Machine Learning 2024 spring

HW3: Neural Network

Deadline: 2024.5.22

1 Part I.

In HW3, you need to use a deep neural network (DNN) to classify the hand-written numbers from zero to nine. Please use the toolbox of Pytorch to implement DNN and use the following code to download the MNIST dataset. The MNIST dataset is composed of 60,000 training data and 10,000 testing data. Each data is a 28×28 hand-written image.

```
import torchvision
import torchvision.transforms as transforms
transform = transforms.Compose([
    transforms.ToTensor()
])

trainset = torchvision.datasets.MNIST(root='./data',...
train=True, download=True, transform=transform)
trainloader = torch.utils.data.DataLoader(trainset, ...
batch_size=batch_size, shuffle=True)
testset = torchvision.datasets.MNIST(root='./data',...
train=False, download=True, transform=transform)
testloader = torch.utils.data.DataLoader(testset, batch_size=64, shuffle=False)
```

You need to define batch_size in trainloader by yourself.

1. Construct a DNN with one layer. Modify the number of neurons of the layer, 5, 10, 20, 50, 75, 100 with the whole data set with the whole training dataset. Plot the training and testing accuracy versus the number of neurons.

2. Construct a DNN with two layers. The number of neurons is 100 in each layer. Modify the number of training data and plot the training and testing accuracy versus the number of training data.

3. Construct a DNN and modify the number of hidden layers from 1 to 5 with the whole training dataset. The number of neurons is 100 in each layer. Plot the training and testing accuracy versus the number of hidden layers.

2 Part II.

Use DNN to predict HW2 again. The input data is the raw input data from the training data we gave in HW2. Compare the testing accuracy of classification with DNN.

- Compare the training and testing accuracy and training and testing confusion matrix of DNN with the generative model and the discriminative model in HW2, and plot the corresponding decision boundaries for your DNN results. You can use any toolbox or function to plot the decision boundaries for your prediction results.

  Explain about designing the structure of DNN.

Homework Rules and Grading Policy

Homework will be graded by:

1. Report 50%
   - The correctness of your classification.
   - Your discussion of what you observe in the classification problems. For example,
     - What is the difference between DNN and traditional methods (generative model, and discriminative model)
     - How do you utilize the toolbox of Pytorch?
     - And any other topics you would like to discuss.
2. Demo 50%
3. The final score is determined by an equal weight of 50% for both the demo and report. In order to achieve an average score of around B+, the report will be graded around 60.

Upload:

- [Web] E3
- [File Name] hw3_StudentID.zip (ex: hw3_1234567.zip)
  The file should include your code and report.

Remind:

1. Your report in the format of .pdf.
2. Deadline:
   If you have a late submission by 1 to 7 days, you will only get 70% of the score. We DO NOT accept any late submissions after 7 days after the deadline.
3. We encourage open discussion to ensure program correctness, but plagiarism is strictly prohibited. Violators will receive a score of 0.

Demonstration:

1. In the demo part, you need to train and test your program with the additional test data prepared by TAs. You will be required to evaluate the accuracy of this dataset.
2. Your submitted program should be executable directly (with the dataset and program placed in the same folder).