FashionMNISTProject

June 28, 2025

Fashion-MNIST Project

Table of Contents

In this project, you will classify Fashion-MNIST dataset using convolutional neural networks.

Preparation

Questions 1: Create a Dataset Class

Define Softmax, Criterion function, Optimizer and Train the Model

Estimated Time Needed: 30 min

Preparation

Download the datasets you needed for this lab.

The following are the PyTorch modules you are going to need

[1]:
```
!pip install torch
!pip install torchvision
!pip install matplotlib
```

```
Collecting torch
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contourpy, matplotlib
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kiwisolver-1.4.8 matplotlib-3.10.3 pyparsing-3.2.3
```

[2]:
```python
# PyTorch Modules you need for this lab

from torch.utils.data import Dataset, DataLoader

from torchvision import transforms
import torch
import torch.nn as nn
import torchvision.transforms as transforms
import torchvision.datasets as dsets
torch.manual_seed(0)
```

[2]:
```
<torch._C.Generator at 0x732190dadf70>
```

Import Non-PyTorch Modules

[3]:
```python
# Other non-PyTorch Modules

from matplotlib.pyplot import imshow
import matplotlib.pylab as plt
```

```
from PIL import Image
```

[4]:
```
def show_data(data_sample):
    plt.imshow(data_sample[0].numpy().reshape(IMAGE_SIZE, IMAGE_SIZE),␣
 ↪cmap='gray')
    plt.title('y = '+ str(data_sample[1]))
```

Questions 1: Create a Dataset Class

In this section, you will load a Dataset object, but first you must transform the dataset. Use the Compose function to perform the following transforms:.

Use the transforms object to Resize to resize the image.

Use the transforms object to ToTensor to convert the image to a tensor.

You will then take a screen shot of your validation data.

Use the Compose function to compose the transforms

[5]:
```
IMAGE_SIZE = 16
composed = transforms.Compose([
    transforms.Resize((IMAGE_SIZE, IMAGE_SIZE)),
    transforms.ToTensor()
])
```

Create two dataset objects for the Fashion MNIST dataset. One for training data called dataset_train and one for validation data dataset_val. You will be asked to take a screenshot of several samples.

Hint: dsets.FashionMNIST(root= ‘.fashion/data’, train=???, transform=composed, download=True)

[6]:
```
dataset_train = dsets.FashionMNIST(
    root='./fashion/data', train=True, transform=composed, download=True)

dataset_val = dsets.FashionMNIST(
    root='./fashion/data', train=False, transform=composed, download=True)
```

```
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100%|      | 5.15k/5.15k [00:00<00:00, 8.82MB/s]
```
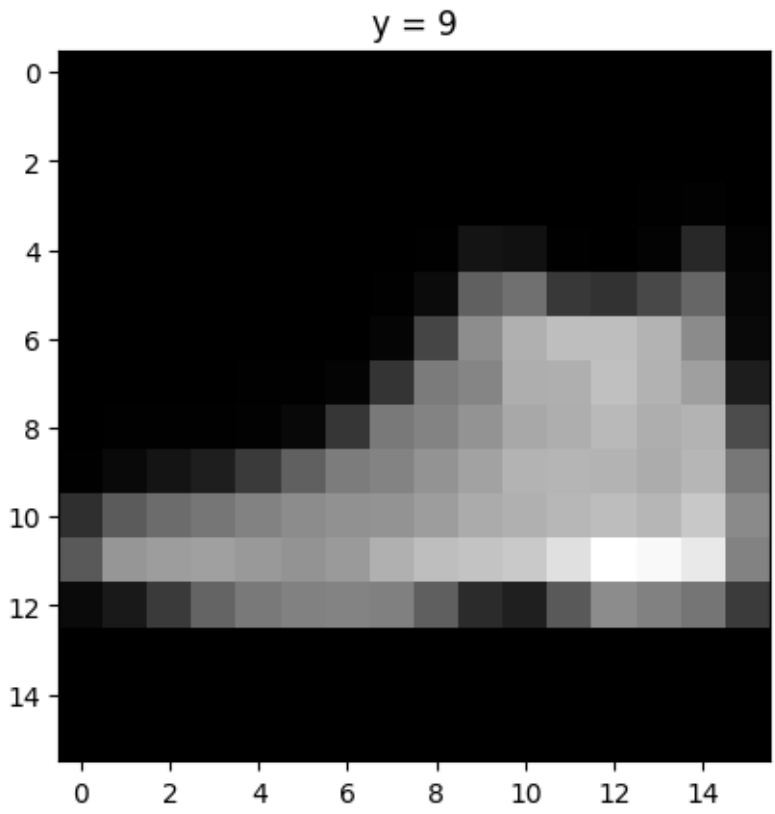

[7]:
```
for n,data_sample in enumerate(dataset_val):

    show_data(data_sample)
    plt.show()
    if n==2:
        break
```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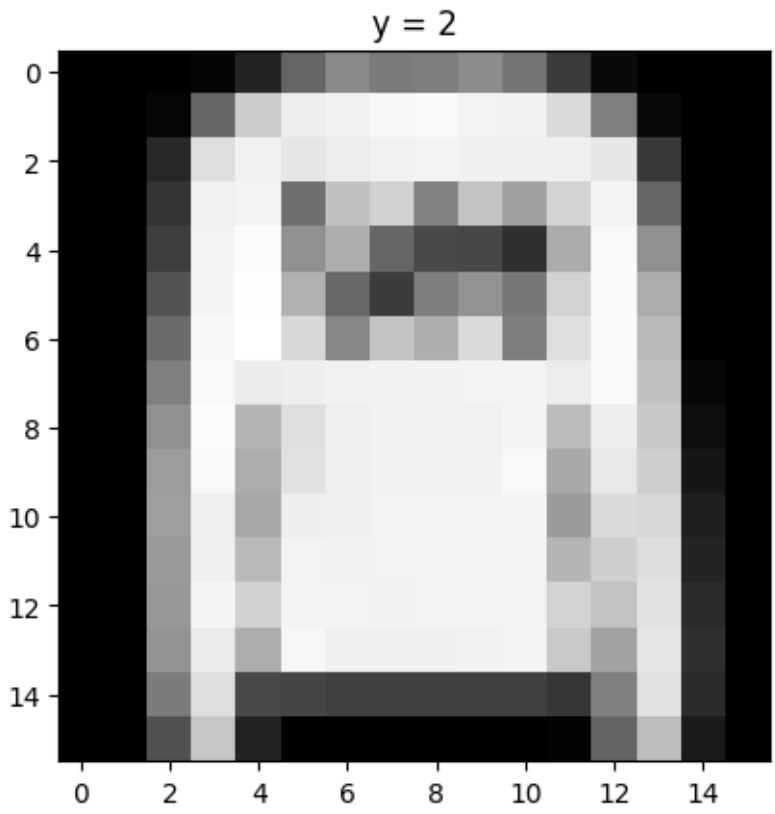
0
2
4
6
8
10
12
14
0
2
4
6
8
10
12
14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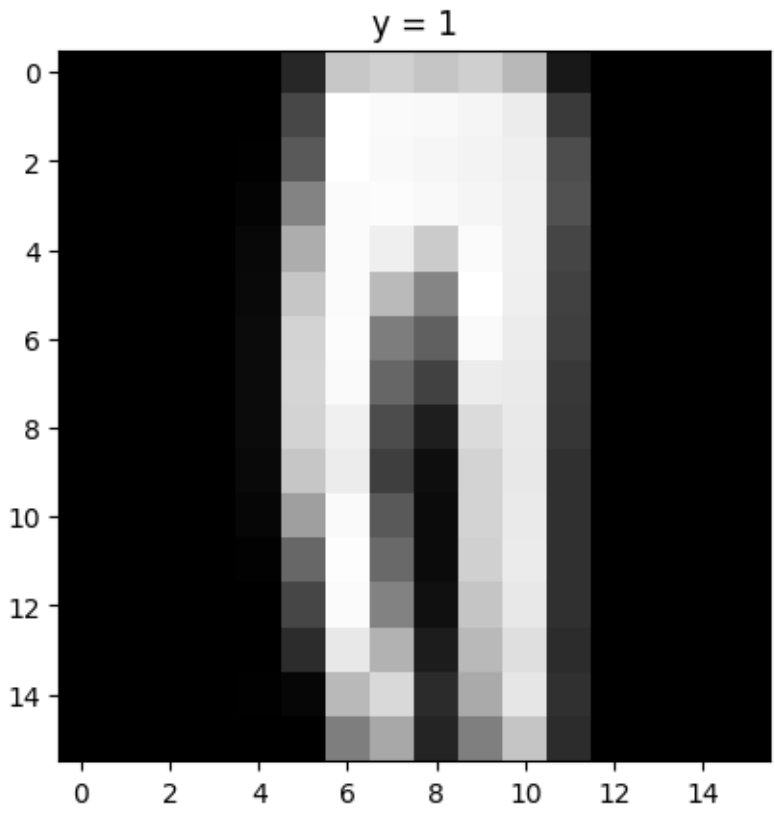
0
2
4
6
8
10
12
14
0
2
4
6
8
10
12
14



Questions 2

Create a Convolutional Neural Network class using ONE of the following constructors. Train the network using the provided code then provide a screenshot of your training cost and accuracy with your validation data.

Constructor using Batch Norm

[10]:
```
class CNN_batch(nn.Module):

    # Constructor
    def __init__(self, out_1=16, out_2=32,number_of_classes=10):
        super(CNN_batch, self).__init__()
        self.cnn1 = nn.Conv2d(in_channels=1, out_channels=out_1, kernel_size=5,␣
↪padding=2)
        self.conv1_bn = nn.BatchNorm2d(out_1)

        self.maxpool1=nn.MaxPool2d(kernel_size=2)

        self.cnn2 = nn.Conv2d(in_channels=out_1, out_channels=out_2,␣
↪kernel_size=5, stride=1, padding=2)
        self.conv2_bn = nn.BatchNorm2d(out_2)
```

```
        self.maxpool2=nn.MaxPool2d(kernel_size=2)
        self.fc1 = nn.Linear(out_2 * 4 * 4, number_of_classes)
        self.bn_fc1 = nn.BatchNorm1d(10)

    # Prediction
    def forward(self, x):
        x = self.cnn1(x)
        x=self.conv1_bn(x)
        x = torch.relu(x)
        x = self.maxpool1(x)
        x = self.cnn2(x)
        x=self.conv2_bn(x)
        x = torch.relu(x)
        x = self.maxpool2(x)
        x = x.view(x.size(0), -1)
        x = self.fc1(x)
        x=self.bn_fc1(x)
        return x
```

Constructor for regular Convolutional Neural Network

[9]:
```
class CNN(nn.Module):

    # Constructor
    def __init__(self, out_1=16, out_2=32,number_of_classes=10):
        super(CNN, self).__init__()
        self.cnn1 = nn.Conv2d(in_channels=1, out_channels=out_1, kernel_size=5,␣
↪padding=2)
        self.maxpool1=nn.MaxPool2d(kernel_size=2)

        self.cnn2 = nn.Conv2d(in_channels=out_1, out_channels=out_2,␣
↪kernel_size=5, stride=1, padding=2)
        self.maxpool2=nn.MaxPool2d(kernel_size=2)
        self.fc1 = nn.Linear(out_2 * 4 * 4, number_of_classes)

    # Prediction
    def forward(self, x):
        x = self.cnn1(x)
        x = torch.relu(x)
        x = self.maxpool1(x)
        x = self.cnn2(x)
        x = torch.relu(x)
        x = self.maxpool2(x)
        x = x.view(x.size(0), -1)
        x = self.fc1(x)
        return x
```

train loader and validation loader

[11]:
```
train_loader = torch.utils.data.DataLoader(dataset=dataset_train,␣
↪batch_size=100 )
test_loader = torch.utils.data.DataLoader(dataset=dataset_val, batch_size=100 )
```

Convolutional Neural Network object

[12]:
```
model = CNN_batch(out_1=16, out_2=32,number_of_classes=10)
```

Create the objects for the criterion and the optimizer named criterion and optimizer. Make the optimizer use SGD with a learning rate of 0.1 and the optimizer use Cross Entropy Loss

[13]:
```
criterion = nn.CrossEntropyLoss()
optimizer = torch.optim.SGD(model.parameters(), lr=0.1)
```

Code used to train the model

[14]:
```
import time

start_time = time.time()
cost_list = []
accuracy_list = []
N_test = len(dataset_val)
n_epochs = 5

for epoch in range(n_epochs):
    cost = 0
    model.train()
    for x, y in train_loader:
        optimizer.zero_grad()
        z = model(x)
        loss = criterion(z, y)
        loss.backward()
        optimizer.step()
        cost += loss.item()

    correct = 0
    model.eval()
    for x_test, y_test in test_loader:
        z = model(x_test)
        _, yhat = torch.max(z.data, 1)
        correct += (yhat == y_test).sum().item()

    accuracy = correct / N_test
    accuracy_list.append(accuracy)
    cost_list.append(cost)
    print(f"Epoch {epoch+1} | Cost: {cost:.2f} | Accuracy: {accuracy:.4f}")
```

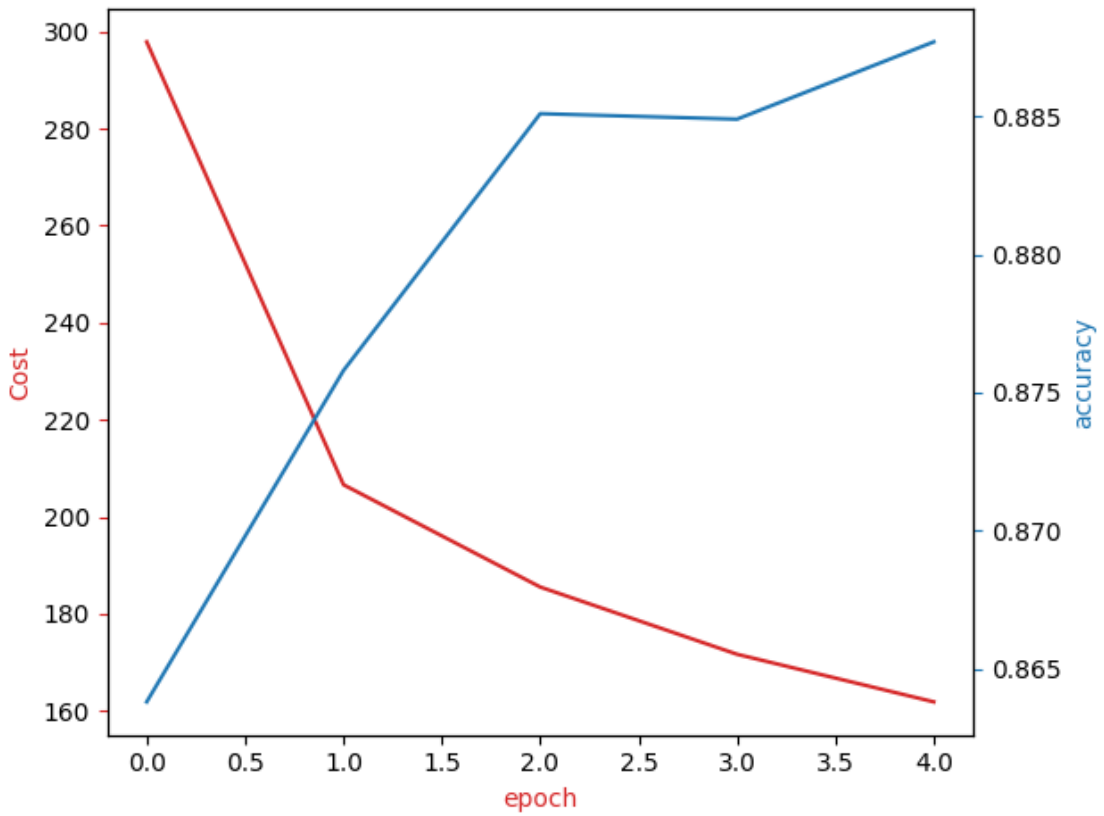
```
Epoch 1 | Cost: 297.84 | Accuracy: 0.8638
```

```
Epoch 2 | Cost: 206.62 | Accuracy: 0.8758
Epoch 3 | Cost: 185.55 | Accuracy: 0.8851
Epoch 4 | Cost: 171.70 | Accuracy: 0.8849
Epoch 5 | Cost: 161.90 | Accuracy: 0.8877
```

You will use the following to plot the Cost and accuracy for each epoch for the training and testing data, respectively.

[15]:
```
fig, ax1 = plt.subplots()
color = 'tab:red'
ax1.plot(cost_list, color=color)
ax1.set_xlabel('epoch', color=color)
ax1.set_ylabel('Cost', color=color)
ax1.tick_params(axis='y', color=color)

ax2 = ax1.twinx()
color = 'tab:blue'
ax2.set_ylabel('accuracy', color=color)
ax2.set_xlabel('epoch', color=color)
ax2.plot(accuracy_list, color=color)
ax2.tick_params(axis='y', color=color)
fig.tight_layout()
plt.show()
```



dataset: https://github.com/zalandoresearch/fashion-mnist

About the Authors:

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