# Đề kiểm tra lập trình nhập môn phân tích dữ liệu và học sâu

## Sinh viên không được phép sử dụng internet

## Sinh viên sau khi làm bài xong xuất ra file PDF đồng thời nộp lên Fit-lab và push lên git-hub

## Sinh viên làm bắt đầu làm bài từ 15h40 - 18h00

In [147…
```python
# Họ và Tên: Nguyễn Minh Huy
# MSSV: 2174802010934
```

In [147…
```python
import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import Dataset, DataLoader, random_split
import numpy as np
from sklearn.datasets import load_iris
import matplotlib.pyplot as plt
```

In [148…
```python
# Bước 1: Load data
def load_dataset():
    X, y = load_iris(return_X_y=True)
    # Loại bỏ các mẫu thuộc lớp 2
    X = X[y != 2]
    y = y[y != 2]
    return X, y

# Điền ở đây
X, y = load_dataset()
print("X:", X.shape)
print("y:", y.shape)
```

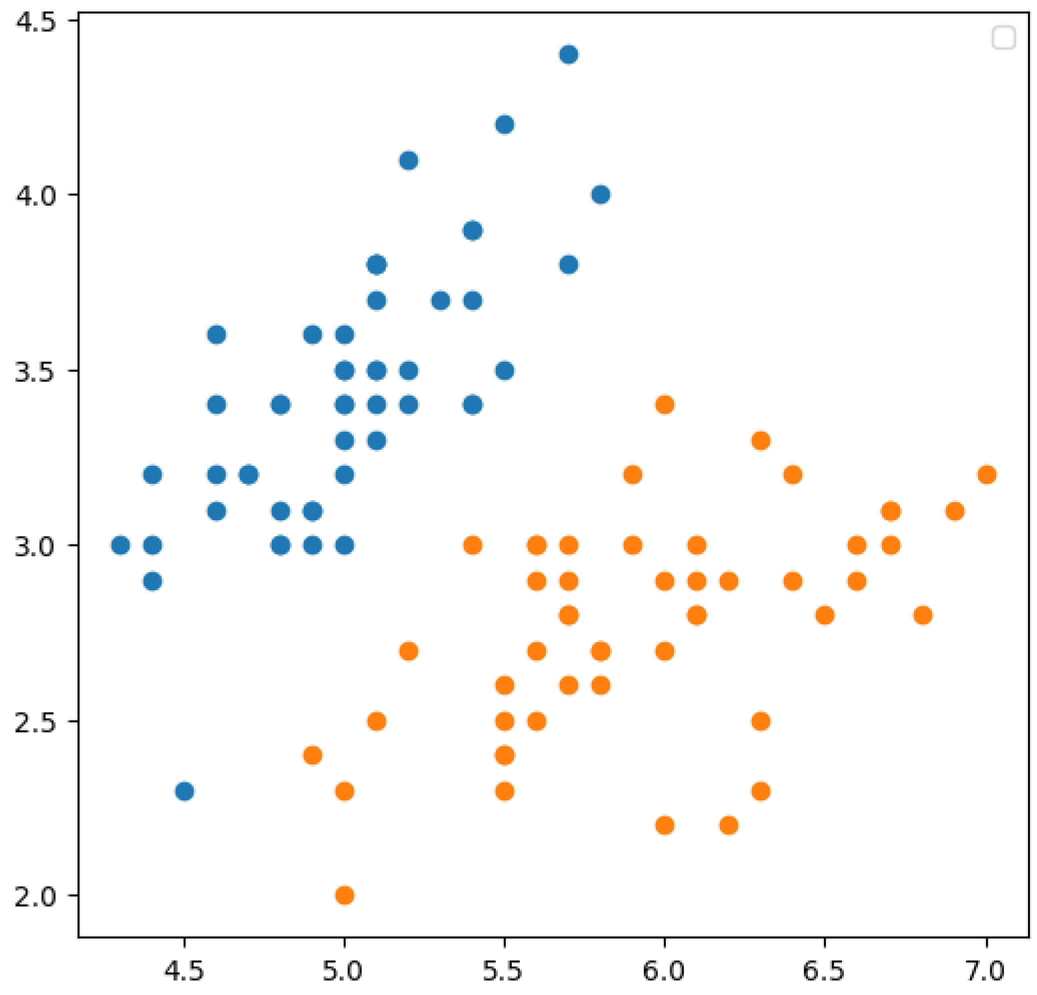
```
X: (100, 4)
y: (100,)
```

Kết quả: (100, 4) (100,)

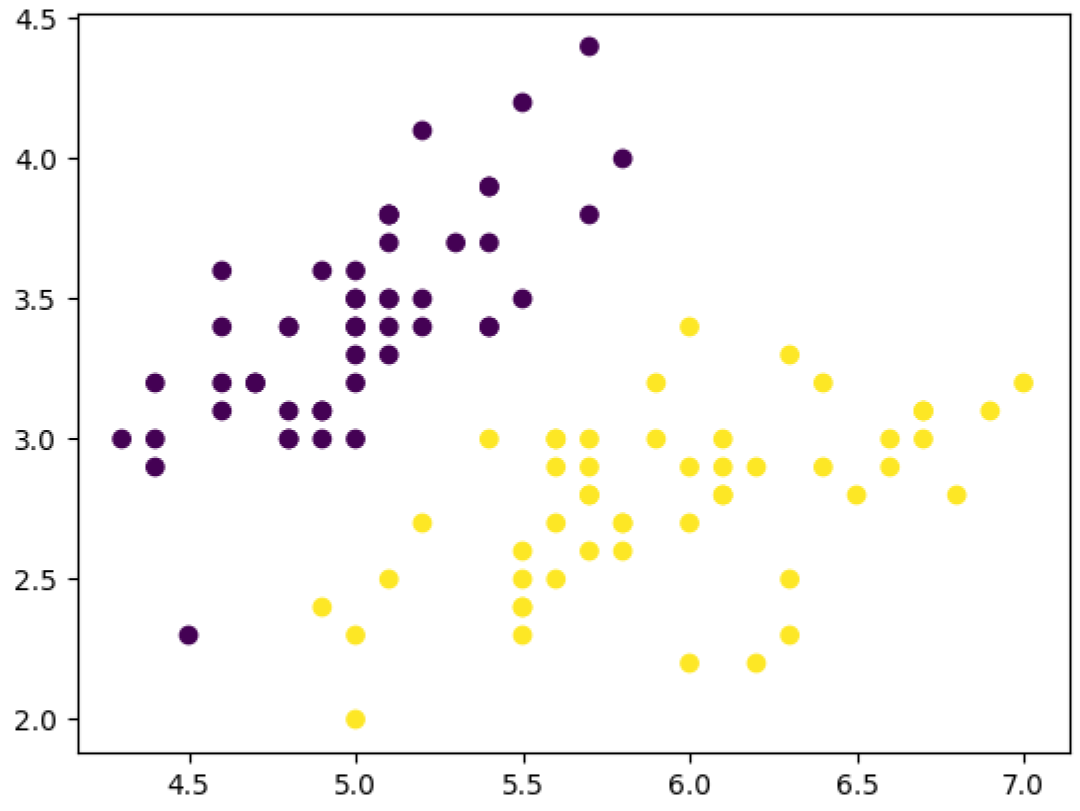
Kết quả: (100, 4) (100,)

In [148…
```python
# Trực quan hóa dữ liệu
def visualize_data(X, y):
    plt.figure(figsize=(13.5, 6))
    plt.subplot(1, 2, 1)
    plt.scatter(X[y == 0][:, 0], X[y == 0][:, 1],)
    plt.scatter(X[y == 1][:, 0], X[y == 1][:, 1],)
    plt.legend()
    plt.show()
visualize_data(X, y)
```

```
No artists with labels found to put in legend.  Note that artists whose label start with
an underscore are ignored when legend() is called with no argument.
```



Kết quả



In [148…

```
# Bước 2: Định nghĩa mô hình hồi quy logistic bằng PyTorch
class LogisticRegressTorch(nn.Module):
    def __init__(self, n_features):
        super(LogisticRegressTorch, self).__init__()
        # Tạo một lớp tuyến tính (nn.Linear) với n_features đầu vào và 1 đầu ra
        self.linear = nn.Linear(n_features, 1)

    def forward(self, x):
        return torch.sigmoid(self.linear(x))

LogisticRegressTorch(n_features=4)
```

Out[1482]:
```
LogisticRegressTorch(
  (linear): Linear(in_features=4, out_features=1, bias=True)
)
```

In [148…
```
# Bước 3: Định nghĩa lớp dữ liệu
class IrisTorch(Dataset):
    def __init__(self, X, y):
        self.X = torch.tensor(X, dtype=torch.float32)
        self.y = torch.tensor(y, dtype=torch.float32).unsqueeze(1)

    def __len__(self):
        return len(self.X)  # Trả về số lượng mẫu trong tập dữ liệu

    def __getitem__(self, idx):
        return self.X[idx], self.y[idx]  # Trả về một cặp đặc trưng và nhãn tương ứng v
```

In [148…
```
# Tạo dữ liệu
dataset = IrisTorch(X, y)

print(f"Số lượng mẫu trong tập dữ liệu: {len(dataset)}")
print("Một mẫu dữ liệu:", dataset[0])
```

```
Số lượng mẫu trong tập dữ liệu: 100
Một mẫu dữ liệu: (tensor([5.1000, 3.5000, 1.4000, 0.2000]), tensor([0.]))
```

In [148…
```
# Bước 4: Chia tập dữ liệu thành tập huấn luyện và tập kiểm tra bằng cách chia ngẫu nhi
dataset_size = len(dataset)
train_size = int(0.7 * dataset_size)  # 70%
test_size = dataset_size - train_size  # Còn lại là 30%

train_dataset, test_dataset = random_split(dataset, [train_size, test_size])
```

In [148…
```
# Tạo DataLoader
batch_size = 64
train_loader = DataLoader(train_dataset, batch_size=batch_size, shuffle=True)
test_loader = DataLoader(test_dataset, batch_size=batch_size, shuffle=False)
```

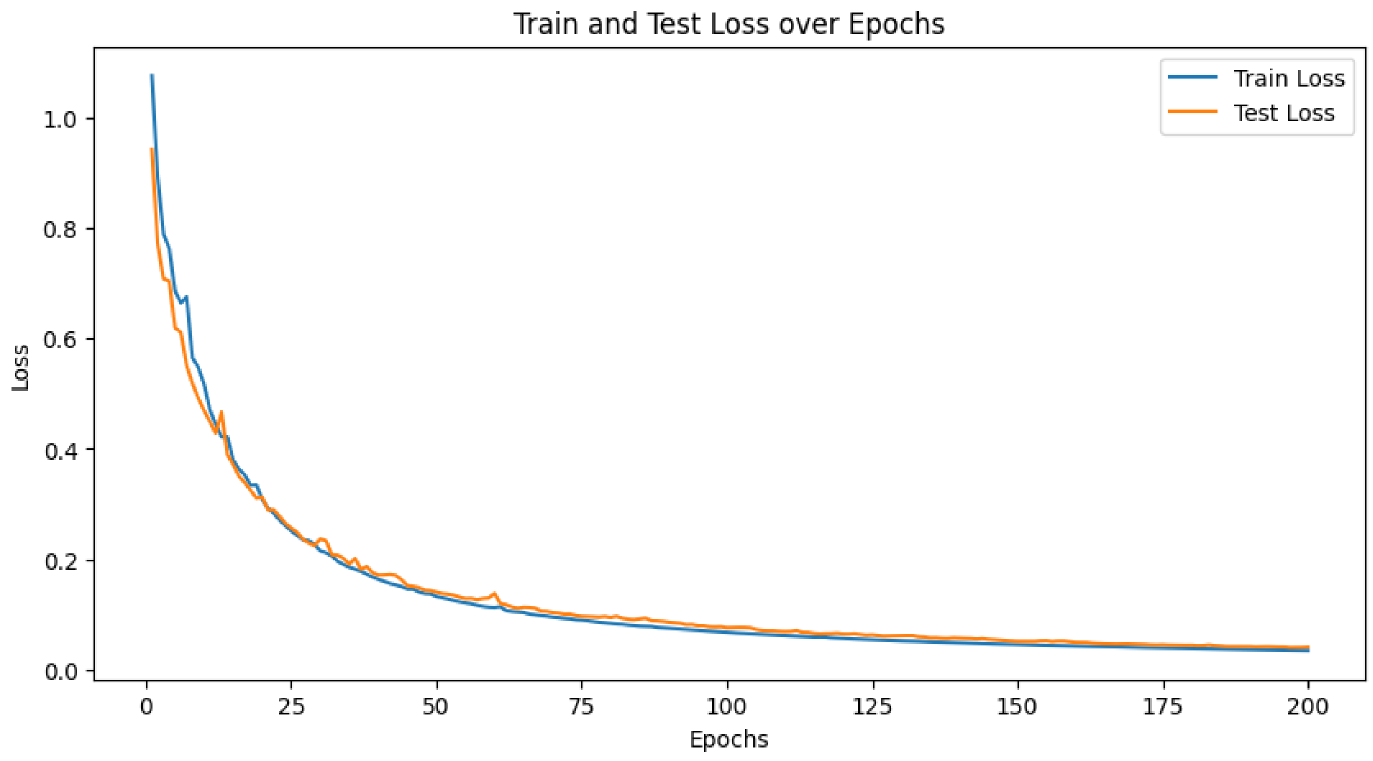
In [148…
```
# Bước 5: Định nghĩa criterion và optimizer
n_features = X.shape[1]
model = LogisticRegressTorch(n_features=n_features)
criterion = nn.BCELoss()
optimizer = optim.SGD(model.parameters(), lr=0.05)
```

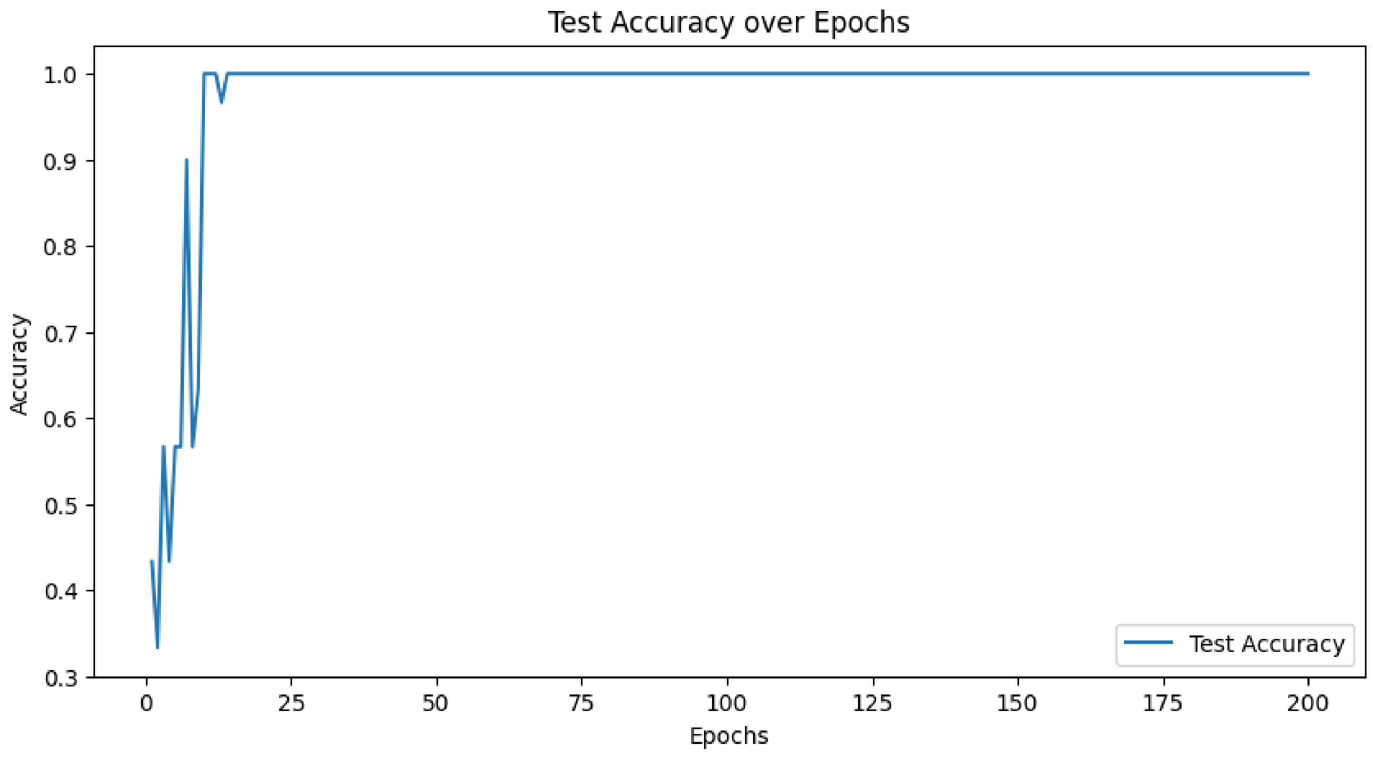
In [148…
```
# Huấn luyện mô hình
n_epochs = 200
train_losses = []
test_losses = []
test_accuracies = []

for epoch in range(n_epochs):
    model.train()
    train_loss = 0.0
    for inputs, targets in train_loader:
        optimizer.zero_grad()
        outputs = model(inputs)
        loss = criterion(outputs, targets)
        loss.backward()
        optimizer.step()
        train_loss += loss.item() * inputs.size(0)

    train_loss /= len(train_loader.dataset)
    train_losses.append(train_loss)

    # Đánh giá trên tập kiểm tra
    model.eval()
    test_loss = 0.0
    correct = 0
    total = 0
    with torch.no_grad():
        for inputs, targets in test_loader:
            outputs = model(inputs)
            loss = criterion(outputs, targets)
            test_loss += loss.item() * inputs.size(0)

            predicted = (outputs >= 0.5).float()
            total += targets.size(0)
            correct += (predicted == targets).sum().item()

    test_loss /= len(test_loader.dataset)
    test_losses.append(test_loss)

    accuracy = correct / total
    test_accuracies.append(accuracy)

    print(f'Epoch {epoch+1}/{n_epochs}, Train Loss: {train_loss:.4f}, Test Loss: {test_l
```

```
Epoch 1/200, Train Loss: 1.0758, Test Loss: 0.9427, Test Accuracy: 0.4333
Epoch 2/200, Train Loss: 0.8932, Test Loss: 0.7720, Test Accuracy: 0.3333
Epoch 3/200, Train Loss: 0.7889, Test Loss: 0.7081, Test Accuracy: 0.5667
Epoch 4/200, Train Loss: 0.7626, Test Loss: 0.7034, Test Accuracy: 0.4333
Epoch 5/200, Train Loss: 0.6853, Test Loss: 0.6187, Test Accuracy: 0.5667
Epoch 6/200, Train Loss: 0.6639, Test Loss: 0.6103, Test Accuracy: 0.5667
Epoch 7/200, Train Loss: 0.6751, Test Loss: 0.5510, Test Accuracy: 0.9000
Epoch 8/200, Train Loss: 0.5643, Test Loss: 0.5180, Test Accuracy: 0.5667
Epoch 9/200, Train Loss: 0.5477, Test Loss: 0.4916, Test Accuracy: 0.6333
Epoch 10/200, Train Loss: 0.5165, Test Loss: 0.4692, Test Accuracy: 1.0000
Epoch 11/200, Train Loss: 0.4706, Test Loss: 0.4490, Test Accuracy: 1.0000
Epoch 12/200, Train Loss: 0.4441, Test Loss: 0.4278, Test Accuracy: 1.0000
Epoch 13/200, Train Loss: 0.4213, Test Loss: 0.4668, Test Accuracy: 0.9667
Epoch 14/200, Train Loss: 0.4218, Test Loss: 0.3895, Test Accuracy: 1.0000
Epoch 15/200, Train Loss: 0.3800, Test Loss: 0.3715, Test Accuracy: 1.0000
Epoch 16/200, Train Loss: 0.3631, Test Loss: 0.3505, Test Accuracy: 1.0000
Epoch 17/200, Train Loss: 0.3526, Test Loss: 0.3391, Test Accuracy: 1.0000
Epoch 18/200, Train Loss: 0.3343, Test Loss: 0.3248, Test Accuracy: 1.0000
Epoch 19/200, Train Loss: 0.3350, Test Loss: 0.3109, Test Accuracy: 1.0000
Epoch 20/200, Train Loss: 0.3083, Test Loss: 0.3129, Test Accuracy: 1.0000
Epoch 21/200, Train Loss: 0.2928, Test Loss: 0.2894, Test Accuracy: 1.0000
Epoch 22/200, Train Loss: 0.2829, Test Loss: 0.2897, Test Accuracy: 1.0000
Epoch 23/200, Train Loss: 0.2709, Test Loss: 0.2773, Test Accuracy: 1.0000
Epoch 24/200, Train Loss: 0.2607, Test Loss: 0.2651, Test Accuracy: 1.0000
Epoch 25/200, Train Loss: 0.2517, Test Loss: 0.2566, Test Accuracy: 1.0000
Epoch 26/200, Train Loss: 0.2432, Test Loss: 0.2492, Test Accuracy: 1.0000
Epoch 27/200, Train Loss: 0.2356, Test Loss: 0.2365, Test Accuracy: 1.0000
Epoch 28/200, Train Loss: 0.2337, Test Loss: 0.2296, Test Accuracy: 1.0000
Epoch 29/200, Train Loss: 0.2272, Test Loss: 0.2249, Test Accuracy: 1.0000
Epoch 30/200, Train Loss: 0.2152, Test Loss: 0.2368, Test Accuracy: 1.0000
Epoch 31/200, Train Loss: 0.2119, Test Loss: 0.2335, Test Accuracy: 1.0000
Epoch 32/200, Train Loss: 0.2060, Test Loss: 0.2084, Test Accuracy: 1.0000
Epoch 33/200, Train Loss: 0.1962, Test Loss: 0.2074, Test Accuracy: 1.0000
Epoch 34/200, Train Loss: 0.1906, Test Loss: 0.2018, Test Accuracy: 1.0000
Epoch 35/200, Train Loss: 0.1856, Test Loss: 0.1913, Test Accuracy: 1.0000
Epoch 36/200, Train Loss: 0.1821, Test Loss: 0.2018, Test Accuracy: 1.0000
Epoch 37/200, Train Loss: 0.1782, Test Loss: 0.1818, Test Accuracy: 1.0000
Epoch 38/200, Train Loss: 0.1731, Test Loss: 0.1869, Test Accuracy: 1.0000
Epoch 39/200, Train Loss: 0.1678, Test Loss: 0.1757, Test Accuracy: 1.0000
Epoch 40/200, Train Loss: 0.1637, Test Loss: 0.1714, Test Accuracy: 1.0000
Epoch 41/200, Train Loss: 0.1600, Test Loss: 0.1717, Test Accuracy: 1.0000
Epoch 42/200, Train Loss: 0.1560, Test Loss: 0.1726, Test Accuracy: 1.0000
Epoch 43/200, Train Loss: 0.1535, Test Loss: 0.1710, Test Accuracy: 1.0000
Epoch 44/200, Train Loss: 0.1505, Test Loss: 0.1628, Test Accuracy: 1.0000
Epoch 45/200, Train Loss: 0.1462, Test Loss: 0.1522, Test Accuracy: 1.0000
Epoch 46/200, Train Loss: 0.1460, Test Loss: 0.1509, Test Accuracy: 1.0000
Epoch 47/200, Train Loss: 0.1406, Test Loss: 0.1485, Test Accuracy: 1.0000
Epoch 48/200, Train Loss: 0.1380, Test Loss: 0.1442, Test Accuracy: 1.0000
Epoch 49/200, Train Loss: 0.1374, Test Loss: 0.1433, Test Accuracy: 1.0000
Epoch 50/200, Train Loss: 0.1327, Test Loss: 0.1405, Test Accuracy: 1.0000
Epoch 51/200, Train Loss: 0.1304, Test Loss: 0.1379, Test Accuracy: 1.0000
Epoch 52/200, Train Loss: 0.1281, Test Loss: 0.1368, Test Accuracy: 1.0000
Epoch 53/200, Train Loss: 0.1252, Test Loss: 0.1349, Test Accuracy: 1.0000
Epoch 54/200, Train Loss: 0.1229, Test Loss: 0.1316, Test Accuracy: 1.0000
Epoch 55/200, Train Loss: 0.1211, Test Loss: 0.1289, Test Accuracy: 1.0000
Epoch 56/200, Train Loss: 0.1193, Test Loss: 0.1294, Test Accuracy: 1.0000
Epoch 57/200, Train Loss: 0.1166, Test Loss: 0.1270, Test Accuracy: 1.0000
Epoch 58/200, Train Loss: 0.1146, Test Loss: 0.1291, Test Accuracy: 1.0000
Epoch 59/200, Train Loss: 0.1131, Test Loss: 0.1299, Test Accuracy: 1.0000
Epoch 60/200, Train Loss: 0.1125, Test Loss: 0.1384, Test Accuracy: 1.0000
Epoch 61/200, Train Loss: 0.1140, Test Loss: 0.1198, Test Accuracy: 1.0000
Epoch 62/200, Train Loss: 0.1070, Test Loss: 0.1175, Test Accuracy: 1.0000
Epoch 63/200, Train Loss: 0.1056, Test Loss: 0.1135, Test Accuracy: 1.0000
Epoch 64/200, Train Loss: 0.1049, Test Loss: 0.1114, Test Accuracy: 1.0000
Epoch 65/200, Train Loss: 0.1038, Test Loss: 0.1131, Test Accuracy: 1.0000
Epoch 66/200, Train Loss: 0.1008, Test Loss: 0.1127, Test Accuracy: 1.0000
Epoch 67/200, Train Loss: 0.0994, Test Loss: 0.1114, Test Accuracy: 1.0000
Epoch 68/200, Train Loss: 0.0980, Test Loss: 0.1063, Test Accuracy: 1.0000
Epoch 69/200, Train Loss: 0.0971, Test Loss: 0.1058, Test Accuracy: 1.0000
Epoch 70/200, Train Loss: 0.0954, Test Loss: 0.1035, Test Accuracy: 1.0000
Epoch 71/200, Train Loss: 0.0944, Test Loss: 0.1027, Test Accuracy: 1.0000
Epoch 72/200, Train Loss: 0.0930, Test Loss: 0.1007, Test Accuracy: 1.0000
Epoch 73/200, Train Loss: 0.0922, Test Loss: 0.1009, Test Accuracy: 1.0000
Epoch 74/200, Train Loss: 0.0904, Test Loss: 0.0981, Test Accuracy: 1.0000
Epoch 75/200, Train Loss: 0.0899, Test Loss: 0.0968, Test Accuracy: 1.0000
Epoch 76/200, Train Loss: 0.0888, Test Loss: 0.0962, Test Accuracy: 1.0000
Epoch 77/200, Train Loss: 0.0873, Test Loss: 0.0960, Test Accuracy: 1.0000
Epoch 78/200, Train Loss: 0.0860, Test Loss: 0.0954, Test Accuracy: 1.0000
Epoch 79/200, Train Loss: 0.0849, Test Loss: 0.0964, Test Accuracy: 1.0000
Epoch 80/200, Train Loss: 0.0838, Test Loss: 0.0947, Test Accuracy: 1.0000
Epoch 81/200, Train Loss: 0.0828, Test Loss: 0.0969, Test Accuracy: 1.0000
Epoch 82/200, Train Loss: 0.0823, Test Loss: 0.0934, Test Accuracy: 1.0000
Epoch 83/200, Train Loss: 0.0809, Test Loss: 0.0915, Test Accuracy: 1.0000
Epoch 84/200, Train Loss: 0.0799, Test Loss: 0.0908, Test Accuracy: 1.0000
Epoch 85/200, Train Loss: 0.0791, Test Loss: 0.0922, Test Accuracy: 1.0000
Epoch 86/200, Train Loss: 0.0787, Test Loss: 0.0935, Test Accuracy: 1.0000
Epoch 87/200, Train Loss: 0.0783, Test Loss: 0.0889, Test Accuracy: 1.0000
Epoch 88/200, Train Loss: 0.0766, Test Loss: 0.0884, Test Accuracy: 1.0000
Epoch 89/200, Train Loss: 0.0758, Test Loss: 0.0876, Test Accuracy: 1.0000
Epoch 90/200, Train Loss: 0.0750, Test Loss: 0.0861, Test Accuracy: 1.0000
Epoch 91/200, Train Loss: 0.0740, Test Loss: 0.0849, Test Accuracy: 1.0000
Epoch 92/200, Train Loss: 0.0733, Test Loss: 0.0840, Test Accuracy: 1.0000
Epoch 93/200, Train Loss: 0.0725, Test Loss: 0.0816, Test Accuracy: 1.0000
Epoch 94/200, Train Loss: 0.0717, Test Loss: 0.0819, Test Accuracy: 1.0000
Epoch 95/200, Train Loss: 0.0709, Test Loss: 0.0798, Test Accuracy: 1.0000
Epoch 96/200, Train Loss: 0.0703, Test Loss: 0.0796, Test Accuracy: 1.0000
Epoch 97/200, Train Loss: 0.0695, Test Loss: 0.0778, Test Accuracy: 1.0000
Epoch 98/200, Train Loss: 0.0690, Test Loss: 0.0775, Test Accuracy: 1.0000
Epoch 99/200, Train Loss: 0.0682, Test Loss: 0.0778, Test Accuracy: 1.0000
Epoch 100/200, Train Loss: 0.0675, Test Loss: 0.0761, Test Accuracy: 1.0000
Epoch 101/200, Train Loss: 0.0668, Test Loss: 0.0763, Test Accuracy: 1.0000
Epoch 102/200, Train Loss: 0.0662, Test Loss: 0.0766, Test Accuracy: 1.0000
Epoch 103/200, Train Loss: 0.0656, Test Loss: 0.0765, Test Accuracy: 1.0000
Epoch 104/200, Train Loss: 0.0651, Test Loss: 0.0759, Test Accuracy: 1.0000
Epoch 105/200, Train Loss: 0.0645, Test Loss: 0.0729, Test Accuracy: 1.0000
Epoch 106/200, Train Loss: 0.0638, Test Loss: 0.0712, Test Accuracy: 1.0000
Epoch 107/200, Train Loss: 0.0635, Test Loss: 0.0706, Test Accuracy: 1.0000
Epoch 108/200, Train Loss: 0.0629, Test Loss: 0.0706, Test Accuracy: 1.0000
Epoch 109/200, Train Loss: 0.0622, Test Loss: 0.0697, Test Accuracy: 1.0000
Epoch 110/200, Train Loss: 0.0618, Test Loss: 0.0692, Test Accuracy: 1.0000
Epoch 111/200, Train Loss: 0.0613, Test Loss: 0.0695, Test Accuracy: 1.0000
Epoch 112/200, Train Loss: 0.0606, Test Loss: 0.0711, Test Accuracy: 1.0000
Epoch 113/200, Train Loss: 0.0602, Test Loss: 0.0677, Test Accuracy: 1.0000
Epoch 114/200, Train Loss: 0.0596, Test Loss: 0.0675, Test Accuracy: 1.0000
Epoch 115/200, Train Loss: 0.0592, Test Loss: 0.0656, Test Accuracy: 1.0000
Epoch 116/200, Train Loss: 0.0593, Test Loss: 0.0649, Test Accuracy: 1.0000
Epoch 117/200, Train Loss: 0.0590, Test Loss: 0.0653, Test Accuracy: 1.0000
Epoch 118/200, Train Loss: 0.0578, Test Loss: 0.0653, Test Accuracy: 1.0000
Epoch 119/200, Train Loss: 0.0572, Test Loss: 0.0660, Test Accuracy: 1.0000
Epoch 120/200, Train Loss: 0.0566, Test Loss: 0.0647, Test Accuracy: 1.0000
Epoch 121/200, Train Loss: 0.0561, Test Loss: 0.0646, Test Accuracy: 1.0000
Epoch 122/200, Train Loss: 0.0557, Test Loss: 0.0652, Test Accuracy: 1.0000
Epoch 123/200, Train Loss: 0.0553, Test Loss: 0.0638, Test Accuracy: 1.0000
Epoch 124/200, Train Loss: 0.0548, Test Loss: 0.0626, Test Accuracy: 1.0000
Epoch 125/200, Train Loss: 0.0544, Test Loss: 0.0632, Test Accuracy: 1.0000
Epoch 126/200, Train Loss: 0.0540, Test Loss: 0.0621, Test Accuracy: 1.0000
Epoch 127/200, Train Loss: 0.0535, Test Loss: 0.0610, Test Accuracy: 1.0000
Epoch 128/200, Train Loss: 0.0531, Test Loss: 0.0612, Test Accuracy: 1.0000
Epoch 129/200, Train Loss: 0.0527, Test Loss: 0.0615, Test Accuracy: 1.0000
Epoch 130/200, Train Loss: 0.0524, Test Loss: 0.0621, Test Accuracy: 1.0000
Epoch 131/200, Train Loss: 0.0521, Test Loss: 0.0619, Test Accuracy: 1.0000
Epoch 132/200, Train Loss: 0.0518, Test Loss: 0.0618, Test Accuracy: 1.0000
Epoch 133/200, Train Loss: 0.0515, Test Loss: 0.0598, Test Accuracy: 1.0000
Epoch 134/200, Train Loss: 0.0509, Test Loss: 0.0592, Test Accuracy: 1.0000
Epoch 135/200, Train Loss: 0.0505, Test Loss: 0.0578, Test Accuracy: 1.0000
Epoch 136/200, Train Loss: 0.0501, Test Loss: 0.0579, Test Accuracy: 1.0000
Epoch 137/200, Train Loss: 0.0498, Test Loss: 0.0571, Test Accuracy: 1.0000
Epoch 138/200, Train Loss: 0.0494, Test Loss: 0.0568, Test Accuracy: 1.0000
Epoch 139/200, Train Loss: 0.0491, Test Loss: 0.0577, Test Accuracy: 1.0000
Epoch 140/200, Train Loss: 0.0487, Test Loss: 0.0573, Test Accuracy: 1.0000
Epoch 141/200, Train Loss: 0.0484, Test Loss: 0.0569, Test Accuracy: 1.0000
Epoch 142/200, Train Loss: 0.0481, Test Loss: 0.0567, Test Accuracy: 1.0000
Epoch 143/200, Train Loss: 0.0477, Test Loss: 0.0558, Test Accuracy: 1.0000
Epoch 144/200, Train Loss: 0.0474, Test Loss: 0.0565, Test Accuracy: 1.0000
Epoch 145/200, Train Loss: 0.0472, Test Loss: 0.0552, Test Accuracy: 1.0000
Epoch 146/200, Train Loss: 0.0468, Test Loss: 0.0544, Test Accuracy: 1.0000
Epoch 147/200, Train Loss: 0.0465, Test Loss: 0.0533, Test Accuracy: 1.0000
Epoch 148/200, Train Loss: 0.0462, Test Loss: 0.0531, Test Accuracy: 1.0000
Epoch 149/200, Train Loss: 0.0460, Test Loss: 0.0522, Test Accuracy: 1.0000
Epoch 150/200, Train Loss: 0.0458, Test Loss: 0.0516, Test Accuracy: 1.0000
Epoch 151/200, Train Loss: 0.0456, Test Loss: 0.0515, Test Accuracy: 1.0000
Epoch 152/200, Train Loss: 0.0452, Test Loss: 0.0518, Test Accuracy: 1.0000
Epoch 153/200, Train Loss: 0.0447, Test Loss: 0.0515, Test Accuracy: 1.0000
Epoch 154/200, Train Loss: 0.0444, Test Loss: 0.0525, Test Accuracy: 1.0000
Epoch 155/200, Train Loss: 0.0442, Test Loss: 0.0526, Test Accuracy: 1.0000
Epoch 156/200, Train Loss: 0.0439, Test Loss: 0.0512, Test Accuracy: 1.0000
Epoch 157/200, Train Loss: 0.0436, Test Loss: 0.0520, Test Accuracy: 1.0000
Epoch 158/200, Train Loss: 0.0434, Test Loss: 0.0520, Test Accuracy: 1.0000
Epoch 159/200, Train Loss: 0.0431, Test Loss: 0.0510, Test Accuracy: 1.0000
Epoch 160/200, Train Loss: 0.0428, Test Loss: 0.0497, Test Accuracy: 1.0000
Epoch 161/200, Train Loss: 0.0424, Test Loss: 0.0496, Test Accuracy: 1.0000
Epoch 162/200, Train Loss: 0.0422, Test Loss: 0.0494, Test Accuracy: 1.0000
Epoch 163/200, Train Loss: 0.0420, Test Loss: 0.0481, Test Accuracy: 1.0000
Epoch 164/200, Train Loss: 0.0419, Test Loss: 0.0475, Test Accuracy: 1.0000
Epoch 165/200, Train Loss: 0.0417, Test Loss: 0.0471, Test Accuracy: 1.0000
Epoch 166/200, Train Loss: 0.0415, Test Loss: 0.0469, Test Accuracy: 1.0000
Epoch 167/200, Train Loss: 0.0413, Test Loss: 0.0468, Test Accuracy: 1.0000
Epoch 168/200, Train Loss: 0.0409, Test Loss: 0.0470, Test Accuracy: 1.0000
Epoch 169/200, Train Loss: 0.0406, Test Loss: 0.0470, Test Accuracy: 1.0000
Epoch 170/200, Train Loss: 0.0403, Test Loss: 0.0467, Test Accuracy: 1.0000
Epoch 171/200, Train Loss: 0.0402, Test Loss: 0.0463, Test Accuracy: 1.0000
Epoch 172/200, Train Loss: 0.0400, Test Loss: 0.0461, Test Accuracy: 1.0000
Epoch 173/200, Train Loss: 0.0398, Test Loss: 0.0453, Test Accuracy: 1.0000
Epoch 174/200, Train Loss: 0.0397, Test Loss: 0.0451, Test Accuracy: 1.0000
Epoch 175/200, Train Loss: 0.0394, Test Loss: 0.0454, Test Accuracy: 1.0000
Epoch 176/200, Train Loss: 0.0391, Test Loss: 0.0449, Test Accuracy: 1.0000
Epoch 177/200, Train Loss: 0.0389, Test Loss: 0.0447, Test Accuracy: 1.0000
Epoch 178/200, Train Loss: 0.0387, Test Loss: 0.0446, Test Accuracy: 1.0000
Epoch 179/200, Train Loss: 0.0384, Test Loss: 0.0444, Test Accuracy: 1.0000
Epoch 180/200, Train Loss: 0.0382, Test Loss: 0.0445, Test Accuracy: 1.0000
Epoch 181/200, Train Loss: 0.0380, Test Loss: 0.0439, Test Accuracy: 1.0000
Epoch 182/200, Train Loss: 0.0379, Test Loss: 0.0440, Test Accuracy: 1.0000
Epoch 183/200, Train Loss: 0.0376, Test Loss: 0.0450, Test Accuracy: 1.0000
Epoch 184/200, Train Loss: 0.0375, Test Loss: 0.0438, Test Accuracy: 1.0000
Epoch 185/200, Train Loss: 0.0372, Test Loss: 0.0432, Test Accuracy: 1.0000
Epoch 186/200, Train Loss: 0.0371, Test Loss: 0.0422, Test Accuracy: 1.0000
Epoch 187/200, Train Loss: 0.0371, Test Loss: 0.0422, Test Accuracy: 1.0000
Epoch 188/200, Train Loss: 0.0368, Test Loss: 0.0420, Test Accuracy: 1.0000
Epoch 189/200, Train Loss: 0.0366, Test Loss: 0.0424, Test Accuracy: 1.0000
Epoch 190/200, Train Loss: 0.0363, Test Loss: 0.0421, Test Accuracy: 1.0000
Epoch 191/200, Train Loss: 0.0362, Test Loss: 0.0415, Test Accuracy: 1.0000
Epoch 192/200, Train Loss: 0.0361, Test Loss: 0.0416, Test Accuracy: 1.0000
Epoch 193/200, Train Loss: 0.0358, Test Loss: 0.0419, Test Accuracy: 1.0000
Epoch 194/200, Train Loss: 0.0356, Test Loss: 0.0414, Test Accuracy: 1.0000
Epoch 195/200, Train Loss: 0.0354, Test Loss: 0.0413, Test Accuracy: 1.0000
Epoch 196/200, Train Loss: 0.0352, Test Loss: 0.0412, Test Accuracy: 1.0000
Epoch 197/200, Train Loss: 0.0351, Test Loss: 0.0403, Test Accuracy: 1.0000
Epoch 198/200, Train Loss: 0.0350, Test Loss: 0.0403, Test Accuracy: 1.0000
Epoch 199/200, Train Loss: 0.0348, Test Loss: 0.0405, Test Accuracy: 1.0000
Epoch 200/200, Train Loss: 0.0346, Test Loss: 0.0410, Test Accuracy: 1.0000
```

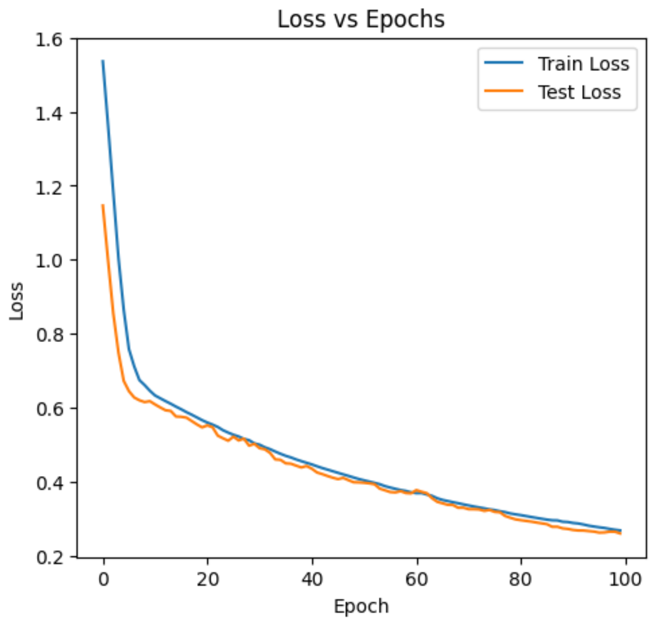
In [148…

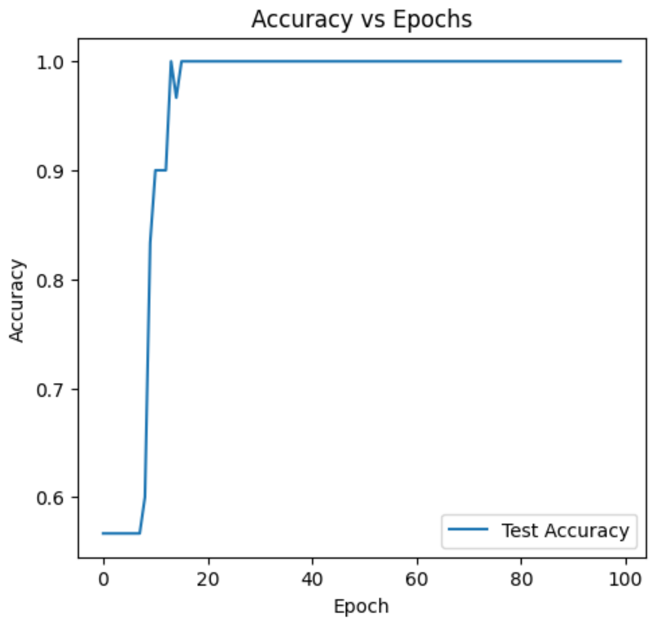
```
# Vẽ đồ thị Train Loss và Test Loss
plt.figure(figsize=(10, 5))
plt.plot(range(1, n_epochs+1), train_losses, label='Train Loss')
plt.plot(range(1, n_epochs+1), test_losses, label='Test Loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()
plt.title('Train and Test Loss over Epochs')
plt.show()

import matplotlib.pyplot as plt


# Vẽ đồ thị Test Accuracy
plt.figure(figsize=(10, 5))
plt.plot(range(1, n_epochs+1), test_accuracies, label='Test Accuracy')
plt.xlabel('Epochs')
plt.ylabel('Accuracy')
plt.legend()
plt.title('Test Accuracy over Epochs')
plt.show()
```


Train and Test Loss over Epochs
Train Loss
Test Loss
Loss
Epochs
0.0
0.2
0.4
0.6
0.8
1.0
0
25
50
75
100
125
150
175
200


Test Accuracy over Epochs
Test Accuracy
Accuracy
Epochs
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
25
50
75
100
125
150
175
200

Kết quả:


Loss vs Epochs
Train Loss
Test Loss
Loss
Epoch


Accuracy vs Epochs
Test Accuracy
Accuracy
Epoch