```
import torch
import torch.nn as nn
import torch.optim as optim
from torchvision import models, datasets, transforms
from torch.utils.data import DataLoader
import matplotlib.pyplot as plt
import numpy as np
```

Device setup

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

```
Device:  cuda
```

Load pre-trained model

```
model = models.resnet18(pretrained=True)
# Freeze all convolutional layers
for param in model.parameters():
    param.requires_grad = False

# Replace the final layer for CIFAR-10 (10 classes)
num_features = model.fc.in_features
model.fc = nn.Linear(num_features, 10)
model = model.to(device)
```

```
/usr/local/lib/python3.12/dist-packages/torchvision/models/
_utils.py:208: UserWarning: The parameter 'pretrained' is deprecated
since 0.13 and may be removed in the future, please use 'weights'
instead.
  warnings.warn(
/usr/local/lib/python3.12/dist-packages/torchvision/models/_utils.py:2
23: UserWarning: Arguments other than a weight enum or `None` for
'weights' are deprecated since 0.13 and may be removed in the future.
The current behavior is equivalent to passing
`weights=ResNet18_Weights.IMAGENET1K_V1`. You can also use
`weights=ResNet18_Weights.DEFAULT` to get the most up-to-date weights.
  warnings.warn(msg)
```

```
Downloading: "https://download.pytorch.org/models/resnet18-
f37072fd.pth" to /root/.cache/torch/hub/checkpoints/resnet18-
f37072fd.pth
```

```
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```

Load CIFAR-10 dataset

```
transform = transforms.Compose([
    transforms.Resize((224,224)),
    transforms.ToTensor(),
    transforms.Normalize([0.485,0.456,0.406], [0.229,0.224,0.225])
])

train_dataset = datasets.CIFAR10(root='~/.keras/datasets', train=True,
download=True, transform=transform)
test_dataset = datasets.CIFAR10(root='~/.keras/datasets', train=False,
download=True, transform=transform)

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

```
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```

Loss and optimizer

```
criterion = nn.CrossEntropyLoss()
optimizer = optim.Adam(model.fc.parameters(), lr=0.001)
```

Training Loop

```
epochs = 10
train_losses, train_accuracies = [], []
test_losses, test_accuracies = [], []

for epoch in range(epochs):
    # Training
    model.train()
    running_loss, running_corrects = 0.0, 0
    for imgs, labels in train_loader:
        imgs, labels = imgs.to(device), labels.to(device)

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

        running_loss += loss.item() * imgs.size(0)
        running_corrects += (outputs.argmax(1) == labels).sum().item()

    epoch_loss = running_loss / len(train_dataset)
    epoch_acc = running_corrects / len(train_dataset)
    train_losses.append(epoch_loss)
    train_accuracies.append(epoch_acc)

    # Validation
    model.eval()
    val_loss, val_corrects = 0.0, 0
    with torch.no_grad():
        for imgs, labels in test_loader:
            imgs, labels = imgs.to(device), labels.to(device)
            outputs = model(imgs)
            loss = criterion(outputs, labels)
            val_loss += loss.item() * imgs.size(0)
            val_corrects += (outputs.argmax(1) == labels).sum().item()

    val_epoch_loss = val_loss / len(test_dataset)
    val_epoch_acc = val_corrects / len(test_dataset)
    test_losses.append(val_epoch_loss)
    test_accuracies.append(val_epoch_acc)

    print(f"Epoch [{epoch+1}/{epochs}] "
          f"Train Loss: {epoch_loss:.4f}, Train Acc: {epoch_acc:.4f} "
          f"Val Loss: {val_epoch_loss:.4f}, Val Acc:
{val_epoch_acc:.4f}")
```

```
Epoch [1/10] Train Loss: 0.8278, Train Acc: 0.7322 Val Loss: 0.6560,
Val Acc: 0.7771
Epoch [2/10] Train Loss: 0.6163, Train Acc: 0.7876 Val Loss: 0.6097,
Val Acc: 0.7883
Epoch [3/10] Train Loss: 0.5886, Train Acc: 0.7969 Val Loss: 0.5841,
Val Acc: 0.7987
Epoch [4/10] Train Loss: 0.5787, Train Acc: 0.7993 Val Loss: 0.5832,
Val Acc: 0.8028
Epoch [5/10] Train Loss: 0.5645, Train Acc: 0.8037 Val Loss: 0.5793,
Val Acc: 0.8035
Epoch [6/10] Train Loss: 0.5607, Train Acc: 0.8049 Val Loss: 0.5681,
Val Acc: 0.8028
Epoch [7/10] Train Loss: 0.5538, Train Acc: 0.8090 Val Loss: 0.5576,
Val Acc: 0.8089
Epoch [8/10] Train Loss: 0.5520, Train Acc: 0.8086 Val Loss: 0.5646,
Val Acc: 0.8061
Epoch [9/10] Train Loss: 0.5500, Train Acc: 0.8100 Val Loss: 0.5655,
Val Acc: 0.8062
Epoch [10/10] Train Loss: 0.5467, Train Acc: 0.8106 Val Loss: 0.5623,
Val Acc: 0.8095
```

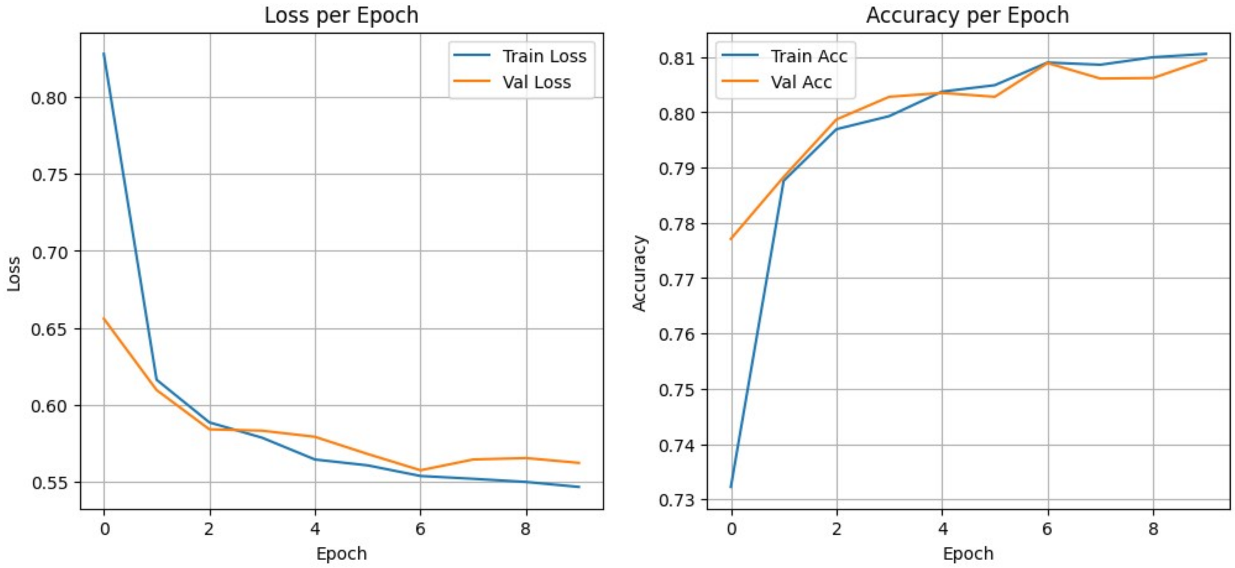
Plot Accuracy and Loss

```
plt.figure(figsize=(12,5))

plt.subplot(1,2,1)
plt.plot(train_losses, label='Train Loss')
plt.plot(test_losses, label='Val Loss')
plt.title('Loss per Epoch')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
plt.grid(True)

plt.subplot(1,2,2)
plt.plot(train_accuracies, label='Train Acc')
plt.plot(test_accuracies, label='Val Acc')
plt.title('Accuracy per Epoch')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()
plt.grid(True)

plt.show()
```



Display sample predictions

```
import matplotlib.pyplot as plt

classes = train_dataset.classes
model.eval()
imgs, labels = next(iter(test_loader))
imgs, labels = imgs.to(device), labels.to(device)
outputs = model(imgs)
preds = outputs.argmax(1)

plt.figure(figsize=(12,6))
for i in range(8):
    plt.subplot(2,4,i+1)
    img_np = imgs[i].cpu().permute(1,2,0).numpy()
    img_np = img_np * np.array([0.229,0.224,0.225]) +
np.array([0.485,0.456,0.406])  # denormalize
    img_np = np.clip(img_np,0,1)
    plt.imshow(img_np)
    plt.title(f"Pred: {classes[preds[i]]}\nTrue:
{classes[labels[i]]}")
    plt.axis('off')
plt.show()
```