```
In [ ]:
```

```python
import torch
import torchvision
import torch.nn as nn
import torch.optim as optim
import tensorflow as tf
import numpy as np
from torchvision import datasets, transforms
from matplotlib import pyplot as plt
from torch.utils.data import DataLoader
import os
from tensorflow import keras

from google.colab import drive
drive.mount('sample_data/drive')
```

```
Mounted at sample_data/drive
```

```
In [ ]:
```

```python
!unzip "sample_data/drive/MyDrive/Colab Notebooks/Lab_4/face-HQ.zip" -d "sample_data/drive
/MyDrive/Colab Notebooks/Lab_4"
```

```
Archive:  sample_data/drive/MyDrive/Colab Notebooks/Lab_4/face-HQ.zip
replace sample_data/drive/MyDrive/Colab Notebooks/Lab_4/face-HQ/test/1/39175.png? [y]es, [
n]o, [A]ll, [N]one, [r]ename: N
N
```

```
In [ ]:
```

```python
batch_size = 32
epochs = 300
```

```
In [ ]:
```

```python
learning_rate = .001
```

```
In [ ]:
```

```python
train_dir = "sample_data/drive/MyDrive/Colab Notebooks/Lab_4/face-HQ/train"
test_dir = "sample_data/drive/MyDrive/Colab Notebooks/Lab_4/face-HQ/test"

train_transforms = transforms.Compose([transforms.ToTensor(),])
test_transforms = transforms.Compose([transforms.ToTensor(),])

train_val_data = datasets.ImageFolder(train_dir, transform = train_transforms)


train_data, validation_data = torch.utils.data.random_split(dataset = train_val_data, leng
ths = [2000, 700])
test_data = datasets.ImageFolder(test_dir, transform = test_transforms)

train_loader = torch.utils.data.DataLoader(train_data, batch_size = batch_size, shuffle =
True)
validation_loader = torch.utils.data.DataLoader(validation_data, batch_size = batch_size,
shuffle = False)
test_loader = torch.utils.data.DataLoader(test_data, batch_size = batch_size, shuffle = Fa
lse)
```

```
In [ ]:
```

```python
#Test Grayscale Conversion
for data, target in train_loader:
  print(data.shape)
  #data = tf.image.rgb_to_grayscale(data[0].permute(1,2,0))
  gray_convert = transforms.Grayscale(num_output_channels = 3)
  gray_data = gray_convert(data)
  print(gray_data.shape)
```
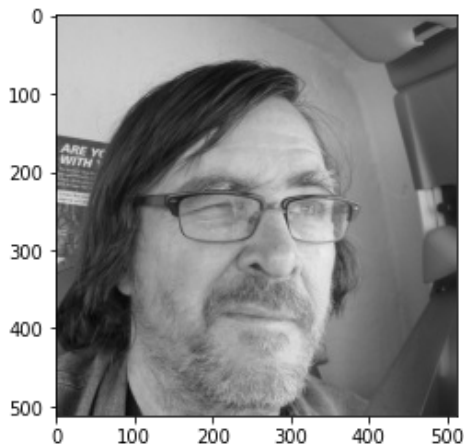
```
    data.numpy()
    gray_data.numpy()
    plt.imshow(np.transpose(data[0].reshape((3,512,512)), (1,2,0)))
    plt.imshow(np.transpose(gray_data[0].reshape((3,512,512)), (1,2,0)))
    break
```

```
torch.Size([32, 3, 512, 512])
torch.Size([32, 3, 512, 512])
```


In [ ]:

```python
class Autoencoder(nn.Module):
  def __init__(self):
    super(Autoencoder, self).__init__()

    self.encoder = nn.Sequential(
        nn.Conv2d(3,12,4, stride = 2, padding = 1),
        nn.ReLU(),
        nn.Conv2d(12,24,4, stride = 2, padding = 1),
        nn.ReLU(),
        nn.Conv2d(24,48,4, stride = 2, padding = 1),
        nn.ReLU(),
        nn.Conv2d(48,96,4, stride = 2, padding = 1),
        nn.ReLU(),
        nn.Conv2d(96,192,4, stride = 2, padding = 1),
        nn.ReLU(),
        nn.Conv2d(192,384,4, stride = 2, padding = 1),
        nn.ReLU(),
        #nn.Conv2d(384,768,4, stride = 2, padding = 1),
        #nn.ReLU(),
        #nn.Conv2d(768,1536,4, stride = 2, padding = 1),
        #nn.ReLU(),
        #nn.Conv2d(1536,3072,4, stride = 2, padding = 1),
        #nn.ReLU(),
        #nn.Conv2d(3072,6144,4, stride = 2, padding = 1),
        #nn.ReLU(),
    )

    self.decoder = nn.Sequential(
        #nn.ConvTranspose2d(6144,3072,4,stride = 2, padding = 1),
        #nn.ReLU(),
        #nn.ConvTranspose2d(3072,1536,4,stride = 2, padding = 1),
        #nn.ReLU(),
        #nn.ConvTranspose2d(1536,768,4,stride = 2, padding = 1),
        #nn.ReLU(),
        #nn.ConvTranspose2d(768,384,4,stride = 2, padding = 1),
        #nn.ReLU(),
        nn.ConvTranspose2d(384,192,4,stride = 2, padding = 1),
        nn.ReLU(),

        nn.ConvTranspose2d(192,96,4,stride = 2, padding = 1),
        nn.ReLU(),
        nn.ConvTranspose2d(96,48,4,stride = 2, padding = 1),
        nn.ReLU(),
        nn.ConvTranspose2d(48,24,4,stride = 2, padding = 1),
```

```python
            nn.ReLU(),
            nn.ConvTranspose2d(24,12,4,stride = 2, padding = 1),
            nn.ReLU(),
            nn.ConvTranspose2d(12,3,4,stride = 2, padding = 1),
            nn.Sigmoid(),
        )

    def forward(self, x):
        encoded = self.encoder(x)
        decoded = self.decoder(encoded)
        return decoded
```

In [ ]:

```python
path = "sample_data/drive/MyDrive/Colab Notebooks/Lab_4/Lab_4_Pro/checkpoint_pro"
device = torch.device('cuda:0')
net = Autoencoder().to(device)

for layer in net.modules():
    if isinstance(layer, nn.Conv2d):
        nn.init.kaiming_normal_(layer.weight, mode = 'fan_out')

criterion = nn.MSELoss().to(device)
optimizer = optim.Adam(net.parameters(), lr = learning_rate)
scheduler = torch.optim.lr_scheduler.ReduceLROnPlateau(optimizer, mode = 'min', patience =
30, verbose = True)
#scheduler = torch.optim.lr_scheduler.MultiStepLR(optimizer, milestones = [120, 160, 200],
gamma = 0.5)

# After first trials comment in the following lines
#checkpoint = torch.load(path)
#net.load_state_dict(checkpoint['model_state_dict'])
#net.eval()
#net.to(device)
#optimizer.load_state_dict(checkpoint['optimizer_state_dict'])
#epoch = checkpoint['epoch']
#val_loss = checkpoint['val_loss']
#train_loss = checkpoint['train_loss']
```

In [ ]:

```python
gray_convert = transforms.Grayscale(num_output_channels = 3)
for epoch in range(epochs):
    train_loss = 0
    val_loss = 0
    net.train()

    for data, target in train_loader:
        gray_data = gray_convert(data).to(device)
        data = data.to(device)

        outputs = net(gray_data)
        loss = criterion(outputs, data)
        optimizer.zero_grad()
        loss.backward()
        optimizer.step()
        train_loss += loss.data

    scheduler.step(loss)
    net.eval()
    with torch.no_grad():
        for data, target in validation_loader:
            data = data.to(device)
            outputs = net(data)
            loss = criterion(outputs, data)
            val_loss += loss.data


    torch.save({'epoch': epoch+1,
                'model_state_dict': net.state_dict(),
                'optimizer_state_dict': optimizer.state_dict(),
                'val_loss': val_loss,
```

```
                    'train_loss':train_loss}, path)

    print("Train Epochs: {}  Train Loss: {:.6f}  Validation Loss: {:.6f}  ".format(epoch+1,
train_loss/len(train_loader), val_loss/len(validation_loader)))
    #writer.add_scalars('Loss', {'training loss': train_loss/len(train_loader), 'validation
loss': val_loss/len(validation_loader)}, epoch + 1)
```

```
Train Epochs: 1   Train Loss: 0.066925   Validation Loss: 0.045031
Train Epochs: 2   Train Loss: 0.023136   Validation Loss: 0.026082
Train Epochs: 3   Train Loss: 0.015403   Validation Loss: 0.020341
Train Epochs: 4   Train Loss: 0.013219   Validation Loss: 0.016516
Train Epochs: 5   Train Loss: 0.011865   Validation Loss: 0.014921
Train Epochs: 6   Train Loss: 0.011337   Validation Loss: 0.013874
Train Epochs: 7   Train Loss: 0.011056   Validation Loss: 0.013749
Train Epochs: 8   Train Loss: 0.010400   Validation Loss: 0.013999
Train Epochs: 9   Train Loss: 0.010040   Validation Loss: 0.014262
Train Epochs: 10   Train Loss: 0.009844   Validation Loss: 0.013562
Train Epochs: 11   Train Loss: 0.009883   Validation Loss: 0.016165
Train Epochs: 12   Train Loss: 0.009697   Validation Loss: 0.012647
Train Epochs: 13   Train Loss: 0.009461   Validation Loss: 0.013195
Train Epochs: 14   Train Loss: 0.009353   Validation Loss: 0.014582
Train Epochs: 15   Train Loss: 0.009219   Validation Loss: 0.012970
Train Epochs: 16   Train Loss: 0.009087   Validation Loss: 0.012131
Train Epochs: 17   Train Loss: 0.009103   Validation Loss: 0.012310
Train Epochs: 18   Train Loss: 0.009129   Validation Loss: 0.011887
Train Epochs: 19   Train Loss: 0.008965   Validation Loss: 0.012521
Train Epochs: 20   Train Loss: 0.008705   Validation Loss: 0.012803
Train Epochs: 21   Train Loss: 0.008764   Validation Loss: 0.012432
Train Epochs: 22   Train Loss: 0.008578   Validation Loss: 0.013923
Train Epochs: 23   Train Loss: 0.008522   Validation Loss: 0.012417
Train Epochs: 24   Train Loss: 0.008532   Validation Loss: 0.011349
Train Epochs: 25   Train Loss: 0.008439   Validation Loss: 0.013175
Train Epochs: 26   Train Loss: 0.008299   Validation Loss: 0.011405
Train Epochs: 27   Train Loss: 0.008266   Validation Loss: 0.010696
Train Epochs: 28   Train Loss: 0.008099   Validation Loss: 0.012388
Train Epochs: 29   Train Loss: 0.007965   Validation Loss: 0.012638
Train Epochs: 30   Train Loss: 0.007956   Validation Loss: 0.011817
Train Epochs: 31   Train Loss: 0.007713   Validation Loss: 0.012077
Train Epochs: 32   Train Loss: 0.007748   Validation Loss: 0.012876
Train Epochs: 33   Train Loss: 0.007527   Validation Loss: 0.011597
Train Epochs: 34   Train Loss: 0.007240   Validation Loss: 0.012176
Train Epochs: 35   Train Loss: 0.007121   Validation Loss: 0.012572
Train Epochs: 36   Train Loss: 0.006931   Validation Loss: 0.011204
Train Epochs: 37   Train Loss: 0.006816   Validation Loss: 0.012062
Train Epochs: 38   Train Loss: 0.006549   Validation Loss: 0.013365
Train Epochs: 39   Train Loss: 0.006529   Validation Loss: 0.012594
Train Epochs: 40   Train Loss: 0.006313   Validation Loss: 0.012013
Train Epochs: 41   Train Loss: 0.006230   Validation Loss: 0.012714
Train Epochs: 42   Train Loss: 0.005987   Validation Loss: 0.013638
Train Epochs: 43   Train Loss: 0.005895   Validation Loss: 0.011468
Train Epochs: 44   Train Loss: 0.005643   Validation Loss: 0.012973
Train Epochs: 45   Train Loss: 0.005834   Validation Loss: 0.011683
Train Epochs: 46   Train Loss: 0.005511   Validation Loss: 0.011570
Train Epochs: 47   Train Loss: 0.005356   Validation Loss: 0.012863
Train Epochs: 48   Train Loss: 0.005306   Validation Loss: 0.011485
Train Epochs: 49   Train Loss: 0.005175   Validation Loss: 0.012176
Train Epochs: 50   Train Loss: 0.005033   Validation Loss: 0.012163
Train Epochs: 51   Train Loss: 0.005035   Validation Loss: 0.012094
Train Epochs: 52   Train Loss: 0.004975   Validation Loss: 0.012124
Train Epochs: 53   Train Loss: 0.004984   Validation Loss: 0.011329
Train Epochs: 54   Train Loss: 0.004964   Validation Loss: 0.011514
Train Epochs: 55   Train Loss: 0.005126   Validation Loss: 0.012296
Train Epochs: 56   Train Loss: 0.004809   Validation Loss: 0.011828
Train Epochs: 57   Train Loss: 0.004776   Validation Loss: 0.012513
Train Epochs: 58   Train Loss: 0.004749   Validation Loss: 0.011587
Train Epochs: 59   Train Loss: 0.004629   Validation Loss: 0.011534
Train Epochs: 60   Train Loss: 0.004586   Validation Loss: 0.011566
Train Epochs: 61   Train Loss: 0.004478   Validation Loss: 0.012688
Train Epochs: 62   Train Loss: 0.004587   Validation Loss: 0.011505
Train Epochs: 63   Train Loss: 0.004573   Validation Loss: 0.011894
Train Epochs: 64   Train Loss: 0.004481   Validation Loss: 0.011568
Train Epochs: 65   Train Loss: 0.004461   Validation Loss: 0.011198
Train Epochs: 66   Train Loss: 0.004411   Validation Loss: 0.011947
```

```
Train Epochs: 67   Train Loss: 0.004469   Validation Loss: 0.011442
Train Epochs: 68   Train Loss: 0.004372   Validation Loss: 0.011927
Train Epochs: 69   Train Loss: 0.004283   Validation Loss: 0.011785
Train Epochs: 70   Train Loss: 0.004242   Validation Loss: 0.012450
Train Epochs: 71   Train Loss: 0.004270   Validation Loss: 0.011938
Train Epochs: 72   Train Loss: 0.004225   Validation Loss: 0.012227
Train Epochs: 73   Train Loss: 0.004223   Validation Loss: 0.011816
Train Epochs: 74   Train Loss: 0.004193   Validation Loss: 0.011709
Train Epochs: 75   Train Loss: 0.004196   Validation Loss: 0.012861
Train Epochs: 76   Train Loss: 0.004064   Validation Loss: 0.011697
Train Epochs: 77   Train Loss: 0.004133   Validation Loss: 0.011875
Train Epochs: 78   Train Loss: 0.004022   Validation Loss: 0.011437
Train Epochs: 79   Train Loss: 0.003980   Validation Loss: 0.011860
Train Epochs: 80   Train Loss: 0.004031   Validation Loss: 0.011078
Train Epochs: 81   Train Loss: 0.003980   Validation Loss: 0.011355
Train Epochs: 82   Train Loss: 0.003871   Validation Loss: 0.011313
Train Epochs: 83   Train Loss: 0.003840   Validation Loss: 0.011676
Train Epochs: 84   Train Loss: 0.003807   Validation Loss: 0.011857
Train Epochs: 85   Train Loss: 0.003714   Validation Loss: 0.011182
Train Epochs: 86   Train Loss: 0.003682   Validation Loss: 0.011637
Train Epochs: 87   Train Loss: 0.003637   Validation Loss: 0.011114
Train Epochs: 88   Train Loss: 0.003615   Validation Loss: 0.011807
Train Epochs: 89   Train Loss: 0.003629   Validation Loss: 0.011540
Train Epochs: 90   Train Loss: 0.003789   Validation Loss: 0.010770
Train Epochs: 91   Train Loss: 0.003617   Validation Loss: 0.011455
Train Epochs: 92   Train Loss: 0.003550   Validation Loss: 0.011525
Train Epochs: 93   Train Loss: 0.003514   Validation Loss: 0.010908
Train Epochs: 94   Train Loss: 0.003614   Validation Loss: 0.011257
Train Epochs: 95   Train Loss: 0.003454   Validation Loss: 0.011341
Train Epochs: 96   Train Loss: 0.003435   Validation Loss: 0.010840
Train Epochs: 97   Train Loss: 0.003442   Validation Loss: 0.011353
Train Epochs: 98   Train Loss: 0.003353   Validation Loss: 0.011526
Train Epochs: 99   Train Loss: 0.003396   Validation Loss: 0.011592
Train Epochs: 100   Train Loss: 0.003360   Validation Loss: 0.011384
Train Epochs: 101   Train Loss: 0.003399   Validation Loss: 0.011076
Train Epochs: 102   Train Loss: 0.003390   Validation Loss: 0.011514
Train Epochs: 103   Train Loss: 0.003304   Validation Loss: 0.011985
Train Epochs: 104   Train Loss: 0.003274   Validation Loss: 0.010967
Train Epochs: 105   Train Loss: 0.003271   Validation Loss: 0.011324
Train Epochs: 106   Train Loss: 0.003320   Validation Loss: 0.011606
Train Epochs: 107   Train Loss: 0.003373   Validation Loss: 0.011972
Train Epochs: 108   Train Loss: 0.003289   Validation Loss: 0.011633
Train Epochs: 109   Train Loss: 0.003214   Validation Loss: 0.011600
Train Epochs: 110   Train Loss: 0.003177   Validation Loss: 0.011638
Train Epochs: 111   Train Loss: 0.003313   Validation Loss: 0.011468
Train Epochs: 112   Train Loss: 0.003177   Validation Loss: 0.011266
Train Epochs: 113   Train Loss: 0.003290   Validation Loss: 0.011844
Train Epochs: 114   Train Loss: 0.003125   Validation Loss: 0.012236
Train Epochs: 115   Train Loss: 0.003174   Validation Loss: 0.011407
Train Epochs: 116   Train Loss: 0.003085   Validation Loss: 0.011913
Train Epochs: 117   Train Loss: 0.003094   Validation Loss: 0.010803
Train Epochs: 118   Train Loss: 0.003186   Validation Loss: 0.011427
Train Epochs: 119   Train Loss: 0.003135   Validation Loss: 0.012582
Train Epochs: 120   Train Loss: 0.003107   Validation Loss: 0.011111
Train Epochs: 121   Train Loss: 0.003054   Validation Loss: 0.011793
Train Epochs: 122   Train Loss: 0.003159   Validation Loss: 0.011317
Train Epochs: 123   Train Loss: 0.003101   Validation Loss: 0.011287
Train Epochs: 124   Train Loss: 0.003041   Validation Loss: 0.011432
Train Epochs: 125   Train Loss: 0.002996   Validation Loss: 0.011629
Train Epochs: 126   Train Loss: 0.002994   Validation Loss: 0.011415
Train Epochs: 127   Train Loss: 0.003096   Validation Loss: 0.012508
Train Epochs: 128   Train Loss: 0.003081   Validation Loss: 0.011447
Train Epochs: 129   Train Loss: 0.002989   Validation Loss: 0.012509
Train Epochs: 130   Train Loss: 0.003034   Validation Loss: 0.011452
Train Epochs: 131   Train Loss: 0.002929   Validation Loss: 0.012273
Train Epochs: 132   Train Loss: 0.003137   Validation Loss: 0.011155
Train Epochs: 133   Train Loss: 0.002954   Validation Loss: 0.011201
Train Epochs: 134   Train Loss: 0.002902   Validation Loss: 0.011256
Train Epochs: 135   Train Loss: 0.002979   Validation Loss: 0.011297
Train Epochs: 136   Train Loss: 0.003004   Validation Loss: 0.011250
Train Epochs: 137   Train Loss: 0.003109   Validation Loss: 0.011022
Train Epochs: 138   Train Loss: 0.002939   Validation Loss: 0.011448
Train Epochs: 139   Train Loss: 0.002902   Validation Loss: 0.011578
```

```
Train Epochs: 140   Train Loss: 0.002971   Validation Loss: 0.011389
Train Epochs: 141   Train Loss: 0.002881   Validation Loss: 0.011389
Train Epochs: 142   Train Loss: 0.002855   Validation Loss: 0.011179
Train Epochs: 143   Train Loss: 0.002870   Validation Loss: 0.011409
Train Epochs: 144   Train Loss: 0.002855   Validation Loss: 0.011861
Train Epochs: 145   Train Loss: 0.002912   Validation Loss: 0.011051
Train Epochs: 146   Train Loss: 0.002924   Validation Loss: 0.011627
Train Epochs: 147   Train Loss: 0.002928   Validation Loss: 0.012420
Train Epochs: 148   Train Loss: 0.002891   Validation Loss: 0.011881
Train Epochs: 149   Train Loss: 0.002876   Validation Loss: 0.011421
Train Epochs: 150   Train Loss: 0.002799   Validation Loss: 0.010940
Train Epochs: 151   Train Loss: 0.002801   Validation Loss: 0.010926
Train Epochs: 152   Train Loss: 0.002899   Validation Loss: 0.011652
Train Epochs: 153   Train Loss: 0.002858   Validation Loss: 0.011338
Train Epochs: 154   Train Loss: 0.002740   Validation Loss: 0.011504
Train Epochs: 155   Train Loss: 0.002745   Validation Loss: 0.011425
Train Epochs: 156   Train Loss: 0.002898   Validation Loss: 0.011698
Train Epochs: 157   Train Loss: 0.002924   Validation Loss: 0.011290
Train Epochs: 158   Train Loss: 0.002816   Validation Loss: 0.011004
Train Epochs: 159   Train Loss: 0.002792   Validation Loss: 0.011507
Train Epochs: 160   Train Loss: 0.002737   Validation Loss: 0.011363
Train Epochs: 161   Train Loss: 0.002717   Validation Loss: 0.011239
Train Epochs: 162   Train Loss: 0.002749   Validation Loss: 0.011163
Train Epochs: 163   Train Loss: 0.003038   Validation Loss: 0.011067
Train Epochs: 164   Train Loss: 0.002843   Validation Loss: 0.011215
Train Epochs: 165   Train Loss: 0.002778   Validation Loss: 0.011136
Train Epochs: 166   Train Loss: 0.002712   Validation Loss: 0.011418
Train Epochs: 167   Train Loss: 0.002687   Validation Loss: 0.011499
Train Epochs: 168   Train Loss: 0.002711   Validation Loss: 0.012267
Train Epochs: 169   Train Loss: 0.002813   Validation Loss: 0.011187
Train Epochs: 170   Train Loss: 0.002691   Validation Loss: 0.011900
Epoch   171: reducing learning rate of group 0 to 1.0000e-04.
Train Epochs: 171   Train Loss: 0.002707   Validation Loss: 0.011470
Train Epochs: 172   Train Loss: 0.002562   Validation Loss: 0.011321
Train Epochs: 173   Train Loss: 0.002534   Validation Loss: 0.011436
Train Epochs: 174   Train Loss: 0.002525   Validation Loss: 0.011386
Train Epochs: 175   Train Loss: 0.002515   Validation Loss: 0.011413
Train Epochs: 176   Train Loss: 0.002510   Validation Loss: 0.011427
Train Epochs: 177   Train Loss: 0.002506   Validation Loss: 0.011409
Train Epochs: 178   Train Loss: 0.002504   Validation Loss: 0.011428
Train Epochs: 179   Train Loss: 0.002499   Validation Loss: 0.011411
Train Epochs: 180   Train Loss: 0.002502   Validation Loss: 0.011417
Train Epochs: 181   Train Loss: 0.002492   Validation Loss: 0.011440
Train Epochs: 182   Train Loss: 0.002492   Validation Loss: 0.011447
Train Epochs: 183   Train Loss: 0.002492   Validation Loss: 0.011499
Train Epochs: 184   Train Loss: 0.002487   Validation Loss: 0.011474
Train Epochs: 185   Train Loss: 0.002489   Validation Loss: 0.011452
Train Epochs: 186   Train Loss: 0.002489   Validation Loss: 0.011464
Train Epochs: 187   Train Loss: 0.002485   Validation Loss: 0.011492
Train Epochs: 188   Train Loss: 0.002480   Validation Loss: 0.011484
Train Epochs: 189   Train Loss: 0.002486   Validation Loss: 0.011556
Train Epochs: 190   Train Loss: 0.002475   Validation Loss: 0.011525
Train Epochs: 191   Train Loss: 0.002476   Validation Loss: 0.011518
Train Epochs: 192   Train Loss: 0.002475   Validation Loss: 0.011529
Train Epochs: 193   Train Loss: 0.002474   Validation Loss: 0.011526
Train Epochs: 194   Train Loss: 0.002470   Validation Loss: 0.011550
Train Epochs: 195   Train Loss: 0.002472   Validation Loss: 0.011557
Train Epochs: 196   Train Loss: 0.002470   Validation Loss: 0.011608
Train Epochs: 197   Train Loss: 0.002470   Validation Loss: 0.011520
Train Epochs: 198   Train Loss: 0.002463   Validation Loss: 0.011556
Train Epochs: 199   Train Loss: 0.002463   Validation Loss: 0.011609
Train Epochs: 200   Train Loss: 0.002464   Validation Loss: 0.011616
Train Epochs: 201   Train Loss: 0.002462   Validation Loss: 0.011556
Train Epochs: 202   Train Loss: 0.002458   Validation Loss: 0.011631
Epoch   203: reducing learning rate of group 0 to 1.0000e-05.
Train Epochs: 203   Train Loss: 0.002460   Validation Loss: 0.011606
Train Epochs: 204   Train Loss: 0.002454   Validation Loss: 0.011610
Train Epochs: 205   Train Loss: 0.002452   Validation Loss: 0.011595
Train Epochs: 206   Train Loss: 0.002451   Validation Loss: 0.011605
Train Epochs: 207   Train Loss: 0.002450   Validation Loss: 0.011608
Train Epochs: 208   Train Loss: 0.002451   Validation Loss: 0.011615
Train Epochs: 209   Train Loss: 0.002450   Validation Loss: 0.011612
Train Epochs: 210   Train Loss: 0.002450   Validation Loss: 0.011611
```

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Train Epochs: 210   Train Loss: 0.002450   Validation Loss: 0.011611
Train Epochs: 211   Train Loss: 0.002447   Validation Loss: 0.011610
Train Epochs: 212   Train Loss: 0.002449   Validation Loss: 0.011611
Train Epochs: 213   Train Loss: 0.002447   Validation Loss: 0.011611
Train Epochs: 214   Train Loss: 0.002451   Validation Loss: 0.011621
Train Epochs: 215   Train Loss: 0.002445   Validation Loss: 0.011625
Train Epochs: 216   Train Loss: 0.002445   Validation Loss: 0.011620
Train Epochs: 217   Train Loss: 0.002449   Validation Loss: 0.011614
Train Epochs: 218   Train Loss: 0.002449   Validation Loss: 0.011617
Train Epochs: 219   Train Loss: 0.002446   Validation Loss: 0.011618
Train Epochs: 220   Train Loss: 0.002447   Validation Loss: 0.011624
Train Epochs: 221   Train Loss: 0.002445   Validation Loss: 0.011624
Train Epochs: 222   Train Loss: 0.002446   Validation Loss: 0.011617
Train Epochs: 223   Train Loss: 0.002449   Validation Loss: 0.011621
Train Epochs: 224   Train Loss: 0.002447   Validation Loss: 0.011621
Train Epochs: 225   Train Loss: 0.002445   Validation Loss: 0.011640
Train Epochs: 226   Train Loss: 0.002446   Validation Loss: 0.011634
Train Epochs: 227   Train Loss: 0.002446   Validation Loss: 0.011632
Train Epochs: 228   Train Loss: 0.002445   Validation Loss: 0.011625
Train Epochs: 229   Train Loss: 0.002447   Validation Loss: 0.011620
Train Epochs: 230   Train Loss: 0.002448   Validation Loss: 0.011644
Train Epochs: 231   Train Loss: 0.002443   Validation Loss: 0.011626
Train Epochs: 232   Train Loss: 0.002443   Validation Loss: 0.011623
Train Epochs: 233   Train Loss: 0.002446   Validation Loss: 0.011634
Train Epochs: 234   Train Loss: 0.002445   Validation Loss: 0.011622
Train Epochs: 235   Train Loss: 0.002443   Validation Loss: 0.011642
Train Epochs: 236   Train Loss: 0.002448   Validation Loss: 0.011639
Train Epochs: 237   Train Loss: 0.002441   Validation Loss: 0.011641
Train Epochs: 238   Train Loss: 0.002443   Validation Loss: 0.011648
Train Epochs: 239   Train Loss: 0.002443   Validation Loss: 0.011617
Train Epochs: 240   Train Loss: 0.002442   Validation Loss: 0.011641
Train Epochs: 241   Train Loss: 0.002443   Validation Loss: 0.011652
Train Epochs: 242   Train Loss: 0.002440   Validation Loss: 0.011630
Train Epochs: 243   Train Loss: 0.002439   Validation Loss: 0.011633
Train Epochs: 244   Train Loss: 0.002444   Validation Loss: 0.011635
Train Epochs: 245   Train Loss: 0.002441   Validation Loss: 0.011654
Train Epochs: 246   Train Loss: 0.002438   Validation Loss: 0.011649
Epoch   247: reducing learning rate of group 0 to 1.0000e-06.
Train Epochs: 247   Train Loss: 0.002439   Validation Loss: 0.011650
Train Epochs: 248   Train Loss: 0.002441   Validation Loss: 0.011655
Train Epochs: 249   Train Loss: 0.002442   Validation Loss: 0.011654
Train Epochs: 250   Train Loss: 0.002437   Validation Loss: 0.011649
Train Epochs: 251   Train Loss: 0.002437   Validation Loss: 0.011648
Train Epochs: 252   Train Loss: 0.002443   Validation Loss: 0.011645
Train Epochs: 253   Train Loss: 0.002435   Validation Loss: 0.011652
Train Epochs: 254   Train Loss: 0.002437   Validation Loss: 0.011646
Train Epochs: 255   Train Loss: 0.002436   Validation Loss: 0.011648
Train Epochs: 256   Train Loss: 0.002437   Validation Loss: 0.011644
Train Epochs: 257   Train Loss: 0.002438   Validation Loss: 0.011648
Train Epochs: 258   Train Loss: 0.002439   Validation Loss: 0.011644
Train Epochs: 259   Train Loss: 0.002438   Validation Loss: 0.011652
Train Epochs: 260   Train Loss: 0.002439   Validation Loss: 0.011648
Train Epochs: 261   Train Loss: 0.002436   Validation Loss: 0.011643
Train Epochs: 262   Train Loss: 0.002440   Validation Loss: 0.011647
Train Epochs: 263   Train Loss: 0.002441   Validation Loss: 0.011648
Train Epochs: 264   Train Loss: 0.002442   Validation Loss: 0.011648
Train Epochs: 265   Train Loss: 0.002440   Validation Loss: 0.011657
Train Epochs: 266   Train Loss: 0.002442   Validation Loss: 0.011647
Train Epochs: 267   Train Loss: 0.002437   Validation Loss: 0.011647
Train Epochs: 268   Train Loss: 0.002443   Validation Loss: 0.011652
Train Epochs: 269   Train Loss: 0.002438   Validation Loss: 0.011651
Train Epochs: 270   Train Loss: 0.002440   Validation Loss: 0.011649
Train Epochs: 271   Train Loss: 0.002438   Validation Loss: 0.011651
Train Epochs: 272   Train Loss: 0.002437   Validation Loss: 0.011656
Train Epochs: 273   Train Loss: 0.002438   Validation Loss: 0.011649
Train Epochs: 274   Train Loss: 0.002436   Validation Loss: 0.011646
Train Epochs: 275   Train Loss: 0.002443   Validation Loss: 0.011644
Train Epochs: 276   Train Loss: 0.002435   Validation Loss: 0.011654
Train Epochs: 277   Train Loss: 0.002438   Validation Loss: 0.011650
Train Epochs: 278   Train Loss: 0.002437   Validation Loss: 0.011654
Train Epochs: 279   Train Loss: 0.002439   Validation Loss: 0.011650
Train Epochs: 280   Train Loss: 0.002440   Validation Loss: 0.011648
Train Epochs: 281   Train Loss: 0.002439   Validation Loss: 0.011646
Train Epochs: 282   Train Loss: 0.002439   Validation Loss: 0.011652
```

```
Train Epochs: 282   Train Loss: 0.002439  Validation Loss: 0.011652
Train Epochs: 283   Train Loss: 0.002439  Validation Loss: 0.011650
Epoch    284: reducing learning rate of group 0 to 1.0000e-07.
Train Epochs: 284   Train Loss: 0.002438  Validation Loss: 0.011646
Train Epochs: 285   Train Loss: 0.002435  Validation Loss: 0.011651
Train Epochs: 286   Train Loss: 0.002436  Validation Loss: 0.011651
Train Epochs: 287   Train Loss: 0.002436  Validation Loss: 0.011652
Train Epochs: 288   Train Loss: 0.002436  Validation Loss: 0.011650
Train Epochs: 289   Train Loss: 0.002440  Validation Loss: 0.011652
Train Epochs: 290   Train Loss: 0.002441  Validation Loss: 0.011650
Train Epochs: 291   Train Loss: 0.002435  Validation Loss: 0.011649
Train Epochs: 292   Train Loss: 0.002438  Validation Loss: 0.011652
Train Epochs: 293   Train Loss: 0.002437  Validation Loss: 0.011652
Train Epochs: 294   Train Loss: 0.002439  Validation Loss: 0.011651
Train Epochs: 295   Train Loss: 0.002439  Validation Loss: 0.011650
Train Epochs: 296   Train Loss: 0.002436  Validation Loss: 0.011650
Train Epochs: 297   Train Loss: 0.002440  Validation Loss: 0.011651
Train Epochs: 298   Train Loss: 0.002437  Validation Loss: 0.011652
Train Epochs: 299   Train Loss: 0.002436  Validation Loss: 0.011651
Train Epochs: 300   Train Loss: 0.002436  Validation Loss: 0.011650
```

In [ ]:

```python
def plot_image_reconstruction(net, testloader):

  for batch in testloader:
    img, _ = batch
    img = img.to(device)
    outputs = net(img)

    img = img.view(img.size(0),3,512,512).cpu().data
    grid_img = torchvision.utils.make_grid(img, nrow = 8)
    plt.figure(figsize = [16,16])
    plt.imshow(grid_img.permute(1,2,0))

    outputs = outputs.view(outputs.size(0), 3, 512, 512).cpu().data
    grid_img = torchvision.utils.make_grid(outputs, nrow = 8)
    plt.figure(figsize = [16,16])
    plt.imshow(grid_img.permute(1,2,0))
    break
```

In [ ]:

```python
plot_image_reconstruction(net, test_loader)
```