```
import torch
import torch.nn as nn
import torch.nn.functional as F
import torch.optim as optim
from torchvision import datasets, transforms
import matplotlib.pyplot as plt
import numpy as np
```

```
batch_size = 64
num_epochs = 10
learning_rate = 0.01
```

```
# Define the transformation to apply to the images
transform = transforms.Compose([
    transforms.ToTensor(),
    transforms.Normalize((0.1307,), (0.3081,))
])
```

```
# Load the MNIST
train_dataset = datasets.MNIST(root='.', train=True, download=True, transform=transform)
test_dataset = datasets.MNIST(root='.', train=False, download=True, transform=transform)
```

```
Downloading http://yann.lecun.com/exdb/mnist/train-images-idx3-ubyte.gz
Failed to download (trying next):
HTTP Error 403: Forbidden

Downloading https://ossci-datasets.s3.amazonaws.com/mnist/train-images-idx3-ubyte.gz
Downloading https://ossci-datasets.s3.amazonaws.com/mnist/train-images-idx3-ubyte.gz
100%|██████████| 9912422/9912422 [00:00<00:00, 16450851.77it/s]
Extracting ./MNIST/raw/train-images-idx3-ubyte.gz to ./MNIST/raw

Downloading http://yann.lecun.com/exdb/mnist/train-labels-idx1-ubyte.gz
Failed to download (trying next):
HTTP Error 403: Forbidden

Downloading https://ossci-datasets.s3.amazonaws.com/mnist/train-labels-idx1-ubyte.gz
Downloading https://ossci-datasets.s3.amazonaws.com/mnist/train-labels-idx1-ubyte.gz
100%|██████████| 28881/28881 [00:00<00:00, 707634.44it/s]
Extracting ./MNIST/raw/train-labels-idx1-ubyte.gz to ./MNIST/raw

Downloading http://yann.lecun.com/exdb/mnist/t10k-images-idx3-ubyte.gz
Failed to download (trying next):
HTTP Error 403: Forbidden

Downloading https://ossci-datasets.s3.amazonaws.com/mnist/t10k-images-idx3-ubyte.gz
Downloading https://ossci-datasets.s3.amazonaws.com/mnist/t10k-images-idx3-ubyte.gz t
100%|██████████| 1648877/1648877 [00:00<00:00, 3818438.78it/s]
Extracting ./MNIST/raw/t10k-images-idx3-ubyte.gz to ./MNIST/raw

Downloading http://yann.lecun.com/exdb/mnist/t10k-labels-idx1-ubyte.gz
Failed to download (trying next):
```

```
HTTP Error 403: Forbidden

Downloading https://ossci-datasets.s3.amazonaws.com/mnist/t10k-labels-idx1-ubyte.gz
Downloading https://ossci-datasets.s3.amazonaws.com/mnist/t10k-labels-idx1-ubyte.gz t
100%|██████████| 4542/4542 [00:00<00:00, 8414544.51it/s]
Extracting ./MNIST/raw/t10k-labels-idx1-ubyte.gz to ./MNIST/raw
```

```
# Create the data loaders
train_loader = torch.utils.data.DataLoader(train_dataset, batch_size=batch_size, shuffle=True)
test_loader = torch.utils.data.DataLoader(test_dataset, batch_size=batch_size, shuffle=False)
```

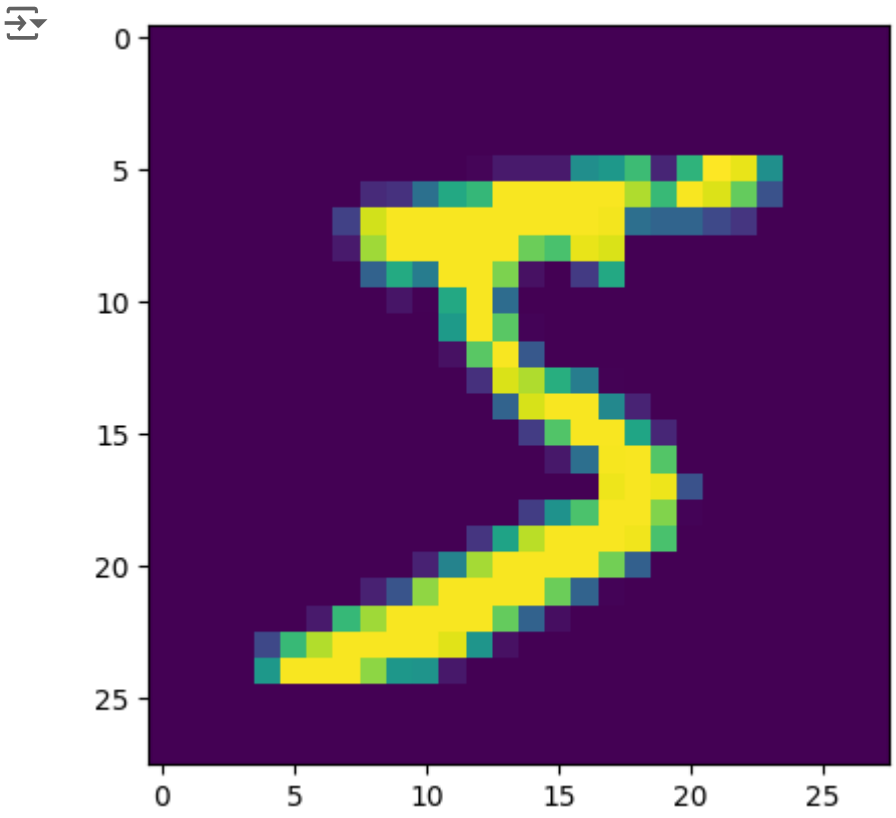
```
print(train_dataset)
```

```
Dataset MNIST
    Number of datapoints: 60000
    Root location: .
    Split: Train
    StandardTransform
Transform: Compose(
               ToTensor()
               Normalize(mean=(0.1307,), std=(0.3081,))
           )
```

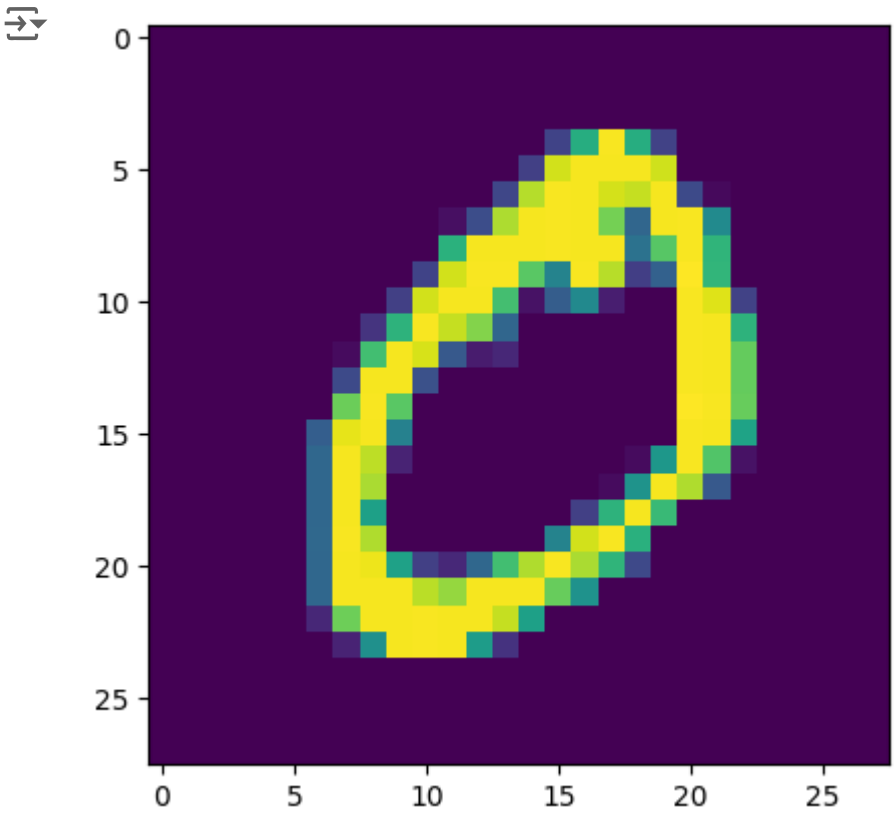
```
print(test_dataset)
```

```
Dataset MNIST
    Number of datapoints: 10000
    Root location: .
    Split: Test
    StandardTransform
Transform: Compose(
               ToTensor()
               Normalize(mean=(0.1307,), std=(0.3081,))
           )
```

```
digit=train_dataset[0][0][0]
plt.imshow(digit)
plt.show()
```




```
digit=train_dataset[1][0][0]
plt.imshow(digit)
plt.show()
```



```
# Define a Neural Network
class NeuralNet(nn.Module):
    def __init__(self):
        super(NeuralNet, self).__init__()
        self.fc1 = nn.Linear(28 * 28, 512)
        self.fc2 = nn.Linear(512, 256)
        self.fc3 = nn.Linear(256, 10)

    def forward(self, x):
        x = x.view(-1, 28 * 28)  # Flatten the image
        x = torch.relu(self.fc1(x))
        x = torch.relu(self.fc2(x))
        x = self.fc3(x)
        return x

# Train the Neural Network
criterion = nn.CrossEntropyLoss()
optimizer = optim.SGD(model.parameters(), lr=0.01, momentum=0.9)

num_epochs = 5
for epoch in range(num_epochs):
    for images, labels in train_loader:
        outputs = model(images)
        loss = criterion(outputs, labels)

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

    print(f'Epoch [{epoch+1}/{num_epochs}], Loss: {loss.item():.4f}')
```

```
Epoch [1/5], Loss: 0.1078
Epoch [2/5], Loss: 0.0775
Epoch [3/5], Loss: 0.0131
Epoch [4/5], Loss: 0.0173
Epoch [5/5], Loss: 0.0092
```

```
#  Evaluate the Neural Network
model.eval()
with torch.no_grad():
    correct = 0
    total = 0
    for images, labels in test_loader:
        outputs = model(images)
        _, predicted = torch.max(outputs.data, 1)
        total += labels.size(0)
        correct += (predicted == labels).sum().item()

    print(f'Accuracy of the model on the 10000 test images: {100 * correct / total:.2f}%')
```

```
Accuracy of the model on the 10000 test images: 97.93%
```