MSPL Week 3 何柏昇

MNIST

CNN Model

#input_shape=(1,28,28)

(cnn1): Conv2d(1, 16, kernel_size=(5, 5), stride=(1, 1))

#output_shape=(16,24,24)

(relu1): ReLU()

(maxpool1): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)

#output_shape=(16,12,12)

(cnn2): Conv2d(16, 32, kernel_size=(5, 5), stride=(1, 1))

#output_shape=(32,8,8)

(relu2): ReLU()

(maxpool2): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode=False)

#output_shape=(32,4,4)

#input_shape=(32*4*4)

(fc1): Linear(in_features=512, out_features=10, bias=True)

```
import torch
import torch.nn as nn
import torch.nn.functional as F
from torch.autograd import Variable
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt

# Preprocessing
# Loading MNIst dataset
from keras.datasets import mnist
(X_train, Y_train), (X_test, Y_test) = mnist.load_data()

# Normalization
X_train = X_train.astype('float32') / 255
X_test = X_test.astype('float32') / 255

# Train : Validation = 8 : 2
features_train, features_valid, targets_train, targets_valid =
train_test_split(X_train, Y_train, test_size = 0.2, random_state = 42)

# Data's type to tensor
featuresTrain = torch.from_numpy(features_train)
targetsTrain = torch.from_numpy(targets_train).type(torch.LongTensor) # data
type is long
featuresValid = torch.from_numpy(features_valid)
targetsValid = torch.from_numpy(targets_valid).type(torch.LongTensor) # data
type is long
featuresTest = torch.from_numpy(X_test)
targetsTest = torch.from_numpy(Y_test).type(torch.LongTensor) # data type is
long

# Pytorch train and test TensorDataset
train = torch.utils.data.TensorDataset(featuresTrain,targetsTrain)
valid = torch.utils.data.TensorDataset(featuresValid,targetsValid)
test = torch.utils.data.TensorDataset(featuresTest,targetsTest)

# Hyper Parameters :batch_size, epoch and iteration
LR = 0.01
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batch_size = 100
n_iters = 10000
num_epochs = n_iters / (len(features_train) / batch_size)
num_epochs = int(num_epochs)

# Pytorch DataLoader
train_loader = torch.utils.data.DataLoader(train, batch_size = batch_size,
shuffle = True)
valid_loader = torch.utils.data.DataLoader(valid, batch_size = batch_size,
shuffle = True)
test_loader = torch.utils.data.DataLoader(test, batch_size = batch_size,
shuffle = True)

# Create CNN Model
class CNN_Model(nn.Module):
    def __init__(self):
        super(CNN_Model, self).__init__()
        # Convolution 1 , input_shape=(1,28,28)
        self.cnn1 = nn.Conv2d(in_channels=1, out_channels=16, kernel_size=5,
stride=1, padding=0) #output_shape=(16,24,24)
        self.relu1 = nn.ReLU() # activation
        # Max pool 1
        self.maxpool1 = nn.MaxPool2d(kernel_size=2) #output_shape=(16,12,12)
        # Convolution 2
        self.cnn2 = nn.Conv2d(in_channels=16, out_channels=32,
kernel_size=5, stride=1, padding=0) #output_shape=(32,8,8)
        self.relu2 = nn.ReLU() # activation
        # Max pool 2
        self.maxpool2 = nn.MaxPool2d(kernel_size=2) #output_shape=(32,4,4)
        # Fully connected 1 ,#input_shape=(32*4*4)
        self.fc1 = nn.Linear(32 * 4 * 4, 10)

    def forward(self, x):
        # Convolution 1
        out = self.cnn1(x)
        out = self.relu1(out)
        # Max pool 1
        out = self.maxpool1(out)
```

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        # Convolution 2
        out = self.cnn2(out)
        out = self.relu2(out)
        # Max pool 2
        out = self.maxpool2(out)
        out = out.view(out.size(0), -1)
        # Linear function (readout)
        out = self.fc1(out)
        return out

# Build the model
model = CNN_Model()
print(model)
optimizer = torch.optim.Adam(model.parameters(), lr=LR)   # optimize all cnn
parameters
loss_func = nn.CrossEntropyLoss()   # the target label is not one-hotted
input_shape = (-1,1,28,28)

# Traning the Model
def fit_model(model, loss_func, optimizer, input_shape, num_epochs,
train_loader, vaild_loader):
    #history-like list for store loss & acc value
    training_loss = []
    training_accuracy = []
    validation_loss = []
    validation_accuracy = []
    for epoch in range(num_epochs):
        #training model & store loss & acc / epoch
        correct_train = 0
        total_train = 0
        for i, (images, labels) in enumerate(train_loader):
            # 1.Define variables
            train = Variable(images.view(input_shape))
            labels = Variable(labels)
            # 2.Clear gradients
            optimizer.zero_grad()
            # 3.Forward propagation
            outputs = model(train)
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        # 4.Calculate softmax and cross entropy loss
        train_loss = loss_func(outputs, labels)
        # 5.Calculate gradients
        train_loss.backward()
        # 6.Update parameters
        optimizer.step()
        # 7.Get predictions from the maximum value
        predicted = torch.max(outputs.data, 1)[1]
        # 8.Total number of labels
        total_train += len(labels)
        # 9.Total correct predictions
        correct_train += (predicted == labels).float().sum()
    #10.store val_acc / epoch
    train_accuracy = 100 * correct_train / float(total_train)
    training_accuracy.append(train_accuracy)
    # 11.store loss / epoch
    training_loss.append(train_loss.data)

    #evaluate model & store loss & acc / epoch
    correct_test = 0
    total_test = 0
    for images, labels in vaild_loader:
        # 1.Define variables
        test = Variable(images.view(input_shape))
        # 2.Forward propagation
        outputs = model(test)
        # 3.Calculate softmax and cross entropy loss
        val_loss = loss_func(outputs, labels)
        # 4.Get predictions from the maximum value
        predicted = torch.max(outputs.data, 1)[1]
        # 5.Total number of labels
        total_test += len(labels)
        # 6.Total correct predictions
        correct_test += (predicted == labels).float().sum()
    #6.store val_acc / epoch
    val_accuracy = 100 * correct_test / float(total_test)
    validation_accuracy.append(val_accuracy)
    # 11.store val_loss / epoch
```

```
        validation_loss.append(val_loss.data)
        print('Train Epoch: {}/{} Traing_Loss: {} Traing_acc: {:.6f}%
Val_Loss: {} Val_accuracy: {:.6f}%'.format(epoch+1, num_epochs,
train_loss.data, train_accuracy, val_loss.data, val_accuracy))
    return training_loss, training_accuracy, validation_loss,
validation_accuracy

# Model fit
training_loss, training_accuracy, validation_loss, validation_accuracy =
fit_model(model, loss_func, optimizer, input_shape, num_epochs,
train_loader, valid_loader)

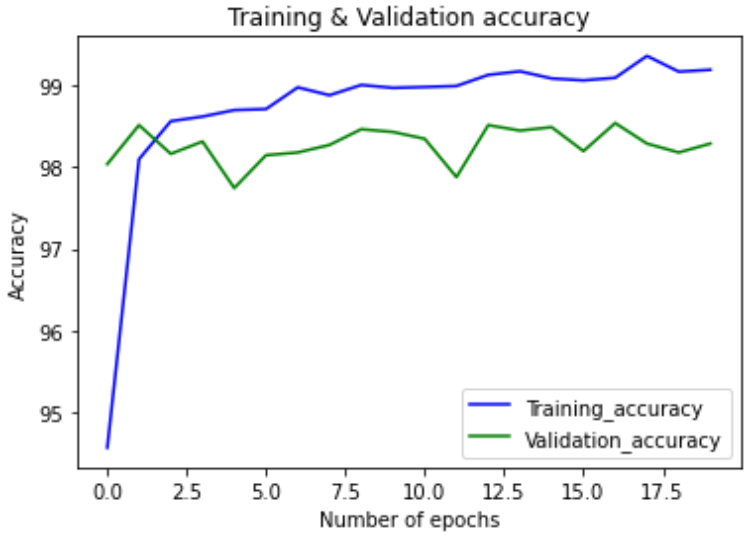
# visualization
plt.plot(range(num_epochs), training_loss, 'b-', label='Training_loss')
plt.plot(range(num_epochs), validation_loss, 'g-', label='validation_loss')
plt.title('Training & Validation loss')
plt.xlabel('Number of epochs')
plt.ylabel('Loss')
plt.legend()
plt.show()
plt.plot(range(num_epochs), training_accuracy, 'b-',
label='Training_accuracy')
plt.plot(range(num_epochs), validation_accuracy, 'g-',
label='Validation_accuracy')
plt.title('Training & Validation accuracy')
plt.xlabel('Number of epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.show()

# Predict testing data
def predict_model(test_loader):
    training_loss = []
    training_accuracy = []
    #evaluate model & store loss & acc / epoch
    correct_test = 0
    total_test = 0
    for images, labels in test_loader:
```

```
        # 1.Define variables
        test = Variable(images.view(input_shape))
        # 2.Forward propagation
        outputs = model(test)
        # 3.Calculate softmax and cross entropy loss
        test_loss = loss_func(outputs, labels)
        # 4.Get predictions from the maximum value
        predicted = torch.max(outputs.data, 1)[1]
        # 5.Total number of labels
        total_test += len(labels)
        # 6.Total correct predictions
        correct_test += (predicted == labels).float().sum()
    # Store test_acc
    test_accuracy = 100 * correct_test / float(total_test)
    return test_loss, test_accuracy

test_loss, test_accuracy = predict_model(test_loader)
print("Loss: ",test_loss,"\tAccuracy: ", test_accuracy)
```

Training + Validation



Testing

Accuracy: 98.4900%

Github

MSPL/ week3