

federated-learning-rolling

December 21, 2023

0.1 Federated Learning Rolling

```
[8]: import torch
      from torchvision import datasets, transforms
      from torch.utils.data import DataLoader
      import torch.nn as nn
      import torch.optim as optim
      import time
      from torchvision.models import resnet50, ResNet50_Weights
```

```
[9]: dataset_paths = ['../Dataset/5_percent_data', '../Dataset/10_percent_data', '../Dataset/15_percent_data',
      ↪ '../Dataset/20_percent_data', '../Dataset/25_percent_data']

      train_transforms = transforms.Compose([
          transforms.Resize(64),
          transforms.ToTensor()
      ])

      dataset_5 = datasets.ImageFolder(root=dataset_paths[0], ↪
          ↪ transform=train_transforms)
      dataset_10 = datasets.ImageFolder(root=dataset_paths[1], ↪
          ↪ transform=train_transforms)
      dataset_15 = datasets.ImageFolder(root=dataset_paths[2], ↪
          ↪ transform=train_transforms)
      dataset_20 = datasets.ImageFolder(root=dataset_paths[3], ↪
          ↪ transform=train_transforms)
      dataset_25 = datasets.ImageFolder(root=dataset_paths[4], ↪
          ↪ transform=train_transforms)

      num_classes = 6
```

```
[10]: def train_model(global_model_name, train_dataset, output_model_name):
      # Load the model architecture
      model = resnet50(weights=None)
      model.eval()
```

```

    # Replace the final fully connected layer for transfer learning with the
    ↪ same num_classes
    num_fters = model.fc.in_features
    num_classes = 6
    model.fc = nn.Linear(num_fters, num_classes)

    # Load the trained weights from the saved .pth file
    model.load_state_dict(torch.load(global_model_name))
    model.eval()

    # Define the loss function and optimizer
    criterion = nn.CrossEntropyLoss()
    optimizer = optim.SGD(model.fc.parameters(), lr=0.001, momentum=0.9)

    # Move the model to GPU if available
    device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")
    model = model.to(device)

    train_dataloader = torch.utils.data.DataLoader(train_dataset,
    ↪ batch_size=32, shuffle=True)

    # Train the model
    start_time = time.time() # Record the end time of the epoch
    num_epochs = 20 # You can change this
    for epoch in range(num_epochs):
        model.train()
        running_loss = 0.0

        for inputs, labels in train_dataloader:
            inputs = inputs.to(device)
            labels = labels.to(device)

            optimizer.zero_grad()
            outputs = model(inputs)

            loss = criterion(outputs, labels)

            loss.backward()
            optimizer.step()

            running_loss += loss.item() * inputs.size(0)

        epoch_loss = running_loss / len(train_dataset)
        print(f'Epoch {epoch+1}/{num_epochs} | Loss: {epoch_loss:.4f}')
        if epoch_loss <= 0.01:
            print(" Early Stopping ")
            break
    end_time = time.time() # Record the end time of the epoch

```

```

print(" Training Time ", end_time - start_time)

# Save the trained model
torch.save(model.state_dict(), output_model_name)
return model

```

```

[11]: def test_model(data_dir, model_name):
    import torch
    from torchvision import datasets, transforms
    from torch.utils.data import DataLoader
    import torch.nn as nn

    # Define paths to your test dataset folder
    test_data_dir = data_dir # Update with your test dataset path

    # Define transformations for testing (similar to training)
    test_transforms = transforms.Compose([
        transforms.Resize(64),
        transforms.ToTensor()
    ])

    # Load the test dataset using ImageFolder with the defined transformations
    test_dataset = datasets.ImageFolder(root=test_data_dir,
    ↪transform=test_transforms)

    # Define the test dataloader
    test_dataloader = DataLoader(test_dataset, batch_size=32, shuffle=False,
    ↪num_workers=4)

    # Load the model architecture
    model = resnet50(weights=None)
    model.eval()

    # Replace the final fully connected layer for transfer learning with the
    ↪same num_classes
    num_fters = model.fc.in_features
    num_classes = 6
    model.fc = nn.Linear(num_fters, num_classes)

    # Load the trained weights from the saved .pth file
    model.load_state_dict(torch.load(model_name))
    model.eval()

    # Move the model to GPU if available
    device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")
    model = model.to(device)

```

```

# Evaluate the model on the test dataset for both top-1 and top-3 accuracy
correct_top1 = 0
correct_top3 = 0

total = 0
with torch.no_grad():
    for images, labels in test_dataloader:
        images = images.to(device)
        labels = labels.to(device)

        outputs = model(images)
        _, preds = torch.topk(outputs, 3, dim=1) # Get top-3 predictions
        total += labels.size(0)
        for i in range(labels.size(0)):
            if labels[i] == preds[i, 0]: # Check top-1 accuracy
                correct_top1 += 1
            if labels[i] in preds[i]: # Check top-3 accuracy
                correct_top3 += 1

top1_accuracy = 100 * correct_top1 / total
top3_accuracy = 100 * correct_top3 / total
print(f'Top-1 Accuracy on the {data_dir} dataset: {top1_accuracy:.2f}%')
print(f'Top-3 Accuracy on the {data_dir} dataset: {top3_accuracy:.2f}%')

```

```

[12]: def update_global_model(model_5, model_10, model_15, model_20, model_25,
    ↪ global_model, iteration):
    state_dict_5 = model_5.state_dict()
    state_dict_10 = model_10.state_dict()
    state_dict_15 = model_15.state_dict()
    state_dict_20 = model_20.state_dict()
    state_dict_25 = model_25.state_dict()

    for key in global_model.state_dict():
        w1 = state_dict_5[key]
        w2 = state_dict_10[key]
        w3 = state_dict_15[key]
        w4 = state_dict_20[key]
        w5 = state_dict_25[key]

        updated_weight = (w1 * 1 + w2 * 2 + w3 * 3 + w4 * 4 + w5 * 5) / 15
        global_model.state_dict()[key].copy_(updated_weight)
    global_model_name = 'updated_global_model_' + str(iteration) + '.pth'
    torch.save(global_model.state_dict(), global_model_name)

    return global_model_name

```

```

[13]: # Load model
model = resnet50(weights=ResNet50_Weights.DEFAULT)
model.eval()
# Replace the final fully connected layer for transfer learning with the same
↳ num_classes
num_fters = model.fc.in_features
num_classes = 6
model.fc = nn.Linear(num_fters, num_classes)

global_model_name = "trained_global_model.pth"
torch.save(model.state_dict(), global_model_name)
test_model('../Dataset/validation_data', global_model_name)

global_model_name = "trained_global_model.pth"
i = 0
interval = 10
for i in range(interval):
    print("Iteration: ", i+1)
    print(" Global model ", global_model_name)
    total_5 = len(dataset_5)
    start_index_5 = (i*total_5)//interval
    end_index_5 = min(total_5, ((i+1)*total_5)//interval)
    portion_dataset_5 = torch.utils.data.Subset(dataset_5,
↳ list(range(start_index_5, end_index_5)))
    model_name_5 = "trained_model_5_" + str(i+1) + ".pth"
    print(" Model : ", model_name_5)
    model_5 = train_model(global_model_name, portion_dataset_5, model_name_5)
    test_model('../Dataset/validation_data', model_name_5)

    total_10 = len(dataset_10)
    start_index_10 = (i*total_10)//interval
    end_index_10 = min(total_10, ((i+1)*total_10)//interval)
    portion_dataset_10 = torch.utils.data.Subset(dataset_10,
↳ list(range(start_index_10, end_index_10)))
    model_name_10 = "trained_model_10_" + str(i+1) + ".pth"
    print(" Model : ", model_name_10)
    model_10 = train_model(global_model_name, portion_dataset_10, model_name_10)
    test_model('../Dataset/validation_data', model_name_10)

    total_15 = len(dataset_15)
    start_index_15 = (i*total_15)//interval
    end_index_15 = min(total_15, ((i+1)*total_15)//interval)
    portion_dataset_15 = torch.utils.data.Subset(dataset_15,
↳ list(range(start_index_15, end_index_15)))
    model_name_15 = "trained_model_15_" + str(i+1) + ".pth"
    print(" Model : ", model_name_15)
    model_15 = train_model(global_model_name, portion_dataset_15, model_name_15)

```

```

test_model('../Dataset/validation_data', model_name_15)

total_20 = len(dataset_20)
start_index_20 = (i*total_20)//interval
end_index_20 = min(total_20, ((i+1)*total_20)//interval)
portion_dataset_20 = torch.utils.data.Subset(dataset_20,
↪list(range(start_index_20, end_index_20)))
model_name_20 = "trained_model_20_" + str(i+1) + ".pth"
print(" Model : ", model_name_20)
model_20 = train_model(global_model_name, portion_dataset_20, model_name_20)
test_model('../Dataset/validation_data', model_name_20)

total_25 = len(dataset_25)
start_index_25 = (i*total_25)//interval
end_index_25 = min(total_25, ((i+1)*total_25)//interval)
portion_dataset_25 = torch.utils.data.Subset(dataset_25,
↪list(range(start_index_25, end_index_25)))
model_name_25 = "trained_model_25_" + str(i+1) + ".pth"
print(" Model : ", model_name_25)
model_25 = train_model(global_model_name, portion_dataset_25, model_name_25)
test_model('../Dataset/validation_data', model_name_25)

## Update global model

# Load the model architecture
global_model = resnet50(weights=None)
global_model.eval()

# Replace the final fully connected layer for transfer learning with the
↪same num_classes
num_fters = global_model.fc.in_features
global_model.fc = nn.Linear(num_fters, num_classes)

# Load the trained weights from the saved .pth file
global_model.load_state_dict(torch.load(global_model_name))
global_model.eval()

global_model_name = update_global_model(model_5, model_10, model_15,
↪model_20, model_25, global_model, i+1)
print(" Updated global Model : ", global_model_name)
test_model('../Dataset/validation_data', global_model_name)

```

Top-1 Accuracy on the ../Dataset/validation_data dataset: 13.94%

Top-3 Accuracy on the ../Dataset/validation_data dataset: 53.68%

Iteration: 1

Global model trained_global_model.pth

```

Model : trained_model_5_1.pth
Epoch 1/20 | Loss: 1.4510
Epoch 2/20 | Loss: 0.5829
Epoch 3/20 | Loss: 0.2752
Epoch 4/20 | Loss: 0.1824
Epoch 5/20 | Loss: 0.0978
Epoch 6/20 | Loss: 0.0880
Epoch 7/20 | Loss: 0.0815
Epoch 8/20 | Loss: 0.0681
Epoch 9/20 | Loss: 0.0794
Epoch 10/20 | Loss: 0.0772
Epoch 11/20 | Loss: 0.0707
Epoch 12/20 | Loss: 0.0758
Epoch 13/20 | Loss: 0.0619
Epoch 14/20 | Loss: 0.0671
Epoch 15/20 | Loss: 0.0525
Epoch 16/20 | Loss: 0.0533
Epoch 17/20 | Loss: 0.0423
Epoch 18/20 | Loss: 0.0492
Epoch 19/20 | Loss: 0.0383
Epoch 20/20 | Loss: 0.0350
Training Time 7.331625938415527
Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%
Top-3 Accuracy on the ../Dataset/validation_data dataset: 70.12%
Model : trained_model_10_1.pth
Epoch 1/20 | Loss: 1.2011
Epoch 2/20 | Loss: 0.3110
Epoch 3/20 | Loss: 0.1514
Epoch 4/20 | Loss: 0.1088
Epoch 5/20 | Loss: 0.0868
Epoch 6/20 | Loss: 0.0737
Epoch 7/20 | Loss: 0.0730
Epoch 8/20 | Loss: 0.0563
Epoch 9/20 | Loss: 0.0689
Epoch 10/20 | Loss: 0.0433
Epoch 11/20 | Loss: 0.0484
Epoch 12/20 | Loss: 0.0365
Epoch 13/20 | Loss: 0.0284
Epoch 14/20 | Loss: 0.0371
Epoch 15/20 | Loss: 0.0418
Epoch 16/20 | Loss: 0.0302
Epoch 17/20 | Loss: 0.0339
Epoch 18/20 | Loss: 0.0379
Epoch 19/20 | Loss: 0.0278
Epoch 20/20 | Loss: 0.0253
Training Time 11.69282579421997
Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%
Top-3 Accuracy on the ../Dataset/validation_data dataset: 70.64%

```

```
Model : trained_model_15_1.pth
Epoch 1/20 | Loss: 0.9297
Epoch 2/20 | Loss: 0.1748
Epoch 3/20 | Loss: 0.0990
Epoch 4/20 | Loss: 0.0758
Epoch 5/20 | Loss: 0.0552
Epoch 6/20 | Loss: 0.0590
Epoch 7/20 | Loss: 0.0499
Epoch 8/20 | Loss: 0.0403
Epoch 9/20 | Loss: 0.0381
Epoch 10/20 | Loss: 0.0413
Epoch 11/20 | Loss: 0.0329
Epoch 12/20 | Loss: 0.0254
Epoch 13/20 | Loss: 0.0299
Epoch 14/20 | Loss: 0.0226
Epoch 15/20 | Loss: 0.0229
Epoch 16/20 | Loss: 0.0280
Epoch 17/20 | Loss: 0.0241
Epoch 18/20 | Loss: 0.0249
Epoch 19/20 | Loss: 0.0193
Epoch 20/20 | Loss: 0.0207
Training Time 17.494003534317017
Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%
Top-3 Accuracy on the ../Dataset/validation_data dataset: 71.87%
Model : trained_model_20_1.pth
Epoch 1/20 | Loss: 0.8324
Epoch 2/20 | Loss: 0.1632
Epoch 3/20 | Loss: 0.1046
Epoch 4/20 | Loss: 0.0822
Epoch 5/20 | Loss: 0.0802
Epoch 6/20 | Loss: 0.0491
Epoch 7/20 | Loss: 0.0483
Epoch 8/20 | Loss: 0.0468
Epoch 9/20 | Loss: 0.0402
Epoch 10/20 | Loss: 0.0390
Epoch 11/20 | Loss: 0.0291
Epoch 12/20 | Loss: 0.0270
Epoch 13/20 | Loss: 0.0250
Epoch 14/20 | Loss: 0.0243
Epoch 15/20 | Loss: 0.0268
Epoch 16/20 | Loss: 0.0237
Epoch 17/20 | Loss: 0.0262
Epoch 18/20 | Loss: 0.0204
Epoch 19/20 | Loss: 0.0170
Epoch 20/20 | Loss: 0.0227
Training Time 21.685173749923706
Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%
Top-3 Accuracy on the ../Dataset/validation_data dataset: 72.45%
```



```

Model : trained_model_25_1.pth
Epoch 1/20 | Loss: 0.6500
Epoch 2/20 | Loss: 0.1037
Epoch 3/20 | Loss: 0.0642
Epoch 4/20 | Loss: 0.0531
Epoch 5/20 | Loss: 0.0447
Epoch 6/20 | Loss: 0.0334
Epoch 7/20 | Loss: 0.0320
Epoch 8/20 | Loss: 0.0289
Epoch 9/20 | Loss: 0.0234
Epoch 10/20 | Loss: 0.0223
Epoch 11/20 | Loss: 0.0199
Epoch 12/20 | Loss: 0.0207
Epoch 13/20 | Loss: 0.0206
Epoch 14/20 | Loss: 0.0200
Epoch 15/20 | Loss: 0.0163
Epoch 16/20 | Loss: 0.0132
Epoch 17/20 | Loss: 0.0170
Epoch 18/20 | Loss: 0.0148
Epoch 19/20 | Loss: 0.0144
Epoch 20/20 | Loss: 0.0119
Training Time 28.948309898376465
Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%
Top-3 Accuracy on the ../Dataset/validation_data dataset: 71.26%
Updated global Model : updated_global_model_1.pth
Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%
Top-3 Accuracy on the ../Dataset/validation_data dataset: 71.53%
Iteration: 2
Global model updated_global_model_1.pth
Model : trained_model_5_2.pth
Epoch 1/20 | Loss: 2.0103
Epoch 2/20 | Loss: 1.5211
Epoch 3/20 | Loss: 0.9293
Epoch 4/20 | Loss: 0.4724
Epoch 5/20 | Loss: 0.2531
Epoch 6/20 | Loss: 0.1924
Epoch 7/20 | Loss: 0.1602
Epoch 8/20 | Loss: 0.1569
Epoch 9/20 | Loss: 0.1451
Epoch 10/20 | Loss: 0.1257
Epoch 11/20 | Loss: 0.1362
Epoch 12/20 | Loss: 0.1280
Epoch 13/20 | Loss: 0.1141
Epoch 14/20 | Loss: 0.0952
Epoch 15/20 | Loss: 0.0861
Epoch 16/20 | Loss: 0.0942
Epoch 17/20 | Loss: 0.0863
Epoch 18/20 | Loss: 0.0861

```

Epoch 19/20 | Loss: 0.0926
 Epoch 20/20 | Loss: 0.1148
 Training Time 7.321229457855225
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 31.52%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 51.56%
 Model : trained_model_10_2.pth
 Epoch 1/20 | Loss: 1.9707
 Epoch 2/20 | Loss: 1.0819
 Epoch 3/20 | Loss: 0.3236
 Epoch 4/20 | Loss: 0.1892
 Epoch 5/20 | Loss: 0.1553
 Epoch 6/20 | Loss: 0.1493
 Epoch 7/20 | Loss: 0.1434
 Epoch 8/20 | Loss: 0.1282
 Epoch 9/20 | Loss: 0.1325
 Epoch 10/20 | Loss: 0.1243
 Epoch 11/20 | Loss: 0.1080
 Epoch 12/20 | Loss: 0.1040
 Epoch 13/20 | Loss: 0.0953
 Epoch 14/20 | Loss: 0.0956
 Epoch 15/20 | Loss: 0.1091
 Epoch 16/20 | Loss: 0.0817
 Epoch 17/20 | Loss: 0.0782
 Epoch 18/20 | Loss: 0.0841
 Epoch 19/20 | Loss: 0.0789
 Epoch 20/20 | Loss: 0.0652
 Training Time 11.691212892532349
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 31.84%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 50.48%
 Model : trained_model_15_2.pth
 Epoch 1/20 | Loss: 1.6676
 Epoch 2/20 | Loss: 0.5483
 Epoch 3/20 | Loss: 0.1806
 Epoch 4/20 | Loss: 0.1495
 Epoch 5/20 | Loss: 0.1581
 Epoch 6/20 | Loss: 0.1403
 Epoch 7/20 | Loss: 0.1216
 Epoch 8/20 | Loss: 0.1033
 Epoch 9/20 | Loss: 0.1053
 Epoch 10/20 | Loss: 0.0977
 Epoch 11/20 | Loss: 0.0910
 Epoch 12/20 | Loss: 0.0950
 Epoch 13/20 | Loss: 0.0848
 Epoch 14/20 | Loss: 0.0679
 Epoch 15/20 | Loss: 0.0715
 Epoch 16/20 | Loss: 0.0747
 Epoch 17/20 | Loss: 0.0643
 Epoch 18/20 | Loss: 0.0593

Epoch 19/20 | Loss: 0.0612
 Epoch 20/20 | Loss: 0.0569
 Training Time 17.440737009048462
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 31.92%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 51.69%
 Model : trained_model_20_2.pth
 Epoch 1/20 | Loss: 1.6001
 Epoch 2/20 | Loss: 0.3240
 Epoch 3/20 | Loss: 0.1742
 Epoch 4/20 | Loss: 0.1517
 Epoch 5/20 | Loss: 0.1356
 Epoch 6/20 | Loss: 0.1136
 Epoch 7/20 | Loss: 0.1123
 Epoch 8/20 | Loss: 0.0927
 Epoch 9/20 | Loss: 0.0975
 Epoch 10/20 | Loss: 0.0798
 Epoch 11/20 | Loss: 0.0792
 Epoch 12/20 | Loss: 0.0877
 Epoch 13/20 | Loss: 0.0828
 Epoch 14/20 | Loss: 0.0677
 Epoch 15/20 | Loss: 0.0616
 Epoch 16/20 | Loss: 0.0631
 Epoch 17/20 | Loss: 0.0607
 Epoch 18/20 | Loss: 0.0574
 Epoch 19/20 | Loss: 0.0523
 Epoch 20/20 | Loss: 0.0615
 Training Time 21.546999216079712
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 31.94%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 52.08%
 Model : trained_model_25_2.pth
 Epoch 1/20 | Loss: 1.3263
 Epoch 2/20 | Loss: 0.2130
 Epoch 3/20 | Loss: 0.1488
 Epoch 4/20 | Loss: 0.1401
 Epoch 5/20 | Loss: 0.1068
 Epoch 6/20 | Loss: 0.0901
 Epoch 7/20 | Loss: 0.0984
 Epoch 8/20 | Loss: 0.0857
 Epoch 9/20 | Loss: 0.0945
 Epoch 10/20 | Loss: 0.0769
 Epoch 11/20 | Loss: 0.0622
 Epoch 12/20 | Loss: 0.0688
 Epoch 13/20 | Loss: 0.0639
 Epoch 14/20 | Loss: 0.0636
 Epoch 15/20 | Loss: 0.0571
 Epoch 16/20 | Loss: 0.0531
 Epoch 17/20 | Loss: 0.0537
 Epoch 18/20 | Loss: 0.0474

Epoch 19/20 | Loss: 0.0474
 Epoch 20/20 | Loss: 0.0577
 Training Time 29.05228042602539
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 31.89%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 50.76%
 Updated global Model : updated_global_model_2.pth
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 31.94%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 51.22%
 Iteration: 3
 Global model updated_global_model_2.pth
 Model : trained_model_5_3.pth
 Epoch 1/20 | Loss: 2.2370
 Epoch 2/20 | Loss: 0.6803
 Epoch 3/20 | Loss: 0.1854
 Epoch 4/20 | Loss: 0.0906
 Epoch 5/20 | Loss: 0.0707
 Epoch 6/20 | Loss: 0.0642
 Epoch 7/20 | Loss: 0.0543
 Epoch 8/20 | Loss: 0.0613
 Epoch 9/20 | Loss: 0.0435
 Epoch 10/20 | Loss: 0.0409
 Epoch 11/20 | Loss: 0.0381
 Epoch 12/20 | Loss: 0.0411
 Epoch 13/20 | Loss: 0.0372
 Epoch 14/20 | Loss: 0.0304
 Epoch 15/20 | Loss: 0.0361
 Epoch 16/20 | Loss: 0.0276
 Epoch 17/20 | Loss: 0.0300
 Epoch 18/20 | Loss: 0.0277
 Epoch 19/20 | Loss: 0.0217
 Epoch 20/20 | Loss: 0.0266
 Training Time 7.1968724727630615
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 15.17%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 58.02%
 Model : trained_model_10_3.pth
 Epoch 1/20 | Loss: 1.6868
 Epoch 2/20 | Loss: 0.2071
 Epoch 3/20 | Loss: 0.0809
 Epoch 4/20 | Loss: 0.0595
 Epoch 5/20 | Loss: 0.0493
 Epoch 6/20 | Loss: 0.0496
 Epoch 7/20 | Loss: 0.0431
 Epoch 8/20 | Loss: 0.0393
 Epoch 9/20 | Loss: 0.0366
 Epoch 10/20 | Loss: 0.0396
 Epoch 11/20 | Loss: 0.0325
 Epoch 12/20 | Loss: 0.0271
 Epoch 13/20 | Loss: 0.0278

Epoch 14/20 | Loss: 0.0281
 Epoch 15/20 | Loss: 0.0240
 Epoch 16/20 | Loss: 0.0222
 Epoch 17/20 | Loss: 0.0260
 Epoch 18/20 | Loss: 0.0235
 Epoch 19/20 | Loss: 0.0208
 Epoch 20/20 | Loss: 0.0208
 Training Time 11.621193647384644
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 15.18%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 58.37%
 Model : trained_model_15_3.pth
 Epoch 1/20 | Loss: 1.2243
 Epoch 2/20 | Loss: 0.1095
 Epoch 3/20 | Loss: 0.0643
 Epoch 4/20 | Loss: 0.0459
 Epoch 5/20 | Loss: 0.0445
 Epoch 6/20 | Loss: 0.0397
 Epoch 7/20 | Loss: 0.0343
 Epoch 8/20 | Loss: 0.0298
 Epoch 9/20 | Loss: 0.0274
 Epoch 10/20 | Loss: 0.0274
 Epoch 11/20 | Loss: 0.0267
 Epoch 12/20 | Loss: 0.0250
 Epoch 13/20 | Loss: 0.0255
 Epoch 14/20 | Loss: 0.0227
 Epoch 15/20 | Loss: 0.0215
 Epoch 16/20 | Loss: 0.0192
 Epoch 17/20 | Loss: 0.0206
 Epoch 18/20 | Loss: 0.0157
 Epoch 19/20 | Loss: 0.0160
 Epoch 20/20 | Loss: 0.0175
 Training Time 17.602529764175415
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 15.18%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 57.86%
 Model : trained_model_20_3.pth
 Epoch 1/20 | Loss: 1.0410
 Epoch 2/20 | Loss: 0.0812
 Epoch 3/20 | Loss: 0.0534
 Epoch 4/20 | Loss: 0.0479
 Epoch 5/20 | Loss: 0.0365
 Epoch 6/20 | Loss: 0.0331
 Epoch 7/20 | Loss: 0.0304
 Epoch 8/20 | Loss: 0.0313
 Epoch 9/20 | Loss: 0.0233
 Epoch 10/20 | Loss: 0.0245
 Epoch 11/20 | Loss: 0.0192
 Epoch 12/20 | Loss: 0.0214
 Epoch 13/20 | Loss: 0.0194

Epoch 14/20 | Loss: 0.0176
 Epoch 15/20 | Loss: 0.0186
 Epoch 16/20 | Loss: 0.0157
 Epoch 17/20 | Loss: 0.0179
 Epoch 18/20 | Loss: 0.0170
 Epoch 19/20 | Loss: 0.0142
 Epoch 20/20 | Loss: 0.0131
 Training Time 21.26693868637085
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 15.18%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 58.22%
 Model : trained_model_25_3.pth
 Epoch 1/20 | Loss: 0.7746
 Epoch 2/20 | Loss: 0.0564
 Epoch 3/20 | Loss: 0.0434
 Epoch 4/20 | Loss: 0.0370
 Epoch 5/20 | Loss: 0.0308
 Epoch 6/20 | Loss: 0.0289
 Epoch 7/20 | Loss: 0.0252
 Epoch 8/20 | Loss: 0.0227
 Epoch 9/20 | Loss: 0.0190
 Epoch 10/20 | Loss: 0.0200
 Epoch 11/20 | Loss: 0.0170
 Epoch 12/20 | Loss: 0.0160
 Epoch 13/20 | Loss: 0.0147
 Epoch 14/20 | Loss: 0.0143
 Epoch 15/20 | Loss: 0.0127
 Epoch 16/20 | Loss: 0.0136
 Epoch 17/20 | Loss: 0.0135
 Epoch 18/20 | Loss: 0.0108
 Epoch 19/20 | Loss: 0.0130
 Epoch 20/20 | Loss: 0.0106
 Training Time 29.262059926986694
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 15.18%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 58.72%
 Updated global Model : updated_global_model_3.pth
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 15.18%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 58.78%
 Iteration: 4
 Global model updated_global_model_3.pth
 Model : trained_model_5_4.pth
 Epoch 1/20 | Loss: 7.2719
 Epoch 2/20 | Loss: 4.4160
 Epoch 3/20 | Loss: 1.4038
 Epoch 4/20 | Loss: 0.3198
 Epoch 5/20 | Loss: 0.2039
 Epoch 6/20 | Loss: 0.1952
 Epoch 7/20 | Loss: 0.2296
 Epoch 8/20 | Loss: 0.1599

Epoch 9/20 | Loss: 0.1575
 Epoch 10/20 | Loss: 0.1687
 Epoch 11/20 | Loss: 0.1531
 Epoch 12/20 | Loss: 0.1102
 Epoch 13/20 | Loss: 0.1040
 Epoch 14/20 | Loss: 0.1121
 Epoch 15/20 | Loss: 0.1296
 Epoch 16/20 | Loss: 0.1256
 Epoch 17/20 | Loss: 0.1048
 Epoch 18/20 | Loss: 0.1055
 Epoch 19/20 | Loss: 0.0878
 Epoch 20/20 | Loss: 0.0838
 Training Time 7.380084991455078
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 31.52%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 49.64%
 Model : trained_model_10_4.pth
 Epoch 1/20 | Loss: 6.1166
 Epoch 2/20 | Loss: 2.1329
 Epoch 3/20 | Loss: 0.2575
 Epoch 4/20 | Loss: 0.2296
 Epoch 5/20 | Loss: 0.1789
 Epoch 6/20 | Loss: 0.1534
 Epoch 7/20 | Loss: 0.1351
 Epoch 8/20 | Loss: 0.1327
 Epoch 9/20 | Loss: 0.1204
 Epoch 10/20 | Loss: 0.1288
 Epoch 11/20 | Loss: 0.1122
 Epoch 12/20 | Loss: 0.0997
 Epoch 13/20 | Loss: 0.1181
 Epoch 14/20 | Loss: 0.0981
 Epoch 15/20 | Loss: 0.0722
 Epoch 16/20 | Loss: 0.0987
 Epoch 17/20 | Loss: 0.1028
 Epoch 18/20 | Loss: 0.0846
 Epoch 19/20 | Loss: 0.0705
 Epoch 20/20 | Loss: 0.0747
 Training Time 11.844669342041016
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 31.97%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 50.07%
 Model : trained_model_15_4.pth
 Epoch 1/20 | Loss: 5.1561
 Epoch 2/20 | Loss: 0.6059
 Epoch 3/20 | Loss: 0.2277
 Epoch 4/20 | Loss: 0.1692
 Epoch 5/20 | Loss: 0.1490
 Epoch 6/20 | Loss: 0.1335
 Epoch 7/20 | Loss: 0.1270
 Epoch 8/20 | Loss: 0.1159

Epoch 9/20 | Loss: 0.1200
 Epoch 10/20 | Loss: 0.0987
 Epoch 11/20 | Loss: 0.1000
 Epoch 12/20 | Loss: 0.0967
 Epoch 13/20 | Loss: 0.0823
 Epoch 14/20 | Loss: 0.0752
 Epoch 15/20 | Loss: 0.0741
 Epoch 16/20 | Loss: 0.0729
 Epoch 17/20 | Loss: 0.0577
 Epoch 18/20 | Loss: 0.0626
 Epoch 19/20 | Loss: 0.0702
 Epoch 20/20 | Loss: 0.0624
 Training Time 17.675637006759644
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 31.98%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 50.53%
 Model : trained_model_20_4.pth
 Epoch 1/20 | Loss: 4.5208
 Epoch 2/20 | Loss: 0.2769
 Epoch 3/20 | Loss: 0.1845
 Epoch 4/20 | Loss: 0.1448
 Epoch 5/20 | Loss: 0.1260
 Epoch 6/20 | Loss: 0.1216
 Epoch 7/20 | Loss: 0.1000
 Epoch 8/20 | Loss: 0.1084
 Epoch 9/20 | Loss: 0.0840
 Epoch 10/20 | Loss: 0.0904
 Epoch 11/20 | Loss: 0.0780
 Epoch 12/20 | Loss: 0.0846
 Epoch 13/20 | Loss: 0.0730
 Epoch 14/20 | Loss: 0.0642
 Epoch 15/20 | Loss: 0.0585
 Epoch 16/20 | Loss: 0.0550
 Epoch 17/20 | Loss: 0.0568
 Epoch 18/20 | Loss: 0.0566
 Epoch 19/20 | Loss: 0.0551
 Epoch 20/20 | Loss: 0.0721
 Training Time 21.835453271865845
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 32.01%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 50.43%
 Model : trained_model_25_4.pth
 Epoch 1/20 | Loss: 3.4998
 Epoch 2/20 | Loss: 0.2096
 Epoch 3/20 | Loss: 0.1618
 Epoch 4/20 | Loss: 0.1249
 Epoch 5/20 | Loss: 0.1010
 Epoch 6/20 | Loss: 0.0968
 Epoch 7/20 | Loss: 0.0873
 Epoch 8/20 | Loss: 0.0801

Epoch 9/20 | Loss: 0.0697
 Epoch 10/20 | Loss: 0.0792
 Epoch 11/20 | Loss: 0.0628
 Epoch 12/20 | Loss: 0.0633
 Epoch 13/20 | Loss: 0.0627
 Epoch 14/20 | Loss: 0.0615
 Epoch 15/20 | Loss: 0.0469
 Epoch 16/20 | Loss: 0.0540
 Epoch 17/20 | Loss: 0.0478
 Epoch 18/20 | Loss: 0.0515
 Epoch 19/20 | Loss: 0.0474
 Epoch 20/20 | Loss: 0.0405
 Training Time 29.285688161849976
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 32.02%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 51.07%
 Updated global Model : updated_global_model_4.pth
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 31.98%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 50.54%
 Iteration: 5
 Global model updated_global_model_4.pth
 Model : trained_model_5_5.pth
 Epoch 1/20 | Loss: 0.4975
 Epoch 2/20 | Loss: 0.4755
 Epoch 3/20 | Loss: 0.4297
 Epoch 4/20 | Loss: 0.3626
 Epoch 5/20 | Loss: 0.3181
 Epoch 6/20 | Loss: 0.2478
 Epoch 7/20 | Loss: 0.2213
 Epoch 8/20 | Loss: 0.2032
 Epoch 9/20 | Loss: 0.1676
 Epoch 10/20 | Loss: 0.1604
 Epoch 11/20 | Loss: 0.0998
 Epoch 12/20 | Loss: 0.1130
 Epoch 13/20 | Loss: 0.1022
 Epoch 14/20 | Loss: 0.0798
 Epoch 15/20 | Loss: 0.0861
 Epoch 16/20 | Loss: 0.0677
 Epoch 17/20 | Loss: 0.0634
 Epoch 18/20 | Loss: 0.0661
 Epoch 19/20 | Loss: 0.0630
 Epoch 20/20 | Loss: 0.0706
 Training Time 7.38347053527832
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 43.58%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 53.18%
 Model : trained_model_10_5.pth
 Epoch 1/20 | Loss: 0.5417
 Epoch 2/20 | Loss: 0.4395
 Epoch 3/20 | Loss: 0.3292

Epoch 4/20 | Loss: 0.2694
Epoch 5/20 | Loss: 0.2100
Epoch 6/20 | Loss: 0.1588
Epoch 7/20 | Loss: 0.1367
Epoch 8/20 | Loss: 0.1334
Epoch 9/20 | Loss: 0.0956
Epoch 10/20 | Loss: 0.1137
Epoch 11/20 | Loss: 0.0927
Epoch 12/20 | Loss: 0.0709
Epoch 13/20 | Loss: 0.0579
Epoch 14/20 | Loss: 0.0537
Epoch 15/20 | Loss: 0.0611
Epoch 16/20 | Loss: 0.0693
Epoch 17/20 | Loss: 0.0442
Epoch 18/20 | Loss: 0.0477
Epoch 19/20 | Loss: 0.0410
Epoch 20/20 | Loss: 0.0467

Training Time 11.749433040618896

Top-1 Accuracy on the ../Dataset/validation_data dataset: 43.34%

Top-3 Accuracy on the ../Dataset/validation_data dataset: 53.95%

Model : trained_model_15_5.pth

Epoch 1/20 | Loss: 0.4893
Epoch 2/20 | Loss: 0.3634
Epoch 3/20 | Loss: 0.2502
Epoch 4/20 | Loss: 0.1732
Epoch 5/20 | Loss: 0.1277
Epoch 6/20 | Loss: 0.1106
Epoch 7/20 | Loss: 0.0862
Epoch 8/20 | Loss: 0.0824
Epoch 9/20 | Loss: 0.0745
Epoch 10/20 | Loss: 0.0742
Epoch 11/20 | Loss: 0.0616
Epoch 12/20 | Loss: 0.0529
Epoch 13/20 | Loss: 0.0509
Epoch 14/20 | Loss: 0.0566
Epoch 15/20 | Loss: 0.0474
Epoch 16/20 | Loss: 0.0452
Epoch 17/20 | Loss: 0.0362
Epoch 18/20 | Loss: 0.0409
Epoch 19/20 | Loss: 0.0350
Epoch 20/20 | Loss: 0.0290

Training Time 17.540384769439697

Top-1 Accuracy on the ../Dataset/validation_data dataset: 42.87%

Top-3 Accuracy on the ../Dataset/validation_data dataset: 53.45%

Model : trained_model_20_5.pth

Epoch 1/20 | Loss: 0.4739
Epoch 2/20 | Loss: 0.3206
Epoch 3/20 | Loss: 0.1896

Epoch 4/20 | Loss: 0.1361
 Epoch 5/20 | Loss: 0.0984
 Epoch 6/20 | Loss: 0.0750
 Epoch 7/20 | Loss: 0.0608
 Epoch 8/20 | Loss: 0.0472
 Epoch 9/20 | Loss: 0.0623
 Epoch 10/20 | Loss: 0.0523
 Epoch 11/20 | Loss: 0.0465
 Epoch 12/20 | Loss: 0.0399
 Epoch 13/20 | Loss: 0.0422
 Epoch 14/20 | Loss: 0.0383
 Epoch 15/20 | Loss: 0.0345
 Epoch 16/20 | Loss: 0.0313
 Epoch 17/20 | Loss: 0.0388
 Epoch 18/20 | Loss: 0.0264
 Epoch 19/20 | Loss: 0.0322
 Epoch 20/20 | Loss: 0.0347
 Training Time 21.827000379562378
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 41.09%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 54.80%
 Model : trained_model_25_5.pth
 Epoch 1/20 | Loss: 0.4444
 Epoch 2/20 | Loss: 0.2559
 Epoch 3/20 | Loss: 0.1634
 Epoch 4/20 | Loss: 0.0994
 Epoch 5/20 | Loss: 0.0754
 Epoch 6/20 | Loss: 0.0643
 Epoch 7/20 | Loss: 0.0610
 Epoch 8/20 | Loss: 0.0561
 Epoch 9/20 | Loss: 0.0471
 Epoch 10/20 | Loss: 0.0425
 Epoch 11/20 | Loss: 0.0441
 Epoch 12/20 | Loss: 0.0401
 Epoch 13/20 | Loss: 0.0353
 Epoch 14/20 | Loss: 0.0405
 Epoch 15/20 | Loss: 0.0337
 Epoch 16/20 | Loss: 0.0359
 Epoch 17/20 | Loss: 0.0306
 Epoch 18/20 | Loss: 0.0401
 Epoch 19/20 | Loss: 0.0295
 Epoch 20/20 | Loss: 0.0250
 Training Time 29.2343966960907
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 40.82%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 54.74%
 Updated global Model : updated_global_model_5.pth
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 42.21%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 54.13%
 Iteration: 6

```

Global model  updated_global_model_5.pth
Model :  trained_model_5_6.pth
Epoch 1/20 | Loss: 6.4411
Epoch 2/20 | Loss: 2.5264
Epoch 3/20 | Loss: 0.3198
Epoch 4/20 | Loss: 0.1183
Epoch 5/20 | Loss: 0.0727
Epoch 6/20 | Loss: 0.0611
Epoch 7/20 | Loss: 0.0567
Epoch 8/20 | Loss: 0.0364
Epoch 9/20 | Loss: 0.0335
Epoch 10/20 | Loss: 0.0376
Epoch 11/20 | Loss: 0.0397
Epoch 12/20 | Loss: 0.0326
Epoch 13/20 | Loss: 0.0250
Epoch 14/20 | Loss: 0.0414
Epoch 15/20 | Loss: 0.0190
Epoch 16/20 | Loss: 0.0298
Epoch 17/20 | Loss: 0.0266
Epoch 18/20 | Loss: 0.0187
Epoch 19/20 | Loss: 0.0197
Epoch 20/20 | Loss: 0.0267
Training Time  7.247140645980835
Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%
Top-3 Accuracy on the ../Dataset/validation_data dataset: 51.28%
Model :  trained_model_10_6.pth
Epoch 1/20 | Loss: 5.1151
Epoch 2/20 | Loss: 0.7635
Epoch 3/20 | Loss: 0.0985
Epoch 4/20 | Loss: 0.0765
Epoch 5/20 | Loss: 0.0655
Epoch 6/20 | Loss: 0.0490
Epoch 7/20 | Loss: 0.0520
Epoch 8/20 | Loss: 0.0364
Epoch 9/20 | Loss: 0.0369
Epoch 10/20 | Loss: 0.0464
Epoch 11/20 | Loss: 0.0375
Epoch 12/20 | Loss: 0.0381
Epoch 13/20 | Loss: 0.0320
Epoch 14/20 | Loss: 0.0402
Epoch 15/20 | Loss: 0.0283
Epoch 16/20 | Loss: 0.0288
Epoch 17/20 | Loss: 0.0256
Epoch 18/20 | Loss: 0.0226
Epoch 19/20 | Loss: 0.0206
Epoch 20/20 | Loss: 0.0222
Training Time  11.858228921890259
Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%

```

Top-3 Accuracy on the ../Dataset/validation_data dataset: 51.10%

Model : trained_model_15_6.pth

Epoch 1/20 | Loss: 3.8978
Epoch 2/20 | Loss: 0.1489
Epoch 3/20 | Loss: 0.0493
Epoch 4/20 | Loss: 0.0537
Epoch 5/20 | Loss: 0.0436
Epoch 6/20 | Loss: 0.0385
Epoch 7/20 | Loss: 0.0358
Epoch 8/20 | Loss: 0.0287
Epoch 9/20 | Loss: 0.0299
Epoch 10/20 | Loss: 0.0259
Epoch 11/20 | Loss: 0.0297
Epoch 12/20 | Loss: 0.0274
Epoch 13/20 | Loss: 0.0201
Epoch 14/20 | Loss: 0.0201
Epoch 15/20 | Loss: 0.0201
Epoch 16/20 | Loss: 0.0243
Epoch 17/20 | Loss: 0.0165
Epoch 18/20 | Loss: 0.0187
Epoch 19/20 | Loss: 0.0227
Epoch 20/20 | Loss: 0.0191

Training Time 17.62905240058899

Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%

Top-3 Accuracy on the ../Dataset/validation_data dataset: 50.16%

Model : trained_model_20_6.pth

Epoch 1/20 | Loss: 3.1583
Epoch 2/20 | Loss: 0.0650
Epoch 3/20 | Loss: 0.0381
Epoch 4/20 | Loss: 0.0351
Epoch 5/20 | Loss: 0.0311
Epoch 6/20 | Loss: 0.0250
Epoch 7/20 | Loss: 0.0203
Epoch 8/20 | Loss: 0.0225
Epoch 9/20 | Loss: 0.0195
Epoch 10/20 | Loss: 0.0261
Epoch 11/20 | Loss: 0.0152
Epoch 12/20 | Loss: 0.0180
Epoch 13/20 | Loss: 0.0175
Epoch 14/20 | Loss: 0.0148
Epoch 15/20 | Loss: 0.0178
Epoch 16/20 | Loss: 0.0155
Epoch 17/20 | Loss: 0.0093

Early Stopping

Training Time 18.255753993988037

Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%

Top-3 Accuracy on the ../Dataset/validation_data dataset: 51.40%

Model : trained_model_25_6.pth

```

Epoch 1/20 | Loss: 2.3970
Epoch 2/20 | Loss: 0.0625
Epoch 3/20 | Loss: 0.0446
Epoch 4/20 | Loss: 0.0337
Epoch 5/20 | Loss: 0.0295
Epoch 6/20 | Loss: 0.0290
Epoch 7/20 | Loss: 0.0223
Epoch 8/20 | Loss: 0.0220
Epoch 9/20 | Loss: 0.0191
Epoch 10/20 | Loss: 0.0172
Epoch 11/20 | Loss: 0.0147
Epoch 12/20 | Loss: 0.0177
Epoch 13/20 | Loss: 0.0125
Epoch 14/20 | Loss: 0.0137
Epoch 15/20 | Loss: 0.0138
Epoch 16/20 | Loss: 0.0131
Epoch 17/20 | Loss: 0.0124
Epoch 18/20 | Loss: 0.0115
Epoch 19/20 | Loss: 0.0110
Epoch 20/20 | Loss: 0.0085
Early Stopping
Training Time 29.576329231262207
Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%
Top-3 Accuracy on the ../Dataset/validation_data dataset: 50.08%
Updated global Model : updated_global_model_6.pth
Top-1 Accuracy on the ../Dataset/validation_data dataset: 16.96%
Top-3 Accuracy on the ../Dataset/validation_data dataset: 51.39%
Iteration: 7
Global model updated_global_model_6.pth
Model : trained_model_5_7.pth
Epoch 1/20 | Loss: 3.5838
Epoch 2/20 | Loss: 2.6292
Epoch 3/20 | Loss: 1.6709
Epoch 4/20 | Loss: 0.8901
Epoch 5/20 | Loss: 0.4021
Epoch 6/20 | Loss: 0.2594
Epoch 7/20 | Loss: 0.2342
Epoch 8/20 | Loss: 0.2057
Epoch 9/20 | Loss: 0.1632
Epoch 10/20 | Loss: 0.2001
Epoch 11/20 | Loss: 0.1718
Epoch 12/20 | Loss: 0.1714
Epoch 13/20 | Loss: 0.1463
Epoch 14/20 | Loss: 0.1517
Epoch 15/20 | Loss: 0.1415
Epoch 16/20 | Loss: 0.1061
Epoch 17/20 | Loss: 0.1442
Epoch 18/20 | Loss: 0.1161

```

Epoch 19/20 | Loss: 0.1174
 Epoch 20/20 | Loss: 0.1301
 Training Time 7.446937561035156
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 41.24%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 68.82%
 Model : trained_model_10_7.pth
 Epoch 1/20 | Loss: 3.4648
 Epoch 2/20 | Loss: 1.7863
 Epoch 3/20 | Loss: 0.5584
 Epoch 4/20 | Loss: 0.2271
 Epoch 5/20 | Loss: 0.1735
 Epoch 6/20 | Loss: 0.1482
 Epoch 7/20 | Loss: 0.1602
 Epoch 8/20 | Loss: 0.1213
 Epoch 9/20 | Loss: 0.1173
 Epoch 10/20 | Loss: 0.1055
 Epoch 11/20 | Loss: 0.1210
 Epoch 12/20 | Loss: 0.0975
 Epoch 13/20 | Loss: 0.0971
 Epoch 14/20 | Loss: 0.1171
 Epoch 15/20 | Loss: 0.1004
 Epoch 16/20 | Loss: 0.1083
 Epoch 17/20 | Loss: 0.0843
 Epoch 18/20 | Loss: 0.0833
 Epoch 19/20 | Loss: 0.0749
 Epoch 20/20 | Loss: 0.0761
 Training Time 11.847095489501953
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 38.55%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 69.94%
 Model : trained_model_15_7.pth
 Epoch 1/20 | Loss: 3.0021
 Epoch 2/20 | Loss: 0.8674
 Epoch 3/20 | Loss: 0.2274
 Epoch 4/20 | Loss: 0.1714
 Epoch 5/20 | Loss: 0.1545
 Epoch 6/20 | Loss: 0.1345
 Epoch 7/20 | Loss: 0.1234
 Epoch 8/20 | Loss: 0.1190
 Epoch 9/20 | Loss: 0.1046
 Epoch 10/20 | Loss: 0.1063
 Epoch 11/20 | Loss: 0.1097
 Epoch 12/20 | Loss: 0.0841
 Epoch 13/20 | Loss: 0.0877
 Epoch 14/20 | Loss: 0.0760
 Epoch 15/20 | Loss: 0.0846
 Epoch 16/20 | Loss: 0.0713
 Epoch 17/20 | Loss: 0.0839
 Epoch 18/20 | Loss: 0.0786

Epoch 19/20 | Loss: 0.0622
 Epoch 20/20 | Loss: 0.0802
 Training Time 17.628785371780396
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 37.51%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 68.80%
 Model : trained_model_20_7.pth
 Epoch 1/20 | Loss: 2.7023
 Epoch 2/20 | Loss: 0.5132
 Epoch 3/20 | Loss: 0.2016
 Epoch 4/20 | Loss: 0.1566
 Epoch 5/20 | Loss: 0.1257
 Epoch 6/20 | Loss: 0.1442
 Epoch 7/20 | Loss: 0.1208
 Epoch 8/20 | Loss: 0.1117
 Epoch 9/20 | Loss: 0.1009
 Epoch 10/20 | Loss: 0.1012
 Epoch 11/20 | Loss: 0.0845
 Epoch 12/20 | Loss: 0.0823
 Epoch 13/20 | Loss: 0.0840
 Epoch 14/20 | Loss: 0.0757
 Epoch 15/20 | Loss: 0.0706
 Epoch 16/20 | Loss: 0.0838
 Epoch 17/20 | Loss: 0.0650
 Epoch 18/20 | Loss: 0.0651
 Epoch 19/20 | Loss: 0.0625
 Epoch 20/20 | Loss: 0.0658
 Training Time 21.652684688568115
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 36.47%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 68.68%
 Model : trained_model_25_7.pth
 Epoch 1/20 | Loss: 2.2638
 Epoch 2/20 | Loss: 0.2626
 Epoch 3/20 | Loss: 0.1649
 Epoch 4/20 | Loss: 0.1276
 Epoch 5/20 | Loss: 0.1206
 Epoch 6/20 | Loss: 0.1244
 Epoch 7/20 | Loss: 0.0930
 Epoch 8/20 | Loss: 0.0892
 Epoch 9/20 | Loss: 0.0901
 Epoch 10/20 | Loss: 0.0781
 Epoch 11/20 | Loss: 0.0808
 Epoch 12/20 | Loss: 0.0786
 Epoch 13/20 | Loss: 0.0880
 Epoch 14/20 | Loss: 0.0660
 Epoch 15/20 | Loss: 0.0566
 Epoch 16/20 | Loss: 0.0686
 Epoch 17/20 | Loss: 0.0554
 Epoch 18/20 | Loss: 0.0616

Epoch 19/20 | Loss: 0.0521
 Epoch 20/20 | Loss: 0.0511
 Training Time 29.455316305160522
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 41.11%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 73.57%
 Updated global Model : updated_global_model_7.pth
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 40.41%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 71.88%
 Iteration: 8
 Global model updated_global_model_7.pth
 Model : trained_model_5_8.pth
 Epoch 1/20 | Loss: 1.4312
 Epoch 2/20 | Loss: 0.6885
 Epoch 3/20 | Loss: 0.2585
 Epoch 4/20 | Loss: 0.1963
 Epoch 5/20 | Loss: 0.1424
 Epoch 6/20 | Loss: 0.1129
 Epoch 7/20 | Loss: 0.0607
 Epoch 8/20 | Loss: 0.0812
 Epoch 9/20 | Loss: 0.0709
 Epoch 10/20 | Loss: 0.0790
 Epoch 11/20 | Loss: 0.0814
 Epoch 12/20 | Loss: 0.0605
 Epoch 13/20 | Loss: 0.0691
 Epoch 14/20 | Loss: 0.0585
 Epoch 15/20 | Loss: 0.0685
 Epoch 16/20 | Loss: 0.0536
 Epoch 17/20 | Loss: 0.0374
 Epoch 18/20 | Loss: 0.0475
 Epoch 19/20 | Loss: 0.0358
 Epoch 20/20 | Loss: 0.0488
 Training Time 7.548370599746704
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 24.62%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 67.62%
 Model : trained_model_10_8.pth
 Epoch 1/20 | Loss: 1.1408
 Epoch 2/20 | Loss: 0.3590
 Epoch 3/20 | Loss: 0.1734
 Epoch 4/20 | Loss: 0.1285
 Epoch 5/20 | Loss: 0.1102
 Epoch 6/20 | Loss: 0.0870
 Epoch 7/20 | Loss: 0.0723
 Epoch 8/20 | Loss: 0.0683
 Epoch 9/20 | Loss: 0.0552
 Epoch 10/20 | Loss: 0.0593
 Epoch 11/20 | Loss: 0.0528
 Epoch 12/20 | Loss: 0.0534
 Epoch 13/20 | Loss: 0.0495

Epoch 14/20 | Loss: 0.0449
 Epoch 15/20 | Loss: 0.0426
 Epoch 16/20 | Loss: 0.0355
 Epoch 17/20 | Loss: 0.0262
 Epoch 18/20 | Loss: 0.0355
 Epoch 19/20 | Loss: 0.0521
 Epoch 20/20 | Loss: 0.0348
 Training Time 11.826012372970581
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 24.95%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 70.89%
 Model : trained_model_15_8.pth
 Epoch 1/20 | Loss: 0.9587
 Epoch 2/20 | Loss: 0.2230
 Epoch 3/20 | Loss: 0.1327
 Epoch 4/20 | Loss: 0.1117
 Epoch 5/20 | Loss: 0.0767
 Epoch 6/20 | Loss: 0.0678
 Epoch 7/20 | Loss: 0.0497
 Epoch 8/20 | Loss: 0.0482
 Epoch 9/20 | Loss: 0.0460
 Epoch 10/20 | Loss: 0.0508
 Epoch 11/20 | Loss: 0.0357
 Epoch 12/20 | Loss: 0.0349
 Epoch 13/20 | Loss: 0.0360
 Epoch 14/20 | Loss: 0.0315
 Epoch 15/20 | Loss: 0.0311
 Epoch 16/20 | Loss: 0.0315
 Epoch 17/20 | Loss: 0.0239
 Epoch 18/20 | Loss: 0.0305
 Epoch 19/20 | Loss: 0.0255
 Epoch 20/20 | Loss: 0.0195
 Training Time 17.694520711898804
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 21.66%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 68.85%
 Model : trained_model_20_8.pth
 Epoch 1/20 | Loss: 0.8026
 Epoch 2/20 | Loss: 0.1456
 Epoch 3/20 | Loss: 0.0998
 Epoch 4/20 | Loss: 0.0652
 Epoch 5/20 | Loss: 0.0639
 Epoch 6/20 | Loss: 0.0554
 Epoch 7/20 | Loss: 0.0413
 Epoch 8/20 | Loss: 0.0401
 Epoch 9/20 | Loss: 0.0414
 Epoch 10/20 | Loss: 0.0321
 Epoch 11/20 | Loss: 0.0345
 Epoch 12/20 | Loss: 0.0300
 Epoch 13/20 | Loss: 0.0279

Epoch 14/20 | Loss: 0.0310
 Epoch 15/20 | Loss: 0.0246
 Epoch 16/20 | Loss: 0.0288
 Epoch 17/20 | Loss: 0.0209
 Epoch 18/20 | Loss: 0.0251
 Epoch 19/20 | Loss: 0.0218
 Epoch 20/20 | Loss: 0.0189
 Training Time 21.971256494522095
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 21.79%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 71.27%
 Model : trained_model_25_8.pth
 Epoch 1/20 | Loss: 0.6533
 Epoch 2/20 | Loss: 0.1201
 Epoch 3/20 | Loss: 0.0768
 Epoch 4/20 | Loss: 0.0666
 Epoch 5/20 | Loss: 0.0570
 Epoch 6/20 | Loss: 0.0396
 Epoch 7/20 | Loss: 0.0354
 Epoch 8/20 | Loss: 0.0343
 Epoch 9/20 | Loss: 0.0277
 Epoch 10/20 | Loss: 0.0358
 Epoch 11/20 | Loss: 0.0308
 Epoch 12/20 | Loss: 0.0277
 Epoch 13/20 | Loss: 0.0203
 Epoch 14/20 | Loss: 0.0200
 Epoch 15/20 | Loss: 0.0203
 Epoch 16/20 | Loss: 0.0182
 Epoch 17/20 | Loss: 0.0196
 Epoch 18/20 | Loss: 0.0144
 Epoch 19/20 | Loss: 0.0155
 Epoch 20/20 | Loss: 0.0171
 Training Time 29.455976009368896
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 17.87%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 70.33%
 Updated global Model : updated_global_model_8.pth
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 20.83%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 70.46%
 Iteration: 9
 Global model updated_global_model_8.pth
 Model : trained_model_5_9.pth
 Epoch 1/20 | Loss: 6.0993
 Epoch 2/20 | Loss: 4.5339
 Epoch 3/20 | Loss: 2.6251
 Epoch 4/20 | Loss: 1.1816
 Epoch 5/20 | Loss: 0.4116
 Epoch 6/20 | Loss: 0.2869
 Epoch 7/20 | Loss: 0.2395
 Epoch 8/20 | Loss: 0.1915

Epoch 9/20 | Loss: 0.1679
 Epoch 10/20 | Loss: 0.1717
 Epoch 11/20 | Loss: 0.1518
 Epoch 12/20 | Loss: 0.1866
 Epoch 13/20 | Loss: 0.1596
 Epoch 14/20 | Loss: 0.1567
 Epoch 15/20 | Loss: 0.1305
 Epoch 16/20 | Loss: 0.1663
 Epoch 17/20 | Loss: 0.1431
 Epoch 18/20 | Loss: 0.1445
 Epoch 19/20 | Loss: 0.1359
 Epoch 20/20 | Loss: 0.1293
 Training Time 7.453106880187988
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 33.77%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 74.06%
 Model : trained_model_10_9.pth
 Epoch 1/20 | Loss: 5.7545
 Epoch 2/20 | Loss: 2.8719
 Epoch 3/20 | Loss: 0.6528
 Epoch 4/20 | Loss: 0.2858
 Epoch 5/20 | Loss: 0.2102
 Epoch 6/20 | Loss: 0.1984
 Epoch 7/20 | Loss: 0.1869
 Epoch 8/20 | Loss: 0.1652
 Epoch 9/20 | Loss: 0.1717
 Epoch 10/20 | Loss: 0.1610
 Epoch 11/20 | Loss: 0.1480
 Epoch 12/20 | Loss: 0.1481
 Epoch 13/20 | Loss: 0.1308
 Epoch 14/20 | Loss: 0.1234
 Epoch 15/20 | Loss: 0.1235
 Epoch 16/20 | Loss: 0.1107
 Epoch 17/20 | Loss: 0.1158
 Epoch 18/20 | Loss: 0.1085
 Epoch 19/20 | Loss: 0.1110
 Epoch 20/20 | Loss: 0.1064
 Training Time 11.79749321937561
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 33.75%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 74.41%
 Model : trained_model_15_9.pth
 Epoch 1/20 | Loss: 4.9971
 Epoch 2/20 | Loss: 1.2789
 Epoch 3/20 | Loss: 0.2733
 Epoch 4/20 | Loss: 0.1874
 Epoch 5/20 | Loss: 0.1897
 Epoch 6/20 | Loss: 0.1596
 Epoch 7/20 | Loss: 0.1552
 Epoch 8/20 | Loss: 0.1462

Epoch 9/20 | Loss: 0.1222
 Epoch 10/20 | Loss: 0.1145
 Epoch 11/20 | Loss: 0.1212
 Epoch 12/20 | Loss: 0.1106
 Epoch 13/20 | Loss: 0.1126
 Epoch 14/20 | Loss: 0.1022
 Epoch 15/20 | Loss: 0.1014
 Epoch 16/20 | Loss: 0.1050
 Epoch 17/20 | Loss: 0.0939
 Epoch 18/20 | Loss: 0.0844
 Epoch 19/20 | Loss: 0.0743
 Epoch 20/20 | Loss: 0.0776
 Training Time 17.529508352279663
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 33.60%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 73.26%
 Model : trained_model_20_9.pth
 Epoch 1/20 | Loss: 4.3940
 Epoch 2/20 | Loss: 0.7803
 Epoch 3/20 | Loss: 0.2026
 Epoch 4/20 | Loss: 0.1830
 Epoch 5/20 | Loss: 0.1622
 Epoch 6/20 | Loss: 0.1527
 Epoch 7/20 | Loss: 0.1417
 Epoch 8/20 | Loss: 0.1251
 Epoch 9/20 | Loss: 0.1174
 Epoch 10/20 | Loss: 0.1040
 Epoch 11/20 | Loss: 0.1128
 Epoch 12/20 | Loss: 0.1057
 Epoch 13/20 | Loss: 0.1060
 Epoch 14/20 | Loss: 0.0861
 Epoch 15/20 | Loss: 0.0925
 Epoch 16/20 | Loss: 0.0877
 Epoch 17/20 | Loss: 0.0770
 Epoch 18/20 | Loss: 0.0760
 Epoch 19/20 | Loss: 0.0798
 Epoch 20/20 | Loss: 0.0788
 Training Time 21.652093410491943
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 33.67%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 78.03%
 Model : trained_model_25_9.pth
 Epoch 1/20 | Loss: 3.7376
 Epoch 2/20 | Loss: 0.2864
 Epoch 3/20 | Loss: 0.1858
 Epoch 4/20 | Loss: 0.1619
 Epoch 5/20 | Loss: 0.1443
 Epoch 6/20 | Loss: 0.1244
 Epoch 7/20 | Loss: 0.1202
 Epoch 8/20 | Loss: 0.1090

Epoch 9/20 | Loss: 0.0992
 Epoch 10/20 | Loss: 0.1004
 Epoch 11/20 | Loss: 0.0866
 Epoch 12/20 | Loss: 0.0875
 Epoch 13/20 | Loss: 0.0832
 Epoch 14/20 | Loss: 0.0744
 Epoch 15/20 | Loss: 0.0735
 Epoch 16/20 | Loss: 0.0720
 Epoch 17/20 | Loss: 0.0725
 Epoch 18/20 | Loss: 0.0673
 Epoch 19/20 | Loss: 0.0694
 Epoch 20/20 | Loss: 0.0659
 Training Time 29.384427547454834
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 33.44%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 70.27%
 Updated global Model : updated_global_model_9.pth
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 33.58%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 74.06%
 Iteration: 10
 Global model updated_global_model_9.pth
 Model : trained_model_5_10.pth
 Epoch 1/20 | Loss: 0.2011
 Epoch 2/20 | Loss: 0.1406
 Epoch 3/20 | Loss: 0.1150
 Epoch 4/20 | Loss: 0.0819
 Epoch 5/20 | Loss: 0.0781
 Epoch 6/20 | Loss: 0.0758
 Epoch 7/20 | Loss: 0.0553
 Epoch 8/20 | Loss: 0.0619
 Epoch 9/20 | Loss: 0.0561
 Epoch 10/20 | Loss: 0.0380
 Epoch 11/20 | Loss: 0.0421
 Epoch 12/20 | Loss: 0.0385
 Epoch 13/20 | Loss: 0.0422
 Epoch 14/20 | Loss: 0.0376
 Epoch 15/20 | Loss: 0.0302
 Epoch 16/20 | Loss: 0.0315
 Epoch 17/20 | Loss: 0.0293
 Epoch 18/20 | Loss: 0.0288
 Epoch 19/20 | Loss: 0.0285
 Epoch 20/20 | Loss: 0.0258
 Training Time 7.523771286010742
 Top-1 Accuracy on the ../Dataset/validation_data dataset: 32.00%
 Top-3 Accuracy on the ../Dataset/validation_data dataset: 48.94%
 Model : trained_model_10_10.pth
 Epoch 1/20 | Loss: 0.2031
 Epoch 2/20 | Loss: 0.1379
 Epoch 3/20 | Loss: 0.0977

Epoch 4/20 | Loss: 0.0774
Epoch 5/20 | Loss: 0.0646
Epoch 6/20 | Loss: 0.0683
Epoch 7/20 | Loss: 0.0562
Epoch 8/20 | Loss: 0.0547
Epoch 9/20 | Loss: 0.0457
Epoch 10/20 | Loss: 0.0516
Epoch 11/20 | Loss: 0.0495
Epoch 12/20 | Loss: 0.0407
Epoch 13/20 | Loss: 0.0334
Epoch 14/20 | Loss: 0.0381
Epoch 15/20 | Loss: 0.0280
Epoch 16/20 | Loss: 0.0320
Epoch 17/20 | Loss: 0.0277
Epoch 18/20 | Loss: 0.0269
Epoch 19/20 | Loss: 0.0341
Epoch 20/20 | Loss: 0.0269

Training Time 11.792267322540283

Top-1 Accuracy on the ../Dataset/validation_data dataset: 30.85%

Top-3 Accuracy on the ../Dataset/validation_data dataset: 49.69%

Model : trained_model_15_10.pth

Epoch 1/20 | Loss: 0.1798
Epoch 2/20 | Loss: 0.1105
Epoch 3/20 | Loss: 0.0823
Epoch 4/20 | Loss: 0.0665
Epoch 5/20 | Loss: 0.0526
Epoch 6/20 | Loss: 0.0501
Epoch 7/20 | Loss: 0.0458
Epoch 8/20 | Loss: 0.0375
Epoch 9/20 | Loss: 0.0420
Epoch 10/20 | Loss: 0.0398
Epoch 11/20 | Loss: 0.0344
Epoch 12/20 | Loss: 0.0298
Epoch 13/20 | Loss: 0.0318
Epoch 14/20 | Loss: 0.0260
Epoch 15/20 | Loss: 0.0251
Epoch 16/20 | Loss: 0.0235
Epoch 17/20 | Loss: 0.0251
Epoch 18/20 | Loss: 0.0224
Epoch 19/20 | Loss: 0.0185
Epoch 20/20 | Loss: 0.0214

Training Time 17.41605257987976

Top-1 Accuracy on the ../Dataset/validation_data dataset: 29.78%

Top-3 Accuracy on the ../Dataset/validation_data dataset: 50.49%

Model : trained_model_20_10.pth

Epoch 1/20 | Loss: 0.1715
Epoch 2/20 | Loss: 0.1016
Epoch 3/20 | Loss: 0.0696

Epoch 4/20 | Loss: 0.0606
Epoch 5/20 | Loss: 0.0552
Epoch 6/20 | Loss: 0.0459
Epoch 7/20 | Loss: 0.0404
Epoch 8/20 | Loss: 0.0340
Epoch 9/20 | Loss: 0.0315
Epoch 10/20 | Loss: 0.0321
Epoch 11/20 | Loss: 0.0296
Epoch 12/20 | Loss: 0.0265
Epoch 13/20 | Loss: 0.0257
Epoch 14/20 | Loss: 0.0243
Epoch 15/20 | Loss: 0.0192
Epoch 16/20 | Loss: 0.0213
Epoch 17/20 | Loss: 0.0242
Epoch 18/20 | Loss: 0.0189
Epoch 19/20 | Loss: 0.0172
Epoch 20/20 | Loss: 0.0203

Training Time 21.625617504119873

Top-1 Accuracy on the ../Dataset/validation_data dataset: 30.11%

Top-3 Accuracy on the ../Dataset/validation_data dataset: 50.69%

Model : trained_model_25_10.pth

Epoch 1/20 | Loss: 0.1541
Epoch 2/20 | Loss: 0.0826
Epoch 3/20 | Loss: 0.0547
Epoch 4/20 | Loss: 0.0484
Epoch 5/20 | Loss: 0.0412
Epoch 6/20 | Loss: 0.0350
Epoch 7/20 | Loss: 0.0305
Epoch 8/20 | Loss: 0.0265
Epoch 9/20 | Loss: 0.0270
Epoch 10/20 | Loss: 0.0210
Epoch 11/20 | Loss: 0.0204
Epoch 12/20 | Loss: 0.0219
Epoch 13/20 | Loss: 0.0188
Epoch 14/20 | Loss: 0.0192
Epoch 15/20 | Loss: 0.0190
Epoch 16/20 | Loss: 0.0159
Epoch 17/20 | Loss: 0.0163
Epoch 18/20 | Loss: 0.0152
Epoch 19/20 | Loss: 0.0136
Epoch 20/20 | Loss: 0.0156

Training Time 29.440067291259766

Top-1 Accuracy on the ../Dataset/validation_data dataset: 26.11%

Top-3 Accuracy on the ../Dataset/validation_data dataset: 49.40%

Updated global Model : updated_global_model_10.pth

Top-1 Accuracy on the ../Dataset/validation_data dataset: 29.48%

Top-3 Accuracy on the ../Dataset/validation_data dataset: 50.20%


```
[15]: test_model('../Dataset/test_data', global_model_name)
```

```
Top-1 Accuracy on the ../Dataset/test_data dataset: 29.48%
```

```
Top-3 Accuracy on the ../Dataset/test_data dataset: 50.40%
```

```
[ ]:
```