```
import torch
import torch.nn.functional as F
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import DataLoader
from torch.utils.data import sampler
import torchvision.datasets as dset
import torchvision.transforms as T
import numpy as np

from google.colab import drive
drive.mount('/content/gdrive/', force_remount=True)

import sys
sys.path.insert(0,'/content/gdrive/My Drive/Colab Notebooks')

## Loss function and effiency metrics are already provided to you.
from project_utilities import Loss
from project_utilities import efficiency
from project_utilities import ValueSet
```

```
Mounted at /content/gdrive/
```

```
DEVICE = torch.device('cuda:0' if torch.cuda.is_available() else
'cpu')

from sklearn.model_selection import train_test_split
train_set_idx, val_set_idx = train_test_split(list(range(1,3)),
test_size=1)

print(train_set_idx)
print(val_set_idx)
```

```
[1]
[2]
```

```
%cd /content/gdrive/MyDrive/Project/data
```

```
/content/gdrive/MyDrive/Project/data
```

```
%ls
```

```
bi_rnn.pt                Set_1.npz   Set_36.npz  Set_52.npz
Set_69.npz
linear.pt                Set_20.npz  Set_37.npz  Set_53.npz  Set_6.npz
RCNN_h64_l3_loss0351.pt  Set_21.npz  Set_38.npz  Set_54.npz
Set_70.npz
RCNN_h64_l3_loss0356.pt  Set_22.npz  Set_39.npz  Set_55.npz
Set_71.npz
RCNN_h64_l3.pt           Set_23.npz  Set_3.npz   Set_56.npz
Set_72.npz
RCNN.pt                  Set_24.npz  Set_40.npz  Set_57.npz
```

```
Set_73.npz
res_cnn.pt              Set_25.npz  Set_41.npz  Set_58.npz
Set_74.npz
RNN.pt                  Set_26.npz  Set_42.npz  Set_59.npz
Set_75.npz
Set_10.npz              Set_27.npz  Set_43.npz  Set_5.npz
Set_76.npz
Set_11.npz              Set_28.npz  Set_44.npz  Set_60.npz
Set_77.npz
Set_12.npz              Set_29.npz  Set_45.npz  Set_61.npz
Set_78.npz
Set_13.npz              Set_2.npz   Set_46.npz  Set_62.npz
Set_79.npz
Set_14.npz              Set_30.npz  Set_47.npz  Set_63.npz  Set_7.npz
Set_15.npz              Set_31.npz  Set_48.npz  Set_64.npz
Set_80.npz
Set_16.npz              Set_32.npz  Set_49.npz  Set_65.npz  Set_8.npz
Set_17.npz              Set_33.npz  Set_4.npz   Set_66.npz  Set_9.npz
Set_18.npz              Set_34.npz  Set_50.npz  Set_67.npz
Set_19.npz              Set_35.npz  Set_51.npz  Set_68.npz
```

```
class MyDataset(torch.utils.data.Dataset):
  def __init__(self, setID):
        'Initialization'
        npz_files_content = np.load("./Set_"+str(setID)+".npz")
        self.X_set = torch.tensor(npz_files_content['X'])
        self.y_set = torch.tensor(npz_files_content['y'])

        # sets all nans to 0.0
        self.y_set[self.y_set != self.y_set] = 0.0
        self.X_set[self.X_set != self.X_set] = 0.0
  def __len__(self):
        'Denotes the total number of samples'
        return len(self.y_set)
  def __getitem__(self, index):
        'Generates one sample of data'
        # Select sample
        X = self.X_set[index]
        y = self.y_set[index]
        return X, y

# Train loader
for setID in train_set_idx:
  train_set = MyDataset(setID)
  train_loader = torch.utils.data.DataLoader(train_set,
                                             batch_size=128,
                                             shuffle=True)
  print(setID)
  for X_train, y_train in train_loader:
    print(X_train.shape)
```

```
    print(y_train.shape)
    #print(X_train.sum())
    #print(set(y_train.reshape(-1).numpy()))
    break

# Validation loader
for setID in val_set_idx:
  val_set = MyDataset(setID)
  val_loader = torch.utils.data.DataLoader(val_set,
                                           batch_size=128,
                                           shuffle=True)
  print(setID)
  for X_val, y_val in val_loader:
    print(X_val.shape)
    print(y_val.shape)
    break
```

```
1
torch.Size([128, 4, 4000])
torch.Size([128, 4000])
2
torch.Size([128, 4, 4000])
torch.Size([128, 4000])
```

```
loss_model = Loss(0.00001)

# Once created this class object can be used in training and
validation.
computed_loss = loss_model.forward(X_train[1][1].squeeze(),
y_train[1])
print(computed_loss)
```

```
tensor(1.3717)
```

```
computed_loss = loss_model.forward(y_train[1], y_train[1])
print(computed_loss)
```

```
tensor(0.)
```

```
class RCNN(torch.nn.Module):
    def __init__(self, hidden_size, num_layers):
      super(RCNN, self).__init__()

      # Encoder

      # 4000
      self.conv1 = torch.nn.Conv1d(in_channels=4, out_channels=64,
kernel_size=5, stride=2, padding=2)
      self.bn1 = torch.nn.BatchNorm1d(num_features=64)

      # 2000
```

```
      self.conv2 = torch.nn.Conv1d(in_channels=64, out_channels=128,
kernel_size=5, stride=2, padding=2)
      self.bn2 = torch.nn.BatchNorm1d(num_features=128)

      # 1000
      self.conv3 = torch.nn.Conv1d(in_channels=128, out_channels=256,
kernel_size=5, stride=2, padding=2)
      self.bn3 = torch.nn.BatchNorm1d(num_features=256)

      # 500
      self.lstm_1 = nn.LSTM(256, hidden_size, num_layers,
batch_first=True, bidirectional=True)

      # Decoder

      # 500
      self.tconv1 =
torch.nn.ConvTranspose1d(in_channels=2*hidden_size, out_channels=128,
kernel_size=5, stride=2, padding=2, output_padding=1)
      self.bn5 = torch.nn.BatchNorm1d(num_features=2*128)

      # 1000
      self.tconv2 = torch.nn.ConvTranspose1d(in_channels=2*128,
out_channels=64, kernel_size=5, stride=2, padding=2, output_padding=1)
      self.bn6 = torch.nn.BatchNorm1d(num_features=2*64)

      # 2000
      self.tconv3 = torch.nn.ConvTranspose1d(in_channels=2*64,
out_channels=32, kernel_size=5, stride=2, padding=2, output_padding=1)
      self.bn7 = torch.nn.BatchNorm1d(num_features=(32+4))

      # 4000
      # reduces out_channels
      self.conv5 = torch.nn.Conv1d(in_channels=(32+4), out_channels=1,
kernel_size=1, stride=1, padding=0)



    def forward(self, input_x):
      # x dim: [batch size, feature dim=4, sentence length=4000]

      # Encoder
      conv1_x = self.conv1(input_x)
      x = self.bn1(conv1_x)

      conv2_x = self.conv2(x)
      x = self.bn2(conv2_x)

      conv3_x = self.conv3(x)
```

```
        x = self.bn3(conv3_x)

        # RNN
        x = x.permute(0, 2, 1)
        x, _ = self.lstm_1(x)
        x = x.permute(0, 2, 1)

        # Decoder
        x = torch.cat((self.tconv1(x), conv2_x), dim=1)
        x = self.bn5(x)

        x = torch.cat((self.tconv2(x), conv1_x), dim=1)
        x = self.bn6(x)

        x = torch.cat((self.tconv3(x), input_x), dim=1)
        x = self.bn7(x)

        x = self.conv5(x)

        return x.squeeze()

print(train_set_idx)
print(val_set_idx)

[1]
[2]

#####################################################
##### Training and evaluation wrappers
#####################################################

def train(model, num_epochs, learning_rate=0.01, seed=123,
batch_size=128):
  cost = []
  val_cost = []
  torch.manual_seed(seed)
  optimizer = torch.optim.Adam(model.parameters(), lr=learning_rate)

  for e in range(1,num_epochs):
    batch_num = 0

    for setID in train_set_idx:
        train_set = MyDataset(setID+1)
        train_generator = torch.utils.data.DataLoader(train_set,

batch_size=batch_size,
                                                      shuffle=True,
                                                      num_workers=4)
        print(setID)
        for X_train, y_train in train_generator:
```

```
            batch_num = batch_num + 1

            # move to DEVICE
            X_train = X_train.to(DEVICE)
            y_train = y_train.to(DEVICE)

            #### Compute outputs ####
            yhat = model(X_train)
            loss = loss_model.forward(yhat, y_train)
            #### Reset gradients from previous iteration ####
            optimizer.zero_grad()
            #### Compute gradients ####
            loss.backward()
            #### Update weights ####
            optimizer.step()
            #### Logging ####
            with torch.no_grad():
              if batch_num%20 == 0:
                yhat = model.forward(X_train)
                curr_loss = loss_model.forward(yhat, y_train)
                print('Epoch ID: %d ' % e, end="")
                print('  Set ID: %d' % setID, end="")
                print('  Batch ID: %d' % batch_num, end="")
                print(' | Loss: %.5f' % curr_loss)
                cost.append(curr_loss)
                #loss_val, eff_rate, fp_rate = validate(model)
                #val_cost.append(loss_val)
            model.train()
    return cost, val_cost

def validate(model):
    loss_val = []
    eff = ValueSet(0, 0, 0, 0)
    # switch to evaluate mode
    #model.to("cpu")
    model.eval()
    with torch.no_grad():
        for setID in val_set_idx:
          #val_set = MyDataset(setID+1)
          val_set = MyDataset(11)
          val_generator = torch.utils.data.DataLoader(val_set,
                                                      batch_size=64,
                                                      shuffle=True)
          #print(setID)
          for X_val, y_val in val_generator:
            # Forward pass
            X_val = X_val.to(DEVICE)
            y_val = y_val.to(DEVICE)
            val_outputs = model(X_val)
            loss_output = loss_model.forward(val_outputs, y_val)
```

```
            loss_val.append(loss_output)
            for label, output in zip(y_val.cpu().numpy(),
val_outputs.cpu().numpy()):
                eff += efficiency(label, output, difference = 5.0,
                                  threshold = 1e-2, integral_threshold
= 0.2,
                                  min_width = 3)
    return sum(loss_val)/len(loss_val), eff.eff_rate, eff.fp_rate
```

lr=0.001, hidden_size=64, num_layers=2

```
model = RCNN(hidden_size=64, num_layers=2)

model = model.to(DEVICE)

cost, val_cost = train(model,
             num_epochs=50,
             learning_rate=0.001,
             seed=123, batch_size=64)
```

```
2

/usr/local/lib/python3.7/dist-packages/torch/utils/data/
dataloader.py:566: UserWarning: This DataLoader will create 4 worker
processes in total. Our suggested max number of worker in current
system is 2, which is smaller than what this DataLoader is going to
create. Please be aware that excessive worker creation might get
DataLoader running slow or even freeze, lower the worker number to
avoid potential slowness/freeze if necessary.
  cpuset_checked))

Epoch ID: 1   Set ID: 2  Batch ID: 20 | Loss: 6.81218
Epoch ID: 1   Set ID: 2  Batch ID: 40 | Loss: 5.75211
Epoch ID: 1   Set ID: 2  Batch ID: 60 | Loss: 5.09478
2
Epoch ID: 2   Set ID: 2  Batch ID: 20 | Loss: 5.36983
Epoch ID: 2   Set ID: 2  Batch ID: 40 | Loss: 5.64973
Epoch ID: 2   Set ID: 2  Batch ID: 60 | Loss: 6.15872
2
Epoch ID: 3   Set ID: 2  Batch ID: 20 | Loss: 5.61522
Epoch ID: 3   Set ID: 2  Batch ID: 40 | Loss: 6.07926
Epoch ID: 3   Set ID: 2  Batch ID: 60 | Loss: 6.09488
2
Epoch ID: 4   Set ID: 2  Batch ID: 20 | Loss: 5.54235
Epoch ID: 4   Set ID: 2  Batch ID: 40 | Loss: 5.00796
Epoch ID: 4   Set ID: 2  Batch ID: 60 | Loss: 5.26388
2
Epoch ID: 5   Set ID: 2  Batch ID: 20 | Loss: 5.01297
Epoch ID: 5   Set ID: 2  Batch ID: 40 | Loss: 5.08149
Epoch ID: 5   Set ID: 2  Batch ID: 60 | Loss: 4.62697
2
```

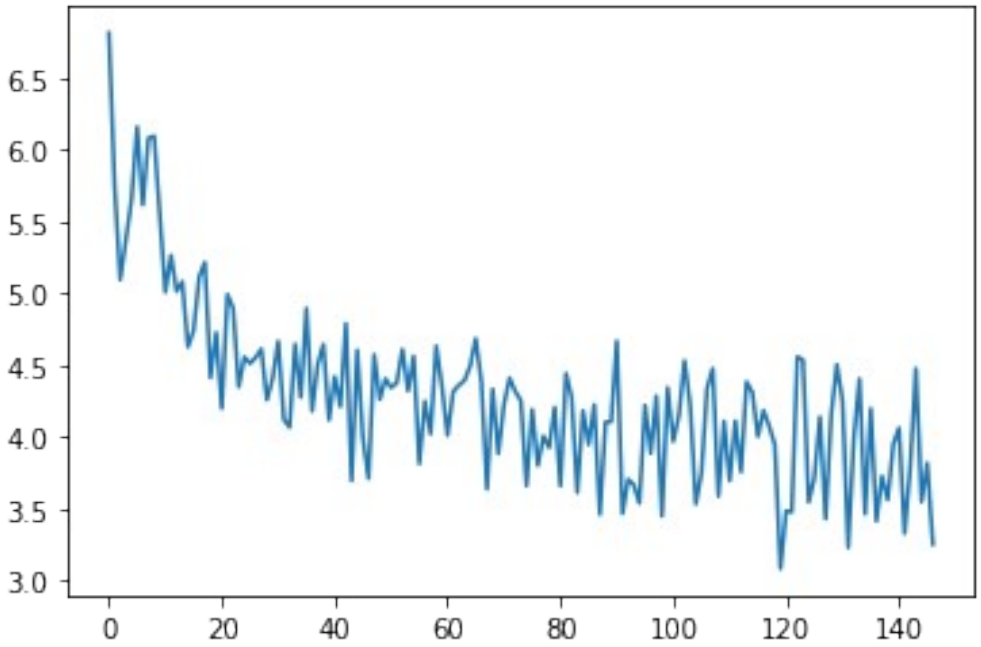
```
Epoch ID: 6   Set ID: 2  Batch ID: 20 | Loss: 4.74018
Epoch ID: 6   Set ID: 2  Batch ID: 40 | Loss: 5.11453
Epoch ID: 6   Set ID: 2  Batch ID: 60 | Loss: 5.21571
2
Epoch ID: 7   Set ID: 2  Batch ID: 20 | Loss: 4.41134
Epoch ID: 7   Set ID: 2  Batch ID: 40 | Loss: 4.72606
Epoch ID: 7   Set ID: 2  Batch ID: 60 | Loss: 4.19794
2
Epoch ID: 8   Set ID: 2  Batch ID: 20 | Loss: 4.99132
Epoch ID: 8   Set ID: 2  Batch ID: 40 | Loss: 4.89715
Epoch ID: 8   Set ID: 2  Batch ID: 60 | Loss: 4.34815
2
Epoch ID: 9   Set ID: 2  Batch ID: 20 | Loss: 4.55560
Epoch ID: 9   Set ID: 2  Batch ID: 40 | Loss: 4.51167
Epoch ID: 9   Set ID: 2  Batch ID: 60 | Loss: 4.55220
2
Epoch ID: 10   Set ID: 2  Batch ID: 20 | Loss: 4.61181
Epoch ID: 10   Set ID: 2  Batch ID: 40 | Loss: 4.25811
Epoch ID: 10   Set ID: 2  Batch ID: 60 | Loss: 4.40615
2
Epoch ID: 11   Set ID: 2  Batch ID: 20 | Loss: 4.66617
Epoch ID: 11   Set ID: 2  Batch ID: 40 | Loss: 4.12222
Epoch ID: 11   Set ID: 2  Batch ID: 60 | Loss: 4.06745
2
Epoch ID: 12   Set ID: 2  Batch ID: 20 | Loss: 4.64574
Epoch ID: 12   Set ID: 2  Batch ID: 40 | Loss: 4.27567
Epoch ID: 12   Set ID: 2  Batch ID: 60 | Loss: 4.89478
2
Epoch ID: 13   Set ID: 2  Batch ID: 20 | Loss: 4.17922
Epoch ID: 13   Set ID: 2  Batch ID: 40 | Loss: 4.50474
Epoch ID: 13   Set ID: 2  Batch ID: 60 | Loss: 4.64460
2
Epoch ID: 14   Set ID: 2  Batch ID: 20 | Loss: 4.11789
Epoch ID: 14   Set ID: 2  Batch ID: 40 | Loss: 4.41965
Epoch ID: 14   Set ID: 2  Batch ID: 60 | Loss: 4.21101
2
Epoch ID: 15   Set ID: 2  Batch ID: 20 | Loss: 4.78891
Epoch ID: 15   Set ID: 2  Batch ID: 40 | Loss: 3.69427
Epoch ID: 15   Set ID: 2  Batch ID: 60 | Loss: 4.60406
2
Epoch ID: 16   Set ID: 2  Batch ID: 20 | Loss: 3.99531
Epoch ID: 16   Set ID: 2  Batch ID: 40 | Loss: 3.71075
Epoch ID: 16   Set ID: 2  Batch ID: 60 | Loss: 4.57179
2
Epoch ID: 17   Set ID: 2  Batch ID: 20 | Loss: 4.26025
Epoch ID: 17   Set ID: 2  Batch ID: 40 | Loss: 4.40438
Epoch ID: 17   Set ID: 2  Batch ID: 60 | Loss: 4.34300
2
Epoch ID: 18   Set ID: 2  Batch ID: 20 | Loss: 4.37543
Epoch ID: 18   Set ID: 2  Batch ID: 40 | Loss: 4.60857
```

```
Epoch ID: 18   Set ID: 2  Batch ID: 60 | Loss: 4.32073
2
Epoch ID: 19   Set ID: 2  Batch ID: 20 | Loss: 4.56218
Epoch ID: 19   Set ID: 2  Batch ID: 40 | Loss: 3.81340
Epoch ID: 19   Set ID: 2  Batch ID: 60 | Loss: 4.24889
2
Epoch ID: 20   Set ID: 2  Batch ID: 20 | Loss: 4.02107
Epoch ID: 20   Set ID: 2  Batch ID: 40 | Loss: 4.63239
Epoch ID: 20   Set ID: 2  Batch ID: 60 | Loss: 4.35531
2
Epoch ID: 21   Set ID: 2  Batch ID: 20 | Loss: 4.01081
Epoch ID: 21   Set ID: 2  Batch ID: 40 | Loss: 4.31453
Epoch ID: 21   Set ID: 2  Batch ID: 60 | Loss: 4.35944
2
Epoch ID: 22   Set ID: 2  Batch ID: 20 | Loss: 4.39207
Epoch ID: 22   Set ID: 2  Batch ID: 40 | Loss: 4.49172
Epoch ID: 22   Set ID: 2  Batch ID: 60 | Loss: 4.68450
2
Epoch ID: 23   Set ID: 2  Batch ID: 20 | Loss: 4.38285
Epoch ID: 23   Set ID: 2  Batch ID: 40 | Loss: 3.63745
Epoch ID: 23   Set ID: 2  Batch ID: 60 | Loss: 4.33237
2
Epoch ID: 24   Set ID: 2  Batch ID: 20 | Loss: 3.88271
Epoch ID: 24   Set ID: 2  Batch ID: 40 | Loss: 4.22683
Epoch ID: 24   Set ID: 2  Batch ID: 60 | Loss: 4.40923
2
Epoch ID: 25   Set ID: 2  Batch ID: 20 | Loss: 4.31693
Epoch ID: 25   Set ID: 2  Batch ID: 40 | Loss: 4.25196
Epoch ID: 25   Set ID: 2  Batch ID: 60 | Loss: 3.65981
2
Epoch ID: 26   Set ID: 2  Batch ID: 20 | Loss: 4.19011
Epoch ID: 26   Set ID: 2  Batch ID: 40 | Loss: 3.80068
Epoch ID: 26   Set ID: 2  Batch ID: 60 | Loss: 4.00516
2
Epoch ID: 27   Set ID: 2  Batch ID: 20 | Loss: 3.92480
Epoch ID: 27   Set ID: 2  Batch ID: 40 | Loss: 4.20664
Epoch ID: 27   Set ID: 2  Batch ID: 60 | Loss: 3.65915
2
Epoch ID: 28   Set ID: 2  Batch ID: 20 | Loss: 4.44159
Epoch ID: 28   Set ID: 2  Batch ID: 40 | Loss: 4.27362
Epoch ID: 28   Set ID: 2  Batch ID: 60 | Loss: 3.61256
2
Epoch ID: 29   Set ID: 2  Batch ID: 20 | Loss: 4.18161
Epoch ID: 29   Set ID: 2  Batch ID: 40 | Loss: 3.94636
Epoch ID: 29   Set ID: 2  Batch ID: 60 | Loss: 4.22360
2
Epoch ID: 30   Set ID: 2  Batch ID: 20 | Loss: 3.46030
Epoch ID: 30   Set ID: 2  Batch ID: 40 | Loss: 4.10255
Epoch ID: 30   Set ID: 2  Batch ID: 60 | Loss: 4.10571
2
```

```
Epoch ID: 31   Set ID: 2  Batch ID: 20 | Loss: 4.66714
Epoch ID: 31   Set ID: 2  Batch ID: 40 | Loss: 3.46668
Epoch ID: 31   Set ID: 2  Batch ID: 60 | Loss: 3.70426
2
Epoch ID: 32   Set ID: 2  Batch ID: 20 | Loss: 3.66645
Epoch ID: 32   Set ID: 2  Batch ID: 40 | Loss: 3.53830
Epoch ID: 32   Set ID: 2  Batch ID: 60 | Loss: 4.22023
2
Epoch ID: 33   Set ID: 2  Batch ID: 20 | Loss: 3.88630
Epoch ID: 33   Set ID: 2  Batch ID: 40 | Loss: 4.28488
Epoch ID: 33   Set ID: 2  Batch ID: 60 | Loss: 3.44847
2
Epoch ID: 34   Set ID: 2  Batch ID: 20 | Loss: 4.34262
Epoch ID: 34   Set ID: 2  Batch ID: 40 | Loss: 3.96837
Epoch ID: 34   Set ID: 2  Batch ID: 60 | Loss: 4.15004
2
Epoch ID: 35   Set ID: 2  Batch ID: 20 | Loss: 4.53040
Epoch ID: 35   Set ID: 2  Batch ID: 40 | Loss: 4.21998
Epoch ID: 35   Set ID: 2  Batch ID: 60 | Loss: 3.53331
2
Epoch ID: 36   Set ID: 2  Batch ID: 20 | Loss: 3.74916
Epoch ID: 36   Set ID: 2  Batch ID: 40 | Loss: 4.34011
Epoch ID: 36   Set ID: 2  Batch ID: 60 | Loss: 4.47604
2
Epoch ID: 37   Set ID: 2  Batch ID: 20 | Loss: 3.58708
Epoch ID: 37   Set ID: 2  Batch ID: 40 | Loss: 4.10852
Epoch ID: 37   Set ID: 2  Batch ID: 60 | Loss: 3.69462
2
Epoch ID: 38   Set ID: 2  Batch ID: 20 | Loss: 4.11101
Epoch ID: 38   Set ID: 2  Batch ID: 40 | Loss: 3.75625
Epoch ID: 38   Set ID: 2  Batch ID: 60 | Loss: 4.38297
2
Epoch ID: 39   Set ID: 2  Batch ID: 20 | Loss: 4.31124
Epoch ID: 39   Set ID: 2  Batch ID: 40 | Loss: 4.00336
Epoch ID: 39   Set ID: 2  Batch ID: 60 | Loss: 4.18344
2
Epoch ID: 40   Set ID: 2  Batch ID: 20 | Loss: 4.07384
Epoch ID: 40   Set ID: 2  Batch ID: 40 | Loss: 3.94713
Epoch ID: 40   Set ID: 2  Batch ID: 60 | Loss: 3.08263
2
Epoch ID: 41   Set ID: 2  Batch ID: 20 | Loss: 3.48360
Epoch ID: 41   Set ID: 2  Batch ID: 40 | Loss: 3.47769
Epoch ID: 41   Set ID: 2  Batch ID: 60 | Loss: 4.55729
2
Epoch ID: 42   Set ID: 2  Batch ID: 20 | Loss: 4.53565
Epoch ID: 42   Set ID: 2  Batch ID: 40 | Loss: 3.54575
Epoch ID: 42   Set ID: 2  Batch ID: 60 | Loss: 3.71289
2
Epoch ID: 43   Set ID: 2  Batch ID: 20 | Loss: 4.13887
Epoch ID: 43   Set ID: 2  Batch ID: 40 | Loss: 3.42878
```

```
Epoch ID: 43   Set ID: 2  Batch ID: 60 | Loss: 4.15617
2
Epoch ID: 44   Set ID: 2  Batch ID: 20 | Loss: 4.50277
Epoch ID: 44   Set ID: 2  Batch ID: 40 | Loss: 4.24982
Epoch ID: 44   Set ID: 2  Batch ID: 60 | Loss: 3.22901
2
Epoch ID: 45   Set ID: 2  Batch ID: 20 | Loss: 3.98798
Epoch ID: 45   Set ID: 2  Batch ID: 40 | Loss: 4.40419
Epoch ID: 45   Set ID: 2  Batch ID: 60 | Loss: 3.46375
2
Epoch ID: 46   Set ID: 2  Batch ID: 20 | Loss: 4.19670
Epoch ID: 46   Set ID: 2  Batch ID: 40 | Loss: 3.41403
Epoch ID: 46   Set ID: 2  Batch ID: 60 | Loss: 3.72599
2
Epoch ID: 47   Set ID: 2  Batch ID: 20 | Loss: 3.56164
Epoch ID: 47   Set ID: 2  Batch ID: 40 | Loss: 3.94863
Epoch ID: 47   Set ID: 2  Batch ID: 60 | Loss: 4.06198
2
Epoch ID: 48   Set ID: 2  Batch ID: 20 | Loss: 3.32813
Epoch ID: 48   Set ID: 2  Batch ID: 40 | Loss: 3.79620
Epoch ID: 48   Set ID: 2  Batch ID: 60 | Loss: 4.47555
2
Epoch ID: 49   Set ID: 2  Batch ID: 20 | Loss: 3.54786
Epoch ID: 49   Set ID: 2  Batch ID: 40 | Loss: 3.81813
Epoch ID: 49   Set ID: 2  Batch ID: 60 | Loss: 3.25216
```

```
import matplotlib.pyplot as plt

cost = [c.to('cpu') for c in cost]
val_cost = [c.to('cpu') for c in val_cost]
plt.plot(cost)
#plt.plot(val_cost)
plt.show()
```

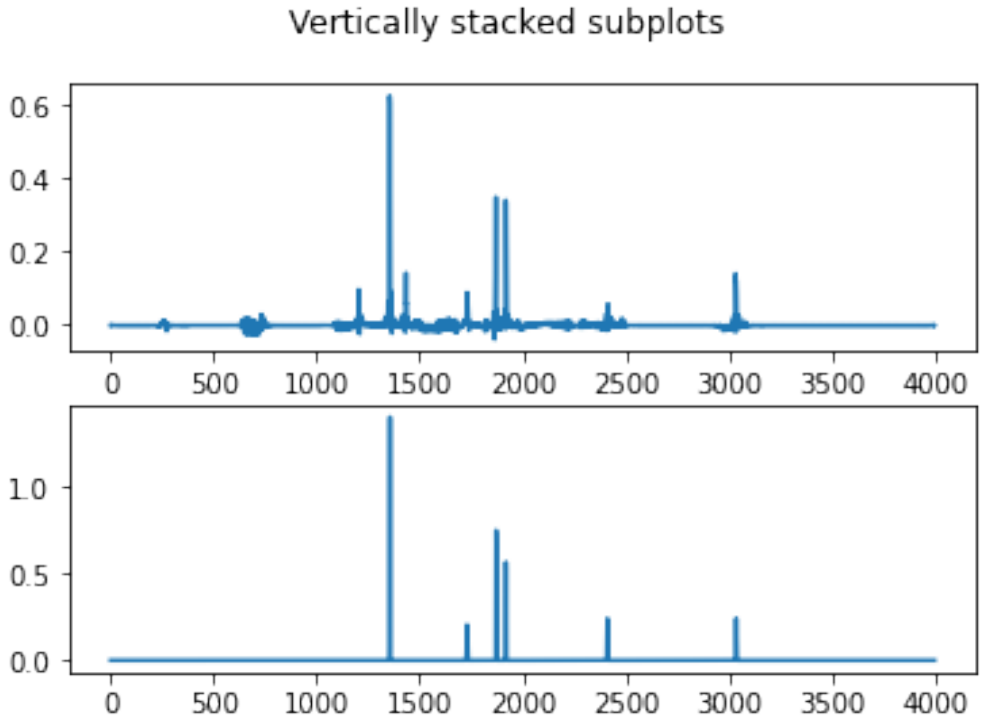



```
loss_val, eff_rate, fp_rate = validate(model)

print(f"Loss: {loss_val}")
print(f"Eff: {eff_rate}")
print(f"FP: {fp_rate}")
```

```
Loss: 4.4561028480529785
Eff: 0.8607240286072403
FP: 1.3273345330933812
```

```
import matplotlib.pyplot as plt

model.to("cpu")
model.eval()
with torch.no_grad():
    for setID in val_set_idx:
      val_set = MyDataset(setID+1)
      val_generator = torch.utils.data.DataLoader(val_set,
                                                  batch_size=64,
                                                  shuffle=True)
      print(setID)
      for X_val, y_val in val_generator:
        # Forward pass
        val_outputs = model(X_val)
        fig, axs = plt.subplots(2)
        fig.suptitle('Vertically stacked subplots')
        axs[0].plot(val_outputs[0])
        axs[1].plot(y_val[0])
        plt.show()
        break
```

1



lr=0.0005, hidden_size=64, num_layers=2

```
model = RCNN(hidden_size=64, num_layers=2)

model = model.to(DEVICE)

cost, val_cost = train(model,
             num_epochs=50,
             learning_rate=0.0005,
             seed=123, batch_size=64)
```

2

```
/usr/local/lib/python3.7/dist-packages/torch/utils/data/
dataloader.py:566: UserWarning: This DataLoader will create 4 worker
processes in total. Our suggested max number of worker in current
system is 2, which is smaller than what this DataLoader is going to
create. Please be aware that excessive worker creation might get
DataLoader running slow or even freeze, lower the worker number to
avoid potential slowness/freeze if necessary.
  cpuset_checked))

Epoch ID: 1   Set ID: 2  Batch ID: 20 | Loss: 8.58292
Epoch ID: 1   Set ID: 2  Batch ID: 40 | Loss: 8.26985
Epoch ID: 1   Set ID: 2  Batch ID: 60 | Loss: 7.80849
2
Epoch ID: 2   Set ID: 2  Batch ID: 20 | Loss: 5.52027
```

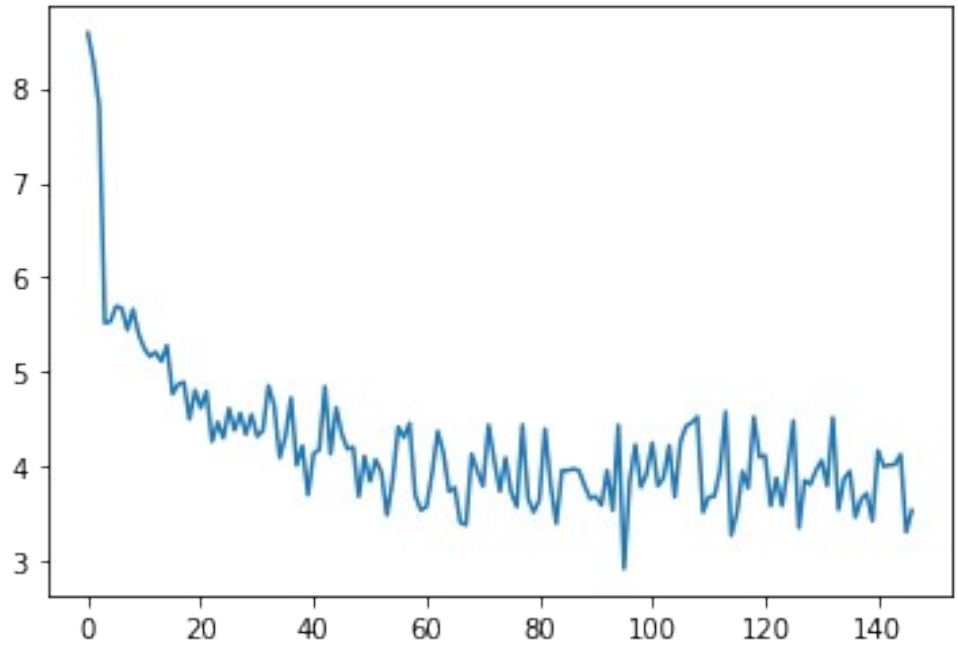
```
Epoch ID: 2   Set ID: 2  Batch ID: 40 | Loss: 5.53469
Epoch ID: 2   Set ID: 2  Batch ID: 60 | Loss: 5.69746
2
Epoch ID: 3   Set ID: 2  Batch ID: 20 | Loss: 5.67417
Epoch ID: 3   Set ID: 2  Batch ID: 40 | Loss: 5.44657
Epoch ID: 3   Set ID: 2  Batch ID: 60 | Loss: 5.66485
2
Epoch ID: 4   Set ID: 2  Batch ID: 20 | Loss: 5.40055
Epoch ID: 4   Set ID: 2  Batch ID: 40 | Loss: 5.25011
Epoch ID: 4   Set ID: 2  Batch ID: 60 | Loss: 5.16630
2
Epoch ID: 5   Set ID: 2  Batch ID: 20 | Loss: 5.21140
Epoch ID: 5   Set ID: 2  Batch ID: 40 | Loss: 5.11447
Epoch ID: 5   Set ID: 2  Batch ID: 60 | Loss: 5.28304
2
Epoch ID: 6   Set ID: 2  Batch ID: 20 | Loss: 4.77090
Epoch ID: 6   Set ID: 2  Batch ID: 40 | Loss: 4.87179
Epoch ID: 6   Set ID: 2  Batch ID: 60 | Loss: 4.89443
2
Epoch ID: 7   Set ID: 2  Batch ID: 20 | Loss: 4.50468
Epoch ID: 7   Set ID: 2  Batch ID: 40 | Loss: 4.80829
Epoch ID: 7   Set ID: 2  Batch ID: 60 | Loss: 4.62279
2
Epoch ID: 8   Set ID: 2  Batch ID: 20 | Loss: 4.79745
Epoch ID: 8   Set ID: 2  Batch ID: 40 | Loss: 4.26955
Epoch ID: 8   Set ID: 2  Batch ID: 60 | Loss: 4.47222
2
Epoch ID: 9   Set ID: 2  Batch ID: 20 | Loss: 4.30553
Epoch ID: 9   Set ID: 2  Batch ID: 40 | Loss: 4.61692
Epoch ID: 9   Set ID: 2  Batch ID: 60 | Loss: 4.38765
2
Epoch ID: 10   Set ID: 2  Batch ID: 20 | Loss: 4.56440
Epoch ID: 10   Set ID: 2  Batch ID: 40 | Loss: 4.34403
Epoch ID: 10   Set ID: 2  Batch ID: 60 | Loss: 4.55196
2
Epoch ID: 11   Set ID: 2  Batch ID: 20 | Loss: 4.32291
Epoch ID: 11   Set ID: 2  Batch ID: 40 | Loss: 4.38102
Epoch ID: 11   Set ID: 2  Batch ID: 60 | Loss: 4.85534
2
Epoch ID: 12   Set ID: 2  Batch ID: 20 | Loss: 4.65189
Epoch ID: 12   Set ID: 2  Batch ID: 40 | Loss: 4.09879
Epoch ID: 12   Set ID: 2  Batch ID: 60 | Loss: 4.31854
2
Epoch ID: 13   Set ID: 2  Batch ID: 20 | Loss: 4.72985
Epoch ID: 13   Set ID: 2  Batch ID: 40 | Loss: 4.01702
Epoch ID: 13   Set ID: 2  Batch ID: 60 | Loss: 4.22133
2
Epoch ID: 14   Set ID: 2  Batch ID: 20 | Loss: 3.70507
Epoch ID: 14   Set ID: 2  Batch ID: 40 | Loss: 4.14158
Epoch ID: 14   Set ID: 2  Batch ID: 60 | Loss: 4.18106
```

```
2
Epoch ID: 15   Set ID: 2  Batch ID: 20 | Loss: 4.84703
Epoch ID: 15   Set ID: 2  Batch ID: 40 | Loss: 4.13691
Epoch ID: 15   Set ID: 2  Batch ID: 60 | Loss: 4.62455
2
Epoch ID: 16   Set ID: 2  Batch ID: 20 | Loss: 4.34320
Epoch ID: 16   Set ID: 2  Batch ID: 40 | Loss: 4.18849
Epoch ID: 16   Set ID: 2  Batch ID: 60 | Loss: 4.20885
2
Epoch ID: 17   Set ID: 2  Batch ID: 20 | Loss: 3.68645
Epoch ID: 17   Set ID: 2  Batch ID: 40 | Loss: 4.11374
Epoch ID: 17   Set ID: 2  Batch ID: 60 | Loss: 3.84652
2
Epoch ID: 18   Set ID: 2  Batch ID: 20 | Loss: 4.07632
Epoch ID: 18   Set ID: 2  Batch ID: 40 | Loss: 3.94381
Epoch ID: 18   Set ID: 2  Batch ID: 60 | Loss: 3.49192
2
Epoch ID: 19   Set ID: 2  Batch ID: 20 | Loss: 3.86033
Epoch ID: 19   Set ID: 2  Batch ID: 40 | Loss: 4.42034
Epoch ID: 19   Set ID: 2  Batch ID: 60 | Loss: 4.31024
2
Epoch ID: 20   Set ID: 2  Batch ID: 20 | Loss: 4.45954
Epoch ID: 20   Set ID: 2  Batch ID: 40 | Loss: 3.70003
Epoch ID: 20   Set ID: 2  Batch ID: 60 | Loss: 3.54361
2
Epoch ID: 21   Set ID: 2  Batch ID: 20 | Loss: 3.57814
Epoch ID: 21   Set ID: 2  Batch ID: 40 | Loss: 3.93662
Epoch ID: 21   Set ID: 2  Batch ID: 60 | Loss: 4.37582
2
Epoch ID: 22   Set ID: 2  Batch ID: 20 | Loss: 4.14493
Epoch ID: 22   Set ID: 2  Batch ID: 40 | Loss: 3.73895
Epoch ID: 22   Set ID: 2  Batch ID: 60 | Loss: 3.78272
2
Epoch ID: 23   Set ID: 2  Batch ID: 20 | Loss: 3.41194
Epoch ID: 23   Set ID: 2  Batch ID: 40 | Loss: 3.38651
Epoch ID: 23   Set ID: 2  Batch ID: 60 | Loss: 4.13477
2
Epoch ID: 24   Set ID: 2  Batch ID: 20 | Loss: 3.96002
Epoch ID: 24   Set ID: 2  Batch ID: 40 | Loss: 3.79796
Epoch ID: 24   Set ID: 2  Batch ID: 60 | Loss: 4.44172
2
Epoch ID: 25   Set ID: 2  Batch ID: 20 | Loss: 4.06776
Epoch ID: 25   Set ID: 2  Batch ID: 40 | Loss: 3.74129
Epoch ID: 25   Set ID: 2  Batch ID: 60 | Loss: 4.09513
2
Epoch ID: 26   Set ID: 2  Batch ID: 20 | Loss: 3.73061
Epoch ID: 26   Set ID: 2  Batch ID: 40 | Loss: 3.57999
Epoch ID: 26   Set ID: 2  Batch ID: 60 | Loss: 4.44361
2
Epoch ID: 27   Set ID: 2  Batch ID: 20 | Loss: 3.66502
```

```
Epoch ID: 27   Set ID: 2  Batch ID: 40 | Loss: 3.52146
Epoch ID: 27   Set ID: 2  Batch ID: 60 | Loss: 3.65148
2
Epoch ID: 28   Set ID: 2  Batch ID: 20 | Loss: 4.39918
Epoch ID: 28   Set ID: 2  Batch ID: 40 | Loss: 3.81078
Epoch ID: 28   Set ID: 2  Batch ID: 60 | Loss: 3.40238
2
Epoch ID: 29   Set ID: 2  Batch ID: 20 | Loss: 3.96166
Epoch ID: 29   Set ID: 2  Batch ID: 40 | Loss: 3.95936
Epoch ID: 29   Set ID: 2  Batch ID: 60 | Loss: 3.97924
2
Epoch ID: 30   Set ID: 2  Batch ID: 20 | Loss: 3.96134
Epoch ID: 30   Set ID: 2  Batch ID: 40 | Loss: 3.80486
Epoch ID: 30   Set ID: 2  Batch ID: 60 | Loss: 3.66548
2
Epoch ID: 31   Set ID: 2  Batch ID: 20 | Loss: 3.68857
Epoch ID: 31   Set ID: 2  Batch ID: 40 | Loss: 3.59594
Epoch ID: 31   Set ID: 2  Batch ID: 60 | Loss: 3.96341
2
Epoch ID: 32   Set ID: 2  Batch ID: 20 | Loss: 3.54046
Epoch ID: 32   Set ID: 2  Batch ID: 40 | Loss: 4.44087
Epoch ID: 32   Set ID: 2  Batch ID: 60 | Loss: 2.92505
2
Epoch ID: 33   Set ID: 2  Batch ID: 20 | Loss: 3.84886
Epoch ID: 33   Set ID: 2  Batch ID: 40 | Loss: 4.23526
Epoch ID: 33   Set ID: 2  Batch ID: 60 | Loss: 3.78622
2
Epoch ID: 34   Set ID: 2  Batch ID: 20 | Loss: 3.92835
Epoch ID: 34   Set ID: 2  Batch ID: 40 | Loss: 4.25182
Epoch ID: 34   Set ID: 2  Batch ID: 60 | Loss: 3.80128
2
Epoch ID: 35   Set ID: 2  Batch ID: 20 | Loss: 3.88142
Epoch ID: 35   Set ID: 2  Batch ID: 40 | Loss: 4.22523
Epoch ID: 35   Set ID: 2  Batch ID: 60 | Loss: 3.68173
2
Epoch ID: 36   Set ID: 2  Batch ID: 20 | Loss: 4.26665
Epoch ID: 36   Set ID: 2  Batch ID: 40 | Loss: 4.43032
Epoch ID: 36   Set ID: 2  Batch ID: 60 | Loss: 4.46537
2
Epoch ID: 37   Set ID: 2  Batch ID: 20 | Loss: 4.52868
Epoch ID: 37   Set ID: 2  Batch ID: 40 | Loss: 3.52017
Epoch ID: 37   Set ID: 2  Batch ID: 60 | Loss: 3.68221
2
Epoch ID: 38   Set ID: 2  Batch ID: 20 | Loss: 3.68756
Epoch ID: 38   Set ID: 2  Batch ID: 40 | Loss: 3.96015
Epoch ID: 38   Set ID: 2  Batch ID: 60 | Loss: 4.58174
2
Epoch ID: 39   Set ID: 2  Batch ID: 20 | Loss: 3.27701
Epoch ID: 39   Set ID: 2  Batch ID: 40 | Loss: 3.51450
Epoch ID: 39   Set ID: 2  Batch ID: 60 | Loss: 3.95347
```

```
2
Epoch ID: 40   Set ID: 2  Batch ID: 20 | Loss: 3.77568
Epoch ID: 40   Set ID: 2  Batch ID: 40 | Loss: 4.52760
Epoch ID: 40   Set ID: 2  Batch ID: 60 | Loss: 4.10284
2
Epoch ID: 41   Set ID: 2  Batch ID: 20 | Loss: 4.11961
Epoch ID: 41   Set ID: 2  Batch ID: 40 | Loss: 3.58917
Epoch ID: 41   Set ID: 2  Batch ID: 60 | Loss: 3.88308
2
Epoch ID: 42   Set ID: 2  Batch ID: 20 | Loss: 3.58938
Epoch ID: 42   Set ID: 2  Batch ID: 40 | Loss: 3.98190
Epoch ID: 42   Set ID: 2  Batch ID: 60 | Loss: 4.48612
2
Epoch ID: 43   Set ID: 2  Batch ID: 20 | Loss: 3.35744
Epoch ID: 43   Set ID: 2  Batch ID: 40 | Loss: 3.85770
Epoch ID: 43   Set ID: 2  Batch ID: 60 | Loss: 3.81152
2
Epoch ID: 44   Set ID: 2  Batch ID: 20 | Loss: 3.96028
Epoch ID: 44   Set ID: 2  Batch ID: 40 | Loss: 4.06813
Epoch ID: 44   Set ID: 2  Batch ID: 60 | Loss: 3.80215
2
Epoch ID: 45   Set ID: 2  Batch ID: 20 | Loss: 4.52139
Epoch ID: 45   Set ID: 2  Batch ID: 40 | Loss: 3.54961
Epoch ID: 45   Set ID: 2  Batch ID: 60 | Loss: 3.87329
2
Epoch ID: 46   Set ID: 2  Batch ID: 20 | Loss: 3.95292
Epoch ID: 46   Set ID: 2  Batch ID: 40 | Loss: 3.46816
Epoch ID: 46   Set ID: 2  Batch ID: 60 | Loss: 3.65611
2
Epoch ID: 47   Set ID: 2  Batch ID: 20 | Loss: 3.71999
Epoch ID: 47   Set ID: 2  Batch ID: 40 | Loss: 3.43068
Epoch ID: 47   Set ID: 2  Batch ID: 60 | Loss: 4.17250
2
Epoch ID: 48   Set ID: 2  Batch ID: 20 | Loss: 4.00423
Epoch ID: 48   Set ID: 2  Batch ID: 40 | Loss: 4.01797
Epoch ID: 48   Set ID: 2  Batch ID: 60 | Loss: 4.02398
2
Epoch ID: 49   Set ID: 2  Batch ID: 20 | Loss: 4.12900
Epoch ID: 49   Set ID: 2  Batch ID: 40 | Loss: 3.31140
Epoch ID: 49   Set ID: 2  Batch ID: 60 | Loss: 3.54128
```

```
cost = [c.to('cpu') for c in cost]
val_cost = [c.to('cpu') for c in val_cost]
plt.plot(cost)
#plt.plot(val_cost)
plt.show()
```

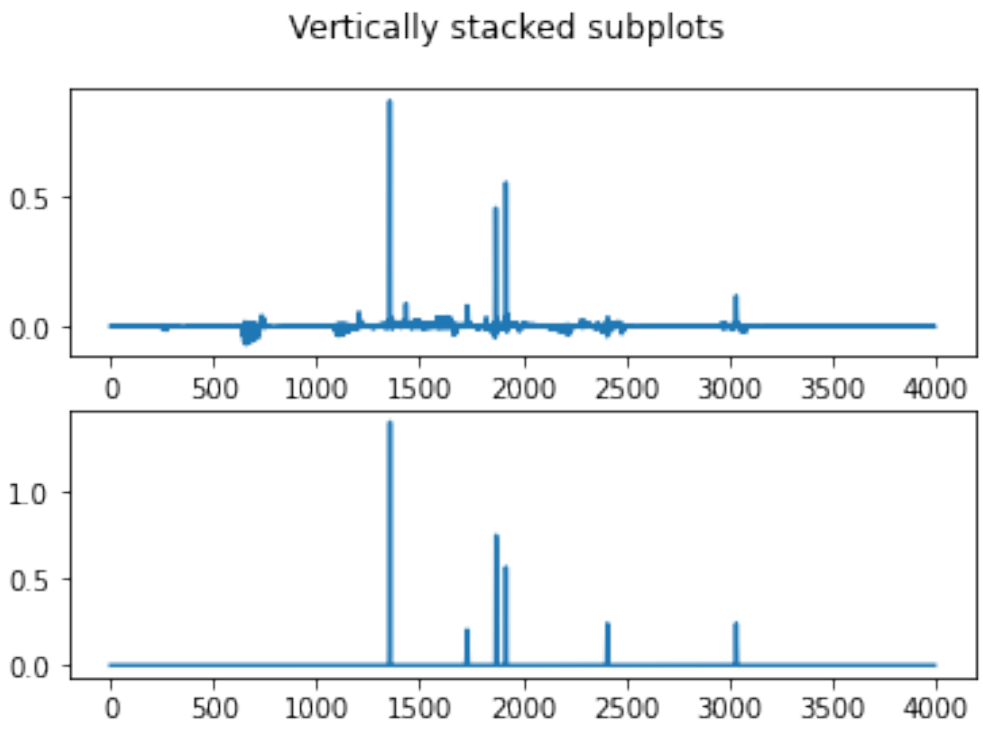



```
loss_val, eff_rate, fp_rate = validate(model)

print(f"Loss: {loss_val}")
print(f"Eff: {eff_rate}")
print(f"FP: {fp_rate}")
```

```
Loss: 4.017274379730225
Eff: 0.8290569932905699
FP: 0.7096580683863227
```

```
model.to("cpu")
model.eval()
with torch.no_grad():
    for setID in val_set_idx:
      val_set = MyDataset(setID+1)
      val_generator = torch.utils.data.DataLoader(val_set,
                                                  batch_size=64,
                                                  shuffle=True)
      print(setID)
      for X_val, y_val in val_generator:
        # Forward pass
        val_outputs = model(X_val)
        fig, axs = plt.subplots(2)
        fig.suptitle('Vertically stacked subplots')
        axs[0].plot(val_outputs[0])
        axs[1].plot(y_val[0])
        plt.show()
        break
```

```
1
```



lr=0.0005, hidden_size=96, num_layers=2

```
model = RCNN(hidden_size=96, num_layers=2)

model = model.to(DEVICE)

cost, val_cost = train(model,
             num_epochs=50,
             learning_rate=0.001,
             seed=123, batch_size=64)
```

```
2

/usr/local/lib/python3.7/dist-packages/torch/utils/data/
dataloader.py:566: UserWarning: This DataLoader will create 4 worker
processes in total. Our suggested max number of worker in current
system is 2, which is smaller than what this DataLoader is going to
create. Please be aware that excessive worker creation might get
DataLoader running slow or even freeze, lower the worker number to
avoid potential slowness/freeze if necessary.
  cpuset_checked))

Epoch ID: 1   Set ID: 2  Batch ID: 20 | Loss: 6.94792
Epoch ID: 1   Set ID: 2  Batch ID: 40 | Loss: 5.74941
Epoch ID: 1   Set ID: 2  Batch ID: 60 | Loss: 4.87427
2
Epoch ID: 2   Set ID: 2  Batch ID: 20 | Loss: 4.83869
Epoch ID: 2   Set ID: 2  Batch ID: 40 | Loss: 5.20391
```

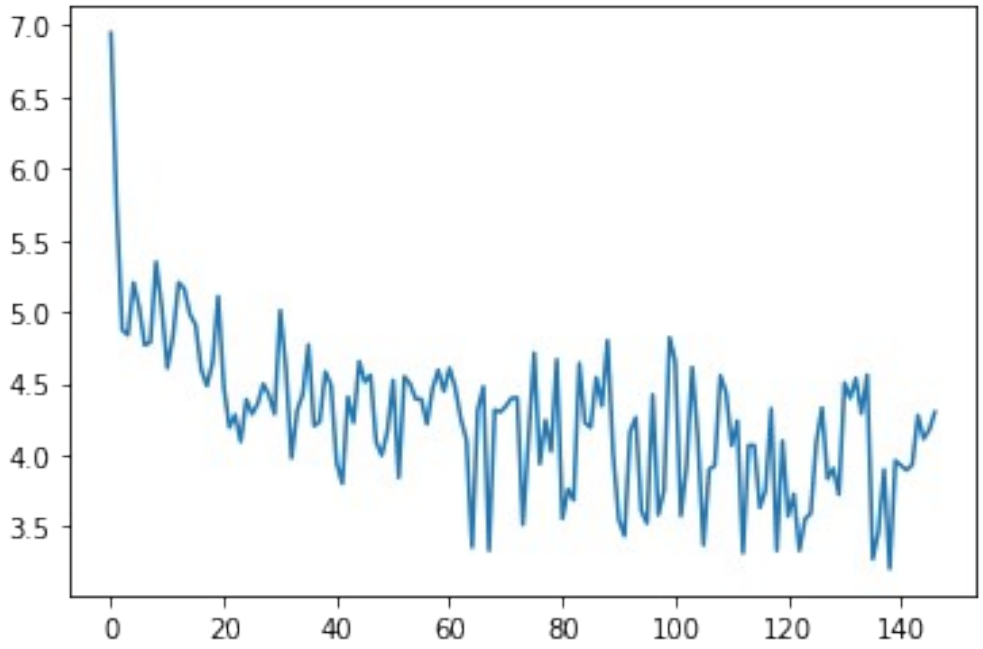
```
Epoch ID: 2   Set ID: 2  Batch ID: 60 | Loss: 5.03069
2
Epoch ID: 3   Set ID: 2  Batch ID: 20 | Loss: 4.76707
Epoch ID: 3   Set ID: 2  Batch ID: 40 | Loss: 4.78839
Epoch ID: 3   Set ID: 2  Batch ID: 60 | Loss: 5.34842
2
Epoch ID: 4   Set ID: 2  Batch ID: 20 | Loss: 5.03211
Epoch ID: 4   Set ID: 2  Batch ID: 40 | Loss: 4.60742
Epoch ID: 4   Set ID: 2  Batch ID: 60 | Loss: 4.83211
2
Epoch ID: 5   Set ID: 2  Batch ID: 20 | Loss: 5.20509
Epoch ID: 5   Set ID: 2  Batch ID: 40 | Loss: 5.16014
Epoch ID: 5   Set ID: 2  Batch ID: 60 | Loss: 4.98243
2
Epoch ID: 6   Set ID: 2  Batch ID: 20 | Loss: 4.90955
Epoch ID: 6   Set ID: 2  Batch ID: 40 | Loss: 4.59758
Epoch ID: 6   Set ID: 2  Batch ID: 60 | Loss: 4.48391
2
Epoch ID: 7   Set ID: 2  Batch ID: 20 | Loss: 4.64351
Epoch ID: 7   Set ID: 2  Batch ID: 40 | Loss: 5.10812
Epoch ID: 7   Set ID: 2  Batch ID: 60 | Loss: 4.47994
2
Epoch ID: 8   Set ID: 2  Batch ID: 20 | Loss: 4.19349
Epoch ID: 8   Set ID: 2  Batch ID: 40 | Loss: 4.28089
Epoch ID: 8   Set ID: 2  Batch ID: 60 | Loss: 4.09382
2
Epoch ID: 9   Set ID: 2  Batch ID: 20 | Loss: 4.38673
Epoch ID: 9   Set ID: 2  Batch ID: 40 | Loss: 4.28659
Epoch ID: 9   Set ID: 2  Batch ID: 60 | Loss: 4.35648
2
Epoch ID: 10   Set ID: 2  Batch ID: 20 | Loss: 4.49650
Epoch ID: 10   Set ID: 2  Batch ID: 40 | Loss: 4.41931
Epoch ID: 10   Set ID: 2  Batch ID: 60 | Loss: 4.28705
2
Epoch ID: 11   Set ID: 2  Batch ID: 20 | Loss: 5.01037
Epoch ID: 11   Set ID: 2  Batch ID: 40 | Loss: 4.60765
Epoch ID: 11   Set ID: 2  Batch ID: 60 | Loss: 3.97982
2
Epoch ID: 12   Set ID: 2  Batch ID: 20 | Loss: 4.30983
Epoch ID: 12   Set ID: 2  Batch ID: 40 | Loss: 4.42628
Epoch ID: 12   Set ID: 2  Batch ID: 60 | Loss: 4.77044
2
Epoch ID: 13   Set ID: 2  Batch ID: 20 | Loss: 4.20366
Epoch ID: 13   Set ID: 2  Batch ID: 40 | Loss: 4.23333
Epoch ID: 13   Set ID: 2  Batch ID: 60 | Loss: 4.58138
2
Epoch ID: 14   Set ID: 2  Batch ID: 20 | Loss: 4.48917
Epoch ID: 14   Set ID: 2  Batch ID: 40 | Loss: 3.94640
Epoch ID: 14   Set ID: 2  Batch ID: 60 | Loss: 3.80133
2
```

```
Epoch ID: 15   Set ID: 2  Batch ID: 20 | Loss: 4.40539
Epoch ID: 15   Set ID: 2  Batch ID: 40 | Loss: 4.22629
Epoch ID: 15   Set ID: 2  Batch ID: 60 | Loss: 4.65310
2
Epoch ID: 16   Set ID: 2  Batch ID: 20 | Loss: 4.51025
Epoch ID: 16   Set ID: 2  Batch ID: 40 | Loss: 4.55798
Epoch ID: 16   Set ID: 2  Batch ID: 60 | Loss: 4.09205
2
Epoch ID: 17   Set ID: 2  Batch ID: 20 | Loss: 3.99753
Epoch ID: 17   Set ID: 2  Batch ID: 40 | Loss: 4.16825
Epoch ID: 17   Set ID: 2  Batch ID: 60 | Loss: 4.52210
2
Epoch ID: 18   Set ID: 2  Batch ID: 20 | Loss: 3.84227
Epoch ID: 18   Set ID: 2  Batch ID: 40 | Loss: 4.54752
Epoch ID: 18   Set ID: 2  Batch ID: 60 | Loss: 4.49745
2
Epoch ID: 19   Set ID: 2  Batch ID: 20 | Loss: 4.39251
Epoch ID: 19   Set ID: 2  Batch ID: 40 | Loss: 4.38907
Epoch ID: 19   Set ID: 2  Batch ID: 60 | Loss: 4.21649
2
Epoch ID: 20   Set ID: 2  Batch ID: 20 | Loss: 4.46409
Epoch ID: 20   Set ID: 2  Batch ID: 40 | Loss: 4.59254
Epoch ID: 20   Set ID: 2  Batch ID: 60 | Loss: 4.44593
2
Epoch ID: 21   Set ID: 2  Batch ID: 20 | Loss: 4.60649
Epoch ID: 21   Set ID: 2  Batch ID: 40 | Loss: 4.47196
Epoch ID: 21   Set ID: 2  Batch ID: 60 | Loss: 4.25286
2
Epoch ID: 22   Set ID: 2  Batch ID: 20 | Loss: 4.10797
Epoch ID: 22   Set ID: 2  Batch ID: 40 | Loss: 3.35588
Epoch ID: 22   Set ID: 2  Batch ID: 60 | Loss: 4.31573
2
Epoch ID: 23   Set ID: 2  Batch ID: 20 | Loss: 4.47759
Epoch ID: 23   Set ID: 2  Batch ID: 40 | Loss: 3.33356
Epoch ID: 23   Set ID: 2  Batch ID: 60 | Loss: 4.31527
2
Epoch ID: 24   Set ID: 2  Batch ID: 20 | Loss: 4.30036
Epoch ID: 24   Set ID: 2  Batch ID: 40 | Loss: 4.34127
Epoch ID: 24   Set ID: 2  Batch ID: 60 | Loss: 4.39789
2
Epoch ID: 25   Set ID: 2  Batch ID: 20 | Loss: 4.39959
Epoch ID: 25   Set ID: 2  Batch ID: 40 | Loss: 3.51420
Epoch ID: 25   Set ID: 2  Batch ID: 60 | Loss: 4.12927
2
Epoch ID: 26   Set ID: 2  Batch ID: 20 | Loss: 4.71351
Epoch ID: 26   Set ID: 2  Batch ID: 40 | Loss: 3.93811
Epoch ID: 26   Set ID: 2  Batch ID: 60 | Loss: 4.24386
2
Epoch ID: 27   Set ID: 2  Batch ID: 20 | Loss: 4.02667
Epoch ID: 27   Set ID: 2  Batch ID: 40 | Loss: 4.66637
```

```
Epoch ID: 27   Set ID: 2  Batch ID: 60 | Loss: 3.55536
2
Epoch ID: 28   Set ID: 2  Batch ID: 20 | Loss: 3.76195
Epoch ID: 28   Set ID: 2  Batch ID: 40 | Loss: 3.68538
Epoch ID: 28   Set ID: 2  Batch ID: 60 | Loss: 4.64072
2
Epoch ID: 29   Set ID: 2  Batch ID: 20 | Loss: 4.22582
Epoch ID: 29   Set ID: 2  Batch ID: 40 | Loss: 4.19256
Epoch ID: 29   Set ID: 2  Batch ID: 60 | Loss: 4.54092
2
Epoch ID: 30   Set ID: 2  Batch ID: 20 | Loss: 4.34318
Epoch ID: 30   Set ID: 2  Batch ID: 40 | Loss: 4.80062
Epoch ID: 30   Set ID: 2  Batch ID: 60 | Loss: 4.00561
2
Epoch ID: 31   Set ID: 2  Batch ID: 20 | Loss: 3.54762
Epoch ID: 31   Set ID: 2  Batch ID: 40 | Loss: 3.43574
Epoch ID: 31   Set ID: 2  Batch ID: 60 | Loss: 4.16426
2
Epoch ID: 32   Set ID: 2  Batch ID: 20 | Loss: 4.26179
Epoch ID: 32   Set ID: 2  Batch ID: 40 | Loss: 3.60829
Epoch ID: 32   Set ID: 2  Batch ID: 60 | Loss: 3.52344
2
Epoch ID: 33   Set ID: 2  Batch ID: 20 | Loss: 4.42034
Epoch ID: 33   Set ID: 2  Batch ID: 40 | Loss: 3.58199
Epoch ID: 33   Set ID: 2  Batch ID: 60 | Loss: 3.75276
2
Epoch ID: 34   Set ID: 2  Batch ID: 20 | Loss: 4.82009
Epoch ID: 34   Set ID: 2  Batch ID: 40 | Loss: 4.65463
Epoch ID: 34   Set ID: 2  Batch ID: 60 | Loss: 3.57520
2
Epoch ID: 35   Set ID: 2  Batch ID: 20 | Loss: 3.92299
Epoch ID: 35   Set ID: 2  Batch ID: 40 | Loss: 4.61197
Epoch ID: 35   Set ID: 2  Batch ID: 60 | Loss: 4.12183
2
Epoch ID: 36   Set ID: 2  Batch ID: 20 | Loss: 3.37125
Epoch ID: 36   Set ID: 2  Batch ID: 40 | Loss: 3.89945
Epoch ID: 36   Set ID: 2  Batch ID: 60 | Loss: 3.92576
2
Epoch ID: 37   Set ID: 2  Batch ID: 20 | Loss: 4.55470
Epoch ID: 37   Set ID: 2  Batch ID: 40 | Loss: 4.43590
Epoch ID: 37   Set ID: 2  Batch ID: 60 | Loss: 4.06642
2
Epoch ID: 38   Set ID: 2  Batch ID: 20 | Loss: 4.23937
Epoch ID: 38   Set ID: 2  Batch ID: 40 | Loss: 3.31669
Epoch ID: 38   Set ID: 2  Batch ID: 60 | Loss: 4.06687
2
Epoch ID: 39   Set ID: 2  Batch ID: 20 | Loss: 4.06781
Epoch ID: 39   Set ID: 2  Batch ID: 40 | Loss: 3.63256
Epoch ID: 39   Set ID: 2  Batch ID: 60 | Loss: 3.75407
2
```

```
Epoch ID: 40   Set ID: 2  Batch ID: 20 | Loss: 4.32330
Epoch ID: 40   Set ID: 2  Batch ID: 40 | Loss: 3.33197
Epoch ID: 40   Set ID: 2  Batch ID: 60 | Loss: 4.09800
2
Epoch ID: 41   Set ID: 2  Batch ID: 20 | Loss: 3.57344
Epoch ID: 41   Set ID: 2  Batch ID: 40 | Loss: 3.72686
Epoch ID: 41   Set ID: 2  Batch ID: 60 | Loss: 3.33334
2
Epoch ID: 42   Set ID: 2  Batch ID: 20 | Loss: 3.55395
Epoch ID: 42   Set ID: 2  Batch ID: 40 | Loss: 3.59168
Epoch ID: 42   Set ID: 2  Batch ID: 60 | Loss: 4.08758
2
Epoch ID: 43   Set ID: 2  Batch ID: 20 | Loss: 4.32942
Epoch ID: 43   Set ID: 2  Batch ID: 40 | Loss: 3.83416
Epoch ID: 43   Set ID: 2  Batch ID: 60 | Loss: 3.90621
2
Epoch ID: 44   Set ID: 2  Batch ID: 20 | Loss: 3.72494
Epoch ID: 44   Set ID: 2  Batch ID: 40 | Loss: 4.50467
Epoch ID: 44   Set ID: 2  Batch ID: 60 | Loss: 4.39791
2
Epoch ID: 45   Set ID: 2  Batch ID: 20 | Loss: 4.53517
Epoch ID: 45   Set ID: 2  Batch ID: 40 | Loss: 4.29023
Epoch ID: 45   Set ID: 2  Batch ID: 60 | Loss: 4.55952
2
Epoch ID: 46   Set ID: 2  Batch ID: 20 | Loss: 3.27456
Epoch ID: 46   Set ID: 2  Batch ID: 40 | Loss: 3.46190
Epoch ID: 46   Set ID: 2  Batch ID: 60 | Loss: 3.89877
2
Epoch ID: 47   Set ID: 2  Batch ID: 20 | Loss: 3.20637
Epoch ID: 47   Set ID: 2  Batch ID: 40 | Loss: 3.96015
Epoch ID: 47   Set ID: 2  Batch ID: 60 | Loss: 3.92743
2
Epoch ID: 48   Set ID: 2  Batch ID: 20 | Loss: 3.89431
Epoch ID: 48   Set ID: 2  Batch ID: 40 | Loss: 3.93220
Epoch ID: 48   Set ID: 2  Batch ID: 60 | Loss: 4.27656
2
Epoch ID: 49   Set ID: 2  Batch ID: 20 | Loss: 4.11430
Epoch ID: 49   Set ID: 2  Batch ID: 40 | Loss: 4.17436
Epoch ID: 49   Set ID: 2  Batch ID: 60 | Loss: 4.29883
```

```
cost = [c.to('cpu') for c in cost]
val_cost = [c.to('cpu') for c in val_cost]
plt.plot(cost)
#plt.plot(val_cost)
plt.show()
```

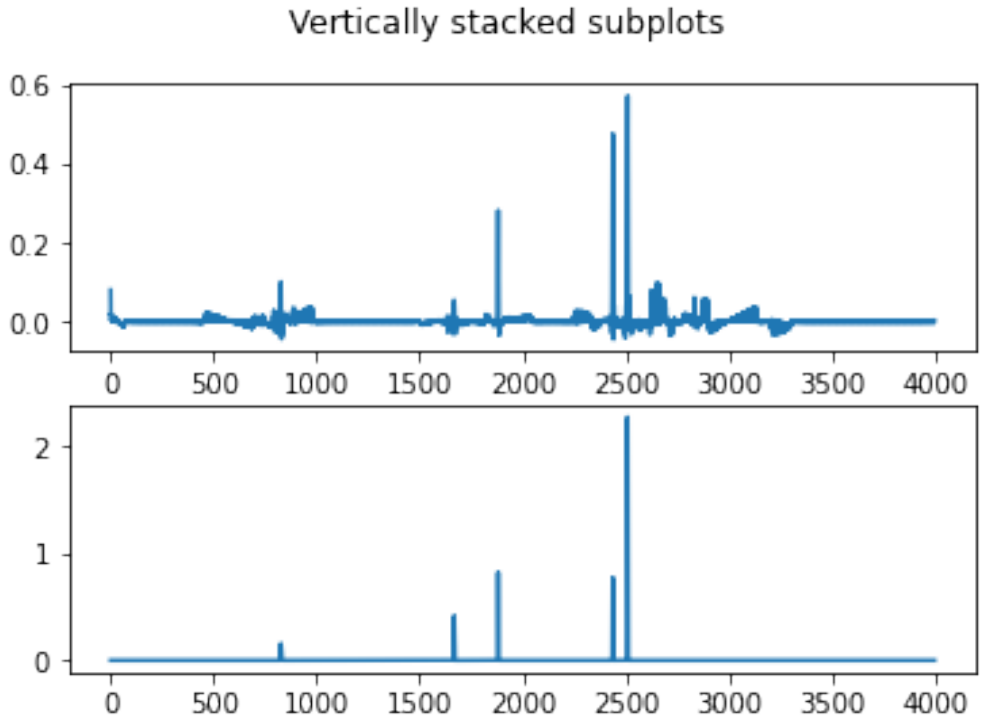



```
model.to(DEVICE)

loss_val, eff_rate, fp_rate = validate(model)

print(f"Loss: {loss_val}")
print(f"Eff: {eff_rate}")
print(f"FP: {fp_rate}")
```

```
Loss: 4.517522811889648
Eff: 0.8171864631718646
FP: 1.2723455308938212
```

```
model.to("cpu")
model.eval()
with torch.no_grad():
    for setID in val_set_idx:
      val_set = MyDataset(setID+1)
      val_generator = torch.utils.data.DataLoader(val_set,
                                                  batch_size=64,
                                                  shuffle=True)
      print(setID)
      for X_val, y_val in val_generator:
        # Forward pass
        val_outputs = model(X_val)
        fig, axs = plt.subplots(2)
        fig.suptitle('Vertically stacked subplots')
        axs[0].plot(val_outputs[0])
        axs[1].plot(y_val[0])
        plt.show()
        break
```

1



lr=0.0005, hidden_size=64, num_layers=3

```
model = BiRNN_2(input_size=4, hidden_size=64, num_layers=3)

model = model.to(DEVICE)

cost, val_cost = train(model,
             num_epochs=50,
             learning_rate=0.0005,
             seed=123, batch_size=64)
```

2

```
/usr/local/lib/python3.7/dist-packages/torch/utils/data/
dataloader.py:566: UserWarning: This DataLoader will create 4 worker
processes in total. Our suggested max number of worker in current
system is 2, which is smaller than what this DataLoader is going to
create. Please be aware that excessive worker creation might get
DataLoader running slow or even freeze, lower the worker number to
avoid potential slowness/freeze if necessary.
  cpuset_checked))

Epoch ID: 1   Set ID: 2  Batch ID: 20 | Loss: 0.93709
Epoch ID: 1   Set ID: 2  Batch ID: 40 | Loss: 4.73078
Epoch ID: 1   Set ID: 2  Batch ID: 60 | Loss: 3.42222
2
Epoch ID: 2   Set ID: 2  Batch ID: 20 | Loss: 3.14333
```

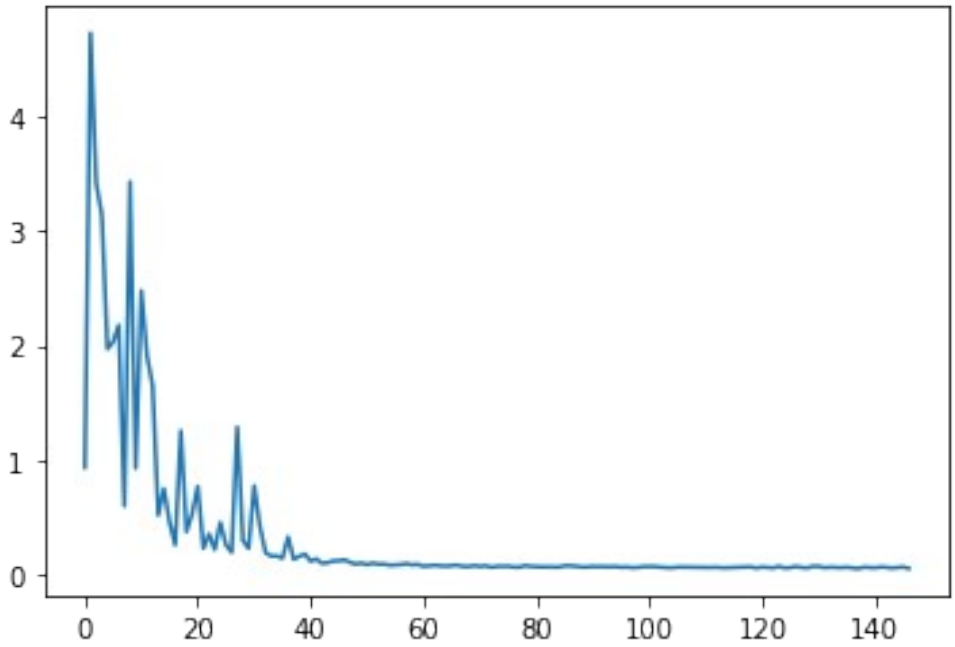
```
Epoch ID: 2   Set ID: 2  Batch ID: 40 | Loss: 1.97236
Epoch ID: 2   Set ID: 2  Batch ID: 60 | Loss: 2.03300
2
Epoch ID: 3   Set ID: 2  Batch ID: 20 | Loss: 2.17802
Epoch ID: 3   Set ID: 2  Batch ID: 40 | Loss: 0.60007
Epoch ID: 3   Set ID: 2  Batch ID: 60 | Loss: 3.43168
2
Epoch ID: 4   Set ID: 2  Batch ID: 20 | Loss: 0.92996
Epoch ID: 4   Set ID: 2  Batch ID: 40 | Loss: 2.48113
Epoch ID: 4   Set ID: 2  Batch ID: 60 | Loss: 1.91301
2
Epoch ID: 5   Set ID: 2  Batch ID: 20 | Loss: 1.65358
Epoch ID: 5   Set ID: 2  Batch ID: 40 | Loss: 0.51878
Epoch ID: 5   Set ID: 2  Batch ID: 60 | Loss: 0.75083
2
Epoch ID: 6   Set ID: 2  Batch ID: 20 | Loss: 0.46058
Epoch ID: 6   Set ID: 2  Batch ID: 40 | Loss: 0.25943
Epoch ID: 6   Set ID: 2  Batch ID: 60 | Loss: 1.25652
2
Epoch ID: 7   Set ID: 2  Batch ID: 20 | Loss: 0.37471
Epoch ID: 7   Set ID: 2  Batch ID: 40 | Loss: 0.53246
Epoch ID: 7   Set ID: 2  Batch ID: 60 | Loss: 0.77086
2
Epoch ID: 8   Set ID: 2  Batch ID: 20 | Loss: 0.22971
Epoch ID: 8   Set ID: 2  Batch ID: 40 | Loss: 0.35597
Epoch ID: 8   Set ID: 2  Batch ID: 60 | Loss: 0.21939
2
Epoch ID: 9   Set ID: 2  Batch ID: 20 | Loss: 0.45470
Epoch ID: 9   Set ID: 2  Batch ID: 40 | Loss: 0.25986
Epoch ID: 9   Set ID: 2  Batch ID: 60 | Loss: 0.19434
2
Epoch ID: 10   Set ID: 2  Batch ID: 20 | Loss: 1.28788
Epoch ID: 10   Set ID: 2  Batch ID: 40 | Loss: 0.29906
Epoch ID: 10   Set ID: 2  Batch ID: 60 | Loss: 0.22881
2
Epoch ID: 11   Set ID: 2  Batch ID: 20 | Loss: 0.77547
Epoch ID: 11   Set ID: 2  Batch ID: 40 | Loss: 0.42424
Epoch ID: 11   Set ID: 2  Batch ID: 60 | Loss: 0.19395
2
Epoch ID: 12   Set ID: 2  Batch ID: 20 | Loss: 0.16138
Epoch ID: 12   Set ID: 2  Batch ID: 40 | Loss: 0.16318
Epoch ID: 12   Set ID: 2  Batch ID: 60 | Loss: 0.14328
2
Epoch ID: 13   Set ID: 2  Batch ID: 20 | Loss: 0.32892
Epoch ID: 13   Set ID: 2  Batch ID: 40 | Loss: 0.13394
Epoch ID: 13   Set ID: 2  Batch ID: 60 | Loss: 0.15976
2
Epoch ID: 14   Set ID: 2  Batch ID: 20 | Loss: 0.18031
Epoch ID: 14   Set ID: 2  Batch ID: 40 | Loss: 0.11692
Epoch ID: 14   Set ID: 2  Batch ID: 60 | Loss: 0.13719
```

```
2
Epoch ID: 15   Set ID: 2  Batch ID: 20 | Loss: 0.09939
Epoch ID: 15   Set ID: 2  Batch ID: 40 | Loss: 0.10409
Epoch ID: 15   Set ID: 2  Batch ID: 60 | Loss: 0.11985
2
Epoch ID: 16   Set ID: 2  Batch ID: 20 | Loss: 0.12085
Epoch ID: 16   Set ID: 2  Batch ID: 40 | Loss: 0.12885
Epoch ID: 16   Set ID: 2  Batch ID: 60 | Loss: 0.10688
2
Epoch ID: 17   Set ID: 2  Batch ID: 20 | Loss: 0.09178
Epoch ID: 17   Set ID: 2  Batch ID: 40 | Loss: 0.10133
Epoch ID: 17   Set ID: 2  Batch ID: 60 | Loss: 0.08710
2
Epoch ID: 18   Set ID: 2  Batch ID: 20 | Loss: 0.10062
Epoch ID: 18   Set ID: 2  Batch ID: 40 | Loss: 0.09070
Epoch ID: 18   Set ID: 2  Batch ID: 60 | Loss: 0.09253
2
Epoch ID: 19   Set ID: 2  Batch ID: 20 | Loss: 0.08167
Epoch ID: 19   Set ID: 2  Batch ID: 40 | Loss: 0.08486
Epoch ID: 19   Set ID: 2  Batch ID: 60 | Loss: 0.08795
2
Epoch ID: 20   Set ID: 2  Batch ID: 20 | Loss: 0.09550
Epoch ID: 20   Set ID: 2  Batch ID: 40 | Loss: 0.08430
Epoch ID: 20   Set ID: 2  Batch ID: 60 | Loss: 0.08987
2
Epoch ID: 21   Set ID: 2  Batch ID: 20 | Loss: 0.07245
Epoch ID: 21   Set ID: 2  Batch ID: 40 | Loss: 0.07629
Epoch ID: 21   Set ID: 2  Batch ID: 60 | Loss: 0.08211
2
Epoch ID: 22   Set ID: 2  Batch ID: 20 | Loss: 0.07840
Epoch ID: 22   Set ID: 2  Batch ID: 40 | Loss: 0.07325
Epoch ID: 22   Set ID: 2  Batch ID: 60 | Loss: 0.07973
2
Epoch ID: 23   Set ID: 2  Batch ID: 20 | Loss: 0.08237
Epoch ID: 23   Set ID: 2  Batch ID: 40 | Loss: 0.07110
Epoch ID: 23   Set ID: 2  Batch ID: 60 | Loss: 0.07166
2
Epoch ID: 24   Set ID: 2  Batch ID: 20 | Loss: 0.07787
Epoch ID: 24   Set ID: 2  Batch ID: 40 | Loss: 0.07153
Epoch ID: 24   Set ID: 2  Batch ID: 60 | Loss: 0.07716
2
Epoch ID: 25   Set ID: 2  Batch ID: 20 | Loss: 0.06441
Epoch ID: 25   Set ID: 2  Batch ID: 40 | Loss: 0.07166
Epoch ID: 25   Set ID: 2  Batch ID: 60 | Loss: 0.07252
2
Epoch ID: 26   Set ID: 2  Batch ID: 20 | Loss: 0.07305
Epoch ID: 26   Set ID: 2  Batch ID: 40 | Loss: 0.06626
Epoch ID: 26   Set ID: 2  Batch ID: 60 | Loss: 0.06517
2
Epoch ID: 27   Set ID: 2  Batch ID: 20 | Loss: 0.07920
```

```
Epoch ID: 27   Set ID: 2  Batch ID: 40 | Loss: 0.07260
Epoch ID: 27   Set ID: 2  Batch ID: 60 | Loss: 0.06898
2
Epoch ID: 28   Set ID: 2  Batch ID: 20 | Loss: 0.06811
Epoch ID: 28   Set ID: 2  Batch ID: 40 | Loss: 0.06892
Epoch ID: 28   Set ID: 2  Batch ID: 60 | Loss: 0.06860
2
Epoch ID: 29   Set ID: 2  Batch ID: 20 | Loss: 0.06582
Epoch ID: 29   Set ID: 2  Batch ID: 40 | Loss: 0.07764
Epoch ID: 29   Set ID: 2  Batch ID: 60 | Loss: 0.07698
2
Epoch ID: 30   Set ID: 2  Batch ID: 20 | Loss: 0.07368
Epoch ID: 30   Set ID: 2  Batch ID: 40 | Loss: 0.06601
Epoch ID: 30   Set ID: 2  Batch ID: 60 | Loss: 0.06681
2
Epoch ID: 31   Set ID: 2  Batch ID: 20 | Loss: 0.07033
Epoch ID: 31   Set ID: 2  Batch ID: 40 | Loss: 0.07112
Epoch ID: 31   Set ID: 2  Batch ID: 60 | Loss: 0.07034
2
Epoch ID: 32   Set ID: 2  Batch ID: 20 | Loss: 0.06693
Epoch ID: 32   Set ID: 2  Batch ID: 40 | Loss: 0.07092
Epoch ID: 32   Set ID: 2  Batch ID: 60 | Loss: 0.06389
2
Epoch ID: 33   Set ID: 2  Batch ID: 20 | Loss: 0.06699
Epoch ID: 33   Set ID: 2  Batch ID: 40 | Loss: 0.06144
Epoch ID: 33   Set ID: 2  Batch ID: 60 | Loss: 0.06303
2
Epoch ID: 34   Set ID: 2  Batch ID: 20 | Loss: 0.07029
Epoch ID: 34   Set ID: 2  Batch ID: 40 | Loss: 0.07048
Epoch ID: 34   Set ID: 2  Batch ID: 60 | Loss: 0.07098
2
Epoch ID: 35   Set ID: 2  Batch ID: 20 | Loss: 0.06473
Epoch ID: 35   Set ID: 2  Batch ID: 40 | Loss: 0.06274
Epoch ID: 35   Set ID: 2  Batch ID: 60 | Loss: 0.05943
2
Epoch ID: 36   Set ID: 2  Batch ID: 20 | Loss: 0.06652
Epoch ID: 36   Set ID: 2  Batch ID: 40 | Loss: 0.06566
Epoch ID: 36   Set ID: 2  Batch ID: 60 | Loss: 0.06332
2
Epoch ID: 37   Set ID: 2  Batch ID: 20 | Loss: 0.06544
Epoch ID: 37   Set ID: 2  Batch ID: 40 | Loss: 0.06404
Epoch ID: 37   Set ID: 2  Batch ID: 60 | Loss: 0.06241
2
Epoch ID: 38   Set ID: 2  Batch ID: 20 | Loss: 0.06259
Epoch ID: 38   Set ID: 2  Batch ID: 40 | Loss: 0.06517
Epoch ID: 38   Set ID: 2  Batch ID: 60 | Loss: 0.05934
2
Epoch ID: 39   Set ID: 2  Batch ID: 20 | Loss: 0.06198
Epoch ID: 39   Set ID: 2  Batch ID: 40 | Loss: 0.06584
Epoch ID: 39   Set ID: 2  Batch ID: 60 | Loss: 0.06478
```

```
2
Epoch ID: 40   Set ID: 2  Batch ID: 20 | Loss: 0.06672
Epoch ID: 40   Set ID: 2  Batch ID: 40 | Loss: 0.06806
Epoch ID: 40   Set ID: 2  Batch ID: 60 | Loss: 0.05724
2
Epoch ID: 41   Set ID: 2  Batch ID: 20 | Loss: 0.06655
Epoch ID: 41   Set ID: 2  Batch ID: 40 | Loss: 0.06309
Epoch ID: 41   Set ID: 2  Batch ID: 60 | Loss: 0.05890
2
Epoch ID: 42   Set ID: 2  Batch ID: 20 | Loss: 0.07260
Epoch ID: 42   Set ID: 2  Batch ID: 40 | Loss: 0.05739
Epoch ID: 42   Set ID: 2  Batch ID: 60 | Loss: 0.06141
2
Epoch ID: 43   Set ID: 2  Batch ID: 20 | Loss: 0.07092
Epoch ID: 43   Set ID: 2  Batch ID: 40 | Loss: 0.06233
Epoch ID: 43   Set ID: 2  Batch ID: 60 | Loss: 0.05808
2
Epoch ID: 44   Set ID: 2  Batch ID: 20 | Loss: 0.07299
Epoch ID: 44   Set ID: 2  Batch ID: 40 | Loss: 0.07183
Epoch ID: 44   Set ID: 2  Batch ID: 60 | Loss: 0.06016
2
Epoch ID: 45   Set ID: 2  Batch ID: 20 | Loss: 0.06522
Epoch ID: 45   Set ID: 2  Batch ID: 40 | Loss: 0.06428
Epoch ID: 45   Set ID: 2  Batch ID: 60 | Loss: 0.06078
2
Epoch ID: 46   Set ID: 2  Batch ID: 20 | Loss: 0.06513
Epoch ID: 46   Set ID: 2  Batch ID: 40 | Loss: 0.05859
Epoch ID: 46   Set ID: 2  Batch ID: 60 | Loss: 0.05245
2
Epoch ID: 47   Set ID: 2  Batch ID: 20 | Loss: 0.06464
Epoch ID: 47   Set ID: 2  Batch ID: 40 | Loss: 0.06328
Epoch ID: 47   Set ID: 2  Batch ID: 60 | Loss: 0.05909
2
Epoch ID: 48   Set ID: 2  Batch ID: 20 | Loss: 0.06727
Epoch ID: 48   Set ID: 2  Batch ID: 40 | Loss: 0.06456
Epoch ID: 48   Set ID: 2  Batch ID: 60 | Loss: 0.05662
2
Epoch ID: 49   Set ID: 2  Batch ID: 20 | Loss: 0.06283
Epoch ID: 49   Set ID: 2  Batch ID: 40 | Loss: 0.06604
Epoch ID: 49   Set ID: 2  Batch ID: 60 | Loss: 0.05401
```

```
cost = [c.to('cpu') for c in cost]
val_cost = [c.to('cpu') for c in val_cost]
plt.plot(cost)
#plt.plot(val_cost)
plt.show()
```

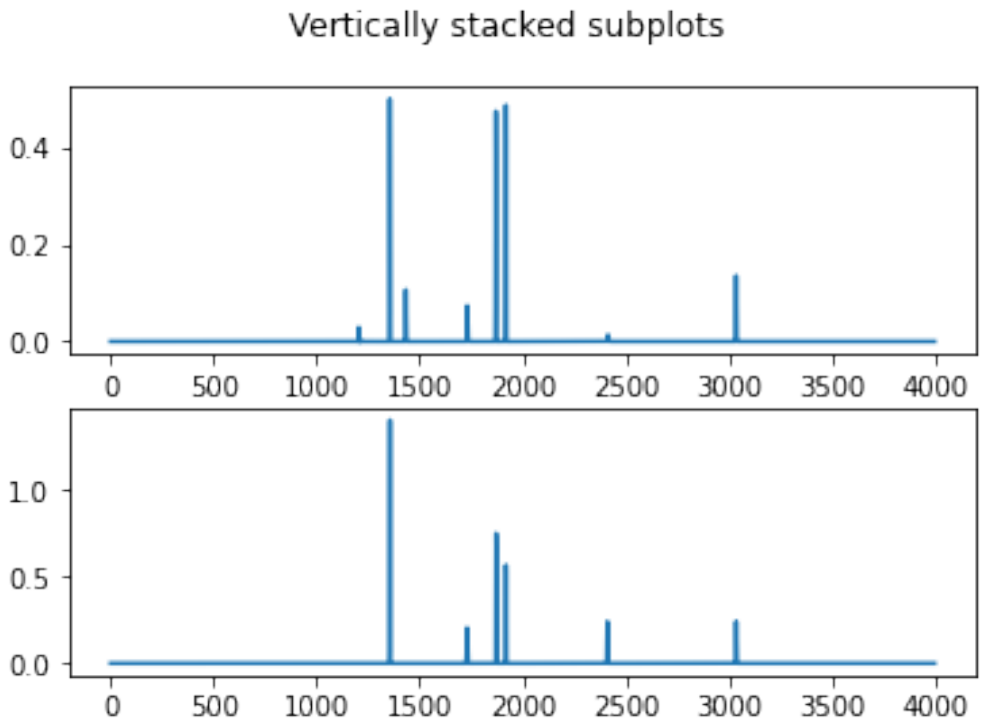



```
loss_val, eff_rate, fp_rate = validate(model)

print(f"Loss: {loss_val}")
print(f"Eff: {eff_rate}")
print(f"FP: {fp_rate}")
```

```
Loss: 0.05866293981671333
Eff: 0.7837867728378677
FP: 0.17436512697460507
```

```
model.to("cpu")
model.eval()
with torch.no_grad():
    for setID in val_set_idx:
      val_set = MyDataset(setID+1)
      val_generator = torch.utils.data.DataLoader(val_set,
                                                  batch_size=64,
                                                  shuffle=True)
      print(setID)
      for X_val, y_val in val_generator:
        # Forward pass
        val_outputs = model(X_val)
        fig, axs = plt.subplots(2)
        fig.suptitle('Vertically stacked subplots')
        axs[0].plot(val_outputs[0])
        axs[1].plot(y_val[0])
        plt.show()
        break
```

```
1
```




```
torch.save(model.state_dict(), "RCNN_h64_l3.pt")

from google.colab import files
files.download('RCNN_h64_l3.pt')
```

```
<IPython.core.display.Javascript object>

<IPython.core.display.Javascript object>
```

```
model.to(DEVICE)
model.train()

cost, val_cost = train(model,
             num_epochs=50,
             learning_rate=0.0003,
             seed=123, batch_size=64)
```

```
2

/usr/local/lib/python3.7/dist-packages/torch/utils/data/
dataloader.py:566: UserWarning: This DataLoader will create 4 worker
processes in total. Our suggested max number of worker in current
system is 2, which is smaller than what this DataLoader is going to
create. Please be aware that excessive worker creation might get
DataLoader running slow or even freeze, lower the worker number to
avoid potential slowness/freeze if necessary.
  cpuset_checked))
```

```
Epoch ID: 1   Set ID: 2  Batch ID: 20 | Loss: 0.04864
Epoch ID: 1   Set ID: 2  Batch ID: 40 | Loss: 0.04665
Epoch ID: 1   Set ID: 2  Batch ID: 60 | Loss: 0.04745
2
Epoch ID: 2   Set ID: 2  Batch ID: 20 | Loss: 0.04557
Epoch ID: 2   Set ID: 2  Batch ID: 40 | Loss: 0.04374
Epoch ID: 2   Set ID: 2  Batch ID: 60 | Loss: 0.04666
2
Epoch ID: 3   Set ID: 2  Batch ID: 20 | Loss: 0.06155
Epoch ID: 3   Set ID: 2  Batch ID: 40 | Loss: 0.05150
Epoch ID: 3   Set ID: 2  Batch ID: 60 | Loss: 0.04413
2
Epoch ID: 4   Set ID: 2  Batch ID: 20 | Loss: 0.04854
Epoch ID: 4   Set ID: 2  Batch ID: 40 | Loss: 0.04292
Epoch ID: 4   Set ID: 2  Batch ID: 60 | Loss: 0.04551
2
Epoch ID: 5   Set ID: 2  Batch ID: 20 | Loss: 0.04063
Epoch ID: 5   Set ID: 2  Batch ID: 40 | Loss: 0.04166
Epoch ID: 5   Set ID: 2  Batch ID: 60 | Loss: 0.04208
2
Epoch ID: 6   Set ID: 2  Batch ID: 20 | Loss: 0.04233
Epoch ID: 6   Set ID: 2  Batch ID: 40 | Loss: 0.04054
Epoch ID: 6   Set ID: 2  Batch ID: 60 | Loss: 0.04064
2
Epoch ID: 7   Set ID: 2  Batch ID: 20 | Loss: 0.04508
Epoch ID: 7   Set ID: 2  Batch ID: 40 | Loss: 0.04204
Epoch ID: 7   Set ID: 2  Batch ID: 60 | Loss: 0.04342
2
Epoch ID: 8   Set ID: 2  Batch ID: 20 | Loss: 0.04422
Epoch ID: 8   Set ID: 2  Batch ID: 40 | Loss: 0.03693
Epoch ID: 8   Set ID: 2  Batch ID: 60 | Loss: 0.03680
2
Epoch ID: 9   Set ID: 2  Batch ID: 20 | Loss: 0.04361
Epoch ID: 9   Set ID: 2  Batch ID: 40 | Loss: 0.04531
Epoch ID: 9   Set ID: 2  Batch ID: 60 | Loss: 0.04139
2
Epoch ID: 10   Set ID: 2  Batch ID: 20 | Loss: 0.04283
Epoch ID: 10   Set ID: 2  Batch ID: 40 | Loss: 0.04057
Epoch ID: 10   Set ID: 2  Batch ID: 60 | Loss: 0.03729
2
Epoch ID: 11   Set ID: 2  Batch ID: 20 | Loss: 0.03861
Epoch ID: 11   Set ID: 2  Batch ID: 40 | Loss: 0.04270
Epoch ID: 11   Set ID: 2  Batch ID: 60 | Loss: 0.03510
2
Epoch ID: 12   Set ID: 2  Batch ID: 20 | Loss: 0.04062
Epoch ID: 12   Set ID: 2  Batch ID: 40 | Loss: 0.03752
Epoch ID: 12   Set ID: 2  Batch ID: 60 | Loss: 0.04571
2
Epoch ID: 13   Set ID: 2  Batch ID: 20 | Loss: 0.04201
Epoch ID: 13   Set ID: 2  Batch ID: 40 | Loss: 0.03562
```

```
Epoch ID: 13   Set ID: 2  Batch ID: 60 | Loss: 0.03968
2
Epoch ID: 14   Set ID: 2  Batch ID: 20 | Loss: 0.03468
Epoch ID: 14   Set ID: 2  Batch ID: 40 | Loss: 0.03556
Epoch ID: 14   Set ID: 2  Batch ID: 60 | Loss: 0.04269
2
Epoch ID: 15   Set ID: 2  Batch ID: 20 | Loss: 0.03472
Epoch ID: 15   Set ID: 2  Batch ID: 40 | Loss: 0.03983
Epoch ID: 15   Set ID: 2  Batch ID: 60 | Loss: 0.04861
2
Epoch ID: 16   Set ID: 2  Batch ID: 20 | Loss: 0.05194
Epoch ID: 16   Set ID: 2  Batch ID: 40 | Loss: 0.05034
Epoch ID: 16   Set ID: 2  Batch ID: 60 | Loss: 0.04763
2
Epoch ID: 17   Set ID: 2  Batch ID: 20 | Loss: 0.04206
Epoch ID: 17   Set ID: 2  Batch ID: 40 | Loss: 0.04730
Epoch ID: 17   Set ID: 2  Batch ID: 60 | Loss: 0.03842
2
Epoch ID: 18   Set ID: 2  Batch ID: 20 | Loss: 0.03609
Epoch ID: 18   Set ID: 2  Batch ID: 40 | Loss: 0.03755
Epoch ID: 18   Set ID: 2  Batch ID: 60 | Loss: 0.04275
2
Epoch ID: 19   Set ID: 2  Batch ID: 20 | Loss: 0.03992
Epoch ID: 19   Set ID: 2  Batch ID: 40 | Loss: 0.03772
Epoch ID: 19   Set ID: 2  Batch ID: 60 | Loss: 0.04770
2
Epoch ID: 20   Set ID: 2  Batch ID: 20 | Loss: 0.04088
Epoch ID: 20   Set ID: 2  Batch ID: 40 | Loss: 0.04472
Epoch ID: 20   Set ID: 2  Batch ID: 60 | Loss: 0.03562
2
Epoch ID: 21   Set ID: 2  Batch ID: 20 | Loss: 0.03501
Epoch ID: 21   Set ID: 2  Batch ID: 40 | Loss: 0.03505
Epoch ID: 21   Set ID: 2  Batch ID: 60 | Loss: 0.03668
2
Epoch ID: 22   Set ID: 2  Batch ID: 20 | Loss: 0.03751
Epoch ID: 22   Set ID: 2  Batch ID: 40 | Loss: 0.03686
Epoch ID: 22   Set ID: 2  Batch ID: 60 | Loss: 0.03889
2
Epoch ID: 23   Set ID: 2  Batch ID: 20 | Loss: 0.04214
Epoch ID: 23   Set ID: 2  Batch ID: 40 | Loss: 0.03465
Epoch ID: 23   Set ID: 2  Batch ID: 60 | Loss: 0.03728
2
Epoch ID: 24   Set ID: 2  Batch ID: 20 | Loss: 0.03744
Epoch ID: 24   Set ID: 2  Batch ID: 40 | Loss: 0.03764
Epoch ID: 24   Set ID: 2  Batch ID: 60 | Loss: 0.04015
2
Epoch ID: 25   Set ID: 2  Batch ID: 20 | Loss: 0.03546
Epoch ID: 25   Set ID: 2  Batch ID: 40 | Loss: 0.03292
Epoch ID: 25   Set ID: 2  Batch ID: 60 | Loss: 0.03918
2
```

```
Epoch ID: 26   Set ID: 2  Batch ID: 20 | Loss: 0.03984
Epoch ID: 26   Set ID: 2  Batch ID: 40 | Loss: 0.03688
Epoch ID: 26   Set ID: 2  Batch ID: 60 | Loss: 0.03589
2
Epoch ID: 27   Set ID: 2  Batch ID: 20 | Loss: 0.04185
Epoch ID: 27   Set ID: 2  Batch ID: 40 | Loss: 0.03736
Epoch ID: 27   Set ID: 2  Batch ID: 60 | Loss: 0.03619
2
Epoch ID: 28   Set ID: 2  Batch ID: 20 | Loss: 0.03294
Epoch ID: 28   Set ID: 2  Batch ID: 40 | Loss: 0.04172
Epoch ID: 28   Set ID: 2  Batch ID: 60 | Loss: 0.03999
2
Epoch ID: 29   Set ID: 2  Batch ID: 20 | Loss: 0.03208
Epoch ID: 29   Set ID: 2  Batch ID: 40 | Loss: 0.04315
Epoch ID: 29   Set ID: 2  Batch ID: 60 | Loss: 0.04201
2
Epoch ID: 30   Set ID: 2  Batch ID: 20 | Loss: 0.03546
Epoch ID: 30   Set ID: 2  Batch ID: 40 | Loss: 0.03659
Epoch ID: 30   Set ID: 2  Batch ID: 60 | Loss: 0.03831
2
Epoch ID: 31   Set ID: 2  Batch ID: 20 | Loss: 0.04168
Epoch ID: 31   Set ID: 2  Batch ID: 40 | Loss: 0.04078
Epoch ID: 31   Set ID: 2  Batch ID: 60 | Loss: 0.03777
2
Epoch ID: 32   Set ID: 2  Batch ID: 20 | Loss: 0.03893
Epoch ID: 32   Set ID: 2  Batch ID: 40 | Loss: 0.04139
Epoch ID: 32   Set ID: 2  Batch ID: 60 | Loss: 0.03850
2
Epoch ID: 33   Set ID: 2  Batch ID: 20 | Loss: 0.04266
Epoch ID: 33   Set ID: 2  Batch ID: 40 | Loss: 0.03556
Epoch ID: 33   Set ID: 2  Batch ID: 60 | Loss: 0.03274
2
Epoch ID: 34   Set ID: 2  Batch ID: 20 | Loss: 0.04124
Epoch ID: 34   Set ID: 2  Batch ID: 40 | Loss: 0.04599
Epoch ID: 34   Set ID: 2  Batch ID: 60 | Loss: 0.03715
2
Epoch ID: 35   Set ID: 2  Batch ID: 20 | Loss: 0.03767
Epoch ID: 35   Set ID: 2  Batch ID: 40 | Loss: 0.03326
Epoch ID: 35   Set ID: 2  Batch ID: 60 | Loss: 0.03214
2
Epoch ID: 36   Set ID: 2  Batch ID: 20 | Loss: 0.03367
Epoch ID: 36   Set ID: 2  Batch ID: 40 | Loss: 0.03607
Epoch ID: 36   Set ID: 2  Batch ID: 60 | Loss: 0.03267
2
Epoch ID: 37   Set ID: 2  Batch ID: 20 | Loss: 0.03546
Epoch ID: 37   Set ID: 2  Batch ID: 40 | Loss: 0.03969
Epoch ID: 37   Set ID: 2  Batch ID: 60 | Loss: 0.03474
2
Epoch ID: 38   Set ID: 2  Batch ID: 20 | Loss: 0.03780
Epoch ID: 38   Set ID: 2  Batch ID: 40 | Loss: 0.03803
```

```
Epoch ID: 38   Set ID: 2  Batch ID: 60 | Loss: 0.03554
2
Epoch ID: 39   Set ID: 2  Batch ID: 20 | Loss: 0.03362
Epoch ID: 39   Set ID: 2  Batch ID: 40 | Loss: 0.03610
Epoch ID: 39   Set ID: 2  Batch ID: 60 | Loss: 0.03431
2
Epoch ID: 40   Set ID: 2  Batch ID: 20 | Loss: 0.04289
Epoch ID: 40   Set ID: 2  Batch ID: 40 | Loss: 0.04081
Epoch ID: 40   Set ID: 2  Batch ID: 60 | Loss: 0.03382
2
Epoch ID: 41   Set ID: 2  Batch ID: 20 | Loss: 0.03274
Epoch ID: 41   Set ID: 2  Batch ID: 40 | Loss: 0.03500
Epoch ID: 41   Set ID: 2  Batch ID: 60 | Loss: 0.03740
2
Epoch ID: 42   Set ID: 2  Batch ID: 20 | Loss: 0.04229
Epoch ID: 42   Set ID: 2  Batch ID: 40 | Loss: 0.03374
Epoch ID: 42   Set ID: 2  Batch ID: 60 | Loss: 0.04107
2
Epoch ID: 43   Set ID: 2  Batch ID: 20 | Loss: 0.03595
Epoch ID: 43   Set ID: 2  Batch ID: 40 | Loss: 0.03357
Epoch ID: 43   Set ID: 2  Batch ID: 60 | Loss: 0.03416
2
Epoch ID: 44   Set ID: 2  Batch ID: 20 | Loss: 0.03800
Epoch ID: 44   Set ID: 2  Batch ID: 40 | Loss: 0.03611
Epoch ID: 44   Set ID: 2  Batch ID: 60 | Loss: 0.03647
2
Epoch ID: 45   Set ID: 2  Batch ID: 20 | Loss: 0.03867
Epoch ID: 45   Set ID: 2  Batch ID: 40 | Loss: 0.03772
Epoch ID: 45   Set ID: 2  Batch ID: 60 | Loss: 0.03729
2
Epoch ID: 46   Set ID: 2  Batch ID: 20 | Loss: 0.03950
Epoch ID: 46   Set ID: 2  Batch ID: 40 | Loss: 0.03775
Epoch ID: 46   Set ID: 2  Batch ID: 60 | Loss: 0.03162
2
Epoch ID: 47   Set ID: 2  Batch ID: 20 | Loss: 0.04137
Epoch ID: 47   Set ID: 2  Batch ID: 40 | Loss: 0.03610
Epoch ID: 47   Set ID: 2  Batch ID: 60 | Loss: 0.03673
2
Epoch ID: 48   Set ID: 2  Batch ID: 20 | Loss: 0.03946
Epoch ID: 48   Set ID: 2  Batch ID: 40 | Loss: 0.04103
Epoch ID: 48   Set ID: 2  Batch ID: 60 | Loss: 0.03560
2
Epoch ID: 49   Set ID: 2  Batch ID: 20 | Loss: 0.03855
Epoch ID: 49   Set ID: 2  Batch ID: 40 | Loss: 0.04122
Epoch ID: 49   Set ID: 2  Batch ID: 60 | Loss: 0.03409
```

Larger Sample Size 10,000

```
train_set_idx, val_set_idx = train_test_split(list(range(1,4)),
test_size=1)
```

```
print(train_set_idx)
print(val_set_idx)
```

```
[3, 2]
[1]
```

```
model = BiRNN_2(input_size=4, hidden_size=64, num_layers=3)

model = model.to(DEVICE)

cost, val_cost = train(model,
             num_epochs=50,
             learning_rate=0.0005,
             seed=123, batch_size=64)
```

```
3

/usr/local/lib/python3.7/dist-packages/torch/utils/data/
dataloader.py:566: UserWarning: This DataLoader will create 4 worker
processes in total. Our suggested max number of worker in current
system is 2, which is smaller than what this DataLoader is going to
create. Please be aware that excessive worker creation might get
DataLoader running slow or even freeze, lower the worker number to
avoid potential slowness/freeze if necessary.
  cpuset_checked))

Epoch ID: 1   Set ID: 3  Batch ID: 20 | Loss: 6.34068
Epoch ID: 1   Set ID: 3  Batch ID: 40 | Loss: 4.65284
Epoch ID: 1   Set ID: 3  Batch ID: 60 | Loss: 3.27109
2
Epoch ID: 1   Set ID: 2  Batch ID: 80 | Loss: 3.63377
Epoch ID: 1   Set ID: 2  Batch ID: 100 | Loss: 3.51216
Epoch ID: 1   Set ID: 2  Batch ID: 120 | Loss: 3.22676
Epoch ID: 1   Set ID: 2  Batch ID: 140 | Loss: 3.00598
3
Epoch ID: 2   Set ID: 3  Batch ID: 20 | Loss: 1.16430
Epoch ID: 2   Set ID: 3  Batch ID: 40 | Loss: 1.96171
Epoch ID: 2   Set ID: 3  Batch ID: 60 | Loss: 3.34772
2
Epoch ID: 2   Set ID: 2  Batch ID: 80 | Loss: 3.44137
Epoch ID: 2   Set ID: 2  Batch ID: 100 | Loss: 4.37922
Epoch ID: 2   Set ID: 2  Batch ID: 120 | Loss: 2.56360
Epoch ID: 2   Set ID: 2  Batch ID: 140 | Loss: 1.88827
3
Epoch ID: 3   Set ID: 3  Batch ID: 20 | Loss: 1.54743
Epoch ID: 3   Set ID: 3  Batch ID: 40 | Loss: 1.45620
Epoch ID: 3   Set ID: 3  Batch ID: 60 | Loss: 3.64886
2
Epoch ID: 3   Set ID: 2  Batch ID: 80 | Loss: 2.88188
Epoch ID: 3   Set ID: 2  Batch ID: 100 | Loss: 2.93087
Epoch ID: 3   Set ID: 2  Batch ID: 120 | Loss: 2.58976
```

```
Epoch ID: 3   Set ID: 2  Batch ID: 140 | Loss: 2.22538
3
Epoch ID: 4   Set ID: 3  Batch ID: 20 | Loss: 2.20873
Epoch ID: 4   Set ID: 3  Batch ID: 40 | Loss: 1.81792
Epoch ID: 4   Set ID: 3  Batch ID: 60 | Loss: 1.93691
2
Epoch ID: 4   Set ID: 2  Batch ID: 80 | Loss: 0.47598
Epoch ID: 4   Set ID: 2  Batch ID: 100 | Loss: 0.61820
Epoch ID: 4   Set ID: 2  Batch ID: 120 | Loss: 0.92445
Epoch ID: 4   Set ID: 2  Batch ID: 140 | Loss: 0.75415
3
Epoch ID: 5   Set ID: 3  Batch ID: 20 | Loss: 0.73405
Epoch ID: 5   Set ID: 3  Batch ID: 40 | Loss: 1.50772
Epoch ID: 5   Set ID: 3  Batch ID: 60 | Loss: 1.54951
2
Epoch ID: 5   Set ID: 2  Batch ID: 80 | Loss: 0.28339
Epoch ID: 5   Set ID: 2  Batch ID: 100 | Loss: 0.55191
Epoch ID: 5   Set ID: 2  Batch ID: 120 | Loss: 0.75149
Epoch ID: 5   Set ID: 2  Batch ID: 140 | Loss: 0.34389
3
Epoch ID: 6   Set ID: 3  Batch ID: 20 | Loss: 0.68703
Epoch ID: 6   Set ID: 3  Batch ID: 40 | Loss: 0.52011
Epoch ID: 6   Set ID: 3  Batch ID: 60 | Loss: 0.20123
2
Epoch ID: 6   Set ID: 2  Batch ID: 80 | Loss: 0.55627
Epoch ID: 6   Set ID: 2  Batch ID: 100 | Loss: 0.83815
Epoch ID: 6   Set ID: 2  Batch ID: 120 | Loss: 0.41171
Epoch ID: 6   Set ID: 2  Batch ID: 140 | Loss: 1.17113
3
Epoch ID: 7   Set ID: 3  Batch ID: 20 | Loss: 0.19650
Epoch ID: 7   Set ID: 3  Batch ID: 40 | Loss: 0.26869
Epoch ID: 7   Set ID: 3  Batch ID: 60 | Loss: 0.32897
2
Epoch ID: 7   Set ID: 2  Batch ID: 80 | Loss: 0.17265
Epoch ID: 7   Set ID: 2  Batch ID: 100 | Loss: 0.17283
Epoch ID: 7   Set ID: 2  Batch ID: 120 | Loss: 0.16937
Epoch ID: 7   Set ID: 2  Batch ID: 140 | Loss: 0.14143
3
Epoch ID: 8   Set ID: 3  Batch ID: 20 | Loss: 0.16708
Epoch ID: 8   Set ID: 3  Batch ID: 40 | Loss: 0.14178
Epoch ID: 8   Set ID: 3  Batch ID: 60 | Loss: 0.14204
2
Epoch ID: 8   Set ID: 2  Batch ID: 80 | Loss: 0.16127
Epoch ID: 8   Set ID: 2  Batch ID: 100 | Loss: 0.17003
Epoch ID: 8   Set ID: 2  Batch ID: 120 | Loss: 0.14727
Epoch ID: 8   Set ID: 2  Batch ID: 140 | Loss: 0.14747
3
Epoch ID: 9   Set ID: 3  Batch ID: 20 | Loss: 0.14194
Epoch ID: 9   Set ID: 3  Batch ID: 40 | Loss: 0.14567
Epoch ID: 9   Set ID: 3  Batch ID: 60 | Loss: 0.21260
```

```
2
Epoch ID: 9   Set ID: 2  Batch ID: 80 | Loss: 0.21501
Epoch ID: 9   Set ID: 2  Batch ID: 100 | Loss: 0.13474
Epoch ID: 9   Set ID: 2  Batch ID: 120 | Loss: 0.12268
Epoch ID: 9   Set ID: 2  Batch ID: 140 | Loss: 0.12373
3
Epoch ID: 10   Set ID: 3  Batch ID: 20 | Loss: 0.11266
Epoch ID: 10   Set ID: 3  Batch ID: 40 | Loss: 0.15573
Epoch ID: 10   Set ID: 3  Batch ID: 60 | Loss: 0.11333
2
Epoch ID: 10   Set ID: 2  Batch ID: 80 | Loss: 0.18824
Epoch ID: 10   Set ID: 2  Batch ID: 100 | Loss: 0.16246
Epoch ID: 10   Set ID: 2  Batch ID: 120 | Loss: 0.11698
Epoch ID: 10   Set ID: 2  Batch ID: 140 | Loss: 0.09726
3
Epoch ID: 11   Set ID: 3  Batch ID: 20 | Loss: 0.16926
Epoch ID: 11   Set ID: 3  Batch ID: 40 | Loss: 0.10026
Epoch ID: 11   Set ID: 3  Batch ID: 60 | Loss: 0.09370
2
Epoch ID: 11   Set ID: 2  Batch ID: 80 | Loss: 0.14645
Epoch ID: 11   Set ID: 2  Batch ID: 100 | Loss: 0.13514
Epoch ID: 11   Set ID: 2  Batch ID: 120 | Loss: 0.10899
Epoch ID: 11   Set ID: 2  Batch ID: 140 | Loss: 0.09995
3
Epoch ID: 12   Set ID: 3  Batch ID: 20 | Loss: 0.10993
Epoch ID: 12   Set ID: 3  Batch ID: 40 | Loss: 0.09317
Epoch ID: 12   Set ID: 3  Batch ID: 60 | Loss: 0.10964
2
Epoch ID: 12   Set ID: 2  Batch ID: 80 | Loss: 0.09991
Epoch ID: 12   Set ID: 2  Batch ID: 100 | Loss: 0.07823
Epoch ID: 12   Set ID: 2  Batch ID: 120 | Loss: 0.08684
Epoch ID: 12   Set ID: 2  Batch ID: 140 | Loss: 0.10273
3
Epoch ID: 13   Set ID: 3  Batch ID: 20 | Loss: 0.09261
Epoch ID: 13   Set ID: 3  Batch ID: 40 | Loss: 0.09182
Epoch ID: 13   Set ID: 3  Batch ID: 60 | Loss: 0.09897
2
Epoch ID: 13   Set ID: 2  Batch ID: 80 | Loss: 0.10080
Epoch ID: 13   Set ID: 2  Batch ID: 100 | Loss: 0.13911
Epoch ID: 13   Set ID: 2  Batch ID: 120 | Loss: 0.10267
Epoch ID: 13   Set ID: 2  Batch ID: 140 | Loss: 0.08986
3
Epoch ID: 14   Set ID: 3  Batch ID: 20 | Loss: 0.11963
Epoch ID: 14   Set ID: 3  Batch ID: 40 | Loss: 0.08984
Epoch ID: 14   Set ID: 3  Batch ID: 60 | Loss: 0.08159
2
Epoch ID: 14   Set ID: 2  Batch ID: 80 | Loss: 0.14183
Epoch ID: 14   Set ID: 2  Batch ID: 100 | Loss: 0.08352
Epoch ID: 14   Set ID: 2  Batch ID: 120 | Loss: 0.07560
Epoch ID: 14   Set ID: 2  Batch ID: 140 | Loss: 0.07983
```

```
3
Epoch ID: 15   Set ID: 3  Batch ID: 20 | Loss: 0.08844
Epoch ID: 15   Set ID: 3  Batch ID: 40 | Loss: 0.07483
Epoch ID: 15   Set ID: 3  Batch ID: 60 | Loss: 0.07467
2
Epoch ID: 15   Set ID: 2  Batch ID: 80 | Loss: 0.08848
Epoch ID: 15   Set ID: 2  Batch ID: 100 | Loss: 0.08320
Epoch ID: 15   Set ID: 2  Batch ID: 120 | Loss: 0.08871
Epoch ID: 15   Set ID: 2  Batch ID: 140 | Loss: 0.08242
3
Epoch ID: 16   Set ID: 3  Batch ID: 20 | Loss: 0.08678
Epoch ID: 16   Set ID: 3  Batch ID: 40 | Loss: 0.07951
Epoch ID: 16   Set ID: 3  Batch ID: 60 | Loss: 0.07692
2
Epoch ID: 16   Set ID: 2  Batch ID: 80 | Loss: 0.08472
Epoch ID: 16   Set ID: 2  Batch ID: 100 | Loss: 0.10089
Epoch ID: 16   Set ID: 2  Batch ID: 120 | Loss: 0.09141
Epoch ID: 16   Set ID: 2  Batch ID: 140 | Loss: 0.08366
3
Epoch ID: 17   Set ID: 3  Batch ID: 20 | Loss: 0.07990
Epoch ID: 17   Set ID: 3  Batch ID: 40 | Loss: 0.07834
Epoch ID: 17   Set ID: 3  Batch ID: 60 | Loss: 0.08025
2
Epoch ID: 17   Set ID: 2  Batch ID: 80 | Loss: 0.12821
Epoch ID: 17   Set ID: 2  Batch ID: 100 | Loss: 0.08510
Epoch ID: 17   Set ID: 2  Batch ID: 120 | Loss: 0.07087
Epoch ID: 17   Set ID: 2  Batch ID: 140 | Loss: 0.08261
3
Epoch ID: 18   Set ID: 3  Batch ID: 20 | Loss: 0.07657
Epoch ID: 18   Set ID: 3  Batch ID: 40 | Loss: 0.07697
Epoch ID: 18   Set ID: 3  Batch ID: 60 | Loss: 0.08027
2
Epoch ID: 18   Set ID: 2  Batch ID: 80 | Loss: 0.08696
Epoch ID: 18   Set ID: 2  Batch ID: 100 | Loss: 0.08878
Epoch ID: 18   Set ID: 2  Batch ID: 120 | Loss: 0.08317
Epoch ID: 18   Set ID: 2  Batch ID: 140 | Loss: 0.07675
3
Epoch ID: 19   Set ID: 3  Batch ID: 20 | Loss: 0.07709
Epoch ID: 19   Set ID: 3  Batch ID: 40 | Loss: 0.06549
Epoch ID: 19   Set ID: 3  Batch ID: 60 | Loss: 0.07973
2
Epoch ID: 19   Set ID: 2  Batch ID: 80 | Loss: 0.09522
Epoch ID: 19   Set ID: 2  Batch ID: 100 | Loss: 0.07778
Epoch ID: 19   Set ID: 2  Batch ID: 120 | Loss: 0.09327
Epoch ID: 19   Set ID: 2  Batch ID: 140 | Loss: 0.07515
3
Epoch ID: 20   Set ID: 3  Batch ID: 20 | Loss: 0.08290
Epoch ID: 20   Set ID: 3  Batch ID: 40 | Loss: 0.08341
Epoch ID: 20   Set ID: 3  Batch ID: 60 | Loss: 0.08384
2
```

```
Epoch ID: 20   Set ID: 2  Batch ID: 80 | Loss: 0.08568
Epoch ID: 20   Set ID: 2  Batch ID: 100 | Loss: 0.08029
Epoch ID: 20   Set ID: 2  Batch ID: 120 | Loss: 0.07203
Epoch ID: 20   Set ID: 2  Batch ID: 140 | Loss: 0.08148
3
Epoch ID: 21   Set ID: 3  Batch ID: 20 | Loss: 0.08070
Epoch ID: 21   Set ID: 3  Batch ID: 40 | Loss: 0.09345
Epoch ID: 21   Set ID: 3  Batch ID: 60 | Loss: 0.07996
2
Epoch ID: 21   Set ID: 2  Batch ID: 80 | Loss: 0.08315
Epoch ID: 21   Set ID: 2  Batch ID: 100 | Loss: 0.09069
Epoch ID: 21   Set ID: 2  Batch ID: 120 | Loss: 0.09027
Epoch ID: 21   Set ID: 2  Batch ID: 140 | Loss: 0.07729
3
Epoch ID: 22   Set ID: 3  Batch ID: 20 | Loss: 0.08349
Epoch ID: 22   Set ID: 3  Batch ID: 40 | Loss: 0.08418
Epoch ID: 22   Set ID: 3  Batch ID: 60 | Loss: 0.08423
2
Epoch ID: 22   Set ID: 2  Batch ID: 80 | Loss: 0.10056
Epoch ID: 22   Set ID: 2  Batch ID: 100 | Loss: 0.09559
Epoch ID: 22   Set ID: 2  Batch ID: 120 | Loss: 0.08005
Epoch ID: 22   Set ID: 2  Batch ID: 140 | Loss: 0.07243
3
Epoch ID: 23   Set ID: 3  Batch ID: 20 | Loss: 0.08490
Epoch ID: 23   Set ID: 3  Batch ID: 40 | Loss: 0.09395
Epoch ID: 23   Set ID: 3  Batch ID: 60 | Loss: 0.09640
2
Epoch ID: 23   Set ID: 2  Batch ID: 80 | Loss: 0.08566
Epoch ID: 23   Set ID: 2  Batch ID: 100 | Loss: 0.06696
Epoch ID: 23   Set ID: 2  Batch ID: 120 | Loss: 0.08034
Epoch ID: 23   Set ID: 2  Batch ID: 140 | Loss: 0.07289
3
Epoch ID: 24   Set ID: 3  Batch ID: 20 | Loss: 0.09335
Epoch ID: 24   Set ID: 3  Batch ID: 40 | Loss: 0.08300
Epoch ID: 24   Set ID: 3  Batch ID: 60 | Loss: 0.08784
2
Epoch ID: 24   Set ID: 2  Batch ID: 80 | Loss: 0.09646
Epoch ID: 24   Set ID: 2  Batch ID: 100 | Loss: 0.07642
Epoch ID: 24   Set ID: 2  Batch ID: 120 | Loss: 0.06878
Epoch ID: 24   Set ID: 2  Batch ID: 140 | Loss: 0.07648
3
Epoch ID: 25   Set ID: 3  Batch ID: 20 | Loss: 0.07176
Epoch ID: 25   Set ID: 3  Batch ID: 40 | Loss: 0.08185
Epoch ID: 25   Set ID: 3  Batch ID: 60 | Loss: 0.07487
2
Epoch ID: 25   Set ID: 2  Batch ID: 80 | Loss: 0.10415
Epoch ID: 25   Set ID: 2  Batch ID: 100 | Loss: 0.08323
Epoch ID: 25   Set ID: 2  Batch ID: 120 | Loss: 0.07471
Epoch ID: 25   Set ID: 2  Batch ID: 140 | Loss: 0.06717
3
```

```
Epoch ID: 26   Set ID: 3  Batch ID: 20 | Loss: 0.07345
Epoch ID: 26   Set ID: 3  Batch ID: 40 | Loss: 0.08697
Epoch ID: 26   Set ID: 3  Batch ID: 60 | Loss: 0.07654
2
Epoch ID: 26   Set ID: 2  Batch ID: 80 | Loss: 0.09909
Epoch ID: 26   Set ID: 2  Batch ID: 100 | Loss: 0.06362
Epoch ID: 26   Set ID: 2  Batch ID: 120 | Loss: 0.06688
Epoch ID: 26   Set ID: 2  Batch ID: 140 | Loss: 0.07171
3
Epoch ID: 27   Set ID: 3  Batch ID: 20 | Loss: 0.06057
Epoch ID: 27   Set ID: 3  Batch ID: 40 | Loss: 0.06449
Epoch ID: 27   Set ID: 3  Batch ID: 60 | Loss: 0.07004
2
Epoch ID: 27   Set ID: 2  Batch ID: 80 | Loss: 0.07780
Epoch ID: 27   Set ID: 2  Batch ID: 100 | Loss: 0.07490
Epoch ID: 27   Set ID: 2  Batch ID: 120 | Loss: 0.06137
Epoch ID: 27   Set ID: 2  Batch ID: 140 | Loss: 0.07432
3
Epoch ID: 28   Set ID: 3  Batch ID: 20 | Loss: 0.07439
Epoch ID: 28   Set ID: 3  Batch ID: 40 | Loss: 0.06266
Epoch ID: 28   Set ID: 3  Batch ID: 60 | Loss: 0.05946
2
Epoch ID: 28   Set ID: 2  Batch ID: 80 | Loss: 0.08731
Epoch ID: 28   Set ID: 2  Batch ID: 100 | Loss: 0.06331
Epoch ID: 28   Set ID: 2  Batch ID: 120 | Loss: 0.06464
Epoch ID: 28   Set ID: 2  Batch ID: 140 | Loss: 0.07260
3
Epoch ID: 29   Set ID: 3  Batch ID: 20 | Loss: 0.06920
Epoch ID: 29   Set ID: 3  Batch ID: 40 | Loss: 0.06666
Epoch ID: 29   Set ID: 3  Batch ID: 60 | Loss: 0.06041
2
Epoch ID: 29   Set ID: 2  Batch ID: 80 | Loss: 0.05893
Epoch ID: 29   Set ID: 2  Batch ID: 100 | Loss: 0.06782
Epoch ID: 29   Set ID: 2  Batch ID: 120 | Loss: 0.06656
Epoch ID: 29   Set ID: 2  Batch ID: 140 | Loss: 0.06530
3
Epoch ID: 30   Set ID: 3  Batch ID: 20 | Loss: 0.05739
Epoch ID: 30   Set ID: 3  Batch ID: 40 | Loss: 0.06276
Epoch ID: 30   Set ID: 3  Batch ID: 60 | Loss: 0.06254
2
Epoch ID: 30   Set ID: 2  Batch ID: 80 | Loss: 0.07700
Epoch ID: 30   Set ID: 2  Batch ID: 100 | Loss: 0.06283
Epoch ID: 30   Set ID: 2  Batch ID: 120 | Loss: 0.06059
Epoch ID: 30   Set ID: 2  Batch ID: 140 | Loss: 0.06608
3
Epoch ID: 31   Set ID: 3  Batch ID: 20 | Loss: 0.05921
Epoch ID: 31   Set ID: 3  Batch ID: 40 | Loss: 0.06031
Epoch ID: 31   Set ID: 3  Batch ID: 60 | Loss: 0.07254
2
Epoch ID: 31   Set ID: 2  Batch ID: 80 | Loss: 0.07429
```

```
Epoch ID: 31   Set ID: 2  Batch ID: 100 | Loss: 0.05899
Epoch ID: 31   Set ID: 2  Batch ID: 120 | Loss: 0.06139
Epoch ID: 31   Set ID: 2  Batch ID: 140 | Loss: 0.06244
3
Epoch ID: 32   Set ID: 3  Batch ID: 20 | Loss: 0.06165
Epoch ID: 32   Set ID: 3  Batch ID: 40 | Loss: 0.05557
Epoch ID: 32   Set ID: 3  Batch ID: 60 | Loss: 0.06694
2
Epoch ID: 32   Set ID: 2  Batch ID: 80 | Loss: 0.07021
Epoch ID: 32   Set ID: 2  Batch ID: 100 | Loss: 0.06655
Epoch ID: 32   Set ID: 2  Batch ID: 120 | Loss: 0.05985
Epoch ID: 32   Set ID: 2  Batch ID: 140 | Loss: 0.05627
3
Epoch ID: 33   Set ID: 3  Batch ID: 20 | Loss: 0.07178
Epoch ID: 33   Set ID: 3  Batch ID: 40 | Loss: 0.05681
Epoch ID: 33   Set ID: 3  Batch ID: 60 | Loss: 0.06017
2
Epoch ID: 33   Set ID: 2  Batch ID: 80 | Loss: 0.06648
Epoch ID: 33   Set ID: 2  Batch ID: 100 | Loss: 0.06552
Epoch ID: 33   Set ID: 2  Batch ID: 120 | Loss: 0.05304
Epoch ID: 33   Set ID: 2  Batch ID: 140 | Loss: 0.05474
3
Epoch ID: 34   Set ID: 3  Batch ID: 20 | Loss: 0.07405
Epoch ID: 34   Set ID: 3  Batch ID: 40 | Loss: 0.06344
Epoch ID: 34   Set ID: 3  Batch ID: 60 | Loss: 0.05207
2
Epoch ID: 34   Set ID: 2  Batch ID: 80 | Loss: 0.05924
Epoch ID: 34   Set ID: 2  Batch ID: 100 | Loss: 0.06126
Epoch ID: 34   Set ID: 2  Batch ID: 120 | Loss: 0.05539
Epoch ID: 34   Set ID: 2  Batch ID: 140 | Loss: 0.06098
3
Epoch ID: 35   Set ID: 3  Batch ID: 20 | Loss: 0.06692
Epoch ID: 35   Set ID: 3  Batch ID: 40 | Loss: 0.05690
Epoch ID: 35   Set ID: 3  Batch ID: 60 | Loss: 0.06383
2
Epoch ID: 35   Set ID: 2  Batch ID: 80 | Loss: 0.05967
Epoch ID: 35   Set ID: 2  Batch ID: 100 | Loss: 0.05452
Epoch ID: 35   Set ID: 2  Batch ID: 120 | Loss: 0.06098
Epoch ID: 35   Set ID: 2  Batch ID: 140 | Loss: 0.05631
3
Epoch ID: 36   Set ID: 3  Batch ID: 20 | Loss: 0.06124
Epoch ID: 36   Set ID: 3  Batch ID: 40 | Loss: 0.06681
Epoch ID: 36   Set ID: 3  Batch ID: 60 | Loss: 0.05383
2
Epoch ID: 36   Set ID: 2  Batch ID: 80 | Loss: 0.07127
Epoch ID: 36   Set ID: 2  Batch ID: 100 | Loss: 0.06561
Epoch ID: 36   Set ID: 2  Batch ID: 120 | Loss: 0.05978
Epoch ID: 36   Set ID: 2  Batch ID: 140 | Loss: 0.05406
3
Epoch ID: 37   Set ID: 3  Batch ID: 20 | Loss: 0.05931
```

```
Epoch ID: 37   Set ID: 3  Batch ID: 40 | Loss: 0.05687
Epoch ID: 37   Set ID: 3  Batch ID: 60 | Loss: 0.05742
2
Epoch ID: 37   Set ID: 2  Batch ID: 80 | Loss: 0.05976
Epoch ID: 37   Set ID: 2  Batch ID: 100 | Loss: 0.06369
Epoch ID: 37   Set ID: 2  Batch ID: 120 | Loss: 0.05790
Epoch ID: 37   Set ID: 2  Batch ID: 140 | Loss: 0.05626
3
Epoch ID: 38   Set ID: 3  Batch ID: 20 | Loss: 0.07075
Epoch ID: 38   Set ID: 3  Batch ID: 40 | Loss: 0.05471
Epoch ID: 38   Set ID: 3  Batch ID: 60 | Loss: 0.05811
2
Epoch ID: 38   Set ID: 2  Batch ID: 80 | Loss: 0.06500
Epoch ID: 38   Set ID: 2  Batch ID: 100 | Loss: 0.05518
Epoch ID: 38   Set ID: 2  Batch ID: 120 | Loss: 0.05169
Epoch ID: 38   Set ID: 2  Batch ID: 140 | Loss: 0.05872
3
Epoch ID: 39   Set ID: 3  Batch ID: 20 | Loss: 0.05728
Epoch ID: 39   Set ID: 3  Batch ID: 40 | Loss: 0.06121
Epoch ID: 39   Set ID: 3  Batch ID: 60 | Loss: 0.06161
2
Epoch ID: 39   Set ID: 2  Batch ID: 80 | Loss: 0.06842
Epoch ID: 39   Set ID: 2  Batch ID: 100 | Loss: 0.05614
Epoch ID: 39   Set ID: 2  Batch ID: 120 | Loss: 0.06433
Epoch ID: 39   Set ID: 2  Batch ID: 140 | Loss: 0.06180
3
Epoch ID: 40   Set ID: 3  Batch ID: 20 | Loss: 0.05251
Epoch ID: 40   Set ID: 3  Batch ID: 40 | Loss: 0.05241
Epoch ID: 40   Set ID: 3  Batch ID: 60 | Loss: 0.05668
2
Epoch ID: 40   Set ID: 2  Batch ID: 80 | Loss: 0.06701
Epoch ID: 40   Set ID: 2  Batch ID: 100 | Loss: 0.05705
Epoch ID: 40   Set ID: 2  Batch ID: 120 | Loss: 0.05904
Epoch ID: 40   Set ID: 2  Batch ID: 140 | Loss: 0.05314
3
Epoch ID: 41   Set ID: 3  Batch ID: 20 | Loss: 0.06035
Epoch ID: 41   Set ID: 3  Batch ID: 40 | Loss: 0.06511
Epoch ID: 41   Set ID: 3  Batch ID: 60 | Loss: 0.05526
2
Epoch ID: 41   Set ID: 2  Batch ID: 80 | Loss: 0.06695
Epoch ID: 41   Set ID: 2  Batch ID: 100 | Loss: 0.05443
Epoch ID: 41   Set ID: 2  Batch ID: 120 | Loss: 0.04494
Epoch ID: 41   Set ID: 2  Batch ID: 140 | Loss: 0.05696
3
Epoch ID: 42   Set ID: 3  Batch ID: 20 | Loss: 0.05978
Epoch ID: 42   Set ID: 3  Batch ID: 40 | Loss: 0.06129
Epoch ID: 42   Set ID: 3  Batch ID: 60 | Loss: 0.05252
2
Epoch ID: 42   Set ID: 2  Batch ID: 80 | Loss: 0.05326
Epoch ID: 42   Set ID: 2  Batch ID: 100 | Loss: 0.05340
```

```
Epoch ID: 42   Set ID: 2  Batch ID: 120 | Loss: 0.05784
Epoch ID: 42   Set ID: 2  Batch ID: 140 | Loss: 0.05517
3
Epoch ID: 43   Set ID: 3  Batch ID: 20 | Loss: 0.06437
Epoch ID: 43   Set ID: 3  Batch ID: 40 | Loss: 0.05616
Epoch ID: 43   Set ID: 3  Batch ID: 60 | Loss: 0.05831
2
Epoch ID: 43   Set ID: 2  Batch ID: 80 | Loss: 0.05994
Epoch ID: 43   Set ID: 2  Batch ID: 100 | Loss: 0.05179
Epoch ID: 43   Set ID: 2  Batch ID: 120 | Loss: 0.05683
Epoch ID: 43   Set ID: 2  Batch ID: 140 | Loss: 0.04788
3
Epoch ID: 44   Set ID: 3  Batch ID: 20 | Loss: 0.05348
Epoch ID: 44   Set ID: 3  Batch ID: 40 | Loss: 0.04891
Epoch ID: 44   Set ID: 3  Batch ID: 60 | Loss: 0.05374
2
Epoch ID: 44   Set ID: 2  Batch ID: 80 | Loss: 0.05847
Epoch ID: 44   Set ID: 2  Batch ID: 100 | Loss: 0.05192
Epoch ID: 44   Set ID: 2  Batch ID: 120 | Loss: 0.05589
Epoch ID: 44   Set ID: 2  Batch ID: 140 | Loss: 0.04896
3
Epoch ID: 45   Set ID: 3  Batch ID: 20 | Loss: 0.05246
Epoch ID: 45   Set ID: 3  Batch ID: 40 | Loss: 0.05836
Epoch ID: 45   Set ID: 3  Batch ID: 60 | Loss: 0.05372
2
Epoch ID: 45   Set ID: 2  Batch ID: 80 | Loss: 0.05632
Epoch ID: 45   Set ID: 2  Batch ID: 100 | Loss: 0.05219
Epoch ID: 45   Set ID: 2  Batch ID: 120 | Loss: 0.05198
Epoch ID: 45   Set ID: 2  Batch ID: 140 | Loss: 0.05252
3
Epoch ID: 46   Set ID: 3  Batch ID: 20 | Loss: 0.06552
Epoch ID: 46   Set ID: 3  Batch ID: 40 | Loss: 0.05962
Epoch ID: 46   Set ID: 3  Batch ID: 60 | Loss: 0.05151
2
Epoch ID: 46   Set ID: 2  Batch ID: 80 | Loss: 0.05806
Epoch ID: 46   Set ID: 2  Batch ID: 100 | Loss: 0.05453
Epoch ID: 46   Set ID: 2  Batch ID: 120 | Loss: 0.04713
Epoch ID: 46   Set ID: 2  Batch ID: 140 | Loss: 0.05332
3
Epoch ID: 47   Set ID: 3  Batch ID: 20 | Loss: 0.05641
Epoch ID: 47   Set ID: 3  Batch ID: 40 | Loss: 0.05292
Epoch ID: 47   Set ID: 3  Batch ID: 60 | Loss: 0.05872
2
Epoch ID: 47   Set ID: 2  Batch ID: 80 | Loss: 0.05997
Epoch ID: 47   Set ID: 2  Batch ID: 100 | Loss: 0.05082
Epoch ID: 47   Set ID: 2  Batch ID: 120 | Loss: 0.05509
Epoch ID: 47   Set ID: 2  Batch ID: 140 | Loss: 0.05044
3
Epoch ID: 48   Set ID: 3  Batch ID: 20 | Loss: 0.04999
Epoch ID: 48   Set ID: 3  Batch ID: 40 | Loss: 0.05398
```

```
Epoch ID: 48   Set ID: 3  Batch ID: 60 | Loss: 0.05884
2
Epoch ID: 48   Set ID: 2  Batch ID: 80 | Loss: 0.05251
Epoch ID: 48   Set ID: 2  Batch ID: 100 | Loss: 0.05108
Epoch ID: 48   Set ID: 2  Batch ID: 120 | Loss: 0.05005
Epoch ID: 48   Set ID: 2  Batch ID: 140 | Loss: 0.05237
3
Epoch ID: 49   Set ID: 3  Batch ID: 20 | Loss: 0.06130
Epoch ID: 49   Set ID: 3  Batch ID: 40 | Loss: 0.05099
Epoch ID: 49   Set ID: 3  Batch ID: 60 | Loss: 0.04620
2
Epoch ID: 49   Set ID: 2  Batch ID: 80 | Loss: 0.05382
Epoch ID: 49   Set ID: 2  Batch ID: 100 | Loss: 0.04815
Epoch ID: 49   Set ID: 2  Batch ID: 120 | Loss: 0.05793
Epoch ID: 49   Set ID: 2  Batch ID: 140 | Loss: 0.04429
```

```
loss_val, eff_rate, fp_rate = validate(model)

print(f"Loss: {loss_val}")
print(f"Eff: {eff_rate}")
print(f"FP: {fp_rate}")
```

```
Loss: 0.053513798862695694
Eff: 0.8207992332079923
FP: 0.21715656868626274
```

Larger Sample Size 15,000

```
train_set_idx, val_set_idx = train_test_split(list(range(1,5)),
test_size=1)
print(train_set_idx)
print(val_set_idx)
```

```
[2, 4, 1]
[3]
```

```
model = BiRNN_2(input_size=4, hidden_size=64, num_layers=3)

model = model.to(DEVICE)

cost, val_cost = train(model,
             num_epochs=50,
             learning_rate=0.0005,
             seed=123, batch_size=64)
```

```
2
Epoch ID: 1   Set ID: 2  Batch ID: 20 | Loss: 4.74880
Epoch ID: 1   Set ID: 2  Batch ID: 40 | Loss: 3.09926
Epoch ID: 1   Set ID: 2  Batch ID: 60 | Loss: 4.40766
4
Epoch ID: 1   Set ID: 4  Batch ID: 80 | Loss: 3.29708
Epoch ID: 1   Set ID: 4  Batch ID: 100 | Loss: 0.83155
```

```
Epoch ID: 1   Set ID: 4  Batch ID: 120 | Loss: 1.26246
Epoch ID: 1   Set ID: 4  Batch ID: 140 | Loss: 1.17862
1
Epoch ID: 1   Set ID: 1  Batch ID: 160 | Loss: 2.04503
Epoch ID: 1   Set ID: 1  Batch ID: 180 | Loss: 0.74065
Epoch ID: 1   Set ID: 1  Batch ID: 200 | Loss: 2.06474
Epoch ID: 1   Set ID: 1  Batch ID: 220 | Loss: 2.21173
2
Epoch ID: 2   Set ID: 2  Batch ID: 20 | Loss: 2.15022
Epoch ID: 2   Set ID: 2  Batch ID: 40 | Loss: 1.59553
Epoch ID: 2   Set ID: 2  Batch ID: 60 | Loss: 1.18528
4
Epoch ID: 2   Set ID: 4  Batch ID: 80 | Loss: 1.77601
Epoch ID: 2   Set ID: 4  Batch ID: 100 | Loss: 2.79409
Epoch ID: 2   Set ID: 4  Batch ID: 120 | Loss: 3.03212
Epoch ID: 2   Set ID: 4  Batch ID: 140 | Loss: 1.81480
1
Epoch ID: 2   Set ID: 1  Batch ID: 160 | Loss: 2.01158
Epoch ID: 2   Set ID: 1  Batch ID: 180 | Loss: 0.66944
Epoch ID: 2   Set ID: 1  Batch ID: 200 | Loss: 1.36215
Epoch ID: 2   Set ID: 1  Batch ID: 220 | Loss: 0.69968
2
Epoch ID: 3   Set ID: 2  Batch ID: 20 | Loss: 1.53616
Epoch ID: 3   Set ID: 2  Batch ID: 40 | Loss: 0.73947
Epoch ID: 3   Set ID: 2  Batch ID: 60 | Loss: 0.74852
4
Epoch ID: 3   Set ID: 4  Batch ID: 80 | Loss: 2.39237
Epoch ID: 3   Set ID: 4  Batch ID: 100 | Loss: 2.44160
Epoch ID: 3   Set ID: 4  Batch ID: 120 | Loss: 3.01178
Epoch ID: 3   Set ID: 4  Batch ID: 140 | Loss: 1.43900
1
Epoch ID: 3   Set ID: 1  Batch ID: 160 | Loss: 1.78294
Epoch ID: 3   Set ID: 1  Batch ID: 180 | Loss: 1.59178
Epoch ID: 3   Set ID: 1  Batch ID: 200 | Loss: 1.22298
Epoch ID: 3   Set ID: 1  Batch ID: 220 | Loss: 1.53879
2
Epoch ID: 4   Set ID: 2  Batch ID: 20 | Loss: 1.44053
Epoch ID: 4   Set ID: 2  Batch ID: 40 | Loss: 3.81381
Epoch ID: 4   Set ID: 2  Batch ID: 60 | Loss: 1.09223
4
Epoch ID: 4   Set ID: 4  Batch ID: 80 | Loss: 0.65728
Epoch ID: 4   Set ID: 4  Batch ID: 100 | Loss: 1.27747
Epoch ID: 4   Set ID: 4  Batch ID: 120 | Loss: 0.76609
Epoch ID: 4   Set ID: 4  Batch ID: 140 | Loss: 0.44478
1
Epoch ID: 4   Set ID: 1  Batch ID: 160 | Loss: 0.36754
Epoch ID: 4   Set ID: 1  Batch ID: 180 | Loss: 0.35506
Epoch ID: 4   Set ID: 1  Batch ID: 200 | Loss: 0.20884
Epoch ID: 4   Set ID: 1  Batch ID: 220 | Loss: 0.30495
2
```

```
Epoch ID: 5   Set ID: 2  Batch ID: 20 | Loss: 0.41300
Epoch ID: 5   Set ID: 2  Batch ID: 40 | Loss: 0.21280
Epoch ID: 5   Set ID: 2  Batch ID: 60 | Loss: 0.37365
4
Epoch ID: 5   Set ID: 4  Batch ID: 80 | Loss: 3.07396
Epoch ID: 5   Set ID: 4  Batch ID: 100 | Loss: 0.26479
Epoch ID: 5   Set ID: 4  Batch ID: 120 | Loss: 0.28032
Epoch ID: 5   Set ID: 4  Batch ID: 140 | Loss: 0.26009
1
Epoch ID: 5   Set ID: 1  Batch ID: 160 | Loss: 0.21446
Epoch ID: 5   Set ID: 1  Batch ID: 180 | Loss: 0.27489
Epoch ID: 5   Set ID: 1  Batch ID: 200 | Loss: 0.22715
Epoch ID: 5   Set ID: 1  Batch ID: 220 | Loss: 0.19234
2
Epoch ID: 6   Set ID: 2  Batch ID: 20 | Loss: 0.21512
Epoch ID: 6   Set ID: 2  Batch ID: 40 | Loss: 0.21591
Epoch ID: 6   Set ID: 2  Batch ID: 60 | Loss: 0.20741
4
Epoch ID: 6   Set ID: 4  Batch ID: 80 | Loss: 0.18754
Epoch ID: 6   Set ID: 4  Batch ID: 100 | Loss: 0.24533
Epoch ID: 6   Set ID: 4  Batch ID: 120 | Loss: 0.16829
Epoch ID: 6   Set ID: 4  Batch ID: 140 | Loss: 0.19613
1
Epoch ID: 6   Set ID: 1  Batch ID: 160 | Loss: 0.23113
Epoch ID: 6   Set ID: 1  Batch ID: 180 | Loss: 0.17734
Epoch ID: 6   Set ID: 1  Batch ID: 200 | Loss: 0.18794
Epoch ID: 6   Set ID: 1  Batch ID: 220 | Loss: 0.20784
2
Epoch ID: 7   Set ID: 2  Batch ID: 20 | Loss: 0.15668
Epoch ID: 7   Set ID: 2  Batch ID: 40 | Loss: 0.16216
Epoch ID: 7   Set ID: 2  Batch ID: 60 | Loss: 0.14742
4
Epoch ID: 7   Set ID: 4  Batch ID: 80 | Loss: 0.18621
Epoch ID: 7   Set ID: 4  Batch ID: 100 | Loss: 0.14141
Epoch ID: 7   Set ID: 4  Batch ID: 120 | Loss: 0.13687
Epoch ID: 7   Set ID: 4  Batch ID: 140 | Loss: 0.13839
1
Epoch ID: 7   Set ID: 1  Batch ID: 160 | Loss: 0.14463
Epoch ID: 7   Set ID: 1  Batch ID: 180 | Loss: 0.15372
Epoch ID: 7   Set ID: 1  Batch ID: 200 | Loss: 0.13357
Epoch ID: 7   Set ID: 1  Batch ID: 220 | Loss: 0.12257
2
Epoch ID: 8   Set ID: 2  Batch ID: 20 | Loss: 0.13869
Epoch ID: 8   Set ID: 2  Batch ID: 40 | Loss: 0.12755
Epoch ID: 8   Set ID: 2  Batch ID: 60 | Loss: 0.12743
4
Epoch ID: 8   Set ID: 4  Batch ID: 80 | Loss: 0.15968
Epoch ID: 8   Set ID: 4  Batch ID: 100 | Loss: 0.12334
Epoch ID: 8   Set ID: 4  Batch ID: 120 | Loss: 0.12220
Epoch ID: 8   Set ID: 4  Batch ID: 140 | Loss: 0.14058
```

```
1
Epoch ID: 8   Set ID: 1  Batch ID: 160 | Loss: 0.12921
Epoch ID: 8   Set ID: 1  Batch ID: 180 | Loss: 0.13258
Epoch ID: 8   Set ID: 1  Batch ID: 200 | Loss: 0.11746
Epoch ID: 8   Set ID: 1  Batch ID: 220 | Loss: 0.11186
2
Epoch ID: 9   Set ID: 2  Batch ID: 20 | Loss: 0.09945
Epoch ID: 9   Set ID: 2  Batch ID: 40 | Loss: 0.11250
Epoch ID: 9   Set ID: 2  Batch ID: 60 | Loss: 0.12468
4
Epoch ID: 9   Set ID: 4  Batch ID: 80 | Loss: 0.14001
Epoch ID: 9   Set ID: 4  Batch ID: 100 | Loss: 0.12609
Epoch ID: 9   Set ID: 4  Batch ID: 120 | Loss: 0.10667
Epoch ID: 9   Set ID: 4  Batch ID: 140 | Loss: 0.11452
1
Epoch ID: 9   Set ID: 1  Batch ID: 160 | Loss: 0.11838
Epoch ID: 9   Set ID: 1  Batch ID: 180 | Loss: 0.12092
Epoch ID: 9   Set ID: 1  Batch ID: 200 | Loss: 0.10476
Epoch ID: 9   Set ID: 1  Batch ID: 220 | Loss: 0.09319
2
Epoch ID: 10   Set ID: 2  Batch ID: 20 | Loss: 0.09487
Epoch ID: 10   Set ID: 2  Batch ID: 40 | Loss: 0.11280
Epoch ID: 10   Set ID: 2  Batch ID: 60 | Loss: 0.10149
4
Epoch ID: 10   Set ID: 4  Batch ID: 80 | Loss: 0.11211
Epoch ID: 10   Set ID: 4  Batch ID: 100 | Loss: 0.09110
Epoch ID: 10   Set ID: 4  Batch ID: 120 | Loss: 0.10939
Epoch ID: 10   Set ID: 4  Batch ID: 140 | Loss: 0.09464
1
Epoch ID: 10   Set ID: 1  Batch ID: 160 | Loss: 0.20641
Epoch ID: 10   Set ID: 1  Batch ID: 180 | Loss: 0.10984
Epoch ID: 10   Set ID: 1  Batch ID: 200 | Loss: 0.09920
Epoch ID: 10   Set ID: 1  Batch ID: 220 | Loss: 0.10228
2
Epoch ID: 11   Set ID: 2  Batch ID: 20 | Loss: 0.10300
Epoch ID: 11   Set ID: 2  Batch ID: 40 | Loss: 0.11823
Epoch ID: 11   Set ID: 2  Batch ID: 60 | Loss: 0.11253
4
Epoch ID: 11   Set ID: 4  Batch ID: 80 | Loss: 0.13443
Epoch ID: 11   Set ID: 4  Batch ID: 100 | Loss: 0.10407
Epoch ID: 11   Set ID: 4  Batch ID: 120 | Loss: 0.08877
Epoch ID: 11   Set ID: 4  Batch ID: 140 | Loss: 0.10641
1
Epoch ID: 11   Set ID: 1  Batch ID: 160 | Loss: 0.11079
Epoch ID: 11   Set ID: 1  Batch ID: 180 | Loss: 0.12642
Epoch ID: 11   Set ID: 1  Batch ID: 200 | Loss: 0.09755
Epoch ID: 11   Set ID: 1  Batch ID: 220 | Loss: 0.08655
2
Epoch ID: 12   Set ID: 2  Batch ID: 20 | Loss: 0.10281
Epoch ID: 12   Set ID: 2  Batch ID: 40 | Loss: 0.09878
```

```
Epoch ID: 12   Set ID: 2  Batch ID: 60 | Loss: 0.09898
4
Epoch ID: 12   Set ID: 4  Batch ID: 80 | Loss: 0.11345
Epoch ID: 12   Set ID: 4  Batch ID: 100 | Loss: 0.09084
Epoch ID: 12   Set ID: 4  Batch ID: 120 | Loss: 0.08818
Epoch ID: 12   Set ID: 4  Batch ID: 140 | Loss: 0.09231
1
Epoch ID: 12   Set ID: 1  Batch ID: 160 | Loss: 0.10128
Epoch ID: 12   Set ID: 1  Batch ID: 180 | Loss: 0.08271
Epoch ID: 12   Set ID: 1  Batch ID: 200 | Loss: 0.10997
Epoch ID: 12   Set ID: 1  Batch ID: 220 | Loss: 0.09783
2
Epoch ID: 13   Set ID: 2  Batch ID: 20 | Loss: 0.11572
Epoch ID: 13   Set ID: 2  Batch ID: 40 | Loss: 0.09484
Epoch ID: 13   Set ID: 2  Batch ID: 60 | Loss: 0.10011
4
Epoch ID: 13   Set ID: 4  Batch ID: 80 | Loss: 0.09805
Epoch ID: 13   Set ID: 4  Batch ID: 100 | Loss: 0.09053
Epoch ID: 13   Set ID: 4  Batch ID: 120 | Loss: 0.08927
Epoch ID: 13   Set ID: 4  Batch ID: 140 | Loss: 0.09864
1
Epoch ID: 13   Set ID: 1  Batch ID: 160 | Loss: 0.08898
Epoch ID: 13   Set ID: 1  Batch ID: 180 | Loss: 0.09043
Epoch ID: 13   Set ID: 1  Batch ID: 200 | Loss: 0.08823
Epoch ID: 13   Set ID: 1  Batch ID: 220 | Loss: 0.10418
2
Epoch ID: 14   Set ID: 2  Batch ID: 20 | Loss: 0.09287
Epoch ID: 14   Set ID: 2  Batch ID: 40 | Loss: 0.08937
Epoch ID: 14   Set ID: 2  Batch ID: 60 | Loss: 0.08008
4
Epoch ID: 14   Set ID: 4  Batch ID: 80 | Loss: 0.10898
Epoch ID: 14   Set ID: 4  Batch ID: 100 | Loss: 0.11852
Epoch ID: 14   Set ID: 4  Batch ID: 120 | Loss: 0.09601
Epoch ID: 14   Set ID: 4  Batch ID: 140 | Loss: 0.08700
1
Epoch ID: 14   Set ID: 1  Batch ID: 160 | Loss: 0.18527
Epoch ID: 14   Set ID: 1  Batch ID: 180 | Loss: 0.09743
Epoch ID: 14   Set ID: 1  Batch ID: 200 | Loss: 0.08548
Epoch ID: 14   Set ID: 1  Batch ID: 220 | Loss: 0.10044
2
Epoch ID: 15   Set ID: 2  Batch ID: 20 | Loss: 0.08656
Epoch ID: 15   Set ID: 2  Batch ID: 40 | Loss: 0.08859
Epoch ID: 15   Set ID: 2  Batch ID: 60 | Loss: 0.08449
4
Epoch ID: 15   Set ID: 4  Batch ID: 80 | Loss: 0.10717
Epoch ID: 15   Set ID: 4  Batch ID: 100 | Loss: 0.08966
Epoch ID: 15   Set ID: 4  Batch ID: 120 | Loss: 0.08281
Epoch ID: 15   Set ID: 4  Batch ID: 140 | Loss: 0.08279
1
Epoch ID: 15   Set ID: 1  Batch ID: 160 | Loss: 0.10159
```

```
Epoch ID: 15   Set ID: 1  Batch ID: 180 | Loss: 0.08756
Epoch ID: 15   Set ID: 1  Batch ID: 200 | Loss: 0.09670
Epoch ID: 15   Set ID: 1  Batch ID: 220 | Loss: 0.08776
2
Epoch ID: 16   Set ID: 2  Batch ID: 20 | Loss: 0.09124
Epoch ID: 16   Set ID: 2  Batch ID: 40 | Loss: 0.09169
Epoch ID: 16   Set ID: 2  Batch ID: 60 | Loss: 0.07395
4
Epoch ID: 16   Set ID: 4  Batch ID: 80 | Loss: 0.15253
Epoch ID: 16   Set ID: 4  Batch ID: 100 | Loss: 0.07826
Epoch ID: 16   Set ID: 4  Batch ID: 120 | Loss: 0.07765
Epoch ID: 16   Set ID: 4  Batch ID: 140 | Loss: 0.08208
1
Epoch ID: 16   Set ID: 1  Batch ID: 160 | Loss: 0.10214
Epoch ID: 16   Set ID: 1  Batch ID: 180 | Loss: 0.08663
Epoch ID: 16   Set ID: 1  Batch ID: 200 | Loss: 0.09800
Epoch ID: 16   Set ID: 1  Batch ID: 220 | Loss: 0.09222
2
Epoch ID: 17   Set ID: 2  Batch ID: 20 | Loss: 0.08129
Epoch ID: 17   Set ID: 2  Batch ID: 40 | Loss: 0.08614
Epoch ID: 17   Set ID: 2  Batch ID: 60 | Loss: 0.08484
4
Epoch ID: 17   Set ID: 4  Batch ID: 80 | Loss: 0.12171
Epoch ID: 17   Set ID: 4  Batch ID: 100 | Loss: 0.07668
Epoch ID: 17   Set ID: 4  Batch ID: 120 | Loss: 0.07973
Epoch ID: 17   Set ID: 4  Batch ID: 140 | Loss: 0.09579
1
Epoch ID: 17   Set ID: 1  Batch ID: 160 | Loss: 0.07795
Epoch ID: 17   Set ID: 1  Batch ID: 180 | Loss: 0.07390
Epoch ID: 17   Set ID: 1  Batch ID: 200 | Loss: 0.09295
Epoch ID: 17   Set ID: 1  Batch ID: 220 | Loss: 0.09690
2
Epoch ID: 18   Set ID: 2  Batch ID: 20 | Loss: 0.08267
Epoch ID: 18   Set ID: 2  Batch ID: 40 | Loss: 0.08531
Epoch ID: 18   Set ID: 2  Batch ID: 60 | Loss: 0.07798
4
Epoch ID: 18   Set ID: 4  Batch ID: 80 | Loss: 0.08889
Epoch ID: 18   Set ID: 4  Batch ID: 100 | Loss: 0.06628
Epoch ID: 18   Set ID: 4  Batch ID: 120 | Loss: 0.07168
Epoch ID: 18   Set ID: 4  Batch ID: 140 | Loss: 0.07572
1
Epoch ID: 18   Set ID: 1  Batch ID: 160 | Loss: 0.11396
Epoch ID: 18   Set ID: 1  Batch ID: 180 | Loss: 0.08433
Epoch ID: 18   Set ID: 1  Batch ID: 200 | Loss: 0.06793
Epoch ID: 18   Set ID: 1  Batch ID: 220 | Loss: 0.08779
2
Epoch ID: 19   Set ID: 2  Batch ID: 20 | Loss: 0.07463
Epoch ID: 19   Set ID: 2  Batch ID: 40 | Loss: 0.07195
Epoch ID: 19   Set ID: 2  Batch ID: 60 | Loss: 0.08832
4
```

```
Epoch ID: 19   Set ID: 4  Batch ID: 80 | Loss: 0.13588
Epoch ID: 19   Set ID: 4  Batch ID: 100 | Loss: 0.08287
Epoch ID: 19   Set ID: 4  Batch ID: 120 | Loss: 0.08929
Epoch ID: 19   Set ID: 4  Batch ID: 140 | Loss: 0.07785
1
Epoch ID: 19   Set ID: 1  Batch ID: 160 | Loss: 0.08449
Epoch ID: 19   Set ID: 1  Batch ID: 180 | Loss: 0.07712
Epoch ID: 19   Set ID: 1  Batch ID: 200 | Loss: 0.07808
Epoch ID: 19   Set ID: 1  Batch ID: 220 | Loss: 0.07240
2
Epoch ID: 20   Set ID: 2  Batch ID: 20 | Loss: 0.07387
Epoch ID: 20   Set ID: 2  Batch ID: 40 | Loss: 0.08922
Epoch ID: 20   Set ID: 2  Batch ID: 60 | Loss: 0.07354
4
Epoch ID: 20   Set ID: 4  Batch ID: 80 | Loss: 0.07879
Epoch ID: 20   Set ID: 4  Batch ID: 100 | Loss: 0.07682
Epoch ID: 20   Set ID: 4  Batch ID: 120 | Loss: 0.07137
Epoch ID: 20   Set ID: 4  Batch ID: 140 | Loss: 0.08534
1
Epoch ID: 20   Set ID: 1  Batch ID: 160 | Loss: 0.09021
Epoch ID: 20   Set ID: 1  Batch ID: 180 | Loss: 0.07151
Epoch ID: 20   Set ID: 1  Batch ID: 200 | Loss: 0.08844
Epoch ID: 20   Set ID: 1  Batch ID: 220 | Loss: 0.07883
2
Epoch ID: 21   Set ID: 2  Batch ID: 20 | Loss: 0.07422
Epoch ID: 21   Set ID: 2  Batch ID: 40 | Loss: 0.06550
Epoch ID: 21   Set ID: 2  Batch ID: 60 | Loss: 0.07481
4
Epoch ID: 21   Set ID: 4  Batch ID: 80 | Loss: 0.12363
Epoch ID: 21   Set ID: 4  Batch ID: 100 | Loss: 0.09047
Epoch ID: 21   Set ID: 4  Batch ID: 120 | Loss: 0.06806
Epoch ID: 21   Set ID: 4  Batch ID: 140 | Loss: 0.07582
1
Epoch ID: 21   Set ID: 1  Batch ID: 160 | Loss: 0.10211
Epoch ID: 21   Set ID: 1  Batch ID: 180 | Loss: 0.08045
Epoch ID: 21   Set ID: 1  Batch ID: 200 | Loss: 0.06409
Epoch ID: 21   Set ID: 1  Batch ID: 220 | Loss: 0.06686
2
Epoch ID: 22   Set ID: 2  Batch ID: 20 | Loss: 0.07821
Epoch ID: 22   Set ID: 2  Batch ID: 40 | Loss: 0.07778
Epoch ID: 22   Set ID: 2  Batch ID: 60 | Loss: 0.07472
4
Epoch ID: 22   Set ID: 4  Batch ID: 80 | Loss: 0.09555
Epoch ID: 22   Set ID: 4  Batch ID: 100 | Loss: 0.07605
Epoch ID: 22   Set ID: 4  Batch ID: 120 | Loss: 0.07141
Epoch ID: 22   Set ID: 4  Batch ID: 140 | Loss: 0.08226
1
Epoch ID: 22   Set ID: 1  Batch ID: 160 | Loss: 0.08275
Epoch ID: 22   Set ID: 1  Batch ID: 180 | Loss: 0.08211
Epoch ID: 22   Set ID: 1  Batch ID: 200 | Loss: 0.06370
```

```
Epoch ID: 22   Set ID: 1  Batch ID: 220 | Loss: 0.07815
2
Epoch ID: 23   Set ID: 2  Batch ID: 20 | Loss: 0.07113
Epoch ID: 23   Set ID: 2  Batch ID: 40 | Loss: 0.06779
Epoch ID: 23   Set ID: 2  Batch ID: 60 | Loss: 0.08477
4
Epoch ID: 23   Set ID: 4  Batch ID: 80 | Loss: 0.08670
Epoch ID: 23   Set ID: 4  Batch ID: 100 | Loss: 0.07166
Epoch ID: 23   Set ID: 4  Batch ID: 120 | Loss: 0.06103
Epoch ID: 23   Set ID: 4  Batch ID: 140 | Loss: 0.06825
1
Epoch ID: 23   Set ID: 1  Batch ID: 160 | Loss: 0.09262
Epoch ID: 23   Set ID: 1  Batch ID: 180 | Loss: 0.07379
Epoch ID: 23   Set ID: 1  Batch ID: 200 | Loss: 0.07875
Epoch ID: 23   Set ID: 1  Batch ID: 220 | Loss: 0.07086
2
Epoch ID: 24   Set ID: 2  Batch ID: 20 | Loss: 0.08724
Epoch ID: 24   Set ID: 2  Batch ID: 40 | Loss: 0.07944
Epoch ID: 24   Set ID: 2  Batch ID: 60 | Loss: 0.07506
4
Epoch ID: 24   Set ID: 4  Batch ID: 80 | Loss: 0.09248
Epoch ID: 24   Set ID: 4  Batch ID: 100 | Loss: 0.07671
Epoch ID: 24   Set ID: 4  Batch ID: 120 | Loss: 0.07065
Epoch ID: 24   Set ID: 4  Batch ID: 140 | Loss: 0.09588
1
Epoch ID: 24   Set ID: 1  Batch ID: 160 | Loss: 0.10304
Epoch ID: 24   Set ID: 1  Batch ID: 180 | Loss: 0.08601
Epoch ID: 24   Set ID: 1  Batch ID: 200 | Loss: 0.07617
Epoch ID: 24   Set ID: 1  Batch ID: 220 | Loss: 0.08279
2
Epoch ID: 25   Set ID: 2  Batch ID: 20 | Loss: 0.08523
Epoch ID: 25   Set ID: 2  Batch ID: 40 | Loss: 0.08382
Epoch ID: 25   Set ID: 2  Batch ID: 60 | Loss: 0.07981
4
Epoch ID: 25   Set ID: 4  Batch ID: 80 | Loss: 0.09750
Epoch ID: 25   Set ID: 4  Batch ID: 100 | Loss: 0.08683
Epoch ID: 25   Set ID: 4  Batch ID: 120 | Loss: 0.07000
Epoch ID: 25   Set ID: 4  Batch ID: 140 | Loss: 0.06970
1
Epoch ID: 25   Set ID: 1  Batch ID: 160 | Loss: 0.12259
Epoch ID: 25   Set ID: 1  Batch ID: 180 | Loss: 0.08660
Epoch ID: 25   Set ID: 1  Batch ID: 200 | Loss: 0.07869
Epoch ID: 25   Set ID: 1  Batch ID: 220 | Loss: 0.07152
2
Epoch ID: 26   Set ID: 2  Batch ID: 20 | Loss: 0.08388
Epoch ID: 26   Set ID: 2  Batch ID: 40 | Loss: 0.07197
Epoch ID: 26   Set ID: 2  Batch ID: 60 | Loss: 0.08052
4
Epoch ID: 26   Set ID: 4  Batch ID: 80 | Loss: 0.08597
Epoch ID: 26   Set ID: 4  Batch ID: 100 | Loss: 0.07217
```

```
Epoch ID: 26   Set ID: 4  Batch ID: 120 | Loss: 0.07142
Epoch ID: 26   Set ID: 4  Batch ID: 140 | Loss: 0.06845
1
Epoch ID: 26   Set ID: 1  Batch ID: 160 | Loss: 0.08231
Epoch ID: 26   Set ID: 1  Batch ID: 180 | Loss: 0.06680
Epoch ID: 26   Set ID: 1  Batch ID: 200 | Loss: 0.06931
Epoch ID: 26   Set ID: 1  Batch ID: 220 | Loss: 0.07147
2
Epoch ID: 27   Set ID: 2  Batch ID: 20 | Loss: 0.07498
Epoch ID: 27   Set ID: 2  Batch ID: 40 | Loss: 0.07774
Epoch ID: 27   Set ID: 2  Batch ID: 60 | Loss: 0.07585
4
Epoch ID: 27   Set ID: 4  Batch ID: 80 | Loss: 0.09132
Epoch ID: 27   Set ID: 4  Batch ID: 100 | Loss: 0.07774
Epoch ID: 27   Set ID: 4  Batch ID: 120 | Loss: 0.07568
Epoch ID: 27   Set ID: 4  Batch ID: 140 | Loss: 0.07204
1
Epoch ID: 27   Set ID: 1  Batch ID: 160 | Loss: 0.07957
Epoch ID: 27   Set ID: 1  Batch ID: 180 | Loss: 0.05843
Epoch ID: 27   Set ID: 1  Batch ID: 200 | Loss: 0.06495
Epoch ID: 27   Set ID: 1  Batch ID: 220 | Loss: 0.06731
2
Epoch ID: 28   Set ID: 2  Batch ID: 20 | Loss: 0.06129
Epoch ID: 28   Set ID: 2  Batch ID: 40 | Loss: 0.07170
Epoch ID: 28   Set ID: 2  Batch ID: 60 | Loss: 0.06565
4
Epoch ID: 28   Set ID: 4  Batch ID: 80 | Loss: 0.06393
Epoch ID: 28   Set ID: 4  Batch ID: 100 | Loss: 0.07496
Epoch ID: 28   Set ID: 4  Batch ID: 120 | Loss: 0.05907
Epoch ID: 28   Set ID: 4  Batch ID: 140 | Loss: 0.07085
1
Epoch ID: 28   Set ID: 1  Batch ID: 160 | Loss: 0.06912
Epoch ID: 28   Set ID: 1  Batch ID: 180 | Loss: 0.06379
Epoch ID: 28   Set ID: 1  Batch ID: 200 | Loss: 0.06488
Epoch ID: 28   Set ID: 1  Batch ID: 220 | Loss: 0.06556
2
Epoch ID: 29   Set ID: 2  Batch ID: 20 | Loss: 0.05995
Epoch ID: 29   Set ID: 2  Batch ID: 40 | Loss: 0.06426
Epoch ID: 29   Set ID: 2  Batch ID: 60 | Loss: 0.06710
4
Epoch ID: 29   Set ID: 4  Batch ID: 80 | Loss: 0.07022
Epoch ID: 29   Set ID: 4  Batch ID: 100 | Loss: 0.06424
Epoch ID: 29   Set ID: 4  Batch ID: 120 | Loss: 0.06765
Epoch ID: 29   Set ID: 4  Batch ID: 140 | Loss: 0.06322
1
Epoch ID: 29   Set ID: 1  Batch ID: 160 | Loss: 0.05670
Epoch ID: 29   Set ID: 1  Batch ID: 180 | Loss: 0.06554
Epoch ID: 29   Set ID: 1  Batch ID: 200 | Loss: 0.05707
Epoch ID: 29   Set ID: 1  Batch ID: 220 | Loss: 0.06098
2
```

```
Epoch ID: 30   Set ID: 2  Batch ID: 20 | Loss: 0.06092
Epoch ID: 30   Set ID: 2  Batch ID: 40 | Loss: 0.06338
Epoch ID: 30   Set ID: 2  Batch ID: 60 | Loss: 0.06235
4
Epoch ID: 30   Set ID: 4  Batch ID: 80 | Loss: 0.08013
Epoch ID: 30   Set ID: 4  Batch ID: 100 | Loss: 0.07036
Epoch ID: 30   Set ID: 4  Batch ID: 120 | Loss: 0.05922
Epoch ID: 30   Set ID: 4  Batch ID: 140 | Loss: 0.06208
1
Epoch ID: 30   Set ID: 1  Batch ID: 160 | Loss: 0.06991
Epoch ID: 30   Set ID: 1  Batch ID: 180 | Loss: 0.06052
Epoch ID: 30   Set ID: 1  Batch ID: 200 | Loss: 0.06116
Epoch ID: 30   Set ID: 1  Batch ID: 220 | Loss: 0.06564
2
Epoch ID: 31   Set ID: 2  Batch ID: 20 | Loss: 0.06553
Epoch ID: 31   Set ID: 2  Batch ID: 40 | Loss: 0.06459
Epoch ID: 31   Set ID: 2  Batch ID: 60 | Loss: 0.06475
4
Epoch ID: 31   Set ID: 4  Batch ID: 80 | Loss: 0.07023
Epoch ID: 31   Set ID: 4  Batch ID: 100 | Loss: 0.06315
Epoch ID: 31   Set ID: 4  Batch ID: 120 | Loss: 0.06335
Epoch ID: 31   Set ID: 4  Batch ID: 140 | Loss: 0.05937
1
Epoch ID: 31   Set ID: 1  Batch ID: 160 | Loss: 0.06701
Epoch ID: 31   Set ID: 1  Batch ID: 180 | Loss: 0.05784
Epoch ID: 31   Set ID: 1  Batch ID: 200 | Loss: 0.06510
Epoch ID: 31   Set ID: 1  Batch ID: 220 | Loss: 0.05827
2
Epoch ID: 32   Set ID: 2  Batch ID: 20 | Loss: 0.05233
Epoch ID: 32   Set ID: 2  Batch ID: 40 | Loss: 0.05933
Epoch ID: 32   Set ID: 2  Batch ID: 60 | Loss: 0.05136
4
Epoch ID: 32   Set ID: 4  Batch ID: 80 | Loss: 0.06896
Epoch ID: 32   Set ID: 4  Batch ID: 100 | Loss: 0.05940
Epoch ID: 32   Set ID: 4  Batch ID: 120 | Loss: 0.05627
Epoch ID: 32   Set ID: 4  Batch ID: 140 | Loss: 0.06935
1
Epoch ID: 32   Set ID: 1  Batch ID: 160 | Loss: 0.06352
Epoch ID: 32   Set ID: 1  Batch ID: 180 | Loss: 0.06834
Epoch ID: 32   Set ID: 1  Batch ID: 200 | Loss: 0.05791
Epoch ID: 32   Set ID: 1  Batch ID: 220 | Loss: 0.05728
2
Epoch ID: 33   Set ID: 2  Batch ID: 20 | Loss: 0.05853
Epoch ID: 33   Set ID: 2  Batch ID: 40 | Loss: 0.05961
Epoch ID: 33   Set ID: 2  Batch ID: 60 | Loss: 0.05615
4
Epoch ID: 33   Set ID: 4  Batch ID: 80 | Loss: 0.07213
Epoch ID: 33   Set ID: 4  Batch ID: 100 | Loss: 0.06080
Epoch ID: 33   Set ID: 4  Batch ID: 120 | Loss: 0.06349
Epoch ID: 33   Set ID: 4  Batch ID: 140 | Loss: 0.05775
```

```
1
Epoch ID: 33   Set ID: 1  Batch ID: 160 | Loss: 0.06669
Epoch ID: 33   Set ID: 1  Batch ID: 180 | Loss: 0.06043
Epoch ID: 33   Set ID: 1  Batch ID: 200 | Loss: 0.06162
Epoch ID: 33   Set ID: 1  Batch ID: 220 | Loss: 0.05192
2
Epoch ID: 34   Set ID: 2  Batch ID: 20 | Loss: 0.05834
Epoch ID: 34   Set ID: 2  Batch ID: 40 | Loss: 0.05502
Epoch ID: 34   Set ID: 2  Batch ID: 60 | Loss: 0.06354
4
Epoch ID: 34   Set ID: 4  Batch ID: 80 | Loss: 0.05971
Epoch ID: 34   Set ID: 4  Batch ID: 100 | Loss: 0.04963
Epoch ID: 34   Set ID: 4  Batch ID: 120 | Loss: 0.06036
Epoch ID: 34   Set ID: 4  Batch ID: 140 | Loss: 0.05767
1
Epoch ID: 34   Set ID: 1  Batch ID: 160 | Loss: 0.06390
Epoch ID: 34   Set ID: 1  Batch ID: 180 | Loss: 0.05716
Epoch ID: 34   Set ID: 1  Batch ID: 200 | Loss: 0.06312
Epoch ID: 34   Set ID: 1  Batch ID: 220 | Loss: 0.05411
2
Epoch ID: 35   Set ID: 2  Batch ID: 20 | Loss: 0.06372
Epoch ID: 35   Set ID: 2  Batch ID: 40 | Loss: 0.05479
Epoch ID: 35   Set ID: 2  Batch ID: 60 | Loss: 0.05445
4
Epoch ID: 35   Set ID: 4  Batch ID: 80 | Loss: 0.08286
Epoch ID: 35   Set ID: 4  Batch ID: 100 | Loss: 0.05760
Epoch ID: 35   Set ID: 4  Batch ID: 120 | Loss: 0.06253
Epoch ID: 35   Set ID: 4  Batch ID: 140 | Loss: 0.05407
1
Epoch ID: 35   Set ID: 1  Batch ID: 160 | Loss: 0.06015
Epoch ID: 35   Set ID: 1  Batch ID: 180 | Loss: 0.06730
Epoch ID: 35   Set ID: 1  Batch ID: 200 | Loss: 0.05639
Epoch ID: 35   Set ID: 1  Batch ID: 220 | Loss: 0.05039
2
Epoch ID: 36   Set ID: 2  Batch ID: 20 | Loss: 0.05026
Epoch ID: 36   Set ID: 2  Batch ID: 40 | Loss: 0.05367
Epoch ID: 36   Set ID: 2  Batch ID: 60 | Loss: 0.05596
4
Epoch ID: 36   Set ID: 4  Batch ID: 80 | Loss: 0.05935
Epoch ID: 36   Set ID: 4  Batch ID: 100 | Loss: 0.05435
Epoch ID: 36   Set ID: 4  Batch ID: 120 | Loss: 0.05379
Epoch ID: 36   Set ID: 4  Batch ID: 140 | Loss: 0.05631
1
Epoch ID: 36   Set ID: 1  Batch ID: 160 | Loss: 0.05997
Epoch ID: 36   Set ID: 1  Batch ID: 180 | Loss: 0.06169
Epoch ID: 36   Set ID: 1  Batch ID: 200 | Loss: 0.04760
Epoch ID: 36   Set ID: 1  Batch ID: 220 | Loss: 0.04913
2
Epoch ID: 37   Set ID: 2  Batch ID: 20 | Loss: 0.05124
Epoch ID: 37   Set ID: 2  Batch ID: 40 | Loss: 0.05317
```

```
Epoch ID: 37   Set ID: 2  Batch ID: 60 | Loss: 0.05051
4
Epoch ID: 37   Set ID: 4  Batch ID: 80 | Loss: 0.06434
Epoch ID: 37   Set ID: 4  Batch ID: 100 | Loss: 0.05345
Epoch ID: 37   Set ID: 4  Batch ID: 120 | Loss: 0.05470
Epoch ID: 37   Set ID: 4  Batch ID: 140 | Loss: 0.06075
1
Epoch ID: 37   Set ID: 1  Batch ID: 160 | Loss: 0.06810
Epoch ID: 37   Set ID: 1  Batch ID: 180 | Loss: 0.05621
Epoch ID: 37   Set ID: 1  Batch ID: 200 | Loss: 0.05155
Epoch ID: 37   Set ID: 1  Batch ID: 220 | Loss: 0.05572
2
Epoch ID: 38   Set ID: 2  Batch ID: 20 | Loss: 0.05916
Epoch ID: 38   Set ID: 2  Batch ID: 40 | Loss: 0.05395
Epoch ID: 38   Set ID: 2  Batch ID: 60 | Loss: 0.04955
4
Epoch ID: 38   Set ID: 4  Batch ID: 80 | Loss: 0.06687
Epoch ID: 38   Set ID: 4  Batch ID: 100 | Loss: 0.05512
Epoch ID: 38   Set ID: 4  Batch ID: 120 | Loss: 0.05059
Epoch ID: 38   Set ID: 4  Batch ID: 140 | Loss: 0.05762
1
Epoch ID: 38   Set ID: 1  Batch ID: 160 | Loss: 0.05775
Epoch ID: 38   Set ID: 1  Batch ID: 180 | Loss: 0.05619
Epoch ID: 38   Set ID: 1  Batch ID: 200 | Loss: 0.05222
Epoch ID: 38   Set ID: 1  Batch ID: 220 | Loss: 0.05597
2
Epoch ID: 39   Set ID: 2  Batch ID: 20 | Loss: 0.05873
Epoch ID: 39   Set ID: 2  Batch ID: 40 | Loss: 0.05387
Epoch ID: 39   Set ID: 2  Batch ID: 60 | Loss: 0.05655
4
Epoch ID: 39   Set ID: 4  Batch ID: 80 | Loss: 0.06051
Epoch ID: 39   Set ID: 4  Batch ID: 100 | Loss: 0.06038
Epoch ID: 39   Set ID: 4  Batch ID: 120 | Loss: 0.06149
Epoch ID: 39   Set ID: 4  Batch ID: 140 | Loss: 0.05479
1
Epoch ID: 39   Set ID: 1  Batch ID: 160 | Loss: 0.05738
Epoch ID: 39   Set ID: 1  Batch ID: 180 | Loss: 0.05820
Epoch ID: 39   Set ID: 1  Batch ID: 200 | Loss: 0.06129
Epoch ID: 39   Set ID: 1  Batch ID: 220 | Loss: 0.05731
2
Epoch ID: 40   Set ID: 2  Batch ID: 20 | Loss: 0.05221
Epoch ID: 40   Set ID: 2  Batch ID: 40 | Loss: 0.04422
Epoch ID: 40   Set ID: 2  Batch ID: 60 | Loss: 0.05906
4
Epoch ID: 40   Set ID: 4  Batch ID: 80 | Loss: 0.09003
Epoch ID: 40   Set ID: 4  Batch ID: 100 | Loss: 0.06025
Epoch ID: 40   Set ID: 4  Batch ID: 120 | Loss: 0.05020
Epoch ID: 40   Set ID: 4  Batch ID: 140 | Loss: 0.05771
1
Epoch ID: 40   Set ID: 1  Batch ID: 160 | Loss: 0.05608
```

```
Epoch ID: 40   Set ID: 1  Batch ID: 180 | Loss: 0.06131
Epoch ID: 40   Set ID: 1  Batch ID: 200 | Loss: 0.05306
Epoch ID: 40   Set ID: 1  Batch ID: 220 | Loss: 0.04692
2
Epoch ID: 41   Set ID: 2  Batch ID: 20 | Loss: 0.05198
Epoch ID: 41   Set ID: 2  Batch ID: 40 | Loss: 0.05277
Epoch ID: 41   Set ID: 2  Batch ID: 60 | Loss: 0.04927
4
Epoch ID: 41   Set ID: 4  Batch ID: 80 | Loss: 0.06623
Epoch ID: 41   Set ID: 4  Batch ID: 100 | Loss: 0.05827
Epoch ID: 41   Set ID: 4  Batch ID: 120 | Loss: 0.05038
Epoch ID: 41   Set ID: 4  Batch ID: 140 | Loss: 0.05125
1
Epoch ID: 41   Set ID: 1  Batch ID: 160 | Loss: 0.05560
Epoch ID: 41   Set ID: 1  Batch ID: 180 | Loss: 0.05302
Epoch ID: 41   Set ID: 1  Batch ID: 200 | Loss: 0.05340
Epoch ID: 41   Set ID: 1  Batch ID: 220 | Loss: 0.06160
2
Epoch ID: 42   Set ID: 2  Batch ID: 20 | Loss: 0.05710
Epoch ID: 42   Set ID: 2  Batch ID: 40 | Loss: 0.05422
Epoch ID: 42   Set ID: 2  Batch ID: 60 | Loss: 0.05423
4
Epoch ID: 42   Set ID: 4  Batch ID: 80 | Loss: 0.05927
Epoch ID: 42   Set ID: 4  Batch ID: 100 | Loss: 0.05988
Epoch ID: 42   Set ID: 4  Batch ID: 120 | Loss: 0.05353
Epoch ID: 42   Set ID: 4  Batch ID: 140 | Loss: 0.05526
1
Epoch ID: 42   Set ID: 1  Batch ID: 160 | Loss: 0.06761
Epoch ID: 42   Set ID: 1  Batch ID: 180 | Loss: 0.05463
Epoch ID: 42   Set ID: 1  Batch ID: 200 | Loss: 0.05850
Epoch ID: 42   Set ID: 1  Batch ID: 220 | Loss: 0.05682
2
Epoch ID: 43   Set ID: 2  Batch ID: 20 | Loss: 0.05010
Epoch ID: 43   Set ID: 2  Batch ID: 40 | Loss: 0.05087
Epoch ID: 43   Set ID: 2  Batch ID: 60 | Loss: 0.04924
4
Epoch ID: 43   Set ID: 4  Batch ID: 80 | Loss: 0.06721
Epoch ID: 43   Set ID: 4  Batch ID: 100 | Loss: 0.05885
Epoch ID: 43   Set ID: 4  Batch ID: 120 | Loss: 0.05364
Epoch ID: 43   Set ID: 4  Batch ID: 140 | Loss: 0.05133
1
Epoch ID: 43   Set ID: 1  Batch ID: 160 | Loss: 0.05023
Epoch ID: 43   Set ID: 1  Batch ID: 180 | Loss: 0.06413
Epoch ID: 43   Set ID: 1  Batch ID: 200 | Loss: 0.05640
Epoch ID: 43   Set ID: 1  Batch ID: 220 | Loss: 0.05476
2
Epoch ID: 44   Set ID: 2  Batch ID: 20 | Loss: 0.05139
Epoch ID: 44   Set ID: 2  Batch ID: 40 | Loss: 0.05798
Epoch ID: 44   Set ID: 2  Batch ID: 60 | Loss: 0.05860
4
```

```
Epoch ID: 44   Set ID: 4  Batch ID: 80 | Loss: 0.04817
Epoch ID: 44   Set ID: 4  Batch ID: 100 | Loss: 0.05272
Epoch ID: 44   Set ID: 4  Batch ID: 120 | Loss: 0.05874
Epoch ID: 44   Set ID: 4  Batch ID: 140 | Loss: 0.05658
1
Epoch ID: 44   Set ID: 1  Batch ID: 160 | Loss: 0.05625
Epoch ID: 44   Set ID: 1  Batch ID: 180 | Loss: 0.05256
Epoch ID: 44   Set ID: 1  Batch ID: 200 | Loss: 0.05711
Epoch ID: 44   Set ID: 1  Batch ID: 220 | Loss: 0.04842
2
Epoch ID: 45   Set ID: 2  Batch ID: 20 | Loss: 0.05190
Epoch ID: 45   Set ID: 2  Batch ID: 40 | Loss: 0.05308
Epoch ID: 45   Set ID: 2  Batch ID: 60 | Loss: 0.05803
4
Epoch ID: 45   Set ID: 4  Batch ID: 80 | Loss: 0.05077
Epoch ID: 45   Set ID: 4  Batch ID: 100 | Loss: 0.05263
Epoch ID: 45   Set ID: 4  Batch ID: 120 | Loss: 0.04897
Epoch ID: 45   Set ID: 4  Batch ID: 140 | Loss: 0.05929
1
Epoch ID: 45   Set ID: 1  Batch ID: 160 | Loss: 0.06073
Epoch ID: 45   Set ID: 1  Batch ID: 180 | Loss: 0.06020
Epoch ID: 45   Set ID: 1  Batch ID: 200 | Loss: 0.05773
Epoch ID: 45   Set ID: 1  Batch ID: 220 | Loss: 0.04813
2
Epoch ID: 46   Set ID: 2  Batch ID: 20 | Loss: 0.05208
Epoch ID: 46   Set ID: 2  Batch ID: 40 | Loss: 0.05425
Epoch ID: 46   Set ID: 2  Batch ID: 60 | Loss: 0.05057
4
Epoch ID: 46   Set ID: 4  Batch ID: 80 | Loss: 0.05637
Epoch ID: 46   Set ID: 4  Batch ID: 100 | Loss: 0.05293
Epoch ID: 46   Set ID: 4  Batch ID: 120 | Loss: 0.06452
Epoch ID: 46   Set ID: 4  Batch ID: 140 | Loss: 0.05410
1
Epoch ID: 46   Set ID: 1  Batch ID: 160 | Loss: 0.04704
Epoch ID: 46   Set ID: 1  Batch ID: 180 | Loss: 0.05477
Epoch ID: 46   Set ID: 1  Batch ID: 200 | Loss: 0.05702
Epoch ID: 46   Set ID: 1  Batch ID: 220 | Loss: 0.04993
2
Epoch ID: 47   Set ID: 2  Batch ID: 20 | Loss: 0.05194
Epoch ID: 47   Set ID: 2  Batch ID: 40 | Loss: 0.04760
Epoch ID: 47   Set ID: 2  Batch ID: 60 | Loss: 0.05555
4
Epoch ID: 47   Set ID: 4  Batch ID: 80 | Loss: 0.06354
Epoch ID: 47   Set ID: 4  Batch ID: 100 | Loss: 0.06141
Epoch ID: 47   Set ID: 4  Batch ID: 120 | Loss: 0.05078
Epoch ID: 47   Set ID: 4  Batch ID: 140 | Loss: 0.04878
1
Epoch ID: 47   Set ID: 1  Batch ID: 160 | Loss: 0.05501
Epoch ID: 47   Set ID: 1  Batch ID: 180 | Loss: 0.05507
Epoch ID: 47   Set ID: 1  Batch ID: 200 | Loss: 0.05672
```

```
Epoch ID: 47   Set ID: 1  Batch ID: 220 | Loss: 0.05901
2
Epoch ID: 48   Set ID: 2  Batch ID: 20 | Loss: 0.04774
Epoch ID: 48   Set ID: 2  Batch ID: 40 | Loss: 0.04888
Epoch ID: 48   Set ID: 2  Batch ID: 60 | Loss: 0.05383
4
Epoch ID: 48   Set ID: 4  Batch ID: 80 | Loss: 0.05371
Epoch ID: 48   Set ID: 4  Batch ID: 100 | Loss: 0.05137
Epoch ID: 48   Set ID: 4  Batch ID: 120 | Loss: 0.04879
Epoch ID: 48   Set ID: 4  Batch ID: 140 | Loss: 0.05276
1
Epoch ID: 48   Set ID: 1  Batch ID: 160 | Loss: 0.06048
Epoch ID: 48   Set ID: 1  Batch ID: 180 | Loss: 0.05024
Epoch ID: 48   Set ID: 1  Batch ID: 200 | Loss: 0.05404
Epoch ID: 48   Set ID: 1  Batch ID: 220 | Loss: 0.05071
2
Epoch ID: 49   Set ID: 2  Batch ID: 20 | Loss: 0.05264
Epoch ID: 49   Set ID: 2  Batch ID: 40 | Loss: 0.05630
Epoch ID: 49   Set ID: 2  Batch ID: 60 | Loss: 0.04645
4
Epoch ID: 49   Set ID: 4  Batch ID: 80 | Loss: 0.05107
Epoch ID: 49   Set ID: 4  Batch ID: 100 | Loss: 0.04775
Epoch ID: 49   Set ID: 4  Batch ID: 120 | Loss: 0.05133
Epoch ID: 49   Set ID: 4  Batch ID: 140 | Loss: 0.05092
1
Epoch ID: 49   Set ID: 1  Batch ID: 160 | Loss: 0.05876
Epoch ID: 49   Set ID: 1  Batch ID: 180 | Loss: 0.05562
Epoch ID: 49   Set ID: 1  Batch ID: 200 | Loss: 0.05189
Epoch ID: 49   Set ID: 1  Batch ID: 220 | Loss: 0.05051
```

```
loss_val, eff_rate, fp_rate = validate(model)
```

```
print(f"Loss: {loss_val}")
print(f"Eff: {eff_rate}")
print(f"FP: {fp_rate}")
```

```
Loss: 0.05029470846056938
Eff: 0.7874732728747327
FP: 0.14437112577484504
```