LandClassifier

August 26, 2025

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# ================================
# 1. ENVIRONMENT SETUP
# ================================
import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import DataLoader, random_split
import torchvision
from torchvision import datasets, transforms, models
import matplotlib.pyplot as plt
import numpy as np
from sklearn.metrics import confusion_matrix, classification_report
import seaborn as sns
```

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# Check device
device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
print("Using device:", device)
```

```
Using device: cuda
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# ================================
# 2. LOAD DATASET (EuroSAT)
# ================================
transform = transforms.Compose([
    transforms.Resize((64,64)),
    transforms.ToTensor(),
    transforms.Normalize(mean=[0.5,0.5,0.5], std=[0.5,0.5,0.5])
])

dataset = datasets.EuroSAT(root="./data", download=True, transform=transform)

classes = dataset.classes
print("Classes:", classes)
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Classes: ['AnnualCrop', 'Forest', 'HerbaceousVegetation', 'Highway',
'Industrial', 'Pasture', 'PermanentCrop', 'Residential', 'River', 'SeaLake']
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# ================================
# 3. SPLIT DATA
# ================================
train_size = int(0.8 * len(dataset))
test_size = len(dataset) - train_size
train_dataset, test_dataset = random_split(dataset, [train_size, test_size])

train_loader = DataLoader(train_dataset, batch_size=64, shuffle=True)
test_loader = DataLoader(test_dataset, batch_size=64, shuffle=False)

print(f"Train samples: {len(train_dataset)}, Test samples: {len(test_dataset)}")
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Train samples: 21600, Test samples: 5400
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# ================================
# 4. MODEL SETUP
# ================================
model = models.resnet18(weights=models.ResNet18_Weights.IMAGENET1K_V1)
model.fc = nn.Linear(model.fc.in_features, len(classes))  # 10 classes
model = model.to(device)

criterion = nn.CrossEntropyLoss()
optimizer = optim.Adam(model.parameters(), lr=0.001)
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# ================================
# 5. TRAINING LOOP
# ================================
def train_model(model, train_loader, criterion, optimizer, epochs=5):
    model.train()
    for epoch in range(epochs):
        running_loss = 0.0
        correct, total = 0, 0

        for images, labels in train_loader:
            images, labels = images.to(device), labels.to(device)

            optimizer.zero_grad()
            outputs = model(images)
            loss = criterion(outputs, labels)
            loss.backward()
            optimizer.step()

            running_loss += loss.item()

            _, predicted = torch.max(outputs, 1)
            total += labels.size(0)
            correct += (predicted == labels).sum().item()
        acc = 100 * correct / total
        print(f"Epoch [{epoch+1}/{epochs}] - Loss: {running_loss/
 ↪len(train_loader):.4f} - Acc: {acc:.2f}%")

train_model(model, train_loader, criterion, optimizer, epochs=5)
```

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Epoch [1/5] - Loss: 0.3843 - Acc: 88.32%
Epoch [2/5] - Loss: 0.2096 - Acc: 93.43%
Epoch [3/5] - Loss: 0.1568 - Acc: 94.97%
Epoch [4/5] - Loss: 0.1271 - Acc: 95.80%
Epoch [5/5] - Loss: 0.1121 - Acc: 96.29%
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# ================================
# 6. EVALUATION
# ================================
model.eval()
y_true, y_pred = [], []

with torch.no_grad():
    for images, labels in test_loader:
        images, labels = images.to(device), labels.to(device)
        outputs = model(images)
        _, predicted = torch.max(outputs, 1)
        y_true.extend(labels.cpu().numpy())
        y_pred.extend(predicted.cpu().numpy())

print("Classification Report:\n", classification_report(y_true, y_pred,␣
 ↪target_names=classes))

cm = confusion_matrix(y_true, y_pred)
plt.figure(figsize=(10,8))
sns.heatmap(cm, annot=False, cmap="Blues", xticklabels=classes,␣
 ↪yticklabels=classes)
plt.xlabel("Predicted")
plt.ylabel("True")
plt.title("Confusion Matrix")
plt.show()
```

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Classification Report:
                        precision    recall  f1-score   support

           AnnualCrop       0.73      0.97      0.83       601
               Forest       1.00      0.23      0.38       629
HerbaceousVegetation       0.90      0.94      0.92       578
              Highway       0.96      0.88      0.92       502
           Industrial       0.91      0.99      0.95       510
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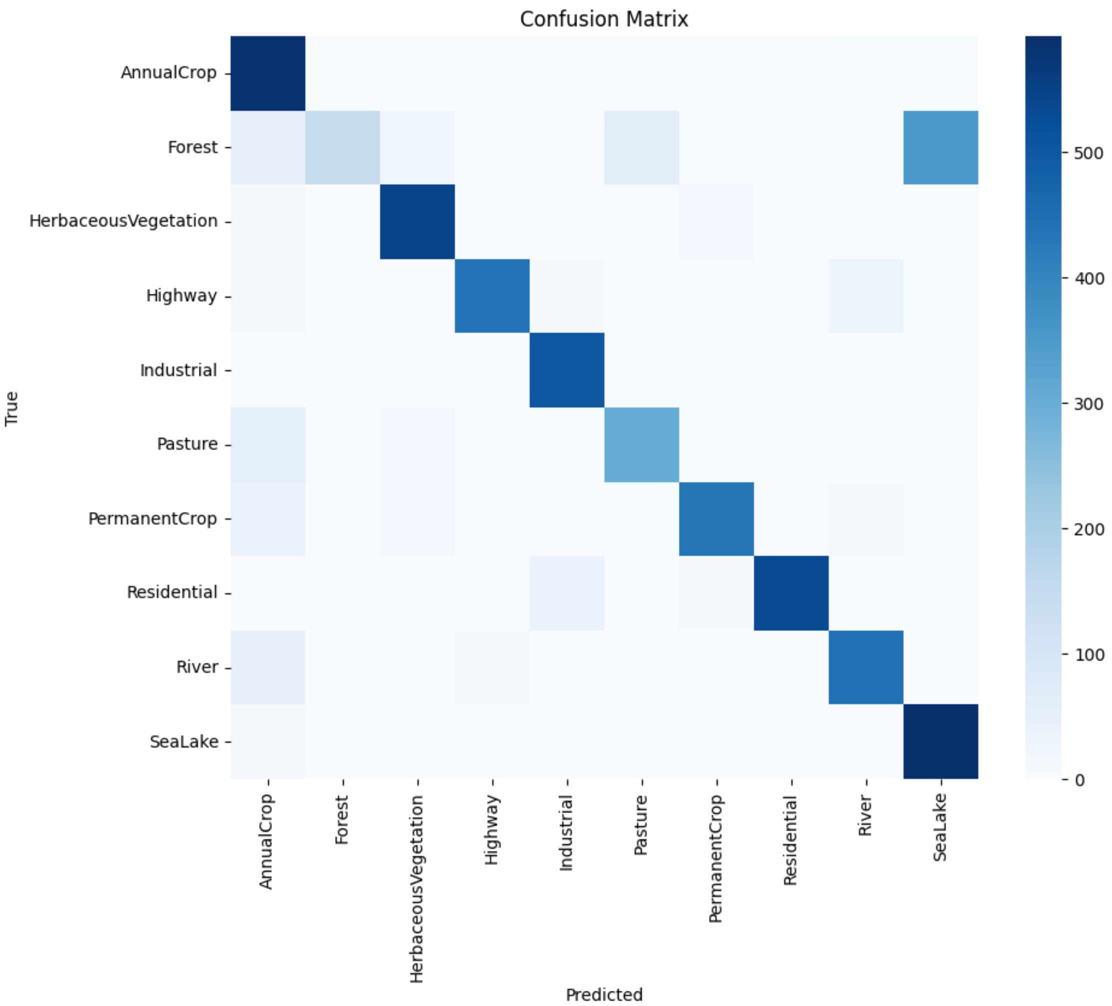
     Pasture       0.80      0.79      0.80       383
PermanentCrop       0.93      0.86      0.89       506
  Residential       1.00      0.91      0.95       586
        River       0.89      0.89      0.89       503
      SeaLake       0.62      0.98      0.76       602

     accuracy                           0.84      5400
    macro avg       0.87      0.84      0.83      5400
 weighted avg       0.87      0.84      0.82      5400
```



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# ================================
# 7. VISUALIZATION OF SAMPLE PREDICTIONS
# ================================
def imshow(img, title):
    img = img / 2 + 0.5  # unnormalize
    npimg = img.numpy()
    plt.imshow(np.transpose(npimg, (1,2,0)))
    plt.title(title)
    plt.axis("off")

# Show some test predictions
dataiter = iter(test_loader)
images, labels = next(dataiter)
images, labels = images.to(device), labels.to(device)

outputs = model(images)
_, preds = torch.max(outputs, 1)

plt.figure(figsize=(12,6))
for i in range(8):
    plt.subplot(2,4,i+1)
    imshow(images[i].cpu(), f"Pred: {classes[preds[i]]}\nTrue: {classes[labels[i]]}")
plt.show()
```