CNN_pytorch_ch05

October 30, 2025

[2]:

```
import os
import torch
import torch.nn as nn
from torch.autograd import Variable
import torch.utils.data as Data
import torchvision
import torch.nn.functional as F
import numpy as np
#
learning_rate = 1e-4
# Dropout       PyTorch   Dropout      p    (1 -   )
keep_prob_rate = 0.7
#
max_epoch = 3
#
BATCH_SIZE = 50

DOWNLOAD_MNIST = False
#      ./mnist/
if not(os.path.exists('./mnist/')) or not os.listdir('./mnist/'):
    # not mnist dir or mnist is empty dir
    DOWNLOAD_MNIST = True


#   ToTensor()   [0,255]      [0,1]     (C,H,W)
train_data = torchvision.datasets.MNIST(root='./mnist/', train=True,␣
 ↪transform=torchvision.transforms.ToTensor(), download=DOWNLOAD_MNIST,)
# DataLoader
train_loader = Data.DataLoader(dataset=train_data, batch_size=BATCH_SIZE,␣
 ↪shuffle=True)

#     transform
test_data = torchvision.datasets.MNIST(root='./mnist/', train=False)
#    500        [0,1]      [batch, 1, 28, 28]
test_x = test_data.test_data.unsqueeze(1).float()[:500] / 255.  #   [500, 1,␣
 ↪28, 28]
#     torchvision      data/targets
```

```
test_y = test_data.test_labels[:500].numpy()

class CNN(nn.Module):
    def __init__(self):
        super(CNN, self).__init__()
        self.conv1 = nn.Sequential(
            #   [B,1,28,28] -> Conv7x7   28x28 -> MaxPool2d(2) -> [B,32,14,14]
            nn.Conv2d(
                # 7x7      =1      =32  =1
                # padding = (kernel_size - 1) // 2 = 3      28x28
                in_channels=1,
                out_channels=32,
                kernel_size=7,
                stride=1,
                padding=3
            ),
            nn.ReLU(),         #
            nn.MaxPool2d(2)    # 2x2      28x28 -> 14x14
        )
        self.conv2 = nn.Sequential(
            #   [B,32,14,14] -> Conv5x5   14x14 -> MaxPool2d(2) -> [B,64,7,7]
            nn.Conv2d(
                # 5x5      =32    =64  =1 padding=2    14x14
                in_channels=32,
                out_channels=64,
                kernel_size=5,
                stride=1,
                padding=2
            ),
            nn.ReLU(),         #
            nn.MaxPool2d(2)    # 2x2      14x14 -> 7x7
        )
        # Flatten    64*7*7=3136
        self.out1 = nn.Linear(7*7*64, 1024, bias=True)   #   1  64*7*7  1024
        self.dropout = nn.Dropout(p=1 - keep_prob_rate)  # PyTorch   p      ␣
 ↪model.train()
        self.out2 = nn.Linear(1024,10,bias=True)



    def forward(self, x):
        x = self.conv1(x)   # -> [B,32,14,14]
        x = self.conv2(x)   # -> [B,64,7,7]
        x = x.view(x.size(0), -1)  #     [batch, 64, 7, 7] -> [batch, 64*7*7]
        out1 = self.out1(x)
        out1 = F.relu(out1)
        out1 = self.dropout(out1)
        out2 = self.out2(out1)           #     logits
        output = F.softmax(out2, dim=1)  #      softmax          logits  ␣
 ↪CrossEntropyLoss
        return output


def test(cnn):
    #     Dropout
    cnn.eval()
    with torch.no_grad():
        y_pre = cnn(test_x)
        #
        _, pre_index = torch.max(y_pre, 1)
        prediction = pre_index.view(-1).cpu().numpy()
    correct = np.sum(prediction == test_y)
    return correct / 500.0


def train(cnn):
    # Adam
    optimizer = torch.optim.Adam(cnn.parameters(), lr=learning_rate)
    #        logits   softmax
    loss_func = nn.CrossEntropyLoss()
    for epoch in range(max_epoch):
        cnn.train()  #      Dropout
        for step, (x, y) in enumerate(train_loader):
            output = cnn(x)  #           softmax     logits
            loss = loss_func(output, y)  #
            optimizer.zero_grad()  #
            loss.backward()  #
            optimizer.step()  #

            if step != 0 and step % 20 == 0:
                print("=" * 10, step, "=" * 5, "=" * 5, "test accuracy is ",␣
 ↪test(cnn), "=" * 10)

if __name__ == '__main__':
    cnn = CNN()
    train(cnn)
```

```
100.0%
100.0%
100.0%
100.0%
d:\code\python\deeplearning\.venv\Lib\site-
packages\torchvision\datasets\mnist.py:81: UserWarning: test_data has been
renamed data
```

```
  warnings.warn("test_data has been renamed data")
d:\code\python\deeplearning\.venv\Lib\site-
packages\torchvision\datasets\mnist.py:71: UserWarning: test_labels has been
renamed targets
  warnings.warn("test_labels has been renamed targets")
```

```
========== 20 ===== ===== test accuracy is  0.25 ==========
========== 40 ===== ===== test accuracy is  0.442 ==========
========== 60 ===== ===== test accuracy is  0.604 ==========
========== 80 ===== ===== test accuracy is  0.614 ==========
========== 100 ===== ===== test accuracy is  0.646 ==========
========== 120 ===== ===== test accuracy is  0.73 ==========
========== 140 ===== ===== test accuracy is  0.772 ==========
========== 160 ===== ===== test accuracy is  0.852 ==========
========== 180 ===== ===== test accuracy is  0.878 ==========
========== 200 ===== ===== test accuracy is  0.872 ==========
========== 220 ===== ===== test accuracy is  0.884 ==========
========== 240 ===== ===== test accuracy is  0.892 ==========
========== 260 ===== ===== test accuracy is  0.898 ==========
========== 280 ===== ===== test accuracy is  0.902 ==========
========== 300 ===== ===== test accuracy is  0.898 ==========
========== 320 ===== ===== test accuracy is  0.908 ==========
========== 340 ===== ===== test accuracy is  0.906 ==========
========== 360 ===== ===== test accuracy is  0.918 ==========
========== 380 ===== ===== test accuracy is  0.91 ==========
========== 400 ===== ===== test accuracy is  0.912 ==========
========== 420 ===== ===== test accuracy is  0.902 ==========
========== 440 ===== ===== test accuracy is  0.924 ==========
========== 460 ===== ===== test accuracy is  0.932 ==========
========== 480 ===== ===== test accuracy is  0.942 ==========
========== 500 ===== ===== test accuracy is  0.932 ==========
========== 520 ===== ===== test accuracy is  0.926 ==========
========== 540 ===== ===== test accuracy is  0.928 ==========
========== 560 ===== ===== test accuracy is  0.932 ==========
========== 580 ===== ===== test accuracy is  0.94 ==========
========== 600 ===== ===== test accuracy is  0.932 ==========
========== 620 ===== ===== test accuracy is  0.944 ==========
========== 640 ===== ===== test accuracy is  0.944 ==========
========== 660 ===== ===== test accuracy is  0.952 ==========
========== 680 ===== ===== test accuracy is  0.95 ==========
========== 700 ===== ===== test accuracy is  0.954 ==========
========== 720 ===== ===== test accuracy is  0.958 ==========
========== 740 ===== ===== test accuracy is  0.958 ==========
========== 760 ===== ===== test accuracy is  0.948 ==========
========== 780 ===== ===== test accuracy is  0.954 ==========
========== 800 ===== ===== test accuracy is  0.956 ==========
========== 820 ===== ===== test accuracy is  0.964 ==========
========== 840 ===== ===== test accuracy is  0.964 ==========
========== 860 ===== ===== test accuracy is  0.952 ==========
========== 880 ===== ===== test accuracy is  0.96 ==========
========== 900 ===== ===== test accuracy is  0.954 ==========
========== 920 ===== ===== test accuracy is  0.95 ==========
========== 940 ===== ===== test accuracy is  0.954 ==========
========== 960 ===== ===== test accuracy is  0.96 ==========
========== 980 ===== ===== test accuracy is  0.96 ==========
========== 1000 ===== ===== test accuracy is  0.95 ==========
========== 1020 ===== ===== test accuracy is  0.952 ==========
========== 1040 ===== ===== test accuracy is  0.962 ==========
========== 1060 ===== ===== test accuracy is  0.958 ==========
========== 1080 ===== ===== test accuracy is  0.956 ==========
========== 1100 ===== ===== test accuracy is  0.968 ==========
========== 1120 ===== ===== test accuracy is  0.962 ==========
========== 1140 ===== ===== test accuracy is  0.964 ==========
========== 1160 ===== ===== test accuracy is  0.966 ==========
========== 1180 ===== ===== test accuracy is  0.958 ==========
========== 20 ===== ===== test accuracy is  0.962 ==========
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========== 260 ===== ===== test accuracy is  0.962 ==========
========== 280 ===== ===== test accuracy is  0.97 ==========
========== 300 ===== ===== test accuracy is  0.974 ==========
========== 320 ===== ===== test accuracy is  0.97 ==========
========== 340 ===== ===== test accuracy is  0.978 ==========
========== 360 ===== ===== test accuracy is  0.968 ==========
========== 380 ===== ===== test accuracy is  0.974 ==========
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========== 420 ===== ===== test accuracy is  0.974 ==========
========== 440 ===== ===== test accuracy is  0.978 ==========
========== 460 ===== ===== test accuracy is  0.966 ==========
========== 480 ===== ===== test accuracy is  0.976 ==========
========== 500 ===== ===== test accuracy is  0.972 ==========
========== 520 ===== ===== test accuracy is  0.974 ==========
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========== 560 ===== ===== test accuracy is  0.974 ==========
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========== 620 ===== ===== test accuracy is  0.98 ==========
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========== 680 ===== ===== test accuracy is  0.976 ==========
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========== 720 ===== ===== test accuracy is  0.976 ==========
========== 740 ===== ===== test accuracy is  0.982 ==========
========== 760 ===== ===== test accuracy is  0.978 ==========
========== 780 ===== ===== test accuracy is  0.978 ==========
========== 800 ===== ===== test accuracy is  0.97 ==========
========== 820 ===== ===== test accuracy is  0.97 ==========
========== 840 ===== ===== test accuracy is  0.98 ==========
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========== 1140 ===== ===== test accuracy is  0.978 ==========
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========== 1180 ===== ===== test accuracy is  0.99 ==========
========== 20 ===== ===== test accuracy is  0.984 ==========
========== 40 ===== ===== test accuracy is  0.986 ==========
========== 60 ===== ===== test accuracy is  0.978 ==========
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