

## 6. Formación de un modelo de predicción de series temporales basado en RNN

A partir del código base proporcionado, se completa la construcción de un modelo de predicción de series temporales utilizando una **Red Neuronal Recurrente (RNN)**. El modelo recibe una serie de datos escalados y aprende a predecir el valor futuro con base en ventanas de observaciones pasadas.

```
In [2]: import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler
import tensorflow as tf
import matplotlib.pyplot as plt
```

```
In [3]: ## Lectura de datos
df = pd.read_csv(r'./data_boston.csv',
                 header='infer',
                 encoding='latin1')
df = df[['PRICE']]
```

```
In [4]: ## Escalar los datos
scaler = MinMaxScaler()
scaleddata = scaler.fit_transform(df)
```

```
In [5]: ## Crear datos de entrada para RNN
def crear_secuencias(data, lensec=5):
    """Creacion de datos de entrada
    data = datos a introducir
    lensec = secuencia de datos por defecto 5"""
    X, y = [], []
    for i in range(len(data) - lensec):
        X.append(data[i:i+lensec])
        y.append(data[i+lensec])
    return np.array(X), np.array(y)
lensecuencias = 5
X, y = crear_secuencias(scaleddata)
```

```
In [6]: ## Dividir datos en entrenamiento y prueba
X_train, X_test, y_train, y_test = train_test_split(X, y,
                                                    test_size=0.2,
                                                    shuffle=False)
```

```
In [7]: ## Parámetros de entrenamiento
batch_size = 1
n_epochs = 1_000
learn_rate = 0.0001
```





























```
In [8]: ##? Definicion del modelo RNN  
model = tf.keras.Sequential()  
model.add(tf.keras.layers.SimpleRNN(50, activation='tanh', return_sequences=False,  
model.add(tf.keras.layers.Dense(1))
```

c:\Users\chapu\Documents\Repositorios2\Samsung\_InovationCampus\env\Lib\site-packages\keras\src\layers\rnn\rnn.py:200: UserWarning: Do not pass an `input\_shape`/`input\_dim` argument to a layer. When using Sequential models, prefer using an `Input(shape)` object as the first layer in the model instead.  
super().\_\_init\_\_(\*\*kwargs)

```
In [9]: ##? Compilar modelo  
model.compile(optimizer=tf.keras.optimizers.Adam(learning_rate=learn_rate),  
loss='mse')
```

```
In [10]: ##? Entrenar modelo  
history = model.fit(X_train, y_train,  
epochs=n_epochs,  
batch_size=batch_size,  
validation_data=(X_test, y_test),  
verbose=1)
```

```

Epoch 1/1000
400/400  1s 2ms/step - loss: 0.0484 - val_loss: 0.0103
Epoch 2/1000
400/400  1s 1ms/step - loss: 0.0243 - val_loss: 0.0107
Epoch 3/1000
400/400  1s 1ms/step - loss: 0.0288 - val_loss: 0.0112
Epoch 4/1000
400/400  0s 1ms/step - loss: 0.0196 - val_loss: 0.0096
Epoch 5/1000
400/400  1s 1ms/step - loss: 0.0226 - val_loss: 0.0091
Epoch 6/1000
400/400  1s 1ms/step - loss: 0.0263 - val_loss: 0.0097
Epoch 7/1000
400/400  0s 1ms/step - loss: 0.0216 - val_loss: 0.0093
Epoch 8/1000
400/400  0s 1ms/step - loss: 0.0232 - val_loss: 0.0093
Epoch 9/1000
400/400  1s 1ms/step - loss: 0.0193 - val_loss: 0.0090
Epoch 10/1000
400/400  1s 1ms/step - loss: 0.0207 - val_loss: 0.0118
Epoch 11/1000
400/400  1s 1ms/step - loss: 0.0204 - val_loss: 0.0091
Epoch 12/1000
400/400  1s 1ms/step - loss: 0.0202 - val_loss: 0.0088
Epoch 13/1000
400/400  0s 1ms/step - loss: 0.0198 - val_loss: 0.0100
Epoch 14/1000
400/400  0s 1ms/step - loss: 0.0201 - val_loss: 0.0107
Epoch 15/1000
400/400  1s 1ms/step - loss: 0.0217 - val_loss: 0.0108
Epoch 16/1000
400/400  1s 1ms/step - loss: 0.0204 - val_loss: 0.0094
Epoch 17/1000
400/400  1s 1ms/step - loss: 0.0208 - val_loss: 0.0091
Epoch 18/1000
400/400  1s 1ms/step - loss: 0.0221 - val_loss: 0.0102
Epoch 19/1000
400/400  1s 1ms/step - loss: 0.0211 - val_loss: 0.0110
Epoch 20/1000
400/400  1s 1ms/step - loss: 0.0201 - val_loss: 0.0127
Epoch 21/1000
400/400  1s 1ms/step - loss: 0.0216 - val_loss: 0.0104
Epoch 22/1000
400/400  0s 1ms/step - loss: 0.0169 - val_loss: 0.0099
Epoch 23/1000
400/400  0s 1ms/step - loss: 0.0217 - val_loss: 0.0093
Epoch 24/1000
400/400  0s 1ms/step - loss: 0.0187 - val_loss: 0.0106
Epoch 25/1000
400/400  0s 1ms/step - loss: 0.0195 - val_loss: 0.0093
Epoch 26/1000
400/400  0s 1ms/step - loss: 0.0241 - val_loss: 0.0091
Epoch 27/1000
400/400  0s 1ms/step - loss: 0.0226 - val_loss: 0.0090
Epoch 28/1000
400/400  0s 1ms/step - loss: 0.0242 - val_loss: 0.0094

```

```

Epoch 29/1000
400/400 ————— 1s 1ms/step - loss: 0.0206 - val_loss: 0.0101
Epoch 30/1000
400/400 ————— 1s 2ms/step - loss: 0.0175 - val_loss: 0.0100
Epoch 31/1000
400/400 ————— 1s 1ms/step - loss: 0.0163 - val_loss: 0.0117
Epoch 32/1000
400/400 ————— 1s 1ms/step - loss: 0.0221 - val_loss: 0.0098
Epoch 33/1000
400/400 ————— 1s 1ms/step - loss: 0.0181 - val_loss: 0.0170
Epoch 34/1000
400/400 ————— 1s 1ms/step - loss: 0.0226 - val_loss: 0.0094
Epoch 35/1000
400/400 ————— 1s 1ms/step - loss: 0.0277 - val_loss: 0.0098
Epoch 36/1000
400/400 ————— 1s 1ms/step - loss: 0.0175 - val_loss: 0.0109
Epoch 37/1000
400/400 ————— 0s 1ms/step - loss: 0.0189 - val_loss: 0.0105
Epoch 38/1000
400/400 ————— 1s 1ms/step - loss: 0.0203 - val_loss: 0.0096
Epoch 39/1000
400/400 ————— 1s 1ms/step - loss: 0.0201 - val_loss: 0.0094
Epoch 40/1000
400/400 ————— 1s 1ms/step - loss: 0.0222 - val_loss: 0.0112
Epoch 41/1000
400/400 ————— 1s 1ms/step - loss: 0.0202 - val_loss: 0.0097
Epoch 42/1000
400/400 ————— 0s 1ms/step - loss: 0.0208 - val_loss: 0.0097
Epoch 43/1000
400/400 ————— 1s 1ms/step - loss: 0.0176 - val_loss: 0.0096
Epoch 44/1000
400/400 ————— 0s 1ms/step - loss: 0.0203 - val_loss: 0.0111
Epoch 45/1000
400/400 ————— 0s 1ms/step - loss: 0.0197 - val_loss: 0.0097
Epoch 46/1000
400/400 ————— 0s 1ms/step - loss: 0.0232 - val_loss: 0.0097
Epoch 47/1000
400/400 ————— 0s 1ms/step - loss: 0.0163 - val_loss: 0.0097
Epoch 48/1000
400/400 ————— 0s 1ms/step - loss: 0.0184 - val_loss: 0.0116
Epoch 49/1000
400/400 ————— 1s 1ms/step - loss: 0.0201 - val_loss: 0.0105
Epoch 50/1000
400/400 ————— 1s 1ms/step - loss: 0.0203 - val_loss: 0.0108
Epoch 51/1000
400/400 ————— 1s 1ms/step - loss: 0.0196 - val_loss: 0.0102
Epoch 52/1000
400/400 ————— 1s 1ms/step - loss: 0.0194 - val_loss: 0.0104
Epoch 53/1000
400/400 ————— 1s 1ms/step - loss: 0.0190 - val_loss: 0.0105
Epoch 54/1000
400/400 ————— 1s 1ms/step - loss: 0.0235 - val_loss: 0.0112
Epoch 55/1000
400/400 ————— 0s 1ms/step - loss: 0.0176 - val_loss: 0.0108
Epoch 56/1000
400/400 ————— 1s 1ms/step - loss: 0.0197 - val_loss: 0.0103

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```

Epoch 57/1000
400/400 ————— 1s 1ms/step - loss: 0.0196 - val_loss: 0.0109
Epoch 58/1000
400/400 ————— 1s 1ms/step - loss: 0.0196 - val_loss: 0.0114
Epoch 59/1000
400/400 ————— 0s 1ms/step - loss: 0.0206 - val_loss: 0.0120
Epoch 60/1000
400/400 ————— 1s 1ms/step - loss: 0.0194 - val_loss: 0.0136
Epoch 61/1000
400/400 ————— 1s 1ms/step - loss: 0.0184 - val_loss: 0.0103
Epoch 62/1000
400/400 ————— 1s 1ms/step - loss: 0.0172 - val_loss: 0.0100
Epoch 63/1000
400/400 ————— 1s 1ms/step - loss: 0.0156 - val_loss: 0.0138
Epoch 64/1000
400/400 ————— 1s 1ms/step - loss: 0.0191 - val_loss: 0.0100
Epoch 65/1000
400/400 ————— 0s 1ms/step - loss: 0.0210 - val_loss: 0.0106
Epoch 66/1000
400/400 ————— 0s 1ms/step - loss: 0.0206 - val_loss: 0.0128
Epoch 67/1000
400/400 ————— 0s 1ms/step - loss: 0.0256 - val_loss: 0.0112
Epoch 68/1000
400/400 ————— 1s 1ms/step - loss: 0.0216 - val_loss: 0.0109
Epoch 69/1000
400/400 ————— 0s 1ms/step - loss: 0.0159 - val_loss: 0.0114
Epoch 70/1000
400/400 ————— 0s 1ms/step - loss: 0.0179 - val_loss: 0.0115
Epoch 71/1000
400/400 ————— 0s 1ms/step - loss: 0.0179 - val_loss: 0.0142
Epoch 72/1000
400/400 ————— 0s 1ms/step - loss: 0.0245 - val_loss: 0.0101
Epoch 73/1000
400/400 ————— 0s 1ms/step - loss: 0.0207 - val_loss: 0.0112
Epoch 74/1000
400/400 ————— 1s 1ms/step - loss: 0.0187 - val_loss: 0.0098
Epoch 75/1000
400/400 ————— 1s 1ms/step - loss: 0.0198 - val_loss: 0.0132
Epoch 76/1000
400/400 ————— 1s 2ms/step - loss: 0.0200 - val_loss: 0.0103
Epoch 77/1000
400/400 ————— 1s 1ms/step - loss: 0.0198 - val_loss: 0.0104
Epoch 78/1000
400/400 ————— 1s 1ms/step - loss: 0.0245 - val_loss: 0.0104
Epoch 79/1000
400/400 ————— 1s 1ms/step - loss: 0.0178 - val_loss: 0.0118
Epoch 80/1000
400/400 ————— 1s 1ms/step - loss: 0.0185 - val_loss: 0.0102
Epoch 81/1000
400/400 ————— 1s 2ms/step - loss: 0.0175 - val_loss: 0.0126
Epoch 82/1000
400/400 ————— 1s 1ms/step - loss: 0.0206 - val_loss: 0.0104
Epoch 83/1000
400/400 ————— 1s 1ms/step - loss: 0.0191 - val_loss: 0.0113
Epoch 84/1000
400/400 ————— 1s 1ms/step - loss: 0.0230 - val_loss: 0.0106





























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Epoch 85/1000
400/400 ————— 1s 1ms/step - loss: 0.0205 - val_loss: 0.0109
Epoch 86/1000
400/400 ————— 1s 1ms/step - loss: 0.0215 - val_loss: 0.0116
Epoch 87/1000
400/400 ————— 1s 2ms/step - loss: 0.0189 - val_loss: 0.0103
Epoch 88/1000
400/400 ————— 1s 2ms/step - loss: 0.0213 - val_loss: 0.0116
Epoch 89/1000
400/400 ————— 1s 1ms/step - loss: 0.0255 - val_loss: 0.0105
Epoch 90/1000
400/400 ————— 1s 1ms/step - loss: 0.0184 - val_loss: 0.0108
Epoch 91/1000
400/400 ————— 1s 1ms/step - loss: 0.0191 - val_loss: 0.0102
Epoch 92/1000
400/400 ————— 1s 2ms/step - loss: 0.0190 - val_loss: 0.0110
Epoch 93/1000
400/400 ————— 1s 1ms/step - loss: 0.0202 - val_loss: 0.0105
Epoch 94/1000
400/400 ————— 1s 2ms/step - loss: 0.0202 - val_loss: 0.0113
Epoch 95/1000
400/400 ————— 1s 1ms/step - loss: 0.0212 - val_loss: 0.0105
Epoch 96/1000
400/400 ————— 1s 1ms/step - loss: 0.0165 - val_loss: 0.0101
Epoch 97/1000
400/400 ————— 1s 2ms/step - loss: 0.0207 - val_loss: 0.0119
Epoch 98/1000
400/400 ————— 1s 2ms/step - loss: 0.0234 - val_loss: 0.0104
Epoch 99/1000
400/400 ————— 1s 2ms/step - loss: 0.0196 - val_loss: 0.0110
Epoch 100/1000
400/400 ————— 1s 2ms/step - loss: 0.0180 - val_loss: 0.0104
Epoch 101/1000
400/400 ————— 1s 2ms/step - loss: 0.0186 - val_loss: 0.0108
Epoch 102/1000
400/400 ————— 1s 2ms/step - loss: 0.0175 - val_loss: 0.0115
Epoch 103/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0107
Epoch 104/1000
400/400 ————— 1s 1ms/step - loss: 0.0205 - val_loss: 0.0114
Epoch 105/1000
400/400 ————— 1s 1ms/step - loss: 0.0152 - val_loss: 0.0112
Epoch 106/1000
400/400 ————— 1s 1ms/step - loss: 0.0195 - val_loss: 0.0118
Epoch 107/1000
400/400 ————— 1s 1ms/step - loss: 0.0193 - val_loss: 0.0111
Epoch 108/1000
400/400 ————— 0s 1ms/step - loss: 0.0190 - val_loss: 0.0107
Epoch 109/1000
400/400 ————— 1s 1ms/step - loss: 0.0218 - val_loss: 0.0111
Epoch 110/1000
400/400 ————— 0s 1ms/step - loss: 0.0167 - val_loss: 0.0105
Epoch 111/1000
400/400 ————— 1s 1ms/step - loss: 0.0241 - val_loss: 0.0101
Epoch 112/1000
400/400 ————— 1s 1ms/step - loss: 0.0196 - val_loss: 0.0101

```

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Epoch 113/1000
400/400  1s 1ms/step - loss: 0.0189 - val_loss: 0.0107
Epoch 114/1000
400/400  1s 1ms/step - loss: 0.0193 - val_loss: 0.0107
Epoch 115/1000
400/400  0s 1ms/step - loss: 0.0170 - val_loss: 0.0099
Epoch 116/1000
400/400  1s 1ms/step - loss: 0.0198 - val_loss: 0.0100
Epoch 117/1000
400/400  1s 1ms/step - loss: 0.0197 - val_loss: 0.0109
Epoch 118/1000
400/400  1s 1ms/step - loss: 0.0208 - val_loss: 0.0116
Epoch 119/1000
400/400  1s 1ms/step - loss: 0.0170 - val_loss: 0.0117
Epoch 120/1000
400/400  1s 1ms/step - loss: 0.0176 - val_loss: 0.0106
Epoch 121/1000
400/400  1s 1ms/step - loss: 0.0183 - val_loss: 0.0111
Epoch 122/1000
400/400  1s 1ms/step - loss: 0.0196 - val_loss: 0.0109
Epoch 123/1000
400/400  1s 1ms/step - loss: 0.0183 - val_loss: 0.0109
Epoch 124/1000
400/400  1s 1ms/step - loss: 0.0200 - val_loss: 0.0107
Epoch 125/1000
400/400  0s 1ms/step - loss: 0.0186 - val_loss: 0.0112
Epoch 126/1000
400/400  0s 1ms/step - loss: 0.0199 - val_loss: 0.0115
Epoch 127/1000
400/400  0s 1ms/step - loss: 0.0210 - val_loss: 0.0107
Epoch 128/1000
400/400  0s 1ms/step - loss: 0.0214 - val_loss: 0.0109
Epoch 129/1000
400/400  0s 1ms/step - loss: 0.0177 - val_loss: 0.0111
Epoch 130/1000
400/400  0s 1ms/step - loss: 0.0230 - val_loss: 0.0106
Epoch 131/1000
400/400  0s 1ms/step - loss: 0.0229 - val_loss: 0.0102
Epoch 132/1000
400/400  0s 1ms/step - loss: 0.0191 - val_loss: 0.0099
Epoch 133/1000
400/400  0s 1ms/step - loss: 0.0214 - val_loss: 0.0107
Epoch 134/1000
400/400  0s 1ms/step - loss: 0.0184 - val_loss: 0.0111
Epoch 135/1000
400/400  0s 1ms/step - loss: 0.0255 - val_loss: 0.0114
Epoch 136/1000
400/400  0s 1ms/step - loss: 0.0208 - val_loss: 0.0097
Epoch 137/1000
400/400  0s 1ms/step - loss: 0.0249 - val_loss: 0.0104
Epoch 138/1000
400/400  0s 1ms/step - loss: 0.0200 - val_loss: 0.0104
Epoch 139/1000
400/400  0s 1ms/step - loss: 0.0191 - val_loss: 0.0104
Epoch 140/1000
400/400  0s 1ms/step - loss: 0.0201 - val_loss: 0.0107





























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Epoch 141/1000  
400/400 ————— 1s 1ms/step - loss: 0.0181 - val\_loss: 0.0101  
Epoch 142/1000  
400/400 ————— 0s 1ms/step - loss: 0.0167 - val\_loss: 0.0105  
Epoch 143/1000  
400/400 ————— 0s 1ms/step - loss: 0.0176 - val\_loss: 0.0102  
Epoch 144/1000  
400/400 ————— 0s 1ms/step - loss: 0.0203 - val\_loss: 0.0099  
Epoch 145/1000  
400/400 ————— 0s 1ms/step - loss: 0.0185 - val\_loss: 0.0116  
Epoch 146/1000  
400/400 ————— 0s 1ms/step - loss: 0.0191 - val\_loss: 0.0103  
Epoch 147/1000  
400/400 ————— 0s 1ms/step - loss: 0.0218 - val\_loss: 0.0106  
Epoch 148/1000  
400/400 ————— 0s 1ms/step - loss: 0.0214 - val\_loss: 0.0096  
Epoch 149/1000  
400/400 ————— 0s 1ms/step - loss: 0.0216 - val\_loss: 0.0101  
Epoch 150/1000  
400/400 ————— 0s 1ms/step - loss: 0.0185 - val\_loss: 0.0102  
Epoch 151/1000  
400/400 ————— 0s 1ms/step - loss: 0.0170 - val\_loss: 0.0101  
Epoch 152/1000  
400/400 ————— 1s 1ms/step - loss: 0.0196 - val\_loss: 0.0105  
Epoch 153/1000  
400/400 ————— 1s 1ms/step - loss: 0.0161 - val\_loss: 0.0108  
Epoch 154/1000  
400/400 ————— 1s 1ms/step - loss: 0.0220 - val\_loss: 0.0107  
Epoch 155/1000  
400/400 ————— 1s 1ms/step - loss: 0.0231 - val\_loss: 0.0097  
Epoch 156/1000  
400/400 ————— 1s 1ms/step - loss: 0.0241 - val\_loss: 0.0098  
Epoch 157/1000  
400/400 ————— 1s 1ms/step - loss: 0.0179 - val\_loss: 0.0117  
Epoch 158/1000  
400/400 ————— 1s 1ms/step - loss: 0.0216 - val\_loss: 0.0101  
Epoch 159/1000  
400/400 ————— 1s 1ms/step - loss: 0.0203 - val\_loss: 0.0104  
Epoch 160/1000  
400/400 ————— 1s 1ms/step - loss: 0.0174 - val\_loss: 0.0097  
Epoch 161/1000  
400/400 ————— 1s 1ms/step - loss: 0.0184 - val\_loss: 0.0106  
Epoch 162/1000  
400/400 ————— 1s 1ms/step - loss: 0.0167 - val\_loss: 0.0101  
Epoch 163/1000  
400/400 ————— 1s 1ms/step - loss: 0.0231 - val\_loss: 0.0108  
Epoch 164/1000  
400/400 ————— 1s 1ms/step - loss: 0.0191 - val\_loss: 0.0103  
Epoch 165/1000  
400/400 ————— 1s 1ms/step - loss: 0.0175 - val\_loss: 0.0102  
Epoch 166/1000  
400/400 ————— 1s 1ms/step - loss: 0.0176 - val\_loss: 0.0107  
Epoch 167/1000  
400/400 ————— 1s 1ms/step - loss: 0.0200 - val\_loss: 0.0097  
Epoch 168/1000  
400/400 ————— 1s 1ms/step - loss: 0.0239 - val\_loss: 0.0104































Epoch 169/1000  
400/400 ————— 1s 1ms/step - loss: 0.0181 - val\_loss: 0.0107  
Epoch 170/1000  
400/400 ————— 1s 2ms/step - loss: 0.0202 - val\_loss: 0.0101  
Epoch 171/1000  
400/400 ————— 1s 2ms/step - loss: 0.0207 - val\_loss: 0.0104  
Epoch 172/1000  
400/400 ————— 1s 1ms/step - loss: 0.0170 - val\_loss: 0.0095  
Epoch 173/1000  
400/400 ————— 1s 1ms/step - loss: 0.0166 - val\_loss: 0.0103  
Epoch 174/1000  
400/400 ————— 1s 2ms/step - loss: 0.0251 - val\_loss: 0.0100  
Epoch 175/1000  
400/400 ————— 1s 1ms/step - loss: 0.0189 - val\_loss: 0.0104  
Epoch 176/1000  
400/400 ————— 1s 1ms/step - loss: 0.0196 - val\_loss: 0.0100  
Epoch 177/1000  
400/400 ————— 1s 1ms/step - loss: 0.0177 - val\_loss: 0.0106  
Epoch 178/1000  
400/400 ————— 1s 1ms/step - loss: 0.0161 - val\_loss: 0.0107  
Epoch 179/1000  
400/400 ————— 1s 1ms/step - loss: 0.0215 - val\_loss: 0.0103  
Epoch 180/1000  
400/400 ————— 1s 1ms/step - loss: 0.0177 - val\_loss: 0.0106  
Epoch 181/1000  
400/400 ————— 1s 2ms/step - loss: 0.0205 - val\_loss: 0.0103  
Epoch 182/1000  
400/400 ————— 1s 2ms/step - loss: 0.0178 - val\_loss: 0.0101  
Epoch 183/1000  
400/400 ————— 1s 1ms/step - loss: 0.0191 - val\_loss: 0.0108  
Epoch 184/1000  
400/400 ————— 1s 1ms/step - loss: 0.0220 - val\_loss: 0.0101  
Epoch 185/1000  
400/400 ————— 1s 1ms/step - loss: 0.0224 - val\_loss: 0.0103  
Epoch 186/1000  
400/400 ————— 1s 1ms/step - loss: 0.0188 - val\_loss: 0.0102  
Epoch 187/1000  
400/400 ————— 1s 1ms/step - loss: 0.0212 - val\_loss: 0.0105  
Epoch 188/1000  
400/400 ————— 1s 1ms/step - loss: 0.0187 - val\_loss: 0.0098  
Epoch 189/1000  
400/400 ————— 1s 1ms/step - loss: 0.0196 - val\_loss: 0.0098  
Epoch 190/1000  
400/400 ————— 1s 1ms/step - loss: 0.0169 - val\_loss: 0.0097  
Epoch 191/1000  
400/400 ————— 1s 1ms/step - loss: 0.0171 - val\_loss: 0.0096  
Epoch 192/1000  
400/400 ————— 1s 1ms/step - loss: 0.0173 - val\_loss: 0.0102  
Epoch 193/1000  
400/400 ————— 1s 1ms/step - loss: 0.0186 - val\_loss: 0.0102  
Epoch 194/1000  
400/400 ————— 1s 1ms/step - loss: 0.0198 - val\_loss: 0.0098  
Epoch 195/1000  
400/400 ————— 1s 1ms/step - loss: 0.0213 - val\_loss: 0.0109  
Epoch 196/1000  
400/400 ————— 1s 1ms/step - loss: 0.0167 - val\_loss: 0.0098

```

Epoch 197/1000
400/400  1s 1ms/step - loss: 0.0198 - val_loss: 0.0108
Epoch 198/1000
400/400  1s 1ms/step - loss: 0.0190 - val_loss: 0.0097
Epoch 199/1000
400/400  1s 1ms/step - loss: 0.0200 - val_loss: 0.0103
Epoch 200/1000
400/400  1s 1ms/step - loss: 0.0182 - val_loss: 0.0097
Epoch 201/1000
400/400  1s 1ms/step - loss: 0.0216 - val_loss: 0.0099
Epoch 202/1000
400/400  1s 1ms/step - loss: 0.0201 - val_loss: 0.0104
Epoch 203/1000
400/400  1s 1ms/step - loss: 0.0181 - val_loss: 0.0109
Epoch 204/1000
400/400  1s 1ms/step - loss: 0.0151 - val_loss: 0.0099
Epoch 205/1000
400/400  1s 1ms/step - loss: 0.0178 - val_loss: 0.0101
Epoch 206/1000
400/400  1s 1ms/step - loss: 0.0197 - val_loss: 0.0103
Epoch 207/1000
400/400  1s 1ms/step - loss: 0.0169 - val_loss: 0.0105
Epoch 208/1000
400/400  1s 1ms/step - loss: 0.0194 - val_loss: 0.0097
Epoch 209/1000
400/400  1s 1ms/step - loss: 0.0188 - val_loss: 0.0098
Epoch 210/1000
400/400  1s 1ms/step - loss: 0.0194 - val_loss: 0.0102
Epoch 211/1000
400/400  1s 2ms/step - loss: 0.0219 - val_loss: 0.0104
Epoch 212/1000
400/400  1s 1ms/step - loss: 0.0187 - val_loss: 0.0101
Epoch 213/1000
400/400  1s 2ms/step - loss: 0.0178 - val_loss: 0.0109
Epoch 214/1000
400/400  1s 2ms/step - loss: 0.0174 - val_loss: 0.0101
Epoch 215/1000
400/400  1s 2ms/step - loss: 0.0158 - val_loss: 0.0104
Epoch 216/1000
400/400  1s 2ms/step - loss: 0.0183 - val_loss: 0.0101
Epoch 217/1000
400/400  1s 2ms/step - loss: 0.0190 - val_loss: 0.0102
Epoch 218/1000
400/400  1s 1ms/step - loss: 0.0192 - val_loss: 0.0103
Epoch 219/1000
400/400  1s 1ms/step - loss: 0.0202 - val_loss: 0.0106
Epoch 220/1000
400/400  1s 2ms/step - loss: 0.0182 - val_loss: 0.0099
Epoch 221/1000
400/400  1s 1ms/step - loss: 0.0194 - val_loss: 0.0103
Epoch 222/1000
400/400  1s 1ms/step - loss: 0.0162 - val_loss: 0.0122
Epoch 223/1000
400/400  1s 2ms/step - loss: 0.0193 - val_loss: 0.0103
Epoch 224/1000
400/400  1s 1ms/step - loss: 0.0206 - val_loss: 0.0099

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Epoch 225/1000
400/400  0s 1ms/step - loss: 0.0211 - val_loss: 0.0116
Epoch 226/1000
400/400  0s 1ms/step - loss: 0.0212 - val_loss: 0.0107
Epoch 227/1000
400/400  0s 1ms/step - loss: 0.0180 - val_loss: 0.0102
Epoch 228/1000
400/400  0s 1ms/step - loss: 0.0178 - val_loss: 0.0109
Epoch 229/1000
400/400  0s 1ms/step - loss: 0.0172 - val_loss: 0.0110
Epoch 230/1000
400/400  0s 1ms/step - loss: 0.0202 - val_loss: 0.0098
Epoch 231/1000
400/400  0s 1ms/step - loss: 0.0183 - val_loss: 0.0104
Epoch 232/1000
400/400  1s 1ms/step - loss: 0.0205 - val_loss: 0.0102
Epoch 233/1000
400/400  1s 1ms/step - loss: 0.0184 - val_loss: 0.0112
Epoch 234/1000
400/400  0s 1ms/step - loss: 0.0153 - val_loss: 0.0100
Epoch 235/1000
400/400  1s 1ms/step - loss: 0.0201 - val_loss: 0.0104
Epoch 236/1000
400/400  1s 1ms/step - loss: 0.0196 - val_loss: 0.0102
Epoch 237/1000
400/400  1s 1ms/step - loss: 0.0188 - val_loss: 0.0098
Epoch 238/1000
400/400  1s 1ms/step - loss: 0.0202 - val_loss: 0.0109
Epoch 239/1000
400/400  1s 1ms/step - loss: 0.0223 - val_loss: 0.0101
Epoch 240/1000
400/400  1s 1ms/step - loss: 0.0200 - val_loss: 0.0103
Epoch 241/1000
400/400  1s 1ms/step - loss: 0.0168 - val_loss: 0.0108
Epoch 242/1000
400/400  1s 1ms/step - loss: 0.0181 - val_loss: 0.0099
Epoch 243/1000
400/400  1s 1ms/step - loss: 0.0211 - val_loss: 0.0107
Epoch 244/1000
400/400  1s 1ms/step - loss: 0.0170 - val_loss: 0.0107
Epoch 245/1000
400/400  0s 1ms/step - loss: 0.0225 - val_loss: 0.0101
Epoch 246/1000
400/400  0s 1ms/step - loss: 0.0167 - val_loss: 0.0105
Epoch 247/1000
400/400  0s 1ms/step - loss: 0.0171 - val_loss: 0.0103
Epoch 248/1000
400/400  1s 1ms/step - loss: 0.0178 - val_loss: 0.0102
Epoch 249/1000
400/400  1s 1ms/step - loss: 0.0225 - val_loss: 0.0102
Epoch 250/1000
400/400  1s 1ms/step - loss: 0.0209 - val_loss: 0.0095
Epoch 251/1000
400/400  1s 1ms/step - loss: 0.0195 - val_loss: 0.0098
Epoch 252/1000
400/400  1s 1ms/step - loss: 0.0206 - val_loss: 0.0102

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Epoch 253/1000
400/400 ————— 1s 1ms/step - loss: 0.0211 - val_loss: 0.0097
Epoch 254/1000
400/400 ————— 1s 1ms/step - loss: 0.0156 - val_loss: 0.0105
Epoch 255/1000
400/400 ————— 0s 1ms/step - loss: 0.0192 - val_loss: 0.0112
Epoch 256/1000
400/400 ————— 0s 1ms/step - loss: 0.0185 - val_loss: 0.0102
Epoch 257/1000
400/400 ————— 1s 1ms/step - loss: 0.0204 - val_loss: 0.0103
Epoch 258/1000
400/400 ————— 1s 1ms/step - loss: 0.0171 - val_loss: 0.0103
Epoch 259/1000
400/400 ————— 1s 1ms/step - loss: 0.0188 - val_loss: 0.0098
Epoch 260/1000
400/400 ————— 0s 1ms/step - loss: 0.0172 - val_loss: 0.0113
Epoch 261/1000
400/400 ————— 0s 1ms/step - loss: 0.0192 - val_loss: 0.0097
Epoch 262/1000
400/400 ————— 0s 1ms/step - loss: 0.0151 - val_loss: 0.0096
Epoch 263/1000
400/400 ————— 1s 1ms/step - loss: 0.0185 - val_loss: 0.0105
Epoch 264/1000
400/400 ————— 0s 1ms/step - loss: 0.0198 - val_loss: 0.0097
Epoch 265/1000
400/400 ————— 1s 1ms/step - loss: 0.0189 - val_loss: 0.0104
Epoch 266/1000
400/400 ————— 0s 1ms/step - loss: 0.0193 - val_loss: 0.0103
Epoch 267/1000
400/400 ————— 1s 1ms/step - loss: 0.0149 - val_loss: 0.0113
Epoch 268/1000
400/400 ————— 1s 1ms/step - loss: 0.0190 - val_loss: 0.0097
Epoch 269/1000
400/400 ————— 1s 1ms/step - loss: 0.0172 - val_loss: 0.0105
Epoch 270/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0108
Epoch 271/1000
400/400 ————— 1s 1ms/step - loss: 0.0187 - val_loss: 0.0101
Epoch 272/1000
400/400 ————— 1s 1ms/step - loss: 0.0193 - val_loss: 0.0100
Epoch 273/1000
400/400 ————— 0s 1ms/step - loss: 0.0188 - val_loss: 0.0104
Epoch 274/1000
400/400 ————— 0s 1ms/step - loss: 0.0173 - val_loss: 0.0115
Epoch 275/1000
400/400 ————— 0s 1ms/step - loss: 0.0241 - val_loss: 0.0106
Epoch 276/1000
400/400 ————— 1s 1ms/step - loss: 0.0205 - val_loss: 0.0104
Epoch 277/1000
400/400 ————— 1s 1ms/step - loss: 0.0196 - val_loss: 0.0098
Epoch 278/1000
400/400 ————— 1s 1ms/step - loss: 0.0151 - val_loss: 0.0108
Epoch 279/1000
400/400 ————— 1s 1ms/step - loss: 0.0194 - val_loss: 0.0104
Epoch 280/1000
400/400 ————— 1s 1ms/step - loss: 0.0222 - val_loss: 0.0096





























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Epoch 281/1000
400/400 ————— 0s 1ms/step - loss: 0.0163 - val_loss: 0.0108
Epoch 282/1000
400/400 ————— 1s 1ms/step - loss: 0.0195 - val_loss: 0.0102
Epoch 283/1000
400/400 ————— 1s 1ms/step - loss: 0.0184 - val_loss: 0.0100
Epoch 284/1000
400/400 ————— 0s 1ms/step - loss: 0.0168 - val_loss: 0.0104
Epoch 285/1000
400/400 ————— 1s 1ms/step - loss: 0.0206 - val_loss: 0.0102
Epoch 286/1000
400/400 ————— 1s 1ms/step - loss: 0.0210 - val_loss: 0.0108
Epoch 287/1000
400/400 ————— 1s 1ms/step - loss: 0.0208 - val_loss: 0.0098
Epoch 288/1000
400/400 ————— 0s 1ms/step - loss: 0.0223 - val_loss: 0.0097
Epoch 289/1000
400/400 ————— 0s 1ms/step - loss: 0.0194 - val_loss: 0.0116
Epoch 290/1000
400/400 ————— 0s 1ms/step - loss: 0.0219 - val_loss: 0.0100
Epoch 291/1000
400/400 ————— 0s 1ms/step - loss: 0.0184 - val_loss: 0.0106
Epoch 292/1000
400/400 ————— 1s 1ms/step - loss: 0.0175 - val_loss: 0.0107
Epoch 293/1000
400/400 ————— 0s 1ms/step - loss: 0.0163 - val_loss: 0.0103
Epoch 294/1000
400/400 ————— 1s 1ms/step - loss: 0.0176 - val_loss: 0.0102
Epoch 295/1000
400/400 ————— 0s 1ms/step - loss: 0.0198 - val_loss: 0.0104
Epoch 296/1000
400/400 ————— 0s 1ms/step - loss: 0.0189 - val_loss: 0.0111
Epoch 297/1000
400/400 ————— 0s 1ms/step - loss: 0.0207 - val_loss: 0.0098
Epoch 298/1000
400/400 ————— 1s 1ms/step - loss: 0.0180 - val_loss: 0.0105
Epoch 299/1000
400/400 ————— 1s 1ms/step - loss: 0.0180 - val_loss: 0.0103
Epoch 300/1000
400/400 ————— 1s 1ms/step - loss: 0.0193 - val_loss: 0.0102
Epoch 301/1000
400/400 ————— 1s 1ms/step - loss: 0.0186 - val_loss: 0.0095
Epoch 302/1000
400/400 ————— 1s 1ms/step - loss: 0.0190 - val_loss: 0.0103
Epoch 303/1000
400/400 ————— 1s 1ms/step - loss: 0.0152 - val_loss: 0.0108
Epoch 304/1000
400/400 ————— 1s 1ms/step - loss: 0.0209 - val_loss: 0.0105
Epoch 305/1000
400/400 ————— 1s 1ms/step - loss: 0.0167 - val_loss: 0.0102
Epoch 306/1000
400/400 ————— 1s 1ms/step - loss: 0.0199 - val_loss: 0.0099
Epoch 307/1000
400/400 ————— 1s 1ms/step - loss: 0.0188 - val_loss: 0.0096
Epoch 308/1000
400/400 ————— 1s 1ms/step - loss: 0.0190 - val_loss: 0.0103

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Epoch 309/1000
400/400  1s 1ms/step - loss: 0.0220 - val_loss: 0.0096
Epoch 310/1000
400/400  1s 1ms/step - loss: 0.0224 - val_loss: 0.0098
Epoch 311/1000
400/400  1s 1ms/step - loss: 0.0220 - val_loss: 0.0103
Epoch 312/1000
400/400  1s 1ms/step - loss: 0.0239 - val_loss: 0.0110
Epoch 313/1000
400/400  1s 1ms/step - loss: 0.0210 - val_loss: 0.0103
Epoch 314/1000
400/400  0s 1ms/step - loss: 0.0171 - val_loss: 0.0102
Epoch 315/1000
400/400  0s 1ms/step - loss: 0.0183 - val_loss: 0.0106
Epoch 316/1000
400/400  1s 1ms/step - loss: 0.0205 - val_loss: 0.0105
Epoch 317/1000
400/400  1s 1ms/step - loss: 0.0233 - val_loss: 0.0103
Epoch 318/1000
400/400  1s 1ms/step - loss: 0.0195 - val_loss: 0.0103
Epoch 319/1000
400/400  1s 1ms/step - loss: 0.0168 - val_loss: 0.0096
Epoch 320/1000
400/400  0s 1ms/step - loss: 0.0194 - val_loss: 0.0102
Epoch 321/1000
400/400  1s 1ms/step - loss: 0.0185 - val_loss: 0.0105
Epoch 322/1000
400/400  1s 1ms/step - loss: 0.0187 - val_loss: 0.0101
Epoch 323/1000
400/400  0s 1ms/step - loss: 0.0208 - val_loss: 0.0109
Epoch 324/1000
400/400  1s 1ms/step - loss: 0.0220 - val_loss: 0.0104
Epoch 325/1000
400/400  1s 1ms/step - loss: 0.0230 - val_loss: 0.0102
Epoch 326/1000
400/400  1s 1ms/step - loss: 0.0219 - val_loss: 0.0106
Epoch 327/1000
400/400  1s 1ms/step - loss: 0.0184 - val_loss: 0.0100
Epoch 328/1000
400/400  0s 1ms/step - loss: 0.0196 - val_loss: 0.0097
Epoch 329/1000
400/400  1s 1ms/step - loss: 0.0187 - val_loss: 0.0102
Epoch 330/1000
400/400  1s 1ms/step - loss: 0.0197 - val_loss: 0.0099
Epoch 331/1000
400/400  1s 1ms/step - loss: 0.0158 - val_loss: 0.0102
Epoch 332/1000
400/400  1s 1ms/step - loss: 0.0169 - val_loss: 0.0104
Epoch 333/1000
400/400  1s 1ms/step - loss: 0.0186 - val_loss: 0.0109
Epoch 334/1000
400/400  1s 1ms/step - loss: 0.0179 - val_loss: 0.0114
Epoch 335/1000
400/400  1s 1ms/step - loss: 0.0192 - val_loss: 0.0099
Epoch 336/1000
400/400  1s 1ms/step - loss: 0.0183 - val_loss: 0.0105

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Epoch 337/1000
400/400 ————— 1s 1ms/step - loss: 0.0207 - val_loss: 0.0101
Epoch 338/1000
400/400 ————— 1s 1ms/step - loss: 0.0184 - val_loss: 0.0099
Epoch 339/1000
400/400 ————— 0s 1ms/step - loss: 0.0174 - val_loss: 0.0101
Epoch 340/1000
400/400 ————— 1s 1ms/step - loss: 0.0190 - val_loss: 0.0098
Epoch 341/1000
400/400 ————— 1s 1ms/step - loss: 0.0171 - val_loss: 0.0119
Epoch 342/1000
400/400 ————— 1s 1ms/step - loss: 0.0169 - val_loss: 0.0100
Epoch 343/1000
400/400 ————— 1s 1ms/step - loss: 0.0210 - val_loss: 0.0104
Epoch 344/1000
400/400 ————— 1s 1ms/step - loss: 0.0187 - val_loss: 0.0100
Epoch 345/1000
400/400 ————— 1s 1ms/step - loss: 0.0187 - val_loss: 0.0102
Epoch 346/1000
400/400 ————— 1s 1ms/step - loss: 0.0194 - val_loss: 0.0094
Epoch 347/1000
400/400 ————— 1s 1ms/step - loss: 0.0176 - val_loss: 0.0104
Epoch 348/1000
400/400 ————— 1s 1ms/step - loss: 0.0220 - val_loss: 0.0103
Epoch 349/1000
400/400 ————— 1s 1ms/step - loss: 0.0189 - val_loss: 0.0102
Epoch 350/1000
400/400 ————— 1s 1ms/step - loss: 0.0195 - val_loss: 0.0098
Epoch 351/1000
400/400 ————— 0s 1ms/step - loss: 0.0214 - val_loss: 0.0109
Epoch 352/1000
400/400 ————— 1s 1ms/step - loss: 0.0217 - val_loss: 0.0116
Epoch 353/1000
400/400 ————— 0s 1ms/step - loss: 0.0166 - val_loss: 0.0097
Epoch 354/1000
400/400 ————— 0s 1ms/step - loss: 0.0206 - val_loss: 0.0103
Epoch 355/1000
400/400 ————— 0s 1ms/step - loss: 0.0181 - val_loss: 0.0110
Epoch 356/1000
400/400 ————— 0s 1ms/step - loss: 0.0227 - val_loss: 0.0096
Epoch 357/1000
400/400 ————— 1s 1ms/step - loss: 0.0189 - val_loss: 0.0103
Epoch 358/1000
400/400 ————— 1s 1ms/step - loss: 0.0180 - val_loss: 0.0105
Epoch 359/1000
400/400 ————— 1s 1ms/step - loss: 0.0202 - val_loss: 0.0107
Epoch 360/1000
400/400 ————— 1s 1ms/step - loss: 0.0180 - val_loss: 0.0101
Epoch 361/1000
400/400 ————— 1s 1ms/step - loss: 0.0209 - val_loss: 0.0102
Epoch 362/1000
400/400 ————— 1s 1ms/step - loss: 0.0178 - val_loss: 0.0107
Epoch 363/1000
400/400 ————— 1s 1ms/step - loss: 0.0213 - val_loss: 0.0108
Epoch 364/1000
400/400 ————— 1s 1ms/step - loss: 0.0168 - val_loss: 0.0103

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Epoch 365/1000
400/400 ————— 1s 1ms/step - loss: 0.0185 - val_loss: 0.0103
Epoch 366/1000
400/400 ————— 1s 1ms/step - loss: 0.0197 - val_loss: 0.0104
Epoch 367/1000
400/400 ————— 1s 1ms/step - loss: 0.0186 - val_loss: 0.0100
Epoch 368/1000
400/400 ————— 1s 1ms/step - loss: 0.0192 - val_loss: 0.0100
Epoch 369/1000
400/400 ————— 1s 1ms/step - loss: 0.0257 - val_loss: 0.0099
Epoch 370/1000
400/400 ————— 1s 1ms/step - loss: 0.0166 - val_loss: 0.0107
Epoch 371/1000
400/400 ————— 1s 1ms/step - loss: 0.0156 - val_loss: 0.0107
Epoch 372/1000
400/400 ————— 1s 1ms/step - loss: 0.0188 - val_loss: 0.0104
Epoch 373/1000
400/400 ————— 1s 1ms/step - loss: 0.0157 - val_loss: 0.0103
Epoch 374/1000
400/400 ————— 1s 1ms/step - loss: 0.0183 - val_loss: 0.0109
Epoch 375/1000
400/400 ————— 1s 1ms/step - loss: 0.0173 - val_loss: 0.0103
Epoch 376/1000
400/400 ————— 1s 1ms/step - loss: 0.0208 - val_loss: 0.0107
Epoch 377/1000
400/400 ————— 1s 1ms/step - loss: 0.0173 - val_loss: 0.0099
Epoch 378/1000
400/400 ————— 0s 1ms/step - loss: 0.0171 - val_loss: 0.0106
Epoch 379/1000
400/400 ————— 0s 1ms/step - loss: 0.0213 - val_loss: 0.0108
Epoch 380/1000
400/400 ————— 0s 1ms/step - loss: 0.0204 - val_loss: 0.0101
Epoch 381/1000
400/400 ————— 1s 1ms/step - loss: 0.0213 - val_loss: 0.0100
Epoch 382/1000
400/400 ————— 1s 1ms/step - loss: 0.0178 - val_loss: 0.0106
Epoch 383/1000
400/400 ————— 1s 1ms/step - loss: 0.0173 - val_loss: 0.0105
Epoch 384/1000
400/400 ————— 1s 1ms/step - loss: 0.0178 - val_loss: 0.0104
Epoch 385/1000
400/400 ————— 1s 1ms/step - loss: 0.0193 - val_loss: 0.0116
Epoch 386/1000
400/400 ————— 1s 2ms/step - loss: 0.0200 - val_loss: 0.0103
Epoch 387/1000
400/400 ————— 1s 1ms/step - loss: 0.0165 - val_loss: 0.0104
Epoch 388/1000
400/400 ————— 1s 1ms/step - loss: 0.0193 - val_loss: 0.0103
Epoch 389/1000
400/400 ————— 1s 1ms/step - loss: 0.0241 - val_loss: 0.0103
Epoch 390/1000
400/400 ————— 1s 1ms/step - loss: 0.0236 - val_loss: 0.0109
Epoch 391/1000
400/400 ————— 1s 1ms/step - loss: 0.0163 - val_loss: 0.0105
Epoch 392/1000
400/400 ————— 1s 1ms/step - loss: 0.0200 - val_loss: 0.0108

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Epoch 393/1000
400/400 ————— 1s 1ms/step - loss: 0.0171 - val_loss: 0.0108
Epoch 394/1000
400/400 ————— 1s 1ms/step - loss: 0.0196 - val_loss: 0.0099
Epoch 395/1000
400/400 ————— 1s 1ms/step - loss: 0.0188 - val_loss: 0.0106
Epoch 396/1000
400/400 ————— 1s 1ms/step - loss: 0.0192 - val_loss: 0.0111
Epoch 397/1000
400/400 ————— 1s 1ms/step - loss: 0.0184 - val_loss: 0.0107
Epoch 398/1000
400/400 ————— 1s 1ms/step - loss: 0.0194 - val_loss: 0.0103
Epoch 399/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0103
Epoch 400/1000
400/400 ————— 1s 1ms/step - loss: 0.0212 - val_loss: 0.0103
Epoch 401/1000
400/400 ————— 1s 1ms/step - loss: 0.0179 - val_loss: 0.0107
Epoch 402/1000
400/400 ————— 1s 1ms/step - loss: 0.0184 - val_loss: 0.0098
Epoch 403/1000
400/400 ————— 1s 1ms/step - loss: 0.0174 - val_loss: 0.0104
Epoch 404/1000
400/400 ————— 1s 1ms/step - loss: 0.0189 - val_loss: 0.0100
Epoch 405/1000
400/400 ————— 1s 1ms/step - loss: 0.0195 - val_loss: 0.0101
Epoch 406/1000
400/400 ————— 1s 1ms/step - loss: 0.0188 - val_loss: 0.0104
Epoch 407/1000
400/400 ————— 1s 1ms/step - loss: 0.0217 - val_loss: 0.0103
Epoch 408/1000
400/400 ————— 1s 1ms/step - loss: 0.0175 - val_loss: 0.0101
Epoch 409/1000
400/400 ————— 1s 1ms/step - loss: 0.0171 - val_loss: 0.0111
Epoch 410/1000
400/400 ————— 0s 1ms/step - loss: 0.0210 - val_loss: 0.0104
Epoch 411/1000
400/400 ————— 1s 1ms/step - loss: 0.0219 - val_loss: 0.0110
Epoch 412/1000
400/400 ————— 1s 1ms/step - loss: 0.0173 - val_loss: 0.0105
Epoch 413/1000
400/400 ————— 1s 1ms/step - loss: 0.0187 - val_loss: 0.0103
Epoch 414/1000
400/400 ————— 1s 1ms/step - loss: 0.0145 - val_loss: 0.0112
Epoch 415/1000
400/400 ————— 1s 1ms/step - loss: 0.0193 - val_loss: 0.0109
Epoch 416/1000
400/400 ————— 0s 1ms/step - loss: 0.0195 - val_loss: 0.0104
Epoch 417/1000
400/400 ————— 1s 1ms/step - loss: 0.0196 - val_loss: 0.0102
Epoch 418/1000
400/400 ————— 0s 1ms/step - loss: 0.0163 - val_loss: 0.0118
Epoch 419/1000
400/400 ————— 0s 1ms/step - loss: 0.0189 - val_loss: 0.0106
Epoch 420/1000
400/400 ————— 1s 1ms/step - loss: 0.0183 - val_loss: 0.0106





























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Epoch 421/1000
400/400 ————— 1s 1ms/step - loss: 0.0177 - val_loss: 0.0117
Epoch 422/1000
400/400 ————— 0s 1ms/step - loss: 0.0180 - val_loss: 0.0108
Epoch 423/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0126
Epoch 424/1000
400/400 ————— 1s 1ms/step - loss: 0.0188 - val_loss: 0.0113
Epoch 425/1000
400/400 ————— 1s 1ms/step - loss: 0.0164 - val_loss: 0.0125
Epoch 426/1000
400/400 ————— 1s 1ms/step - loss: 0.0212 - val_loss: 0.0105
Epoch 427/1000
400/400 ————— 1s 1ms/step - loss: 0.0191 - val_loss: 0.0108
Epoch 428/1000
400/400 ————— 1s 1ms/step - loss: 0.0182 - val_loss: 0.0102
Epoch 429/1000
400/400 ————— 1s 1ms/step - loss: 0.0194 - val_loss: 0.0105
Epoch 430/1000
400/400 ————— 1s 1ms/step - loss: 0.0181 - val_loss: 0.0106
Epoch 431/1000
400/400 ————— 0s 1ms/step - loss: 0.0188 - val_loss: 0.0105
Epoch 432/1000
400/400 ————— 0s 1ms/step - loss: 0.0214 - val_loss: 0.0106
Epoch 433/1000
400/400 ————— 0s 1ms/step - loss: 0.0193 - val_loss: 0.0115
Epoch 434/1000
400/400 ————— 1s 1ms/step - loss: 0.0190 - val_loss: 0.0103
Epoch 435/1000
400/400 ————— 1s 1ms/step - loss: 0.0187 - val_loss: 0.0109
Epoch 436/1000
400/400 ————— 1s 1ms/step - loss: 0.0164 - val_loss: 0.0108
Epoch 437/1000
400/400 ————— 1s 1ms/step - loss: 0.0165 - val_loss: 0.0103
Epoch 438/1000
400/400 ————— 1s 1ms/step - loss: 0.0185 - val_loss: 0.0105
Epoch 439/1000
400/400 ————— 1s 1ms/step - loss: 0.0184 - val_loss: 0.0103
Epoch 440/1000
400/400 ————— 1s 1ms/step - loss: 0.0179 - val_loss: 0.0129
Epoch 441/1000
400/400 ————— 0s 1ms/step - loss: 0.0204 - val_loss: 0.0107
Epoch 442/1000
400/400 ————— 1s 1ms/step - loss: 0.0188 - val_loss: 0.0112
Epoch 443/1000
400/400 ————— 1s 1ms/step - loss: 0.0178 - val_loss: 0.0106
Epoch 444/1000
400/400 ————— 0s 1ms/step - loss: 0.0173 - val_loss: 0.0109
Epoch 445/1000
400/400 ————— 0s 1ms/step - loss: 0.0173 - val_loss: 0.0109
Epoch 446/1000
400/400 ————— 0s 1ms/step - loss: 0.0163 - val_loss: 0.0129
Epoch 447/1000
400/400 ————— 0s 1ms/step - loss: 0.0193 - val_loss: 0.0104
Epoch 448/1000
400/400 ————— 0s 1ms/step - loss: 0.0182 - val_loss: 0.0104

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Epoch 449/1000
400/400  1s 1ms/step - loss: 0.0187 - val_loss: 0.0102
Epoch 450/1000
400/400  0s 1ms/step - loss: 0.0223 - val_loss: 0.0106
Epoch 451/1000
400/400  0s 1ms/step - loss: 0.0211 - val_loss: 0.0102
Epoch 452/1000
400/400  1s 1ms/step - loss: 0.0178 - val_loss: 0.0124
Epoch 453/1000
400/400  0s 1ms/step - loss: 0.0217 - val_loss: 0.0112
Epoch 454/1000
400/400  1s 1ms/step - loss: 0.0178 - val_loss: 0.0108
Epoch 455/1000
400/400  1s 1ms/step - loss: 0.0214 - val_loss: 0.0108
Epoch 456/1000
400/400  1s 1ms/step - loss: 0.0189 - val_loss: 0.0108
Epoch 457/1000
400/400  1s 1ms/step - loss: 0.0166 - val_loss: 0.0104
Epoch 458/1000
400/400  1s 1ms/step - loss: 0.0228 - val_loss: 0.0103
Epoch 459/1000
400/400  1s 1ms/step - loss: 0.0170 - val_loss: 0.0108
Epoch 460/1000
400/400  1s 1ms/step - loss: 0.0159 - val_loss: 0.0110
Epoch 461/1000
400/400  1s 1ms/step - loss: 0.0152 - val_loss: 0.0109
Epoch 462/1000
400/400  1s 1ms/step - loss: 0.0170 - val_loss: 0.0109
Epoch 463/1000
400/400  1s 1ms/step - loss: 0.0181 - val_loss: 0.0106
Epoch 464/1000
400/400  1s 1ms/step - loss: 0.0189 - val_loss: 0.0119
Epoch 465/1000
400/400  1s 1ms/step - loss: 0.0174 - val_loss: 0.0105
Epoch 466/1000
400/400  1s 1ms/step - loss: 0.0215 - val_loss: 0.0111
Epoch 467/1000
400/400  1s 1ms/step - loss: 0.0225 - val_loss: 0.0111
Epoch 468/1000
400/400  1s 1ms/step - loss: 0.0189 - val_loss: 0.0109
Epoch 469/1000
400/400  1s 1ms/step - loss: 0.0230 - val_loss: 0.0115
Epoch 470/1000
400/400  1s 1ms/step - loss: 0.0172 - val_loss: 0.0107
Epoch 471/1000
400/400  1s 1ms/step - loss: 0.0161 - val_loss: 0.0114
Epoch 472/1000
400/400  1s 1ms/step - loss: 0.0177 - val_loss: 0.0105
Epoch 473/1000
400/400  1s 1ms/step - loss: 0.0180 - val_loss: 0.0106
Epoch 474/1000
400/400  0s 1ms/step - loss: 0.0173 - val_loss: 0.0111
Epoch 475/1000
400/400  1s 1ms/step - loss: 0.0206 - val_loss: 0.0111
Epoch 476/1000
400/400  1s 1ms/step - loss: 0.0190 - val_loss: 0.0105

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Epoch 477/1000  
400/400 ————— 1s 1ms/step - loss: 0.0162 - val\_loss: 0.0113  
Epoch 478/1000  
400/400 ————— 0s 1ms/step - loss: 0.0197 - val\_loss: 0.0119  
Epoch 479/1000  
400/400 ————— 0s 1ms/step - loss: 0.0184 - val\_loss: 0.0111  
Epoch 480/1000  
400/400 ————— 1s 1ms/step - loss: 0.0150 - val\_loss: 0.0113  
Epoch 481/1000  
400/400 ————— 1s 1ms/step - loss: 0.0173 - val\_loss: 0.0110  
Epoch 482/1000  
400/400 ————— 0s 1ms/step - loss: 0.0206 - val\_loss: 0.0112  
Epoch 483/1000  
400/400 ————— 0s 1ms/step - loss: 0.0196 - val\_loss: 0.0106  
Epoch 484/1000  
400/400 ————— 1s 1ms/step - loss: 0.0216 - val\_loss: 0.0110  
Epoch 485/1000  
400/400 ————— 1s 1ms/step - loss: 0.0178 - val\_loss: 0.0107  
Epoch 486/1000  
400/400 ————— 0s 1ms/step - loss: 0.0205 - val\_loss: 0.0104  
Epoch 487/1000  
400/400 ————— 0s 1ms/step - loss: 0.0237 - val\_loss: 0.0111  
Epoch 488/1000  
400/400 ————— 1s 1ms/step - loss: 0.0184 - val\_loss: 0.0109  
Epoch 489/1000  
400/400 ————— 1s 1ms/step - loss: 0.0181 - val\_loss: 0.0120  
Epoch 490/1000  
400/400 ————— 1s 1ms/step - loss: 0.0193 - val\_loss: 0.0107  
Epoch 491/1000  
400/400 ————— 0s 1ms/step - loss: 0.0225 - val\_loss: 0.0106  
Epoch 492/1000  
400/400 ————— 0s 1ms/step - loss: 0.0214 - val\_loss: 0.0111  
Epoch 493/1000  
400/400 ————— 1s 1ms/step - loss: 0.0193 - val\_loss: 0.0108  
Epoch 494/1000  
400/400 ————— 1s 1ms/step - loss: 0.0167 - val\_loss: 0.0120  
Epoch 495/1000  
400/400 ————— 1s 1ms/step - loss: 0.0176 - val\_loss: 0.0104  
Epoch 496/1000  
400/400 ————— 1s 1ms/step - loss: 0.0191 - val\_loss: 0.0113  
Epoch 497/1000  
400/400 ————— 1s 1ms/step - loss: 0.0160 - val\_loss: 0.0113  
Epoch 498/1000  
400/400 ————— 1s 1ms/step - loss: 0.0218 - val\_loss: 0.0119  
Epoch 499/1000  
400/400 ————— 1s 1ms/step - loss: 0.0168 - val\_loss: 0.0119  
Epoch 500/1000  
400/400 ————— 1s 1ms/step - loss: 0.0217 - val\_loss: 0.0115  
Epoch 501/1000  
400/400 ————— 0s 1ms/step - loss: 0.0167 - val\_loss: 0.0105  
Epoch 502/1000  
400/400 ————— 1s 1ms/step - loss: 0.0153 - val\_loss: 0.0109  
Epoch 503/1000  
400/400 ————— 1s 1ms/step - loss: 0.0183 - val\_loss: 0.0138  
Epoch 504/1000  
400/400 ————— 0s 1ms/step - loss: 0.0170 - val\_loss: 0.0107

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Epoch 505/1000
400/400 ————— 0s 1ms/step - loss: 0.0184 - val_loss: 0.0126
Epoch 506/1000
400/400 ————— 1s 1ms/step - loss: 0.0189 - val_loss: 0.0109
Epoch 507/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0108
Epoch 508/1000
400/400 ————— 1s 1ms/step - loss: 0.0177 - val_loss: 0.0110
Epoch 509/1000
400/400 ————— 1s 1ms/step - loss: 0.0137 - val_loss: 0.0121
Epoch 510/1000
400/400 ————— 1s 1ms/step - loss: 0.0177 - val_loss: 0.0112
Epoch 511/1000
400/400 ————— 0s 1ms/step - loss: 0.0182 - val_loss: 0.0131
Epoch 512/1000
400/400 ————— 0s 1ms/step - loss: 0.0184 - val_loss: 0.0128
Epoch 513/1000
400/400 ————— 0s 1ms/step - loss: 0.0233 - val_loss: 0.0114
Epoch 514/1000
400/400 ————— 0s 1ms/step - loss: 0.0207 - val_loss: 0.0113
Epoch 515/1000
400/400 ————— 0s 1ms/step - loss: 0.0166 - val_loss: 0.0110
Epoch 516/1000
400/400 ————— 0s 1ms/step - loss: 0.0176 - val_loss: 0.0109
Epoch 517/1000
400/400 ————— 0s 1ms/step - loss: 0.0220 - val_loss: 0.0111
Epoch 518/1000
400/400 ————— 0s 1ms/step - loss: 0.0243 - val_loss: 0.0132
Epoch 519/1000
400/400 ————— 0s 1ms/step - loss: 0.0187 - val_loss: 0.0115
Epoch 520/1000
400/400 ————— 0s 1ms/step - loss: 0.0198 - val_loss: 0.0110
Epoch 521/1000
400/400 ————— 0s 1ms/step - loss: 0.0189 - val_loss: 0.0107
Epoch 522/1000
400/400 ————— 0s 1ms/step - loss: 0.0174 - val_loss: 0.0112
Epoch 523/1000
400/400 ————— 0s 1ms/step - loss: 0.0181 - val_loss: 0.0107
Epoch 524/1000
400/400 ————— 0s 1ms/step - loss: 0.0187 - val_loss: 0.0109
Epoch 525/1000
400/400 ————— 1s 1ms/step - loss: 0.0183 - val_loss: 0.0111
Epoch 526/1000
400/400 ————— 1s 1ms/step - loss: 0.0195 - val_loss: 0.0113
Epoch 527/1000
400/400 ————— 0s 1ms/step - loss: 0.0180 - val_loss: 0.0111
Epoch 528/1000
400/400 ————— 0s 1ms/step - loss: 0.0207 - val_loss: 0.0109
Epoch 529/1000
400/400 ————— 1s 1ms/step - loss: 0.0171 - val_loss: 0.0107
Epoch 530/1000
400/400 ————— 0s 1ms/step - loss: 0.0204 - val_loss: 0.0107
Epoch 531/1000
400/400 ————— 1s 1ms/step - loss: 0.0147 - val_loss: 0.0110
Epoch 532/1000
400/400 ————— 0s 1ms/step - loss: 0.0204 - val_loss: 0.0110

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Epoch 533/1000
400/400 ————— 0s 1ms/step - loss: 0.0165 - val_loss: 0.0114
Epoch 534/1000
400/400 ————— 0s 1ms/step - loss: 0.0177 - val_loss: 0.0111
Epoch 535/1000
400/400 ————— 0s 1ms/step - loss: 0.0153 - val_loss: 0.0114
Epoch 536/1000
400/400 ————— 0s 1ms/step - loss: 0.0181 - val_loss: 0.0118
Epoch 537/1000
400/400 ————— 0s 1ms/step - loss: 0.0177 - val_loss: 0.0119
Epoch 538/1000
400/400 ————— 1s 1ms/step - loss: 0.0187 - val_loss: 0.0106
Epoch 539/1000
400/400 ————— 1s 1ms/step - loss: 0.0190 - val_loss: 0.0108
Epoch 540/1000
400/400 ————— 1s 1ms/step - loss: 0.0193 - val_loss: 0.0111
Epoch 541/1000
400/400 ————— 1s 1ms/step - loss: 0.0169 - val_loss: 0.0113
Epoch 542/1000
400/400 ————— 1s 1ms/step - loss: 0.0200 - val_loss: 0.0104
Epoch 543/1000
400/400 ————— 1s 1ms/step - loss: 0.0174 - val_loss: 0.0104
Epoch 544/1000
400/400 ————— 0s 1ms/step - loss: 0.0213 - val_loss: 0.0116
Epoch 545/1000
400/400 ————— 0s 1ms/step - loss: 0.0174 - val_loss: 0.0114
Epoch 546/1000
400/400 ————— 0s 1ms/step - loss: 0.0146 - val_loss: 0.0113
Epoch 547/1000
400/400 ————— 0s 1ms/step - loss: 0.0170 - val_loss: 0.0115
Epoch 548/1000
400/400 ————— 0s 1ms/step - loss: 0.0194 - val_loss: 0.0113
Epoch 549/1000
400/400 ————— 0s 1ms/step - loss: 0.0171 - val_loss: 0.0115
Epoch 550/1000
400/400 ————— 0s 1ms/step - loss: 0.0192 - val_loss: 0.0110
Epoch 551/1000
400/400 ————— 0s 1ms/step - loss: 0.0158 - val_loss: 0.0109
Epoch 552/1000
400/400 ————— 0s 1ms/step - loss: 0.0195 - val_loss: 0.0117
Epoch 553/1000
400/400 ————— 1s 1ms/step - loss: 0.0195 - val_loss: 0.0108
Epoch 554/1000
400/400 ————— 1s 1ms/step - loss: 0.0183 - val_loss: 0.0113
Epoch 555/1000
400/400 ————— 1s 1ms/step - loss: 0.0210 - val_loss: 0.0111
Epoch 556/1000
400/400 ————— 1s 1ms/step - loss: 0.0163 - val_loss: 0.0115
Epoch 557/1000
400/400 ————— 1s 1ms/step - loss: 0.0188 - val_loss: 0.0122
Epoch 558/1000
400/400 ————— 1s 1ms/step - loss: 0.0191 - val_loss: 0.0112
Epoch 559/1000
400/400 ————— 1s 1ms/step - loss: 0.0210 - val_loss: 0.0111
Epoch 560/1000
400/400 ————— 1s 1ms/step - loss: 0.0181 - val_loss: 0.0114

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Epoch 561/1000
400/400 ————— 1s 2ms/step - loss: 0.0185 - val_loss: 0.0115
Epoch 562/1000
400/400 ————— 1s 1ms/step - loss: 0.0202 - val_loss: 0.0113
Epoch 563/1000
400/400 ————— 1s 1ms/step - loss: 0.0173 - val_loss: 0.0108
Epoch 564/1000
400/400 ————— 1s 1ms/step - loss: 0.0172 - val_loss: 0.0117
Epoch 565/1000
400/400 ————— 1s 1ms/step - loss: 0.0180 - val_loss: 0.0114
Epoch 566/1000
400/400 ————— 1s 1ms/step - loss: 0.0168 - val_loss: 0.0111
Epoch 567/1000
400/400 ————— 1s 1ms/step - loss: 0.0157 - val_loss: 0.0108
Epoch 568/1000
400/400 ————— 1s 1ms/step - loss: 0.0181 - val_loss: 0.0126
Epoch 569/1000
400/400 ————— 1s 1ms/step - loss: 0.0184 - val_loss: 0.0112
Epoch 570/1000
400/400 ————— 1s 1ms/step - loss: 0.0153 - val_loss: 0.0113
Epoch 571/1000
400/400 ————— 0s 1ms/step - loss: 0.0187 - val_loss: 0.0113
Epoch 572/1000
400/400 ————— 0s 1ms/step - loss: 0.0179 - val_loss: 0.0115
Epoch 573/1000
400/400 ————— 0s 1ms/step - loss: 0.0185 - val_loss: 0.0107
Epoch 574/1000
400/400 ————— 1s 1ms/step - loss: 0.0190 - val_loss: 0.0111
Epoch 575/1000
400/400 ————— 0s 1ms/step - loss: 0.0174 - val_loss: 0.0125
Epoch 576/1000
400/400 ————— 0s 1ms/step - loss: 0.0209 - val_loss: 0.0108
Epoch 577/1000
400/400 ————— 1s 1ms/step - loss: 0.0163 - val_loss: 0.0114
Epoch 578/1000
400/400 ————— 1s 1ms/step - loss: 0.0158 - val_loss: 0.0123
Epoch 579/1000
400/400 ————— 1s 1ms/step - loss: 0.0175 - val_loss: 0.0112
Epoch 580/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0114
Epoch 581/1000
400/400 ————— 1s 1ms/step - loss: 0.0181 - val_loss: 0.0106
Epoch 582/1000
400/400 ————— 0s 1ms/step - loss: 0.0185 - val_loss: 0.0111
Epoch 583/1000
400/400 ————— 0s 1ms/step - loss: 0.0204 - val_loss: 0.0110
Epoch 584/1000
400/400 ————— 0s 1ms/step - loss: 0.0180 - val_loss: 0.0110
Epoch 585/1000
400/400 ————— 1s 1ms/step - loss: 0.0141 - val_loss: 0.0119
Epoch 586/1000
400/400 ————— 1s 1ms/step - loss: 0.0200 - val_loss: 0.0112
Epoch 587/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0115
Epoch 588/1000
400/400 ————— 1s 1ms/step - loss: 0.0183 - val_loss: 0.0105

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Epoch 589/1000  
400/400 ————— 1s 1ms/step - loss: 0.0234 - val\_loss: 0.0108  
Epoch 590/1000  
400/400 ————— 1s 1ms/step - loss: 0.0216 - val\_loss: 0.0123  
Epoch 591/1000  
400/400 ————— 0s 1ms/step - loss: 0.0211 - val\_loss: 0.0110  
Epoch 592/1000  
400/400 ————— 1s 1ms/step - loss: 0.0182 - val\_loss: 0.0113  
Epoch 593/1000  
400/400 ————— 1s 1ms/step - loss: 0.0164 - val\_loss: 0.0121  
Epoch 594/1000  
400/400 ————— 0s 1ms/step - loss: 0.0171 - val\_loss: 0.0113  
Epoch 595/1000  
400/400 ————— 1s 1ms/step - loss: 0.0189 - val\_loss: 0.0119  
Epoch 596/1000  
400/400 ————— 1s 1ms/step - loss: 0.0179 - val\_loss: 0.0111  
Epoch 597/1000  
400/400 ————— 0s 1ms/step - loss: 0.0138 - val\_loss: 0.0117  
Epoch 598/1000  
400/400 ————— 0s 1ms/step - loss: 0.0164 - val\_loss: 0.0110  
Epoch 599/1000  
400/400 ————— 1s 1ms/step - loss: 0.0172 - val\_loss: 0.0127  
Epoch 600/1000  
400/400 ————— 0s 1ms/step - loss: 0.0178 - val\_loss: 0.0111  
Epoch 601/1000  
400/400 ————— 1s 1ms/step - loss: 0.0179 - val\_loss: 0.0110  
Epoch 602/1000  
400/400 ————— 1s 1ms/step - loss: 0.0202 - val\_loss: 0.0109  
Epoch 603/1000  
400/400 ————— 1s 1ms/step - loss: 0.0187 - val\_loss: 0.0104  
Epoch 604/1000  
400/400 ————— 1s 1ms/step - loss: 0.0175 - val\_loss: 0.0110  
Epoch 605/1000  
400/400 ————— 1s 1ms/step - loss: 0.0140 - val\_loss: 0.0125  
Epoch 606/1000  
400/400 ————— 1s 1ms/step - loss: 0.0193 - val\_loss: 0.0114  
Epoch 607/1000  
400/400 ————— 0s 1ms/step - loss: 0.0176 - val\_loss: 0.0126  
Epoch 608/1000  
400/400 ————— 1s 1ms/step - loss: 0.0194 - val\_loss: 0.0111  
Epoch 609/1000  
400/400 ————— 1s 1ms/step - loss: 0.0141 - val\_loss: 0.0112  
Epoch 610/1000  
400/400 ————— 1s 1ms/step - loss: 0.0158 - val\_loss: 0.0112  
Epoch 611/1000  
400/400 ————— 1s 1ms/step - loss: 0.0215 - val\_loss: 0.0109  
Epoch 612/1000  
400/400 ————— 1s 1ms/step - loss: 0.0173 - val\_loss: 0.0109  
Epoch 613/1000  
400/400 ————— 1s 1ms/step - loss: 0.0156 - val\_loss: 0.0115  
Epoch 614/1000  
400/400 ————— 1s 1ms/step - loss: 0.0186 - val\_loss: 0.0120  
Epoch 615/1000  
400/400 ————— 1s 1ms/step - loss: 0.0203 - val\_loss: 0.0109  
Epoch 616/1000  
400/400 ————— 1s 1ms/step - loss: 0.0201 - val\_loss: 0.0104































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Epoch 617/1000
400/400 ————— 1s 1ms/step - loss: 0.0184 - val_loss: 0.0112
Epoch 618/1000
400/400 ————— 1s 1ms/step - loss: 0.0185 - val_loss: 0.0110
Epoch 619/1000
400/400 ————— 1s 1ms/step - loss: 0.0190 - val_loss: 0.0118
Epoch 620/1000
400/400 ————— 1s 1ms/step - loss: 0.0192 - val_loss: 0.0111
Epoch 621/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0114
Epoch 622/1000
400/400 ————— 0s 1ms/step - loss: 0.0153 - val_loss: 0.0119
Epoch 623/1000
400/400 ————— 1s 1ms/step - loss: 0.0194 - val_loss: 0.0115
Epoch 624/1000
400/400 ————— 1s 1ms/step - loss: 0.0157 - val_loss: 0.0117
Epoch 625/1000
400/400 ————— 1s 1ms/step - loss: 0.0213 - val_loss: 0.0110
Epoch 626/1000
400/400 ————— 1s 1ms/step - loss: 0.0165 - val_loss: 0.0108
Epoch 627/1000
400/400 ————— 1s 1ms/step - loss: 0.0225 - val_loss: 0.0115
Epoch 628/1000
400/400 ————— 1s 1ms/step - loss: 0.0131 - val_loss: 0.0137
Epoch 629/1000
400/400 ————— 1s 1ms/step - loss: 0.0183 - val_loss: 0.0112
Epoch 630/1000
400/400 ————— 1s 1ms/step - loss: 0.0199 - val_loss: 0.0116
Epoch 631/1000
400/400 ————— 1s 1ms/step - loss: 0.0164 - val_loss: 0.0109
Epoch 632/1000
400/400 ————— 0s 1ms/step - loss: 0.0189 - val_loss: 0.0116
Epoch 633/1000
400/400 ————— 1s 1ms/step - loss: 0.0161 - val_loss: 0.0108
Epoch 634/1000
400/400 ————— 1s 1ms/step - loss: 0.0171 - val_loss: 0.0113
Epoch 635/1000
400/400 ————— 0s 1ms/step - loss: 0.0186 - val_loss: 0.0114
Epoch 636/1000
400/400 ————— 1s 1ms/step - loss: 0.0171 - val_loss: 0.0106
Epoch 637/1000
400/400 ————— 1s 1ms/step - loss: 0.0181 - val_loss: 0.0122
Epoch 638/1000
400/400 ————— 1s 1ms/step - loss: 0.0130 - val_loss: 0.0131
Epoch 639/1000
400/400 ————— 1s 1ms/step - loss: 0.0181 - val_loss: 0.0115
Epoch 640/1000
400/400 ————— 1s 2ms/step - loss: 0.0172 - val_loss: 0.0108
Epoch 641/1000
400/400 ————— 1s 2ms/step - loss: 0.0186 - val_loss: 0.0113
Epoch 642/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0110
Epoch 643/1000
400/400 ————— 1s 1ms/step - loss: 0.0178 - val_loss: 0.0113
Epoch 644/1000
400/400 ————— 1s 1ms/step - loss: 0.0193 - val_loss: 0.0116





























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Epoch 645/1000
400/400  1s 1ms/step - loss: 0.0162 - val_loss: 0.0114
Epoch 646/1000
400/400  1s 1ms/step - loss: 0.0163 - val_loss: 0.0116
Epoch 647/1000
400/400  0s 1ms/step - loss: 0.0180 - val_loss: 0.0109
Epoch 648/1000
400/400  1s 1ms/step - loss: 0.0174 - val_loss: 0.0114
Epoch 649/1000
400/400  1s 1ms/step - loss: 0.0204 - val_loss: 0.0122
Epoch 650/1000
400/400  1s 1ms/step - loss: 0.0171 - val_loss: 0.0113
Epoch 651/1000
400/400  1s 1ms/step - loss: 0.0165 - val_loss: 0.0117
Epoch 652/1000
400/400  1s 2ms/step - loss: 0.0161 - val_loss: 0.0117
Epoch 653/1000
400/400  1s 1ms/step - loss: 0.0212 - val_loss: 0.0117
Epoch 654/1000
400/400  1s 1ms/step - loss: 0.0199 - val_loss: 0.0120
Epoch 655/1000
400/400  0s 1ms/step - loss: 0.0178 - val_loss: 0.0113
Epoch 656/1000
400/400  1s 1ms/step - loss: 0.0161 - val_loss: 0.0117
Epoch 657/1000
400/400  1s 1ms/step - loss: 0.0165 - val_loss: 0.0112
Epoch 658/1000
400/400  1s 1ms/step - loss: 0.0183 - val_loss: 0.0111
Epoch 659/1000
400/400  1s 1ms/step - loss: 0.0176 - val_loss: 0.0113
Epoch 660/1000
400/400  1s 1ms/step - loss: 0.0183 - val_loss: 0.0113
Epoch 661/1000
400/400  0s 1ms/step - loss: 0.0164 - val_loss: 0.0112
Epoch 662/1000
400/400  1s 1ms/step - loss: 0.0191 - val_loss: 0.0113
Epoch 663/1000
400/400  1s 1ms/step - loss: 0.0200 - val_loss: 0.0112
Epoch 664/1000
400/400  1s 1ms/step - loss: 0.0195 - val_loss: 0.0127
Epoch 665/1000
400/400  1s 1ms/step - loss: 0.0186 - val_loss: 0.0111
Epoch 666/1000
400/400  0s 1ms/step - loss: 0.0188 - val_loss: 0.0112
Epoch 667/1000
400/400  0s 1ms/step - loss: 0.0181 - val_loss: 0.0109
Epoch 668/1000
400/400  1s 1ms/step - loss: 0.0185 - val_loss: 0.0109
Epoch 669/1000
400/400  1s 2ms/step - loss: 0.0174 - val_loss: 0.0116
Epoch 670/1000
400/400  1s 1ms/step - loss: 0.0158 - val_loss: 0.0128
Epoch 671/1000
400/400  1s 1ms/step - loss: 0.0192 - val_loss: 0.0119
Epoch 672/1000
400/400  1s 1ms/step - loss: 0.0188 - val_loss: 0.0110





























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Epoch 673/1000
400/400  1s 1ms/step - loss: 0.0170 - val_loss: 0.0111
Epoch 674/1000
400/400  1s 1ms/step - loss: 0.0154 - val_loss: 0.0112
Epoch 675/1000
400/400  1s 2ms/step - loss: 0.0162 - val_loss: 0.0111
Epoch 676/1000
400/400  1s 2ms/step - loss: 0.0161 - val_loss: 0.0115
Epoch 677/1000
400/400  1s 2ms/step - loss: 0.0192 - val_loss: 0.0110
Epoch 678/1000
400/400  1s 2ms/step - loss: 0.0177 - val_loss: 0.0119
Epoch 679/1000
400/400  1s 2ms/step - loss: 0.0174 - val_loss: 0.0115
Epoch 680/1000
400/400  1s 2ms/step - loss: 0.0169 - val_loss: 0.0109
Epoch 681/1000
400/400  1s 2ms/step - loss: 0.0166 - val_loss: 0.0115
Epoch 682/1000
400/400  1s 1ms/step - loss: 0.0174 - val_loss: 0.0115
Epoch 683/1000
400/400  1s 2ms/step - loss: 0.0175 - val_loss: 0.0124
Epoch 684/1000
400/400  1s 2ms/step - loss: 0.0189 - val_loss: 0.0113
Epoch 685/1000
400/400  1s 2ms/step - loss: 0.0179 - val_loss: 0.0132
Epoch 686/1000
400/400  1s 1ms/step - loss: 0.0177 - val_loss: 0.0117
Epoch 687/1000
400/400  1s 1ms/step - loss: 0.0204 - val_loss: 0.0113
Epoch 688/1000
400/400  1s 1ms/step - loss: 0.0176 - val_loss: 0.0128
Epoch 689/1000
400/400  1s 1ms/step - loss: 0.0180 - val_loss: 0.0110
Epoch 690/1000
400/400  1s 2ms/step - loss: 0.0171 - val_loss: 0.0111
Epoch 691/1000
400/400  1s 2ms/step - loss: 0.0161 - val_loss: 0.0111
Epoch 692/1000
400/400  1s 2ms/step - loss: 0.0194 - val_loss: 0.0116
Epoch 693/1000
400/400  1s 2ms/step - loss: 0.0177 - val_loss: 0.0114
Epoch 694/1000
400/400  1s 1ms/step - loss: 0.0183 - val_loss: 0.0112
Epoch 695/1000
400/400  1s 1ms/step - loss: 0.0167 - val_loss: 0.0122
Epoch 696/1000
400/400  1s 1ms/step - loss: 0.0174 - val_loss: 0.0116
Epoch 697/1000
400/400  1s 1ms/step - loss: 0.0172 - val_loss: 0.0112
Epoch 698/1000
400/400  1s 2ms/step - loss: 0.0190 - val_loss: 0.0108
Epoch 699/1000
400/400  1s 2ms/step - loss: 0.0192 - val_loss: 0.0106
Epoch 700/1000
400/400  1s 2ms/step - loss: 0.0146 - val_loss: 0.0112





























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Epoch 701/1000
400/400  1s 1ms/step - loss: 0.0151 - val_loss: 0.0110
Epoch 702/1000
400/400  1s 1ms/step - loss: 0.0186 - val_loss: 0.0112
Epoch 703/1000
400/400  1s 2ms/step - loss: 0.0173 - val_loss: 0.0116
Epoch 704/1000
400/400  1s 2ms/step - loss: 0.0179 - val_loss: 0.0106
Epoch 705/1000
400/400  1s 2ms/step - loss: 0.0210 - val_loss: 0.0113
Epoch 706/1000
400/400  1s 1ms/step - loss: 0.0225 - val_loss: 0.0116
Epoch 707/1000
400/400  1s 1ms/step - loss: 0.0146 - val_loss: 0.0111
Epoch 708/1000
400/400  1s 2ms/step - loss: 0.0149 - val_loss: 0.0124
Epoch 709/1000
400/400  1s 2ms/step - loss: 0.0172 - val_loss: 0.0112
Epoch 710/1000
400/400  1s 2ms/step - loss: 0.0161 - val_loss: 0.0112
Epoch 711/1000
400/400  1s 2ms/step - loss: 0.0187 - val_loss: 0.0113
Epoch 712/1000
400/400  1s 1ms/step - loss: 0.0155 - val_loss: 0.0110
Epoch 713/1000
400/400  1s 2ms/step - loss: 0.0172 - val_loss: 0.0123
Epoch 714/1000
400/400  1s 1ms/step - loss: 0.0200 - val_loss: 0.0108
Epoch 715/1000
400/400  1s 1ms/step - loss: 0.0165 - val_loss: 0.0119
Epoch 716/1000
400/400  1s 1ms/step - loss: 0.0176 - val_loss: 0.0124
Epoch 717/1000
400/400  1s 1ms/step - loss: 0.0166 - val_loss: 0.0118
Epoch 718/1000
400/400  1s 1ms/step - loss: 0.0146 - val_loss: 0.0139
Epoch 719/1000
400/400  1s 1ms/step - loss: 0.0155 - val_loss: 0.0119
Epoch 720/1000
400/400  1s 2ms/step - loss: 0.0141 - val_loss: 0.0120
Epoch 721/1000
400/400  1s 1ms/step - loss: 0.0173 - val_loss: 0.0116
Epoch 722/1000
400/400  1s 2ms/step - loss: 0.0154 - val_loss: 0.0109
Epoch 723/1000
400/400  1s 1ms/step - loss: 0.0155 - val_loss: 0.0111
Epoch 724/1000
400/400  1s 2ms/step - loss: 0.0193 - val_loss: 0.0112
Epoch 725/1000
400/400  1s 2ms/step - loss: 0.0198 - val_loss: 0.0110
Epoch 726/1000
400/400  1s 1ms/step - loss: 0.0147 - val_loss: 0.0116
Epoch 727/1000
400/400  1s 2ms/step - loss: 0.0162 - val_loss: 0.0127
Epoch 728/1000
400/400  1s 1ms/step - loss: 0.0147 - val_loss: 0.0118

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Epoch 729/1000
400/400  1s 1ms/step - loss: 0.0144 - val_loss: 0.0112
Epoch 730/1000
400/400  1s 2ms/step - loss: 0.0178 - val_loss: 0.0110
Epoch 731/1000
400/400  1s 2ms/step - loss: 0.0177 - val_loss: 0.0106
Epoch 732/1000
400/400  1s 1ms/step - loss: 0.0160 - val_loss: 0.0117
Epoch 733/1000
400/400  1s 1ms/step - loss: 0.0137 - val_loss: 0.0110
Epoch 734/1000
400/400  1s 2ms/step - loss: 0.0191 - val_loss: 0.0112
Epoch 735/1000
400/400  1s 1ms/step - loss: 0.0186 - val_loss: 0.0110
Epoch 736/1000
400/400  1s 2ms/step - loss: 0.0177 - val_loss: 0.0109
Epoch 737/1000
400/400  1s 1ms/step - loss: 0.0166 - val_loss: 0.0105
Epoch 738/1000
400/400  1s 1ms/step - loss: 0.0170 - val_loss: 0.0104
Epoch 739/1000
400/400  1s 1ms/step - loss: 0.0163 - val_loss: 0.0117
Epoch 740/1000
400/400  1s 1ms/step - loss: 0.0210 - val_loss: 0.0109
Epoch 741/1000
400/400  1s 1ms/step - loss: 0.0176 - val_loss: 0.0111
Epoch 742/1000
400/400  1s 2ms/step - loss: 0.0197 - val_loss: 0.0111
Epoch 743/1000
400/400  1s 2ms/step - loss: 0.0166 - val_loss: 0.0113
Epoch 744/1000
400/400  1s 2ms/step - loss: 0.0162 - val_loss: 0.0113
Epoch 745/1000
400/400  1s 2ms/step - loss: 0.0193 - val_loss: 0.0108
Epoch 746/1000
400/400  1s 1ms/step - loss: 0.0175 - val_loss: 0.0110
Epoch 747/1000
400/400  1s 1ms/step - loss: 0.0160 - val_loss: 0.0111
Epoch 748/1000
400/400  1s 2ms/step - loss: 0.0154 - val_loss: 0.0108
Epoch 749/1000
400/400  1s 1ms/step - loss: 0.0177 - val_loss: 0.0108
Epoch 750/1000
400/400  1s 1ms/step - loss: 0.0223 - val_loss: 0.0118
Epoch 751/1000
400/400  1s 1ms/step - loss: 0.0167 - val_loss: 0.0111
Epoch 752/1000
400/400  1s 2ms/step - loss: 0.0154 - val_loss: 0.0108
Epoch 753/1000
400/400  1s 2ms/step - loss: 0.0188 - val_loss: 0.0107
Epoch 754/1000
400/400  1s 1ms/step - loss: 0.0165 - val_loss: 0.0114
Epoch 755/1000
400/400  1s 1ms/step - loss: 0.0206 - val_loss: 0.0113
Epoch 756/1000
400/400  1s 2ms/step - loss: 0.0197 - val_loss: 0.0116

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Epoch 757/1000
400/400 ————— 1s 2ms/step - loss: 0.0165 - val_loss: 0.0116
Epoch 758/1000
400/400 ————— 1s 1ms/step - loss: 0.0153 - val_loss: 0.0116
Epoch 759/1000
400/400 ————— 1s 2ms/step - loss: 0.0170 - val_loss: 0.0108
Epoch 760/1000
400/400 ————— 1s 1ms/step - loss: 0.0145 - val_loss: 0.0109
Epoch 761/1000
400/400 ————— 1s 1ms/step - loss: 0.0165 - val_loss: 0.0117
Epoch 762/1000
400/400 ————— 1s 1ms/step - loss: 0.0209 - val_loss: 0.0109
Epoch 763/1000
400/400 ————— 1s 1ms/step - loss: 0.0169 - val_loss: 0.0117
Epoch 764/1000
400/400 ————— 1s 1ms/step - loss: 0.0189 - val_loss: 0.0112
Epoch 765/1000
400/400 ————— 1s 1ms/step - loss: 0.0184 - val_loss: 0.0110
Epoch 766/1000
400/400 ————— 1s 1ms/step - loss: 0.0176 - val_loss: 0.0117
Epoch 767/1000
400/400 ————— 1s 1ms/step - loss: 0.0171 - val_loss: 0.0120
Epoch 768/1000
400/400 ————— 1s 1ms/step - loss: 0.0168 - val_loss: 0.0107
Epoch 769/1000
400/400 ————— 1s 1ms/step - loss: 0.0178 - val_loss: 0.0111
Epoch 770/1000
400/400 ————— 1s 1ms/step - loss: 0.0178 - val_loss: 0.0112
Epoch 771/1000
400/400 ————— 1s 1ms/step - loss: 0.0182 - val_loss: 0.0106
Epoch 772/1000
400/400 ————— 1s 1ms/step - loss: 0.0165 - val_loss: 0.0114
Epoch 773/1000
400/400 ————— 1s 2ms/step - loss: 0.0175 - val_loss: 0.0107
Epoch 774/1000
400/400 ————— 1s 1ms/step - loss: 0.0182 - val_loss: 0.0119
Epoch 775/1000
400/400 ————— 1s 1ms/step - loss: 0.0182 - val_loss: 0.0109
Epoch 776/1000
400/400 ————— 1s 1ms/step - loss: 0.0208 - val_loss: 0.0110
Epoch 777/1000
400/400 ————— 1s 1ms/step - loss: 0.0183 - val_loss: 0.0111
Epoch 778/1000
400/400 ————— 1s 2ms/step - loss: 0.0185 - val_loss: 0.0112
Epoch 779/1000
400/400 ————— 1s 2ms/step - loss: 0.0172 - val_loss: 0.0104
Epoch 780/1000
400/400 ————— 1s 2ms/step - loss: 0.0193 - val_loss: 0.0108
Epoch 781/1000
400/400 ————— 1s 2ms/step - loss: 0.0170 - val_loss: 0.0118
Epoch 782/1000
400/400 ————— 1s 1ms/step - loss: 0.0164 - val_loss: 0.0107
Epoch 783/1000
400/400 ————— 1s 1ms/step - loss: 0.0154 - val_loss: 0.0111
Epoch 784/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0106

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Epoch 785/1000
400/400 ————— 1s 1ms/step - loss: 0.0192 - val_loss: 0.0112
Epoch 786/1000
400/400 ————— 1s 2ms/step - loss: 0.0187 - val_loss: 0.0120
Epoch 787/1000
400/400 ————— 1s 1ms/step - loss: 0.0160 - val_loss: 0.0112
Epoch 788/1000
400/400 ————— 1s 1ms/step - loss: 0.0179 - val_loss: 0.0107
Epoch 789/1000
400/400 ————— 1s 1ms/step - loss: 0.0172 - val_loss: 0.0109
Epoch 790/1000
400/400 ————— 0s 1ms/step - loss: 0.0202 - val_loss: 0.0129
Epoch 791/1000
400/400 ————— 0s 1ms/step - loss: 0.0192 - val_loss: 0.0112
Epoch 792/1000
400/400 ————— 0s 1ms/step - loss: 0.0155 - val_loss: 0.0117
Epoch 793/1000
400/400 ————— 1s 1ms/step - loss: 0.0227 - val_loss: 0.0104
Epoch 794/1000
400/400 ————— 1s 1ms/step - loss: 0.0159 - val_loss: 0.0116
Epoch 795/1000
400/400 ————— 1s 1ms/step - loss: 0.0141 - val_loss: 0.0122
Epoch 796/1000
400/400 ————— 1s 1ms/step - loss: 0.0182 - val_loss: 0.0108
Epoch 797/1000
400/400 ————— 0s 1ms/step - loss: 0.0179 - val_loss: 0.0108
Epoch 798/1000
400/400 ————— 0s 1ms/step - loss: 0.0163 - val_loss: 0.0106
Epoch 799/1000
400/400 ————— 0s 1ms/step - loss: 0.0166 - val_loss: 0.0115
Epoch 800/1000
400/400 ————— 0s 1ms/step - loss: 0.0139 - val_loss: 0.0112
Epoch 801/1000
400/400 ————— 0s 1ms/step - loss: 0.0166 - val_loss: 0.0121
Epoch 802/1000
400/400 ————— 0s 1ms/step - loss: 0.0176 - val_loss: 0.0114
Epoch 803/1000
400/400 ————— 1s 1ms/step - loss: 0.0187 - val_loss: 0.0113
Epoch 804/1000
400/400 ————— 1s 1ms/step - loss: 0.0167 - val_loss: 0.0118
Epoch 805/1000
400/400 ————— 1s 2ms/step - loss: 0.0165 - val_loss: 0.0114
Epoch 806/1000
400/400 ————— 1s 2ms/step - loss: 0.0156 - val_loss: 0.0123
Epoch 807/1000
400/400 ————— 1s 2ms/step - loss: 0.0194 - val_loss: 0.0111
Epoch 808/1000
400/400 ————— 1s 2ms/step - loss: 0.0156 - val_loss: 0.0107
Epoch 809/1000
400/400 ————— 1s 1ms/step - loss: 0.0192 - val_loss: 0.0109
Epoch 810/1000
400/400 ————— 1s 2ms/step - loss: 0.0177 - val_loss: 0.0110
Epoch 811/1000
400/400 ————— 1s 1ms/step - loss: 0.0155 - val_loss: 0.0119
Epoch 812/1000
400/400 ————— 1s 1ms/step - loss: 0.0167 - val_loss: 0.0109

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Epoch 813/1000
400/400 ————— 1s 2ms/step - loss: 0.0130 - val_loss: 0.0112
Epoch 814/1000
400/400 ————— 1s 2ms/step - loss: 0.0162 - val_loss: 0.0108
Epoch 815/1000
400/400 ————— 1s 2ms/step - loss: 0.0156 - val_loss: 0.0106
Epoch 816/1000
400/400 ————— 1s 2ms/step - loss: 0.0168 - val_loss: 0.0112
Epoch 817/1000
400/400 ————— 1s 2ms/step - loss: 0.0187 - val_loss: 0.0106
Epoch 818/1000
400/400 ————— 1s 1ms/step - loss: 0.0145 - val_loss: 0.0119
Epoch 819/1000
400/400 ————— 1s 1ms/step - loss: 0.0176 - val_loss: 0.0109
Epoch 820/1000
400/400 ————— 1s 2ms/step - loss: 0.0165 - val_loss: 0.0111
Epoch 821/1000
400/400 ————— 1s 1ms/step - loss: 0.0176 - val_loss: 0.0112
Epoch 822/1000
400/400 ————— 1s 2ms/step - loss: 0.0171 - val_loss: 0.0110
Epoch 823/1000
400/400 ————— 1s 2ms/step - loss: 0.0196 - val_loss: 0.0115
Epoch 824/1000
400/400 ————— 1s 1ms/step - loss: 0.0172 - val_loss: 0.0129
Epoch 825/1000
400/400 ————— 1s 2ms/step - loss: 0.0150 - val_loss: 0.0112
Epoch 826/1000
400/400 ————— 1s 2ms/step - loss: 0.0160 - val_loss: 0.0113
Epoch 827/1000
400/400 ————— 1s 2ms/step - loss: 0.0148 - val_loss: 0.0135
Epoch 828/1000
400/400 ————— 1s 1ms/step - loss: 0.0198 - val_loss: 0.0114
Epoch 829/1000
400/400 ————— 1s 1ms/step - loss: 0.0176 - val_loss: 0.0113
Epoch 830/1000
400/400 ————— 1s 1ms/step - loss: 0.0157 - val_loss: 0.0108
Epoch 831/1000
400/400 ————— 1s 1ms/step - loss: 0.0154 - val_loss: 0.0107
Epoch 832/1000
400/400 ————— 1s 1ms/step - loss: 0.0155 - val_loss: 0.0108
Epoch 833/1000
400/400 ————— 1s 1ms/step - loss: 0.0190 - val_loss: 0.0110
Epoch 834/1000
400/400 ————— 1s 1ms/step - loss: 0.0156 - val_loss: 0.0138
Epoch 835/1000
400/400 ————— 1s 1ms/step - loss: 0.0183 - val_loss: 0.0114
Epoch 836/1000
400/400 ————— 1s 1ms/step - loss: 0.0166 - val_loss: 0.0116
Epoch 837/1000
400/400 ————— 1s 1ms/step - loss: 0.0162 - val_loss: 0.0112
Epoch 838/1000
400/400 ————— 1s 1ms/step - loss: 0.0181 - val_loss: 0.0111
Epoch 839/1000
400/400 ————— 1s 1ms/step - loss: 0.0186 - val_loss: 0.0107
Epoch 840/1000
400/400 ————— 1s 1ms/step - loss: 0.0163 - val_loss: 0.0107

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Epoch 841/1000
400/400 ————— 1s 1ms/step - loss: 0.0185 - val_loss: 0.0107
Epoch 842/1000
400/400 ————— 1s 1ms/step - loss: 0.0150 - val_loss: 0.0118
Epoch 843/1000
400/400 ————— 1s 1ms/step - loss: 0.0182 - val_loss: 0.0114
Epoch 844/1000
400/400 ————— 1s 1ms/step - loss: 0.0173 - val_loss: 0.0119
Epoch 845/1000
400/400 ————— 1s 1ms/step - loss: 0.0154 - val_loss: 0.0111
Epoch 846/1000
400/400 ————— 1s 1ms/step - loss: 0.0175 - val_loss: 0.0121
Epoch 847/1000
400/400 ————— 1s 1ms/step - loss: 0.0144 - val_loss: 0.0114
Epoch 848/1000
400/400 ————— 1s 1ms/step - loss: 0.0175 - val_loss: 0.0110
Epoch 849/1000
400/400 ————— 1s 1ms/step - loss: 0.0153 - val_loss: 0.0108
Epoch 850/1000
400/400 ————— 1s 1ms/step - loss: 0.0178 - val_loss: 0.0117
Epoch 851/1000
400/400 ————— 1s 1ms/step - loss: 0.0181 - val_loss: 0.0107
Epoch 852/1000
400/400 ————— 1s 1ms/step - loss: 0.0174 - val_loss: 0.0111
Epoch 853/1000
400/400 ————— 1s 2ms/step - loss: 0.0191 - val_loss: 0.0108
Epoch 854/1000
400/400 ————— 1s 2ms/step - loss: 0.0138 - val_loss: 0.0110
Epoch 855/1000
400/400 ————— 1s 2ms/step - loss: 0.0188 - val_loss: 0.0105
Epoch 856/1000
400/400 ————— 1s 1ms/step - loss: 0.0179 - val_loss: 0.0103
Epoch 857/1000
400/400 ————— 1s 1ms/step - loss: 0.0196 - val_loss: 0.0104
Epoch 858/1000
400/400 ————— 1s 1ms/step - loss: 0.0151 - val_loss: 0.0116
Epoch 859/1000
400/400 ————— 1s 1ms/step - loss: 0.0162 - val_loss: 0.0109
Epoch 860/1000
400/400 ————— 1s 1ms/step - loss: 0.0143 - val_loss: 0.0113
Epoch 861/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0114
Epoch 862/1000
400/400 ————— 1s 1ms/step - loss: 0.0142 - val_loss: 0.0115
Epoch 863/1000
400/400 ————— 1s 1ms/step - loss: 0.0151 - val_loss: 0.0114
Epoch 864/1000
400/400 ————— 1s 1ms/step - loss: 0.0159 - val_loss: 0.0110
Epoch 865/1000
400/400 ————— 1s 1ms/step - loss: 0.0173 - val_loss: 0.0116
Epoch 866/1000
400/400 ————— 1s 1ms/step - loss: 0.0131 - val_loss: 0.0119
Epoch 867/1000
400/400 ————— 1s 1ms/step - loss: 0.0195 - val_loss: 0.0115
Epoch 868/1000
400/400 ————— 1s 2ms/step - loss: 0.0172 - val_loss: 0.0110

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Epoch 869/1000  
400/400 ————— 1s 1ms/step - loss: 0.0182 - val\_loss: 0.0113  
Epoch 870/1000  
400/400 ————— 1s 1ms/step - loss: 0.0148 - val\_loss: 0.0103  
Epoch 871/1000  
400/400 ————— 1s 1ms/step - loss: 0.0132 - val\_loss: 0.0118  
Epoch 872/1000  
400/400 ————— 1s 1ms/step - loss: 0.0142 - val\_loss: 0.0118  
Epoch 873/1000  
400/400 ————— 1s 1ms/step - loss: 0.0194 - val\_loss: 0.0107  
Epoch 874/1000  
400/400 ————— 1s 1ms/step - loss: 0.0171 - val\_loss: 0.0111  
Epoch 875/1000  
400/400 ————— 1s 1ms/step - loss: 0.0151 - val\_loss: 0.0110  
Epoch 876/1000  
400/400 ————— 1s 1ms/step - loss: 0.0182 - val\_loss: 0.0108  
Epoch 877/1000  
400/400 ————— 1s 1ms/step - loss: 0.0185 - val\_loss: 0.0108  
Epoch 878/1000  
400/400 ————— 1s 1ms/step - loss: 0.0187 - val\_loss: 0.0109  
Epoch 879/1000  
400/400 ————— 1s 1ms/step - loss: 0.0196 - val\_loss: 0.0117  
Epoch 880/1000  
400/400 ————— 1s 1ms/step - loss: 0.0144 - val\_loss: 0.0138  
Epoch 881/1000  
400/400 ————— 1s 2ms/step - loss: 0.0171 - val\_loss: 0.0107  
Epoch 882/1000  
400/400 ————— 1s 2ms/step - loss: 0.0171 - val\_loss: 0.0106  
Epoch 883/1000  
400/400 ————— 1s 2ms/step - loss: 0.0198 - val\_loss: 0.0110  
Epoch 884/1000  
400/400 ————— 1s 2ms/step - loss: 0.0207 - val\_loss: 0.0106  
Epoch 885/1000  
400/400 ————— 1s 1ms/step - loss: 0.0167 - val\_loss: 0.0120  
Epoch 886/1000  
400/400 ————— 1s 1ms/step - loss: 0.0182 - val\_loss: 0.0109  
Epoch 887/1000  
400/400 ————— 1s 1ms/step - loss: 0.0135 - val\_loss: 0.0113  
Epoch 888/1000  
400/400 ————— 1s 1ms/step - loss: 0.0157 - val\_loss: 0.0108  
Epoch 889/1000  
400/400 ————— 1s 1ms/step - loss: 0.0155 - val\_loss: 0.0124  
Epoch 890/1000  
400/400 ————— 1s 1ms/step - loss: 0.0153 - val\_loss: 0.0106  
Epoch 891/1000  
400/400 ————— 1s 1ms/step - loss: 0.0153 - val\_loss: 0.0127  
Epoch 892/1000  
400/400 ————— 1s 1ms/step - loss: 0.0137 - val\_loss: 0.0117  
Epoch 893/1000  
400/400 ————— 1s 1ms/step - loss: 0.0152 - val\_loss: 0.0113  
Epoch 894/1000  
400/400 ————— 1s 1ms/step - loss: 0.0211 - val\_loss: 0.0105  
Epoch 895/1000  
400/400 ————— 1s 1ms/step - loss: 0.0157 - val\_loss: 0.0124  
Epoch 896/1000  
400/400 ————— 1s 1ms/step - loss: 0.0171 - val\_loss: 0.0112

```

Epoch 897/1000
400/400 ————— 1s 2ms/step - loss: 0.0157 - val_loss: 0.0112
Epoch 898/1000
400/400 ————— 1s 1ms/step - loss: 0.0146 - val_loss: 0.0121
Epoch 899/1000
400/400 ————— 1s 1ms/step - loss: 0.0171 - val_loss: 0.0109
Epoch 900/1000
400/400 ————— 1s 1ms/step - loss: 0.0160 - val_loss: 0.0114
Epoch 901/1000
400/400 ————— 1s 1ms/step - loss: 0.0124 - val_loss: 0.0109
Epoch 902/1000
400/400 ————— 1s 1ms/step - loss: 0.0190 - val_loss: 0.0119
Epoch 903/1000
400/400 ————— 1s 1ms/step - loss: 0.0168 - val_loss: 0.0104
Epoch 904/1000
400/400 ————— 1s 1ms/step - loss: 0.0158 - val_loss: 0.0112
Epoch 905/1000
400/400 ————— 1s 1ms/step - loss: 0.0134 - val_loss: 0.0110
Epoch 906/1000
400/400 ————— 1s 1ms/step - loss: 0.0165 - val_loss: 0.0105
Epoch 907/1000
400/400 ————— 1s 1ms/step - loss: 0.0144 - val_loss: 0.0110
Epoch 908/1000
400/400 ————— 1s 1ms/step - loss: 0.0169 - val_loss: 0.0109
Epoch 909/1000
400/400 ————— 1s 1ms/step - loss: 0.0198 - val_loss: 0.0123
Epoch 910/1000
400/400 ————— 1s 1ms/step - loss: 0.0144 - val_loss: 0.0111
Epoch 911/1000
400/400 ————— 1s 1ms/step - loss: 0.0132 - val_loss: 0.0107
Epoch 912/1000
400/400 ————— 1s 1ms/step - loss: 0.0156 - val_loss: 0.0105
Epoch 913/1000
400/400 ————— 1s 1ms/step - loss: 0.0181 - val_loss: 0.0107
Epoch 914/1000
400/400 ————— 1s 1ms/step - loss: 0.0193 - val_loss: 0.0115
Epoch 915/1000
400/400 ————— 1s 1ms/step - loss: 0.0140 - val_loss: 0.0110
Epoch 916/1000
400/400 ————— 1s 1ms/step - loss: 0.0162 - val_loss: 0.0112
Epoch 917/1000
400/400 ————— 1s 1ms/step - loss: 0.0149 - val_loss: 0.0112
Epoch 918/1000
400/400 ————— 1s 1ms/step - loss: 0.0171 - val_loss: 0.0109
Epoch 919/1000
400/400 ————— 1s 1ms/step - loss: 0.0149 - val_loss: 0.0109
Epoch 920/1000
400/400 ————— 1s 1ms/step - loss: 0.0156 - val_loss: 0.0113
Epoch 921/1000
400/400 ————— 1s 1ms/step - loss: 0.0160 - val_loss: 0.0107
Epoch 922/1000
400/400 ————— 1s 1ms/step - loss: 0.0140 - val_loss: 0.0154
Epoch 923/1000
400/400 ————— 1s 1ms/step - loss: 0.0164 - val_loss: 0.0105
Epoch 924/1000
400/400 ————— 1s 1ms/step - loss: 0.0168 - val_loss: 0.0112

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Epoch 925/1000
400/400 ————— 1s 1ms/step - loss: 0.0180 - val_loss: 0.0111
Epoch 926/1000
400/400 ————— 1s 1ms/step - loss: 0.0154 - val_loss: 0.0116
Epoch 927/1000
400/400 ————— 1s 1ms/step - loss: 0.0163 - val_loss: 0.0102
Epoch 928/1000
400/400 ————— 1s 1ms/step - loss: 0.0153 - val_loss: 0.0112
Epoch 929/1000
400/400 ————— 1s 1ms/step - loss: 0.0175 - val_loss: 0.0117
Epoch 930/1000
400/400 ————— 1s 1ms/step - loss: 0.0185 - val_loss: 0.0111
Epoch 931/1000
400/400 ————— 1s 1ms/step - loss: 0.0155 - val_loss: 0.0127
Epoch 932/1000
400/400 ————— 1s 1ms/step - loss: 0.0176 - val_loss: 0.0112
Epoch 933/1000
400/400 ————— 1s 1ms/step - loss: 0.0189 - val_loss: 0.0105
Epoch 934/1000
400/400 ————— 1s 2ms/step - loss: 0.0190 - val_loss: 0.0106
Epoch 935/1000
400/400 ————— 1s 2ms/step - loss: 0.0177 - val_loss: 0.0108
Epoch 936/1000
400/400 ————— 1s 1ms/step - loss: 0.0162 - val_loss: 0.0111
Epoch 937/1000
400/400 ————— 1s 1ms/step - loss: 0.0159 - val_loss: 0.0114
Epoch 938/1000
400/400 ————— 1s 1ms/step - loss: 0.0192 - val_loss: 0.0109
Epoch 939/1000
400/400 ————— 1s 1ms/step - loss: 0.0155 - val_loss: 0.0111
Epoch 940/1000
400/400 ————— 1s 1ms/step - loss: 0.0157 - val_loss: 0.0106
Epoch 941/1000
400/400 ————— 1s 1ms/step - loss: 0.0165 - val_loss: 0.0110
Epoch 942/1000
400/400 ————— 1s 1ms/step - loss: 0.0161 - val_loss: 0.0106
Epoch 943/1000
400/400 ————— 1s 1ms/step - loss: 0.0158 - val_loss: 0.0125
Epoch 944/1000
400/400 ————— 1s 1ms/step - loss: 0.0158 - val_loss: 0.0117
Epoch 945/1000
400/400 ————— 1s 1ms/step - loss: 0.0172 - val_loss: 0.0107
Epoch 946/1000
400/400 ————— 1s 2ms/step - loss: 0.0196 - val_loss: 0.0112
Epoch 947/1000
400/400 ————— 1s 1ms/step - loss: 0.0159 - val_loss: 0.0109
Epoch 948/1000
400/400 ————— 1s 1ms/step - loss: 0.0152 - val_loss: 0.0111
Epoch 949/1000
400/400 ————— 1s 1ms/step - loss: 0.0163 - val_loss: 0.0115
Epoch 950/1000
400/400 ————— 1s 1ms/step - loss: 0.0184 - val_loss: 0.0108
Epoch 951/1000
400/400 ————— 1s 1ms/step - loss: 0.0159 - val_loss: 0.0108
Epoch 952/1000
400/400 ————— 1s 1ms/step - loss: 0.0213 - val_loss: 0.0104

```

Epoch 953/1000  
400/400 ————— 1s 1ms/step - loss: 0.0194 - val\_loss: 0.0107  
Epoch 954/1000  
400/400 ————— 1s 1ms/step - loss: 0.0155 - val\_loss: 0.0106  
Epoch 955/1000  
400/400 ————— 1s 1ms/step - loss: 0.0186 - val\_loss: 0.0110  
Epoch 956/1000  
400/400 ————— 1s 1ms/step - loss: 0.0147 - val\_loss: 0.0104  
Epoch 957/1000  
400/400 ————— 1s 1ms/step - loss: 0.0164 - val\_loss: 0.0111  
Epoch 958/1000  
400/400 ————— 1s 1ms/step - loss: 0.0151 - val\_loss: 0.0108  
Epoch 959/1000  
400/400 ————— 1s 1ms/step - loss: 0.0154 - val\_loss: 0.0106  
Epoch 960/1000  
400/400 ————— 1s 1ms/step - loss: 0.0151 - val\_loss: 0.0118  
Epoch 961/1000  
400/400 ————— 1s 1ms/step - loss: 0.0140 - val\_loss: 0.0118  
Epoch 962/1000  
400/400 ————— 1s 1ms/step - loss: 0.0190 - val\_loss: 0.0104  
Epoch 963/1000  
400/400 ————— 1s 1ms/step - loss: 0.0181 - val\_loss: 0.0107  
Epoch 964/1000  
400/400 ————— 1s 1ms/step - loss: 0.0144 - val\_loss: 0.0121  
Epoch 965/1000  
400/400 ————— 1s 1ms/step - loss: 0.0155 - val\_loss: 0.0113  
Epoch 966/1000  
400/400 ————— 1s 1ms/step - loss: 0.0150 - val\_loss: 0.0108  
Epoch 967/1000  
400/400 ————— 1s 1ms/step - loss: 0.0167 - val\_loss: 0.0112  
Epoch 968/1000  
400/400 ————— 1s 1ms/step - loss: 0.0164 - val\_loss: 0.0114  
Epoch 969/1000  
400/400 ————— 1s 1ms/step - loss: 0.0179 - val\_loss: 0.0107  
Epoch 970/1000  
400/400 ————— 1s 1ms/step - loss: 0.0175 - val\_loss: 0.0106  
Epoch 971/1000  
400/400 ————— 1s 1ms/step - loss: 0.0168 - val\_loss: 0.0102  
Epoch 972/1000  
400/400 ————— 1s 1ms/step - loss: 0.0168 - val\_loss: 0.0119  
Epoch 973/1000  
400/400 ————— 1s 1ms/step - loss: 0.0179 - val\_loss: 0.0104  
Epoch 974/1000  
400/400 ————— 1s 1ms/step - loss: 0.0179 - val\_loss: 0.0111  
Epoch 975/1000  
400/400 ————— 1s 1ms/step - loss: 0.0155 - val\_loss: 0.0109  
Epoch 976/1000  
400/400 ————— 1s 1ms/step - loss: 0.0155 - val\_loss: 0.0106  
Epoch 977/1000  
400/400 ————— 1s 1ms/step - loss: 0.0153 - val\_loss: 0.0109  
Epoch 978/1000  
400/400 ————— 1s 1ms/step - loss: 0.0158 - val\_loss: 0.0106  
Epoch 979/1000  
400/400 ————— 1s 1ms/step - loss: 0.0158 - val\_loss: 0.0111  
Epoch 980/1000  
400/400 ————— 1s 1ms/step - loss: 0.0169 - val\_loss: 0.0122

```

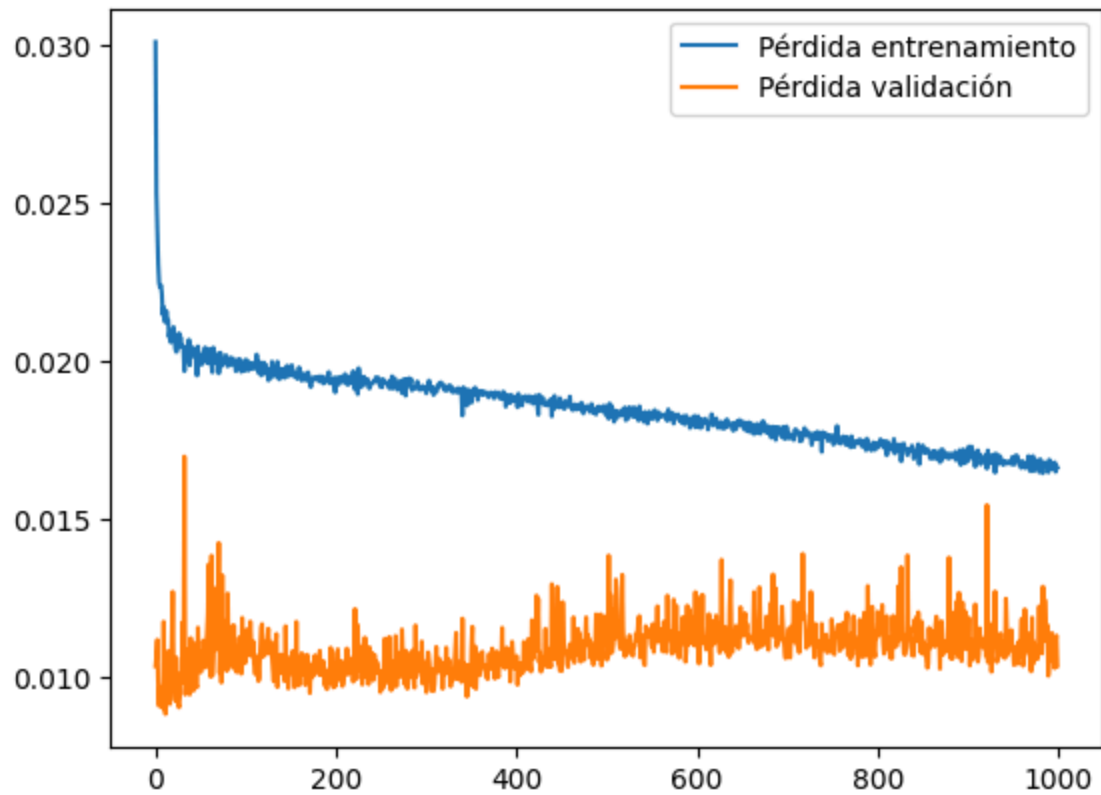
Epoch 981/1000
400/400 ————— 1s 1ms/step - loss: 0.0147 - val_loss: 0.0110
Epoch 982/1000
400/400 ————— 1s 1ms/step - loss: 0.0146 - val_loss: 0.0109
Epoch 983/1000
400/400 ————— 1s 1ms/step - loss: 0.0159 - val_loss: 0.0107
Epoch 984/1000
400/400 ————— 1s 1ms/step - loss: 0.0134 - val_loss: 0.0129
Epoch 985/1000
400/400 ————— 1s 1ms/step - loss: 0.0180 - val_loss: 0.0112
Epoch 986/1000
400/400 ————— 1s 1ms/step - loss: 0.0142 - val_loss: 0.0124
Epoch 987/1000
400/400 ————— 1s 1ms/step - loss: 0.0163 - val_loss: 0.0118
Epoch 988/1000
400/400 ————— 1s 2ms/step - loss: 0.0165 - val_loss: 0.0111
Epoch 989/1000
400/400 ————— 1s 1ms/step - loss: 0.0170 - val_loss: 0.0116
Epoch 990/1000
400/400 ————— 1s 1ms/step - loss: 0.0173 - val_loss: 0.0100
Epoch 991/1000
400/400 ————— 1s 1ms/step - loss: 0.0156 - val_loss: 0.0104
Epoch 992/1000
400/400 ————— 1s 1ms/step - loss: 0.0179 - val_loss: 0.0109
Epoch 993/1000
400/400 ————— 1s 1ms/step - loss: 0.0145 - val_loss: 0.0105
Epoch 994/1000
400/400 ————— 1s 1ms/step - loss: 0.0141 - val_loss: 0.0114
Epoch 995/1000
400/400 ————— 1s 1ms/step - loss: 0.0143 - val_loss: 0.0110
Epoch 996/1000
400/400 ————— 1s 1ms/step - loss: 0.0164 - val_loss: 0.0107
Epoch 997/1000
400/400 ————— 1s 1ms/step - loss: 0.0162 - val_loss: 0.0103
Epoch 998/1000
400/400 ————— 1s 1ms/step - loss: 0.0159 - val_loss: 0.0111
Epoch 999/1000
400/400 ————— 1s 1ms/step - loss: 0.0181 - val_loss: 0.0113
Epoch 1000/1000
400/400 ————— 1s 1ms/step - loss: 0.0162 - val_loss: 0.0104

```

```

In [11]: ## Graficar pérdida
plt.plot(history.history['loss'], label='Pérdida entrenamiento')
plt.plot(history.history['val_loss'], label='Pérdida validación')
plt.legend()
plt.show()

```



```
In [12]: # Predicción final para verificar funcionamiento
         predictions = model.predict(X_test)
         predictions = scaler.inverse_transform(predictions)
```

4/4 ————— 0s 35ms/step