计算机科学与技术学院神经网络与深度学习课程实验报告

实验题目：华为云使用测试		学号：201600301304
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实验目的：使用华为云，基于 mnist 数据集任务，训练 tensorflow 和 pytorch 模型，并可视化		
实验软件和硬件环境： 操作系统 mac os，内存 16GB，编译器 pycharm		
实验原理和方法： 操作步骤参考华为云使用手册		

实验步骤：（不要求罗列完整源代码）

tensorflow

```
from __future__ import absolute_import
from __future__ import division
from __future__ import print_function

import argparse
import os
import sys

import tensorflow as tf

from tensorflow.examples.tutorials.mnist import input_data

FLAGS = None


def train():
  # Import data
  mnist = input_data.read_data_sets(FLAGS.data_dir,
                                    fake_data=FLAGS.fake_data)

  sess = tf.InteractiveSession()
  # Create a multilayer model.

  # Input placeholders
```

```
  with tf.name_scope('input'):
    x = tf.placeholder(tf.float32, [None, 784], name='x-input')
    y_ = tf.placeholder(tf.int64, [None], name='y-input')

  with tf.name_scope('input_reshape'):
    image_shaped_input = tf.reshape(x, [-1, 28, 28, 1])
    tf.summary.image('input', image_shaped_input, 10)

  # We can't initialize these variables to 0 - the network will get stuck.
  def weight_variable(shape):
    """Create a weight variable with appropriate initialization."""
    initial = tf.truncated_normal(shape, stddev=0.1)
    return tf.Variable(initial)

  def bias_variable(shape):
    """Create a bias variable with appropriate initialization."""
    initial = tf.constant(0.1, shape=shape)
    return tf.Variable(initial)

  def variable_summaries(var):
    """Attach a lot of summaries to a Tensor (for TensorBoard visualization)."""
    with tf.name_scope('summaries'):
      mean = tf.reduce_mean(var)
      tf.summary.scalar('mean', mean)
      with tf.name_scope('stddev'):
        stddev = tf.sqrt(tf.reduce_mean(tf.square(var - mean)))
      tf.summary.scalar('stddev', stddev)
      tf.summary.scalar('max', tf.reduce_max(var))
      tf.summary.scalar('min', tf.reduce_min(var))
      tf.summary.histogram('histogram', var)

  def nn_layer(input_tensor, input_dim, output_dim, layer_name,
act=tf.nn.relu):
    """Reusable code for making a simple neural net layer.
    It does a matrix multiply, bias add, and then uses ReLU to nonlinearize.
    It also sets up name scoping so that the resultant graph is easy to read,
    and adds a number of summary ops.
    """
    # Adding a name scope ensures logical grouping of the layers in the graph.
    with tf.name_scope(layer_name):
      # This Variable will hold the state of the weights for the layer
      with tf.name_scope('weights'):
        weights = weight_variable([input_dim, output_dim])
        variable_summaries(weights)
```

```
    with tf.name_scope('biases'):
      biases = bias_variable([output_dim])
      variable_summaries(biases)
    with tf.name_scope('Wx_plus_b'):
      preactivate = tf.matmul(input_tensor, weights) + biases
      tf.summary.histogram('pre_activations', preactivate)
    activations = act(preactivate, name='activation')
    tf.summary.histogram('activations', activations)
    return activations

hidden1 = nn_layer(x, 784, 500, 'layer1')

with tf.name_scope('dropout'):
  keep_prob = tf.placeholder(tf.float32)
  tf.summary.scalar('dropout_keep_probability', keep_prob)
  dropped = tf.nn.dropout(hidden1, keep_prob)

# Do not apply softmax activation yet, see below.
y = nn_layer(dropped, 500, 10, 'layer2', act=tf.identity)

with tf.name_scope('cross_entropy'):
  # The raw formulation of cross-entropy,
  #
  # tf.reduce_mean(-tf.reduce_sum(y_ * tf.log(tf.softmax(y)),
  #                           reduction_indices=[1]))
  #
  # can be numerically unstable.
  #
  # So here we use tf.losses.sparse_softmax_cross_entropy on the
  # raw logit outputs of the nn_layer above, and then average across
  # the batch.
  with tf.name_scope('total'):
    cross_entropy = tf.losses.sparse_softmax_cross_entropy(
       labels=y_, logits=y)
tf.summary.scalar('cross_entropy', cross_entropy)

with tf.name_scope('train'):
  train_step = tf.train.AdamOptimizer(FLAGS.learning_rate).minimize(
     cross_entropy)

with tf.name_scope('accuracy'):
  with tf.name_scope('correct_prediction'):
    correct_prediction = tf.equal(tf.argmax(y, 1), y_)
  with tf.name_scope('accuracy'):
```

```
    accuracy = tf.reduce_mean(tf.cast(correct_prediction, tf.float32))
tf.summary.scalar('accuracy', accuracy)

# Merge all the summaries and write them out to
# /tmp/tensorflow/mnist/logs/mnist_with_summaries (by default)
merged = tf.summary.merge_all()
train_writer = tf.summary.FileWriter(FLAGS.log_dir + '/train', sess.graph)
test_writer = tf.summary.FileWriter(FLAGS.log_dir + '/test')
tf.global_variables_initializer().run()

# Train the model, and also write summaries.
# Every 10th step, measure test-set accuracy, and write test summaries
# All other steps, run train_step on training data, & add training summaries

def feed_dict(train):
  """Make a TensorFlow feed_dict: maps data onto Tensor placeholders."""
  if train or FLAGS.fake_data:
    xs, ys = mnist.train.next_batch(100, fake_data=FLAGS.fake_data)
    k = FLAGS.dropout
  else:
    xs, ys = mnist.test.images, mnist.test.labels
    k = 1.0
  return {x: xs, y_: ys, keep_prob: k}

for i in range(FLAGS.max_steps):
  if i % 10 == 0:  # Record summaries and test-set accuracy
    summary, acc = sess.run([merged, accuracy], feed_dict=feed_dict(False))
    test_writer.add_summary(summary, i)
    print('Accuracy at step %s: %s' % (i, acc))
  else:  # Record train set summaries, and train
    if i % 100 == 99:  # Record execution stats
      run_options = tf.RunOptions(trace_level=tf.RunOptions.FULL_TRACE)
      run_metadata = tf.RunMetadata()
      summary, _ = sess.run([merged, train_step],
                            feed_dict=feed_dict(True),
                            options=run_options,
                            run_metadata=run_metadata)
      train_writer.add_run_metadata(run_metadata, 'step%03d' % i)
      train_writer.add_summary(summary, i)
      print('Adding run metadata for', i)
    else:  # Record a summary
      summary, _ = sess.run([merged, train_step], feed_dict=feed_dict(True))
      train_writer.add_summary(summary, i)
train_writer.close()
```

```
  test_writer.close()


def main(_):
  if tf.gfile.Exists(FLAGS.log_dir):
    tf.gfile.DeleteRecursively(FLAGS.log_dir)
  tf.gfile.MakeDirs(FLAGS.log_dir)
  with tf.Graph().as_default():
    train()


if __name__ == '__main__':
  parser = argparse.ArgumentParser()
  parser.add_argument('--fake_data', nargs='?', const=True, type=bool,
                      default=False,
                      help='If true, uses fake data for unit testing.')
  parser.add_argument('--max_steps', type=int, default=1000,
                      help='Number of steps to run trainer.')
  parser.add_argument('--learning_rate', type=float, default=0.001,
                      help='Initial learning rate')
  parser.add_argument('--dropout', type=float, default=0.9,
                      help='Keep probability for training dropout.')
  parser.add_argument(
      '--data_dir',
      type=str,
      default=os.path.join(os.getenv('TEST_TMPDIR', '/tmp'),
                           'tensorflow/mnist/input_data'),
      help='Directory for storing input data')
  parser.add_argument(
      '--log_dir',
      type=str,
      default=os.path.join(os.getenv('TEST_TMPDIR', '/tmp'),
                           'tensorflow/mnist/logs/mnist_with_summaries'),
      help='Summaries log directory')
  FLAGS, unparsed = parser.parse_known_args()
  tf.app.run(main=main, argv=[sys.argv[0]] + unparsed)


pytorch

from __future__ import print_function
import argparse
import torch
import torch.nn as nn
```

```
import torch.nn.functional as F
import torch.optim as optim
from torchvision import datasets, transforms
import os
import moxing as mox
_S3_SECRET_ACCESS_KEY=(os.environ.get('SECRET_ACCESS_KEY',None)
                  or os.environ.get('S3_SECRET_ACCESS_KEY',None)
                  or os.environ.get('AWS_SECRET_ACCESS_KEY',None))
_S3_ACCESS_KEY_ID=(os.environ.get('ACCESS_KEY_ID',None)
               or os.environ.get('S3_ACCESS_KEY_ID',None)
               or os.environ.get('AWS_ACCESS_KEY_ID'),None)
mox.file.set_auth(ak=_S3_ACCESS_KEY_ID,sk=_S3_SECRET_ACCESS_KEY)
class Net(nn.Module):
    def __init__(self):
        super(Net, self).__init__()
        self.conv1 = nn.Conv2d(1, 20, 5, 1)
        self.conv2 = nn.Conv2d(20, 50, 5, 1)
        self.fc1 = nn.Linear(4*4*50, 500)
        self.fc2 = nn.Linear(500, 10)

    def forward(self, x):
        x = F.relu(self.conv1(x))
        x = F.max_pool2d(x, 2, 2)
        x = F.relu(self.conv2(x))
        x = F.max_pool2d(x, 2, 2)
        x = x.view(-1, 4*4*50)
        x = F.relu(self.fc1(x))
        x = self.fc2(x)
        return F.log_softmax(x, dim=1)


def train(args, model, device, train_loader, optimizer, epoch):
    model.train()
    for batch_idx, (data, target) in enumerate(train_loader):
        data, target = data.to(device), target.to(device)
        optimizer.zero_grad()
        output = model(data)
        loss = F.nll_loss(output, target)
        loss.backward()
        optimizer.step()
        if batch_idx % args.log_interval == 0:
            print('Train Epoch: {} [{}/{} ({:.0f}%)]\tLoss: {:.6f}'.format(
                epoch, batch_idx * len(data), len(train_loader.dataset),
                100. * batch_idx / len(train_loader), loss.item()))
```

```
def test(args, model, device, test_loader):
    model.eval()
    test_loss = 0
    correct = 0
    with torch.no_grad():
        for data, target in test_loader:
            data, target = data.to(device), target.to(device)
            output = model(data)
            # sum up batch loss
            test_loss += F.nll_loss(output, target, reduction='sum').item()
            # get the index of the max log-probability
            pred = output.argmax(dim=1, keepdim=True)
            correct += pred.eq(target.view_as(pred)).sum().item()

    test_loss /= len(test_loader.dataset)

    print('\nTest set: Average loss: {:.4f}, Accuracy: {}/{} ({:.0f}%)\n'.format(
        test_loss, correct, len(test_loader.dataset),
        100. * correct / len(test_loader.dataset)))


def main():
    # Training settings
    parser = argparse.ArgumentParser(description='PyTorch MNIST Example')
    parser.add_argument('--batch-size', type=int, default=64,
                        help='input batch size for training (default: 64)')
    parser.add_argument('--test-batch-size', type=int, default=1000,
                        help='input batch size for testing (default: 1000)')
    parser.add_argument('--epochs', type=int, default=10,
                        help='number of epochs to train (default: 10)')
    parser.add_argument('--lr', type=float, default=0.01,
                        help='learning rate (default: 0.01)')
    parser.add_argument('--momentum', type=float, default=0.5,
                        help='SGD momentum (default: 0.5)')
    parser.add_argument('--no-cuda', action='store_true', default=False,
                        help='disables CUDA training')
    parser.add_argument('--seed', type=int, default=1,
                        help='random seed (default: 1)')
    parser.add_argument('--log-interval', type=int, default=10,
                        help='how many batches to wait before logging training
status')
#    parser.add_argument(
#        '--data_url',type=str,default='s3://obs-5619'
```

```
#        ,help=''
#    )
#    parser.add_argument(
#        '--train_url',type=str,default='s3://obs-5619/log'
#        ,help=''
#    )
    parser.add_argument('--save-model', action='store_true', default=False,
                        help='For Saving the current Model')
#    args = parser.parse_args()
    args = parser.parse_known_args()[0]
    use_cuda = not args.no_cuda and torch.cuda.is_available()

    torch.manual_seed(args.seed)

    device = torch.device("cuda" if use_cuda else "cpu")

    kwargs = {'num_workers': 1, 'pin_memory': True} if use_cuda else {}
    train_loader = torch.utils.data.DataLoader(
        datasets.MNIST('s3://obs-5619/minst_dataset', train=True,
download=True,
                       transform=transforms.Compose([
                           transforms.ToTensor(),
                           transforms.Normalize((0.1307,), (0.3081,))
                       ])),
        batch_size=args.batch_size, shuffle=True, **kwargs)
    test_loader = torch.utils.data.DataLoader(
        datasets.MNIST('s3://obs-5619/minst_dataset', train=False,
transform=transforms.Compose([
            transforms.ToTensor(),
            transforms.Normalize((0.1307,), (0.3081,))
        ])),
        batch_size=args.test_batch_size, shuffle=True, **kwargs)

    model = Net().to(device)
    optimizer = optim.SGD(model.parameters(), lr=args.lr,
                          momentum=args.momentum)

    for epoch in range(1, args.epochs + 1):
        train(args, model, device, train_loader, optimizer, epoch)
        test(args, model, device, test_loader)

    if (args.save_model):
        torch.save(model.state_dict(), "mnist_cnn.pt")
```

```
if __name__ == '__main__':
    main()
```

结论分析与体会：

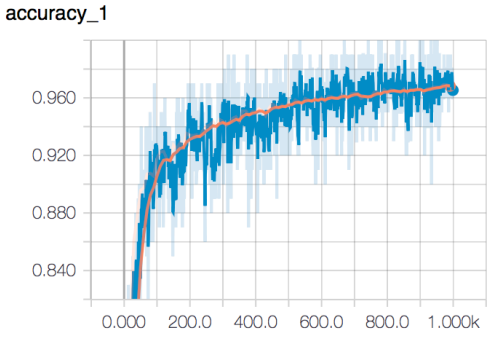
tensorflow结果

```
Accuracy at step 0: 0.1189
Accuracy at step 10: 0.6787
Accuracy at step 20: 0.8192
Accuracy at step 30: 0.8602
Accuracy at step 40: 0.8808
Accuracy at step 50: 0.8886
Accuracy at step 60: 0.8964
Accuracy at step 70: 0.8983
Accuracy at step 80: 0.9036
Accuracy at step 90: 0.9088
Adding run metadata for 99
Accuracy at step 100: 0.9128
Accuracy at step 110: 0.9156
Accuracy at step 120: 0.9251
Accuracy at step 130: 0.9255
Accuracy at step 140: 0.9259
Accuracy at step 150: 0.9268
Accuracy at step 160: 0.927
Accuracy at step 170: 0.9308
Accuracy at step 180: 0.9327
Accuracy at step 190: 0.9336
Adding run metadata for 199
Accuracy at step 200: 0.9355
Accuracy at step 210: 0.9371
Accuracy at step 220: 0.9373
Accuracy at step 230: 0.9389
Accuracy at step 240: 0.9396
Accuracy at step 250: 0.9427
Accuracy at step 260: 0.9432
Accuracy at step 270: 0.9429
Accuracy at step 280: 0.9417
Accuracy at step 290: 0.9448
Adding run metadata for 299
```

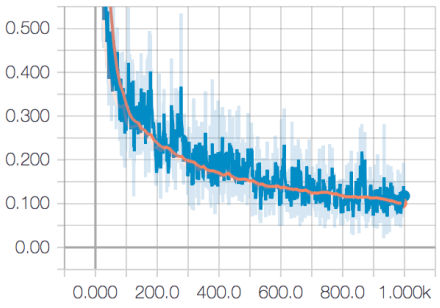
```
Accuracy at step 300: 0.9457
Accuracy at step 310: 0.9463
Accuracy at step 320: 0.9452
Accuracy at step 330: 0.9476
Accuracy at step 340: 0.9468
Accuracy at step 350: 0.9475
Accuracy at step 360: 0.9491
Accuracy at step 370: 0.9503
Accuracy at step 380: 0.9472
Accuracy at step 390: 0.9477
Adding run metadata for 399
Accuracy at step 400: 0.9503
Accuracy at step 410: 0.9522
Accuracy at step 420: 0.9489
Accuracy at step 430: 0.9532
Accuracy at step 440: 0.9553
Accuracy at step 450: 0.9555
Accuracy at step 460: 0.9513
Accuracy at step 470: 0.957
Accuracy at step 480: 0.9564
Accuracy at step 490: 0.956
Adding run metadata for 499
Accuracy at step 500: 0.9583
Accuracy at step 510: 0.9579
Accuracy at step 520: 0.9568
Accuracy at step 530: 0.9541
Accuracy at step 540: 0.9582
Accuracy at step 550: 0.9573
Accuracy at step 560: 0.9594
Accuracy at step 570: 0.9563
Accuracy at step 580: 0.9608
Accuracy at step 590: 0.9594
Adding run metadata for 599
Accuracy at step 600: 0.9607
Accuracy at step 610: 0.9602
Accuracy at step 620: 0.9595
Accuracy at step 630: 0.9591
Accuracy at step 640: 0.9611
Accuracy at step 650: 0.9624
Accuracy at step 660: 0.9602
Accuracy at step 670: 0.9623
Accuracy at step 680: 0.962
Accuracy at step 690: 0.9607
Adding run metadata for 699
```

```
Accuracy at step 700: 0.9622
Accuracy at step 710: 0.9624
Accuracy at step 720: 0.9607
Accuracy at step 730: 0.9637
Accuracy at step 740: 0.9645
Accuracy at step 750: 0.9614
Accuracy at step 760: 0.9613
Accuracy at step 770: 0.9627
Accuracy at step 780: 0.9641
Accuracy at step 790: 0.9642
Adding run metadata for 799
Accuracy at step 800: 0.962
Accuracy at step 810: 0.9664
Accuracy at step 820: 0.9658
Accuracy at step 830: 0.9643
Accuracy at step 840: 0.9664
Accuracy at step 850: 0.9669
Accuracy at step 860: 0.9644
Accuracy at step 870: 0.9611
Accuracy at step 880: 0.9659
Accuracy at step 890: 0.9623
Adding run metadata for 899
Accuracy at step 900: 0.9662
Accuracy at step 910: 0.9681
Accuracy at step 920: 0.9649
Accuracy at step 930: 0.9655
Accuracy at step 940: 0.9676
Accuracy at step 950: 0.9674
Accuracy at step 960: 0.9664
Accuracy at step 970: 0.9659
Accuracy at step 980: 0.9669
Accuracy at step 990: 0.9664
Adding run metadata for 999
```

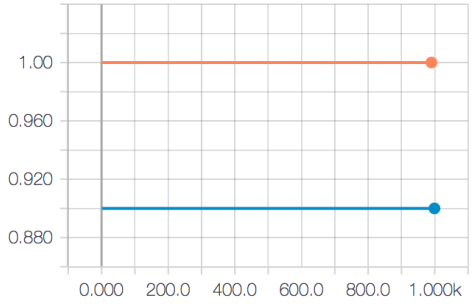
Tensorboard可视化



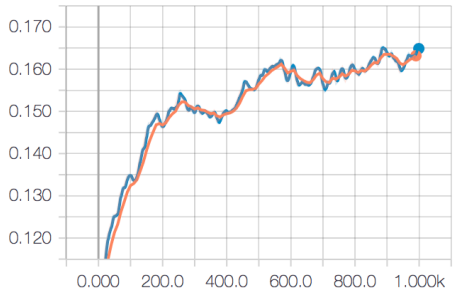
cross_entropy_1



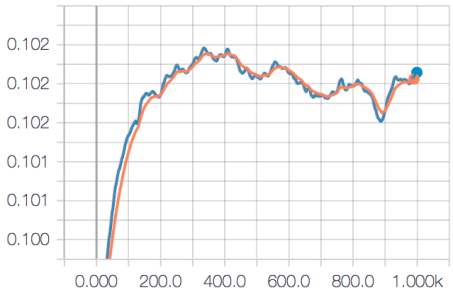
dropout/dropout_keep_probability



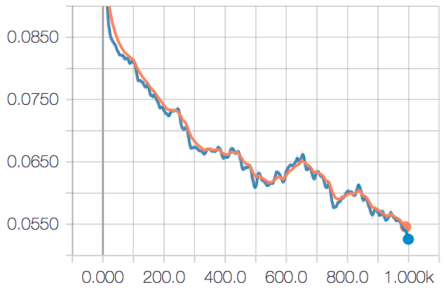
layer1/biases/summaries/max



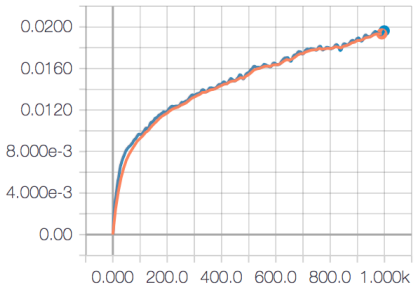
layer1/biases/summaries/mean



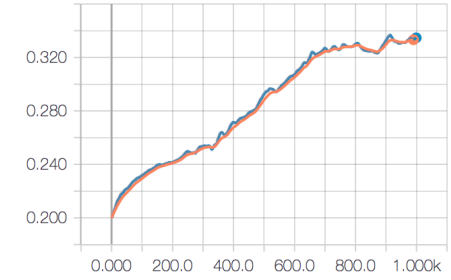
layer1/biases/summaries/min



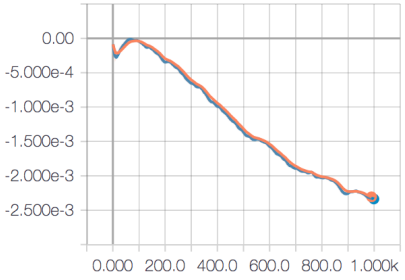
layer1/biases/summaries/stddev_1

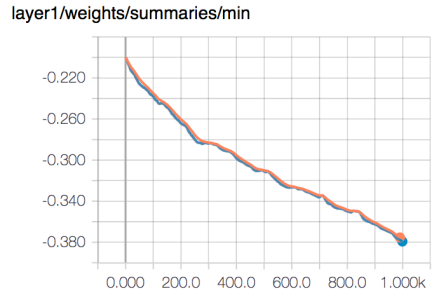


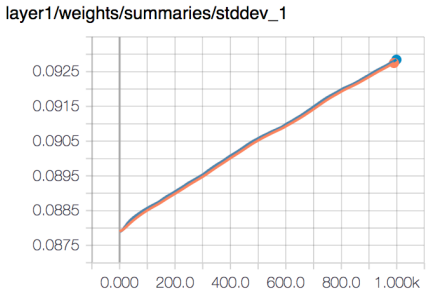
layer1/weights/summaries/max

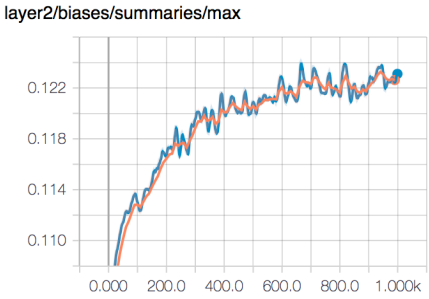


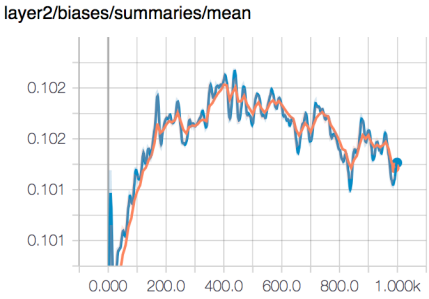
layer1/weights/summaries/mean

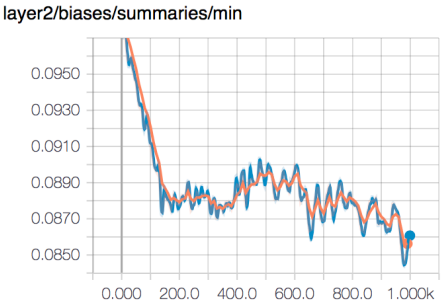


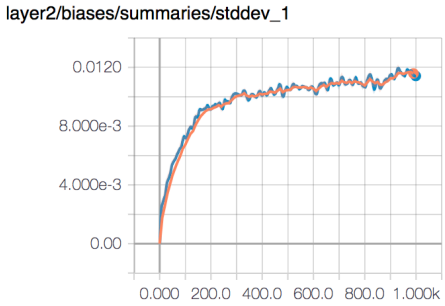


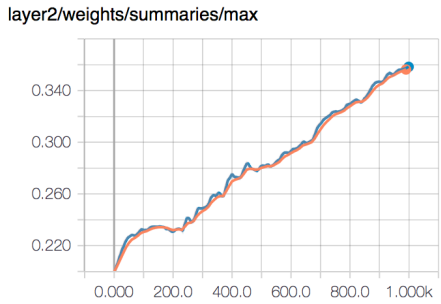


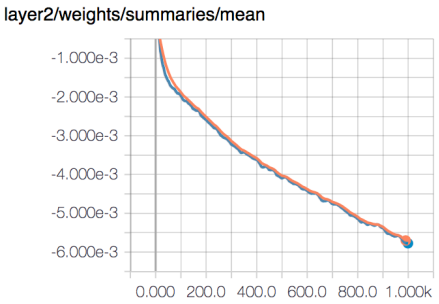


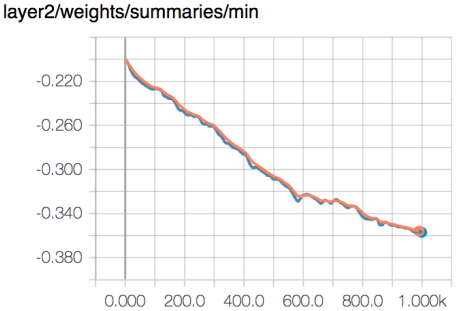












Pytorch

Processing...

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Done!
Train Epoch: 1 [0/60000 (0%)]   Loss: 2.300039
Train Epoch: 1 [640/60000 (1%)] Loss: 2.213460
Train Epoch: 1 [1280/60000 (2%)]    Loss: 2.170403
Train Epoch: 1 [1920/60000 (3%)]    Loss: 2.076579
Train Epoch: 1 [2560/60000 (4%)]    Loss: 1.867874
Train Epoch: 1 [3200/60000 (5%)]    Loss: 1.413479
Train Epoch: 1 [3840/60000 (6%)]    Loss: 1.000340
Train Epoch: 1 [4480/60000 (7%)]    Loss: 0.776303
Train Epoch: 1 [5120/60000 (9%)]    Loss: 0.459811
Train Epoch: 1 [5760/60000 (10%)]   Loss: 0.487046
Train Epoch: 1 [6400/60000 (11%)]   Loss: 0.438144
Train Epoch: 1 [7040/60000 (12%)]   Loss: 0.408856
Train Epoch: 1 [7680/60000 (13%)]   Loss: 0.461841
Train Epoch: 1 [8320/60000 (14%)]   Loss: 0.428374
Train Epoch: 1 [8960/60000 (15%)]   Loss: 0.399202
Train Epoch: 1 [9600/60000 (16%)]   Loss: 0.384034
Train Epoch: 1 [10240/60000 (17%)]  Loss: 0.298051
Train Epoch: 1 [10880/60000 (18%)]  Loss: 0.501322
Train Epoch: 1 [11520/60000 (19%)]  Loss: 0.524580
Train Epoch: 1 [12160/60000 (20%)]  Loss: 0.337594
Train Epoch: 1 [12800/60000 (21%)]  Loss: 0.367772
Train Epoch: 1 [13440/60000 (22%)]  Loss: 0.451532
Train Epoch: 1 [14080/60000 (23%)]  Loss: 0.304324
Train Epoch: 1 [14720/60000 (25%)]  Loss: 0.358088
Train Epoch: 1 [15360/60000 (26%)]  Loss: 0.330108
Train Epoch: 1 [16000/60000 (27%)]  Loss: 0.439247
Train Epoch: 1 [16640/60000 (28%)]  Loss: 0.362622
Train Epoch: 1 [17280/60000 (29%)]  Loss: 0.317910
Train Epoch: 1 [17920/60000 (30%)]  Loss: 0.201307
Train Epoch: 1 [18560/60000 (31%)]  Loss: 0.500353
Train Epoch: 1 [19200/60000 (32%)]  Loss: 0.326589
Train Epoch: 1 [19840/60000 (33%)]  Loss: 0.119402
Train Epoch: 1 [20480/60000 (34%)]  Loss: 0.189782
Train Epoch: 1 [21120/60000 (35%)]  Loss: 0.140237
Train Epoch: 1 [21760/60000 (36%)]  Loss: 0.316014
Train Epoch: 1 [22400/60000 (37%)]  Loss: 0.149900
Train Epoch: 1 [23040/60000 (38%)]  Loss: 0.288650
Train Epoch: 1 [23680/60000 (39%)]  Loss: 0.468395
Train Epoch: 1 [24320/60000 (41%)]  Loss: 0.215614
Train Epoch: 1 [24960/60000 (42%)]  Loss: 0.152429
Train Epoch: 1 [25600/60000 (43%)]  Loss: 0.224683
Train Epoch: 1 [26240/60000 (44%)]  Loss: 0.263283
Train Epoch: 1 [26880/60000 (45%)]  Loss: 0.232621
```

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Train Epoch: 1 [27520/60000 (46%)]  Loss: 0.263381
Train Epoch: 1 [28160/60000 (47%)]  Loss: 0.212269
Train Epoch: 1 [28800/60000 (48%)]  Loss: 0.133421
Train Epoch: 1 [29440/60000 (49%)]  Loss: 0.278359
Train Epoch: 1 [30080/60000 (50%)]  Loss: 0.093708
Train Epoch: 1 [30720/60000 (51%)]  Loss: 0.127433
Train Epoch: 1 [31360/60000 (52%)]  Loss: 0.246622
Train Epoch: 1 [32000/60000 (53%)]  Loss: 0.338711
Train Epoch: 1 [32640/60000 (54%)]  Loss: 0.152402
Train Epoch: 1 [33280/60000 (55%)]  Loss: 0.090370
Train Epoch: 1 [33920/60000 (57%)]  Loss: 0.144396
Train Epoch: 1 [34560/60000 (58%)]  Loss: 0.197434
Train Epoch: 1 [35200/60000 (59%)]  Loss: 0.219226
Train Epoch: 1 [35840/60000 (60%)]  Loss: 0.064045
Train Epoch: 1 [36480/60000 (61%)]  Loss: 0.136504
Train Epoch: 1 [37120/60000 (62%)]  Loss: 0.115647
Train Epoch: 1 [37760/60000 (63%)]  Loss: 0.235189
Train Epoch: 1 [38400/60000 (64%)]  Loss: 0.063158
Train Epoch: 1 [39040/60000 (65%)]  Loss: 0.107763
Train Epoch: 1 [39680/60000 (66%)]  Loss: 0.160305
Train Epoch: 1 [40320/60000 (67%)]  Loss: 0.109566
Train Epoch: 1 [40960/60000 (68%)]  Loss: 0.178810
Train Epoch: 1 [41600/60000 (69%)]  Loss: 0.230396
Train Epoch: 1 [42240/60000 (70%)]  Loss: 0.074181
Train Epoch: 1 [42880/60000 (71%)]  Loss: 0.157079
Train Epoch: 1 [43520/60000 (72%)]  Loss: 0.276172
Train Epoch: 1 [44160/60000 (74%)]  Loss: 0.143293
Train Epoch: 1 [44800/60000 (75%)]  Loss: 0.115587
Train Epoch: 1 [45440/60000 (76%)]  Loss: 0.121468
Train Epoch: 1 [46080/60000 (77%)]  Loss: 0.077773
Train Epoch: 1 [46720/60000 (78%)]  Loss: 0.192820
Train Epoch: 1 [47360/60000 (79%)]  Loss: 0.069337
Train Epoch: 1 [48000/60000 (80%)]  Loss: 0.208362
Train Epoch: 1 [48640/60000 (81%)]  Loss: 0.137465
Train Epoch: 1 [49280/60000 (82%)]  Loss: 0.094280
Train Epoch: 1 [49920/60000 (83%)]  Loss: 0.107089
Train Epoch: 1 [50560/60000 (84%)]  Loss: 0.119265
Train Epoch: 1 [51200/60000 (85%)]  Loss: 0.143486
Train Epoch: 1 [51840/60000 (86%)]  Loss: 0.066627
Train Epoch: 1 [52480/60000 (87%)]  Loss: 0.024459
Train Epoch: 1 [53120/60000 (88%)]  Loss: 0.262314
Train Epoch: 1 [53760/60000 (90%)]  Loss: 0.091620
Train Epoch: 1 [54400/60000 (91%)]  Loss: 0.129327
Train Epoch: 1 [55040/60000 (92%)]  Loss: 0.190677
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Train Epoch: 1 [55680/60000 (93%)]  Loss: 0.034206
Train Epoch: 1 [56320/60000 (94%)]  Loss: 0.036080
Train Epoch: 1 [56960/60000 (95%)]  Loss: 0.076670
Train Epoch: 1 [57600/60000 (96%)]  Loss: 0.117531
Train Epoch: 1 [58240/60000 (97%)]  Loss: 0.193812
Train Epoch: 1 [58880/60000 (98%)]  Loss: 0.206221
Train Epoch: 1 [59520/60000 (99%)]  Loss: 0.062983

Test set: Average loss: 0.1015, Accuracy: 9666/10000 (97%)

Train Epoch: 2 [0/60000 (0%)]   Loss: 0.144591
Train Epoch: 2 [640/60000 (1%)] Loss: 0.118235
Train Epoch: 2 [1280/60000 (2%)]    Loss: 0.102577
Train Epoch: 2 [1920/60000 (3%)]    Loss: 0.067554
Train Epoch: 2 [2560/60000 (4%)]    Loss: 0.104064
Train Epoch: 2 [3200/60000 (5%)]    Loss: 0.115403
Train Epoch: 2 [3840/60000 (6%)]    Loss: 0.096531
Train Epoch: 2 [4480/60000 (7%)]    Loss: 0.090643
Train Epoch: 2 [5120/60000 (9%)]    Loss: 0.187789
Train Epoch: 2 [5760/60000 (10%)]   Loss: 0.095927
Train Epoch: 2 [6400/60000 (11%)]   Loss: 0.098530
Train Epoch: 2 [7040/60000 (12%)]   Loss: 0.068576
Train Epoch: 2 [7680/60000 (13%)]   Loss: 0.078231
Train Epoch: 2 [8320/60000 (14%)]   Loss: 0.079208
Train Epoch: 2 [8960/60000 (15%)]   Loss: 0.118560
Train Epoch: 2 [9600/60000 (16%)]   Loss: 0.042858
Train Epoch: 2 [10240/60000 (17%)]  Loss: 0.012425
Train Epoch: 2 [10880/60000 (18%)]  Loss: 0.246333
Train Epoch: 2 [11520/60000 (19%)]  Loss: 0.146869
Train Epoch: 2 [12160/60000 (20%)]  Loss: 0.093515
Train Epoch: 2 [12800/60000 (21%)]  Loss: 0.057429
Train Epoch: 2 [13440/60000 (22%)]  Loss: 0.051660
Train Epoch: 2 [14080/60000 (23%)]  Loss: 0.073805
Train Epoch: 2 [14720/60000 (25%)]  Loss: 0.057326
Train Epoch: 2 [15360/60000 (26%)]  Loss: 0.025699
Train Epoch: 2 [16000/60000 (27%)]  Loss: 0.175018
Train Epoch: 2 [16640/60000 (28%)]  Loss: 0.060841
Train Epoch: 2 [17280/60000 (29%)]  Loss: 0.062789
Train Epoch: 2 [17920/60000 (30%)]  Loss: 0.136912
Train Epoch: 2 [18560/60000 (31%)]  Loss: 0.110569
Train Epoch: 2 [19200/60000 (32%)]  Loss: 0.066006
Train Epoch: 2 [19840/60000 (33%)]  Loss: 0.099025
Train Epoch: 2 [20480/60000 (34%)]  Loss: 0.075251
Train Epoch: 2 [21120/60000 (35%)]  Loss: 0.117901
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Train Epoch: 2 [21760/60000 (36%)]  Loss: 0.092943
Train Epoch: 2 [22400/60000 (37%)]  Loss: 0.275165
Train Epoch: 2 [23040/60000 (38%)]  Loss: 0.062935
Train Epoch: 2 [23680/60000 (39%)]  Loss: 0.028984
Train Epoch: 2 [24320/60000 (41%)]  Loss: 0.193350
Train Epoch: 2 [24960/60000 (42%)]  Loss: 0.108540
Train Epoch: 2 [25600/60000 (43%)]  Loss: 0.120146
Train Epoch: 2 [26240/60000 (44%)]  Loss: 0.022655
Train Epoch: 2 [26880/60000 (45%)]  Loss: 0.071791
Train Epoch: 2 [27520/60000 (46%)]  Loss: 0.144387
Train Epoch: 2 [28160/60000 (47%)]  Loss: 0.050804
Train Epoch: 2 [28800/60000 (48%)]  Loss: 0.131548
Train Epoch: 2 [29440/60000 (49%)]  Loss: 0.202221
Train Epoch: 2 [30080/60000 (50%)]  Loss: 0.057246
Train Epoch: 2 [30720/60000 (51%)]  Loss: 0.131895
Train Epoch: 2 [31360/60000 (52%)]  Loss: 0.145592
Train Epoch: 2 [32000/60000 (53%)]  Loss: 0.033488
Train Epoch: 2 [32640/60000 (54%)]  Loss: 0.129208
Train Epoch: 2 [33280/60000 (55%)]  Loss: 0.072967
Train Epoch: 2 [33920/60000 (57%)]  Loss: 0.130145
Train Epoch: 2 [34560/60000 (58%)]  Loss: 0.147894
Train Epoch: 2 [35200/60000 (59%)]  Loss: 0.029994
Train Epoch: 2 [35840/60000 (60%)]  Loss: 0.166325
Train Epoch: 2 [36480/60000 (61%)]  Loss: 0.029096
Train Epoch: 2 [37120/60000 (62%)]  Loss: 0.042800
Train Epoch: 2 [37760/60000 (63%)]  Loss: 0.060054
Train Epoch: 2 [38400/60000 (64%)]  Loss: 0.033117
Train Epoch: 2 [39040/60000 (65%)]  Loss: 0.059781
Train Epoch: 2 [39680/60000 (66%)]  Loss: 0.134507
Train Epoch: 2 [40320/60000 (67%)]  Loss: 0.094088

Train Epoch: 2 [40960/60000 (68%)]  Loss: 0.074633
Train Epoch: 2 [41600/60000 (69%)]  Loss: 0.032898
Train Epoch: 2 [42240/60000 (70%)]  Loss: 0.037577
Train Epoch: 2 [42880/60000 (71%)]  Loss: 0.020421
Train Epoch: 2 [43520/60000 (72%)]  Loss: 0.032090
Train Epoch: 2 [44160/60000 (74%)]  Loss: 0.044131
Train Epoch: 2 [44800/60000 (75%)]  Loss: 0.037834
Train Epoch: 2 [45440/60000 (76%)]  Loss: 0.147264
Train Epoch: 2 [46080/60000 (77%)]  Loss: 0.104130
Train Epoch: 2 [46720/60000 (78%)]  Loss: 0.134119
Train Epoch: 2 [47360/60000 (79%)]  Loss: 0.140484
Train Epoch: 2 [48000/60000 (80%)]  Loss: 0.054975
Train Epoch: 2 [48640/60000 (81%)]  Loss: 0.054355
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Train Epoch: 2 [49280/60000 (82%)]  Loss: 0.028645
Train Epoch: 2 [49920/60000 (83%)]  Loss: 0.071256
Train Epoch: 2 [50560/60000 (84%)]  Loss: 0.098485
Train Epoch: 2 [51200/60000 (85%)]  Loss: 0.029431
Train Epoch: 2 [51840/60000 (86%)]  Loss: 0.038554
Train Epoch: 2 [52480/60000 (87%)]  Loss: 0.024910
Train Epoch: 2 [53120/60000 (88%)]  Loss: 0.040504
Train Epoch: 2 [53760/60000 (90%)]  Loss: 0.191544
Train Epoch: 2 [54400/60000 (91%)]  Loss: 0.062894
Train Epoch: 2 [55040/60000 (92%)]  Loss: 0.045602
Train Epoch: 2 [55680/60000 (93%)]  Loss: 0.020384
Train Epoch: 2 [56320/60000 (94%)]  Loss: 0.067832
Train Epoch: 2 [56960/60000 (95%)]  Loss: 0.084467
Train Epoch: 2 [57600/60000 (96%)]  Loss: 0.039404
Train Epoch: 2 [58240/60000 (97%)]  Loss: 0.163555
Train Epoch: 2 [58880/60000 (98%)]  Loss: 0.034934
Train Epoch: 2 [59520/60000 (99%)]  Loss: 0.068579

Test set: Average loss: 0.0615, Accuracy: 9827/10000 (98%)

Train Epoch: 3 [0/60000 (0%)]   Loss: 0.052006
Train Epoch: 3 [640/60000 (1%)] Loss: 0.055986
Train Epoch: 3 [1280/60000 (2%)]    Loss: 0.036592
Train Epoch: 3 [1920/60000 (3%)]    Loss: 0.054616
Train Epoch: 3 [2560/60000 (4%)]    Loss: 0.027808
Train Epoch: 3 [3200/60000 (5%)]    Loss: 0.126764
Train Epoch: 3 [3840/60000 (6%)]    Loss: 0.026680
Train Epoch: 3 [4480/60000 (7%)]    Loss: 0.153431
Train Epoch: 3 [5120/60000 (9%)]    Loss: 0.080951
Train Epoch: 3 [5760/60000 (10%)]   Loss: 0.016019
Train Epoch: 3 [6400/60000 (11%)]   Loss: 0.099477
Train Epoch: 3 [7040/60000 (12%)]   Loss: 0.026975
Train Epoch: 3 [7680/60000 (13%)]   Loss: 0.010844
Train Epoch: 3 [8320/60000 (14%)]   Loss: 0.035644
Train Epoch: 3 [8960/60000 (15%)]   Loss: 0.041044
Train Epoch: 3 [9600/60000 (16%)]   Loss: 0.017450
Train Epoch: 3 [10240/60000 (17%)]  Loss: 0.050340
Train Epoch: 3 [10880/60000 (18%)]  Loss: 0.067978
Train Epoch: 3 [11520/60000 (19%)]  Loss: 0.032194
Train Epoch: 3 [12160/60000 (20%)]  Loss: 0.036462
Train Epoch: 3 [12800/60000 (21%)]  Loss: 0.033308
Train Epoch: 3 [13440/60000 (22%)]  Loss: 0.117693
Train Epoch: 3 [14080/60000 (23%)]  Loss: 0.031297
Train Epoch: 3 [14720/60000 (25%)]  Loss: 0.064369
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Train Epoch: 3 [15360/60000 (26%)]  Loss: 0.024751
Train Epoch: 3 [16000/60000 (27%)]  Loss: 0.079443
Train Epoch: 3 [16640/60000 (28%)]  Loss: 0.065789
Train Epoch: 3 [17280/60000 (29%)]  Loss: 0.067504
Train Epoch: 3 [17920/60000 (30%)]  Loss: 0.049740
Train Epoch: 3 [18560/60000 (31%)]  Loss: 0.022647
Train Epoch: 3 [19200/60000 (32%)]  Loss: 0.067783
Train Epoch: 3 [19840/60000 (33%)]  Loss: 0.067873
Train Epoch: 3 [20480/60000 (34%)]  Loss: 0.094241
Train Epoch: 3 [21120/60000 (35%)]  Loss: 0.044697
Train Epoch: 3 [21760/60000 (36%)]  Loss: 0.031258
Train Epoch: 3 [22400/60000 (37%)]  Loss: 0.102060
Train Epoch: 3 [23040/60000 (38%)]  Loss: 0.156136
Train Epoch: 3 [23680/60000 (39%)]  Loss: 0.034622
Train Epoch: 3 [24320/60000 (41%)]  Loss: 0.090212
Train Epoch: 3 [24960/60000 (42%)]  Loss: 0.040385
Train Epoch: 3 [25600/60000 (43%)]  Loss: 0.033785
Train Epoch: 3 [26240/60000 (44%)]  Loss: 0.122830
Train Epoch: 3 [26880/60000 (45%)]  Loss: 0.024050
Train Epoch: 3 [27520/60000 (46%)]  Loss: 0.030148
Train Epoch: 3 [28160/60000 (47%)]  Loss: 0.057241
Train Epoch: 3 [28800/60000 (48%)]  Loss: 0.065398
Train Epoch: 3 [29440/60000 (49%)]  Loss: 0.007582
Train Epoch: 3 [30080/60000 (50%)]  Loss: 0.079954
Train Epoch: 3 [30720/60000 (51%)]  Loss: 0.083349
Train Epoch: 3 [31360/60000 (52%)]  Loss: 0.091316
Train Epoch: 3 [32000/60000 (53%)]  Loss: 0.028387
Train Epoch: 3 [32640/60000 (54%)]  Loss: 0.021545
Train Epoch: 3 [33280/60000 (55%)]  Loss: 0.029848
Train Epoch: 3 [33920/60000 (57%)]  Loss: 0.043709
Train Epoch: 3 [34560/60000 (58%)]  Loss: 0.042561
Train Epoch: 3 [35200/60000 (59%)]  Loss: 0.076382
Train Epoch: 3 [35840/60000 (60%)]  Loss: 0.046256
Train Epoch: 3 [36480/60000 (61%)]  Loss: 0.027359
Train Epoch: 3 [37120/60000 (62%)]  Loss: 0.020977
Train Epoch: 3 [37760/60000 (63%)]  Loss: 0.052974
Train Epoch: 3 [38400/60000 (64%)]  Loss: 0.021661
Train Epoch: 3 [39040/60000 (65%)]  Loss: 0.026136
Train Epoch: 3 [39680/60000 (66%)]  Loss: 0.078350
Train Epoch: 3 [40320/60000 (67%)]  Loss: 0.082385
Train Epoch: 3 [40960/60000 (68%)]  Loss: 0.014897
Train Epoch: 3 [41600/60000 (69%)]  Loss: 0.147838
Train Epoch: 3 [42240/60000 (70%)]  Loss: 0.088518
Train Epoch: 3 [42880/60000 (71%)]  Loss: 0.031680
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```
Train Epoch: 3 [43520/60000 (72%)]  Loss: 0.040140
Train Epoch: 3 [44160/60000 (74%)]  Loss: 0.036225
Train Epoch: 3 [44800/60000 (75%)]  Loss: 0.062954
Train Epoch: 3 [45440/60000 (76%)]  Loss: 0.166012
Train Epoch: 3 [46080/60000 (77%)]  Loss: 0.036110
Train Epoch: 3 [46720/60000 (78%)]  Loss: 0.050815
Train Epoch: 3 [47360/60000 (79%)]  Loss: 0.137706
Train Epoch: 3 [48000/60000 (80%)]  Loss: 0.119454
Train Epoch: 3 [48640/60000 (81%)]  Loss: 0.044965
Train Epoch: 3 [49280/60000 (82%)]  Loss: 0.057113
Train Epoch: 3 [49920/60000 (83%)]  Loss: 0.136251
Train Epoch: 3 [50560/60000 (84%)]  Loss: 0.010203
Train Epoch: 3 [51200/60000 (85%)]  Loss: 0.047752
Train Epoch: 3 [51840/60000 (86%)]  Loss: 0.058534
Train Epoch: 3 [52480/60000 (87%)]  Loss: 0.035447
Train Epoch: 3 [53120/60000 (88%)]  Loss: 0.014844
Train Epoch: 3 [53760/60000 (90%)]  Loss: 0.027868
Train Epoch: 3 [54400/60000 (91%)]  Loss: 0.058276
Train Epoch: 3 [55040/60000 (92%)]  Loss: 0.052562
Train Epoch: 3 [55680/60000 (93%)]  Loss: 0.017844
Train Epoch: 3 [56320/60000 (94%)]  Loss: 0.072829
Train Epoch: 3 [56960/60000 (95%)]  Loss: 0.004986
Train Epoch: 3 [57600/60000 (96%)]  Loss: 0.015616
Train Epoch: 3 [58240/60000 (97%)]  Loss: 0.022478
Train Epoch: 3 [58880/60000 (98%)]  Loss: 0.037333
Train Epoch: 3 [59520/60000 (99%)]  Loss: 0.023604

Test set: Average loss: 0.0561, Accuracy: 9813/10000 (98%)

Train Epoch: 4 [0/60000 (0%)]   Loss: 0.019289
Train Epoch: 4 [640/60000 (1%)] Loss: 0.062937
Train Epoch: 4 [1280/60000 (2%)]    Loss: 0.045683
Train Epoch: 4 [1920/60000 (3%)]    Loss: 0.053014
Train Epoch: 4 [2560/60000 (4%)]    Loss: 0.038584
Train Epoch: 4 [3200/60000 (5%)]    Loss: 0.066504
Train Epoch: 4 [3840/60000 (6%)]    Loss: 0.010983
Train Epoch: 4 [4480/60000 (7%)]    Loss: 0.059775
Train Epoch: 4 [5120/60000 (9%)]    Loss: 0.028611
Train Epoch: 4 [5760/60000 (10%)]   Loss: 0.062132
Train Epoch: 4 [6400/60000 (11%)]   Loss: 0.023466
Train Epoch: 4 [7040/60000 (12%)]   Loss: 0.045497
Train Epoch: 4 [7680/60000 (13%)]   Loss: 0.024092
Train Epoch: 4 [8320/60000 (14%)]   Loss: 0.053458
Train Epoch: 4 [8960/60000 (15%)]   Loss: 0.042803
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Train Epoch: 4 [9600/60000 (16%)]   Loss: 0.011472
Train Epoch: 4 [10240/60000 (17%)]  Loss: 0.055098
Train Epoch: 4 [10880/60000 (18%)]  Loss: 0.083072
Train Epoch: 4 [11520/60000 (19%)]  Loss: 0.080142
Train Epoch: 4 [12160/60000 (20%)]  Loss: 0.028828
Train Epoch: 4 [12800/60000 (21%)]  Loss: 0.074067
Train Epoch: 4 [13440/60000 (22%)]  Loss: 0.021676
Train Epoch: 4 [14080/60000 (23%)]  Loss: 0.027672
Train Epoch: 4 [14720/60000 (25%)]  Loss: 0.013691
Train Epoch: 4 [15360/60000 (26%)]  Loss: 0.028708
Train Epoch: 4 [16000/60000 (27%)]  Loss: 0.221310
Train Epoch: 4 [16640/60000 (28%)]  Loss: 0.068713
Train Epoch: 4 [17280/60000 (29%)]  Loss: 0.033679
Train Epoch: 4 [17920/60000 (30%)]  Loss: 0.017752
Train Epoch: 4 [18560/60000 (31%)]  Loss: 0.024891
Train Epoch: 4 [19200/60000 (32%)]  Loss: 0.025996
Train Epoch: 4 [19840/60000 (33%)]  Loss: 0.010904
Train Epoch: 4 [20480/60000 (34%)]  Loss: 0.089226
Train Epoch: 4 [21120/60000 (35%)]  Loss: 0.013190
Train Epoch: 4 [21760/60000 (36%)]  Loss: 0.017643
Train Epoch: 4 [22400/60000 (37%)]  Loss: 0.027336
Train Epoch: 4 [23040/60000 (38%)]  Loss: 0.043344
Train Epoch: 4 [23680/60000 (39%)]  Loss: 0.021757
Train Epoch: 4 [24320/60000 (41%)]  Loss: 0.025143

Train Epoch: 4 [24960/60000 (42%)]  Loss: 0.005555
Train Epoch: 4 [25600/60000 (43%)]  Loss: 0.015410
Train Epoch: 4 [26240/60000 (44%)]  Loss: 0.025104
Train Epoch: 4 [26880/60000 (45%)]  Loss: 0.040123
Train Epoch: 4 [27520/60000 (46%)]  Loss: 0.015697
Train Epoch: 4 [28160/60000 (47%)]  Loss: 0.043397
Train Epoch: 4 [28800/60000 (48%)]  Loss: 0.024706
Train Epoch: 4 [29440/60000 (49%)]  Loss: 0.006652
Train Epoch: 4 [30080/60000 (50%)]  Loss: 0.059988
Train Epoch: 4 [30720/60000 (51%)]  Loss: 0.009232
Train Epoch: 4 [31360/60000 (52%)]  Loss: 0.033626
Train Epoch: 4 [32000/60000 (53%)]  Loss: 0.014795
Train Epoch: 4 [32640/60000 (54%)]  Loss: 0.012822
Train Epoch: 4 [33280/60000 (55%)]  Loss: 0.126887
Train Epoch: 4 [33920/60000 (57%)]  Loss: 0.059995
Train Epoch: 4 [34560/60000 (58%)]  Loss: 0.086523
Train Epoch: 4 [35200/60000 (59%)]  Loss: 0.075335
Train Epoch: 4 [35840/60000 (60%)]  Loss: 0.030712
Train Epoch: 4 [36480/60000 (61%)]  Loss: 0.125261
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Train Epoch: 4 [37120/60000 (62%)]  Loss: 0.009176
Train Epoch: 4 [37760/60000 (63%)]  Loss: 0.034007
Train Epoch: 4 [38400/60000 (64%)]  Loss: 0.010344
Train Epoch: 4 [39040/60000 (65%)]  Loss: 0.011955
Train Epoch: 4 [39680/60000 (66%)]  Loss: 0.053461
Train Epoch: 4 [40320/60000 (67%)]  Loss: 0.152651
Train Epoch: 4 [40960/60000 (68%)]  Loss: 0.012722
Train Epoch: 4 [41600/60000 (69%)]  Loss: 0.036382
Train Epoch: 4 [42240/60000 (70%)]  Loss: 0.006020
Train Epoch: 4 [42880/60000 (71%)]  Loss: 0.011446
Train Epoch: 4 [43520/60000 (72%)]  Loss: 0.023023
Train Epoch: 4 [44160/60000 (74%)]  Loss: 0.015092
Train Epoch: 4 [44800/60000 (75%)]  Loss: 0.064223
Train Epoch: 4 [45440/60000 (76%)]  Loss: 0.028453
Train Epoch: 4 [46080/60000 (77%)]  Loss: 0.040976
Train Epoch: 4 [46720/60000 (78%)]  Loss: 0.009203
Train Epoch: 4 [47360/60000 (79%)]  Loss: 0.077070
Train Epoch: 4 [48000/60000 (80%)]  Loss: 0.021600
Train Epoch: 4 [48640/60000 (81%)]  Loss: 0.089680
Train Epoch: 4 [49280/60000 (82%)]  Loss: 0.019838
Train Epoch: 4 [49920/60000 (83%)]  Loss: 0.009900
Train Epoch: 4 [50560/60000 (84%)]  Loss: 0.020214
Train Epoch: 4 [51200/60000 (85%)]  Loss: 0.013653
Train Epoch: 4 [51840/60000 (86%)]  Loss: 0.017833
Train Epoch: 4 [52480/60000 (87%)]  Loss: 0.027173
Train Epoch: 4 [53120/60000 (88%)]  Loss: 0.089136
Train Epoch: 4 [53760/60000 (90%)]  Loss: 0.019716
Train Epoch: 4 [54400/60000 (91%)]  Loss: 0.021296
Train Epoch: 4 [55040/60000 (92%)]  Loss: 0.130912
Train Epoch: 4 [55680/60000 (93%)]  Loss: 0.011553
Train Epoch: 4 [56320/60000 (94%)]  Loss: 0.045472
Train Epoch: 4 [56960/60000 (95%)]  Loss: 0.038617
Train Epoch: 4 [57600/60000 (96%)]  Loss: 0.060103
Train Epoch: 4 [58240/60000 (97%)]  Loss: 0.076934
Train Epoch: 4 [58880/60000 (98%)]  Loss: 0.025633
Train Epoch: 4 [59520/60000 (99%)]  Loss: 0.032134

Test set: Average loss: 0.0412, Accuracy: 9862/10000 (99%)

Train Epoch: 5 [0/60000 (0%)]   Loss: 0.010356
Train Epoch: 5 [640/60000 (1%)] Loss: 0.007751
Train Epoch: 5 [1280/60000 (2%)]    Loss: 0.014350
Train Epoch: 5 [1920/60000 (3%)]    Loss: 0.013445
Train Epoch: 5 [2560/60000 (4%)]    Loss: 0.021335
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Train Epoch: 5 [3200/60000 (5%)]    Loss: 0.020781
Train Epoch: 5 [3840/60000 (6%)]    Loss: 0.005659
Train Epoch: 5 [4480/60000 (7%)]    Loss: 0.050137
Train Epoch: 5 [5120/60000 (9%)]    Loss: 0.169696
Train Epoch: 5 [5760/60000 (10%)]   Loss: 0.001950
Train Epoch: 5 [6400/60000 (11%)]   Loss: 0.057822
Train Epoch: 5 [7040/60000 (12%)]   Loss: 0.047363
Train Epoch: 5 [7680/60000 (13%)]   Loss: 0.032860
Train Epoch: 5 [8320/60000 (14%)]   Loss: 0.011308
Train Epoch: 5 [8960/60000 (15%)]   Loss: 0.073682
Train Epoch: 5 [9600/60000 (16%)]   Loss: 0.021908
Train Epoch: 5 [10240/60000 (17%)]  Loss: 0.077191
Train Epoch: 5 [10880/60000 (18%)]  Loss: 0.017802
Train Epoch: 5 [11520/60000 (19%)]  Loss: 0.010055
Train Epoch: 5 [12160/60000 (20%)]  Loss: 0.011238
Train Epoch: 5 [12800/60000 (21%)]  Loss: 0.060579
Train Epoch: 5 [13440/60000 (22%)]  Loss: 0.069746
Train Epoch: 5 [14080/60000 (23%)]  Loss: 0.014592
Train Epoch: 5 [14720/60000 (25%)]  Loss: 0.014090
Train Epoch: 5 [15360/60000 (26%)]  Loss: 0.064750
Train Epoch: 5 [16000/60000 (27%)]  Loss: 0.030573
Train Epoch: 5 [16640/60000 (28%)]  Loss: 0.010125
Train Epoch: 5 [17280/60000 (29%)]  Loss: 0.043040
Train Epoch: 5 [17920/60000 (30%)]  Loss: 0.037306
Train Epoch: 5 [18560/60000 (31%)]  Loss: 0.006193
Train Epoch: 5 [19200/60000 (32%)]  Loss: 0.051932
Train Epoch: 5 [19840/60000 (33%)]  Loss: 0.032053
Train Epoch: 5 [20480/60000 (34%)]  Loss: 0.067529
Train Epoch: 5 [21120/60000 (35%)]  Loss: 0.005451
Train Epoch: 5 [21760/60000 (36%)]  Loss: 0.024593
Train Epoch: 5 [22400/60000 (37%)]  Loss: 0.019230
Train Epoch: 5 [23040/60000 (38%)]  Loss: 0.058816
Train Epoch: 5 [23680/60000 (39%)]  Loss: 0.008988
Train Epoch: 5 [24320/60000 (41%)]  Loss: 0.020103
Train Epoch: 5 [24960/60000 (42%)]  Loss: 0.026480
Train Epoch: 5 [25600/60000 (43%)]  Loss: 0.025795
Train Epoch: 5 [26240/60000 (44%)]  Loss: 0.109583
Train Epoch: 5 [26880/60000 (45%)]  Loss: 0.005329
Train Epoch: 5 [27520/60000 (46%)]  Loss: 0.062115
Train Epoch: 5 [28160/60000 (47%)]  Loss: 0.086529
Train Epoch: 5 [28800/60000 (48%)]  Loss: 0.004168
Train Epoch: 5 [29440/60000 (49%)]  Loss: 0.166796
Train Epoch: 5 [30080/60000 (50%)]  Loss: 0.070961
Train Epoch: 5 [30720/60000 (51%)]  Loss: 0.015139
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Train Epoch: 5 [31360/60000 (52%)]  Loss: 0.024640
Train Epoch: 5 [32000/60000 (53%)]  Loss: 0.042751
Train Epoch: 5 [32640/60000 (54%)]  Loss: 0.011526
Train Epoch: 5 [33280/60000 (55%)]  Loss: 0.028435
Train Epoch: 5 [33920/60000 (57%)]  Loss: 0.103416
Train Epoch: 5 [34560/60000 (58%)]  Loss: 0.024691
Train Epoch: 5 [35200/60000 (59%)]  Loss: 0.027711
Train Epoch: 5 [35840/60000 (60%)]  Loss: 0.019586
Train Epoch: 5 [36480/60000 (61%)]  Loss: 0.045892
Train Epoch: 5 [37120/60000 (62%)]  Loss: 0.018516
Train Epoch: 5 [37760/60000 (63%)]  Loss: 0.170626
Train Epoch: 5 [38400/60000 (64%)]  Loss: 0.054834
Train Epoch: 5 [39040/60000 (65%)]  Loss: 0.027004
Train Epoch: 5 [39680/60000 (66%)]  Loss: 0.021652
Train Epoch: 5 [40320/60000 (67%)]  Loss: 0.057698
Train Epoch: 5 [40960/60000 (68%)]  Loss: 0.024412
Train Epoch: 5 [41600/60000 (69%)]  Loss: 0.029677
Train Epoch: 5 [42240/60000 (70%)]  Loss: 0.009340
Train Epoch: 5 [42880/60000 (71%)]  Loss: 0.007936
Train Epoch: 5 [43520/60000 (72%)]  Loss: 0.018800
Train Epoch: 5 [44160/60000 (74%)]  Loss: 0.004920
Train Epoch: 5 [44800/60000 (75%)]  Loss: 0.177081
Train Epoch: 5 [45440/60000 (76%)]  Loss: 0.017025
Train Epoch: 5 [46080/60000 (77%)]  Loss: 0.024590
Train Epoch: 5 [46720/60000 (78%)]  Loss: 0.017825
Train Epoch: 5 [47360/60000 (79%)]  Loss: 0.031469
Train Epoch: 5 [48000/60000 (80%)]  Loss: 0.030821
Train Epoch: 5 [48640/60000 (81%)]  Loss: 0.021725
Train Epoch: 5 [49280/60000 (82%)]  Loss: 0.016568
Train Epoch: 5 [49920/60000 (83%)]  Loss: 0.022965
Train Epoch: 5 [50560/60000 (84%)]  Loss: 0.011337
Train Epoch: 5 [51200/60000 (85%)]  Loss: 0.073163
Train Epoch: 5 [51840/60000 (86%)]  Loss: 0.104889
Train Epoch: 5 [52480/60000 (87%)]  Loss: 0.188511
Train Epoch: 5 [53120/60000 (88%)]  Loss: 0.012430
Train Epoch: 5 [53760/60000 (90%)]  Loss: 0.002407
Train Epoch: 5 [54400/60000 (91%)]  Loss: 0.026999
Train Epoch: 5 [55040/60000 (92%)]  Loss: 0.028272
Train Epoch: 5 [55680/60000 (93%)]  Loss: 0.017544
Train Epoch: 5 [56320/60000 (94%)]  Loss: 0.014187
Train Epoch: 5 [56960/60000 (95%)]  Loss: 0.015706
Train Epoch: 5 [57600/60000 (96%)]  Loss: 0.030305
Train Epoch: 5 [58240/60000 (97%)]  Loss: 0.016816
Train Epoch: 5 [58880/60000 (98%)]  Loss: 0.017663
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Train Epoch: 5 [59520/60000 (99%)]  Loss: 0.017370

Test set: Average loss: 0.0383, Accuracy: 9870/10000 (99%)

Train Epoch: 6 [0/60000 (0%)]   Loss: 0.126213
Train Epoch: 6 [640/60000 (1%)] Loss: 0.050233
Train Epoch: 6 [1280/60000 (2%)]    Loss: 0.104856
Train Epoch: 6 [1920/60000 (3%)]    Loss: 0.035950
Train Epoch: 6 [2560/60000 (4%)]    Loss: 0.007041
Train Epoch: 6 [3200/60000 (5%)]    Loss: 0.048809
Train Epoch: 6 [3840/60000 (6%)]    Loss: 0.006670
Train Epoch: 6 [4480/60000 (7%)]    Loss: 0.024534
Train Epoch: 6 [5120/60000 (9%)]    Loss: 0.037453
Train Epoch: 6 [5760/60000 (10%)]   Loss: 0.007729
Train Epoch: 6 [6400/60000 (11%)]   Loss: 0.021554
Train Epoch: 6 [7040/60000 (12%)]   Loss: 0.013691
Train Epoch: 6 [7680/60000 (13%)]   Loss: 0.040271
Train Epoch: 6 [8320/60000 (14%)]   Loss: 0.011896

Train Epoch: 6 [8960/60000 (15%)]   Loss: 0.055086
Train Epoch: 6 [9600/60000 (16%)]   Loss: 0.021578
Train Epoch: 6 [10240/60000 (17%)]  Loss: 0.004005
Train Epoch: 6 [10880/60000 (18%)]  Loss: 0.056266
Train Epoch: 6 [11520/60000 (19%)]  Loss: 0.035199
Train Epoch: 6 [12160/60000 (20%)]  Loss: 0.016100
Train Epoch: 6 [12800/60000 (21%)]  Loss: 0.035886
Train Epoch: 6 [13440/60000 (22%)]  Loss: 0.015922
Train Epoch: 6 [14080/60000 (23%)]  Loss: 0.028257
Train Epoch: 6 [14720/60000 (25%)]  Loss: 0.007476
Train Epoch: 6 [15360/60000 (26%)]  Loss: 0.011814
Train Epoch: 6 [16000/60000 (27%)]  Loss: 0.018365
Train Epoch: 6 [16640/60000 (28%)]  Loss: 0.013362
Train Epoch: 6 [17280/60000 (29%)]  Loss: 0.013151
Train Epoch: 6 [17920/60000 (30%)]  Loss: 0.052843
Train Epoch: 6 [18560/60000 (31%)]  Loss: 0.022958
Train Epoch: 6 [19200/60000 (32%)]  Loss: 0.017849
Train Epoch: 6 [19840/60000 (33%)]  Loss: 0.033280
Train Epoch: 6 [20480/60000 (34%)]  Loss: 0.042238
Train Epoch: 6 [21120/60000 (35%)]  Loss: 0.002340
Train Epoch: 6 [21760/60000 (36%)]  Loss: 0.054737
Train Epoch: 6 [22400/60000 (37%)]  Loss: 0.030341
Train Epoch: 6 [23040/60000 (38%)]  Loss: 0.003471
Train Epoch: 6 [23680/60000 (39%)]  Loss: 0.020303
Train Epoch: 6 [24320/60000 (41%)]  Loss: 0.009679
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Train Epoch: 6 [24960/60000 (42%)]  Loss: 0.021954
Train Epoch: 6 [25600/60000 (43%)]  Loss: 0.060636
Train Epoch: 6 [26240/60000 (44%)]  Loss: 0.044849
Train Epoch: 6 [26880/60000 (45%)]  Loss: 0.028601
Train Epoch: 6 [27520/60000 (46%)]  Loss: 0.006125
Train Epoch: 6 [28160/60000 (47%)]  Loss: 0.003502
Train Epoch: 6 [28800/60000 (48%)]  Loss: 0.008070
Train Epoch: 6 [29440/60000 (49%)]  Loss: 0.011741
Train Epoch: 6 [30080/60000 (50%)]  Loss: 0.009859
Train Epoch: 6 [30720/60000 (51%)]  Loss: 0.021837
Train Epoch: 6 [31360/60000 (52%)]  Loss: 0.034562
Train Epoch: 6 [32000/60000 (53%)]  Loss: 0.013128
Train Epoch: 6 [32640/60000 (54%)]  Loss: 0.038043
Train Epoch: 6 [33280/60000 (55%)]  Loss: 0.007053
Train Epoch: 6 [33920/60000 (57%)]  Loss: 0.014536
Train Epoch: 6 [34560/60000 (58%)]  Loss: 0.091405
Train Epoch: 6 [35200/60000 (59%)]  Loss: 0.056837
Train Epoch: 6 [35840/60000 (60%)]  Loss: 0.004163
Train Epoch: 6 [36480/60000 (61%)]  Loss: 0.014264
Train Epoch: 6 [37120/60000 (62%)]  Loss: 0.007672
Train Epoch: 6 [37760/60000 (63%)]  Loss: 0.027118
Train Epoch: 6 [38400/60000 (64%)]  Loss: 0.043507
Train Epoch: 6 [39040/60000 (65%)]  Loss: 0.004362
Train Epoch: 6 [39680/60000 (66%)]  Loss: 0.071144
Train Epoch: 6 [40320/60000 (67%)]  Loss: 0.009166
Train Epoch: 6 [40960/60000 (68%)]  Loss: 0.082178
Train Epoch: 6 [41600/60000 (69%)]  Loss: 0.012111
Train Epoch: 6 [42240/60000 (70%)]  Loss: 0.002183
Train Epoch: 6 [42880/60000 (71%)]  Loss: 0.009207
Train Epoch: 6 [43520/60000 (72%)]  Loss: 0.022408
Train Epoch: 6 [44160/60000 (74%)]  Loss: 0.053352
Train Epoch: 6 [44800/60000 (75%)]  Loss: 0.006928
Train Epoch: 6 [45440/60000 (76%)]  Loss: 0.081292
Train Epoch: 6 [46080/60000 (77%)]  Loss: 0.052457
Train Epoch: 6 [46720/60000 (78%)]  Loss: 0.014432
Train Epoch: 6 [47360/60000 (79%)]  Loss: 0.029015
Train Epoch: 6 [48000/60000 (80%)]  Loss: 0.026411
Train Epoch: 6 [48640/60000 (81%)]  Loss: 0.050691
Train Epoch: 6 [49280/60000 (82%)]  Loss: 0.010973
Train Epoch: 6 [49920/60000 (83%)]  Loss: 0.052716
Train Epoch: 6 [50560/60000 (84%)]  Loss: 0.014698
Train Epoch: 6 [51200/60000 (85%)]  Loss: 0.034308
Train Epoch: 6 [51840/60000 (86%)]  Loss: 0.005697
Train Epoch: 6 [52480/60000 (87%)]  Loss: 0.016059
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Train Epoch: 6 [53120/60000 (88%)]  Loss: 0.022726
Train Epoch: 6 [53760/60000 (90%)]  Loss: 0.002761
Train Epoch: 6 [54400/60000 (91%)]  Loss: 0.029782
Train Epoch: 6 [55040/60000 (92%)]  Loss: 0.027664
Train Epoch: 6 [55680/60000 (93%)]  Loss: 0.018658
Train Epoch: 6 [56320/60000 (94%)]  Loss: 0.016026
Train Epoch: 6 [56960/60000 (95%)]  Loss: 0.022412
Train Epoch: 6 [57600/60000 (96%)]  Loss: 0.005552
Train Epoch: 6 [58240/60000 (97%)]  Loss: 0.031687
Train Epoch: 6 [58880/60000 (98%)]  Loss: 0.027048
Train Epoch: 6 [59520/60000 (99%)]  Loss: 0.001957

Test set: Average loss: 0.0337, Accuracy: 9892/10000 (99%)

Train Epoch: 7 [0/60000 (0%)]   Loss: 0.029722
Train Epoch: 7 [640/60000 (1%)] Loss: 0.019105
Train Epoch: 7 [1280/60000 (2%)]    Loss: 0.020701
Train Epoch: 7 [1920/60000 (3%)]    Loss: 0.038894
Train Epoch: 7 [2560/60000 (4%)]    Loss: 0.005242
Train Epoch: 7 [3200/60000 (5%)]    Loss: 0.006381
Train Epoch: 7 [3840/60000 (6%)]    Loss: 0.005486
Train Epoch: 7 [4480/60000 (7%)]    Loss: 0.002152
Train Epoch: 7 [5120/60000 (9%)]    Loss: 0.111671
Train Epoch: 7 [5760/60000 (10%)]   Loss: 0.062343
Train Epoch: 7 [6400/60000 (11%)]   Loss: 0.006507
Train Epoch: 7 [7040/60000 (12%)]   Loss: 0.014991
Train Epoch: 7 [7680/60000 (13%)]   Loss: 0.012073
Train Epoch: 7 [8320/60000 (14%)]   Loss: 0.004907
Train Epoch: 7 [8960/60000 (15%)]   Loss: 0.021469
Train Epoch: 7 [9600/60000 (16%)]   Loss: 0.054258
Train Epoch: 7 [10240/60000 (17%)]  Loss: 0.018279
Train Epoch: 7 [10880/60000 (18%)]  Loss: 0.002218
Train Epoch: 7 [11520/60000 (19%)]  Loss: 0.011435
Train Epoch: 7 [12160/60000 (20%)]  Loss: 0.006285
Train Epoch: 7 [12800/60000 (21%)]  Loss: 0.077834
Train Epoch: 7 [13440/60000 (22%)]  Loss: 0.006722
Train Epoch: 7 [14080/60000 (23%)]  Loss: 0.048124
Train Epoch: 7 [14720/60000 (25%)]  Loss: 0.014825
Train Epoch: 7 [15360/60000 (26%)]  Loss: 0.006223
Train Epoch: 7 [16000/60000 (27%)]  Loss: 0.038078
Train Epoch: 7 [16640/60000 (28%)]  Loss: 0.026490
Train Epoch: 7 [17280/60000 (29%)]  Loss: 0.043234
Train Epoch: 7 [17920/60000 (30%)]  Loss: 0.146249
Train Epoch: 7 [18560/60000 (31%)]  Loss: 0.034506
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Train Epoch: 7 [19200/60000 (32%)]  Loss: 0.026990
Train Epoch: 7 [19840/60000 (33%)]  Loss: 0.032723
Train Epoch: 7 [20480/60000 (34%)]  Loss: 0.017582
Train Epoch: 7 [21120/60000 (35%)]  Loss: 0.041188
Train Epoch: 7 [21760/60000 (36%)]  Loss: 0.010204
Train Epoch: 7 [22400/60000 (37%)]  Loss: 0.026069
Train Epoch: 7 [23040/60000 (38%)]  Loss: 0.011370
Train Epoch: 7 [23680/60000 (39%)]  Loss: 0.010659
Train Epoch: 7 [24320/60000 (41%)]  Loss: 0.022436
Train Epoch: 7 [24960/60000 (42%)]  Loss: 0.004323
Train Epoch: 7 [25600/60000 (43%)]  Loss: 0.005764
Train Epoch: 7 [26240/60000 (44%)]  Loss: 0.009953
Train Epoch: 7 [26880/60000 (45%)]  Loss: 0.021592
Train Epoch: 7 [27520/60000 (46%)]  Loss: 0.063895
Train Epoch: 7 [28160/60000 (47%)]  Loss: 0.091569
Train Epoch: 7 [28800/60000 (48%)]  Loss: 0.021659
Train Epoch: 7 [29440/60000 (49%)]  Loss: 0.008436
Train Epoch: 7 [30080/60000 (50%)]  Loss: 0.014632
Train Epoch: 7 [30720/60000 (51%)]  Loss: 0.039018
Train Epoch: 7 [31360/60000 (52%)]  Loss: 0.002524
Train Epoch: 7 [32000/60000 (53%)]  Loss: 0.012835
Train Epoch: 7 [32640/60000 (54%)]  Loss: 0.132550
Train Epoch: 7 [33280/60000 (55%)]  Loss: 0.040743
Train Epoch: 7 [33920/60000 (57%)]  Loss: 0.003667
Train Epoch: 7 [34560/60000 (58%)]  Loss: 0.006823
Train Epoch: 7 [35200/60000 (59%)]  Loss: 0.024305
Train Epoch: 7 [35840/60000 (60%)]  Loss: 0.012061
Train Epoch: 7 [36480/60000 (61%)]  Loss: 0.008187
Train Epoch: 7 [37120/60000 (62%)]  Loss: 0.094661
Train Epoch: 7 [37760/60000 (63%)]  Loss: 0.019781
Train Epoch: 7 [38400/60000 (64%)]  Loss: 0.035973
Train Epoch: 7 [39040/60000 (65%)]  Loss: 0.166252
Train Epoch: 7 [39680/60000 (66%)]  Loss: 0.023392
Train Epoch: 7 [40320/60000 (67%)]  Loss: 0.013927
Train Epoch: 7 [40960/60000 (68%)]  Loss: 0.003907
Train Epoch: 7 [41600/60000 (69%)]  Loss: 0.056180
Train Epoch: 7 [42240/60000 (70%)]  Loss: 0.015571
Train Epoch: 7 [42880/60000 (71%)]  Loss: 0.119161
Train Epoch: 7 [43520/60000 (72%)]  Loss: 0.019813
Train Epoch: 7 [44160/60000 (74%)]  Loss: 0.049940
Train Epoch: 7 [44800/60000 (75%)]  Loss: 0.004472
Train Epoch: 7 [45440/60000 (76%)]  Loss: 0.004284
Train Epoch: 7 [46080/60000 (77%)]  Loss: 0.001794
Train Epoch: 7 [46720/60000 (78%)]  Loss: 0.032431
```

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Train Epoch: 7 [47360/60000 (79%)]  Loss: 0.095485
Train Epoch: 7 [48000/60000 (80%)]  Loss: 0.026115
Train Epoch: 7 [48640/60000 (81%)]  Loss: 0.055659
Train Epoch: 7 [49280/60000 (82%)]  Loss: 0.038559
Train Epoch: 7 [49920/60000 (83%)]  Loss: 0.038155
Train Epoch: 7 [50560/60000 (84%)]  Loss: 0.011218
Train Epoch: 7 [51200/60000 (85%)]  Loss: 0.077378
Train Epoch: 7 [51840/60000 (86%)]  Loss: 0.033608
Train Epoch: 7 [52480/60000 (87%)]  Loss: 0.003339
Train Epoch: 7 [53120/60000 (88%)]  Loss: 0.098918

Train Epoch: 7 [53760/60000 (90%)]  Loss: 0.011957
Train Epoch: 7 [54400/60000 (91%)]  Loss: 0.004049
Train Epoch: 7 [55040/60000 (92%)]  Loss: 0.070942
Train Epoch: 7 [55680/60000 (93%)]  Loss: 0.032415
Train Epoch: 7 [56320/60000 (94%)]  Loss: 0.048045
Train Epoch: 7 [56960/60000 (95%)]  Loss: 0.003400
Train Epoch: 7 [57600/60000 (96%)]  Loss: 0.010759
Train Epoch: 7 [58240/60000 (97%)]  Loss: 0.048965
Train Epoch: 7 [58880/60000 (98%)]  Loss: 0.013356
Train Epoch: 7 [59520/60000 (99%)]  Loss: 0.033926

Test set: Average loss: 0.0342, Accuracy: 9874/10000 (99%)

Train Epoch: 8 [0/60000 (0%)]   Loss: 0.005319
Train Epoch: 8 [640/60000 (1%)] Loss: 0.005395
Train Epoch: 8 [1280/60000 (2%)]    Loss: 0.009671
Train Epoch: 8 [1920/60000 (3%)]    Loss: 0.015060
Train Epoch: 8 [2560/60000 (4%)]    Loss: 0.057346
Train Epoch: 8 [3200/60000 (5%)]    Loss: 0.027025
Train Epoch: 8 [3840/60000 (6%)]    Loss: 0.023652
Train Epoch: 8 [4480/60000 (7%)]    Loss: 0.005174
Train Epoch: 8 [5120/60000 (9%)]    Loss: 0.003084
Train Epoch: 8 [5760/60000 (10%)]   Loss: 0.009381
Train Epoch: 8 [6400/60000 (11%)]   Loss: 0.036264
Train Epoch: 8 [7040/60000 (12%)]   Loss: 0.003416
Train Epoch: 8 [7680/60000 (13%)]   Loss: 0.009517
Train Epoch: 8 [8320/60000 (14%)]   Loss: 0.001108
Train Epoch: 8 [8960/60000 (15%)]   Loss: 0.002019
Train Epoch: 8 [9600/60000 (16%)]   Loss: 0.066908
Train Epoch: 8 [10240/60000 (17%)]  Loss: 0.000903
Train Epoch: 8 [10880/60000 (18%)]  Loss: 0.006952
Train Epoch: 8 [11520/60000 (19%)]  Loss: 0.038021
Train Epoch: 8 [12160/60000 (20%)]  Loss: 0.006185
```

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Train Epoch: 8 [12800/60000 (21%)]  Loss: 0.052784
Train Epoch: 8 [13440/60000 (22%)]  Loss: 0.029004
Train Epoch: 8 [14080/60000 (23%)]  Loss: 0.004117
Train Epoch: 8 [14720/60000 (25%)]  Loss: 0.060690
Train Epoch: 8 [15360/60000 (26%)]  Loss: 0.008388
Train Epoch: 8 [16000/60000 (27%)]  Loss: 0.002183
Train Epoch: 8 [16640/60000 (28%)]  Loss: 0.006131
Train Epoch: 8 [17280/60000 (29%)]  Loss: 0.020574
Train Epoch: 8 [17920/60000 (30%)]  Loss: 0.003676
Train Epoch: 8 [18560/60000 (31%)]  Loss: 0.011765
Train Epoch: 8 [19200/60000 (32%)]  Loss: 0.017637
Train Epoch: 8 [19840/60000 (33%)]  Loss: 0.043329
Train Epoch: 8 [20480/60000 (34%)]  Loss: 0.018086
Train Epoch: 8 [21120/60000 (35%)]  Loss: 0.003192
Train Epoch: 8 [21760/60000 (36%)]  Loss: 0.003579
Train Epoch: 8 [22400/60000 (37%)]  Loss: 0.082802
Train Epoch: 8 [23040/60000 (38%)]  Loss: 0.004743
Train Epoch: 8 [23680/60000 (39%)]  Loss: 0.011254
Train Epoch: 8 [24320/60000 (41%)]  Loss: 0.022281
Train Epoch: 8 [24960/60000 (42%)]  Loss: 0.034359
Train Epoch: 8 [25600/60000 (43%)]  Loss: 0.020449
Train Epoch: 8 [26240/60000 (44%)]  Loss: 0.000567
Train Epoch: 8 [26880/60000 (45%)]  Loss: 0.029199
Train Epoch: 8 [27520/60000 (46%)]  Loss: 0.033457
Train Epoch: 8 [28160/60000 (47%)]  Loss: 0.003844
Train Epoch: 8 [28800/60000 (48%)]  Loss: 0.040755
Train Epoch: 8 [29440/60000 (49%)]  Loss: 0.005881
Train Epoch: 8 [30080/60000 (50%)]  Loss: 0.003898
Train Epoch: 8 [30720/60000 (51%)]  Loss: 0.006877
Train Epoch: 8 [31360/60000 (52%)]  Loss: 0.007553
Train Epoch: 8 [32000/60000 (53%)]  Loss: 0.012553
Train Epoch: 8 [32640/60000 (54%)]  Loss: 0.057266
Train Epoch: 8 [33280/60000 (55%)]  Loss: 0.026207
Train Epoch: 8 [33920/60000 (57%)]  Loss: 0.012011
Train Epoch: 8 [34560/60000 (58%)]  Loss: 0.008041
Train Epoch: 8 [35200/60000 (59%)]  Loss: 0.027287
Train Epoch: 8 [35840/60000 (60%)]  Loss: 0.002346
Train Epoch: 8 [36480/60000 (61%)]  Loss: 0.021167
Train Epoch: 8 [37120/60000 (62%)]  Loss: 0.002858
Train Epoch: 8 [37760/60000 (63%)]  Loss: 0.012386
Train Epoch: 8 [38400/60000 (64%)]  Loss: 0.097658
Train Epoch: 8 [39040/60000 (65%)]  Loss: 0.273263
Train Epoch: 8 [39680/60000 (66%)]  Loss: 0.015617
Train Epoch: 8 [40320/60000 (67%)]  Loss: 0.005265
```

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Train Epoch: 8 [40960/60000 (68%)]  Loss: 0.001446
Train Epoch: 8 [41600/60000 (69%)]  Loss: 0.003217
Train Epoch: 8 [42240/60000 (70%)]  Loss: 0.002500
Train Epoch: 8 [42880/60000 (71%)]  Loss: 0.095915
Train Epoch: 8 [43520/60000 (72%)]  Loss: 0.010662
Train Epoch: 8 [44160/60000 (74%)]  Loss: 0.181074
Train Epoch: 8 [44800/60000 (75%)]  Loss: 0.006851
Train Epoch: 8 [45440/60000 (76%)]  Loss: 0.015467
Train Epoch: 8 [46080/60000 (77%)]  Loss: 0.013749
Train Epoch: 8 [46720/60000 (78%)]  Loss: 0.015353
Train Epoch: 8 [47360/60000 (79%)]  Loss: 0.003095
Train Epoch: 8 [48000/60000 (80%)]  Loss: 0.049991
Train Epoch: 8 [48640/60000 (81%)]  Loss: 0.005472
Train Epoch: 8 [49280/60000 (82%)]  Loss: 0.007360
Train Epoch: 8 [49920/60000 (83%)]  Loss: 0.021523
Train Epoch: 8 [50560/60000 (84%)]  Loss: 0.033255
Train Epoch: 8 [51200/60000 (85%)]  Loss: 0.076767
Train Epoch: 8 [51840/60000 (86%)]  Loss: 0.012638
Train Epoch: 8 [52480/60000 (87%)]  Loss: 0.025063
Train Epoch: 8 [53120/60000 (88%)]  Loss: 0.004480
Train Epoch: 8 [53760/60000 (90%)]  Loss: 0.013525
Train Epoch: 8 [54400/60000 (91%)]  Loss: 0.015583
Train Epoch: 8 [55040/60000 (92%)]  Loss: 0.012243
Train Epoch: 8 [55680/60000 (93%)]  Loss: 0.008292
Train Epoch: 8 [56320/60000 (94%)]  Loss: 0.005478
Train Epoch: 8 [56960/60000 (95%)]  Loss: 0.035386
Train Epoch: 8 [57600/60000 (96%)]  Loss: 0.009556
Train Epoch: 8 [58240/60000 (97%)]  Loss: 0.036007
Train Epoch: 8 [58880/60000 (98%)]  Loss: 0.002460
Train Epoch: 8 [59520/60000 (99%)]  Loss: 0.120706

Test set: Average loss: 0.0388, Accuracy: 9881/10000 (99%)

Train Epoch: 9 [0/60000 (0%)]   Loss: 0.084697
Train Epoch: 9 [640/60000 (1%)] Loss: 0.034575
Train Epoch: 9 [1280/60000 (2%)]    Loss: 0.008109
Train Epoch: 9 [1920/60000 (3%)]    Loss: 0.023725
Train Epoch: 9 [2560/60000 (4%)]    Loss: 0.002250
Train Epoch: 9 [3200/60000 (5%)]    Loss: 0.032552
Train Epoch: 9 [3840/60000 (6%)]    Loss: 0.052621
Train Epoch: 9 [4480/60000 (7%)]    Loss: 0.002801
Train Epoch: 9 [5120/60000 (9%)]    Loss: 0.019804
Train Epoch: 9 [5760/60000 (10%)]   Loss: 0.004831
Train Epoch: 9 [6400/60000 (11%)]   Loss: 0.007969
```

```
Train Epoch: 9 [7040/60000 (12%)]   Loss: 0.010094
Train Epoch: 9 [7680/60000 (13%)]   Loss: 0.021994
Train Epoch: 9 [8320/60000 (14%)]   Loss: 0.032272
Train Epoch: 9 [8960/60000 (15%)]   Loss: 0.004357
Train Epoch: 9 [9600/60000 (16%)]   Loss: 0.017535
Train Epoch: 9 [10240/60000 (17%)]  Loss: 0.026174
Train Epoch: 9 [10880/60000 (18%)]  Loss: 0.000621
Train Epoch: 9 [11520/60000 (19%)]  Loss: 0.009457
Train Epoch: 9 [12160/60000 (20%)]  Loss: 0.003144
Train Epoch: 9 [12800/60000 (21%)]  Loss: 0.012929
Train Epoch: 9 [13440/60000 (22%)]  Loss: 0.013086
Train Epoch: 9 [14080/60000 (23%)]  Loss: 0.007104
Train Epoch: 9 [14720/60000 (25%)]  Loss: 0.008375
Train Epoch: 9 [15360/60000 (26%)]  Loss: 0.002841
Train Epoch: 9 [16000/60000 (27%)]  Loss: 0.009142
Train Epoch: 9 [16640/60000 (28%)]  Loss: 0.004838
Train Epoch: 9 [17280/60000 (29%)]  Loss: 0.031183
Train Epoch: 9 [17920/60000 (30%)]  Loss: 0.013318
Train Epoch: 9 [18560/60000 (31%)]  Loss: 0.036396
Train Epoch: 9 [19200/60000 (32%)]  Loss: 0.004974
Train Epoch: 9 [19840/60000 (33%)]  Loss: 0.015584
Train Epoch: 9 [20480/60000 (34%)]  Loss: 0.010939
Train Epoch: 9 [21120/60000 (35%)]  Loss: 0.014692
Train Epoch: 9 [21760/60000 (36%)]  Loss: 0.013196
Train Epoch: 9 [22400/60000 (37%)]  Loss: 0.015222
Train Epoch: 9 [23040/60000 (38%)]  Loss: 0.018252
Train Epoch: 9 [23680/60000 (39%)]  Loss: 0.050641
Train Epoch: 9 [24320/60000 (41%)]  Loss: 0.034552
Train Epoch: 9 [24960/60000 (42%)]  Loss: 0.016510
Train Epoch: 9 [25600/60000 (43%)]  Loss: 0.006982
Train Epoch: 9 [26240/60000 (44%)]  Loss: 0.035291
Train Epoch: 9 [26880/60000 (45%)]  Loss: 0.032347
Train Epoch: 9 [27520/60000 (46%)]  Loss: 0.018470
Train Epoch: 9 [28160/60000 (47%)]  Loss: 0.010571
Train Epoch: 9 [28800/60000 (48%)]  Loss: 0.009015
Train Epoch: 9 [29440/60000 (49%)]  Loss: 0.004280
Train Epoch: 9 [30080/60000 (50%)]  Loss: 0.008895
Train Epoch: 9 [30720/60000 (51%)]  Loss: 0.004660
Train Epoch: 9 [31360/60000 (52%)]  Loss: 0.038525
Train Epoch: 9 [32000/60000 (53%)]  Loss: 0.007617
Train Epoch: 9 [32640/60000 (54%)]  Loss: 0.026014
Train Epoch: 9 [33280/60000 (55%)]  Loss: 0.090435
Train Epoch: 9 [33920/60000 (57%)]  Loss: 0.003702
Train Epoch: 9 [34560/60000 (58%)]  Loss: 0.036775
```

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Train Epoch: 9 [35200/60000 (59%)]  Loss: 0.019838
Train Epoch: 9 [35840/60000 (60%)]  Loss: 0.009436
Train Epoch: 9 [36480/60000 (61%)]  Loss: 0.002328
Train Epoch: 9 [37120/60000 (62%)]  Loss: 0.002853

Train Epoch: 9 [37760/60000 (63%)]  Loss: 0.015555
Train Epoch: 9 [38400/60000 (64%)]  Loss: 0.005833
Train Epoch: 9 [39040/60000 (65%)]  Loss: 0.037468
Train Epoch: 9 [39680/60000 (66%)]  Loss: 0.041464
Train Epoch: 9 [40320/60000 (67%)]  Loss: 0.021133
Train Epoch: 9 [40960/60000 (68%)]  Loss: 0.003350
Train Epoch: 9 [41600/60000 (69%)]  Loss: 0.008357
Train Epoch: 9 [42240/60000 (70%)]  Loss: 0.004859
Train Epoch: 9 [42880/60000 (71%)]  Loss: 0.024792
Train Epoch: 9 [43520/60000 (72%)]  Loss: 0.004867
Train Epoch: 9 [44160/60000 (74%)]  Loss: 0.002627
Train Epoch: 9 [44800/60000 (75%)]  Loss: 0.036636
Train Epoch: 9 [45440/60000 (76%)]  Loss: 0.022538
Train Epoch: 9 [46080/60000 (77%)]  Loss: 0.060838
Train Epoch: 9 [46720/60000 (78%)]  Loss: 0.047339
Train Epoch: 9 [47360/60000 (79%)]  Loss: 0.000999
Train Epoch: 9 [48000/60000 (80%)]  Loss: 0.019009
Train Epoch: 9 [48640/60000 (81%)]  Loss: 0.001050
Train Epoch: 9 [49280/60000 (82%)]  Loss: 0.020398
Train Epoch: 9 [49920/60000 (83%)]  Loss: 0.002342
Train Epoch: 9 [50560/60000 (84%)]  Loss: 0.008764
Train Epoch: 9 [51200/60000 (85%)]  Loss: 0.005450
Train Epoch: 9 [51840/60000 (86%)]  Loss: 0.005224
Train Epoch: 9 [52480/60000 (87%)]  Loss: 0.028015
Train Epoch: 9 [53120/60000 (88%)]  Loss: 0.004606
Train Epoch: 9 [53760/60000 (90%)]  Loss: 0.035582
Train Epoch: 9 [54400/60000 (91%)]  Loss: 0.001882
Train Epoch: 9 [55040/60000 (92%)]  Loss: 0.055118
Train Epoch: 9 [55680/60000 (93%)]  Loss: 0.015622
Train Epoch: 9 [56320/60000 (94%)]  Loss: 0.008126
Train Epoch: 9 [56960/60000 (95%)]  Loss: 0.073361
Train Epoch: 9 [57600/60000 (96%)]  Loss: 0.084524
Train Epoch: 9 [58240/60000 (97%)]  Loss: 0.009923
Train Epoch: 9 [58880/60000 (98%)]  Loss: 0.080174
Train Epoch: 9 [59520/60000 (99%)]  Loss: 0.012197

Test set: Average loss: 0.0291, Accuracy: 9912/10000 (99%)

Train Epoch: 10 [0/60000 (0%)]  Loss: 0.124967
```

```
Train Epoch: 10 [640/60000 (1%)]    Loss: 0.013199
Train Epoch: 10 [1280/60000 (2%)]   Loss: 0.008873
Train Epoch: 10 [1920/60000 (3%)]   Loss: 0.029083
Train Epoch: 10 [2560/60000 (4%)]   Loss: 0.006250
Train Epoch: 10 [3200/60000 (5%)]   Loss: 0.015071
Train Epoch: 10 [3840/60000 (6%)]   Loss: 0.010627
Train Epoch: 10 [4480/60000 (7%)]   Loss: 0.002760
Train Epoch: 10 [5120/60000 (9%)]   Loss: 0.005103
Train Epoch: 10 [5760/60000 (10%)]  Loss: 0.012635
Train Epoch: 10 [6400/60000 (11%)]  Loss: 0.028240
Train Epoch: 10 [7040/60000 (12%)]  Loss: 0.016184
Train Epoch: 10 [7680/60000 (13%)]  Loss: 0.005765
Train Epoch: 10 [8320/60000 (14%)]  Loss: 0.003568
Train Epoch: 10 [8960/60000 (15%)]  Loss: 0.031939
Train Epoch: 10 [9600/60000 (16%)]  Loss: 0.007868
Train Epoch: 10 [10240/60000 (17%)] Loss: 0.002515
Train Epoch: 10 [10880/60000 (18%)] Loss: 0.008510
Train Epoch: 10 [11520/60000 (19%)] Loss: 0.007039
Train Epoch: 10 [12160/60000 (20%)] Loss: 0.001552
Train Epoch: 10 [12800/60000 (21%)] Loss: 0.001358
Train Epoch: 10 [13440/60000 (22%)] Loss: 0.001308
Train Epoch: 10 [14080/60000 (23%)] Loss: 0.013259
Train Epoch: 10 [14720/60000 (25%)] Loss: 0.008570
Train Epoch: 10 [15360/60000 (26%)] Loss: 0.011390
Train Epoch: 10 [16000/60000 (27%)] Loss: 0.016988
Train Epoch: 10 [16640/60000 (28%)] Loss: 0.018844
Train Epoch: 10 [17280/60000 (29%)] Loss: 0.043240
Train Epoch: 10 [17920/60000 (30%)] Loss: 0.004204
Train Epoch: 10 [18560/60000 (31%)] Loss: 0.048123
Train Epoch: 10 [19200/60000 (32%)] Loss: 0.028336
Train Epoch: 10 [19840/60000 (33%)] Loss: 0.004887
Train Epoch: 10 [20480/60000 (34%)] Loss: 0.010916
Train Epoch: 10 [21120/60000 (35%)] Loss: 0.044343
Train Epoch: 10 [21760/60000 (36%)] Loss: 0.001666
Train Epoch: 10 [22400/60000 (37%)] Loss: 0.001561
Train Epoch: 10 [23040/60000 (38%)] Loss: 0.016616
Train Epoch: 10 [23680/60000 (39%)] Loss: 0.007027
Train Epoch: 10 [24320/60000 (41%)] Loss: 0.010851
Train Epoch: 10 [24960/60000 (42%)] Loss: 0.009382
Train Epoch: 10 [25600/60000 (43%)] Loss: 0.002248
Train Epoch: 10 [26240/60000 (44%)] Loss: 0.005225
Train Epoch: 10 [26880/60000 (45%)] Loss: 0.040897
Train Epoch: 10 [27520/60000 (46%)] Loss: 0.006696
Train Epoch: 10 [28160/60000 (47%)] Loss: 0.006315
```

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Train Epoch: 10 [28800/60000 (48%)] Loss: 0.006295
Train Epoch: 10 [29440/60000 (49%)] Loss: 0.015380
Train Epoch: 10 [30080/60000 (50%)] Loss: 0.024972
Train Epoch: 10 [30720/60000 (51%)] Loss: 0.109114
Train Epoch: 10 [31360/60000 (52%)] Loss: 0.056376
Train Epoch: 10 [32000/60000 (53%)] Loss: 0.011942
Train Epoch: 10 [32640/60000 (54%)] Loss: 0.035948
Train Epoch: 10 [33280/60000 (55%)] Loss: 0.053332
Train Epoch: 10 [33920/60000 (57%)] Loss: 0.053515
Train Epoch: 10 [34560/60000 (58%)] Loss: 0.006416
Train Epoch: 10 [35200/60000 (59%)] Loss: 0.008709
Train Epoch: 10 [35840/60000 (60%)] Loss: 0.009216
Train Epoch: 10 [36480/60000 (61%)] Loss: 0.019891
Train Epoch: 10 [37120/60000 (62%)] Loss: 0.087642
Train Epoch: 10 [37760/60000 (63%)] Loss: 0.014718
Train Epoch: 10 [38400/60000 (64%)] Loss: 0.017033
Train Epoch: 10 [39040/60000 (65%)] Loss: 0.015801
Train Epoch: 10 [39680/60000 (66%)] Loss: 0.006864
Train Epoch: 10 [40320/60000 (67%)] Loss: 0.004813
Train Epoch: 10 [40960/60000 (68%)] Loss: 0.003148
Train Epoch: 10 [41600/60000 (69%)] Loss: 0.011369
Train Epoch: 10 [42240/60000 (70%)] Loss: 0.023909
Train Epoch: 10 [42880/60000 (71%)] Loss: 0.006820
Train Epoch: 10 [43520/60000 (72%)] Loss: 0.010916
Train Epoch: 10 [44160/60000 (74%)] Loss: 0.003867
Train Epoch: 10 [44800/60000 (75%)] Loss: 0.014076
Train Epoch: 10 [45440/60000 (76%)] Loss: 0.007646
Train Epoch: 10 [46080/60000 (77%)] Loss: 0.015754
Train Epoch: 10 [46720/60000 (78%)] Loss: 0.038607
Train Epoch: 10 [47360/60000 (79%)] Loss: 0.006719
Train Epoch: 10 [48000/60000 (80%)] Loss: 0.006232
Train Epoch: 10 [48640/60000 (81%)] Loss: 0.012978
Train Epoch: 10 [49280/60000 (82%)] Loss: 0.003165
Train Epoch: 10 [49920/60000 (83%)] Loss: 0.006593
Train Epoch: 10 [50560/60000 (84%)] Loss: 0.043128
Train Epoch: 10 [51200/60000 (85%)] Loss: 0.022184
Train Epoch: 10 [51840/60000 (86%)] Loss: 0.034332
Train Epoch: 10 [52480/60000 (87%)] Loss: 0.005865
Train Epoch: 10 [53120/60000 (88%)] Loss: 0.005392
Train Epoch: 10 [53760/60000 (90%)] Loss: 0.036281
Train Epoch: 10 [54400/60000 (91%)] Loss: 0.009267
Train Epoch: 10 [55040/60000 (92%)] Loss: 0.005003
Train Epoch: 10 [55680/60000 (93%)] Loss: 0.000648
Train Epoch: 10 [56320/60000 (94%)] Loss: 0.007059
```

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Train Epoch: 10 [56960/60000 (95%)] Loss: 0.102807
Train Epoch: 10 [57600/60000 (96%)] Loss: 0.004590
Train Epoch: 10 [58240/60000 (97%)] Loss: 0.177058
Train Epoch: 10 [58880/60000 (98%)] Loss: 0.005649
Train Epoch: 10 [59520/60000 (99%)] Loss: 0.008369

Test set: Average loss: 0.0315, Accuracy: 9891/10000 (99%)
```

就实验过程中遇到和出现的问题，你是如何解决和处理的，自拟 1－3 道问答题：

1. pytorch 路径问题：改为下载数据集为 true
2. 数据集问题：加入 key
3. 可视化问题：启动完毕即为可视化完成