

0724-small_hybrid_model

July 25, 2023

```
[1]: import torch
import torch.nn as nn
import torch.optim as optim
```

```
[2]: import numpy as np
```

```
[3]: import sys
sys.path.append('.')

from my_code import functions as f
```

1 Data

```
[4]: file_path = '../data/energies/Trial/Strings_Energies_4_aa.txt' # Replace with
    ↳ the actual path to your 'data.txt' file
string_list, number_list = f.read_data_file(file_path)
score_list = np.array(number_list)/100
angles_list = np.array([f.string_to_numbers(string) for string in string_list])
```

```
[5]: X, Y, X_validation, Y_validation = f.create_validating_set(angles_list,
    ↳ score_list, percentage=0.1)
```

```
[6]: # Define the dataset
input_data = torch.tensor(X, dtype=torch.float32)
target_data = torch.tensor(Y, dtype=torch.float32).view(-1, 1)

# Define the validation set
input_validation = torch.tensor(X_validation, dtype=torch.float32)
target_validation = torch.tensor(Y_validation, dtype=torch.float32).view(-1, 1)
```

2 Quantum node

```
[7]: def qml_RZZ(params, wires):
    """
    RZZ gate.
    """
```

```

qml.CNOT(wires=wires)
qml.RZ(params, wires=wires[1])
qml.CNOT(wires=wires)

```

```

[8]: import pennylane as qml

n_qubits = 4
n_layers_block = 50
n_layers_embedding = 3
n_layers = n_layers_block + n_layers_embedding
n_params = 5
dev = qml.device("default.qubit", wires=n_qubits)

@qml.qnode(dev)
def qnode(inputs, weights):

    # state preparation (we create an embedding with 3 layers, paper: 2001.
    ↪03622)
    for i in range(n_layers_embedding):

        # angle embedding for each qubit
        qml.AngleEmbedding(inputs, wires=range(n_qubits))

        # ZZ rotation for neighboring qubits
        for x in range(2):
            for j in range(x, n_qubits, 2):
                qml_RZZ(weights[i, j, 0], wires=[j, (j+1)%n_qubits])

        # rotations for each qubit
        for j in range(n_qubits):
            qml.RY(weights[i, j, 1], wires=j)

        # last angle embedding
        qml.AngleEmbedding(inputs, wires=range(n_qubits))

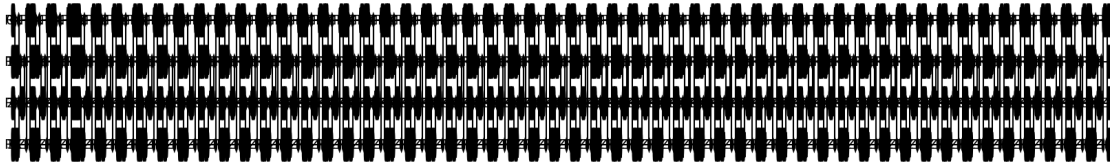
    #layers
    for i in range(n_layers_embedding, n_layers):
        # rotations for each qubit
        for j in range(n_qubits):
            qml.RX(weights[i, j, 2], wires=j)
            qml.RZ(weights[i, j, 3], wires=j)

        # ZZ rotation for neighboring qubits
        for x in range(2):
            for j in range(x, n_qubits, 2):
                qml_RZZ(weights[i, j, 4], wires=[j, (j+1)%n_qubits])

```

```
# measurement
return [qml.expval(qml.PauliZ(wires=i)) for i in range(n_qubits)]
```

```
[9]: qml.drawer.use_style("black_white")
fig, ax = qml.draw_mpl(qnode, expansion_strategy="device")([i for i in
    ↪range(n_qubits)], np.zeros((n_layers, n_qubits, n_params)))
fig.set_size_inches((16,3))
```



```
[10]: weight_shapes = {"weights": (n_layers, n_qubits, n_params)}
```

```
[11]: qlayer = qml.qnn.TorchLayer(qnode, weight_shapes)
```

3 Hybrid model

```
[12]: input_dim = input_data.size(1)

layers = [nn.Linear(input_dim*1, input_dim*2), nn.ReLU()]
layers += [nn.Linear(input_dim*2, input_dim*3), nn.ReLU()]
layers += [nn.Linear(input_dim*3, input_dim*3), nn.ReLU()]
layers += [nn.Linear(input_dim*3, input_dim*2), nn.ReLU()]
layers += [nn.Linear(input_dim*2, input_dim*1)]
layers += [qlayer]
layers += [nn.Linear(input_dim*1, input_dim*1)]
layers += [nn.Linear(input_dim*1, input_dim*1), nn.ReLU()] * 2
layers += [nn.Linear(input_dim*1, 1          )]
Net = nn.Sequential(*layers)
```

```
[13]: # Create an instance of the network
model = Net
```

```
[14]: import time
```

```
[15]: # time
start_time = time.time()

# Define the loss function and optimizer
```

```

criterion = nn.MSELoss() # Mean Squared Error loss
# optimizer = optim.Adam(model.parameters(), lr=0.001) # Adam optimizer with
↳ learning rate 0.001
optimizer = optim.SGD(model.parameters(), lr=0.01)

# Training loop
num_epochs = 10
batch_size = 32

losses = []
losses_epochs = []

for epoch in range(num_epochs):
    # Shuffle the dataset
    indices = torch.randperm(input_data.size(0))
    input_data = input_data[indices]
    target_data = target_data[indices]

    losses_epochs.append(0)

    # Mini-batch training
    for i in range(0, input_data.size(0), batch_size):
        inputs = input_data[i:i+batch_size]
        targets = target_data[i:i+batch_size]

        # Forward pass
        outputs = model(inputs)

        # Compute the loss
        loss = criterion(outputs, targets)

        # Backward pass and optimization
        optimizer.zero_grad()
        loss.backward()
        optimizer.step()

        # Store the loss
        losses.append(loss.item())

        print('- Epoch [{}/{}], i: [{}/{}], Loss: {:.4f}'.format(epoch+1,
↳ num_epochs, i, input_data.size(0), loss.item()), end='\r')

        # add to the epoch loss
        losses_epochs[-1] += loss.item() / (input_data.size(0) / batch_size)

    # time
    # Compute elapsed time and remaining time

```

```

elapsed_time = time.time() - start_time
avg_time_per_epoch = elapsed_time / (epoch + 1)
remaining_epochs = num_epochs - (epoch + 1)
estimated_remaining_time = avg_time_per_epoch * remaining_epochs

# Convert remaining time to hours, minutes, and seconds for better
↳readability
hours, remainder = divmod(estimated_remaining_time, 3600)
minutes, seconds = divmod(remainder, 60)

# Print the loss and remaining time for this epoch
print('Epoch [{} / {}], Loss: {:.4f}, Time remaining: ~{}h {}m {:.0f}s'.
↳format(
    epoch+1, num_epochs, losses_epochs[-1], hours, minutes, seconds))

```

```

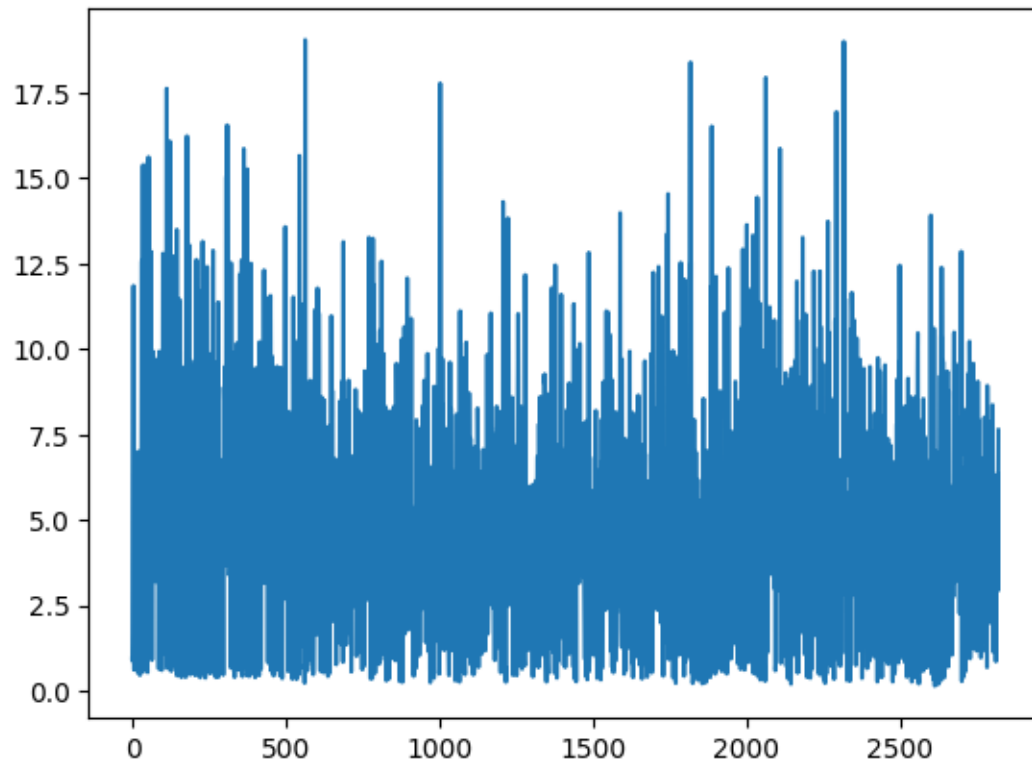
Epoch [1/10], Loss: 5.4461, Time remaining: ~0.0h 57.0m 2s
Epoch [2/10], Loss: 5.2342, Time remaining: ~0.0h 48.0m 49s
Epoch [3/10], Loss: 4.5576, Time remaining: ~0.0h 43.0m 4s
Epoch [4/10], Loss: 4.3959, Time remaining: ~0.0h 36.0m 55s
Epoch [5/10], Loss: 4.3820, Time remaining: ~0.0h 31.0m 44s
Epoch [6/10], Loss: 4.3678, Time remaining: ~0.0h 25.0m 45s
Epoch [7/10], Loss: 4.4844, Time remaining: ~0.0h 19.0m 32s
Epoch [8/10], Loss: 5.0477, Time remaining: ~0.0h 13.0m 9s
Epoch [9/10], Loss: 4.6933, Time remaining: ~0.0h 6.0m 33s
Epoch [10/10], Loss: 4.5230, Time remaining: ~0.0h 0.0m 0s

```

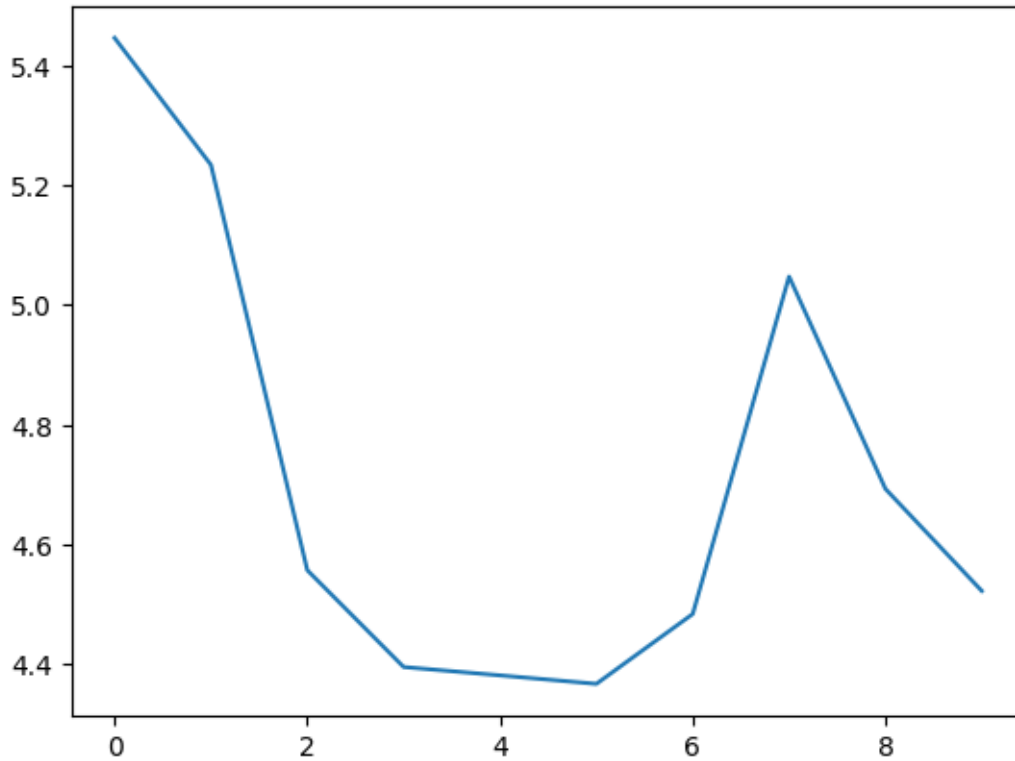
```

[16]: #plot the loss
import matplotlib.pyplot as plt
plt.plot(losses)
plt.show()

```



```
[17]: #plot the loss  
import matplotlib.pyplot as plt  
plt.plot(losses_epochs)  
plt.show()
```



```
[18]: avg_loss = 0
for x, (i, t) in enumerate(zip((input_validation), target_validation)):
    loss = criterion(model(i), t)
    avg_loss += loss/len(target_validation)
    print('i: {}, target: {:.3f}, output: {:.3f}, loss: {:.3f}'.format(x, t.
    ↪item(), model(i).item(), loss))
    print('')

print('Average loss: {:.3f}'.format(avg_loss))
```

i: 0, target: -0.823, output: -1.060, loss: 0.056

i: 1, target: -1.038, output: -1.075, loss: 0.001

i: 2, target: -1.033, output: -1.066, loss: 0.001

i: 3, target: -1.630, output: -1.017, loss: 0.376

i: 4, target: -1.342, output: 0.827, loss: 4.707

i: 5, target: 9.708, output: 2.162, loss: 56.949

i: 6, target: -0.973, output: -1.069, loss: 0.009
i: 7, target: -1.139, output: -1.002, loss: 0.019
i: 8, target: -0.672, output: -1.075, loss: 0.163
i: 9, target: -0.626, output: -1.099, loss: 0.224
i: 10, target: -0.777, output: -0.995, loss: 0.048
i: 11, target: -0.491, output: -1.159, loss: 0.445
i: 12, target: -1.207, output: -1.032, loss: 0.031
i: 13, target: -0.540, output: -0.982, loss: 0.195
i: 14, target: -1.343, output: -0.995, loss: 0.121
i: 15, target: -1.815, output: -0.972, loss: 0.712
i: 16, target: -0.755, output: -1.080, loss: 0.105
i: 17, target: -1.270, output: -1.095, loss: 0.030
i: 18, target: -0.547, output: -1.036, loss: 0.239
i: 19, target: -1.248, output: 0.995, loss: 5.030
i: 20, target: -1.173, output: -0.973, loss: 0.040
i: 21, target: -0.772, output: 1.209, loss: 3.924
i: 22, target: -1.273, output: -1.110, loss: 0.027
i: 23, target: -1.530, output: -1.001, loss: 0.280
i: 24, target: -0.943, output: -1.068, loss: 0.016
i: 25, target: -2.097, output: -1.001, loss: 1.202
i: 26, target: 0.159, output: 2.826, loss: 7.115
i: 27, target: -1.229, output: -1.071, loss: 0.025
i: 28, target: -0.498, output: -1.099, loss: 0.361
i: 29, target: -1.327, output: -1.217, loss: 0.012

i: 30, target: -1.584, output: -1.135, loss: 0.201
i: 31, target: -1.455, output: -1.138, loss: 0.101
i: 32, target: -1.360, output: -0.892, loss: 0.219
i: 33, target: -0.411, output: -1.121, loss: 0.504
i: 34, target: -0.755, output: -1.059, loss: 0.092
i: 35, target: -0.656, output: 0.859, loss: 2.293
i: 36, target: -1.261, output: -0.897, loss: 0.133
i: 37, target: -0.789, output: -1.185, loss: 0.157
i: 38, target: -0.654, output: -0.987, loss: 0.111
i: 39, target: -1.358, output: -1.073, loss: 0.081
i: 40, target: -1.313, output: 0.873, loss: 4.778
i: 41, target: -1.457, output: -0.979, loss: 0.228
i: 42, target: -1.061, output: -1.132, loss: 0.005
i: 43, target: -1.136, output: -0.978, loss: 0.025
i: 44, target: -0.668, output: -1.073, loss: 0.164
i: 45, target: -0.862, output: -1.157, loss: 0.087
i: 46, target: -1.200, output: -1.206, loss: 0.000
i: 47, target: -0.702, output: -0.996, loss: 0.087
i: 48, target: -1.322, output: -1.000, loss: 0.104
i: 49, target: -0.521, output: -1.008, loss: 0.237
i: 50, target: -0.984, output: -1.097, loss: 0.013
i: 51, target: -0.912, output: -0.892, loss: 0.000
i: 52, target: -1.294, output: -1.110, loss: 0.034
i: 53, target: 8.926, output: 0.163, loss: 76.789

i: 54, target: -0.529, output: -1.119, loss: 0.348
i: 55, target: -0.984, output: 0.768, loss: 3.070
i: 56, target: -0.626, output: -1.111, loss: 0.235
i: 57, target: -0.992, output: -1.056, loss: 0.004
i: 58, target: -0.432, output: -1.159, loss: 0.529
i: 59, target: -1.190, output: 0.954, loss: 4.593
i: 60, target: -1.336, output: 0.728, loss: 4.260
i: 61, target: -1.222, output: -1.067, loss: 0.024
i: 62, target: 0.742, output: 2.877, loss: 4.561
i: 63, target: -0.228, output: -1.197, loss: 0.938
i: 64, target: -1.515, output: -1.003, loss: 0.262
i: 65, target: -1.223, output: -1.108, loss: 0.013
i: 66, target: -0.477, output: -1.014, loss: 0.288
i: 67, target: -1.615, output: -0.988, loss: 0.392
i: 68, target: -1.330, output: -1.109, loss: 0.049
i: 69, target: -1.262, output: -1.039, loss: 0.050
i: 70, target: -0.921, output: -1.022, loss: 0.010
i: 71, target: -1.034, output: -1.016, loss: 0.000
i: 72, target: -0.937, output: -1.198, loss: 0.068
i: 73, target: -0.827, output: -0.974, loss: 0.022
i: 74, target: -0.594, output: 1.702, loss: 5.273
i: 75, target: -1.561, output: -1.083, loss: 0.228
i: 76, target: -0.302, output: -1.051, loss: 0.561
i: 77, target: -1.533, output: -1.140, loss: 0.154

i: 78, target: -2.190, output: -1.120, loss: 1.146
i: 79, target: -1.948, output: -1.001, loss: 0.896
i: 80, target: -0.780, output: -1.096, loss: 0.100
i: 81, target: -1.091, output: -1.110, loss: 0.000
i: 82, target: -0.631, output: -0.986, loss: 0.126
i: 83, target: -0.722, output: -1.057, loss: 0.112
i: 84, target: -0.700, output: -1.005, loss: 0.093
i: 85, target: -1.215, output: -1.141, loss: 0.005
i: 86, target: -0.866, output: -1.113, loss: 0.061
i: 87, target: 0.364, output: 2.905, loss: 6.456
i: 88, target: -0.766, output: -1.057, loss: 0.085
i: 89, target: -0.337, output: 2.299, loss: 6.948
i: 90, target: -0.384, output: -1.023, loss: 0.408
i: 91, target: 9.510, output: 2.526, loss: 48.771
i: 92, target: -0.827, output: -0.995, loss: 0.028
i: 93, target: -0.491, output: -1.120, loss: 0.395
i: 94, target: -0.952, output: -1.053, loss: 0.010
i: 95, target: -1.069, output: -1.021, loss: 0.002
i: 96, target: -0.575, output: -1.120, loss: 0.297
i: 97, target: -1.615, output: -0.987, loss: 0.394
i: 98, target: -0.682, output: -1.006, loss: 0.105
i: 99, target: -0.573, output: -1.121, loss: 0.301
i: 100, target: 8.852, output: 0.931, loss: 62.746
i: 101, target: -0.734, output: -1.076, loss: 0.117

i: 102, target: -1.187, output: -1.130, loss: 0.003
i: 103, target: 8.715, output: 1.265, loss: 55.505
i: 104, target: -0.628, output: -1.072, loss: 0.197
i: 105, target: -0.581, output: -0.895, loss: 0.098
i: 106, target: -0.388, output: -1.077, loss: 0.475
i: 107, target: -0.711, output: -1.214, loss: 0.253
i: 108, target: -1.368, output: -1.081, loss: 0.083
i: 109, target: -0.071, output: 2.791, loss: 8.192
i: 110, target: -0.979, output: -0.996, loss: 0.000
i: 111, target: 0.912, output: -1.003, loss: 3.666
i: 112, target: -0.797, output: -1.067, loss: 0.073
i: 113, target: -1.408, output: -0.994, loss: 0.171
i: 114, target: -1.314, output: -1.052, loss: 0.069
i: 115, target: -1.728, output: -1.026, loss: 0.492
i: 116, target: -1.481, output: -1.134, loss: 0.120
i: 117, target: -1.487, output: -1.217, loss: 0.072
i: 118, target: -0.939, output: -1.073, loss: 0.018
i: 119, target: -1.658, output: -1.145, loss: 0.263
i: 120, target: -1.453, output: -1.127, loss: 0.106
i: 121, target: -1.125, output: -1.064, loss: 0.004
i: 122, target: -0.521, output: 2.907, loss: 11.747
i: 123, target: 9.188, output: 1.841, loss: 53.980
i: 124, target: -1.350, output: -1.121, loss: 0.052
i: 125, target: -0.589, output: -1.017, loss: 0.183

i: 126, target: -1.314, output: -1.137, loss: 0.031
i: 127, target: -1.024, output: -1.119, loss: 0.009
i: 128, target: -1.600, output: -1.075, loss: 0.275
i: 129, target: 0.018, output: 2.838, loss: 7.957
i: 130, target: -1.016, output: -1.154, loss: 0.019
i: 131, target: -2.679, output: -1.008, loss: 2.792
i: 132, target: -1.865, output: -1.074, loss: 0.625
i: 133, target: -1.063, output: 2.912, loss: 15.799
i: 134, target: -1.129, output: -1.134, loss: 0.000
i: 135, target: -0.383, output: -1.118, loss: 0.540
i: 136, target: 9.619, output: 0.211, loss: 88.501
i: 137, target: -1.079, output: -1.127, loss: 0.002
i: 138, target: -0.173, output: 0.028, loss: 0.040
i: 139, target: 9.251, output: 0.668, loss: 73.675
i: 140, target: -1.377, output: -1.136, loss: 0.058
i: 141, target: -1.095, output: -0.988, loss: 0.011
i: 142, target: -0.272, output: -1.028, loss: 0.572
i: 143, target: -0.314, output: -1.039, loss: 0.526
i: 144, target: -0.325, output: -1.078, loss: 0.567
i: 145, target: 0.198, output: 2.807, loss: 6.810
i: 146, target: -1.988, output: -0.990, loss: 0.995
i: 147, target: -1.199, output: -1.197, loss: 0.000
i: 148, target: -0.503, output: -1.086, loss: 0.339
i: 149, target: -1.209, output: -1.063, loss: 0.021

i: 150, target: -0.667, output: -1.086, loss: 0.176
i: 151, target: -2.958, output: -1.052, loss: 3.633
i: 152, target: -1.178, output: 1.151, loss: 5.422
i: 153, target: -1.408, output: -1.070, loss: 0.115
i: 154, target: -1.309, output: -1.105, loss: 0.042
i: 155, target: -0.908, output: -1.134, loss: 0.051
i: 156, target: -1.336, output: -0.894, loss: 0.195
i: 157, target: -0.531, output: -1.080, loss: 0.302
i: 158, target: -1.762, output: -1.133, loss: 0.395
i: 159, target: -1.325, output: -1.214, loss: 0.012
i: 160, target: -1.225, output: -1.068, loss: 0.025
i: 161, target: -0.810, output: -1.031, loss: 0.049
i: 162, target: -0.643, output: -1.129, loss: 0.236
i: 163, target: -1.530, output: -1.049, loss: 0.231
i: 164, target: -1.335, output: -1.151, loss: 0.034
i: 165, target: -1.424, output: -1.150, loss: 0.075
i: 166, target: -0.868, output: -0.991, loss: 0.015
i: 167, target: -1.903, output: -1.055, loss: 0.720
i: 168, target: -1.465, output: -1.122, loss: 0.118
i: 169, target: -0.524, output: -1.075, loss: 0.303
i: 170, target: 9.576, output: -0.168, loss: 94.938
i: 171, target: -1.535, output: 1.660, loss: 10.208
i: 172, target: -0.993, output: -1.008, loss: 0.000
i: 173, target: 0.178, output: -1.055, loss: 1.519

i: 174, target: -1.427, output: -1.063, loss: 0.133
i: 175, target: -1.351, output: -1.047, loss: 0.092
i: 176, target: 0.072, output: -1.119, loss: 1.419
i: 177, target: -2.387, output: -1.018, loss: 1.874
i: 178, target: -0.861, output: -1.146, loss: 0.082
i: 179, target: -2.127, output: -1.002, loss: 1.265
i: 180, target: -1.418, output: -1.005, loss: 0.171
i: 181, target: -1.458, output: -1.162, loss: 0.088
i: 182, target: -1.128, output: -1.162, loss: 0.001
i: 183, target: -0.005, output: -1.053, loss: 1.098
i: 184, target: -0.170, output: -1.053, loss: 0.780
i: 185, target: -0.595, output: -1.110, loss: 0.265
i: 186, target: -0.010, output: -1.121, loss: 1.233
i: 187, target: 0.278, output: 2.796, loss: 6.339
i: 188, target: -0.598, output: -1.134, loss: 0.288
i: 189, target: -1.151, output: -0.970, loss: 0.033
i: 190, target: -1.660, output: -0.986, loss: 0.453
i: 191, target: 0.332, output: 2.816, loss: 6.170
i: 192, target: -0.285, output: -1.095, loss: 0.655
i: 193, target: -0.595, output: -0.981, loss: 0.149
i: 194, target: -0.411, output: -1.073, loss: 0.437
i: 195, target: -0.745, output: -1.144, loss: 0.159
i: 196, target: -0.311, output: 2.815, loss: 9.774
i: 197, target: -0.243, output: 2.828, loss: 9.428

i: 198, target: -1.474, output: -1.120, loss: 0.126
i: 199, target: -0.609, output: -0.949, loss: 0.116
i: 200, target: -0.475, output: -1.056, loss: 0.337
i: 201, target: -0.945, output: -1.078, loss: 0.018
i: 202, target: -0.580, output: -1.013, loss: 0.187
i: 203, target: -0.551, output: 2.112, loss: 7.093
i: 204, target: -0.442, output: 0.944, loss: 1.922
i: 205, target: -1.041, output: -1.101, loss: 0.004
i: 206, target: -0.704, output: -1.118, loss: 0.171
i: 207, target: -2.190, output: -1.108, loss: 1.171
i: 208, target: 0.371, output: 2.821, loss: 5.999
i: 209, target: -0.829, output: -1.041, loss: 0.045
i: 210, target: -0.974, output: -1.027, loss: 0.003
i: 211, target: -0.472, output: -1.078, loss: 0.366
i: 212, target: 0.437, output: 2.818, loss: 5.670
i: 213, target: -1.580, output: -1.136, loss: 0.197
i: 214, target: 8.281, output: 0.431, loss: 61.627
i: 215, target: -1.120, output: -1.177, loss: 0.003
i: 216, target: -0.607, output: 0.158, loss: 0.585
i: 217, target: -1.354, output: -1.119, loss: 0.055
i: 218, target: -1.429, output: -0.916, loss: 0.263
i: 219, target: -1.045, output: -1.141, loss: 0.009
i: 220, target: -0.449, output: -1.123, loss: 0.454
i: 221, target: -1.355, output: -1.036, loss: 0.102

i: 222, target: -2.642, output: -1.003, loss: 2.686
i: 223, target: -0.743, output: -0.994, loss: 0.063
i: 224, target: -1.216, output: -1.094, loss: 0.015
i: 225, target: -0.129, output: 2.887, loss: 9.098
i: 226, target: -1.778, output: -1.187, loss: 0.350
i: 227, target: -0.207, output: -1.026, loss: 0.670
i: 228, target: 0.259, output: 2.903, loss: 6.992
i: 229, target: -1.118, output: -1.091, loss: 0.001
i: 230, target: -2.121, output: -0.986, loss: 1.287
i: 231, target: -1.962, output: -1.075, loss: 0.788
i: 232, target: -0.419, output: -1.144, loss: 0.525
i: 233, target: -2.017, output: -1.000, loss: 1.034
i: 234, target: -0.616, output: -1.104, loss: 0.238
i: 235, target: -0.793, output: -0.992, loss: 0.039
i: 236, target: -0.648, output: -1.074, loss: 0.181
i: 237, target: -0.436, output: -1.159, loss: 0.523
i: 238, target: -0.616, output: -0.945, loss: 0.108
i: 239, target: -1.407, output: -1.078, loss: 0.108
i: 240, target: -0.790, output: -1.039, loss: 0.062
i: 241, target: -2.068, output: -1.079, loss: 0.978
i: 242, target: -0.964, output: -1.079, loss: 0.013
i: 243, target: -1.429, output: -1.086, loss: 0.117
i: 244, target: -0.728, output: 0.729, loss: 2.124
i: 245, target: -0.172, output: -1.136, loss: 0.929

i: 246, target: -1.648, output: -1.003, loss: 0.416
i: 247, target: -1.056, output: -0.995, loss: 0.004
i: 248, target: -1.188, output: -1.000, loss: 0.035
i: 249, target: 0.024, output: 2.821, loss: 7.822
i: 250, target: -1.296, output: -1.180, loss: 0.013
i: 251, target: 9.072, output: 1.288, loss: 60.588
i: 252, target: 9.496, output: -0.199, loss: 94.005
i: 253, target: -2.114, output: -1.117, loss: 0.994
i: 254, target: -0.512, output: 1.188, loss: 2.891
i: 255, target: -1.305, output: -1.085, loss: 0.048
i: 256, target: -1.335, output: -1.055, loss: 0.079
i: 257, target: -1.260, output: 1.166, loss: 5.885
i: 258, target: -1.906, output: -1.040, loss: 0.751
i: 259, target: -1.757, output: -1.144, loss: 0.376
i: 260, target: -1.030, output: -1.146, loss: 0.013
i: 261, target: -1.163, output: -1.111, loss: 0.003
i: 262, target: -1.386, output: 0.968, loss: 5.540
i: 263, target: -0.507, output: -0.978, loss: 0.222
i: 264, target: -0.729, output: -1.153, loss: 0.180
i: 265, target: -0.567, output: 0.958, loss: 2.327
i: 266, target: -0.722, output: -1.117, loss: 0.156
i: 267, target: -1.023, output: -1.048, loss: 0.001
i: 268, target: -1.671, output: -1.038, loss: 0.400
i: 269, target: -0.473, output: -1.077, loss: 0.365

i: 270, target: -0.577, output: -1.036, loss: 0.210
i: 271, target: -0.771, output: -1.118, loss: 0.120
i: 272, target: -1.603, output: -1.127, loss: 0.226
i: 273, target: -1.235, output: -0.989, loss: 0.061
i: 274, target: -0.568, output: -1.116, loss: 0.301
i: 275, target: -0.557, output: -1.061, loss: 0.253
i: 276, target: -1.387, output: -1.058, loss: 0.108
i: 277, target: -0.661, output: -0.999, loss: 0.114
i: 278, target: -1.238, output: -1.009, loss: 0.052
i: 279, target: 9.028, output: 0.559, loss: 71.733
i: 280, target: -0.958, output: -1.029, loss: 0.005
i: 281, target: -0.218, output: 2.837, loss: 9.331
i: 282, target: -0.481, output: -1.145, loss: 0.441
i: 283, target: -1.331, output: -1.120, loss: 0.044
i: 284, target: -0.401, output: -1.038, loss: 0.407
i: 285, target: -0.373, output: -1.108, loss: 0.540
i: 286, target: 0.318, output: 2.840, loss: 6.364
i: 287, target: -1.784, output: -1.142, loss: 0.412
i: 288, target: 0.291, output: 2.913, loss: 6.876
i: 289, target: -1.471, output: -1.027, loss: 0.197
i: 290, target: -0.434, output: -1.040, loss: 0.368
i: 291, target: -1.579, output: -1.079, loss: 0.250
i: 292, target: -1.015, output: -1.001, loss: 0.000
i: 293, target: -0.472, output: -1.018, loss: 0.298

i: 294, target: -0.586, output: -0.989, loss: 0.163
i: 295, target: -1.771, output: -1.049, loss: 0.521
i: 296, target: -0.920, output: -1.092, loss: 0.030
i: 297, target: -0.797, output: -1.120, loss: 0.104
i: 298, target: -2.281, output: -1.219, loss: 1.126
i: 299, target: -0.658, output: -1.077, loss: 0.176
i: 300, target: -0.992, output: -1.159, loss: 0.028
i: 301, target: -1.922, output: -1.146, loss: 0.603
i: 302, target: -1.648, output: -1.081, loss: 0.322
i: 303, target: -2.159, output: -1.009, loss: 1.324
i: 304, target: -0.704, output: -1.055, loss: 0.123
i: 305, target: -0.957, output: -1.022, loss: 0.004
i: 306, target: -0.946, output: -1.112, loss: 0.028
i: 307, target: -0.732, output: 0.049, loss: 0.610
i: 308, target: -0.949, output: -1.001, loss: 0.003
i: 309, target: -0.712, output: -1.050, loss: 0.114
i: 310, target: -0.538, output: -1.136, loss: 0.358
i: 311, target: 8.506, output: 0.802, loss: 59.356
i: 312, target: -1.201, output: -1.155, loss: 0.002
i: 313, target: -1.496, output: -1.104, loss: 0.153
i: 314, target: -0.512, output: 1.738, loss: 5.063
i: 315, target: -1.139, output: -1.054, loss: 0.007
i: 316, target: 9.842, output: 1.266, loss: 73.544
i: 317, target: -0.462, output: -1.003, loss: 0.293

i: 318, target: -0.179, output: -1.208, loss: 1.059
i: 319, target: -1.204, output: -1.089, loss: 0.013
i: 320, target: -0.355, output: 1.203, loss: 2.427
i: 321, target: -1.828, output: -1.146, loss: 0.465
i: 322, target: 9.581, output: 1.902, loss: 58.961
i: 323, target: -0.564, output: -1.120, loss: 0.310
i: 324, target: 0.266, output: -1.061, loss: 1.762
i: 325, target: -1.766, output: -1.094, loss: 0.452
i: 326, target: -0.727, output: -1.011, loss: 0.081
i: 327, target: 0.091, output: 2.875, loss: 7.753
i: 328, target: -0.342, output: -1.031, loss: 0.474
i: 329, target: -0.826, output: 1.069, loss: 3.592
i: 330, target: 8.929, output: 0.731, loss: 67.210
i: 331, target: 0.567, output: 2.779, loss: 4.891
i: 332, target: -0.767, output: -1.075, loss: 0.095
i: 333, target: -1.259, output: -1.109, loss: 0.022
i: 334, target: 8.906, output: 0.717, loss: 67.072
i: 335, target: -1.429, output: -1.145, loss: 0.081
i: 336, target: 8.911, output: 2.257, loss: 44.278
i: 337, target: -0.670, output: -1.109, loss: 0.192
i: 338, target: -2.227, output: -1.040, loss: 1.409
i: 339, target: -0.433, output: -1.080, loss: 0.418
i: 340, target: -0.547, output: -1.021, loss: 0.224
i: 341, target: -2.304, output: -1.003, loss: 1.693

i: 342, target: -0.594, output: -1.010, loss: 0.173
i: 343, target: -0.466, output: -1.024, loss: 0.311
i: 344, target: -1.921, output: 1.058, loss: 8.879
i: 345, target: -0.899, output: -1.063, loss: 0.027
i: 346, target: -0.783, output: -1.156, loss: 0.139
i: 347, target: -1.394, output: -1.020, loss: 0.140
i: 348, target: -1.946, output: -1.086, loss: 0.739
i: 349, target: -0.643, output: -1.079, loss: 0.190
i: 350, target: -0.541, output: 0.604, loss: 1.312
i: 351, target: 0.352, output: 2.913, loss: 6.558
i: 352, target: -1.346, output: -0.893, loss: 0.206
i: 353, target: -0.358, output: -1.111, loss: 0.568
i: 354, target: -0.942, output: -1.101, loss: 0.025
i: 355, target: -2.157, output: -0.987, loss: 1.371
i: 356, target: -1.330, output: -1.106, loss: 0.050
i: 357, target: -0.622, output: -1.119, loss: 0.247
i: 358, target: -0.772, output: 2.852, loss: 13.130
i: 359, target: -1.708, output: -1.007, loss: 0.491
i: 360, target: -1.023, output: -1.053, loss: 0.001
i: 361, target: -1.442, output: -1.080, loss: 0.131
i: 362, target: -0.825, output: -1.119, loss: 0.086
i: 363, target: -0.784, output: 2.546, loss: 11.089
i: 364, target: 9.815, output: -0.653, loss: 109.570
i: 365, target: -1.240, output: -1.120, loss: 0.015

i: 366, target: -1.236, output: -1.061, loss: 0.031
i: 367, target: 9.580, output: 0.509, loss: 82.282
i: 368, target: -2.003, output: -1.217, loss: 0.619
i: 369, target: -1.463, output: -1.115, loss: 0.121
i: 370, target: -0.429, output: -1.114, loss: 0.469
i: 371, target: -0.695, output: -1.126, loss: 0.185
i: 372, target: -1.401, output: -1.014, loss: 0.150
i: 373, target: -1.473, output: -1.177, loss: 0.087
i: 374, target: -1.025, output: -1.021, loss: 0.000
i: 375, target: -1.152, output: -1.059, loss: 0.009
i: 376, target: -1.554, output: -0.987, loss: 0.321
i: 377, target: -1.133, output: -1.075, loss: 0.003
i: 378, target: -0.878, output: -1.095, loss: 0.047
i: 379, target: -1.050, output: -1.148, loss: 0.010
i: 380, target: -1.313, output: -1.195, loss: 0.014
i: 381, target: -1.088, output: -0.903, loss: 0.034
i: 382, target: 0.693, output: 2.888, loss: 4.819
i: 383, target: -0.654, output: -1.042, loss: 0.151
i: 384, target: -1.945, output: -1.007, loss: 0.879
i: 385, target: -1.146, output: -0.982, loss: 0.027
i: 386, target: -0.872, output: -1.039, loss: 0.028
i: 387, target: -0.667, output: -1.178, loss: 0.261
i: 388, target: -1.077, output: -1.144, loss: 0.004
i: 389, target: -0.560, output: 0.201, loss: 0.578

i: 390, target: -0.787, output: -1.028, loss: 0.058
i: 391, target: -0.434, output: -0.933, loss: 0.250
i: 392, target: -1.684, output: -1.079, loss: 0.366
i: 393, target: -0.002, output: 2.891, loss: 8.370
i: 394, target: -0.745, output: -1.111, loss: 0.134
i: 395, target: -1.708, output: -1.027, loss: 0.464
i: 396, target: -1.001, output: -1.142, loss: 0.020
i: 397, target: -1.191, output: -1.067, loss: 0.015
i: 398, target: -0.967, output: -1.075, loss: 0.012
i: 399, target: -1.316, output: -1.055, loss: 0.068
i: 400, target: -0.363, output: 1.292, loss: 2.739
i: 401, target: -1.587, output: -1.032, loss: 0.308
i: 402, target: -0.726, output: -0.989, loss: 0.069
i: 403, target: -1.290, output: -1.074, loss: 0.047
i: 404, target: -2.471, output: -1.038, loss: 2.051
i: 405, target: -1.373, output: -1.055, loss: 0.101
i: 406, target: -1.775, output: -1.079, loss: 0.484
i: 407, target: -0.927, output: -1.027, loss: 0.010
i: 408, target: -1.558, output: -1.150, loss: 0.166
i: 409, target: -1.280, output: -1.117, loss: 0.027
i: 410, target: -1.703, output: -1.098, loss: 0.366
i: 411, target: -0.714, output: -0.966, loss: 0.063
i: 412, target: -0.512, output: -1.133, loss: 0.385
i: 413, target: -1.357, output: 1.100, loss: 6.034

i: 414, target: -1.232, output: -1.048, loss: 0.034
i: 415, target: 9.369, output: 0.307, loss: 82.117
i: 416, target: -1.333, output: -1.031, loss: 0.091
i: 417, target: -1.151, output: -0.997, loss: 0.024
i: 418, target: 8.939, output: 0.848, loss: 65.461
i: 419, target: -0.940, output: -0.977, loss: 0.001
i: 420, target: -1.348, output: -1.101, loss: 0.061
i: 421, target: -1.123, output: -1.062, loss: 0.004
i: 422, target: 0.152, output: 2.851, loss: 7.284
i: 423, target: -1.865, output: -0.989, loss: 0.767
i: 424, target: -1.426, output: -1.220, loss: 0.043
i: 425, target: -1.022, output: -1.080, loss: 0.003
i: 426, target: -1.117, output: -1.159, loss: 0.002
i: 427, target: -1.200, output: -1.127, loss: 0.005
i: 428, target: 9.070, output: 2.517, loss: 42.941
i: 429, target: -0.409, output: 1.005, loss: 1.999
i: 430, target: -1.347, output: -0.997, loss: 0.123
i: 431, target: -0.694, output: -1.214, loss: 0.270
i: 432, target: -1.180, output: -1.079, loss: 0.010
i: 433, target: -1.352, output: 1.951, loss: 10.905
i: 434, target: -0.709, output: -1.078, loss: 0.136
i: 435, target: -0.247, output: -0.987, loss: 0.548
i: 436, target: -0.982, output: -1.076, loss: 0.009
i: 437, target: -0.929, output: -1.078, loss: 0.022

i: 438, target: -1.033, output: -1.219, loss: 0.034
i: 439, target: -0.601, output: -1.009, loss: 0.166
i: 440, target: -1.113, output: -1.007, loss: 0.011
i: 441, target: -2.098, output: -1.090, loss: 1.017
i: 442, target: -0.675, output: -1.159, loss: 0.235
i: 443, target: 1.098, output: -1.057, loss: 4.642
i: 444, target: -0.255, output: -1.077, loss: 0.676
i: 445, target: -1.195, output: -1.165, loss: 0.001
i: 446, target: -1.199, output: 0.880, loss: 4.323
i: 447, target: -0.647, output: -1.020, loss: 0.139
i: 448, target: -1.760, output: -1.098, loss: 0.439
i: 449, target: -1.036, output: -0.978, loss: 0.003
i: 450, target: -0.990, output: -1.061, loss: 0.005
i: 451, target: -0.724, output: -1.008, loss: 0.081
i: 452, target: -1.610, output: -1.158, loss: 0.204
i: 453, target: -1.398, output: 2.366, loss: 14.172
i: 454, target: -0.527, output: -1.073, loss: 0.299
i: 455, target: -1.438, output: -1.120, loss: 0.101
i: 456, target: -1.647, output: -0.837, loss: 0.656
i: 457, target: -0.235, output: -1.076, loss: 0.707
i: 458, target: -0.750, output: -1.029, loss: 0.078
i: 459, target: -1.358, output: -1.063, loss: 0.087
i: 460, target: -1.102, output: -1.187, loss: 0.007
i: 461, target: -0.397, output: -0.996, loss: 0.359

i: 462, target: -1.269, output: -0.997, loss: 0.074
i: 463, target: -1.143, output: -1.138, loss: 0.000
i: 464, target: -0.819, output: -1.009, loss: 0.036
i: 465, target: -1.317, output: -1.073, loss: 0.059
i: 466, target: -0.556, output: -1.034, loss: 0.229
i: 467, target: -1.380, output: -1.129, loss: 0.063
i: 468, target: 9.511, output: 1.157, loss: 69.794
i: 469, target: -1.275, output: -1.144, loss: 0.017
i: 470, target: -1.080, output: -1.110, loss: 0.001
i: 471, target: -1.254, output: -1.005, loss: 0.062
i: 472, target: -0.637, output: 0.580, loss: 1.481
i: 473, target: -0.724, output: -1.016, loss: 0.085
i: 474, target: -1.110, output: -1.051, loss: 0.004
i: 475, target: 9.316, output: 0.843, loss: 71.806
i: 476, target: -0.774, output: -1.029, loss: 0.065
i: 477, target: 0.935, output: -1.150, loss: 4.347
i: 478, target: -0.581, output: -0.993, loss: 0.170
i: 479, target: -1.524, output: -1.015, loss: 0.260
i: 480, target: -1.639, output: -1.003, loss: 0.405
i: 481, target: -1.169, output: -1.066, loss: 0.011
i: 482, target: -1.345, output: -1.080, loss: 0.070
i: 483, target: -1.902, output: -1.135, loss: 0.588
i: 484, target: -1.277, output: -1.080, loss: 0.039
i: 485, target: -1.038, output: -1.220, loss: 0.033

i: 486, target: -0.919, output: -1.029, loss: 0.012
i: 487, target: -0.665, output: -0.992, loss: 0.107
i: 488, target: -0.421, output: -1.189, loss: 0.589
i: 489, target: -1.544, output: -1.003, loss: 0.292
i: 490, target: 9.696, output: 2.493, loss: 51.886
i: 491, target: -1.439, output: -1.026, loss: 0.171
i: 492, target: -1.028, output: -1.109, loss: 0.007
i: 493, target: -0.412, output: -1.059, loss: 0.418
i: 494, target: -0.831, output: -1.104, loss: 0.074
i: 495, target: -0.206, output: -1.000, loss: 0.631
i: 496, target: -0.670, output: -1.108, loss: 0.192
i: 497, target: -0.681, output: -1.063, loss: 0.146
i: 498, target: -0.865, output: -1.090, loss: 0.051
i: 499, target: 9.150, output: 1.282, loss: 61.911
i: 500, target: -0.684, output: -1.051, loss: 0.134
i: 501, target: -0.708, output: -1.002, loss: 0.087
i: 502, target: 9.649, output: -0.103, loss: 95.091
i: 503, target: -0.621, output: -1.081, loss: 0.211
i: 504, target: -1.706, output: -1.213, loss: 0.243
i: 505, target: -0.827, output: -1.219, loss: 0.154
i: 506, target: -1.541, output: 1.087, loss: 6.908
i: 507, target: -1.010, output: -1.000, loss: 0.000
i: 508, target: -0.662, output: -1.077, loss: 0.173
i: 509, target: -0.748, output: -1.023, loss: 0.076

i: 510, target: -2.433, output: -0.993, loss: 2.072
i: 511, target: 9.344, output: 2.080, loss: 52.774
i: 512, target: -0.659, output: -1.044, loss: 0.148
i: 513, target: -1.541, output: -1.215, loss: 0.106
i: 514, target: -1.132, output: -0.984, loss: 0.022
i: 515, target: -0.602, output: 1.235, loss: 3.375
i: 516, target: 9.310, output: 1.664, loss: 58.472
i: 517, target: -1.741, output: -1.055, loss: 0.471
i: 518, target: 0.520, output: 2.909, loss: 5.710
i: 519, target: -0.652, output: -1.113, loss: 0.212
i: 520, target: -0.587, output: -0.995, loss: 0.166
i: 521, target: -0.589, output: -0.997, loss: 0.166
i: 522, target: 8.293, output: 0.595, loss: 59.262
i: 523, target: -0.511, output: 0.924, loss: 2.061
i: 524, target: -1.434, output: -1.080, loss: 0.126
i: 525, target: -0.874, output: -0.992, loss: 0.014
i: 526, target: -0.537, output: -1.072, loss: 0.286
i: 527, target: -1.183, output: -1.123, loss: 0.004
i: 528, target: -0.816, output: -1.098, loss: 0.079
i: 529, target: -0.560, output: -1.053, loss: 0.243
i: 530, target: -0.405, output: -1.063, loss: 0.432
i: 531, target: -0.680, output: -1.069, loss: 0.152
i: 532, target: -0.653, output: -1.096, loss: 0.196
i: 533, target: -1.381, output: -1.071, loss: 0.097

i: 534, target: -1.345, output: -1.111, loss: 0.055
i: 535, target: -0.673, output: 0.470, loss: 1.307
i: 536, target: -0.595, output: -1.102, loss: 0.257
i: 537, target: -0.793, output: -1.053, loss: 0.068
i: 538, target: 9.650, output: -0.248, loss: 97.965
i: 539, target: -0.575, output: -0.989, loss: 0.172
i: 540, target: -1.167, output: -1.139, loss: 0.001
i: 541, target: -1.674, output: -1.136, loss: 0.290
i: 542, target: 8.978, output: -0.185, loss: 83.976
i: 543, target: -0.669, output: -1.014, loss: 0.119
i: 544, target: 9.816, output: 2.209, loss: 57.871
i: 545, target: -0.740, output: -1.107, loss: 0.135
i: 546, target: -1.180, output: -1.075, loss: 0.011
i: 547, target: -1.749, output: -1.059, loss: 0.476
i: 548, target: -1.551, output: -1.026, loss: 0.276
i: 549, target: -1.919, output: -1.112, loss: 0.651
i: 550, target: -1.427, output: -0.987, loss: 0.194
i: 551, target: -0.951, output: -0.989, loss: 0.001
i: 552, target: -1.428, output: -1.002, loss: 0.182
i: 553, target: -1.790, output: -1.214, loss: 0.332
i: 554, target: 0.511, output: -1.044, loss: 2.418
i: 555, target: -0.502, output: 0.587, loss: 1.188
i: 556, target: -0.961, output: -1.114, loss: 0.023
i: 557, target: 9.539, output: -0.340, loss: 97.590

i: 558, target: -0.152, output: 2.857, loss: 9.054
i: 559, target: -1.160, output: -1.099, loss: 0.004
i: 560, target: -1.715, output: -1.156, loss: 0.312
i: 561, target: -0.644, output: -0.902, loss: 0.066
i: 562, target: -0.723, output: -0.991, loss: 0.071
i: 563, target: -0.992, output: 1.083, loss: 4.306
i: 564, target: -0.729, output: -1.001, loss: 0.074
i: 565, target: -0.792, output: -1.011, loss: 0.048
i: 566, target: -2.066, output: -1.202, loss: 0.747
i: 567, target: -0.617, output: -1.100, loss: 0.234
i: 568, target: 8.536, output: -0.378, loss: 79.455
i: 569, target: -0.693, output: -0.005, loss: 0.474
i: 570, target: -1.544, output: -1.096, loss: 0.201
i: 571, target: -0.871, output: -1.047, loss: 0.031
i: 572, target: -0.455, output: -1.072, loss: 0.381
i: 573, target: -1.070, output: -1.101, loss: 0.001
i: 574, target: -2.262, output: -1.027, loss: 1.525
i: 575, target: -1.467, output: -0.973, loss: 0.244
i: 576, target: -1.464, output: -1.097, loss: 0.134
i: 577, target: -1.286, output: -1.168, loss: 0.014
i: 578, target: -0.618, output: -1.100, loss: 0.232
i: 579, target: -0.887, output: -1.058, loss: 0.029
i: 580, target: -0.771, output: -1.138, loss: 0.135
i: 581, target: -1.294, output: -1.063, loss: 0.053

i: 582, target: -1.516, output: -1.204, loss: 0.097
i: 583, target: -0.915, output: -1.003, loss: 0.008
i: 584, target: 9.474, output: 0.479, loss: 80.908
i: 585, target: -2.365, output: -1.077, loss: 1.659
i: 586, target: -1.344, output: -1.136, loss: 0.043
i: 587, target: -0.009, output: 2.911, loss: 8.527
i: 588, target: -0.534, output: -0.977, loss: 0.197
i: 589, target: -2.127, output: -0.903, loss: 1.499
i: 590, target: -1.304, output: 0.854, loss: 4.660
i: 591, target: -2.121, output: -0.986, loss: 1.287
i: 592, target: 0.840, output: 2.867, loss: 4.108
i: 593, target: 9.034, output: 0.189, loss: 78.226
i: 594, target: -0.409, output: -1.086, loss: 0.458
i: 595, target: -0.851, output: -1.143, loss: 0.085
i: 596, target: -0.539, output: -1.038, loss: 0.249
i: 597, target: -2.228, output: -1.137, loss: 1.190
i: 598, target: -0.729, output: -1.080, loss: 0.123
i: 599, target: -1.492, output: -1.081, loss: 0.168
i: 600, target: -1.206, output: -1.082, loss: 0.015
i: 601, target: -0.888, output: -1.010, loss: 0.015
i: 602, target: -1.547, output: -1.180, loss: 0.135
i: 603, target: -0.942, output: -1.146, loss: 0.042
i: 604, target: -1.032, output: -0.998, loss: 0.001
i: 605, target: -0.645, output: -1.033, loss: 0.150

i: 606, target: -1.451, output: -1.124, loss: 0.107
i: 607, target: -2.613, output: -1.124, loss: 2.218
i: 608, target: -1.156, output: -1.054, loss: 0.010
i: 609, target: -1.427, output: -1.017, loss: 0.168
i: 610, target: -1.304, output: -1.002, loss: 0.091
i: 611, target: -0.098, output: -1.171, loss: 1.152
i: 612, target: -0.597, output: -1.084, loss: 0.237
i: 613, target: -1.493, output: -1.130, loss: 0.132
i: 614, target: -1.231, output: -1.093, loss: 0.019
i: 615, target: 9.560, output: 1.849, loss: 59.462
i: 616, target: -1.778, output: -0.973, loss: 0.649
i: 617, target: 9.448, output: 0.119, loss: 87.035
i: 618, target: -2.205, output: -1.059, loss: 1.312
i: 619, target: -1.188, output: -1.136, loss: 0.003
i: 620, target: -0.819, output: -1.080, loss: 0.068
i: 621, target: -1.310, output: -1.057, loss: 0.064
i: 622, target: -1.099, output: -1.002, loss: 0.009
i: 623, target: -1.062, output: -1.032, loss: 0.001
i: 624, target: -0.843, output: -1.080, loss: 0.056
i: 625, target: -0.577, output: -1.015, loss: 0.191
i: 626, target: -1.047, output: -1.185, loss: 0.019
i: 627, target: -0.768, output: -0.971, loss: 0.041
i: 628, target: -1.433, output: -1.121, loss: 0.097
i: 629, target: -1.474, output: -1.133, loss: 0.116

i: 630, target: -0.826, output: -1.027, loss: 0.040
i: 631, target: -1.838, output: -1.024, loss: 0.663
i: 632, target: 0.520, output: 2.845, loss: 5.408
i: 633, target: -1.465, output: -1.116, loss: 0.121
i: 634, target: -0.714, output: -0.986, loss: 0.074
i: 635, target: -2.105, output: -1.077, loss: 1.058
i: 636, target: -0.785, output: -1.105, loss: 0.103
i: 637, target: 0.641, output: 2.782, loss: 4.585
i: 638, target: -0.386, output: -1.080, loss: 0.481
i: 639, target: -0.805, output: -1.099, loss: 0.087
i: 640, target: -0.402, output: -1.151, loss: 0.561
i: 641, target: -1.714, output: -1.061, loss: 0.426
i: 642, target: -1.464, output: -1.123, loss: 0.116
i: 643, target: -1.223, output: -1.079, loss: 0.021
i: 644, target: -0.235, output: 2.828, loss: 9.384
i: 645, target: -0.930, output: -1.024, loss: 0.009
i: 646, target: 8.785, output: -0.395, loss: 84.263
i: 647, target: -0.570, output: -0.892, loss: 0.103
i: 648, target: -1.099, output: -1.212, loss: 0.013
i: 649, target: -0.929, output: -1.097, loss: 0.028
i: 650, target: -1.132, output: -1.136, loss: 0.000
i: 651, target: -0.885, output: -1.003, loss: 0.014
i: 652, target: -1.489, output: -1.080, loss: 0.167
i: 653, target: -0.568, output: -1.121, loss: 0.306

i: 654, target: -0.881, output: -0.895, loss: 0.000
i: 655, target: -1.134, output: -1.135, loss: 0.000
i: 656, target: -0.460, output: -1.119, loss: 0.434
i: 657, target: -0.852, output: -0.983, loss: 0.017
i: 658, target: -1.007, output: -1.073, loss: 0.004
i: 659, target: 9.694, output: 2.460, loss: 52.334
i: 660, target: -0.701, output: -1.090, loss: 0.151
i: 661, target: -0.527, output: -1.215, loss: 0.473
i: 662, target: -1.264, output: -0.994, loss: 0.073
i: 663, target: -0.416, output: 1.445, loss: 3.460
i: 664, target: -1.364, output: -1.047, loss: 0.101
i: 665, target: -1.310, output: -1.078, loss: 0.054
i: 666, target: -1.887, output: -1.098, loss: 0.623
i: 667, target: 0.286, output: 2.898, loss: 6.824
i: 668, target: -0.077, output: 2.860, loss: 8.630
i: 669, target: -1.202, output: -1.142, loss: 0.004
i: 670, target: 0.329, output: 2.813, loss: 6.173
i: 671, target: -1.465, output: -1.042, loss: 0.179
i: 672, target: -1.070, output: -1.145, loss: 0.006
i: 673, target: -1.246, output: -1.080, loss: 0.028
i: 674, target: -1.377, output: -0.994, loss: 0.147
i: 675, target: -0.631, output: -1.053, loss: 0.178
i: 676, target: 0.615, output: 2.890, loss: 5.177
i: 677, target: -1.590, output: -1.080, loss: 0.260

i: 678, target: -0.657, output: -1.080, loss: 0.179
i: 679, target: -1.244, output: -1.003, loss: 0.058
i: 680, target: -0.579, output: -1.026, loss: 0.200
i: 681, target: -0.626, output: -1.077, loss: 0.203
i: 682, target: -0.792, output: -1.058, loss: 0.071
i: 683, target: -0.458, output: -1.043, loss: 0.342
i: 684, target: -0.150, output: -1.088, loss: 0.880
i: 685, target: -0.438, output: -1.077, loss: 0.408
i: 686, target: -1.735, output: -1.045, loss: 0.475
i: 687, target: -1.021, output: -1.023, loss: 0.000
i: 688, target: 0.752, output: 2.779, loss: 4.108
i: 689, target: -0.419, output: -1.138, loss: 0.517
i: 690, target: -1.398, output: 1.903, loss: 10.900
i: 691, target: -1.217, output: -0.995, loss: 0.049
i: 692, target: -0.417, output: 1.444, loss: 3.463
i: 693, target: -0.740, output: -0.975, loss: 0.055
i: 694, target: -2.102, output: -1.148, loss: 0.910
i: 695, target: 9.054, output: 1.824, loss: 52.269
i: 696, target: -0.673, output: -1.027, loss: 0.125
i: 697, target: -1.085, output: -1.023, loss: 0.004
i: 698, target: -0.693, output: -1.096, loss: 0.163
i: 699, target: -0.807, output: -1.008, loss: 0.041
i: 700, target: 9.252, output: 0.527, loss: 76.124
i: 701, target: -1.326, output: -1.113, loss: 0.045

i: 702, target: -0.493, output: -1.214, loss: 0.520
i: 703, target: -0.744, output: -1.039, loss: 0.087
i: 704, target: -1.282, output: -1.006, loss: 0.076
i: 705, target: -1.286, output: -1.090, loss: 0.038
i: 706, target: -1.267, output: 2.333, loss: 12.961
i: 707, target: -0.800, output: 0.704, loss: 2.261
i: 708, target: -0.395, output: -1.219, loss: 0.679
i: 709, target: -0.793, output: -1.069, loss: 0.076
i: 710, target: -1.004, output: -0.992, loss: 0.000
i: 711, target: -0.703, output: -1.212, loss: 0.259
i: 712, target: -1.335, output: -0.973, loss: 0.131
i: 713, target: -1.098, output: -1.119, loss: 0.000
i: 714, target: -1.059, output: -1.109, loss: 0.003
i: 715, target: -1.598, output: -1.074, loss: 0.275
i: 716, target: -1.009, output: 0.633, loss: 2.695
i: 717, target: -0.607, output: -1.156, loss: 0.301
i: 718, target: -0.729, output: -1.137, loss: 0.167
i: 719, target: -0.515, output: -0.977, loss: 0.213
i: 720, target: -0.827, output: -0.997, loss: 0.029
i: 721, target: -0.707, output: -1.156, loss: 0.201
i: 722, target: -0.518, output: 2.856, loss: 11.385
i: 723, target: 9.584, output: 0.106, loss: 89.825
i: 724, target: -0.274, output: -1.212, loss: 0.879
i: 725, target: -0.734, output: -1.028, loss: 0.087

i: 726, target: -1.294, output: -1.217, loss: 0.006
i: 727, target: -0.595, output: -1.069, loss: 0.225
i: 728, target: -0.814, output: 1.093, loss: 3.638
i: 729, target: -0.352, output: 1.907, loss: 5.103
i: 730, target: -0.515, output: -1.005, loss: 0.240
i: 731, target: -1.300, output: -1.141, loss: 0.025
i: 732, target: -0.351, output: -1.042, loss: 0.477
i: 733, target: -2.270, output: -1.078, loss: 1.420
i: 734, target: -1.269, output: -1.140, loss: 0.017
i: 735, target: -1.367, output: -1.135, loss: 0.054
i: 736, target: -0.641, output: -1.073, loss: 0.186
i: 737, target: -0.675, output: -0.993, loss: 0.101
i: 738, target: -0.745, output: -1.114, loss: 0.136
i: 739, target: -0.613, output: -1.028, loss: 0.172
i: 740, target: -0.573, output: -1.049, loss: 0.227
i: 741, target: -0.536, output: -0.898, loss: 0.131
i: 742, target: 0.032, output: 2.890, loss: 8.167
i: 743, target: -0.796, output: 1.121, loss: 3.674
i: 744, target: -1.777, output: -0.999, loss: 0.605
i: 745, target: -0.676, output: -1.116, loss: 0.194
i: 746, target: -0.494, output: -1.027, loss: 0.284
i: 747, target: -0.301, output: -1.094, loss: 0.628
i: 748, target: -0.499, output: -0.970, loss: 0.222
i: 749, target: -1.431, output: -0.992, loss: 0.193

i: 750, target: -0.853, output: -0.894, loss: 0.002
i: 751, target: 0.636, output: 2.899, loss: 5.122
i: 752, target: -1.687, output: -1.036, loss: 0.425
i: 753, target: -0.940, output: -1.064, loss: 0.015
i: 754, target: -0.728, output: -1.053, loss: 0.106
i: 755, target: -1.475, output: -1.098, loss: 0.143
i: 756, target: -1.285, output: -1.086, loss: 0.040
i: 757, target: -1.066, output: -1.022, loss: 0.002
i: 758, target: -0.845, output: -1.113, loss: 0.072
i: 759, target: -0.722, output: -1.115, loss: 0.154
i: 760, target: -0.749, output: -0.294, loss: 0.206
i: 761, target: -1.353, output: -1.068, loss: 0.081
i: 762, target: -0.869, output: -1.040, loss: 0.029
i: 763, target: -0.946, output: -1.053, loss: 0.011
i: 764, target: -1.413, output: -1.024, loss: 0.151
i: 765, target: 9.765, output: 2.207, loss: 57.121
i: 766, target: -0.495, output: -1.132, loss: 0.406
i: 767, target: -0.628, output: -1.022, loss: 0.155
i: 768, target: -0.560, output: -1.102, loss: 0.294
i: 769, target: -0.630, output: 1.881, loss: 6.303
i: 770, target: -1.478, output: -1.114, loss: 0.133
i: 771, target: -1.298, output: -1.083, loss: 0.046
i: 772, target: -1.119, output: -1.013, loss: 0.011
i: 773, target: -0.502, output: 1.046, loss: 2.396

i: 774, target: -0.428, output: 1.630, loss: 4.236
i: 775, target: -1.612, output: -1.038, loss: 0.330
i: 776, target: -0.590, output: -1.030, loss: 0.194
i: 777, target: -2.089, output: -1.179, loss: 0.828
i: 778, target: -1.435, output: 1.171, loss: 6.791
i: 779, target: -0.652, output: -1.001, loss: 0.122
i: 780, target: -1.083, output: -0.934, loss: 0.022
i: 781, target: -1.074, output: -1.090, loss: 0.000
i: 782, target: -0.425, output: -1.096, loss: 0.450
i: 783, target: -1.166, output: 1.352, loss: 6.342
i: 784, target: 9.540, output: 0.566, loss: 80.525
i: 785, target: -0.372, output: -1.205, loss: 0.694
i: 786, target: -0.925, output: -1.048, loss: 0.015
i: 787, target: -0.500, output: 2.096, loss: 6.738
i: 788, target: -0.826, output: -1.120, loss: 0.086
i: 789, target: -1.127, output: -1.094, loss: 0.001
i: 790, target: -0.561, output: -1.038, loss: 0.227
i: 791, target: -1.004, output: -1.202, loss: 0.039
i: 792, target: -1.042, output: -1.067, loss: 0.001
i: 793, target: -0.884, output: -1.097, loss: 0.045
i: 794, target: -0.791, output: -1.080, loss: 0.083
i: 795, target: -0.357, output: -1.098, loss: 0.550
i: 796, target: -1.361, output: -1.121, loss: 0.058
i: 797, target: -1.231, output: -1.068, loss: 0.027

i: 798, target: 8.694, output: -0.198, loss: 79.069
i: 799, target: -0.624, output: -0.988, loss: 0.132
i: 800, target: -0.084, output: -1.053, loss: 0.939
i: 801, target: -1.409, output: -1.074, loss: 0.112
i: 802, target: -0.389, output: -1.049, loss: 0.436
i: 803, target: -1.221, output: 1.247, loss: 6.090
i: 804, target: -0.492, output: -1.016, loss: 0.274
i: 805, target: -1.096, output: -1.048, loss: 0.002
i: 806, target: -0.578, output: -1.040, loss: 0.214
i: 807, target: -1.027, output: -1.100, loss: 0.005
i: 808, target: -0.849, output: -1.078, loss: 0.052
i: 809, target: -1.428, output: -1.144, loss: 0.081
i: 810, target: -0.794, output: -1.220, loss: 0.181
i: 811, target: -1.162, output: -1.002, loss: 0.026
i: 812, target: -0.691, output: -1.121, loss: 0.185
i: 813, target: -0.640, output: -1.116, loss: 0.226
i: 814, target: 1.015, output: -0.993, loss: 4.030
i: 815, target: -0.478, output: -1.121, loss: 0.414
i: 816, target: -0.948, output: -1.152, loss: 0.041
i: 817, target: 0.312, output: 2.912, loss: 6.756
i: 818, target: 9.650, output: 1.705, loss: 63.134
i: 819, target: -1.434, output: -1.146, loss: 0.083
i: 820, target: -0.450, output: -1.078, loss: 0.395
i: 821, target: -0.571, output: 1.190, loss: 3.102

```

i: 822, target: -1.145, output: -0.896, loss: 0.062
i: 823, target: -1.323, output: -1.075, loss: 0.061
i: 824, target: -1.290, output: -0.980, loss: 0.096
i: 825, target: -1.140, output: -1.112, loss: 0.001
i: 826, target: -1.114, output: -1.071, loss: 0.002
i: 827, target: -1.380, output: -1.024, loss: 0.127

```

4 Save the Notebook as a PDF

```

[ ]: # SAVE THE NOTEBOOK

from IPython.display import Javascript

# Define the function to save the notebook
def save_notebook():
    display(Javascript('IPython.notebook.save_notebook()'))

# Call the save_notebook function to save the notebook
save_notebook()

```

```

[ ]: import subprocess
import os

name_notebook = "0724-small_hybrid_model.ipynb"

output_filename = "results/" + name_notebook[:4] + "/" + name_notebook[:-6] + "_0.
↳ pdf"

#check if the output file already exists
while os.path.exists(output_filename):
    print("The file {} already exists".format(output_filename))
    output_filename = output_filename[:-5] + str(int(output_filename[-5]) + 1)
↳ + ".pdf"
    print("Trying to save the file as {}".format(output_filename))

subprocess.run(["jupyter", "nbconvert", "--to", "pdf", "--output",
↳ output_filename, name_notebook])

```

```

[ ]: CompletedProcess(args=['jupyter', 'nbconvert', '--to', 'pdf', '--output',
'results/0724/0724-small_hybrid_model_0.pdf', '0724-small_hybrid_model.ipynb'],

```

```
returncode=0)
```