Lab4 : MNIST Handwritten Digit Recognition

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Components Used

1. Rpi 5 & its power supply adapter

- Diagram:
  [PC Training] → Save as mnist_cnn.pth → [Raspberry Pi Inference]

- Description:
  - Train CNN model using PyTorch on PC
  - Use MNIST handwritten digits dataset
  - Save model weights as .pth
  - Load model and perform inference on Raspberry Pi

PC-Side Training Code Summary

- ## 1.Define CNN model

```
class Net(nn.Module)
```

- ## 2.Load MNIST dataset and train

```python
optimizer = optim.Adam(model.parameters(), lr=learning_rate)
criterion = nn.CrossEntropyLoss()
for epoch in range(epochs):
    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 = criterion(output, target)
        loss.backward()
        optimizer.step()
    print(f"Epoch {epoch+1}/{epochs} - Loss: {loss.item():.4f}"
```

- ## 3.Save model weights as mnist_cnn.pth

```python
torch.save(model.state_dict(), "mnist_cnn.pth")
```

```
≡ mnist_cnn.pth
```

Inference Code on Raspberry Pi

```python
from PIL import Image
import torch
from torchvision import transforms
# Load model
model = Net()
model.load_state_dict(torch.load("mnist_cnn.pth", map_location="cpu"))
model.eval()


img = Image.open("mydigit.png").convert("L")
transform = transforms.Compose([
    transforms.Resize((28, 28)),
    transforms.ToTensor(),
    transforms.Normalize((0.1307,), (0.3081,))])
img_tensor = transform(img).unsqueeze(0)


# Predict
with torch.no_grad():
    output = model(img_tensor)
    pred = output.argmax(dim=1)
    print(f"Prediction: {pred.item()}")
```

Test Results & Demo

- Input image: show handwritten digit

- Output: predicted digit

```
(myenv) cirlab@raspberrypi:~ $ python3 lab4.py
/home/cirlab/myenv/lib/python3.11/site-packages/PIL
Palette images with Transparency expressed in bytes
images
  warnings.warn(
預測結果是 : 2
```

Lab 4

- This project uses the MNIST handwritten digit dataset to design a Convolutional Neural Network (CNN) for digit classification.

- The model is trained on a computer and then deployed to a Raspberry Pi for inference.

- During the inference phase, the system displays:

    1. The input handwritten digit image

    2. The model's prediction result (recognized digit)

Lab 4

The lab report should include the following:

Video

Code

Problems Encountered

End the report with a section called "Problems Encountered:" where you can describe missing features, problems with your codes, or difficulties encountered with using ssh/scp or other Unix commands. If there were no problems, write "None".

Deadline : **(It is best to complete it in class)**

Submission Email : 61275068h@ntnu.edu.tw