Tanawin-st123975-UNet

November 12, 2023

[6]:
```
!nvidia-smi
```

```
Fri Nov 10 04:41:51 2023
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 525.105.17   Driver Version: 525.105.17   CUDA Version: 12.0     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
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|                               |                      |               MIG M. |
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+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|  No running processes found                                                 |
+-----------------------------------------------------------------------------+
```

[7]:
```
# from google.colab import files
# files.upload()
```

[8]:
```
# import os

# # Set Kaggle API credentials as environment variables
# os.environ['KAGGLE_USERNAME'] = 'kmutnb'
# os.environ['KAGGLE_KEY'] = '2e8f3eec48ac90959791a330f9109431'

# import kaggle

# # Authenticate with Kaggle API
# kaggle.api.authenticate()
```

[9]:
```
# !kaggle datasets download -d dansbecker/cityscapes-image-pairs
```

[10]:
```
# !unzip  /content/cityscapes-image-pairs.zip
```

[11]:
```
import os
from PIL import Image
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans

import torch
import torch.nn as nn
import torch.nn.functional as F
import torch.optim as optim
from torch.utils.data import Dataset, DataLoader
from torchvision import transforms

from torch.optim import lr_scheduler

from tqdm.notebook import tqdm
```

[12]:
```
device = "cuda:0" if torch.cuda.is_available() else "cpu"
device = torch.device(device)
print(device)
```

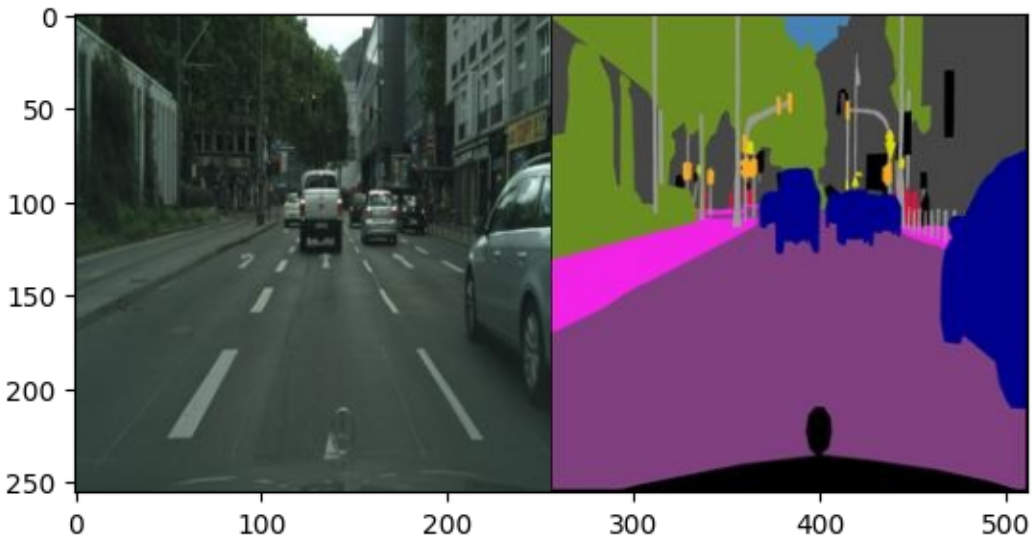
```
cuda:0
```

[13]:
```
data_dir = "/content/cityscapes_data/"


# Now you can use 'data_dir' in your code
train_dir = os.path.join(data_dir, "train")
val_dir = os.path.join(data_dir, "val")
train_fns = os.listdir(train_dir)
val_fns = os.listdir(val_dir)
```

[14]:
```
sample_image_fp = os.path.join(train_dir, train_fns[0])
sample_image = Image.open(sample_image_fp).convert("RGB")
plt.imshow(sample_image)
print(sample_image_fp)
```

```
/content/cityscapes_data/train/653.jpg
```

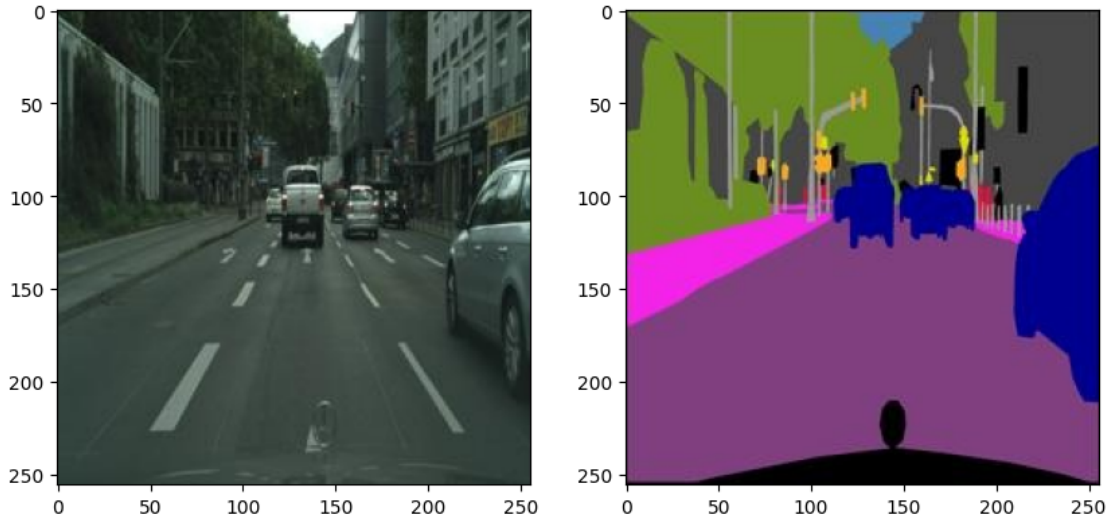


[15]:
```
def split_image(image):
    image = np.array(image)
    cityscape, label = image[:, :256, :], image[:, 256:, :]
    return cityscape, label
```

[16]:
```
sample_image = np.array(sample_image)
print(sample_image.shape)
cityscape, label = split_image(sample_image)
print(cityscape.min(), cityscape.max(), label.min(), label.max())
cityscape, label = Image.fromarray(cityscape), Image.fromarray(label)
fig, axes = plt.subplots(1, 2, figsize=(10, 5))
axes[0].imshow(cityscape)
axes[1].imshow(label)
```

```
(256, 512, 3)
1 255 0 255
```

[16]: <matplotlib.image.AxesImage at 0x7d661881dd20>



[17]:
```
"""
color_set = set()
for train_fn in tqdm(train_fns[:10]):
    train_fp = os.path.join(train_dir, train_fn)
    image = np.array(Image.open(train_fp))
    cityscape, label = split_image(sample_image)
    label = label.reshape(-1, 3)
    local_color_set = set([tuple(c) for c in list(label)])
    color_set.update(local_color_set)
color_array = np.array(list(color_set))
"""

num_items = 1000
color_array = np.random.choice(range(256), 3*num_items).reshape(-1, 3)
print(color_array.shape)
print(color_array[:5, :])
```

```
(1000, 3)
[[165  19   4]
 [ 35 206 168]
 [ 30 251  15]
 [225 152  29]
 [136  64  93]]
```

[18]:
```
num_classes = 10
label_model = KMeans(n_clusters=num_classes)
label_model.fit(color_array)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
```

```
1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
```

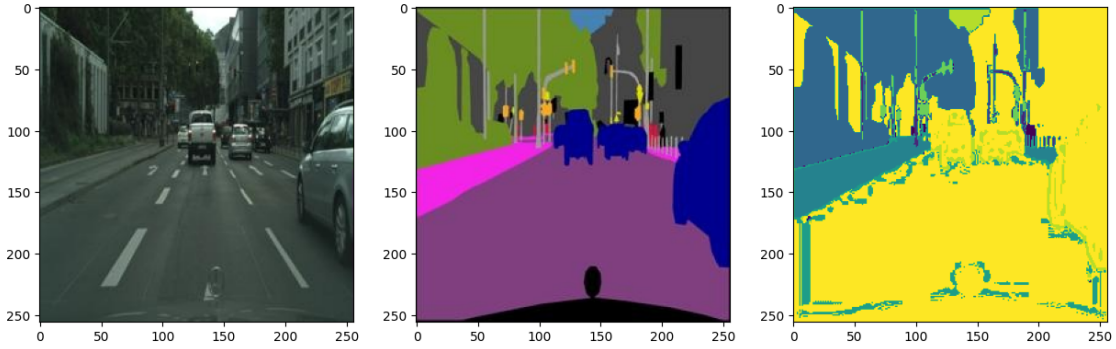
[18]:
```
KMeans(n_clusters=10)
```

[19]:
```
label_model.predict(color_array[:5, :])
```

[19]:
```
array([0, 6, 2, 7, 0], dtype=int32)
```

[20]:
```
cityscape, label = split_image(sample_image)
label_class = label_model.predict(label.reshape(-1, 3)).reshape(256, 256)
fig, axes = plt.subplots(1, 3, figsize=(15, 5))
axes[0].imshow(cityscape)
axes[1].imshow(label)
axes[2].imshow(label_class)
```

[20]:
```
<matplotlib.image.AxesImage at 0x7d64db12c400>
```



[21]:
```
label_class
```

[21]:
```
array([[9, 9, 9, …, 9, 9, 9],
       [9, 3, 3, …, 9, 9, 9],
       [9, 3, 3, …, 9, 9, 9],
       …,
       [9, 9, 9, …, 9, 9, 9],
       [9, 9, 9, …, 9, 9, 9],
       [9, 9, 9, …, 9, 9, 9]], dtype=int32)
```

[22]:
```
class CityscapeDataset(Dataset):

    def __init__(self, image_dir, label_model):
        self.image_dir = image_dir
        self.image_fns = os.listdir(image_dir)
        self.label_model = label_model
```

```
    def __len__(self):
        return len(self.image_fns)

    def __getitem__(self, index):
        image_fn = self.image_fns[index]
        image_fp = os.path.join(self.image_dir, image_fn)
        image = Image.open(image_fp).convert('RGB')
        image = np.array(image)
        cityscape, label = self.split_image(image)
        label_class = self.label_model.predict(label.reshape(-1, 3)).
↪reshape(256, 256)
        cityscape = self.transform(cityscape)
        label_class = torch.Tensor(label_class).long()
        return cityscape, label_class

    def split_image(self, image):
        image = np.array(image)
        cityscape, label = image[:, :256, :], image[:, 256:, :]
        return cityscape, label

    def transform(self, image):
        transform_ops = transforms.Compose([
            transforms.ToTensor(),
            transforms.Normalize(mean=(0.485, 0.456, 0.406), std=(0.229, 0.224,␣
↪0.225))
        ])
        return transform_ops(image)
```

[23]:
```
dataset = CityscapeDataset(train_dir, label_model)
print(len(dataset))
```

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```

[24]:
```
cityscape, label_class = dataset[0]
print(cityscape.shape, label_class.shape)
```

```
torch.Size([3, 256, 256]) torch.Size([256, 256])
```

[25]:
```
class UNet(nn.Module):

    def __init__(self, num_classes):
        super(UNet, self).__init__()
        self.num_classes = num_classes
        self.contracting_11 = self.conv_block(in_channels=3, out_channels=64)
        self.contracting_12 = nn.MaxPool2d(kernel_size=2, stride=2)
        self.contracting_21 = self.conv_block(in_channels=64, out_channels=128)
```

```
        self.contracting_22 = nn.MaxPool2d(kernel_size=2, stride=2)
        self.contracting_31 = self.conv_block(in_channels=128, out_channels=256)
        self.contracting_32 = nn.MaxPool2d(kernel_size=2, stride=2)
        self.contracting_41 = self.conv_block(in_channels=256, out_channels=512)
        self.contracting_42 = nn.MaxPool2d(kernel_size=2, stride=2)
        self.middle = self.conv_block(in_channels=512, out_channels=1024)
        self.expansive_11 = nn.ConvTranspose2d(in_channels=1024,␣
↪out_channels=512, kernel_size=3, stride=2, padding=1, output_padding=1)
        self.expansive_12 = self.conv_block(in_channels=1024, out_channels=512)
        self.expansive_21 = nn.ConvTranspose2d(in_channels=512,␣
↪out_channels=256, kernel_size=3, stride=2, padding=1, output_padding=1)
        self.expansive_22 = self.conv_block(in_channels=512, out_channels=256)
        self.expansive_31 = nn.ConvTranspose2d(in_channels=256,␣
↪out_channels=128, kernel_size=3, stride=2, padding=1, output_padding=1)
        self.expansive_32 = self.conv_block(in_channels=256, out_channels=128)
        self.expansive_41 = nn.ConvTranspose2d(in_channels=128,␣
↪out_channels=64, kernel_size=3, stride=2, padding=1, output_padding=1)
        self.expansive_42 = self.conv_block(in_channels=128, out_channels=64)
        self.output = nn.Conv2d(in_channels=64, out_channels=num_classes,␣
↪kernel_size=3, stride=1, padding=1)

    def conv_block(self, in_channels, out_channels):
        block = nn.Sequential(nn.Conv2d(in_channels=in_channels,␣
↪out_channels=out_channels, kernel_size=3, stride=1, padding=1),
                                    nn.ReLU(),
                                    nn.BatchNorm2d(num_features=out_channels),
                                    nn.Conv2d(in_channels=out_channels,␣
↪out_channels=out_channels, kernel_size=3, stride=1, padding=1),
                                    nn.ReLU(),
                                    nn.BatchNorm2d(num_features=out_channels))
        return block

    def forward(self, X):
        contracting_11_out = self.contracting_11(X) # [-1, 64, 256, 256]
        contracting_12_out = self.contracting_12(contracting_11_out) # [-1, 64,␣
↪128, 128]
        contracting_21_out = self.contracting_21(contracting_12_out) # [-1,␣
↪128, 128, 128]
        contracting_22_out = self.contracting_22(contracting_21_out) # [-1,␣
↪128, 64, 64]
        contracting_31_out = self.contracting_31(contracting_22_out) # [-1,␣
↪256, 64, 64]
        contracting_32_out = self.contracting_32(contracting_31_out) # [-1,␣
↪256, 32, 32]
        contracting_41_out = self.contracting_41(contracting_32_out) # [-1,␣
↪512, 32, 32]
```

```
        contracting_42_out = self.contracting_42(contracting_41_out) # [-1,␣
↪512, 16, 16]
        middle_out = self.middle(contracting_42_out) # [-1, 1024, 16, 16]
        expansive_11_out = self.expansive_11(middle_out) # [-1, 512, 32, 32]
        expansive_12_out = self.expansive_12(torch.cat((expansive_11_out,␣
↪contracting_41_out), dim=1)) # [-1, 1024, 32, 32] -> [-1, 512, 32, 32]
        expansive_21_out = self.expansive_21(expansive_12_out) # [-1, 256, 64,␣
↪64]
        expansive_22_out = self.expansive_22(torch.cat((expansive_21_out,␣
↪contracting_31_out), dim=1)) # [-1, 512, 64, 64] -> [-1, 256, 64, 64]
        expansive_31_out = self.expansive_31(expansive_22_out) # [-1, 128, 128,␣
↪128]
        expansive_32_out = self.expansive_32(torch.cat((expansive_31_out,␣
↪contracting_21_out), dim=1)) # [-1, 256, 128, 128] -> [-1, 128, 128, 128]
        expansive_41_out = self.expansive_41(expansive_32_out) # [-1, 64, 256,␣
↪256]
        expansive_42_out = self.expansive_42(torch.cat((expansive_41_out,␣
↪contracting_11_out), dim=1)) # [-1, 128, 256, 256] -> [-1, 64, 256, 256]
        output_out = self.output(expansive_42_out) # [-1, num_classes, 256, 256]
        return output_out
```

[26]:
```
model = UNet(num_classes=num_classes)
```

[27]:
```
# import os
# from PIL import Image
# import numpy as np
# import matplotlib.pyplot as plt
# from sklearn.cluster import KMeans

# import torch
# import torch.nn as nn
# from torch.utils.data import Dataset, DataLoader
# from torchvision import transforms
```

[28]:
```
data_loader = DataLoader(dataset, batch_size=4)
print(len(dataset), len(data_loader))

for X, Y in data_loader:
    # Your code to process each batch goes here
    print(X.shape, Y.shape)
```

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[29]:
```
Y_pred = model(X)
print(Y_pred.shape)
```

```
torch.Size([3, 10, 256, 256])
```

[30]:
```
batch_size = 16

epochs = 10
lr = 0.01
```

[31]:
```
dataset = CityscapeDataset(train_dir, label_model)
data_loader = DataLoader(dataset, batch_size=batch_size)
```

[32]:
```
model = UNet(num_classes=num_classes).to(device)
```

[33]:
```
criterion = nn.CrossEntropyLoss()
optimizer = optim.SGD(model.parameters(), lr=lr, momentum=0.9)
scheduler = lr_scheduler.StepLR(optimizer, step_size=10, gamma=0.5)
```

[34]:
```
import torch
import matplotlib.pyplot as plt
from tqdm import tqdm

# Lists to store losses and accuracies
step_losses = []
epoch_losses = []
train_losses = []
```

```
train_accuracies = []

for epoch in tqdm(range(epochs)):
    # Training loop
    model.train()
    epoch_loss = 0.0
    correct_train = 0
    total_train = 0

    for X, Y in tqdm(data_loader, total=len(data_loader), leave=False):
        X, Y = X.to(device), Y.to(device)
        optimizer.zero_grad()
        Y_pred = model(X)
        loss = criterion(Y_pred, Y)
        loss.backward()
        optimizer.step()

        epoch_loss += loss.item()
        step_losses.append(loss.item())

        _, predicted = torch.max(Y_pred.data, 1)
        total_train += Y.size(0)
        correct_train += (predicted == Y).sum().item()

    epoch_losses.append(epoch_loss/len(data_loader))
    train_accuracy = 100 * correct_train / total_train
    train_accuracies.append(train_accuracy)

    # Update the learning rate scheduler
    scheduler.step()

    # Print and/or log the metrics for each epoch
    print(f"Epoch {epoch + 1}/{epochs}:")
    print(f"Train Loss: {epoch_losses[-1]:.4f}, Train Accuracy: {train_accuracy:
 ↪.2f}%")

# Plot step and epoch losses
fig, axes = plt.subplots(1, 2, figsize=(10, 5))
axes[0].plot(step_losses)
axes[0].set_title("Step Losses")
axes[1].plot(epoch_losses)
axes[1].set_title("Epoch Losses")

# Save the model
model_name = "U-Net-SDG.pth"
torch.save(model.state_dict(), model_name)
```

```
  0%|          | 0/10 [00:00<?, ?it/s]
  0%|          | 0/186 [00:00<?, ?it/s]
  1%|          | 1/186 [00:08<26:16,  8.52s/it]
  1%|          | 2/186 [00:09<13:15,  4.32s/it]
  2%|          | 3/186 [00:11<09:03,  2.97s/it]
  2%|          | 4/186 [00:12<07:17,  2.40s/it]
  3%|          | 5/186 [00:14<06:07,  2.03s/it]
  3%|          | 6/186 [00:15<05:29,  1.83s/it]
  4%|          | 7/186 [00:17<05:03,  1.70s/it]
  4%|          | 8/186 [00:18<04:46,  1.61s/it]
  5%|          | 9/186 [00:19<04:36,  1.56s/it]
  5%|          | 10/186 [00:21<04:26,  1.51s/it]
  6%|          | 11/186 [00:22<04:18,  1.48s/it]
  6%|          | 12/186 [00:24<04:24,  1.52s/it]
  7%|          | 13/186 [00:25<04:15,  1.48s/it]
  8%|          | 14/186 [00:27<04:10,  1.46s/it]
  8%|          | 15/186 [00:28<04:07,  1.45s/it]
  9%|          | 16/186 [00:29<04:05,  1.44s/it]
  9%|          | 17/186 [00:31<04:02,  1.44s/it]
 10%|          | 18/186 [00:32<04:00,  1.43s/it]
 10%|          | 19/186 [00:34<03:59,  1.43s/it]
 11%|          | 20/186 [00:35<04:05,  1.48s/it]
 11%|          | 21/186 [00:37<04:01,  1.46s/it]
 12%|          | 22/186 [00:38<03:57,  1.45s/it]
 12%|          | 23/186 [00:40<03:55,  1.44s/it]
 13%|          | 24/186 [00:41<03:54,  1.44s/it]
 13%|          | 25/186 [00:42<03:49,  1.43s/it]
 14%|          | 26/186 [00:44<03:47,  1.42s/it]
 15%|          | 27/186 [00:45<03:44,  1.41s/it]
 15%|          | 28/186 [00:47<03:53,  1.47s/it]
 16%|          | 29/186 [00:48<03:48,  1.46s/it]
 16%|          | 30/186 [00:50<03:47,  1.46s/it]
 17%|          | 31/186 [00:51<03:46,  1.46s/it]
 17%|          | 32/186 [00:53<03:44,  1.46s/it]
 18%|          | 33/186 [00:54<03:43,  1.46s/it]
 18%|          | 34/186 [00:56<03:43,  1.47s/it]
 19%|          | 35/186 [00:57<03:42,  1.47s/it]
 19%|          | 36/186 [00:59<03:45,  1.50s/it]
 20%|          | 37/186 [01:00<03:41,  1.49s/it]
 20%|          | 38/186 [01:02<03:39,  1.48s/it]
 21%|          | 39/186 [01:03<03:34,  1.46s/it]
 22%|          | 40/186 [01:04<03:32,  1.46s/it]
 22%|          | 41/186 [01:06<03:30,  1.45s/it]
 23%|          | 42/186 [01:07<03:30,  1.46s/it]
 23%|          | 43/186 [01:09<03:31,  1.48s/it]
 24%|          | 44/186 [01:10<03:29,  1.48s/it]
 24%|          | 45/186 [01:12<03:25,  1.46s/it]
 25%|          | 46/186 [01:13<03:25,  1.46s/it]
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25%|         | 47/186 [01:15<03:24,  1.47s/it]
26%|         | 48/186 [01:16<03:24,  1.48s/it]
26%|         | 49/186 [01:18<03:22,  1.48s/it]
27%|         | 50/186 [01:19<03:21,  1.48s/it]
27%|         | 51/186 [01:21<03:23,  1.51s/it]
28%|         | 52/186 [01:22<03:20,  1.49s/it]
28%|         | 53/186 [01:24<03:17,  1.49s/it]
29%|         | 54/186 [01:25<03:16,  1.49s/it]
30%|         | 55/186 [01:27<03:13,  1.48s/it]
30%|         | 56/186 [01:28<03:10,  1.47s/it]
31%|         | 57/186 [01:30<03:10,  1.48s/it]
31%|         | 58/186 [01:31<03:09,  1.48s/it]
32%|        | 59/186 [01:33<03:17,  1.56s/it]
32%|        | 60/186 [01:34<03:13,  1.53s/it]
33%|        | 61/186 [01:36<03:10,  1.53s/it]
33%|        | 62/186 [01:37<03:07,  1.52s/it]
34%|        | 63/186 [01:39<03:05,  1.51s/it]
34%|        | 64/186 [01:40<03:01,  1.49s/it]
35%|        | 65/186 [01:42<02:59,  1.48s/it]
35%|        | 66/186 [01:43<02:57,  1.48s/it]
36%|        | 67/186 [01:45<03:01,  1.52s/it]
37%|        | 68/186 [01:46<02:58,  1.51s/it]
37%|        | 69/186 [01:48<02:55,  1.50s/it]
38%|        | 70/186 [01:49<02:54,  1.51s/it]
38%|        | 71/186 [01:51<03:01,  1.58s/it]
39%|        | 72/186 [01:53<02:57,  1.56s/it]
39%|        | 73/186 [01:54<02:54,  1.55s/it]
40%|        | 74/186 [01:56<02:56,  1.58s/it]
40%|        | 75/186 [01:57<02:52,  1.56s/it]
41%|        | 76/186 [01:59<02:49,  1.54s/it]
41%|       | 77/186 [02:00<02:46,  1.53s/it]
42%|       | 78/186 [02:02<02:43,  1.52s/it]
42%|       | 79/186 [02:03<02:41,  1.51s/it]
43%|       | 80/186 [02:05<02:40,  1.52s/it]
44%|       | 81/186 [02:06<02:40,  1.53s/it]
44%|       | 82/186 [02:08<02:40,  1.54s/it]
45%|       | 83/186 [02:09<02:37,  1.53s/it]
45%|       | 84/186 [02:11<02:37,  1.54s/it]
46%|       | 85/186 [02:12<02:34,  1.53s/it]
46%|       | 86/186 [02:14<02:32,  1.52s/it]
47%|       | 87/186 [02:15<02:29,  1.51s/it]
47%|       | 88/186 [02:17<02:28,  1.52s/it]
48%|       | 89/186 [02:19<02:30,  1.55s/it]
48%|       | 90/186 [02:20<02:28,  1.54s/it]
49%|       | 91/186 [02:22<02:25,  1.54s/it]
49%|       | 92/186 [02:23<02:23,  1.53s/it]
50%|       | 93/186 [02:25<02:24,  1.55s/it]
51%|       | 94/186 [02:26<02:22,  1.55s/it]
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51%|        | 95/186 [02:28<02:22,  1.56s/it]
52%|        | 96/186 [02:29<02:19,  1.56s/it]
52%|        | 97/186 [02:31<02:22,  1.60s/it]
53%|        | 98/186 [02:33<02:21,  1.61s/it]
53%|        | 99/186 [02:34<02:19,  1.61s/it]
54%|        | 100/186 [02:36<02:17,  1.60s/it]
54%|        | 101/186 [02:38<02:14,  1.58s/it]
55%|        | 102/186 [02:39<02:14,  1.60s/it]
55%|        | 103/186 [02:41<02:11,  1.59s/it]
56%|        | 104/186 [02:43<02:16,  1.66s/it]
56%|        | 105/186 [02:44<02:11,  1.62s/it]
57%|        | 106/186 [02:46<02:07,  1.60s/it]
58%|        | 107/186 [02:47<02:05,  1.59s/it]
58%|        | 108/186 [02:49<02:02,  1.57s/it]
59%|        | 109/186 [02:50<02:01,  1.58s/it]
59%|        | 110/186 [02:52<01:58,  1.56s/it]
60%|        | 111/186 [02:54<02:02,  1.63s/it]
60%|        | 112/186 [02:55<01:59,  1.61s/it]
61%|        | 113/186 [02:57<01:56,  1.59s/it]
61%|       | 114/186 [02:58<01:52,  1.57s/it]
62%|       | 115/186 [03:00<01:49,  1.54s/it]
62%|       | 116/186 [03:01<01:47,  1.54s/it]
63%|       | 117/186 [03:03<01:46,  1.54s/it]
63%|       | 118/186 [03:04<01:45,  1.55s/it]
64%|       | 119/186 [03:06<01:44,  1.56s/it]
65%|       | 120/186 [03:07<01:42,  1.56s/it]
65%|       | 121/186 [03:09<01:40,  1.55s/it]
66%|       | 122/186 [03:11<01:38,  1.55s/it]
66%|       | 123/186 [03:12<01:35,  1.52s/it]
67%|       | 124/186 [03:14<01:34,  1.52s/it]
67%|       | 125/186 [03:15<01:32,  1.52s/it]
68%|       | 126/186 [03:17<01:35,  1.59s/it]
68%|       | 127/186 [03:18<01:32,  1.57s/it]
69%|       | 128/186 [03:20<01:29,  1.55s/it]
69%|       | 129/186 [03:21<01:28,  1.55s/it]
70%|       | 130/186 [03:23<01:25,  1.53s/it]
70%|       | 131/186 [03:24<01:23,  1.52s/it]
71%|       | 132/186 [03:26<01:22,  1.53s/it]
72%|      | 133/186 [03:28<01:23,  1.58s/it]
72%|      | 134/186 [03:29<01:20,  1.55s/it]
73%|      | 135/186 [03:31<01:18,  1.53s/it]
73%|      | 136/186 [03:32<01:16,  1.52s/it]
74%|      | 137/186 [03:34<01:14,  1.52s/it]
74%|      | 138/186 [03:35<01:13,  1.53s/it]
75%|      | 139/186 [03:37<01:12,  1.54s/it]
75%|      | 140/186 [03:38<01:10,  1.54s/it]
76%|      | 141/186 [03:40<01:11,  1.59s/it]
76%|      | 142/186 [03:42<01:09,  1.58s/it]
```

```
 77%|       | 143/186 [03:43<01:07,  1.57s/it]
 77%|       | 144/186 [03:45<01:05,  1.57s/it]
 78%|       | 145/186 [03:46<01:04,  1.57s/it]
 78%|       | 146/186 [03:48<01:02,  1.57s/it]
 79%|       | 147/186 [03:49<01:00,  1.55s/it]
 80%|       | 148/186 [03:51<01:00,  1.58s/it]
 80%|       | 149/186 [03:53<00:58,  1.58s/it]
 81%|       | 150/186 [03:54<00:56,  1.56s/it]
 81%|       | 151/186 [03:56<00:54,  1.56s/it]
 82%|      | 152/186 [03:57<00:52,  1.55s/it]
 82%|      | 153/186 [03:59<00:50,  1.54s/it]
 83%|      | 154/186 [04:00<00:49,  1.55s/it]
 83%|      | 155/186 [04:02<00:48,  1.56s/it]
 84%|      | 156/186 [04:03<00:47,  1.57s/it]
 84%|      | 157/186 [04:05<00:45,  1.55s/it]
 85%|      | 158/186 [04:06<00:43,  1.55s/it]
 85%|      | 159/186 [04:08<00:41,  1.54s/it]
 86%|      | 160/186 [04:09<00:39,  1.53s/it]
 87%|      | 161/186 [04:11<00:37,  1.52s/it]
 87%|      | 162/186 [04:12<00:36,  1.52s/it]
 88%|      | 163/186 [04:14<00:36,  1.58s/it]
 88%|      | 164/186 [04:16<00:34,  1.55s/it]
 89%|      | 165/186 [04:17<00:32,  1.54s/it]
 89%|      | 166/186 [04:19<00:30,  1.54s/it]
 90%|      | 167/186 [04:20<00:29,  1.54s/it]
 90%|      | 168/186 [04:22<00:27,  1.53s/it]
 91%|      | 169/186 [04:23<00:26,  1.54s/it]
 91%|     | 170/186 [04:25<00:24,  1.55s/it]
 92%|     | 171/186 [04:26<00:23,  1.56s/it]
 92%|     | 172/186 [04:28<00:21,  1.54s/it]
 93%|     | 173/186 [04:29<00:19,  1.52s/it]
 94%|     | 174/186 [04:31<00:18,  1.52s/it]
 94%|     | 175/186 [04:33<00:16,  1.52s/it]
 95%|     | 176/186 [04:34<00:15,  1.52s/it]
 95%|     | 177/186 [04:36<00:13,  1.53s/it]
 96%|     | 178/186 [04:37<00:12,  1.58s/it]
 96%|     | 179/186 [04:39<00:10,  1.56s/it]
 97%|     | 180/186 [04:40<00:09,  1.54s/it]
 97%|     | 181/186 [04:42<00:07,  1.54s/it]
 98%|     | 182/186 [04:43<00:06,  1.53s/it]
 98%|     | 183/186 [04:45<00:04,  1.55s/it]
 99%|     | 184/186 [04:46<00:03,  1.55s/it]
 99%|     | 185/186 [04:48<00:01,  1.59s/it]
100%|     | 186/186 [04:50<00:00,  1.55s/it]
 10%|         | 1/10 [04:50<43:31, 290.12s/it]

Epoch 1/10:
Train Loss: 0.9602, Train Accuracy: 4774509.51%
```

```
  0%|          | 0/186 [00:00<?, ?it/s]
  1%|          | 1/186 [00:01<04:38,  1.50s/it]
  1%|          | 2/186 [00:02<04:34,  1.49s/it]
  2%|          | 3/186 [00:04<04:32,  1.49s/it]
  2%|          | 4/186 [00:06<04:38,  1.53s/it]
  3%|          | 5/186 [00:07<04:37,  1.53s/it]
  3%|          | 6/186 [00:09<04:37,  1.54s/it]
  4%|          | 7/186 [00:10<04:45,  1.60s/it]
  4%|          | 8/186 [00:12<04:39,  1.57s/it]
  5%|          | 9/186 [00:13<04:35,  1.56s/it]
  5%|          | 10/186 [00:15<04:30,  1.54s/it]
  6%|          | 11/186 [00:16<04:29,  1.54s/it]
  6%|          | 12/186 [00:18<04:27,  1.54s/it]
  7%|          | 13/186 [00:20<04:28,  1.55s/it]
  8%|          | 14/186 [00:21<04:35,  1.60s/it]
  8%|          | 15/186 [00:23<04:31,  1.59s/it]
  9%|          | 16/186 [00:24<04:28,  1.58s/it]
  9%|          | 17/186 [00:26<04:25,  1.57s/it]
 10%|          | 18/186 [00:27<04:22,  1.56s/it]
 10%|          | 19/186 [00:29<04:21,  1.57s/it]
 11%|          | 20/186 [00:31<04:18,  1.56s/it]
 11%|          | 21/186 [00:32<04:23,  1.60s/it]
 12%|          | 22/186 [00:34<04:18,  1.58s/it]
 12%|          | 23/186 [00:35<04:13,  1.56s/it]
 13%|          | 24/186 [00:37<04:11,  1.55s/it]
 13%|          | 25/186 [00:38<04:08,  1.54s/it]
 14%|          | 26/186 [00:40<04:06,  1.54s/it]
 15%|          | 27/186 [00:41<04:03,  1.53s/it]
 15%|          | 28/186 [00:43<04:01,  1.53s/it]
 16%|          | 29/186 [00:45<04:12,  1.61s/it]
 16%|          | 30/186 [00:46<04:06,  1.58s/it]
 17%|          | 31/186 [00:48<04:01,  1.56s/it]
 17%|          | 32/186 [00:49<03:58,  1.55s/it]
 18%|          | 33/186 [00:51<03:56,  1.55s/it]
 18%|          | 34/186 [00:52<03:53,  1.54s/it]
 19%|          | 35/186 [00:54<03:50,  1.53s/it]
 19%|          | 36/186 [00:56<03:57,  1.59s/it]
 20%|          | 37/186 [00:57<03:51,  1.55s/it]
 20%|          | 38/186 [00:59<03:48,  1.54s/it]
 21%|          | 39/186 [01:00<03:47,  1.54s/it]
 22%|          | 40/186 [01:02<03:44,  1.54s/it]
 22%|          | 41/186 [01:03<03:42,  1.54s/it]
 23%|          | 42/186 [01:05<03:42,  1.54s/it]
 23%|          | 43/186 [01:06<03:40,  1.55s/it]
 24%|          | 44/186 [01:08<03:43,  1.58s/it]
 24%|          | 45/186 [01:10<03:50,  1.63s/it]
 25%|          | 46/186 [01:11<03:44,  1.61s/it]
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25%|         | 47/186 [01:13<03:39,  1.58s/it]
26%|         | 48/186 [01:14<03:35,  1.56s/it]
26%|         | 49/186 [01:16<03:32,  1.55s/it]
27%|         | 50/186 [01:17<03:30,  1.55s/it]
27%|         | 51/186 [01:19<03:37,  1.61s/it]
28%|         | 52/186 [01:21<03:35,  1.61s/it]
28%|         | 53/186 [01:22<03:31,  1.59s/it]
29%|         | 54/186 [01:24<03:26,  1.56s/it]
30%|         | 55/186 [01:25<03:24,  1.56s/it]
30%|         | 56/186 [01:27<03:22,  1.56s/it]
31%|         | 57/186 [01:28<03:20,  1.55s/it]
31%|         | 58/186 [01:30<03:27,  1.62s/it]
32%|        | 59/186 [01:32<03:22,  1.59s/it]
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34%|        | 63/186 [01:38<03:10,  1.55s/it]
34%|        | 64/186 [01:39<03:08,  1.55s/it]
35%|        | 65/186 [01:41<03:08,  1.56s/it]
35%|        | 66/186 [01:43<03:10,  1.59s/it]
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37%|        | 69/186 [01:47<02:58,  1.53s/it]
38%|        | 70/186 [01:49<02:58,  1.53s/it]
38%|        | 71/186 [01:50<02:57,  1.54s/it]
39%|        | 72/186 [01:52<02:55,  1.54s/it]
39%|        | 73/186 [01:53<02:59,  1.59s/it]
40%|        | 74/186 [01:55<02:55,  1.57s/it]
40%|        | 75/186 [01:57<02:54,  1.57s/it]
41%|        | 76/186 [01:58<02:49,  1.54s/it]
41%|       | 77/186 [02:00<02:49,  1.55s/it]
42%|       | 78/186 [02:01<02:47,  1.55s/it]
42%|       | 79/186 [02:03<02:45,  1.55s/it]
43%|       | 80/186 [02:04<02:49,  1.60s/it]
44%|       | 81/186 [02:06<02:44,  1.57s/it]
44%|       | 82/186 [02:07<02:42,  1.56s/it]
45%|       | 83/186 [02:09<02:39,  1.55s/it]
45%|       | 84/186 [02:11<02:38,  1.56s/it]
46%|       | 85/186 [02:12<02:37,  1.56s/it]
46%|       | 86/186 [02:14<02:35,  1.56s/it]
47%|       | 87/186 [02:15<02:35,  1.57s/it]
47%|       | 88/186 [02:17<02:34,  1.58s/it]
48%|       | 89/186 [02:18<02:32,  1.57s/it]
48%|       | 90/186 [02:20<02:29,  1.56s/it]
49%|       | 91/186 [02:22<02:28,  1.56s/it]
49%|       | 92/186 [02:23<02:25,  1.55s/it]
50%|       | 93/186 [02:25<02:23,  1.54s/it]
51%|       | 94/186 [02:26<02:21,  1.54s/it]
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51%|        | 95/186 [02:28<02:24,  1.59s/it]
52%|        | 96/186 [02:29<02:19,  1.55s/it]
52%|        | 97/186 [02:31<02:16,  1.54s/it]
53%|        | 98/186 [02:32<02:15,  1.54s/it]
53%|        | 99/186 [02:34<02:14,  1.55s/it]
54%|        | 100/186 [02:35<02:11,  1.53s/it]
54%|        | 101/186 [02:37<02:11,  1.54s/it]
55%|        | 102/186 [02:39<02:10,  1.55s/it]
55%|        | 103/186 [02:40<02:09,  1.56s/it]
56%|        | 104/186 [02:42<02:07,  1.55s/it]
56%|        | 105/186 [02:43<02:04,  1.54s/it]
57%|        | 106/186 [02:45<02:03,  1.54s/it]
58%|        | 107/186 [02:46<02:01,  1.54s/it]
58%|        | 108/186 [02:48<01:59,  1.53s/it]
59%|        | 109/186 [02:49<01:57,  1.52s/it]
59%|        | 110/186 [02:51<01:58,  1.56s/it]
60%|        | 111/186 [02:52<01:56,  1.56s/it]
60%|        | 112/186 [02:54<01:54,  1.54s/it]
61%|        | 113/186 [02:56<01:52,  1.54s/it]
61%|       | 114/186 [02:57<01:49,  1.52s/it]
62%|       | 115/186 [02:58<01:47,  1.52s/it]
62%|       | 116/186 [03:00<01:47,  1.53s/it]
63%|       | 117/186 [03:02<01:45,  1.53s/it]
63%|       | 118/186 [03:03<01:45,  1.55s/it]
64%|       | 119/186 [03:05<01:43,  1.55s/it]
65%|       | 120/186 [03:06<01:42,  1.55s/it]
65%|       | 121/186 [03:08<01:39,  1.54s/it]
66%|       | 122/186 [03:09<01:38,  1.54s/it]
66%|       | 123/186 [03:11<01:37,  1.55s/it]
67%|       | 124/186 [03:12<01:35,  1.54s/it]
67%|       | 125/186 [03:14<01:37,  1.60s/it]
68%|       | 126/186 [03:16<01:34,  1.57s/it]
68%|       | 127/186 [03:17<01:32,  1.57s/it]
69%|       | 128/186 [03:19<01:30,  1.56s/it]
69%|       | 129/186 [03:20<01:28,  1.55s/it]
70%|       | 130/186 [03:22<01:26,  1.54s/it]
70%|       | 131/186 [03:23<01:24,  1.54s/it]
71%|       | 132/186 [03:25<01:25,  1.59s/it]
72%|      | 133/186 [03:27<01:23,  1.58s/it]
72%|      | 134/186 [03:28<01:20,  1.55s/it]
73%|      | 135/186 [03:30<01:19,  1.56s/it]
73%|      | 136/186 [03:31<01:17,  1.54s/it]
74%|      | 137/186 [03:33<01:15,  1.53s/it]
74%|      | 138/186 [03:34<01:13,  1.54s/it]
75%|      | 139/186 [03:36<01:11,  1.53s/it]
75%|      | 140/186 [03:37<01:12,  1.58s/it]
76%|      | 141/186 [03:39<01:10,  1.57s/it]
76%|      | 142/186 [03:41<01:08,  1.56s/it]
```

```
 77%|       | 143/186 [03:42<01:06,  1.56s/it]
 77%|       | 144/186 [03:44<01:05,  1.55s/it]
 78%|       | 145/186 [03:45<01:03,  1.55s/it]
 78%|       | 146/186 [03:47<01:01,  1.53s/it]
 79%|       | 147/186 [03:48<01:02,  1.62s/it]
 80%|       | 148/186 [03:50<01:00,  1.60s/it]
 80%|       | 149/186 [03:52<00:58,  1.58s/it]
 81%|       | 150/186 [03:53<00:57,  1.59s/it]
 81%|       | 151/186 [03:55<00:55,  1.58s/it]
 82%|      | 152/186 [03:56<00:53,  1.57s/it]
 82%|      | 153/186 [03:58<00:51,  1.56s/it]
 83%|      | 154/186 [04:00<00:51,  1.62s/it]
 83%|      | 155/186 [04:01<00:48,  1.58s/it]
 84%|      | 156/186 [04:03<00:47,  1.57s/it]
 84%|      | 157/186 [04:04<00:45,  1.55s/it]
 85%|      | 158/186 [04:06<00:42,  1.53s/it]
 85%|      | 159/186 [04:07<00:41,  1.54s/it]
 86%|      | 160/186 [04:09<00:39,  1.53s/it]
 87%|      | 161/186 [04:10<00:38,  1.54s/it]
 87%|      | 162/186 [04:12<00:37,  1.57s/it]
 88%|      | 163/186 [04:13<00:36,  1.57s/it]
 88%|      | 164/186 [04:15<00:34,  1.56s/it]
 89%|      | 165/186 [04:17<00:32,  1.55s/it]
 89%|      | 166/186 [04:18<00:30,  1.54s/it]
 90%|      | 167/186 [04:20<00:29,  1.54s/it]
 90%|      | 168/186 [04:21<00:27,  1.54s/it]
 91%|      | 169/186 [04:23<00:27,  1.61s/it]
 91%|     | 170/186 [04:24<00:25,  1.58s/it]
 92%|     | 171/186 [04:26<00:23,  1.57s/it]
 92%|     | 172/186 [04:27<00:21,  1.54s/it]
 93%|     | 173/186 [04:29<00:19,  1.54s/it]
 94%|     | 174/186 [04:30<00:18,  1.54s/it]
 94%|     | 175/186 [04:32<00:16,  1.52s/it]
 95%|     | 176/186 [04:34<00:15,  1.53s/it]
 95%|     | 177/186 [04:35<00:14,  1.58s/it]
 96%|     | 178/186 [04:37<00:12,  1.54s/it]
 96%|     | 179/186 [04:38<00:10,  1.53s/it]
 97%|     | 180/186 [04:40<00:09,  1.54s/it]
 97%|     | 181/186 [04:41<00:07,  1.52s/it]
 98%|     | 182/186 [04:43<00:06,  1.54s/it]
 98%|     | 183/186 [04:44<00:04,  1.56s/it]
 99%|     | 184/186 [04:46<00:03,  1.61s/it]
 99%|     | 185/186 [04:48<00:01,  1.56s/it]
100%|     | 186/186 [04:49<00:00,  1.53s/it]
 20%|         | 2/10 [09:39<38:38, 289.78s/it]

Epoch 2/10:
Train Loss: 0.6564, Train Accuracy: 5202132.71%
```

```
  0%|          | 0/186 [00:00<?, ?it/s]
  1%|          | 1/186 [00:01<04:48,  1.56s/it]
  1%|          | 2/186 [00:03<04:39,  1.52s/it]
  2%|          | 3/186 [00:04<04:38,  1.52s/it]
  2%|          | 4/186 [00:06<04:40,  1.54s/it]
  3%|          | 5/186 [00:07<04:45,  1.58s/it]
  3%|          | 6/186 [00:09<04:40,  1.56s/it]
  4%|          | 7/186 [00:10<04:36,  1.54s/it]
  4%|          | 8/186 [00:12<04:35,  1.55s/it]
  5%|          | 9/186 [00:13<04:28,  1.52s/it]
  5%|          | 10/186 [00:15<04:29,  1.53s/it]
  6%|          | 11/186 [00:16<04:30,  1.54s/it]
  6%|          | 12/186 [00:18<04:30,  1.55s/it]
  7%|          | 13/186 [00:20<04:36,  1.60s/it]
  8%|          | 14/186 [00:21<04:30,  1.57s/it]
  8%|          | 15/186 [00:23<04:25,  1.56s/it]
  9%|          | 16/186 [00:24<04:25,  1.56s/it]
  9%|          | 17/186 [00:26<04:20,  1.54s/it]
 10%|          | 18/186 [00:27<04:17,  1.53s/it]
 10%|          | 19/186 [00:29<04:15,  1.53s/it]
 11%|          | 20/186 [00:31<04:22,  1.58s/it]
 11%|          | 21/186 [00:32<04:18,  1.56s/it]
 12%|          | 22/186 [00:34<04:15,  1.56s/it]
 12%|          | 23/186 [00:35<04:14,  1.56s/it]
 13%|          | 24/186 [00:37<04:11,  1.55s/it]
 13%|          | 25/186 [00:38<04:07,  1.54s/it]
 14%|          | 26/186 [00:40<04:05,  1.54s/it]
 15%|          | 27/186 [00:41<04:03,  1.53s/it]
 15%|          | 28/186 [00:43<04:15,  1.61s/it]
 16%|          | 29/186 [00:45<04:09,  1.59s/it]
 16%|          | 30/186 [00:46<04:04,  1.57s/it]
 17%|          | 31/186 [00:48<04:02,  1.56s/it]
 17%|          | 32/186 [00:49<03:59,  1.55s/it]
 18%|          | 33/186 [00:51<03:56,  1.55s/it]
 18%|          | 34/186 [00:52<03:54,  1.54s/it]
 19%|          | 35/186 [00:54<03:59,  1.59s/it]
 19%|          | 36/186 [00:56<03:59,  1.59s/it]
 20%|          | 37/186 [00:57<03:55,  1.58s/it]
 20%|          | 38/186 [00:59<03:50,  1.55s/it]
 21%|          | 39/186 [01:00<03:48,  1.56s/it]
 22%|          | 40/186 [01:02<03:47,  1.56s/it]
 22%|          | 41/186 [01:03<03:45,  1.56s/it]
 23%|          | 42/186 [01:05<03:45,  1.57s/it]
 23%|          | 43/186 [01:06<03:43,  1.56s/it]
 24%|          | 44/186 [01:08<03:40,  1.55s/it]
 24%|          | 45/186 [01:10<03:39,  1.55s/it]
 25%|          | 46/186 [01:11<03:38,  1.56s/it]
```

```
25%|         | 47/186 [01:13<03:36,  1.56s/it]
26%|         | 48/186 [01:14<03:33,  1.55s/it]
26%|         | 49/186 [01:16<03:32,  1.55s/it]
27%|         | 50/186 [01:17<03:35,  1.59s/it]
27%|         | 51/186 [01:19<03:31,  1.57s/it]
28%|         | 52/186 [01:20<03:26,  1.54s/it]
28%|         | 53/186 [01:22<03:25,  1.54s/it]
29%|         | 54/186 [01:23<03:22,  1.53s/it]
30%|         | 55/186 [01:25<03:21,  1.54s/it]
30%|         | 56/186 [01:27<03:18,  1.53s/it]
31%|         | 57/186 [01:28<03:26,  1.60s/it]
31%|         | 58/186 [01:30<03:22,  1.58s/it]
32%|        | 59/186 [01:31<03:20,  1.58s/it]
32%|        | 60/186 [01:33<03:15,  1.55s/it]
33%|        | 61/186 [01:34<03:13,  1.55s/it]
33%|        | 62/186 [01:36<03:12,  1.55s/it]
34%|        | 63/186 [01:38<03:08,  1.53s/it]
34%|        | 64/186 [01:39<03:06,  1.53s/it]
35%|        | 65/186 [01:41<03:08,  1.56s/it]
35%|        | 66/186 [01:42<03:04,  1.54s/it]
36%|        | 67/186 [01:44<03:03,  1.54s/it]
37%|        | 68/186 [01:45<03:03,  1.56s/it]
37%|        | 69/186 [01:47<03:01,  1.55s/it]
38%|        | 70/186 [01:48<02:58,  1.54s/it]
38%|        | 71/186 [01:50<02:57,  1.55s/it]
39%|        | 72/186 [01:52<03:05,  1.62s/it]
39%|        | 73/186 [01:53<03:00,  1.60s/it]
40%|        | 74/186 [01:55<02:57,  1.59s/it]
40%|        | 75/186 [01:56<02:53,  1.56s/it]
41%|        | 76/186 [01:58<02:51,  1.56s/it]
41%|       | 77/186 [01:59<02:47,  1.54s/it]
42%|       | 78/186 [02:01<02:45,  1.53s/it]
42%|       | 79/186 [02:02<02:46,  1.56s/it]
43%|       | 80/186 [02:04<02:46,  1.57s/it]
44%|       | 81/186 [02:06<02:45,  1.57s/it]
44%|       | 82/186 [02:07<02:42,  1.56s/it]
45%|       | 83/186 [02:09<02:39,  1.55s/it]
45%|       | 84/186 [02:10<02:37,  1.55s/it]
46%|       | 85/186 [02:12<02:35,  1.54s/it]
46%|       | 86/186 [02:13<02:33,  1.54s/it]
47%|       | 87/186 [02:15<02:36,  1.59s/it]
47%|       | 88/186 [02:17<02:32,  1.56s/it]
48%|       | 89/186 [02:18<02:31,  1.56s/it]
48%|       | 90/186 [02:20<02:29,  1.56s/it]
49%|       | 91/186 [02:21<02:26,  1.54s/it]
49%|       | 92/186 [02:23<02:25,  1.55s/it]
50%|       | 93/186 [02:24<02:22,  1.53s/it]
51%|       | 94/186 [02:26<02:26,  1.59s/it]
```

```
51%|        | 95/186 [02:27<02:23,  1.58s/it]
52%|        | 96/186 [02:29<02:21,  1.57s/it]
52%|        | 97/186 [02:31<02:18,  1.56s/it]
53%|        | 98/186 [02:32<02:15,  1.54s/it]
53%|        | 99/186 [02:34<02:12,  1.53s/it]
54%|        | 100/186 [02:35<02:11,  1.53s/it]
54%|        | 101/186 [02:37<02:09,  1.52s/it]
55%|        | 102/186 [02:38<02:11,  1.57s/it]
55%|        | 103/186 [02:40<02:08,  1.55s/it]
56%|        | 104/186 [02:41<02:06,  1.55s/it]
56%|        | 105/186 [02:43<02:04,  1.53s/it]
57%|        | 106/186 [02:44<02:04,  1.55s/it]
58%|        | 107/186 [02:46<02:02,  1.55s/it]
58%|        | 108/186 [02:47<02:00,  1.54s/it]
59%|        | 109/186 [02:49<02:04,  1.62s/it]
59%|        | 110/186 [02:51<02:02,  1.61s/it]
60%|        | 111/186 [02:52<01:57,  1.57s/it]
60%|        | 112/186 [02:54<01:55,  1.56s/it]
61%|        | 113/186 [02:55<01:52,  1.54s/it]
61%|       | 114/186 [02:57<01:50,  1.54s/it]
62%|       | 115/186 [02:58<01:47,  1.52s/it]
62%|       | 116/186 [03:00<01:48,  1.55s/it]
63%|       | 117/186 [03:02<01:47,  1.56s/it]
63%|       | 118/186 [03:03<01:45,  1.55s/it]
64%|       | 119/186 [03:05<01:43,  1.54s/it]
65%|       | 120/186 [03:06<01:42,  1.55s/it]
65%|       | 121/186 [03:08<01:39,  1.54s/it]
66%|       | 122/186 [03:09<01:39,  1.55s/it]
66%|       | 123/186 [03:11<01:36,  1.53s/it]
67%|       | 124/186 [03:12<01:38,  1.59s/it]
67%|       | 125/186 [03:14<01:36,  1.58s/it]
68%|       | 126/186 [03:16<01:34,  1.57s/it]
68%|       | 127/186 [03:17<01:31,  1.55s/it]
69%|       | 128/186 [03:19<01:29,  1.54s/it]
69%|       | 129/186 [03:20<01:27,  1.54s/it]
70%|       | 130/186 [03:22<01:26,  1.55s/it]
70%|       | 131/186 [03:24<01:29,  1.63s/it]
71%|       | 132/186 [03:25<01:26,  1.60s/it]
72%|      | 133/186 [03:27<01:23,  1.57s/it]
72%|      | 134/186 [03:28<01:20,  1.55s/it]
73%|      | 135/186 [03:30<01:18,  1.53s/it]
73%|      | 136/186 [03:31<01:17,  1.54s/it]
74%|      | 137/186 [03:33<01:15,  1.53s/it]
74%|      | 138/186 [03:34<01:13,  1.54s/it]
75%|      | 139/186 [03:36<01:13,  1.56s/it]
75%|      | 140/186 [03:37<01:10,  1.53s/it]
76%|      | 141/186 [03:39<01:09,  1.54s/it]
76%|      | 142/186 [03:40<01:07,  1.53s/it]
```

```
 77%|       | 143/186 [03:42<01:06,  1.54s/it]
 77%|       | 144/186 [03:43<01:04,  1.53s/it]
 78%|       | 145/186 [03:45<01:02,  1.52s/it]
 78%|       | 146/186 [03:47<01:02,  1.57s/it]
 79%|       | 147/186 [03:48<01:01,  1.57s/it]
 80%|       | 148/186 [03:50<00:59,  1.56s/it]
 80%|       | 149/186 [03:51<00:56,  1.54s/it]
 81%|       | 150/186 [03:53<00:55,  1.53s/it]
 81%|       | 151/186 [03:54<00:53,  1.52s/it]
 82%|      | 152/186 [03:56<00:51,  1.52s/it]
 82%|      | 153/186 [03:57<00:51,  1.56s/it]
 83%|      | 154/186 [03:59<00:50,  1.57s/it]
 83%|      | 155/186 [04:01<00:48,  1.58s/it]
 84%|      | 156/186 [04:02<00:47,  1.58s/it]
 84%|      | 157/186 [04:04<00:45,  1.58s/it]
 85%|      | 158/186 [04:05<00:43,  1.55s/it]
 85%|      | 159/186 [04:07<00:42,  1.56s/it]
 86%|      | 160/186 [04:08<00:40,  1.55s/it]
 87%|      | 161/186 [04:10<00:39,  1.59s/it]
 87%|      | 162/186 [04:12<00:37,  1.58s/it]
 88%|      | 163/186 [04:13<00:35,  1.56s/it]
 88%|      | 164/186 [04:15<00:34,  1.56s/it]
 89%|      | 165/186 [04:16<00:32,  1.54s/it]
 89%|      | 166/186 [04:18<00:30,  1.55s/it]
 90%|      | 167/186 [04:19<00:29,  1.55s/it]
 90%|      | 168/186 [04:21<00:28,  1.58s/it]
 91%|      | 169/186 [04:22<00:26,  1.56s/it]
 91%|     | 170/186 [04:24<00:24,  1.54s/it]
 92%|     | 171/186 [04:25<00:23,  1.54s/it]
 92%|     | 172/186 [04:27<00:21,  1.54s/it]
 93%|     | 173/186 [04:29<00:20,  1.56s/it]
 94%|     | 174/186 [04:30<00:18,  1.54s/it]
 94%|     | 175/186 [04:32<00:16,  1.53s/it]
 95%|     | 176/186 [04:33<00:15,  1.58s/it]
 95%|     | 177/186 [04:35<00:14,  1.56s/it]
 96%|     | 178/186 [04:36<00:12,  1.55s/it]
 96%|     | 179/186 [04:38<00:10,  1.54s/it]
 97%|     | 180/186 [04:39<00:09,  1.55s/it]
 97%|     | 181/186 [04:41<00:07,  1.53s/it]
 98%|     | 182/186 [04:42<00:06,  1.54s/it]
 98%|     | 183/186 [04:44<00:04,  1.60s/it]
 99%|     | 184/186 [04:46<00:03,  1.58s/it]
 99%|     | 185/186 [04:47<00:01,  1.55s/it]
100%|     | 186/186 [04:49<00:00,  1.52s/it]
 30%|        | 3/10 [14:28<33:46, 289.52s/it]

Epoch 3/10:
Train Loss: 0.5787, Train Accuracy: 5329590.39%
```

```
  0%|          | 0/186 [00:00<?, ?it/s]
  1%|          | 1/186 [00:01<04:46,  1.55s/it]
  1%|          | 2/186 [00:03<04:44,  1.55s/it]
  2%|          | 3/186 [00:04<04:40,  1.53s/it]
  2%|          | 4/186 [00:06<04:55,  1.62s/it]
  3%|          | 5/186 [00:08<04:55,  1.63s/it]
  3%|          | 6/186 [00:09<04:48,  1.60s/it]
  4%|          | 7/186 [00:11<04:39,  1.56s/it]
  4%|          | 8/186 [00:12<04:38,  1.57s/it]
  5%|          | 9/186 [00:14<04:37,  1.57s/it]
  5%|          | 10/186 [00:15<04:36,  1.57s/it]
  6%|          | 11/186 [00:17<04:32,  1.56s/it]
  6%|          | 12/186 [00:19<04:44,  1.63s/it]
  7%|          | 13/186 [00:20<04:37,  1.61s/it]
  8%|          | 14/186 [00:22<04:34,  1.59s/it]
  8%|          | 15/186 [00:23<04:27,  1.56s/it]
  9%|          | 16/186 [00:25<04:24,  1.56s/it]
  9%|          | 17/186 [00:26<04:21,  1.54s/it]
 10%|          | 18/186 [00:28<04:17,  1.53s/it]
 10%|          | 19/186 [00:29<04:20,  1.56s/it]
 11%|          | 20/186 [00:31<04:15,  1.54s/it]
 11%|          | 21/186 [00:32<04:13,  1.54s/it]
 12%|          | 22/186 [00:34<04:11,  1.53s/it]
 12%|          | 23/186 [00:35<04:10,  1.54s/it]
 13%|          | 24/186 [00:37<04:09,  1.54s/it]
 13%|          | 25/186 [00:39<04:09,  1.55s/it]
 14%|          | 26/186 [00:40<04:06,  1.54s/it]
 15%|          | 27/186 [00:42<04:15,  1.61s/it]
 15%|          | 28/186 [00:43<04:11,  1.59s/it]
 16%|          | 29/186 [00:45<04:08,  1.58s/it]
 16%|          | 30/186 [00:47<04:05,  1.57s/it]
 17%|          | 31/186 [00:48<04:03,  1.57s/it]
 17%|          | 32/186 [00:50<03:59,  1.55s/it]
 18%|          | 33/186 [00:51<03:58,  1.56s/it]
 18%|          | 34/186 [00:53<04:02,  1.59s/it]
 19%|          | 35/186 [00:54<03:57,  1.58s/it]
 19%|          | 36/186 [00:56<03:54,  1.56s/it]
 20%|          | 37/186 [00:58<03:53,  1.56s/it]
 20%|          | 38/186 [00:59<03:49,  1.55s/it]
 21%|          | 39/186 [01:01<03:45,  1.54s/it]
 22%|          | 40/186 [01:02<03:43,  1.53s/it]
 22%|          | 41/186 [01:04<03:44,  1.55s/it]
 23%|          | 42/186 [01:05<03:44,  1.56s/it]
 23%|          | 43/186 [01:07<03:42,  1.56s/it]
 24%|          | 44/186 [01:08<03:39,  1.55s/it]
 24%|          | 45/186 [01:10<03:36,  1.53s/it]
 25%|          | 46/186 [01:11<03:34,  1.53s/it]
```

```
25%|         | 47/186 [01:13<03:32,  1.53s/it]
26%|         | 48/186 [01:14<03:31,  1.54s/it]
26%|         | 49/186 [01:16<03:39,  1.60s/it]
27%|         | 50/186 [01:18<03:34,  1.58s/it]
27%|         | 51/186 [01:19<03:29,  1.55s/it]
28%|         | 52/186 [01:21<03:29,  1.56s/it]
28%|         | 53/186 [01:22<03:26,  1.55s/it]
29%|         | 54/186 [01:24<03:24,  1.55s/it]
30%|         | 55/186 [01:25<03:22,  1.54s/it]
30%|         | 56/186 [01:27<03:29,  1.61s/it]
31%|         | 57/186 [01:29<03:24,  1.59s/it]
31%|         | 58/186 [01:30<03:22,  1.58s/it]
32%|        | 59/186 [01:32<03:17,  1.55s/it]
32%|        | 60/186 [01:33<03:14,  1.54s/it]
33%|        | 61/186 [01:35<03:13,  1.55s/it]
33%|        | 62/186 [01:36<03:11,  1.55s/it]
34%|        | 63/186 [01:38<03:09,  1.54s/it]
34%|        | 64/186 [01:40<03:13,  1.58s/it]
35%|        | 65/186 [01:41<03:09,  1.57s/it]
35%|        | 66/186 [01:43<03:06,  1.55s/it]
36%|        | 67/186 [01:44<03:04,  1.55s/it]
37%|        | 68/186 [01:46<03:01,  1.54s/it]
37%|        | 69/186 [01:47<02:59,  1.53s/it]
38%|        | 70/186 [01:49<02:57,  1.53s/it]
38%|        | 71/186 [01:50<03:02,  1.59s/it]
39%|        | 72/186 [01:52<03:01,  1.59s/it]
39%|        | 73/186 [01:54<02:56,  1.56s/it]
40%|        | 74/186 [01:55<02:52,  1.54s/it]
40%|        | 75/186 [01:57<02:52,  1.56s/it]
41%|        | 76/186 [01:58<02:49,  1.54s/it]
41%|       | 77/186 [02:00<02:48,  1.55s/it]
42%|       | 78/186 [02:01<02:49,  1.57s/it]
42%|       | 79/186 [02:03<02:47,  1.57s/it]
43%|       | 80/186 [02:04<02:44,  1.55s/it]
44%|       | 81/186 [02:06<02:43,  1.56s/it]
44%|       | 82/186 [02:07<02:40,  1.55s/it]
45%|       | 83/186 [02:09<02:40,  1.56s/it]
45%|       | 84/186 [02:11<02:37,  1.55s/it]
46%|       | 85/186 [02:12<02:34,  1.53s/it]
46%|       | 86/186 [02:14<02:39,  1.59s/it]
47%|       | 87/186 [02:15<02:35,  1.57s/it]
47%|       | 88/186 [02:17<02:32,  1.55s/it]
48%|       | 89/186 [02:18<02:31,  1.57s/it]
48%|       | 90/186 [02:20<02:29,  1.56s/it]
49%|       | 91/186 [02:21<02:26,  1.54s/it]
49%|       | 92/186 [02:23<02:24,  1.54s/it]
50%|       | 93/186 [02:25<02:27,  1.58s/it]
51%|       | 94/186 [02:26<02:23,  1.56s/it]
```

```
51%|        | 95/186 [02:28<02:20,  1.55s/it]
52%|        | 96/186 [02:29<02:18,  1.54s/it]
52%|        | 97/186 [02:31<02:16,  1.54s/it]
53%|        | 98/186 [02:32<02:16,  1.55s/it]
53%|        | 99/186 [02:34<02:14,  1.55s/it]
54%|        | 100/186 [02:35<02:12,  1.54s/it]
54%|        | 101/186 [02:37<02:12,  1.56s/it]
55%|        | 102/186 [02:39<02:11,  1.56s/it]
55%|        | 103/186 [02:40<02:08,  1.55s/it]
56%|        | 104/186 [02:42<02:07,  1.55s/it]
56%|        | 105/186 [02:43<02:05,  1.54s/it]
57%|        | 106/186 [02:45<02:03,  1.55s/it]
58%|        | 107/186 [02:46<02:02,  1.55s/it]
58%|        | 108/186 [02:48<02:05,  1.61s/it]
59%|        | 109/186 [02:50<02:03,  1.60s/it]
59%|        | 110/186 [02:51<01:59,  1.58s/it]
60%|        | 111/186 [02:53<01:57,  1.56s/it]
60%|        | 112/186 [02:54<01:54,  1.55s/it]
61%|        | 113/186 [02:56<01:53,  1.56s/it]
61%|       | 114/186 [02:57<01:51,  1.55s/it]
62%|       | 115/186 [02:59<01:51,  1.57s/it]
62%|       | 116/186 [03:00<01:49,  1.57s/it]
63%|       | 117/186 [03:02<01:47,  1.56s/it]
63%|       | 118/186 [03:04<01:44,  1.53s/it]
64%|       | 119/186 [03:05<01:43,  1.54s/it]
65%|       | 120/186 [03:07<01:41,  1.53s/it]
65%|       | 121/186 [03:08<01:40,  1.54s/it]
66%|       | 122/186 [03:10<01:38,  1.55s/it]
66%|       | 123/186 [03:11<01:40,  1.59s/it]
67%|       | 124/186 [03:13<01:38,  1.59s/it]
67%|       | 125/186 [03:15<01:36,  1.57s/it]
68%|       | 126/186 [03:16<01:33,  1.57s/it]
68%|       | 127/186 [03:18<01:32,  1.56s/it]
69%|       | 128/186 [03:19<01:31,  1.57s/it]
69%|       | 129/186 [03:21<01:29,  1.57s/it]
70%|       | 130/186 [03:22<01:30,  1.61s/it]
70%|       | 131/186 [03:24<01:27,  1.59s/it]
71%|       | 132/186 [03:26<01:24,  1.57s/it]
72%|      | 133/186 [03:27<01:22,  1.56s/it]
72%|      | 134/186 [03:29<01:20,  1.55s/it]
73%|      | 135/186 [03:30<01:18,  1.55s/it]
73%|      | 136/186 [03:32<01:17,  1.55s/it]
74%|      | 137/186 [03:33<01:17,  1.59s/it]
74%|      | 138/186 [03:35<01:15,  1.57s/it]
75%|      | 139/186 [03:36<01:12,  1.55s/it]
75%|      | 140/186 [03:38<01:12,  1.57s/it]
76%|      | 141/186 [03:40<01:10,  1.56s/it]
76%|      | 142/186 [03:41<01:07,  1.53s/it]
```

```
 77%|       | 143/186 [03:43<01:05,  1.53s/it]
 77%|       | 144/186 [03:44<01:03,  1.52s/it]
 78%|       | 145/186 [03:46<01:05,  1.59s/it]
 78%|       | 146/186 [03:47<01:03,  1.58s/it]
 79%|       | 147/186 [03:49<01:01,  1.57s/it]
 80%|       | 148/186 [03:51<00:59,  1.58s/it]
 80%|       | 149/186 [03:52<00:57,  1.56s/it]
 81%|       | 150/186 [03:54<00:55,  1.55s/it]
 81%|       | 151/186 [03:55<00:54,  1.54s/it]
 82%|      | 152/186 [03:57<00:54,  1.61s/it]
 82%|      | 153/186 [03:58<00:52,  1.60s/it]
 83%|      | 154/186 [04:00<00:50,  1.58s/it]
 83%|      | 155/186 [04:02<00:48,  1.57s/it]
 84%|      | 156/186 [04:03<00:46,  1.55s/it]
 84%|      | 157/186 [04:05<00:44,  1.54s/it]
 85%|      | 158/186 [04:06<00:43,  1.54s/it]
 85%|      | 159/186 [04:08<00:42,  1.56s/it]
 86%|      | 160/186 [04:09<00:40,  1.57s/it]
 87%|      | 161/186 [04:11<00:38,  1.55s/it]
 87%|      | 162/186 [04:12<00:36,  1.54s/it]
 88%|      | 163/186 [04:14<00:35,  1.54s/it]
 88%|      | 164/186 [04:15<00:33,  1.53s/it]
 89%|      | 165/186 [04:17<00:33,  1.60s/it]
 89%|      | 166/186 [04:19<00:31,  1.57s/it]
 90%|      | 167/186 [04:20<00:30,  1.63s/it]
 90%|      | 168/186 [04:22<00:28,  1.61s/it]
 91%|      | 169/186 [04:23<00:26,  1.59s/it]
 91%|     | 170/186 [04:25<00:25,  1.59s/it]
 92%|     | 171/186 [04:27<00:23,  1.57s/it]
 92%|     | 172/186 [04:28<00:21,  1.55s/it]
 93%|     | 173/186 [04:30<00:20,  1.54s/it]
 94%|     | 174/186 [04:31<00:19,  1.59s/it]
 94%|     | 175/186 [04:33<00:17,  1.57s/it]
 95%|     | 176/186 [04:34<00:15,  1.56s/it]
 95%|     | 177/186 [04:36<00:13,  1.55s/it]
 96%|     | 178/186 [04:37<00:12,  1.54s/it]
 96%|     | 179/186 [04:39<00:10,  1.54s/it]
 97%|     | 180/186 [04:40<00:09,  1.53s/it]
 97%|     | 181/186 [04:42<00:07,  1.54s/it]
 98%|     | 182/186 [04:44<00:06,  1.58s/it]
 98%|     | 183/186 [04:45<00:04,  1.56s/it]
 99%|     | 184/186 [04:47<00:03,  1.57s/it]
 99%|     | 185/186 [04:48<00:01,  1.55s/it]
100%|     | 186/186 [04:50<00:00,  1.51s/it]
 40%|       | 4/10 [19:19<28:58, 289.82s/it]

Epoch 4/10:
Train Loss: 0.5340, Train Accuracy: 5406619.36%
```

```
  0%|          | 0/186 [00:00<?, ?it/s]
  1%|          | 1/186 [00:01<04:45,  1.55s/it]
  1%|          | 2/186 [00:03<04:49,  1.57s/it]
  2%|          | 3/186 [00:04<05:02,  1.65s/it]
  2%|          | 4/186 [00:06<04:52,  1.61s/it]
  3%|          | 5/186 [00:07<04:43,  1.57s/it]
  3%|          | 6/186 [00:09<04:39,  1.55s/it]
  4%|          | 7/186 [00:11<04:39,  1.56s/it]
  4%|          | 8/186 [00:12<04:36,  1.56s/it]
  5%|          | 9/186 [00:14<04:33,  1.55s/it]
  5%|          | 10/186 [00:15<04:39,  1.59s/it]
  6%|          | 11/186 [00:17<04:34,  1.57s/it]
  6%|          | 12/186 [00:18<04:32,  1.57s/it]
  7%|          | 13/186 [00:20<04:29,  1.56s/it]
  8%|          | 14/186 [00:21<04:23,  1.53s/it]
  8%|          | 15/186 [00:23<04:24,  1.54s/it]
  9%|          | 16/186 [00:24<04:20,  1.53s/it]
  9%|          | 17/186 [00:26<04:19,  1.54s/it]
 10%|          | 18/186 [00:28<04:23,  1.57s/it]
 10%|          | 19/186 [00:29<04:20,  1.56s/it]
 11%|          | 20/186 [00:31<04:16,  1.54s/it]
 11%|          | 21/186 [00:32<04:14,  1.54s/it]
 12%|          | 22/186 [00:34<04:11,  1.53s/it]
 12%|          | 23/186 [00:35<04:14,  1.56s/it]
 13%|          | 24/186 [00:37<04:11,  1.55s/it]
 13%|          | 25/186 [00:39<04:19,  1.61s/it]
 14%|          | 26/186 [00:40<04:13,  1.59s/it]
 15%|          | 27/186 [00:42<04:08,  1.56s/it]
 15%|          | 28/186 [00:43<04:04,  1.55s/it]
 16%|          | 29/186 [00:45<04:02,  1.55s/it]
 16%|          | 30/186 [00:46<04:00,  1.54s/it]
 17%|          | 31/186 [00:48<03:55,  1.52s/it]
 17%|          | 32/186 [00:49<03:54,  1.52s/it]
 18%|          | 33/186 [00:51<03:55,  1.54s/it]
 18%|          | 34/186 [00:52<03:54,  1.54s/it]
 19%|          | 35/186 [00:54<03:52,  1.54s/it]
 19%|          | 36/186 [00:55<03:49,  1.53s/it]
 20%|          | 37/186 [00:57<03:47,  1.53s/it]
 20%|          | 38/186 [00:58<03:46,  1.53s/it]
 21%|          | 39/186 [01:00<03:43,  1.52s/it]
 22%|          | 40/186 [01:02<03:52,  1.59s/it]
 22%|          | 41/186 [01:03<03:47,  1.57s/it]
 23%|          | 42/186 [01:05<03:42,  1.55s/it]
 23%|          | 43/186 [01:06<03:38,  1.53s/it]
 24%|          | 44/186 [01:08<03:39,  1.55s/it]
 24%|          | 45/186 [01:09<03:38,  1.55s/it]
 25%|          | 46/186 [01:11<03:36,  1.55s/it]
```

```
25%|         | 47/186 [01:12<03:35,  1.55s/it]
26%|         | 48/186 [01:14<03:36,  1.57s/it]
26%|         | 49/186 [01:16<03:32,  1.55s/it]
27%|         | 50/186 [01:17<03:29,  1.54s/it]
27%|         | 51/186 [01:19<03:28,  1.54s/it]
28%|         | 52/186 [01:20<03:25,  1.53s/it]
28%|         | 53/186 [01:22<03:22,  1.52s/it]
29%|         | 54/186 [01:23<03:19,  1.51s/it]
30%|         | 55/186 [01:25<03:27,  1.59s/it]
30%|         | 56/186 [01:26<03:24,  1.57s/it]
31%|         | 57/186 [01:28<03:22,  1.57s/it]
31%|         | 58/186 [01:30<03:21,  1.57s/it]
32%|        | 59/186 [01:31<03:19,  1.57s/it]
32%|        | 60/186 [01:33<03:15,  1.55s/it]
33%|        | 61/186 [01:34<03:14,  1.55s/it]
33%|        | 62/186 [01:36<03:18,  1.60s/it]
34%|        | 63/186 [01:38<03:15,  1.59s/it]
34%|        | 64/186 [01:39<03:11,  1.57s/it]
35%|        | 65/186 [01:41<03:06,  1.54s/it]
35%|        | 66/186 [01:42<03:05,  1.54s/it]
36%|        | 67/186 [01:44<03:03,  1.54s/it]
37%|        | 68/186 [01:45<03:02,  1.55s/it]
37%|        | 69/186 [01:47<03:02,  1.56s/it]
38%|        | 70/186 [01:48<03:04,  1.59s/it]
38%|        | 71/186 [01:50<03:01,  1.58s/it]
39%|        | 72/186 [01:51<02:58,  1.56s/it]
39%|        | 73/186 [01:53<02:55,  1.55s/it]
40%|        | 74/186 [01:55<02:53,  1.55s/it]
40%|        | 75/186 [01:56<02:49,  1.52s/it]
41%|        | 76/186 [01:58<02:48,  1.53s/it]
41%|       | 77/186 [01:59<02:51,  1.58s/it]
42%|       | 78/186 [02:01<02:49,  1.57s/it]
42%|       | 79/186 [02:02<02:47,  1.57s/it]
43%|       | 80/186 [02:04<02:44,  1.55s/it]
44%|       | 81/186 [02:05<02:41,  1.54s/it]
44%|       | 82/186 [02:07<02:40,  1.54s/it]
45%|       | 83/186 [02:09<02:39,  1.55s/it]
45%|       | 84/186 [02:10<02:41,  1.58s/it]
46%|       | 85/186 [02:12<02:38,  1.57s/it]
46%|       | 86/186 [02:13<02:35,  1.56s/it]
47%|       | 87/186 [02:15<02:33,  1.55s/it]
47%|       | 88/186 [02:16<02:29,  1.52s/it]
48%|       | 89/186 [02:18<02:28,  1.53s/it]
48%|       | 90/186 [02:19<02:27,  1.54s/it]
49%|       | 91/186 [02:21<02:26,  1.54s/it]
49%|       | 92/186 [02:23<02:30,  1.60s/it]
50%|       | 93/186 [02:24<02:26,  1.58s/it]
51%|       | 94/186 [02:26<02:24,  1.57s/it]
```

```
51%|        | 95/186 [02:27<02:21,  1.55s/it]
52%|        | 96/186 [02:29<02:20,  1.56s/it]
52%|        | 97/186 [02:30<02:17,  1.55s/it]
53%|        | 98/186 [02:32<02:15,  1.54s/it]
53%|        | 99/186 [02:34<02:18,  1.60s/it]
54%|        | 100/186 [02:35<02:15,  1.57s/it]
54%|        | 101/186 [02:37<02:13,  1.57s/it]
55%|        | 102/186 [02:38<02:11,  1.57s/it]
55%|        | 103/186 [02:40<02:09,  1.56s/it]
56%|        | 104/186 [02:41<02:08,  1.57s/it]
56%|        | 105/186 [02:43<02:06,  1.56s/it]
57%|        | 106/186 [02:44<02:05,  1.56s/it]
58%|        | 107/186 [02:46<02:05,  1.59s/it]
58%|        | 108/186 [02:48<02:02,  1.57s/it]
59%|        | 109/186 [02:49<02:00,  1.56s/it]
59%|        | 110/186 [02:51<01:57,  1.54s/it]
60%|        | 111/186 [02:52<01:55,  1.54s/it]
60%|        | 112/186 [02:54<01:54,  1.54s/it]
61%|        | 113/186 [02:55<01:52,  1.54s/it]
61%|       | 114/186 [02:57<01:55,  1.61s/it]
62%|       | 115/186 [02:59<01:52,  1.59s/it]
62%|       | 116/186 [03:00<01:50,  1.58s/it]
63%|       | 117/186 [03:02<01:47,  1.55s/it]
63%|       | 118/186 [03:03<01:45,  1.55s/it]
64%|       | 119/186 [03:05<01:43,  1.55s/it]
65%|       | 120/186 [03:06<01:41,  1.54s/it]
65%|       | 121/186 [03:08<01:43,  1.59s/it]
66%|       | 122/186 [03:09<01:40,  1.57s/it]
66%|       | 123/186 [03:11<01:37,  1.55s/it]
67%|       | 124/186 [03:13<01:36,  1.56s/it]
67%|       | 125/186 [03:14<01:34,  1.55s/it]
68%|       | 126/186 [03:16<01:32,  1.54s/it]
68%|       | 127/186 [03:17<01:30,  1.54s/it]
69%|       | 128/186 [03:19<01:29,  1.54s/it]
69%|       | 129/186 [03:20<01:31,  1.60s/it]
70%|       | 130/186 [03:22<01:28,  1.58s/it]
70%|       | 131/186 [03:24<01:26,  1.58s/it]
71%|       | 132/186 [03:25<01:24,  1.57s/it]
72%|      | 133/186 [03:27<01:22,  1.55s/it]
72%|      | 134/186 [03:28<01:20,  1.55s/it]
73%|      | 135/186 [03:30<01:19,  1.55s/it]
73%|      | 136/186 [03:31<01:19,  1.60s/it]
74%|      | 137/186 [03:33<01:17,  1.58s/it]
74%|      | 138/186 [03:34<01:14,  1.56s/it]
75%|      | 139/186 [03:36<01:13,  1.56s/it]
75%|      | 140/186 [03:38<01:11,  1.55s/it]
76%|      | 141/186 [03:39<01:09,  1.54s/it]
76%|      | 142/186 [03:41<01:09,  1.58s/it]
```

```
 77%|       | 143/186 [03:42<01:10,  1.63s/it]
 77%|       | 144/186 [03:44<01:07,  1.61s/it]
 78%|       | 145/186 [03:46<01:04,  1.58s/it]
 78%|       | 146/186 [03:47<01:02,  1.57s/it]
 79%|       | 147/186 [03:49<01:01,  1.57s/it]
 80%|       | 148/186 [03:50<00:58,  1.55s/it]
 80%|       | 149/186 [03:52<00:57,  1.56s/it]
 81%|       | 150/186 [03:53<00:55,  1.54s/it]
 81%|       | 151/186 [03:55<00:55,  1.57s/it]
 82%|      | 152/186 [03:56<00:52,  1.55s/it]
 82%|      | 153/186 [03:58<00:51,  1.55s/it]
 83%|      | 154/186 [03:59<00:49,  1.54s/it]
 83%|      | 155/186 [04:01<00:47,  1.55s/it]
 84%|      | 156/186 [04:03<00:46,  1.55s/it]
 84%|      | 157/186 [04:04<00:44,  1.54s/it]
 85%|      | 158/186 [04:06<00:44,  1.59s/it]
 85%|      | 159/186 [04:07<00:42,  1.58s/it]
 86%|      | 160/186 [04:09<00:41,  1.58s/it]
 87%|      | 161/186 [04:10<00:39,  1.57s/it]
 87%|      | 162/186 [04:12<00:36,  1.54s/it]
 88%|      | 163/186 [04:13<00:35,  1.54s/it]
 88%|      | 164/186 [04:15<00:34,  1.55s/it]
 89%|      | 165/186 [04:17<00:33,  1.59s/it]
 89%|      | 166/186 [04:18<00:31,  1.60s/it]
 90%|      | 167/186 [04:20<00:30,  1.58s/it]
 90%|      | 168/186 [04:21<00:28,  1.57s/it]
 91%|      | 169/186 [04:23<00:26,  1.55s/it]
 91%|     | 170/186 [04:25<00:24,  1.56s/it]
 92%|     | 171/186 [04:26<00:23,  1.55s/it]
 92%|     | 172/186 [04:28<00:21,  1.54s/it]
 93%|     | 173/186 [04:29<00:20,  1.58s/it]
 94%|     | 174/186 [04:31<00:18,  1.57s/it]
 94%|     | 175/186 [04:32<00:17,  1.56s/it]
 95%|     | 176/186 [04:34<00:15,  1.55s/it]
 95%|     | 177/186 [04:35<00:13,  1.55s/it]
 96%|     | 178/186 [04:37<00:12,  1.56s/it]
 96%|     | 179/186 [04:39<00:10,  1.55s/it]
 97%|     | 180/186 [04:40<00:09,  1.62s/it]
 97%|     | 181/186 [04:42<00:07,  1.59s/it]
 98%|     | 182/186 [04:43<00:06,  1.58s/it]
 98%|     | 183/186 [04:45<00:04,  1.55s/it]
 99%|     | 184/186 [04:46<00:03,  1.54s/it]
 99%|     | 185/186 [04:48<00:01,  1.53s/it]
100%|     | 186/186 [04:49<00:00,  1.51s/it]
 50%|       | 5/10 [24:08<24:09, 289.83s/it]

Epoch 5/10:
Train Loss: 0.5022, Train Accuracy: 5465060.47%
```

```
  0%|          | 0/186 [00:00<?, ?it/s]
  1%|          | 1/186 [00:01<04:41,  1.52s/it]
  1%|          | 2/186 [00:03<04:51,  1.58s/it]
  2%|          | 3/186 [00:04<04:46,  1.57s/it]
  2%|          | 4/186 [00:06<04:44,  1.56s/it]
  3%|          | 5/186 [00:07<04:40,  1.55s/it]
  3%|          | 6/186 [00:09<04:38,  1.55s/it]
  4%|          | 7/186 [00:10<04:38,  1.55s/it]
  4%|          | 8/186 [00:12<04:35,  1.55s/it]
  5%|          | 9/186 [00:14<04:47,  1.62s/it]
  5%|          | 10/186 [00:15<04:40,  1.60s/it]
  6%|          | 11/186 [00:17<04:36,  1.58s/it]
  6%|          | 12/186 [00:18<04:33,  1.57s/it]
  7%|          | 13/186 [00:20<04:28,  1.55s/it]
  8%|          | 14/186 [00:21<04:23,  1.53s/it]
  8%|          | 15/186 [00:23<04:19,  1.52s/it]
  9%|          | 16/186 [00:24<04:25,  1.56s/it]
  9%|          | 17/186 [00:26<04:25,  1.57s/it]
 10%|          | 18/186 [00:28<04:22,  1.56s/it]
 10%|          | 19/186 [00:29<04:16,  1.54s/it]
 11%|          | 20/186 [00:31<04:16,  1.55s/it]
 11%|          | 21/186 [00:32<04:13,  1.54s/it]
 12%|          | 22/186 [00:34<04:11,  1.53s/it]
 12%|          | 23/186 [00:35<04:09,  1.53s/it]
 13%|          | 24/186 [00:37<04:18,  1.60s/it]
 13%|          | 25/186 [00:38<04:12,  1.57s/it]
 14%|          | 26/186 [00:40<04:10,  1.57s/it]
 15%|          | 27/186 [00:42<04:07,  1.56s/it]
 15%|          | 28/186 [00:43<04:05,  1.55s/it]
 16%|          | 29/186 [00:45<04:01,  1.54s/it]
 16%|          | 30/186 [00:46<04:03,  1.56s/it]
 17%|          | 31/186 [00:48<04:11,  1.62s/it]
 17%|          | 32/186 [00:50<04:04,  1.59s/it]
 18%|          | 33/186 [00:51<04:04,  1.60s/it]
 18%|          | 34/186 [00:53<04:00,  1.58s/it]
 19%|          | 35/186 [00:54<03:56,  1.56s/it]
 19%|          | 36/186 [00:56<03:55,  1.57s/it]
 20%|          | 37/186 [00:57<03:53,  1.57s/it]
 20%|          | 38/186 [00:59<03:59,  1.62s/it]
 21%|          | 39/186 [01:01<03:53,  1.59s/it]
 22%|          | 40/186 [01:02<03:50,  1.58s/it]
 22%|          | 41/186 [01:04<03:44,  1.55s/it]
 23%|          | 42/186 [01:05<03:44,  1.56s/it]
 23%|          | 43/186 [01:07<03:41,  1.55s/it]
 24%|          | 44/186 [01:08<03:39,  1.54s/it]
 24%|          | 45/186 [01:10<03:37,  1.54s/it]
 25%|          | 46/186 [01:11<03:39,  1.57s/it]
```

```
25%|        | 47/186 [01:13<03:36,  1.56s/it]
26%|        | 48/186 [01:15<03:36,  1.57s/it]
26%|        | 49/186 [01:16<03:32,  1.55s/it]
27%|        | 50/186 [01:18<03:28,  1.54s/it]
27%|        | 51/186 [01:19<03:29,  1.55s/it]
28%|        | 52/186 [01:21<03:30,  1.57s/it]
28%|        | 53/186 [01:22<03:34,  1.61s/it]
29%|        | 54/186 [01:24<03:29,  1.59s/it]
30%|        | 55/186 [01:26<03:26,  1.58s/it]
30%|        | 56/186 [01:27<03:24,  1.57s/it]
31%|        | 57/186 [01:29<03:19,  1.54s/it]
31%|        | 58/186 [01:30<03:17,  1.55s/it]
32%|        | 59/186 [01:32<03:14,  1.53s/it]
32%|        | 60/186 [01:33<03:17,  1.56s/it]
33%|        | 61/186 [01:35<03:17,  1.58s/it]
33%|        | 62/186 [01:36<03:15,  1.58s/it]
34%|        | 63/186 [01:38<03:12,  1.57s/it]
34%|        | 64/186 [01:40<03:09,  1.56s/it]
35%|        | 65/186 [01:41<03:08,  1.56s/it]
35%|        | 66/186 [01:43<03:06,  1.56s/it]
36%|        | 67/186 [01:44<03:04,  1.55s/it]
37%|        | 68/186 [01:46<03:07,  1.59s/it]
37%|        | 69/186 [01:47<03:04,  1.58s/it]
38%|        | 70/186 [01:49<03:01,  1.57s/it]
38%|        | 71/186 [01:50<02:57,  1.54s/it]
39%|        | 72/186 [01:52<02:55,  1.54s/it]
39%|        | 73/186 [01:53<02:52,  1.53s/it]
40%|        | 74/186 [01:55<02:52,  1.54s/it]
40%|        | 75/186 [01:57<02:55,  1.58s/it]
41%|        | 76/186 [01:58<02:53,  1.57s/it]
41%|        | 77/186 [02:00<02:49,  1.56s/it]
42%|        | 78/186 [02:01<02:46,  1.54s/it]
42%|        | 79/186 [02:03<02:44,  1.54s/it]
43%|        | 80/186 [02:04<02:43,  1.54s/it]
44%|        | 81/186 [02:06<02:41,  1.54s/it]
44%|        | 82/186 [02:07<02:39,  1.53s/it]
45%|        | 83/186 [02:09<02:42,  1.57s/it]
45%|        | 84/186 [02:11<02:38,  1.55s/it]
46%|        | 85/186 [02:12<02:36,  1.55s/it]
46%|        | 86/186 [02:14<02:34,  1.55s/it]
47%|        | 87/186 [02:15<02:34,  1.56s/it]
47%|        | 88/186 [02:17<02:32,  1.55s/it]
48%|        | 89/186 [02:18<02:29,  1.54s/it]
48%|        | 90/186 [02:20<02:34,  1.60s/it]
49%|        | 91/186 [02:22<02:31,  1.59s/it]
49%|        | 92/186 [02:23<02:28,  1.58s/it]
50%|        | 93/186 [02:25<02:26,  1.57s/it]
51%|        | 94/186 [02:26<02:23,  1.56s/it]
```

```
51%|        | 95/186 [02:28<02:20,  1.54s/it]
52%|        | 96/186 [02:29<02:17,  1.53s/it]
52%|        | 97/186 [02:31<02:19,  1.57s/it]
53%|        | 98/186 [02:33<02:17,  1.56s/it]
53%|        | 99/186 [02:34<02:15,  1.55s/it]
54%|        | 100/186 [02:36<02:13,  1.55s/it]
54%|        | 101/186 [02:37<02:11,  1.55s/it]
55%|        | 102/186 [02:39<02:11,  1.56s/it]
55%|        | 103/186 [02:40<02:08,  1.54s/it]
56%|        | 104/186 [02:42<02:05,  1.53s/it]
56%|        | 105/186 [02:44<02:09,  1.60s/it]
57%|        | 106/186 [02:45<02:05,  1.57s/it]
58%|        | 107/186 [02:47<02:03,  1.57s/it]
58%|        | 108/186 [02:48<02:00,  1.55s/it]
59%|        | 109/186 [02:50<02:00,  1.56s/it]
59%|        | 110/186 [02:51<01:57,  1.54s/it]
60%|        | 111/186 [02:53<01:54,  1.53s/it]
60%|        | 112/186 [02:54<01:57,  1.59s/it]
61%|        | 113/186 [02:56<01:55,  1.58s/it]
61%|       | 114/186 [02:57<01:51,  1.55s/it]
62%|       | 115/186 [02:59<01:49,  1.54s/it]
62%|       | 116/186 [03:00<01:48,  1.54s/it]
63%|       | 117/186 [03:02<01:46,  1.54s/it]
63%|       | 118/186 [03:03<01:43,  1.52s/it]
64%|       | 119/186 [03:05<01:46,  1.58s/it]
65%|       | 120/186 [03:07<01:44,  1.59s/it]
65%|       | 121/186 [03:08<01:41,  1.56s/it]
66%|       | 122/186 [03:10<01:39,  1.55s/it]
66%|       | 123/186 [03:11<01:38,  1.56s/it]
67%|       | 124/186 [03:13<01:36,  1.55s/it]
67%|       | 125/186 [03:14<01:34,  1.54s/it]
68%|       | 126/186 [03:16<01:33,  1.55s/it]
68%|       | 127/186 [03:18<01:34,  1.60s/it]
69%|       | 128/186 [03:19<01:31,  1.58s/it]
69%|       | 129/186 [03:21<01:30,  1.59s/it]
70%|       | 130/186 [03:23<01:28,  1.59s/it]
70%|       | 131/186 [03:24<01:27,  1.60s/it]
71%|       | 132/186 [03:26<01:25,  1.59s/it]
72%|      | 133/186 [03:27<01:23,  1.57s/it]
72%|      | 134/186 [03:29<01:25,  1.63s/it]
73%|      | 135/186 [03:31<01:22,  1.61s/it]
73%|      | 136/186 [03:32<01:19,  1.58s/it]
74%|      | 137/186 [03:34<01:18,  1.59s/it]
74%|      | 138/186 [03:35<01:14,  1.56s/it]
75%|      | 139/186 [03:37<01:12,  1.55s/it]
75%|      | 140/186 [03:38<01:11,  1.55s/it]
76%|      | 141/186 [03:40<01:11,  1.58s/it]
76%|      | 142/186 [03:41<01:09,  1.57s/it]
```

```
 77%|       | 143/186 [03:43<01:07,  1.56s/it]
 77%|       | 144/186 [03:45<01:05,  1.55s/it]
 78%|       | 145/186 [03:46<01:03,  1.55s/it]
 78%|       | 146/186 [03:48<01:01,  1.54s/it]
 79%|       | 147/186 [03:49<01:00,  1.55s/it]
 80%|       | 148/186 [03:51<00:59,  1.55s/it]
 80%|       | 149/186 [03:52<00:59,  1.60s/it]
 81%|       | 150/186 [03:54<00:57,  1.58s/it]
 81%|       | 151/186 [03:56<00:55,  1.57s/it]
 82%|      | 152/186 [03:57<00:53,  1.56s/it]
 82%|      | 153/186 [03:59<00:51,  1.56s/it]
 83%|      | 154/186 [04:00<00:49,  1.55s/it]
 83%|      | 155/186 [04:02<00:47,  1.54s/it]
 84%|      | 156/186 [04:03<00:48,  1.62s/it]
 84%|      | 157/186 [04:05<00:46,  1.61s/it]
 85%|      | 158/186 [04:07<00:44,  1.57s/it]
 85%|      | 159/186 [04:08<00:42,  1.57s/it]
 86%|      | 160/186 [04:10<00:40,  1.56s/it]
 87%|      | 161/186 [04:11<00:38,  1.54s/it]
 87%|      | 162/186 [04:13<00:37,  1.55s/it]
 88%|      | 163/186 [04:14<00:35,  1.56s/it]
 88%|      | 164/186 [04:16<00:34,  1.56s/it]
 89%|      | 165/186 [04:17<00:32,  1.57s/it]
 89%|      | 166/186 [04:19<00:31,  1.57s/it]
 90%|      | 167/186 [04:21<00:29,  1.56s/it]
 90%|      | 168/186 [04:22<00:27,  1.54s/it]
 91%|      | 169/186 [04:24<00:26,  1.54s/it]
 91%|     | 170/186 [04:25<00:24,  1.55s/it]
 92%|     | 171/186 [04:27<00:24,  1.60s/it]
 92%|     | 172/186 [04:28<00:22,  1.59s/it]
 93%|     | 173/186 [04:30<00:20,  1.57s/it]
 94%|     | 174/186 [04:32<00:18,  1.57s/it]
 94%|     | 175/186 [04:33<00:17,  1.55s/it]
 95%|     | 176/186 [04:35<00:15,  1.53s/it]
 95%|     | 177/186 [04:36<00:13,  1.53s/it]
 96%|     | 178/186 [04:38<00:12,  1.59s/it]
 96%|     | 179/186 [04:39<00:10,  1.56s/it]
 97%|     | 180/186 [04:41<00:09,  1.55s/it]
 97%|     | 181/186 [04:42<00:07,  1.56s/it]
 98%|     | 182/186 [04:44<00:06,  1.55s/it]
 98%|     | 183/186 [04:45<00:04,  1.56s/it]
 99%|     | 184/186 [04:47<00:03,  1.55s/it]
 99%|     | 185/186 [04:49<00:01,  1.54s/it]
100%|     | 186/186 [04:50<00:00,  1.53s/it]
 60%|       | 6/10 [28:59<19:20, 290.08s/it]

Epoch 6/10:
Train Loss: 0.4762, Train Accuracy: 5512685.78%
```

```
  0%|          | 0/186 [00:00<?, ?it/s]
  1%|          | 1/186 [00:01<04:43,  1.53s/it]
  1%|          | 2/186 [00:03<04:38,  1.51s/it]
  2%|          | 3/186 [00:04<04:36,  1.51s/it]
  2%|          | 4/186 [00:06<04:35,  1.52s/it]
  3%|          | 5/186 [00:07<04:31,  1.50s/it]
  3%|          | 6/186 [00:09<04:30,  1.50s/it]
  4%|          | 7/186 [00:10<04:41,  1.57s/it]
  4%|          | 8/186 [00:12<04:36,  1.56s/it]
  5%|          | 9/186 [00:13<04:33,  1.55s/it]
  5%|          | 10/186 [00:15<04:33,  1.56s/it]
  6%|          | 11/186 [00:16<04:31,  1.55s/it]
  6%|          | 12/186 [00:18<04:29,  1.55s/it]
  7%|          | 13/186 [00:20<04:28,  1.55s/it]
  8%|          | 14/186 [00:21<04:26,  1.55s/it]
  8%|          | 15/186 [00:23<04:28,  1.57s/it]
  9%|          | 16/186 [00:24<04:24,  1.55s/it]
  9%|          | 17/186 [00:26<04:20,  1.54s/it]
 10%|          | 18/186 [00:27<04:19,  1.55s/it]
 10%|          | 19/186 [00:29<04:19,  1.55s/it]
 11%|          | 20/186 [00:30<04:17,  1.55s/it]
 11%|          | 21/186 [00:32<04:13,  1.54s/it]
 12%|          | 22/186 [00:34<04:22,  1.60s/it]
 12%|          | 23/186 [00:35<04:17,  1.58s/it]
 13%|          | 24/186 [00:37<04:12,  1.56s/it]
 13%|          | 25/186 [00:38<04:09,  1.55s/it]
 14%|          | 26/186 [00:40<04:04,  1.53s/it]
 15%|          | 27/186 [00:41<04:03,  1.53s/it]
 15%|          | 28/186 [00:43<04:00,  1.52s/it]
 16%|          | 29/186 [00:44<04:08,  1.58s/it]
 16%|          | 30/186 [00:46<04:04,  1.57s/it]
 17%|          | 31/186 [00:48<04:01,  1.56s/it]
 17%|          | 32/186 [00:49<03:58,  1.55s/it]
 18%|          | 33/186 [00:51<03:57,  1.56s/it]
 18%|          | 34/186 [00:52<03:56,  1.56s/it]
 19%|          | 35/186 [00:54<03:52,  1.54s/it]
 19%|          | 36/186 [00:55<03:49,  1.53s/it]
 20%|          | 37/186 [00:57<03:53,  1.57s/it]
 20%|          | 38/186 [00:58<03:53,  1.58s/it]
 21%|          | 39/186 [01:00<03:48,  1.55s/it]
 22%|          | 40/186 [01:02<03:47,  1.56s/it]
 22%|          | 41/186 [01:03<03:47,  1.57s/it]
 23%|          | 42/186 [01:05<03:44,  1.56s/it]
 23%|          | 43/186 [01:06<03:41,  1.55s/it]
 24%|          | 44/186 [01:08<03:47,  1.60s/it]
 24%|          | 45/186 [01:09<03:42,  1.58s/it]
 25%|          | 46/186 [01:11<03:40,  1.57s/it]
```

```
25%|         | 47/186 [01:13<03:37,  1.56s/it]
26%|         | 48/186 [01:14<03:31,  1.53s/it]
26%|         | 49/186 [01:16<03:29,  1.53s/it]
27%|         | 50/186 [01:17<03:27,  1.53s/it]
27%|         | 51/186 [01:19<03:29,  1.55s/it]
28%|         | 52/186 [01:20<03:28,  1.56s/it]
28%|         | 53/186 [01:22<03:26,  1.55s/it]
29%|         | 54/186 [01:23<03:24,  1.55s/it]
30%|         | 55/186 [01:25<03:21,  1.54s/it]
30%|         | 56/186 [01:26<03:20,  1.54s/it]
31%|         | 57/186 [01:28<03:19,  1.55s/it]
31%|         | 58/186 [01:29<03:18,  1.55s/it]
32%|        | 59/186 [01:31<03:22,  1.59s/it]
32%|        | 60/186 [01:33<03:19,  1.58s/it]
33%|        | 61/186 [01:34<03:15,  1.57s/it]
33%|        | 62/186 [01:36<03:12,  1.55s/it]
34%|        | 63/186 [01:37<03:09,  1.54s/it]
34%|        | 64/186 [01:39<03:07,  1.54s/it]
35%|        | 65/186 [01:40<03:08,  1.56s/it]
35%|        | 66/186 [01:42<03:10,  1.59s/it]
36%|        | 67/186 [01:44<03:06,  1.57s/it]
37%|        | 68/186 [01:45<03:04,  1.56s/it]
37%|        | 69/186 [01:47<03:00,  1.54s/it]
38%|        | 70/186 [01:48<02:58,  1.54s/it]
38%|        | 71/186 [01:50<02:57,  1.55s/it]
39%|        | 72/186 [01:51<02:56,  1.55s/it]
39%|        | 73/186 [01:53<02:54,  1.55s/it]
40%|        | 74/186 [01:54<02:52,  1.54s/it]
40%|        | 75/186 [01:56<02:50,  1.54s/it]
41%|        | 76/186 [01:57<02:48,  1.54s/it]
41%|       | 77/186 [01:59<02:48,  1.55s/it]
42%|       | 78/186 [02:01<02:46,  1.54s/it]
42%|       | 79/186 [02:02<02:45,  1.55s/it]
43%|       | 80/186 [02:04<02:42,  1.54s/it]
44%|       | 81/186 [02:05<02:47,  1.60s/it]
44%|       | 82/186 [02:07<02:46,  1.60s/it]
45%|       | 83/186 [02:08<02:41,  1.57s/it]
45%|       | 84/186 [02:10<02:35,  1.52s/it]
46%|       | 85/186 [02:11<02:34,  1.53s/it]
46%|       | 86/186 [02:13<02:33,  1.53s/it]
47%|       | 87/186 [02:14<02:30,  1.52s/it]
47%|       | 88/186 [02:16<02:30,  1.54s/it]
48%|       | 89/186 [02:18<02:30,  1.55s/it]
48%|       | 90/186 [02:19<02:28,  1.55s/it]
49%|       | 91/186 [02:21<02:25,  1.54s/it]
49%|       | 92/186 [02:22<02:24,  1.54s/it]
50%|       | 93/186 [02:24<02:23,  1.54s/it]
51%|       | 94/186 [02:25<02:21,  1.54s/it]
```

```
51%|        | 95/186 [02:27<02:20,  1.54s/it]
52%|        | 96/186 [02:28<02:21,  1.57s/it]
52%|        | 97/186 [02:30<02:18,  1.56s/it]
53%|        | 98/186 [02:32<02:17,  1.57s/it]
53%|        | 99/186 [02:33<02:18,  1.59s/it]
54%|        | 100/186 [02:35<02:16,  1.58s/it]
54%|        | 101/186 [02:36<02:13,  1.57s/it]
55%|        | 102/186 [02:38<02:09,  1.55s/it]
55%|        | 103/186 [02:39<02:11,  1.59s/it]
56%|        | 104/186 [02:41<02:08,  1.57s/it]
56%|        | 105/186 [02:43<02:05,  1.55s/it]
57%|        | 106/186 [02:44<02:03,  1.55s/it]
58%|        | 107/186 [02:46<02:02,  1.55s/it]
58%|        | 108/186 [02:47<02:01,  1.55s/it]
59%|        | 109/186 [02:49<01:58,  1.54s/it]
59%|        | 110/186 [02:50<01:57,  1.55s/it]
60%|        | 111/186 [02:52<01:57,  1.56s/it]
60%|        | 112/186 [02:53<01:54,  1.55s/it]
61%|        | 113/186 [02:55<01:53,  1.56s/it]
61%|       | 114/186 [02:57<01:52,  1.56s/it]
62%|       | 115/186 [02:58<01:50,  1.55s/it]
62%|       | 116/186 [03:00<01:49,  1.56s/it]
63%|       | 117/186 [03:01<01:48,  1.57s/it]
63%|       | 118/186 [03:03<01:50,  1.63s/it]
64%|       | 119/186 [03:04<01:46,  1.60s/it]
65%|       | 120/186 [03:06<01:45,  1.60s/it]
65%|       | 121/186 [03:08<01:42,  1.57s/it]
66%|       | 122/186 [03:09<01:38,  1.54s/it]
66%|       | 123/186 [03:11<01:36,  1.53s/it]
67%|       | 124/186 [03:12<01:35,  1.53s/it]
67%|       | 125/186 [03:14<01:35,  1.56s/it]
68%|       | 126/186 [03:15<01:33,  1.56s/it]
68%|       | 127/186 [03:17<01:31,  1.56s/it]
69%|       | 128/186 [03:18<01:29,  1.55s/it]
69%|       | 129/186 [03:20<01:28,  1.55s/it]
70%|       | 130/186 [03:21<01:25,  1.53s/it]
70%|       | 131/186 [03:23<01:24,  1.53s/it]
71%|       | 132/186 [03:24<01:22,  1.52s/it]
72%|      | 133/186 [03:26<01:23,  1.57s/it]
72%|      | 134/186 [03:28<01:20,  1.55s/it]
73%|      | 135/186 [03:29<01:19,  1.56s/it]
73%|      | 136/186 [03:31<01:17,  1.54s/it]
74%|      | 137/186 [03:32<01:15,  1.53s/it]
74%|      | 138/186 [03:34<01:13,  1.52s/it]
75%|      | 139/186 [03:35<01:12,  1.54s/it]
75%|      | 140/186 [03:37<01:14,  1.63s/it]
76%|      | 141/186 [03:39<01:12,  1.61s/it]
76%|      | 142/186 [03:40<01:09,  1.58s/it]
```

```
 77%|       | 143/186 [03:42<01:07,  1.57s/it]
 77%|       | 144/186 [03:43<01:05,  1.56s/it]
 78%|       | 145/186 [03:45<01:02,  1.54s/it]
 78%|       | 146/186 [03:46<01:01,  1.54s/it]
 79%|       | 147/186 [03:48<00:59,  1.52s/it]
 80%|       | 148/186 [03:49<00:59,  1.56s/it]
 80%|       | 149/186 [03:51<00:57,  1.56s/it]
 81%|       | 150/186 [03:52<00:55,  1.53s/it]
 81%|       | 151/186 [03:54<00:54,  1.55s/it]
 82%|      | 152/186 [03:56<00:52,  1.54s/it]
 82%|      | 153/186 [03:57<00:50,  1.54s/it]
 83%|      | 154/186 [03:59<00:49,  1.54s/it]
 83%|      | 155/186 [04:00<00:49,  1.60s/it]
 84%|      | 156/186 [04:02<00:47,  1.58s/it]
 84%|      | 157/186 [04:03<00:45,  1.56s/it]
 85%|      | 158/186 [04:05<00:43,  1.55s/it]
 85%|      | 159/186 [04:07<00:42,  1.57s/it]
 86%|      | 160/186 [04:08<00:40,  1.54s/it]
 87%|      | 161/186 [04:10<00:38,  1.54s/it]
 87%|      | 162/186 [04:11<00:38,  1.58s/it]
 88%|      | 163/186 [04:13<00:36,  1.59s/it]
 88%|      | 164/186 [04:14<00:34,  1.57s/it]
 89%|      | 165/186 [04:16<00:32,  1.56s/it]
 89%|      | 166/186 [04:17<00:30,  1.55s/it]
 90%|      | 167/186 [04:19<00:29,  1.54s/it]
 90%|      | 168/186 [04:21<00:27,  1.54s/it]
 91%|      | 169/186 [04:22<00:26,  1.54s/it]
 91%|     | 170/186 [04:24<00:25,  1.56s/it]
 92%|     | 171/186 [04:25<00:23,  1.54s/it]
 92%|     | 172/186 [04:27<00:21,  1.54s/it]
 93%|     | 173/186 [04:28<00:19,  1.53s/it]
 94%|     | 174/186 [04:30<00:18,  1.54s/it]
 94%|     | 175/186 [04:31<00:16,  1.54s/it]
 95%|     | 176/186 [04:33<00:15,  1.54s/it]
 95%|     | 177/186 [04:35<00:14,  1.58s/it]
 96%|     | 178/186 [04:36<00:12,  1.57s/it]
 96%|     | 179/186 [04:38<00:10,  1.55s/it]
 97%|     | 180/186 [04:39<00:09,  1.54s/it]
 97%|     | 181/186 [04:41<00:07,  1.56s/it]
 98%|     | 182/186 [04:42<00:06,  1.56s/it]
 98%|     | 183/186 [04:44<00:04,  1.56s/it]
 99%|     | 184/186 [04:45<00:03,  1.54s/it]
 99%|     | 185/186 [04:47<00:01,  1.55s/it]
100%|     | 186/186 [04:48<00:00,  1.52s/it]
 70%|      | 7/10 [33:48<14:29, 289.69s/it]

Epoch 7/10:
Train Loss: 0.4530, Train Accuracy: 5556494.89%
```

```
  0%|          | 0/186 [00:00<?, ?it/s]
  1%|          | 1/186 [00:01<04:42,  1.53s/it]
  1%|          | 2/186 [00:02<04:35,  1.49s/it]
  2%|          | 3/186 [00:04<04:36,  1.51s/it]
  2%|          | 4/186 [00:06<04:34,  1.51s/it]
  3%|          | 5/186 [00:07<04:32,  1.51s/it]
  3%|          | 6/186 [00:09<04:46,  1.59s/it]
  4%|          | 7/186 [00:10<04:42,  1.58s/it]
  4%|          | 8/186 [00:12<04:35,  1.55s/it]
  5%|          | 9/186 [00:13<04:33,  1.54s/it]
  5%|          | 10/186 [00:15<04:26,  1.51s/it]
  6%|          | 11/186 [00:16<04:25,  1.52s/it]
  6%|          | 12/186 [00:18<04:24,  1.52s/it]
  7%|          | 13/186 [00:19<04:27,  1.55s/it]
  8%|          | 14/186 [00:21<04:26,  1.55s/it]
  8%|          | 15/186 [00:22<04:20,  1.52s/it]
  9%|          | 16/186 [00:24<04:21,  1.54s/it]
  9%|          | 17/186 [00:26<04:19,  1.53s/it]
 10%|          | 18/186 [00:27<04:19,  1.54s/it]
 10%|          | 19/186 [00:29<04:15,  1.53s/it]
 11%|          | 20/186 [00:30<04:15,  1.54s/it]
 11%|          | 21/186 [00:32<04:26,  1.61s/it]
 12%|          | 22/186 [00:34<04:20,  1.59s/it]
 12%|          | 23/186 [00:35<04:14,  1.56s/it]
 13%|          | 24/186 [00:37<04:13,  1.57s/it]
 13%|          | 25/186 [00:38<04:10,  1.56s/it]
 14%|          | 26/186 [00:40<04:07,  1.55s/it]
 15%|          | 27/186 [00:41<04:05,  1.54s/it]
 15%|          | 28/186 [00:43<04:16,  1.62s/it]
 16%|          | 29/186 [00:44<04:07,  1.58s/it]
 16%|          | 30/186 [00:46<04:03,  1.56s/it]
 17%|          | 31/186 [00:48<04:02,  1.56s/it]
 17%|          | 32/186 [00:49<03:59,  1.55s/it]
 18%|          | 33/186 [00:51<03:58,  1.56s/it]
 18%|          | 34/186 [00:52<03:56,  1.56s/it]
 19%|          | 35/186 [00:54<03:56,  1.56s/it]
 19%|          | 36/186 [00:55<03:59,  1.60s/it]
 20%|          | 37/186 [00:57<03:57,  1.59s/it]
 20%|          | 38/186 [00:59<03:53,  1.58s/it]
 21%|          | 39/186 [01:00<03:50,  1.57s/it]
 22%|          | 40/186 [01:02<03:52,  1.59s/it]
 22%|          | 41/186 [01:03<03:49,  1.58s/it]
 23%|          | 42/186 [01:05<03:46,  1.57s/it]
 23%|          | 43/186 [01:07<03:51,  1.62s/it]
 24%|          | 44/186 [01:08<03:46,  1.59s/it]
 24%|          | 45/186 [01:10<03:45,  1.60s/it]
 25%|          | 46/186 [01:11<03:43,  1.60s/it]
```

```
25%|         | 47/186 [01:13<03:38,  1.57s/it]
26%|         | 48/186 [01:14<03:37,  1.57s/it]
26%|         | 49/186 [01:16<03:35,  1.57s/it]
27%|         | 50/186 [01:18<03:43,  1.64s/it]
27%|         | 51/186 [01:19<03:38,  1.62s/it]
28%|         | 52/186 [01:21<03:34,  1.60s/it]
28%|         | 53/186 [01:22<03:28,  1.57s/it]
29%|         | 54/186 [01:24<03:24,  1.55s/it]
30%|         | 55/186 [01:26<03:22,  1.55s/it]
30%|         | 56/186 [01:27<03:21,  1.55s/it]
31%|         | 57/186 [01:29<03:22,  1.57s/it]
31%|         | 58/186 [01:30<03:17,  1.54s/it]
32%|        | 59/186 [01:32<03:14,  1.53s/it]
32%|        | 60/186 [01:33<03:14,  1.54s/it]
33%|        | 61/186 [01:35<03:14,  1.56s/it]
33%|        | 62/186 [01:36<03:14,  1.57s/it]
34%|        | 63/186 [01:38<03:14,  1.58s/it]
34%|        | 64/186 [01:40<03:12,  1.58s/it]
35%|        | 65/186 [01:41<03:16,  1.62s/it]
35%|        | 66/186 [01:43<03:13,  1.61s/it]
36%|        | 67/186 [01:44<03:10,  1.60s/it]
37%|        | 68/186 [01:46<03:05,  1.57s/it]
37%|        | 69/186 [01:48<03:02,  1.56s/it]
38%|        | 70/186 [01:49<03:00,  1.55s/it]
38%|        | 71/186 [01:51<02:58,  1.55s/it]
39%|        | 72/186 [01:52<03:06,  1.63s/it]
39%|        | 73/186 [01:54<03:00,  1.60s/it]
40%|        | 74/186 [01:55<02:55,  1.57s/it]
40%|        | 75/186 [01:57<02:50,  1.54s/it]
41%|        | 76/186 [01:58<02:49,  1.54s/it]
41%|       | 77/186 [02:00<02:47,  1.54s/it]
42%|       | 78/186 [02:02<02:53,  1.61s/it]
42%|       | 79/186 [02:03<02:54,  1.63s/it]
43%|       | 80/186 [02:05<02:51,  1.62s/it]
44%|       | 81/186 [02:07<02:47,  1.59s/it]
44%|       | 82/186 [02:08<02:44,  1.58s/it]
45%|       | 83/186 [02:10<02:42,  1.57s/it]
45%|       | 84/186 [02:11<02:39,  1.57s/it]
46%|       | 85/186 [02:13<02:37,  1.56s/it]
46%|       | 86/186 [02:14<02:36,  1.56s/it]
47%|       | 87/186 [02:16<02:38,  1.61s/it]
47%|       | 88/186 [02:18<02:34,  1.58s/it]
48%|       | 89/186 [02:19<02:32,  1.57s/it]
48%|       | 90/186 [02:21<02:29,  1.56s/it]
49%|       | 91/186 [02:22<02:28,  1.56s/it]
49%|       | 92/186 [02:24<02:26,  1.56s/it]
50%|       | 93/186 [02:25<02:24,  1.55s/it]
51%|       | 94/186 [02:27<02:28,  1.62s/it]
```

```
51%|        | 95/186 [02:29<02:25,  1.60s/it]
52%|        | 96/186 [02:30<02:20,  1.56s/it]
52%|        | 97/186 [02:32<02:18,  1.56s/it]
53%|        | 98/186 [02:33<02:17,  1.56s/it]
53%|        | 99/186 [02:35<02:14,  1.55s/it]
54%|        | 100/186 [02:36<02:12,  1.54s/it]
54%|        | 101/186 [02:38<02:09,  1.53s/it]
55%|        | 102/186 [02:39<02:11,  1.57s/it]
55%|        | 103/186 [02:41<02:09,  1.56s/it]
56%|        | 104/186 [02:42<02:06,  1.54s/it]
56%|        | 105/186 [02:44<02:04,  1.54s/it]
57%|        | 106/186 [02:46<02:02,  1.53s/it]
58%|        | 107/186 [02:47<02:01,  1.54s/it]
58%|        | 108/186 [02:49<02:01,  1.56s/it]
59%|        | 109/186 [02:50<02:05,  1.62s/it]
59%|        | 110/186 [02:52<02:01,  1.60s/it]
60%|        | 111/186 [02:54<01:57,  1.57s/it]
60%|        | 112/186 [02:55<01:56,  1.57s/it]
61%|        | 113/186 [02:57<01:53,  1.56s/it]
61%|       | 114/186 [02:58<01:52,  1.56s/it]
62%|       | 115/186 [03:00<01:50,  1.56s/it]
62%|       | 116/186 [03:01<01:52,  1.61s/it]
63%|       | 117/186 [03:03<01:49,  1.59s/it]
63%|       | 118/186 [03:05<01:47,  1.58s/it]
64%|       | 119/186 [03:06<01:43,  1.55s/it]
65%|       | 120/186 [03:08<01:42,  1.56s/it]
65%|       | 121/186 [03:09<01:40,  1.55s/it]
66%|       | 122/186 [03:11<01:38,  1.54s/it]
66%|       | 123/186 [03:12<01:37,  1.55s/it]
67%|       | 124/186 [03:14<01:38,  1.58s/it]
67%|       | 125/186 [03:15<01:36,  1.58s/it]
68%|       | 126/186 [03:17<01:33,  1.55s/it]
68%|       | 127/186 [03:19<01:31,  1.56s/it]
69%|       | 128/186 [03:20<01:29,  1.55s/it]
69%|       | 129/186 [03:22<01:28,  1.56s/it]
70%|       | 130/186 [03:23<01:26,  1.54s/it]
70%|       | 131/186 [03:25<01:27,  1.60s/it]
71%|       | 132/186 [03:26<01:25,  1.59s/it]
72%|      | 133/186 [03:28<01:23,  1.57s/it]
72%|      | 134/186 [03:30<01:21,  1.57s/it]
73%|      | 135/186 [03:31<01:20,  1.58s/it]
73%|      | 136/186 [03:33<01:19,  1.58s/it]
74%|      | 137/186 [03:34<01:16,  1.57s/it]
74%|      | 138/186 [03:36<01:17,  1.62s/it]
75%|      | 139/186 [03:38<01:15,  1.61s/it]
75%|      | 140/186 [03:39<01:12,  1.58s/it]
76%|      | 141/186 [03:41<01:10,  1.57s/it]
76%|      | 142/186 [03:42<01:09,  1.57s/it]
```

```
 77%|       | 143/186 [03:44<01:07,  1.57s/it]
 77%|       | 144/186 [03:45<01:05,  1.57s/it]
 78%|       | 145/186 [03:47<01:03,  1.56s/it]
 78%|       | 146/186 [03:49<01:03,  1.60s/it]
 79%|       | 147/186 [03:50<01:02,  1.59s/it]
 80%|       | 148/186 [03:52<01:00,  1.58s/it]
 80%|       | 149/186 [03:53<00:57,  1.57s/it]
 81%|       | 150/186 [03:55<00:55,  1.55s/it]
 81%|       | 151/186 [03:56<00:54,  1.55s/it]
 82%|      | 152/186 [03:58<00:52,  1.55s/it]
 82%|      | 153/186 [04:00<00:52,  1.59s/it]
 83%|      | 154/186 [04:01<00:50,  1.58s/it]
 83%|      | 155/186 [04:03<00:48,  1.57s/it]
 84%|      | 156/186 [04:04<00:47,  1.57s/it]
 84%|      | 157/186 [04:06<00:45,  1.57s/it]
 85%|      | 158/186 [04:07<00:43,  1.56s/it]
 85%|      | 159/186 [04:09<00:41,  1.55s/it]
 86%|      | 160/186 [04:11<00:41,  1.59s/it]
 87%|      | 161/186 [04:12<00:39,  1.58s/it]
 87%|      | 162/186 [04:14<00:37,  1.56s/it]
 88%|      | 163/186 [04:15<00:35,  1.55s/it]
 88%|      | 164/186 [04:17<00:34,  1.55s/it]
 89%|      | 165/186 [04:18<00:32,  1.53s/it]
 89%|      | 166/186 [04:20<00:30,  1.55s/it]
 90%|      | 167/186 [04:21<00:29,  1.55s/it]
 90%|      | 168/186 [04:23<00:28,  1.57s/it]
 91%|      | 169/186 [04:24<00:26,  1.56s/it]
 91%|     | 170/186 [04:26<00:24,  1.54s/it]
 92%|     | 171/186 [04:27<00:23,  1.55s/it]
 92%|     | 172/186 [04:29<00:21,  1.54s/it]
 93%|     | 173/186 [04:31<00:20,  1.56s/it]
 94%|     | 174/186 [04:32<00:18,  1.55s/it]
 94%|     | 175/186 [04:34<00:17,  1.59s/it]
 95%|     | 176/186 [04:35<00:15,  1.56s/it]
 95%|     | 177/186 [04:37<00:14,  1.56s/it]
 96%|     | 178/186 [04:38<00:12,  1.56s/it]
 96%|     | 179/186 [04:40<00:10,  1.56s/it]
 97%|     | 180/186 [04:42<00:09,  1.58s/it]
 97%|     | 181/186 [04:43<00:07,  1.58s/it]
 98%|     | 182/186 [04:45<00:06,  1.61s/it]
 98%|     | 183/186 [04:46<00:04,  1.60s/it]
 99%|     | 184/186 [04:48<00:03,  1.58s/it]
 99%|     | 185/186 [04:50<00:01,  1.57s/it]
100%|     | 186/186 [04:51<00:00,  1.54s/it]
 80%|      | 8/10 [38:39<09:40, 290.28s/it]

Epoch 8/10:
Train Loss: 0.4347, Train Accuracy: 5592890.55%
```

```
  0%|          | 0/186 [00:00<?, ?it/s]
  1%|          | 1/186 [00:01<04:44,  1.54s/it]
  1%|          | 2/186 [00:03<04:43,  1.54s/it]
  2%|          | 3/186 [00:04<04:39,  1.53s/it]
  2%|          | 4/186 [00:06<04:54,  1.62s/it]
  3%|          | 5/186 [00:07<04:47,  1.59s/it]
  3%|          | 6/186 [00:09<04:42,  1.57s/it]
  4%|          | 7/186 [00:10<04:39,  1.56s/it]
  4%|          | 8/186 [00:12<04:36,  1.56s/it]
  5%|          | 9/186 [00:14<04:38,  1.58s/it]
  5%|          | 10/186 [00:15<04:34,  1.56s/it]
  6%|          | 11/186 [00:17<04:42,  1.62s/it]
  6%|          | 12/186 [00:18<04:38,  1.60s/it]
  7%|          | 13/186 [00:20<04:34,  1.59s/it]
  8%|          | 14/186 [00:22<04:30,  1.57s/it]
  8%|          | 15/186 [00:23<04:26,  1.56s/it]
  9%|          | 16/186 [00:25<04:23,  1.55s/it]
  9%|          | 17/186 [00:26<04:19,  1.53s/it]
 10%|          | 18/186 [00:28<04:21,  1.56s/it]
 10%|          | 19/186 [00:29<04:24,  1.58s/it]
 11%|          | 20/186 [00:31<04:23,  1.59s/it]
 11%|          | 21/186 [00:33<04:20,  1.58s/it]
 12%|          | 22/186 [00:34<04:15,  1.56s/it]
 12%|          | 23/186 [00:36<04:14,  1.56s/it]
 13%|          | 24/186 [00:37<04:10,  1.54s/it]
 13%|          | 25/186 [00:39<04:07,  1.54s/it]
 14%|          | 26/186 [00:40<04:15,  1.60s/it]
 15%|          | 27/186 [00:42<04:08,  1.56s/it]
 15%|          | 28/186 [00:43<04:07,  1.57s/it]
 16%|          | 29/186 [00:45<04:06,  1.57s/it]
 16%|          | 30/186 [00:46<04:00,  1.54s/it]
 17%|          | 31/186 [00:48<03:57,  1.53s/it]
 17%|          | 32/186 [00:50<03:57,  1.55s/it]
 18%|          | 33/186 [00:51<04:03,  1.59s/it]
 18%|          | 34/186 [00:53<03:58,  1.57s/it]
 19%|          | 35/186 [00:54<03:54,  1.55s/it]
 19%|          | 36/186 [00:56<03:52,  1.55s/it]
 20%|          | 37/186 [00:57<03:51,  1.55s/it]
 20%|          | 38/186 [00:59<03:48,  1.55s/it]
 21%|          | 39/186 [01:00<03:46,  1.54s/it]
 22%|          | 40/186 [01:02<03:46,  1.55s/it]
 22%|          | 41/186 [01:04<03:49,  1.58s/it]
 23%|          | 42/186 [01:05<03:46,  1.57s/it]
 23%|          | 43/186 [01:07<03:44,  1.57s/it]
 24%|          | 44/186 [01:08<03:42,  1.57s/it]
 24%|          | 45/186 [01:10<03:42,  1.58s/it]
 25%|          | 46/186 [01:12<03:40,  1.57s/it]
```

```
25%|         | 47/186 [01:13<03:35,  1.55s/it]
26%|         | 48/186 [01:15<03:41,  1.61s/it]
26%|         | 49/186 [01:16<03:36,  1.58s/it]
27%|         | 50/186 [01:18<03:33,  1.57s/it]
27%|         | 51/186 [01:19<03:28,  1.55s/it]
28%|         | 52/186 [01:21<03:26,  1.54s/it]
28%|         | 53/186 [01:22<03:23,  1.53s/it]
29%|         | 54/186 [01:24<03:22,  1.54s/it]
30%|         | 55/186 [01:26<03:30,  1.61s/it]
30%|         | 56/186 [01:27<03:28,  1.60s/it]
31%|         | 57/186 [01:29<03:32,  1.65s/it]
31%|         | 58/186 [01:31<03:26,  1.62s/it]
32%|        | 59/186 [01:32<03:22,  1.60s/it]
32%|        | 60/186 [01:34<03:20,  1.59s/it]
33%|        | 61/186 [01:35<03:15,  1.57s/it]
33%|        | 62/186 [01:37<03:15,  1.58s/it]
34%|        | 63/186 [01:38<03:15,  1.59s/it]
34%|        | 64/186 [01:40<03:14,  1.60s/it]
35%|        | 65/186 [01:42<03:11,  1.59s/it]
35%|        | 66/186 [01:43<03:09,  1.58s/it]
36%|        | 67/186 [01:45<03:05,  1.56s/it]
37%|        | 68/186 [01:46<03:04,  1.56s/it]
37%|        | 69/186 [01:48<03:02,  1.56s/it]
38%|        | 70/186 [01:50<03:06,  1.61s/it]
38%|        | 71/186 [01:51<03:04,  1.60s/it]
39%|        | 72/186 [01:53<03:00,  1.58s/it]
39%|        | 73/186 [01:54<02:55,  1.56s/it]
40%|        | 74/186 [01:56<02:53,  1.55s/it]
40%|        | 75/186 [01:57<02:51,  1.54s/it]
41%|        | 76/186 [01:59<02:49,  1.54s/it]
41%|       | 77/186 [02:00<02:54,  1.60s/it]
42%|       | 78/186 [02:02<02:51,  1.59s/it]
42%|       | 79/186 [02:04<02:49,  1.59s/it]
43%|       | 80/186 [02:05<02:47,  1.58s/it]
44%|       | 81/186 [02:07<02:44,  1.56s/it]
44%|       | 82/186 [02:08<02:40,  1.55s/it]
45%|       | 83/186 [02:10<02:37,  1.53s/it]
45%|       | 84/186 [02:11<02:37,  1.54s/it]
46%|       | 85/186 [02:13<02:39,  1.57s/it]
46%|       | 86/186 [02:14<02:36,  1.57s/it]
47%|       | 87/186 [02:16<02:33,  1.56s/it]
47%|       | 88/186 [02:18<02:31,  1.55s/it]
48%|       | 89/186 [02:19<02:29,  1.54s/it]
48%|       | 90/186 [02:21<02:27,  1.54s/it]
49%|       | 91/186 [02:22<02:27,  1.56s/it]
49%|       | 92/186 [02:24<02:31,  1.61s/it]
50%|       | 93/186 [02:25<02:27,  1.59s/it]
51%|       | 94/186 [02:27<02:24,  1.57s/it]
```

```
51%|        | 95/186 [02:29<02:22,  1.56s/it]
52%|        | 96/186 [02:30<02:19,  1.55s/it]
52%|        | 97/186 [02:32<02:18,  1.55s/it]
53%|        | 98/186 [02:33<02:16,  1.55s/it]
53%|        | 99/186 [02:35<02:19,  1.60s/it]
54%|        | 100/186 [02:36<02:15,  1.58s/it]
54%|        | 101/186 [02:38<02:13,  1.57s/it]
55%|        | 102/186 [02:39<02:10,  1.55s/it]
55%|        | 103/186 [02:41<02:08,  1.55s/it]
56%|        | 104/186 [02:43<02:07,  1.55s/it]
56%|        | 105/186 [02:44<02:06,  1.57s/it]
57%|        | 106/186 [02:46<02:04,  1.56s/it]
58%|        | 107/186 [02:47<02:04,  1.58s/it]
58%|        | 108/186 [02:49<02:01,  1.56s/it]
59%|        | 109/186 [02:50<02:00,  1.56s/it]
59%|        | 110/186 [02:52<01:57,  1.54s/it]
60%|        | 111/186 [02:53<01:56,  1.55s/it]
60%|        | 112/186 [02:55<01:54,  1.55s/it]
61%|        | 113/186 [02:57<01:52,  1.54s/it]
61%|       | 114/186 [02:58<01:55,  1.61s/it]
62%|       | 115/186 [03:00<01:52,  1.58s/it]
62%|       | 116/186 [03:01<01:49,  1.57s/it]
63%|       | 117/186 [03:03<01:48,  1.57s/it]
63%|       | 118/186 [03:04<01:46,  1.56s/it]
64%|       | 119/186 [03:06<01:44,  1.55s/it]
65%|       | 120/186 [03:08<01:41,  1.54s/it]
65%|       | 121/186 [03:09<01:40,  1.55s/it]
66%|       | 122/186 [03:11<01:38,  1.55s/it]
66%|       | 123/186 [03:12<01:36,  1.53s/it]
67%|       | 124/186 [03:14<01:35,  1.54s/it]
67%|       | 125/186 [03:15<01:34,  1.55s/it]
68%|       | 126/186 [03:17<01:33,  1.55s/it]
68%|       | 127/186 [03:18<01:31,  1.55s/it]
69%|       | 128/186 [03:20<01:29,  1.54s/it]
69%|       | 129/186 [03:22<01:30,  1.58s/it]
70%|       | 130/186 [03:23<01:27,  1.57s/it]
70%|       | 131/186 [03:25<01:26,  1.56s/it]
71%|       | 132/186 [03:26<01:23,  1.54s/it]
72%|      | 133/186 [03:28<01:21,  1.55s/it]
72%|      | 134/186 [03:29<01:20,  1.55s/it]
73%|      | 135/186 [03:31<01:18,  1.54s/it]
73%|      | 136/186 [03:32<01:19,  1.59s/it]
74%|      | 137/186 [03:34<01:17,  1.58s/it]
74%|      | 138/186 [03:36<01:15,  1.57s/it]
75%|      | 139/186 [03:37<01:13,  1.57s/it]
75%|      | 140/186 [03:39<01:12,  1.57s/it]
76%|      | 141/186 [03:40<01:09,  1.55s/it]
76%|      | 142/186 [03:42<01:07,  1.53s/it]
```

```
 77%|       | 143/186 [03:43<01:05,  1.53s/it]
 77%|       | 144/186 [03:45<01:05,  1.56s/it]
 78%|       | 145/186 [03:46<01:03,  1.55s/it]
 78%|       | 146/186 [03:48<01:01,  1.55s/it]
 79%|       | 147/186 [03:49<00:59,  1.53s/it]
 80%|       | 148/186 [03:51<00:58,  1.54s/it]
 80%|       | 149/186 [03:53<00:56,  1.54s/it]
 81%|       | 150/186 [03:54<00:55,  1.54s/it]
 81%|       | 151/186 [03:56<00:56,  1.61s/it]
 82%|      | 152/186 [03:57<00:54,  1.60s/it]
 82%|      | 153/186 [03:59<00:52,  1.59s/it]
 83%|      | 154/186 [04:00<00:49,  1.56s/it]
 83%|      | 155/186 [04:02<00:48,  1.56s/it]
 84%|      | 156/186 [04:04<00:46,  1.54s/it]
 84%|      | 157/186 [04:05<00:44,  1.54s/it]
 85%|      | 158/186 [04:07<00:43,  1.55s/it]
 85%|      | 159/186 [04:08<00:41,  1.54s/it]
 86%|      | 160/186 [04:10<00:40,  1.55s/it]
 87%|      | 161/186 [04:11<00:38,  1.54s/it]
 87%|      | 162/186 [04:13<00:37,  1.55s/it]
 88%|      | 163/186 [04:14<00:35,  1.55s/it]
 88%|      | 164/186 [04:16<00:34,  1.55s/it]
 89%|      | 165/186 [04:17<00:32,  1.55s/it]
 89%|      | 166/186 [04:19<00:32,  1.63s/it]
 90%|      | 167/186 [04:21<00:30,  1.61s/it]
 90%|      | 168/186 [04:22<00:28,  1.60s/it]
 91%|      | 169/186 [04:24<00:26,  1.57s/it]
 91%|     | 170/186 [04:26<00:25,  1.58s/it]
 92%|     | 171/186 [04:27<00:23,  1.56s/it]
 92%|     | 172/186 [04:29<00:21,  1.55s/it]
 93%|     | 173/186 [04:30<00:21,  1.64s/it]
 94%|     | 174/186 [04:32<00:19,  1.63s/it]
 94%|     | 175/186 [04:34<00:17,  1.61s/it]
 95%|     | 176/186 [04:35<00:16,  1.60s/it]
 95%|     | 177/186 [04:37<00:14,  1.59s/it]
 96%|     | 178/186 [04:38<00:12,  1.56s/it]
 96%|     | 179/186 [04:40<00:11,  1.58s/it]
 97%|     | 180/186 [04:42<00:09,  1.61s/it]
 97%|     | 181/186 [04:43<00:08,  1.60s/it]
 98%|     | 182/186 [04:45<00:06,  1.58s/it]
 98%|     | 183/186 [04:46<00:04,  1.57s/it]
 99%|     | 184/186 [04:48<00:03,  1.56s/it]
 99%|     | 185/186 [04:49<00:01,  1.57s/it]
100%|     | 186/186 [04:51<00:00,  1.52s/it]
 90%|      | 9/10 [43:31<04:50, 290.58s/it]

Epoch 9/10:
Train Loss: 0.4195, Train Accuracy: 5621344.03%
```

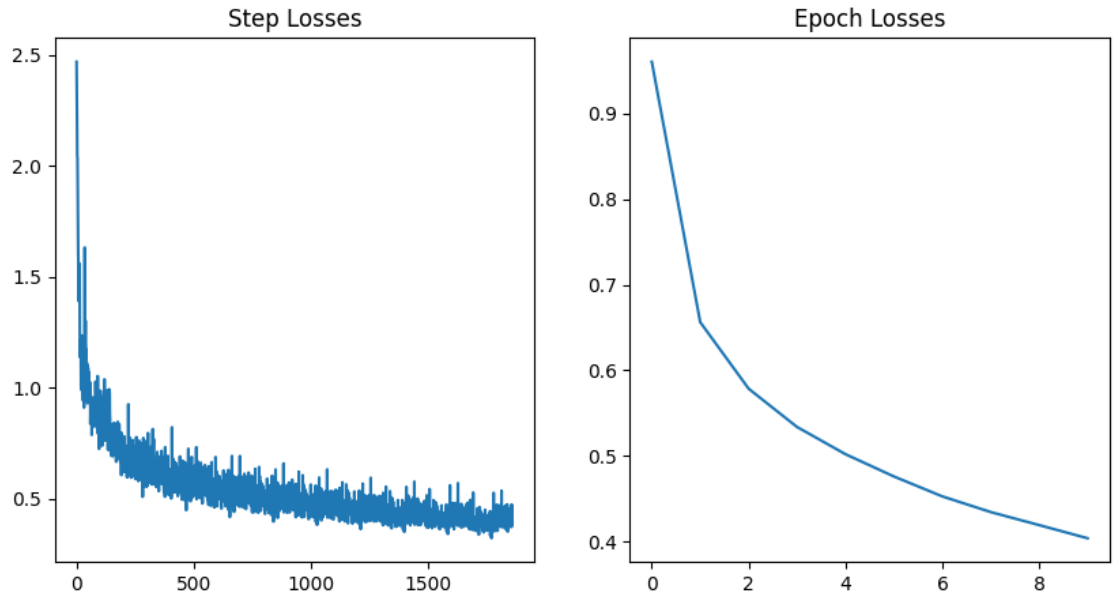
```
  0%|          | 0/186 [00:00<?, ?it/s]
  1%|          | 1/186 [00:01<04:54,  1.59s/it]
  1%|          | 2/186 [00:03<04:59,  1.63s/it]
  2%|          | 3/186 [00:04<04:52,  1.60s/it]
  2%|          | 4/186 [00:06<04:41,  1.55s/it]
  3%|          | 5/186 [00:07<04:39,  1.54s/it]
  3%|          | 6/186 [00:09<04:39,  1.55s/it]
  4%|          | 7/186 [00:10<04:36,  1.54s/it]
  4%|          | 8/186 [00:12<04:39,  1.57s/it]
  5%|          | 9/186 [00:14<04:52,  1.65s/it]
  5%|          | 10/186 [00:15<04:46,  1.63s/it]
  6%|          | 11/186 [00:17<04:43,  1.62s/it]
  6%|          | 12/186 [00:19<04:36,  1.59s/it]
  7%|          | 13/186 [00:20<04:35,  1.59s/it]
  8%|          | 14/186 [00:22<04:33,  1.59s/it]
  8%|          | 15/186 [00:23<04:30,  1.58s/it]
  9%|          | 16/186 [00:25<04:37,  1.63s/it]
  9%|          | 17/186 [00:27<04:30,  1.60s/it]
 10%|          | 18/186 [00:28<04:27,  1.59s/it]
 10%|          | 19/186 [00:30<04:22,  1.57s/it]
 11%|          | 20/186 [00:31<04:18,  1.56s/it]
 11%|          | 21/186 [00:33<04:14,  1.54s/it]
 12%|          | 22/186 [00:34<04:14,  1.55s/it]
 12%|          | 23/186 [00:36<04:12,  1.55s/it]
 13%|          | 24/186 [00:37<04:15,  1.58s/it]
 13%|          | 25/186 [00:39<04:15,  1.59s/it]
 14%|          | 26/186 [00:41<04:11,  1.57s/it]
 15%|          | 27/186 [00:42<04:10,  1.57s/it]
 15%|          | 28/186 [00:44<04:05,  1.55s/it]
 16%|          | 29/186 [00:45<04:05,  1.56s/it]
 16%|          | 30/186 [00:47<04:01,  1.55s/it]
 17%|          | 31/186 [00:49<04:08,  1.60s/it]
 17%|          | 32/186 [00:50<04:05,  1.59s/it]
 18%|          | 33/186 [00:52<03:59,  1.57s/it]
 18%|          | 34/186 [00:53<03:54,  1.54s/it]
 19%|          | 35/186 [00:55<03:53,  1.54s/it]
 19%|          | 36/186 [00:56<03:54,  1.56s/it]
 20%|          | 37/186 [00:58<04:01,  1.62s/it]
 20%|          | 38/186 [01:00<04:05,  1.66s/it]
 21%|          | 39/186 [01:01<03:59,  1.63s/it]
 22%|          | 40/186 [01:03<03:57,  1.62s/it]
 22%|          | 41/186 [01:05<03:53,  1.61s/it]
 23%|          | 42/186 [01:06<03:47,  1.58s/it]
 23%|          | 43/186 [01:08<03:42,  1.56s/it]
 24%|          | 44/186 [01:09<03:42,  1.57s/it]
 24%|          | 45/186 [01:11<03:43,  1.58s/it]
 25%|          | 46/186 [01:12<03:45,  1.61s/it]
```

```
25%|         | 47/186 [01:14<03:41,  1.59s/it]
26%|         | 48/186 [01:15<03:37,  1.58s/it]
26%|         | 49/186 [01:17<03:34,  1.56s/it]
27%|         | 50/186 [01:19<03:31,  1.56s/it]
27%|         | 51/186 [01:20<03:30,  1.56s/it]
28%|         | 52/186 [01:22<03:29,  1.57s/it]
28%|         | 53/186 [01:23<03:36,  1.63s/it]
29%|         | 54/186 [01:25<03:31,  1.60s/it]
30%|         | 55/186 [01:27<03:26,  1.58s/it]
30%|         | 56/186 [01:28<03:23,  1.57s/it]
31%|         | 57/186 [01:30<03:20,  1.56s/it]
31%|         | 58/186 [01:31<03:19,  1.56s/it]
32%|        | 59/186 [01:33<03:20,  1.58s/it]
32%|        | 60/186 [01:35<03:27,  1.65s/it]
33%|        | 61/186 [01:36<03:23,  1.63s/it]
33%|        | 62/186 [01:38<03:20,  1.62s/it]
34%|        | 63/186 [01:39<03:17,  1.61s/it]
34%|        | 64/186 [01:41<03:12,  1.58s/it]
35%|        | 65/186 [01:42<03:08,  1.56s/it]
35%|        | 66/186 [01:44<03:05,  1.55s/it]
36%|        | 67/186 [01:46<03:07,  1.57s/it]
37%|        | 68/186 [01:47<03:03,  1.56s/it]
37%|        | 69/186 [01:49<03:01,  1.55s/it]
38%|        | 70/186 [01:50<02:59,  1.55s/it]
38%|        | 71/186 [01:52<02:58,  1.55s/it]
39%|        | 72/186 [01:53<02:58,  1.56s/it]
39%|        | 73/186 [01:55<02:55,  1.56s/it]
40%|        | 74/186 [01:56<02:53,  1.55s/it]
40%|        | 75/186 [01:58<02:58,  1.61s/it]
41%|        | 76/186 [02:00<02:55,  1.60s/it]
41%|       | 77/186 [02:01<02:52,  1.58s/it]
42%|       | 78/186 [02:03<02:51,  1.59s/it]
42%|       | 79/186 [02:04<02:48,  1.58s/it]
43%|       | 80/186 [02:06<02:45,  1.56s/it]
44%|       | 81/186 [02:07<02:42,  1.54s/it]
44%|       | 82/186 [02:09<02:45,  1.59s/it]
45%|       | 83/186 [02:11<02:42,  1.58s/it]
45%|       | 84/186 [02:12<02:39,  1.57s/it]
46%|       | 85/186 [02:14<02:36,  1.55s/it]
46%|       | 86/186 [02:15<02:36,  1.56s/it]
47%|       | 87/186 [02:17<02:34,  1.56s/it]
47%|       | 88/186 [02:18<02:30,  1.54s/it]
48%|       | 89/186 [02:20<02:30,  1.55s/it]
48%|       | 90/186 [02:21<02:27,  1.53s/it]
49%|       | 91/186 [02:23<02:26,  1.55s/it]
49%|       | 92/186 [02:25<02:24,  1.53s/it]
50%|       | 93/186 [02:26<02:20,  1.52s/it]
51%|       | 94/186 [02:28<02:20,  1.52s/it]
```

```
51%|        | 95/186 [02:29<02:19,  1.53s/it]
52%|        | 96/186 [02:31<02:18,  1.54s/it]
52%|        | 97/186 [02:32<02:22,  1.60s/it]
53%|        | 98/186 [02:34<02:19,  1.58s/it]
53%|        | 99/186 [02:36<02:18,  1.60s/it]
54%|        | 100/186 [02:37<02:15,  1.58s/it]
54%|        | 101/186 [02:39<02:13,  1.57s/it]
55%|        | 102/186 [02:40<02:11,  1.57s/it]
55%|        | 103/186 [02:42<02:08,  1.55s/it]
56%|        | 104/186 [02:43<02:10,  1.59s/it]
56%|        | 105/186 [02:45<02:07,  1.57s/it]
57%|        | 106/186 [02:46<02:04,  1.56s/it]
58%|        | 107/186 [02:48<02:02,  1.55s/it]
58%|        | 108/186 [02:50<02:01,  1.55s/it]
59%|        | 109/186 [02:51<01:58,  1.54s/it]
59%|        | 110/186 [02:53<01:57,  1.54s/it]
60%|        | 111/186 [02:54<01:56,  1.55s/it]
60%|        | 112/186 [02:56<01:56,  1.58s/it]
61%|        | 113/186 [02:57<01:53,  1.55s/it]
61%|       | 114/186 [02:59<01:52,  1.56s/it]
62%|       | 115/186 [03:00<01:50,  1.56s/it]
62%|       | 116/186 [03:02<01:49,  1.56s/it]
63%|       | 117/186 [03:04<01:46,  1.55s/it]
63%|       | 118/186 [03:05<01:45,  1.55s/it]
64%|       | 119/186 [03:07<01:47,  1.61s/it]
65%|       | 120/186 [03:08<01:44,  1.59s/it]
65%|       | 121/186 [03:10<01:41,  1.57s/it]
66%|       | 122/186 [03:11<01:39,  1.56s/it]
66%|       | 123/186 [03:13<01:38,  1.56s/it]
67%|       | 124/186 [03:14<01:35,  1.54s/it]
67%|       | 125/186 [03:16<01:34,  1.55s/it]
68%|       | 126/186 [03:18<01:32,  1.54s/it]
68%|       | 127/186 [03:19<01:32,  1.57s/it]
69%|       | 128/186 [03:21<01:30,  1.56s/it]
69%|       | 129/186 [03:22<01:29,  1.56s/it]
70%|       | 130/186 [03:24<01:27,  1.57s/it]
70%|       | 131/186 [03:25<01:25,  1.56s/it]
71%|       | 132/186 [03:27<01:24,  1.56s/it]
72%|      | 133/186 [03:29<01:23,  1.57s/it]
72%|      | 134/186 [03:30<01:23,  1.60s/it]
73%|      | 135/186 [03:32<01:21,  1.59s/it]
73%|      | 136/186 [03:33<01:18,  1.58s/it]
74%|      | 137/186 [03:35<01:16,  1.57s/it]
74%|      | 138/186 [03:37<01:15,  1.57s/it]
75%|      | 139/186 [03:38<01:12,  1.55s/it]
75%|      | 140/186 [03:40<01:10,  1.53s/it]
76%|      | 141/186 [03:41<01:11,  1.59s/it]
76%|      | 142/186 [03:43<01:09,  1.57s/it]
```

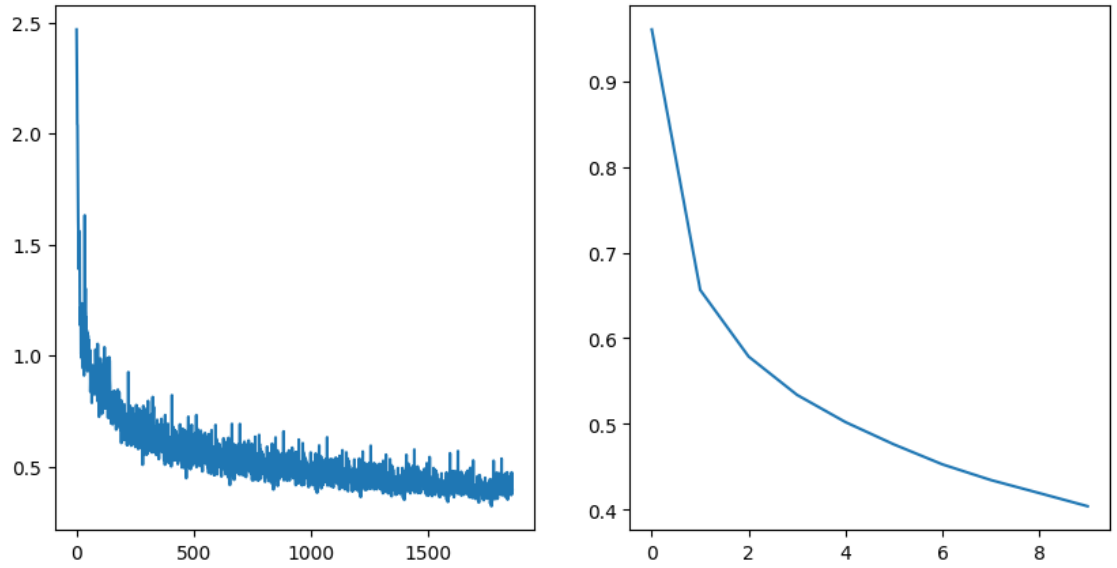
```
 77%|       | 143/186 [03:44<01:07,  1.56s/it]
 77%|       | 144/186 [03:46<01:05,  1.55s/it]
 78%|       | 145/186 [03:47<01:03,  1.56s/it]
 78%|       | 146/186 [03:49<01:02,  1.56s/it]
 79%|       | 147/186 [03:50<01:00,  1.54s/it]
 80%|       | 148/186 [03:52<00:58,  1.55s/it]
 80%|       | 149/186 [03:54<00:58,  1.58s/it]
 81%|       | 150/186 [03:55<00:56,  1.57s/it]
 81%|       | 151/186 [03:57<00:55,  1.57s/it]
 82%|      | 152/186 [03:58<00:53,  1.56s/it]
 82%|      | 153/186 [04:00<00:51,  1.56s/it]
 83%|      | 154/186 [04:01<00:49,  1.54s/it]
 83%|      | 155/186 [04:03<00:48,  1.55s/it]
 84%|      | 156/186 [04:05<00:48,  1.63s/it]
 84%|      | 157/186 [04:06<00:47,  1.62s/it]
 85%|      | 158/186 [04:08<00:44,  1.61s/it]
 85%|      | 159/186 [04:10<00:42,  1.59s/it]
 86%|      | 160/186 [04:11<00:40,  1.57s/it]
 87%|      | 161/186 [04:13<00:39,  1.57s/it]
 87%|      | 162/186 [04:14<00:37,  1.56s/it]
 88%|      | 163/186 [04:16<00:36,  1.59s/it]
 88%|      | 164/186 [04:17<00:34,  1.57s/it]
 89%|      | 165/186 [04:19<00:32,  1.56s/it]
 89%|      | 166/186 [04:20<00:30,  1.54s/it]
 90%|      | 167/186 [04:22<00:29,  1.53s/it]
 90%|      | 168/186 [04:23<00:27,  1.53s/it]
 91%|      | 169/186 [04:25<00:26,  1.54s/it]
 91%|     | 170/186 [04:27<00:24,  1.56s/it]
 92%|     | 171/186 [04:28<00:23,  1.58s/it]
 92%|     | 172/186 [04:30<00:21,  1.57s/it]
 93%|     | 173/186 [04:31<00:20,  1.56s/it]
 94%|     | 174/186 [04:33<00:18,  1.55s/it]
 94%|     | 175/186 [04:34<00:16,  1.54s/it]
 95%|     | 176/186 [04:36<00:15,  1.53s/it]
 95%|     | 177/186 [04:37<00:13,  1.52s/it]
 96%|     | 178/186 [04:39<00:12,  1.61s/it]
 96%|     | 179/186 [04:41<00:11,  1.58s/it]
 97%|     | 180/186 [04:42<00:09,  1.56s/it]
 97%|     | 181/186 [04:44<00:07,  1.55s/it]
 98%|     | 182/186 [04:45<00:06,  1.54s/it]
 98%|     | 183/186 [04:47<00:04,  1.56s/it]
 99%|     | 184/186 [04:48<00:03,  1.55s/it]
 99%|     | 185/186 [04:50<00:01,  1.55s/it]
100%|     | 186/186 [04:51<00:00,  1.55s/it]
100%|     | 10/10 [48:23<00:00, 290.31s/it]

Epoch 10/10:
Train Loss: 0.4041, Train Accuracy: 5653398.89%
```



[35]:
```
fig, axes = plt.subplots(1, 2, figsize=(10, 5))
axes[0].plot(step_losses)
axes[1].plot(epoch_losses)
```

[35]: [<matplotlib.lines.Line2D at 0x7d64b5a7b310>]



[36]:
```
model_path = model_name
model_ = UNet(num_classes=num_classes).to(device)
```

```
model_.load_state_dict(torch.load(model_path))
```

[36]:
```
<All keys matched successfully>
```

[37]:
```
test_batch_size = 8
dataset = CityscapeDataset(val_dir, label_model)
data_loader = DataLoader(dataset, batch_size=test_batch_size)
```

[38]:
```
X, Y = next(iter(data_loader))
X, Y = X.to(device), Y.to(device)
Y_pred = model_(X)
print(Y_pred.shape)
Y_pred = torch.argmax(Y_pred, dim=1)
print(Y_pred.shape)
```

```
torch.Size([8, 10, 256, 256])
torch.Size([8, 256, 256])
```

[39]:
```
inverse_transform = transforms.Compose([
    transforms.Normalize((-0.485/0.229, -0.456/0.224, -0.406/0.225), (1/0.229,␣
 ↪1/0.224, 1/0.225))
])
```

[40]:
```
fig, axes = plt.subplots(test_batch_size, 3, figsize=(3*5, test_batch_size*5))

for i in range(test_batch_size):

    landscape = inverse_transform(X[i]).permute(1, 2, 0).cpu().detach().numpy()
    label_class = Y[i].cpu().detach().numpy()
    label_class_predicted = Y_pred[i].cpu().detach().numpy()

    axes[i, 0].imshow(landscape)
    axes[i, 0].set_title("Landscape")
    axes[i, 1].imshow(label_class)
    axes[i, 1].set_title("Label Class")
    axes[i, 2].imshow(label_class_predicted)
    axes[i, 2].set_title("Label Class - Predicted")
```

```
Output hidden; open in https://colab.research.google.com to view.
```

[49]:
```
model.eval()
predictions = []

with torch.no_grad():
    for X_val, Y_val in data_loader:
        X_val, Y_val = X_val.to(device), Y_val.to(device)
        Y_pred_val = model(X_val)
```

```
        predictions.append(Y_pred_val.cpu().numpy())

predictions = np.concatenate(predictions, axis=0)
```

[59]:
```
threshold = 0.5
binary_predictions = (predictions > threshold).astype(np.uint8)
flat_predictions = binary_predictions.reshape(-1, num_classes)
```

[60]:
```
ground_truth_labels = np.concatenate([Y_val.cpu().numpy().reshape(-1, 1) for␣
↪X_val, Y_val in data_loader], axis=0)
```

[61]:
```
from sklearn.metrics import average_precision_score

mAP_per_class = []
for class_index in range(num_classes):
    y_true = (ground_truth_labels == class_index).astype(np.uint8)
    y_score = flat_predictions[:, class_index]
    mAP_class = average_precision_score(y_true, y_score)
    mAP_per_class.append(mAP_class)

mAP = np.mean(mAP_per_class)
print(f'mAP: {mAP:.4f}')
```

```
mAP: 0.1007
```