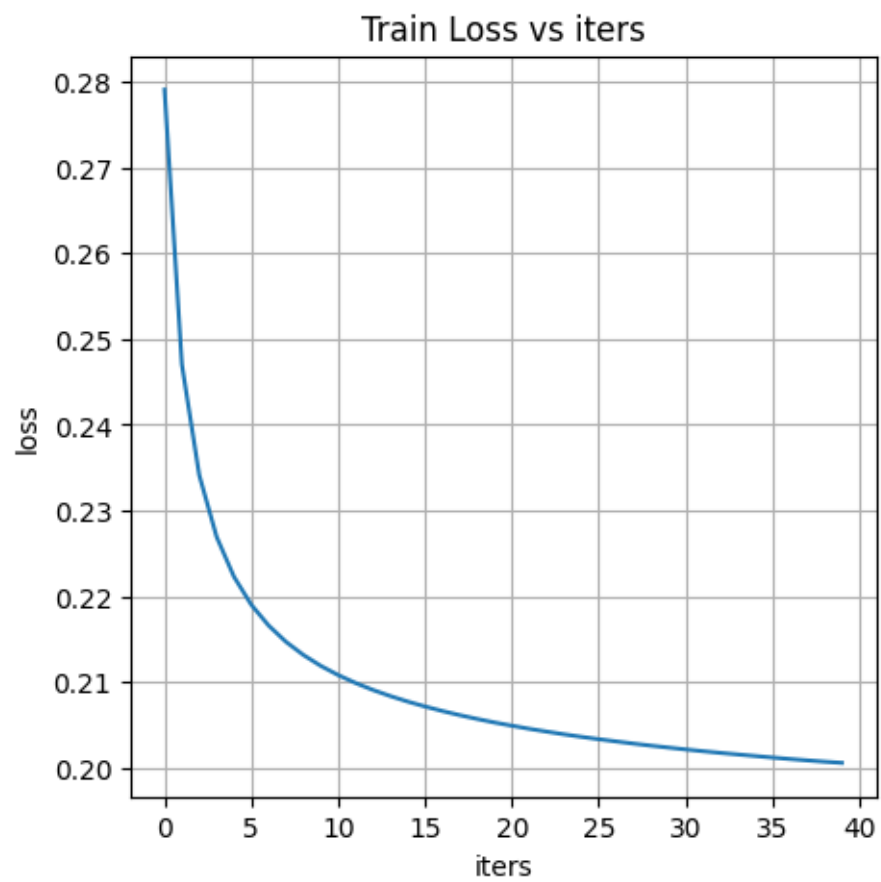


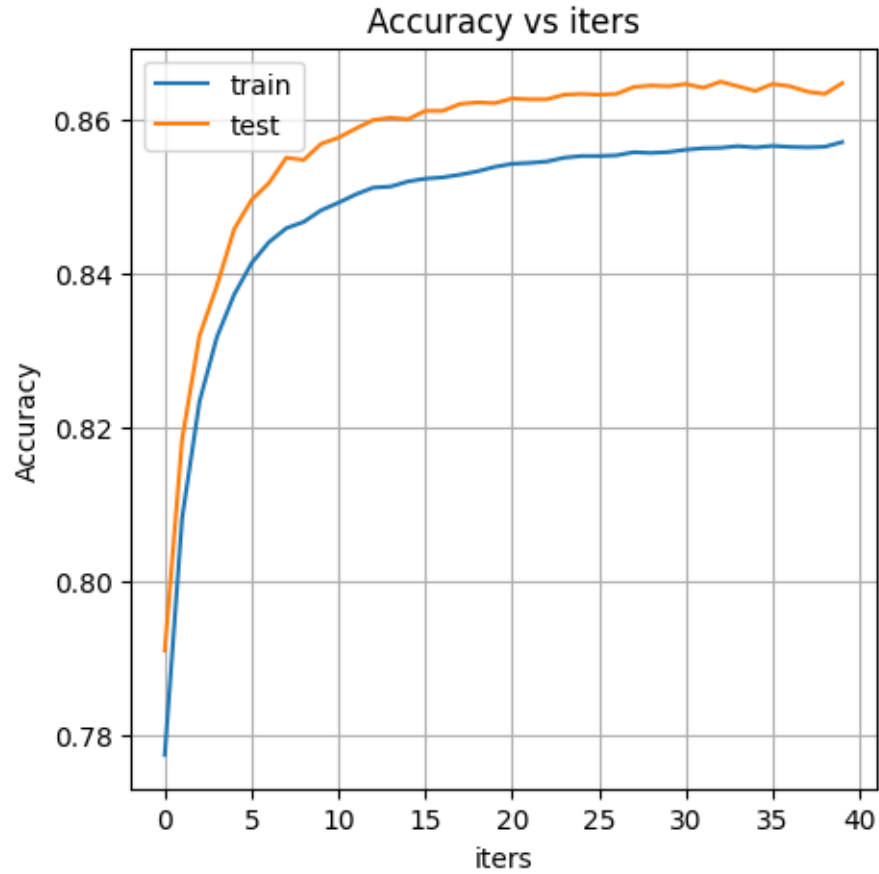
-----  
batch size: 1000 and learning rate: 0.001





-----  
batch size: 10000 and learning rate: 0.001





```
[16]: # create a dataframe from all the results as computed above
df = pd.DataFrame.from_records(summary_objects)
print (df)
```

	batch_size	learning_rate	test_acc	train_acc	time
0	1	0.001	0.8049	0.797250	2.622874
1	10	0.001	0.8671	0.856250	3.071779
2	100	0.001	0.8666	0.858483	3.449923
3	1000	0.001	0.8654	0.857967	10.710572
4	10000	0.001	0.8650	0.857133	98.582386

### Role of batch size.

As batch size increases the cost of computation and time taken for forward and backward pass increases. We can see the time being directly proportional to the batch size.

Also, as we increase the batch size, we are getting better train and test accuracy and this means that the model is able to generalize better and not overfit to the data.

However, even though the time and computation increases significantly for increase in batch size, the accuracy seems to be stagnating as a fixed level.

## 0.0.6 Role of Dataset Size

```
[17]: # create summary object to store stats
summary_object = []

# fix the learning rate, n_iters and n_epochs as computed from experimentation
↳above
learning_rate = 0.001
n_epoch = 40
n_iter = 100

# fix the batch size as provided in problem statement
batch_size = 100

# test for a variety of dataset sizes
for dataset_size in [100, 500, 1000, 10000]:

    print ()
    print (' ----- ')
    print ('batch size: {}, dataset size: {} and learning rate: {}'.
↳format(batch_size, dataset_size, learning_rate))

    # time before train start
    t0 = time.time()

    # convert y to one hot encoded
    y_train_oh = convert_to_one_hot(y_train)
    y_test_oh = convert_to_one_hot(y_test)

    # generate random indices from all the training samples (60000) and pick
↳the top XXX samples where XXX is dataset size.
    # This means generate random numbers from 0 to len(dataset) and pick
↳only required size so that we can have shuffled data without replacement
    # the random numbers are generated from normal distribution
    random_indices = torch.randperm(y_train_oh.shape[0])[:dataset_size]

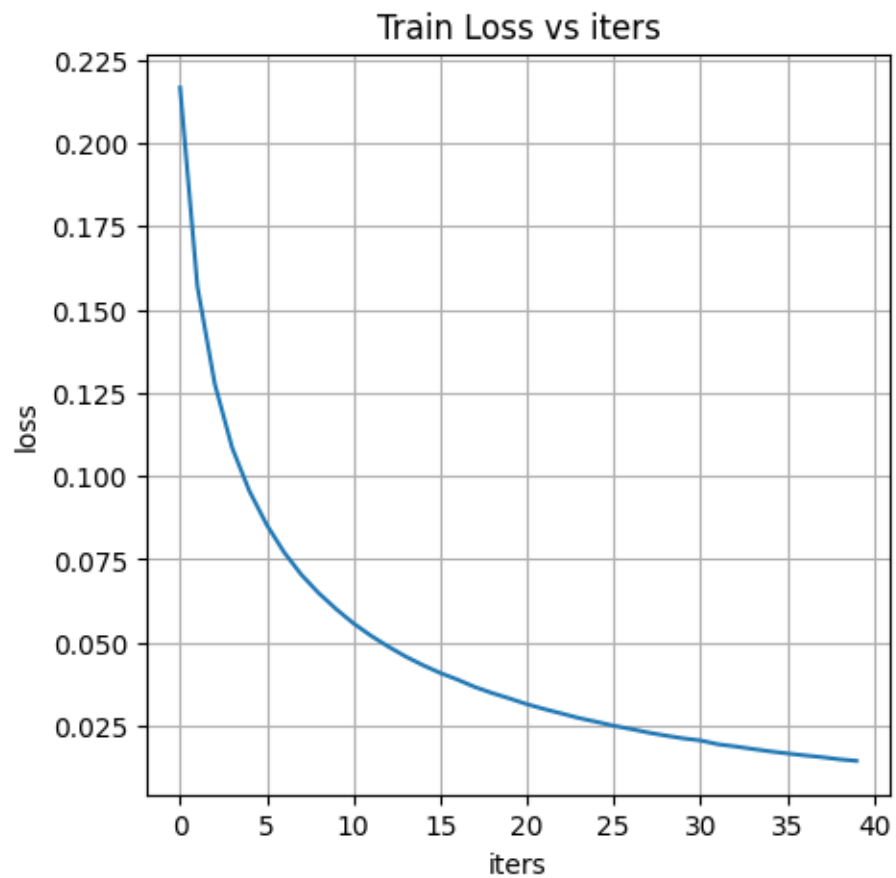
    w,b,train_loss, train_acc, test_acc = linear_model(x_train[random_indices],
↳y_train[random_indices], y_train_oh[random_indices], x_test, y_test,
↳y_test_oh, lr=learning_rate, n_epochs= n_epoch, n_iters=n_iter,
↳batch_size=batch_size)

    # time after train end
    t1 = time.time()

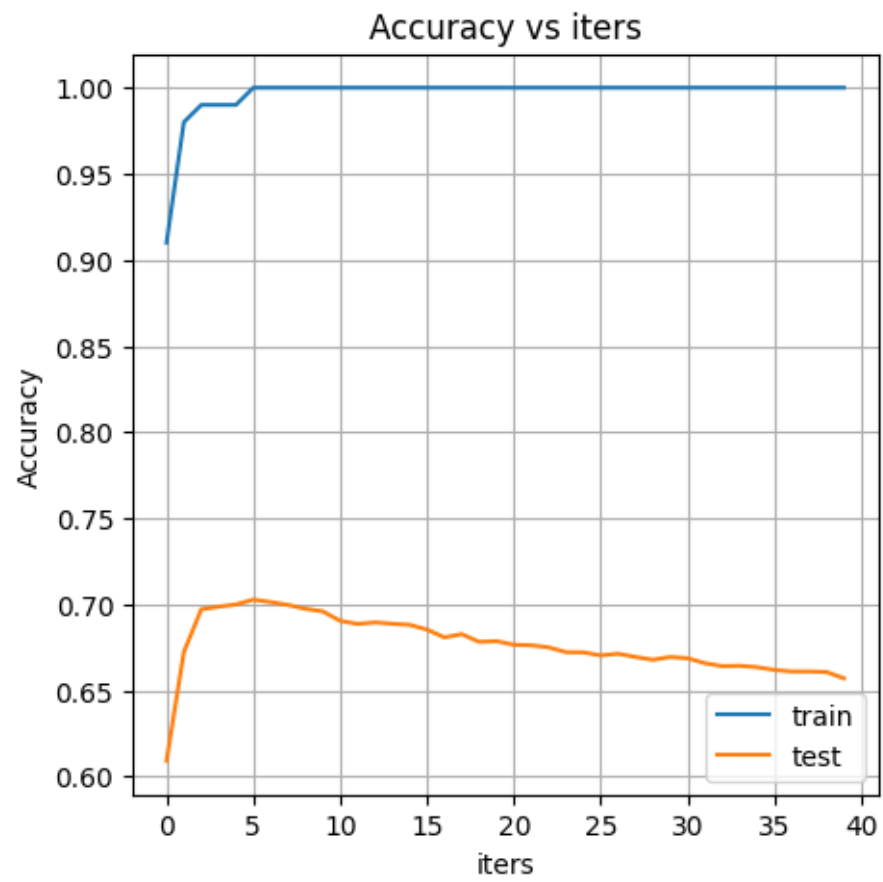
    # plot graphs
    plot_loss(train_loss)
    plot_accuracy(train_acc, test_acc)
```

```
temp_summary = {  
    'dataset_size': dataset_size,  
    'batch_size': batch_size,  
    'learning_rate': learning_rate,  
    'test_acc': max(test_acc),  
    'train_acc': max(train_acc),  
    'time': t1-t0  
}  
  
summary_object.append(temp_summary)
```

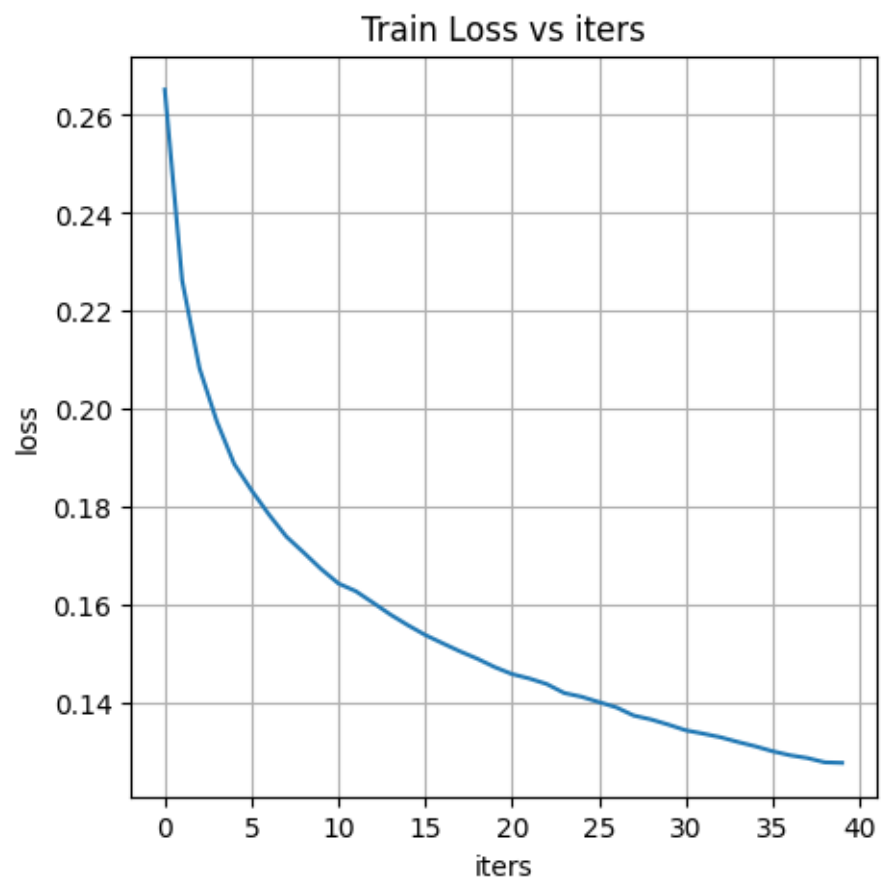
-----  
batch size: 100, dataset size: 100 and learning rate: 0.001

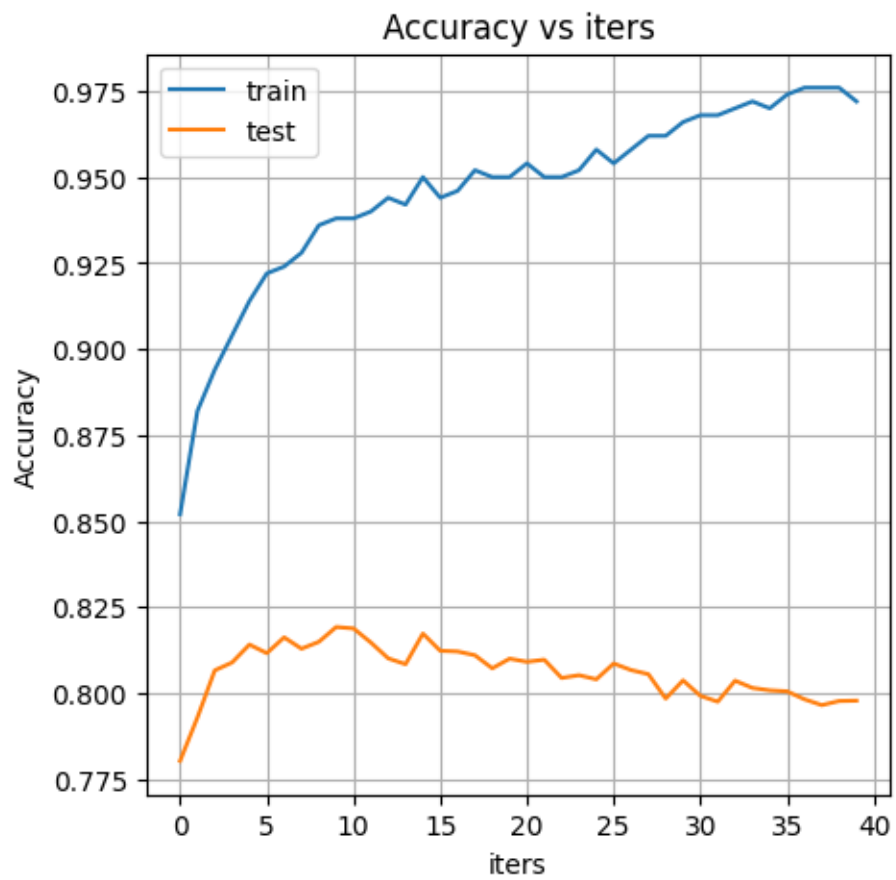




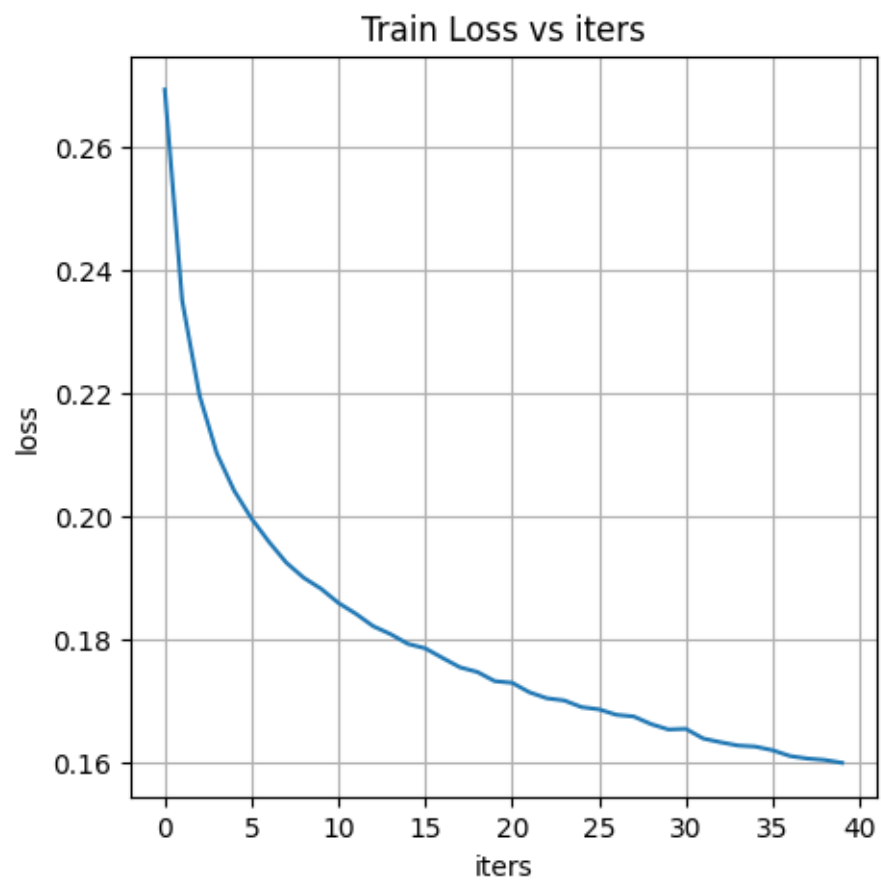


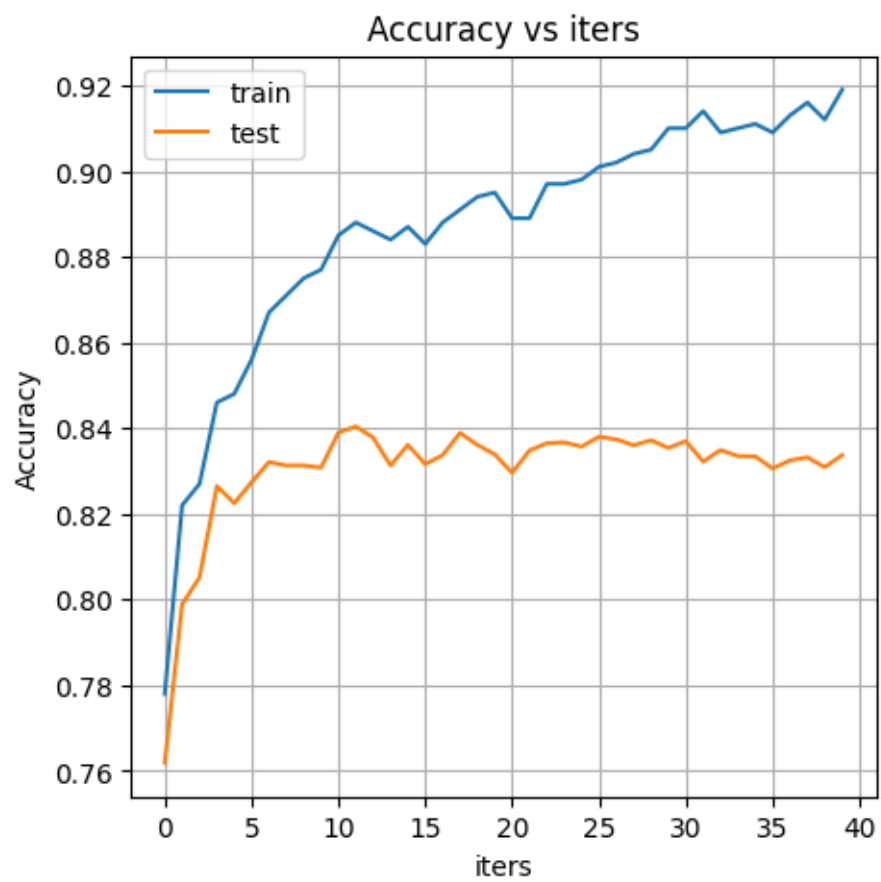
-----  
batch size: 100, dataset size: 500 and learning rate: 0.001



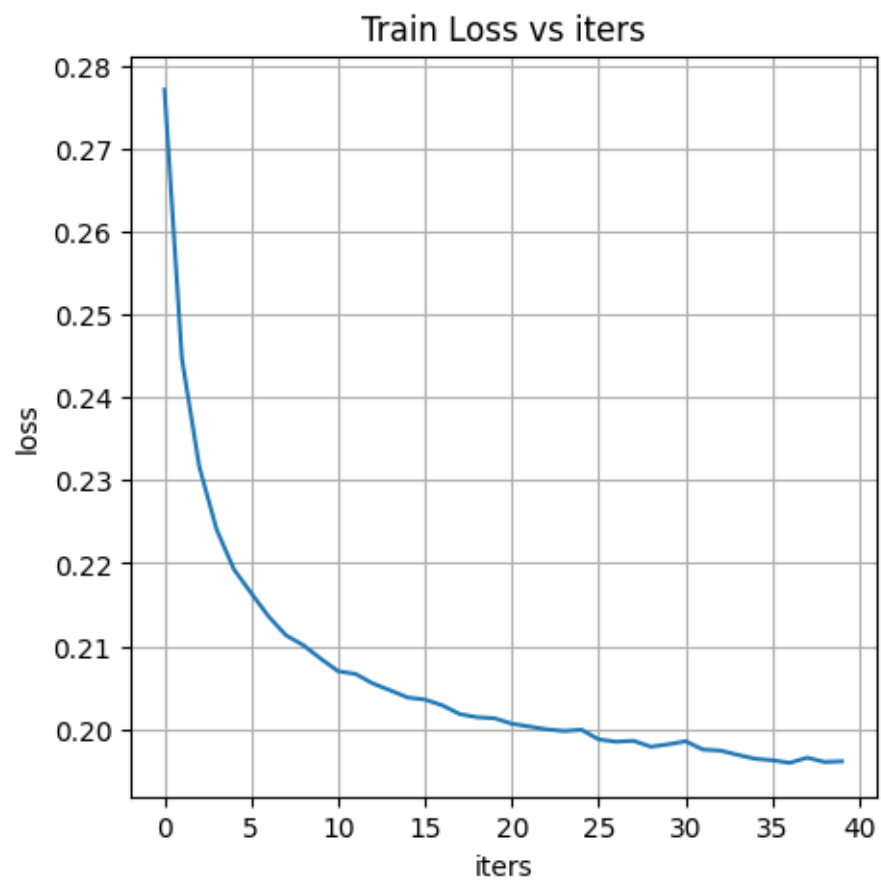


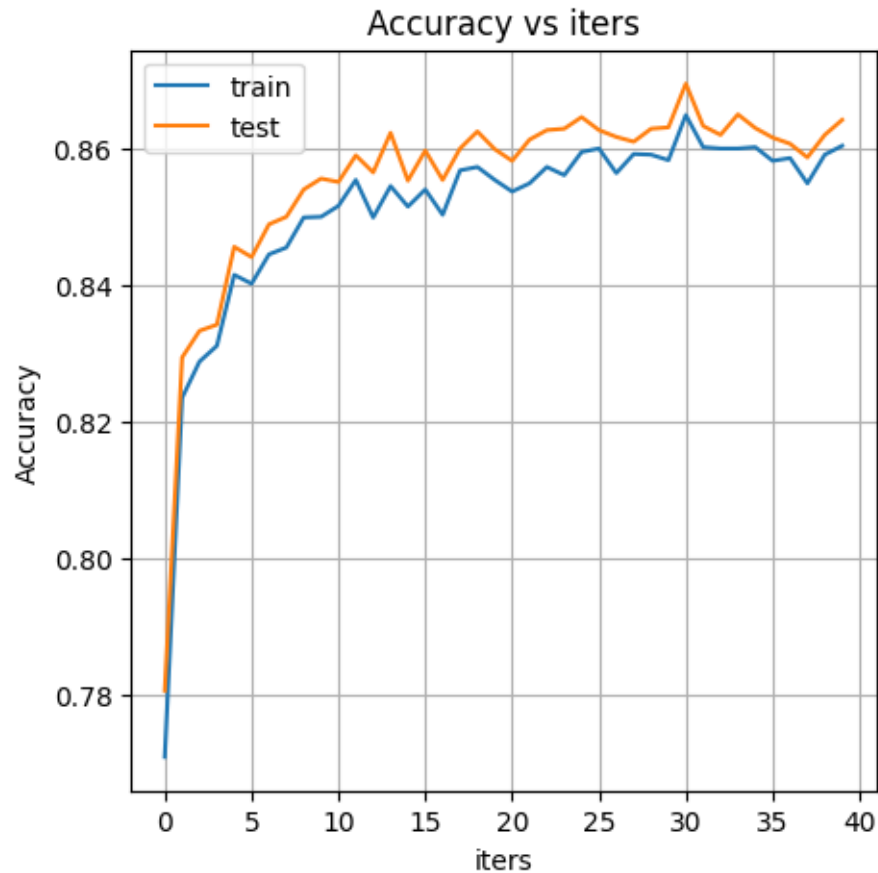
-----  
batch size: 100, dataset size: 1000 and learning rate: 0.001





-----  
batch size: 100, dataset size: 10000 and learning rate: 0.001





```
[18]: # create a dataframe from the data generated above and compare results
df = pd.DataFrame.from_records(summary_object)
print('--- Effect of Learning_rate ---')
print(df.sort_values(by=['learning_rate', 'batch_size']))
print()
```

--- Effect of Learning\_rate ---

	dataset_size	batch_size	learning_rate	test_acc	train_acc	time
0	100	100	0.001	0.7027	1.0000	1.845775
1	500	100	0.001	0.8192	0.9760	1.405012
2	1000	100	0.001	0.8404	0.9190	1.427882
3	10000	100	0.001	0.8695	0.8649	1.790095

### Role of dataset size.

As the dataset size increases, test accuracy increases and train accuracy decreases for the same number of epochs and iterations.

This means we are generalizing on the data more and not overfitting the data.

Generally if we train a simple model longer on smaller dataset, we tend to overfit on train set and perform poorly on the test set. This can be seen in the dataframe results above

### 0.0.7 Inbuilt Pytorch Classifier

```
[19]: # create a linear model
model = torch.nn.Linear(784, 10, bias=True)

# initialize weights to 0
with torch.no_grad():
    model.weight.zero_()
    model.bias.zero_()

# use MSE loss
criterion = torch.nn.MSELoss()

# use SGD optimizer with 0.001 learning rate, same as out model
optimizer = torch.optim.SGD(model.parameters(), lr=0.001)

# convert y to one hot encoded vectors
y_train_oh = convert_to_one_hot(y_train)

# Constant Hyperparameters
batch_size = 100
n_epochs = 40
n_iters = 100

# store stats
all_loss = []
train_acc = []
test_acc = []

for epoch in range(n_epochs):

    for iter in range(n_iters):

        # generate a random batch of size 100
        random_batch_indices = torch.randint(x_train.shape[0], (batch_size,))

        # forward pass
        output = model(x_train[random_batch_indices])

        # loss function
        loss = criterion(output, y_train_oh[random_batch_indices])

        # backprop
```



```
    loss.backward()
    optimizer.step()
    optimizer.zero_grad()

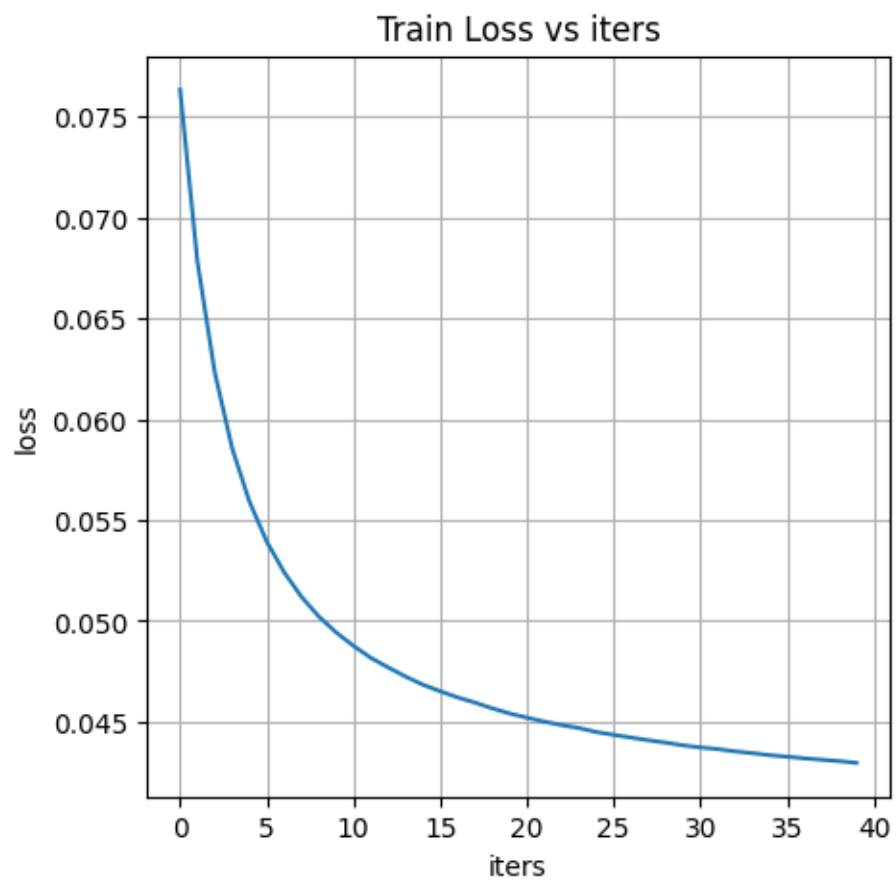
    with torch.no_grad():

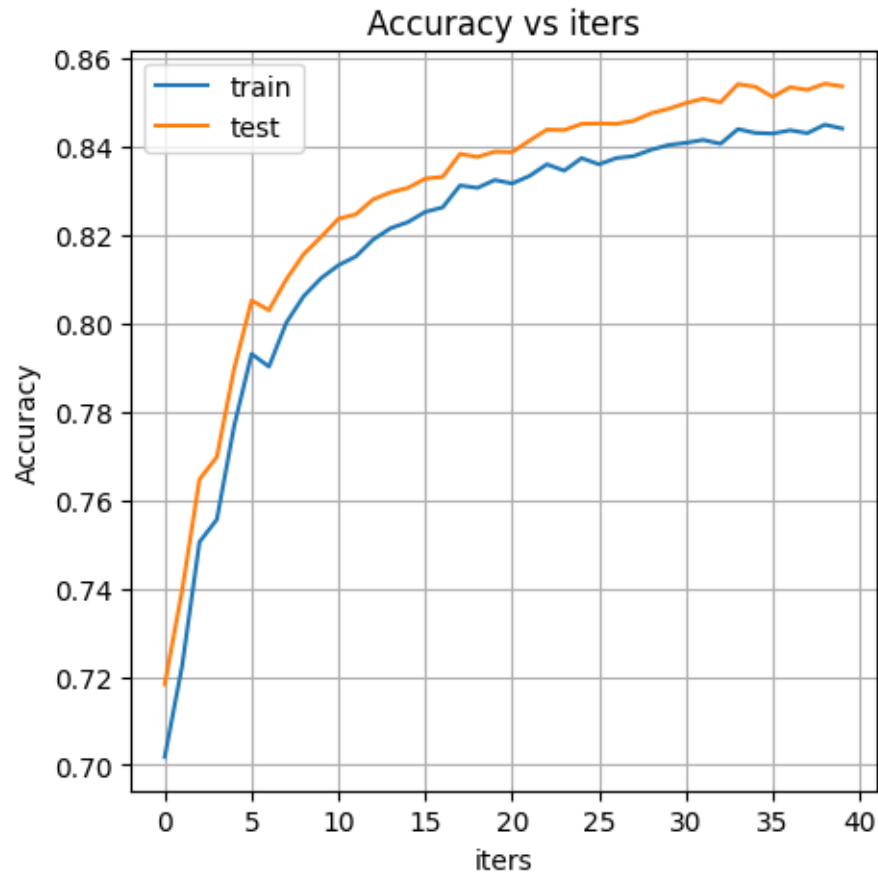
        # train loss on complete dataset
        output = model(x_train)
        train_l = criterion(output, y_train_oh)
        all_loss.append(train_l)

        # train accuracy
        train_acc.append(accuracy(y_train, output))

        # test accuracy
        output = model(x_test)
        test_acc.append(accuracy(y_test, output))

# plot graphs
plot_loss(all_loss)
plot_accuracy(train_acc, test_acc)
```





```
[20]: print ('max train acc is {} and max test accuracy is {}'.format(max(train_acc),
    ↪max(test_acc)))
```

max train acc is 0.8450166583061218 and max test accuracy is 0.8543000221252441

The max train and test accuracy of pytorch implementation with similar initialization is same as the max test train accuracy of self implementation and can be verified and seen in dataframes above

### 0.0.8 Generate PDF

```
[21]: !sudo apt-get update
    !sudo apt-get install texlive-xetex texlive-fonts-recommended
```

```
Get:1 http://security.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Hit:2 http://archive.ubuntu.com/ubuntu focal InRelease
Get:3 http://archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:4 https://cloud.r-project.org/bin/linux/ubuntu focal-cran40/ InRelease
[3,622 B]
Get:5 http://archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Get:6 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu2004/x86_64
```

```

InRelease [1,581 B]
Hit:7 http://ppa.launchpad.net/c2d4u.team/c2d4u4.0+/ubuntu focal InRelease
Hit:8 http://ppa.launchpad.net/cran/libgit2/ubuntu focal InRelease
Get:9 http://security.ubuntu.com/ubuntu focal-security/main amd64 Packages
[2,629 kB]
Hit:10 http://ppa.launchpad.net/deadsnakes/ppa/ubuntu focal InRelease
Get:11 http://security.ubuntu.com/ubuntu focal-security/universe amd64 Packages
[1,033 kB]
Hit:12 http://ppa.launchpad.net/graphics-drivers/ppa/ubuntu focal InRelease
Get:13 http://archive.ubuntu.com/ubuntu focal-updates/restricted amd64 Packages
[2,277 kB]
Hit:14 http://ppa.launchpad.net/ubuntugis/ppa/ubuntu focal InRelease
Get:15 http://archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 Packages
[31.2 kB]
Get:16 http://archive.ubuntu.com/ubuntu focal-updates/universe amd64 Packages
[1,329 kB]
Get:17 http://archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [3,111
kB]
Get:18
https://developer.download.nvidia.com/compute/cuda/repos/ubuntu2004/x86_64
Packages [993 kB]
Fetched 11.7 MB in 2s (7,509 kB/s)
Reading package lists... Done
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  dvisvgm fonts-droid-fallback fonts-lato fonts-lmodern fonts-noto-mono
  fonts-texgyre fonts-urw-base35 javascript-common libapache-pom-java
  libcommons-logging-java libcommons-parent-java libfontbox-java libfontenc1
  libgs9 libgs9-common libharfbuzz-icu0 libidn11 libijs-0.35 libjbig2dec0
  libjs-jquery libkpathsea6 libpdfbox-java libptexenc1 libruby2.7 libsynchronet
  libteckit0 libtexlua53 libtexluajit2 libwoff1 libzzip-0-13 lmodern
  poppler-data preview-latex-style rake ruby ruby-minitest ruby-net-telnet
  ruby-power-assert ruby-test-unit ruby-xmlrpc ruby2.7 rubygems-integration
  tlutils teckit tex-common tex-gyre texlive-base texlive-binaries
  texlive-latex-base texlive-latex-extra texlive-latex-recommended
  texlive-pictures texlive-plain-generic tipa xfonts-encodings xfonts-utils
Suggested packages:
  fonts-noto fonts-freefont-otf | fonts-freefont-ttf apache2 | lighttpd
  | httpd libavalon-framework-java libcommons-logging-java-doc
  libexcalibur-logkit-java liblog4j1.2-java poppler-utils ghostscript
  fonts-japanese-mincho | fonts-ipafont-mincho fonts-japanese-gothic
  | fonts-ipafont-gothic fonts-arphic-ukai fonts-arphic-uming fonts-nanum ri
  ruby-dev bundler debhelper gv | postscript-viewer perl-tk xpdf | pdf-viewer
  xzdec texlive-fonts-recommended-doc texlive-latex-base-doc python3-pygments
  icc-profiles libfile-which-perl libspreadsheet-parseexcel-perl
  texlive-latex-extra-doc texlive-latex-recommended-doc texlive-luatex

```

```

texlive-pstricks dot2tex prerex ruby-tcltk | libtcltk-ruby
texlive-pictures-doc vprerex default-jre-headless
The following NEW packages will be installed:
dvisvgm fonts-droid-fallback fonts-lato fonts-lmodern fonts-noto-mono
fonts-texgyre fonts-urw-base35 javascript-common libapache-pom-java
libcommons-logging-java libcommons-parent-java libfontbox-java libfontenc1
libgs9 libgs9-common libharfbuzz-icu0 libidn11 libijs-0.35 libjbig2dec0
libjs-jquery libkpathsea6 libpdfbox-java libptexenc1 libruby2.7 libsynchronet2
libteckit0 libtexlua53 libtexluajit2 libwoff1 libzzip-0-13 lmodern
poppler-data preview-latex-style rake ruby ruby-minitest ruby-net-telnet
ruby-power-assert ruby-test-unit ruby-xmlrpc ruby2.7 rubygems-integration
tlutils teckit tex-common tex-gyre texlive-base texlive-binaries
texlive-fonts-recommended texlive-latex-base texlive-latex-extra
texlive-latex-recommended texlive-pictures texlive-plain-generic
texlive-xetex tipa xfonts-encodings xfonts-utils
0 upgraded, 58 newly installed, 0 to remove and 26 not upgraded.
Need to get 169 MB of archives.
After this operation, 537 MB of additional disk space will be used.
Get:1 http://archive.ubuntu.com/ubuntu focal/main amd64 fonts-droid-fallback all
1:6.0.1r16-1.1 [1,805 kB]
Get:2 http://archive.ubuntu.com/ubuntu focal/main amd64 fonts-lato all 2.0-2
[2,698 kB]
Get:3 http://archive.ubuntu.com/ubuntu focal/main amd64 poppler-data all 0.4.9-2
[1,475 kB]
Get:4 http://archive.ubuntu.com/ubuntu focal/universe amd64 tex-common all 6.13
[32.7 kB]
Get:5 http://archive.ubuntu.com/ubuntu focal/main amd64 fonts-urw-base35 all
20170801.1-3 [6,333 kB]
Get:6 http://archive.ubuntu.com/ubuntu focal-updates/main amd64 libgs9-common
all 9.50~dfsg-5ubuntu4.7 [681 kB]
Get:7 http://archive.ubuntu.com/ubuntu focal/main amd64 libidn11 amd64
1.33-2.2ubuntu2 [46.2 kB]
Get:8 http://archive.ubuntu.com/ubuntu focal/main amd64 libijs-0.35 amd64
0.35-15 [15.7 kB]
Get:9 http://archive.ubuntu.com/ubuntu focal/main amd64 libjbig2dec0 amd64
0.18-1ubuntu1 [60.0 kB]
Get:10 http://archive.ubuntu.com/ubuntu focal-updates/main amd64 libgs9 amd64
9.50~dfsg-5ubuntu4.7 [2,173 kB]
Get:11 http://archive.ubuntu.com/ubuntu focal/main amd64 libkpathsea6 amd64
2019.20190605.51237-3build2 [57.0 kB]
Get:12 http://archive.ubuntu.com/ubuntu focal/main amd64 libwoff1 amd64
1.0.2-1build2 [42.0 kB]
Get:13 http://archive.ubuntu.com/ubuntu focal/universe amd64 dvisvgm amd64
2.8.1-1build1 [1,048 kB]
Get:14 http://archive.ubuntu.com/ubuntu focal/universe amd64 fonts-lmodern all
2.004.5-6 [4,532 kB]
Get:15 http://archive.ubuntu.com/ubuntu focal-updates/main amd64 fonts-noto-mono
all 20200323-1build1~ubuntu20.04.1 [80.6 kB]

```

Get:16 <http://archive.ubuntu.com/ubuntu> focal/universe amd64 fonts-texgyre all 20180621-3 [10.2 MB]  
Get:17 <http://archive.ubuntu.com/ubuntu> focal/main amd64 javascript-common all 11 [6,066 B]  
Get:18 <http://archive.ubuntu.com/ubuntu> focal/universe amd64 libapache-pom-java all 18-1 [4,720 B]  
Get:19 <http://archive.ubuntu.com/ubuntu> focal/universe amd64 libcommons-parent-java all 43-1 [10.8 kB]  
Get:20 <http://archive.ubuntu.com/ubuntu> focal/universe amd64 libcommons-logging-java all 1.2-2 [60.3 kB]  
Get:21 <http://archive.ubuntu.com/ubuntu> focal/main amd64 libfontenc1 amd64 1:1.1.4-0ubuntu1 [14.0 kB]  
Get:22 <http://archive.ubuntu.com/ubuntu> focal-updates/main amd64 libharfbuzz-icu0 amd64 2.6.4-1ubuntu4.2 [5,580 B]  
Get:23 <http://archive.ubuntu.com/ubuntu> focal/main amd64 libjs-jquery all 3.3.1~dfsg-3 [329 kB]  
Get:24 <http://archive.ubuntu.com/ubuntu> focal/main amd64 libptexenc1 amd64 2019.20190605.51237-3build2 [35.5 kB]  
Get:25 <http://archive.ubuntu.com/ubuntu> focal/main amd64 rubygems-integration all 1.16 [5,092 B]  
Get:26 <http://archive.ubuntu.com/ubuntu> focal-updates/main amd64 ruby2.7 amd64 2.7.0-5ubuntu1.8 [95.6 kB]  
Get:27 <http://archive.ubuntu.com/ubuntu> focal/main amd64 ruby amd64 1:2.7+1 [5,412 B]  
Get:28 <http://archive.ubuntu.com/ubuntu> focal/main amd64 rake all 13.0.1-4 [61.6 kB]  
Get:29 <http://archive.ubuntu.com/ubuntu> focal/main amd64 ruby-minitest all 5.13.0-1 [40.9 kB]  
Get:30 <http://archive.ubuntu.com/ubuntu> focal/main amd64 ruby-net-telnet all 0.1.1-2 [12.6 kB]  
Get:31 <http://archive.ubuntu.com/ubuntu> focal/main amd64 ruby-power-assert all 1.1.7-1 [11.4 kB]  
Get:32 <http://archive.ubuntu.com/ubuntu> focal/main amd64 ruby-test-unit all 3.3.5-1 [73.2 kB]  
Get:33 <http://archive.ubuntu.com/ubuntu> focal/main amd64 ruby-xmlrpc all 0.3.0-2 [23.8 kB]  
Get:34 <http://archive.ubuntu.com/ubuntu> focal-updates/main amd64 libruby2.7 amd64 2.7.0-5ubuntu1.8 [3,532 kB]  
Get:35 <http://archive.ubuntu.com/ubuntu> focal/main amd64 libsynchronet2 amd64 2019.20190605.51237-3build2 [55.0 kB]  
Get:36 <http://archive.ubuntu.com/ubuntu> focal/universe amd64 libteckit0 amd64 2.5.8+ds2-5ubuntu2 [320 kB]  
Get:37 <http://archive.ubuntu.com/ubuntu> focal/main amd64 libtexlua53 amd64 2019.20190605.51237-3build2 [105 kB]  
Get:38 <http://archive.ubuntu.com/ubuntu> focal/main amd64 libtexluajit2 amd64 2019.20190605.51237-3build2 [235 kB]  
Get:39 <http://archive.ubuntu.com/ubuntu> focal/universe amd64 libzip-0-13 amd64 0.13.62-3.2ubuntu1 [26.2 kB]

```

Get:40 http://archive.ubuntu.com/ubuntu focal/main amd64 xfonts-encodings all
1:1.0.5-0ubuntu1 [573 kB]
Get:41 http://archive.ubuntu.com/ubuntu focal/main amd64 xfonts-utils amd64
1:7.7+6 [91.5 kB]
Get:42 http://archive.ubuntu.com/ubuntu focal/universe amd64 lmodern all
2.004.5-6 [9,474 kB]
Get:43 http://archive.ubuntu.com/ubuntu focal/universe amd64 preview-latex-style
all 11.91-2ubuntu2 [184 kB]
Get:44 http://archive.ubuntu.com/ubuntu focal/main amd64 tiutils amd64 1.41-3
[56.1 kB]
Get:45 http://archive.ubuntu.com/ubuntu focal/universe amd64 teckit amd64
2.5.8+ds2-5ubuntu2 [687 kB]
Get:46 http://archive.ubuntu.com/ubuntu focal/universe amd64 tex-gyre all
20180621-3 [6,209 kB]
Get:47 http://archive.ubuntu.com/ubuntu focal/universe amd64 texlive-binaries
amd64 2019.20190605.51237-3build2 [8,041 kB]
Get:48 http://archive.ubuntu.com/ubuntu focal/universe amd64 texlive-base all
2019.20200218-1 [20.8 MB]
Get:49 http://archive.ubuntu.com/ubuntu focal/universe amd64 texlive-fonts-
recommended all 2019.20200218-1 [4,972 kB]
Get:50 http://archive.ubuntu.com/ubuntu focal/universe amd64 texlive-latex-base
all 2019.20200218-1 [990 kB]
Get:51 http://archive.ubuntu.com/ubuntu focal/universe amd64 libfontbox-java all
1:1.8.16-2 [207 kB]
Get:52 http://archive.ubuntu.com/ubuntu focal/universe amd64 libpdfbox-java all
1:1.8.16-2 [5,199 kB]
Get:53 http://archive.ubuntu.com/ubuntu focal/universe amd64 texlive-latex-
recommended all 2019.20200218-1 [15.7 MB]
Get:54 http://archive.ubuntu.com/ubuntu focal/universe amd64 texlive-pictures
all 2019.20200218-1 [4,492 kB]
Get:55 http://archive.ubuntu.com/ubuntu focal/universe amd64 texlive-latex-extra
all 2019.202000218-1 [12.5 MB]
Get:56 http://archive.ubuntu.com/ubuntu focal/universe amd64 texlive-plain-
generic all 2019.202000218-1 [24.6 MB]
Get:57 http://archive.ubuntu.com/ubuntu focal/universe amd64 tipa all 2:1.3-20
[2,978 kB]
Get:58 http://archive.ubuntu.com/ubuntu focal/universe amd64 texlive-xetex all
2019.20200218-1 [14.6 MB]
Fetched 169 MB in 2s (87.5 MB/s)
debconf: unable to initialize frontend: Dialog
debconf: (No usable dialog-like program is installed, so the dialog based
frontend cannot be used. at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line 76,
<> line 58.)
debconf: falling back to frontend: Readline
debconf: unable to initialize frontend: Readline
debconf: (This frontend requires a controlling tty.)
debconf: falling back to frontend: Teletype
dpkg-preconfigure: unable to re-open stdin:

```

```

Selecting previously unselected package fonts-droid-fallback.
(Reading database ... 122352 files and directories currently installed.)
Preparing to unpack .../00-fonts-droid-fallback_1%3a6.0.1r16-1.1_all.deb ...
Unpacking fonts-droid-fallback (1:6.0.1r16-1.1) ...
Selecting previously unselected package fonts-lato.
Preparing to unpack .../01-fonts-lato_2.0-2_all.deb ...
Unpacking fonts-lato (2.0-2) ...
Selecting previously unselected package poppler-data.
Preparing to unpack .../02-poppler-data_0.4.9-2_all.deb ...
Unpacking poppler-data (0.4.9-2) ...
Selecting previously unselected package tex-common.
Preparing to unpack .../03-tex-common_6.13_all.deb ...
Unpacking tex-common (6.13) ...
Selecting previously unselected package fonts-urw-base35.
Preparing to unpack .../04-fonts-urw-base35_20170801.1-3_all.deb ...
Unpacking fonts-urw-base35 (20170801.1-3) ...
Selecting previously unselected package libgs9-common.
Preparing to unpack .../05-libgs9-common_9.50~dfsg-5ubuntu4.7_all.deb ...
Unpacking libgs9-common (9.50~dfsg-5ubuntu4.7) ...
Selecting previously unselected package libidn11:amd64.
Preparing to unpack .../06-libidn11_1.33-2.2ubuntu2_amd64.deb ...
Unpacking libidn11:amd64 (1.33-2.2ubuntu2) ...
Selecting previously unselected package libijs-0.35:amd64.
Preparing to unpack .../07-libijs-0.35_0.35-15_amd64.deb ...
Unpacking libijs-0.35:amd64 (0.35-15) ...
Selecting previously unselected package libjbig2dec0:amd64.
Preparing to unpack .../08-libjbig2dec0_0.18-1ubuntu1_amd64.deb ...
Unpacking libjbig2dec0:amd64 (0.18-1ubuntu1) ...
Selecting previously unselected package libgs9:amd64.
Preparing to unpack .../09-libgs9_9.50~dfsg-5ubuntu4.7_amd64.deb ...
Unpacking libgs9:amd64 (9.50~dfsg-5ubuntu4.7) ...
Selecting previously unselected package libkpathsea6:amd64.
Preparing to unpack .../10-libkpathsea6_2019.20190605.51237-3build2_amd64.deb
...
Unpacking libkpathsea6:amd64 (2019.20190605.51237-3build2) ...
Selecting previously unselected package libwoff1:amd64.
Preparing to unpack .../11-libwoff1_1.0.2-1build2_amd64.deb ...
Unpacking libwoff1:amd64 (1.0.2-1build2) ...
Selecting previously unselected package dvisvgm.
Preparing to unpack .../12-dvisvgm_2.8.1-1build1_amd64.deb ...
Unpacking dvisvgm (2.8.1-1build1) ...
Selecting previously unselected package fonts-lmodern.
Preparing to unpack .../13-fonts-lmodern_2.004.5-6_all.deb ...
Unpacking fonts-lmodern (2.004.5-6) ...
Selecting previously unselected package fonts-noto-mono.
Preparing to unpack .../14-fonts-noto-
mono_20200323-1build1~ubuntu20.04.1_all.deb ...
Unpacking fonts-noto-mono (20200323-1build1~ubuntu20.04.1) ...

```



Selecting previously unselected package fonts-texgyre.  
 Preparing to unpack .../15-fonts-texgyre\_20180621-3\_all.deb ...  
 Unpacking fonts-texgyre (20180621-3) ...  
 Selecting previously unselected package javascript-common.  
 Preparing to unpack .../16-javascript-common\_11\_all.deb ...  
 Unpacking javascript-common (11) ...  
 Selecting previously unselected package libapache-pom-java.  
 Preparing to unpack .../17-libapache-pom-java\_18-1\_all.deb ...  
 Unpacking libapache-pom-java (18-1) ...  
 Selecting previously unselected package libcommons-parent-java.  
 Preparing to unpack .../18-libcommons-parent-java\_43-1\_all.deb ...  
 Unpacking libcommons-parent-java (43-1) ...  
 Selecting previously unselected package libcommons-logging-java.  
 Preparing to unpack .../19-libcommons-logging-java\_1.2-2\_all.deb ...  
 Unpacking libcommons-logging-java (1.2-2) ...  
 Selecting previously unselected package libfontenc1:amd64.  
 Preparing to unpack .../20-libfontenc1\_1%3a1.1.4-0ubuntu1\_amd64.deb ...  
 Unpacking libfontenc1:amd64 (1:1.1.4-0ubuntu1) ...  
 Selecting previously unselected package libharfbuzz-icu0:amd64.  
 Preparing to unpack .../21-libharfbuzz-icu0\_2.6.4-1ubuntu4.2\_amd64.deb ...  
 Unpacking libharfbuzz-icu0:amd64 (2.6.4-1ubuntu4.2) ...  
 Selecting previously unselected package libjs-jquery.  
 Preparing to unpack .../22-libjs-jquery\_3.3.1~dfsg-3\_all.deb ...  
 Unpacking libjs-jquery (3.3.1~dfsg-3) ...  
 Selecting previously unselected package libptexenc1:amd64.  
 Preparing to unpack .../23-libptexenc1\_2019.20190605.51237-3build2\_amd64.deb ...  
 Unpacking libptexenc1:amd64 (2019.20190605.51237-3build2) ...  
 Selecting previously unselected package rubygems-integration.  
 Preparing to unpack .../24-rubygems-integration\_1.16\_all.deb ...  
 Unpacking rubygems-integration (1.16) ...  
 Selecting previously unselected package ruby2.7.  
 Preparing to unpack .../25-ruby2.7\_2.7.0-5ubuntu1.8\_amd64.deb ...  
 Unpacking ruby2.7 (2.7.0-5ubuntu1.8) ...  
 Selecting previously unselected package ruby.  
 Preparing to unpack .../26-ruby\_1%3a2.7+1\_amd64.deb ...  
 Unpacking ruby (1:2.7+1) ...  
 Selecting previously unselected package rake.  
 Preparing to unpack .../27-rake\_13.0.1-4\_all.deb ...  
 Unpacking rake (13.0.1-4) ...  
 Selecting previously unselected package ruby-minitest.  
 Preparing to unpack .../28-ruby-minitest\_5.13.0-1\_all.deb ...  
 Unpacking ruby-minitest (5.13.0-1) ...  
 Selecting previously unselected package ruby-net-telnet.  
 Preparing to unpack .../29-ruby-net-telnet\_0.1.1-2\_all.deb ...  
 Unpacking ruby-net-telnet (0.1.1-2) ...  
 Selecting previously unselected package ruby-power-assert.  
 Preparing to unpack .../30-ruby-power-assert\_1.1.7-1\_all.deb ...  
 Unpacking ruby-power-assert (1.1.7-1) ...

```

Selecting previously unselected package ruby-test-unit.
Preparing to unpack .../31-ruby-test-unit_3.3.5-1_all.deb ...
Unpacking ruby-test-unit (3.3.5-1) ...
Selecting previously unselected package ruby-xmlrpc.
Preparing to unpack .../32-ruby-xmlrpc_0.3.0-2_all.deb ...
Unpacking ruby-xmlrpc (0.3.0-2) ...
Selecting previously unselected package libruby2.7:amd64.
Preparing to unpack .../33-libruby2.7_2.7.0-5ubuntu1.8_amd64.deb ...
Unpacking libruby2.7:amd64 (2.7.0-5ubuntu1.8) ...
Selecting previously unselected package libsyntax2:amd64.
Preparing to unpack .../34-libsyntax2_2019.20190605.51237-3build2_amd64.deb ...
Unpacking libsyntax2:amd64 (2019.20190605.51237-3build2) ...
Selecting previously unselected package libteckit0:amd64.
Preparing to unpack .../35-libteckit0_2.5.8+ds2-5ubuntu2_amd64.deb ...
Unpacking libteckit0:amd64 (2.5.8+ds2-5ubuntu2) ...
Selecting previously unselected package libtexlua53:amd64.
Preparing to unpack .../36-libtexlua53_2019.20190605.51237-3build2_amd64.deb ...
Unpacking libtexlua53:amd64 (2019.20190605.51237-3build2) ...
Selecting previously unselected package libtexluajit2:amd64.
Preparing to unpack .../37-libtexluajit2_2019.20190605.51237-3build2_amd64.deb
...
Unpacking libtexluajit2:amd64 (2019.20190605.51237-3build2) ...
Selecting previously unselected package libzip-0-13:amd64.
Preparing to unpack .../38-libzip-0-13_0.13.62-3.2ubuntu1_amd64.deb ...
Unpacking libzip-0-13:amd64 (0.13.62-3.2ubuntu1) ...
Selecting previously unselected package xfonts-encodings.
Preparing to unpack .../39-xfonts-encodings_1%3a1.0.5-0ubuntu1_all.deb ...
Unpacking xfonts-encodings (1:1.0.5-0ubuntu1) ...
Selecting previously unselected package xfonts-utils.
Preparing to unpack .../40-xfonts-utils_1%3a7.7+6_amd64.deb ...
Unpacking xfonts-utils (1:7.7+6) ...
Selecting previously unselected package lmodern.
Preparing to unpack .../41-lmodern_2.004.5-6_all.deb ...
Unpacking lmodern (2.004.5-6) ...
Selecting previously unselected package preview-latex-style.
Preparing to unpack .../42-preview-latex-style_11.91-2ubuntu2_all.deb ...
Unpacking preview-latex-style (11.91-2ubuntu2) ...
Selecting previously unselected package t1utils.
Preparing to unpack .../43-t1utils_1.41-3_amd64.deb ...
Unpacking t1utils (1.41-3) ...
Selecting previously unselected package teckit.
Preparing to unpack .../44-teckit_2.5.8+ds2-5ubuntu2_amd64.deb ...
Unpacking teckit (2.5.8+ds2-5ubuntu2) ...
Selecting previously unselected package tex-gyre.
Preparing to unpack .../45-tex-gyre_20180621-3_all.deb ...
Unpacking tex-gyre (20180621-3) ...
Selecting previously unselected package texlive-binaries.
Preparing to unpack .../46-texlive-

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binaries_2019.20190605.51237-3build2_amd64.deb ...
Unpacking texlive-binaries (2019.20190605.51237-3build2) ...
Selecting previously unselected package texlive-base.
Preparing to unpack .../47-texlive-base_2019.20200218-1_all.deb ...
Unpacking texlive-base (2019.20200218-1) ...
Selecting previously unselected package texlive-fonts-recommended.
Preparing to unpack .../48-texlive-fonts-recommended_2019.20200218-1_all.deb ...
Unpacking texlive-fonts-recommended (2019.20200218-1) ...
Selecting previously unselected package texlive-latex-base.
Preparing to unpack .../49-texlive-latex-base_2019.20200218-1_all.deb ...
Unpacking texlive-latex-base (2019.20200218-1) ...
Selecting previously unselected package libfontbox-java.
Preparing to unpack .../50-libfontbox-java_1%3a1.8.16-2_all.deb ...
Unpacking libfontbox-java (1:1.8.16-2) ...
Selecting previously unselected package libpdfbox-java.
Preparing to unpack .../51-libpdfbox-java_1%3a1.8.16-2_all.deb ...
Unpacking libpdfbox-java (1:1.8.16-2) ...
Selecting previously unselected package texlive-latex-recommended.
Preparing to unpack .../52-texlive-latex-recommended_2019.20200218-1_all.deb ...
Unpacking texlive-latex-recommended (2019.20200218-1) ...
Selecting previously unselected package texlive-pictures.
Preparing to unpack .../53-texlive-pictures_2019.20200218-1_all.deb ...
Unpacking texlive-pictures (2019.20200218-1) ...
Selecting previously unselected package texlive-latex-extra.
Preparing to unpack .../54-texlive-latex-extra_2019.202000218-1_all.deb ...
Unpacking texlive-latex-extra (2019.202000218-1) ...
Selecting previously unselected package texlive-plain-generic.
Preparing to unpack .../55-texlive-plain-generic_2019.202000218-1_all.deb ...
Unpacking texlive-plain-generic (2019.202000218-1) ...
Selecting previously unselected package tipa.
Preparing to unpack .../56-tipa_2%3a1.3-20_all.deb ...
Unpacking tipa (2:1.3-20) ...
Selecting previously unselected package texlive-xetex.
Preparing to unpack .../57-texlive-xetex_2019.20200218-1_all.deb ...
Unpacking texlive-xetex (2019.20200218-1) ...
Setting up javascript-common (11) ...
Setting up libharfbuzz-icu0:amd64 (2.6.4-1ubuntu4.2) ...
Setting up fonts-lato (2.0-2) ...
Setting up fonts-noto-mono (20200323-1build1~ubuntu20.04.1) ...
Setting up libwoff1:amd64 (1.0.2-1build2) ...
Setting up ruby-power-assert (1.1.7-1) ...
Setting up libtexlua53:amd64 (2019.20190605.51237-3build2) ...
Setting up libijs-0.35:amd64 (0.35-15) ...
Setting up libtexluajit2:amd64 (2019.20190605.51237-3build2) ...
Setting up libfontbox-java (1:1.8.16-2) ...
Setting up rubygems-integration (1.16) ...
Setting up libzip-0-13:amd64 (0.13.62-3.2ubuntu1) ...
Setting up fonts-urw-base35 (20170801.1-3) ...

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Setting up poppler-data (0.4.9-2) ...
Setting up ruby-minitest (5.13.0-1) ...
Setting up tex-common (6.13) ...
debconf: unable to initialize frontend: Dialog
debconf: (No usable dialog-like program is installed, so the dialog based
frontend cannot be used. at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line
76.)
debconf: falling back to frontend: Readline
update-language: texlive-base not installed and configured, doing nothing!
Setting up libfontenc1:amd64 (1:1.1.4-0ubuntu1) ...
Setting up ruby-test-unit (3.3.5-1) ...
Setting up libjbig2dec0:amd64 (0.18-1ubuntu1) ...
Setting up libidn11:amd64 (1.33-2.2ubuntu2) ...
Setting up libteckit0:amd64 (2.5.8+ds2-5ubuntu2) ...
Setting up libapache-pom-java (18-1) ...
Setting up ruby-net-telnet (0.1.1-2) ...
Setting up xfonts-encodings (1:1.0.5-0ubuntu1) ...
Setting up t1utils (1.41-3) ...
Setting up fonts-texgyre (20180621-3) ...
Setting up libkpathsea6:amd64 (2019.20190605.51237-3build2) ...
Setting up fonts-lmodern (2.004.5-6) ...
Setting up fonts-droid-fallback (1:6.0.1r16-1.1) ...
Setting up libjs-jquery (3.3.1~dfsg-3) ...
Setting up ruby-xmlrpc (0.3.0-2) ...
Setting up libsynchronet2:amd64 (2019.20190605.51237-3build2) ...
Setting up libgs9-common (9.50~dfsg-5ubuntu4.7) ...
Setting up teckit (2.5.8+ds2-5ubuntu2) ...
Setting up libpdfbox-java (1:1.8.16-2) ...
Setting up libgs9:amd64 (9.50~dfsg-5ubuntu4.7) ...
Setting up preview-latex-style (11.91-2ubuntu2) ...
Setting up libcommons-parent-java (43-1) ...
Setting up dvisvgm (2.8.1-1build1) ...
Setting up libcommons-logging-java (1.2-2) ...
Setting up xfonts-utils (1:7.7+6) ...
Setting up libptexenc1:amd64 (2019.20190605.51237-3build2) ...
Setting up texlive-binaries (2019.20190605.51237-3build2) ...
update-alternatives: using /usr/bin/xdvi-xaw to provide /usr/bin/xdvi.bin
(xdvi.bin) in auto mode
update-alternatives: using /usr/bin/bibtex.original to provide /usr/bin/bibtex
(bibtex) in auto mode
Setting up lmodern (2.004.5-6) ...
Setting up texlive-base (2019.20200218-1) ...
mktexlsr: Updating /var/lib/texmf/ls-R-TEXLIVEDIST...
mktexlsr: Updating /var/lib/texmf/ls-R-TEXMFMAIN...
mktexlsr: Updating /var/lib/texmf/ls-R...
mktexlsr: Done.
tl-paper: setting paper size for dvips to a4:
/var/lib/texmf/dvips/config/config-paper.ps

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tl-paper: setting paper size for dvipdfmx to a4:
/var/lib/texmf/dvipdfmx/dvipdfmx-paper.cfg
tl-paper: setting paper size for xdvi to a4: /var/lib/texmf/xdvi/XDvi-paper
tl-paper: setting paper size for pdftex to a4:
/var/lib/texmf/tex/generic/config/pdftexconfig.tex
debconf: unable to initialize frontend: Dialog
debconf: (No usable dialog-like program is installed, so the dialog based
frontend cannot be used. at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line
76.)
debconf: falling back to frontend: Readline
Setting up tex-gyre (20180621-3) ...
Setting up texlive-plain-generic (2019.20200218-1) ...
Setting up texlive-latex-base (2019.20200218-1) ...
Setting up texlive-latex-recommended (2019.20200218-1) ...
Setting up texlive-pictures (2019.20200218-1) ...
Setting up texlive-fonts-recommended (2019.20200218-1) ...
Setting up tipa (2:1.3-20) ...
Regenerating '/var/lib/texmf/fmtutil.cnf-DEBIAN'... done.
Regenerating '/var/lib/texmf/fmtutil.cnf-TEXLIVEDIST'... done.
update-fmtutil has updated the following file(s):
    /var/lib/texmf/fmtutil.cnf-DEBIAN
    /var/lib/texmf/fmtutil.cnf-TEXLIVEDIST
If you want to activate the changes in the above file(s),
you should run fmtutil-sys or fmtutil.
Setting up texlive-latex-extra (2019.20200218-1) ...
Setting up texlive-xetex (2019.20200218-1) ...
Setting up rake (13.0.1-4) ...
Setting up libruby2.7:amd64 (2.7.0-5ubuntu1.8) ...
Setting up ruby2.7 (2.7.0-5ubuntu1.8) ...
Setting up ruby (1:2.7+1) ...
Processing triggers for fontconfig (2.13.1-2ubuntu3) ...
Processing triggers for mime-support (3.64ubuntu1) ...
Processing triggers for libc-bin (2.31-0ubuntu9.9) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for tex-common (6.13) ...
debconf: unable to initialize frontend: Dialog
debconf: (No usable dialog-like program is installed, so the dialog based
frontend cannot be used. at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line
76.)
debconf: falling back to frontend: Readline
Running updmapper-sys. This may take some time... done.
Running mktexlsr /var/lib/texmf ... done.
Building format(s) --all.
    This may take some time... done.

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[ ]: !jupyter nbconvert --log-level CRITICAL --to pdf CS_228_DL_HW_1.ipynb
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