



```
In [1]: import torch
import torch.nn as nn
import matplotlib.pyplot as plt
from torch.utils.data import Dataset, random_split, DataLoader
import numpy as np
import torch.nn.functional as F
from PIL import Image
```

```
In [2]: import torchvision
from torchvision import datasets
from torchvision import datasets, transforms
transform = transforms.Compose([
    transforms.ToTensor(),
    transforms.Normalize((0.1307,), (0.3081,)) # (mean,), (std,)
])
train_data = datasets.MNIST(root="data", train=True, download=True, transform=transform)
train_data, val_data = random_split(train_data, [50000, 10000])
test_data = datasets.MNIST(root="data", train=False, download=True, transform=transform)
```

```
100%|██████████| 9.91M/9.91M [00:01<00:00, 4.98MB/s]
100%|██████████| 28.9k/28.9k [00:00<00:00, 130kB/s]
100%|██████████| 1.65M/1.65M [00:01<00:00, 1.24MB/s]
100%|██████████| 4.54k/4.54k [00:00<00:00, 9.59MB/s]
```

```
In [3]: device="cuda" if torch.cuda.is_available() else "cpu"
print(f"Using {device} device")
```

Using cuda device

```
In [4]: BATCH_SIZE = 64
train_loader = torch.utils.data.DataLoader(train_data, batch_size=BATCH_SIZE, shuffle=True)
val_loader = torch.utils.data.DataLoader(val_data, batch_size=BATCH_SIZE, shuffle=True)
test_loader = torch.utils.data.DataLoader(test_data, batch_size=BATCH_SIZE, shuffle=True)
```

```
In [5]: input_size=28
sequence_length=28
num_layers=2
hidden_size=128
num_classes=10
num_epochs=15
batch_size=64
lr=1e-3
```

```
In [6]: class RNN(nn.Module):
    def __init__(self, input_size, hidden_size, num_layers, num_classes, rnn_type, bidirectional=False):
        super().__init__()
        self.hidden_size = hidden_size
        self.num_layers = num_layers
        self.rnn_type = rnn_type
        self.bidirectional = bidirectional
        if rnn_type == "LSTM":
            self.rnn = nn.LSTM(input_size, hidden_size, num_layers, batch_first=True, bidirectional=bidirectional)
        elif rnn_type == "GRU":
```

```

        self.rnn=nn.GRU(input_size,hidden_size,num_layers,batch_first=True,bidirectional=False)
    else:
        self.rnn=nn.RNN(input_size,hidden_size,num_layers,batch_first=True,bidirectional=False)
        fc_input=hidden_size*2 if bidirectional else hidden_size
        #x -> [batch,seq,input_size]
        self.fc=nn.Linear(fc_input,num_classes)

    def forward(self,x):
        num_directions=2 if self.bidirectional else 1
        h0=torch.zeros(self.num_layers*num_directions,x.size(0),self.hidden_size).float()
        if self.rnn_type=="LSTM":
            c0=torch.zeros(self.num_layers*num_directions,x.size(0),self.hidden_size).float()
            out,_=self.rnn(x,(h0,c0))
        else:
            out,_=self.rnn(x,h0)
            #out:n,seq,hidden_size
            out=out[:,-1,:]
            #out(n,128)
            out=out.reshape(out.shape[0],-1)
            out=self.fc(out)
        return out

```

```

In [7]: def train(model,epochs,train_loader,val_loader,optimizer,criterion):
    train_loss=[]
    val_loss=[]
    val_acc=[]
    test_acc=[]
    for epoch in range(epochs):
        model.train()
        runn_train_loss=0
        for data in train_loader:
            img,label=data
            img=torch.reshape(img,(img.shape[0],28,28))
            img=img.to(device)
            label=label.to(device)
            optimizer.zero_grad()
            output=model(img)
            loss=criterion(output,label)
            loss.backward()
            optimizer.step()
            runn_train_loss+=loss.item()
        train_loss.append(runn_train_loss/len(train_loader))
        with torch.no_grad():
            model.eval()
            runn_val_loss=0
            n_correct=0
            n_samples=0
            n_t_correct=0
            n_t_samples=0
            for val_data in val_loader:
                img,label=val_data
                img=torch.reshape(img,(img.shape[0],28,28))

```

```

        img=img.to(device)
        label=label.to(device)
        output=model(img)
        predicted=torch.argmax(output,1)
        n_correct+=(predicted==label).sum().item()
        n_samples+=label.size(0)
        loss=criterion(output,label)
        runn_val_loss+=loss.item()
    val_loss.append(runn_val_loss/len(val_loader))
    val_acc.append(n_correct/n_samples)
    for test_data in test_loader:
        img,label=test_data
        img=torch.reshape(img,(img.shape[0],28,28))
        img=img.to(device)
        label=label.to(device)
        output=model(img)
        predicted=torch.argmax(output,1)
        n_t_correct+=(predicted==label).sum().item()
        n_t_samples+=label.size(0)
        test_acc.append(n_t_correct/n_t_samples)
    print (f'Epoch [{epoch+1}/{epochs}], train_loss: {train_loss[-1]:.4f} , va
return train_loss,val_loss,val_acc,test_acc

```

In [8]:

```

def plot_image(model):
    model.eval()
    plt.figure(figsize=(15, 4))
    random_test=np.random.randint(0,10000,(10,))
    index=0
    with torch.no_grad():
        for i in random_test:
            original_img=test_data[i][0].reshape(28,28)
            ax=plt.subplot(2,len(random_test),index+1)
            model_img=test_data[i][0].reshape(1,28,28).to(device)
            label=test_data[i][1]
            predicted=model(model_img)
            predicted=torch.argmax(predicted,1).to("cpu").item()
            plt.imshow(original_img,cmap="gray")
            ax.set_title(f"actual:{label}|prediction:{predicted}",size=8)
            ax.axis("off")
            index+=1

```

1. VANILLA RNN

In [12]:

```
criterion=nn.CrossEntropyLoss()
```

In []:

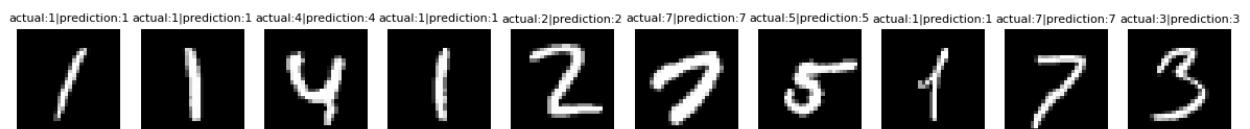
```
vanilla_rnn=RNN(input_size,hidden_size,num_layers,num_classes,"RNN").to(device)
```

In []:

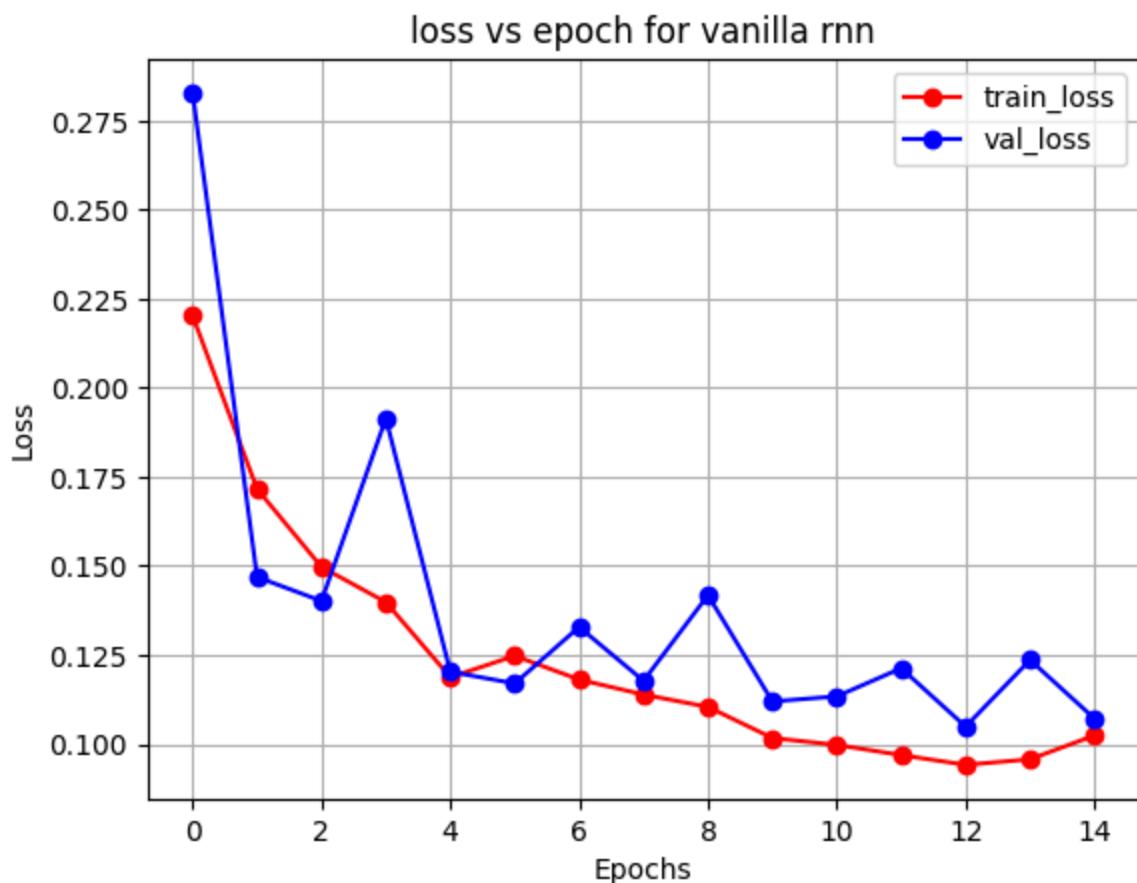
```
criterion=nn.CrossEntropyLoss()
optimizer=torch.optim.Adam(vanilla_rnn.parameters(),lr=1e-3)
train_loss,val_loss,val_acc,test_acc=train(vanilla_rnn,num_epochs,train_loader)
```

```
Epoch [1/15], train_loss: 0.2203 , val_loss: 0.2829 , val_acc: 0.9147 , test_ac  
c: 0.9176  
Epoch [2/15], train_loss: 0.1716 , val_loss: 0.1469 , val_acc: 0.9579 , test_ac  
c: 0.9579  
Epoch [3/15], train_loss: 0.1497 , val_loss: 0.1402 , val_acc: 0.9583 , test_ac  
c: 0.9646  
Epoch [4/15], train_loss: 0.1398 , val_loss: 0.1914 , val_acc: 0.9405 , test_ac  
c: 0.9485  
Epoch [5/15], train_loss: 0.1187 , val_loss: 0.1203 , val_acc: 0.9643 , test_ac  
c: 0.9666  
Epoch [6/15], train_loss: 0.1248 , val_loss: 0.1170 , val_acc: 0.9669 , test_ac  
c: 0.9678  
Epoch [7/15], train_loss: 0.1181 , val_loss: 0.1329 , val_acc: 0.9624 , test_ac  
c: 0.9640  
Epoch [8/15], train_loss: 0.1139 , val_loss: 0.1178 , val_acc: 0.9659 , test_ac  
c: 0.9672  
Epoch [9/15], train_loss: 0.1104 , val_loss: 0.1418 , val_acc: 0.9595 , test_ac  
c: 0.9646  
Epoch [10/15], train_loss: 0.1017 , val_loss: 0.1120 , val_acc: 0.9691 , test_a  
cc: 0.9729  
Epoch [11/15], train_loss: 0.0997 , val_loss: 0.1134 , val_acc: 0.9666 , test_a  
cc: 0.9732  
Epoch [12/15], train_loss: 0.0969 , val_loss: 0.1213 , val_acc: 0.9648 , test_a  
cc: 0.9682  
Epoch [13/15], train_loss: 0.0941 , val_loss: 0.1049 , val_acc: 0.9725 , test_a  
cc: 0.9731  
Epoch [14/15], train_loss: 0.0957 , val_loss: 0.1236 , val_acc: 0.9666 , test_a  
cc: 0.9699  
Epoch [15/15], train_loss: 0.1024 , val_loss: 0.1071 , val_acc: 0.9709 , test_a  
cc: 0.9718
```

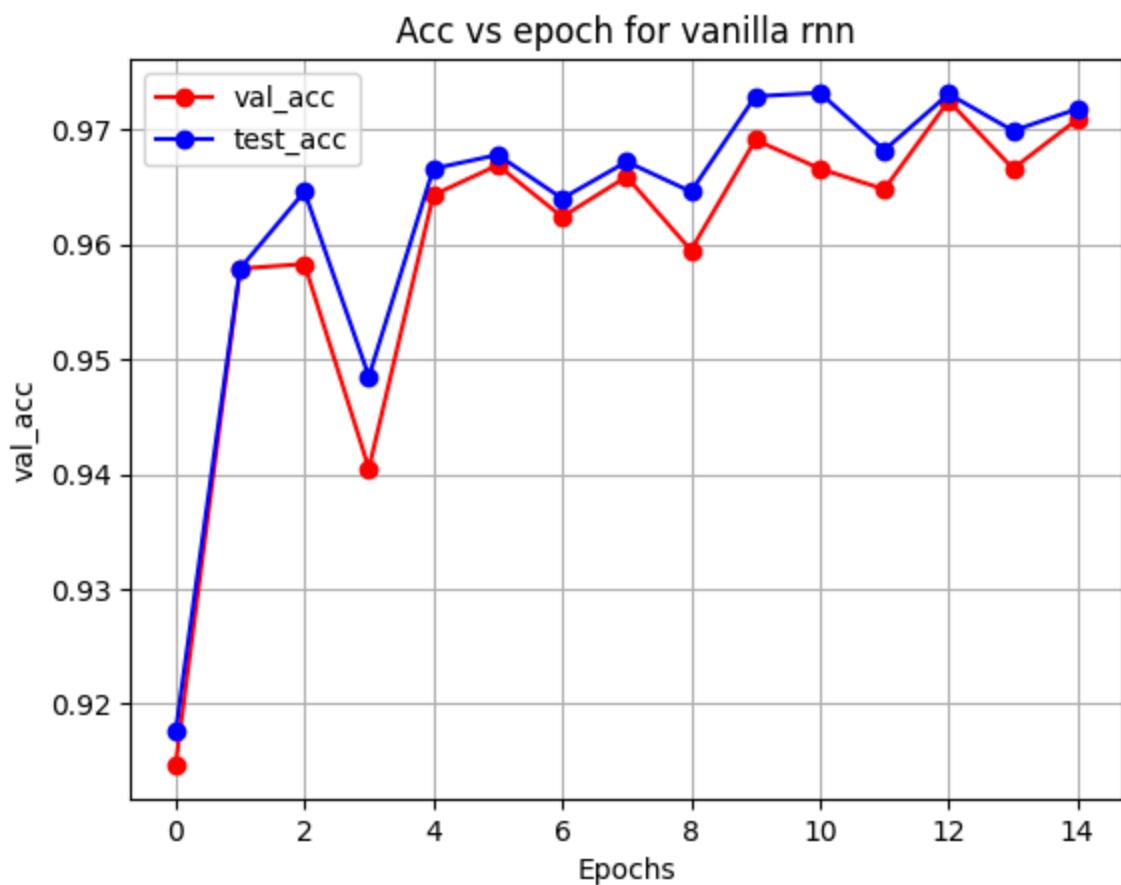
```
In [ ]: plot_image(vanilla_rnn)
```



```
In [ ]: plt.plot(range(15),train_loss,c="r",marker="o",label="train_loss")  
plt.plot(range(15),val_loss,c="b",marker="o",label="val_loss")  
plt.xlabel("Epochs")  
plt.ylabel("Loss")  
plt.title("loss vs epoch for vanilla rnn")  
plt.grid(True)  
plt.legend()  
plt.show()
```



```
In [ ]: plt.plot(range(15),val_acc,c="r",marker="o",label="val_acc")
plt.plot(range(15),test_acc,c="b",marker="o",label="test_acc")
plt.xlabel("Epochs")
plt.ylabel("val_acc")
plt.title("Acc vs epoch for vanilla rnn")
plt.grid(True)
plt.legend()
plt.show()
```

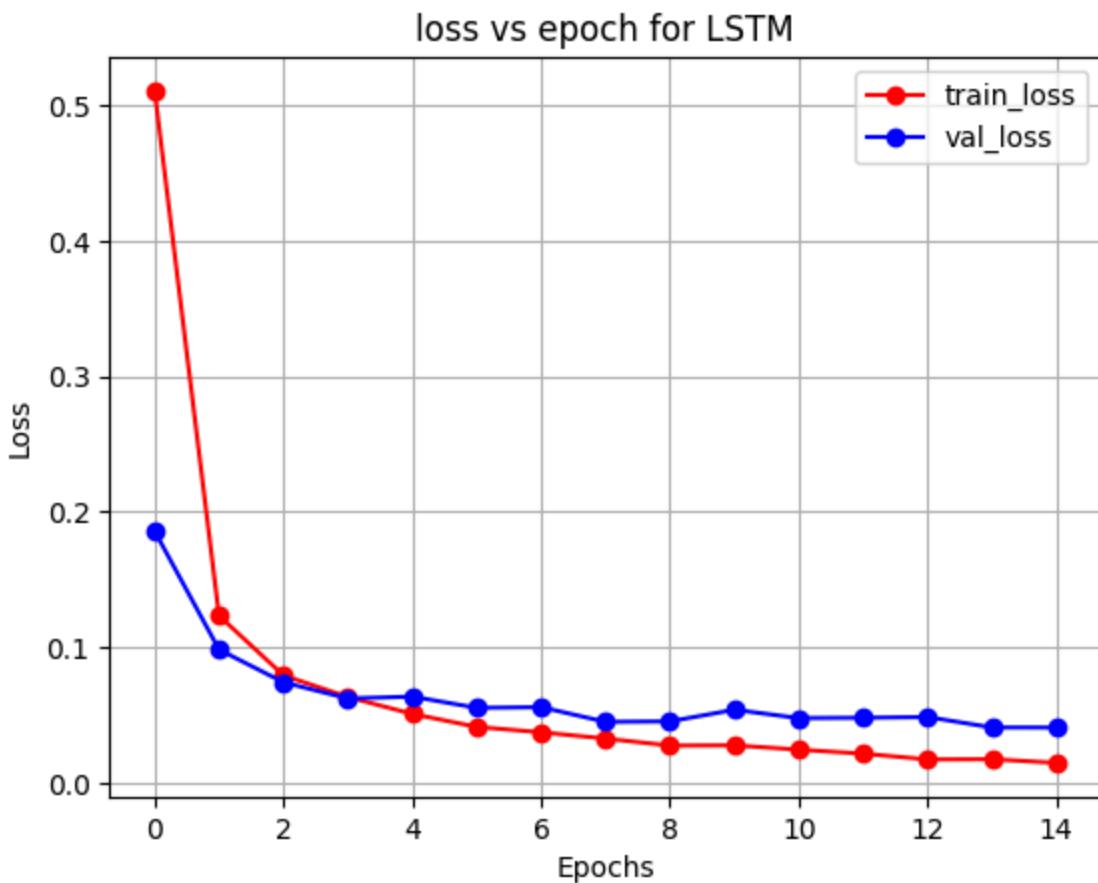


2. LSTM

```
In [ ]: lstm=RNN(input_size,hidden_size,num_layers,num_classes,"LSTM").to(device)
optimizer=torch.optim.Adam(lstm.parameters(),lr=1e-3)
train_loss,val_loss,val_acc,test_acc=train(lstm,num_epochs,train_loader,val_lo
```

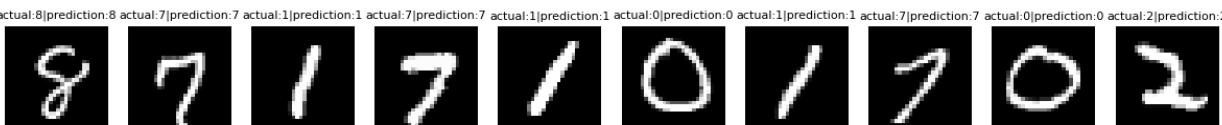
```
Epoch [1/15], train_loss: 0.5106 , val_loss: 0.1856 , val_acc: 0.9440 , test_ac  
c: 0.9532  
Epoch [2/15], train_loss: 0.1231 , val_loss: 0.0982 , val_acc: 0.9686 , test_ac  
c: 0.9722  
Epoch [3/15], train_loss: 0.0792 , val_loss: 0.0740 , val_acc: 0.9768 , test_ac  
c: 0.9781  
Epoch [4/15], train_loss: 0.0631 , val_loss: 0.0621 , val_acc: 0.9818 , test_ac  
c: 0.9807  
Epoch [5/15], train_loss: 0.0507 , val_loss: 0.0635 , val_acc: 0.9809 , test_ac  
c: 0.9808  
Epoch [6/15], train_loss: 0.0411 , val_loss: 0.0552 , val_acc: 0.9838 , test_ac  
c: 0.9826  
Epoch [7/15], train_loss: 0.0371 , val_loss: 0.0557 , val_acc: 0.9834 , test_ac  
c: 0.9830  
Epoch [8/15], train_loss: 0.0325 , val_loss: 0.0448 , val_acc: 0.9865 , test_ac  
c: 0.9869  
Epoch [9/15], train_loss: 0.0273 , val_loss: 0.0452 , val_acc: 0.9882 , test_ac  
c: 0.9880  
Epoch [10/15], train_loss: 0.0275 , val_loss: 0.0538 , val_acc: 0.9838 , test_a  
cc: 0.9845  
Epoch [11/15], train_loss: 0.0243 , val_loss: 0.0476 , val_acc: 0.9855 , test_a  
cc: 0.9869  
Epoch [12/15], train_loss: 0.0214 , val_loss: 0.0479 , val_acc: 0.9868 , test_a  
cc: 0.9872  
Epoch [13/15], train_loss: 0.0171 , val_loss: 0.0484 , val_acc: 0.9875 , test_a  
cc: 0.9884  
Epoch [14/15], train_loss: 0.0173 , val_loss: 0.0407 , val_acc: 0.9877 , test_a  
cc: 0.9873  
Epoch [15/15], train_loss: 0.0146 , val_loss: 0.0407 , val_acc: 0.9875 , test_a  
cc: 0.9893
```

```
In [ ]: plt.plot(range(15),train_loss,c="r",marker="o",label="train_loss")  
plt.plot(range(15),val_loss,c="b",marker="o",label="val_loss")  
plt.xlabel("Epochs")  
plt.ylabel("Loss")  
plt.title("loss vs epoch for LSTM")  
plt.grid(True)  
plt.legend()  
plt.show()
```

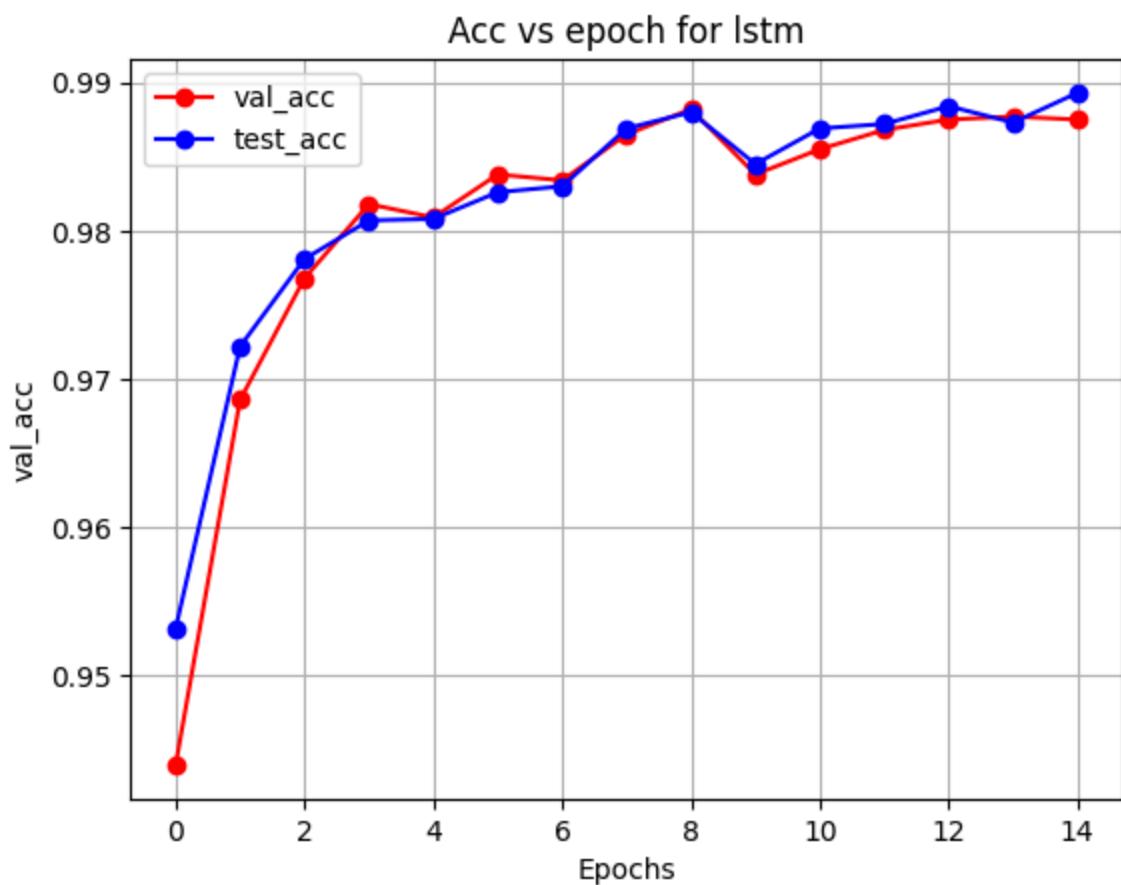


```
In [ ]: plot_image(lstm)
```

actual:8|prediction:8 actual:7|prediction:7 actual:1|prediction:1 actual:7|prediction:7 actual:1|prediction:1 actual:0|prediction:0 actual:1|prediction:1 actual:7|prediction:7 actual:0|prediction:0 actual:2|prediction:2



```
In [ ]: plt.plot(range(15),val_acc,c="r",marker="o",label="val_acc")
plt.plot(range(15),test_acc,c="b",marker="o",label="test_acc")
plt.xlabel("Epochs")
plt.ylabel("val_acc")
plt.title("Acc vs epoch for lstm")
plt.grid(True)
plt.legend()
plt.show()
```

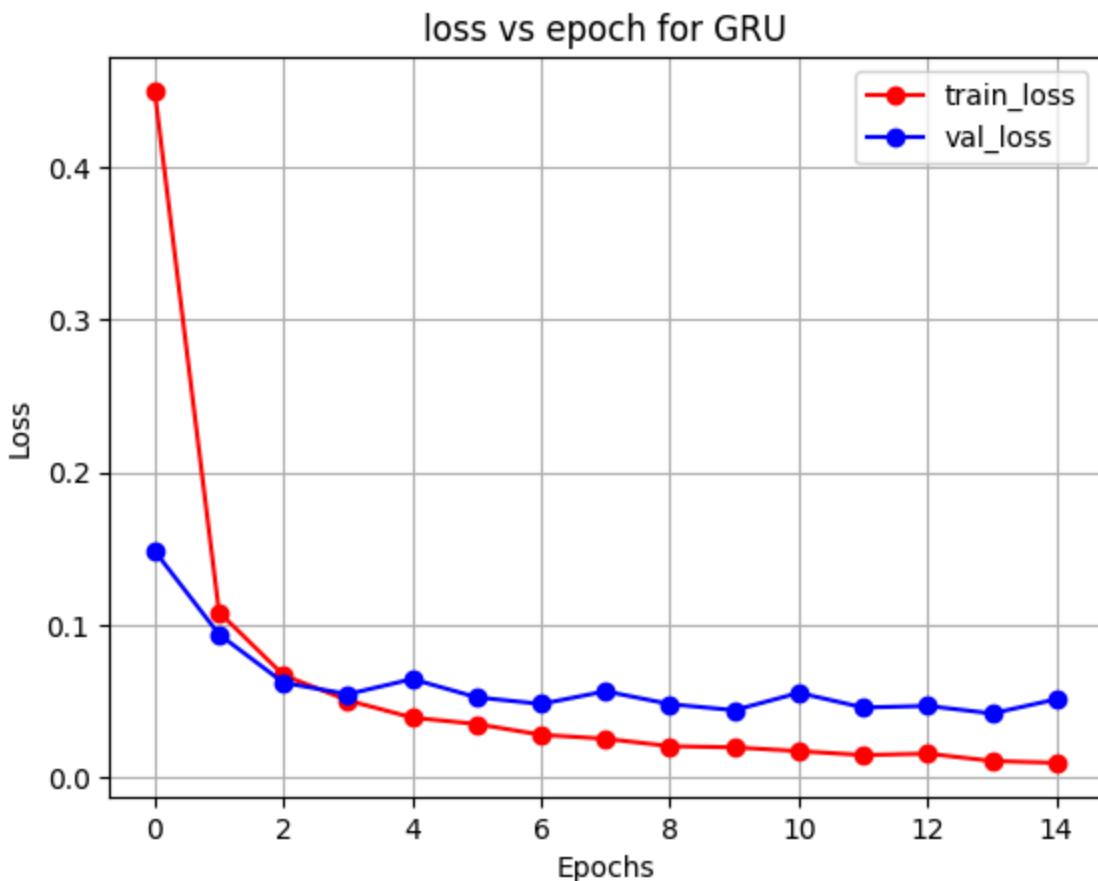


3. GRU

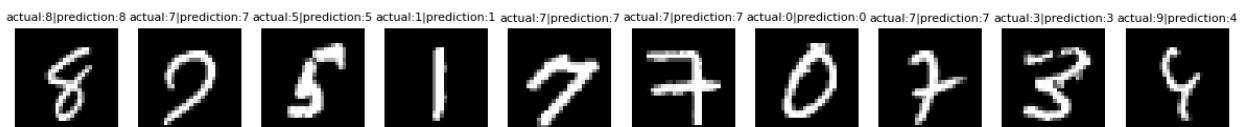
```
In [ ]: gru=RNN(input_size,hidden_size,num_layers,num_classes,"GRU").to(device)
optimizer=torch.optim.Adam(gru.parameters(),lr=1e-3)
train_loss,val_loss,val_acc,test_acc=train(gru,num_epochs,train_loader,val_loa
```

```
Epoch [1/15], train_loss: 0.4500 , val_loss: 0.1485 , val_acc: 0.9551 , test_ac  
c: 0.9593  
Epoch [2/15], train_loss: 0.1083 , val_loss: 0.0938 , val_acc: 0.9698 , test_ac  
c: 0.9720  
Epoch [3/15], train_loss: 0.0670 , val_loss: 0.0621 , val_acc: 0.9811 , test_ac  
c: 0.9828  
Epoch [4/15], train_loss: 0.0505 , val_loss: 0.0546 , val_acc: 0.9835 , test_ac  
c: 0.9852  
Epoch [5/15], train_loss: 0.0392 , val_loss: 0.0645 , val_acc: 0.9810 , test_ac  
c: 0.9846  
Epoch [6/15], train_loss: 0.0350 , val_loss: 0.0525 , val_acc: 0.9844 , test_ac  
c: 0.9870  
Epoch [7/15], train_loss: 0.0279 , val_loss: 0.0481 , val_acc: 0.9864 , test_ac  
c: 0.9857  
Epoch [8/15], train_loss: 0.0253 , val_loss: 0.0564 , val_acc: 0.9849 , test_ac  
c: 0.9854  
Epoch [9/15], train_loss: 0.0205 , val_loss: 0.0480 , val_acc: 0.9867 , test_ac  
c: 0.9886  
Epoch [10/15], train_loss: 0.0197 , val_loss: 0.0441 , val_acc: 0.9865 , test_a  
cc: 0.9892  
Epoch [11/15], train_loss: 0.0173 , val_loss: 0.0554 , val_acc: 0.9855 , test_a  
cc: 0.9850  
Epoch [12/15], train_loss: 0.0146 , val_loss: 0.0458 , val_acc: 0.9876 , test_a  
cc: 0.9884  
Epoch [13/15], train_loss: 0.0156 , val_loss: 0.0469 , val_acc: 0.9881 , test_a  
cc: 0.9882  
Epoch [14/15], train_loss: 0.0108 , val_loss: 0.0419 , val_acc: 0.9894 , test_a  
cc: 0.9888  
Epoch [15/15], train_loss: 0.0096 , val_loss: 0.0513 , val_acc: 0.9862 , test_a  
cc: 0.9897
```

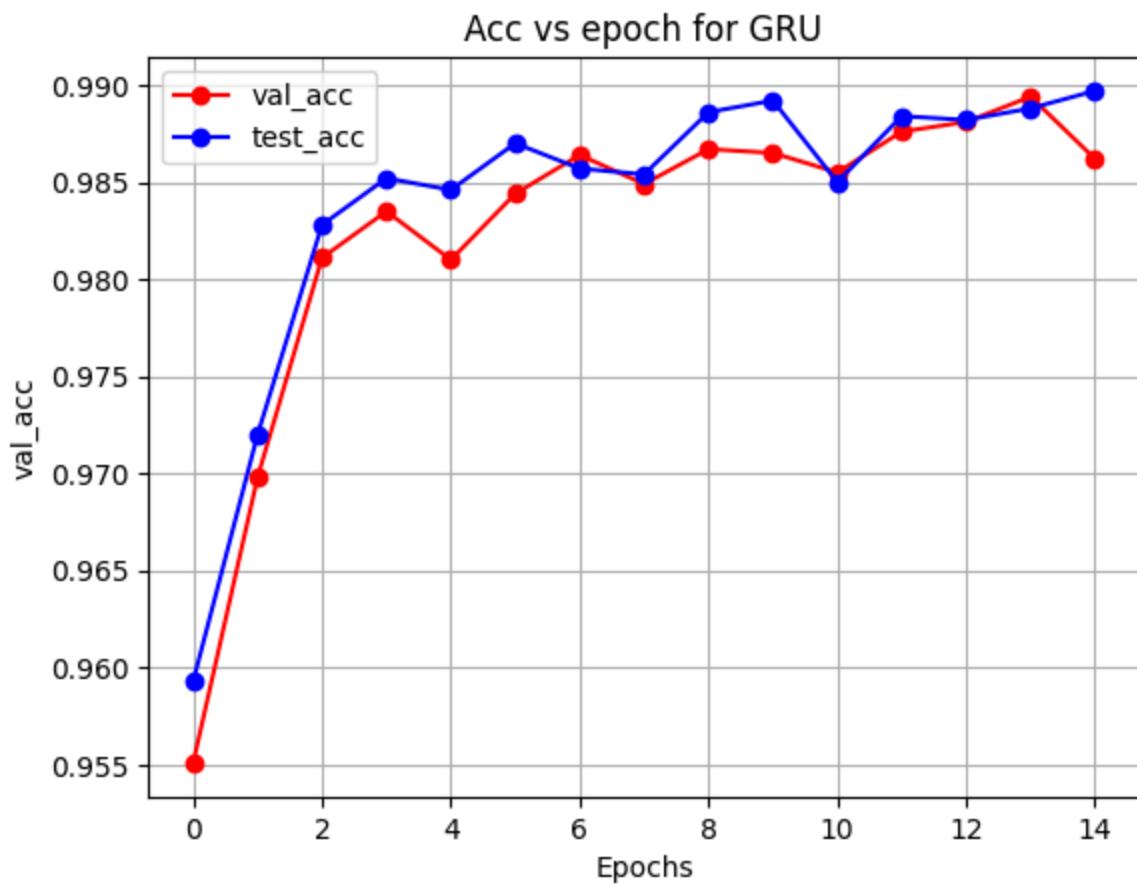
```
In [ ]: plt.plot(range(15),train_loss,c="r",marker="o",label="train_loss")  
plt.plot(range(15),val_loss,c="b",marker="o",label="val_loss")  
plt.xlabel("Epochs")  
plt.ylabel("Loss")  
plt.title("loss vs epoch for GRU")  
plt.grid(True)  
plt.legend()  
plt.show()
```



```
In [ ]: plot_image(gru)
```



```
In [ ]: plt.plot(range(15),val_acc,c="r",marker="o",label="val_acc")
plt.plot(range(15),test_acc,c="b",marker="o",label="test_acc")
plt.xlabel("Epochs")
plt.ylabel("val_acc")
plt.title("Acc vs epoch for GRU")
plt.grid(True)
plt.legend()
plt.show()
```



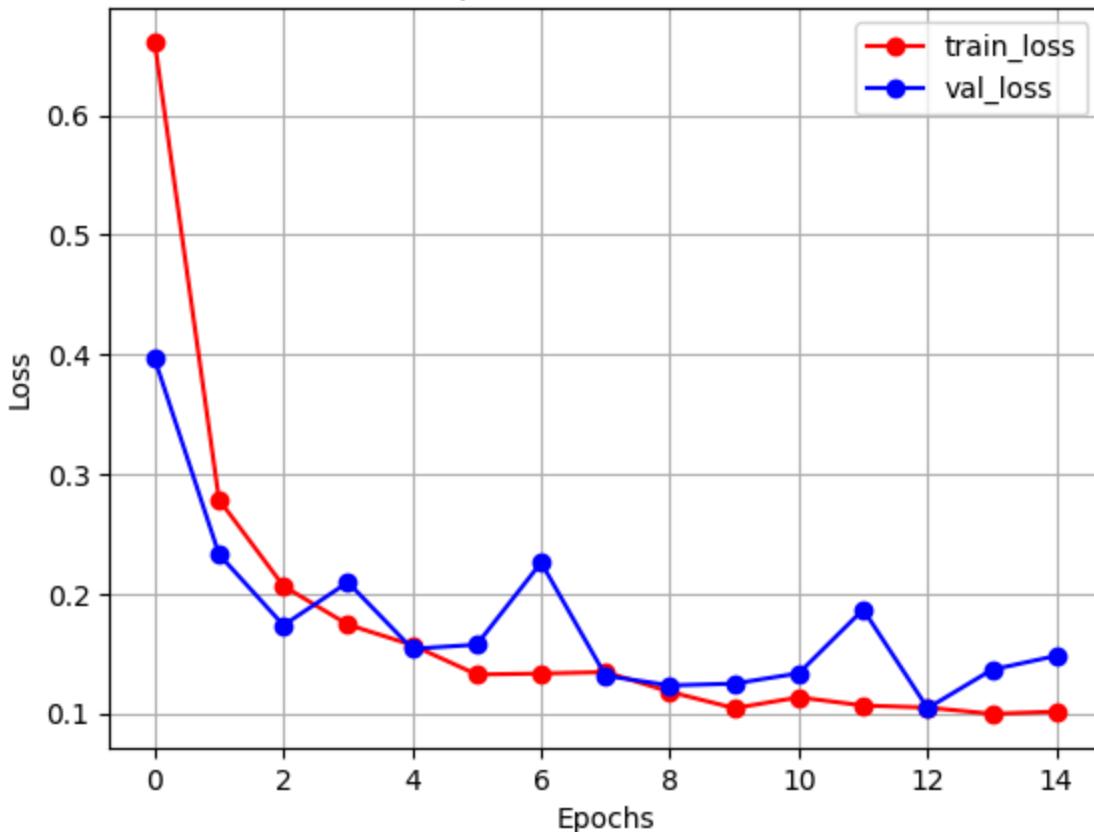
4. BIDIRECTIONAL RNN

```
In [ ]: vanilla_rnn_bi=RNN(input_size,hidden_size,num_layers,num_classes,"RNN",bidirectional=True)
optimizer=torch.optim.Adam(vanilla_rnn_bi.parameters(),lr=1e-3)
train_loss,val_loss,val_acc,test_acc=train(vanilla_rnn_bi,num_epochs,train_loss,
val_loss,train_loss)
```

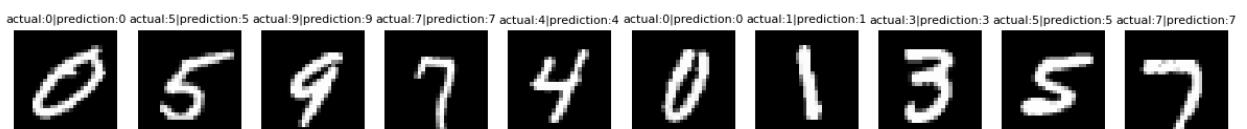
```
Epoch [1/15], train_loss: 0.6613 , val_loss: 0.3964 , val_acc: 0.8726 , test_ac  
c: 0.8768  
Epoch [2/15], train_loss: 0.2785 , val_loss: 0.2328 , val_acc: 0.9344 , test_ac  
c: 0.9370  
Epoch [3/15], train_loss: 0.2064 , val_loss: 0.1736 , val_acc: 0.9498 , test_ac  
c: 0.9532  
Epoch [4/15], train_loss: 0.1742 , val_loss: 0.2096 , val_acc: 0.9385 , test_ac  
c: 0.9448  
Epoch [5/15], train_loss: 0.1571 , val_loss: 0.1539 , val_acc: 0.9570 , test_ac  
c: 0.9598  
Epoch [6/15], train_loss: 0.1325 , val_loss: 0.1575 , val_acc: 0.9562 , test_ac  
c: 0.9611  
Epoch [7/15], train_loss: 0.1333 , val_loss: 0.2261 , val_acc: 0.9315 , test_ac  
c: 0.9342  
Epoch [8/15], train_loss: 0.1345 , val_loss: 0.1315 , val_acc: 0.9626 , test_ac  
c: 0.9648  
Epoch [9/15], train_loss: 0.1180 , val_loss: 0.1233 , val_acc: 0.9647 , test_ac  
c: 0.9686  
Epoch [10/15], train_loss: 0.1043 , val_loss: 0.1249 , val_acc: 0.9659 , test_a  
cc: 0.9679  
Epoch [11/15], train_loss: 0.1134 , val_loss: 0.1335 , val_acc: 0.9619 , test_a  
cc: 0.9639  
Epoch [12/15], train_loss: 0.1066 , val_loss: 0.1868 , val_acc: 0.9466 , test_a  
cc: 0.9532  
Epoch [13/15], train_loss: 0.1048 , val_loss: 0.1043 , val_acc: 0.9710 , test_a  
cc: 0.9705  
Epoch [14/15], train_loss: 0.0996 , val_loss: 0.1365 , val_acc: 0.9634 , test_a  
cc: 0.9634  
Epoch [15/15], train_loss: 0.1015 , val_loss: 0.1481 , val_acc: 0.9609 , test_a  
cc: 0.9681
```

```
In [ ]: plt.plot(range(15),train_loss,c="r",marker="o",label="train_loss")  
plt.plot(range(15),val_loss,c="b",marker="o",label="val_loss")  
plt.xlabel("Epochs")  
plt.ylabel("Loss")  
plt.title("loss vs epoch for bidirectional RNN")  
plt.grid(True)  
plt.legend()  
plt.show()
```

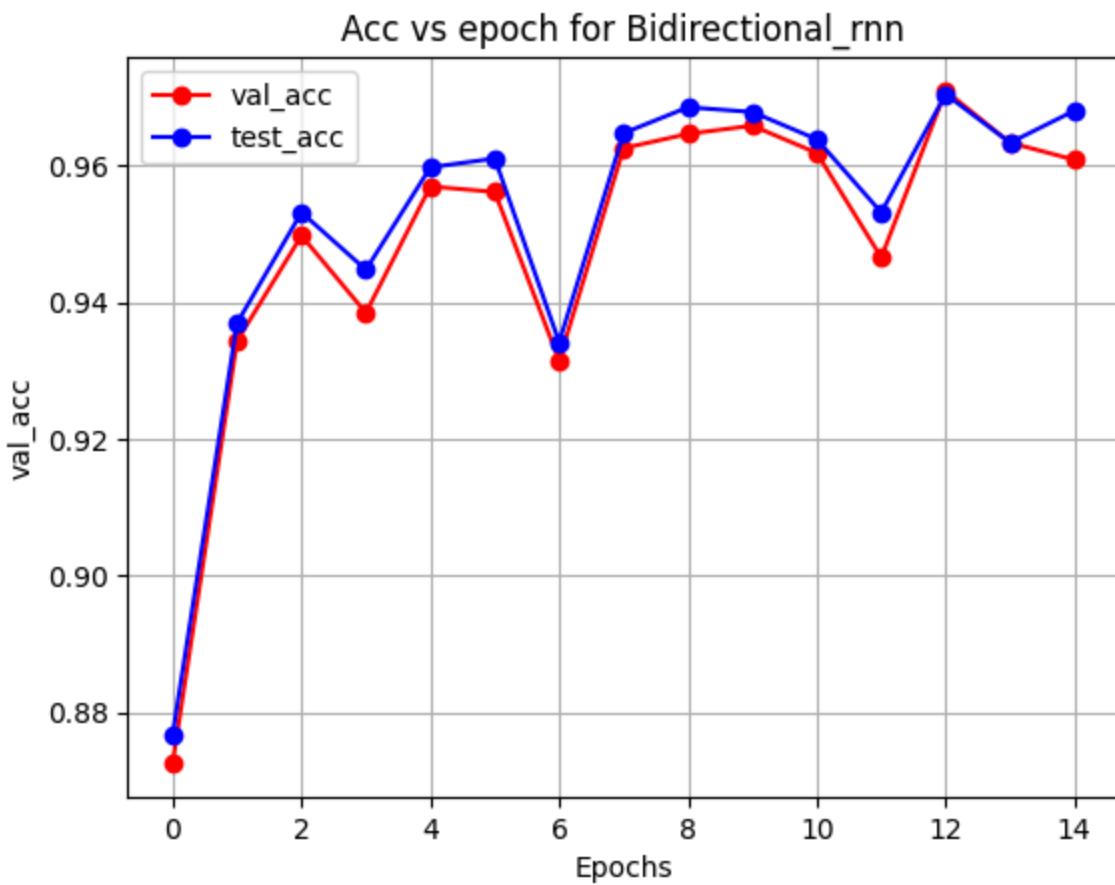
loss vs epoch for bidirectional RNN



```
In [ ]: plot_image(vanilla_rnn_bi)
```



```
In [ ]: plt.plot(range(15),val_acc,c="r",marker="o",label="val_acc")
plt.plot(range(15),test_acc,c="b",marker="o",label="test_acc")
plt.xlabel("Epochs")
plt.ylabel("val_acc")
plt.title("Acc vs epoch for Bidirectional_rnn")
plt.grid(True)
plt.legend()
plt.show()
```



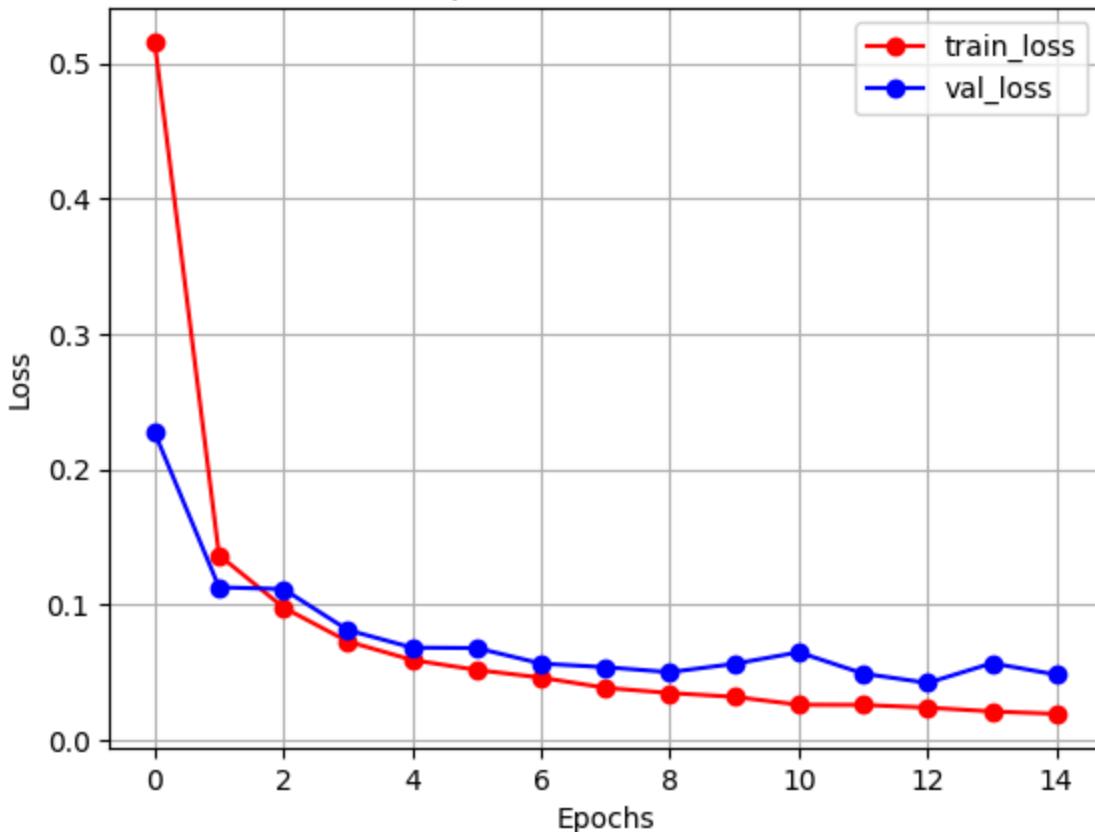
5. BIDIRECTIONAL LSTM

```
In [ ]: lstm_bi=RNN(input_size,hidden_size,num_layers,num_classes,"LSTM",bidirectional  
optimizer=torch.optim.Adam(lstm_bi.parameters(),lr=1e-3)  
train_loss,val_loss,val_acc,test_acc=train(lstm_bi,num_epochs,train_loader,val
```

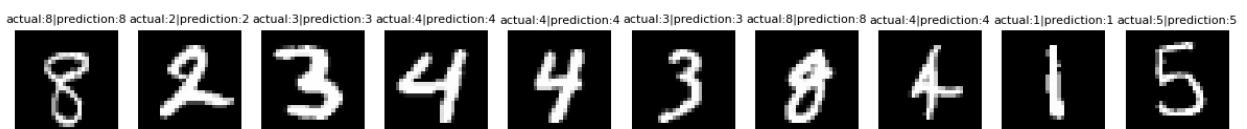
```
Epoch [1/15], train_loss: 0.5160 , val_loss: 0.2271 , val_acc: 0.9341 , test_ac  
c: 0.9410  
Epoch [2/15], train_loss: 0.1365 , val_loss: 0.1128 , val_acc: 0.9663 , test_ac  
c: 0.9687  
Epoch [3/15], train_loss: 0.0978 , val_loss: 0.1114 , val_acc: 0.9656 , test_ac  
c: 0.9677  
Epoch [4/15], train_loss: 0.0727 , val_loss: 0.0811 , val_acc: 0.9757 , test_ac  
c: 0.9763  
Epoch [5/15], train_loss: 0.0590 , val_loss: 0.0681 , val_acc: 0.9792 , test_ac  
c: 0.9811  
Epoch [6/15], train_loss: 0.0517 , val_loss: 0.0678 , val_acc: 0.9802 , test_ac  
c: 0.9795  
Epoch [7/15], train_loss: 0.0460 , val_loss: 0.0563 , val_acc: 0.9833 , test_ac  
c: 0.9843  
Epoch [8/15], train_loss: 0.0384 , val_loss: 0.0537 , val_acc: 0.9838 , test_ac  
c: 0.9831  
Epoch [9/15], train_loss: 0.0346 , val_loss: 0.0500 , val_acc: 0.9864 , test_ac  
c: 0.9827  
Epoch [10/15], train_loss: 0.0318 , val_loss: 0.0562 , val_acc: 0.9835 , test_a  
cc: 0.9853  
Epoch [11/15], train_loss: 0.0259 , val_loss: 0.0647 , val_acc: 0.9817 , test_a  
cc: 0.9837  
Epoch [12/15], train_loss: 0.0258 , val_loss: 0.0490 , val_acc: 0.9862 , test_a  
cc: 0.9865  
Epoch [13/15], train_loss: 0.0238 , val_loss: 0.0420 , val_acc: 0.9893 , test_a  
cc: 0.9890  
Epoch [14/15], train_loss: 0.0210 , val_loss: 0.0566 , val_acc: 0.9847 , test_a  
cc: 0.9818  
Epoch [15/15], train_loss: 0.0192 , val_loss: 0.0481 , val_acc: 0.9869 , test_a  
cc: 0.9878
```

```
In [ ]: plt.plot(range(15),train_loss,c="r",marker="o",label="train_loss")  
plt.plot(range(15),val_loss,c="b",marker="o",label="val_loss")  
plt.xlabel("Epochs")  
plt.ylabel("Loss")  
plt.title("loss vs epoch for Bidirectional LSTM")  
plt.grid(True)  
plt.legend()  
plt.show()
```

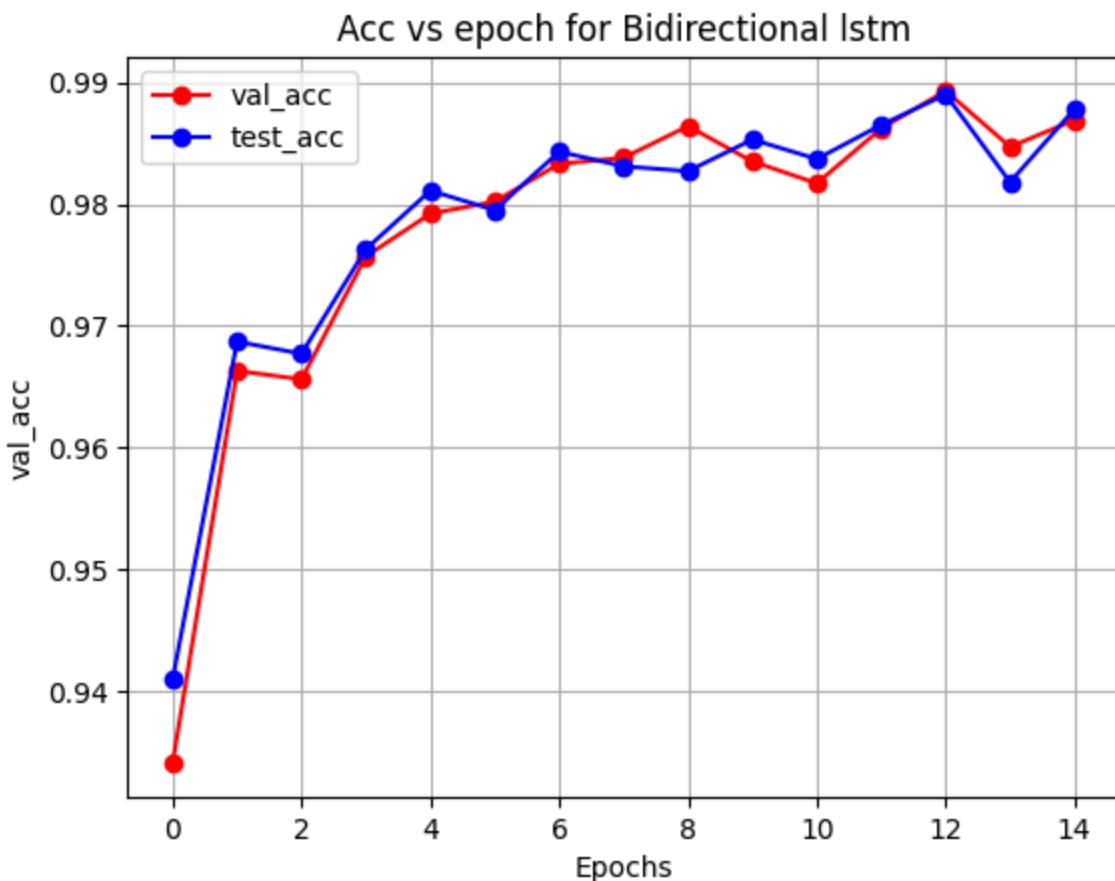
loss vs epoch for Bidirectional LSTM



```
In [ ]: plot_image(lstm_bi)
```



```
In [ ]: plt.plot(range(15),val_acc,c="r",marker="o",label="val_acc")
plt.plot(range(15),test_acc,c="b",marker="o",label="test_acc")
plt.xlabel("Epochs")
plt.ylabel("val_acc")
plt.title("Acc vs epoch for Bidirectional lstm")
plt.grid(True)
plt.legend()
plt.show()
```



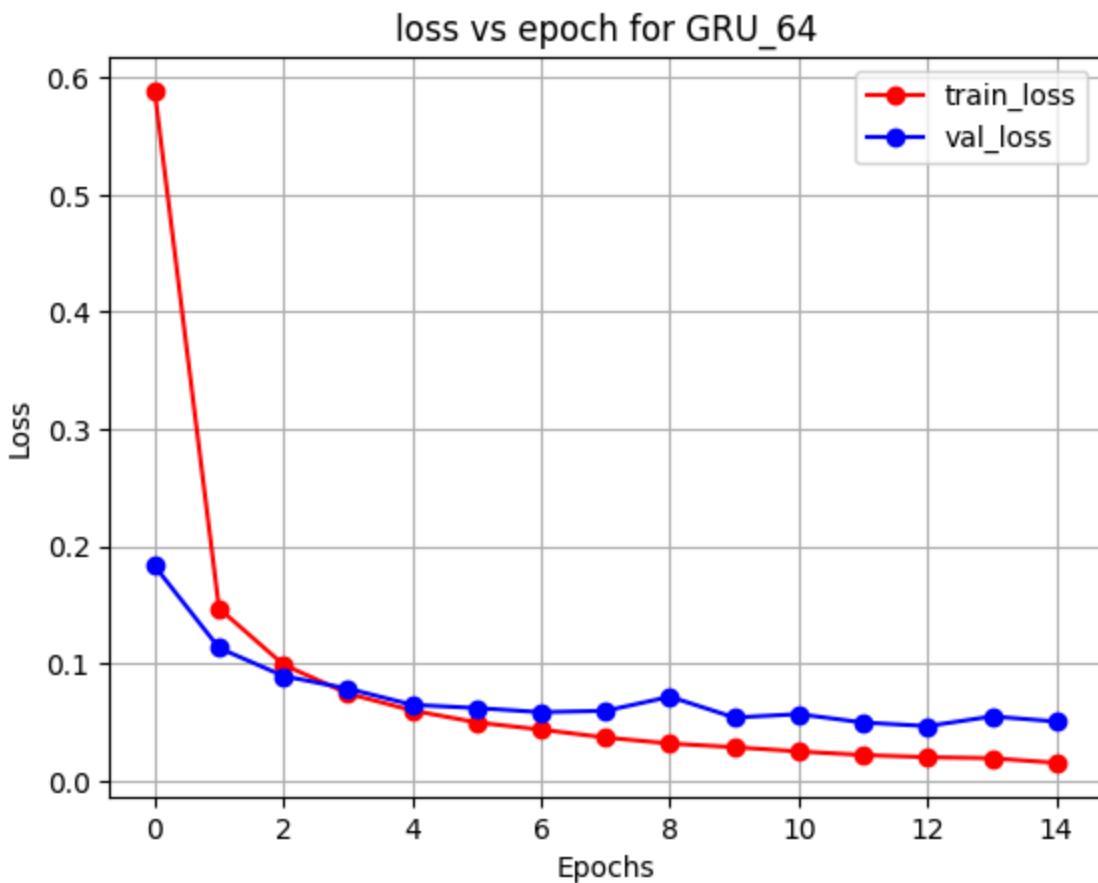
GRU wit hidden_size=64

```
In [9]: input_size=28
sequence_length=28
num_layers=2
hidden_size=64
num_classes=10
num_epochs=15
batch_size=64
lr=1e-3
```

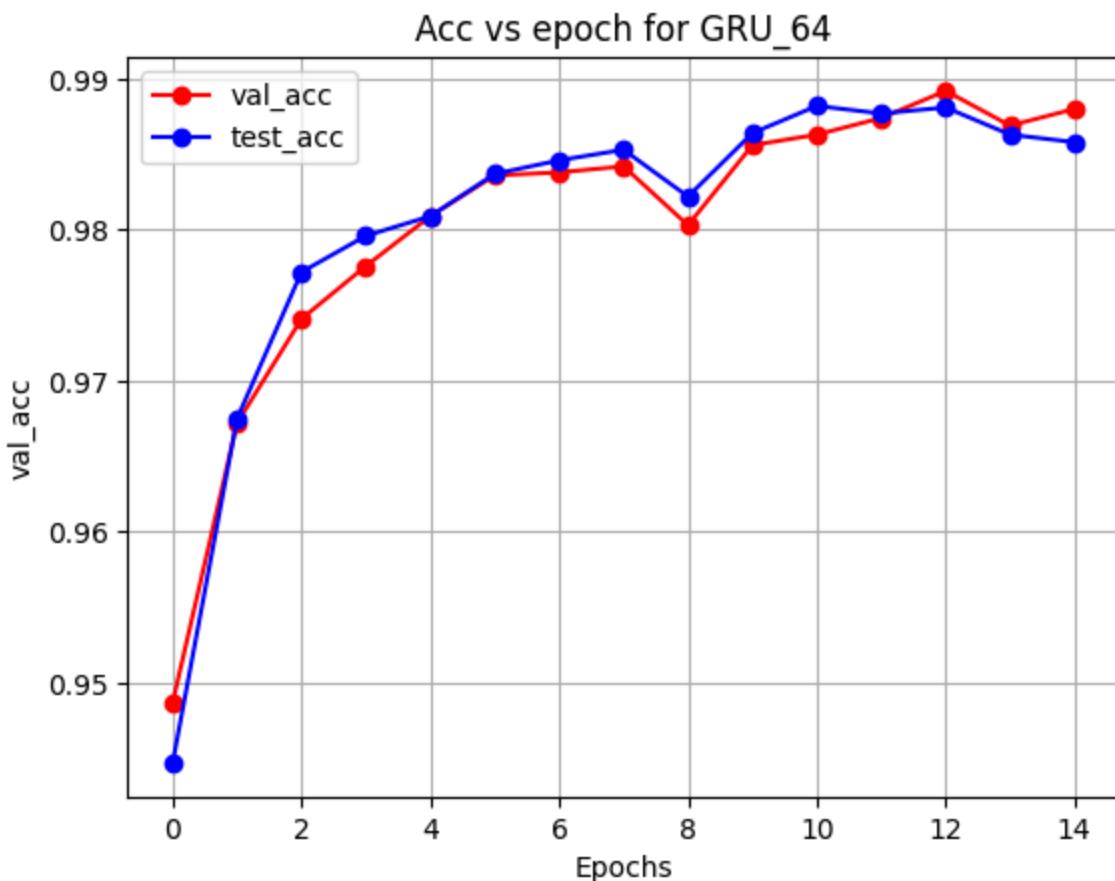
```
In [13]: gru_64=RNN(input_size,hidden_size,num_layers,num_classes,"GRU").to(device)
optimizer=torch.optim.Adam(gru_64.parameters(),lr=1e-3)
train_loss,val_loss,val_acc,test_acc=train(gru_64,num_epochs,train_loader,val_
```

```
Epoch [1/15], train_loss: 0.5887 , val_loss: 0.1832 , val_acc: 0.9487 , test_ac  
c: 0.9447  
Epoch [2/15], train_loss: 0.1470 , val_loss: 0.1133 , val_acc: 0.9672 , test_ac  
c: 0.9675  
Epoch [3/15], train_loss: 0.0990 , val_loss: 0.0893 , val_acc: 0.9741 , test_ac  
c: 0.9772  
Epoch [4/15], train_loss: 0.0743 , val_loss: 0.0786 , val_acc: 0.9776 , test_ac  
c: 0.9796  
Epoch [5/15], train_loss: 0.0599 , val_loss: 0.0647 , val_acc: 0.9809 , test_ac  
c: 0.9809  
Epoch [6/15], train_loss: 0.0497 , val_loss: 0.0620 , val_acc: 0.9836 , test_ac  
c: 0.9837  
Epoch [7/15], train_loss: 0.0436 , val_loss: 0.0585 , val_acc: 0.9838 , test_ac  
c: 0.9846  
Epoch [8/15], train_loss: 0.0368 , val_loss: 0.0596 , val_acc: 0.9842 , test_ac  
c: 0.9853  
Epoch [9/15], train_loss: 0.0317 , val_loss: 0.0716 , val_acc: 0.9803 , test_ac  
c: 0.9822  
Epoch [10/15], train_loss: 0.0286 , val_loss: 0.0539 , val_acc: 0.9856 , test_a  
cc: 0.9864  
Epoch [11/15], train_loss: 0.0250 , val_loss: 0.0568 , val_acc: 0.9863 , test_a  
cc: 0.9882  
Epoch [12/15], train_loss: 0.0219 , val_loss: 0.0496 , val_acc: 0.9874 , test_a  
cc: 0.9877  
Epoch [13/15], train_loss: 0.0201 , val_loss: 0.0466 , val_acc: 0.9892 , test_a  
cc: 0.9881  
Epoch [14/15], train_loss: 0.0192 , val_loss: 0.0549 , val_acc: 0.9869 , test_a  
cc: 0.9863  
Epoch [15/15], train_loss: 0.0152 , val_loss: 0.0505 , val_acc: 0.9880 , test_a  
cc: 0.9858
```

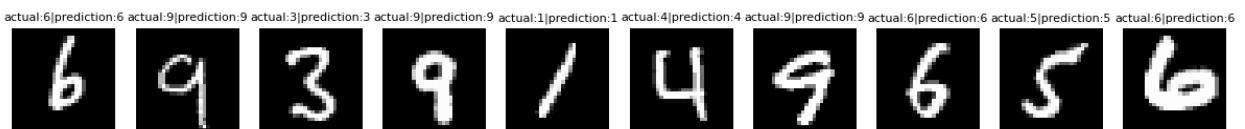
```
In [16]: plt.plot(range(15),train_loss,c="r",marker="o",label="train_loss")  
plt.plot(range(15),val_loss,c="b",marker="o",label="val_loss")  
plt.xlabel("Epochs")  
plt.ylabel("Loss")  
plt.title("loss vs epoch for GRU_64")  
plt.grid(True)  
plt.legend()  
plt.show()
```



```
In [17]: plt.plot(range(15),val_acc,c="r",marker="o",label="val_acc")
plt.plot(range(15),test_acc,c="b",marker="o",label="test_acc")
plt.xlabel("Epochs")
plt.ylabel("val_acc")
plt.title("Acc vs epoch for GRU_64")
plt.grid(True)
plt.legend()
plt.show()
```



```
In [18]: plot_image(gru_64)
```



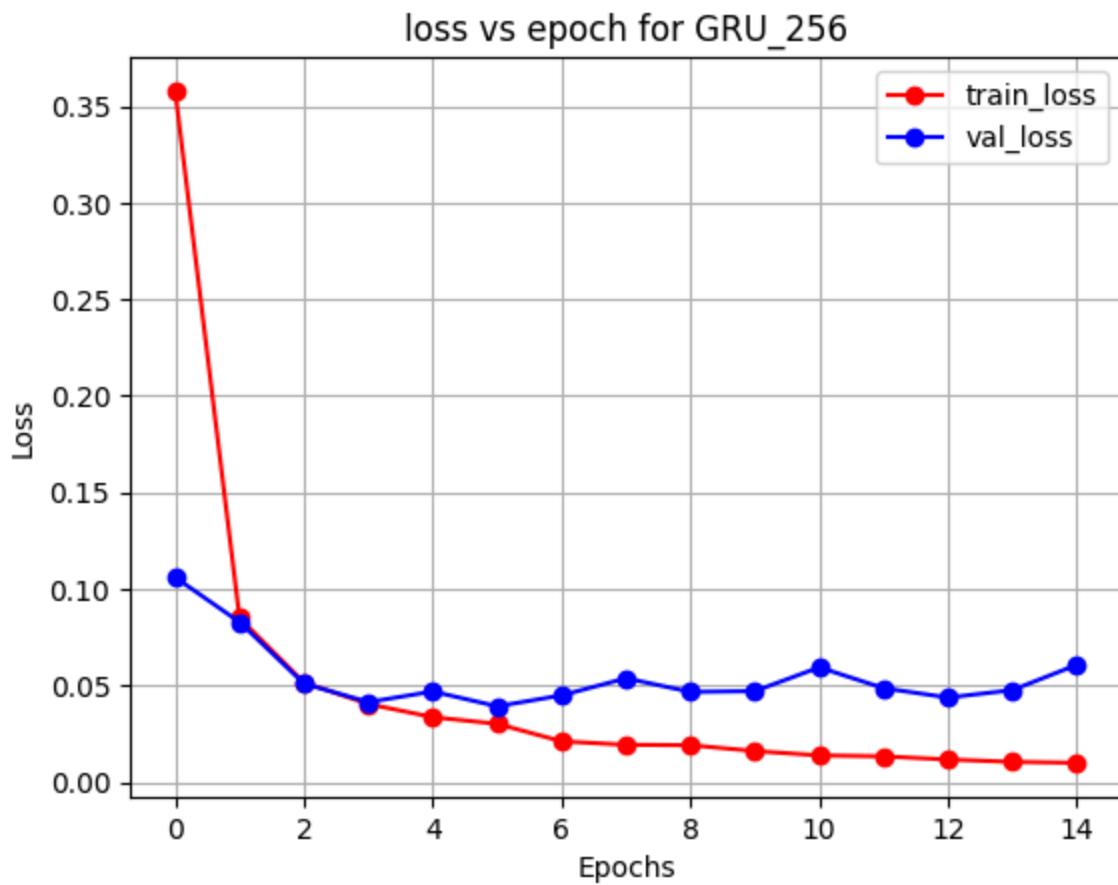
GRU with hidden_size = 256

```
In [19]: input_size=28
sequence_length=28
num_layers=2
hidden_size=256
num_classes=10
num_epochs=15
batch_size=64
lr=1e-3
```

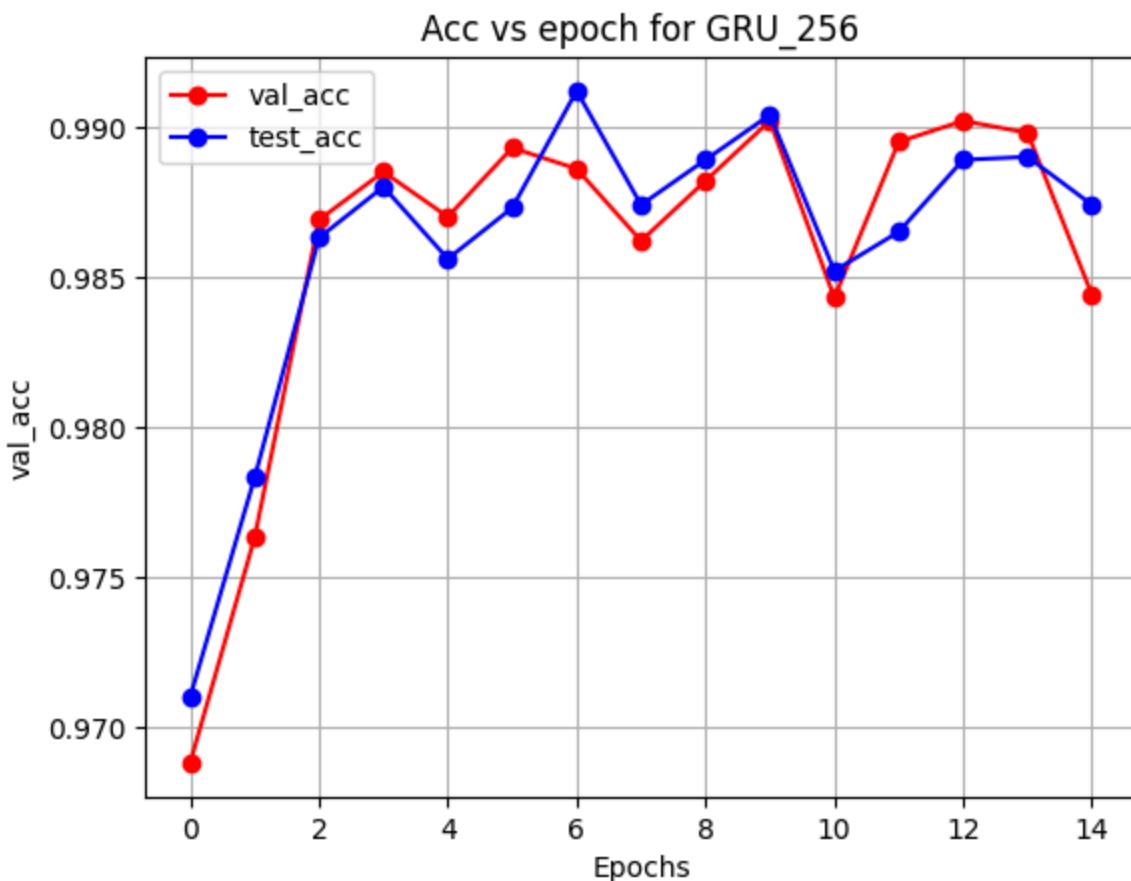
```
In [20]: gru_256=RNN(input_size,hidden_size,num_layers,num_classes,"GRU").to(device)
optimizer=torch.optim.Adam(gru_256.parameters(),lr=1e-3)
train_loss,val_loss,val_acc,test_acc=train(gru_256,num_epochs,train_loader,val
```

```
Epoch [1/15], train_loss: 0.3580 , val_loss: 0.1061 , val_acc: 0.9688 , test_ac  
c: 0.9710  
Epoch [2/15], train_loss: 0.0851 , val_loss: 0.0829 , val_acc: 0.9763 , test_ac  
c: 0.9783  
Epoch [3/15], train_loss: 0.0517 , val_loss: 0.0511 , val_acc: 0.9869 , test_ac  
c: 0.9863  
Epoch [4/15], train_loss: 0.0405 , val_loss: 0.0415 , val_acc: 0.9885 , test_ac  
c: 0.9880  
Epoch [5/15], train_loss: 0.0337 , val_loss: 0.0470 , val_acc: 0.9870 , test_ac  
c: 0.9856  
Epoch [6/15], train_loss: 0.0303 , val_loss: 0.0393 , val_acc: 0.9893 , test_ac  
c: 0.9873  
Epoch [7/15], train_loss: 0.0212 , val_loss: 0.0450 , val_acc: 0.9886 , test_ac  
c: 0.9912  
Epoch [8/15], train_loss: 0.0194 , val_loss: 0.0539 , val_acc: 0.9862 , test_ac  
c: 0.9874  
Epoch [9/15], train_loss: 0.0192 , val_loss: 0.0468 , val_acc: 0.9882 , test_ac  
c: 0.9889  
Epoch [10/15], train_loss: 0.0162 , val_loss: 0.0472 , val_acc: 0.9902 , test_a  
cc: 0.9904  
Epoch [11/15], train_loss: 0.0139 , val_loss: 0.0595 , val_acc: 0.9843 , test_a  
cc: 0.9852  
Epoch [12/15], train_loss: 0.0134 , val_loss: 0.0487 , val_acc: 0.9895 , test_a  
cc: 0.9865  
Epoch [13/15], train_loss: 0.0118 , val_loss: 0.0439 , val_acc: 0.9902 , test_a  
cc: 0.9889  
Epoch [14/15], train_loss: 0.0106 , val_loss: 0.0477 , val_acc: 0.9898 , test_a  
cc: 0.9890  
Epoch [15/15], train_loss: 0.0101 , val_loss: 0.0609 , val_acc: 0.9844 , test_a  
cc: 0.9874
```

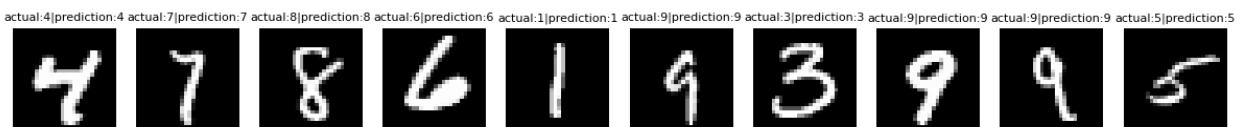
```
In [22]: plt.plot(range(15),train_loss,c="r",marker="o",label="train_loss")  
plt.plot(range(15),val_loss,c="b",marker="o",label="val_loss")  
plt.xlabel("Epochs")  
plt.ylabel("Loss")  
plt.title("loss vs epoch for GRU_256")  
plt.grid(True)  
plt.legend()  
plt.show()
```



```
In [24]: plt.plot(range(15),val_acc,c="r",marker="o",label="val_acc")
plt.plot(range(15),test_acc,c="b",marker="o",label="test_acc")
plt.xlabel("Epochs")
plt.ylabel("val_acc")
plt.title("Acc vs epoch for GRU_256")
plt.grid(True)
plt.legend()
plt.show()
```



```
In [23]: plot_image(gru_256)
```



Prediction for hand written digits

```
In [ ]: import torch
from PIL import Image
import torchvision.transforms as transforms

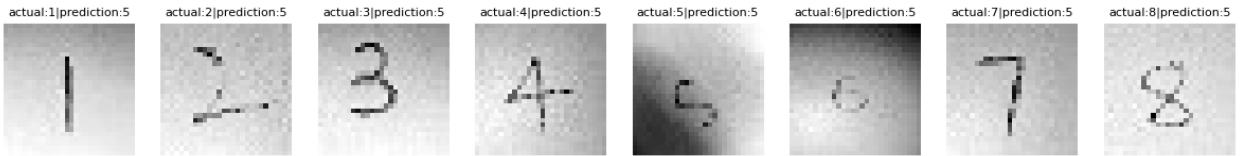
def conversion_img_tensor(imag_path):
    image = Image.open(imag_path)
    transform = transforms.Compose([
        transforms.PILToTensor()
    ])
    img_tensor = transform(image)/255
    img_tensor = (img_tensor[0]+img_tensor[1]+img_tensor[2])/3
    return img_tensor
```

```
In [ ]: gru.eval()
plt.figure(figsize=(15, 4))
index=1
```

```

with torch.no_grad():
    for i in range(1,9):
        original_img=conversion_img_tensor("image_" +str(i) + ".jpeg")
        ax=plt.subplot(2,8,index)
        model_img=original_img.reshape(1,28,28).to(device)
        label=i
        predicted=gru(model_img)
        predicted=torch.argmax(predicted,1).to("cpu").item()
        plt.imshow(original_img,cmap="gray")
        ax.set_title(f"actual:{label}|prediction:{predicted}",size=8)
        ax.axis("off")
        index+=1

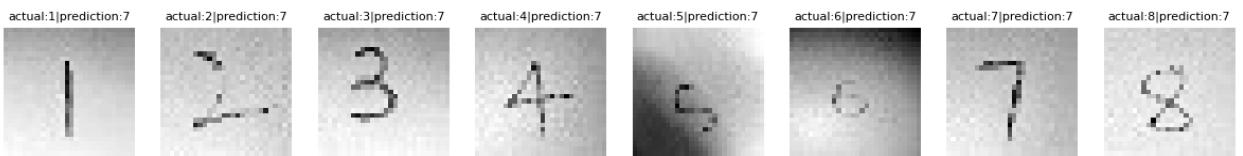
```



```

In [ ]: vanilla_rnn.eval()
plt.figure(figsize=(15, 4))
index=1
with torch.no_grad():
    for i in range(1,9):
        original_img=conversion_img_tensor("image_" +str(i) + ".jpeg")
        ax=plt.subplot(2,8,index)
        model_img=original_img.reshape(1,28,28).to(device)
        label=i
        predicted=vanilla_rnn(model_img)
        predicted=torch.argmax(predicted,1).to("cpu").item()
        plt.imshow(original_img,cmap="gray")
        ax.set_title(f"actual:{label}|prediction:{predicted}",size=8)
        ax.axis("off")
        index+=1

```

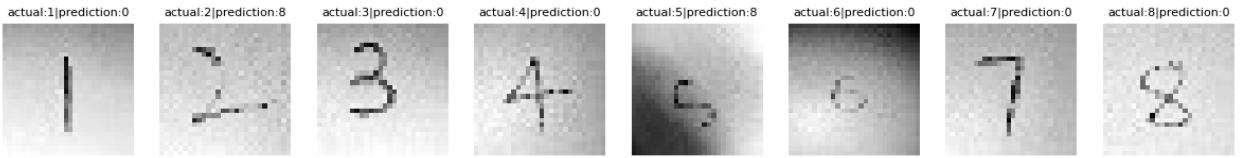


```

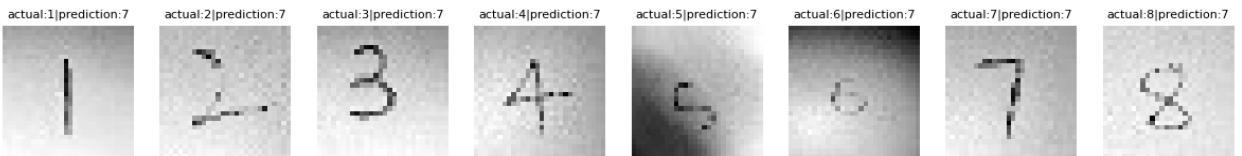
In [ ]: lstm.eval()
plt.figure(figsize=(15, 4))
index=1
with torch.no_grad():
    for i in range(1,9):
        original_img=conversion_img_tensor("image_" +str(i) + ".jpeg")
        ax=plt.subplot(2,8,index)
        model_img=original_img.reshape(1,28,28).to(device)
        label=i
        predicted=lstm(model_img)
        predicted=torch.argmax(predicted,1).to("cpu").item()
        plt.imshow(original_img,cmap="gray")
        ax.set_title(f"actual:{label}|prediction:{predicted}",size=8)

```

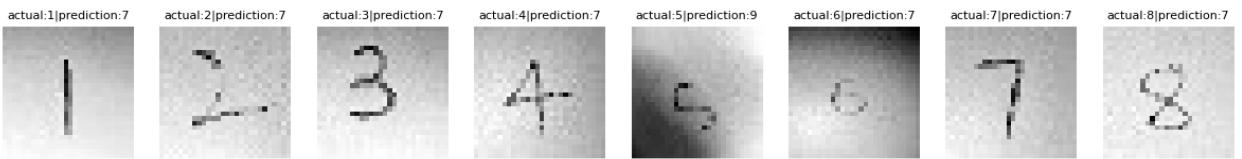
```
    ax.axis("off")
    index+=1
```



```
In [ ]: vanilla_rnn.eval()
plt.figure(figsize=(15, 4))
index=1
with torch.no_grad():
    for i in range(1,9):
        original_img=conversion_img_tensor("image_" +str(i) + ".jpeg")
        ax=plt.subplot(2,8,index)
        model_img=original_img.reshape(1,28,28).to(device)
        label=i
        predicted=vanilla_rnn(model_img)
        predicted=torch.argmax(predicted,1).to("cpu").item()
        plt.imshow(original_img,cmap="gray")
        ax.set_title(f"actual:{label}|prediction:{predicted}",size=8)
        ax.axis("off")
        index+=1
```



```
In [ ]: lstm_bi.eval()
plt.figure(figsize=(15, 4))
index=1
with torch.no_grad():
    for i in range(1,9):
        original_img=conversion_img_tensor("image_" +str(i) + ".jpeg")
        ax=plt.subplot(2,8,index)
        model_img=original_img.reshape(1,28,28).to(device)
        label=i
        predicted=lstm_bi(model_img)
        predicted=torch.argmax(predicted,1).to("cpu").item()
        plt.imshow(original_img,cmap="gray")
        ax.set_title(f"actual:{label}|prediction:{predicted}",size=8)
        ax.axis("off")
        index+=1
```



2 ADDING TWO BINARY STRINGS

```
In [ ]: def create_data_batch(batch_size,L):
    seq_len=L+1
    i1=np.random.randint(0,2,size=(batch_size,L))
    i2=np.random.randint(0,2,size=(batch_size,L))
    i1_padded=np.hstack((i1,np.zeros((batch_size,1))))
    i2_padded=np.hstack((i2,np.zeros((batch_size,1))))
    pow2=2**np.arange(L)
    i1_d=i1@pow2
    i2_d=i2@pow2
    sum_d=i1_d+i2_d
    sum_bits=np.zeros((batch_size,seq_len))
    shifters=np.arange(seq_len).reshape(1,-1)
    sum_bits=(sum_d.reshape(-1,1) >> shifters) & 1
    input_data=np.stack([i1_padded,i2_padded],axis=2)
    inputs_tensor = torch.tensor(input_data, dtype=torch.float32)
    targets_tensor = torch.tensor(sum_bits, dtype=torch.float32).unsqueeze(-1)
    return inputs_tensor, targets_tensor
```

```
In [ ]:
```

```
Out[ ]: array([[0, 1, 2, 3, 4]])
```

```
In [ ]: create_data_batch(10,2)
```

```
Out[ ]: (tensor([[ [1., 0.],
                    [0., 1.],
                    [0., 0.]],

                   [[1., 0.],
                    [1., 0.],
                    [0., 0.]],

                   [[1., 1.],
                    [0., 1.],
                    [0., 0.]],

                   [[0., 0.],
                    [0., 0.],
                    [0., 0.]],

                   [[0., 0.],
                    [1., 0.],
                    [0., 0.]],

                   [[1., 1.],
                    [0., 0.],
                    [0., 0.]],

                   [[1., 1.],
                    [1., 1.],
                    [0., 0.]],

                   [[0., 1.],
                    [0., 1.],
                    [0., 0.]],

                   [[0., 1.],
                    [0., 0.],
                    [0., 0.]],

                   [[0., 0.],
                    [1., 1.],
                    [0., 0.]]]),  
tensor([[ [1.],
                    [1.],
                    [0.]],

                   [[0.],
                    [0.],
                    [1.]],

                   [[0.],
                    [0.],
                    [0.]]],
```

```

[[0.],
 [1.],
 [0.]],

[[0.],
 [1.],
 [0.]],

[[0.],
 [1.],
 [1.]],

[[1.],
 [1.],
 [0.]],

[[1.],
 [0.],
 [0.]],

[[0.],
 [0.],
 [1.]])))

```

```
In [ ]: class Binary_adder(nn.Module):
    def __init__(self,input_size,hidden_size,num_layers):
        super().__init__()
        self.lstm=nn.LSTM(input_size,hidden_size,num_layers,batch_first=True)
        self.fc=nn.Linear(hidden_size,1)
        self.sigmoid=nn.Sigmoid()

    def forward(self,x):
        out,_=self.lstm(x)
        out=self.fc(out)
        return self.sigmoid(out)
```

```
In [ ]: def training_loop(model,epochs,optimizer,criterion,batch_size,l_train,l_test):
    train_loss=[]
    test_loss=[]
    for epoch in range(epochs):
        model.train()
        inputs,targets=create_data_batch(batch_size,l_train)
        inputs=inputs.to(device)
        targets=targets.to(device)
        outputs=model(inputs)
        loss=criterion(outputs,targets)
        optimizer.zero_grad()
        loss.backward()
        optimizer.step()
        train_loss.append(loss.item())
        model.eval()
        with torch.no_grad():
```

```

    test_inputs,test_targets=create_data_batch(batch_size,l_test)
    test_inputs=test_inputs.to(device)
    test_targets=test_targets.to(device)
    test_outputs=model(test_inputs)
    test_loss.append(criterion(test_outputs,test_targets).item())
if (epoch) % 50 == 0:
    print(f'Epoch [{epoch}/{epoch}], Train Loss: {train_loss[-1]:.4f}, Tes
return train_loss,test_loss

```

```

In [ ]: def plot_loss(train_loss,test_loss,hidden_size,l_train,l_test,loss_type):
    plt.figure(figsize=(10, 5))
    plt.plot(train_loss, label='Training Loss',marker="o")
    plt.plot(test_loss, label='Test (Validation) Loss')
    plt.title(f'Loss vs. Epochs (H={hidden_size}, L_train={l_train}, L_test={l_t
    plt.xlabel('Epoch')
    plt.ylabel('Loss')
    plt.legend()
    plt.grid(True)
    plt.show()

```

```

In [ ]: def avg_bit_accuracy(model,hidden_size,l_train,l_test,batch_size=100):
    avg_bit_acc=[]
    sum_acc=0
    for i in range(1,21):
        model.eval()
        with torch.no_grad():
            test_inputs,test_targets=create_data_batch(batch_size,i)
            test_inputs=test_inputs.to(device)
            test_targets=test_targets.to(device)
            test_outputs=model(test_inputs)
            predicted_bits=(test_outputs > 0.5).float()
            acc=(predicted_bits==test_targets).float().mean().item()
            sum_acc+=acc
            avg_bit_acc.append(acc)
    plt.figure(figsize=(10, 5))
    plt.plot(range(1,21),avg_bit_acc,label="acc",marker="o",linestyle="-")
    plt.title(f"Avg-bit-acc vs Input length(L) for hidden_size={hidden_size}, l_
    plt.xlabel("Input length(L)")
    plt.ylabel("Avg-bit-acc")
    plt.ylim(-0.05, 1.05)
    plt.grid(True)
    plt.legend()
    plt.show()
    return sum_acc/20

```

MODEL_0:

```

In [ ]: input_size=2
hidden_size=5
num_layers=1
l_train=5
l_test=5

```

```
epochs=100000
batch_size=128
lr=1e-4
```

```
In [ ]: model=Binary_adder(input_size,hidden_size,num_layers).to(device)
criterion=nn.BCELoss()
optimizer=torch.optim.Adam(model.parameters(), lr=lr)
```

```
In [ ]: train_loss,test_loss=training_loop(model,epochs,optimizer,criterion,batch_size
```

Epoch [0/0], Train Loss: 0.1954, Test Loss: 0.1966
Epoch [50/50], Train Loss: 0.2040, Test Loss: 0.1932
Epoch [100/100], Train Loss: 0.2036, Test Loss: 0.1874
Epoch [150/150], Train Loss: 0.2067, Test Loss: 0.2127
Epoch [200/200], Train Loss: 0.2170, Test Loss: 0.2114
Epoch [250/250], Train Loss: 0.1985, Test Loss: 0.2003
Epoch [300/300], Train Loss: 0.2037, Test Loss: 0.2111
Epoch [350/350], Train Loss: 0.1813, Test Loss: 0.1874
Epoch [400/400], Train Loss: 0.1780, Test Loss: 0.1966
Epoch [450/450], Train Loss: 0.2033, Test Loss: 0.1880
Epoch [500/500], Train Loss: 0.2030, Test Loss: 0.2015
Epoch [550/550], Train Loss: 0.2028, Test Loss: 0.1968
Epoch [600/600], Train Loss: 0.2004, Test Loss: 0.1924
Epoch [650/650], Train Loss: 0.1969, Test Loss: 0.1883
Epoch [700/700], Train Loss: 0.1679, Test Loss: 0.1805
Epoch [750/750], Train Loss: 0.1721, Test Loss: 0.1874
Epoch [800/800], Train Loss: 0.1861, Test Loss: 0.1862
Epoch [850/850], Train Loss: 0.1928, Test Loss: 0.1773
Epoch [900/900], Train Loss: 0.1918, Test Loss: 0.1840
Epoch [950/950], Train Loss: 0.1875, Test Loss: 0.1830
Epoch [1000/1000], Train Loss: 0.1835, Test Loss: 0.1814
Epoch [1050/1050], Train Loss: 0.1863, Test Loss: 0.1812
Epoch [1100/1100], Train Loss: 0.1978, Test Loss: 0.1790
Epoch [1150/1150], Train Loss: 0.1719, Test Loss: 0.1884
Epoch [1200/1200], Train Loss: 0.1933, Test Loss: 0.1744
Epoch [1250/1250], Train Loss: 0.1701, Test Loss: 0.1748
Epoch [1300/1300], Train Loss: 0.1823, Test Loss: 0.1787
Epoch [1350/1350], Train Loss: 0.1834, Test Loss: 0.1825
Epoch [1400/1400], Train Loss: 0.1791, Test Loss: 0.1753
Epoch [1450/1450], Train Loss: 0.1742, Test Loss: 0.1830
Epoch [1500/1500], Train Loss: 0.1640, Test Loss: 0.1664
Epoch [1550/1550], Train Loss: 0.1870, Test Loss: 0.1598
Epoch [1600/1600], Train Loss: 0.1699, Test Loss: 0.1701
Epoch [1650/1650], Train Loss: 0.1652, Test Loss: 0.1718
Epoch [1700/1700], Train Loss: 0.1609, Test Loss: 0.1679
Epoch [1750/1750], Train Loss: 0.1670, Test Loss: 0.1607
Epoch [1800/1800], Train Loss: 0.1773, Test Loss: 0.1639
Epoch [1850/1850], Train Loss: 0.1647, Test Loss: 0.1671
Epoch [1900/1900], Train Loss: 0.1636, Test Loss: 0.1736
Epoch [1950/1950], Train Loss: 0.1654, Test Loss: 0.1669
Epoch [2000/2000], Train Loss: 0.1560, Test Loss: 0.1738
Epoch [2050/2050], Train Loss: 0.1671, Test Loss: 0.1769
Epoch [2100/2100], Train Loss: 0.1551, Test Loss: 0.1712
Epoch [2150/2150], Train Loss: 0.1781, Test Loss: 0.1839
Epoch [2200/2200], Train Loss: 0.1766, Test Loss: 0.1676
Epoch [2250/2250], Train Loss: 0.1683, Test Loss: 0.1537
Epoch [2300/2300], Train Loss: 0.1589, Test Loss: 0.1595
Epoch [2350/2350], Train Loss: 0.1631, Test Loss: 0.1438
Epoch [2400/2400], Train Loss: 0.1675, Test Loss: 0.1465
Epoch [2450/2450], Train Loss: 0.1634, Test Loss: 0.1566
Epoch [2500/2500], Train Loss: 0.1587, Test Loss: 0.1484
Epoch [2550/2550], Train Loss: 0.1482, Test Loss: 0.1437
Epoch [2600/2600], Train Loss: 0.1502, Test Loss: 0.1610
Epoch [2650/2650], Train Loss: 0.1746, Test Loss: 0.1371

Epoch [2700/2700], Train Loss: 0.1737, Test Loss: 0.1454
Epoch [2750/2750], Train Loss: 0.1690, Test Loss: 0.1448
Epoch [2800/2800], Train Loss: 0.1584, Test Loss: 0.1544
Epoch [2850/2850], Train Loss: 0.1393, Test Loss: 0.1603
Epoch [2900/2900], Train Loss: 0.1485, Test Loss: 0.1472
Epoch [2950/2950], Train Loss: 0.1465, Test Loss: 0.1424
Epoch [3000/3000], Train Loss: 0.1632, Test Loss: 0.1547
Epoch [3050/3050], Train Loss: 0.1456, Test Loss: 0.1601
Epoch [3100/3100], Train Loss: 0.1649, Test Loss: 0.1656
Epoch [3150/3150], Train Loss: 0.1513, Test Loss: 0.1573
Epoch [3200/3200], Train Loss: 0.1336, Test Loss: 0.1408
Epoch [3250/3250], Train Loss: 0.1585, Test Loss: 0.1530
Epoch [3300/3300], Train Loss: 0.1504, Test Loss: 0.1557
Epoch [3350/3350], Train Loss: 0.1443, Test Loss: 0.1316
Epoch [3400/3400], Train Loss: 0.1392, Test Loss: 0.1389
Epoch [3450/3450], Train Loss: 0.1412, Test Loss: 0.1635
Epoch [3500/3500], Train Loss: 0.1476, Test Loss: 0.1493
Epoch [3550/3550], Train Loss: 0.1246, Test Loss: 0.1457
Epoch [3600/3600], Train Loss: 0.1349, Test Loss: 0.1365
Epoch [3650/3650], Train Loss: 0.1361, Test Loss: 0.1365
Epoch [3700/3700], Train Loss: 0.1344, Test Loss: 0.1326
Epoch [3750/3750], Train Loss: 0.1449, Test Loss: 0.1511
Epoch [3800/3800], Train Loss: 0.1407, Test Loss: 0.1525
Epoch [3850/3850], Train Loss: 0.1303, Test Loss: 0.1382
Epoch [3900/3900], Train Loss: 0.1504, Test Loss: 0.1434
Epoch [3950/3950], Train Loss: 0.1517, Test Loss: 0.1361
Epoch [4000/4000], Train Loss: 0.1347, Test Loss: 0.1320
Epoch [4050/4050], Train Loss: 0.1434, Test Loss: 0.1516
Epoch [4100/4100], Train Loss: 0.1396, Test Loss: 0.1388
Epoch [4150/4150], Train Loss: 0.1517, Test Loss: 0.1373
Epoch [4200/4200], Train Loss: 0.1331, Test Loss: 0.1366
Epoch [4250/4250], Train Loss: 0.1382, Test Loss: 0.1218
Epoch [4300/4300], Train Loss: 0.1266, Test Loss: 0.1159
Epoch [4350/4350], Train Loss: 0.1276, Test Loss: 0.1489
Epoch [4400/4400], Train Loss: 0.1346, Test Loss: 0.1352
Epoch [4450/4450], Train Loss: 0.1304, Test Loss: 0.1356
Epoch [4500/4500], Train Loss: 0.1242, Test Loss: 0.1078
Epoch [4550/4550], Train Loss: 0.1247, Test Loss: 0.1330
Epoch [4600/4600], Train Loss: 0.1159, Test Loss: 0.1301
Epoch [4650/4650], Train Loss: 0.1297, Test Loss: 0.1212
Epoch [4700/4700], Train Loss: 0.1193, Test Loss: 0.1292
Epoch [4750/4750], Train Loss: 0.1167, Test Loss: 0.1136
Epoch [4800/4800], Train Loss: 0.1284, Test Loss: 0.1168
Epoch [4850/4850], Train Loss: 0.1229, Test Loss: 0.1131
Epoch [4900/4900], Train Loss: 0.1342, Test Loss: 0.1358
Epoch [4950/4950], Train Loss: 0.1287, Test Loss: 0.1123
Epoch [5000/5000], Train Loss: 0.1133, Test Loss: 0.1141
Epoch [5050/5050], Train Loss: 0.1142, Test Loss: 0.1260
Epoch [5100/5100], Train Loss: 0.1221, Test Loss: 0.1147
Epoch [5150/5150], Train Loss: 0.1126, Test Loss: 0.1306
Epoch [5200/5200], Train Loss: 0.1095, Test Loss: 0.1275
Epoch [5250/5250], Train Loss: 0.1168, Test Loss: 0.1131
Epoch [5300/5300], Train Loss: 0.1257, Test Loss: 0.1259
Epoch [5350/5350], Train Loss: 0.1046, Test Loss: 0.1243

Epoch [5400/5400], Train Loss: 0.1076, Test Loss: 0.1224
Epoch [5450/5450], Train Loss: 0.1146, Test Loss: 0.1077
Epoch [5500/5500], Train Loss: 0.1169, Test Loss: 0.1166
Epoch [5550/5550], Train Loss: 0.1016, Test Loss: 0.1145
Epoch [5600/5600], Train Loss: 0.1050, Test Loss: 0.1200
Epoch [5650/5650], Train Loss: 0.1037, Test Loss: 0.1196
Epoch [5700/5700], Train Loss: 0.1112, Test Loss: 0.1062
Epoch [5750/5750], Train Loss: 0.1161, Test Loss: 0.1038
Epoch [5800/5800], Train Loss: 0.1239, Test Loss: 0.1056
Epoch [5850/5850], Train Loss: 0.1054, Test Loss: 0.0978
Epoch [5900/5900], Train Loss: 0.1069, Test Loss: 0.1182
Epoch [5950/5950], Train Loss: 0.0959, Test Loss: 0.1259
Epoch [6000/6000], Train Loss: 0.1223, Test Loss: 0.0900
Epoch [6050/6050], Train Loss: 0.1224, Test Loss: 0.1146
Epoch [6100/6100], Train Loss: 0.1018, Test Loss: 0.1128
Epoch [6150/6150], Train Loss: 0.1224, Test Loss: 0.1168
Epoch [6200/6200], Train Loss: 0.1068, Test Loss: 0.1040
Epoch [6250/6250], Train Loss: 0.1198, Test Loss: 0.0892
Epoch [6300/6300], Train Loss: 0.1151, Test Loss: 0.1119
Epoch [6350/6350], Train Loss: 0.1055, Test Loss: 0.1037
Epoch [6400/6400], Train Loss: 0.1029, Test Loss: 0.1101
Epoch [6450/6450], Train Loss: 0.1063, Test Loss: 0.0943
Epoch [6500/6500], Train Loss: 0.0966, Test Loss: 0.1040
Epoch [6550/6550], Train Loss: 0.0930, Test Loss: 0.0936
Epoch [6600/6600], Train Loss: 0.1028, Test Loss: 0.1041
Epoch [6650/6650], Train Loss: 0.1058, Test Loss: 0.1071
Epoch [6700/6700], Train Loss: 0.0993, Test Loss: 0.0882
Epoch [6750/6750], Train Loss: 0.1104, Test Loss: 0.0919
Epoch [6800/6800], Train Loss: 0.1000, Test Loss: 0.0984
Epoch [6850/6850], Train Loss: 0.0881, Test Loss: 0.0983
Epoch [6900/6900], Train Loss: 0.1027, Test Loss: 0.0845
Epoch [6950/6950], Train Loss: 0.1094, Test Loss: 0.1106
Epoch [7000/7000], Train Loss: 0.0947, Test Loss: 0.0935
Epoch [7050/7050], Train Loss: 0.0994, Test Loss: 0.1030
Epoch [7100/7100], Train Loss: 0.0989, Test Loss: 0.1069
Epoch [7150/7150], Train Loss: 0.0973, Test Loss: 0.1030
Epoch [7200/7200], Train Loss: 0.0955, Test Loss: 0.0977
Epoch [7250/7250], Train Loss: 0.1005, Test Loss: 0.0940
Epoch [7300/7300], Train Loss: 0.0986, Test Loss: 0.0903
Epoch [7350/7350], Train Loss: 0.0950, Test Loss: 0.0984
Epoch [7400/7400], Train Loss: 0.0943, Test Loss: 0.0885
Epoch [7450/7450], Train Loss: 0.0983, Test Loss: 0.0957
Epoch [7500/7500], Train Loss: 0.0981, Test Loss: 0.0917
Epoch [7550/7550], Train Loss: 0.0878, Test Loss: 0.1049
Epoch [7600/7600], Train Loss: 0.1094, Test Loss: 0.0842
Epoch [7650/7650], Train Loss: 0.0848, Test Loss: 0.0943
Epoch [7700/7700], Train Loss: 0.0793, Test Loss: 0.0786
Epoch [7750/7750], Train Loss: 0.0965, Test Loss: 0.0700
Epoch [7800/7800], Train Loss: 0.0901, Test Loss: 0.0847
Epoch [7850/7850], Train Loss: 0.0854, Test Loss: 0.0929
Epoch [7900/7900], Train Loss: 0.0960, Test Loss: 0.0891
Epoch [7950/7950], Train Loss: 0.0957, Test Loss: 0.0890
Epoch [8000/8000], Train Loss: 0.0999, Test Loss: 0.0933
Epoch [8050/8050], Train Loss: 0.0848, Test Loss: 0.0808

Epoch [8100/8100], Train Loss: 0.0900, Test Loss: 0.0905
Epoch [8150/8150], Train Loss: 0.0954, Test Loss: 0.0933
Epoch [8200/8200], Train Loss: 0.0629, Test Loss: 0.0862
Epoch [8250/8250], Train Loss: 0.0955, Test Loss: 0.0938
Epoch [8300/8300], Train Loss: 0.0937, Test Loss: 0.0860
Epoch [8350/8350], Train Loss: 0.0836, Test Loss: 0.0780
Epoch [8400/8400], Train Loss: 0.0822, Test Loss: 0.0837
Epoch [8450/8450], Train Loss: 0.0757, Test Loss: 0.0869
Epoch [8500/8500], Train Loss: 0.0772, Test Loss: 0.0814
Epoch [8550/8550], Train Loss: 0.0860, Test Loss: 0.0826
Epoch [8600/8600], Train Loss: 0.0844, Test Loss: 0.0800
Epoch [8650/8650], Train Loss: 0.0848, Test Loss: 0.0874
Epoch [8700/8700], Train Loss: 0.0912, Test Loss: 0.0805
Epoch [8750/8750], Train Loss: 0.0737, Test Loss: 0.0733
Epoch [8800/8800], Train Loss: 0.0821, Test Loss: 0.0796
Epoch [8850/8850], Train Loss: 0.0818, Test Loss: 0.0791
Epoch [8900/8900], Train Loss: 0.0707, Test Loss: 0.0778
Epoch [8950/8950], Train Loss: 0.0749, Test Loss: 0.0786
Epoch [9000/9000], Train Loss: 0.0936, Test Loss: 0.0785
Epoch [9050/9050], Train Loss: 0.0875, Test Loss: 0.0739
Epoch [9100/9100], Train Loss: 0.0878, Test Loss: 0.0742
Epoch [9150/9150], Train Loss: 0.0741, Test Loss: 0.0676
Epoch [9200/9200], Train Loss: 0.0790, Test Loss: 0.0829
Epoch [9250/9250], Train Loss: 0.0800, Test Loss: 0.0822
Epoch [9300/9300], Train Loss: 0.0769, Test Loss: 0.0773
Epoch [9350/9350], Train Loss: 0.0799, Test Loss: 0.0689
Epoch [9400/9400], Train Loss: 0.0739, Test Loss: 0.0739
Epoch [9450/9450], Train Loss: 0.0870, Test Loss: 0.0700
Epoch [9500/9500], Train Loss: 0.0763, Test Loss: 0.0696
Epoch [9550/9550], Train Loss: 0.0782, Test Loss: 0.0850
Epoch [9600/9600], Train Loss: 0.0708, Test Loss: 0.0712
Epoch [9650/9650], Train Loss: 0.0702, Test Loss: 0.0715
Epoch [9700/9700], Train Loss: 0.0712, Test Loss: 0.0752
Epoch [9750/9750], Train Loss: 0.0673, Test Loss: 0.0682
Epoch [9800/9800], Train Loss: 0.0696, Test Loss: 0.0745
Epoch [9850/9850], Train Loss: 0.0615, Test Loss: 0.0743
Epoch [9900/9900], Train Loss: 0.0681, Test Loss: 0.0762
Epoch [9950/9950], Train Loss: 0.0663, Test Loss: 0.0633
Epoch [10000/10000], Train Loss: 0.0617, Test Loss: 0.0746
Epoch [10050/10050], Train Loss: 0.0753, Test Loss: 0.0619
Epoch [10100/10100], Train Loss: 0.0673, Test Loss: 0.0638
Epoch [10150/10150], Train Loss: 0.0736, Test Loss: 0.0770
Epoch [10200/10200], Train Loss: 0.0691, Test Loss: 0.0640
Epoch [10250/10250], Train Loss: 0.0670, Test Loss: 0.0656
Epoch [10300/10300], Train Loss: 0.0664, Test Loss: 0.0638
Epoch [10350/10350], Train Loss: 0.0642, Test Loss: 0.0659
Epoch [10400/10400], Train Loss: 0.0739, Test Loss: 0.0693
Epoch [10450/10450], Train Loss: 0.0653, Test Loss: 0.0752
Epoch [10500/10500], Train Loss: 0.0687, Test Loss: 0.0618
Epoch [10550/10550], Train Loss: 0.0657, Test Loss: 0.0655
Epoch [10600/10600], Train Loss: 0.0650, Test Loss: 0.0694
Epoch [10650/10650], Train Loss: 0.0729, Test Loss: 0.0643
Epoch [10700/10700], Train Loss: 0.0620, Test Loss: 0.0655
Epoch [10750/10750], Train Loss: 0.0662, Test Loss: 0.0725

Epoch [10800/10800], Train Loss: 0.0602, Test Loss: 0.0653
Epoch [10850/10850], Train Loss: 0.0577, Test Loss: 0.0661
Epoch [10900/10900], Train Loss: 0.0513, Test Loss: 0.0678
Epoch [10950/10950], Train Loss: 0.0625, Test Loss: 0.0621
Epoch [11000/11000], Train Loss: 0.0682, Test Loss: 0.0787
Epoch [11050/11050], Train Loss: 0.0609, Test Loss: 0.0605
Epoch [11100/11100], Train Loss: 0.0625, Test Loss: 0.0507
Epoch [11150/11150], Train Loss: 0.0627, Test Loss: 0.0606
Epoch [11200/11200], Train Loss: 0.0632, Test Loss: 0.0527
Epoch [11250/11250], Train Loss: 0.0706, Test Loss: 0.0582
Epoch [11300/11300], Train Loss: 0.0568, Test Loss: 0.0656
Epoch [11350/11350], Train Loss: 0.0668, Test Loss: 0.0605
Epoch [11400/11400], Train Loss: 0.0686, Test Loss: 0.0598
Epoch [11450/11450], Train Loss: 0.0628, Test Loss: 0.0549
Epoch [11500/11500], Train Loss: 0.0574, Test Loss: 0.0556
Epoch [11550/11550], Train Loss: 0.0515, Test Loss: 0.0560
Epoch [11600/11600], Train Loss: 0.0648, Test Loss: 0.0635
Epoch [11650/11650], Train Loss: 0.0627, Test Loss: 0.0550
Epoch [11700/11700], Train Loss: 0.0667, Test Loss: 0.0507
Epoch [11750/11750], Train Loss: 0.0659, Test Loss: 0.0529
Epoch [11800/11800], Train Loss: 0.0626, Test Loss: 0.0538
Epoch [11850/11850], Train Loss: 0.0521, Test Loss: 0.0562
Epoch [11900/11900], Train Loss: 0.0611, Test Loss: 0.0536
Epoch [11950/11950], Train Loss: 0.0615, Test Loss: 0.0570
Epoch [12000/12000], Train Loss: 0.0543, Test Loss: 0.0555
Epoch [12050/12050], Train Loss: 0.0588, Test Loss: 0.0503
Epoch [12100/12100], Train Loss: 0.0595, Test Loss: 0.0538
Epoch [12150/12150], Train Loss: 0.0606, Test Loss: 0.0491
Epoch [12200/12200], Train Loss: 0.0579, Test Loss: 0.0622
Epoch [12250/12250], Train Loss: 0.0524, Test Loss: 0.0525
Epoch [12300/12300], Train Loss: 0.0464, Test Loss: 0.0524
Epoch [12350/12350], Train Loss: 0.0543, Test Loss: 0.0502
Epoch [12400/12400], Train Loss: 0.0515, Test Loss: 0.0470
Epoch [12450/12450], Train Loss: 0.0513, Test Loss: 0.0637
Epoch [12500/12500], Train Loss: 0.0512, Test Loss: 0.0579
Epoch [12550/12550], Train Loss: 0.0520, Test Loss: 0.0567
Epoch [12600/12600], Train Loss: 0.0573, Test Loss: 0.0530
Epoch [12650/12650], Train Loss: 0.0580, Test Loss: 0.0497
Epoch [12700/12700], Train Loss: 0.0510, Test Loss: 0.0461
Epoch [12750/12750], Train Loss: 0.0534, Test Loss: 0.0588
Epoch [12800/12800], Train Loss: 0.0564, Test Loss: 0.0495
Epoch [12850/12850], Train Loss: 0.0617, Test Loss: 0.0473
Epoch [12900/12900], Train Loss: 0.0488, Test Loss: 0.0505
Epoch [12950/12950], Train Loss: 0.0394, Test Loss: 0.0525
Epoch [13000/13000], Train Loss: 0.0473, Test Loss: 0.0549
Epoch [13050/13050], Train Loss: 0.0468, Test Loss: 0.0439
Epoch [13100/13100], Train Loss: 0.0546, Test Loss: 0.0575
Epoch [13150/13150], Train Loss: 0.0440, Test Loss: 0.0506
Epoch [13200/13200], Train Loss: 0.0517, Test Loss: 0.0553
Epoch [13250/13250], Train Loss: 0.0468, Test Loss: 0.0525
Epoch [13300/13300], Train Loss: 0.0453, Test Loss: 0.0456
Epoch [13350/13350], Train Loss: 0.0441, Test Loss: 0.0506
Epoch [13400/13400], Train Loss: 0.0442, Test Loss: 0.0525
Epoch [13450/13450], Train Loss: 0.0405, Test Loss: 0.0495

Epoch [13500/13500], Train Loss: 0.0458, Test Loss: 0.0569
Epoch [13550/13550], Train Loss: 0.0439, Test Loss: 0.0485
Epoch [13600/13600], Train Loss: 0.0495, Test Loss: 0.0478
Epoch [13650/13650], Train Loss: 0.0517, Test Loss: 0.0512
Epoch [13700/13700], Train Loss: 0.0451, Test Loss: 0.0515
Epoch [13750/13750], Train Loss: 0.0531, Test Loss: 0.0480
Epoch [13800/13800], Train Loss: 0.0374, Test Loss: 0.0435
Epoch [13850/13850], Train Loss: 0.0480, Test Loss: 0.0418
Epoch [13900/13900], Train Loss: 0.0478, Test Loss: 0.0505
Epoch [13950/13950], Train Loss: 0.0427, Test Loss: 0.0369
Epoch [14000/14000], Train Loss: 0.0414, Test Loss: 0.0416
Epoch [14050/14050], Train Loss: 0.0381, Test Loss: 0.0394
Epoch [14100/14100], Train Loss: 0.0447, Test Loss: 0.0459
Epoch [14150/14150], Train Loss: 0.0441, Test Loss: 0.0407
Epoch [14200/14200], Train Loss: 0.0454, Test Loss: 0.0489
Epoch [14250/14250], Train Loss: 0.0407, Test Loss: 0.0352
Epoch [14300/14300], Train Loss: 0.0449, Test Loss: 0.0439
Epoch [14350/14350], Train Loss: 0.0476, Test Loss: 0.0434
Epoch [14400/14400], Train Loss: 0.0372, Test Loss: 0.0466
Epoch [14450/14450], Train Loss: 0.0454, Test Loss: 0.0520
Epoch [14500/14500], Train Loss: 0.0458, Test Loss: 0.0400
Epoch [14550/14550], Train Loss: 0.0384, Test Loss: 0.0453
Epoch [14600/14600], Train Loss: 0.0439, Test Loss: 0.0400
Epoch [14650/14650], Train Loss: 0.0490, Test Loss: 0.0392
Epoch [14700/14700], Train Loss: 0.0368, Test Loss: 0.0459
Epoch [14750/14750], Train Loss: 0.0374, Test Loss: 0.0445
Epoch [14800/14800], Train Loss: 0.0419, Test Loss: 0.0484
Epoch [14850/14850], Train Loss: 0.0457, Test Loss: 0.0450
Epoch [14900/14900], Train Loss: 0.0367, Test Loss: 0.0391
Epoch [14950/14950], Train Loss: 0.0398, Test Loss: 0.0431
Epoch [15000/15000], Train Loss: 0.0367, Test Loss: 0.0452
Epoch [15050/15050], Train Loss: 0.0451, Test Loss: 0.0354
Epoch [15100/15100], Train Loss: 0.0329, Test Loss: 0.0385
Epoch [15150/15150], Train Loss: 0.0345, Test Loss: 0.0381
Epoch [15200/15200], Train Loss: 0.0351, Test Loss: 0.0416
Epoch [15250/15250], Train Loss: 0.0430, Test Loss: 0.0385
Epoch [15300/15300], Train Loss: 0.0407, Test Loss: 0.0382
Epoch [15350/15350], Train Loss: 0.0399, Test Loss: 0.0434
Epoch [15400/15400], Train Loss: 0.0330, Test Loss: 0.0440
Epoch [15450/15450], Train Loss: 0.0416, Test Loss: 0.0405
Epoch [15500/15500], Train Loss: 0.0434, Test Loss: 0.0354
Epoch [15550/15550], Train Loss: 0.0388, Test Loss: 0.0381
Epoch [15600/15600], Train Loss: 0.0367, Test Loss: 0.0370
Epoch [15650/15650], Train Loss: 0.0380, Test Loss: 0.0388
Epoch [15700/15700], Train Loss: 0.0338, Test Loss: 0.0359
Epoch [15750/15750], Train Loss: 0.0362, Test Loss: 0.0382
Epoch [15800/15800], Train Loss: 0.0313, Test Loss: 0.0342
Epoch [15850/15850], Train Loss: 0.0334, Test Loss: 0.0366
Epoch [15900/15900], Train Loss: 0.0371, Test Loss: 0.0312
Epoch [15950/15950], Train Loss: 0.0388, Test Loss: 0.0336
Epoch [16000/16000], Train Loss: 0.0386, Test Loss: 0.0379
Epoch [16050/16050], Train Loss: 0.0318, Test Loss: 0.0375
Epoch [16100/16100], Train Loss: 0.0320, Test Loss: 0.0342
Epoch [16150/16150], Train Loss: 0.0366, Test Loss: 0.0321

Epoch [16200/16200], Train Loss: 0.0305, Test Loss: 0.0342
Epoch [16250/16250], Train Loss: 0.0350, Test Loss: 0.0318
Epoch [16300/16300], Train Loss: 0.0340, Test Loss: 0.0336
Epoch [16350/16350], Train Loss: 0.0375, Test Loss: 0.0295
Epoch [16400/16400], Train Loss: 0.0374, Test Loss: 0.0364
Epoch [16450/16450], Train Loss: 0.0334, Test Loss: 0.0357
Epoch [16500/16500], Train Loss: 0.0290, Test Loss: 0.0339
Epoch [16550/16550], Train Loss: 0.0350, Test Loss: 0.0328
Epoch [16600/16600], Train Loss: 0.0326, Test Loss: 0.0309
Epoch [16650/16650], Train Loss: 0.0317, Test Loss: 0.0370
Epoch [16700/16700], Train Loss: 0.0291, Test Loss: 0.0292
Epoch [16750/16750], Train Loss: 0.0293, Test Loss: 0.0354
Epoch [16800/16800], Train Loss: 0.0313, Test Loss: 0.0327
Epoch [16850/16850], Train Loss: 0.0308, Test Loss: 0.0346
Epoch [16900/16900], Train Loss: 0.0374, Test Loss: 0.0323
Epoch [16950/16950], Train Loss: 0.0357, Test Loss: 0.0308
Epoch [17000/17000], Train Loss: 0.0292, Test Loss: 0.0342
Epoch [17050/17050], Train Loss: 0.0295, Test Loss: 0.0310
Epoch [17100/17100], Train Loss: 0.0342, Test Loss: 0.0301
Epoch [17150/17150], Train Loss: 0.0314, Test Loss: 0.0294
Epoch [17200/17200], Train Loss: 0.0320, Test Loss: 0.0340
Epoch [17250/17250], Train Loss: 0.0340, Test Loss: 0.0317
Epoch [17300/17300], Train Loss: 0.0302, Test Loss: 0.0310
Epoch [17350/17350], Train Loss: 0.0304, Test Loss: 0.0214
Epoch [17400/17400], Train Loss: 0.0274, Test Loss: 0.0287
Epoch [17450/17450], Train Loss: 0.0305, Test Loss: 0.0331
Epoch [17500/17500], Train Loss: 0.0297, Test Loss: 0.0283
Epoch [17550/17550], Train Loss: 0.0323, Test Loss: 0.0259
Epoch [17600/17600], Train Loss: 0.0297, Test Loss: 0.0313
Epoch [17650/17650], Train Loss: 0.0263, Test Loss: 0.0263
Epoch [17700/17700], Train Loss: 0.0287, Test Loss: 0.0293
Epoch [17750/17750], Train Loss: 0.0315, Test Loss: 0.0300
Epoch [17800/17800], Train Loss: 0.0298, Test Loss: 0.0258
Epoch [17850/17850], Train Loss: 0.0272, Test Loss: 0.0259
Epoch [17900/17900], Train Loss: 0.0291, Test Loss: 0.0247
Epoch [17950/17950], Train Loss: 0.0303, Test Loss: 0.0303
Epoch [18000/18000], Train Loss: 0.0265, Test Loss: 0.0269
Epoch [18050/18050], Train Loss: 0.0246, Test Loss: 0.0281
Epoch [18100/18100], Train Loss: 0.0305, Test Loss: 0.0260
Epoch [18150/18150], Train Loss: 0.0261, Test Loss: 0.0232
Epoch [18200/18200], Train Loss: 0.0219, Test Loss: 0.0267
Epoch [18250/18250], Train Loss: 0.0233, Test Loss: 0.0271
Epoch [18300/18300], Train Loss: 0.0287, Test Loss: 0.0226
Epoch [18350/18350], Train Loss: 0.0296, Test Loss: 0.0266
Epoch [18400/18400], Train Loss: 0.0298, Test Loss: 0.0303
Epoch [18450/18450], Train Loss: 0.0283, Test Loss: 0.0292
Epoch [18500/18500], Train Loss: 0.0280, Test Loss: 0.0237
Epoch [18550/18550], Train Loss: 0.0312, Test Loss: 0.0261
Epoch [18600/18600], Train Loss: 0.0251, Test Loss: 0.0259
Epoch [18650/18650], Train Loss: 0.0260, Test Loss: 0.0258
Epoch [18700/18700], Train Loss: 0.0262, Test Loss: 0.0292
Epoch [18750/18750], Train Loss: 0.0257, Test Loss: 0.0240
Epoch [18800/18800], Train Loss: 0.0267, Test Loss: 0.0258
Epoch [18850/18850], Train Loss: 0.0263, Test Loss: 0.0321

Epoch [18900/18900], Train Loss: 0.0221, Test Loss: 0.0246
Epoch [18950/18950], Train Loss: 0.0242, Test Loss: 0.0276
Epoch [19000/19000], Train Loss: 0.0219, Test Loss: 0.0261
Epoch [19050/19050], Train Loss: 0.0189, Test Loss: 0.0261
Epoch [19100/19100], Train Loss: 0.0215, Test Loss: 0.0260
Epoch [19150/19150], Train Loss: 0.0229, Test Loss: 0.0261
Epoch [19200/19200], Train Loss: 0.0240, Test Loss: 0.0226
Epoch [19250/19250], Train Loss: 0.0257, Test Loss: 0.0222
Epoch [19300/19300], Train Loss: 0.0277, Test Loss: 0.0247
Epoch [19350/19350], Train Loss: 0.0210, Test Loss: 0.0219
Epoch [19400/19400], Train Loss: 0.0223, Test Loss: 0.0269
Epoch [19450/19450], Train Loss: 0.0213, Test Loss: 0.0229
Epoch [19500/19500], Train Loss: 0.0264, Test Loss: 0.0254
Epoch [19550/19550], Train Loss: 0.0202, Test Loss: 0.0218
Epoch [19600/19600], Train Loss: 0.0232, Test Loss: 0.0216
Epoch [19650/19650], Train Loss: 0.0228, Test Loss: 0.0243
Epoch [19700/19700], Train Loss: 0.0235, Test Loss: 0.0224
Epoch [19750/19750], Train Loss: 0.0215, Test Loss: 0.0179
Epoch [19800/19800], Train Loss: 0.0200, Test Loss: 0.0215
Epoch [19850/19850], Train Loss: 0.0264, Test Loss: 0.0201
Epoch [19900/19900], Train Loss: 0.0234, Test Loss: 0.0232
Epoch [19950/19950], Train Loss: 0.0216, Test Loss: 0.0252
Epoch [20000/20000], Train Loss: 0.0213, Test Loss: 0.0225
Epoch [20050/20050], Train Loss: 0.0195, Test Loss: 0.0260
Epoch [20100/20100], Train Loss: 0.0211, Test Loss: 0.0212
Epoch [20150/20150], Train Loss: 0.0198, Test Loss: 0.0227
Epoch [20200/20200], Train Loss: 0.0228, Test Loss: 0.0269
Epoch [20250/20250], Train Loss: 0.0206, Test Loss: 0.0249
Epoch [20300/20300], Train Loss: 0.0197, Test Loss: 0.0208
Epoch [20350/20350], Train Loss: 0.0205, Test Loss: 0.0187
Epoch [20400/20400], Train Loss: 0.0240, Test Loss: 0.0244
Epoch [20450/20450], Train Loss: 0.0179, Test Loss: 0.0216
Epoch [20500/20500], Train Loss: 0.0185, Test Loss: 0.0216
Epoch [20550/20550], Train Loss: 0.0211, Test Loss: 0.0220
Epoch [20600/20600], Train Loss: 0.0248, Test Loss: 0.0164
Epoch [20650/20650], Train Loss: 0.0197, Test Loss: 0.0209
Epoch [20700/20700], Train Loss: 0.0193, Test Loss: 0.0200
Epoch [20750/20750], Train Loss: 0.0198, Test Loss: 0.0217
Epoch [20800/20800], Train Loss: 0.0211, Test Loss: 0.0228
Epoch [20850/20850], Train Loss: 0.0195, Test Loss: 0.0186
Epoch [20900/20900], Train Loss: 0.0185, Test Loss: 0.0231
Epoch [20950/20950], Train Loss: 0.0237, Test Loss: 0.0197
Epoch [21000/21000], Train Loss: 0.0156, Test Loss: 0.0200
Epoch [21050/21050], Train Loss: 0.0189, Test Loss: 0.0192
Epoch [21100/21100], Train Loss: 0.0163, Test Loss: 0.0150
Epoch [21150/21150], Train Loss: 0.0164, Test Loss: 0.0204
Epoch [21200/21200], Train Loss: 0.0192, Test Loss: 0.0173
Epoch [21250/21250], Train Loss: 0.0174, Test Loss: 0.0199
Epoch [21300/21300], Train Loss: 0.0176, Test Loss: 0.0174
Epoch [21350/21350], Train Loss: 0.0174, Test Loss: 0.0219
Epoch [21400/21400], Train Loss: 0.0172, Test Loss: 0.0173
Epoch [21450/21450], Train Loss: 0.0181, Test Loss: 0.0201
Epoch [21500/21500], Train Loss: 0.0179, Test Loss: 0.0189
Epoch [21550/21550], Train Loss: 0.0209, Test Loss: 0.0182

Epoch [21600/21600], Train Loss: 0.0174, Test Loss: 0.0150
Epoch [21650/21650], Train Loss: 0.0159, Test Loss: 0.0186
Epoch [21700/21700], Train Loss: 0.0175, Test Loss: 0.0160
Epoch [21750/21750], Train Loss: 0.0189, Test Loss: 0.0189
Epoch [21800/21800], Train Loss: 0.0182, Test Loss: 0.0181
Epoch [21850/21850], Train Loss: 0.0169, Test Loss: 0.0164
Epoch [21900/21900], Train Loss: 0.0168, Test Loss: 0.0144
Epoch [21950/21950], Train Loss: 0.0160, Test Loss: 0.0214
Epoch [22000/22000], Train Loss: 0.0135, Test Loss: 0.0141
Epoch [22050/22050], Train Loss: 0.0146, Test Loss: 0.0165
Epoch [22100/22100], Train Loss: 0.0148, Test Loss: 0.0166
Epoch [22150/22150], Train Loss: 0.0162, Test Loss: 0.0195
Epoch [22200/22200], Train Loss: 0.0175, Test Loss: 0.0147
Epoch [22250/22250], Train Loss: 0.0170, Test Loss: 0.0128
Epoch [22300/22300], Train Loss: 0.0137, Test Loss: 0.0180
Epoch [22350/22350], Train Loss: 0.0158, Test Loss: 0.0165
Epoch [22400/22400], Train Loss: 0.0140, Test Loss: 0.0170
Epoch [22450/22450], Train Loss: 0.0190, Test Loss: 0.0152
Epoch [22500/22500], Train Loss: 0.0163, Test Loss: 0.0155
Epoch [22550/22550], Train Loss: 0.0152, Test Loss: 0.0163
Epoch [22600/22600], Train Loss: 0.0139, Test Loss: 0.0152
Epoch [22650/22650], Train Loss: 0.0178, Test Loss: 0.0155
Epoch [22700/22700], Train Loss: 0.0170, Test Loss: 0.0163
Epoch [22750/22750], Train Loss: 0.0168, Test Loss: 0.0187
Epoch [22800/22800], Train Loss: 0.0150, Test Loss: 0.0172
Epoch [22850/22850], Train Loss: 0.0142, Test Loss: 0.0142
Epoch [22900/22900], Train Loss: 0.0170, Test Loss: 0.0164
Epoch [22950/22950], Train Loss: 0.0154, Test Loss: 0.0149
Epoch [23000/23000], Train Loss: 0.0195, Test Loss: 0.0153
Epoch [23050/23050], Train Loss: 0.0141, Test Loss: 0.0147
Epoch [23100/23100], Train Loss: 0.0156, Test Loss: 0.0161
Epoch [23150/23150], Train Loss: 0.0125, Test Loss: 0.0135
Epoch [23200/23200], Train Loss: 0.0132, Test Loss: 0.0166
Epoch [23250/23250], Train Loss: 0.0131, Test Loss: 0.0149
Epoch [23300/23300], Train Loss: 0.0152, Test Loss: 0.0166
Epoch [23350/23350], Train Loss: 0.0163, Test Loss: 0.0160
Epoch [23400/23400], Train Loss: 0.0131, Test Loss: 0.0143
Epoch [23450/23450], Train Loss: 0.0148, Test Loss: 0.0167
Epoch [23500/23500], Train Loss: 0.0163, Test Loss: 0.0133
Epoch [23550/23550], Train Loss: 0.0143, Test Loss: 0.0138
Epoch [23600/23600], Train Loss: 0.0131, Test Loss: 0.0107
Epoch [23650/23650], Train Loss: 0.0128, Test Loss: 0.0160
Epoch [23700/23700], Train Loss: 0.0150, Test Loss: 0.0148
Epoch [23750/23750], Train Loss: 0.0109, Test Loss: 0.0137
Epoch [23800/23800], Train Loss: 0.0145, Test Loss: 0.0146
Epoch [23850/23850], Train Loss: 0.0122, Test Loss: 0.0124
Epoch [23900/23900], Train Loss: 0.0092, Test Loss: 0.0148
Epoch [23950/23950], Train Loss: 0.0125, Test Loss: 0.0097
Epoch [24000/24000], Train Loss: 0.0113, Test Loss: 0.0130
Epoch [24050/24050], Train Loss: 0.0121, Test Loss: 0.0142
Epoch [24100/24100], Train Loss: 0.0148, Test Loss: 0.0134
Epoch [24150/24150], Train Loss: 0.0096, Test Loss: 0.0141
Epoch [24200/24200], Train Loss: 0.0143, Test Loss: 0.0135
Epoch [24250/24250], Train Loss: 0.0116, Test Loss: 0.0094

Epoch [24300/24300], Train Loss: 0.0107, Test Loss: 0.0122
Epoch [24350/24350], Train Loss: 0.0114, Test Loss: 0.0125
Epoch [24400/24400], Train Loss: 0.0125, Test Loss: 0.0108
Epoch [24450/24450], Train Loss: 0.0129, Test Loss: 0.0130
Epoch [24500/24500], Train Loss: 0.0131, Test Loss: 0.0142
Epoch [24550/24550], Train Loss: 0.0117, Test Loss: 0.0130
Epoch [24600/24600], Train Loss: 0.0120, Test Loss: 0.0120
Epoch [24650/24650], Train Loss: 0.0124, Test Loss: 0.0124
Epoch [24700/24700], Train Loss: 0.0144, Test Loss: 0.0110
Epoch [24750/24750], Train Loss: 0.0125, Test Loss: 0.0121
Epoch [24800/24800], Train Loss: 0.0131, Test Loss: 0.0123
Epoch [24850/24850], Train Loss: 0.0109, Test Loss: 0.0108
Epoch [24900/24900], Train Loss: 0.0110, Test Loss: 0.0125
Epoch [24950/24950], Train Loss: 0.0109, Test Loss: 0.0127
Epoch [25000/25000], Train Loss: 0.0117, Test Loss: 0.0123
Epoch [25050/25050], Train Loss: 0.0115, Test Loss: 0.0114
Epoch [25100/25100], Train Loss: 0.0119, Test Loss: 0.0122
Epoch [25150/25150], Train Loss: 0.0119, Test Loss: 0.0105
Epoch [25200/25200], Train Loss: 0.0097, Test Loss: 0.0113
Epoch [25250/25250], Train Loss: 0.0104, Test Loss: 0.0103
Epoch [25300/25300], Train Loss: 0.0103, Test Loss: 0.0093
Epoch [25350/25350], Train Loss: 0.0115, Test Loss: 0.0112
Epoch [25400/25400], Train Loss: 0.0111, Test Loss: 0.0104
Epoch [25450/25450], Train Loss: 0.0110, Test Loss: 0.0097
Epoch [25500/25500], Train Loss: 0.0118, Test Loss: 0.0095
Epoch [25550/25550], Train Loss: 0.0092, Test Loss: 0.0112
Epoch [25600/25600], Train Loss: 0.0109, Test Loss: 0.0111
Epoch [25650/25650], Train Loss: 0.0110, Test Loss: 0.0113
Epoch [25700/25700], Train Loss: 0.0096, Test Loss: 0.0119
Epoch [25750/25750], Train Loss: 0.0122, Test Loss: 0.0101
Epoch [25800/25800], Train Loss: 0.0096, Test Loss: 0.0112
Epoch [25850/25850], Train Loss: 0.0102, Test Loss: 0.0092
Epoch [25900/25900], Train Loss: 0.0096, Test Loss: 0.0125
Epoch [25950/25950], Train Loss: 0.0100, Test Loss: 0.0107
Epoch [26000/26000], Train Loss: 0.0116, Test Loss: 0.0104
Epoch [26050/26050], Train Loss: 0.0099, Test Loss: 0.0097
Epoch [26100/26100], Train Loss: 0.0112, Test Loss: 0.0117
Epoch [26150/26150], Train Loss: 0.0095, Test Loss: 0.0107
Epoch [26200/26200], Train Loss: 0.0089, Test Loss: 0.0104
Epoch [26250/26250], Train Loss: 0.0094, Test Loss: 0.0104
Epoch [26300/26300], Train Loss: 0.0093, Test Loss: 0.0105
Epoch [26350/26350], Train Loss: 0.0101, Test Loss: 0.0104
Epoch [26400/26400], Train Loss: 0.0100, Test Loss: 0.0098
Epoch [26450/26450], Train Loss: 0.0097, Test Loss: 0.0104
Epoch [26500/26500], Train Loss: 0.0095, Test Loss: 0.0102
Epoch [26550/26550], Train Loss: 0.0090, Test Loss: 0.0126
Epoch [26600/26600], Train Loss: 0.0091, Test Loss: 0.0109
Epoch [26650/26650], Train Loss: 0.0108, Test Loss: 0.0101
Epoch [26700/26700], Train Loss: 0.0112, Test Loss: 0.0098
Epoch [26750/26750], Train Loss: 0.0079, Test Loss: 0.0094
Epoch [26800/26800], Train Loss: 0.0104, Test Loss: 0.0074
Epoch [26850/26850], Train Loss: 0.0101, Test Loss: 0.0099
Epoch [26900/26900], Train Loss: 0.0086, Test Loss: 0.0076
Epoch [26950/26950], Train Loss: 0.0089, Test Loss: 0.0093

Epoch [27000/27000], Train Loss: 0.0075, Test Loss: 0.0097
Epoch [27050/27050], Train Loss: 0.0090, Test Loss: 0.0085
Epoch [27100/27100], Train Loss: 0.0091, Test Loss: 0.0067
Epoch [27150/27150], Train Loss: 0.0062, Test Loss: 0.0094
Epoch [27200/27200], Train Loss: 0.0092, Test Loss: 0.0089
Epoch [27250/27250], Train Loss: 0.0096, Test Loss: 0.0103
Epoch [27300/27300], Train Loss: 0.0086, Test Loss: 0.0082
Epoch [27350/27350], Train Loss: 0.0099, Test Loss: 0.0093
Epoch [27400/27400], Train Loss: 0.0074, Test Loss: 0.0085
Epoch [27450/27450], Train Loss: 0.0071, Test Loss: 0.0092
Epoch [27500/27500], Train Loss: 0.0071, Test Loss: 0.0081
Epoch [27550/27550], Train Loss: 0.0079, Test Loss: 0.0071
Epoch [27600/27600], Train Loss: 0.0071, Test Loss: 0.0082
Epoch [27650/27650], Train Loss: 0.0067, Test Loss: 0.0073
Epoch [27700/27700], Train Loss: 0.0062, Test Loss: 0.0080
Epoch [27750/27750], Train Loss: 0.0082, Test Loss: 0.0077
Epoch [27800/27800], Train Loss: 0.0075, Test Loss: 0.0080
Epoch [27850/27850], Train Loss: 0.0096, Test Loss: 0.0086
Epoch [27900/27900], Train Loss: 0.0078, Test Loss: 0.0077
Epoch [27950/27950], Train Loss: 0.0081, Test Loss: 0.0075
Epoch [28000/28000], Train Loss: 0.0082, Test Loss: 0.0067
Epoch [28050/28050], Train Loss: 0.0105, Test Loss: 0.0083
Epoch [28100/28100], Train Loss: 0.0080, Test Loss: 0.0080
Epoch [28150/28150], Train Loss: 0.0066, Test Loss: 0.0073
Epoch [28200/28200], Train Loss: 0.0071, Test Loss: 0.0078
Epoch [28250/28250], Train Loss: 0.0071, Test Loss: 0.0086
Epoch [28300/28300], Train Loss: 0.0073, Test Loss: 0.0073
Epoch [28350/28350], Train Loss: 0.0086, Test Loss: 0.0077
Epoch [28400/28400], Train Loss: 0.0084, Test Loss: 0.0080
Epoch [28450/28450], Train Loss: 0.0061, Test Loss: 0.0079
Epoch [28500/28500], Train Loss: 0.0075, Test Loss: 0.0086
Epoch [28550/28550], Train Loss: 0.0074, Test Loss: 0.0093
Epoch [28600/28600], Train Loss: 0.0063, Test Loss: 0.0060
Epoch [28650/28650], Train Loss: 0.0074, Test Loss: 0.0071
Epoch [28700/28700], Train Loss: 0.0051, Test Loss: 0.0074
Epoch [28750/28750], Train Loss: 0.0067, Test Loss: 0.0059
Epoch [28800/28800], Train Loss: 0.0058, Test Loss: 0.0057
Epoch [28850/28850], Train Loss: 0.0086, Test Loss: 0.0074
Epoch [28900/28900], Train Loss: 0.0066, Test Loss: 0.0095
Epoch [28950/28950], Train Loss: 0.0068, Test Loss: 0.0061
Epoch [29000/29000], Train Loss: 0.0080, Test Loss: 0.0065
Epoch [29050/29050], Train Loss: 0.0070, Test Loss: 0.0067
Epoch [29100/29100], Train Loss: 0.0062, Test Loss: 0.0070
Epoch [29150/29150], Train Loss: 0.0056, Test Loss: 0.0074
Epoch [29200/29200], Train Loss: 0.0058, Test Loss: 0.0055
Epoch [29250/29250], Train Loss: 0.0070, Test Loss: 0.0065
Epoch [29300/29300], Train Loss: 0.0063, Test Loss: 0.0073
Epoch [29350/29350], Train Loss: 0.0070, Test Loss: 0.0067
Epoch [29400/29400], Train Loss: 0.0065, Test Loss: 0.0066
Epoch [29450/29450], Train Loss: 0.0064, Test Loss: 0.0077
Epoch [29500/29500], Train Loss: 0.0043, Test Loss: 0.0066
Epoch [29550/29550], Train Loss: 0.0063, Test Loss: 0.0068
Epoch [29600/29600], Train Loss: 0.0070, Test Loss: 0.0066
Epoch [29650/29650], Train Loss: 0.0063, Test Loss: 0.0065

Epoch [29700/29700], Train Loss: 0.0056, Test Loss: 0.0060
Epoch [29750/29750], Train Loss: 0.0055, Test Loss: 0.0052
Epoch [29800/29800], Train Loss: 0.0054, Test Loss: 0.0061
Epoch [29850/29850], Train Loss: 0.0058, Test Loss: 0.0062
Epoch [29900/29900], Train Loss: 0.0067, Test Loss: 0.0073
Epoch [29950/29950], Train Loss: 0.0077, Test Loss: 0.0055
Epoch [30000/30000], Train Loss: 0.0056, Test Loss: 0.0065
Epoch [30050/30050], Train Loss: 0.0058, Test Loss: 0.0051
Epoch [30100/30100], Train Loss: 0.0045, Test Loss: 0.0062
Epoch [30150/30150], Train Loss: 0.0066, Test Loss: 0.0065
Epoch [30200/30200], Train Loss: 0.0072, Test Loss: 0.0060
Epoch [30250/30250], Train Loss: 0.0060, Test Loss: 0.0059
Epoch [30300/30300], Train Loss: 0.0071, Test Loss: 0.0065
Epoch [30350/30350], Train Loss: 0.0059, Test Loss: 0.0061
Epoch [30400/30400], Train Loss: 0.0063, Test Loss: 0.0055
Epoch [30450/30450], Train Loss: 0.0050, Test Loss: 0.0054
Epoch [30500/30500], Train Loss: 0.0067, Test Loss: 0.0064
Epoch [30550/30550], Train Loss: 0.0049, Test Loss: 0.0055
Epoch [30600/30600], Train Loss: 0.0060, Test Loss: 0.0065
Epoch [30650/30650], Train Loss: 0.0061, Test Loss: 0.0061
Epoch [30700/30700], Train Loss: 0.0057, Test Loss: 0.0058
Epoch [30750/30750], Train Loss: 0.0058, Test Loss: 0.0063
Epoch [30800/30800], Train Loss: 0.0053, Test Loss: 0.0055
Epoch [30850/30850], Train Loss: 0.0050, Test Loss: 0.0044
Epoch [30900/30900], Train Loss: 0.0054, Test Loss: 0.0053
Epoch [30950/30950], Train Loss: 0.0053, Test Loss: 0.0051
Epoch [31000/31000], Train Loss: 0.0056, Test Loss: 0.0053
Epoch [31050/31050], Train Loss: 0.0054, Test Loss: 0.0061
Epoch [31100/31100], Train Loss: 0.0065, Test Loss: 0.0051
Epoch [31150/31150], Train Loss: 0.0048, Test Loss: 0.0044
Epoch [31200/31200], Train Loss: 0.0042, Test Loss: 0.0055
Epoch [31250/31250], Train Loss: 0.0048, Test Loss: 0.0055
Epoch [31300/31300], Train Loss: 0.0067, Test Loss: 0.0050
Epoch [31350/31350], Train Loss: 0.0063, Test Loss: 0.0054
Epoch [31400/31400], Train Loss: 0.0054, Test Loss: 0.0041
Epoch [31450/31450], Train Loss: 0.0051, Test Loss: 0.0055
Epoch [31500/31500], Train Loss: 0.0050, Test Loss: 0.0063
Epoch [31550/31550], Train Loss: 0.0057, Test Loss: 0.0055
Epoch [31600/31600], Train Loss: 0.0051, Test Loss: 0.0049
Epoch [31650/31650], Train Loss: 0.0056, Test Loss: 0.0049
Epoch [31700/31700], Train Loss: 0.0053, Test Loss: 0.0048
Epoch [31750/31750], Train Loss: 0.0045, Test Loss: 0.0051
Epoch [31800/31800], Train Loss: 0.0060, Test Loss: 0.0057
Epoch [31850/31850], Train Loss: 0.0051, Test Loss: 0.0047
Epoch [31900/31900], Train Loss: 0.0050, Test Loss: 0.0055
Epoch [31950/31950], Train Loss: 0.0045, Test Loss: 0.0061
Epoch [32000/32000], Train Loss: 0.0045, Test Loss: 0.0061
Epoch [32050/32050], Train Loss: 0.0043, Test Loss: 0.0039
Epoch [32100/32100], Train Loss: 0.0040, Test Loss: 0.0044
Epoch [32150/32150], Train Loss: 0.0056, Test Loss: 0.0041
Epoch [32200/32200], Train Loss: 0.0056, Test Loss: 0.0059
Epoch [32250/32250], Train Loss: 0.0047, Test Loss: 0.0036
Epoch [32300/32300], Train Loss: 0.0041, Test Loss: 0.0053
Epoch [32350/32350], Train Loss: 0.0052, Test Loss: 0.0047

Epoch [32400/32400], Train Loss: 0.0051, Test Loss: 0.0044
Epoch [32450/32450], Train Loss: 0.0050, Test Loss: 0.0046
Epoch [32500/32500], Train Loss: 0.0045, Test Loss: 0.0048
Epoch [32550/32550], Train Loss: 0.0050, Test Loss: 0.0039
Epoch [32600/32600], Train Loss: 0.0049, Test Loss: 0.0036
Epoch [32650/32650], Train Loss: 0.0042, Test Loss: 0.0046
Epoch [32700/32700], Train Loss: 0.0051, Test Loss: 0.0051
Epoch [32750/32750], Train Loss: 0.0045, Test Loss: 0.0045
Epoch [32800/32800], Train Loss: 0.0048, Test Loss: 0.0044
Epoch [32850/32850], Train Loss: 0.0041, Test Loss: 0.0042
Epoch [32900/32900], Train Loss: 0.0041, Test Loss: 0.0038
Epoch [32950/32950], Train Loss: 0.0047, Test Loss: 0.0042
Epoch [33000/33000], Train Loss: 0.0045, Test Loss: 0.0037
Epoch [33050/33050], Train Loss: 0.0044, Test Loss: 0.0033
Epoch [33100/33100], Train Loss: 0.0035, Test Loss: 0.0045
Epoch [33150/33150], Train Loss: 0.0039, Test Loss: 0.0043
Epoch [33200/33200], Train Loss: 0.0037, Test Loss: 0.0039
Epoch [33250/33250], Train Loss: 0.0040, Test Loss: 0.0043
Epoch [33300/33300], Train Loss: 0.0039, Test Loss: 0.0040
Epoch [33350/33350], Train Loss: 0.0039, Test Loss: 0.0044
Epoch [33400/33400], Train Loss: 0.0040, Test Loss: 0.0034
Epoch [33450/33450], Train Loss: 0.0042, Test Loss: 0.0042
Epoch [33500/33500], Train Loss: 0.0042, Test Loss: 0.0032
Epoch [33550/33550], Train Loss: 0.0032, Test Loss: 0.0042
Epoch [33600/33600], Train Loss: 0.0035, Test Loss: 0.0043
Epoch [33650/33650], Train Loss: 0.0038, Test Loss: 0.0034
Epoch [33700/33700], Train Loss: 0.0040, Test Loss: 0.0036
Epoch [33750/33750], Train Loss: 0.0032, Test Loss: 0.0036
Epoch [33800/33800], Train Loss: 0.0047, Test Loss: 0.0041
Epoch [33850/33850], Train Loss: 0.0039, Test Loss: 0.0037
Epoch [33900/33900], Train Loss: 0.0036, Test Loss: 0.0041
Epoch [33950/33950], Train Loss: 0.0032, Test Loss: 0.0044
Epoch [34000/34000], Train Loss: 0.0034, Test Loss: 0.0034
Epoch [34050/34050], Train Loss: 0.0035, Test Loss: 0.0036
Epoch [34100/34100], Train Loss: 0.0038, Test Loss: 0.0037
Epoch [34150/34150], Train Loss: 0.0032, Test Loss: 0.0035
Epoch [34200/34200], Train Loss: 0.0037, Test Loss: 0.0031
Epoch [34250/34250], Train Loss: 0.0038, Test Loss: 0.0034
Epoch [34300/34300], Train Loss: 0.0038, Test Loss: 0.0033
Epoch [34350/34350], Train Loss: 0.0036, Test Loss: 0.0039
Epoch [34400/34400], Train Loss: 0.0032, Test Loss: 0.0035
Epoch [34450/34450], Train Loss: 0.0043, Test Loss: 0.0037
Epoch [34500/34500], Train Loss: 0.0027, Test Loss: 0.0034
Epoch [34550/34550], Train Loss: 0.0027, Test Loss: 0.0033
Epoch [34600/34600], Train Loss: 0.0032, Test Loss: 0.0030
Epoch [34650/34650], Train Loss: 0.0036, Test Loss: 0.0034
Epoch [34700/34700], Train Loss: 0.0028, Test Loss: 0.0035
Epoch [34750/34750], Train Loss: 0.0040, Test Loss: 0.0036
Epoch [34800/34800], Train Loss: 0.0030, Test Loss: 0.0032
Epoch [34850/34850], Train Loss: 0.0027, Test Loss: 0.0038
Epoch [34900/34900], Train Loss: 0.0033, Test Loss: 0.0032
Epoch [34950/34950], Train Loss: 0.0043, Test Loss: 0.0035
Epoch [35000/35000], Train Loss: 0.0035, Test Loss: 0.0040
Epoch [35050/35050], Train Loss: 0.0029, Test Loss: 0.0034

Epoch [35100/35100], Train Loss: 0.0026, Test Loss: 0.0037
Epoch [35150/35150], Train Loss: 0.0034, Test Loss: 0.0028
Epoch [35200/35200], Train Loss: 0.0033, Test Loss: 0.0034
Epoch [35250/35250], Train Loss: 0.0031, Test Loss: 0.0025
Epoch [35300/35300], Train Loss: 0.0032, Test Loss: 0.0031
Epoch [35350/35350], Train Loss: 0.0031, Test Loss: 0.0032
Epoch [35400/35400], Train Loss: 0.0027, Test Loss: 0.0031
Epoch [35450/35450], Train Loss: 0.0030, Test Loss: 0.0026
Epoch [35500/35500], Train Loss: 0.0036, Test Loss: 0.0032
Epoch [35550/35550], Train Loss: 0.0029, Test Loss: 0.0030
Epoch [35600/35600], Train Loss: 0.0024, Test Loss: 0.0032
Epoch [35650/35650], Train Loss: 0.0028, Test Loss: 0.0022
Epoch [35700/35700], Train Loss: 0.0025, Test Loss: 0.0023
Epoch [35750/35750], Train Loss: 0.0025, Test Loss: 0.0028
Epoch [35800/35800], Train Loss: 0.0030, Test Loss: 0.0026
Epoch [35850/35850], Train Loss: 0.0033, Test Loss: 0.0026
Epoch [35900/35900], Train Loss: 0.0029, Test Loss: 0.0031
Epoch [35950/35950], Train Loss: 0.0028, Test Loss: 0.0023
Epoch [36000/36000], Train Loss: 0.0031, Test Loss: 0.0026
Epoch [36050/36050], Train Loss: 0.0026, Test Loss: 0.0030
Epoch [36100/36100], Train Loss: 0.0029, Test Loss: 0.0034
Epoch [36150/36150], Train Loss: 0.0024, Test Loss: 0.0030
Epoch [36200/36200], Train Loss: 0.0033, Test Loss: 0.0027
Epoch [36250/36250], Train Loss: 0.0025, Test Loss: 0.0026
Epoch [36300/36300], Train Loss: 0.0032, Test Loss: 0.0024
Epoch [36350/36350], Train Loss: 0.0031, Test Loss: 0.0028
Epoch [36400/36400], Train Loss: 0.0033, Test Loss: 0.0029
Epoch [36450/36450], Train Loss: 0.0032, Test Loss: 0.0023
Epoch [36500/36500], Train Loss: 0.0027, Test Loss: 0.0022
Epoch [36550/36550], Train Loss: 0.0030, Test Loss: 0.0025
Epoch [36600/36600], Train Loss: 0.0029, Test Loss: 0.0028
Epoch [36650/36650], Train Loss: 0.0025, Test Loss: 0.0019
Epoch [36700/36700], Train Loss: 0.0023, Test Loss: 0.0029
Epoch [36750/36750], Train Loss: 0.0025, Test Loss: 0.0026
Epoch [36800/36800], Train Loss: 0.0020, Test Loss: 0.0030
Epoch [36850/36850], Train Loss: 0.0023, Test Loss: 0.0022
Epoch [36900/36900], Train Loss: 0.0026, Test Loss: 0.0029
Epoch [36950/36950], Train Loss: 0.0021, Test Loss: 0.0022
Epoch [37000/37000], Train Loss: 0.0029, Test Loss: 0.0026
Epoch [37050/37050], Train Loss: 0.0016, Test Loss: 0.0024
Epoch [37100/37100], Train Loss: 0.0021, Test Loss: 0.0017
Epoch [37150/37150], Train Loss: 0.0027, Test Loss: 0.0022
Epoch [37200/37200], Train Loss: 0.0028, Test Loss: 0.0028
Epoch [37250/37250], Train Loss: 0.0028, Test Loss: 0.0020
Epoch [37300/37300], Train Loss: 0.0023, Test Loss: 0.0029
Epoch [37350/37350], Train Loss: 0.0029, Test Loss: 0.0020
Epoch [37400/37400], Train Loss: 0.0022, Test Loss: 0.0023
Epoch [37450/37450], Train Loss: 0.0023, Test Loss: 0.0022
Epoch [37500/37500], Train Loss: 0.0024, Test Loss: 0.0019
Epoch [37550/37550], Train Loss: 0.0026, Test Loss: 0.0022
Epoch [37600/37600], Train Loss: 0.0024, Test Loss: 0.0022
Epoch [37650/37650], Train Loss: 0.0022, Test Loss: 0.0024
Epoch [37700/37700], Train Loss: 0.0016, Test Loss: 0.0027
Epoch [37750/37750], Train Loss: 0.0028, Test Loss: 0.0018

Epoch [37800/37800], Train Loss: 0.0026, Test Loss: 0.0024
Epoch [37850/37850], Train Loss: 0.0024, Test Loss: 0.0020
Epoch [37900/37900], Train Loss: 0.0030, Test Loss: 0.0021
Epoch [37950/37950], Train Loss: 0.0020, Test Loss: 0.0020
Epoch [38000/38000], Train Loss: 0.0021, Test Loss: 0.0020
Epoch [38050/38050], Train Loss: 0.0024, Test Loss: 0.0018
Epoch [38100/38100], Train Loss: 0.0019, Test Loss: 0.0020
Epoch [38150/38150], Train Loss: 0.0017, Test Loss: 0.0024
Epoch [38200/38200], Train Loss: 0.0022, Test Loss: 0.0021
Epoch [38250/38250], Train Loss: 0.0026, Test Loss: 0.0030
Epoch [38300/38300], Train Loss: 0.0020, Test Loss: 0.0021
Epoch [38350/38350], Train Loss: 0.0019, Test Loss: 0.0019
Epoch [38400/38400], Train Loss: 0.0021, Test Loss: 0.0023
Epoch [38450/38450], Train Loss: 0.0016, Test Loss: 0.0020
Epoch [38500/38500], Train Loss: 0.0020, Test Loss: 0.0023
Epoch [38550/38550], Train Loss: 0.0026, Test Loss: 0.0019
Epoch [38600/38600], Train Loss: 0.0018, Test Loss: 0.0017
Epoch [38650/38650], Train Loss: 0.0017, Test Loss: 0.0021
Epoch [38700/38700], Train Loss: 0.0019, Test Loss: 0.0022
Epoch [38750/38750], Train Loss: 0.0022, Test Loss: 0.0024
Epoch [38800/38800], Train Loss: 0.0016, Test Loss: 0.0016
Epoch [38850/38850], Train Loss: 0.0016, Test Loss: 0.0021
Epoch [38900/38900], Train Loss: 0.0016, Test Loss: 0.0018
Epoch [38950/38950], Train Loss: 0.0018, Test Loss: 0.0023
Epoch [39000/39000], Train Loss: 0.0017, Test Loss: 0.0019
Epoch [39050/39050], Train Loss: 0.0015, Test Loss: 0.0020
Epoch [39100/39100], Train Loss: 0.0017, Test Loss: 0.0021
Epoch [39150/39150], Train Loss: 0.0019, Test Loss: 0.0019
Epoch [39200/39200], Train Loss: 0.0013, Test Loss: 0.0019
Epoch [39250/39250], Train Loss: 0.0018, Test Loss: 0.0017
Epoch [39300/39300], Train Loss: 0.0017, Test Loss: 0.0019
Epoch [39350/39350], Train Loss: 0.0016, Test Loss: 0.0021
Epoch [39400/39400], Train Loss: 0.0020, Test Loss: 0.0020
Epoch [39450/39450], Train Loss: 0.0019, Test Loss: 0.0018
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Epoch [39650/39650], Train Loss: 0.0017, Test Loss: 0.0018
Epoch [39700/39700], Train Loss: 0.0018, Test Loss: 0.0014
Epoch [39750/39750], Train Loss: 0.0016, Test Loss: 0.0017
Epoch [39800/39800], Train Loss: 0.0017, Test Loss: 0.0015
Epoch [39850/39850], Train Loss: 0.0017, Test Loss: 0.0017
Epoch [39900/39900], Train Loss: 0.0020, Test Loss: 0.0019
Epoch [39950/39950], Train Loss: 0.0013, Test Loss: 0.0019
Epoch [40000/40000], Train Loss: 0.0013, Test Loss: 0.0015
Epoch [40050/40050], Train Loss: 0.0016, Test Loss: 0.0022
Epoch [40100/40100], Train Loss: 0.0015, Test Loss: 0.0017
Epoch [40150/40150], Train Loss: 0.0022, Test Loss: 0.0017
Epoch [40200/40200], Train Loss: 0.0021, Test Loss: 0.0018
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Epoch [40300/40300], Train Loss: 0.0018, Test Loss: 0.0014
Epoch [40350/40350], Train Loss: 0.0017, Test Loss: 0.0016
Epoch [40400/40400], Train Loss: 0.0019, Test Loss: 0.0014
Epoch [40450/40450], Train Loss: 0.0016, Test Loss: 0.0017

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Epoch [41150/41150], Train Loss: 0.0015, Test Loss: 0.0018
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Epoch [41300/41300], Train Loss: 0.0015, Test Loss: 0.0015
Epoch [41350/41350], Train Loss: 0.0016, Test Loss: 0.0013
Epoch [41400/41400], Train Loss: 0.0014, Test Loss: 0.0020
Epoch [41450/41450], Train Loss: 0.0013, Test Loss: 0.0012
Epoch [41500/41500], Train Loss: 0.0015, Test Loss: 0.0012
Epoch [41550/41550], Train Loss: 0.0013, Test Loss: 0.0011
Epoch [41600/41600], Train Loss: 0.0016, Test Loss: 0.0018
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Epoch [41700/41700], Train Loss: 0.0015, Test Loss: 0.0013
Epoch [41750/41750], Train Loss: 0.0014, Test Loss: 0.0015
Epoch [41800/41800], Train Loss: 0.0012, Test Loss: 0.0013
Epoch [41850/41850], Train Loss: 0.0016, Test Loss: 0.0013
Epoch [41900/41900], Train Loss: 0.0015, Test Loss: 0.0012
Epoch [41950/41950], Train Loss: 0.0012, Test Loss: 0.0012
Epoch [42000/42000], Train Loss: 0.0013, Test Loss: 0.0015
Epoch [42050/42050], Train Loss: 0.0013, Test Loss: 0.0015
Epoch [42100/42100], Train Loss: 0.0014, Test Loss: 0.0018
Epoch [42150/42150], Train Loss: 0.0016, Test Loss: 0.0012
Epoch [42200/42200], Train Loss: 0.0010, Test Loss: 0.0014
Epoch [42250/42250], Train Loss: 0.0016, Test Loss: 0.0014
Epoch [42300/42300], Train Loss: 0.0013, Test Loss: 0.0012
Epoch [42350/42350], Train Loss: 0.0014, Test Loss: 0.0013
Epoch [42400/42400], Train Loss: 0.0013, Test Loss: 0.0015
Epoch [42450/42450], Train Loss: 0.0012, Test Loss: 0.0012
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Epoch [42600/42600], Train Loss: 0.0013, Test Loss: 0.0011
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Epoch [43050/43050], Train Loss: 0.0014, Test Loss: 0.0012
Epoch [43100/43100], Train Loss: 0.0011, Test Loss: 0.0012
Epoch [43150/43150], Train Loss: 0.0012, Test Loss: 0.0011

Epoch [43200/43200], Train Loss: 0.0011, Test Loss: 0.0011
Epoch [43250/43250], Train Loss: 0.0011, Test Loss: 0.0011
Epoch [43300/43300], Train Loss: 0.0012, Test Loss: 0.0012
Epoch [43350/43350], Train Loss: 0.0013, Test Loss: 0.0010
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Epoch [43550/43550], Train Loss: 0.0012, Test Loss: 0.0008
Epoch [43600/43600], Train Loss: 0.0010, Test Loss: 0.0010
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Epoch [44150/44150], Train Loss: 0.0010, Test Loss: 0.0010
Epoch [44200/44200], Train Loss: 0.0011, Test Loss: 0.0012
Epoch [44250/44250], Train Loss: 0.0009, Test Loss: 0.0009
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Epoch [44350/44350], Train Loss: 0.0009, Test Loss: 0.0007
Epoch [44400/44400], Train Loss: 0.0009, Test Loss: 0.0011
Epoch [44450/44450], Train Loss: 0.0008, Test Loss: 0.0009
Epoch [44500/44500], Train Loss: 0.0009, Test Loss: 0.0008
Epoch [44550/44550], Train Loss: 0.0009, Test Loss: 0.0010
Epoch [44600/44600], Train Loss: 0.0009, Test Loss: 0.0011
Epoch [44650/44650], Train Loss: 0.0009, Test Loss: 0.0008
Epoch [44700/44700], Train Loss: 0.0009, Test Loss: 0.0009
Epoch [44750/44750], Train Loss: 0.0009, Test Loss: 0.0008
Epoch [44800/44800], Train Loss: 0.0008, Test Loss: 0.0009
Epoch [44850/44850], Train Loss: 0.0008, Test Loss: 0.0007
Epoch [44900/44900], Train Loss: 0.0009, Test Loss: 0.0012
Epoch [44950/44950], Train Loss: 0.0010, Test Loss: 0.0009
Epoch [45000/45000], Train Loss: 0.0009, Test Loss: 0.0010
Epoch [45050/45050], Train Loss: 0.0010, Test Loss: 0.0007
Epoch [45100/45100], Train Loss: 0.0008, Test Loss: 0.0007
Epoch [45150/45150], Train Loss: 0.0011, Test Loss: 0.0010
Epoch [45200/45200], Train Loss: 0.0008, Test Loss: 0.0010
Epoch [45250/45250], Train Loss: 0.0010, Test Loss: 0.0008
Epoch [45300/45300], Train Loss: 0.0011, Test Loss: 0.0008
Epoch [45350/45350], Train Loss: 0.0009, Test Loss: 0.0010
Epoch [45400/45400], Train Loss: 0.0007, Test Loss: 0.0011
Epoch [45450/45450], Train Loss: 0.0007, Test Loss: 0.0008
Epoch [45500/45500], Train Loss: 0.0009, Test Loss: 0.0007
Epoch [45550/45550], Train Loss: 0.0009, Test Loss: 0.0008
Epoch [45600/45600], Train Loss: 0.0007, Test Loss: 0.0011
Epoch [45650/45650], Train Loss: 0.0009, Test Loss: 0.0007
Epoch [45700/45700], Train Loss: 0.0009, Test Loss: 0.0007
Epoch [45750/45750], Train Loss: 0.0011, Test Loss: 0.0010
Epoch [45800/45800], Train Loss: 0.0009, Test Loss: 0.0009
Epoch [45850/45850], Train Loss: 0.0007, Test Loss: 0.0008

Epoch [45900/45900], Train Loss: 0.0009, Test Loss: 0.0008
Epoch [45950/45950], Train Loss: 0.0010, Test Loss: 0.0009
Epoch [46000/46000], Train Loss: 0.0006, Test Loss: 0.0008
Epoch [46050/46050], Train Loss: 0.0009, Test Loss: 0.0006
Epoch [46100/46100], Train Loss: 0.0007, Test Loss: 0.0009
Epoch [46150/46150], Train Loss: 0.0009, Test Loss: 0.0010
Epoch [46200/46200], Train Loss: 0.0007, Test Loss: 0.0009
Epoch [46250/46250], Train Loss: 0.0007, Test Loss: 0.0007
Epoch [46300/46300], Train Loss: 0.0007, Test Loss: 0.0005
Epoch [46350/46350], Train Loss: 0.0007, Test Loss: 0.0008
Epoch [46400/46400], Train Loss: 0.0007, Test Loss: 0.0009
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Epoch [46750/46750], Train Loss: 0.0010, Test Loss: 0.0007
Epoch [46800/46800], Train Loss: 0.0009, Test Loss: 0.0007
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Epoch [47100/47100], Train Loss: 0.0007, Test Loss: 0.0008
Epoch [47150/47150], Train Loss: 0.0007, Test Loss: 0.0007
Epoch [47200/47200], Train Loss: 0.0007, Test Loss: 0.0007
Epoch [47250/47250], Train Loss: 0.0009, Test Loss: 0.0007
Epoch [47300/47300], Train Loss: 0.0007, Test Loss: 0.0005
Epoch [47350/47350], Train Loss: 0.0007, Test Loss: 0.0008
Epoch [47400/47400], Train Loss: 0.0006, Test Loss: 0.0005
Epoch [47450/47450], Train Loss: 0.0005, Test Loss: 0.0007
Epoch [47500/47500], Train Loss: 0.0007, Test Loss: 0.0006
Epoch [47550/47550], Train Loss: 0.0009, Test Loss: 0.0007
Epoch [47600/47600], Train Loss: 0.0005, Test Loss: 0.0006
Epoch [47650/47650], Train Loss: 0.0008, Test Loss: 0.0009
Epoch [47700/47700], Train Loss: 0.0005, Test Loss: 0.0006
Epoch [47750/47750], Train Loss: 0.0006, Test Loss: 0.0005
Epoch [47800/47800], Train Loss: 0.0006, Test Loss: 0.0006
Epoch [47850/47850], Train Loss: 0.0008, Test Loss: 0.0005
Epoch [47900/47900], Train Loss: 0.0006, Test Loss: 0.0007
Epoch [47950/47950], Train Loss: 0.0006, Test Loss: 0.0006
Epoch [48000/48000], Train Loss: 0.0005, Test Loss: 0.0006
Epoch [48050/48050], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [48100/48100], Train Loss: 0.0006, Test Loss: 0.0006
Epoch [48150/48150], Train Loss: 0.0006, Test Loss: 0.0006
Epoch [48200/48200], Train Loss: 0.0006, Test Loss: 0.0005
Epoch [48250/48250], Train Loss: 0.0006, Test Loss: 0.0005
Epoch [48300/48300], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [48350/48350], Train Loss: 0.0007, Test Loss: 0.0004
Epoch [48400/48400], Train Loss: 0.0005, Test Loss: 0.0006
Epoch [48450/48450], Train Loss: 0.0006, Test Loss: 0.0005
Epoch [48500/48500], Train Loss: 0.0007, Test Loss: 0.0005
Epoch [48550/48550], Train Loss: 0.0005, Test Loss: 0.0005

Epoch [48600/48600], Train Loss: 0.0005, Test Loss: 0.0004
Epoch [48650/48650], Train Loss: 0.0006, Test Loss: 0.0007
Epoch [48700/48700], Train Loss: 0.0006, Test Loss: 0.0005
Epoch [48750/48750], Train Loss: 0.0005, Test Loss: 0.0006
Epoch [48800/48800], Train Loss: 0.0005, Test Loss: 0.0006
Epoch [48850/48850], Train Loss: 0.0004, Test Loss: 0.0006
Epoch [48900/48900], Train Loss: 0.0005, Test Loss: 0.0006
Epoch [48950/48950], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [49000/49000], Train Loss: 0.0003, Test Loss: 0.0005
Epoch [49050/49050], Train Loss: 0.0004, Test Loss: 0.0006
Epoch [49100/49100], Train Loss: 0.0005, Test Loss: 0.0006
Epoch [49150/49150], Train Loss: 0.0005, Test Loss: 0.0004
Epoch [49200/49200], Train Loss: 0.0005, Test Loss: 0.0005
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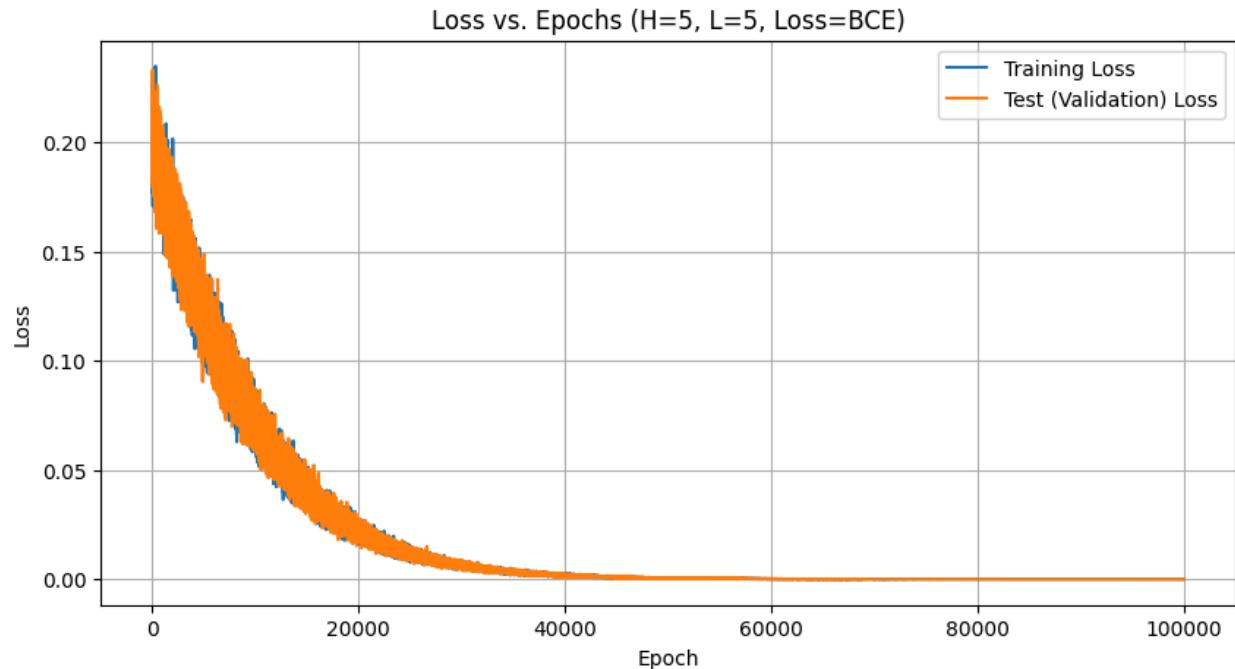
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```
Epoch [99900/99900], Train Loss: 0.0000, Test Loss: 0.0000
Epoch [99950/99950], Train Loss: 0.0000, Test Loss: 0.0000
```

```
In [ ]: plt.figure(figsize=(10, 5))
plt.plot(train_loss, label='Training Loss')
plt.plot(test_loss, label='Test (Validation) Loss')
plt.title(f'Loss vs. Epochs (H={hidden_size}, L={l_train}, Loss=BCE)')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()
plt.grid(True)
plt.show()
```

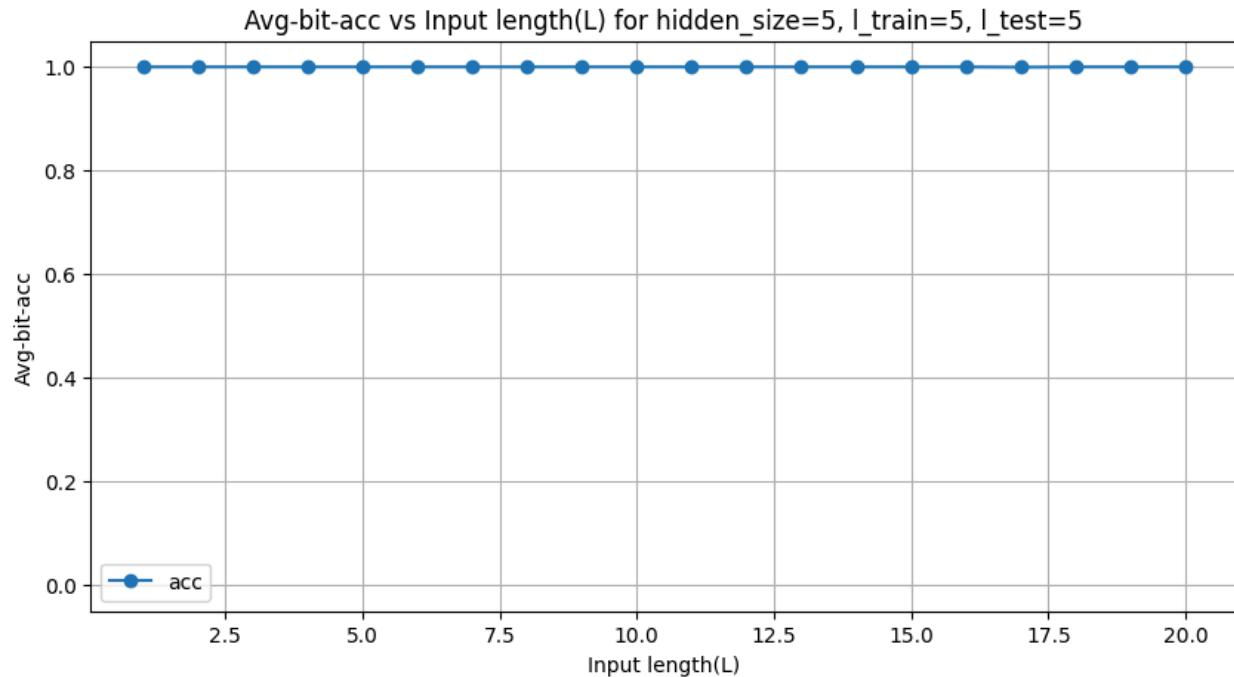


```
In [ ]: x,y=create_data_batch(1,10)
y_1=model(x)
print(y_1)
print(y)
```

```
tensor([[1.0000e+00],  
       [1.0000e+00],  
       [1.6658e-08],  
       [4.4280e-09],  
       [7.3997e-08],  
       [2.4249e-08],  
       [1.3330e-06],  
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       [1.0000e+00]]], grad_fn=<SigmoidBackward0>)  
tensor([[1.],  
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       [0.],  
       [0.],  
       [0.],  
       [0.],  
       [1.],  
       [1.],  
       [0.],  
       [1.]])
```

In []:

In []: avg_bit_accuracy(model, 5, 5, 5, 100)



Out[]: 0.9999722212553024

MODEL_1:

In []: input_size=2

```
hidden_size=5
num_layers=1
l_train=5
l_test=5
epoches=50000
batch_size=128
lr=1e-4
loss_type="MSE"
```

```
In [ ]: model_1=Binary_adder(input_size,hidden_size,num_layers).to(device)
criterion=nn.MSELoss()
optimizer=torch.optim.Adam(model_1.parameters(),lr=lr)
```

```
In [ ]: train_loss,test_loss=training_loop(model_1,epoches,optimizer,criterion,batch_si
```

Epoch [0/0], Train Loss: 0.2526, Test Loss: 0.2588
Epoch [50/50], Train Loss: 0.2527, Test Loss: 0.2544
Epoch [100/100], Train Loss: 0.2492, Test Loss: 0.2537
Epoch [150/150], Train Loss: 0.2542, Test Loss: 0.2546
Epoch [200/200], Train Loss: 0.2544, Test Loss: 0.2548
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Epoch [700/700], Train Loss: 0.2492, Test Loss: 0.2491
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Epoch [2200/2200], Train Loss: 0.2497, Test Loss: 0.2472
Epoch [2250/2250], Train Loss: 0.2470, Test Loss: 0.2469
Epoch [2300/2300], Train Loss: 0.2479, Test Loss: 0.2467
Epoch [2350/2350], Train Loss: 0.2463, Test Loss: 0.2472
Epoch [2400/2400], Train Loss: 0.2457, Test Loss: 0.2464
Epoch [2450/2450], Train Loss: 0.2450, Test Loss: 0.2466
Epoch [2500/2500], Train Loss: 0.2457, Test Loss: 0.2452
Epoch [2550/2550], Train Loss: 0.2431, Test Loss: 0.2457
Epoch [2600/2600], Train Loss: 0.2461, Test Loss: 0.2448
Epoch [2650/2650], Train Loss: 0.2451, Test Loss: 0.2436

Epoch [2700/2700], Train Loss: 0.2451, Test Loss: 0.2437
Epoch [2750/2750], Train Loss: 0.2445, Test Loss: 0.2447
Epoch [2800/2800], Train Loss: 0.2431, Test Loss: 0.2445
Epoch [2850/2850], Train Loss: 0.2451, Test Loss: 0.2440
Epoch [2900/2900], Train Loss: 0.2421, Test Loss: 0.2402
Epoch [2950/2950], Train Loss: 0.2433, Test Loss: 0.2445
Epoch [3000/3000], Train Loss: 0.2450, Test Loss: 0.2443
Epoch [3050/3050], Train Loss: 0.2429, Test Loss: 0.2472
Epoch [3100/3100], Train Loss: 0.2388, Test Loss: 0.2421
Epoch [3150/3150], Train Loss: 0.2456, Test Loss: 0.2440
Epoch [3200/3200], Train Loss: 0.2393, Test Loss: 0.2446
Epoch [3250/3250], Train Loss: 0.2435, Test Loss: 0.2408
Epoch [3300/3300], Train Loss: 0.2372, Test Loss: 0.2432
Epoch [3350/3350], Train Loss: 0.2422, Test Loss: 0.2412
Epoch [3400/3400], Train Loss: 0.2430, Test Loss: 0.2401
Epoch [3450/3450], Train Loss: 0.2439, Test Loss: 0.2413
Epoch [3500/3500], Train Loss: 0.2393, Test Loss: 0.2377
Epoch [3550/3550], Train Loss: 0.2409, Test Loss: 0.2412
Epoch [3600/3600], Train Loss: 0.2375, Test Loss: 0.2412
Epoch [3650/3650], Train Loss: 0.2410, Test Loss: 0.2396
Epoch [3700/3700], Train Loss: 0.2369, Test Loss: 0.2386
Epoch [3750/3750], Train Loss: 0.2440, Test Loss: 0.2409
Epoch [3800/3800], Train Loss: 0.2461, Test Loss: 0.2439
Epoch [3850/3850], Train Loss: 0.2377, Test Loss: 0.2422
Epoch [3900/3900], Train Loss: 0.2399, Test Loss: 0.2410
Epoch [3950/3950], Train Loss: 0.2375, Test Loss: 0.2350
Epoch [4000/4000], Train Loss: 0.2403, Test Loss: 0.2389
Epoch [4050/4050], Train Loss: 0.2371, Test Loss: 0.2412
Epoch [4100/4100], Train Loss: 0.2389, Test Loss: 0.2394
Epoch [4150/4150], Train Loss: 0.2376, Test Loss: 0.2375
Epoch [4200/4200], Train Loss: 0.2380, Test Loss: 0.2374
Epoch [4250/4250], Train Loss: 0.2411, Test Loss: 0.2364
Epoch [4300/4300], Train Loss: 0.2400, Test Loss: 0.2349
Epoch [4350/4350], Train Loss: 0.2386, Test Loss: 0.2352
Epoch [4400/4400], Train Loss: 0.2366, Test Loss: 0.2386
Epoch [4450/4450], Train Loss: 0.2335, Test Loss: 0.2406
Epoch [4500/4500], Train Loss: 0.2371, Test Loss: 0.2357
Epoch [4550/4550], Train Loss: 0.2323, Test Loss: 0.2331
Epoch [4600/4600], Train Loss: 0.2356, Test Loss: 0.2363
Epoch [4650/4650], Train Loss: 0.2318, Test Loss: 0.2328
Epoch [4700/4700], Train Loss: 0.2348, Test Loss: 0.2364
Epoch [4750/4750], Train Loss: 0.2297, Test Loss: 0.2381
Epoch [4800/4800], Train Loss: 0.2349, Test Loss: 0.2328
Epoch [4850/4850], Train Loss: 0.2335, Test Loss: 0.2341
Epoch [4900/4900], Train Loss: 0.2332, Test Loss: 0.2336
Epoch [4950/4950], Train Loss: 0.2298, Test Loss: 0.2306
Epoch [5000/5000], Train Loss: 0.2332, Test Loss: 0.2302
Epoch [5050/5050], Train Loss: 0.2353, Test Loss: 0.2327
Epoch [5100/5100], Train Loss: 0.2315, Test Loss: 0.2354
Epoch [5150/5150], Train Loss: 0.2353, Test Loss: 0.2337
Epoch [5200/5200], Train Loss: 0.2334, Test Loss: 0.2302
Epoch [5250/5250], Train Loss: 0.2319, Test Loss: 0.2262
Epoch [5300/5300], Train Loss: 0.2366, Test Loss: 0.2361
Epoch [5350/5350], Train Loss: 0.2313, Test Loss: 0.2306

Epoch [5400/5400], Train Loss: 0.2340, Test Loss: 0.2247
Epoch [5450/5450], Train Loss: 0.2224, Test Loss: 0.2290
Epoch [5500/5500], Train Loss: 0.2381, Test Loss: 0.2323
Epoch [5550/5550], Train Loss: 0.2226, Test Loss: 0.2237
Epoch [5600/5600], Train Loss: 0.2224, Test Loss: 0.2246
Epoch [5650/5650], Train Loss: 0.2283, Test Loss: 0.2284
Epoch [5700/5700], Train Loss: 0.2251, Test Loss: 0.2297
Epoch [5750/5750], Train Loss: 0.2208, Test Loss: 0.2298
Epoch [5800/5800], Train Loss: 0.2311, Test Loss: 0.2280
Epoch [5850/5850], Train Loss: 0.2220, Test Loss: 0.2202
Epoch [5900/5900], Train Loss: 0.2244, Test Loss: 0.2282
Epoch [5950/5950], Train Loss: 0.2296, Test Loss: 0.2212
Epoch [6000/6000], Train Loss: 0.2276, Test Loss: 0.2298
Epoch [6050/6050], Train Loss: 0.2253, Test Loss: 0.2245
Epoch [6100/6100], Train Loss: 0.2299, Test Loss: 0.2257
Epoch [6150/6150], Train Loss: 0.2310, Test Loss: 0.2329
Epoch [6200/6200], Train Loss: 0.2166, Test Loss: 0.2202
Epoch [6250/6250], Train Loss: 0.2319, Test Loss: 0.2205
Epoch [6300/6300], Train Loss: 0.2263, Test Loss: 0.2257
Epoch [6350/6350], Train Loss: 0.2262, Test Loss: 0.2272
Epoch [6400/6400], Train Loss: 0.2176, Test Loss: 0.2183
Epoch [6450/6450], Train Loss: 0.2198, Test Loss: 0.2239
Epoch [6500/6500], Train Loss: 0.2186, Test Loss: 0.2242
Epoch [6550/6550], Train Loss: 0.2216, Test Loss: 0.2176
Epoch [6600/6600], Train Loss: 0.2208, Test Loss: 0.2174
Epoch [6650/6650], Train Loss: 0.2243, Test Loss: 0.2184
Epoch [6700/6700], Train Loss: 0.2183, Test Loss: 0.2210
Epoch [6750/6750], Train Loss: 0.2254, Test Loss: 0.2170
Epoch [6800/6800], Train Loss: 0.2232, Test Loss: 0.2252
Epoch [6850/6850], Train Loss: 0.2169, Test Loss: 0.2179
Epoch [6900/6900], Train Loss: 0.2121, Test Loss: 0.2214
Epoch [6950/6950], Train Loss: 0.2239, Test Loss: 0.2244
Epoch [7000/7000], Train Loss: 0.2144, Test Loss: 0.2168
Epoch [7050/7050], Train Loss: 0.2160, Test Loss: 0.2139
Epoch [7100/7100], Train Loss: 0.2185, Test Loss: 0.2132
Epoch [7150/7150], Train Loss: 0.2161, Test Loss: 0.2146
Epoch [7200/7200], Train Loss: 0.2216, Test Loss: 0.2192
Epoch [7250/7250], Train Loss: 0.2174, Test Loss: 0.2044
Epoch [7300/7300], Train Loss: 0.2179, Test Loss: 0.2181
Epoch [7350/7350], Train Loss: 0.2163, Test Loss: 0.2144
Epoch [7400/7400], Train Loss: 0.2134, Test Loss: 0.2137
Epoch [7450/7450], Train Loss: 0.2162, Test Loss: 0.2116
Epoch [7500/7500], Train Loss: 0.2132, Test Loss: 0.2148
Epoch [7550/7550], Train Loss: 0.2048, Test Loss: 0.2143
Epoch [7600/7600], Train Loss: 0.2147, Test Loss: 0.2164
Epoch [7650/7650], Train Loss: 0.2138, Test Loss: 0.2130
Epoch [7700/7700], Train Loss: 0.2124, Test Loss: 0.2096
Epoch [7750/7750], Train Loss: 0.2114, Test Loss: 0.2153
Epoch [7800/7800], Train Loss: 0.2101, Test Loss: 0.2139
Epoch [7850/7850], Train Loss: 0.2119, Test Loss: 0.2131
Epoch [7900/7900], Train Loss: 0.2091, Test Loss: 0.2052
Epoch [7950/7950], Train Loss: 0.2135, Test Loss: 0.2102
Epoch [8000/8000], Train Loss: 0.2034, Test Loss: 0.2096
Epoch [8050/8050], Train Loss: 0.2088, Test Loss: 0.2098

Epoch [8100/8100], Train Loss: 0.2092, Test Loss: 0.2127
Epoch [8150/8150], Train Loss: 0.2087, Test Loss: 0.2020
Epoch [8200/8200], Train Loss: 0.2115, Test Loss: 0.2102
Epoch [8250/8250], Train Loss: 0.2069, Test Loss: 0.2173
Epoch [8300/8300], Train Loss: 0.2033, Test Loss: 0.1998
Epoch [8350/8350], Train Loss: 0.2148, Test Loss: 0.2108
Epoch [8400/8400], Train Loss: 0.2025, Test Loss: 0.2060
Epoch [8450/8450], Train Loss: 0.2065, Test Loss: 0.2081
Epoch [8500/8500], Train Loss: 0.2062, Test Loss: 0.2093
Epoch [8550/8550], Train Loss: 0.2060, Test Loss: 0.2022
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Epoch [8650/8650], Train Loss: 0.1988, Test Loss: 0.2020
Epoch [8700/8700], Train Loss: 0.2032, Test Loss: 0.2032
Epoch [8750/8750], Train Loss: 0.1960, Test Loss: 0.1931
Epoch [8800/8800], Train Loss: 0.2007, Test Loss: 0.2112
Epoch [8850/8850], Train Loss: 0.1962, Test Loss: 0.2033
Epoch [8900/8900], Train Loss: 0.2099, Test Loss: 0.2100
Epoch [8950/8950], Train Loss: 0.1972, Test Loss: 0.2105
Epoch [9000/9000], Train Loss: 0.2025, Test Loss: 0.2031
Epoch [9050/9050], Train Loss: 0.2009, Test Loss: 0.1935
Epoch [9100/9100], Train Loss: 0.1982, Test Loss: 0.1891
Epoch [9150/9150], Train Loss: 0.2014, Test Loss: 0.1987
Epoch [9200/9200], Train Loss: 0.1960, Test Loss: 0.1921
Epoch [9250/9250], Train Loss: 0.1977, Test Loss: 0.2051
Epoch [9300/9300], Train Loss: 0.2001, Test Loss: 0.1969
Epoch [9350/9350], Train Loss: 0.1977, Test Loss: 0.2011
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Epoch [9750/9750], Train Loss: 0.1963, Test Loss: 0.1937
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Epoch [9850/9850], Train Loss: 0.1921, Test Loss: 0.1980
Epoch [9900/9900], Train Loss: 0.1932, Test Loss: 0.1863
Epoch [9950/9950], Train Loss: 0.1998, Test Loss: 0.1882
Epoch [10000/10000], Train Loss: 0.1885, Test Loss: 0.1892
Epoch [10050/10050], Train Loss: 0.1848, Test Loss: 0.1925
Epoch [10100/10100], Train Loss: 0.1959, Test Loss: 0.1886
Epoch [10150/10150], Train Loss: 0.1898, Test Loss: 0.1761
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Epoch [10250/10250], Train Loss: 0.1889, Test Loss: 0.1899
Epoch [10300/10300], Train Loss: 0.1880, Test Loss: 0.1938
Epoch [10350/10350], Train Loss: 0.1829, Test Loss: 0.1868
Epoch [10400/10400], Train Loss: 0.1800, Test Loss: 0.1923
Epoch [10450/10450], Train Loss: 0.1896, Test Loss: 0.1785
Epoch [10500/10500], Train Loss: 0.1882, Test Loss: 0.1786
Epoch [10550/10550], Train Loss: 0.1902, Test Loss: 0.1856
Epoch [10600/10600], Train Loss: 0.1893, Test Loss: 0.1803
Epoch [10650/10650], Train Loss: 0.1861, Test Loss: 0.1861
Epoch [10700/10700], Train Loss: 0.1917, Test Loss: 0.1899
Epoch [10750/10750], Train Loss: 0.1817, Test Loss: 0.1841

Epoch [10800/10800], Train Loss: 0.1854, Test Loss: 0.1800
Epoch [10850/10850], Train Loss: 0.1766, Test Loss: 0.1786
Epoch [10900/10900], Train Loss: 0.1852, Test Loss: 0.1886
Epoch [10950/10950], Train Loss: 0.1879, Test Loss: 0.1775
Epoch [11000/11000], Train Loss: 0.1778, Test Loss: 0.1861
Epoch [11050/11050], Train Loss: 0.1897, Test Loss: 0.1824
Epoch [11100/11100], Train Loss: 0.1841, Test Loss: 0.1702
Epoch [11150/11150], Train Loss: 0.1753, Test Loss: 0.1812
Epoch [11200/11200], Train Loss: 0.1813, Test Loss: 0.1835
Epoch [11250/11250], Train Loss: 0.1778, Test Loss: 0.1677
Epoch [11300/11300], Train Loss: 0.1845, Test Loss: 0.1776
Epoch [11350/11350], Train Loss: 0.1742, Test Loss: 0.1702
Epoch [11400/11400], Train Loss: 0.1750, Test Loss: 0.1795
Epoch [11450/11450], Train Loss: 0.1698, Test Loss: 0.1746
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Epoch [11550/11550], Train Loss: 0.1784, Test Loss: 0.1714
Epoch [11600/11600], Train Loss: 0.1730, Test Loss: 0.1681
Epoch [11650/11650], Train Loss: 0.1726, Test Loss: 0.1739
Epoch [11700/11700], Train Loss: 0.1793, Test Loss: 0.1780
Epoch [11750/11750], Train Loss: 0.1652, Test Loss: 0.1590
Epoch [11800/11800], Train Loss: 0.1653, Test Loss: 0.1722
Epoch [11850/11850], Train Loss: 0.1740, Test Loss: 0.1792
Epoch [11900/11900], Train Loss: 0.1729, Test Loss: 0.1699
Epoch [11950/11950], Train Loss: 0.1695, Test Loss: 0.1732
Epoch [12000/12000], Train Loss: 0.1773, Test Loss: 0.1662
Epoch [12050/12050], Train Loss: 0.1689, Test Loss: 0.1634
Epoch [12100/12100], Train Loss: 0.1678, Test Loss: 0.1499
Epoch [12150/12150], Train Loss: 0.1709, Test Loss: 0.1772
Epoch [12200/12200], Train Loss: 0.1611, Test Loss: 0.1612
Epoch [12250/12250], Train Loss: 0.1723, Test Loss: 0.1651
Epoch [12300/12300], Train Loss: 0.1689, Test Loss: 0.1602
Epoch [12350/12350], Train Loss: 0.1565, Test Loss: 0.1609
Epoch [12400/12400], Train Loss: 0.1617, Test Loss: 0.1658
Epoch [12450/12450], Train Loss: 0.1635, Test Loss: 0.1631
Epoch [12500/12500], Train Loss: 0.1626, Test Loss: 0.1498
Epoch [12550/12550], Train Loss: 0.1650, Test Loss: 0.1566
Epoch [12600/12600], Train Loss: 0.1608, Test Loss: 0.1696
Epoch [12650/12650], Train Loss: 0.1559, Test Loss: 0.1466
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Epoch [12750/12750], Train Loss: 0.1656, Test Loss: 0.1526
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Epoch [12950/12950], Train Loss: 0.1572, Test Loss: 0.1491
Epoch [13000/13000], Train Loss: 0.1599, Test Loss: 0.1531
Epoch [13050/13050], Train Loss: 0.1580, Test Loss: 0.1539
Epoch [13100/13100], Train Loss: 0.1614, Test Loss: 0.1509
Epoch [13150/13150], Train Loss: 0.1406, Test Loss: 0.1581
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Epoch [13250/13250], Train Loss: 0.1641, Test Loss: 0.1454
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Epoch [13350/13350], Train Loss: 0.1477, Test Loss: 0.1478
Epoch [13400/13400], Train Loss: 0.1449, Test Loss: 0.1538
Epoch [13450/13450], Train Loss: 0.1424, Test Loss: 0.1536

Epoch [13500/13500], Train Loss: 0.1396, Test Loss: 0.1434
Epoch [13550/13550], Train Loss: 0.1424, Test Loss: 0.1559
Epoch [13600/13600], Train Loss: 0.1492, Test Loss: 0.1384
Epoch [13650/13650], Train Loss: 0.1446, Test Loss: 0.1439
Epoch [13700/13700], Train Loss: 0.1569, Test Loss: 0.1412
Epoch [13750/13750], Train Loss: 0.1365, Test Loss: 0.1508
Epoch [13800/13800], Train Loss: 0.1463, Test Loss: 0.1360
Epoch [13850/13850], Train Loss: 0.1480, Test Loss: 0.1418
Epoch [13900/13900], Train Loss: 0.1468, Test Loss: 0.1302
Epoch [13950/13950], Train Loss: 0.1457, Test Loss: 0.1367
Epoch [14000/14000], Train Loss: 0.1336, Test Loss: 0.1405
Epoch [14050/14050], Train Loss: 0.1391, Test Loss: 0.1448
Epoch [14100/14100], Train Loss: 0.1400, Test Loss: 0.1417
Epoch [14150/14150], Train Loss: 0.1318, Test Loss: 0.1274
Epoch [14200/14200], Train Loss: 0.1335, Test Loss: 0.1275
Epoch [14250/14250], Train Loss: 0.1291, Test Loss: 0.1236
Epoch [14300/14300], Train Loss: 0.1394, Test Loss: 0.1458
Epoch [14350/14350], Train Loss: 0.1473, Test Loss: 0.1328
Epoch [14400/14400], Train Loss: 0.1289, Test Loss: 0.1279
Epoch [14450/14450], Train Loss: 0.1293, Test Loss: 0.1225
Epoch [14500/14500], Train Loss: 0.1245, Test Loss: 0.1375
Epoch [14550/14550], Train Loss: 0.1321, Test Loss: 0.1375
Epoch [14600/14600], Train Loss: 0.1374, Test Loss: 0.1397
Epoch [14650/14650], Train Loss: 0.1292, Test Loss: 0.1364
Epoch [14700/14700], Train Loss: 0.1345, Test Loss: 0.1337
Epoch [14750/14750], Train Loss: 0.1336, Test Loss: 0.1223
Epoch [14800/14800], Train Loss: 0.1437, Test Loss: 0.1292
Epoch [14850/14850], Train Loss: 0.1392, Test Loss: 0.1363
Epoch [14900/14900], Train Loss: 0.1345, Test Loss: 0.1291
Epoch [14950/14950], Train Loss: 0.1276, Test Loss: 0.1258
Epoch [15000/15000], Train Loss: 0.1305, Test Loss: 0.1328
Epoch [15050/15050], Train Loss: 0.1505, Test Loss: 0.1305
Epoch [15100/15100], Train Loss: 0.1161, Test Loss: 0.1159
Epoch [15150/15150], Train Loss: 0.1221, Test Loss: 0.1214
Epoch [15200/15200], Train Loss: 0.1235, Test Loss: 0.1256
Epoch [15250/15250], Train Loss: 0.1248, Test Loss: 0.1165
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Epoch [15350/15350], Train Loss: 0.1323, Test Loss: 0.1286
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Epoch [15600/15600], Train Loss: 0.1344, Test Loss: 0.1173
Epoch [15650/15650], Train Loss: 0.1196, Test Loss: 0.1224
Epoch [15700/15700], Train Loss: 0.1242, Test Loss: 0.1188
Epoch [15750/15750], Train Loss: 0.1240, Test Loss: 0.1105
Epoch [15800/15800], Train Loss: 0.1211, Test Loss: 0.1147
Epoch [15850/15850], Train Loss: 0.1280, Test Loss: 0.1296
Epoch [15900/15900], Train Loss: 0.1222, Test Loss: 0.1172
Epoch [15950/15950], Train Loss: 0.1157, Test Loss: 0.1125
Epoch [16000/16000], Train Loss: 0.1245, Test Loss: 0.1320
Epoch [16050/16050], Train Loss: 0.1087, Test Loss: 0.1235
Epoch [16100/16100], Train Loss: 0.1179, Test Loss: 0.1117
Epoch [16150/16150], Train Loss: 0.1195, Test Loss: 0.1187

Epoch [16200/16200], Train Loss: 0.1166, Test Loss: 0.1247
Epoch [16250/16250], Train Loss: 0.1080, Test Loss: 0.1059
Epoch [16300/16300], Train Loss: 0.1049, Test Loss: 0.1140
Epoch [16350/16350], Train Loss: 0.1050, Test Loss: 0.1072
Epoch [16400/16400], Train Loss: 0.1181, Test Loss: 0.1144
Epoch [16450/16450], Train Loss: 0.1034, Test Loss: 0.1109
Epoch [16500/16500], Train Loss: 0.1097, Test Loss: 0.1133
Epoch [16550/16550], Train Loss: 0.1070, Test Loss: 0.0970
Epoch [16600/16600], Train Loss: 0.1059, Test Loss: 0.1068
Epoch [16650/16650], Train Loss: 0.1198, Test Loss: 0.1107
Epoch [16700/16700], Train Loss: 0.1032, Test Loss: 0.1152
Epoch [16750/16750], Train Loss: 0.1054, Test Loss: 0.1084
Epoch [16800/16800], Train Loss: 0.1025, Test Loss: 0.1021
Epoch [16850/16850], Train Loss: 0.1059, Test Loss: 0.0940
Epoch [16900/16900], Train Loss: 0.1075, Test Loss: 0.1052
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Epoch [17000/17000], Train Loss: 0.1069, Test Loss: 0.1196
Epoch [17050/17050], Train Loss: 0.1166, Test Loss: 0.1010
Epoch [17100/17100], Train Loss: 0.1119, Test Loss: 0.0980
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Epoch [17200/17200], Train Loss: 0.1027, Test Loss: 0.1043
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Epoch [17300/17300], Train Loss: 0.1003, Test Loss: 0.1106
Epoch [17350/17350], Train Loss: 0.1214, Test Loss: 0.0983
Epoch [17400/17400], Train Loss: 0.0911, Test Loss: 0.0953
Epoch [17450/17450], Train Loss: 0.0990, Test Loss: 0.0959
Epoch [17500/17500], Train Loss: 0.1112, Test Loss: 0.1125
Epoch [17550/17550], Train Loss: 0.1051, Test Loss: 0.1005
Epoch [17600/17600], Train Loss: 0.1083, Test Loss: 0.1047
Epoch [17650/17650], Train Loss: 0.1015, Test Loss: 0.0947
Epoch [17700/17700], Train Loss: 0.0885, Test Loss: 0.0937
Epoch [17750/17750], Train Loss: 0.0911, Test Loss: 0.1030
Epoch [17800/17800], Train Loss: 0.0893, Test Loss: 0.0894
Epoch [17850/17850], Train Loss: 0.1105, Test Loss: 0.1029
Epoch [17900/17900], Train Loss: 0.1020, Test Loss: 0.0946
Epoch [17950/17950], Train Loss: 0.1039, Test Loss: 0.0917
Epoch [18000/18000], Train Loss: 0.1149, Test Loss: 0.1013
Epoch [18050/18050], Train Loss: 0.1006, Test Loss: 0.1039
Epoch [18100/18100], Train Loss: 0.0987, Test Loss: 0.0824
Epoch [18150/18150], Train Loss: 0.0850, Test Loss: 0.0940
Epoch [18200/18200], Train Loss: 0.1035, Test Loss: 0.0790
Epoch [18250/18250], Train Loss: 0.1075, Test Loss: 0.0971
Epoch [18300/18300], Train Loss: 0.0922, Test Loss: 0.0941
Epoch [18350/18350], Train Loss: 0.0995, Test Loss: 0.0861
Epoch [18400/18400], Train Loss: 0.0954, Test Loss: 0.0965
Epoch [18450/18450], Train Loss: 0.1088, Test Loss: 0.0971
Epoch [18500/18500], Train Loss: 0.0919, Test Loss: 0.0983
Epoch [18550/18550], Train Loss: 0.0977, Test Loss: 0.1010
Epoch [18600/18600], Train Loss: 0.1030, Test Loss: 0.0984
Epoch [18650/18650], Train Loss: 0.0869, Test Loss: 0.0864
Epoch [18700/18700], Train Loss: 0.0941, Test Loss: 0.1017
Epoch [18750/18750], Train Loss: 0.0968, Test Loss: 0.0821
Epoch [18800/18800], Train Loss: 0.0949, Test Loss: 0.0910
Epoch [18850/18850], Train Loss: 0.0970, Test Loss: 0.1012

Epoch [18900/18900], Train Loss: 0.0926, Test Loss: 0.1003
Epoch [18950/18950], Train Loss: 0.1016, Test Loss: 0.0903
Epoch [19000/19000], Train Loss: 0.0959, Test Loss: 0.0993
Epoch [19050/19050], Train Loss: 0.0881, Test Loss: 0.0883
Epoch [19100/19100], Train Loss: 0.0948, Test Loss: 0.0853
Epoch [19150/19150], Train Loss: 0.0934, Test Loss: 0.0846
Epoch [19200/19200], Train Loss: 0.0879, Test Loss: 0.0725
Epoch [19250/19250], Train Loss: 0.0864, Test Loss: 0.0877
Epoch [19300/19300], Train Loss: 0.0902, Test Loss: 0.0931
Epoch [19350/19350], Train Loss: 0.0815, Test Loss: 0.0864
Epoch [19400/19400], Train Loss: 0.0861, Test Loss: 0.0767
Epoch [19450/19450], Train Loss: 0.0746, Test Loss: 0.0936
Epoch [19500/19500], Train Loss: 0.0902, Test Loss: 0.0831
Epoch [19550/19550], Train Loss: 0.0913, Test Loss: 0.0928
Epoch [19600/19600], Train Loss: 0.0903, Test Loss: 0.0893
Epoch [19650/19650], Train Loss: 0.0915, Test Loss: 0.0868
Epoch [19700/19700], Train Loss: 0.0841, Test Loss: 0.0849
Epoch [19750/19750], Train Loss: 0.0778, Test Loss: 0.0737
Epoch [19800/19800], Train Loss: 0.0855, Test Loss: 0.0911
Epoch [19850/19850], Train Loss: 0.0874, Test Loss: 0.0817
Epoch [19900/19900], Train Loss: 0.0997, Test Loss: 0.0909
Epoch [19950/19950], Train Loss: 0.0899, Test Loss: 0.0867
Epoch [20000/20000], Train Loss: 0.0776, Test Loss: 0.0867
Epoch [20050/20050], Train Loss: 0.0768, Test Loss: 0.0802
Epoch [20100/20100], Train Loss: 0.0850, Test Loss: 0.0846
Epoch [20150/20150], Train Loss: 0.0792, Test Loss: 0.0658
Epoch [20200/20200], Train Loss: 0.0783, Test Loss: 0.0799
Epoch [20250/20250], Train Loss: 0.0832, Test Loss: 0.0795
Epoch [20300/20300], Train Loss: 0.0882, Test Loss: 0.0770
Epoch [20350/20350], Train Loss: 0.0753, Test Loss: 0.0897
Epoch [20400/20400], Train Loss: 0.0726, Test Loss: 0.0723
Epoch [20450/20450], Train Loss: 0.0812, Test Loss: 0.0777
Epoch [20500/20500], Train Loss: 0.0873, Test Loss: 0.0763
Epoch [20550/20550], Train Loss: 0.0809, Test Loss: 0.0767
Epoch [20600/20600], Train Loss: 0.0854, Test Loss: 0.0751
Epoch [20650/20650], Train Loss: 0.0855, Test Loss: 0.0808
Epoch [20700/20700], Train Loss: 0.0780, Test Loss: 0.0804
Epoch [20750/20750], Train Loss: 0.1000, Test Loss: 0.0865
Epoch [20800/20800], Train Loss: 0.0795, Test Loss: 0.0767
Epoch [20850/20850], Train Loss: 0.0863, Test Loss: 0.0763
Epoch [20900/20900], Train Loss: 0.0854, Test Loss: 0.0786
Epoch [20950/20950], Train Loss: 0.0638, Test Loss: 0.0721
Epoch [21000/21000], Train Loss: 0.0754, Test Loss: 0.0777
Epoch [21050/21050], Train Loss: 0.0862, Test Loss: 0.0865
Epoch [21100/21100], Train Loss: 0.0829, Test Loss: 0.0689
Epoch [21150/21150], Train Loss: 0.0898, Test Loss: 0.0804
Epoch [21200/21200], Train Loss: 0.0824, Test Loss: 0.0829
Epoch [21250/21250], Train Loss: 0.0770, Test Loss: 0.0796
Epoch [21300/21300], Train Loss: 0.0724, Test Loss: 0.0740
Epoch [21350/21350], Train Loss: 0.0733, Test Loss: 0.0759
Epoch [21400/21400], Train Loss: 0.0837, Test Loss: 0.0837
Epoch [21450/21450], Train Loss: 0.0721, Test Loss: 0.0693
Epoch [21500/21500], Train Loss: 0.0846, Test Loss: 0.0780
Epoch [21550/21550], Train Loss: 0.0622, Test Loss: 0.0721

Epoch [21600/21600], Train Loss: 0.0944, Test Loss: 0.0807
Epoch [21650/21650], Train Loss: 0.0760, Test Loss: 0.0809
Epoch [21700/21700], Train Loss: 0.0800, Test Loss: 0.0685
Epoch [21750/21750], Train Loss: 0.0854, Test Loss: 0.0817
Epoch [21800/21800], Train Loss: 0.0741, Test Loss: 0.0685
Epoch [21850/21850], Train Loss: 0.0723, Test Loss: 0.0781
Epoch [21900/21900], Train Loss: 0.0707, Test Loss: 0.0815
Epoch [21950/21950], Train Loss: 0.0793, Test Loss: 0.0828
Epoch [22000/22000], Train Loss: 0.0696, Test Loss: 0.0676
Epoch [22050/22050], Train Loss: 0.0756, Test Loss: 0.0668
Epoch [22100/22100], Train Loss: 0.0662, Test Loss: 0.0875
Epoch [22150/22150], Train Loss: 0.0698, Test Loss: 0.0663
Epoch [22200/22200], Train Loss: 0.0731, Test Loss: 0.0819
Epoch [22250/22250], Train Loss: 0.0729, Test Loss: 0.0787
Epoch [22300/22300], Train Loss: 0.0652, Test Loss: 0.0698
Epoch [22350/22350], Train Loss: 0.0799, Test Loss: 0.0762
Epoch [22400/22400], Train Loss: 0.0899, Test Loss: 0.0647
Epoch [22450/22450], Train Loss: 0.0691, Test Loss: 0.0871
Epoch [22500/22500], Train Loss: 0.0820, Test Loss: 0.0702
Epoch [22550/22550], Train Loss: 0.0694, Test Loss: 0.0762
Epoch [22600/22600], Train Loss: 0.0747, Test Loss: 0.0707
Epoch [22650/22650], Train Loss: 0.0872, Test Loss: 0.0776
Epoch [22700/22700], Train Loss: 0.0764, Test Loss: 0.0694
Epoch [22750/22750], Train Loss: 0.0788, Test Loss: 0.0732
Epoch [22800/22800], Train Loss: 0.0750, Test Loss: 0.0709
Epoch [22850/22850], Train Loss: 0.0734, Test Loss: 0.0606
Epoch [22900/22900], Train Loss: 0.0666, Test Loss: 0.0639
Epoch [22950/22950], Train Loss: 0.0558, Test Loss: 0.0598
Epoch [23000/23000], Train Loss: 0.0504, Test Loss: 0.0798
Epoch [23050/23050], Train Loss: 0.0717, Test Loss: 0.0696
Epoch [23100/23100], Train Loss: 0.0787, Test Loss: 0.0682
Epoch [23150/23150], Train Loss: 0.0576, Test Loss: 0.0633
Epoch [23200/23200], Train Loss: 0.0648, Test Loss: 0.0590
Epoch [23250/23250], Train Loss: 0.0703, Test Loss: 0.0706
Epoch [23300/23300], Train Loss: 0.0842, Test Loss: 0.0716
Epoch [23350/23350], Train Loss: 0.0766, Test Loss: 0.0717
Epoch [23400/23400], Train Loss: 0.0555, Test Loss: 0.0726
Epoch [23450/23450], Train Loss: 0.0849, Test Loss: 0.0520
Epoch [23500/23500], Train Loss: 0.0702, Test Loss: 0.0692
Epoch [23550/23550], Train Loss: 0.0757, Test Loss: 0.0533
Epoch [23600/23600], Train Loss: 0.0744, Test Loss: 0.0515
Epoch [23650/23650], Train Loss: 0.0586, Test Loss: 0.0726
Epoch [23700/23700], Train Loss: 0.0713, Test Loss: 0.0615
Epoch [23750/23750], Train Loss: 0.0675, Test Loss: 0.0824
Epoch [23800/23800], Train Loss: 0.0780, Test Loss: 0.0801
Epoch [23850/23850], Train Loss: 0.0752, Test Loss: 0.0755
Epoch [23900/23900], Train Loss: 0.0698, Test Loss: 0.0748
Epoch [23950/23950], Train Loss: 0.0630, Test Loss: 0.0730
Epoch [24000/24000], Train Loss: 0.0764, Test Loss: 0.0664
Epoch [24050/24050], Train Loss: 0.0654, Test Loss: 0.0701
Epoch [24100/24100], Train Loss: 0.0737, Test Loss: 0.0795
Epoch [24150/24150], Train Loss: 0.0781, Test Loss: 0.0731
Epoch [24200/24200], Train Loss: 0.0778, Test Loss: 0.0779
Epoch [24250/24250], Train Loss: 0.0536, Test Loss: 0.0770

Epoch [24300/24300], Train Loss: 0.0629, Test Loss: 0.0683
Epoch [24350/24350], Train Loss: 0.0683, Test Loss: 0.0666
Epoch [24400/24400], Train Loss: 0.0754, Test Loss: 0.0699
Epoch [24450/24450], Train Loss: 0.0626, Test Loss: 0.0651
Epoch [24500/24500], Train Loss: 0.0753, Test Loss: 0.0688
Epoch [24550/24550], Train Loss: 0.0775, Test Loss: 0.0668
Epoch [24600/24600], Train Loss: 0.0699, Test Loss: 0.0708
Epoch [24650/24650], Train Loss: 0.0822, Test Loss: 0.0636
Epoch [24700/24700], Train Loss: 0.0567, Test Loss: 0.0609
Epoch [24750/24750], Train Loss: 0.0746, Test Loss: 0.0654
Epoch [24800/24800], Train Loss: 0.0706, Test Loss: 0.0574
Epoch [24850/24850], Train Loss: 0.0653, Test Loss: 0.0521
Epoch [24900/24900], Train Loss: 0.0676, Test Loss: 0.0719
Epoch [24950/24950], Train Loss: 0.0798, Test Loss: 0.0559
Epoch [25000/25000], Train Loss: 0.0724, Test Loss: 0.0667
Epoch [25050/25050], Train Loss: 0.0645, Test Loss: 0.0667
Epoch [25100/25100], Train Loss: 0.0614, Test Loss: 0.0625
Epoch [25150/25150], Train Loss: 0.0629, Test Loss: 0.0716
Epoch [25200/25200], Train Loss: 0.0718, Test Loss: 0.0581
Epoch [25250/25250], Train Loss: 0.0752, Test Loss: 0.0689
Epoch [25300/25300], Train Loss: 0.0694, Test Loss: 0.0911
Epoch [25350/25350], Train Loss: 0.0818, Test Loss: 0.0561
Epoch [25400/25400], Train Loss: 0.0782, Test Loss: 0.0635
Epoch [25450/25450], Train Loss: 0.0779, Test Loss: 0.0789
Epoch [25500/25500], Train Loss: 0.0634, Test Loss: 0.0583
Epoch [25550/25550], Train Loss: 0.0682, Test Loss: 0.0606
Epoch [25600/25600], Train Loss: 0.0614, Test Loss: 0.0668
Epoch [25650/25650], Train Loss: 0.0768, Test Loss: 0.0598
Epoch [25700/25700], Train Loss: 0.0728, Test Loss: 0.0639
Epoch [25750/25750], Train Loss: 0.0716, Test Loss: 0.0527
Epoch [25800/25800], Train Loss: 0.0697, Test Loss: 0.0654
Epoch [25850/25850], Train Loss: 0.0555, Test Loss: 0.0555
Epoch [25900/25900], Train Loss: 0.0700, Test Loss: 0.0569
Epoch [25950/25950], Train Loss: 0.0660, Test Loss: 0.0624
Epoch [26000/26000], Train Loss: 0.0725, Test Loss: 0.0754
Epoch [26050/26050], Train Loss: 0.0737, Test Loss: 0.0641
Epoch [26100/26100], Train Loss: 0.0619, Test Loss: 0.0820
Epoch [26150/26150], Train Loss: 0.0628, Test Loss: 0.0647
Epoch [26200/26200], Train Loss: 0.0727, Test Loss: 0.0598
Epoch [26250/26250], Train Loss: 0.0630, Test Loss: 0.0588
Epoch [26300/26300], Train Loss: 0.0716, Test Loss: 0.0637
Epoch [26350/26350], Train Loss: 0.0746, Test Loss: 0.0598
Epoch [26400/26400], Train Loss: 0.0506, Test Loss: 0.0686
Epoch [26450/26450], Train Loss: 0.0637, Test Loss: 0.0679
Epoch [26500/26500], Train Loss: 0.0617, Test Loss: 0.0693
Epoch [26550/26550], Train Loss: 0.0728, Test Loss: 0.0543
Epoch [26600/26600], Train Loss: 0.0710, Test Loss: 0.0500
Epoch [26650/26650], Train Loss: 0.0604, Test Loss: 0.0619
Epoch [26700/26700], Train Loss: 0.0564, Test Loss: 0.0535
Epoch [26750/26750], Train Loss: 0.0596, Test Loss: 0.0575
Epoch [26800/26800], Train Loss: 0.0695, Test Loss: 0.0733
Epoch [26850/26850], Train Loss: 0.0674, Test Loss: 0.0683
Epoch [26900/26900], Train Loss: 0.0638, Test Loss: 0.0640
Epoch [26950/26950], Train Loss: 0.0585, Test Loss: 0.0503

Epoch [27000/27000], Train Loss: 0.0575, Test Loss: 0.0668
Epoch [27050/27050], Train Loss: 0.0630, Test Loss: 0.0572
Epoch [27100/27100], Train Loss: 0.0600, Test Loss: 0.0606
Epoch [27150/27150], Train Loss: 0.0582, Test Loss: 0.0665
Epoch [27200/27200], Train Loss: 0.0578, Test Loss: 0.0676
Epoch [27250/27250], Train Loss: 0.0625, Test Loss: 0.0677
Epoch [27300/27300], Train Loss: 0.0694, Test Loss: 0.0558
Epoch [27350/27350], Train Loss: 0.0657, Test Loss: 0.0720
Epoch [27400/27400], Train Loss: 0.0586, Test Loss: 0.0582
Epoch [27450/27450], Train Loss: 0.0543, Test Loss: 0.0731
Epoch [27500/27500], Train Loss: 0.0740, Test Loss: 0.0634
Epoch [27550/27550], Train Loss: 0.0558, Test Loss: 0.0642
Epoch [27600/27600], Train Loss: 0.0647, Test Loss: 0.0693
Epoch [27650/27650], Train Loss: 0.0642, Test Loss: 0.0563
Epoch [27700/27700], Train Loss: 0.0691, Test Loss: 0.0730
Epoch [27750/27750], Train Loss: 0.0597, Test Loss: 0.0739
Epoch [27800/27800], Train Loss: 0.0698, Test Loss: 0.0541
Epoch [27850/27850], Train Loss: 0.0619, Test Loss: 0.0687
Epoch [27900/27900], Train Loss: 0.0606, Test Loss: 0.0558
Epoch [27950/27950], Train Loss: 0.0640, Test Loss: 0.0634
Epoch [28000/28000], Train Loss: 0.0508, Test Loss: 0.0396
Epoch [28050/28050], Train Loss: 0.0641, Test Loss: 0.0681
Epoch [28100/28100], Train Loss: 0.0602, Test Loss: 0.0675
Epoch [28150/28150], Train Loss: 0.0657, Test Loss: 0.0599
Epoch [28200/28200], Train Loss: 0.0669, Test Loss: 0.0626
Epoch [28250/28250], Train Loss: 0.0680, Test Loss: 0.0741
Epoch [28300/28300], Train Loss: 0.0484, Test Loss: 0.0707
Epoch [28350/28350], Train Loss: 0.0751, Test Loss: 0.0634
Epoch [28400/28400], Train Loss: 0.0645, Test Loss: 0.0753
Epoch [28450/28450], Train Loss: 0.0723, Test Loss: 0.0785
Epoch [28500/28500], Train Loss: 0.0538, Test Loss: 0.0472
Epoch [28550/28550], Train Loss: 0.0557, Test Loss: 0.0552
Epoch [28600/28600], Train Loss: 0.0566, Test Loss: 0.0438
Epoch [28650/28650], Train Loss: 0.0828, Test Loss: 0.0537
Epoch [28700/28700], Train Loss: 0.0488, Test Loss: 0.0632
Epoch [28750/28750], Train Loss: 0.0600, Test Loss: 0.0501
Epoch [28800/28800], Train Loss: 0.0514, Test Loss: 0.0729
Epoch [28850/28850], Train Loss: 0.0676, Test Loss: 0.0637
Epoch [28900/28900], Train Loss: 0.0708, Test Loss: 0.0761
Epoch [28950/28950], Train Loss: 0.0527, Test Loss: 0.0620
Epoch [29000/29000], Train Loss: 0.0626, Test Loss: 0.0579
Epoch [29050/29050], Train Loss: 0.0697, Test Loss: 0.0755
Epoch [29100/29100], Train Loss: 0.0543, Test Loss: 0.0550
Epoch [29150/29150], Train Loss: 0.0571, Test Loss: 0.0494
Epoch [29200/29200], Train Loss: 0.0720, Test Loss: 0.0772
Epoch [29250/29250], Train Loss: 0.0858, Test Loss: 0.0603
Epoch [29300/29300], Train Loss: 0.0492, Test Loss: 0.0624
Epoch [29350/29350], Train Loss: 0.0733, Test Loss: 0.0524
Epoch [29400/29400], Train Loss: 0.0675, Test Loss: 0.0622
Epoch [29450/29450], Train Loss: 0.0572, Test Loss: 0.0494
Epoch [29500/29500], Train Loss: 0.0542, Test Loss: 0.0893
Epoch [29550/29550], Train Loss: 0.0568, Test Loss: 0.0421
Epoch [29600/29600], Train Loss: 0.0667, Test Loss: 0.0614
Epoch [29650/29650], Train Loss: 0.0734, Test Loss: 0.0568

Epoch [29700/29700], Train Loss: 0.0587, Test Loss: 0.0535
Epoch [29750/29750], Train Loss: 0.0536, Test Loss: 0.0488
Epoch [29800/29800], Train Loss: 0.0611, Test Loss: 0.0505
Epoch [29850/29850], Train Loss: 0.0551, Test Loss: 0.0565
Epoch [29900/29900], Train Loss: 0.0599, Test Loss: 0.0674
Epoch [29950/29950], Train Loss: 0.0537, Test Loss: 0.0731
Epoch [30000/30000], Train Loss: 0.0550, Test Loss: 0.0626
Epoch [30050/30050], Train Loss: 0.0662, Test Loss: 0.0453
Epoch [30100/30100], Train Loss: 0.0542, Test Loss: 0.0486
Epoch [30150/30150], Train Loss: 0.0589, Test Loss: 0.0532
Epoch [30200/30200], Train Loss: 0.0614, Test Loss: 0.0688
Epoch [30250/30250], Train Loss: 0.0630, Test Loss: 0.0624
Epoch [30300/30300], Train Loss: 0.0530, Test Loss: 0.0621
Epoch [30350/30350], Train Loss: 0.0618, Test Loss: 0.0636
Epoch [30400/30400], Train Loss: 0.0734, Test Loss: 0.0565
Epoch [30450/30450], Train Loss: 0.0524, Test Loss: 0.0607
Epoch [30500/30500], Train Loss: 0.0584, Test Loss: 0.0567
Epoch [30550/30550], Train Loss: 0.0592, Test Loss: 0.0726
Epoch [30600/30600], Train Loss: 0.0498, Test Loss: 0.0580
Epoch [30650/30650], Train Loss: 0.0459, Test Loss: 0.0577
Epoch [30700/30700], Train Loss: 0.0674, Test Loss: 0.0685
Epoch [30750/30750], Train Loss: 0.0595, Test Loss: 0.0550
Epoch [30800/30800], Train Loss: 0.0675, Test Loss: 0.0590
Epoch [30850/30850], Train Loss: 0.0616, Test Loss: 0.0515
Epoch [30900/30900], Train Loss: 0.0614, Test Loss: 0.0477
Epoch [30950/30950], Train Loss: 0.0535, Test Loss: 0.0680
Epoch [31000/31000], Train Loss: 0.0667, Test Loss: 0.0704
Epoch [31050/31050], Train Loss: 0.0637, Test Loss: 0.0612
Epoch [31100/31100], Train Loss: 0.0564, Test Loss: 0.0640
Epoch [31150/31150], Train Loss: 0.0584, Test Loss: 0.0673
Epoch [31200/31200], Train Loss: 0.0630, Test Loss: 0.0494
Epoch [31250/31250], Train Loss: 0.0638, Test Loss: 0.0543
Epoch [31300/31300], Train Loss: 0.0564, Test Loss: 0.0567
Epoch [31350/31350], Train Loss: 0.0604, Test Loss: 0.0521
Epoch [31400/31400], Train Loss: 0.0563, Test Loss: 0.0686
Epoch [31450/31450], Train Loss: 0.0671, Test Loss: 0.0519
Epoch [31500/31500], Train Loss: 0.0738, Test Loss: 0.0484
Epoch [31550/31550], Train Loss: 0.0583, Test Loss: 0.0580
Epoch [31600/31600], Train Loss: 0.0610, Test Loss: 0.0576
Epoch [31650/31650], Train Loss: 0.0396, Test Loss: 0.0436
Epoch [31700/31700], Train Loss: 0.0632, Test Loss: 0.0692
Epoch [31750/31750], Train Loss: 0.0640, Test Loss: 0.0501
Epoch [31800/31800], Train Loss: 0.0669, Test Loss: 0.0744
Epoch [31850/31850], Train Loss: 0.0639, Test Loss: 0.0521
Epoch [31900/31900], Train Loss: 0.0591, Test Loss: 0.0619
Epoch [31950/31950], Train Loss: 0.0629, Test Loss: 0.0526
Epoch [32000/32000], Train Loss: 0.0544, Test Loss: 0.0603
Epoch [32050/32050], Train Loss: 0.0425, Test Loss: 0.0656
Epoch [32100/32100], Train Loss: 0.0564, Test Loss: 0.0719
Epoch [32150/32150], Train Loss: 0.0626, Test Loss: 0.0613
Epoch [32200/32200], Train Loss: 0.0681, Test Loss: 0.0605
Epoch [32250/32250], Train Loss: 0.0567, Test Loss: 0.0488
Epoch [32300/32300], Train Loss: 0.0614, Test Loss: 0.0517
Epoch [32350/32350], Train Loss: 0.0538, Test Loss: 0.0622

Epoch [32400/32400], Train Loss: 0.0606, Test Loss: 0.0695
Epoch [32450/32450], Train Loss: 0.0686, Test Loss: 0.0577
Epoch [32500/32500], Train Loss: 0.0674, Test Loss: 0.0624
Epoch [32550/32550], Train Loss: 0.0613, Test Loss: 0.0627
Epoch [32600/32600], Train Loss: 0.0478, Test Loss: 0.0650
Epoch [32650/32650], Train Loss: 0.0547, Test Loss: 0.0569
Epoch [32700/32700], Train Loss: 0.0496, Test Loss: 0.0462
Epoch [32750/32750], Train Loss: 0.0686, Test Loss: 0.0700
Epoch [32800/32800], Train Loss: 0.0613, Test Loss: 0.0710
Epoch [32850/32850], Train Loss: 0.0661, Test Loss: 0.0718
Epoch [32900/32900], Train Loss: 0.0525, Test Loss: 0.0672
Epoch [32950/32950], Train Loss: 0.0618, Test Loss: 0.0515
Epoch [33000/33000], Train Loss: 0.0629, Test Loss: 0.0657
Epoch [33050/33050], Train Loss: 0.0414, Test Loss: 0.0697
Epoch [33100/33100], Train Loss: 0.0519, Test Loss: 0.0596
Epoch [33150/33150], Train Loss: 0.0633, Test Loss: 0.0514
Epoch [33200/33200], Train Loss: 0.0528, Test Loss: 0.0648
Epoch [33250/33250], Train Loss: 0.0576, Test Loss: 0.0609
Epoch [33300/33300], Train Loss: 0.0519, Test Loss: 0.0468
Epoch [33350/33350], Train Loss: 0.0539, Test Loss: 0.0534
Epoch [33400/33400], Train Loss: 0.0588, Test Loss: 0.0576
Epoch [33450/33450], Train Loss: 0.0715, Test Loss: 0.0733
Epoch [33500/33500], Train Loss: 0.0504, Test Loss: 0.0607
Epoch [33550/33550], Train Loss: 0.0581, Test Loss: 0.0611
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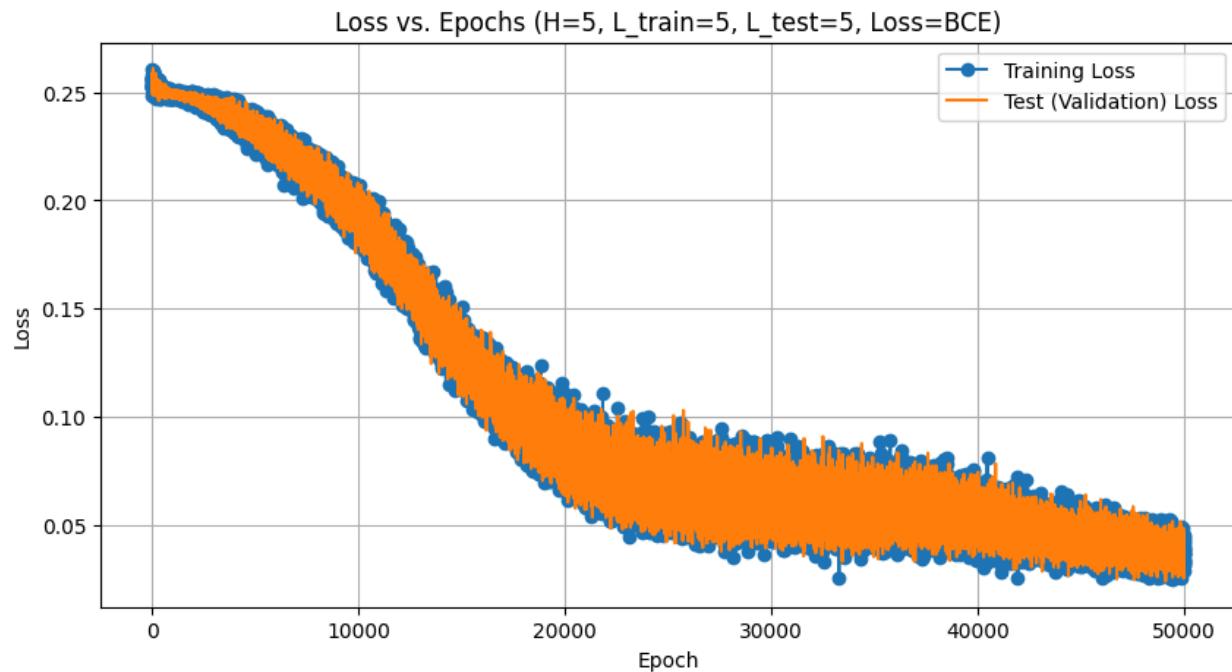
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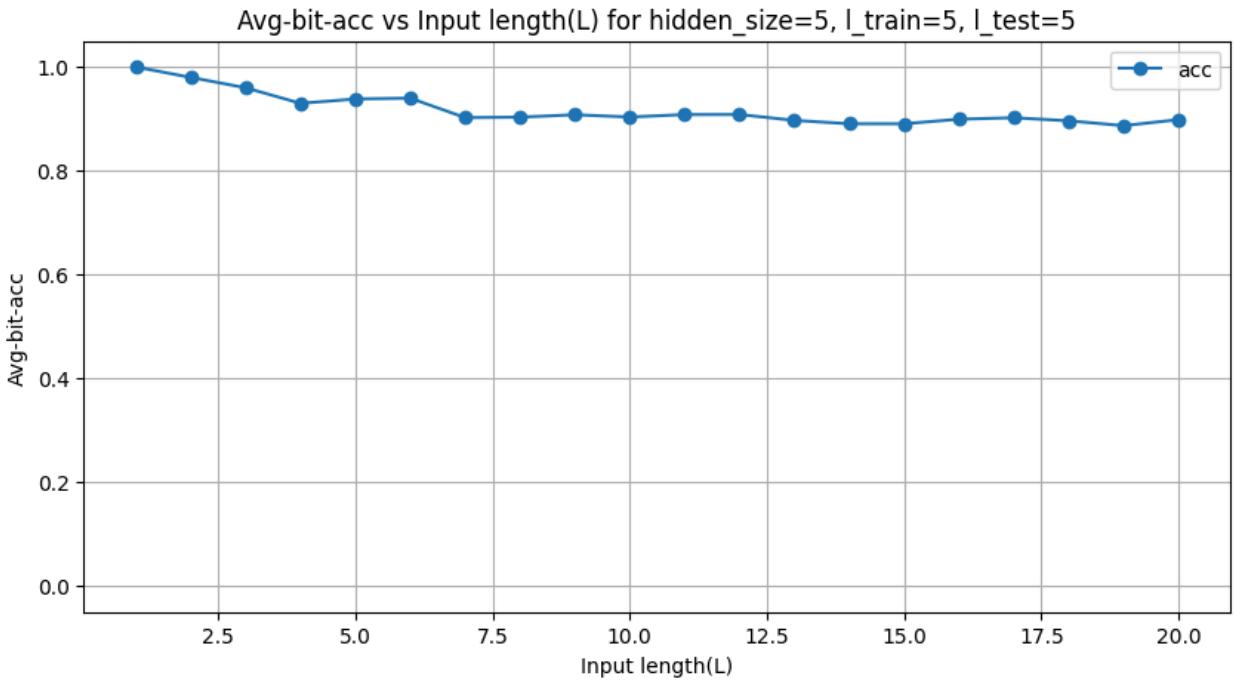
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Epoch [48900/48900], Train Loss: 0.0410, Test Loss: 0.0338
Epoch [48950/48950], Train Loss: 0.0322, Test Loss: 0.0357
Epoch [49000/49000], Train Loss: 0.0351, Test Loss: 0.0364
Epoch [49050/49050], Train Loss: 0.0380, Test Loss: 0.0348
Epoch [49100/49100], Train Loss: 0.0380, Test Loss: 0.0378
Epoch [49150/49150], Train Loss: 0.0419, Test Loss: 0.0378
Epoch [49200/49200], Train Loss: 0.0402, Test Loss: 0.0342
Epoch [49250/49250], Train Loss: 0.0321, Test Loss: 0.0356
Epoch [49300/49300], Train Loss: 0.0354, Test Loss: 0.0410
Epoch [49350/49350], Train Loss: 0.0379, Test Loss: 0.0405
Epoch [49400/49400], Train Loss: 0.0391, Test Loss: 0.0395
Epoch [49450/49450], Train Loss: 0.0394, Test Loss: 0.0403
Epoch [49500/49500], Train Loss: 0.0406, Test Loss: 0.0401
Epoch [49550/49550], Train Loss: 0.0353, Test Loss: 0.0404
Epoch [49600/49600], Train Loss: 0.0406, Test Loss: 0.0272
Epoch [49650/49650], Train Loss: 0.0416, Test Loss: 0.0336
Epoch [49700/49700], Train Loss: 0.0336, Test Loss: 0.0328
Epoch [49750/49750], Train Loss: 0.0367, Test Loss: 0.0461
Epoch [49800/49800], Train Loss: 0.0369, Test Loss: 0.0405
Epoch [49850/49850], Train Loss: 0.0346, Test Loss: 0.0388
Epoch [49900/49900], Train Loss: 0.0348, Test Loss: 0.0384
Epoch [49950/49950], Train Loss: 0.0420, Test Loss: 0.0330
```

```
In [ ]: plot_loss(train_loss,test_loss,hidden_size,l_train,l_test,loss_type)
```



```
In [ ]: avg_bit_accuracy(model_1,hidden_size,l_train,l_test,batch_size=100)
```



Out[]: 0.9172276765108108

MODEL_2:

```
In [ ]: input_size=2
hidden_size=10
num_layers=1
l_train=5
l_test=5
epochs=50000
batch_size=128
lr=1e-4
loss_type="BCE"
```

```
In [ ]: model_2=Binary_adder(input_size,hidden_size,num_layers).to(device)
criterion=nn.BCELoss()
optimizer=torch.optim.Adam(model_2.parameters(),lr=lr)
```

```
In [ ]: train_loss,test_loss=training_loop(model_2,epochs,optimizer,criterion,batch_si
```

Epoch [0/0], Train Loss: 0.6919, Test Loss: 0.6933
Epoch [50/50], Train Loss: 0.6923, Test Loss: 0.6929
Epoch [100/100], Train Loss: 0.6926, Test Loss: 0.6929
Epoch [150/150], Train Loss: 0.6933, Test Loss: 0.6929
Epoch [200/200], Train Loss: 0.6928, Test Loss: 0.6934
Epoch [250/250], Train Loss: 0.6925, Test Loss: 0.6921
Epoch [300/300], Train Loss: 0.6928, Test Loss: 0.6930
Epoch [350/350], Train Loss: 0.6916, Test Loss: 0.6914
Epoch [400/400], Train Loss: 0.6928, Test Loss: 0.6926
Epoch [450/450], Train Loss: 0.6921, Test Loss: 0.6923
Epoch [500/500], Train Loss: 0.6917, Test Loss: 0.6920
Epoch [550/550], Train Loss: 0.6921, Test Loss: 0.6920
Epoch [600/600], Train Loss: 0.6925, Test Loss: 0.6917
Epoch [650/650], Train Loss: 0.6920, Test Loss: 0.6924
Epoch [700/700], Train Loss: 0.6920, Test Loss: 0.6920
Epoch [750/750], Train Loss: 0.6916, Test Loss: 0.6923
Epoch [800/800], Train Loss: 0.6926, Test Loss: 0.6904
Epoch [850/850], Train Loss: 0.6909, Test Loss: 0.6922
Epoch [900/900], Train Loss: 0.6911, Test Loss: 0.6910
Epoch [950/950], Train Loss: 0.6903, Test Loss: 0.6910
Epoch [1000/1000], Train Loss: 0.6900, Test Loss: 0.6887
Epoch [1050/1050], Train Loss: 0.6886, Test Loss: 0.6895
Epoch [1100/1100], Train Loss: 0.6896, Test Loss: 0.6892
Epoch [1150/1150], Train Loss: 0.6875, Test Loss: 0.6891
Epoch [1200/1200], Train Loss: 0.6881, Test Loss: 0.6884
Epoch [1250/1250], Train Loss: 0.6885, Test Loss: 0.6896
Epoch [1300/1300], Train Loss: 0.6881, Test Loss: 0.6890
Epoch [1350/1350], Train Loss: 0.6852, Test Loss: 0.6863
Epoch [1400/1400], Train Loss: 0.6842, Test Loss: 0.6848
Epoch [1450/1450], Train Loss: 0.6839, Test Loss: 0.6836
Epoch [1500/1500], Train Loss: 0.6879, Test Loss: 0.6845
Epoch [1550/1550], Train Loss: 0.6804, Test Loss: 0.6816
Epoch [1600/1600], Train Loss: 0.6783, Test Loss: 0.6791
Epoch [1650/1650], Train Loss: 0.6834, Test Loss: 0.6833
Epoch [1700/1700], Train Loss: 0.6811, Test Loss: 0.6841
Epoch [1750/1750], Train Loss: 0.6755, Test Loss: 0.6816
Epoch [1800/1800], Train Loss: 0.6795, Test Loss: 0.6732
Epoch [1850/1850], Train Loss: 0.6811, Test Loss: 0.6717
Epoch [1900/1900], Train Loss: 0.6790, Test Loss: 0.6791
Epoch [1950/1950], Train Loss: 0.6716, Test Loss: 0.6771
Epoch [2000/2000], Train Loss: 0.6774, Test Loss: 0.6738
Epoch [2050/2050], Train Loss: 0.6746, Test Loss: 0.6744
Epoch [2100/2100], Train Loss: 0.6807, Test Loss: 0.6712
Epoch [2150/2150], Train Loss: 0.6719, Test Loss: 0.6647
Epoch [2200/2200], Train Loss: 0.6782, Test Loss: 0.6768
Epoch [2250/2250], Train Loss: 0.6722, Test Loss: 0.6687
Epoch [2300/2300], Train Loss: 0.6736, Test Loss: 0.6743
Epoch [2350/2350], Train Loss: 0.6640, Test Loss: 0.6718
Epoch [2400/2400], Train Loss: 0.6670, Test Loss: 0.6769
Epoch [2450/2450], Train Loss: 0.6718, Test Loss: 0.6710
Epoch [2500/2500], Train Loss: 0.6734, Test Loss: 0.6607
Epoch [2550/2550], Train Loss: 0.6609, Test Loss: 0.6670
Epoch [2600/2600], Train Loss: 0.6597, Test Loss: 0.6615
Epoch [2650/2650], Train Loss: 0.6579, Test Loss: 0.6730

Epoch [2700/2700], Train Loss: 0.6671, Test Loss: 0.6616
Epoch [2750/2750], Train Loss: 0.6616, Test Loss: 0.6673
Epoch [2800/2800], Train Loss: 0.6592, Test Loss: 0.6631
Epoch [2850/2850], Train Loss: 0.6612, Test Loss: 0.6547
Epoch [2900/2900], Train Loss: 0.6622, Test Loss: 0.6563
Epoch [2950/2950], Train Loss: 0.6659, Test Loss: 0.6531
Epoch [3000/3000], Train Loss: 0.6617, Test Loss: 0.6453
Epoch [3050/3050], Train Loss: 0.6628, Test Loss: 0.6529
Epoch [3100/3100], Train Loss: 0.6645, Test Loss: 0.6567
Epoch [3150/3150], Train Loss: 0.6456, Test Loss: 0.6604
Epoch [3200/3200], Train Loss: 0.6498, Test Loss: 0.6495
Epoch [3250/3250], Train Loss: 0.6570, Test Loss: 0.6403
Epoch [3300/3300], Train Loss: 0.6453, Test Loss: 0.6597
Epoch [3350/3350], Train Loss: 0.6600, Test Loss: 0.6477
Epoch [3400/3400], Train Loss: 0.6452, Test Loss: 0.6553
Epoch [3450/3450], Train Loss: 0.6378, Test Loss: 0.6471
Epoch [3500/3500], Train Loss: 0.6592, Test Loss: 0.6560
Epoch [3550/3550], Train Loss: 0.6501, Test Loss: 0.6487
Epoch [3600/3600], Train Loss: 0.6530, Test Loss: 0.6382
Epoch [3650/3650], Train Loss: 0.6485, Test Loss: 0.6405
Epoch [3700/3700], Train Loss: 0.6471, Test Loss: 0.6439
Epoch [3750/3750], Train Loss: 0.6374, Test Loss: 0.6435
Epoch [3800/3800], Train Loss: 0.6318, Test Loss: 0.6455
Epoch [3850/3850], Train Loss: 0.6424, Test Loss: 0.6370
Epoch [3900/3900], Train Loss: 0.6361, Test Loss: 0.6366
Epoch [3950/3950], Train Loss: 0.6481, Test Loss: 0.6480
Epoch [4000/4000], Train Loss: 0.6350, Test Loss: 0.6507
Epoch [4050/4050], Train Loss: 0.6381, Test Loss: 0.6316
Epoch [4100/4100], Train Loss: 0.6407, Test Loss: 0.6378
Epoch [4150/4150], Train Loss: 0.6323, Test Loss: 0.6336
Epoch [4200/4200], Train Loss: 0.6172, Test Loss: 0.6291
Epoch [4250/4250], Train Loss: 0.6181, Test Loss: 0.6233
Epoch [4300/4300], Train Loss: 0.6321, Test Loss: 0.6315
Epoch [4350/4350], Train Loss: 0.6247, Test Loss: 0.6276
Epoch [4400/4400], Train Loss: 0.6414, Test Loss: 0.6296
Epoch [4450/4450], Train Loss: 0.6297, Test Loss: 0.6334
Epoch [4500/4500], Train Loss: 0.6404, Test Loss: 0.6254
Epoch [4550/4550], Train Loss: 0.6158, Test Loss: 0.6240
Epoch [4600/4600], Train Loss: 0.6339, Test Loss: 0.6251
Epoch [4650/4650], Train Loss: 0.6266, Test Loss: 0.6125
Epoch [4700/4700], Train Loss: 0.6242, Test Loss: 0.6173
Epoch [4750/4750], Train Loss: 0.6146, Test Loss: 0.6251
Epoch [4800/4800], Train Loss: 0.6288, Test Loss: 0.6216
Epoch [4850/4850], Train Loss: 0.6148, Test Loss: 0.6182
Epoch [4900/4900], Train Loss: 0.6147, Test Loss: 0.6225
Epoch [4950/4950], Train Loss: 0.6127, Test Loss: 0.6141
Epoch [5000/5000], Train Loss: 0.6077, Test Loss: 0.6006
Epoch [5050/5050], Train Loss: 0.6143, Test Loss: 0.5953
Epoch [5100/5100], Train Loss: 0.6095, Test Loss: 0.5968
Epoch [5150/5150], Train Loss: 0.6041, Test Loss: 0.6109
Epoch [5200/5200], Train Loss: 0.6113, Test Loss: 0.6022
Epoch [5250/5250], Train Loss: 0.6049, Test Loss: 0.6004
Epoch [5300/5300], Train Loss: 0.5935, Test Loss: 0.6207
Epoch [5350/5350], Train Loss: 0.5919, Test Loss: 0.6054

Epoch [5400/5400], Train Loss: 0.6047, Test Loss: 0.6143
Epoch [5450/5450], Train Loss: 0.6072, Test Loss: 0.6028
Epoch [5500/5500], Train Loss: 0.5835, Test Loss: 0.6034
Epoch [5550/5550], Train Loss: 0.5957, Test Loss: 0.5936
Epoch [5600/5600], Train Loss: 0.5786, Test Loss: 0.5918
Epoch [5650/5650], Train Loss: 0.5892, Test Loss: 0.5999
Epoch [5700/5700], Train Loss: 0.5916, Test Loss: 0.5892
Epoch [5750/5750], Train Loss: 0.5909, Test Loss: 0.5823
Epoch [5800/5800], Train Loss: 0.6011, Test Loss: 0.5961
Epoch [5850/5850], Train Loss: 0.5812, Test Loss: 0.5725
Epoch [5900/5900], Train Loss: 0.5803, Test Loss: 0.5797
Epoch [5950/5950], Train Loss: 0.5649, Test Loss: 0.5832
Epoch [6000/6000], Train Loss: 0.5799, Test Loss: 0.5705
Epoch [6050/6050], Train Loss: 0.5860, Test Loss: 0.5792
Epoch [6100/6100], Train Loss: 0.5634, Test Loss: 0.5822
Epoch [6150/6150], Train Loss: 0.5703, Test Loss: 0.5734
Epoch [6200/6200], Train Loss: 0.5784, Test Loss: 0.5601
Epoch [6250/6250], Train Loss: 0.5586, Test Loss: 0.5601
Epoch [6300/6300], Train Loss: 0.5471, Test Loss: 0.5785
Epoch [6350/6350], Train Loss: 0.5596, Test Loss: 0.5878
Epoch [6400/6400], Train Loss: 0.5468, Test Loss: 0.5568
Epoch [6450/6450], Train Loss: 0.5519, Test Loss: 0.5473
Epoch [6500/6500], Train Loss: 0.5627, Test Loss: 0.5606
Epoch [6550/6550], Train Loss: 0.5482, Test Loss: 0.5447
Epoch [6600/6600], Train Loss: 0.5336, Test Loss: 0.5420
Epoch [6650/6650], Train Loss: 0.5474, Test Loss: 0.5458
Epoch [6700/6700], Train Loss: 0.5427, Test Loss: 0.5569
Epoch [6750/6750], Train Loss: 0.5509, Test Loss: 0.5284
Epoch [6800/6800], Train Loss: 0.5432, Test Loss: 0.5383
Epoch [6850/6850], Train Loss: 0.5300, Test Loss: 0.5324
Epoch [6900/6900], Train Loss: 0.5361, Test Loss: 0.5380
Epoch [6950/6950], Train Loss: 0.5333, Test Loss: 0.5283
Epoch [7000/7000], Train Loss: 0.5289, Test Loss: 0.5361
Epoch [7050/7050], Train Loss: 0.5127, Test Loss: 0.5117
Epoch [7100/7100], Train Loss: 0.5228, Test Loss: 0.5352
Epoch [7150/7150], Train Loss: 0.5511, Test Loss: 0.5241
Epoch [7200/7200], Train Loss: 0.5253, Test Loss: 0.5234
Epoch [7250/7250], Train Loss: 0.5045, Test Loss: 0.5197
Epoch [7300/7300], Train Loss: 0.5150, Test Loss: 0.5134
Epoch [7350/7350], Train Loss: 0.5147, Test Loss: 0.5127
Epoch [7400/7400], Train Loss: 0.4993, Test Loss: 0.4940
Epoch [7450/7450], Train Loss: 0.5011, Test Loss: 0.5013
Epoch [7500/7500], Train Loss: 0.5069, Test Loss: 0.4972
Epoch [7550/7550], Train Loss: 0.4977, Test Loss: 0.4920
Epoch [7600/7600], Train Loss: 0.4974, Test Loss: 0.4794
Epoch [7650/7650], Train Loss: 0.4962, Test Loss: 0.5041
Epoch [7700/7700], Train Loss: 0.4773, Test Loss: 0.4859
Epoch [7750/7750], Train Loss: 0.4908, Test Loss: 0.4805
Epoch [7800/7800], Train Loss: 0.4897, Test Loss: 0.5009
Epoch [7850/7850], Train Loss: 0.4696, Test Loss: 0.4790
Epoch [7900/7900], Train Loss: 0.4763, Test Loss: 0.4568
Epoch [7950/7950], Train Loss: 0.4751, Test Loss: 0.4863
Epoch [8000/8000], Train Loss: 0.4802, Test Loss: 0.4591
Epoch [8050/8050], Train Loss: 0.4694, Test Loss: 0.4705

Epoch [8100/8100], Train Loss: 0.4527, Test Loss: 0.4642
Epoch [8150/8150], Train Loss: 0.4822, Test Loss: 0.4569
Epoch [8200/8200], Train Loss: 0.4396, Test Loss: 0.4482
Epoch [8250/8250], Train Loss: 0.4490, Test Loss: 0.4531
Epoch [8300/8300], Train Loss: 0.4484, Test Loss: 0.4606
Epoch [8350/8350], Train Loss: 0.4510, Test Loss: 0.4198
Epoch [8400/8400], Train Loss: 0.4469, Test Loss: 0.4359
Epoch [8450/8450], Train Loss: 0.4327, Test Loss: 0.4229
Epoch [8500/8500], Train Loss: 0.4273, Test Loss: 0.4428
Epoch [8550/8550], Train Loss: 0.4365, Test Loss: 0.4270
Epoch [8600/8600], Train Loss: 0.4293, Test Loss: 0.4212
Epoch [8650/8650], Train Loss: 0.4232, Test Loss: 0.4397
Epoch [8700/8700], Train Loss: 0.4043, Test Loss: 0.4127
Epoch [8750/8750], Train Loss: 0.4139, Test Loss: 0.4195
Epoch [8800/8800], Train Loss: 0.4168, Test Loss: 0.3920
Epoch [8850/8850], Train Loss: 0.3972, Test Loss: 0.4265
Epoch [8900/8900], Train Loss: 0.4142, Test Loss: 0.4174
Epoch [8950/8950], Train Loss: 0.4279, Test Loss: 0.3930
Epoch [9000/9000], Train Loss: 0.4223, Test Loss: 0.4092
Epoch [9050/9050], Train Loss: 0.4009, Test Loss: 0.3870
Epoch [9100/9100], Train Loss: 0.4054, Test Loss: 0.4045
Epoch [9150/9150], Train Loss: 0.4022, Test Loss: 0.4050
Epoch [9200/9200], Train Loss: 0.3954, Test Loss: 0.4011
Epoch [9250/9250], Train Loss: 0.3739, Test Loss: 0.3747
Epoch [9300/9300], Train Loss: 0.3671, Test Loss: 0.4049
Epoch [9350/9350], Train Loss: 0.3756, Test Loss: 0.3977
Epoch [9400/9400], Train Loss: 0.3807, Test Loss: 0.3594
Epoch [9450/9450], Train Loss: 0.3817, Test Loss: 0.3845
Epoch [9500/9500], Train Loss: 0.3619, Test Loss: 0.3894
Epoch [9550/9550], Train Loss: 0.3822, Test Loss: 0.3687
Epoch [9600/9600], Train Loss: 0.3704, Test Loss: 0.3739
Epoch [9650/9650], Train Loss: 0.3914, Test Loss: 0.3756
Epoch [9700/9700], Train Loss: 0.3568, Test Loss: 0.3549
Epoch [9750/9750], Train Loss: 0.3694, Test Loss: 0.3869
Epoch [9800/9800], Train Loss: 0.3815, Test Loss: 0.3577
Epoch [9850/9850], Train Loss: 0.3530, Test Loss: 0.3594
Epoch [9900/9900], Train Loss: 0.3511, Test Loss: 0.3576
Epoch [9950/9950], Train Loss: 0.3515, Test Loss: 0.3368
Epoch [10000/10000], Train Loss: 0.3462, Test Loss: 0.3605
Epoch [10050/10050], Train Loss: 0.3769, Test Loss: 0.3575
Epoch [10100/10100], Train Loss: 0.3183, Test Loss: 0.3347
Epoch [10150/10150], Train Loss: 0.3378, Test Loss: 0.3282
Epoch [10200/10200], Train Loss: 0.3331, Test Loss: 0.3317
Epoch [10250/10250], Train Loss: 0.3415, Test Loss: 0.3393
Epoch [10300/10300], Train Loss: 0.3251, Test Loss: 0.3477
Epoch [10350/10350], Train Loss: 0.3449, Test Loss: 0.3378
Epoch [10400/10400], Train Loss: 0.3612, Test Loss: 0.3326
Epoch [10450/10450], Train Loss: 0.3266, Test Loss: 0.3331
Epoch [10500/10500], Train Loss: 0.3183, Test Loss: 0.3370
Epoch [10550/10550], Train Loss: 0.3297, Test Loss: 0.3190
Epoch [10600/10600], Train Loss: 0.3154, Test Loss: 0.3242
Epoch [10650/10650], Train Loss: 0.3230, Test Loss: 0.3177
Epoch [10700/10700], Train Loss: 0.3188, Test Loss: 0.3117
Epoch [10750/10750], Train Loss: 0.3039, Test Loss: 0.3111

Epoch [10800/10800], Train Loss: 0.2887, Test Loss: 0.3000
Epoch [10850/10850], Train Loss: 0.3025, Test Loss: 0.3206
Epoch [10900/10900], Train Loss: 0.3106, Test Loss: 0.3039
Epoch [10950/10950], Train Loss: 0.2980, Test Loss: 0.3246
Epoch [11000/11000], Train Loss: 0.3010, Test Loss: 0.2897
Epoch [11050/11050], Train Loss: 0.3001, Test Loss: 0.3009
Epoch [11100/11100], Train Loss: 0.2975, Test Loss: 0.2915
Epoch [11150/11150], Train Loss: 0.3013, Test Loss: 0.3250
Epoch [11200/11200], Train Loss: 0.3009, Test Loss: 0.2994
Epoch [11250/11250], Train Loss: 0.2998, Test Loss: 0.3268
Epoch [11300/11300], Train Loss: 0.2823, Test Loss: 0.2805
Epoch [11350/11350], Train Loss: 0.2912, Test Loss: 0.2759
Epoch [11400/11400], Train Loss: 0.2913, Test Loss: 0.2807
Epoch [11450/11450], Train Loss: 0.2820, Test Loss: 0.2808
Epoch [11500/11500], Train Loss: 0.2805, Test Loss: 0.3009
Epoch [11550/11550], Train Loss: 0.2934, Test Loss: 0.3037
Epoch [11600/11600], Train Loss: 0.2713, Test Loss: 0.2597
Epoch [11650/11650], Train Loss: 0.2868, Test Loss: 0.2844
Epoch [11700/11700], Train Loss: 0.2958, Test Loss: 0.2772
Epoch [11750/11750], Train Loss: 0.2762, Test Loss: 0.2618
Epoch [11800/11800], Train Loss: 0.2790, Test Loss: 0.2754
Epoch [11850/11850], Train Loss: 0.2864, Test Loss: 0.2694
Epoch [11900/11900], Train Loss: 0.2705, Test Loss: 0.2641
Epoch [11950/11950], Train Loss: 0.2796, Test Loss: 0.2470
Epoch [12000/12000], Train Loss: 0.2650, Test Loss: 0.2667
Epoch [12050/12050], Train Loss: 0.2557, Test Loss: 0.2599
Epoch [12100/12100], Train Loss: 0.2625, Test Loss: 0.2491
Epoch [12150/12150], Train Loss: 0.2470, Test Loss: 0.2556
Epoch [12200/12200], Train Loss: 0.2763, Test Loss: 0.2589
Epoch [12250/12250], Train Loss: 0.2515, Test Loss: 0.2586
Epoch [12300/12300], Train Loss: 0.2495, Test Loss: 0.2631
Epoch [12350/12350], Train Loss: 0.2467, Test Loss: 0.2449
Epoch [12400/12400], Train Loss: 0.2712, Test Loss: 0.2577
Epoch [12450/12450], Train Loss: 0.2483, Test Loss: 0.2414
Epoch [12500/12500], Train Loss: 0.2603, Test Loss: 0.2368
Epoch [12550/12550], Train Loss: 0.2565, Test Loss: 0.2391
Epoch [12600/12600], Train Loss: 0.2503, Test Loss: 0.2300
Epoch [12650/12650], Train Loss: 0.2357, Test Loss: 0.2306
Epoch [12700/12700], Train Loss: 0.2300, Test Loss: 0.2346
Epoch [12750/12750], Train Loss: 0.2423, Test Loss: 0.2433
Epoch [12800/12800], Train Loss: 0.2306, Test Loss: 0.2538
Epoch [12850/12850], Train Loss: 0.2365, Test Loss: 0.2408
Epoch [12900/12900], Train Loss: 0.2385, Test Loss: 0.2177
Epoch [12950/12950], Train Loss: 0.2448, Test Loss: 0.2202
Epoch [13000/13000], Train Loss: 0.2303, Test Loss: 0.2239
Epoch [13050/13050], Train Loss: 0.2202, Test Loss: 0.2077
Epoch [13100/13100], Train Loss: 0.2268, Test Loss: 0.2367
Epoch [13150/13150], Train Loss: 0.2457, Test Loss: 0.2145
Epoch [13200/13200], Train Loss: 0.2375, Test Loss: 0.2190
Epoch [13250/13250], Train Loss: 0.2281, Test Loss: 0.2260
Epoch [13300/13300], Train Loss: 0.2115, Test Loss: 0.2201
Epoch [13350/13350], Train Loss: 0.2403, Test Loss: 0.2097
Epoch [13400/13400], Train Loss: 0.2296, Test Loss: 0.2461
Epoch [13450/13450], Train Loss: 0.2239, Test Loss: 0.2032

Epoch [13500/13500], Train Loss: 0.2335, Test Loss: 0.2002
Epoch [13550/13550], Train Loss: 0.2244, Test Loss: 0.2179
Epoch [13600/13600], Train Loss: 0.1940, Test Loss: 0.2075
Epoch [13650/13650], Train Loss: 0.2033, Test Loss: 0.2019
Epoch [13700/13700], Train Loss: 0.2026, Test Loss: 0.2370
Epoch [13750/13750], Train Loss: 0.1935, Test Loss: 0.2260
Epoch [13800/13800], Train Loss: 0.1893, Test Loss: 0.2139
Epoch [13850/13850], Train Loss: 0.2111, Test Loss: 0.2116
Epoch [13900/13900], Train Loss: 0.1914, Test Loss: 0.2004
Epoch [13950/13950], Train Loss: 0.2087, Test Loss: 0.1963
Epoch [14000/14000], Train Loss: 0.2111, Test Loss: 0.2078
Epoch [14050/14050], Train Loss: 0.2077, Test Loss: 0.1933
Epoch [14100/14100], Train Loss: 0.1844, Test Loss: 0.2045
Epoch [14150/14150], Train Loss: 0.2093, Test Loss: 0.2072
Epoch [14200/14200], Train Loss: 0.1849, Test Loss: 0.2040
Epoch [14250/14250], Train Loss: 0.1800, Test Loss: 0.2035
Epoch [14300/14300], Train Loss: 0.1767, Test Loss: 0.1799
Epoch [14350/14350], Train Loss: 0.2060, Test Loss: 0.2049
Epoch [14400/14400], Train Loss: 0.1915, Test Loss: 0.1882
Epoch [14450/14450], Train Loss: 0.1561, Test Loss: 0.1733
Epoch [14500/14500], Train Loss: 0.1736, Test Loss: 0.1652
Epoch [14550/14550], Train Loss: 0.1996, Test Loss: 0.1854
Epoch [14600/14600], Train Loss: 0.1807, Test Loss: 0.1875
Epoch [14650/14650], Train Loss: 0.1791, Test Loss: 0.1736
Epoch [14700/14700], Train Loss: 0.1782, Test Loss: 0.1840
Epoch [14750/14750], Train Loss: 0.1896, Test Loss: 0.1693
Epoch [14800/14800], Train Loss: 0.1749, Test Loss: 0.2000
Epoch [14850/14850], Train Loss: 0.1814, Test Loss: 0.1856
Epoch [14900/14900], Train Loss: 0.1953, Test Loss: 0.1902
Epoch [14950/14950], Train Loss: 0.1695, Test Loss: 0.1668
Epoch [15000/15000], Train Loss: 0.1696, Test Loss: 0.1876
Epoch [15050/15050], Train Loss: 0.1793, Test Loss: 0.1934
Epoch [15100/15100], Train Loss: 0.1813, Test Loss: 0.1694
Epoch [15150/15150], Train Loss: 0.1787, Test Loss: 0.1858
Epoch [15200/15200], Train Loss: 0.1712, Test Loss: 0.1715
Epoch [15250/15250], Train Loss: 0.1705, Test Loss: 0.1677
Epoch [15300/15300], Train Loss: 0.1618, Test Loss: 0.1704
Epoch [15350/15350], Train Loss: 0.1748, Test Loss: 0.1719
Epoch [15400/15400], Train Loss: 0.1692, Test Loss: 0.1584
Epoch [15450/15450], Train Loss: 0.1504, Test Loss: 0.1580
Epoch [15500/15500], Train Loss: 0.1731, Test Loss: 0.1781
Epoch [15550/15550], Train Loss: 0.1826, Test Loss: 0.1593
Epoch [15600/15600], Train Loss: 0.1788, Test Loss: 0.1645
Epoch [15650/15650], Train Loss: 0.1651, Test Loss: 0.1753
Epoch [15700/15700], Train Loss: 0.1541, Test Loss: 0.1682
Epoch [15750/15750], Train Loss: 0.1822, Test Loss: 0.1643
Epoch [15800/15800], Train Loss: 0.1458, Test Loss: 0.1631
Epoch [15850/15850], Train Loss: 0.1688, Test Loss: 0.1794
Epoch [15900/15900], Train Loss: 0.1579, Test Loss: 0.1544
Epoch [15950/15950], Train Loss: 0.1527, Test Loss: 0.1640
Epoch [16000/16000], Train Loss: 0.1662, Test Loss: 0.1519
Epoch [16050/16050], Train Loss: 0.1612, Test Loss: 0.1548
Epoch [16100/16100], Train Loss: 0.1526, Test Loss: 0.1577
Epoch [16150/16150], Train Loss: 0.1517, Test Loss: 0.1296

Epoch [16200/16200], Train Loss: 0.1617, Test Loss: 0.1483
Epoch [16250/16250], Train Loss: 0.1557, Test Loss: 0.1425
Epoch [16300/16300], Train Loss: 0.1525, Test Loss: 0.1447
Epoch [16350/16350], Train Loss: 0.1718, Test Loss: 0.1473
Epoch [16400/16400], Train Loss: 0.1460, Test Loss: 0.1487
Epoch [16450/16450], Train Loss: 0.1453, Test Loss: 0.1474
Epoch [16500/16500], Train Loss: 0.1561, Test Loss: 0.1770
Epoch [16550/16550], Train Loss: 0.1421, Test Loss: 0.1491
Epoch [16600/16600], Train Loss: 0.1469, Test Loss: 0.1513
Epoch [16650/16650], Train Loss: 0.1635, Test Loss: 0.1374
Epoch [16700/16700], Train Loss: 0.1382, Test Loss: 0.1437
Epoch [16750/16750], Train Loss: 0.1350, Test Loss: 0.1480
Epoch [16800/16800], Train Loss: 0.1423, Test Loss: 0.1368
Epoch [16850/16850], Train Loss: 0.1599, Test Loss: 0.1426
Epoch [16900/16900], Train Loss: 0.1483, Test Loss: 0.1492
Epoch [16950/16950], Train Loss: 0.1509, Test Loss: 0.1291
Epoch [17000/17000], Train Loss: 0.1369, Test Loss: 0.1448
Epoch [17050/17050], Train Loss: 0.1332, Test Loss: 0.1530
Epoch [17100/17100], Train Loss: 0.1434, Test Loss: 0.1497
Epoch [17150/17150], Train Loss: 0.1366, Test Loss: 0.1474
Epoch [17200/17200], Train Loss: 0.1364, Test Loss: 0.1136
Epoch [17250/17250], Train Loss: 0.1365, Test Loss: 0.1426
Epoch [17300/17300], Train Loss: 0.1514, Test Loss: 0.1442
Epoch [17350/17350], Train Loss: 0.1382, Test Loss: 0.1283
Epoch [17400/17400], Train Loss: 0.1517, Test Loss: 0.1450
Epoch [17450/17450], Train Loss: 0.1288, Test Loss: 0.1266
Epoch [17500/17500], Train Loss: 0.1485, Test Loss: 0.1397
Epoch [17550/17550], Train Loss: 0.1396, Test Loss: 0.1318
Epoch [17600/17600], Train Loss: 0.1406, Test Loss: 0.1352
Epoch [17650/17650], Train Loss: 0.1541, Test Loss: 0.1551
Epoch [17700/17700], Train Loss: 0.1253, Test Loss: 0.1436
Epoch [17750/17750], Train Loss: 0.1254, Test Loss: 0.1391
Epoch [17800/17800], Train Loss: 0.1317, Test Loss: 0.1444
Epoch [17850/17850], Train Loss: 0.1387, Test Loss: 0.1253
Epoch [17900/17900], Train Loss: 0.1388, Test Loss: 0.1405
Epoch [17950/17950], Train Loss: 0.1260, Test Loss: 0.1098
Epoch [18000/18000], Train Loss: 0.1444, Test Loss: 0.1187
Epoch [18050/18050], Train Loss: 0.1266, Test Loss: 0.1381
Epoch [18100/18100], Train Loss: 0.1367, Test Loss: 0.1315
Epoch [18150/18150], Train Loss: 0.1121, Test Loss: 0.1348
Epoch [18200/18200], Train Loss: 0.1338, Test Loss: 0.1321
Epoch [18250/18250], Train Loss: 0.1115, Test Loss: 0.1452
Epoch [18300/18300], Train Loss: 0.1439, Test Loss: 0.1274
Epoch [18350/18350], Train Loss: 0.1370, Test Loss: 0.1174
Epoch [18400/18400], Train Loss: 0.1385, Test Loss: 0.1182
Epoch [18450/18450], Train Loss: 0.1220, Test Loss: 0.1146
Epoch [18500/18500], Train Loss: 0.1131, Test Loss: 0.1269
Epoch [18550/18550], Train Loss: 0.1126, Test Loss: 0.1241
Epoch [18600/18600], Train Loss: 0.1126, Test Loss: 0.0968
Epoch [18650/18650], Train Loss: 0.1258, Test Loss: 0.1292
Epoch [18700/18700], Train Loss: 0.1357, Test Loss: 0.1164
Epoch [18750/18750], Train Loss: 0.1115, Test Loss: 0.1202
Epoch [18800/18800], Train Loss: 0.1033, Test Loss: 0.1160
Epoch [18850/18850], Train Loss: 0.1274, Test Loss: 0.1131

Epoch [18900/18900], Train Loss: 0.1066, Test Loss: 0.1204
Epoch [18950/18950], Train Loss: 0.1109, Test Loss: 0.1205
Epoch [19000/19000], Train Loss: 0.1093, Test Loss: 0.1057
Epoch [19050/19050], Train Loss: 0.1129, Test Loss: 0.1254
Epoch [19100/19100], Train Loss: 0.1140, Test Loss: 0.1131
Epoch [19150/19150], Train Loss: 0.1155, Test Loss: 0.1176
Epoch [19200/19200], Train Loss: 0.1058, Test Loss: 0.1146
Epoch [19250/19250], Train Loss: 0.1019, Test Loss: 0.1161
Epoch [19300/19300], Train Loss: 0.0922, Test Loss: 0.1109
Epoch [19350/19350], Train Loss: 0.0970, Test Loss: 0.1113
Epoch [19400/19400], Train Loss: 0.1229, Test Loss: 0.1006
Epoch [19450/19450], Train Loss: 0.1079, Test Loss: 0.1105
Epoch [19500/19500], Train Loss: 0.1108, Test Loss: 0.0980
Epoch [19550/19550], Train Loss: 0.1142, Test Loss: 0.1110
Epoch [19600/19600], Train Loss: 0.1080, Test Loss: 0.1095
Epoch [19650/19650], Train Loss: 0.1071, Test Loss: 0.1060
Epoch [19700/19700], Train Loss: 0.1066, Test Loss: 0.1001
Epoch [19750/19750], Train Loss: 0.1009, Test Loss: 0.1075
Epoch [19800/19800], Train Loss: 0.1007, Test Loss: 0.0955
Epoch [19850/19850], Train Loss: 0.0938, Test Loss: 0.1006
Epoch [19900/19900], Train Loss: 0.1015, Test Loss: 0.1063
Epoch [19950/19950], Train Loss: 0.0973, Test Loss: 0.0953
Epoch [20000/20000], Train Loss: 0.0955, Test Loss: 0.0906
Epoch [20050/20050], Train Loss: 0.1129, Test Loss: 0.1065
Epoch [20100/20100], Train Loss: 0.1121, Test Loss: 0.0904
Epoch [20150/20150], Train Loss: 0.0939, Test Loss: 0.0906
Epoch [20200/20200], Train Loss: 0.0870, Test Loss: 0.0878
Epoch [20250/20250], Train Loss: 0.0854, Test Loss: 0.1070
Epoch [20300/20300], Train Loss: 0.0989, Test Loss: 0.0851
Epoch [20350/20350], Train Loss: 0.1002, Test Loss: 0.0968
Epoch [20400/20400], Train Loss: 0.0899, Test Loss: 0.0803
Epoch [20450/20450], Train Loss: 0.0910, Test Loss: 0.0999
Epoch [20500/20500], Train Loss: 0.0833, Test Loss: 0.1057
Epoch [20550/20550], Train Loss: 0.0871, Test Loss: 0.1001
Epoch [20600/20600], Train Loss: 0.1022, Test Loss: 0.1050
Epoch [20650/20650], Train Loss: 0.0938, Test Loss: 0.0886
Epoch [20700/20700], Train Loss: 0.0845, Test Loss: 0.0828
Epoch [20750/20750], Train Loss: 0.1021, Test Loss: 0.0931
Epoch [20800/20800], Train Loss: 0.0970, Test Loss: 0.0867
Epoch [20850/20850], Train Loss: 0.0994, Test Loss: 0.0899
Epoch [20900/20900], Train Loss: 0.0866, Test Loss: 0.0810
Epoch [20950/20950], Train Loss: 0.0991, Test Loss: 0.0965
Epoch [21000/21000], Train Loss: 0.0855, Test Loss: 0.0773
Epoch [21050/21050], Train Loss: 0.0860, Test Loss: 0.0930
Epoch [21100/21100], Train Loss: 0.0782, Test Loss: 0.0881
Epoch [21150/21150], Train Loss: 0.0681, Test Loss: 0.0806
Epoch [21200/21200], Train Loss: 0.0895, Test Loss: 0.0765
Epoch [21250/21250], Train Loss: 0.0856, Test Loss: 0.0884
Epoch [21300/21300], Train Loss: 0.0824, Test Loss: 0.0892
Epoch [21350/21350], Train Loss: 0.0854, Test Loss: 0.0889
Epoch [21400/21400], Train Loss: 0.0859, Test Loss: 0.0789
Epoch [21450/21450], Train Loss: 0.0971, Test Loss: 0.0842
Epoch [21500/21500], Train Loss: 0.0828, Test Loss: 0.0836
Epoch [21550/21550], Train Loss: 0.0848, Test Loss: 0.0837

Epoch [21600/21600], Train Loss: 0.0786, Test Loss: 0.0904
Epoch [21650/21650], Train Loss: 0.0810, Test Loss: 0.0830
Epoch [21700/21700], Train Loss: 0.0856, Test Loss: 0.0761
Epoch [21750/21750], Train Loss: 0.0818, Test Loss: 0.0708
Epoch [21800/21800], Train Loss: 0.0824, Test Loss: 0.0706
Epoch [21850/21850], Train Loss: 0.0819, Test Loss: 0.0791
Epoch [21900/21900], Train Loss: 0.0717, Test Loss: 0.0707
Epoch [21950/21950], Train Loss: 0.0795, Test Loss: 0.0762
Epoch [22000/22000], Train Loss: 0.0804, Test Loss: 0.0732
Epoch [22050/22050], Train Loss: 0.0860, Test Loss: 0.0712
Epoch [22100/22100], Train Loss: 0.0670, Test Loss: 0.0751
Epoch [22150/22150], Train Loss: 0.0812, Test Loss: 0.0641
Epoch [22200/22200], Train Loss: 0.0737, Test Loss: 0.0638
Epoch [22250/22250], Train Loss: 0.0784, Test Loss: 0.0746
Epoch [22300/22300], Train Loss: 0.0763, Test Loss: 0.0673
Epoch [22350/22350], Train Loss: 0.0753, Test Loss: 0.0787
Epoch [22400/22400], Train Loss: 0.0629, Test Loss: 0.0642
Epoch [22450/22450], Train Loss: 0.0764, Test Loss: 0.0673
Epoch [22500/22500], Train Loss: 0.0718, Test Loss: 0.0727
Epoch [22550/22550], Train Loss: 0.0749, Test Loss: 0.0715
Epoch [22600/22600], Train Loss: 0.0595, Test Loss: 0.0859
Epoch [22650/22650], Train Loss: 0.0801, Test Loss: 0.0852
Epoch [22700/22700], Train Loss: 0.0731, Test Loss: 0.0640
Epoch [22750/22750], Train Loss: 0.0657, Test Loss: 0.0679
Epoch [22800/22800], Train Loss: 0.0631, Test Loss: 0.0706
Epoch [22850/22850], Train Loss: 0.0717, Test Loss: 0.0662
Epoch [22900/22900], Train Loss: 0.0549, Test Loss: 0.0620
Epoch [22950/22950], Train Loss: 0.0658, Test Loss: 0.0691
Epoch [23000/23000], Train Loss: 0.0694, Test Loss: 0.0644
Epoch [23050/23050], Train Loss: 0.0689, Test Loss: 0.0620
Epoch [23100/23100], Train Loss: 0.0721, Test Loss: 0.0713
Epoch [23150/23150], Train Loss: 0.0641, Test Loss: 0.0589
Epoch [23200/23200], Train Loss: 0.0592, Test Loss: 0.0520
Epoch [23250/23250], Train Loss: 0.0665, Test Loss: 0.0587
Epoch [23300/23300], Train Loss: 0.0625, Test Loss: 0.0670
Epoch [23350/23350], Train Loss: 0.0604, Test Loss: 0.0620
Epoch [23400/23400], Train Loss: 0.0683, Test Loss: 0.0578
Epoch [23450/23450], Train Loss: 0.0642, Test Loss: 0.0634
Epoch [23500/23500], Train Loss: 0.0593, Test Loss: 0.0629
Epoch [23550/23550], Train Loss: 0.0569, Test Loss: 0.0665
Epoch [23600/23600], Train Loss: 0.0569, Test Loss: 0.0530
Epoch [23650/23650], Train Loss: 0.0581, Test Loss: 0.0675
Epoch [23700/23700], Train Loss: 0.0616, Test Loss: 0.0583
Epoch [23750/23750], Train Loss: 0.0515, Test Loss: 0.0600
Epoch [23800/23800], Train Loss: 0.0621, Test Loss: 0.0488
Epoch [23850/23850], Train Loss: 0.0547, Test Loss: 0.0553
Epoch [23900/23900], Train Loss: 0.0610, Test Loss: 0.0568
Epoch [23950/23950], Train Loss: 0.0646, Test Loss: 0.0555
Epoch [24000/24000], Train Loss: 0.0487, Test Loss: 0.0520
Epoch [24050/24050], Train Loss: 0.0570, Test Loss: 0.0534
Epoch [24100/24100], Train Loss: 0.0421, Test Loss: 0.0600
Epoch [24150/24150], Train Loss: 0.0551, Test Loss: 0.0565
Epoch [24200/24200], Train Loss: 0.0554, Test Loss: 0.0436
Epoch [24250/24250], Train Loss: 0.0503, Test Loss: 0.0497

Epoch [24300/24300], Train Loss: 0.0532, Test Loss: 0.0452
Epoch [24350/24350], Train Loss: 0.0500, Test Loss: 0.0607
Epoch [24400/24400], Train Loss: 0.0551, Test Loss: 0.0566
Epoch [24450/24450], Train Loss: 0.0536, Test Loss: 0.0494
Epoch [24500/24500], Train Loss: 0.0555, Test Loss: 0.0518
Epoch [24550/24550], Train Loss: 0.0442, Test Loss: 0.0472
Epoch [24600/24600], Train Loss: 0.0538, Test Loss: 0.0431
Epoch [24650/24650], Train Loss: 0.0546, Test Loss: 0.0465
Epoch [24700/24700], Train Loss: 0.0528, Test Loss: 0.0604
Epoch [24750/24750], Train Loss: 0.0472, Test Loss: 0.0509
Epoch [24800/24800], Train Loss: 0.0496, Test Loss: 0.0506
Epoch [24850/24850], Train Loss: 0.0457, Test Loss: 0.0496
Epoch [24900/24900], Train Loss: 0.0510, Test Loss: 0.0453
Epoch [24950/24950], Train Loss: 0.0445, Test Loss: 0.0497
Epoch [25000/25000], Train Loss: 0.0525, Test Loss: 0.0462
Epoch [25050/25050], Train Loss: 0.0428, Test Loss: 0.0462
Epoch [25100/25100], Train Loss: 0.0450, Test Loss: 0.0486
Epoch [25150/25150], Train Loss: 0.0529, Test Loss: 0.0398
Epoch [25200/25200], Train Loss: 0.0494, Test Loss: 0.0449
Epoch [25250/25250], Train Loss: 0.0474, Test Loss: 0.0498
Epoch [25300/25300], Train Loss: 0.0378, Test Loss: 0.0496
Epoch [25350/25350], Train Loss: 0.0450, Test Loss: 0.0448
Epoch [25400/25400], Train Loss: 0.0409, Test Loss: 0.0443
Epoch [25450/25450], Train Loss: 0.0410, Test Loss: 0.0448
Epoch [25500/25500], Train Loss: 0.0436, Test Loss: 0.0454
Epoch [25550/25550], Train Loss: 0.0496, Test Loss: 0.0419
Epoch [25600/25600], Train Loss: 0.0468, Test Loss: 0.0441
Epoch [25650/25650], Train Loss: 0.0443, Test Loss: 0.0503
Epoch [25700/25700], Train Loss: 0.0453, Test Loss: 0.0434
Epoch [25750/25750], Train Loss: 0.0402, Test Loss: 0.0432
Epoch [25800/25800], Train Loss: 0.0397, Test Loss: 0.0478
Epoch [25850/25850], Train Loss: 0.0423, Test Loss: 0.0422
Epoch [25900/25900], Train Loss: 0.0395, Test Loss: 0.0401
Epoch [25950/25950], Train Loss: 0.0418, Test Loss: 0.0368
Epoch [26000/26000], Train Loss: 0.0414, Test Loss: 0.0413
Epoch [26050/26050], Train Loss: 0.0471, Test Loss: 0.0422
Epoch [26100/26100], Train Loss: 0.0469, Test Loss: 0.0407
Epoch [26150/26150], Train Loss: 0.0422, Test Loss: 0.0379
Epoch [26200/26200], Train Loss: 0.0376, Test Loss: 0.0426
Epoch [26250/26250], Train Loss: 0.0406, Test Loss: 0.0374
Epoch [26300/26300], Train Loss: 0.0405, Test Loss: 0.0424
Epoch [26350/26350], Train Loss: 0.0379, Test Loss: 0.0306
Epoch [26400/26400], Train Loss: 0.0406, Test Loss: 0.0362
Epoch [26450/26450], Train Loss: 0.0347, Test Loss: 0.0443
Epoch [26500/26500], Train Loss: 0.0404, Test Loss: 0.0373
Epoch [26550/26550], Train Loss: 0.0388, Test Loss: 0.0368
Epoch [26600/26600], Train Loss: 0.0350, Test Loss: 0.0402
Epoch [26650/26650], Train Loss: 0.0430, Test Loss: 0.0393
Epoch [26700/26700], Train Loss: 0.0361, Test Loss: 0.0403
Epoch [26750/26750], Train Loss: 0.0400, Test Loss: 0.0376
Epoch [26800/26800], Train Loss: 0.0353, Test Loss: 0.0284
Epoch [26850/26850], Train Loss: 0.0350, Test Loss: 0.0328
Epoch [26900/26900], Train Loss: 0.0329, Test Loss: 0.0330
Epoch [26950/26950], Train Loss: 0.0320, Test Loss: 0.0339

Epoch [27000/27000], Train Loss: 0.0361, Test Loss: 0.0319
Epoch [27050/27050], Train Loss: 0.0307, Test Loss: 0.0281
Epoch [27100/27100], Train Loss: 0.0297, Test Loss: 0.0363
Epoch [27150/27150], Train Loss: 0.0405, Test Loss: 0.0340
Epoch [27200/27200], Train Loss: 0.0335, Test Loss: 0.0324
Epoch [27250/27250], Train Loss: 0.0307, Test Loss: 0.0405
Epoch [27300/27300], Train Loss: 0.0322, Test Loss: 0.0324
Epoch [27350/27350], Train Loss: 0.0314, Test Loss: 0.0321
Epoch [27400/27400], Train Loss: 0.0301, Test Loss: 0.0366
Epoch [27450/27450], Train Loss: 0.0333, Test Loss: 0.0367
Epoch [27500/27500], Train Loss: 0.0282, Test Loss: 0.0339
Epoch [27550/27550], Train Loss: 0.0341, Test Loss: 0.0297
Epoch [27600/27600], Train Loss: 0.0296, Test Loss: 0.0315
Epoch [27650/27650], Train Loss: 0.0323, Test Loss: 0.0285
Epoch [27700/27700], Train Loss: 0.0343, Test Loss: 0.0320
Epoch [27750/27750], Train Loss: 0.0346, Test Loss: 0.0276
Epoch [27800/27800], Train Loss: 0.0278, Test Loss: 0.0252
Epoch [27850/27850], Train Loss: 0.0275, Test Loss: 0.0290
Epoch [27900/27900], Train Loss: 0.0329, Test Loss: 0.0268
Epoch [27950/27950], Train Loss: 0.0308, Test Loss: 0.0302
Epoch [28000/28000], Train Loss: 0.0297, Test Loss: 0.0300
Epoch [28050/28050], Train Loss: 0.0261, Test Loss: 0.0296
Epoch [28100/28100], Train Loss: 0.0314, Test Loss: 0.0304
Epoch [28150/28150], Train Loss: 0.0320, Test Loss: 0.0267
Epoch [28200/28200], Train Loss: 0.0285, Test Loss: 0.0309
Epoch [28250/28250], Train Loss: 0.0283, Test Loss: 0.0270
Epoch [28300/28300], Train Loss: 0.0248, Test Loss: 0.0282
Epoch [28350/28350], Train Loss: 0.0240, Test Loss: 0.0340
Epoch [28400/28400], Train Loss: 0.0276, Test Loss: 0.0233
Epoch [28450/28450], Train Loss: 0.0269, Test Loss: 0.0279
Epoch [28500/28500], Train Loss: 0.0293, Test Loss: 0.0287
Epoch [28550/28550], Train Loss: 0.0282, Test Loss: 0.0307
Epoch [28600/28600], Train Loss: 0.0275, Test Loss: 0.0274
Epoch [28650/28650], Train Loss: 0.0250, Test Loss: 0.0242
Epoch [28700/28700], Train Loss: 0.0278, Test Loss: 0.0289
Epoch [28750/28750], Train Loss: 0.0295, Test Loss: 0.0230
Epoch [28800/28800], Train Loss: 0.0243, Test Loss: 0.0281
Epoch [28850/28850], Train Loss: 0.0254, Test Loss: 0.0222
Epoch [28900/28900], Train Loss: 0.0236, Test Loss: 0.0196
Epoch [28950/28950], Train Loss: 0.0291, Test Loss: 0.0251
Epoch [29000/29000], Train Loss: 0.0293, Test Loss: 0.0274
Epoch [29050/29050], Train Loss: 0.0256, Test Loss: 0.0255
Epoch [29100/29100], Train Loss: 0.0237, Test Loss: 0.0293
Epoch [29150/29150], Train Loss: 0.0268, Test Loss: 0.0260
Epoch [29200/29200], Train Loss: 0.0285, Test Loss: 0.0225
Epoch [29250/29250], Train Loss: 0.0233, Test Loss: 0.0235
Epoch [29300/29300], Train Loss: 0.0232, Test Loss: 0.0266
Epoch [29350/29350], Train Loss: 0.0235, Test Loss: 0.0266
Epoch [29400/29400], Train Loss: 0.0230, Test Loss: 0.0295
Epoch [29450/29450], Train Loss: 0.0246, Test Loss: 0.0230
Epoch [29500/29500], Train Loss: 0.0195, Test Loss: 0.0197
Epoch [29550/29550], Train Loss: 0.0238, Test Loss: 0.0235
Epoch [29600/29600], Train Loss: 0.0281, Test Loss: 0.0213
Epoch [29650/29650], Train Loss: 0.0220, Test Loss: 0.0205

Epoch [29700/29700], Train Loss: 0.0236, Test Loss: 0.0210
Epoch [29750/29750], Train Loss: 0.0215, Test Loss: 0.0241
Epoch [29800/29800], Train Loss: 0.0228, Test Loss: 0.0213
Epoch [29850/29850], Train Loss: 0.0232, Test Loss: 0.0215
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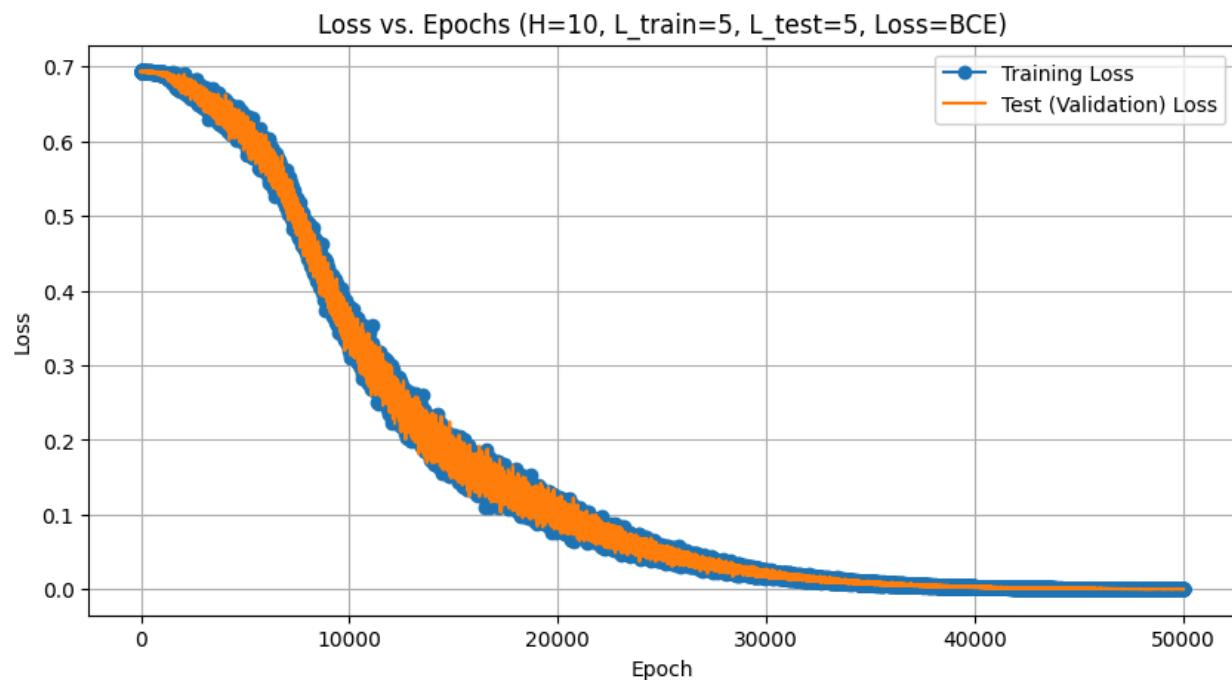
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Epoch [45800/45800], Train Loss: 0.0008, Test Loss: 0.0008
Epoch [45850/45850], Train Loss: 0.0008, Test Loss: 0.0009

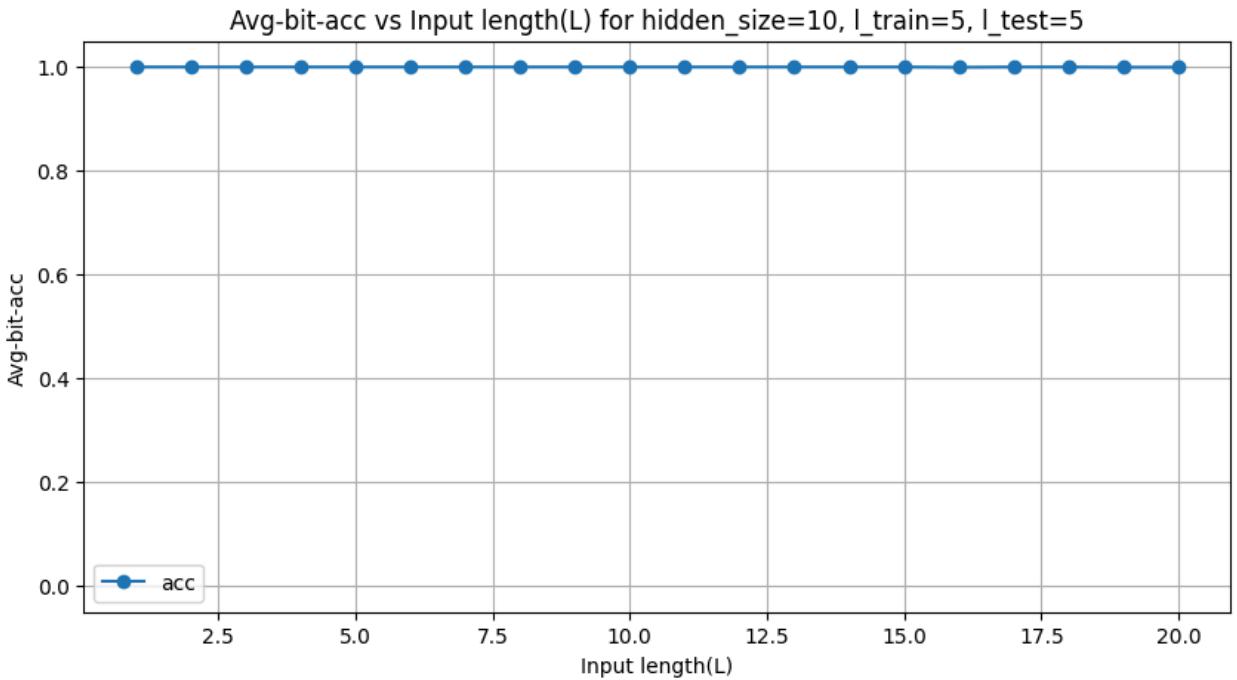
Epoch [45900/45900], Train Loss: 0.0009, Test Loss: 0.0009
Epoch [45950/45950], Train Loss: 0.0008, Test Loss: 0.0009
Epoch [46000/46000], Train Loss: 0.0008, Test Loss: 0.0007
Epoch [46050/46050], Train Loss: 0.0008, Test Loss: 0.0009
Epoch [46100/46100], Train Loss: 0.0008, Test Loss: 0.0008
Epoch [46150/46150], Train Loss: 0.0007, Test Loss: 0.0008
Epoch [46200/46200], Train Loss: 0.0008, Test Loss: 0.0008
Epoch [46250/46250], Train Loss: 0.0006, Test Loss: 0.0007
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Epoch [46400/46400], Train Loss: 0.0008, Test Loss: 0.0008
Epoch [46450/46450], Train Loss: 0.0008, Test Loss: 0.0007
Epoch [46500/46500], Train Loss: 0.0008, Test Loss: 0.0008
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Epoch [46800/46800], Train Loss: 0.0006, Test Loss: 0.0007
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Epoch [47100/47100], Train Loss: 0.0007, Test Loss: 0.0008
Epoch [47150/47150], Train Loss: 0.0007, Test Loss: 0.0007
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Epoch [47250/47250], Train Loss: 0.0006, Test Loss: 0.0006
Epoch [47300/47300], Train Loss: 0.0008, Test Loss: 0.0006
Epoch [47350/47350], Train Loss: 0.0006, Test Loss: 0.0005
Epoch [47400/47400], Train Loss: 0.0006, Test Loss: 0.0007
Epoch [47450/47450], Train Loss: 0.0005, Test Loss: 0.0007
Epoch [47500/47500], Train Loss: 0.0006, Test Loss: 0.0007
Epoch [47550/47550], Train Loss: 0.0004, Test Loss: 0.0005
Epoch [47600/47600], Train Loss: 0.0006, Test Loss: 0.0005
Epoch [47650/47650], Train Loss: 0.0006, Test Loss: 0.0006
Epoch [47700/47700], Train Loss: 0.0006, Test Loss: 0.0006
Epoch [47750/47750], Train Loss: 0.0006, Test Loss: 0.0006
Epoch [47800/47800], Train Loss: 0.0005, Test Loss: 0.0006
Epoch [47850/47850], Train Loss: 0.0005, Test Loss: 0.0006
Epoch [47900/47900], Train Loss: 0.0006, Test Loss: 0.0005
Epoch [47950/47950], Train Loss: 0.0005, Test Loss: 0.0005
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Epoch [48050/48050], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [48100/48100], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [48150/48150], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [48200/48200], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [48250/48250], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [48300/48300], Train Loss: 0.0004, Test Loss: 0.0005
Epoch [48350/48350], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [48400/48400], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [48450/48450], Train Loss: 0.0006, Test Loss: 0.0004
Epoch [48500/48500], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [48550/48550], Train Loss: 0.0005, Test Loss: 0.0004

```
Epoch [48600/48600], Train Loss: 0.0005, Test Loss: 0.0004
Epoch [48650/48650], Train Loss: 0.0004, Test Loss: 0.0005
Epoch [48700/48700], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [48750/48750], Train Loss: 0.0005, Test Loss: 0.0004
Epoch [48800/48800], Train Loss: 0.0005, Test Loss: 0.0004
Epoch [48850/48850], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [48900/48900], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [48950/48950], Train Loss: 0.0004, Test Loss: 0.0005
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Epoch [49050/49050], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [49100/49100], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [49150/49150], Train Loss: 0.0004, Test Loss: 0.0003
Epoch [49200/49200], Train Loss: 0.0003, Test Loss: 0.0004
Epoch [49250/49250], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [49300/49300], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [49350/49350], Train Loss: 0.0004, Test Loss: 0.0003
Epoch [49400/49400], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [49450/49450], Train Loss: 0.0003, Test Loss: 0.0003
Epoch [49500/49500], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [49550/49550], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [49600/49600], Train Loss: 0.0004, Test Loss: 0.0003
Epoch [49650/49650], Train Loss: 0.0003, Test Loss: 0.0004
Epoch [49700/49700], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [49750/49750], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [49800/49800], Train Loss: 0.0004, Test Loss: 0.0003
Epoch [49850/49850], Train Loss: 0.0003, Test Loss: 0.0004
Epoch [49900/49900], Train Loss: 0.0003, Test Loss: 0.0004
Epoch [49950/49950], Train Loss: 0.0003, Test Loss: 0.0004
```

```
In [ ]: plot_loss(train_loss,test_loss,hidden_size,l_train,l_test,loss_type)
```



```
In [ ]: avg_bit_accuracy(model_2,hidden_size,l_train,l_test,batch_size=100)
```



```
Out[ ]: 0.999921777844429
```

Model_3:

```
In [ ]: input_size=2
hidden_size=10
num_layers=1
l_train=5
l_test=5
epochs=37000
batch_size=128
lr=1e-4
loss_type="MSE"
```

```
In [ ]: model_3=Binary_adder(input_size,hidden_size,num_layers).to(device)
criterion=nn.MSELoss()
optimizer=torch.optim.Adam(model_3.parameters(),lr=lr)
```

```
In [ ]: train_loss,test_loss=training_loop(model_3,epochs,optimizer,criterion,batch_si
```

Epoch [0/0], Train Loss: 0.2496, Test Loss: 0.2501
Epoch [50/50], Train Loss: 0.2498, Test Loss: 0.2502
Epoch [100/100], Train Loss: 0.2501, Test Loss: 0.2500
Epoch [150/150], Train Loss: 0.2501, Test Loss: 0.2500
Epoch [200/200], Train Loss: 0.2500, Test Loss: 0.2496
Epoch [250/250], Train Loss: 0.2494, Test Loss: 0.2498
Epoch [300/300], Train Loss: 0.2498, Test Loss: 0.2499
Epoch [350/350], Train Loss: 0.2495, Test Loss: 0.2495
Epoch [400/400], Train Loss: 0.2494, Test Loss: 0.2490
Epoch [450/450], Train Loss: 0.2496, Test Loss: 0.2488
Epoch [500/500], Train Loss: 0.2496, Test Loss: 0.2491
Epoch [550/550], Train Loss: 0.2490, Test Loss: 0.2497
Epoch [600/600], Train Loss: 0.2493, Test Loss: 0.2494
Epoch [650/650], Train Loss: 0.2490, Test Loss: 0.2492
Epoch [700/700], Train Loss: 0.2487, Test Loss: 0.2490
Epoch [750/750], Train Loss: 0.2479, Test Loss: 0.2496
Epoch [800/800], Train Loss: 0.2487, Test Loss: 0.2493
Epoch [850/850], Train Loss: 0.2494, Test Loss: 0.2479
Epoch [900/900], Train Loss: 0.2481, Test Loss: 0.2481
Epoch [950/950], Train Loss: 0.2481, Test Loss: 0.2481
Epoch [1000/1000], Train Loss: 0.2478, Test Loss: 0.2477
Epoch [1050/1050], Train Loss: 0.2477, Test Loss: 0.2472
Epoch [1100/1100], Train Loss: 0.2483, Test Loss: 0.2477
Epoch [1150/1150], Train Loss: 0.2484, Test Loss: 0.2475
Epoch [1200/1200], Train Loss: 0.2466, Test Loss: 0.2470
Epoch [1250/1250], Train Loss: 0.2468, Test Loss: 0.2463
Epoch [1300/1300], Train Loss: 0.2461, Test Loss: 0.2453
Epoch [1350/1350], Train Loss: 0.2470, Test Loss: 0.2447
Epoch [1400/1400], Train Loss: 0.2460, Test Loss: 0.2438
Epoch [1450/1450], Train Loss: 0.2448, Test Loss: 0.2447
Epoch [1500/1500], Train Loss: 0.2452, Test Loss: 0.2462
Epoch [1550/1550], Train Loss: 0.2445, Test Loss: 0.2432
Epoch [1600/1600], Train Loss: 0.2443, Test Loss: 0.2435
Epoch [1650/1650], Train Loss: 0.2441, Test Loss: 0.2446
Epoch [1700/1700], Train Loss: 0.2436, Test Loss: 0.2420
Epoch [1750/1750], Train Loss: 0.2436, Test Loss: 0.2426
Epoch [1800/1800], Train Loss: 0.2415, Test Loss: 0.2430
Epoch [1850/1850], Train Loss: 0.2419, Test Loss: 0.2389
Epoch [1900/1900], Train Loss: 0.2456, Test Loss: 0.2424
Epoch [1950/1950], Train Loss: 0.2403, Test Loss: 0.2401
Epoch [2000/2000], Train Loss: 0.2382, Test Loss: 0.2423
Epoch [2050/2050], Train Loss: 0.2437, Test Loss: 0.2390
Epoch [2100/2100], Train Loss: 0.2417, Test Loss: 0.2386
Epoch [2150/2150], Train Loss: 0.2408, Test Loss: 0.2396
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Epoch [2300/2300], Train Loss: 0.2387, Test Loss: 0.2405
Epoch [2350/2350], Train Loss: 0.2433, Test Loss: 0.2392
Epoch [2400/2400], Train Loss: 0.2404, Test Loss: 0.2375
Epoch [2450/2450], Train Loss: 0.2392, Test Loss: 0.2384
Epoch [2500/2500], Train Loss: 0.2352, Test Loss: 0.2378
Epoch [2550/2550], Train Loss: 0.2391, Test Loss: 0.2362
Epoch [2600/2600], Train Loss: 0.2387, Test Loss: 0.2383
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Epoch [2900/2900], Train Loss: 0.2319, Test Loss: 0.2347
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Epoch [3000/3000], Train Loss: 0.2343, Test Loss: 0.2334
Epoch [3050/3050], Train Loss: 0.2378, Test Loss: 0.2368
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Epoch [3150/3150], Train Loss: 0.2299, Test Loss: 0.2319
Epoch [3200/3200], Train Loss: 0.2305, Test Loss: 0.2313
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Epoch [3450/3450], Train Loss: 0.2348, Test Loss: 0.2320
Epoch [3500/3500], Train Loss: 0.2346, Test Loss: 0.2333
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Epoch [4700/4700], Train Loss: 0.2211, Test Loss: 0.2269
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Epoch [8150/8150], Train Loss: 0.1604, Test Loss: 0.1678
Epoch [8200/8200], Train Loss: 0.1734, Test Loss: 0.1601
Epoch [8250/8250], Train Loss: 0.1636, Test Loss: 0.1634
Epoch [8300/8300], Train Loss: 0.1645, Test Loss: 0.1606
Epoch [8350/8350], Train Loss: 0.1528, Test Loss: 0.1622
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Epoch [8950/8950], Train Loss: 0.1380, Test Loss: 0.1443
Epoch [9000/9000], Train Loss: 0.1432, Test Loss: 0.1387
Epoch [9050/9050], Train Loss: 0.1336, Test Loss: 0.1469
Epoch [9100/9100], Train Loss: 0.1376, Test Loss: 0.1434
Epoch [9150/9150], Train Loss: 0.1370, Test Loss: 0.1425
Epoch [9200/9200], Train Loss: 0.1379, Test Loss: 0.1470
Epoch [9250/9250], Train Loss: 0.1385, Test Loss: 0.1344
Epoch [9300/9300], Train Loss: 0.1316, Test Loss: 0.1318
Epoch [9350/9350], Train Loss: 0.1450, Test Loss: 0.1382
Epoch [9400/9400], Train Loss: 0.1274, Test Loss: 0.1343
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Epoch [9650/9650], Train Loss: 0.1316, Test Loss: 0.1242
Epoch [9700/9700], Train Loss: 0.1259, Test Loss: 0.1186
Epoch [9750/9750], Train Loss: 0.1179, Test Loss: 0.1266
Epoch [9800/9800], Train Loss: 0.1251, Test Loss: 0.1190
Epoch [9850/9850], Train Loss: 0.1252, Test Loss: 0.1197
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Epoch [9950/9950], Train Loss: 0.1188, Test Loss: 0.1277
Epoch [10000/10000], Train Loss: 0.1117, Test Loss: 0.1225
Epoch [10050/10050], Train Loss: 0.1194, Test Loss: 0.1127
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Epoch [10250/10250], Train Loss: 0.1154, Test Loss: 0.1126
Epoch [10300/10300], Train Loss: 0.1214, Test Loss: 0.1136
Epoch [10350/10350], Train Loss: 0.1116, Test Loss: 0.1111
Epoch [10400/10400], Train Loss: 0.1090, Test Loss: 0.1075
Epoch [10450/10450], Train Loss: 0.1141, Test Loss: 0.1091
Epoch [10500/10500], Train Loss: 0.1114, Test Loss: 0.1096
Epoch [10550/10550], Train Loss: 0.1061, Test Loss: 0.1075
Epoch [10600/10600], Train Loss: 0.1005, Test Loss: 0.1080
Epoch [10650/10650], Train Loss: 0.1051, Test Loss: 0.0892
Epoch [10700/10700], Train Loss: 0.1021, Test Loss: 0.1026
Epoch [10750/10750], Train Loss: 0.0944, Test Loss: 0.0984

Epoch [10800/10800], Train Loss: 0.0984, Test Loss: 0.1028
Epoch [10850/10850], Train Loss: 0.1088, Test Loss: 0.0994
Epoch [10900/10900], Train Loss: 0.0975, Test Loss: 0.1008
Epoch [10950/10950], Train Loss: 0.0972, Test Loss: 0.0991
Epoch [11000/11000], Train Loss: 0.0891, Test Loss: 0.0983
Epoch [11050/11050], Train Loss: 0.0966, Test Loss: 0.0943
Epoch [11100/11100], Train Loss: 0.0926, Test Loss: 0.0944
Epoch [11150/11150], Train Loss: 0.0973, Test Loss: 0.0944
Epoch [11200/11200], Train Loss: 0.0923, Test Loss: 0.0949
Epoch [11250/11250], Train Loss: 0.0934, Test Loss: 0.0895
Epoch [11300/11300], Train Loss: 0.0913, Test Loss: 0.0903
Epoch [11350/11350], Train Loss: 0.0898, Test Loss: 0.0855
Epoch [11400/11400], Train Loss: 0.0954, Test Loss: 0.0912
Epoch [11450/11450], Train Loss: 0.0963, Test Loss: 0.0893
Epoch [11500/11500], Train Loss: 0.0968, Test Loss: 0.0894
Epoch [11550/11550], Train Loss: 0.0833, Test Loss: 0.0897
Epoch [11600/11600], Train Loss: 0.0839, Test Loss: 0.0868
Epoch [11650/11650], Train Loss: 0.0892, Test Loss: 0.0800
Epoch [11700/11700], Train Loss: 0.0908, Test Loss: 0.0826
Epoch [11750/11750], Train Loss: 0.0795, Test Loss: 0.0872
Epoch [11800/11800], Train Loss: 0.0840, Test Loss: 0.0844
Epoch [11850/11850], Train Loss: 0.0816, Test Loss: 0.0798
Epoch [11900/11900], Train Loss: 0.0824, Test Loss: 0.0848
Epoch [11950/11950], Train Loss: 0.0780, Test Loss: 0.0820
Epoch [12000/12000], Train Loss: 0.0732, Test Loss: 0.0820
Epoch [12050/12050], Train Loss: 0.0758, Test Loss: 0.0801
Epoch [12100/12100], Train Loss: 0.0749, Test Loss: 0.0861
Epoch [12150/12150], Train Loss: 0.0746, Test Loss: 0.0727
Epoch [12200/12200], Train Loss: 0.0723, Test Loss: 0.0788
Epoch [12250/12250], Train Loss: 0.0832, Test Loss: 0.0753
Epoch [12300/12300], Train Loss: 0.0788, Test Loss: 0.0746
Epoch [12350/12350], Train Loss: 0.0731, Test Loss: 0.0792
Epoch [12400/12400], Train Loss: 0.0722, Test Loss: 0.0751
Epoch [12450/12450], Train Loss: 0.0696, Test Loss: 0.0741
Epoch [12500/12500], Train Loss: 0.0741, Test Loss: 0.0758
Epoch [12550/12550], Train Loss: 0.0685, Test Loss: 0.0723
Epoch [12600/12600], Train Loss: 0.0708, Test Loss: 0.0746
Epoch [12650/12650], Train Loss: 0.0710, Test Loss: 0.0692
Epoch [12700/12700], Train Loss: 0.0711, Test Loss: 0.0764
Epoch [12750/12750], Train Loss: 0.0660, Test Loss: 0.0672
Epoch [12800/12800], Train Loss: 0.0700, Test Loss: 0.0710
Epoch [12850/12850], Train Loss: 0.0673, Test Loss: 0.0728
Epoch [12900/12900], Train Loss: 0.0633, Test Loss: 0.0673
Epoch [12950/12950], Train Loss: 0.0689, Test Loss: 0.0612
Epoch [13000/13000], Train Loss: 0.0653, Test Loss: 0.0677
Epoch [13050/13050], Train Loss: 0.0722, Test Loss: 0.0669
Epoch [13100/13100], Train Loss: 0.0696, Test Loss: 0.0613
Epoch [13150/13150], Train Loss: 0.0660, Test Loss: 0.0608
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Epoch [13250/13250], Train Loss: 0.0669, Test Loss: 0.0648
Epoch [13300/13300], Train Loss: 0.0603, Test Loss: 0.0653
Epoch [13350/13350], Train Loss: 0.0581, Test Loss: 0.0642
Epoch [13400/13400], Train Loss: 0.0572, Test Loss: 0.0610
Epoch [13450/13450], Train Loss: 0.0607, Test Loss: 0.0543

Epoch [13500/13500], Train Loss: 0.0571, Test Loss: 0.0616
Epoch [13550/13550], Train Loss: 0.0640, Test Loss: 0.0656
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Epoch [13700/13700], Train Loss: 0.0581, Test Loss: 0.0532
Epoch [13750/13750], Train Loss: 0.0589, Test Loss: 0.0546
Epoch [13800/13800], Train Loss: 0.0468, Test Loss: 0.0564
Epoch [13850/13850], Train Loss: 0.0590, Test Loss: 0.0523
Epoch [13900/13900], Train Loss: 0.0560, Test Loss: 0.0561
Epoch [13950/13950], Train Loss: 0.0566, Test Loss: 0.0578
Epoch [14000/14000], Train Loss: 0.0543, Test Loss: 0.0474
Epoch [14050/14050], Train Loss: 0.0567, Test Loss: 0.0489
Epoch [14100/14100], Train Loss: 0.0551, Test Loss: 0.0602
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Epoch [14300/14300], Train Loss: 0.0517, Test Loss: 0.0539
Epoch [14350/14350], Train Loss: 0.0564, Test Loss: 0.0470
Epoch [14400/14400], Train Loss: 0.0549, Test Loss: 0.0518
Epoch [14450/14450], Train Loss: 0.0498, Test Loss: 0.0529
Epoch [14500/14500], Train Loss: 0.0475, Test Loss: 0.0528
Epoch [14550/14550], Train Loss: 0.0463, Test Loss: 0.0483
Epoch [14600/14600], Train Loss: 0.0441, Test Loss: 0.0460
Epoch [14650/14650], Train Loss: 0.0456, Test Loss: 0.0512
Epoch [14700/14700], Train Loss: 0.0454, Test Loss: 0.0489
Epoch [14750/14750], Train Loss: 0.0431, Test Loss: 0.0524
Epoch [14800/14800], Train Loss: 0.0468, Test Loss: 0.0494
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Epoch [14900/14900], Train Loss: 0.0474, Test Loss: 0.0428
Epoch [14950/14950], Train Loss: 0.0458, Test Loss: 0.0430
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Epoch [15450/15450], Train Loss: 0.0426, Test Loss: 0.0414
Epoch [15500/15500], Train Loss: 0.0452, Test Loss: 0.0467
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Epoch [15850/15850], Train Loss: 0.0419, Test Loss: 0.0366
Epoch [15900/15900], Train Loss: 0.0377, Test Loss: 0.0408
Epoch [15950/15950], Train Loss: 0.0403, Test Loss: 0.0350
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Epoch [17150/17150], Train Loss: 0.0301, Test Loss: 0.0327
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Epoch [18900/18900], Train Loss: 0.0203, Test Loss: 0.0211
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Epoch [20800/20800], Train Loss: 0.0125, Test Loss: 0.0137
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Epoch [21000/21000], Train Loss: 0.0115, Test Loss: 0.0128
Epoch [21050/21050], Train Loss: 0.0105, Test Loss: 0.0128
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Epoch [21250/21250], Train Loss: 0.0091, Test Loss: 0.0120
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Epoch [21400/21400], Train Loss: 0.0103, Test Loss: 0.0087
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Epoch [21500/21500], Train Loss: 0.0101, Test Loss: 0.0090
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Epoch [22050/22050], Train Loss: 0.0082, Test Loss: 0.0094
Epoch [22100/22100], Train Loss: 0.0082, Test Loss: 0.0084
Epoch [22150/22150], Train Loss: 0.0078, Test Loss: 0.0100
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Epoch [24600/24600], Train Loss: 0.0048, Test Loss: 0.0038
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Epoch [25450/25450], Train Loss: 0.0037, Test Loss: 0.0033
Epoch [25500/25500], Train Loss: 0.0032, Test Loss: 0.0039
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Epoch [25600/25600], Train Loss: 0.0032, Test Loss: 0.0032
Epoch [25650/25650], Train Loss: 0.0035, Test Loss: 0.0031
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Epoch [25850/25850], Train Loss: 0.0032, Test Loss: 0.0030
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Epoch [26550/26550], Train Loss: 0.0022, Test Loss: 0.0026
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Epoch [26750/26750], Train Loss: 0.0025, Test Loss: 0.0023
Epoch [26800/26800], Train Loss: 0.0026, Test Loss: 0.0024
Epoch [26850/26850], Train Loss: 0.0021, Test Loss: 0.0022
Epoch [26900/26900], Train Loss: 0.0020, Test Loss: 0.0021
Epoch [26950/26950], Train Loss: 0.0023, Test Loss: 0.0024

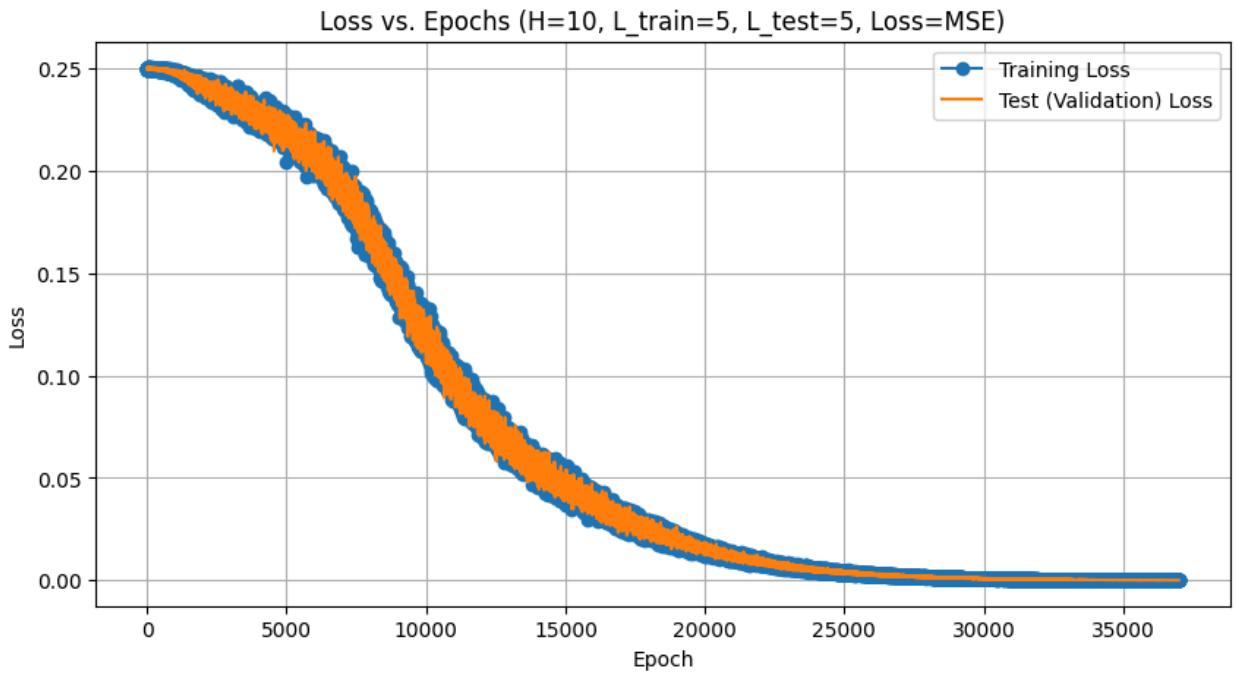
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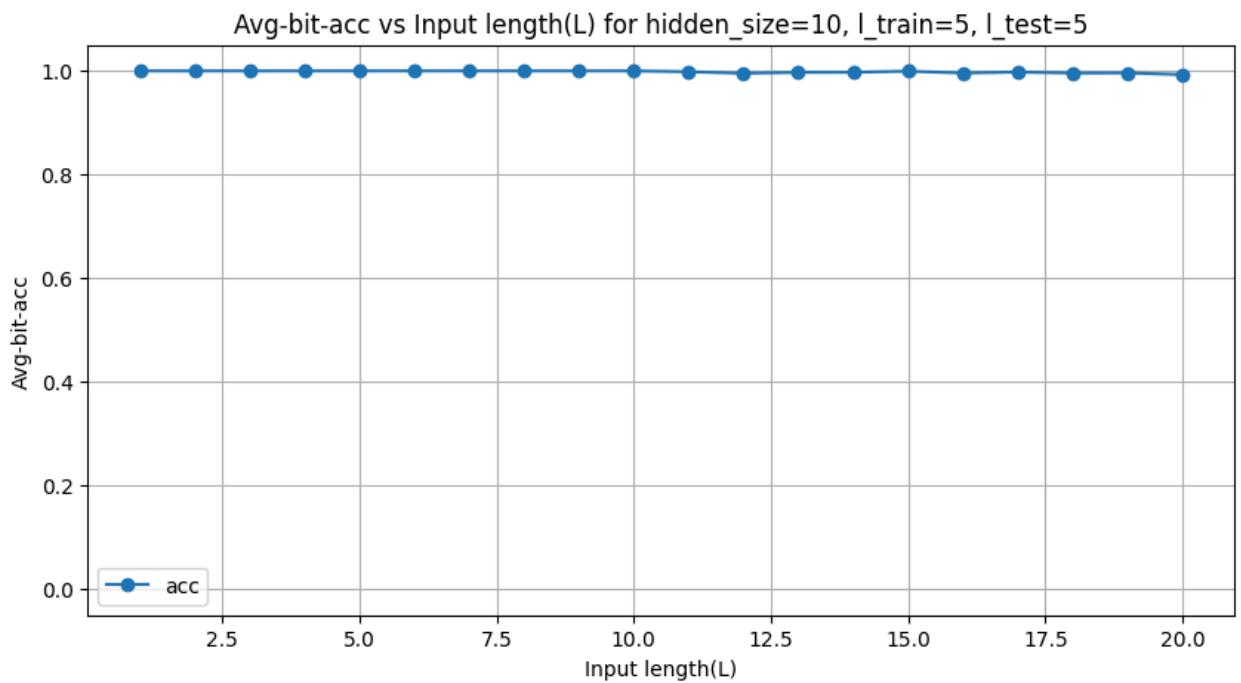
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Epoch [35750/35750], Train Loss: 0.0001, Test Loss: 0.0002
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Epoch [36800/36800], Train Loss: 0.0001, Test Loss: 0.0001
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Epoch [36900/36900], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [36950/36950], Train Loss: 0.0001, Test Loss: 0.0001
```

```
In [ ]: plot_loss(train_loss,test_loss,hidden_size,l_train,l_test,loss_type)
```



```
In [ ]: avg_bit_accuracy(model_3,hidden_size,l_train,l_test,batch_size=100)
```



```
Out[ ]: 0.9982937932014465
```

Model_4:

```
In [ ]: input_size=2  
hidden_size=100  
num_layers=1  
l_train=5  
l_test=5
```

```
epochs=22000
batch_size=128
lr=1e-4
loss_type="BCE"
```

```
In [ ]: model_4=Binary_adder(input_size,hidden_size,num_layers).to(device)
criterion=nn.BCELoss()
optimizer=torch.optim.Adam(model_4.parameters(),lr=lr)
```

```
In [ ]: train_loss,test_loss=training_loop(model_4,epochs,optimizer,criterion,batch_si
```

Epoch [0/0], Train Loss: 0.6925, Test Loss: 0.6932
Epoch [50/50], Train Loss: 0.6931, Test Loss: 0.6933
Epoch [100/100], Train Loss: 0.6925, Test Loss: 0.6920
Epoch [150/150], Train Loss: 0.6915, Test Loss: 0.6913
Epoch [200/200], Train Loss: 0.6897, Test Loss: 0.6913
Epoch [250/250], Train Loss: 0.6873, Test Loss: 0.6880
Epoch [300/300], Train Loss: 0.6896, Test Loss: 0.6856
Epoch [350/350], Train Loss: 0.6859, Test Loss: 0.6812
Epoch [400/400], Train Loss: 0.6777, Test Loss: 0.6772
Epoch [450/450], Train Loss: 0.6779, Test Loss: 0.6703
Epoch [500/500], Train Loss: 0.6629, Test Loss: 0.6704
Epoch [550/550], Train Loss: 0.6611, Test Loss: 0.6613
Epoch [600/600], Train Loss: 0.6643, Test Loss: 0.6687
Epoch [650/650], Train Loss: 0.6599, Test Loss: 0.6617
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Epoch [750/750], Train Loss: 0.6636, Test Loss: 0.6687
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Epoch [1500/1500], Train Loss: 0.6354, Test Loss: 0.6229
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Epoch [2000/2000], Train Loss: 0.6114, Test Loss: 0.6166
Epoch [2050/2050], Train Loss: 0.6067, Test Loss: 0.6153
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Epoch [2150/2150], Train Loss: 0.6104, Test Loss: 0.6086
Epoch [2200/2200], Train Loss: 0.6108, Test Loss: 0.6049
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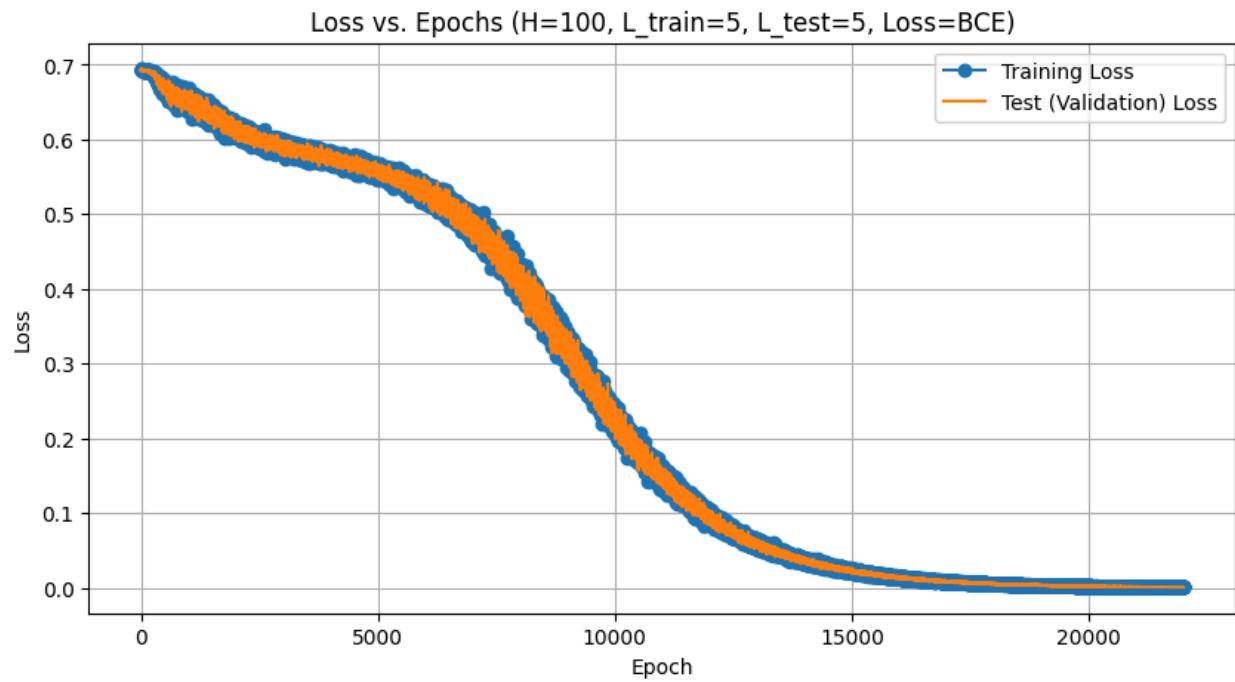
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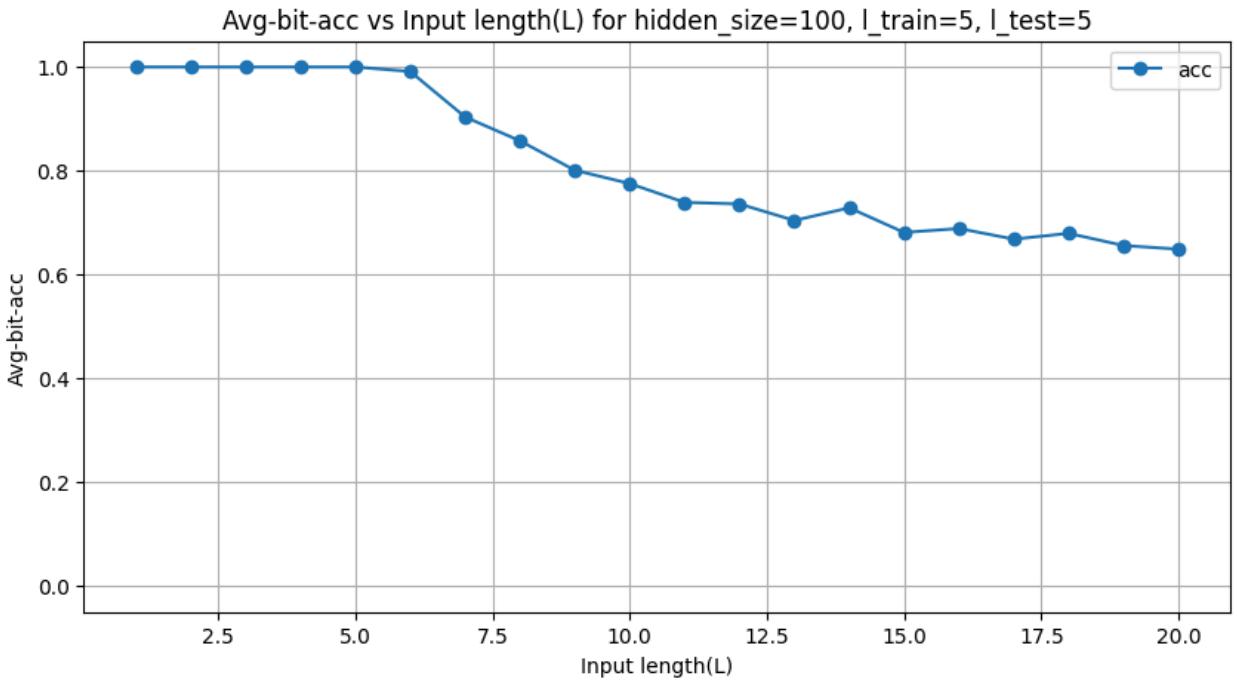
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Epoch [21300/21300], Train Loss: 0.0010, Test Loss: 0.0010
Epoch [21350/21350], Train Loss: 0.0010, Test Loss: 0.0011
Epoch [21400/21400], Train Loss: 0.0010, Test Loss: 0.0009
Epoch [21450/21450], Train Loss: 0.0009, Test Loss: 0.0010
Epoch [21500/21500], Train Loss: 0.0009, Test Loss: 0.0009
Epoch [21550/21550], Train Loss: 0.0009, Test Loss: 0.0009

```
Epoch [21600/21600], Train Loss: 0.0009, Test Loss: 0.0009
Epoch [21650/21650], Train Loss: 0.0010, Test Loss: 0.0008
Epoch [21700/21700], Train Loss: 0.0009, Test Loss: 0.0008
Epoch [21750/21750], Train Loss: 0.0008, Test Loss: 0.0009
Epoch [21800/21800], Train Loss: 0.0008, Test Loss: 0.0008
Epoch [21850/21850], Train Loss: 0.0009, Test Loss: 0.0007
Epoch [21900/21900], Train Loss: 0.0008, Test Loss: 0.0007
Epoch [21950/21950], Train Loss: 0.0008, Test Loss: 0.0008
```

```
In [ ]: plot_loss(train_loss,test_loss,hidden_size,l_train,l_test,loss_type)
```



```
In [ ]: avg_bit_accuracy(model_4,hidden_size,l_train,l_test,batch_size=100)
```



Out[]: 0.8130305975675582

model_5:

```
In [ ]: input_size=2
hidden_size=100
num_layers=1
l_train=5
l_test=5
epochs=20000
batch_size=128
lr=1e-4
loss_type="MSE"
```

```
In [ ]: model_5=Binary_adder(input_size,hidden_size,num_layers).to(device)
criterion=nn.MSELoss()
optimizer=torch.optim.Adam(model_5.parameters(),lr=lr)
```

```
In [ ]: train_loss,test_loss=training_loop(model_5,epochs,optimizer,criterion,batch_si
```

Epoch [0/0], Train Loss: 0.2499, Test Loss: 0.2497
Epoch [50/50], Train Loss: 0.2494, Test Loss: 0.2498
Epoch [100/100], Train Loss: 0.2490, Test Loss: 0.2493
Epoch [150/150], Train Loss: 0.2493, Test Loss: 0.2490
Epoch [200/200], Train Loss: 0.2482, Test Loss: 0.2481
Epoch [250/250], Train Loss: 0.2476, Test Loss: 0.2471
Epoch [300/300], Train Loss: 0.2457, Test Loss: 0.2454
Epoch [350/350], Train Loss: 0.2446, Test Loss: 0.2440
Epoch [400/400], Train Loss: 0.2417, Test Loss: 0.2439
Epoch [450/450], Train Loss: 0.2407, Test Loss: 0.2407
Epoch [500/500], Train Loss: 0.2399, Test Loss: 0.2386
Epoch [550/550], Train Loss: 0.2365, Test Loss: 0.2352
Epoch [600/600], Train Loss: 0.2393, Test Loss: 0.2361
Epoch [650/650], Train Loss: 0.2346, Test Loss: 0.2327
Epoch [700/700], Train Loss: 0.2334, Test Loss: 0.2299
Epoch [750/750], Train Loss: 0.2351, Test Loss: 0.2300
Epoch [800/800], Train Loss: 0.2344, Test Loss: 0.2365
Epoch [850/850], Train Loss: 0.2298, Test Loss: 0.2342
Epoch [900/900], Train Loss: 0.2328, Test Loss: 0.2324
Epoch [950/950], Train Loss: 0.2334, Test Loss: 0.2342
Epoch [1000/1000], Train Loss: 0.2367, Test Loss: 0.2355
Epoch [1050/1050], Train Loss: 0.2303, Test Loss: 0.2296
Epoch [1100/1100], Train Loss: 0.2289, Test Loss: 0.2305
Epoch [1150/1150], Train Loss: 0.2270, Test Loss: 0.2256
Epoch [1200/1200], Train Loss: 0.2290, Test Loss: 0.2233
Epoch [1250/1250], Train Loss: 0.2247, Test Loss: 0.2209
Epoch [1300/1300], Train Loss: 0.2273, Test Loss: 0.2267
Epoch [1350/1350], Train Loss: 0.2274, Test Loss: 0.2269
Epoch [1400/1400], Train Loss: 0.2228, Test Loss: 0.2215
Epoch [1450/1450], Train Loss: 0.2228, Test Loss: 0.2302
Epoch [1500/1500], Train Loss: 0.2262, Test Loss: 0.2229
Epoch [1550/1550], Train Loss: 0.2237, Test Loss: 0.2234
Epoch [1600/1600], Train Loss: 0.2235, Test Loss: 0.2196
Epoch [1650/1650], Train Loss: 0.2222, Test Loss: 0.2201
Epoch [1700/1700], Train Loss: 0.2209, Test Loss: 0.2185
Epoch [1750/1750], Train Loss: 0.2240, Test Loss: 0.2234
Epoch [1800/1800], Train Loss: 0.2199, Test Loss: 0.2200
Epoch [1850/1850], Train Loss: 0.2182, Test Loss: 0.2181
Epoch [1900/1900], Train Loss: 0.2199, Test Loss: 0.2190
Epoch [1950/1950], Train Loss: 0.2197, Test Loss: 0.2178
Epoch [2000/2000], Train Loss: 0.2160, Test Loss: 0.2178
Epoch [2050/2050], Train Loss: 0.2191, Test Loss: 0.2183
Epoch [2100/2100], Train Loss: 0.2142, Test Loss: 0.2172
Epoch [2150/2150], Train Loss: 0.2146, Test Loss: 0.2154
Epoch [2200/2200], Train Loss: 0.2127, Test Loss: 0.2143
Epoch [2250/2250], Train Loss: 0.2162, Test Loss: 0.2135
Epoch [2300/2300], Train Loss: 0.2166, Test Loss: 0.2158
Epoch [2350/2350], Train Loss: 0.2165, Test Loss: 0.2145
Epoch [2400/2400], Train Loss: 0.2143, Test Loss: 0.2176
Epoch [2450/2450], Train Loss: 0.2141, Test Loss: 0.2123
Epoch [2500/2500], Train Loss: 0.2163, Test Loss: 0.2153
Epoch [2550/2550], Train Loss: 0.2135, Test Loss: 0.2130
Epoch [2600/2600], Train Loss: 0.2139, Test Loss: 0.2104
Epoch [2650/2650], Train Loss: 0.2128, Test Loss: 0.2105

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Epoch [2800/2800], Train Loss: 0.2124, Test Loss: 0.2127
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Epoch [7700/7700], Train Loss: 0.0832, Test Loss: 0.0870
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Epoch [7950/7950], Train Loss: 0.0722, Test Loss: 0.0700
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Epoch [8050/8050], Train Loss: 0.0749, Test Loss: 0.0692

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Epoch [8200/8200], Train Loss: 0.0666, Test Loss: 0.0680
Epoch [8250/8250], Train Loss: 0.0638, Test Loss: 0.0627
Epoch [8300/8300], Train Loss: 0.0585, Test Loss: 0.0596
Epoch [8350/8350], Train Loss: 0.0591, Test Loss: 0.0562
Epoch [8400/8400], Train Loss: 0.0588, Test Loss: 0.0617
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Epoch [8500/8500], Train Loss: 0.0555, Test Loss: 0.0541
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Epoch [8600/8600], Train Loss: 0.0500, Test Loss: 0.0519
Epoch [8650/8650], Train Loss: 0.0508, Test Loss: 0.0473
Epoch [8700/8700], Train Loss: 0.0483, Test Loss: 0.0471
Epoch [8750/8750], Train Loss: 0.0457, Test Loss: 0.0460
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Epoch [8850/8850], Train Loss: 0.0395, Test Loss: 0.0440
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Epoch [8950/8950], Train Loss: 0.0441, Test Loss: 0.0373
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Epoch [9050/9050], Train Loss: 0.0427, Test Loss: 0.0404
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Epoch [9150/9150], Train Loss: 0.0417, Test Loss: 0.0388
Epoch [9200/9200], Train Loss: 0.0355, Test Loss: 0.0381
Epoch [9250/9250], Train Loss: 0.0338, Test Loss: 0.0330
Epoch [9300/9300], Train Loss: 0.0342, Test Loss: 0.0357
Epoch [9350/9350], Train Loss: 0.0350, Test Loss: 0.0355
Epoch [9400/9400], Train Loss: 0.0336, Test Loss: 0.0286
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Epoch [9500/9500], Train Loss: 0.0335, Test Loss: 0.0315
Epoch [9550/9550], Train Loss: 0.0295, Test Loss: 0.0309
Epoch [9600/9600], Train Loss: 0.0287, Test Loss: 0.0318
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Epoch [9700/9700], Train Loss: 0.0261, Test Loss: 0.0249
Epoch [9750/9750], Train Loss: 0.0259, Test Loss: 0.0298
Epoch [9800/9800], Train Loss: 0.0244, Test Loss: 0.0266
Epoch [9850/9850], Train Loss: 0.0281, Test Loss: 0.0261
Epoch [9900/9900], Train Loss: 0.0271, Test Loss: 0.0259
Epoch [9950/9950], Train Loss: 0.0241, Test Loss: 0.0252
Epoch [10000/10000], Train Loss: 0.0240, Test Loss: 0.0230
Epoch [10050/10050], Train Loss: 0.0235, Test Loss: 0.0238
Epoch [10100/10100], Train Loss: 0.0245, Test Loss: 0.0205
Epoch [10150/10150], Train Loss: 0.0204, Test Loss: 0.0213
Epoch [10200/10200], Train Loss: 0.0200, Test Loss: 0.0188
Epoch [10250/10250], Train Loss: 0.0219, Test Loss: 0.0198
Epoch [10300/10300], Train Loss: 0.0197, Test Loss: 0.0205
Epoch [10350/10350], Train Loss: 0.0202, Test Loss: 0.0192
Epoch [10400/10400], Train Loss: 0.0174, Test Loss: 0.0188
Epoch [10450/10450], Train Loss: 0.0188, Test Loss: 0.0177
Epoch [10500/10500], Train Loss: 0.0164, Test Loss: 0.0181
Epoch [10550/10550], Train Loss: 0.0174, Test Loss: 0.0167
Epoch [10600/10600], Train Loss: 0.0166, Test Loss: 0.0162
Epoch [10650/10650], Train Loss: 0.0174, Test Loss: 0.0174
Epoch [10700/10700], Train Loss: 0.0156, Test Loss: 0.0163
Epoch [10750/10750], Train Loss: 0.0149, Test Loss: 0.0152

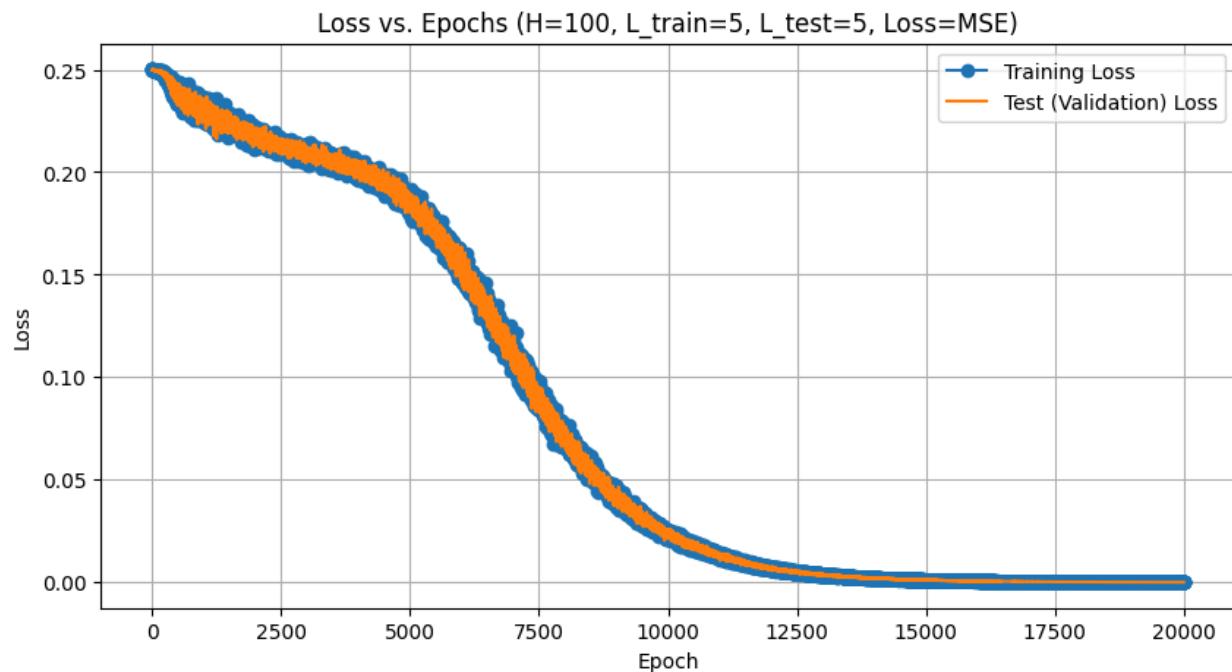
Epoch [10800/10800], Train Loss: 0.0149, Test Loss: 0.0149
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Epoch [10950/10950], Train Loss: 0.0123, Test Loss: 0.0122
Epoch [11000/11000], Train Loss: 0.0140, Test Loss: 0.0129
Epoch [11050/11050], Train Loss: 0.0124, Test Loss: 0.0120
Epoch [11100/11100], Train Loss: 0.0124, Test Loss: 0.0125
Epoch [11150/11150], Train Loss: 0.0117, Test Loss: 0.0111
Epoch [11200/11200], Train Loss: 0.0119, Test Loss: 0.0120
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Epoch [11300/11300], Train Loss: 0.0101, Test Loss: 0.0111
Epoch [11350/11350], Train Loss: 0.0101, Test Loss: 0.0102
Epoch [11400/11400], Train Loss: 0.0111, Test Loss: 0.0102
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Epoch [11650/11650], Train Loss: 0.0092, Test Loss: 0.0083
Epoch [11700/11700], Train Loss: 0.0078, Test Loss: 0.0082
Epoch [11750/11750], Train Loss: 0.0079, Test Loss: 0.0080
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Epoch [12000/12000], Train Loss: 0.0064, Test Loss: 0.0072
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Epoch [12150/12150], Train Loss: 0.0059, Test Loss: 0.0065
Epoch [12200/12200], Train Loss: 0.0063, Test Loss: 0.0054
Epoch [12250/12250], Train Loss: 0.0064, Test Loss: 0.0051
Epoch [12300/12300], Train Loss: 0.0051, Test Loss: 0.0057
Epoch [12350/12350], Train Loss: 0.0052, Test Loss: 0.0057
Epoch [12400/12400], Train Loss: 0.0053, Test Loss: 0.0055
Epoch [12450/12450], Train Loss: 0.0051, Test Loss: 0.0052
Epoch [12500/12500], Train Loss: 0.0052, Test Loss: 0.0052
Epoch [12550/12550], Train Loss: 0.0046, Test Loss: 0.0046
Epoch [12600/12600], Train Loss: 0.0043, Test Loss: 0.0046
Epoch [12650/12650], Train Loss: 0.0045, Test Loss: 0.0050
Epoch [12700/12700], Train Loss: 0.0043, Test Loss: 0.0040
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Epoch [12800/12800], Train Loss: 0.0044, Test Loss: 0.0043
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Epoch [12950/12950], Train Loss: 0.0036, Test Loss: 0.0039
Epoch [13000/13000], Train Loss: 0.0037, Test Loss: 0.0038
Epoch [13050/13050], Train Loss: 0.0037, Test Loss: 0.0035
Epoch [13100/13100], Train Loss: 0.0033, Test Loss: 0.0031
Epoch [13150/13150], Train Loss: 0.0032, Test Loss: 0.0034
Epoch [13200/13200], Train Loss: 0.0035, Test Loss: 0.0036
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Epoch [13300/13300], Train Loss: 0.0030, Test Loss: 0.0031
Epoch [13350/13350], Train Loss: 0.0031, Test Loss: 0.0029
Epoch [13400/13400], Train Loss: 0.0028, Test Loss: 0.0027
Epoch [13450/13450], Train Loss: 0.0027, Test Loss: 0.0027

Epoch [13500/13500], Train Loss: 0.0027, Test Loss: 0.0025
Epoch [13550/13550], Train Loss: 0.0027, Test Loss: 0.0024
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Epoch [13650/13650], Train Loss: 0.0024, Test Loss: 0.0025
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Epoch [13750/13750], Train Loss: 0.0024, Test Loss: 0.0022
Epoch [13800/13800], Train Loss: 0.0022, Test Loss: 0.0022
Epoch [13850/13850], Train Loss: 0.0020, Test Loss: 0.0021
Epoch [13900/13900], Train Loss: 0.0022, Test Loss: 0.0023
Epoch [13950/13950], Train Loss: 0.0020, Test Loss: 0.0019
Epoch [14000/14000], Train Loss: 0.0020, Test Loss: 0.0022
Epoch [14050/14050], Train Loss: 0.0019, Test Loss: 0.0020
Epoch [14100/14100], Train Loss: 0.0019, Test Loss: 0.0021
Epoch [14150/14150], Train Loss: 0.0019, Test Loss: 0.0018
Epoch [14200/14200], Train Loss: 0.0018, Test Loss: 0.0018
Epoch [14250/14250], Train Loss: 0.0019, Test Loss: 0.0019
Epoch [14300/14300], Train Loss: 0.0019, Test Loss: 0.0017
Epoch [14350/14350], Train Loss: 0.0016, Test Loss: 0.0015
Epoch [14400/14400], Train Loss: 0.0017, Test Loss: 0.0016
Epoch [14450/14450], Train Loss: 0.0015, Test Loss: 0.0016
Epoch [14500/14500], Train Loss: 0.0015, Test Loss: 0.0014
Epoch [14550/14550], Train Loss: 0.0013, Test Loss: 0.0013
Epoch [14600/14600], Train Loss: 0.0015, Test Loss: 0.0014
Epoch [14650/14650], Train Loss: 0.0013, Test Loss: 0.0014
Epoch [14700/14700], Train Loss: 0.0015, Test Loss: 0.0013
Epoch [14750/14750], Train Loss: 0.0014, Test Loss: 0.0013
Epoch [14800/14800], Train Loss: 0.0012, Test Loss: 0.0013
Epoch [14850/14850], Train Loss: 0.0012, Test Loss: 0.0012
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Epoch [14950/14950], Train Loss: 0.0011, Test Loss: 0.0012
Epoch [15000/15000], Train Loss: 0.0011, Test Loss: 0.0012
Epoch [15050/15050], Train Loss: 0.0010, Test Loss: 0.0011
Epoch [15100/15100], Train Loss: 0.0011, Test Loss: 0.0011
Epoch [15150/15150], Train Loss: 0.0011, Test Loss: 0.0010
Epoch [15200/15200], Train Loss: 0.0009, Test Loss: 0.0010
Epoch [15250/15250], Train Loss: 0.0009, Test Loss: 0.0009
Epoch [15300/15300], Train Loss: 0.0010, Test Loss: 0.0009
Epoch [15350/15350], Train Loss: 0.0009, Test Loss: 0.0010
Epoch [15400/15400], Train Loss: 0.0009, Test Loss: 0.0009
Epoch [15450/15450], Train Loss: 0.0008, Test Loss: 0.0009
Epoch [15500/15500], Train Loss: 0.0008, Test Loss: 0.0009
Epoch [15550/15550], Train Loss: 0.0008, Test Loss: 0.0009
Epoch [15600/15600], Train Loss: 0.0008, Test Loss: 0.0008
Epoch [15650/15650], Train Loss: 0.0007, Test Loss: 0.0008
Epoch [15700/15700], Train Loss: 0.0008, Test Loss: 0.0008
Epoch [15750/15750], Train Loss: 0.0008, Test Loss: 0.0007
Epoch [15800/15800], Train Loss: 0.0007, Test Loss: 0.0007
Epoch [15850/15850], Train Loss: 0.0007, Test Loss: 0.0008
Epoch [15900/15900], Train Loss: 0.0007, Test Loss: 0.0007
Epoch [15950/15950], Train Loss: 0.0007, Test Loss: 0.0007
Epoch [16000/16000], Train Loss: 0.0006, Test Loss: 0.0006
Epoch [16050/16050], Train Loss: 0.0007, Test Loss: 0.0006
Epoch [16100/16100], Train Loss: 0.0006, Test Loss: 0.0006
Epoch [16150/16150], Train Loss: 0.0006, Test Loss: 0.0006

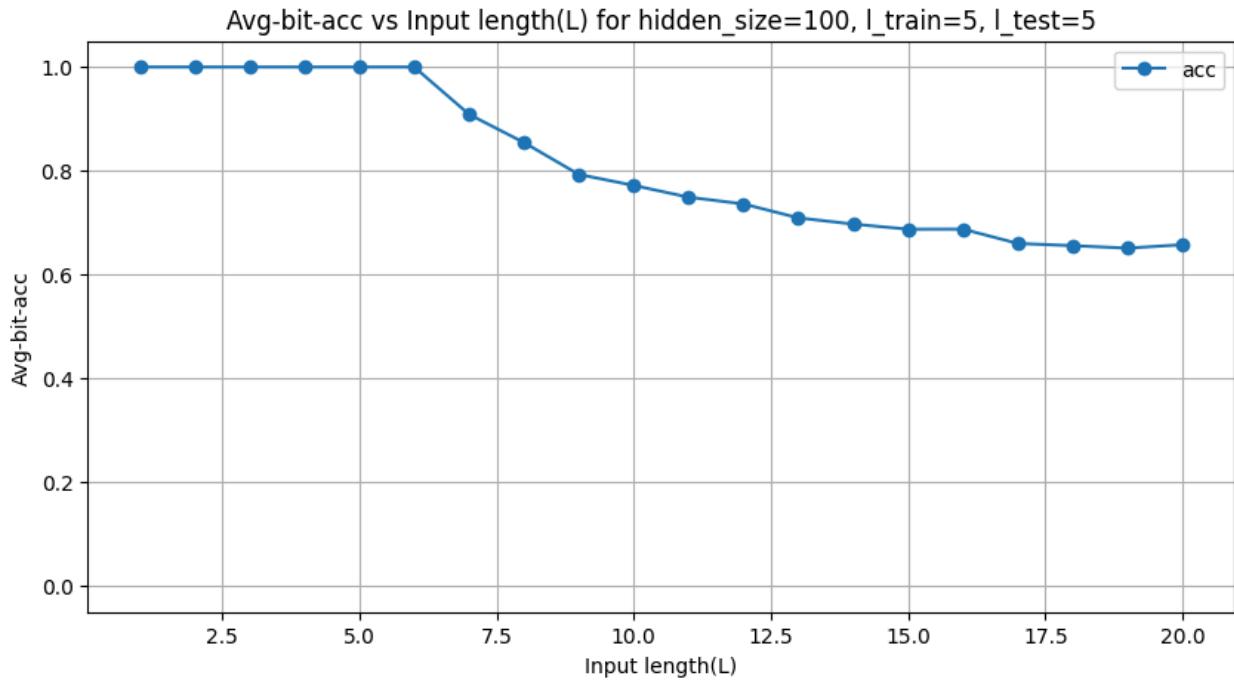
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Epoch [16250/16250], Train Loss: 0.0006, Test Loss: 0.0006
Epoch [16300/16300], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [16350/16350], Train Loss: 0.0005, Test Loss: 0.0005
Epoch [16400/16400], Train Loss: 0.0005, Test Loss: 0.0005
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Epoch [16650/16650], Train Loss: 0.0004, Test Loss: 0.0004
Epoch [16700/16700], Train Loss: 0.0004, Test Loss: 0.0005
Epoch [16750/16750], Train Loss: 0.0004, Test Loss: 0.0004
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Epoch [17100/17100], Train Loss: 0.0003, Test Loss: 0.0003
Epoch [17150/17150], Train Loss: 0.0003, Test Loss: 0.0003
Epoch [17200/17200], Train Loss: 0.0003, Test Loss: 0.0003
Epoch [17250/17250], Train Loss: 0.0003, Test Loss: 0.0004
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Epoch [17400/17400], Train Loss: 0.0003, Test Loss: 0.0003
Epoch [17450/17450], Train Loss: 0.0003, Test Loss: 0.0002
Epoch [17500/17500], Train Loss: 0.0003, Test Loss: 0.0003
Epoch [17550/17550], Train Loss: 0.0003, Test Loss: 0.0003
Epoch [17600/17600], Train Loss: 0.0003, Test Loss: 0.0002
Epoch [17650/17650], Train Loss: 0.0003, Test Loss: 0.0003
Epoch [17700/17700], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [17750/17750], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [17800/17800], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [17850/17850], Train Loss: 0.0003, Test Loss: 0.0002
Epoch [17900/17900], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [17950/17950], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [18000/18000], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [18050/18050], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [18100/18100], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [18150/18150], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [18200/18200], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [18250/18250], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [18300/18300], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [18350/18350], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [18400/18400], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [18450/18450], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [18500/18500], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [18550/18550], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [18600/18600], Train Loss: 0.0002, Test Loss: 0.0001
Epoch [18650/18650], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [18700/18700], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [18750/18750], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [18800/18800], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [18850/18850], Train Loss: 0.0001, Test Loss: 0.0001

```
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Epoch [18950/18950], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19000/19000], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19050/19050], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19100/19100], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19150/19150], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19200/19200], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19250/19250], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19300/19300], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19350/19350], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19400/19400], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19450/19450], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19500/19500], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19550/19550], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19600/19600], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19650/19650], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19700/19700], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19750/19750], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19800/19800], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19850/19850], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19900/19900], Train Loss: 0.0001, Test Loss: 0.0001
Epoch [19950/19950], Train Loss: 0.0001, Test Loss: 0.0001
```

```
In [ ]: plot_loss(train_loss,test_loss,hidden_size,l_train,l_test,loss_type)
```



```
In [ ]: avg_bit_accuracy(model_5,hidden_size,l_train,l_test,batch_size=100)
```



Out[]: 0.8109753906726838

model_6

```
In [ ]: input_size=2
hidden_size=10
num_layers=1
l_train=3
l_test=5
epochs=50000
batch_size=128
lr=1e-4
loss_type="BCE"
```

```
In [ ]: model_6=Binary_adder(input_size,hidden_size,num_layers).to(device)
criterion=nn.BCELoss()
optimizer=torch.optim.Adam(model_6.parameters(),lr=lr)
```

```
In [ ]: train_loss,test_loss=training_loop(model_6,epochs,optimizer,criterion,batch_si
```

Epoch [0/0], Train Loss: 0.7185, Test Loss: 0.7140
Epoch [50/50], Train Loss: 0.7131, Test Loss: 0.7011
Epoch [100/100], Train Loss: 0.7108, Test Loss: 0.7081
Epoch [150/150], Train Loss: 0.7062, Test Loss: 0.7045
Epoch [200/200], Train Loss: 0.7069, Test Loss: 0.6939
Epoch [250/250], Train Loss: 0.7101, Test Loss: 0.6978
Epoch [300/300], Train Loss: 0.7094, Test Loss: 0.7017
Epoch [350/350], Train Loss: 0.7063, Test Loss: 0.6946
Epoch [400/400], Train Loss: 0.7085, Test Loss: 0.6969
Epoch [450/450], Train Loss: 0.7057, Test Loss: 0.6995
Epoch [500/500], Train Loss: 0.7006, Test Loss: 0.6973
Epoch [550/550], Train Loss: 0.6991, Test Loss: 0.6942
Epoch [600/600], Train Loss: 0.7016, Test Loss: 0.6950
Epoch [650/650], Train Loss: 0.6935, Test Loss: 0.6963
Epoch [700/700], Train Loss: 0.6944, Test Loss: 0.6943
Epoch [750/750], Train Loss: 0.6906, Test Loss: 0.6923
Epoch [800/800], Train Loss: 0.6964, Test Loss: 0.6935
Epoch [850/850], Train Loss: 0.6942, Test Loss: 0.6941
Epoch [900/900], Train Loss: 0.6942, Test Loss: 0.6921
Epoch [950/950], Train Loss: 0.6907, Test Loss: 0.6930
Epoch [1000/1000], Train Loss: 0.6929, Test Loss: 0.6903
Epoch [1050/1050], Train Loss: 0.6905, Test Loss: 0.6911
Epoch [1100/1100], Train Loss: 0.6912, Test Loss: 0.6922
Epoch [1150/1150], Train Loss: 0.6897, Test Loss: 0.6916
Epoch [1200/1200], Train Loss: 0.6896, Test Loss: 0.6905
Epoch [1250/1250], Train Loss: 0.6864, Test Loss: 0.6872
Epoch [1300/1300], Train Loss: 0.6900, Test Loss: 0.6892
Epoch [1350/1350], Train Loss: 0.6869, Test Loss: 0.6933
Epoch [1400/1400], Train Loss: 0.6854, Test Loss: 0.6910
Epoch [1450/1450], Train Loss: 0.6853, Test Loss: 0.6882
Epoch [1500/1500], Train Loss: 0.6869, Test Loss: 0.6871
Epoch [1550/1550], Train Loss: 0.6842, Test Loss: 0.6863
Epoch [1600/1600], Train Loss: 0.6839, Test Loss: 0.6866
Epoch [1650/1650], Train Loss: 0.6822, Test Loss: 0.6842
Epoch [1700/1700], Train Loss: 0.6787, Test Loss: 0.6892
Epoch [1750/1750], Train Loss: 0.6811, Test Loss: 0.6900
Epoch [1800/1800], Train Loss: 0.6761, Test Loss: 0.6821
Epoch [1850/1850], Train Loss: 0.6773, Test Loss: 0.6849
Epoch [1900/1900], Train Loss: 0.6755, Test Loss: 0.6844
Epoch [1950/1950], Train Loss: 0.6788, Test Loss: 0.6819
Epoch [2000/2000], Train Loss: 0.6720, Test Loss: 0.6842
Epoch [2050/2050], Train Loss: 0.6681, Test Loss: 0.6843
Epoch [2100/2100], Train Loss: 0.6682, Test Loss: 0.6832
Epoch [2150/2150], Train Loss: 0.6633, Test Loss: 0.6820
Epoch [2200/2200], Train Loss: 0.6637, Test Loss: 0.6796
Epoch [2250/2250], Train Loss: 0.6705, Test Loss: 0.6781
Epoch [2300/2300], Train Loss: 0.6555, Test Loss: 0.6786
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Epoch [2400/2400], Train Loss: 0.6625, Test Loss: 0.6821
Epoch [2450/2450], Train Loss: 0.6492, Test Loss: 0.6757
Epoch [2500/2500], Train Loss: 0.6644, Test Loss: 0.6755
Epoch [2550/2550], Train Loss: 0.6482, Test Loss: 0.6896
Epoch [2600/2600], Train Loss: 0.6518, Test Loss: 0.6767
Epoch [2650/2650], Train Loss: 0.6542, Test Loss: 0.6971

Epoch [2700/2700], Train Loss: 0.6514, Test Loss: 0.6845
Epoch [2750/2750], Train Loss: 0.6500, Test Loss: 0.6763
Epoch [2800/2800], Train Loss: 0.6459, Test Loss: 0.6777
Epoch [2850/2850], Train Loss: 0.6506, Test Loss: 0.6843
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Epoch [2950/2950], Train Loss: 0.6408, Test Loss: 0.6932
Epoch [3000/3000], Train Loss: 0.6434, Test Loss: 0.6832
Epoch [3050/3050], Train Loss: 0.6483, Test Loss: 0.6762
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Epoch [3150/3150], Train Loss: 0.6359, Test Loss: 0.6715
Epoch [3200/3200], Train Loss: 0.6391, Test Loss: 0.6847
Epoch [3250/3250], Train Loss: 0.6435, Test Loss: 0.6869
Epoch [3300/3300], Train Loss: 0.6259, Test Loss: 0.6838
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Epoch [3550/3550], Train Loss: 0.6170, Test Loss: 0.6708
Epoch [3600/3600], Train Loss: 0.6332, Test Loss: 0.6909
Epoch [3650/3650], Train Loss: 0.6108, Test Loss: 0.6717
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Epoch [4000/4000], Train Loss: 0.6024, Test Loss: 0.6735
Epoch [4050/4050], Train Loss: 0.6126, Test Loss: 0.6771
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Epoch [4150/4150], Train Loss: 0.6215, Test Loss: 0.6690
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Epoch [4650/4650], Train Loss: 0.5920, Test Loss: 0.6505
Epoch [4700/4700], Train Loss: 0.5724, Test Loss: 0.6488
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Epoch [4800/4800], Train Loss: 0.5733, Test Loss: 0.6796
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Epoch [5050/5050], Train Loss: 0.5791, Test Loss: 0.6375
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Epoch [8100/8100], Train Loss: 0.3597, Test Loss: 0.6088
Epoch [8150/8150], Train Loss: 0.3686, Test Loss: 0.6086
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Epoch [8250/8250], Train Loss: 0.3594, Test Loss: 0.5668
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Epoch [8450/8450], Train Loss: 0.3518, Test Loss: 0.5841
Epoch [8500/8500], Train Loss: 0.3407, Test Loss: 0.6139
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Epoch [8950/8950], Train Loss: 0.3222, Test Loss: 0.5875
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Epoch [9200/9200], Train Loss: 0.3113, Test Loss: 0.5521
Epoch [9250/9250], Train Loss: 0.2926, Test Loss: 0.5853
Epoch [9300/9300], Train Loss: 0.2850, Test Loss: 0.5541
Epoch [9350/9350], Train Loss: 0.3094, Test Loss: 0.5521
Epoch [9400/9400], Train Loss: 0.2911, Test Loss: 0.5680
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Epoch [9600/9600], Train Loss: 0.2917, Test Loss: 0.5837
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Epoch [9700/9700], Train Loss: 0.2831, Test Loss: 0.5597
Epoch [9750/9750], Train Loss: 0.2749, Test Loss: 0.6040
Epoch [9800/9800], Train Loss: 0.2827, Test Loss: 0.5835
Epoch [9850/9850], Train Loss: 0.2663, Test Loss: 0.5860
Epoch [9900/9900], Train Loss: 0.2799, Test Loss: 0.5555
Epoch [9950/9950], Train Loss: 0.2727, Test Loss: 0.5493
Epoch [10000/10000], Train Loss: 0.2601, Test Loss: 0.5855
Epoch [10050/10050], Train Loss: 0.2799, Test Loss: 0.5473
Epoch [10100/10100], Train Loss: 0.2523, Test Loss: 0.5163
Epoch [10150/10150], Train Loss: 0.2675, Test Loss: 0.5258
Epoch [10200/10200], Train Loss: 0.2624, Test Loss: 0.5858
Epoch [10250/10250], Train Loss: 0.2433, Test Loss: 0.5507
Epoch [10300/10300], Train Loss: 0.2480, Test Loss: 0.5375
Epoch [10350/10350], Train Loss: 0.2433, Test Loss: 0.5946
Epoch [10400/10400], Train Loss: 0.2571, Test Loss: 0.5657
Epoch [10450/10450], Train Loss: 0.2437, Test Loss: 0.4582
Epoch [10500/10500], Train Loss: 0.2450, Test Loss: 0.5076
Epoch [10550/10550], Train Loss: 0.2458, Test Loss: 0.5373
Epoch [10600/10600], Train Loss: 0.2538, Test Loss: 0.5119
Epoch [10650/10650], Train Loss: 0.2414, Test Loss: 0.5493
Epoch [10700/10700], Train Loss: 0.2425, Test Loss: 0.5376
Epoch [10750/10750], Train Loss: 0.2388, Test Loss: 0.5174

Epoch [10800/10800], Train Loss: 0.2406, Test Loss: 0.4779
Epoch [10850/10850], Train Loss: 0.2367, Test Loss: 0.5818
Epoch [10900/10900], Train Loss: 0.2358, Test Loss: 0.5046
Epoch [10950/10950], Train Loss: 0.2171, Test Loss: 0.4922
Epoch [11000/11000], Train Loss: 0.2194, Test Loss: 0.5671
Epoch [11050/11050], Train Loss: 0.2161, Test Loss: 0.5328
Epoch [11100/11100], Train Loss: 0.2220, Test Loss: 0.5153
Epoch [11150/11150], Train Loss: 0.2471, Test Loss: 0.4825
Epoch [11200/11200], Train Loss: 0.2426, Test Loss: 0.5419
Epoch [11250/11250], Train Loss: 0.2239, Test Loss: 0.5386
Epoch [11300/11300], Train Loss: 0.2037, Test Loss: 0.5000
Epoch [11350/11350], Train Loss: 0.2014, Test Loss: 0.5019
Epoch [11400/11400], Train Loss: 0.2176, Test Loss: 0.4718
Epoch [11450/11450], Train Loss: 0.2132, Test Loss: 0.5374
Epoch [11500/11500], Train Loss: 0.1808, Test Loss: 0.5098
Epoch [11550/11550], Train Loss: 0.2100, Test Loss: 0.5008
Epoch [11600/11600], Train Loss: 0.2151, Test Loss: 0.5900
Epoch [11650/11650], Train Loss: 0.1975, Test Loss: 0.5046
Epoch [11700/11700], Train Loss: 0.1934, Test Loss: 0.5200
Epoch [11750/11750], Train Loss: 0.2104, Test Loss: 0.4721
Epoch [11800/11800], Train Loss: 0.2056, Test Loss: 0.4466
Epoch [11850/11850], Train Loss: 0.1949, Test Loss: 0.4825
Epoch [11900/11900], Train Loss: 0.2137, Test Loss: 0.4472
Epoch [11950/11950], Train Loss: 0.2052, Test Loss: 0.5396
Epoch [12000/12000], Train Loss: 0.1793, Test Loss: 0.5280
Epoch [12050/12050], Train Loss: 0.1859, Test Loss: 0.4702
Epoch [12100/12100], Train Loss: 0.1944, Test Loss: 0.5203
Epoch [12150/12150], Train Loss: 0.1804, Test Loss: 0.5377
Epoch [12200/12200], Train Loss: 0.1850, Test Loss: 0.4722
Epoch [12250/12250], Train Loss: 0.1855, Test Loss: 0.5269
Epoch [12300/12300], Train Loss: 0.1796, Test Loss: 0.4548
Epoch [12350/12350], Train Loss: 0.1839, Test Loss: 0.4572
Epoch [12400/12400], Train Loss: 0.1817, Test Loss: 0.4934
Epoch [12450/12450], Train Loss: 0.1610, Test Loss: 0.4989
Epoch [12500/12500], Train Loss: 0.1815, Test Loss: 0.4772
Epoch [12550/12550], Train Loss: 0.1832, Test Loss: 0.4552
Epoch [12600/12600], Train Loss: 0.1835, Test Loss: 0.5265
Epoch [12650/12650], Train Loss: 0.1557, Test Loss: 0.4972
Epoch [12700/12700], Train Loss: 0.1926, Test Loss: 0.4366
Epoch [12750/12750], Train Loss: 0.1492, Test Loss: 0.4179
Epoch [12800/12800], Train Loss: 0.1797, Test Loss: 0.5931
Epoch [12850/12850], Train Loss: 0.1581, Test Loss: 0.5866
Epoch [12900/12900], Train Loss: 0.1875, Test Loss: 0.4601
Epoch [12950/12950], Train Loss: 0.1640, Test Loss: 0.5608
Epoch [13000/13000], Train Loss: 0.1655, Test Loss: 0.4363
Epoch [13050/13050], Train Loss: 0.1463, Test Loss: 0.5158
Epoch [13100/13100], Train Loss: 0.1747, Test Loss: 0.5836
Epoch [13150/13150], Train Loss: 0.1504, Test Loss: 0.3777
Epoch [13200/13200], Train Loss: 0.1497, Test Loss: 0.5412
Epoch [13250/13250], Train Loss: 0.1519, Test Loss: 0.4957
Epoch [13300/13300], Train Loss: 0.1431, Test Loss: 0.5140
Epoch [13350/13350], Train Loss: 0.1490, Test Loss: 0.5013
Epoch [13400/13400], Train Loss: 0.1481, Test Loss: 0.4880
Epoch [13450/13450], Train Loss: 0.1554, Test Loss: 0.4894

Epoch [13500/13500], Train Loss: 0.1467, Test Loss: 0.5093
Epoch [13550/13550], Train Loss: 0.1343, Test Loss: 0.5202
Epoch [13600/13600], Train Loss: 0.1222, Test Loss: 0.4988
Epoch [13650/13650], Train Loss: 0.1413, Test Loss: 0.4170
Epoch [13700/13700], Train Loss: 0.1552, Test Loss: 0.3836
Epoch [13750/13750], Train Loss: 0.1483, Test Loss: 0.5175
Epoch [13800/13800], Train Loss: 0.1587, Test Loss: 0.4647
Epoch [13850/13850], Train Loss: 0.1508, Test Loss: 0.4561
Epoch [13900/13900], Train Loss: 0.1291, Test Loss: 0.4180
Epoch [13950/13950], Train Loss: 0.1432, Test Loss: 0.4916
Epoch [14000/14000], Train Loss: 0.1103, Test Loss: 0.4587
Epoch [14050/14050], Train Loss: 0.1194, Test Loss: 0.4170
Epoch [14100/14100], Train Loss: 0.1502, Test Loss: 0.4317
Epoch [14150/14150], Train Loss: 0.1317, Test Loss: 0.4604
Epoch [14200/14200], Train Loss: 0.1107, Test Loss: 0.4679
Epoch [14250/14250], Train Loss: 0.1257, Test Loss: 0.4426
Epoch [14300/14300], Train Loss: 0.1308, Test Loss: 0.4859
Epoch [14350/14350], Train Loss: 0.1138, Test Loss: 0.5032
Epoch [14400/14400], Train Loss: 0.1285, Test Loss: 0.4470
Epoch [14450/14450], Train Loss: 0.1337, Test Loss: 0.4881
Epoch [14500/14500], Train Loss: 0.1198, Test Loss: 0.4886
Epoch [14550/14550], Train Loss: 0.1255, Test Loss: 0.4663
Epoch [14600/14600], Train Loss: 0.1066, Test Loss: 0.4680
Epoch [14650/14650], Train Loss: 0.1296, Test Loss: 0.4348
Epoch [14700/14700], Train Loss: 0.1305, Test Loss: 0.4603
Epoch [14750/14750], Train Loss: 0.1279, Test Loss: 0.4605
Epoch [14800/14800], Train Loss: 0.1150, Test Loss: 0.4796
Epoch [14850/14850], Train Loss: 0.1289, Test Loss: 0.5548
Epoch [14900/14900], Train Loss: 0.1084, Test Loss: 0.4633
Epoch [14950/14950], Train Loss: 0.1202, Test Loss: 0.4837
Epoch [15000/15000], Train Loss: 0.1175, Test Loss: 0.4155
Epoch [15050/15050], Train Loss: 0.1050, Test Loss: 0.4394
Epoch [15100/15100], Train Loss: 0.1122, Test Loss: 0.5196
Epoch [15150/15150], Train Loss: 0.1102, Test Loss: 0.4829
Epoch [15200/15200], Train Loss: 0.0975, Test Loss: 0.4469
Epoch [15250/15250], Train Loss: 0.1278, Test Loss: 0.4819
Epoch [15300/15300], Train Loss: 0.1105, Test Loss: 0.4846
Epoch [15350/15350], Train Loss: 0.1050, Test Loss: 0.4575
Epoch [15400/15400], Train Loss: 0.1184, Test Loss: 0.4959
Epoch [15450/15450], Train Loss: 0.1016, Test Loss: 0.5021
Epoch [15500/15500], Train Loss: 0.1218, Test Loss: 0.4147
Epoch [15550/15550], Train Loss: 0.1215, Test Loss: 0.4967
Epoch [15600/15600], Train Loss: 0.1153, Test Loss: 0.4052
Epoch [15650/15650], Train Loss: 0.1207, Test Loss: 0.4322
Epoch [15700/15700], Train Loss: 0.1068, Test Loss: 0.4795
Epoch [15750/15750], Train Loss: 0.1041, Test Loss: 0.3761
Epoch [15800/15800], Train Loss: 0.1124, Test Loss: 0.4929
Epoch [15850/15850], Train Loss: 0.1072, Test Loss: 0.4961
Epoch [15900/15900], Train Loss: 0.0886, Test Loss: 0.4476
Epoch [15950/15950], Train Loss: 0.0944, Test Loss: 0.4830
Epoch [16000/16000], Train Loss: 0.1116, Test Loss: 0.4698
Epoch [16050/16050], Train Loss: 0.1012, Test Loss: 0.4562
Epoch [16100/16100], Train Loss: 0.0786, Test Loss: 0.5667
Epoch [16150/16150], Train Loss: 0.0993, Test Loss: 0.5059

Epoch [16200/16200], Train Loss: 0.0961, Test Loss: 0.4052
Epoch [16250/16250], Train Loss: 0.1004, Test Loss: 0.4743
Epoch [16300/16300], Train Loss: 0.0912, Test Loss: 0.4934
Epoch [16350/16350], Train Loss: 0.0991, Test Loss: 0.4989
Epoch [16400/16400], Train Loss: 0.0951, Test Loss: 0.4635
Epoch [16450/16450], Train Loss: 0.0761, Test Loss: 0.4577
Epoch [16500/16500], Train Loss: 0.0949, Test Loss: 0.5002
Epoch [16550/16550], Train Loss: 0.0795, Test Loss: 0.5085
Epoch [16600/16600], Train Loss: 0.0792, Test Loss: 0.4732
Epoch [16650/16650], Train Loss: 0.0810, Test Loss: 0.5257
Epoch [16700/16700], Train Loss: 0.0948, Test Loss: 0.4524
Epoch [16750/16750], Train Loss: 0.0853, Test Loss: 0.4245
Epoch [16800/16800], Train Loss: 0.0779, Test Loss: 0.4500
Epoch [16850/16850], Train Loss: 0.0857, Test Loss: 0.5646
Epoch [16900/16900], Train Loss: 0.0783, Test Loss: 0.5088
Epoch [16950/16950], Train Loss: 0.0764, Test Loss: 0.4116
Epoch [17000/17000], Train Loss: 0.0820, Test Loss: 0.5078
Epoch [17050/17050], Train Loss: 0.0872, Test Loss: 0.5252
Epoch [17100/17100], Train Loss: 0.0839, Test Loss: 0.4950
Epoch [17150/17150], Train Loss: 0.0797, Test Loss: 0.5054
Epoch [17200/17200], Train Loss: 0.0909, Test Loss: 0.4762
Epoch [17250/17250], Train Loss: 0.0971, Test Loss: 0.4569
Epoch [17300/17300], Train Loss: 0.0889, Test Loss: 0.4960
Epoch [17350/17350], Train Loss: 0.0765, Test Loss: 0.5272
Epoch [17400/17400], Train Loss: 0.0769, Test Loss: 0.5427
Epoch [17450/17450], Train Loss: 0.0779, Test Loss: 0.4687
Epoch [17500/17500], Train Loss: 0.0793, Test Loss: 0.5280
Epoch [17550/17550], Train Loss: 0.0864, Test Loss: 0.5190
Epoch [17600/17600], Train Loss: 0.0709, Test Loss: 0.4445
Epoch [17650/17650], Train Loss: 0.0846, Test Loss: 0.5004
Epoch [17700/17700], Train Loss: 0.0912, Test Loss: 0.4764
Epoch [17750/17750], Train Loss: 0.0735, Test Loss: 0.4935
Epoch [17800/17800], Train Loss: 0.0654, Test Loss: 0.5526
Epoch [17850/17850], Train Loss: 0.0678, Test Loss: 0.4415
Epoch [17900/17900], Train Loss: 0.0763, Test Loss: 0.4920
Epoch [17950/17950], Train Loss: 0.0646, Test Loss: 0.5009
Epoch [18000/18000], Train Loss: 0.0635, Test Loss: 0.4520
Epoch [18050/18050], Train Loss: 0.0693, Test Loss: 0.4827
Epoch [18100/18100], Train Loss: 0.0722, Test Loss: 0.5239
Epoch [18150/18150], Train Loss: 0.0633, Test Loss: 0.5449
Epoch [18200/18200], Train Loss: 0.0752, Test Loss: 0.5227
Epoch [18250/18250], Train Loss: 0.0662, Test Loss: 0.4353
Epoch [18300/18300], Train Loss: 0.0757, Test Loss: 0.4609
Epoch [18350/18350], Train Loss: 0.0752, Test Loss: 0.4271
Epoch [18400/18400], Train Loss: 0.0633, Test Loss: 0.4580
Epoch [18450/18450], Train Loss: 0.0623, Test Loss: 0.5296
Epoch [18500/18500], Train Loss: 0.0601, Test Loss: 0.5032
Epoch [18550/18550], Train Loss: 0.0608, Test Loss: 0.5033
Epoch [18600/18600], Train Loss: 0.0609, Test Loss: 0.4394
Epoch [18650/18650], Train Loss: 0.0702, Test Loss: 0.4546
Epoch [18700/18700], Train Loss: 0.0622, Test Loss: 0.5172
Epoch [18750/18750], Train Loss: 0.0609, Test Loss: 0.4513
Epoch [18800/18800], Train Loss: 0.0629, Test Loss: 0.5146
Epoch [18850/18850], Train Loss: 0.0522, Test Loss: 0.4495

Epoch [18900/18900], Train Loss: 0.0561, Test Loss: 0.4053
Epoch [18950/18950], Train Loss: 0.0821, Test Loss: 0.4556
Epoch [19000/19000], Train Loss: 0.0672, Test Loss: 0.5249
Epoch [19050/19050], Train Loss: 0.0578, Test Loss: 0.6355
Epoch [19100/19100], Train Loss: 0.0677, Test Loss: 0.4139
Epoch [19150/19150], Train Loss: 0.0437, Test Loss: 0.4973
Epoch [19200/19200], Train Loss: 0.0504, Test Loss: 0.4512
Epoch [19250/19250], Train Loss: 0.0654, Test Loss: 0.4629
Epoch [19300/19300], Train Loss: 0.0606, Test Loss: 0.4423
Epoch [19350/19350], Train Loss: 0.0480, Test Loss: 0.5011
Epoch [19400/19400], Train Loss: 0.0491, Test Loss: 0.5207
Epoch [19450/19450], Train Loss: 0.0617, Test Loss: 0.4851
Epoch [19500/19500], Train Loss: 0.0544, Test Loss: 0.5191
Epoch [19550/19550], Train Loss: 0.0589, Test Loss: 0.4955
Epoch [19600/19600], Train Loss: 0.0491, Test Loss: 0.5463
Epoch [19650/19650], Train Loss: 0.0687, Test Loss: 0.3717
Epoch [19700/19700], Train Loss: 0.0492, Test Loss: 0.4179
Epoch [19750/19750], Train Loss: 0.0544, Test Loss: 0.4479
Epoch [19800/19800], Train Loss: 0.0469, Test Loss: 0.4741
Epoch [19850/19850], Train Loss: 0.0542, Test Loss: 0.4508
Epoch [19900/19900], Train Loss: 0.0489, Test Loss: 0.3783
Epoch [19950/19950], Train Loss: 0.0470, Test Loss: 0.5248
Epoch [20000/20000], Train Loss: 0.0557, Test Loss: 0.4405
Epoch [20050/20050], Train Loss: 0.0454, Test Loss: 0.5242
Epoch [20100/20100], Train Loss: 0.0461, Test Loss: 0.4252
Epoch [20150/20150], Train Loss: 0.0459, Test Loss: 0.4856
Epoch [20200/20200], Train Loss: 0.0539, Test Loss: 0.4634
Epoch [20250/20250], Train Loss: 0.0433, Test Loss: 0.4559
Epoch [20300/20300], Train Loss: 0.0594, Test Loss: 0.5093
Epoch [20350/20350], Train Loss: 0.0501, Test Loss: 0.4565
Epoch [20400/20400], Train Loss: 0.0573, Test Loss: 0.3576
Epoch [20450/20450], Train Loss: 0.0557, Test Loss: 0.4432
Epoch [20500/20500], Train Loss: 0.0517, Test Loss: 0.5609
Epoch [20550/20550], Train Loss: 0.0430, Test Loss: 0.4368
Epoch [20600/20600], Train Loss: 0.0454, Test Loss: 0.4905
Epoch [20650/20650], Train Loss: 0.0568, Test Loss: 0.3992
Epoch [20700/20700], Train Loss: 0.0529, Test Loss: 0.4885
Epoch [20750/20750], Train Loss: 0.0429, Test Loss: 0.4758
Epoch [20800/20800], Train Loss: 0.0547, Test Loss: 0.5265
Epoch [20850/20850], Train Loss: 0.0373, Test Loss: 0.4736
Epoch [20900/20900], Train Loss: 0.0507, Test Loss: 0.4481
Epoch [20950/20950], Train Loss: 0.0541, Test Loss: 0.4142
Epoch [21000/21000], Train Loss: 0.0475, Test Loss: 0.4146
Epoch [21050/21050], Train Loss: 0.0434, Test Loss: 0.4977
Epoch [21100/21100], Train Loss: 0.0520, Test Loss: 0.4182
Epoch [21150/21150], Train Loss: 0.0391, Test Loss: 0.4282
Epoch [21200/21200], Train Loss: 0.0396, Test Loss: 0.3947
Epoch [21250/21250], Train Loss: 0.0420, Test Loss: 0.3758
Epoch [21300/21300], Train Loss: 0.0380, Test Loss: 0.3821
Epoch [21350/21350], Train Loss: 0.0407, Test Loss: 0.4216
Epoch [21400/21400], Train Loss: 0.0398, Test Loss: 0.4159
Epoch [21450/21450], Train Loss: 0.0367, Test Loss: 0.5401
Epoch [21500/21500], Train Loss: 0.0427, Test Loss: 0.3959
Epoch [21550/21550], Train Loss: 0.0455, Test Loss: 0.4737

Epoch [21600/21600], Train Loss: 0.0356, Test Loss: 0.4320
Epoch [21650/21650], Train Loss: 0.0387, Test Loss: 0.4958
Epoch [21700/21700], Train Loss: 0.0400, Test Loss: 0.4830
Epoch [21750/21750], Train Loss: 0.0391, Test Loss: 0.4151
Epoch [21800/21800], Train Loss: 0.0328, Test Loss: 0.3795
Epoch [21850/21850], Train Loss: 0.0411, Test Loss: 0.4543
Epoch [21900/21900], Train Loss: 0.0416, Test Loss: 0.4804
Epoch [21950/21950], Train Loss: 0.0430, Test Loss: 0.4078
Epoch [22000/22000], Train Loss: 0.0406, Test Loss: 0.3875
Epoch [22050/22050], Train Loss: 0.0406, Test Loss: 0.4375
Epoch [22100/22100], Train Loss: 0.0422, Test Loss: 0.4758
Epoch [22150/22150], Train Loss: 0.0320, Test Loss: 0.3857
Epoch [22200/22200], Train Loss: 0.0355, Test Loss: 0.4593
Epoch [22250/22250], Train Loss: 0.0497, Test Loss: 0.4101
Epoch [22300/22300], Train Loss: 0.0393, Test Loss: 0.4210
Epoch [22350/22350], Train Loss: 0.0389, Test Loss: 0.2839
Epoch [22400/22400], Train Loss: 0.0368, Test Loss: 0.3562
Epoch [22450/22450], Train Loss: 0.0345, Test Loss: 0.3567
Epoch [22500/22500], Train Loss: 0.0383, Test Loss: 0.3592
Epoch [22550/22550], Train Loss: 0.0430, Test Loss: 0.4383
Epoch [22600/22600], Train Loss: 0.0348, Test Loss: 0.3513
Epoch [22650/22650], Train Loss: 0.0329, Test Loss: 0.3773
Epoch [22700/22700], Train Loss: 0.0276, Test Loss: 0.3719
Epoch [22750/22750], Train Loss: 0.0325, Test Loss: 0.4104
Epoch [22800/22800], Train Loss: 0.0397, Test Loss: 0.4282
Epoch [22850/22850], Train Loss: 0.0445, Test Loss: 0.3017
Epoch [22900/22900], Train Loss: 0.0430, Test Loss: 0.3833
Epoch [22950/22950], Train Loss: 0.0410, Test Loss: 0.3331
Epoch [23000/23000], Train Loss: 0.0318, Test Loss: 0.3675
Epoch [23050/23050], Train Loss: 0.0383, Test Loss: 0.3732
Epoch [23100/23100], Train Loss: 0.0304, Test Loss: 0.3944
Epoch [23150/23150], Train Loss: 0.0297, Test Loss: 0.3401
Epoch [23200/23200], Train Loss: 0.0429, Test Loss: 0.3558
Epoch [23250/23250], Train Loss: 0.0342, Test Loss: 0.2949
Epoch [23300/23300], Train Loss: 0.0331, Test Loss: 0.4116
Epoch [23350/23350], Train Loss: 0.0297, Test Loss: 0.3227
Epoch [23400/23400], Train Loss: 0.0295, Test Loss: 0.2929
Epoch [23450/23450], Train Loss: 0.0324, Test Loss: 0.3818
Epoch [23500/23500], Train Loss: 0.0285, Test Loss: 0.3769
Epoch [23550/23550], Train Loss: 0.0321, Test Loss: 0.3151
Epoch [23600/23600], Train Loss: 0.0332, Test Loss: 0.3487
Epoch [23650/23650], Train Loss: 0.0266, Test Loss: 0.3773
Epoch [23700/23700], Train Loss: 0.0317, Test Loss: 0.3543
Epoch [23750/23750], Train Loss: 0.0273, Test Loss: 0.3294
Epoch [23800/23800], Train Loss: 0.0230, Test Loss: 0.3422
Epoch [23850/23850], Train Loss: 0.0276, Test Loss: 0.3700
Epoch [23900/23900], Train Loss: 0.0297, Test Loss: 0.3797
Epoch [23950/23950], Train Loss: 0.0300, Test Loss: 0.3779
Epoch [24000/24000], Train Loss: 0.0294, Test Loss: 0.3308
Epoch [24050/24050], Train Loss: 0.0247, Test Loss: 0.3008
Epoch [24100/24100], Train Loss: 0.0269, Test Loss: 0.2797
Epoch [24150/24150], Train Loss: 0.0297, Test Loss: 0.2619
Epoch [24200/24200], Train Loss: 0.0246, Test Loss: 0.3182
Epoch [24250/24250], Train Loss: 0.0272, Test Loss: 0.3590

Epoch [24300/24300], Train Loss: 0.0283, Test Loss: 0.2825
Epoch [24350/24350], Train Loss: 0.0282, Test Loss: 0.2799
Epoch [24400/24400], Train Loss: 0.0192, Test Loss: 0.3018
Epoch [24450/24450], Train Loss: 0.0260, Test Loss: 0.2213
Epoch [24500/24500], Train Loss: 0.0221, Test Loss: 0.3360
Epoch [24550/24550], Train Loss: 0.0279, Test Loss: 0.2823
Epoch [24600/24600], Train Loss: 0.0304, Test Loss: 0.2368
Epoch [24650/24650], Train Loss: 0.0293, Test Loss: 0.2588
Epoch [24700/24700], Train Loss: 0.0221, Test Loss: 0.2843
Epoch [24750/24750], Train Loss: 0.0222, Test Loss: 0.3399
Epoch [24800/24800], Train Loss: 0.0252, Test Loss: 0.2106
Epoch [24850/24850], Train Loss: 0.0364, Test Loss: 0.2696
Epoch [24900/24900], Train Loss: 0.0233, Test Loss: 0.3576
Epoch [24950/24950], Train Loss: 0.0214, Test Loss: 0.2941
Epoch [25000/25000], Train Loss: 0.0269, Test Loss: 0.3063
Epoch [25050/25050], Train Loss: 0.0265, Test Loss: 0.2548
Epoch [25100/25100], Train Loss: 0.0240, Test Loss: 0.2709
Epoch [25150/25150], Train Loss: 0.0281, Test Loss: 0.3230
Epoch [25200/25200], Train Loss: 0.0232, Test Loss: 0.2937
Epoch [25250/25250], Train Loss: 0.0196, Test Loss: 0.3024
Epoch [25300/25300], Train Loss: 0.0269, Test Loss: 0.2194
Epoch [25350/25350], Train Loss: 0.0262, Test Loss: 0.3124
Epoch [25400/25400], Train Loss: 0.0210, Test Loss: 0.2469
Epoch [25450/25450], Train Loss: 0.0271, Test Loss: 0.2663
Epoch [25500/25500], Train Loss: 0.0193, Test Loss: 0.2703
Epoch [25550/25550], Train Loss: 0.0256, Test Loss: 0.2724
Epoch [25600/25600], Train Loss: 0.0247, Test Loss: 0.3155
Epoch [25650/25650], Train Loss: 0.0213, Test Loss: 0.2541
Epoch [25700/25700], Train Loss: 0.0165, Test Loss: 0.2384
Epoch [25750/25750], Train Loss: 0.0227, Test Loss: 0.1876
Epoch [25800/25800], Train Loss: 0.0187, Test Loss: 0.2063
Epoch [25850/25850], Train Loss: 0.0222, Test Loss: 0.2394
Epoch [25900/25900], Train Loss: 0.0188, Test Loss: 0.1933
Epoch [25950/25950], Train Loss: 0.0143, Test Loss: 0.2206
Epoch [26000/26000], Train Loss: 0.0203, Test Loss: 0.2063
Epoch [26050/26050], Train Loss: 0.0208, Test Loss: 0.1660
Epoch [26100/26100], Train Loss: 0.0122, Test Loss: 0.2367
Epoch [26150/26150], Train Loss: 0.0171, Test Loss: 0.2136
Epoch [26200/26200], Train Loss: 0.0182, Test Loss: 0.2355
Epoch [26250/26250], Train Loss: 0.0173, Test Loss: 0.1816
Epoch [26300/26300], Train Loss: 0.0234, Test Loss: 0.1495
Epoch [26350/26350], Train Loss: 0.0168, Test Loss: 0.2570
Epoch [26400/26400], Train Loss: 0.0164, Test Loss: 0.2105
Epoch [26450/26450], Train Loss: 0.0150, Test Loss: 0.1627
Epoch [26500/26500], Train Loss: 0.0180, Test Loss: 0.2074
Epoch [26550/26550], Train Loss: 0.0195, Test Loss: 0.1601
Epoch [26600/26600], Train Loss: 0.0166, Test Loss: 0.1593
Epoch [26650/26650], Train Loss: 0.0146, Test Loss: 0.1394
Epoch [26700/26700], Train Loss: 0.0152, Test Loss: 0.1464
Epoch [26750/26750], Train Loss: 0.0188, Test Loss: 0.1672
Epoch [26800/26800], Train Loss: 0.0148, Test Loss: 0.1962
Epoch [26850/26850], Train Loss: 0.0176, Test Loss: 0.1345
Epoch [26900/26900], Train Loss: 0.0165, Test Loss: 0.0993
Epoch [26950/26950], Train Loss: 0.0180, Test Loss: 0.1183

Epoch [27000/27000], Train Loss: 0.0190, Test Loss: 0.1641
Epoch [27050/27050], Train Loss: 0.0194, Test Loss: 0.1736
Epoch [27100/27100], Train Loss: 0.0126, Test Loss: 0.1770
Epoch [27150/27150], Train Loss: 0.0165, Test Loss: 0.1291
Epoch [27200/27200], Train Loss: 0.0120, Test Loss: 0.1498
Epoch [27250/27250], Train Loss: 0.0172, Test Loss: 0.1588
Epoch [27300/27300], Train Loss: 0.0138, Test Loss: 0.1557
Epoch [27350/27350], Train Loss: 0.0148, Test Loss: 0.1308
Epoch [27400/27400], Train Loss: 0.0132, Test Loss: 0.1604
Epoch [27450/27450], Train Loss: 0.0160, Test Loss: 0.0896
Epoch [27500/27500], Train Loss: 0.0124, Test Loss: 0.1242
Epoch [27550/27550], Train Loss: 0.0137, Test Loss: 0.1236
Epoch [27600/27600], Train Loss: 0.0108, Test Loss: 0.0844
Epoch [27650/27650], Train Loss: 0.0147, Test Loss: 0.1070
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Epoch [40350/40350], Train Loss: 0.0009, Test Loss: 0.0016
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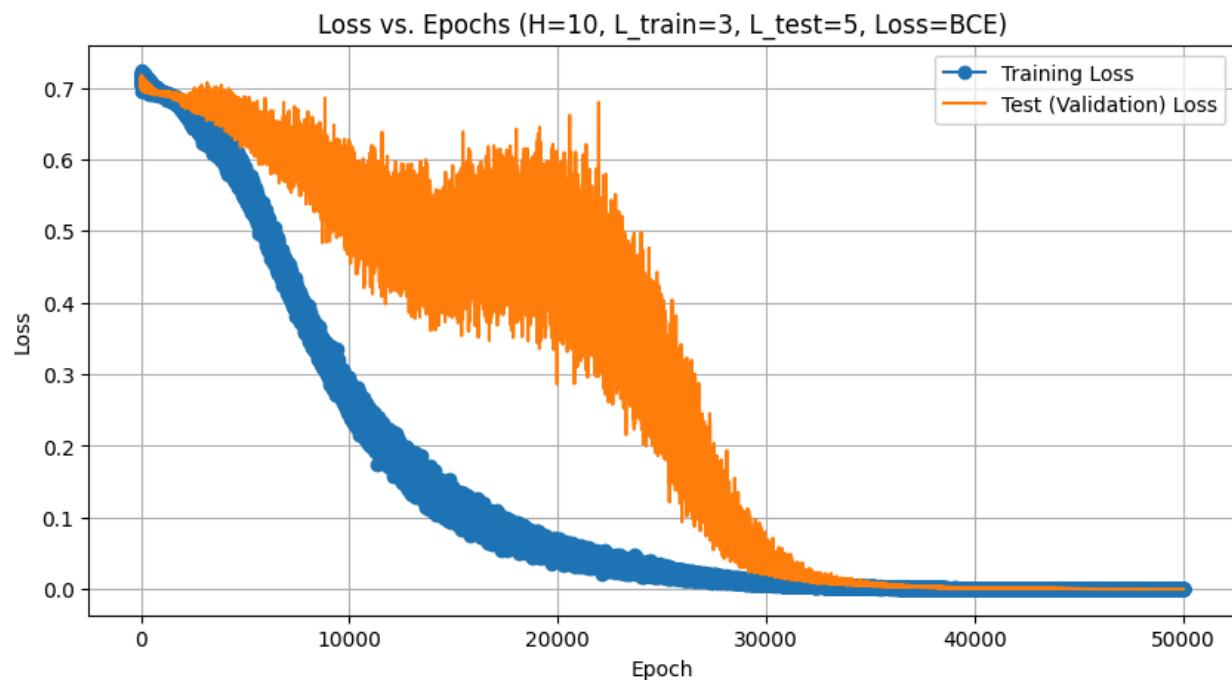
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Epoch [41850/41850], Train Loss: 0.0006, Test Loss: 0.0012
Epoch [41900/41900], Train Loss: 0.0006, Test Loss: 0.0011
Epoch [41950/41950], Train Loss: 0.0005, Test Loss: 0.0012
Epoch [42000/42000], Train Loss: 0.0005, Test Loss: 0.0010
Epoch [42050/42050], Train Loss: 0.0005, Test Loss: 0.0013
Epoch [42100/42100], Train Loss: 0.0006, Test Loss: 0.0009
Epoch [42150/42150], Train Loss: 0.0005, Test Loss: 0.0009
Epoch [42200/42200], Train Loss: 0.0005, Test Loss: 0.0011
Epoch [42250/42250], Train Loss: 0.0005, Test Loss: 0.0009
Epoch [42300/42300], Train Loss: 0.0006, Test Loss: 0.0011
Epoch [42350/42350], Train Loss: 0.0006, Test Loss: 0.0011
Epoch [42400/42400], Train Loss: 0.0005, Test Loss: 0.0011
Epoch [42450/42450], Train Loss: 0.0004, Test Loss: 0.0010
Epoch [42500/42500], Train Loss: 0.0005, Test Loss: 0.0009
Epoch [42550/42550], Train Loss: 0.0004, Test Loss: 0.0010
Epoch [42600/42600], Train Loss: 0.0004, Test Loss: 0.0011
Epoch [42650/42650], Train Loss: 0.0005, Test Loss: 0.0008
Epoch [42700/42700], Train Loss: 0.0005, Test Loss: 0.0011
Epoch [42750/42750], Train Loss: 0.0005, Test Loss: 0.0007
Epoch [42800/42800], Train Loss: 0.0006, Test Loss: 0.0009
Epoch [42850/42850], Train Loss: 0.0006, Test Loss: 0.0008
Epoch [42900/42900], Train Loss: 0.0005, Test Loss: 0.0008
Epoch [42950/42950], Train Loss: 0.0005, Test Loss: 0.0008
Epoch [43000/43000], Train Loss: 0.0003, Test Loss: 0.0009
Epoch [43050/43050], Train Loss: 0.0004, Test Loss: 0.0011
Epoch [43100/43100], Train Loss: 0.0004, Test Loss: 0.0009
Epoch [43150/43150], Train Loss: 0.0004, Test Loss: 0.0009

Epoch [43200/43200], Train Loss: 0.0005, Test Loss: 0.0008
Epoch [43250/43250], Train Loss: 0.0004, Test Loss: 0.0008
Epoch [43300/43300], Train Loss: 0.0005, Test Loss: 0.0010
Epoch [43350/43350], Train Loss: 0.0004, Test Loss: 0.0008
Epoch [43400/43400], Train Loss: 0.0005, Test Loss: 0.0009
Epoch [43450/43450], Train Loss: 0.0004, Test Loss: 0.0009
Epoch [43500/43500], Train Loss: 0.0004, Test Loss: 0.0007
Epoch [43550/43550], Train Loss: 0.0002, Test Loss: 0.0008
Epoch [43600/43600], Train Loss: 0.0004, Test Loss: 0.0008
Epoch [43650/43650], Train Loss: 0.0005, Test Loss: 0.0007
Epoch [43700/43700], Train Loss: 0.0005, Test Loss: 0.0008
Epoch [43750/43750], Train Loss: 0.0004, Test Loss: 0.0007
Epoch [43800/43800], Train Loss: 0.0003, Test Loss: 0.0008
Epoch [43850/43850], Train Loss: 0.0005, Test Loss: 0.0008
Epoch [43900/43900], Train Loss: 0.0003, Test Loss: 0.0007
Epoch [43950/43950], Train Loss: 0.0004, Test Loss: 0.0007
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Epoch [44050/44050], Train Loss: 0.0004, Test Loss: 0.0007
Epoch [44100/44100], Train Loss: 0.0004, Test Loss: 0.0006
Epoch [44150/44150], Train Loss: 0.0003, Test Loss: 0.0008
Epoch [44200/44200], Train Loss: 0.0003, Test Loss: 0.0007
Epoch [44250/44250], Train Loss: 0.0003, Test Loss: 0.0006
Epoch [44300/44300], Train Loss: 0.0004, Test Loss: 0.0007
Epoch [44350/44350], Train Loss: 0.0004, Test Loss: 0.0006
Epoch [44400/44400], Train Loss: 0.0004, Test Loss: 0.0007
Epoch [44450/44450], Train Loss: 0.0003, Test Loss: 0.0006
Epoch [44500/44500], Train Loss: 0.0004, Test Loss: 0.0006
Epoch [44550/44550], Train Loss: 0.0003, Test Loss: 0.0007
Epoch [44600/44600], Train Loss: 0.0004, Test Loss: 0.0007
Epoch [44650/44650], Train Loss: 0.0004, Test Loss: 0.0006
Epoch [44700/44700], Train Loss: 0.0003, Test Loss: 0.0006
Epoch [44750/44750], Train Loss: 0.0002, Test Loss: 0.0006
Epoch [44800/44800], Train Loss: 0.0003, Test Loss: 0.0005
Epoch [44850/44850], Train Loss: 0.0003, Test Loss: 0.0006
Epoch [44900/44900], Train Loss: 0.0003, Test Loss: 0.0005
Epoch [44950/44950], Train Loss: 0.0003, Test Loss: 0.0006
Epoch [45000/45000], Train Loss: 0.0003, Test Loss: 0.0006
Epoch [45050/45050], Train Loss: 0.0003, Test Loss: 0.0006
Epoch [45100/45100], Train Loss: 0.0002, Test Loss: 0.0005
Epoch [45150/45150], Train Loss: 0.0003, Test Loss: 0.0005
Epoch [45200/45200], Train Loss: 0.0003, Test Loss: 0.0006
Epoch [45250/45250], Train Loss: 0.0002, Test Loss: 0.0005
Epoch [45300/45300], Train Loss: 0.0002, Test Loss: 0.0005
Epoch [45350/45350], Train Loss: 0.0003, Test Loss: 0.0006
Epoch [45400/45400], Train Loss: 0.0003, Test Loss: 0.0005
Epoch [45450/45450], Train Loss: 0.0002, Test Loss: 0.0004
Epoch [45500/45500], Train Loss: 0.0002, Test Loss: 0.0005
Epoch [45550/45550], Train Loss: 0.0003, Test Loss: 0.0005
Epoch [45600/45600], Train Loss: 0.0002, Test Loss: 0.0005
Epoch [45650/45650], Train Loss: 0.0002, Test Loss: 0.0005
Epoch [45700/45700], Train Loss: 0.0003, Test Loss: 0.0006
Epoch [45750/45750], Train Loss: 0.0003, Test Loss: 0.0004
Epoch [45800/45800], Train Loss: 0.0002, Test Loss: 0.0005
Epoch [45850/45850], Train Loss: 0.0002, Test Loss: 0.0005

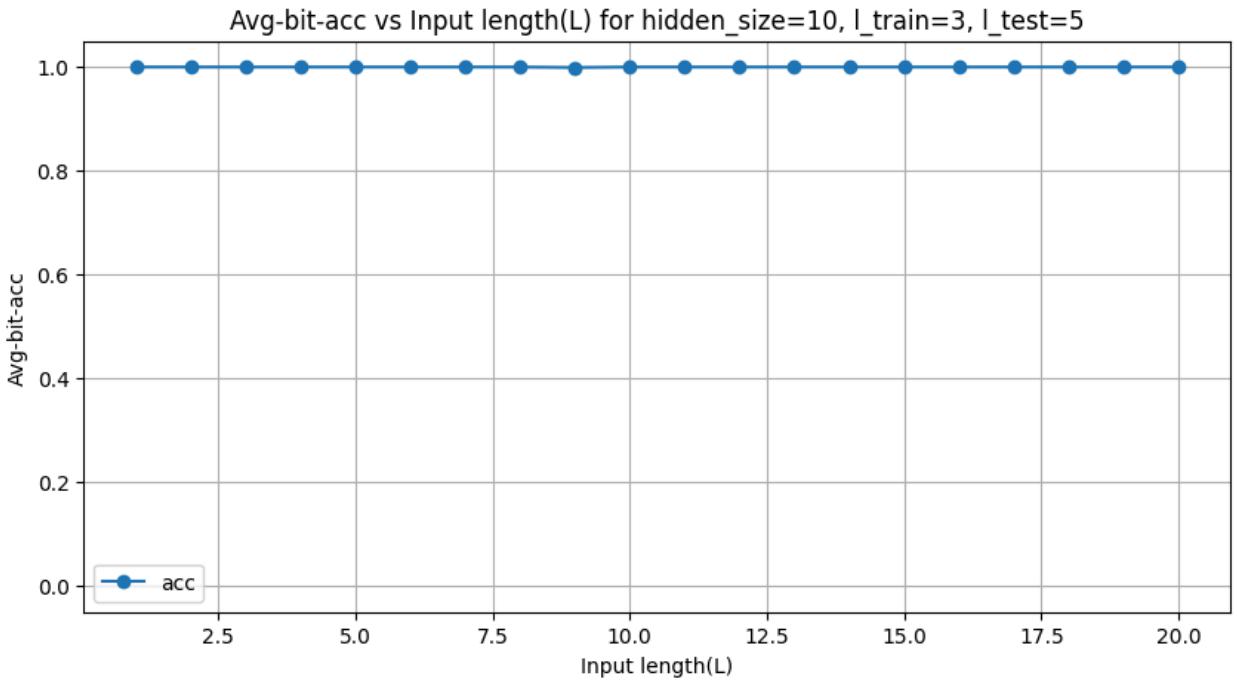
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Epoch [45950/45950], Train Loss: 0.0002, Test Loss: 0.0004
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Epoch [46050/46050], Train Loss: 0.0002, Test Loss: 0.0004
Epoch [46100/46100], Train Loss: 0.0003, Test Loss: 0.0004
Epoch [46150/46150], Train Loss: 0.0002, Test Loss: 0.0005
Epoch [46200/46200], Train Loss: 0.0002, Test Loss: 0.0004
Epoch [46250/46250], Train Loss: 0.0002, Test Loss: 0.0004
Epoch [46300/46300], Train Loss: 0.0003, Test Loss: 0.0004
Epoch [46350/46350], Train Loss: 0.0002, Test Loss: 0.0004
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Epoch [46450/46450], Train Loss: 0.0002, Test Loss: 0.0004
Epoch [46500/46500], Train Loss: 0.0002, Test Loss: 0.0004
Epoch [46550/46550], Train Loss: 0.0003, Test Loss: 0.0003
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Epoch [46850/46850], Train Loss: 0.0002, Test Loss: 0.0003
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Epoch [47150/47150], Train Loss: 0.0002, Test Loss: 0.0003
Epoch [47200/47200], Train Loss: 0.0002, Test Loss: 0.0004
Epoch [47250/47250], Train Loss: 0.0002, Test Loss: 0.0003
Epoch [47300/47300], Train Loss: 0.0002, Test Loss: 0.0004
Epoch [47350/47350], Train Loss: 0.0002, Test Loss: 0.0003
Epoch [47400/47400], Train Loss: 0.0002, Test Loss: 0.0003
Epoch [47450/47450], Train Loss: 0.0001, Test Loss: 0.0004
Epoch [47500/47500], Train Loss: 0.0002, Test Loss: 0.0003
Epoch [47550/47550], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [47600/47600], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [47650/47650], Train Loss: 0.0002, Test Loss: 0.0003
Epoch [47700/47700], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [47750/47750], Train Loss: 0.0002, Test Loss: 0.0003
Epoch [47800/47800], Train Loss: 0.0002, Test Loss: 0.0003
Epoch [47850/47850], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [47900/47900], Train Loss: 0.0001, Test Loss: 0.0004
Epoch [47950/47950], Train Loss: 0.0001, Test Loss: 0.0004
Epoch [48000/48000], Train Loss: 0.0002, Test Loss: 0.0003
Epoch [48050/48050], Train Loss: 0.0002, Test Loss: 0.0003
Epoch [48100/48100], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48150/48150], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48200/48200], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48250/48250], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48300/48300], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48350/48350], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [48400/48400], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48450/48450], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48500/48500], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48550/48550], Train Loss: 0.0001, Test Loss: 0.0003

```
Epoch [48600/48600], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48650/48650], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48700/48700], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48750/48750], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48800/48800], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [48850/48850], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [48900/48900], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [48950/48950], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49000/49000], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49050/49050], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49100/49100], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49150/49150], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49200/49200], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49250/49250], Train Loss: 0.0002, Test Loss: 0.0002
Epoch [49300/49300], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49350/49350], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49400/49400], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49450/49450], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49500/49500], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49550/49550], Train Loss: 0.0001, Test Loss: 0.0003
Epoch [49600/49600], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49650/49650], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49700/49700], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49750/49750], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49800/49800], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49850/49850], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49900/49900], Train Loss: 0.0001, Test Loss: 0.0002
Epoch [49950/49950], Train Loss: 0.0001, Test Loss: 0.0001
```

```
In [ ]: plot_loss(train_loss,test_loss,hidden_size,l_train,l_test,loss_type)
```



```
In [ ]: avg_bit_accuracy(model_6,hidden_size,l_train,l_test,batch_size=100)
```



```
Out[ ]: 0.9999500006437302
```

```
model_7
```

```
In [ ]: input_size=2  
hidden_size=10  
num_layers=1  
l_train=10  
l_test=5  
epochs=50000  
batch_size=128  
lr=1e-4  
loss_type="BCE"
```

```
In [ ]: model_7=Binary_adder(input_size,hidden_size,num_layers).to(device)  
criterion=nn.BCELoss()  
optimizer=torch.optim.Adam(model_7.parameters(),lr=lr)
```

```
In [ ]: train_loss,test_loss=training_loop(model_7,epochs,optimizer,criterion,batch_si
```

Epoch [0/0], Train Loss: 0.7078, Test Loss: 0.7055
Epoch [50/50], Train Loss: 0.7035, Test Loss: 0.7094
Epoch [100/100], Train Loss: 0.6934, Test Loss: 0.6872
Epoch [150/150], Train Loss: 0.6993, Test Loss: 0.6987
Epoch [200/200], Train Loss: 0.6985, Test Loss: 0.6986
Epoch [250/250], Train Loss: 0.6974, Test Loss: 0.6948
Epoch [300/300], Train Loss: 0.6963, Test Loss: 0.6952
Epoch [350/350], Train Loss: 0.6942, Test Loss: 0.6943
Epoch [400/400], Train Loss: 0.6922, Test Loss: 0.6931
Epoch [450/450], Train Loss: 0.6949, Test Loss: 0.6928
Epoch [500/500], Train Loss: 0.6956, Test Loss: 0.6937
Epoch [550/550], Train Loss: 0.6933, Test Loss: 0.6953
Epoch [600/600], Train Loss: 0.6935, Test Loss: 0.6932
Epoch [650/650], Train Loss: 0.6934, Test Loss: 0.6931
Epoch [700/700], Train Loss: 0.6922, Test Loss: 0.6944
Epoch [750/750], Train Loss: 0.6924, Test Loss: 0.6931
Epoch [800/800], Train Loss: 0.6931, Test Loss: 0.6920
Epoch [850/850], Train Loss: 0.6925, Test Loss: 0.6921
Epoch [900/900], Train Loss: 0.6937, Test Loss: 0.6936
Epoch [950/950], Train Loss: 0.6927, Test Loss: 0.6914
Epoch [1000/1000], Train Loss: 0.6924, Test Loss: 0.6929
Epoch [1050/1050], Train Loss: 0.6932, Test Loss: 0.6931
Epoch [1100/1100], Train Loss: 0.6945, Test Loss: 0.6926
Epoch [1150/1150], Train Loss: 0.6945, Test Loss: 0.6926
Epoch [1200/1200], Train Loss: 0.6917, Test Loss: 0.6928
Epoch [1250/1250], Train Loss: 0.6921, Test Loss: 0.6917
Epoch [1300/1300], Train Loss: 0.6918, Test Loss: 0.6926
Epoch [1350/1350], Train Loss: 0.6926, Test Loss: 0.6893
Epoch [1400/1400], Train Loss: 0.6925, Test Loss: 0.6918
Epoch [1450/1450], Train Loss: 0.6937, Test Loss: 0.6929
Epoch [1500/1500], Train Loss: 0.6920, Test Loss: 0.6902
Epoch [1550/1550], Train Loss: 0.6934, Test Loss: 0.6917
Epoch [1600/1600], Train Loss: 0.6910, Test Loss: 0.6912
Epoch [1650/1650], Train Loss: 0.6920, Test Loss: 0.6921
Epoch [1700/1700], Train Loss: 0.6918, Test Loss: 0.6917
Epoch [1750/1750], Train Loss: 0.6918, Test Loss: 0.6900
Epoch [1800/1800], Train Loss: 0.6912, Test Loss: 0.6924
Epoch [1850/1850], Train Loss: 0.6915, Test Loss: 0.6898
Epoch [1900/1900], Train Loss: 0.6906, Test Loss: 0.6900
Epoch [1950/1950], Train Loss: 0.6918, Test Loss: 0.6919
Epoch [2000/2000], Train Loss: 0.6922, Test Loss: 0.6913
Epoch [2050/2050], Train Loss: 0.6897, Test Loss: 0.6905
Epoch [2100/2100], Train Loss: 0.6916, Test Loss: 0.6908
Epoch [2150/2150], Train Loss: 0.6909, Test Loss: 0.6892
Epoch [2200/2200], Train Loss: 0.6915, Test Loss: 0.6890
Epoch [2250/2250], Train Loss: 0.6919, Test Loss: 0.6872
Epoch [2300/2300], Train Loss: 0.6902, Test Loss: 0.6883
Epoch [2350/2350], Train Loss: 0.6909, Test Loss: 0.6876
Epoch [2400/2400], Train Loss: 0.6908, Test Loss: 0.6886
Epoch [2450/2450], Train Loss: 0.6910, Test Loss: 0.6871
Epoch [2500/2500], Train Loss: 0.6913, Test Loss: 0.6890
Epoch [2550/2550], Train Loss: 0.6911, Test Loss: 0.6884
Epoch [2600/2600], Train Loss: 0.6912, Test Loss: 0.6882
Epoch [2650/2650], Train Loss: 0.6912, Test Loss: 0.6896

Epoch [2700/2700], Train Loss: 0.6915, Test Loss: 0.6870
Epoch [2750/2750], Train Loss: 0.6913, Test Loss: 0.6873
Epoch [2800/2800], Train Loss: 0.6909, Test Loss: 0.6871
Epoch [2850/2850], Train Loss: 0.6901, Test Loss: 0.6886
Epoch [2900/2900], Train Loss: 0.6907, Test Loss: 0.6874
Epoch [2950/2950], Train Loss: 0.6889, Test Loss: 0.6874
Epoch [3000/3000], Train Loss: 0.6897, Test Loss: 0.6876
Epoch [3050/3050], Train Loss: 0.6910, Test Loss: 0.6872
Epoch [3100/3100], Train Loss: 0.6898, Test Loss: 0.6869
Epoch [3150/3150], Train Loss: 0.6894, Test Loss: 0.6844
Epoch [3200/3200], Train Loss: 0.6900, Test Loss: 0.6852
Epoch [3250/3250], Train Loss: 0.6879, Test Loss: 0.6879
Epoch [3300/3300], Train Loss: 0.6922, Test Loss: 0.6853
Epoch [3350/3350], Train Loss: 0.6903, Test Loss: 0.6876
Epoch [3400/3400], Train Loss: 0.6898, Test Loss: 0.6830
Epoch [3450/3450], Train Loss: 0.6883, Test Loss: 0.6842
Epoch [3500/3500], Train Loss: 0.6896, Test Loss: 0.6844
Epoch [3550/3550], Train Loss: 0.6896, Test Loss: 0.6837
Epoch [3600/3600], Train Loss: 0.6892, Test Loss: 0.6833
Epoch [3650/3650], Train Loss: 0.6903, Test Loss: 0.6863
Epoch [3700/3700], Train Loss: 0.6900, Test Loss: 0.6841
Epoch [3750/3750], Train Loss: 0.6900, Test Loss: 0.6851
Epoch [3800/3800], Train Loss: 0.6887, Test Loss: 0.6823
Epoch [3850/3850], Train Loss: 0.6890, Test Loss: 0.6813
Epoch [3900/3900], Train Loss: 0.6876, Test Loss: 0.6830
Epoch [3950/3950], Train Loss: 0.6869, Test Loss: 0.6833
Epoch [4000/4000], Train Loss: 0.6892, Test Loss: 0.6836
Epoch [4050/4050], Train Loss: 0.6892, Test Loss: 0.6818
Epoch [4100/4100], Train Loss: 0.6908, Test Loss: 0.6818
Epoch [4150/4150], Train Loss: 0.6864, Test Loss: 0.6817
Epoch [4200/4200], Train Loss: 0.6862, Test Loss: 0.6830
Epoch [4250/4250], Train Loss: 0.6916, Test Loss: 0.6795
Epoch [4300/4300], Train Loss: 0.6882, Test Loss: 0.6814
Epoch [4350/4350], Train Loss: 0.6895, Test Loss: 0.6815
Epoch [4400/4400], Train Loss: 0.6867, Test Loss: 0.6824
Epoch [4450/4450], Train Loss: 0.6873, Test Loss: 0.6767
Epoch [4500/4500], Train Loss: 0.6881, Test Loss: 0.6793
Epoch [4550/4550], Train Loss: 0.6883, Test Loss: 0.6803
Epoch [4600/4600], Train Loss: 0.6839, Test Loss: 0.6787
Epoch [4650/4650], Train Loss: 0.6885, Test Loss: 0.6784
Epoch [4700/4700], Train Loss: 0.6847, Test Loss: 0.6776
Epoch [4750/4750], Train Loss: 0.6836, Test Loss: 0.6809
Epoch [4800/4800], Train Loss: 0.6840, Test Loss: 0.6779
Epoch [4850/4850], Train Loss: 0.6847, Test Loss: 0.6761
Epoch [4900/4900], Train Loss: 0.6861, Test Loss: 0.6776
Epoch [4950/4950], Train Loss: 0.6854, Test Loss: 0.6760
Epoch [5000/5000], Train Loss: 0.6829, Test Loss: 0.6770
Epoch [5050/5050], Train Loss: 0.6839, Test Loss: 0.6774
Epoch [5100/5100], Train Loss: 0.6862, Test Loss: 0.6764
Epoch [5150/5150], Train Loss: 0.6830, Test Loss: 0.6713
Epoch [5200/5200], Train Loss: 0.6823, Test Loss: 0.6745
Epoch [5250/5250], Train Loss: 0.6809, Test Loss: 0.6735
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Epoch [5750/5750], Train Loss: 0.6810, Test Loss: 0.6604
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Epoch [5950/5950], Train Loss: 0.6732, Test Loss: 0.6603
Epoch [6000/6000], Train Loss: 0.6750, Test Loss: 0.6647
Epoch [6050/6050], Train Loss: 0.6708, Test Loss: 0.6652
Epoch [6100/6100], Train Loss: 0.6695, Test Loss: 0.6631
Epoch [6150/6150], Train Loss: 0.6690, Test Loss: 0.6603
Epoch [6200/6200], Train Loss: 0.6661, Test Loss: 0.6585
Epoch [6250/6250], Train Loss: 0.6645, Test Loss: 0.6570
Epoch [6300/6300], Train Loss: 0.6607, Test Loss: 0.6526
Epoch [6350/6350], Train Loss: 0.6686, Test Loss: 0.6515
Epoch [6400/6400], Train Loss: 0.6645, Test Loss: 0.6509
Epoch [6450/6450], Train Loss: 0.6620, Test Loss: 0.6493
Epoch [6500/6500], Train Loss: 0.6613, Test Loss: 0.6461
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Epoch [6600/6600], Train Loss: 0.6610, Test Loss: 0.6441
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Epoch [6700/6700], Train Loss: 0.6546, Test Loss: 0.6452
Epoch [6750/6750], Train Loss: 0.6549, Test Loss: 0.6410
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Epoch [7000/7000], Train Loss: 0.6427, Test Loss: 0.6277
Epoch [7050/7050], Train Loss: 0.6399, Test Loss: 0.6264
Epoch [7100/7100], Train Loss: 0.6414, Test Loss: 0.6251
Epoch [7150/7150], Train Loss: 0.6289, Test Loss: 0.6165
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Epoch [7250/7250], Train Loss: 0.6321, Test Loss: 0.6089
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Epoch [7400/7400], Train Loss: 0.6274, Test Loss: 0.6070
Epoch [7450/7450], Train Loss: 0.6219, Test Loss: 0.6002
Epoch [7500/7500], Train Loss: 0.6152, Test Loss: 0.6039
Epoch [7550/7550], Train Loss: 0.6110, Test Loss: 0.5943
Epoch [7600/7600], Train Loss: 0.6096, Test Loss: 0.6021
Epoch [7650/7650], Train Loss: 0.6103, Test Loss: 0.5940
Epoch [7700/7700], Train Loss: 0.6060, Test Loss: 0.5802
Epoch [7750/7750], Train Loss: 0.5923, Test Loss: 0.5913
Epoch [7800/7800], Train Loss: 0.6034, Test Loss: 0.5813
Epoch [7850/7850], Train Loss: 0.5927, Test Loss: 0.5734
Epoch [7900/7900], Train Loss: 0.5923, Test Loss: 0.5669
Epoch [7950/7950], Train Loss: 0.5876, Test Loss: 0.5764
Epoch [8000/8000], Train Loss: 0.5839, Test Loss: 0.5719
Epoch [8050/8050], Train Loss: 0.5772, Test Loss: 0.5665

Epoch [8100/8100], Train Loss: 0.5797, Test Loss: 0.5602
Epoch [8150/8150], Train Loss: 0.5671, Test Loss: 0.5496
Epoch [8200/8200], Train Loss: 0.5706, Test Loss: 0.5502
Epoch [8250/8250], Train Loss: 0.5669, Test Loss: 0.5514
Epoch [8300/8300], Train Loss: 0.5564, Test Loss: 0.5514
Epoch [8350/8350], Train Loss: 0.5616, Test Loss: 0.5378
Epoch [8400/8400], Train Loss: 0.5524, Test Loss: 0.5327
Epoch [8450/8450], Train Loss: 0.5528, Test Loss: 0.5334
Epoch [8500/8500], Train Loss: 0.5447, Test Loss: 0.5312
Epoch [8550/8550], Train Loss: 0.5399, Test Loss: 0.5292
Epoch [8600/8600], Train Loss: 0.5431, Test Loss: 0.5161
Epoch [8650/8650], Train Loss: 0.5401, Test Loss: 0.5206
Epoch [8700/8700], Train Loss: 0.5273, Test Loss: 0.5042
Epoch [8750/8750], Train Loss: 0.5273, Test Loss: 0.5111
Epoch [8800/8800], Train Loss: 0.5166, Test Loss: 0.5029
Epoch [8850/8850], Train Loss: 0.5199, Test Loss: 0.5052
Epoch [8900/8900], Train Loss: 0.5183, Test Loss: 0.4919
Epoch [8950/8950], Train Loss: 0.5142, Test Loss: 0.4917
Epoch [9000/9000], Train Loss: 0.5008, Test Loss: 0.4926
Epoch [9050/9050], Train Loss: 0.5057, Test Loss: 0.4840
Epoch [9100/9100], Train Loss: 0.5025, Test Loss: 0.4716
Epoch [9150/9150], Train Loss: 0.4911, Test Loss: 0.4763
Epoch [9200/9200], Train Loss: 0.4934, Test Loss: 0.4650
Epoch [9250/9250], Train Loss: 0.4793, Test Loss: 0.4630
Epoch [9300/9300], Train Loss: 0.4830, Test Loss: 0.4625
Epoch [9350/9350], Train Loss: 0.4847, Test Loss: 0.4598
Epoch [9400/9400], Train Loss: 0.4736, Test Loss: 0.4566
Epoch [9450/9450], Train Loss: 0.4780, Test Loss: 0.4528
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Epoch [9550/9550], Train Loss: 0.4678, Test Loss: 0.4433
Epoch [9600/9600], Train Loss: 0.4523, Test Loss: 0.4307
Epoch [9650/9650], Train Loss: 0.4500, Test Loss: 0.4431
Epoch [9700/9700], Train Loss: 0.4438, Test Loss: 0.4274
Epoch [9750/9750], Train Loss: 0.4518, Test Loss: 0.4236
Epoch [9800/9800], Train Loss: 0.4385, Test Loss: 0.4144
Epoch [9850/9850], Train Loss: 0.4366, Test Loss: 0.4170
Epoch [9900/9900], Train Loss: 0.4382, Test Loss: 0.4106
Epoch [9950/9950], Train Loss: 0.4292, Test Loss: 0.4111
Epoch [10000/10000], Train Loss: 0.4188, Test Loss: 0.4062
Epoch [10050/10050], Train Loss: 0.4208, Test Loss: 0.3928
Epoch [10100/10100], Train Loss: 0.4177, Test Loss: 0.3975
Epoch [10150/10150], Train Loss: 0.4182, Test Loss: 0.3871
Epoch [10200/10200], Train Loss: 0.4103, Test Loss: 0.3830
Epoch [10250/10250], Train Loss: 0.4127, Test Loss: 0.3936
Epoch [10300/10300], Train Loss: 0.4078, Test Loss: 0.3765
Epoch [10350/10350], Train Loss: 0.4037, Test Loss: 0.3863
Epoch [10400/10400], Train Loss: 0.4016, Test Loss: 0.3815
Epoch [10450/10450], Train Loss: 0.3943, Test Loss: 0.3784
Epoch [10500/10500], Train Loss: 0.3942, Test Loss: 0.3636
Epoch [10550/10550], Train Loss: 0.3828, Test Loss: 0.3605
Epoch [10600/10600], Train Loss: 0.3817, Test Loss: 0.3719
Epoch [10650/10650], Train Loss: 0.3716, Test Loss: 0.3576
Epoch [10700/10700], Train Loss: 0.3713, Test Loss: 0.3541
Epoch [10750/10750], Train Loss: 0.3725, Test Loss: 0.3556

Epoch [10800/10800], Train Loss: 0.3689, Test Loss: 0.3499
Epoch [10850/10850], Train Loss: 0.3689, Test Loss: 0.3455
Epoch [10900/10900], Train Loss: 0.3646, Test Loss: 0.3411
Epoch [10950/10950], Train Loss: 0.3536, Test Loss: 0.3252
Epoch [11000/11000], Train Loss: 0.3556, Test Loss: 0.3333
Epoch [11050/11050], Train Loss: 0.3467, Test Loss: 0.3213
Epoch [11100/11100], Train Loss: 0.3529, Test Loss: 0.3247
Epoch [11150/11150], Train Loss: 0.3422, Test Loss: 0.3220
Epoch [11200/11200], Train Loss: 0.3459, Test Loss: 0.3153
Epoch [11250/11250], Train Loss: 0.3487, Test Loss: 0.3186
Epoch [11300/11300], Train Loss: 0.3331, Test Loss: 0.3098
Epoch [11350/11350], Train Loss: 0.3388, Test Loss: 0.3052
Epoch [11400/11400], Train Loss: 0.3277, Test Loss: 0.3117
Epoch [11450/11450], Train Loss: 0.3268, Test Loss: 0.3053
Epoch [11500/11500], Train Loss: 0.3199, Test Loss: 0.2975
Epoch [11550/11550], Train Loss: 0.3203, Test Loss: 0.2940
Epoch [11600/11600], Train Loss: 0.3192, Test Loss: 0.2884
Epoch [11650/11650], Train Loss: 0.3059, Test Loss: 0.2789
Epoch [11700/11700], Train Loss: 0.3152, Test Loss: 0.2891
Epoch [11750/11750], Train Loss: 0.2999, Test Loss: 0.2839
Epoch [11800/11800], Train Loss: 0.2973, Test Loss: 0.2703
Epoch [11850/11850], Train Loss: 0.3020, Test Loss: 0.2704
Epoch [11900/11900], Train Loss: 0.2960, Test Loss: 0.2601
Epoch [11950/11950], Train Loss: 0.2879, Test Loss: 0.2670
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Epoch [12350/12350], Train Loss: 0.2695, Test Loss: 0.2415
Epoch [12400/12400], Train Loss: 0.2692, Test Loss: 0.2452
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Epoch [12500/12500], Train Loss: 0.2539, Test Loss: 0.2431
Epoch [12550/12550], Train Loss: 0.2552, Test Loss: 0.2399
Epoch [12600/12600], Train Loss: 0.2538, Test Loss: 0.2364
Epoch [12650/12650], Train Loss: 0.2545, Test Loss: 0.2407
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Epoch [12750/12750], Train Loss: 0.2425, Test Loss: 0.2300
Epoch [12800/12800], Train Loss: 0.2512, Test Loss: 0.2350
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Epoch [13000/13000], Train Loss: 0.2324, Test Loss: 0.2159
Epoch [13050/13050], Train Loss: 0.2290, Test Loss: 0.2127
Epoch [13100/13100], Train Loss: 0.2317, Test Loss: 0.2064
Epoch [13150/13150], Train Loss: 0.2288, Test Loss: 0.2078
Epoch [13200/13200], Train Loss: 0.2227, Test Loss: 0.1989
Epoch [13250/13250], Train Loss: 0.2226, Test Loss: 0.2040
Epoch [13300/13300], Train Loss: 0.2164, Test Loss: 0.2057
Epoch [13350/13350], Train Loss: 0.2222, Test Loss: 0.1926
Epoch [13400/13400], Train Loss: 0.2227, Test Loss: 0.1942
Epoch [13450/13450], Train Loss: 0.2169, Test Loss: 0.1995

Epoch [13500/13500], Train Loss: 0.2107, Test Loss: 0.1929
Epoch [13550/13550], Train Loss: 0.2126, Test Loss: 0.1848
Epoch [13600/13600], Train Loss: 0.2093, Test Loss: 0.1906
Epoch [13650/13650], Train Loss: 0.2058, Test Loss: 0.1864
Epoch [13700/13700], Train Loss: 0.2001, Test Loss: 0.1846
Epoch [13750/13750], Train Loss: 0.2018, Test Loss: 0.1866
Epoch [13800/13800], Train Loss: 0.2008, Test Loss: 0.1784
Epoch [13850/13850], Train Loss: 0.2054, Test Loss: 0.1770
Epoch [13900/13900], Train Loss: 0.1908, Test Loss: 0.1715
Epoch [13950/13950], Train Loss: 0.1896, Test Loss: 0.1785
Epoch [14000/14000], Train Loss: 0.1964, Test Loss: 0.1818
Epoch [14050/14050], Train Loss: 0.1884, Test Loss: 0.1715
Epoch [14100/14100], Train Loss: 0.1890, Test Loss: 0.1699
Epoch [14150/14150], Train Loss: 0.1829, Test Loss: 0.1692
Epoch [14200/14200], Train Loss: 0.1866, Test Loss: 0.1627
Epoch [14250/14250], Train Loss: 0.1830, Test Loss: 0.1660
Epoch [14300/14300], Train Loss: 0.1840, Test Loss: 0.1566
Epoch [14350/14350], Train Loss: 0.1753, Test Loss: 0.1543
Epoch [14400/14400], Train Loss: 0.1774, Test Loss: 0.1669
Epoch [14450/14450], Train Loss: 0.1750, Test Loss: 0.1492
Epoch [14500/14500], Train Loss: 0.1706, Test Loss: 0.1479
Epoch [14550/14550], Train Loss: 0.1723, Test Loss: 0.1550
Epoch [14600/14600], Train Loss: 0.1714, Test Loss: 0.1488
Epoch [14650/14650], Train Loss: 0.1591, Test Loss: 0.1560
Epoch [14700/14700], Train Loss: 0.1649, Test Loss: 0.1487
Epoch [14750/14750], Train Loss: 0.1659, Test Loss: 0.1455
Epoch [14800/14800], Train Loss: 0.1629, Test Loss: 0.1440
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Epoch [14900/14900], Train Loss: 0.1526, Test Loss: 0.1325
Epoch [14950/14950], Train Loss: 0.1550, Test Loss: 0.1315
Epoch [15000/15000], Train Loss: 0.1583, Test Loss: 0.1360
Epoch [15050/15050], Train Loss: 0.1483, Test Loss: 0.1351
Epoch [15100/15100], Train Loss: 0.1449, Test Loss: 0.1343
Epoch [15150/15150], Train Loss: 0.1498, Test Loss: 0.1333
Epoch [15200/15200], Train Loss: 0.1574, Test Loss: 0.1217
Epoch [15250/15250], Train Loss: 0.1555, Test Loss: 0.1247
Epoch [15300/15300], Train Loss: 0.1494, Test Loss: 0.1299
Epoch [15350/15350], Train Loss: 0.1485, Test Loss: 0.1289
Epoch [15400/15400], Train Loss: 0.1428, Test Loss: 0.1319
Epoch [15450/15450], Train Loss: 0.1446, Test Loss: 0.1205
Epoch [15500/15500], Train Loss: 0.1384, Test Loss: 0.1185
Epoch [15550/15550], Train Loss: 0.1341, Test Loss: 0.1131
Epoch [15600/15600], Train Loss: 0.1349, Test Loss: 0.1163
Epoch [15650/15650], Train Loss: 0.1264, Test Loss: 0.1231
Epoch [15700/15700], Train Loss: 0.1415, Test Loss: 0.1198
Epoch [15750/15750], Train Loss: 0.1321, Test Loss: 0.1168
Epoch [15800/15800], Train Loss: 0.1285, Test Loss: 0.1129
Epoch [15850/15850], Train Loss: 0.1249, Test Loss: 0.1132
Epoch [15900/15900], Train Loss: 0.1336, Test Loss: 0.1152
Epoch [15950/15950], Train Loss: 0.1267, Test Loss: 0.1067
Epoch [16000/16000], Train Loss: 0.1264, Test Loss: 0.1066
Epoch [16050/16050], Train Loss: 0.1292, Test Loss: 0.1076
Epoch [16100/16100], Train Loss: 0.1174, Test Loss: 0.1114
Epoch [16150/16150], Train Loss: 0.1235, Test Loss: 0.1108

Epoch [16200/16200], Train Loss: 0.1160, Test Loss: 0.1118
Epoch [16250/16250], Train Loss: 0.1109, Test Loss: 0.0995
Epoch [16300/16300], Train Loss: 0.1181, Test Loss: 0.0998
Epoch [16350/16350], Train Loss: 0.1159, Test Loss: 0.1044
Epoch [16400/16400], Train Loss: 0.1146, Test Loss: 0.0888
Epoch [16450/16450], Train Loss: 0.1172, Test Loss: 0.0949
Epoch [16500/16500], Train Loss: 0.1201, Test Loss: 0.0942
Epoch [16550/16550], Train Loss: 0.1102, Test Loss: 0.0942
Epoch [16600/16600], Train Loss: 0.1164, Test Loss: 0.0918
Epoch [16650/16650], Train Loss: 0.1104, Test Loss: 0.0931
Epoch [16700/16700], Train Loss: 0.1022, Test Loss: 0.0897
Epoch [16750/16750], Train Loss: 0.1049, Test Loss: 0.0959
Epoch [16800/16800], Train Loss: 0.1037, Test Loss: 0.0916
Epoch [16850/16850], Train Loss: 0.1019, Test Loss: 0.0857
Epoch [16900/16900], Train Loss: 0.1050, Test Loss: 0.0973
Epoch [16950/16950], Train Loss: 0.1020, Test Loss: 0.0887
Epoch [17000/17000], Train Loss: 0.1011, Test Loss: 0.0962
Epoch [17050/17050], Train Loss: 0.1066, Test Loss: 0.0845
Epoch [17100/17100], Train Loss: 0.1027, Test Loss: 0.0856
Epoch [17150/17150], Train Loss: 0.0955, Test Loss: 0.0798
Epoch [17200/17200], Train Loss: 0.1033, Test Loss: 0.0789
Epoch [17250/17250], Train Loss: 0.0955, Test Loss: 0.0807
Epoch [17300/17300], Train Loss: 0.0958, Test Loss: 0.0787
Epoch [17350/17350], Train Loss: 0.0917, Test Loss: 0.0815
Epoch [17400/17400], Train Loss: 0.0871, Test Loss: 0.0784
Epoch [17450/17450], Train Loss: 0.0939, Test Loss: 0.0797
Epoch [17500/17500], Train Loss: 0.0876, Test Loss: 0.0816
Epoch [17550/17550], Train Loss: 0.0895, Test Loss: 0.0825
Epoch [17600/17600], Train Loss: 0.0862, Test Loss: 0.0801
Epoch [17650/17650], Train Loss: 0.0890, Test Loss: 0.0746
Epoch [17700/17700], Train Loss: 0.0849, Test Loss: 0.0739
Epoch [17750/17750], Train Loss: 0.0893, Test Loss: 0.0740
Epoch [17800/17800], Train Loss: 0.0830, Test Loss: 0.0691
Epoch [17850/17850], Train Loss: 0.0838, Test Loss: 0.0708
Epoch [17900/17900], Train Loss: 0.0861, Test Loss: 0.0743
Epoch [17950/17950], Train Loss: 0.0855, Test Loss: 0.0647
Epoch [18000/18000], Train Loss: 0.0824, Test Loss: 0.0688
Epoch [18050/18050], Train Loss: 0.0826, Test Loss: 0.0700
Epoch [18100/18100], Train Loss: 0.0831, Test Loss: 0.0650
Epoch [18150/18150], Train Loss: 0.0798, Test Loss: 0.0682
Epoch [18200/18200], Train Loss: 0.0799, Test Loss: 0.0645
Epoch [18250/18250], Train Loss: 0.0760, Test Loss: 0.0619
Epoch [18300/18300], Train Loss: 0.0760, Test Loss: 0.0600
Epoch [18350/18350], Train Loss: 0.0763, Test Loss: 0.0640
Epoch [18400/18400], Train Loss: 0.0747, Test Loss: 0.0645
Epoch [18450/18450], Train Loss: 0.0738, Test Loss: 0.0598
Epoch [18500/18500], Train Loss: 0.0682, Test Loss: 0.0658
Epoch [18550/18550], Train Loss: 0.0740, Test Loss: 0.0594
Epoch [18600/18600], Train Loss: 0.0729, Test Loss: 0.0593
Epoch [18650/18650], Train Loss: 0.0723, Test Loss: 0.0608
Epoch [18700/18700], Train Loss: 0.0681, Test Loss: 0.0619
Epoch [18750/18750], Train Loss: 0.0667, Test Loss: 0.0598
Epoch [18800/18800], Train Loss: 0.0692, Test Loss: 0.0569
Epoch [18850/18850], Train Loss: 0.0691, Test Loss: 0.0546

Epoch [18900/18900], Train Loss: 0.0664, Test Loss: 0.0525
Epoch [18950/18950], Train Loss: 0.0644, Test Loss: 0.0512
Epoch [19000/19000], Train Loss: 0.0680, Test Loss: 0.0529
Epoch [19050/19050], Train Loss: 0.0651, Test Loss: 0.0563
Epoch [19100/19100], Train Loss: 0.0635, Test Loss: 0.0550
Epoch [19150/19150], Train Loss: 0.0650, Test Loss: 0.0520
Epoch [19200/19200], Train Loss: 0.0640, Test Loss: 0.0527
Epoch [19250/19250], Train Loss: 0.0654, Test Loss: 0.0536
Epoch [19300/19300], Train Loss: 0.0662, Test Loss: 0.0504
Epoch [19350/19350], Train Loss: 0.0563, Test Loss: 0.0520
Epoch [19400/19400], Train Loss: 0.0620, Test Loss: 0.0524
Epoch [19450/19450], Train Loss: 0.0563, Test Loss: 0.0513
Epoch [19500/19500], Train Loss: 0.0604, Test Loss: 0.0513
Epoch [19550/19550], Train Loss: 0.0590, Test Loss: 0.0502
Epoch [19600/19600], Train Loss: 0.0619, Test Loss: 0.0484
Epoch [19650/19650], Train Loss: 0.0612, Test Loss: 0.0442
Epoch [19700/19700], Train Loss: 0.0576, Test Loss: 0.0477
Epoch [19750/19750], Train Loss: 0.0557, Test Loss: 0.0449
Epoch [19800/19800], Train Loss: 0.0603, Test Loss: 0.0463
Epoch [19850/19850], Train Loss: 0.0535, Test Loss: 0.0515
Epoch [19900/19900], Train Loss: 0.0517, Test Loss: 0.0419
Epoch [19950/19950], Train Loss: 0.0526, Test Loss: 0.0456
Epoch [20000/20000], Train Loss: 0.0537, Test Loss: 0.0430
Epoch [20050/20050], Train Loss: 0.0521, Test Loss: 0.0431
Epoch [20100/20100], Train Loss: 0.0509, Test Loss: 0.0439
Epoch [20150/20150], Train Loss: 0.0522, Test Loss: 0.0431
Epoch [20200/20200], Train Loss: 0.0521, Test Loss: 0.0436
Epoch [20250/20250], Train Loss: 0.0511, Test Loss: 0.0416
Epoch [20300/20300], Train Loss: 0.0533, Test Loss: 0.0426
Epoch [20350/20350], Train Loss: 0.0519, Test Loss: 0.0411
Epoch [20400/20400], Train Loss: 0.0445, Test Loss: 0.0413
Epoch [20450/20450], Train Loss: 0.0480, Test Loss: 0.0450
Epoch [20500/20500], Train Loss: 0.0499, Test Loss: 0.0403
Epoch [20550/20550], Train Loss: 0.0450, Test Loss: 0.0400
Epoch [20600/20600], Train Loss: 0.0460, Test Loss: 0.0358
Epoch [20650/20650], Train Loss: 0.0481, Test Loss: 0.0389
Epoch [20700/20700], Train Loss: 0.0479, Test Loss: 0.0361
Epoch [20750/20750], Train Loss: 0.0462, Test Loss: 0.0355
Epoch [20800/20800], Train Loss: 0.0435, Test Loss: 0.0378
Epoch [20850/20850], Train Loss: 0.0420, Test Loss: 0.0358
Epoch [20900/20900], Train Loss: 0.0435, Test Loss: 0.0400
Epoch [20950/20950], Train Loss: 0.0426, Test Loss: 0.0369
Epoch [21000/21000], Train Loss: 0.0447, Test Loss: 0.0406
Epoch [21050/21050], Train Loss: 0.0392, Test Loss: 0.0320
Epoch [21100/21100], Train Loss: 0.0432, Test Loss: 0.0361
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Epoch [21250/21250], Train Loss: 0.0409, Test Loss: 0.0326
Epoch [21300/21300], Train Loss: 0.0424, Test Loss: 0.0322
Epoch [21350/21350], Train Loss: 0.0417, Test Loss: 0.0328
Epoch [21400/21400], Train Loss: 0.0411, Test Loss: 0.0301
Epoch [21450/21450], Train Loss: 0.0404, Test Loss: 0.0344
Epoch [21500/21500], Train Loss: 0.0417, Test Loss: 0.0337
Epoch [21550/21550], Train Loss: 0.0371, Test Loss: 0.0303

Epoch [21600/21600], Train Loss: 0.0376, Test Loss: 0.0282
Epoch [21650/21650], Train Loss: 0.0355, Test Loss: 0.0344
Epoch [21700/21700], Train Loss: 0.0411, Test Loss: 0.0322
Epoch [21750/21750], Train Loss: 0.0372, Test Loss: 0.0293
Epoch [21800/21800], Train Loss: 0.0378, Test Loss: 0.0287
Epoch [21850/21850], Train Loss: 0.0342, Test Loss: 0.0324
Epoch [21900/21900], Train Loss: 0.0383, Test Loss: 0.0327
Epoch [21950/21950], Train Loss: 0.0391, Test Loss: 0.0286
Epoch [22000/22000], Train Loss: 0.0355, Test Loss: 0.0264
Epoch [22050/22050], Train Loss: 0.0340, Test Loss: 0.0299
Epoch [22100/22100], Train Loss: 0.0327, Test Loss: 0.0255
Epoch [22150/22150], Train Loss: 0.0326, Test Loss: 0.0246
Epoch [22200/22200], Train Loss: 0.0316, Test Loss: 0.0280
Epoch [22250/22250], Train Loss: 0.0333, Test Loss: 0.0304
Epoch [22300/22300], Train Loss: 0.0330, Test Loss: 0.0270
Epoch [22350/22350], Train Loss: 0.0345, Test Loss: 0.0277
Epoch [22400/22400], Train Loss: 0.0340, Test Loss: 0.0262
Epoch [22450/22450], Train Loss: 0.0325, Test Loss: 0.0249
Epoch [22500/22500], Train Loss: 0.0324, Test Loss: 0.0228
Epoch [22550/22550], Train Loss: 0.0300, Test Loss: 0.0259
Epoch [22600/22600], Train Loss: 0.0317, Test Loss: 0.0256
Epoch [22650/22650], Train Loss: 0.0315, Test Loss: 0.0246
Epoch [22700/22700], Train Loss: 0.0313, Test Loss: 0.0240
Epoch [22750/22750], Train Loss: 0.0295, Test Loss: 0.0234
Epoch [22800/22800], Train Loss: 0.0293, Test Loss: 0.0254
Epoch [22850/22850], Train Loss: 0.0311, Test Loss: 0.0230
Epoch [22900/22900], Train Loss: 0.0275, Test Loss: 0.0244
Epoch [22950/22950], Train Loss: 0.0273, Test Loss: 0.0246
Epoch [23000/23000], Train Loss: 0.0280, Test Loss: 0.0237
Epoch [23050/23050], Train Loss: 0.0288, Test Loss: 0.0215
Epoch [23100/23100], Train Loss: 0.0285, Test Loss: 0.0231
Epoch [23150/23150], Train Loss: 0.0285, Test Loss: 0.0234
Epoch [23200/23200], Train Loss: 0.0276, Test Loss: 0.0231
Epoch [23250/23250], Train Loss: 0.0279, Test Loss: 0.0245
Epoch [23300/23300], Train Loss: 0.0267, Test Loss: 0.0241
Epoch [23350/23350], Train Loss: 0.0266, Test Loss: 0.0221
Epoch [23400/23400], Train Loss: 0.0259, Test Loss: 0.0212
Epoch [23450/23450], Train Loss: 0.0286, Test Loss: 0.0204
Epoch [23500/23500], Train Loss: 0.0252, Test Loss: 0.0235
Epoch [23550/23550], Train Loss: 0.0245, Test Loss: 0.0202
Epoch [23600/23600], Train Loss: 0.0258, Test Loss: 0.0174
Epoch [23650/23650], Train Loss: 0.0229, Test Loss: 0.0201
Epoch [23700/23700], Train Loss: 0.0252, Test Loss: 0.0185
Epoch [23750/23750], Train Loss: 0.0250, Test Loss: 0.0210
Epoch [23800/23800], Train Loss: 0.0232, Test Loss: 0.0187
Epoch [23850/23850], Train Loss: 0.0243, Test Loss: 0.0198
Epoch [23900/23900], Train Loss: 0.0263, Test Loss: 0.0191
Epoch [23950/23950], Train Loss: 0.0244, Test Loss: 0.0200
Epoch [24000/24000], Train Loss: 0.0233, Test Loss: 0.0196
Epoch [24050/24050], Train Loss: 0.0242, Test Loss: 0.0190
Epoch [24100/24100], Train Loss: 0.0222, Test Loss: 0.0198
Epoch [24150/24150], Train Loss: 0.0222, Test Loss: 0.0182
Epoch [24200/24200], Train Loss: 0.0235, Test Loss: 0.0165
Epoch [24250/24250], Train Loss: 0.0229, Test Loss: 0.0170

Epoch [24300/24300], Train Loss: 0.0221, Test Loss: 0.0188
Epoch [24350/24350], Train Loss: 0.0212, Test Loss: 0.0184
Epoch [24400/24400], Train Loss: 0.0222, Test Loss: 0.0173
Epoch [24450/24450], Train Loss: 0.0206, Test Loss: 0.0162
Epoch [24500/24500], Train Loss: 0.0218, Test Loss: 0.0175
Epoch [24550/24550], Train Loss: 0.0225, Test Loss: 0.0164
Epoch [24600/24600], Train Loss: 0.0215, Test Loss: 0.0153
Epoch [24650/24650], Train Loss: 0.0184, Test Loss: 0.0155
Epoch [24700/24700], Train Loss: 0.0213, Test Loss: 0.0172
Epoch [24750/24750], Train Loss: 0.0196, Test Loss: 0.0172
Epoch [24800/24800], Train Loss: 0.0195, Test Loss: 0.0156
Epoch [24850/24850], Train Loss: 0.0195, Test Loss: 0.0161
Epoch [24900/24900], Train Loss: 0.0205, Test Loss: 0.0162
Epoch [24950/24950], Train Loss: 0.0186, Test Loss: 0.0162
Epoch [25000/25000], Train Loss: 0.0216, Test Loss: 0.0161
Epoch [25050/25050], Train Loss: 0.0176, Test Loss: 0.0153
Epoch [25100/25100], Train Loss: 0.0187, Test Loss: 0.0146
Epoch [25150/25150], Train Loss: 0.0163, Test Loss: 0.0154
Epoch [25200/25200], Train Loss: 0.0189, Test Loss: 0.0158
Epoch [25250/25250], Train Loss: 0.0176, Test Loss: 0.0146
Epoch [25300/25300], Train Loss: 0.0181, Test Loss: 0.0146
Epoch [25350/25350], Train Loss: 0.0179, Test Loss: 0.0153
Epoch [25400/25400], Train Loss: 0.0165, Test Loss: 0.0159
Epoch [25450/25450], Train Loss: 0.0173, Test Loss: 0.0140
Epoch [25500/25500], Train Loss: 0.0172, Test Loss: 0.0122
Epoch [25550/25550], Train Loss: 0.0156, Test Loss: 0.0118
Epoch [25600/25600], Train Loss: 0.0165, Test Loss: 0.0136
Epoch [25650/25650], Train Loss: 0.0155, Test Loss: 0.0129
Epoch [25700/25700], Train Loss: 0.0164, Test Loss: 0.0129
Epoch [25750/25750], Train Loss: 0.0172, Test Loss: 0.0132
Epoch [25800/25800], Train Loss: 0.0155, Test Loss: 0.0121
Epoch [25850/25850], Train Loss: 0.0165, Test Loss: 0.0129
Epoch [25900/25900], Train Loss: 0.0165, Test Loss: 0.0136
Epoch [25950/25950], Train Loss: 0.0159, Test Loss: 0.0120
Epoch [26000/26000], Train Loss: 0.0168, Test Loss: 0.0129
Epoch [26050/26050], Train Loss: 0.0150, Test Loss: 0.0129
Epoch [26100/26100], Train Loss: 0.0156, Test Loss: 0.0120
Epoch [26150/26150], Train Loss: 0.0146, Test Loss: 0.0143
Epoch [26200/26200], Train Loss: 0.0157, Test Loss: 0.0112
Epoch [26250/26250], Train Loss: 0.0153, Test Loss: 0.0107
Epoch [26300/26300], Train Loss: 0.0140, Test Loss: 0.0128
Epoch [26350/26350], Train Loss: 0.0122, Test Loss: 0.0110
Epoch [26400/26400], Train Loss: 0.0139, Test Loss: 0.0095
Epoch [26450/26450], Train Loss: 0.0148, Test Loss: 0.0104
Epoch [26500/26500], Train Loss: 0.0145, Test Loss: 0.0112
Epoch [26550/26550], Train Loss: 0.0152, Test Loss: 0.0111
Epoch [26600/26600], Train Loss: 0.0127, Test Loss: 0.0110
Epoch [26650/26650], Train Loss: 0.0136, Test Loss: 0.0123
Epoch [26700/26700], Train Loss: 0.0138, Test Loss: 0.0100
Epoch [26750/26750], Train Loss: 0.0137, Test Loss: 0.0109
Epoch [26800/26800], Train Loss: 0.0116, Test Loss: 0.0096
Epoch [26850/26850], Train Loss: 0.0137, Test Loss: 0.0103
Epoch [26900/26900], Train Loss: 0.0132, Test Loss: 0.0103
Epoch [26950/26950], Train Loss: 0.0130, Test Loss: 0.0106

Epoch [27000/27000], Train Loss: 0.0137, Test Loss: 0.0106
Epoch [27050/27050], Train Loss: 0.0134, Test Loss: 0.0094
Epoch [27100/27100], Train Loss: 0.0123, Test Loss: 0.0094
Epoch [27150/27150], Train Loss: 0.0121, Test Loss: 0.0102
Epoch [27200/27200], Train Loss: 0.0131, Test Loss: 0.0092
Epoch [27250/27250], Train Loss: 0.0114, Test Loss: 0.0099
Epoch [27300/27300], Train Loss: 0.0128, Test Loss: 0.0101
Epoch [27350/27350], Train Loss: 0.0123, Test Loss: 0.0098
Epoch [27400/27400], Train Loss: 0.0110, Test Loss: 0.0100
Epoch [27450/27450], Train Loss: 0.0118, Test Loss: 0.0106
Epoch [27500/27500], Train Loss: 0.0112, Test Loss: 0.0084
Epoch [27550/27550], Train Loss: 0.0123, Test Loss: 0.0088
Epoch [27600/27600], Train Loss: 0.0110, Test Loss: 0.0096
Epoch [27650/27650], Train Loss: 0.0126, Test Loss: 0.0084
Epoch [27700/27700], Train Loss: 0.0105, Test Loss: 0.0096
Epoch [27750/27750], Train Loss: 0.0112, Test Loss: 0.0098
Epoch [27800/27800], Train Loss: 0.0118, Test Loss: 0.0078
Epoch [27850/27850], Train Loss: 0.0115, Test Loss: 0.0080
Epoch [27900/27900], Train Loss: 0.0118, Test Loss: 0.0083
Epoch [27950/27950], Train Loss: 0.0108, Test Loss: 0.0086
Epoch [28000/28000], Train Loss: 0.0103, Test Loss: 0.0089
Epoch [28050/28050], Train Loss: 0.0104, Test Loss: 0.0088
Epoch [28100/28100], Train Loss: 0.0101, Test Loss: 0.0097
Epoch [28150/28150], Train Loss: 0.0106, Test Loss: 0.0084
Epoch [28200/28200], Train Loss: 0.0106, Test Loss: 0.0075
Epoch [28250/28250], Train Loss: 0.0098, Test Loss: 0.0083
Epoch [28300/28300], Train Loss: 0.0093, Test Loss: 0.0078
Epoch [28350/28350], Train Loss: 0.0100, Test Loss: 0.0076
Epoch [28400/28400], Train Loss: 0.0094, Test Loss: 0.0084
Epoch [28450/28450], Train Loss: 0.0097, Test Loss: 0.0072
Epoch [28500/28500], Train Loss: 0.0097, Test Loss: 0.0071
Epoch [28550/28550], Train Loss: 0.0098, Test Loss: 0.0071
Epoch [28600/28600], Train Loss: 0.0094, Test Loss: 0.0081
Epoch [28650/28650], Train Loss: 0.0093, Test Loss: 0.0076
Epoch [28700/28700], Train Loss: 0.0087, Test Loss: 0.0073
Epoch [28750/28750], Train Loss: 0.0093, Test Loss: 0.0075
Epoch [28800/28800], Train Loss: 0.0094, Test Loss: 0.0072
Epoch [28850/28850], Train Loss: 0.0097, Test Loss: 0.0064
Epoch [28900/28900], Train Loss: 0.0099, Test Loss: 0.0065
Epoch [28950/28950], Train Loss: 0.0084, Test Loss: 0.0071
Epoch [29000/29000], Train Loss: 0.0083, Test Loss: 0.0072
Epoch [29050/29050], Train Loss: 0.0082, Test Loss: 0.0066
Epoch [29100/29100], Train Loss: 0.0088, Test Loss: 0.0075
Epoch [29150/29150], Train Loss: 0.0075, Test Loss: 0.0060
Epoch [29200/29200], Train Loss: 0.0084, Test Loss: 0.0069
Epoch [29250/29250], Train Loss: 0.0079, Test Loss: 0.0072
Epoch [29300/29300], Train Loss: 0.0081, Test Loss: 0.0067
Epoch [29350/29350], Train Loss: 0.0079, Test Loss: 0.0064
Epoch [29400/29400], Train Loss: 0.0086, Test Loss: 0.0064
Epoch [29450/29450], Train Loss: 0.0079, Test Loss: 0.0059
Epoch [29500/29500], Train Loss: 0.0074, Test Loss: 0.0056
Epoch [29550/29550], Train Loss: 0.0073, Test Loss: 0.0065
Epoch [29600/29600], Train Loss: 0.0079, Test Loss: 0.0059
Epoch [29650/29650], Train Loss: 0.0081, Test Loss: 0.0059

Epoch [29700/29700], Train Loss: 0.0069, Test Loss: 0.0058
Epoch [29750/29750], Train Loss: 0.0075, Test Loss: 0.0059
Epoch [29800/29800], Train Loss: 0.0073, Test Loss: 0.0063
Epoch [29850/29850], Train Loss: 0.0072, Test Loss: 0.0063
Epoch [29900/29900], Train Loss: 0.0074, Test Loss: 0.0058
Epoch [29950/29950], Train Loss: 0.0072, Test Loss: 0.0060
Epoch [30000/30000], Train Loss: 0.0069, Test Loss: 0.0056
Epoch [30050/30050], Train Loss: 0.0069, Test Loss: 0.0052
Epoch [30100/30100], Train Loss: 0.0068, Test Loss: 0.0054
Epoch [30150/30150], Train Loss: 0.0081, Test Loss: 0.0055
Epoch [30200/30200], Train Loss: 0.0063, Test Loss: 0.0058
Epoch [30250/30250], Train Loss: 0.0062, Test Loss: 0.0047
Epoch [30300/30300], Train Loss: 0.0070, Test Loss: 0.0053
Epoch [30350/30350], Train Loss: 0.0074, Test Loss: 0.0049
Epoch [30400/30400], Train Loss: 0.0065, Test Loss: 0.0055
Epoch [30450/30450], Train Loss: 0.0071, Test Loss: 0.0060
Epoch [30500/30500], Train Loss: 0.0066, Test Loss: 0.0050
Epoch [30550/30550], Train Loss: 0.0067, Test Loss: 0.0046
Epoch [30600/30600], Train Loss: 0.0058, Test Loss: 0.0050
Epoch [30650/30650], Train Loss: 0.0066, Test Loss: 0.0051
Epoch [30700/30700], Train Loss: 0.0065, Test Loss: 0.0047
Epoch [30750/30750], Train Loss: 0.0059, Test Loss: 0.0047
Epoch [30800/30800], Train Loss: 0.0057, Test Loss: 0.0047
Epoch [30850/30850], Train Loss: 0.0063, Test Loss: 0.0048
Epoch [30900/30900], Train Loss: 0.0060, Test Loss: 0.0049
Epoch [30950/30950], Train Loss: 0.0060, Test Loss: 0.0043
Epoch [31000/31000], Train Loss: 0.0059, Test Loss: 0.0045
Epoch [31050/31050], Train Loss: 0.0061, Test Loss: 0.0051
Epoch [31100/31100], Train Loss: 0.0057, Test Loss: 0.0050
Epoch [31150/31150], Train Loss: 0.0061, Test Loss: 0.0044
Epoch [31200/31200], Train Loss: 0.0064, Test Loss: 0.0042
Epoch [31250/31250], Train Loss: 0.0058, Test Loss: 0.0039
Epoch [31300/31300], Train Loss: 0.0060, Test Loss: 0.0043
Epoch [31350/31350], Train Loss: 0.0057, Test Loss: 0.0041
Epoch [31400/31400], Train Loss: 0.0053, Test Loss: 0.0045
Epoch [31450/31450], Train Loss: 0.0057, Test Loss: 0.0049
Epoch [31500/31500], Train Loss: 0.0056, Test Loss: 0.0045
Epoch [31550/31550], Train Loss: 0.0051, Test Loss: 0.0039
Epoch [31600/31600], Train Loss: 0.0051, Test Loss: 0.0043
Epoch [31650/31650], Train Loss: 0.0059, Test Loss: 0.0041
Epoch [31700/31700], Train Loss: 0.0054, Test Loss: 0.0042
Epoch [31750/31750], Train Loss: 0.0046, Test Loss: 0.0039
Epoch [31800/31800], Train Loss: 0.0053, Test Loss: 0.0045
Epoch [31850/31850], Train Loss: 0.0052, Test Loss: 0.0034
Epoch [31900/31900], Train Loss: 0.0050, Test Loss: 0.0041
Epoch [31950/31950], Train Loss: 0.0050, Test Loss: 0.0035
Epoch [32000/32000], Train Loss: 0.0050, Test Loss: 0.0038
Epoch [32050/32050], Train Loss: 0.0051, Test Loss: 0.0041
Epoch [32100/32100], Train Loss: 0.0049, Test Loss: 0.0037
Epoch [32150/32150], Train Loss: 0.0050, Test Loss: 0.0037
Epoch [32200/32200], Train Loss: 0.0042, Test Loss: 0.0037
Epoch [32250/32250], Train Loss: 0.0048, Test Loss: 0.0040
Epoch [32300/32300], Train Loss: 0.0045, Test Loss: 0.0036
Epoch [32350/32350], Train Loss: 0.0046, Test Loss: 0.0033

Epoch [32400/32400], Train Loss: 0.0047, Test Loss: 0.0036
Epoch [32450/32450], Train Loss: 0.0046, Test Loss: 0.0037
Epoch [32500/32500], Train Loss: 0.0044, Test Loss: 0.0033
Epoch [32550/32550], Train Loss: 0.0042, Test Loss: 0.0034
Epoch [32600/32600], Train Loss: 0.0044, Test Loss: 0.0039
Epoch [32650/32650], Train Loss: 0.0041, Test Loss: 0.0034
Epoch [32700/32700], Train Loss: 0.0041, Test Loss: 0.0031
Epoch [32750/32750], Train Loss: 0.0046, Test Loss: 0.0036
Epoch [32800/32800], Train Loss: 0.0042, Test Loss: 0.0034
Epoch [32850/32850], Train Loss: 0.0044, Test Loss: 0.0030
Epoch [32900/32900], Train Loss: 0.0042, Test Loss: 0.0035
Epoch [32950/32950], Train Loss: 0.0039, Test Loss: 0.0038
Epoch [33000/33000], Train Loss: 0.0039, Test Loss: 0.0039
Epoch [33050/33050], Train Loss: 0.0037, Test Loss: 0.0028
Epoch [33100/33100], Train Loss: 0.0040, Test Loss: 0.0034
Epoch [33150/33150], Train Loss: 0.0042, Test Loss: 0.0032
Epoch [33200/33200], Train Loss: 0.0038, Test Loss: 0.0027
Epoch [33250/33250], Train Loss: 0.0037, Test Loss: 0.0030
Epoch [33300/33300], Train Loss: 0.0042, Test Loss: 0.0029
Epoch [33350/33350], Train Loss: 0.0041, Test Loss: 0.0029
Epoch [33400/33400], Train Loss: 0.0041, Test Loss: 0.0032
Epoch [33450/33450], Train Loss: 0.0038, Test Loss: 0.0029
Epoch [33500/33500], Train Loss: 0.0035, Test Loss: 0.0031
Epoch [33550/33550], Train Loss: 0.0036, Test Loss: 0.0032
Epoch [33600/33600], Train Loss: 0.0038, Test Loss: 0.0028
Epoch [33650/33650], Train Loss: 0.0035, Test Loss: 0.0024
Epoch [33700/33700], Train Loss: 0.0037, Test Loss: 0.0028
Epoch [33750/33750], Train Loss: 0.0033, Test Loss: 0.0028
Epoch [33800/33800], Train Loss: 0.0033, Test Loss: 0.0030
Epoch [33850/33850], Train Loss: 0.0035, Test Loss: 0.0029
Epoch [33900/33900], Train Loss: 0.0031, Test Loss: 0.0029
Epoch [33950/33950], Train Loss: 0.0035, Test Loss: 0.0029
Epoch [34000/34000], Train Loss: 0.0038, Test Loss: 0.0028
Epoch [34050/34050], Train Loss: 0.0036, Test Loss: 0.0024
Epoch [34100/34100], Train Loss: 0.0035, Test Loss: 0.0028
Epoch [34150/34150], Train Loss: 0.0034, Test Loss: 0.0025
Epoch [34200/34200], Train Loss: 0.0032, Test Loss: 0.0027
Epoch [34250/34250], Train Loss: 0.0037, Test Loss: 0.0026
Epoch [34300/34300], Train Loss: 0.0029, Test Loss: 0.0022
Epoch [34350/34350], Train Loss: 0.0033, Test Loss: 0.0026
Epoch [34400/34400], Train Loss: 0.0033, Test Loss: 0.0021
Epoch [34450/34450], Train Loss: 0.0029, Test Loss: 0.0026
Epoch [34500/34500], Train Loss: 0.0031, Test Loss: 0.0025
Epoch [34550/34550], Train Loss: 0.0033, Test Loss: 0.0024
Epoch [34600/34600], Train Loss: 0.0030, Test Loss: 0.0023
Epoch [34650/34650], Train Loss: 0.0029, Test Loss: 0.0024
Epoch [34700/34700], Train Loss: 0.0031, Test Loss: 0.0024
Epoch [34750/34750], Train Loss: 0.0030, Test Loss: 0.0019
Epoch [34800/34800], Train Loss: 0.0028, Test Loss: 0.0025
Epoch [34850/34850], Train Loss: 0.0030, Test Loss: 0.0023
Epoch [34900/34900], Train Loss: 0.0031, Test Loss: 0.0021
Epoch [34950/34950], Train Loss: 0.0029, Test Loss: 0.0021
Epoch [35000/35000], Train Loss: 0.0030, Test Loss: 0.0024
Epoch [35050/35050], Train Loss: 0.0030, Test Loss: 0.0024

Epoch [35100/35100], Train Loss: 0.0027, Test Loss: 0.0024
Epoch [35150/35150], Train Loss: 0.0026, Test Loss: 0.0024
Epoch [35200/35200], Train Loss: 0.0025, Test Loss: 0.0025
Epoch [35250/35250], Train Loss: 0.0027, Test Loss: 0.0020
Epoch [35300/35300], Train Loss: 0.0025, Test Loss: 0.0019
Epoch [35350/35350], Train Loss: 0.0028, Test Loss: 0.0017
Epoch [35400/35400], Train Loss: 0.0026, Test Loss: 0.0021
Epoch [35450/35450], Train Loss: 0.0026, Test Loss: 0.0021
Epoch [35500/35500], Train Loss: 0.0024, Test Loss: 0.0017
Epoch [35550/35550], Train Loss: 0.0028, Test Loss: 0.0020
Epoch [35600/35600], Train Loss: 0.0025, Test Loss: 0.0020
Epoch [35650/35650], Train Loss: 0.0028, Test Loss: 0.0019
Epoch [35700/35700], Train Loss: 0.0023, Test Loss: 0.0019
Epoch [35750/35750], Train Loss: 0.0024, Test Loss: 0.0019
Epoch [35800/35800], Train Loss: 0.0023, Test Loss: 0.0019
Epoch [35850/35850], Train Loss: 0.0025, Test Loss: 0.0020
Epoch [35900/35900], Train Loss: 0.0024, Test Loss: 0.0018
Epoch [35950/35950], Train Loss: 0.0024, Test Loss: 0.0021
Epoch [36000/36000], Train Loss: 0.0022, Test Loss: 0.0020
Epoch [36050/36050], Train Loss: 0.0022, Test Loss: 0.0020
Epoch [36100/36100], Train Loss: 0.0024, Test Loss: 0.0016
Epoch [36150/36150], Train Loss: 0.0024, Test Loss: 0.0018
Epoch [36200/36200], Train Loss: 0.0021, Test Loss: 0.0017
Epoch [36250/36250], Train Loss: 0.0021, Test Loss: 0.0018
Epoch [36300/36300], Train Loss: 0.0025, Test Loss: 0.0018
Epoch [36350/36350], Train Loss: 0.0022, Test Loss: 0.0016
Epoch [36400/36400], Train Loss: 0.0024, Test Loss: 0.0017
Epoch [36450/36450], Train Loss: 0.0020, Test Loss: 0.0017
Epoch [36500/36500], Train Loss: 0.0022, Test Loss: 0.0018
Epoch [36550/36550], Train Loss: 0.0019, Test Loss: 0.0017
Epoch [36600/36600], Train Loss: 0.0021, Test Loss: 0.0016
Epoch [36650/36650], Train Loss: 0.0021, Test Loss: 0.0016
Epoch [36700/36700], Train Loss: 0.0020, Test Loss: 0.0015
Epoch [36750/36750], Train Loss: 0.0020, Test Loss: 0.0014
Epoch [36800/36800], Train Loss: 0.0021, Test Loss: 0.0015
Epoch [36850/36850], Train Loss: 0.0021, Test Loss: 0.0016
Epoch [36900/36900], Train Loss: 0.0020, Test Loss: 0.0017
Epoch [36950/36950], Train Loss: 0.0018, Test Loss: 0.0015
Epoch [37000/37000], Train Loss: 0.0020, Test Loss: 0.0016
Epoch [37050/37050], Train Loss: 0.0018, Test Loss: 0.0014
Epoch [37100/37100], Train Loss: 0.0019, Test Loss: 0.0015
Epoch [37150/37150], Train Loss: 0.0020, Test Loss: 0.0015
Epoch [37200/37200], Train Loss: 0.0018, Test Loss: 0.0016
Epoch [37250/37250], Train Loss: 0.0018, Test Loss: 0.0015
Epoch [37300/37300], Train Loss: 0.0019, Test Loss: 0.0015
Epoch [37350/37350], Train Loss: 0.0019, Test Loss: 0.0015
Epoch [37400/37400], Train Loss: 0.0021, Test Loss: 0.0013
Epoch [37450/37450], Train Loss: 0.0018, Test Loss: 0.0014
Epoch [37500/37500], Train Loss: 0.0018, Test Loss: 0.0014
Epoch [37550/37550], Train Loss: 0.0016, Test Loss: 0.0012
Epoch [37600/37600], Train Loss: 0.0016, Test Loss: 0.0014
Epoch [37650/37650], Train Loss: 0.0017, Test Loss: 0.0012
Epoch [37700/37700], Train Loss: 0.0018, Test Loss: 0.0012
Epoch [37750/37750], Train Loss: 0.0017, Test Loss: 0.0013

Epoch [37800/37800], Train Loss: 0.0017, Test Loss: 0.0013
Epoch [37850/37850], Train Loss: 0.0016, Test Loss: 0.0012
Epoch [37900/37900], Train Loss: 0.0017, Test Loss: 0.0010
Epoch [37950/37950], Train Loss: 0.0016, Test Loss: 0.0014
Epoch [38000/38000], Train Loss: 0.0016, Test Loss: 0.0012
Epoch [38050/38050], Train Loss: 0.0016, Test Loss: 0.0013
Epoch [38100/38100], Train Loss: 0.0015, Test Loss: 0.0012
Epoch [38150/38150], Train Loss: 0.0013, Test Loss: 0.0012
Epoch [38200/38200], Train Loss: 0.0015, Test Loss: 0.0012
Epoch [38250/38250], Train Loss: 0.0016, Test Loss: 0.0013
Epoch [38300/38300], Train Loss: 0.0014, Test Loss: 0.0012
Epoch [38350/38350], Train Loss: 0.0014, Test Loss: 0.0012
Epoch [38400/38400], Train Loss: 0.0015, Test Loss: 0.0012
Epoch [38450/38450], Train Loss: 0.0014, Test Loss: 0.0010
Epoch [38500/38500], Train Loss: 0.0014, Test Loss: 0.0011
Epoch [38550/38550], Train Loss: 0.0014, Test Loss: 0.0011
Epoch [38600/38600], Train Loss: 0.0015, Test Loss: 0.0010
Epoch [38650/38650], Train Loss: 0.0014, Test Loss: 0.0011
Epoch [38700/38700], Train Loss: 0.0013, Test Loss: 0.0009
Epoch [38750/38750], Train Loss: 0.0015, Test Loss: 0.0012
Epoch [38800/38800], Train Loss: 0.0015, Test Loss: 0.0011
Epoch [38850/38850], Train Loss: 0.0014, Test Loss: 0.0010
Epoch [38900/38900], Train Loss: 0.0013, Test Loss: 0.0010
Epoch [38950/38950], Train Loss: 0.0015, Test Loss: 0.0011
Epoch [39000/39000], Train Loss: 0.0012, Test Loss: 0.0011
Epoch [39050/39050], Train Loss: 0.0013, Test Loss: 0.0009
Epoch [39100/39100], Train Loss: 0.0014, Test Loss: 0.0011
Epoch [39150/39150], Train Loss: 0.0014, Test Loss: 0.0011
Epoch [39200/39200], Train Loss: 0.0012, Test Loss: 0.0011
Epoch [39250/39250], Train Loss: 0.0013, Test Loss: 0.0010
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Epoch [39350/39350], Train Loss: 0.0013, Test Loss: 0.0009
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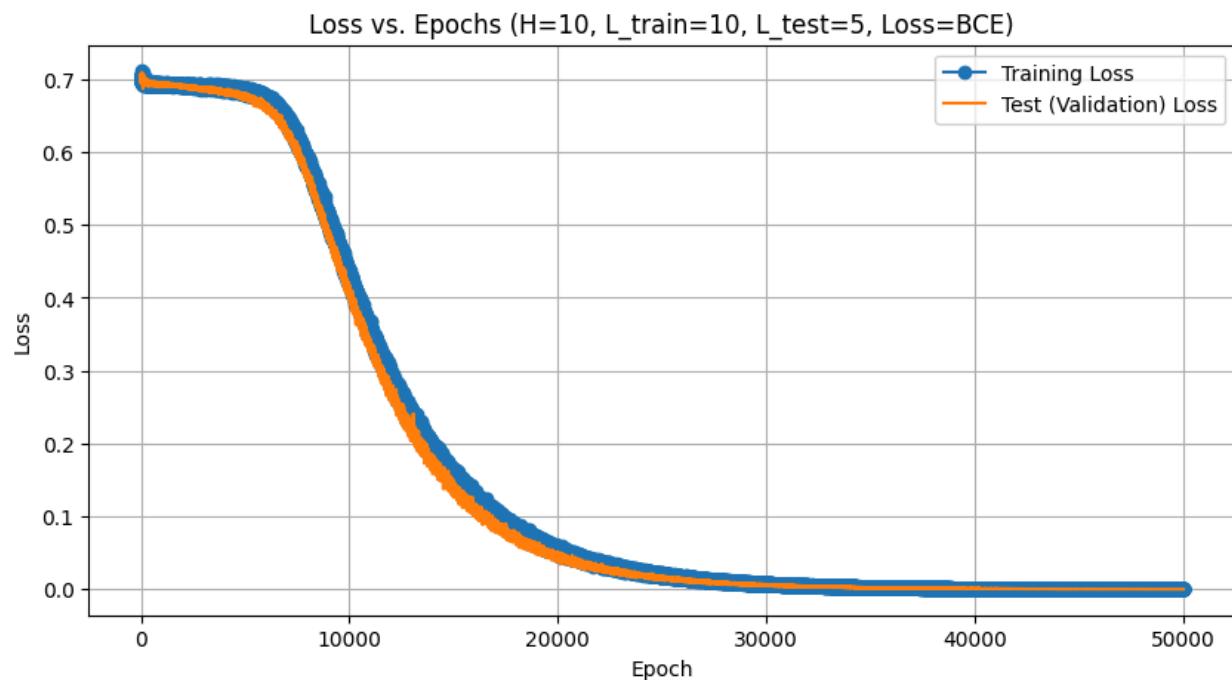
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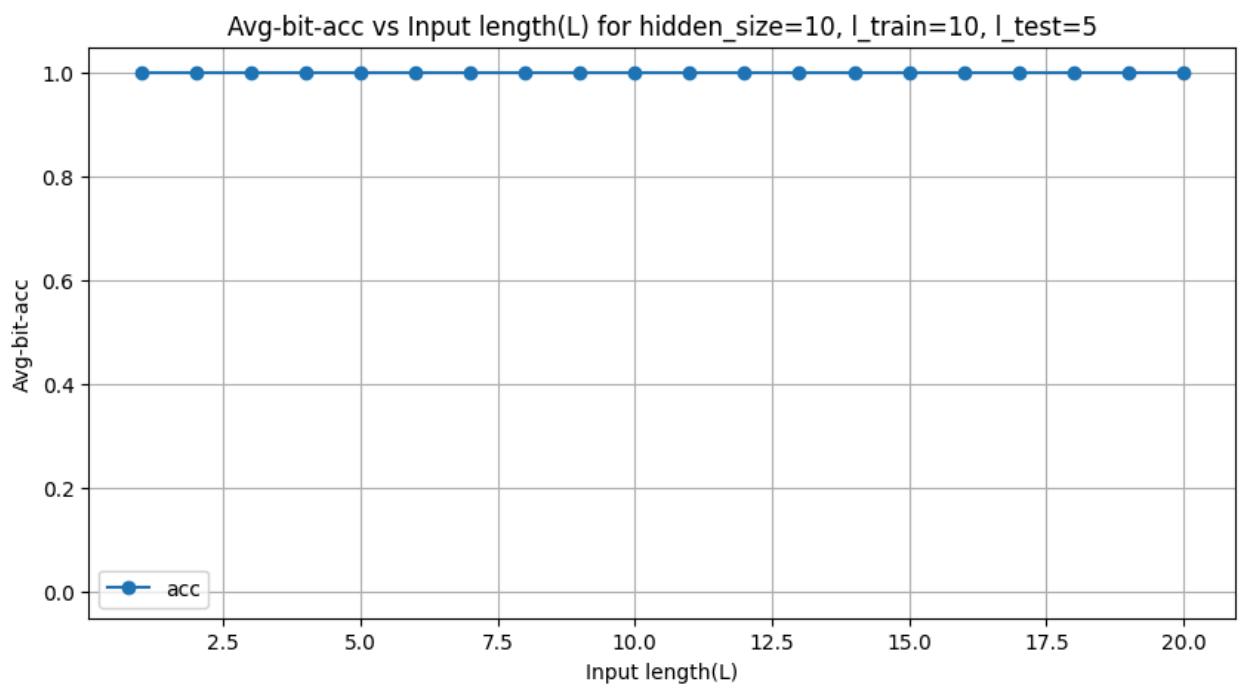
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```
In [ ]: plot_loss(train_loss,test_loss,hidden_size,l_train,l_test,loss_type)
```



```
In [ ]: avg_bit_accuracy(model_7,hidden_size,l_train,l_test,batch_size=100)
```



Out[]: 1.0