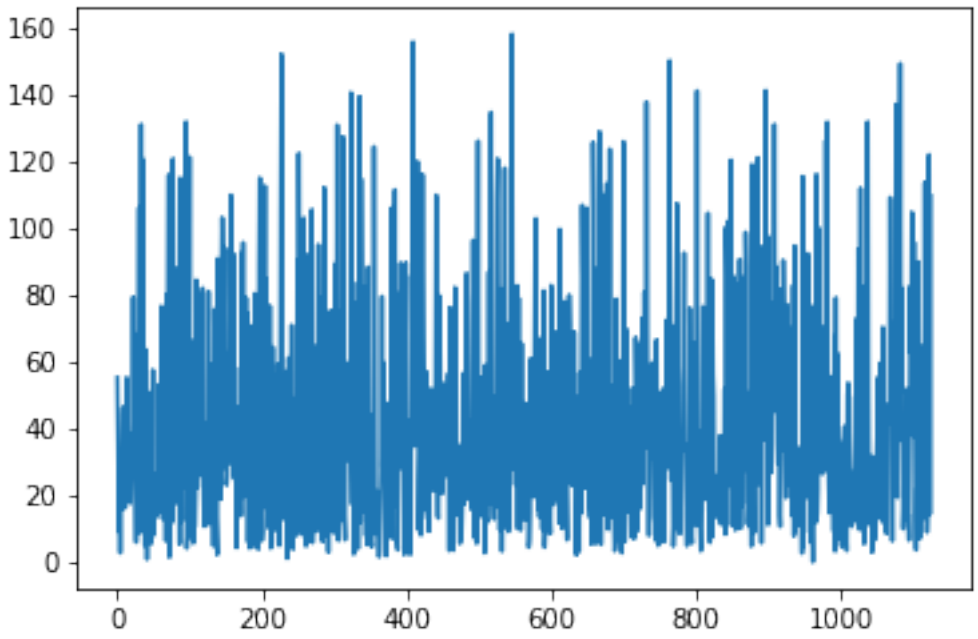
NO2_RNN

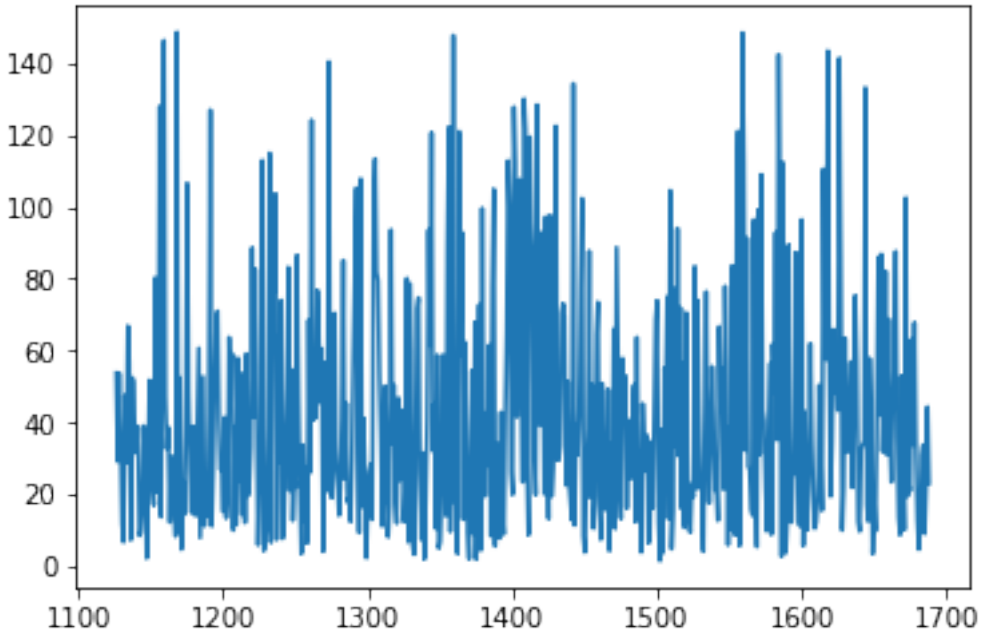
November 30, 2017

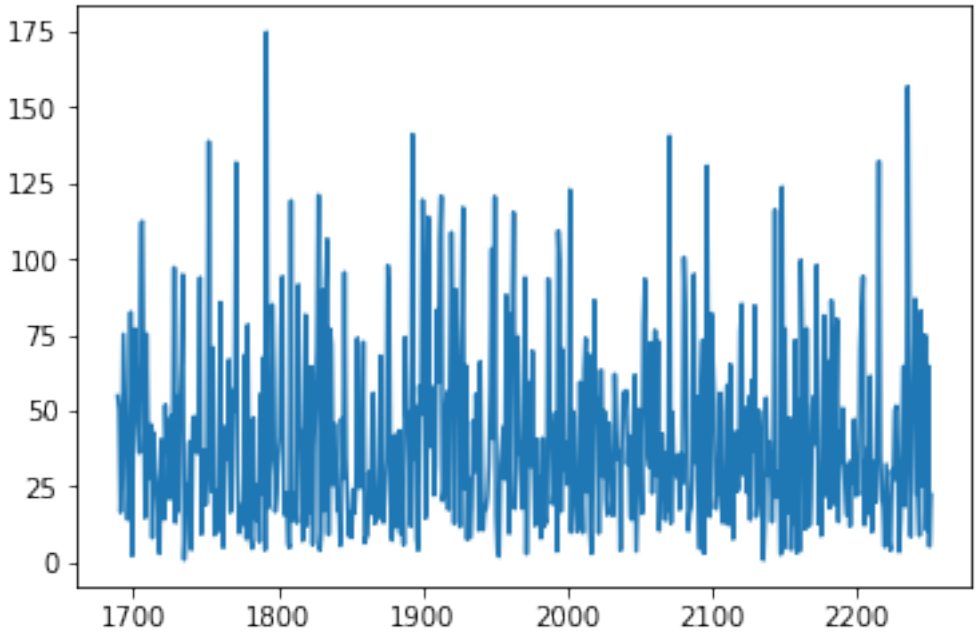
In [1]:
```
import numpy as np
import pandas as pd
import os
import matplotlib.pyplot as plt
```

In [2]:
```
df = pd.read_pickle('data/micro_sud3_normalized.pkl')
df = df.reindex(np.random.permutation(df.index))
df = df.reset_index()

def split_dataframe(dataframe, percent):
    nb_rows = int(np.floor(percent * len(dataframe)))
    return dataframe[:nb_rows], dataframe[nb_rows:]

def dataframe_to_xy(df):
    return (np.array(df[['NO2_61FD', 'NO2_61F0', 'NO2_61EF', 'temp', 'rh',\
                         'tgrad', 'pressure', 'pluvio']]),\
            np.array(df['NO2_ref']))


df_train, df_test = split_dataframe(df, 0.5)
df_valid, df_test = split_dataframe(df_test, 0.5)

X_train, y_train = dataframe_to_xy(df_train)
X_valid, y_valid = dataframe_to_xy(df_valid)
X_test, y_test = dataframe_to_xy(df_test)

X_train = X_train.reshape((X_train.shape[0], 1, X_train.shape[1]))
X_valid= X_valid.reshape((X_valid.shape[0], 1,  X_valid.shape[1]))
X_test = X_test.reshape((X_test.shape[0], 1, X_test.shape[1]))

def dataframe_to_xy_sequences(df, sequence_size):
    out_X = np.zeros((len(df)//sequence_size, sequence_size, 8))
    out_y = np.zeros((len(df)//sequence_size, sequence_size))
    i = 0
    while i + sequence_size < len(df):
        sequence = df.iloc[i:i+sequence_size]
        out_X[i//sequence_size] =  np.array(sequence[['NO2_61FD', 'NO2_61F0', 'NO2_61E
                                   'tgrad', 'pressure', 'pluvio']])
```

```
        out_y[i//sequence_size] = np.array(sequence['NO2_ref'])
        i += sequence_size

    return out_X, out_y

plt.plot(df_train['NO2_ref'])
plt.show()

plt.plot(df_valid['NO2_ref'])
plt.show()

plt.plot(df_test['NO2_ref'])
plt.show()
```







In [3]:
```
from keras.layers import SimpleRNN, Dense, LSTM, GRU
from keras.models import Sequential
from keras.callbacks import EarlyStopping
```

```
        def simple_rnn_model(nb_units, input_dim, loss='mean_squared_error', optimizer='adam')
            model = Sequential()
            model.add(SimpleRNN(nb_units, input_shape=input_dim, recurrent_dropout=1, activati
            model.add(Dense(nb_units, activation='relu'))
            model.add(Dense(1, kernel_initializer='normal', activation='relu'))
            model.compile(loss=loss, optimizer=optimizer)
            model.summary()
            return model

        def lstm_model(nb_units, input_dim, loss='mean_squared_error', optimizer='adam', activa
            model = Sequential()
            model.add(LSTM(nb_units, input_shape=input_dim, activation='relu'))
            model.add(Dense(nb_units, activation='relu'))
            model.add(Dense(1, kernel_initializer='normal'))
            model.compile(loss=loss, optimizer=optimizer)
            model.summary()
            return model

        def gru_model(nb_units, input_dim, loss='mean_squared_error', optimizer='adam', activat
            model = Sequential()
            model.add(GRU(nb_units, input_shape=input_dim, activation='relu'))
            model.add(Dense(nb_units, activation='relu'))
            model.add(Dense(1, kernel_initializer='normal'))
            model.compile(loss=loss, optimizer=optimizer)
            model.summary()
            return model
```

```
Using TensorFlow backend.
```

```
In [4]: print(X_train.shape)
        model = simple_rnn_model(32, X_train.shape[1:])
```

```
(1126, 1, 8)
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
simple_rnn_1 (SimpleRNN)     (None, 32)                1312
_________________________________________________________________
dense_1 (Dense)              (None, 32)                1056
_________________________________________________________________
dense_2 (Dense)              (None, 1)                 33
=================================================================
Total params: 2,401
Trainable params: 2,401
Non-trainable params: 0
_________________________________________________________________
```

```
In [5]: early_stopping = EarlyStopping(monitor='val_loss', verbose=1, mode='auto', patience=10)
        history = model.fit(X_train, y_train, batch_size=32, epochs=10000, validation_data=(X_v

Train on 1126 samples, validate on 563 samples
Epoch 1/10000
1126/1126 [==============================] - 1s 633us/step - loss: 2703.6614 - val_loss: 2811.5
Epoch 2/10000
1126/1126 [==============================] - 0s 73us/step - loss: 2579.3424 - val_loss: 2588.62
Epoch 3/10000
1126/1126 [==============================] - 0s 74us/step - loss: 2251.3971 - val_loss: 2052.84
Epoch 4/10000
1126/1126 [==============================] - 0s 71us/step - loss: 1596.0956 - val_loss: 1172.04
Epoch 5/10000
1126/1126 [==============================] - 0s 75us/step - loss: 796.4403 - val_loss: 477.1721
Epoch 6/10000
1126/1126 [==============================] - 0s 77us/step - loss: 390.9057 - val_loss: 324.6948
Epoch 7/10000
1126/1126 [==============================] - 0s 73us/step - loss: 310.9859 - val_loss: 291.8602
Epoch 8/10000
1126/1126 [==============================] - 0s 67us/step - loss: 280.7700 - val_loss: 270.8609
Epoch 9/10000
1126/1126 [==============================] - 0s 71us/step - loss: 258.7063 - val_loss: 251.9674
Epoch 10/10000
1126/1126 [==============================] - 0s 72us/step - loss: 239.1006 - val_loss: 234.4760
Epoch 11/10000
1126/1126 [==============================] - 0s 73us/step - loss: 221.3857 - val_loss: 218.8044
Epoch 12/10000
1126/1126 [==============================] - 0s 72us/step - loss: 205.4556 - val_loss: 204.9430
Epoch 13/10000
1126/1126 [==============================] - 0s 69us/step - loss: 191.4291 - val_loss: 192.6823
Epoch 14/10000
1126/1126 [==============================] - 0s 69us/step - loss: 179.1869 - val_loss: 181.9944
Epoch 15/10000
1126/1126 [==============================] - 0s 70us/step - loss: 168.5327 - val_loss: 172.6471
Epoch 16/10000
1126/1126 [==============================] - 0s 71us/step - loss: 159.2462 - val_loss: 164.5204
Epoch 17/10000
1126/1126 [==============================] - 0s 70us/step - loss: 151.1110 - val_loss: 157.3538
Epoch 18/10000
1126/1126 [==============================] - 0s 66us/step - loss: 144.1368 - val_loss: 151.3489
Epoch 19/10000
1126/1126 [==============================] - 0s 74us/step - loss: 138.2592 - val_loss: 146.3496
Epoch 20/10000
1126/1126 [==============================] - 0s 78us/step - loss: 133.2873 - val_loss: 142.0115
Epoch 21/10000
1126/1126 [==============================] - 0s 74us/step - loss: 129.1061 - val_loss: 138.4199
Epoch 22/10000
1126/1126 [==============================] - 0s 89us/step - loss: 125.4485 - val_loss: 135.4303
```

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Epoch 23/10000
1126/1126 [==============================] - 0s 71us/step - loss: 122.2919 - val_loss: 132.7224
Epoch 24/10000
1126/1126 [==============================] - 0s 83us/step - loss: 119.4945 - val_loss: 130.3181
Epoch 25/10000
1126/1126 [==============================] - 0s 85us/step - loss: 116.9281 - val_loss: 128.0615
Epoch 26/10000
1126/1126 [==============================] - 0s 73us/step - loss: 114.5721 - val_loss: 125.8357
Epoch 27/10000
1126/1126 [==============================] - 0s 80us/step - loss: 112.3277 - val_loss: 123.7122
Epoch 28/10000
1126/1126 [==============================] - 0s 77us/step - loss: 110.2405 - val_loss: 121.6579
Epoch 29/10000
1126/1126 [==============================] - 0s 72us/step - loss: 108.3517 - val_loss: 119.7054
Epoch 30/10000
1126/1126 [==============================] - 0s 76us/step - loss: 106.6336 - val_loss: 117.9989
Epoch 31/10000
1126/1126 [==============================] - 0s 78us/step - loss: 105.0733 - val_loss: 116.5193
Epoch 32/10000
1126/1126 [==============================] - 0s 81us/step - loss: 103.6658 - val_loss: 115.1391
Epoch 33/10000
1126/1126 [==============================] - 0s 80us/step - loss: 102.4552 - val_loss: 113.9275
Epoch 34/10000
1126/1126 [==============================] - 0s 77us/step - loss: 101.3140 - val_loss: 112.7601
Epoch 35/10000
1126/1126 [==============================] - 0s 72us/step - loss: 100.2302 - val_loss: 111.6837
Epoch 36/10000
1126/1126 [==============================] - 0s 70us/step - loss: 99.1622 - val_loss: 110.5493
Epoch 37/10000
1126/1126 [==============================] - 0s 69us/step - loss: 98.0993 - val_loss: 109.4442
Epoch 38/10000
1126/1126 [==============================] - 0s 74us/step - loss: 97.0732 - val_loss: 108.3324
Epoch 39/10000
1126/1126 [==============================] - 0s 74us/step - loss: 96.0712 - val_loss: 107.2182
Epoch 40/10000
1126/1126 [==============================] - 0s 70us/step - loss: 95.0903 - val_loss: 106.1033
Epoch 41/10000
1126/1126 [==============================] - 0s 70us/step - loss: 94.1240 - val_loss: 105.0020
Epoch 42/10000
1126/1126 [==============================] - 0s 71us/step - loss: 93.1466 - val_loss: 103.8632
Epoch 43/10000
1126/1126 [==============================] - 0s 72us/step - loss: 92.1268 - val_loss: 102.7239
Epoch 44/10000
1126/1126 [==============================] - 0s 73us/step - loss: 91.0819 - val_loss: 101.5806
Epoch 45/10000
1126/1126 [==============================] - 0s 74us/step - loss: 90.0195 - val_loss: 100.4532
Epoch 46/10000
1126/1126 [==============================] - 0s 77us/step - loss: 88.9629 - val_loss: 99.2960
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Epoch 47/10000
1126/1126 [==============================] - 0s 70us/step - loss: 87.8660 - val_loss: 98.0736
Epoch 48/10000
1126/1126 [==============================] - 0s 53us/step - loss: 86.7727 - val_loss: 96.9584
Epoch 49/10000
1126/1126 [==============================] - 0s 70us/step - loss: 85.7003 - val_loss: 95.9208
Epoch 50/10000
1126/1126 [==============================] - 0s 74us/step - loss: 84.6545 - val_loss: 94.8855
Epoch 51/10000
1126/1126 [==============================] - 0s 79us/step - loss: 83.6076 - val_loss: 93.8570
Epoch 52/10000
1126/1126 [==============================] - 0s 68us/step - loss: 82.6117 - val_loss: 92.8794
Epoch 53/10000
1126/1126 [==============================] - 0s 75us/step - loss: 81.5892 - val_loss: 91.9036
Epoch 54/10000
1126/1126 [==============================] - 0s 66us/step - loss: 80.6160 - val_loss: 90.9190
Epoch 55/10000
1126/1126 [==============================] - 0s 68us/step - loss: 79.6390 - val_loss: 89.9923
Epoch 56/10000
1126/1126 [==============================] - 0s 67us/step - loss: 78.6909 - val_loss: 89.0738
Epoch 57/10000
1126/1126 [==============================] - 0s 70us/step - loss: 77.7404 - val_loss: 88.1617
Epoch 58/10000
1126/1126 [==============================] - 0s 64us/step - loss: 76.8250 - val_loss: 87.2641
Epoch 59/10000
1126/1126 [==============================] - 0s 65us/step - loss: 75.9661 - val_loss: 86.3800
Epoch 60/10000
1126/1126 [==============================] - 0s 69us/step - loss: 75.0750 - val_loss: 85.5356
Epoch 61/10000
1126/1126 [==============================] - 0s 57us/step - loss: 74.2602 - val_loss: 84.6682
Epoch 62/10000
1126/1126 [==============================] - 0s 70us/step - loss: 73.3992 - val_loss: 83.8065
Epoch 63/10000
1126/1126 [==============================] - 0s 72us/step - loss: 72.5910 - val_loss: 82.9599
Epoch 64/10000
1126/1126 [==============================] - 0s 70us/step - loss: 71.7992 - val_loss: 82.1202
Epoch 65/10000
1126/1126 [==============================] - 0s 66us/step - loss: 71.0024 - val_loss: 81.3238
Epoch 66/10000
1126/1126 [==============================] - 0s 72us/step - loss: 70.3060 - val_loss: 80.4734
Epoch 67/10000
1126/1126 [==============================] - 0s 68us/step - loss: 69.5537 - val_loss: 79.7712
Epoch 68/10000
1126/1126 [==============================] - 0s 67us/step - loss: 68.9510 - val_loss: 78.9522
Epoch 69/10000
1126/1126 [==============================] - 0s 68us/step - loss: 68.1377 - val_loss: 78.2272
Epoch 70/10000
1126/1126 [==============================] - 0s 72us/step - loss: 67.4900 - val_loss: 77.4182
```

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Epoch 71/10000
1126/1126 [==============================] - 0s 73us/step - loss: 66.7861 - val_loss: 76.7563
Epoch 72/10000
1126/1126 [==============================] - 0s 67us/step - loss: 66.2436 - val_loss: 75.9532
Epoch 73/10000
1126/1126 [==============================] - 0s 70us/step - loss: 65.5103 - val_loss: 75.3072
Epoch 74/10000
1126/1126 [==============================] - 0s 68us/step - loss: 64.9615 - val_loss: 74.6053
Epoch 75/10000
1126/1126 [==============================] - 0s 63us/step - loss: 64.3256 - val_loss: 73.9597
Epoch 76/10000
1126/1126 [==============================] - 0s 69us/step - loss: 63.8063 - val_loss: 73.2687
Epoch 77/10000
1126/1126 [==============================] - 0s 67us/step - loss: 63.2051 - val_loss: 72.6939
Epoch 78/10000
1126/1126 [==============================] - 0s 66us/step - loss: 62.7538 - val_loss: 72.0307
Epoch 79/10000
1126/1126 [==============================] - 0s 68us/step - loss: 62.1738 - val_loss: 71.4797
Epoch 80/10000
1126/1126 [==============================] - 0s 68us/step - loss: 61.7426 - val_loss: 70.8637
Epoch 81/10000
1126/1126 [==============================] - 0s 68us/step - loss: 61.2133 - val_loss: 70.3213
Epoch 82/10000
1126/1126 [==============================] - 0s 62us/step - loss: 60.8065 - val_loss: 69.7626
Epoch 83/10000
1126/1126 [==============================] - 0s 65us/step - loss: 60.3252 - val_loss: 69.2457
Epoch 84/10000
1126/1126 [==============================] - 0s 67us/step - loss: 59.9682 - val_loss: 68.7141
Epoch 85/10000
1126/1126 [==============================] - 0s 67us/step - loss: 59.5373 - val_loss: 68.2480
Epoch 86/10000
1126/1126 [==============================] - 0s 63us/step - loss: 59.1817 - val_loss: 67.7976
Epoch 87/10000
1126/1126 [==============================] - 0s 63us/step - loss: 58.7803 - val_loss: 67.3552
Epoch 88/10000
1126/1126 [==============================] - 0s 65us/step - loss: 58.4252 - val_loss: 66.9541
Epoch 89/10000
1126/1126 [==============================] - 0s 66us/step - loss: 58.0568 - val_loss: 66.5470
Epoch 90/10000
1126/1126 [==============================] - 0s 67us/step - loss: 57.7350 - val_loss: 66.1719
Epoch 91/10000
1126/1126 [==============================] - 0s 68us/step - loss: 57.4339 - val_loss: 65.7947
Epoch 92/10000
1126/1126 [==============================] - 0s 66us/step - loss: 57.1198 - val_loss: 65.4452
Epoch 93/10000
1126/1126 [==============================] - 0s 67us/step - loss: 56.8432 - val_loss: 65.0609
Epoch 94/10000
1126/1126 [==============================] - 0s 66us/step - loss: 56.5043 - val_loss: 64.7599
```

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Epoch 95/10000
1126/1126 [==============================] - 0s 65us/step - loss: 56.2954 - val_loss: 64.4164
Epoch 96/10000
1126/1126 [==============================] - 0s 67us/step - loss: 55.9604 - val_loss: 64.1281
Epoch 97/10000
1126/1126 [==============================] - 0s 66us/step - loss: 55.7716 - val_loss: 63.8141
Epoch 98/10000
1126/1126 [==============================] - 0s 69us/step - loss: 55.4724 - val_loss: 63.5140
Epoch 99/10000
1126/1126 [==============================] - 0s 67us/step - loss: 55.2545 - val_loss: 63.2373
Epoch 100/10000
1126/1126 [==============================] - 0s 65us/step - loss: 54.9811 - val_loss: 62.9465
Epoch 101/10000
1126/1126 [==============================] - 0s 68us/step - loss: 54.7767 - val_loss: 62.6636
Epoch 102/10000
1126/1126 [==============================] - 0s 68us/step - loss: 54.5037 - val_loss: 62.3851
Epoch 103/10000
1126/1126 [==============================] - 0s 66us/step - loss: 54.2872 - val_loss: 62.1504
Epoch 104/10000
1126/1126 [==============================] - 0s 62us/step - loss: 54.0693 - val_loss: 61.8821
Epoch 105/10000
1126/1126 [==============================] - 0s 70us/step - loss: 53.8689 - val_loss: 61.6614
Epoch 106/10000
1126/1126 [==============================] - 0s 77us/step - loss: 53.7179 - val_loss: 61.4384
Epoch 107/10000
1126/1126 [==============================] - 0s 65us/step - loss: 53.4998 - val_loss: 61.2172
Epoch 108/10000
1126/1126 [==============================] - 0s 68us/step - loss: 53.3464 - val_loss: 61.0248
Epoch 109/10000
1126/1126 [==============================] - 0s 73us/step - loss: 53.1732 - val_loss: 60.7894
Epoch 110/10000
1126/1126 [==============================] - 0s 68us/step - loss: 52.9634 - val_loss: 60.6148
Epoch 111/10000
1126/1126 [==============================] - 0s 65us/step - loss: 52.8510 - val_loss: 60.4370
Epoch 112/10000
1126/1126 [==============================] - 0s 65us/step - loss: 52.6563 - val_loss: 60.2430
Epoch 113/10000
1126/1126 [==============================] - 0s 66us/step - loss: 52.5301 - val_loss: 60.1061
Epoch 114/10000
1126/1126 [==============================] - 0s 68us/step - loss: 52.3997 - val_loss: 59.9105
Epoch 115/10000
1126/1126 [==============================] - 0s 70us/step - loss: 52.2001 - val_loss: 59.7463
Epoch 116/10000
1126/1126 [==============================] - 0s 68us/step - loss: 52.1150 - val_loss: 59.5679
Epoch 117/10000
1126/1126 [==============================] - 0s 66us/step - loss: 51.8882 - val_loss: 59.3656
Epoch 118/10000
1126/1126 [==============================] - 0s 70us/step - loss: 51.7606 - val_loss: 59.2364
```

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Epoch 119/10000
1126/1126 [==============================] - 0s 67us/step - loss: 51.6470 - val_loss: 59.0386
Epoch 120/10000
1126/1126 [==============================] - 0s 72us/step - loss: 51.4529 - val_loss: 58.9117
Epoch 121/10000
1126/1126 [==============================] - 0s 71us/step - loss: 51.3578 - val_loss: 58.7901
Epoch 122/10000
1126/1126 [==============================] - 0s 73us/step - loss: 51.2022 - val_loss: 58.6079
Epoch 123/10000
1126/1126 [==============================] - 0s 74us/step - loss: 51.0512 - val_loss: 58.5705
Epoch 124/10000
1126/1126 [==============================] - 0s 68us/step - loss: 51.0299 - val_loss: 58.3636
Epoch 125/10000
1126/1126 [==============================] - 0s 70us/step - loss: 50.7893 - val_loss: 58.2441
Epoch 126/10000
1126/1126 [==============================] - 0s 69us/step - loss: 50.7110 - val_loss: 58.1786
Epoch 127/10000
1126/1126 [==============================] - 0s 65us/step - loss: 50.6037 - val_loss: 58.0196
Epoch 128/10000
1126/1126 [==============================] - 0s 70us/step - loss: 50.4412 - val_loss: 57.9630
Epoch 129/10000
1126/1126 [==============================] - 0s 68us/step - loss: 50.4428 - val_loss: 57.8201
Epoch 130/10000
1126/1126 [==============================] - 0s 72us/step - loss: 50.2199 - val_loss: 57.7343
Epoch 131/10000
1126/1126 [==============================] - 0s 70us/step - loss: 50.1854 - val_loss: 57.6601
Epoch 132/10000
1126/1126 [==============================] - 0s 70us/step - loss: 50.0234 - val_loss: 57.5176
Epoch 133/10000
1126/1126 [==============================] - 0s 67us/step - loss: 49.8972 - val_loss: 57.4497
Epoch 134/10000
1126/1126 [==============================] - 0s 70us/step - loss: 49.9070 - val_loss: 57.3253
Epoch 135/10000
1126/1126 [==============================] - 0s 72us/step - loss: 49.6812 - val_loss: 57.2386
Epoch 136/10000
1126/1126 [==============================] - 0s 72us/step - loss: 49.6540 - val_loss: 57.1805
Epoch 137/10000
1126/1126 [==============================] - 0s 67us/step - loss: 49.5390 - val_loss: 57.0491
Epoch 138/10000
1126/1126 [==============================] - 0s 68us/step - loss: 49.4006 - val_loss: 56.9884
Epoch 139/10000
1126/1126 [==============================] - 0s 69us/step - loss: 49.4035 - val_loss: 56.8786
Epoch 140/10000
1126/1126 [==============================] - 0s 70us/step - loss: 49.2094 - val_loss: 56.8164
Epoch 141/10000
1126/1126 [==============================] - 0s 71us/step - loss: 49.1552 - val_loss: 56.7403
Epoch 142/10000
1126/1126 [==============================] - 0s 72us/step - loss: 49.0334 - val_loss: 56.6208
```

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Epoch 143/10000
1126/1126 [==============================] - 0s 76us/step - loss: 48.9429 - val_loss: 56.5949
Epoch 144/10000
1126/1126 [==============================] - 0s 70us/step - loss: 48.9101 - val_loss: 56.4796
Epoch 145/10000
1126/1126 [==============================] - 0s 67us/step - loss: 48.7198 - val_loss: 56.4136
Epoch 146/10000
1126/1126 [==============================] - 0s 69us/step - loss: 48.6761 - val_loss: 56.3563
Epoch 147/10000
1126/1126 [==============================] - 0s 65us/step - loss: 48.6114 - val_loss: 56.2462
Epoch 148/10000
1126/1126 [==============================] - 0s 74us/step - loss: 48.4478 - val_loss: 56.1935
Epoch 149/10000
1126/1126 [==============================] - 0s 69us/step - loss: 48.4842 - val_loss: 56.1020
Epoch 150/10000
1126/1126 [==============================] - 0s 67us/step - loss: 48.3106 - val_loss: 56.0267
Epoch 151/10000
1126/1126 [==============================] - 0s 68us/step - loss: 48.2370 - val_loss: 55.9924
Epoch 152/10000
1126/1126 [==============================] - 0s 64us/step - loss: 48.1905 - val_loss: 55.8787
Epoch 153/10000
1126/1126 [==============================] - 0s 62us/step - loss: 48.0666 - val_loss: 55.8246
Epoch 154/10000
1126/1126 [==============================] - 0s 67us/step - loss: 48.0767 - val_loss: 55.7687
Epoch 155/10000
1126/1126 [==============================] - 0s 66us/step - loss: 47.9439 - val_loss: 55.6848
Epoch 156/10000
1126/1126 [==============================] - 0s 70us/step - loss: 47.8800 - val_loss: 55.6425
Epoch 157/10000
1126/1126 [==============================] - 0s 66us/step - loss: 47.8431 - val_loss: 55.5511
Epoch 158/10000
1126/1126 [==============================] - 0s 51us/step - loss: 47.7341 - val_loss: 55.5059
Epoch 159/10000
1126/1126 [==============================] - 0s 71us/step - loss: 47.6977 - val_loss: 55.4458
Epoch 160/10000
1126/1126 [==============================] - 0s 65us/step - loss: 47.6059 - val_loss: 55.3240
Epoch 161/10000
1126/1126 [==============================] - 0s 71us/step - loss: 47.5569 - val_loss: 55.2684
Epoch 162/10000
1126/1126 [==============================] - 0s 68us/step - loss: 47.5529 - val_loss: 55.2118
Epoch 163/10000
1126/1126 [==============================] - 0s 64us/step - loss: 47.4137 - val_loss: 55.1268
Epoch 164/10000
1126/1126 [==============================] - 0s 66us/step - loss: 47.4019 - val_loss: 55.0976
Epoch 165/10000
1126/1126 [==============================] - 0s 70us/step - loss: 47.3397 - val_loss: 55.0222
Epoch 166/10000
1126/1126 [==============================] - 0s 70us/step - loss: 47.2350 - val_loss: 54.9705
```

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Epoch 167/10000
1126/1126 [==============================] - 0s 69us/step - loss: 47.3021 - val_loss: 54.9092
Epoch 168/10000
1126/1126 [==============================] - 0s 67us/step - loss: 47.1238 - val_loss: 54.8534
Epoch 169/10000
1126/1126 [==============================] - 0s 66us/step - loss: 47.1100 - val_loss: 54.8374
Epoch 170/10000
1126/1126 [==============================] - 0s 66us/step - loss: 47.0475 - val_loss: 54.7567
Epoch 171/10000
1126/1126 [==============================] - 0s 67us/step - loss: 46.9431 - val_loss: 54.7421
Epoch 172/10000
1126/1126 [==============================] - 0s 71us/step - loss: 46.9698 - val_loss: 54.6825
Epoch 173/10000
1126/1126 [==============================] - 0s 83us/step - loss: 46.8332 - val_loss: 54.6334
Epoch 174/10000
1126/1126 [==============================] - 0s 85us/step - loss: 46.8718 - val_loss: 54.6094
Epoch 175/10000
1126/1126 [==============================] - 0s 83us/step - loss: 46.7772 - val_loss: 54.5496
Epoch 176/10000
1126/1126 [==============================] - 0s 83us/step - loss: 46.6788 - val_loss: 54.5022
Epoch 177/10000
1126/1126 [==============================] - 0s 86us/step - loss: 46.6795 - val_loss: 54.4184
Epoch 178/10000
1126/1126 [==============================] - 0s 87us/step - loss: 46.6018 - val_loss: 54.3176
Epoch 179/10000
1126/1126 [==============================] - 0s 86us/step - loss: 46.5224 - val_loss: 54.2544
Epoch 180/10000
1126/1126 [==============================] - 0s 71us/step - loss: 46.4729 - val_loss: 54.2456
Epoch 181/10000
1126/1126 [==============================] - 0s 79us/step - loss: 46.4068 - val_loss: 54.1878
Epoch 182/10000
1126/1126 [==============================] - 0s 70us/step - loss: 46.4033 - val_loss: 54.1349
Epoch 183/10000
1126/1126 [==============================] - 0s 85us/step - loss: 46.3135 - val_loss: 54.0695
Epoch 184/10000
1126/1126 [==============================] - 0s 85us/step - loss: 46.2496 - val_loss: 54.0372
Epoch 185/10000
1126/1126 [==============================] - 0s 85us/step - loss: 46.2165 - val_loss: 53.9698
Epoch 186/10000
1126/1126 [==============================] - 0s 83us/step - loss: 46.1350 - val_loss: 53.9086
Epoch 187/10000
1126/1126 [==============================] - 0s 87us/step - loss: 46.1216 - val_loss: 53.8799
Epoch 188/10000
1126/1126 [==============================] - 0s 79us/step - loss: 46.0375 - val_loss: 53.8372
Epoch 189/10000
1126/1126 [==============================] - 0s 69us/step - loss: 45.9732 - val_loss: 53.8178
Epoch 190/10000
1126/1126 [==============================] - 0s 69us/step - loss: 45.9871 - val_loss: 53.7773
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Epoch 191/10000
1126/1126 [==============================] - 0s 69us/step - loss: 45.8831 - val_loss: 53.7038
Epoch 192/10000
1126/1126 [==============================] - 0s 70us/step - loss: 45.9146 - val_loss: 53.6757
Epoch 193/10000
1126/1126 [==============================] - 0s 77us/step - loss: 45.7637 - val_loss: 53.6163
Epoch 194/10000
1126/1126 [==============================] - 0s 67us/step - loss: 45.7514 - val_loss: 53.5591
Epoch 195/10000
1126/1126 [==============================] - 0s 61us/step - loss: 45.6653 - val_loss: 53.4612
Epoch 196/10000
1126/1126 [==============================] - 0s 67us/step - loss: 45.6219 - val_loss: 53.4408
Epoch 197/10000
1126/1126 [==============================] - 0s 69us/step - loss: 45.5350 - val_loss: 53.4308
Epoch 198/10000
1126/1126 [==============================] - 0s 68us/step - loss: 45.4567 - val_loss: 53.4072
Epoch 199/10000
1126/1126 [==============================] - 0s 62us/step - loss: 45.4044 - val_loss: 53.3494
Epoch 200/10000
1126/1126 [==============================] - 0s 67us/step - loss: 45.3964 - val_loss: 53.3240
Epoch 201/10000
1126/1126 [==============================] - 0s 66us/step - loss: 45.3376 - val_loss: 53.2740
Epoch 202/10000
1126/1126 [==============================] - 0s 62us/step - loss: 45.2374 - val_loss: 53.2410
Epoch 203/10000
1126/1126 [==============================] - 0s 70us/step - loss: 45.2581 - val_loss: 53.2244
Epoch 204/10000
1126/1126 [==============================] - 0s 67us/step - loss: 45.1258 - val_loss: 53.1778
Epoch 205/10000
1126/1126 [==============================] - 0s 76us/step - loss: 45.1342 - val_loss: 53.1483
Epoch 206/10000
1126/1126 [==============================] - 0s 72us/step - loss: 45.0173 - val_loss: 53.0619
Epoch 207/10000
1126/1126 [==============================] - 0s 66us/step - loss: 44.9671 - val_loss: 53.0390
Epoch 208/10000
1126/1126 [==============================] - 0s 71us/step - loss: 44.9755 - val_loss: 52.9946
Epoch 209/10000
1126/1126 [==============================] - 0s 71us/step - loss: 44.8597 - val_loss: 52.9310
Epoch 210/10000
1126/1126 [==============================] - 0s 67us/step - loss: 44.8527 - val_loss: 52.9414
Epoch 211/10000
1126/1126 [==============================] - 0s 72us/step - loss: 44.8463 - val_loss: 52.8800
Epoch 212/10000
1126/1126 [==============================] - 0s 76us/step - loss: 44.7334 - val_loss: 52.8758
Epoch 213/10000
1126/1126 [==============================] - 0s 46us/step - loss: 44.6784 - val_loss: 52.8033
Epoch 214/10000
1126/1126 [==============================] - 0s 51us/step - loss: 44.6967 - val_loss: 52.8029
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Epoch 215/10000
1126/1126 [==============================] - 0s 44us/step - loss: 44.6186 - val_loss: 52.7587
Epoch 216/10000
1126/1126 [==============================] - 0s 45us/step - loss: 44.5550 - val_loss: 52.7253
Epoch 217/10000
1126/1126 [==============================] - 0s 47us/step - loss: 44.5666 - val_loss: 52.4767
Epoch 218/10000
1126/1126 [==============================] - 0s 46us/step - loss: 44.4476 - val_loss: 52.3899
Epoch 219/10000
1126/1126 [==============================] - 0s 45us/step - loss: 44.3807 - val_loss: 52.3212
Epoch 220/10000
1126/1126 [==============================] - 0s 45us/step - loss: 44.3356 - val_loss: 52.2569
Epoch 221/10000
1126/1126 [==============================] - 0s 45us/step - loss: 44.2958 - val_loss: 52.2514
Epoch 222/10000
1126/1126 [==============================] - 0s 45us/step - loss: 44.2879 - val_loss: 52.0676
Epoch 223/10000
1126/1126 [==============================] - 0s 45us/step - loss: 44.1666 - val_loss: 52.0148
Epoch 224/10000
1126/1126 [==============================] - 0s 44us/step - loss: 44.0889 - val_loss: 51.9581
Epoch 225/10000
1126/1126 [==============================] - 0s 44us/step - loss: 44.0574 - val_loss: 51.9287
Epoch 226/10000
1126/1126 [==============================] - 0s 43us/step - loss: 44.0761 - val_loss: 51.8850
Epoch 227/10000
1126/1126 [==============================] - 0s 55us/step - loss: 43.9700 - val_loss: 51.8642
Epoch 228/10000
1126/1126 [==============================] - 0s 73us/step - loss: 43.9042 - val_loss: 51.8179
Epoch 229/10000
1126/1126 [==============================] - 0s 79us/step - loss: 43.9078 - val_loss: 51.8218
Epoch 230/10000
1126/1126 [==============================] - 0s 79us/step - loss: 43.8627 - val_loss: 51.7337
Epoch 231/10000
1126/1126 [==============================] - 0s 54us/step - loss: 43.8090 - val_loss: 51.7564
Epoch 232/10000
1126/1126 [==============================] - 0s 101us/step - loss: 43.7219 - val_loss: 51.6678
Epoch 233/10000
1126/1126 [==============================] - 0s 88us/step - loss: 43.7841 - val_loss: 51.6717
Epoch 234/10000
1126/1126 [==============================] - 0s 77us/step - loss: 43.6891 - val_loss: 51.5732
Epoch 235/10000
1126/1126 [==============================] - 0s 74us/step - loss: 43.6041 - val_loss: 51.5880
Epoch 236/10000
1126/1126 [==============================] - 0s 49us/step - loss: 43.5627 - val_loss: 51.5118
Epoch 237/10000
1126/1126 [==============================] - 0s 67us/step - loss: 43.5837 - val_loss: 51.4955
Epoch 238/10000
1126/1126 [==============================] - 0s 97us/step - loss: 43.5112 - val_loss: 51.4405
```

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Epoch 239/10000
1126/1126 [==============================] - 0s 81us/step - loss: 43.4435 - val_loss: 51.4258
Epoch 240/10000
1126/1126 [==============================] - 0s 77us/step - loss: 43.3800 - val_loss: 51.3644
Epoch 241/10000
1126/1126 [==============================] - 0s 76us/step - loss: 43.3981 - val_loss: 51.3560
Epoch 242/10000
1126/1126 [==============================] - 0s 77us/step - loss: 43.3158 - val_loss: 51.2836
Epoch 243/10000
1126/1126 [==============================] - 0s 65us/step - loss: 43.2871 - val_loss: 51.2974
Epoch 244/10000
1126/1126 [==============================] - 0s 49us/step - loss: 43.2204 - val_loss: 51.2471
Epoch 245/10000
1126/1126 [==============================] - 0s 49us/step - loss: 43.2176 - val_loss: 51.2371
Epoch 246/10000
1126/1126 [==============================] - 0s 56us/step - loss: 43.1436 - val_loss: 51.1397
Epoch 247/10000
1126/1126 [==============================] - 0s 81us/step - loss: 43.1580 - val_loss: 51.1313
Epoch 248/10000
1126/1126 [==============================] - 0s 45us/step - loss: 43.0478 - val_loss: 51.1133
Epoch 249/10000
1126/1126 [==============================] - 0s 45us/step - loss: 43.1062 - val_loss: 51.0965
Epoch 250/10000
1126/1126 [==============================] - 0s 49us/step - loss: 43.0200 - val_loss: 51.0431
Epoch 251/10000
1126/1126 [==============================] - 0s 60us/step - loss: 42.9178 - val_loss: 51.0292
Epoch 252/10000
1126/1126 [==============================] - 0s 47us/step - loss: 42.8949 - val_loss: 51.0024
Epoch 253/10000
1126/1126 [==============================] - 0s 46us/step - loss: 42.9206 - val_loss: 50.9824
Epoch 254/10000
1126/1126 [==============================] - 0s 44us/step - loss: 42.8781 - val_loss: 50.9277
Epoch 255/10000
1126/1126 [==============================] - 0s 44us/step - loss: 42.7718 - val_loss: 50.8633
Epoch 256/10000
1126/1126 [==============================] - 0s 44us/step - loss: 42.7984 - val_loss: 50.8636
Epoch 257/10000
1126/1126 [==============================] - 0s 47us/step - loss: 42.7063 - val_loss: 50.7912
Epoch 258/10000
1126/1126 [==============================] - 0s 65us/step - loss: 42.7019 - val_loss: 50.8044
Epoch 259/10000
1126/1126 [==============================] - 0s 83us/step - loss: 42.6036 - val_loss: 50.7736
Epoch 260/10000
1126/1126 [==============================] - 0s 88us/step - loss: 42.5920 - val_loss: 50.8099
Epoch 261/10000
1126/1126 [==============================] - 0s 79us/step - loss: 42.6016 - val_loss: 50.7480
Epoch 262/10000
1126/1126 [==============================] - 0s 67us/step - loss: 42.5829 - val_loss: 50.7479
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Epoch 263/10000
1126/1126 [==============================] - 0s 65us/step - loss: 42.4410 - val_loss: 50.6922
Epoch 264/10000
1126/1126 [==============================] - 0s 51us/step - loss: 42.5676 - val_loss: 50.7090
Epoch 265/10000
1126/1126 [==============================] - 0s 44us/step - loss: 42.3955 - val_loss: 50.6785
Epoch 266/10000
1126/1126 [==============================] - 0s 50us/step - loss: 42.3558 - val_loss: 50.6696
Epoch 267/10000
1126/1126 [==============================] - 0s 63us/step - loss: 42.3202 - val_loss: 50.6760
Epoch 268/10000
1126/1126 [==============================] - 0s 68us/step - loss: 42.2777 - val_loss: 50.6189
Epoch 269/10000
1126/1126 [==============================] - 0s 68us/step - loss: 42.2888 - val_loss: 50.6495
Epoch 270/10000
1126/1126 [==============================] - 0s 52us/step - loss: 42.2790 - val_loss: 50.5685
Epoch 271/10000
1126/1126 [==============================] - 0s 45us/step - loss: 42.1354 - val_loss: 50.5432
Epoch 272/10000
1126/1126 [==============================] - 0s 44us/step - loss: 42.2042 - val_loss: 50.5588
Epoch 273/10000
1126/1126 [==============================] - 0s 43us/step - loss: 42.0960 - val_loss: 50.5139
Epoch 274/10000
1126/1126 [==============================] - 0s 56us/step - loss: 42.0756 - val_loss: 50.4985
Epoch 275/10000
1126/1126 [==============================] - 0s 79us/step - loss: 42.1220 - val_loss: 50.4723
Epoch 276/10000
1126/1126 [==============================] - 0s 69us/step - loss: 41.9341 - val_loss: 50.4067
Epoch 277/10000
1126/1126 [==============================] - 0s 87us/step - loss: 41.9792 - val_loss: 50.4137
Epoch 278/10000
1126/1126 [==============================] - 0s 85us/step - loss: 41.9483 - val_loss: 50.3724
Epoch 279/10000
1126/1126 [==============================] - 0s 54us/step - loss: 41.9434 - val_loss: 50.3425
Epoch 280/10000
1126/1126 [==============================] - 0s 48us/step - loss: 41.8157 - val_loss: 50.2630
Epoch 281/10000
1126/1126 [==============================] - 0s 46us/step - loss: 41.9074 - val_loss: 50.2967
Epoch 282/10000
1126/1126 [==============================] - 0s 75us/step - loss: 41.7450 - val_loss: 50.1502
Epoch 283/10000
1126/1126 [==============================] - 0s 77us/step - loss: 41.7056 - val_loss: 50.1046
Epoch 284/10000
1126/1126 [==============================] - 0s 77us/step - loss: 41.6048 - val_loss: 50.0750
Epoch 285/10000
1126/1126 [==============================] - 0s 79us/step - loss: 41.5776 - val_loss: 50.0529
Epoch 286/10000
1126/1126 [==============================] - 0s 62us/step - loss: 41.5646 - val_loss: 49.9644
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Epoch 287/10000
1126/1126 [==============================] - 0s 71us/step - loss: 41.5189 - val_loss: 49.9602
Epoch 288/10000
1126/1126 [==============================] - 0s 58us/step - loss: 41.4365 - val_loss: 49.8951
Epoch 289/10000
1126/1126 [==============================] - 0s 68us/step - loss: 41.4914 - val_loss: 49.9226
Epoch 290/10000
1126/1126 [==============================] - 0s 59us/step - loss: 41.4117 - val_loss: 49.8524
Epoch 291/10000
1126/1126 [==============================] - 0s 48us/step - loss: 41.3687 - val_loss: 49.8344
Epoch 292/10000
1126/1126 [==============================] - 0s 75us/step - loss: 41.3081 - val_loss: 49.8152
Epoch 293/10000
1126/1126 [==============================] - 0s 73us/step - loss: 41.3184 - val_loss: 49.8490
Epoch 294/10000
1126/1126 [==============================] - 0s 49us/step - loss: 41.2790 - val_loss: 49.7592
Epoch 295/10000
1126/1126 [==============================] - 0s 49us/step - loss: 41.2514 - val_loss: 49.7495
Epoch 296/10000
1126/1126 [==============================] - 0s 43us/step - loss: 41.1957 - val_loss: 49.7492
Epoch 297/10000
1126/1126 [==============================] - 0s 45us/step - loss: 41.1427 - val_loss: 49.7125
Epoch 298/10000
1126/1126 [==============================] - 0s 47us/step - loss: 41.1437 - val_loss: 49.7076
Epoch 299/10000
1126/1126 [==============================] - 0s 47us/step - loss: 41.1311 - val_loss: 49.6516
Epoch 300/10000
1126/1126 [==============================] - 0s 44us/step - loss: 41.1418 - val_loss: 49.6500
Epoch 301/10000
1126/1126 [==============================] - 0s 59us/step - loss: 41.0361 - val_loss: 49.5674
Epoch 302/10000
1126/1126 [==============================] - 0s 46us/step - loss: 41.0562 - val_loss: 49.6095
Epoch 303/10000
1126/1126 [==============================] - 0s 57us/step - loss: 41.0671 - val_loss: 49.5777
Epoch 304/10000
1126/1126 [==============================] - 0s 78us/step - loss: 40.9509 - val_loss: 49.5612
Epoch 305/10000
1126/1126 [==============================] - 0s 66us/step - loss: 40.9728 - val_loss: 49.5597
Epoch 306/10000
1126/1126 [==============================] - 0s 64us/step - loss: 40.8847 - val_loss: 49.5232
Epoch 307/10000
1126/1126 [==============================] - 0s 57us/step - loss: 40.8898 - val_loss: 49.5122
Epoch 308/10000
1126/1126 [==============================] - 0s 43us/step - loss: 40.7956 - val_loss: 49.4438
Epoch 309/10000
1126/1126 [==============================] - 0s 46us/step - loss: 40.9008 - val_loss: 49.4909
Epoch 310/10000
1126/1126 [==============================] - 0s 71us/step - loss: 40.7369 - val_loss: 49.4136
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Epoch 311/10000
1126/1126 [==============================] - 0s 64us/step - loss: 40.8136 - val_loss: 49.4504
Epoch 312/10000
1126/1126 [==============================] - 0s 60us/step - loss: 40.6829 - val_loss: 49.3903
Epoch 313/10000
1126/1126 [==============================] - 0s 50us/step - loss: 40.7722 - val_loss: 49.4223
Epoch 314/10000
1126/1126 [==============================] - 0s 84us/step - loss: 40.6323 - val_loss: 49.3276
Epoch 315/10000
1126/1126 [==============================] - 0s 77us/step - loss: 40.7554 - val_loss: 49.3858
Epoch 316/10000
1126/1126 [==============================] - 0s 82us/step - loss: 40.5722 - val_loss: 49.3157
Epoch 317/10000
1126/1126 [==============================] - 0s 88us/step - loss: 40.7607 - val_loss: 49.3604
Epoch 318/10000
1126/1126 [==============================] - 0s 90us/step - loss: 40.5484 - val_loss: 49.2576
Epoch 319/10000
1126/1126 [==============================] - 0s 81us/step - loss: 40.8405 - val_loss: 49.3808
Epoch 320/10000
1126/1126 [==============================] - 0s 78us/step - loss: 40.6734 - val_loss: 49.2044
Epoch 321/10000
1126/1126 [==============================] - 0s 77us/step - loss: 41.1290 - val_loss: 49.4663
Epoch 322/10000
1126/1126 [==============================] - 0s 85us/step - loss: 40.9733 - val_loss: 48.9846
Epoch 323/10000
1126/1126 [==============================] - 0s 79us/step - loss: 41.4449 - val_loss: 49.4325
Epoch 324/10000
1126/1126 [==============================] - 0s 83us/step - loss: 41.3679 - val_loss: 48.8953
Epoch 325/10000
1126/1126 [==============================] - 0s 82us/step - loss: 41.5239 - val_loss: 49.3844
Epoch 326/10000
1126/1126 [==============================] - 0s 88us/step - loss: 40.8114 - val_loss: 48.6825
Epoch 327/10000
1126/1126 [==============================] - 0s 88us/step - loss: 40.5460 - val_loss: 49.1279
Epoch 328/10000
1126/1126 [==============================] - 0s 87us/step - loss: 40.2294 - val_loss: 48.7043
Epoch 329/10000
1126/1126 [==============================] - 0s 86us/step - loss: 40.1595 - val_loss: 48.9598
Epoch 330/10000
1126/1126 [==============================] - 0s 93us/step - loss: 40.0018 - val_loss: 48.6935
Epoch 331/10000
1126/1126 [==============================] - 0s 88us/step - loss: 39.9601 - val_loss: 48.8646
Epoch 332/10000
1126/1126 [==============================] - 0s 87us/step - loss: 39.8840 - val_loss: 48.6900
Epoch 333/10000
1126/1126 [==============================] - 0s 90us/step - loss: 39.8555 - val_loss: 48.7599
Epoch 334/10000
1126/1126 [==============================] - 0s 72us/step - loss: 39.7936 - val_loss: 48.6421
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Epoch 335/10000
1126/1126 [==============================] - 0s 89us/step - loss: 39.7805 - val_loss: 48.6892
Epoch 336/10000
1126/1126 [==============================] - 0s 82us/step - loss: 39.7279 - val_loss: 48.6235
Epoch 337/10000
1126/1126 [==============================] - 0s 83us/step - loss: 39.7041 - val_loss: 48.5762
Epoch 338/10000
1126/1126 [==============================] - 0s 89us/step - loss: 39.6384 - val_loss: 48.5245
Epoch 339/10000
1126/1126 [==============================] - 0s 85us/step - loss: 39.6076 - val_loss: 48.5075
Epoch 340/10000
1126/1126 [==============================] - 0s 91us/step - loss: 39.5639 - val_loss: 48.4598
Epoch 341/10000
1126/1126 [==============================] - 0s 82us/step - loss: 39.5391 - val_loss: 48.4880
Epoch 342/10000
1126/1126 [==============================] - 0s 85us/step - loss: 39.5020 - val_loss: 48.4203
Epoch 343/10000
1126/1126 [==============================] - 0s 81us/step - loss: 39.4530 - val_loss: 48.4301
Epoch 344/10000
1126/1126 [==============================] - 0s 77us/step - loss: 39.4212 - val_loss: 48.3727
Epoch 345/10000
1126/1126 [==============================] - 0s 79us/step - loss: 39.4005 - val_loss: 48.3983
Epoch 346/10000
1126/1126 [==============================] - 0s 72us/step - loss: 39.3596 - val_loss: 48.3584
Epoch 347/10000
1126/1126 [==============================] - 0s 71us/step - loss: 39.3437 - val_loss: 48.3614
Epoch 348/10000
1126/1126 [==============================] - 0s 74us/step - loss: 39.3187 - val_loss: 48.3143
Epoch 349/10000
1126/1126 [==============================] - 0s 78us/step - loss: 39.2815 - val_loss: 48.3443
Epoch 350/10000
1126/1126 [==============================] - 0s 85us/step - loss: 39.2487 - val_loss: 48.2645
Epoch 351/10000
1126/1126 [==============================] - 0s 98us/step - loss: 39.2233 - val_loss: 48.2829
Epoch 352/10000
1126/1126 [==============================] - 0s 81us/step - loss: 39.1964 - val_loss: 48.2099
Epoch 353/10000
1126/1126 [==============================] - 0s 85us/step - loss: 39.1640 - val_loss: 48.2375
Epoch 354/10000
1126/1126 [==============================] - 0s 81us/step - loss: 39.1398 - val_loss: 48.1792
Epoch 355/10000
1126/1126 [==============================] - 0s 88us/step - loss: 39.1090 - val_loss: 48.2032
Epoch 356/10000
1126/1126 [==============================] - 0s 85us/step - loss: 39.0773 - val_loss: 48.1213
Epoch 357/10000
1126/1126 [==============================] - 0s 84us/step - loss: 39.0797 - val_loss: 48.1909
Epoch 358/10000
1126/1126 [==============================] - 0s 84us/step - loss: 39.0416 - val_loss: 48.0498
```

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Epoch 359/10000
1126/1126 [==============================] - 0s 88us/step - loss: 39.1004 - val_loss: 48.2053
Epoch 360/10000
1126/1126 [==============================] - 0s 91us/step - loss: 39.0705 - val_loss: 48.0213
Epoch 361/10000
1126/1126 [==============================] - 0s 84us/step - loss: 39.2541 - val_loss: 48.3217
Epoch 362/10000
1126/1126 [==============================] - 0s 85us/step - loss: 39.1643 - val_loss: 47.8855
Epoch 363/10000
1126/1126 [==============================] - 0s 69us/step - loss: 39.2387 - val_loss: 48.2766
Epoch 364/10000
1126/1126 [==============================] - 0s 73us/step - loss: 39.2345 - val_loss: 47.8583
Epoch 365/10000
1126/1126 [==============================] - 0s 66us/step - loss: 39.4700 - val_loss: 48.3339
Epoch 366/10000
1126/1126 [==============================] - 0s 65us/step - loss: 39.4202 - val_loss: 47.7065
Epoch 367/10000
1126/1126 [==============================] - 0s 72us/step - loss: 39.5247 - val_loss: 48.2345
Epoch 368/10000
1126/1126 [==============================] - 0s 66us/step - loss: 39.3188 - val_loss: 47.6054
Epoch 369/10000
1126/1126 [==============================] - 0s 68us/step - loss: 39.2417 - val_loss: 48.0903
Epoch 370/10000
1126/1126 [==============================] - 0s 76us/step - loss: 38.9755 - val_loss: 47.5476
Epoch 371/10000
1126/1126 [==============================] - 0s 73us/step - loss: 38.9102 - val_loss: 47.9168
Epoch 372/10000
1126/1126 [==============================] - 0s 66us/step - loss: 38.7676 - val_loss: 47.5618
Epoch 373/10000
1126/1126 [==============================] - 0s 68us/step - loss: 38.7282 - val_loss: 47.8060
Epoch 374/10000
1126/1126 [==============================] - 0s 68us/step - loss: 38.6349 - val_loss: 47.5741
Epoch 375/10000
1126/1126 [==============================] - 0s 69us/step - loss: 38.6369 - val_loss: 47.7754
Epoch 376/10000
1126/1126 [==============================] - 0s 70us/step - loss: 38.5724 - val_loss: 47.5754
Epoch 377/10000
1126/1126 [==============================] - 0s 70us/step - loss: 38.5472 - val_loss: 47.7347
Epoch 378/10000
1126/1126 [==============================] - 0s 70us/step - loss: 38.4919 - val_loss: 47.5574
Epoch 379/10000
1126/1126 [==============================] - 0s 68us/step - loss: 38.4778 - val_loss: 47.7339
Epoch 380/10000
1126/1126 [==============================] - 0s 70us/step - loss: 38.4437 - val_loss: 47.5851
Epoch 00380: early stopping
```

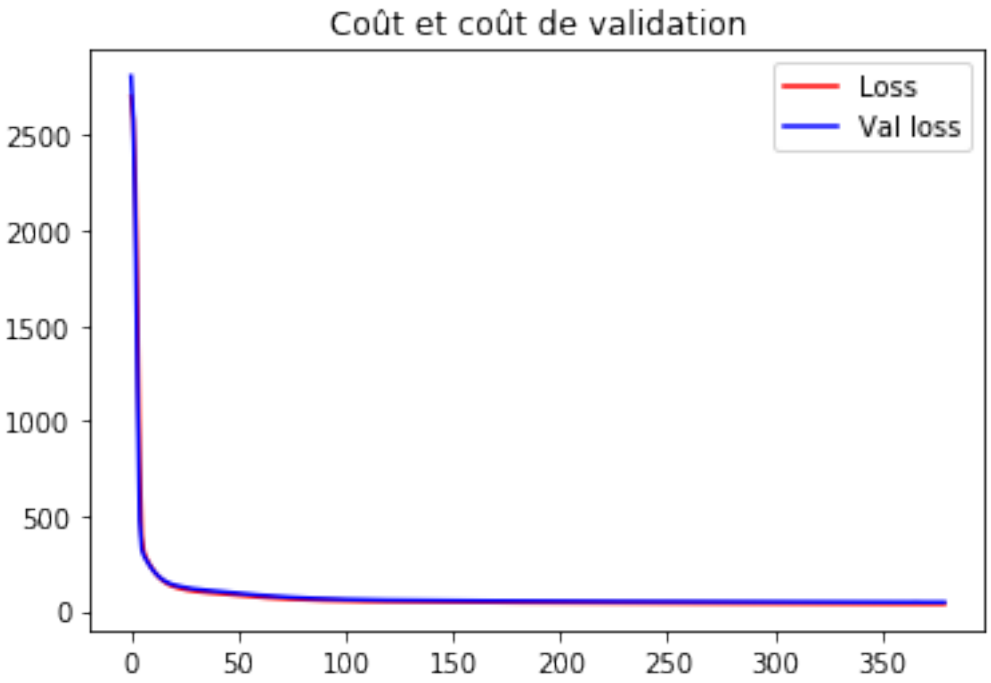
```
In [6]: y_pred = model.predict(X_test, batch_size=32)
```

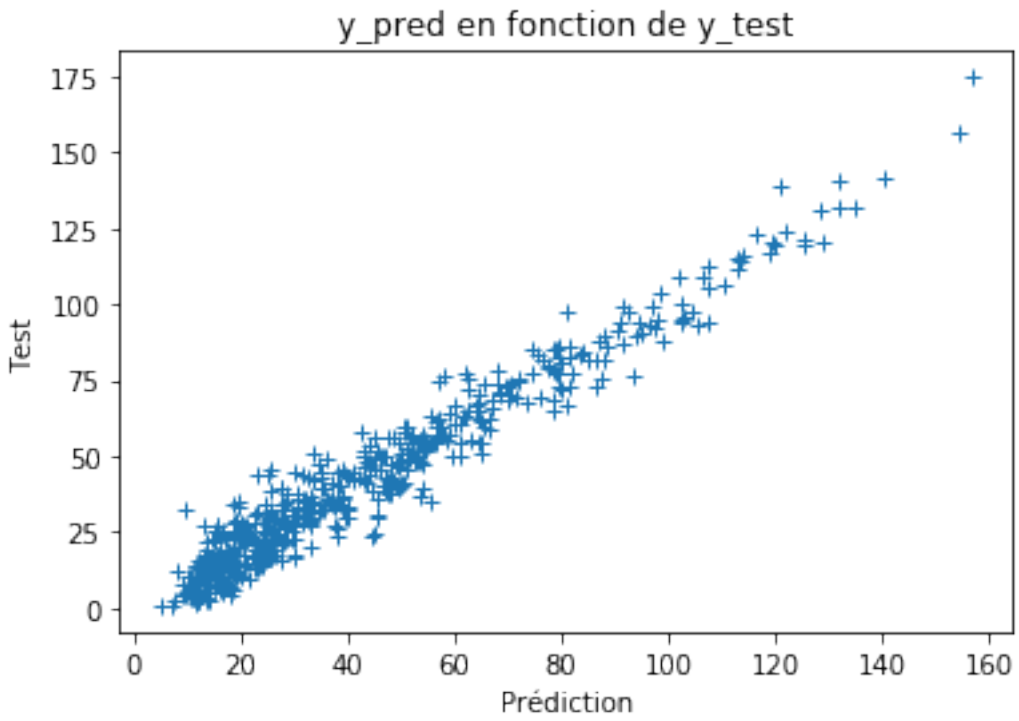
```
plt.title('Coût et coût de validation')
line1,=plt.plot(history.history['loss'], label="Loss", linestyle='-', color='r')
line2,=plt.plot(history.history['val_loss'], label="Val loss", linestyle='-', color='b
first_legend = plt.legend(handles=[line1, line2], loc=1)

plt.show()

plt.title('y_pred en fonction de y_test')

plt.plot(y_pred[:], y_test[:], '+')
plt.ylabel('Test')
plt.xlabel('Prédiction')
plt.show()
```






```
In [7]: model = lstm_model(32, X_train.shape[1:])

_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 32)                5248
_________________________________________________________________
dense_3 (Dense)              (None, 32)                1056
_________________________________________________________________
dense_4 (Dense)              (None, 1)                 33
=================================================================
Total params: 6,337
Trainable params: 6,337
Non-trainable params: 0
_________________________________________________________________
```

```
In [8]: early_stopping = EarlyStopping(monitor='val_loss', verbose=1, mode='auto', patience=10)
        history = model.fit(X_train, y_train, batch_size=32, epochs=10000, validation_data=(X_v

Train on 1126 samples, validate on 563 samples
Epoch 1/10000
1126/1126 [==============================] - 1s 1ms/step - loss: 2737.1121 - val_loss: 2885.129
Epoch 2/10000
```

```
1126/1126 [==============================] - ETA: 0s - loss: 2672.76 - 0s 100us/step - loss: 27
Epoch 3/10000
1126/1126 [==============================] - 0s 104us/step - loss: 2544.5930 - val_loss: 2475.8
Epoch 4/10000
1126/1126 [==============================] - 0s 98us/step - loss: 2032.2900 - val_loss: 1620.80
Epoch 5/10000
1126/1126 [==============================] - 0s 100us/step - loss: 1156.1648 - val_loss: 762.62
Epoch 6/10000
1126/1126 [==============================] - 0s 97us/step - loss: 663.2736 - val_loss: 608.9346
Epoch 7/10000
1126/1126 [==============================] - 0s 100us/step - loss: 565.2683 - val_loss: 535.551
Epoch 8/10000
1126/1126 [==============================] - 0s 99us/step - loss: 501.6293 - val_loss: 476.4746
Epoch 9/10000
1126/1126 [==============================] - 0s 100us/step - loss: 447.6902 - val_loss: 424.887
Epoch 10/10000
1126/1126 [==============================] - 0s 102us/step - loss: 399.5348 - val_loss: 378.823
Epoch 11/10000
1126/1126 [==============================] - 0s 99us/step - loss: 356.1361 - val_loss: 338.1293
Epoch 12/10000
1126/1126 [==============================] - 0s 100us/step - loss: 317.4107 - val_loss: 302.731
Epoch 13/10000
1126/1126 [==============================] - 0s 100us/step - loss: 283.4135 - val_loss: 272.209
Epoch 14/10000
1126/1126 [==============================] - 0s 100us/step - loss: 254.1899 - val_loss: 246.640
Epoch 15/10000
1126/1126 [==============================] - 0s 97us/step - loss: 229.6576 - val_loss: 225.4113
Epoch 16/10000
1126/1126 [==============================] - 0s 100us/step - loss: 209.2304 - val_loss: 207.819
Epoch 17/10000
1126/1126 [==============================] - 0s 99us/step - loss: 192.3033 - val_loss: 193.1491
Epoch 18/10000
1126/1126 [==============================] - 0s 100us/step - loss: 178.5403 - val_loss: 181.022
Epoch 19/10000
1126/1126 [==============================] - 0s 103us/step - loss: 167.3353 - val_loss: 170.934
Epoch 20/10000
1126/1126 [==============================] - 0s 99us/step - loss: 158.0278 - val_loss: 162.3140
Epoch 21/10000
1126/1126 [==============================] - 0s 97us/step - loss: 150.2244 - val_loss: 155.2950
Epoch 22/10000
1126/1126 [==============================] - 0s 98us/step - loss: 143.7682 - val_loss: 149.3295
Epoch 23/10000
1126/1126 [==============================] - 0s 98us/step - loss: 138.2584 - val_loss: 144.2230
Epoch 24/10000
1126/1126 [==============================] - 0s 100us/step - loss: 133.4424 - val_loss: 139.829
Epoch 25/10000
1126/1126 [==============================] - 0s 104us/step - loss: 129.2786 - val_loss: 136.218
Epoch 26/10000
```

```
1126/1126 [==============================] - 0s 101us/step - loss: 125.5731 - val_loss: 133.003
Epoch 27/10000
1126/1126 [==============================] - 0s 99us/step - loss: 122.2288 - val_loss: 130.152
Epoch 28/10000
1126/1126 [==============================] - 0s 103us/step - loss: 119.2185 - val_loss: 127.650
Epoch 29/10000
1126/1126 [==============================] - 0s 100us/step - loss: 116.4814 - val_loss: 125.330
Epoch 30/10000
1126/1126 [==============================] - 0s 101us/step - loss: 113.8718 - val_loss: 123.096
Epoch 31/10000
1126/1126 [==============================] - 0s 103us/step - loss: 111.4243 - val_loss: 121.050
Epoch 32/10000
1126/1126 [==============================] - 0s 100us/step - loss: 109.1593 - val_loss: 119.172
Epoch 33/10000
1126/1126 [==============================] - 0s 98us/step - loss: 107.0207 - val_loss: 117.373
Epoch 34/10000
1126/1126 [==============================] - 0s 101us/step - loss: 104.9513 - val_loss: 115.683
Epoch 35/10000
1126/1126 [==============================] - 0s 110us/step - loss: 102.9478 - val_loss: 114.081
Epoch 36/10000
1126/1126 [==============================] - 0s 102us/step - loss: 101.0051 - val_loss: 112.535
Epoch 37/10000
1126/1126 [==============================] - 0s 101us/step - loss: 99.1665 - val_loss: 111.082
Epoch 38/10000
1126/1126 [==============================] - 0s 101us/step - loss: 97.4281 - val_loss: 109.684
Epoch 39/10000
1126/1126 [==============================] - 0s 106us/step - loss: 95.7702 - val_loss: 108.387
Epoch 40/10000
1126/1126 [==============================] - 0s 107us/step - loss: 94.1770 - val_loss: 107.108
Epoch 41/10000
1126/1126 [==============================] - 0s 99us/step - loss: 92.6411 - val_loss: 105.8405
Epoch 42/10000
1126/1126 [==============================] - 0s 101us/step - loss: 91.1143 - val_loss: 104.646
Epoch 43/10000
1126/1126 [==============================] - 0s 99us/step - loss: 89.6453 - val_loss: 103.5027
Epoch 44/10000
1126/1126 [==============================] - 0s 99us/step - loss: 88.2232 - val_loss: 102.3523
Epoch 45/10000
1126/1126 [==============================] - 0s 100us/step - loss: 86.8165 - val_loss: 101.223
Epoch 46/10000
1126/1126 [==============================] - 0s 102us/step - loss: 85.4535 - val_loss: 100.116
Epoch 47/10000
1126/1126 [==============================] - 0s 106us/step - loss: 84.1403 - val_loss: 99.0214
Epoch 48/10000
1126/1126 [==============================] - 0s 99us/step - loss: 82.8863 - val_loss: 98.0100
Epoch 49/10000
1126/1126 [==============================] - 0s 99us/step - loss: 81.6346 - val_loss: 96.9588
Epoch 50/10000
```

```
1126/1126 [==============================] - 0s 100us/step - loss: 80.4464 - val_loss: 96.0193
Epoch 51/10000
1126/1126 [==============================] - 0s 100us/step - loss: 79.3051 - val_loss: 94.9824
Epoch 52/10000
1126/1126 [==============================] - 0s 102us/step - loss: 78.2113 - val_loss: 94.0788
Epoch 53/10000
1126/1126 [==============================] - 0s 104us/step - loss: 77.1409 - val_loss: 93.0481
Epoch 54/10000
1126/1126 [==============================] - 0s 102us/step - loss: 76.0875 - val_loss: 92.1107
Epoch 55/10000
1126/1126 [==============================] - 0s 99us/step - loss: 75.0573 - val_loss: 91.1100
Epoch 56/10000
1126/1126 [==============================] - 0s 100us/step - loss: 74.0637 - val_loss: 90.1483
Epoch 57/10000
1126/1126 [==============================] - 0s 101us/step - loss: 73.0908 - val_loss: 89.1894
Epoch 58/10000
1126/1126 [==============================] - 0s 107us/step - loss: 72.1260 - val_loss: 88.3501
Epoch 59/10000
1126/1126 [==============================] - 0s 109us/step - loss: 71.2349 - val_loss: 87.4022
Epoch 60/10000
1126/1126 [==============================] - 0s 103us/step - loss: 70.3541 - val_loss: 86.5081
Epoch 61/10000
1126/1126 [==============================] - 0s 101us/step - loss: 69.4940 - val_loss: 85.6500
Epoch 62/10000
1126/1126 [==============================] - 0s 98us/step - loss: 68.6589 - val_loss: 84.7566
Epoch 63/10000
1126/1126 [==============================] - 0s 102us/step - loss: 67.8375 - val_loss: 83.9497
Epoch 64/10000
1126/1126 [==============================] - 0s 99us/step - loss: 67.0625 - val_loss: 83.0458
Epoch 65/10000
1126/1126 [==============================] - 0s 97us/step - loss: 66.2690 - val_loss: 82.1831
Epoch 66/10000
1126/1126 [==============================] - 0s 98us/step - loss: 65.5286 - val_loss: 81.3787
Epoch 67/10000
1126/1126 [==============================] - 0s 100us/step - loss: 64.8120 - val_loss: 80.5937
Epoch 68/10000
1126/1126 [==============================] - 0s 101us/step - loss: 64.1481 - val_loss: 79.7762
Epoch 69/10000
1126/1126 [==============================] - 0s 100us/step - loss: 63.4688 - val_loss: 79.0146
Epoch 70/10000
1126/1126 [==============================] - 0s 98us/step - loss: 62.8524 - val_loss: 78.2629
Epoch 71/10000
1126/1126 [==============================] - 0s 103us/step - loss: 62.2325 - val_loss: 77.4898
Epoch 72/10000
1126/1126 [==============================] - 0s 102us/step - loss: 61.6648 - val_loss: 76.7828
Epoch 73/10000
1126/1126 [==============================] - 0s 100us/step - loss: 61.0970 - val_loss: 76.0519
Epoch 74/10000
```

```
1126/1126 [==============================] - 0s 103us/step - loss: 60.6048 - val_loss: 75.4307
Epoch 75/10000
1126/1126 [==============================] - 0s 99us/step - loss: 60.0743 - val_loss: 74.6655
Epoch 76/10000
1126/1126 [==============================] - 0s 99us/step - loss: 59.5750 - val_loss: 74.1408
Epoch 77/10000
1126/1126 [==============================] - 0s 103us/step - loss: 59.0597 - val_loss: 73.4536
Epoch 78/10000
1126/1126 [==============================] - 0s 117us/step - loss: 58.6121 - val_loss: 72.9414
Epoch 79/10000
1126/1126 [==============================] - 0s 98us/step - loss: 58.1591 - val_loss: 72.3166
Epoch 80/10000
1126/1126 [==============================] - 0s 99us/step - loss: 57.7411 - val_loss: 71.7564
Epoch 81/10000
1126/1126 [==============================] - 0s 98us/step - loss: 57.3065 - val_loss: 71.2280
Epoch 82/10000
1126/1126 [==============================] - 0s 97us/step - loss: 56.8949 - val_loss: 70.6791
Epoch 83/10000
1126/1126 [==============================] - 0s 97us/step - loss: 56.4815 - val_loss: 70.1465
Epoch 84/10000
1126/1126 [==============================] - 0s 96us/step - loss: 56.0772 - val_loss: 69.6134
Epoch 85/10000
1126/1126 [==============================] - 0s 99us/step - loss: 55.6701 - val_loss: 69.1418
Epoch 86/10000
1126/1126 [==============================] - 0s 98us/step - loss: 55.2894 - val_loss: 68.6285
Epoch 87/10000
1126/1126 [==============================] - 0s 97us/step - loss: 54.9071 - val_loss: 68.1110
Epoch 88/10000
1126/1126 [==============================] - 0s 88us/step - loss: 54.5263 - val_loss: 67.5940
Epoch 89/10000
1126/1126 [==============================] - 0s 76us/step - loss: 54.1442 - val_loss: 67.0872
Epoch 90/10000
1126/1126 [==============================] - 0s 104us/step - loss: 53.7817 - val_loss: 66.5989
Epoch 91/10000
1126/1126 [==============================] - 0s 107us/step - loss: 53.4129 - val_loss: 66.1056
Epoch 92/10000
1126/1126 [==============================] - 0s 110us/step - loss: 53.0757 - val_loss: 65.6736
Epoch 93/10000
1126/1126 [==============================] - 0s 131us/step - loss: 52.7566 - val_loss: 65.1352
Epoch 94/10000
1126/1126 [==============================] - 0s 120us/step - loss: 52.5317 - val_loss: 64.8100
Epoch 95/10000
1126/1126 [==============================] - 0s 122us/step - loss: 52.2167 - val_loss: 64.1739
Epoch 96/10000
1126/1126 [==============================] - 0s 111us/step - loss: 51.7810 - val_loss: 63.8501
Epoch 97/10000
1126/1126 [==============================] - 0s 123us/step - loss: 51.3578 - val_loss: 63.3994
Epoch 98/10000
```

```
1126/1126 [==============================] - 0s 120us/step - loss: 51.0241 - val_loss: 62.9684
Epoch 99/10000
1126/1126 [==============================] - 0s 121us/step - loss: 50.6929 - val_loss: 62.5632
Epoch 100/10000
1126/1126 [==============================] - 0s 124us/step - loss: 50.3658 - val_loss: 62.2003
Epoch 101/10000
1126/1126 [==============================] - 0s 115us/step - loss: 50.0678 - val_loss: 61.8388
Epoch 102/10000
1126/1126 [==============================] - 0s 109us/step - loss: 49.7561 - val_loss: 61.4834
Epoch 103/10000
1126/1126 [==============================] - 0s 109us/step - loss: 49.4829 - val_loss: 61.1076
Epoch 104/10000
1126/1126 [==============================] - 0s 122us/step - loss: 49.1617 - val_loss: 60.7728
Epoch 105/10000
1126/1126 [==============================] - 0s 114us/step - loss: 48.8923 - val_loss: 60.3948
Epoch 106/10000
1126/1126 [==============================] - 0s 112us/step - loss: 48.5861 - val_loss: 60.1300
Epoch 107/10000
1126/1126 [==============================] - 0s 128us/step - loss: 48.3248 - val_loss: 59.7664
Epoch 108/10000
1126/1126 [==============================] - 0s 133us/step - loss: 48.0277 - val_loss: 59.4660
Epoch 109/10000
1126/1126 [==============================] - 0s 121us/step - loss: 47.7590 - val_loss: 59.0882
Epoch 110/10000
1126/1126 [==============================] - 0s 127us/step - loss: 47.4563 - val_loss: 58.8316
Epoch 111/10000
1126/1126 [==============================] - 0s 125us/step - loss: 47.1777 - val_loss: 58.5121
Epoch 112/10000
1126/1126 [==============================] - 0s 125us/step - loss: 46.9131 - val_loss: 58.2022
Epoch 113/10000
1126/1126 [==============================] - 0s 137us/step - loss: 46.6468 - val_loss: 57.9290
Epoch 114/10000
1126/1126 [==============================] - 0s 147us/step - loss: 46.3882 - val_loss: 57.6620
Epoch 115/10000
1126/1126 [==============================] - 0s 129us/step - loss: 46.1394 - val_loss: 57.3681
Epoch 116/10000
1126/1126 [==============================] - 0s 123us/step - loss: 45.9057 - val_loss: 57.1247
Epoch 117/10000
1126/1126 [==============================] - 0s 127us/step - loss: 45.6745 - val_loss: 56.8694
Epoch 118/10000
1126/1126 [==============================] - 0s 126us/step - loss: 45.4490 - val_loss: 56.6254
Epoch 119/10000
1126/1126 [==============================] - 0s 126us/step - loss: 45.2185 - val_loss: 56.4125
Epoch 120/10000
1126/1126 [==============================] - 0s 127us/step - loss: 45.0091 - val_loss: 56.1026
Epoch 121/10000
1126/1126 [==============================] - 0s 132us/step - loss: 44.7695 - val_loss: 55.9692
Epoch 122/10000
```

```
1126/1126 [==============================] - 0s 128us/step - loss: 44.5815 - val_loss: 55.6813
Epoch 123/10000
1126/1126 [==============================] - 0s 126us/step - loss: 44.3415 - val_loss: 55.5383
Epoch 124/10000
1126/1126 [==============================] - 0s 123us/step - loss: 44.1764 - val_loss: 55.2374
Epoch 125/10000
1126/1126 [==============================] - 0s 70us/step - loss: 43.9221 - val_loss: 55.1300
Epoch 126/10000
1126/1126 [==============================] - 0s 78us/step - loss: 43.7749 - val_loss: 54.8307
Epoch 127/10000
1126/1126 [==============================] - 0s 68us/step - loss: 43.5273 - val_loss: 54.7400
Epoch 128/10000
1126/1126 [==============================] - 0s 70us/step - loss: 43.3920 - val_loss: 54.4012
Epoch 129/10000
1126/1126 [==============================] - 0s 69us/step - loss: 43.1727 - val_loss: 54.3936
Epoch 130/10000
1126/1126 [==============================] - 0s 67us/step - loss: 43.0128 - val_loss: 54.0653
Epoch 131/10000
1126/1126 [==============================] - 0s 66us/step - loss: 42.7927 - val_loss: 53.8973
Epoch 132/10000
1126/1126 [==============================] - 0s 69us/step - loss: 42.6131 - val_loss: 53.7073
Epoch 133/10000
1126/1126 [==============================] - 0s 66us/step - loss: 42.4249 - val_loss: 53.5613
Epoch 134/10000
1126/1126 [==============================] - 0s 96us/step - loss: 42.2542 - val_loss: 53.3696
Epoch 135/10000
1126/1126 [==============================] - 0s 92us/step - loss: 42.0836 - val_loss: 53.2290
Epoch 136/10000
1126/1126 [==============================] - 0s 69us/step - loss: 41.9100 - val_loss: 53.0373
Epoch 137/10000
1126/1126 [==============================] - 0s 70us/step - loss: 41.7464 - val_loss: 52.9094
Epoch 138/10000
1126/1126 [==============================] - 0s 69us/step - loss: 41.5795 - val_loss: 52.7149
Epoch 139/10000
1126/1126 [==============================] - 0s 67us/step - loss: 41.4183 - val_loss: 52.5539
Epoch 140/10000
1126/1126 [==============================] - 0s 96us/step - loss: 41.2589 - val_loss: 52.3930
Epoch 141/10000
1126/1126 [==============================] - 0s 133us/step - loss: 41.1075 - val_loss: 52.2155
Epoch 142/10000
1126/1126 [==============================] - 0s 138us/step - loss: 40.9311 - val_loss: 52.0086
Epoch 143/10000
1126/1126 [==============================] - 0s 127us/step - loss: 40.7841 - val_loss: 51.9127
Epoch 144/10000
1126/1126 [==============================] - 0s 118us/step - loss: 40.6190 - val_loss: 51.7188
Epoch 145/10000
1126/1126 [==============================] - 0s 100us/step - loss: 40.4929 - val_loss: 51.5604
Epoch 146/10000
```

```
1126/1126 [==============================] - 0s 82us/step - loss: 40.3275 - val_loss: 51.4100
Epoch 147/10000
1126/1126 [==============================] - 0s 98us/step - loss: 40.1806 - val_loss: 51.3009
Epoch 148/10000
1126/1126 [==============================] - 0s 74us/step - loss: 40.0488 - val_loss: 51.1262
Epoch 149/10000
1126/1126 [==============================] - 0s 98us/step - loss: 39.9328 - val_loss: 50.9911
Epoch 150/10000
1126/1126 [==============================] - 0s 120us/step - loss: 39.7785 - val_loss: 50.8530
Epoch 151/10000
1126/1126 [==============================] - 0s 104us/step - loss: 39.6531 - val_loss: 50.7821
Epoch 152/10000
1126/1126 [==============================] - 0s 93us/step - loss: 39.5180 - val_loss: 50.5748
Epoch 153/10000
1126/1126 [==============================] - 0s 71us/step - loss: 39.3994 - val_loss: 50.4886
Epoch 154/10000
1126/1126 [==============================] - 0s 71us/step - loss: 39.2666 - val_loss: 50.2617
Epoch 155/10000
1126/1126 [==============================] - 0s 74us/step - loss: 39.1182 - val_loss: 50.2302
Epoch 156/10000
1126/1126 [==============================] - 0s 83us/step - loss: 39.0022 - val_loss: 50.0627
Epoch 157/10000
1126/1126 [==============================] - 0s 83us/step - loss: 38.8937 - val_loss: 49.9705
Epoch 158/10000
1126/1126 [==============================] - 0s 83us/step - loss: 38.7611 - val_loss: 49.8382
Epoch 159/10000
1126/1126 [==============================] - 0s 90us/step - loss: 38.6603 - val_loss: 49.7155
Epoch 160/10000
1126/1126 [==============================] - 0s 75us/step - loss: 38.5190 - val_loss: 49.6072
Epoch 161/10000
1126/1126 [==============================] - 0s 69us/step - loss: 38.4183 - val_loss: 49.5418
Epoch 162/10000
1126/1126 [==============================] - 0s 80us/step - loss: 38.3206 - val_loss: 49.3345
Epoch 163/10000
1126/1126 [==============================] - 0s 85us/step - loss: 38.1965 - val_loss: 49.3760
Epoch 164/10000
1126/1126 [==============================] - 0s 79us/step - loss: 38.1004 - val_loss: 49.0784
Epoch 165/10000
1126/1126 [==============================] - 0s 78us/step - loss: 38.0442 - val_loss: 49.2907
Epoch 166/10000
1126/1126 [==============================] - 0s 69us/step - loss: 38.0223 - val_loss: 48.7386
Epoch 167/10000
1126/1126 [==============================] - 0s 72us/step - loss: 37.8405 - val_loss: 49.0609
Epoch 168/10000
1126/1126 [==============================] - 0s 77us/step - loss: 37.7013 - val_loss: 48.6532
Epoch 169/10000
1126/1126 [==============================] - 0s 90us/step - loss: 37.5676 - val_loss: 48.7665
Epoch 170/10000
```

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1126/1126 [==============================] - 0s 68us/step - loss: 37.4709 - val_loss: 48.5451
Epoch 171/10000
1126/1126 [==============================] - 0s 102us/step - loss: 37.3678 - val_loss: 48.5946
Epoch 172/10000
1126/1126 [==============================] - 0s 102us/step - loss: 37.2948 - val_loss: 48.3510
Epoch 173/10000
1126/1126 [==============================] - 0s 85us/step - loss: 37.1939 - val_loss: 48.4650
Epoch 174/10000
1126/1126 [==============================] - 0s 78us/step - loss: 37.1141 - val_loss: 48.2008
Epoch 175/10000
1126/1126 [==============================] - 0s 91us/step - loss: 37.0461 - val_loss: 48.2728
Epoch 176/10000
1126/1126 [==============================] - 0s 70us/step - loss: 36.9248 - val_loss: 48.1352
Epoch 177/10000
1126/1126 [==============================] - 0s 104us/step - loss: 36.8648 - val_loss: 48.0937
Epoch 178/10000
1126/1126 [==============================] - 0s 115us/step - loss: 36.7631 - val_loss: 48.0005
Epoch 179/10000
1126/1126 [==============================] - 0s 87us/step - loss: 36.6804 - val_loss: 47.9837
Epoch 180/10000
1126/1126 [==============================] - 0s 86us/step - loss: 36.6141 - val_loss: 47.8619
Epoch 181/10000
1126/1126 [==============================] - 0s 76us/step - loss: 36.5469 - val_loss: 47.7577
Epoch 182/10000
1126/1126 [==============================] - 0s 68us/step - loss: 36.4442 - val_loss: 47.7560
Epoch 183/10000
1126/1126 [==============================] - 0s 70us/step - loss: 36.3829 - val_loss: 47.6959
Epoch 184/10000
1126/1126 [==============================] - 0s 69us/step - loss: 36.3177 - val_loss: 47.6021
Epoch 185/10000
1126/1126 [==============================] - 0s 78us/step - loss: 36.2371 - val_loss: 47.5918
Epoch 186/10000
1126/1126 [==============================] - 0s 88us/step - loss: 36.1660 - val_loss: 47.5176
Epoch 187/10000
1126/1126 [==============================] - 0s 108us/step - loss: 36.0927 - val_loss: 47.3830
Epoch 188/10000
1126/1126 [==============================] - 0s 81us/step - loss: 36.0619 - val_loss: 47.5318
Epoch 189/10000
1126/1126 [==============================] - 0s 67us/step - loss: 35.9902 - val_loss: 47.1943
Epoch 190/10000
1126/1126 [==============================] - 0s 82us/step - loss: 36.0097 - val_loss: 47.6316
Epoch 191/10000
1126/1126 [==============================] - 0s 94us/step - loss: 36.0338 - val_loss: 46.9586
Epoch 192/10000
1126/1126 [==============================] - 0s 71us/step - loss: 36.0004 - val_loss: 47.5582
Epoch 193/10000
1126/1126 [==============================] - 0s 70us/step - loss: 35.7785 - val_loss: 46.9259
Epoch 194/10000
```

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1126/1126 [==============================] - 0s 69us/step - loss: 35.7132 - val_loss: 47.3018
Epoch 195/10000
1126/1126 [==============================] - 0s 89us/step - loss: 35.6093 - val_loss: 46.9238
Epoch 196/10000
1126/1126 [==============================] - 0s 90us/step - loss: 35.5665 - val_loss: 47.1776
Epoch 197/10000
1126/1126 [==============================] - 0s 66us/step - loss: 35.4616 - val_loss: 46.8726
Epoch 198/10000
1126/1126 [==============================] - 0s 102us/step - loss: 35.4066 - val_loss: 47.0211
Epoch 199/10000
1126/1126 [==============================] - 0s 90us/step - loss: 35.3335 - val_loss: 46.8027
Epoch 200/10000
1126/1126 [==============================] - 0s 72us/step - loss: 35.2786 - val_loss: 46.9190
Epoch 201/10000
1126/1126 [==============================] - 0s 69us/step - loss: 35.2100 - val_loss: 46.7768
Epoch 202/10000
1126/1126 [==============================] - 0s 68us/step - loss: 35.1657 - val_loss: 46.8529
Epoch 203/10000
1126/1126 [==============================] - 0s 74us/step - loss: 35.1226 - val_loss: 46.6478
Epoch 204/10000
1126/1126 [==============================] - 0s 77us/step - loss: 35.0615 - val_loss: 46.7471
Epoch 205/10000
1126/1126 [==============================] - 0s 74us/step - loss: 35.0040 - val_loss: 46.6327
Epoch 206/10000
1126/1126 [==============================] - 0s 70us/step - loss: 34.9582 - val_loss: 46.7074
Epoch 207/10000
1126/1126 [==============================] - 0s 95us/step - loss: 34.9230 - val_loss: 46.4330
Epoch 208/10000
1126/1126 [==============================] - 0s 95us/step - loss: 34.8892 - val_loss: 46.7201
Epoch 209/10000
1126/1126 [==============================] - 0s 82us/step - loss: 34.8414 - val_loss: 46.3219
Epoch 210/10000
1126/1126 [==============================] - 0s 99us/step - loss: 34.8822 - val_loss: 46.7616
Epoch 211/10000
1126/1126 [==============================] - 0s 105us/step - loss: 34.7974 - val_loss: 46.2022
Epoch 212/10000
1126/1126 [==============================] - 0s 82us/step - loss: 34.7767 - val_loss: 46.6380
Epoch 213/10000
1126/1126 [==============================] - 0s 104us/step - loss: 34.6453 - val_loss: 46.1968
Epoch 214/10000
1126/1126 [==============================] - 0s 109us/step - loss: 34.6187 - val_loss: 46.4854
Epoch 215/10000
1126/1126 [==============================] - 0s 112us/step - loss: 34.5222 - val_loss: 46.1808
Epoch 216/10000
1126/1126 [==============================] - 0s 107us/step - loss: 34.4878 - val_loss: 46.3537
Epoch 217/10000
1126/1126 [==============================] - 0s 106us/step - loss: 34.4218 - val_loss: 46.1104
Epoch 218/10000
```

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1126/1126 [==============================] - 0s 106us/step - loss: 34.3815 - val_loss: 46.2417
Epoch 219/10000
1126/1126 [==============================] - 0s 107us/step - loss: 34.3216 - val_loss: 46.0834
Epoch 220/10000
1126/1126 [==============================] - 0s 103us/step - loss: 34.2858 - val_loss: 46.1702
Epoch 221/10000
1126/1126 [==============================] - 0s 105us/step - loss: 34.2341 - val_loss: 46.0798
Epoch 222/10000
1126/1126 [==============================] - 0s 106us/step - loss: 34.2134 - val_loss: 46.0565
Epoch 223/10000
1126/1126 [==============================] - 0s 102us/step - loss: 34.1437 - val_loss: 45.9650
Epoch 224/10000
1126/1126 [==============================] - 0s 105us/step - loss: 34.1043 - val_loss: 46.0335
Epoch 225/10000
1126/1126 [==============================] - 0s 102us/step - loss: 34.0550 - val_loss: 45.9431
Epoch 226/10000
1126/1126 [==============================] - 0s 99us/step - loss: 34.0182 - val_loss: 45.9781
Epoch 227/10000
1126/1126 [==============================] - 0s 102us/step - loss: 33.9810 - val_loss: 45.8527
Epoch 228/10000
1126/1126 [==============================] - 0s 101us/step - loss: 33.9309 - val_loss: 45.8511
Epoch 229/10000
1126/1126 [==============================] - 0s 97us/step - loss: 33.8830 - val_loss: 45.7819
Epoch 230/10000
1126/1126 [==============================] - 0s 101us/step - loss: 33.8434 - val_loss: 45.8031
Epoch 231/10000
1126/1126 [==============================] - 0s 98us/step - loss: 33.8035 - val_loss: 45.7390
Epoch 232/10000
1126/1126 [==============================] - 0s 99us/step - loss: 33.7638 - val_loss: 45.7368
Epoch 233/10000
1126/1126 [==============================] - 0s 101us/step - loss: 33.7144 - val_loss: 45.6817
Epoch 234/10000
1126/1126 [==============================] - 0s 103us/step - loss: 33.6753 - val_loss: 45.6817
Epoch 235/10000
1126/1126 [==============================] - 0s 104us/step - loss: 33.6283 - val_loss: 45.6386
Epoch 236/10000
1126/1126 [==============================] - 0s 102us/step - loss: 33.5875 - val_loss: 45.6292
Epoch 237/10000
1126/1126 [==============================] - 0s 99us/step - loss: 33.5430 - val_loss: 45.5588
Epoch 238/10000
1126/1126 [==============================] - 0s 99us/step - loss: 33.5068 - val_loss: 45.5689
Epoch 239/10000
1126/1126 [==============================] - 0s 99us/step - loss: 33.4664 - val_loss: 45.5452
Epoch 240/10000
1126/1126 [==============================] - 0s 101us/step - loss: 33.4193 - val_loss: 45.4866
Epoch 241/10000
1126/1126 [==============================] - 0s 100us/step - loss: 33.3833 - val_loss: 45.4920
Epoch 242/10000
```

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1126/1126 [==============================] - 0s 122us/step - loss: 33.3382 - val_loss: 45.4741
Epoch 243/10000
1126/1126 [==============================] - 0s 129us/step - loss: 33.3132 - val_loss: 45.4664
Epoch 244/10000
1126/1126 [==============================] - 0s 123us/step - loss: 33.2671 - val_loss: 45.4144
Epoch 245/10000
1126/1126 [==============================] - 0s 120us/step - loss: 33.2281 - val_loss: 45.4184
Epoch 246/10000
1126/1126 [==============================] - 0s 122us/step - loss: 33.1820 - val_loss: 45.3673
Epoch 247/10000
1126/1126 [==============================] - 0s 124us/step - loss: 33.1523 - val_loss: 45.3856
Epoch 248/10000
1126/1126 [==============================] - 0s 131us/step - loss: 33.1036 - val_loss: 45.2987
Epoch 249/10000
1126/1126 [==============================] - 0s 126us/step - loss: 33.0719 - val_loss: 45.3587
Epoch 250/10000
1126/1126 [==============================] - 0s 116us/step - loss: 33.0380 - val_loss: 45.2760
Epoch 251/10000
1126/1126 [==============================] - 0s 108us/step - loss: 33.0062 - val_loss: 45.3592
Epoch 252/10000
1126/1126 [==============================] - 0s 119us/step - loss: 32.9604 - val_loss: 45.2002
Epoch 253/10000
1126/1126 [==============================] - 0s 101us/step - loss: 32.9569 - val_loss: 45.3494
Epoch 254/10000
1126/1126 [==============================] - 0s 100us/step - loss: 32.8925 - val_loss: 45.1477
Epoch 255/10000
1126/1126 [==============================] - 0s 102us/step - loss: 32.9108 - val_loss: 45.3362
Epoch 256/10000
1126/1126 [==============================] - 0s 121us/step - loss: 32.8270 - val_loss: 45.0872
Epoch 257/10000
1126/1126 [==============================] - 0s 113us/step - loss: 32.8394 - val_loss: 45.2938
Epoch 258/10000
1126/1126 [==============================] - 0s 120us/step - loss: 32.7453 - val_loss: 45.0002
Epoch 259/10000
1126/1126 [==============================] - 0s 120us/step - loss: 32.7618 - val_loss: 45.1849
Epoch 260/10000
1126/1126 [==============================] - 0s 102us/step - loss: 32.6863 - val_loss: 44.9512
Epoch 261/10000
1126/1126 [==============================] - 0s 70us/step - loss: 32.6723 - val_loss: 45.0729
Epoch 262/10000
1126/1126 [==============================] - 0s 75us/step - loss: 32.6095 - val_loss: 44.9669
Epoch 263/10000
1126/1126 [==============================] - 0s 70us/step - loss: 32.5953 - val_loss: 44.9810
Epoch 264/10000
1126/1126 [==============================] - 0s 68us/step - loss: 32.5425 - val_loss: 44.9058
Epoch 265/10000
1126/1126 [==============================] - 0s 68us/step - loss: 32.5175 - val_loss: 44.9185
Epoch 266/10000
```

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1126/1126 [==============================] - 0s 69us/step - loss: 32.4777 - val_loss: 44.8353
Epoch 267/10000
1126/1126 [==============================] - 0s 67us/step - loss: 32.4483 - val_loss: 44.8542
Epoch 268/10000
1126/1126 [==============================] - 0s 69us/step - loss: 32.4229 - val_loss: 44.8335
Epoch 269/10000
1126/1126 [==============================] - 0s 115us/step - loss: 32.3686 - val_loss: 44.7494
Epoch 270/10000
1126/1126 [==============================] - 0s 141us/step - loss: 32.3562 - val_loss: 44.8366
Epoch 271/10000
1126/1126 [==============================] - 0s 141us/step - loss: 32.3175 - val_loss: 44.7528
Epoch 272/10000
1126/1126 [==============================] - 0s 138us/step - loss: 32.2844 - val_loss: 44.6976
Epoch 273/10000
1126/1126 [==============================] - 0s 135us/step - loss: 32.2736 - val_loss: 44.7597
Epoch 274/10000
1126/1126 [==============================] - 0s 120us/step - loss: 32.2140 - val_loss: 44.6107
Epoch 275/10000
1126/1126 [==============================] - 0s 95us/step - loss: 32.2157 - val_loss: 44.6967
Epoch 276/10000
1126/1126 [==============================] - 0s 164us/step - loss: 32.1546 - val_loss: 44.6147
Epoch 277/10000
1126/1126 [==============================] - 0s 149us/step - loss: 32.1311 - val_loss: 44.6113
Epoch 278/10000
1126/1126 [==============================] - 0s 120us/step - loss: 32.1016 - val_loss: 44.6083
Epoch 279/10000
1126/1126 [==============================] - 0s 129us/step - loss: 32.0600 - val_loss: 44.5580
Epoch 280/10000
1126/1126 [==============================] - 0s 120us/step - loss: 32.0506 - val_loss: 44.5618
Epoch 281/10000
1126/1126 [==============================] - 0s 69us/step - loss: 32.0160 - val_loss: 44.5249
Epoch 282/10000
1126/1126 [==============================] - 0s 110us/step - loss: 31.9694 - val_loss: 44.5042
Epoch 283/10000
1126/1126 [==============================] - 0s 109us/step - loss: 31.9541 - val_loss: 44.5214
Epoch 284/10000
1126/1126 [==============================] - 0s 66us/step - loss: 31.9229 - val_loss: 44.4761
Epoch 285/10000
1126/1126 [==============================] - 0s 73us/step - loss: 31.8875 - val_loss: 44.4535
Epoch 286/10000
1126/1126 [==============================] - 0s 67us/step - loss: 31.8369 - val_loss: 44.4501
Epoch 287/10000
1126/1126 [==============================] - 0s 69us/step - loss: 31.8320 - val_loss: 44.4121
Epoch 288/10000
1126/1126 [==============================] - 0s 66us/step - loss: 31.8121 - val_loss: 44.4163
Epoch 289/10000
1126/1126 [==============================] - 0s 69us/step - loss: 31.7695 - val_loss: 44.3694
Epoch 290/10000
```

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1126/1126 [==============================] - 0s 75us/step - loss: 31.7522 - val_loss: 44.4188
Epoch 291/10000
1126/1126 [==============================] - 0s 136us/step - loss: 31.7044 - val_loss: 44.2861
Epoch 292/10000
1126/1126 [==============================] - 0s 126us/step - loss: 31.6785 - val_loss: 44.3346
Epoch 293/10000
1126/1126 [==============================] - 0s 97us/step - loss: 31.6372 - val_loss: 44.2728
Epoch 294/10000
1126/1126 [==============================] - 0s 89us/step - loss: 31.6271 - val_loss: 44.2629
Epoch 295/10000
1126/1126 [==============================] - 0s 106us/step - loss: 31.6061 - val_loss: 44.3283
Epoch 296/10000
1126/1126 [==============================] - 0s 106us/step - loss: 31.5481 - val_loss: 44.1935
Epoch 297/10000
1126/1126 [==============================] - 0s 96us/step - loss: 31.5268 - val_loss: 44.2807
Epoch 298/10000
1126/1126 [==============================] - 0s 98us/step - loss: 31.4836 - val_loss: 44.1341
Epoch 299/10000
1126/1126 [==============================] - 0s 96us/step - loss: 31.4462 - val_loss: 44.1969
Epoch 300/10000
1126/1126 [==============================] - 0s 98us/step - loss: 31.4623 - val_loss: 44.2095
Epoch 301/10000
1126/1126 [==============================] - 0s 99us/step - loss: 31.4056 - val_loss: 44.1133
Epoch 302/10000
1126/1126 [==============================] - 0s 99us/step - loss: 31.3934 - val_loss: 44.1745
Epoch 303/10000
1126/1126 [==============================] - 0s 99us/step - loss: 31.3465 - val_loss: 44.0892
Epoch 304/10000
1126/1126 [==============================] - 0s 103us/step - loss: 31.3182 - val_loss: 44.1143
Epoch 305/10000
1126/1126 [==============================] - 0s 97us/step - loss: 31.2910 - val_loss: 44.0791
Epoch 306/10000
1126/1126 [==============================] - 0s 98us/step - loss: 31.2628 - val_loss: 44.0198
Epoch 307/10000
1126/1126 [==============================] - 0s 98us/step - loss: 31.2424 - val_loss: 44.0736
Epoch 308/10000
1126/1126 [==============================] - 0s 98us/step - loss: 31.2061 - val_loss: 43.9819
Epoch 309/10000
1126/1126 [==============================] - 0s 99us/step - loss: 31.1684 - val_loss: 44.0168
Epoch 310/10000
1126/1126 [==============================] - 0s 98us/step - loss: 31.1324 - val_loss: 43.9772
Epoch 311/10000
1126/1126 [==============================] - 0s 100us/step - loss: 31.1058 - val_loss: 43.9322
Epoch 312/10000
1126/1126 [==============================] - 0s 104us/step - loss: 31.1001 - val_loss: 43.9695
Epoch 313/10000
1126/1126 [==============================] - 0s 99us/step - loss: 31.0469 - val_loss: 43.9316
Epoch 314/10000
```

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1126/1126 [==============================] - 0s 98us/step - loss: 31.0256 - val_loss: 43.8893
Epoch 315/10000
1126/1126 [==============================] - 0s 99us/step - loss: 30.9967 - val_loss: 43.8622
Epoch 316/10000
1126/1126 [==============================] - 0s 101us/step - loss: 30.9639 - val_loss: 43.8836
Epoch 317/10000
1126/1126 [==============================] - 0s 101us/step - loss: 30.9625 - val_loss: 43.8479
Epoch 318/10000
1126/1126 [==============================] - 0s 109us/step - loss: 30.9248 - val_loss: 43.8361
Epoch 319/10000
1126/1126 [==============================] - 0s 104us/step - loss: 30.8996 - val_loss: 43.8443
Epoch 320/10000
1126/1126 [==============================] - 0s 99us/step - loss: 30.8698 - val_loss: 43.7923
Epoch 321/10000
1126/1126 [==============================] - 0s 116us/step - loss: 30.8602 - val_loss: 43.8312
Epoch 322/10000
1126/1126 [==============================] - 0s 103us/step - loss: 30.8286 - val_loss: 43.7640
Epoch 323/10000
1126/1126 [==============================] - 0s 111us/step - loss: 30.7961 - val_loss: 43.7926
Epoch 324/10000
1126/1126 [==============================] - 0s 99us/step - loss: 30.7718 - val_loss: 43.6940
Epoch 325/10000
1126/1126 [==============================] - 0s 102us/step - loss: 30.7447 - val_loss: 43.6747
Epoch 326/10000
1126/1126 [==============================] - 0s 101us/step - loss: 30.7220 - val_loss: 43.7039
Epoch 327/10000
1126/1126 [==============================] - 0s 96us/step - loss: 30.6852 - val_loss: 43.6199
Epoch 328/10000
1126/1126 [==============================] - 0s 99us/step - loss: 30.6693 - val_loss: 43.6130
Epoch 329/10000
1126/1126 [==============================] - 0s 102us/step - loss: 30.6553 - val_loss: 43.6390
Epoch 330/10000
1126/1126 [==============================] - 0s 113us/step - loss: 30.6301 - val_loss: 43.6230
Epoch 331/10000
1126/1126 [==============================] - 0s 101us/step - loss: 30.6016 - val_loss: 43.5406
Epoch 332/10000
1126/1126 [==============================] - 0s 103us/step - loss: 30.5739 - val_loss: 43.5842
Epoch 333/10000
1126/1126 [==============================] - 0s 99us/step - loss: 30.5244 - val_loss: 43.5704
Epoch 334/10000
1126/1126 [==============================] - 0s 104us/step - loss: 30.5095 - val_loss: 43.5219
Epoch 335/10000
1126/1126 [==============================] - 0s 105us/step - loss: 30.4913 - val_loss: 43.5419
Epoch 336/10000
1126/1126 [==============================] - 0s 106us/step - loss: 30.4718 - val_loss: 43.5043
Epoch 337/10000
1126/1126 [==============================] - 0s 105us/step - loss: 30.4417 - val_loss: 43.4798
Epoch 338/10000
```

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1126/1126 [==============================] - 0s 105us/step - loss: 30.4108 - val_loss: 43.5033
Epoch 339/10000
1126/1126 [==============================] - 0s 102us/step - loss: 30.4130 - val_loss: 43.4498
Epoch 340/10000
1126/1126 [==============================] - 0s 104us/step - loss: 30.3587 - val_loss: 43.4121
Epoch 341/10000
1126/1126 [==============================] - 0s 107us/step - loss: 30.3369 - val_loss: 43.4513
Epoch 342/10000
1126/1126 [==============================] - 0s 108us/step - loss: 30.3468 - val_loss: 43.3987
Epoch 343/10000
1126/1126 [==============================] - 0s 82us/step - loss: 30.3106 - val_loss: 43.4190
Epoch 344/10000
1126/1126 [==============================] - 0s 74us/step - loss: 30.3116 - val_loss: 43.4464
Epoch 345/10000
1126/1126 [==============================] - 0s 69us/step - loss: 30.2832 - val_loss: 43.3700
Epoch 346/10000
1126/1126 [==============================] - 0s 70us/step - loss: 30.2604 - val_loss: 43.4646
Epoch 347/10000
1126/1126 [==============================] - 0s 68us/step - loss: 30.2192 - val_loss: 43.3032
Epoch 348/10000
1126/1126 [==============================] - 0s 92us/step - loss: 30.1724 - val_loss: 43.3655
Epoch 349/10000
1126/1126 [==============================] - 0s 106us/step - loss: 30.1376 - val_loss: 43.2975
Epoch 350/10000
1126/1126 [==============================] - 0s 106us/step - loss: 30.1015 - val_loss: 43.2970
Epoch 351/10000
1126/1126 [==============================] - 0s 109us/step - loss: 30.0821 - val_loss: 43.2193
Epoch 352/10000
1126/1126 [==============================] - 0s 116us/step - loss: 30.0680 - val_loss: 43.2465
Epoch 353/10000
1126/1126 [==============================] - 0s 99us/step - loss: 30.0239 - val_loss: 43.1941
Epoch 354/10000
1126/1126 [==============================] - 0s 101us/step - loss: 29.9996 - val_loss: 43.1965
Epoch 355/10000
1126/1126 [==============================] - 0s 93us/step - loss: 30.0051 - val_loss: 43.2061
Epoch 356/10000
1126/1126 [==============================] - 0s 70us/step - loss: 29.9505 - val_loss: 43.1742
Epoch 357/10000
1126/1126 [==============================] - 0s 79us/step - loss: 29.9279 - val_loss: 43.1326
Epoch 358/10000
1126/1126 [==============================] - 0s 100us/step - loss: 29.9006 - val_loss: 43.1721
Epoch 359/10000
1126/1126 [==============================] - 0s 77us/step - loss: 29.8848 - val_loss: 43.1324
Epoch 360/10000
1126/1126 [==============================] - 0s 115us/step - loss: 29.8418 - val_loss: 43.1226
Epoch 361/10000
1126/1126 [==============================] - 0s 108us/step - loss: 29.8442 - val_loss: 43.1504
Epoch 362/10000
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1126/1126 [==============================] - 0s 94us/step - loss: 29.8038 - val_loss: 43.0532
Epoch 363/10000
1126/1126 [==============================] - 0s 69us/step - loss: 29.7673 - val_loss: 43.0764
Epoch 364/10000
1126/1126 [==============================] - 0s 73us/step - loss: 29.7597 - val_loss: 43.0616
Epoch 365/10000
1126/1126 [==============================] - 0s 85us/step - loss: 29.7549 - val_loss: 43.0289
Epoch 366/10000
1126/1126 [==============================] - 0s 120us/step - loss: 29.7003 - val_loss: 43.0537
Epoch 367/10000
1126/1126 [==============================] - 0s 121us/step - loss: 29.7054 - val_loss: 43.0062
Epoch 368/10000
1126/1126 [==============================] - 0s 91us/step - loss: 29.6911 - val_loss: 43.0565
Epoch 369/10000
1126/1126 [==============================] - 0s 72us/step - loss: 29.6957 - val_loss: 43.0581
Epoch 370/10000
1126/1126 [==============================] - 0s 95us/step - loss: 29.6753 - val_loss: 43.0598
Epoch 371/10000
1126/1126 [==============================] - 0s 113us/step - loss: 29.6199 - val_loss: 43.0017
Epoch 372/10000
1126/1126 [==============================] - 0s 120us/step - loss: 29.5922 - val_loss: 42.9817
Epoch 373/10000
1126/1126 [==============================] - 0s 96us/step - loss: 29.5410 - val_loss: 42.9236
Epoch 374/10000
1126/1126 [==============================] - 0s 69us/step - loss: 29.4930 - val_loss: 42.9042
Epoch 375/10000
1126/1126 [==============================] - 0s 96us/step - loss: 29.5134 - val_loss: 42.8710
Epoch 376/10000
1126/1126 [==============================] - 0s 123us/step - loss: 29.4496 - val_loss: 42.8937
Epoch 377/10000
1126/1126 [==============================] - 0s 121us/step - loss: 29.4506 - val_loss: 42.8402
Epoch 378/10000
1126/1126 [==============================] - 0s 89us/step - loss: 29.4178 - val_loss: 42.8866
Epoch 379/10000
1126/1126 [==============================] - 0s 85us/step - loss: 29.3914 - val_loss: 42.7973
Epoch 380/10000
1126/1126 [==============================] - 0s 78us/step - loss: 29.3747 - val_loss: 42.8076
Epoch 381/10000
1126/1126 [==============================] - 0s 71us/step - loss: 29.3461 - val_loss: 42.7613
Epoch 382/10000
1126/1126 [==============================] - 0s 71us/step - loss: 29.3486 - val_loss: 42.8050
Epoch 383/10000
1126/1126 [==============================] - 0s 72us/step - loss: 29.2951 - val_loss: 42.7356
Epoch 384/10000
1126/1126 [==============================] - 0s 70us/step - loss: 29.2768 - val_loss: 42.6645
Epoch 385/10000
1126/1126 [==============================] - 0s 74us/step - loss: 29.2611 - val_loss: 42.6781
Epoch 386/10000
```

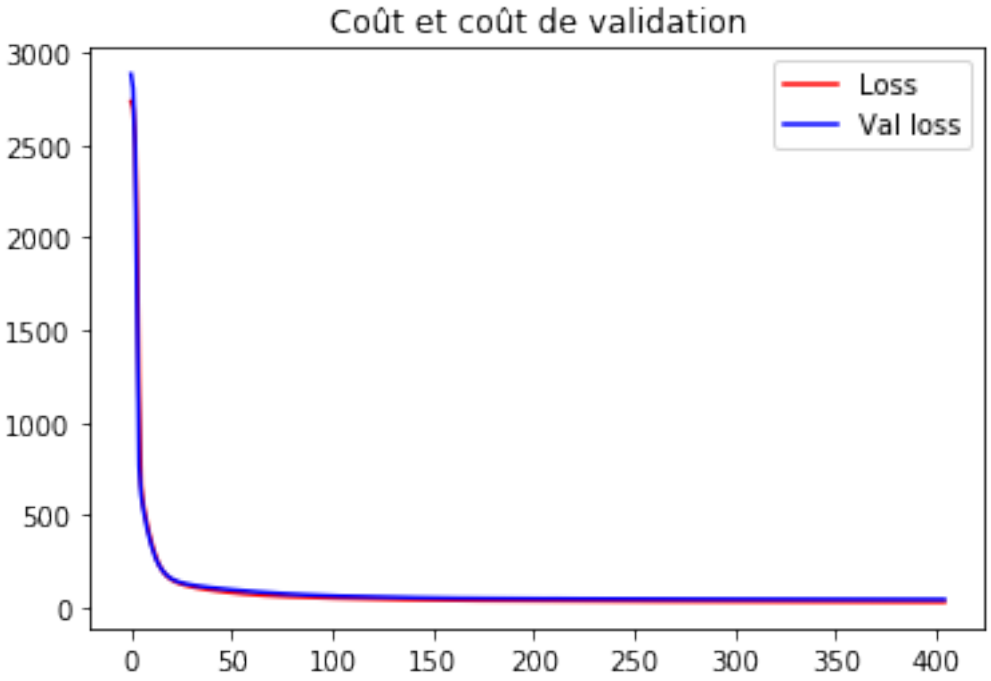
```
1126/1126 [==============================] - 0s 80us/step - loss: 29.2142 - val_loss: 42.6659
Epoch 387/10000
1126/1126 [==============================] - 0s 99us/step - loss: 29.2117 - val_loss: 42.6231
Epoch 388/10000
1126/1126 [==============================] - 0s 80us/step - loss: 29.1960 - val_loss: 42.6446
Epoch 389/10000
1126/1126 [==============================] - 0s 70us/step - loss: 29.1749 - val_loss: 42.5956
Epoch 390/10000
1126/1126 [==============================] - 0s 86us/step - loss: 29.1694 - val_loss: 42.7138
Epoch 391/10000
1126/1126 [==============================] - 0s 95us/step - loss: 29.1445 - val_loss: 42.5779
Epoch 392/10000
1126/1126 [==============================] - 0s 76us/step - loss: 29.1172 - val_loss: 42.6633
Epoch 393/10000
1126/1126 [==============================] - 0s 76us/step - loss: 29.1002 - val_loss: 42.5199
Epoch 394/10000
1126/1126 [==============================] - 0s 72us/step - loss: 29.0715 - val_loss: 42.6638
Epoch 395/10000
1126/1126 [==============================] - 0s 75us/step - loss: 29.0451 - val_loss: 42.4746
Epoch 396/10000
1126/1126 [==============================] - 0s 69us/step - loss: 29.0161 - val_loss: 42.5963
Epoch 397/10000
1126/1126 [==============================] - 0s 74us/step - loss: 28.9905 - val_loss: 42.5114
Epoch 398/10000
1126/1126 [==============================] - 0s 70us/step - loss: 29.0065 - val_loss: 42.5087
Epoch 399/10000
1126/1126 [==============================] - 0s 68us/step - loss: 28.9467 - val_loss: 42.5905
Epoch 400/10000
1126/1126 [==============================] - 0s 73us/step - loss: 28.9502 - val_loss: 42.5616
Epoch 401/10000
1126/1126 [==============================] - 0s 71us/step - loss: 28.9111 - val_loss: 42.5817
Epoch 402/10000
1126/1126 [==============================] - 0s 72us/step - loss: 28.8856 - val_loss: 42.5675
Epoch 403/10000
1126/1126 [==============================] - 0s 71us/step - loss: 28.8711 - val_loss: 42.5523
Epoch 404/10000
1126/1126 [==============================] - 0s 70us/step - loss: 28.8245 - val_loss: 42.5193
Epoch 405/10000
1126/1126 [==============================] - 0s 71us/step - loss: 28.8207 - val_loss: 42.5857
Epoch 00405: early stopping
```

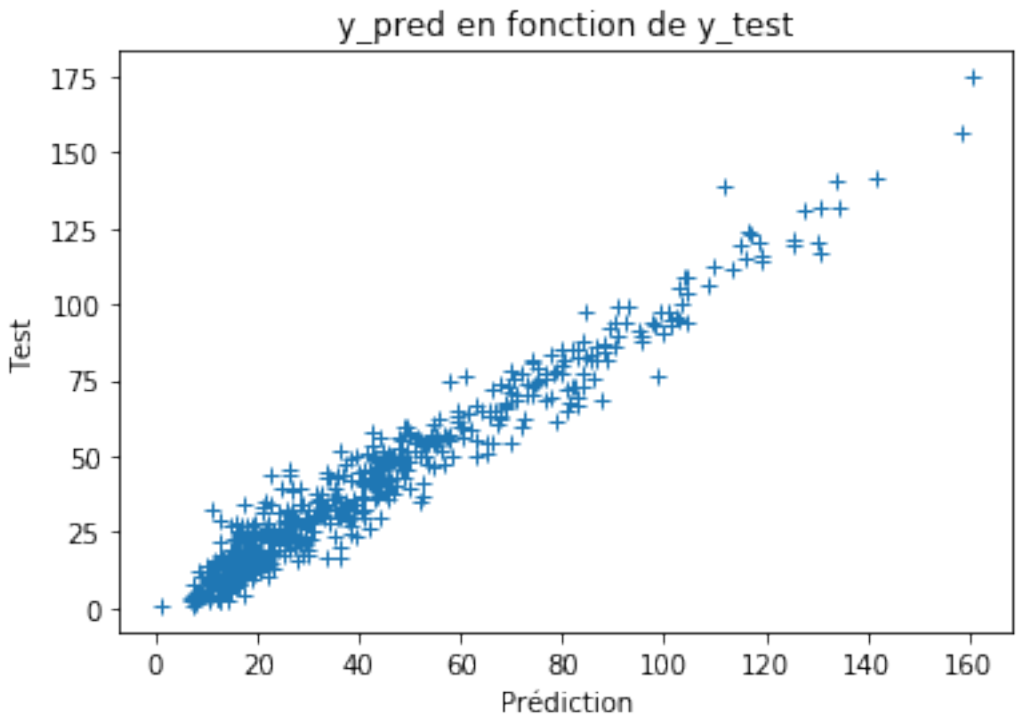
```
In [9]: y_pred = model.predict(X_test)
        y_test.reshape(len(y_test))
        plt.title('Coût et coût de validation')
        line1,=plt.plot(history.history['loss'], label="Loss", linestyle='-', color='r')
        line2,=plt.plot(history.history['val_loss'], label="Val loss", linestyle='-', color='b
        first_legend = plt.legend(handles=[line1, line2], loc=1)
```

```
plt.show()

plt.title('y_pred en fonction de y_test')

plt.plot(y_pred[:], y_test[:], '+')
plt.ylabel('Test')
plt.xlabel('Prédiction')
plt.show()
```






```
In [10]: model = gru_model(32, X_train.shape[1:])

_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
gru_1 (GRU)                  (None, 32)                3936
_________________________________________________________________
dense_5 (Dense)              (None, 32)                1056
_________________________________________________________________
dense_6 (Dense)              (None, 1)                 33
=================================================================
Total params: 5,025
Trainable params: 5,025
Non-trainable params: 0
_________________________________________________________________
```

```
In [11]: early_stopping = EarlyStopping(monitor='val_loss', verbose=1, mode='auto', patience=1
         history = model.fit(X_train, y_train, batch_size=32, epochs=10000, validation_data=(X_

Train on 1126 samples, validate on 563 samples
Epoch 1/10000
1126/1126 [==============================] - 1s 1ms/step - loss: 2737.9662 - val_loss: 2884.626
Epoch 2/10000
```

```
1126/1126 [==============================] - 0s 107us/step - loss: 2699.7910 - val_loss: 2802.4
Epoch 3/10000
1126/1126 [==============================] - 0s 90us/step - loss: 2542.4833 - val_loss: 2492.47
Epoch 4/10000
1126/1126 [==============================] - 0s 76us/step - loss: 2081.5469 - val_loss: 1747.40
Epoch 5/10000
1126/1126 [==============================] - 0s 117us/step - loss: 1276.7518 - val_loss: 845.94
Epoch 6/10000
1126/1126 [==============================] - 0s 109us/step - loss: 645.8847 - val_loss: 521.302
Epoch 7/10000
1126/1126 [==============================] - 0s 71us/step - loss: 493.9093 - val_loss: 468.6530
Epoch 8/10000
1126/1126 [==============================] - 0s 64us/step - loss: 439.7839 - val_loss: 414.8487
Epoch 9/10000
1126/1126 [==============================] - 0s 65us/step - loss: 390.8030 - val_loss: 367.7280
Epoch 10/10000
1126/1126 [==============================] - 0s 92us/step - loss: 346.6063 - val_loss: 326.0852
Epoch 11/10000
1126/1126 [==============================] - 0s 119us/step - loss: 307.4681 - val_loss: 290.056
Epoch 12/10000
1126/1126 [==============================] - 0s 95us/step - loss: 273.3349 - val_loss: 259.1770
Epoch 13/10000
1126/1126 [==============================] - 0s 67us/step - loss: 243.5384 - val_loss: 232.4077
Epoch 14/10000
1126/1126 [==============================] - 0s 82us/step - loss: 217.5232 - val_loss: 209.0025
Epoch 15/10000
1126/1126 [==============================] - 0s 98us/step - loss: 194.8891 - val_loss: 188.8991
Epoch 16/10000
1126/1126 [==============================] - 0s 82us/step - loss: 175.8086 - val_loss: 172.8748
Epoch 17/10000
1126/1126 [==============================] - 0s 83us/step - loss: 160.5788 - val_loss: 160.8681
Epoch 18/10000
1126/1126 [==============================] - 0s 113us/step - loss: 148.9844 - val_loss: 151.814
Epoch 19/10000
1126/1126 [==============================] - 0s 87us/step - loss: 139.8987 - val_loss: 144.5692
Epoch 20/10000
1126/1126 [==============================] - 0s 104us/step - loss: 132.5327 - val_loss: 138.549
Epoch 21/10000
1126/1126 [==============================] - 0s 80us/step - loss: 126.2996 - val_loss: 133.4089
Epoch 22/10000
1126/1126 [==============================] - 0s 99us/step - loss: 120.9250 - val_loss: 128.8938
Epoch 23/10000
1126/1126 [==============================] - 0s 67us/step - loss: 116.1834 - val_loss: 124.8902
Epoch 24/10000
1126/1126 [==============================] - 0s 64us/step - loss: 112.0080 - val_loss: 121.2758
Epoch 25/10000
1126/1126 [==============================] - 0s 74us/step - loss: 108.2384 - val_loss: 117.9846
Epoch 26/10000
```

```
1126/1126 [==============================] - 0s 107us/step - loss: 104.7971 - val_loss: 114.948
Epoch 27/10000
1126/1126 [==============================] - 0s 103us/step - loss: 101.4793 - val_loss: 112.069
Epoch 28/10000
1126/1126 [==============================] - 0s 116us/step - loss: 98.4973 - val_loss: 109.4169
Epoch 29/10000
1126/1126 [==============================] - 0s 108us/step - loss: 95.7675 - val_loss: 106.9540
Epoch 30/10000
1126/1126 [==============================] - 0s 105us/step - loss: 93.3035 - val_loss: 104.6916
Epoch 31/10000
1126/1126 [==============================] - 0s 73us/step - loss: 91.0186 - val_loss: 102.5770
Epoch 32/10000
1126/1126 [==============================] - 0s 66us/step - loss: 88.9178 - val_loss: 100.5582
Epoch 33/10000
1126/1126 [==============================] - 0s 87us/step - loss: 86.9507 - val_loss: 98.6839
Epoch 34/10000
1126/1126 [==============================] - 0s 101us/step - loss: 85.1303 - val_loss: 96.9403
Epoch 35/10000
1126/1126 [==============================] - 0s 102us/step - loss: 83.4253 - val_loss: 95.2607
Epoch 36/10000
1126/1126 [==============================] - 0s 104us/step - loss: 81.8044 - val_loss: 93.6349
Epoch 37/10000
1126/1126 [==============================] - 0s 101us/step - loss: 80.2363 - val_loss: 92.0676
Epoch 38/10000
1126/1126 [==============================] - 0s 109us/step - loss: 78.7467 - val_loss: 90.5899
Epoch 39/10000
1126/1126 [==============================] - 0s 118us/step - loss: 77.3504 - val_loss: 89.1858
Epoch 40/10000
1126/1126 [==============================] - 0s 92us/step - loss: 76.0204 - val_loss: 87.8361
Epoch 41/10000
1126/1126 [==============================] - 0s 63us/step - loss: 74.7889 - val_loss: 86.5697
Epoch 42/10000
1126/1126 [==============================] - 0s 61us/step - loss: 73.6154 - val_loss: 85.3355
Epoch 43/10000
1126/1126 [==============================] - 0s 96us/step - loss: 72.5142 - val_loss: 84.1352
Epoch 44/10000
1126/1126 [==============================] - 0s 87us/step - loss: 71.4605 - val_loss: 82.9587
Epoch 45/10000
1126/1126 [==============================] - 0s 64us/step - loss: 70.4582 - val_loss: 81.8522
Epoch 46/10000
1126/1126 [==============================] - 0s 109us/step - loss: 69.5269 - val_loss: 80.7485
Epoch 47/10000
1126/1126 [==============================] - 0s 133us/step - loss: 68.6018 - val_loss: 79.7255
Epoch 48/10000
1126/1126 [==============================] - 0s 119us/step - loss: 67.7505 - val_loss: 78.7543
Epoch 49/10000
1126/1126 [==============================] - 0s 112us/step - loss: 66.9318 - val_loss: 77.7998
Epoch 50/10000
```

```
1126/1126 [==============================] - 0s 125us/step - loss: 66.1594 - val_loss: 76.8982
Epoch 51/10000
1126/1126 [==============================] - 0s 68us/step - loss: 65.4146 - val_loss: 76.0303
Epoch 52/10000
1126/1126 [==============================] - 0s 61us/step - loss: 64.7033 - val_loss: 75.2017
Epoch 53/10000
1126/1126 [==============================] - 0s 78us/step - loss: 64.0220 - val_loss: 74.4098
Epoch 54/10000
1126/1126 [==============================] - 0s 104us/step - loss: 63.3460 - val_loss: 73.6396
Epoch 55/10000
1126/1126 [==============================] - 0s 60us/step - loss: 62.6837 - val_loss: 72.9040
Epoch 56/10000
1126/1126 [==============================] - 0s 60us/step - loss: 62.0516 - val_loss: 72.1928
Epoch 57/10000
1126/1126 [==============================] - 0s 59us/step - loss: 61.4566 - val_loss: 71.5026
Epoch 58/10000
1126/1126 [==============================] - 0s 59us/step - loss: 60.8780 - val_loss: 70.8147
Epoch 59/10000
1126/1126 [==============================] - 0s 59us/step - loss: 60.3187 - val_loss: 70.1850
Epoch 60/10000
1126/1126 [==============================] - 0s 67us/step - loss: 59.7994 - val_loss: 69.5764
Epoch 61/10000
1126/1126 [==============================] - 0s 61us/step - loss: 59.2992 - val_loss: 68.9818
Epoch 62/10000
1126/1126 [==============================] - 0s 60us/step - loss: 58.8082 - val_loss: 68.3837
Epoch 63/10000
1126/1126 [==============================] - 0s 82us/step - loss: 58.3467 - val_loss: 67.8202
Epoch 64/10000
1126/1126 [==============================] - 0s 77us/step - loss: 57.8892 - val_loss: 67.2826
Epoch 65/10000
1126/1126 [==============================] - 0s 67us/step - loss: 57.4608 - val_loss: 66.7514
Epoch 66/10000
1126/1126 [==============================] - 0s 60us/step - loss: 57.0499 - val_loss: 66.2160
Epoch 67/10000
1126/1126 [==============================] - 0s 59us/step - loss: 56.6529 - val_loss: 65.7205
Epoch 68/10000
1126/1126 [==============================] - 0s 109us/step - loss: 56.2703 - val_loss: 65.2499
Epoch 69/10000
1126/1126 [==============================] - 0s 112us/step - loss: 55.9100 - val_loss: 64.7544
Epoch 70/10000
1126/1126 [==============================] - 0s 59us/step - loss: 55.5568 - val_loss: 64.2991
Epoch 71/10000
1126/1126 [==============================] - 0s 60us/step - loss: 55.2209 - val_loss: 63.8837
Epoch 72/10000
1126/1126 [==============================] - 0s 103us/step - loss: 54.9026 - val_loss: 63.4726
Epoch 73/10000
1126/1126 [==============================] - 0s 98us/step - loss: 54.6027 - val_loss: 63.0795
Epoch 74/10000
```

```
1126/1126 [==============================] - 0s 105us/step - loss: 54.3110 - val_loss: 62.6750
Epoch 75/10000
1126/1126 [==============================] - 0s 89us/step - loss: 54.0157 - val_loss: 62.2957
Epoch 76/10000
1126/1126 [==============================] - 0s 75us/step - loss: 53.7341 - val_loss: 61.9313
Epoch 77/10000
1126/1126 [==============================] - 0s 58us/step - loss: 53.4675 - val_loss: 61.5646
Epoch 78/10000
1126/1126 [==============================] - 0s 59us/step - loss: 53.2068 - val_loss: 61.2149
Epoch 79/10000
1126/1126 [==============================] - 0s 60us/step - loss: 52.9565 - val_loss: 60.8821
Epoch 80/10000
1126/1126 [==============================] - 0s 59us/step - loss: 52.7048 - val_loss: 60.5698
Epoch 81/10000
1126/1126 [==============================] - 0s 60us/step - loss: 52.4641 - val_loss: 60.2308
Epoch 82/10000
1126/1126 [==============================] - 0s 61us/step - loss: 52.2390 - val_loss: 59.9213
Epoch 83/10000
1126/1126 [==============================] - 0s 59us/step - loss: 52.0099 - val_loss: 59.5999
Epoch 84/10000
1126/1126 [==============================] - 0s 61us/step - loss: 51.7857 - val_loss: 59.3121
Epoch 85/10000
1126/1126 [==============================] - 0s 59us/step - loss: 51.5698 - val_loss: 59.0095
Epoch 86/10000
1126/1126 [==============================] - 0s 59us/step - loss: 51.3473 - val_loss: 58.7364
Epoch 87/10000
1126/1126 [==============================] - 0s 61us/step - loss: 51.1461 - val_loss: 58.4559
Epoch 88/10000
1126/1126 [==============================] - 0s 59us/step - loss: 50.9256 - val_loss: 58.2049
Epoch 89/10000
1126/1126 [==============================] - 0s 59us/step - loss: 50.7315 - val_loss: 57.9537
Epoch 90/10000
1126/1126 [==============================] - 0s 59us/step - loss: 50.5247 - val_loss: 57.6992
Epoch 91/10000
1126/1126 [==============================] - 0s 59us/step - loss: 50.3304 - val_loss: 57.4709
Epoch 92/10000
1126/1126 [==============================] - 0s 58us/step - loss: 50.1346 - val_loss: 57.2323
Epoch 93/10000
1126/1126 [==============================] - 0s 60us/step - loss: 49.9386 - val_loss: 56.9957
Epoch 94/10000
1126/1126 [==============================] - 0s 59us/step - loss: 49.7453 - val_loss: 56.7796
Epoch 95/10000
1126/1126 [==============================] - 0s 60us/step - loss: 49.5560 - val_loss: 56.5806
Epoch 96/10000
1126/1126 [==============================] - 0s 58us/step - loss: 49.3717 - val_loss: 56.3725
Epoch 97/10000
1126/1126 [==============================] - 0s 59us/step - loss: 49.1969 - val_loss: 56.1604
Epoch 98/10000
```

```
1126/1126 [==============================] - 0s 60us/step - loss: 49.0103 - val_loss: 55.9712
Epoch 99/10000
1126/1126 [==============================] - 0s 68us/step - loss: 48.8357 - val_loss: 55.7772
Epoch 100/10000
1126/1126 [==============================] - 0s 107us/step - loss: 48.6595 - val_loss: 55.5797
Epoch 101/10000
1126/1126 [==============================] - 0s 65us/step - loss: 48.4806 - val_loss: 55.3842
Epoch 102/10000
1126/1126 [==============================] - 0s 59us/step - loss: 48.3079 - val_loss: 55.2136
Epoch 103/10000
1126/1126 [==============================] - 0s 61us/step - loss: 48.1323 - val_loss: 55.0024
Epoch 104/10000
1126/1126 [==============================] - 0s 59us/step - loss: 47.9594 - val_loss: 54.8150
Epoch 105/10000
1126/1126 [==============================] - 0s 59us/step - loss: 47.7957 - val_loss: 54.6305
Epoch 106/10000
1126/1126 [==============================] - 0s 64us/step - loss: 47.6164 - val_loss: 54.4630
Epoch 107/10000
1126/1126 [==============================] - 0s 119us/step - loss: 47.4649 - val_loss: 54.2480
Epoch 108/10000
1126/1126 [==============================] - 0s 67us/step - loss: 47.2834 - val_loss: 54.0989
Epoch 109/10000
1126/1126 [==============================] - 0s 59us/step - loss: 47.1174 - val_loss: 53.9013
Epoch 110/10000
1126/1126 [==============================] - 0s 59us/step - loss: 46.9547 - val_loss: 53.7481
Epoch 111/10000
1126/1126 [==============================] - 0s 59us/step - loss: 46.7997 - val_loss: 53.5536
Epoch 112/10000
1126/1126 [==============================] - 0s 60us/step - loss: 46.6390 - val_loss: 53.3873
Epoch 113/10000
1126/1126 [==============================] - 0s 59us/step - loss: 46.4739 - val_loss: 53.2080
Epoch 114/10000
1126/1126 [==============================] - 0s 59us/step - loss: 46.3163 - val_loss: 53.0593
Epoch 115/10000
1126/1126 [==============================] - 0s 60us/step - loss: 46.1747 - val_loss: 52.8721
Epoch 116/10000
1126/1126 [==============================] - 0s 59us/step - loss: 46.0203 - val_loss: 52.7384
Epoch 117/10000
1126/1126 [==============================] - 0s 60us/step - loss: 45.8739 - val_loss: 52.5567
Epoch 118/10000
1126/1126 [==============================] - 0s 58us/step - loss: 45.7227 - val_loss: 52.4131
Epoch 119/10000
1126/1126 [==============================] - 0s 59us/step - loss: 45.5726 - val_loss: 52.2502
Epoch 120/10000
1126/1126 [==============================] - 0s 59us/step - loss: 45.4313 - val_loss: 52.1296
Epoch 121/10000
1126/1126 [==============================] - 0s 61us/step - loss: 45.2780 - val_loss: 51.9548
Epoch 122/10000
```

```
1126/1126 [==============================] - 0s 63us/step - loss: 45.1266 - val_loss: 51.8745
Epoch 123/10000
1126/1126 [==============================] - 0s 62us/step - loss: 44.9830 - val_loss: 51.6331
Epoch 124/10000
1126/1126 [==============================] - 0s 61us/step - loss: 44.8720 - val_loss: 51.6503
Epoch 125/10000
1126/1126 [==============================] - 0s 60us/step - loss: 44.7362 - val_loss: 51.3126
Epoch 126/10000
1126/1126 [==============================] - 0s 80us/step - loss: 44.6307 - val_loss: 51.4115
Epoch 127/10000
1126/1126 [==============================] - 0s 77us/step - loss: 44.4706 - val_loss: 51.0292
Epoch 128/10000
1126/1126 [==============================] - 0s 60us/step - loss: 44.3315 - val_loss: 51.0947
Epoch 129/10000
1126/1126 [==============================] - 0s 59us/step - loss: 44.1711 - val_loss: 50.7890
Epoch 130/10000
1126/1126 [==============================] - 0s 59us/step - loss: 44.0343 - val_loss: 50.7682
Epoch 131/10000
1126/1126 [==============================] - 0s 59us/step - loss: 43.8938 - val_loss: 50.5434
Epoch 132/10000
1126/1126 [==============================] - 0s 58us/step - loss: 43.7593 - val_loss: 50.4836
Epoch 133/10000
1126/1126 [==============================] - 0s 66us/step - loss: 43.6435 - val_loss: 50.3331
Epoch 134/10000
1126/1126 [==============================] - 0s 60us/step - loss: 43.5222 - val_loss: 50.2255
Epoch 135/10000
1126/1126 [==============================] - 0s 63us/step - loss: 43.4006 - val_loss: 50.0909
Epoch 136/10000
1126/1126 [==============================] - 0s 59us/step - loss: 43.2881 - val_loss: 49.9865
Epoch 137/10000
1126/1126 [==============================] - 0s 59us/step - loss: 43.1657 - val_loss: 49.8587
Epoch 138/10000
1126/1126 [==============================] - 0s 59us/step - loss: 43.0556 - val_loss: 49.7570
Epoch 139/10000
1126/1126 [==============================] - 0s 60us/step - loss: 42.9378 - val_loss: 49.6327
Epoch 140/10000
1126/1126 [==============================] - 0s 58us/step - loss: 42.8265 - val_loss: 49.5483
Epoch 141/10000
1126/1126 [==============================] - 0s 59us/step - loss: 42.7091 - val_loss: 49.4102
Epoch 142/10000
1126/1126 [==============================] - 0s 59us/step - loss: 42.5897 - val_loss: 49.3048
Epoch 143/10000
1126/1126 [==============================] - 0s 63us/step - loss: 42.4871 - val_loss: 49.2038
Epoch 144/10000
1126/1126 [==============================] - 0s 71us/step - loss: 42.3837 - val_loss: 49.0956
Epoch 145/10000
1126/1126 [==============================] - 0s 89us/step - loss: 42.2665 - val_loss: 48.9691
Epoch 146/10000
```

```
1126/1126 [==============================] - 0s 86us/step - loss: 42.1635 - val_loss: 48.8936
Epoch 147/10000
1126/1126 [==============================] - 0s 65us/step - loss: 42.0514 - val_loss: 48.7909
Epoch 148/10000
1126/1126 [==============================] - 0s 100us/step - loss: 41.9640 - val_loss: 48.6812
Epoch 149/10000
1126/1126 [==============================] - 0s 96us/step - loss: 41.8456 - val_loss: 48.6025
Epoch 150/10000
1126/1126 [==============================] - 0s 96us/step - loss: 41.7457 - val_loss: 48.4864
Epoch 151/10000
1126/1126 [==============================] - 0s 64us/step - loss: 41.6351 - val_loss: 48.4100
Epoch 152/10000
1126/1126 [==============================] - 0s 61us/step - loss: 41.5348 - val_loss: 48.3114
Epoch 153/10000
1126/1126 [==============================] - 0s 77us/step - loss: 41.4326 - val_loss: 48.2577
Epoch 154/10000
1126/1126 [==============================] - 0s 66us/step - loss: 41.3399 - val_loss: 48.1225
Epoch 155/10000
1126/1126 [==============================] - 0s 60us/step - loss: 41.2334 - val_loss: 48.0832
Epoch 156/10000
1126/1126 [==============================] - 0s 85us/step - loss: 41.1354 - val_loss: 47.9623
Epoch 157/10000
1126/1126 [==============================] - 0s 101us/step - loss: 41.0345 - val_loss: 47.8833
Epoch 158/10000
1126/1126 [==============================] - 0s 95us/step - loss: 40.9310 - val_loss: 47.7855
Epoch 159/10000
1126/1126 [==============================] - 0s 97us/step - loss: 40.8495 - val_loss: 47.7307
Epoch 160/10000
1126/1126 [==============================] - 0s 78us/step - loss: 40.7473 - val_loss: 47.5948
Epoch 161/10000
1126/1126 [==============================] - 0s 81us/step - loss: 40.6643 - val_loss: 47.6115
Epoch 162/10000
1126/1126 [==============================] - 0s 66us/step - loss: 40.5646 - val_loss: 47.4433
Epoch 163/10000
1126/1126 [==============================] - 0s 106us/step - loss: 40.5171 - val_loss: 47.5376
Epoch 164/10000
1126/1126 [==============================] - 0s 119us/step - loss: 40.4423 - val_loss: 47.2595
Epoch 165/10000
1126/1126 [==============================] - 0s 101us/step - loss: 40.4735 - val_loss: 47.5517
Epoch 166/10000
1126/1126 [==============================] - 0s 125us/step - loss: 40.3666 - val_loss: 47.0783
Epoch 167/10000
1126/1126 [==============================] - 0s 134us/step - loss: 40.2975 - val_loss: 47.3669
Epoch 168/10000
1126/1126 [==============================] - 0s 136us/step - loss: 40.1140 - val_loss: 46.9659
Epoch 169/10000
1126/1126 [==============================] - 0s 107us/step - loss: 39.9968 - val_loss: 47.1166
Epoch 170/10000
```

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1126/1126 [==============================] - 0s 105us/step - loss: 39.8761 - val_loss: 46.8586
Epoch 171/10000
1126/1126 [==============================] - 0s 81us/step - loss: 39.7757 - val_loss: 46.9289
Epoch 172/10000
1126/1126 [==============================] - 0s 68us/step - loss: 39.6915 - val_loss: 46.7700
Epoch 173/10000
1126/1126 [==============================] - 0s 128us/step - loss: 39.6049 - val_loss: 46.7970
Epoch 174/10000
1126/1126 [==============================] - 0s 128us/step - loss: 39.5202 - val_loss: 46.6653
Epoch 175/10000
1126/1126 [==============================] - 0s 112us/step - loss: 39.4258 - val_loss: 46.6383
Epoch 176/10000
1126/1126 [==============================] - 0s 108us/step - loss: 39.3411 - val_loss: 46.5358
Epoch 177/10000
1126/1126 [==============================] - 0s 101us/step - loss: 39.2619 - val_loss: 46.5012
Epoch 178/10000
1126/1126 [==============================] - 0s 71us/step - loss: 39.1780 - val_loss: 46.4374
Epoch 179/10000
1126/1126 [==============================] - 0s 112us/step - loss: 39.1130 - val_loss: 46.3954
Epoch 180/10000
1126/1126 [==============================] - 0s 123us/step - loss: 39.0462 - val_loss: 46.3194
Epoch 181/10000
1126/1126 [==============================] - 0s 88us/step - loss: 38.9619 - val_loss: 46.2648
Epoch 182/10000
1126/1126 [==============================] - 0s 88us/step - loss: 38.8826 - val_loss: 46.2077
Epoch 183/10000
1126/1126 [==============================] - 0s 82us/step - loss: 38.8167 - val_loss: 46.1512
Epoch 184/10000
1126/1126 [==============================] - 0s 66us/step - loss: 38.7510 - val_loss: 46.1160
Epoch 185/10000
1126/1126 [==============================] - 0s 60us/step - loss: 38.6802 - val_loss: 46.0455
Epoch 186/10000
1126/1126 [==============================] - 0s 65us/step - loss: 38.6137 - val_loss: 46.0054
Epoch 187/10000
1126/1126 [==============================] - 0s 63us/step - loss: 38.5444 - val_loss: 45.9273
Epoch 188/10000
1126/1126 [==============================] - 0s 60us/step - loss: 38.4828 - val_loss: 45.9130
Epoch 189/10000
1126/1126 [==============================] - 0s 62us/step - loss: 38.4170 - val_loss: 45.7891
Epoch 190/10000
1126/1126 [==============================] - 0s 63us/step - loss: 38.3560 - val_loss: 45.7806
Epoch 191/10000
1126/1126 [==============================] - 0s 61us/step - loss: 38.2751 - val_loss: 45.6285
Epoch 192/10000
1126/1126 [==============================] - 0s 60us/step - loss: 38.2073 - val_loss: 45.6635
Epoch 193/10000
1126/1126 [==============================] - 0s 64us/step - loss: 38.1404 - val_loss: 45.4900
Epoch 194/10000
```

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1126/1126 [==============================] - 0s 63us/step - loss: 38.0906 - val_loss: 45.5986
Epoch 195/10000
1126/1126 [==============================] - 0s 61us/step - loss: 38.0201 - val_loss: 45.3437
Epoch 196/10000
1126/1126 [==============================] - 0s 61us/step - loss: 37.9915 - val_loss: 45.5433
Epoch 197/10000
1126/1126 [==============================] - 0s 64us/step - loss: 37.9232 - val_loss: 45.1952
Epoch 198/10000
1126/1126 [==============================] - 0s 86us/step - loss: 37.9168 - val_loss: 45.4912
Epoch 199/10000
1126/1126 [==============================] - 0s 100us/step - loss: 37.8042 - val_loss: 45.0574
Epoch 200/10000
1126/1126 [==============================] - 0s 102us/step - loss: 37.7608 - val_loss: 45.3264
Epoch 201/10000
1126/1126 [==============================] - 0s 78us/step - loss: 37.6255 - val_loss: 44.9846
Epoch 202/10000
1126/1126 [==============================] - 0s 93us/step - loss: 37.5725 - val_loss: 45.1641
Epoch 203/10000
1126/1126 [==============================] - 0s 101us/step - loss: 37.4596 - val_loss: 44.8765
Epoch 204/10000
1126/1126 [==============================] - 0s 70us/step - loss: 37.3929 - val_loss: 44.9757
Epoch 205/10000
1126/1126 [==============================] - 0s 86us/step - loss: 37.3175 - val_loss: 44.8027
Epoch 206/10000
1126/1126 [==============================] - 0s 99us/step - loss: 37.2695 - val_loss: 44.8480
Epoch 207/10000
1126/1126 [==============================] - 0s 91us/step - loss: 37.1900 - val_loss: 44.6708
Epoch 208/10000
1126/1126 [==============================] - 0s 93us/step - loss: 37.1259 - val_loss: 44.6933
Epoch 209/10000
1126/1126 [==============================] - 0s 61us/step - loss: 37.0705 - val_loss: 44.5818
Epoch 210/10000
1126/1126 [==============================] - 0s 81us/step - loss: 37.0152 - val_loss: 44.5747
Epoch 211/10000
1126/1126 [==============================] - 0s 92us/step - loss: 36.9496 - val_loss: 44.4685
Epoch 212/10000
1126/1126 [==============================] - 0s 69us/step - loss: 36.8992 - val_loss: 44.4657
Epoch 213/10000
1126/1126 [==============================] - 0s 67us/step - loss: 36.8301 - val_loss: 44.3517
Epoch 214/10000
1126/1126 [==============================] - 0s 68us/step - loss: 36.7803 - val_loss: 44.3630
Epoch 215/10000
1126/1126 [==============================] - 0s 98us/step - loss: 36.7169 - val_loss: 44.2378
Epoch 216/10000
1126/1126 [==============================] - 0s 96us/step - loss: 36.6779 - val_loss: 44.2821
Epoch 217/10000
1126/1126 [==============================] - 0s 103us/step - loss: 36.6204 - val_loss: 44.1270
Epoch 218/10000
```

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1126/1126 [==============================] - 0s 87us/step - loss: 36.5841 - val_loss: 44.1960
Epoch 219/10000
1126/1126 [==============================] - 0s 93us/step - loss: 36.5149 - val_loss: 44.0151
Epoch 220/10000
1126/1126 [==============================] - 0s 73us/step - loss: 36.4870 - val_loss: 44.1191
Epoch 221/10000
1126/1126 [==============================] - 0s 76us/step - loss: 36.4203 - val_loss: 43.9322
Epoch 222/10000
1126/1126 [==============================] - 0s 95us/step - loss: 36.4131 - val_loss: 44.0835
Epoch 223/10000
1126/1126 [==============================] - 0s 93us/step - loss: 36.3406 - val_loss: 43.8408
Epoch 224/10000
1126/1126 [==============================] - 0s 86us/step - loss: 36.3373 - val_loss: 44.0364
Epoch 225/10000
1126/1126 [==============================] - 0s 94us/step - loss: 36.2489 - val_loss: 43.7373
Epoch 226/10000
1126/1126 [==============================] - 0s 91us/step - loss: 36.2272 - val_loss: 43.9369
Epoch 227/10000
1126/1126 [==============================] - 0s 93us/step - loss: 36.1095 - val_loss: 43.6303
Epoch 228/10000
1126/1126 [==============================] - 0s 95us/step - loss: 36.0703 - val_loss: 43.8060
Epoch 229/10000
1126/1126 [==============================] - 0s 100us/step - loss: 35.9760 - val_loss: 43.5364
Epoch 230/10000
1126/1126 [==============================] - 0s 96us/step - loss: 35.9257 - val_loss: 43.6663
Epoch 231/10000
1126/1126 [==============================] - 0s 94us/step - loss: 35.8278 - val_loss: 43.4576
Epoch 232/10000
1126/1126 [==============================] - 0s 99us/step - loss: 35.7867 - val_loss: 43.5677
Epoch 233/10000
1126/1126 [==============================] - 0s 93us/step - loss: 35.7215 - val_loss: 43.3911
Epoch 234/10000
1126/1126 [==============================] - 0s 92us/step - loss: 35.6755 - val_loss: 43.4579
Epoch 235/10000
1126/1126 [==============================] - 0s 91us/step - loss: 35.6020 - val_loss: 43.3208
Epoch 236/10000
1126/1126 [==============================] - 0s 89us/step - loss: 35.5690 - val_loss: 43.3925
Epoch 237/10000
1126/1126 [==============================] - 0s 107us/step - loss: 35.5079 - val_loss: 43.2440
Epoch 238/10000
1126/1126 [==============================] - 0s 100us/step - loss: 35.4711 - val_loss: 43.3159
Epoch 239/10000
1126/1126 [==============================] - 0s 99us/step - loss: 35.4071 - val_loss: 43.1725
Epoch 240/10000
1126/1126 [==============================] - 0s 106us/step - loss: 35.3820 - val_loss: 43.2596
Epoch 241/10000
1126/1126 [==============================] - 0s 103us/step - loss: 35.3251 - val_loss: 43.1027
Epoch 242/10000
```

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1126/1126 [==============================] - 0s 104us/step - loss: 35.2925 - val_loss: 43.2158
Epoch 243/10000
1126/1126 [==============================] - ETA: 0s - loss: 35.38 - 0s 120us/step - loss: 35.1
Epoch 244/10000
1126/1126 [==============================] - 0s 109us/step - loss: 35.2267 - val_loss: 43.1893
Epoch 245/10000
1126/1126 [==============================] - 0s 106us/step - loss: 35.1629 - val_loss: 42.9946
Epoch 246/10000
1126/1126 [==============================] - 0s 104us/step - loss: 35.1580 - val_loss: 43.1683
Epoch 247/10000
1126/1126 [==============================] - 0s 101us/step - loss: 35.0851 - val_loss: 42.9515
Epoch 248/10000
1126/1126 [==============================] - 0s 97us/step - loss: 35.0642 - val_loss: 43.1342
Epoch 249/10000
1126/1126 [==============================] - 0s 98us/step - loss: 34.9879 - val_loss: 42.8915
Epoch 250/10000
1126/1126 [==============================] - 0s 98us/step - loss: 34.9574 - val_loss: 43.0553
Epoch 251/10000
1126/1126 [==============================] - 0s 92us/step - loss: 34.8845 - val_loss: 42.8476
Epoch 252/10000
1126/1126 [==============================] - 0s 102us/step - loss: 34.8589 - val_loss: 42.9906
Epoch 253/10000
1126/1126 [==============================] - 0s 97us/step - loss: 34.7962 - val_loss: 42.8044
Epoch 254/10000
1126/1126 [==============================] - 0s 92us/step - loss: 34.7553 - val_loss: 42.8793
Epoch 255/10000
1126/1126 [==============================] - 0s 92us/step - loss: 34.6673 - val_loss: 42.7133
Epoch 256/10000
1126/1126 [==============================] - 0s 92us/step - loss: 34.6601 - val_loss: 42.8237
Epoch 257/10000
1126/1126 [==============================] - 0s 92us/step - loss: 34.5904 - val_loss: 42.6988
Epoch 258/10000
1126/1126 [==============================] - 0s 92us/step - loss: 34.5699 - val_loss: 42.7840
Epoch 259/10000
1126/1126 [==============================] - 0s 100us/step - loss: 34.4902 - val_loss: 42.6379
Epoch 260/10000
1126/1126 [==============================] - 0s 92us/step - loss: 34.4743 - val_loss: 42.7276
Epoch 261/10000
1126/1126 [==============================] - 0s 95us/step - loss: 34.3937 - val_loss: 42.5676
Epoch 262/10000
1126/1126 [==============================] - 0s 93us/step - loss: 34.3734 - val_loss: 42.6755
Epoch 263/10000
1126/1126 [==============================] - 0s 98us/step - loss: 34.3068 - val_loss: 42.5148
Epoch 264/10000
1126/1126 [==============================] - 0s 89us/step - loss: 34.3016 - val_loss: 42.6416
Epoch 265/10000
1126/1126 [==============================] - 0s 94us/step - loss: 34.2211 - val_loss: 42.4657
Epoch 266/10000
```

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1126/1126 [==============================] - 0s 92us/step - loss: 34.2039 - val_loss: 42.5764
Epoch 267/10000
1126/1126 [==============================] - 0s 104us/step - loss: 34.1176 - val_loss: 42.4032
Epoch 268/10000
1126/1126 [==============================] - 0s 92us/step - loss: 34.1193 - val_loss: 42.5504
Epoch 269/10000
1126/1126 [==============================] - 0s 92us/step - loss: 34.0321 - val_loss: 42.3531
Epoch 270/10000
1126/1126 [==============================] - 0s 95us/step - loss: 34.0319 - val_loss: 42.5143
Epoch 271/10000
1126/1126 [==============================] - 0s 97us/step - loss: 33.9411 - val_loss: 42.2841
Epoch 272/10000
1126/1126 [==============================] - 0s 93us/step - loss: 33.9242 - val_loss: 42.4007
Epoch 273/10000
1126/1126 [==============================] - 0s 94us/step - loss: 33.8124 - val_loss: 42.2300
Epoch 274/10000
1126/1126 [==============================] - 0s 98us/step - loss: 33.8174 - val_loss: 42.3619
Epoch 275/10000
1126/1126 [==============================] - 0s 98us/step - loss: 33.7129 - val_loss: 42.1918
Epoch 276/10000
1126/1126 [==============================] - 0s 105us/step - loss: 33.6921 - val_loss: 42.2961
Epoch 277/10000
1126/1126 [==============================] - 0s 92us/step - loss: 33.6030 - val_loss: 42.1351
Epoch 278/10000
1126/1126 [==============================] - 0s 97us/step - loss: 33.5857 - val_loss: 42.2508
Epoch 279/10000
1126/1126 [==============================] - 0s 100us/step - loss: 33.5018 - val_loss: 42.0888
Epoch 280/10000
1126/1126 [==============================] - 0s 97us/step - loss: 33.4656 - val_loss: 42.1860
Epoch 281/10000
1126/1126 [==============================] - 0s 96us/step - loss: 33.3869 - val_loss: 42.0379
Epoch 282/10000
1126/1126 [==============================] - 0s 93us/step - loss: 33.3643 - val_loss: 42.1380
Epoch 283/10000
1126/1126 [==============================] - 0s 93us/step - loss: 33.2860 - val_loss: 41.9939
Epoch 284/10000
1126/1126 [==============================] - 0s 94us/step - loss: 33.2584 - val_loss: 42.0934
Epoch 285/10000
1126/1126 [==============================] - 0s 99us/step - loss: 33.1841 - val_loss: 41.9145
Epoch 286/10000
1126/1126 [==============================] - 0s 93us/step - loss: 33.1647 - val_loss: 42.0720
Epoch 287/10000
1126/1126 [==============================] - 0s 94us/step - loss: 33.0889 - val_loss: 41.8596
Epoch 288/10000
1126/1126 [==============================] - 0s 95us/step - loss: 33.0754 - val_loss: 42.0145
Epoch 289/10000
1126/1126 [==============================] - 0s 101us/step - loss: 32.9887 - val_loss: 41.8217
Epoch 290/10000
```

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1126/1126 [==============================] - 0s 94us/step - loss: 32.9899 - val_loss: 41.9710
Epoch 291/10000
1126/1126 [==============================] - 0s 90us/step - loss: 32.9025 - val_loss: 41.7570
Epoch 292/10000
1126/1126 [==============================] - 0s 98us/step - loss: 32.8844 - val_loss: 41.9303
Epoch 293/10000
1126/1126 [==============================] - 0s 100us/step - loss: 32.7968 - val_loss: 41.7158
Epoch 294/10000
1126/1126 [==============================] - 0s 95us/step - loss: 32.7777 - val_loss: 41.9058
Epoch 295/10000
1126/1126 [==============================] - 0s 93us/step - loss: 32.7097 - val_loss: 41.6802
Epoch 296/10000
1126/1126 [==============================] - 0s 100us/step - loss: 32.6805 - val_loss: 41.8604
Epoch 297/10000
1126/1126 [==============================] - 0s 98us/step - loss: 32.5822 - val_loss: 41.6335
Epoch 298/10000
1126/1126 [==============================] - 0s 94us/step - loss: 32.5649 - val_loss: 41.7963
Epoch 299/10000
1126/1126 [==============================] - 0s 92us/step - loss: 32.5796 - val_loss: 41.6096
Epoch 300/10000
1126/1126 [==============================] - 0s 95us/step - loss: 32.8055 - val_loss: 41.9613
Epoch 301/10000
1126/1126 [==============================] - 0s 93us/step - loss: 32.7803 - val_loss: 41.4072
Epoch 302/10000
1126/1126 [==============================] - 0s 72us/step - loss: 32.3940 - val_loss: 41.6019
Epoch 303/10000
1126/1126 [==============================] - 0s 87us/step - loss: 32.2689 - val_loss: 41.4905
Epoch 304/10000
1126/1126 [==============================] - 0s 90us/step - loss: 32.2108 - val_loss: 41.5124
Epoch 305/10000
1126/1126 [==============================] - 0s 85us/step - loss: 32.1642 - val_loss: 41.4765
Epoch 306/10000
1126/1126 [==============================] - 0s 92us/step - loss: 32.1186 - val_loss: 41.4818
Epoch 307/10000
1126/1126 [==============================] - 0s 88us/step - loss: 32.0762 - val_loss: 41.4323
Epoch 308/10000
1126/1126 [==============================] - 0s 96us/step - loss: 32.0296 - val_loss: 41.4234
Epoch 309/10000
1126/1126 [==============================] - 0s 86us/step - loss: 31.9974 - val_loss: 41.4121
Epoch 310/10000
1126/1126 [==============================] - 0s 86us/step - loss: 31.9428 - val_loss: 41.3830
Epoch 311/10000
1126/1126 [==============================] - 0s 91us/step - loss: 31.9203 - val_loss: 41.3890
Epoch 312/10000
1126/1126 [==============================] - 0s 89us/step - loss: 31.8632 - val_loss: 41.3810
Epoch 313/10000
1126/1126 [==============================] - 0s 90us/step - loss: 31.8465 - val_loss: 41.3792
Epoch 314/10000
```

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1126/1126 [==============================] - 0s 89us/step - loss: 31.7981 - val_loss: 41.3668
Epoch 315/10000
1126/1126 [==============================] - 0s 85us/step - loss: 31.7621 - val_loss: 41.3637
Epoch 316/10000
1126/1126 [==============================] - 0s 94us/step - loss: 31.7174 - val_loss: 41.3288
Epoch 317/10000
1126/1126 [==============================] - 0s 90us/step - loss: 31.6679 - val_loss: 41.3239
Epoch 318/10000
1126/1126 [==============================] - 0s 93us/step - loss: 31.6157 - val_loss: 41.2789
Epoch 319/10000
1126/1126 [==============================] - 0s 91us/step - loss: 31.5775 - val_loss: 41.2767
Epoch 320/10000
1126/1126 [==============================] - 0s 89us/step - loss: 31.5386 - val_loss: 41.2699
Epoch 321/10000
1126/1126 [==============================] - 0s 94us/step - loss: 31.5028 - val_loss: 41.2584
Epoch 322/10000
1126/1126 [==============================] - 0s 92us/step - loss: 31.4677 - val_loss: 41.2387
Epoch 323/10000
1126/1126 [==============================] - 0s 93us/step - loss: 31.4108 - val_loss: 41.2133
Epoch 324/10000
1126/1126 [==============================] - 0s 91us/step - loss: 31.3743 - val_loss: 41.1937
Epoch 325/10000
1126/1126 [==============================] - 0s 88us/step - loss: 31.3334 - val_loss: 41.1935
Epoch 326/10000
1126/1126 [==============================] - 0s 92us/step - loss: 31.2945 - val_loss: 41.1399
Epoch 327/10000
1126/1126 [==============================] - 0s 91us/step - loss: 31.2434 - val_loss: 41.1470
Epoch 328/10000
1126/1126 [==============================] - 0s 92us/step - loss: 31.2067 - val_loss: 41.0971
Epoch 329/10000
1126/1126 [==============================] - 0s 90us/step - loss: 31.1626 - val_loss: 41.0823
Epoch 330/10000
1126/1126 [==============================] - 0s 87us/step - loss: 31.1165 - val_loss: 41.0612
Epoch 331/10000
1126/1126 [==============================] - 0s 97us/step - loss: 31.0834 - val_loss: 41.0370
Epoch 332/10000
1126/1126 [==============================] - 0s 95us/step - loss: 31.0420 - val_loss: 41.0160
Epoch 333/10000
1126/1126 [==============================] - 0s 92us/step - loss: 30.9873 - val_loss: 40.9998
Epoch 334/10000
1126/1126 [==============================] - 0s 95us/step - loss: 30.9701 - val_loss: 41.0039
Epoch 335/10000
1126/1126 [==============================] - 0s 93us/step - loss: 30.9880 - val_loss: 40.9626
Epoch 336/10000
1126/1126 [==============================] - 0s 96us/step - loss: 31.2493 - val_loss: 41.0923
Epoch 337/10000
1126/1126 [==============================] - 0s 97us/step - loss: 31.0990 - val_loss: 40.8961
Epoch 338/10000
```

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1126/1126 [==============================] - 0s 88us/step - loss: 30.8834 - val_loss: 40.9233
Epoch 339/10000
1126/1126 [==============================] - 0s 92us/step - loss: 30.7475 - val_loss: 40.8799
Epoch 340/10000
1126/1126 [==============================] - 0s 94us/step - loss: 30.6978 - val_loss: 40.8623
Epoch 341/10000
1126/1126 [==============================] - 0s 124us/step - loss: 30.6575 - val_loss: 40.8621
Epoch 342/10000
1126/1126 [==============================] - 0s 111us/step - loss: 30.6121 - val_loss: 40.8389
Epoch 343/10000
1126/1126 [==============================] - 0s 111us/step - loss: 30.5697 - val_loss: 40.7922
Epoch 344/10000
1126/1126 [==============================] - 0s 120us/step - loss: 30.5152 - val_loss: 40.7518
Epoch 345/10000
1126/1126 [==============================] - 0s 119us/step - loss: 30.4621 - val_loss: 40.7289
Epoch 346/10000
1126/1126 [==============================] - 0s 122us/step - loss: 30.4305 - val_loss: 40.7455
Epoch 347/10000
1126/1126 [==============================] - 0s 119us/step - loss: 30.3981 - val_loss: 40.6992
Epoch 348/10000
1126/1126 [==============================] - 0s 118us/step - loss: 30.3595 - val_loss: 40.7018
Epoch 349/10000
1126/1126 [==============================] - 0s 114us/step - loss: 30.3251 - val_loss: 40.6904
Epoch 350/10000
1126/1126 [==============================] - 0s 97us/step - loss: 30.2867 - val_loss: 40.6750
Epoch 351/10000
1126/1126 [==============================] - 0s 101us/step - loss: 30.2546 - val_loss: 40.6677
Epoch 352/10000
1126/1126 [==============================] - 0s 98us/step - loss: 30.2145 - val_loss: 40.6624
Epoch 353/10000
1126/1126 [==============================] - 0s 100us/step - loss: 30.1799 - val_loss: 40.6645
Epoch 354/10000
1126/1126 [==============================] - 0s 96us/step - loss: 30.1429 - val_loss: 40.6618
Epoch 355/10000
1126/1126 [==============================] - 0s 99us/step - loss: 30.1091 - val_loss: 40.5978
Epoch 356/10000
1126/1126 [==============================] - 0s 94us/step - loss: 30.0691 - val_loss: 40.6073
Epoch 357/10000
1126/1126 [==============================] - 0s 99us/step - loss: 30.0444 - val_loss: 40.5870
Epoch 358/10000
1126/1126 [==============================] - 0s 99us/step - loss: 30.0013 - val_loss: 40.5885
Epoch 359/10000
1126/1126 [==============================] - 0s 93us/step - loss: 29.9748 - val_loss: 40.5847
Epoch 360/10000
1126/1126 [==============================] - 0s 94us/step - loss: 29.9309 - val_loss: 40.5527
Epoch 361/10000
1126/1126 [==============================] - 0s 95us/step - loss: 29.9091 - val_loss: 40.5370
Epoch 362/10000
```

```
1126/1126 [==============================] - 0s 99us/step - loss: 29.8722 - val_loss: 40.5541
Epoch 363/10000
1126/1126 [==============================] - 0s 97us/step - loss: 29.8490 - val_loss: 40.5363
Epoch 364/10000
1126/1126 [==============================] - 0s 101us/step - loss: 29.7989 - val_loss: 40.5498
Epoch 365/10000
1126/1126 [==============================] - 0s 95us/step - loss: 29.7723 - val_loss: 40.5625
Epoch 366/10000
1126/1126 [==============================] - 0s 89us/step - loss: 29.7466 - val_loss: 40.5130
Epoch 367/10000
1126/1126 [==============================] - 0s 95us/step - loss: 29.7185 - val_loss: 40.5428
Epoch 368/10000
1126/1126 [==============================] - 0s 91us/step - loss: 29.6847 - val_loss: 40.4903
Epoch 369/10000
1126/1126 [==============================] - 0s 90us/step - loss: 29.6495 - val_loss: 40.4559
Epoch 370/10000
1126/1126 [==============================] - 0s 93us/step - loss: 29.6152 - val_loss: 40.4785
Epoch 371/10000
1126/1126 [==============================] - 0s 96us/step - loss: 29.5873 - val_loss: 40.4399
Epoch 372/10000
1126/1126 [==============================] - 0s 89us/step - loss: 29.5683 - val_loss: 40.4256
Epoch 373/10000
1126/1126 [==============================] - 0s 91us/step - loss: 29.6009 - val_loss: 40.4314
Epoch 374/10000
1126/1126 [==============================] - 0s 89us/step - loss: 29.5509 - val_loss: 40.4603
Epoch 375/10000
1126/1126 [==============================] - 0s 90us/step - loss: 29.5742 - val_loss: 40.4108
Epoch 376/10000
1126/1126 [==============================] - 0s 91us/step - loss: 29.4864 - val_loss: 40.4479
Epoch 377/10000
1126/1126 [==============================] - 0s 93us/step - loss: 29.4829 - val_loss: 40.3899
Epoch 378/10000
1126/1126 [==============================] - 0s 93us/step - loss: 29.4246 - val_loss: 40.4190
Epoch 379/10000
1126/1126 [==============================] - 0s 93us/step - loss: 29.4151 - val_loss: 40.3675
Epoch 380/10000
1126/1126 [==============================] - 0s 95us/step - loss: 29.3532 - val_loss: 40.4071
Epoch 381/10000
1126/1126 [==============================] - 0s 95us/step - loss: 29.3462 - val_loss: 40.3477
Epoch 382/10000
1126/1126 [==============================] - 0s 92us/step - loss: 29.2958 - val_loss: 40.3721
Epoch 383/10000
1126/1126 [==============================] - 0s 92us/step - loss: 29.2894 - val_loss: 40.3437
Epoch 384/10000
1126/1126 [==============================] - 0s 91us/step - loss: 29.2359 - val_loss: 40.3546
Epoch 385/10000
1126/1126 [==============================] - 0s 92us/step - loss: 29.2320 - val_loss: 40.3436
Epoch 386/10000
```

```
1126/1126 [==============================] - 0s 94us/step - loss: 29.1838 - val_loss: 40.3074
Epoch 387/10000
1126/1126 [==============================] - 0s 103us/step - loss: 29.1719 - val_loss: 40.3050
Epoch 388/10000
1126/1126 [==============================] - 0s 97us/step - loss: 29.1255 - val_loss: 40.2807
Epoch 389/10000
1126/1126 [==============================] - 0s 110us/step - loss: 29.1074 - val_loss: 40.2859
Epoch 390/10000
1126/1126 [==============================] - 0s 121us/step - loss: 29.0687 - val_loss: 40.2466
Epoch 391/10000
1126/1126 [==============================] - 0s 107us/step - loss: 29.0557 - val_loss: 40.2358
Epoch 392/10000
1126/1126 [==============================] - 0s 103us/step - loss: 29.0947 - val_loss: 40.3693
Epoch 393/10000
1126/1126 [==============================] - 0s 96us/step - loss: 29.3946 - val_loss: 40.4361
Epoch 394/10000
1126/1126 [==============================] - 0s 123us/step - loss: 29.3251 - val_loss: 40.3054
Epoch 395/10000
1126/1126 [==============================] - 0s 121us/step - loss: 29.0723 - val_loss: 40.2712
Epoch 396/10000
1126/1126 [==============================] - 0s 108us/step - loss: 28.9198 - val_loss: 40.2221
Epoch 397/10000
1126/1126 [==============================] - 0s 102us/step - loss: 28.8687 - val_loss: 40.2575
Epoch 398/10000
1126/1126 [==============================] - 0s 98us/step - loss: 28.8434 - val_loss: 40.2403
Epoch 399/10000
1126/1126 [==============================] - 0s 112us/step - loss: 28.8133 - val_loss: 40.3158
Epoch 400/10000
1126/1126 [==============================] - 0s 110us/step - loss: 28.8057 - val_loss: 40.2395
Epoch 401/10000
1126/1126 [==============================] - 0s 113us/step - loss: 28.7671 - val_loss: 40.2925
Epoch 402/10000
1126/1126 [==============================] - 0s 112us/step - loss: 28.7599 - val_loss: 40.2511
Epoch 403/10000
1126/1126 [==============================] - 0s 112us/step - loss: 28.7224 - val_loss: 40.2486
Epoch 404/10000
1126/1126 [==============================] - 0s 101us/step - loss: 28.6998 - val_loss: 40.2647
Epoch 405/10000
1126/1126 [==============================] - 0s 118us/step - loss: 28.6909 - val_loss: 40.2514
Epoch 406/10000
1126/1126 [==============================] - 0s 122us/step - loss: 28.6516 - val_loss: 40.2447
Epoch 00406: early stopping
```

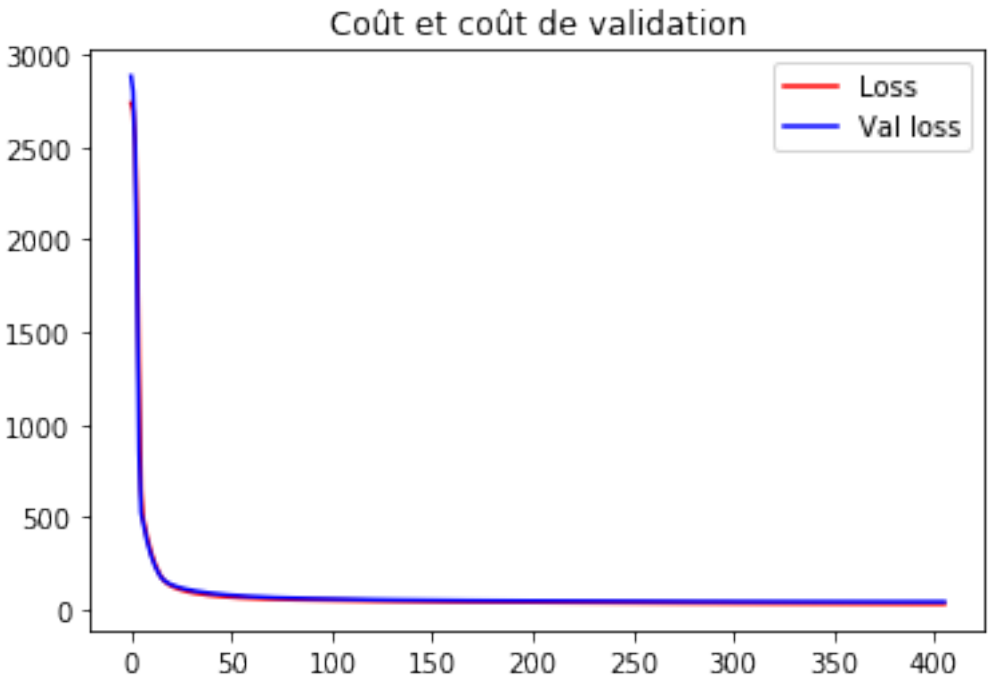
```
In [12]: y_pred = model.predict(X_test)
         plt.title('Coût et coût de validation')
         line1,=plt.plot(history.history['loss'], label="Loss", linestyle='-', color='r')
         line2,=plt.plot(history.history['val_loss'], label="Val loss", linestyle='-', color='
```

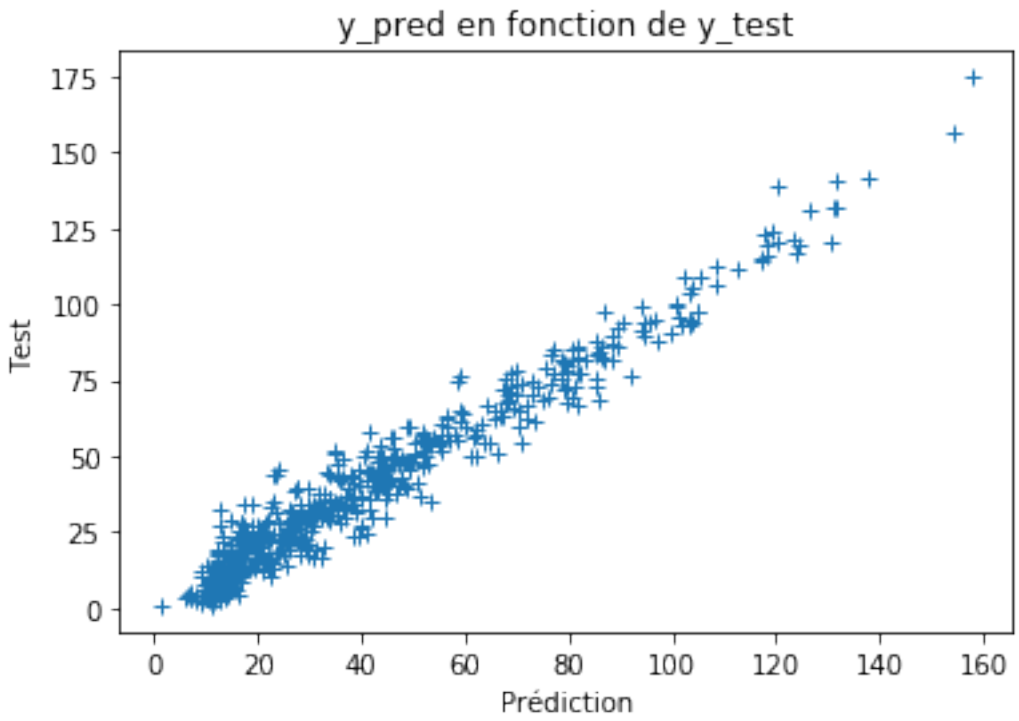
```
first_legend = plt.legend(handles=[line1, line2], loc=1)

plt.show()

plt.title('y_pred en fonction de y_test')

plt.plot(y_pred[:], y_test[:], '+')
plt.ylabel('Test')
plt.xlabel('Prédiction')
plt.show()
```






```
In [13]: y_test.reshape(len(y_test)).shape
```

```
Out[13]: (564,)
```

```
In [ ]:
```