Lab Excercise-08:LSTM/GRU-Based Recurrent Neural Network Construction

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- Created On : 31.08.2024
- Submitted On: 31.08.2024

Import Libraries

- `numpy` : Provides efficient support for numerical computations and array operations.
- `pandas` : Facilitates data manipulation and analysis with powerful data structures like DataFrames.
- `matplotlib.pyplot` : Enables creation of static, animated, and interactive visualizations.
- `seaborn` : Enhances data visualization with advanced statistical plots and improved aesthetics.

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

Load Dataset

1. Country Name

- **Description**: The name of the country.
- **Type**: Categorical/String.

2. Country Code

- **Description**: A unique code or abbreviation representing the country.
- **Type**: Categorical/String.

3. Year

- **Description**: The year for which the data is recorded.
- **Type**: Numeric/Integer.

4. Agriculture (% GDP)

- **Description**: The percentage of a country's Gross Domestic Product (GDP) derived from agriculture.
- **Type**: Numeric/Float.

5. Ease of Doing Business

- **Description**: An index or score representing how easy it is to do business in the country, typically based on various factors like regulatory environment, business regulations, etc.
- **Type**: Numeric/Float or Categorical.

6. Education Expenditure (% GDP)

- **Description**: The percentage of a country's GDP spent on education.
- **Type**: Numeric/Float.

7. Export (% GDP)

- **Description**: The percentage of a country's GDP that comes from exports.
- **Type**: Numeric/Float.

8. GDP

- **Description**: The Gross Domestic Product of the country, which measures the total economic output.
- **Type**: Numeric/Float.

9. Health Expenditure (% GDP)

- **Description**: The percentage of a country's GDP spent on health care.
- **Type**: Numeric/Float.

10. Import (% GDP)

- **Description**: The percentage of a country's GDP that is spent on imports.
- **Type**: Numeric/Float.

11. Industry (% GDP)

- **Description**: The percentage of a country's GDP derived from the industrial sector.
- **Type**: Numeric/Float.

12. Inflation Rate

- **Description**: The rate at which the general level of prices for goods and services is rising, causing purchasing power to fall.
- **Type**: Numeric/Float.

13. R&D

- **Description**: Expenditure on Research and Development as a percentage of GDP, or another measure of R&D investment.
- **Type**: Numeric/Float.

14. Service (% GDP)

- **Description**: The percentage of a country's GDP derived from the service sector.
- **Type**: Numeric/Float.

15. Unemployment

- **Description**: The percentage of the labor force that is unemployed and actively seeking employment.
- **Type**: Numeric/Float.

16. Population

- **Description**: The total number of people living in the country.
- **Type**: Numeric/Integer.

17. Land

- **Description**: The total land area of the country.
- **Type**: Numeric/Float.

18. Continent Name

- **Description**: The continent on which the country is located.
- **Type**: Categorical/String.

19. Export

- **Description**: This feature appears twice in the list; it might be duplicated or refer to different aspects of export data. Ensure consistency or clarification of this feature.
- **Type**: Numeric/Float.

20. Import

- **Description**: Similar to exports, this feature appears twice and might need clarification or correction for duplication.
- **Type**: Numeric/Float.

21. Education Expenditure

- **Description**: This feature also appears twice; confirm whether it’s the same as earlier or a different aspect of education expenditure.
- **Type**: Numeric/Float.

22. Health Expenditure

- **Description**: Same as above, confirm the feature’s duplication or intended different aspect.

- **Type**: Numeric/Float.

23. Net Trade

- **Description**: The difference between exports and imports as a percentage of GDP.
- **Type**: Numeric/Float.

24. GDP Per Capita

- **Description**: The GDP divided by the population, representing the average economic output per person.
- **Type**: Numeric/Float.

25. Population Density

- **Description**: The number of people per unit area of land (e.g., people per square kilometer).
- **Type**: Numeric/Float.

In [2]:
```
df3 = pd.read_csv('/content/Countries.csv')
df3.shape
```
Out[2]:
```
(5106, 25)
```

The dataset consists of 5106 rows and 25 columns

In [3]:
```
df3.head()
```

Out[3]:

	Country Name	Country Code	Year	Agriculture (% GDP)	Ease of Doing Business	Education Expenditure (% GDP)	Export (% GDP)	GDP	Health Expenditure (% GDP)	Import (% GDP)	...	Population	Land	Continent Name	Exp
0	Afghanistan	AFG	2000	27.501127	40.717968	13.670101	NaN	1.415197e+10	10.902580	NaN	...	19542982.0	652860.0	Asia	
1	Afghanistan	AFG	2001	27.501127	40.717968	13.670101	NaN	1.415197e+10	10.902580	NaN	...	19688632.0	652860.0	Asia	
2	Afghanistan	AFG	2002	38.627892	40.717968	13.670101	NaN	3.854235e+09	9.443391	NaN	...	21000256.0	652860.0	Asia	
3	Afghanistan	AFG	2003	37.418855	40.717968	13.670101	NaN	4.539497e+09	8.941258	NaN	...	22645130.0	652860.0	Asia	
4	Afghanistan	AFG	2004	29.721067	40.717968	13.670101	NaN	5.220825e+09	9.808474	NaN	...	23553551.0	652860.0	Asia	

5 rows × 25 columns

In [4]:

```
df3.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5106 entries, 0 to 5105
Data columns (total 25 columns):
 #   Column                       Non-Null Count  Dtype  
---  ------                       --------------  -----  
 0   Country Name                 5106 non-null   object 
 1   Country Code                 5106 non-null   object 
 2   Year                         5106 non-null   int64  
 3   Agriculture (% GDP)          4830 non-null   float64
 4   Ease of Doing Business       4508 non-null   float64
 5   Education Expenditure (% GDP)  4738 non-null   float64
 6   Export (% GDP)               4646 non-null   float64
 7   GDP                          5037 non-null   float64
 8   Health Expenditure (% GDP)   4531 non-null   float64
 9   Import (% GDP)               4646 non-null   float64
 10  Industry (% GDP)             4853 non-null   float64
 11  Inflation Rate               4554 non-null   float64
 12  R&D                          3588 non-null   float64
 13  Service (% GDP)              4807 non-null   float64
 14  Unemployment                 4439 non-null   float64
 15  Population                   5106 non-null   float64
 16  Land                         5106 non-null   float64
 17  Continent Name               5106 non-null   object 
 18  Export                       4646 non-null   float64
 19  Import                       4646 non-null   float64
 20  Education Expenditure        4692 non-null   float64
 21  Health Expenditure           4531 non-null   float64
 22  Net Trade                    4646 non-null   float64
 23  GDP Per Capita               5037 non-null   float64
 24  Population Density           5106 non-null   float64
dtypes: float64(21), int64(1), object(3)
memory usage: 997.4+ KB
```

In [5]:
```
df3.describe()
```

Out[5]:

	Year	Agriculture (% GDP)	Ease of Doing Business	Education Expenditure (% GDP)	Export (% GDP)	GDP	Health Expenditure (% GDP)	Import (% GDP)	Industry (% GDP)	Inflation Rate	...	Unemplo
count	5106.000000	4830.000000	4508.000000	4738.000000	4646.000000	5.037000e+03	4531.000000	4646.000000	4853.000000	4554.000000	...	4439.(
mean	2011.000000	10.893914	61.738665	14.458547	44.018003	3.120245e+11	6.167133	49.445204	26.315490	6.991400	...	8.'
std	6.633899	10.971965	13.775267	4.984259	33.173984	1.405946e+12	2.744570	30.474001	12.924200	19.858123	...	5.8
min	2000.000000	0.012519	19.977700	0.833360	1.571162	1.396473e+07	1.263576	1.127672	2.758632	-16.859691	...	0.(
25%	2005.000000	2.275972	52.919894	10.870940	23.544736	4.186073e+09	4.158750	29.401814	17.919508	1.599237	...	3.8
50%	2011.000000	6.979923	61.982110	13.952830	36.438987	1.777477e+10	5.639608	42.543697	24.119251	3.466447	...	6.5
75%	2017.000000	16.748657	72.535918	17.609406	54.543771	1.216041e+11	7.865923	60.600202	31.812769	7.288914	...	10.8
max	2022.000000	79.042362	87.166330	44.801800	433.836004	2.546270e+13	24.230680	429.359095	86.669555	557.201817	...	37.3

8 rows × 22 columns

In [6]:

```
df3.isnull().sum()
```

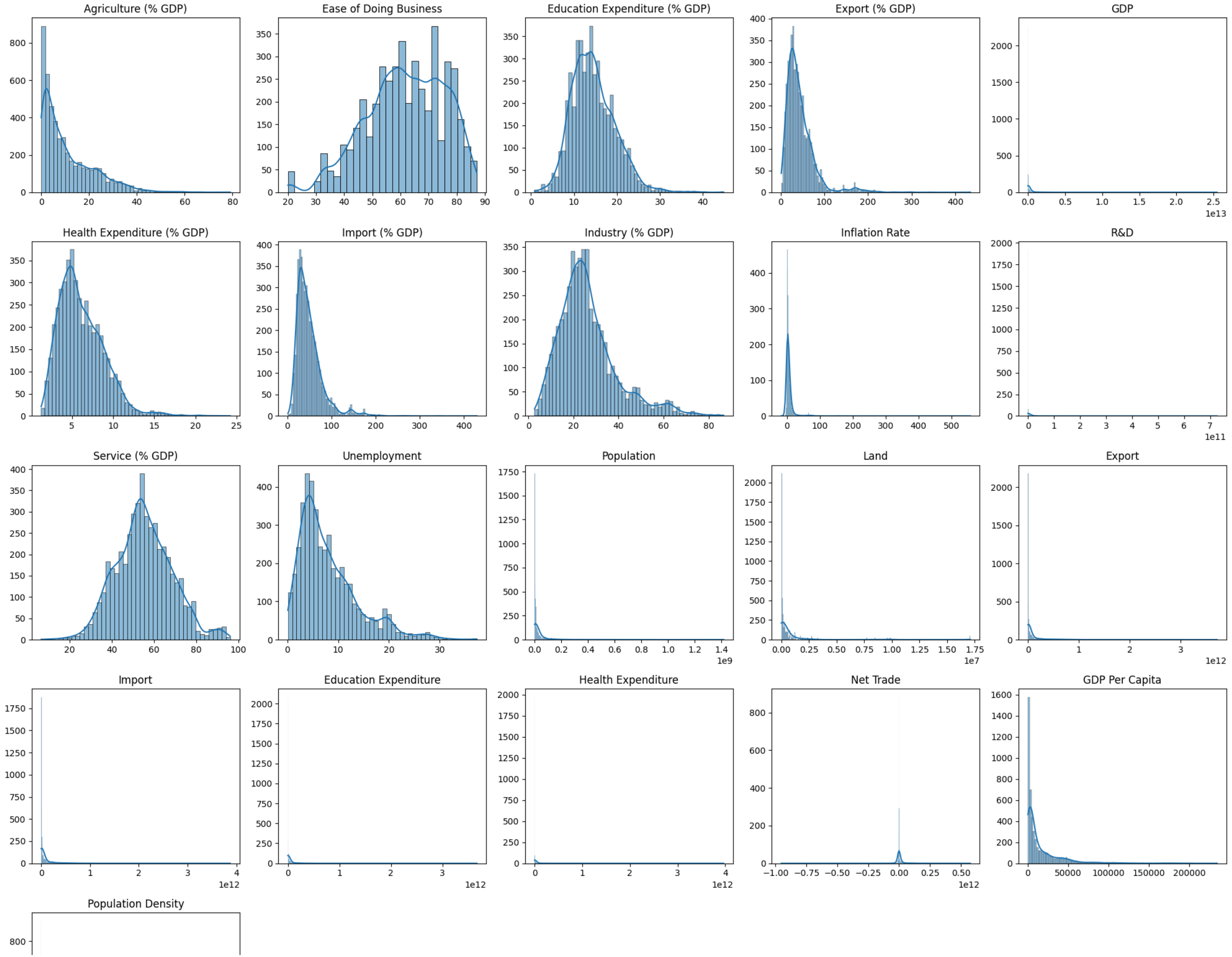
Out[6]:

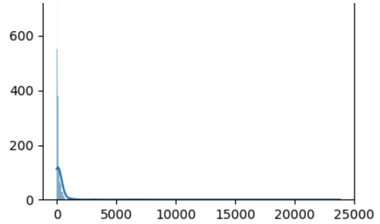
	0
Country Name	0
Country Code	0
Year	0
Agriculture (% GDP)	276
Ease of Doing Business	598
Education Expenditure (% GDP)	368
Export (% GDP)	460
GDP	69
Health Expenditure (% GDP)	575
Import (% GDP)	460
Industry (% GDP)	253
Inflation Rate	552
R&D	1518
Service (% GDP)	299
Unemployment	667
Population	0
Land	0
Continent Name	0
Export	460
Import	460
Education Expenditure	414
Health Expenditure	575
Net Trade	460
GDP Per Capita	69

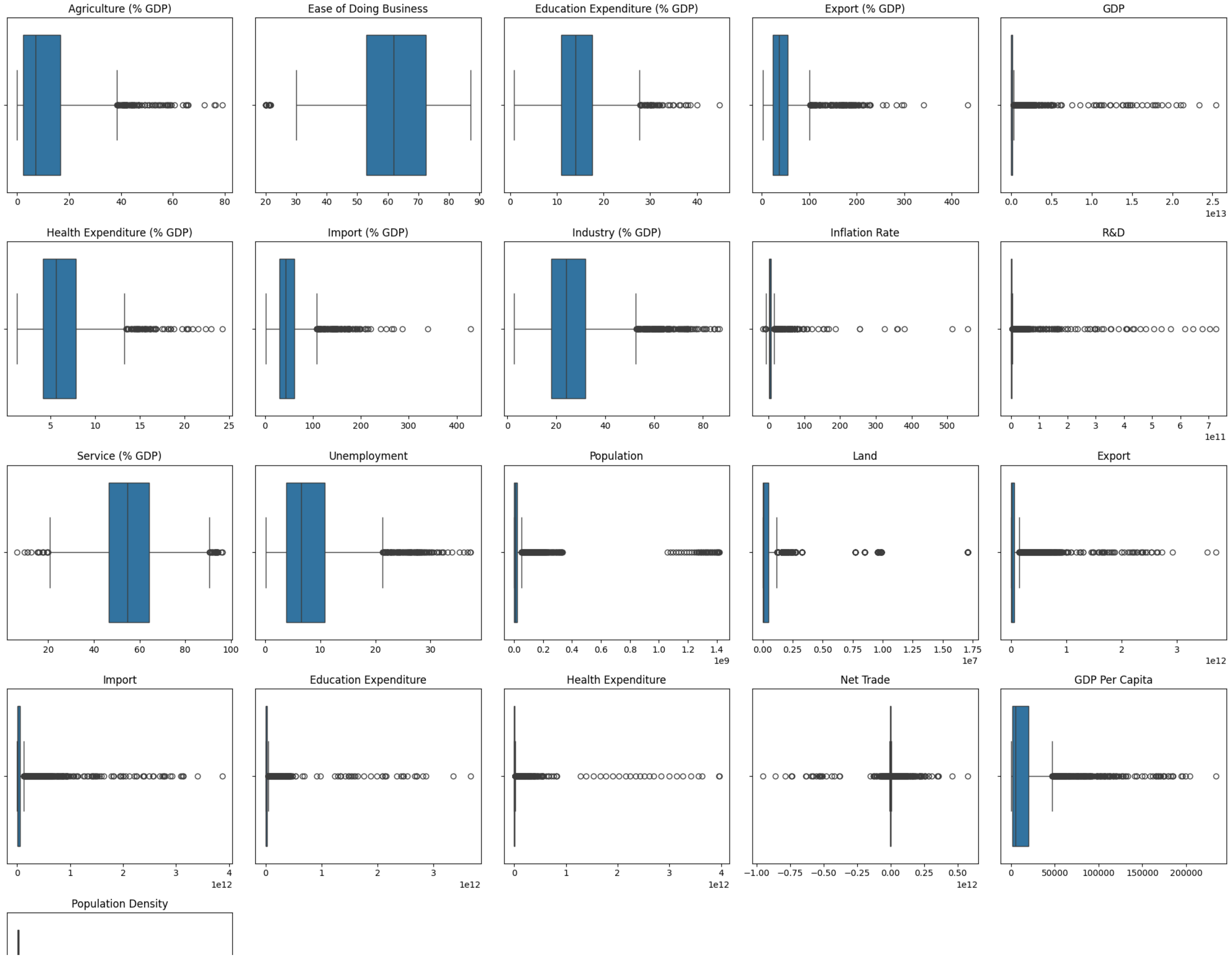
	0
Population Density	0

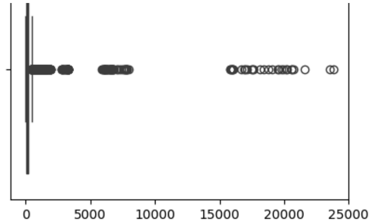
dtype: int64

In [7]:
```
# List of numerical columns
numerical_columns = [
    'Agriculture (% GDP)', 'Ease of Doing Business', 'Education Expenditure (% GDP)',
    'Export (% GDP)', 'GDP', 'Health Expenditure (% GDP)', 'Import (% GDP)',
    'Industry (% GDP)', 'Inflation Rate', 'R&D', 'Service (% GDP)', 'Unemployment',
    'Population', 'Land', 'Export', 'Import', 'Education Expenditure',
    'Health Expenditure', 'Net Trade', 'GDP Per Capita', 'Population Density'
]

# Plot histograms for each numerical column
plt.figure(figsize=(20, 18))
for i, col in enumerate(numerical_columns, 1):
    plt.subplot(5, 5, i)
    sns.histplot(df3[col].dropna(), kde=True)
    plt.title(col)
    plt.xlabel('')
    plt.ylabel('')

plt.tight_layout()
plt.show()

# Plot boxplots for each numerical column to check for outliers
plt.figure(figsize=(20, 18))
for i, col in enumerate(numerical_columns, 1):
    plt.subplot(5, 5, i)
    sns.boxplot(x=df3[col].dropna())
    plt.title(col)
    plt.xlabel('')

plt.tight_layout()
plt.show()
```

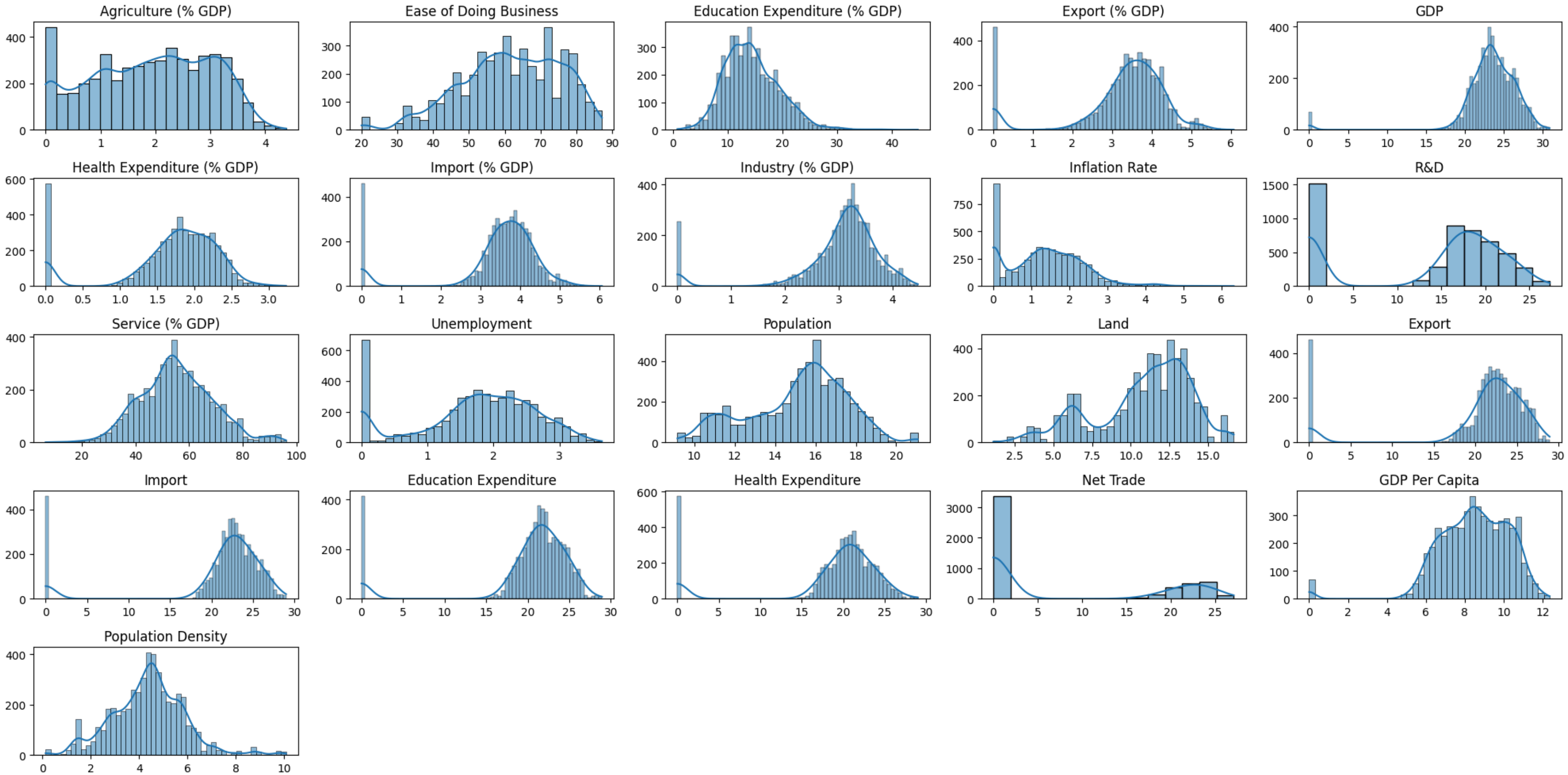

Agriculture (% GDP)
Ease of Doing Business
Education Expenditure (% GDP)
Export (% GDP)
GDP
Health Expenditure (% GDP)
Import (% GDP)
Industry (% GDP)
Inflation Rate
R&D
Service (% GDP)
Unemployment
Population
Land
Export
Import
Education Expenditure
Health Expenditure
Net Trade
GDP Per Capita
Population Density


600
400
200
0
0
5000
10000
15000
20000
25000


Agriculture (% GDP)
0 20 40 60 80
Ease of Doing Business
20 30 40 50 60 70 80 90
Education Expenditure (% GDP)
0 10 20 30 40
Export (% GDP)
0 100 200 300 400
GDP
0.0 0.5 1.0 1.5 2.0 2.5
1e13
Health Expenditure (% GDP)
5 10 15 20 25
Import (% GDP)
0 100 200 300 400
Industry (% GDP)
0 20 40 60 80
Inflation Rate
0 100 200 300 400 500
R&D
0 1 2 3 4 5 6 7
1e11
Service (% GDP)
20 40 60 80 100
Unemployment
0 10 20 30
Population
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4
1e9
Land
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75
1e7
Export
0 1 2 3
1e12
Import
0 1 2 3 4
1e12
Education Expenditure
0 1 2 3
1e12
Health Expenditure
0 1 2 3 4
1e12
Net Trade
−1.00 −0.75 −0.50 −0.25 0.00 0.25 0.50
1e12
GDP Per Capita
0 50000 100000 150000 200000
Population Density



In [8]:
```
# Calculate skewness
skewness = df3[numerical_columns].skew()

# Transformations to reduce skewness
# Apply log transformation for highly skewed data
for col in skewness[abs(skewness) > 1].index:
    df3[col] = df3[col].apply(lambda x: np.log(x + 1) if x > 0 else 0)

# Check the distribution after transformation
plt.figure(figsize=(20, 10))
for i, col in enumerate(numerical_columns, 1):
    plt.subplot(5, 5, i)
    sns.histplot(df3[col], kde=True)
    plt.title(col)
    plt.xlabel('')
    plt.ylabel('')

plt.tight_layout()
plt.show()
```



In [9]:

```
# Using median for imputation
median_values = {
    'Agriculture (% GDP)': df3['Agriculture (% GDP)'].median(),
    'Ease of Doing Business': df3['Ease of Doing Business'].median(),
    'Education Expenditure (% GDP)': df3['Education Expenditure (% GDP)'].median(),
    'Export (% GDP)': df3['Export (% GDP)'].median(),
    'Health Expenditure (% GDP)': df3['Health Expenditure (% GDP)'].median(),
    'Import (% GDP)': df3['Import (% GDP)'].median(),
    'Industry (% GDP)': df3['Industry (% GDP)'].median(),
    'Inflation Rate': df3['Inflation Rate'].median(),
    'R&D': df3['R&D'].median(),
    'Service (% GDP)': df3['Service (% GDP)'].median(),
    'Unemployment': df3['Unemployment'].median(),
    'Net Trade': df3['Net Trade'].median(),
```

```
}
df3.fillna(median_values, inplace=True)

# Columns with smaller amounts of missing data can be imputed with forward fill or backward fill
df3.fillna(method='ffill', inplace=True)  # Forward fill
df3.fillna(method='bfill', inplace=True)  # Backward fill

# Check if all missing values are handled
missing_values_post = df3.isnull().sum()
print(missing_values_post)
```

```
Country Name                    0
Country Code                    0
Year                            0
Agriculture (% GDP)             0
Ease of Doing Business          0
Education Expenditure (% GDP)   0
Export (% GDP)                  0
GDP                             0
Health Expenditure (% GDP)      0
Import (% GDP)                  0
Industry (% GDP)                0
Inflation Rate                  0
R&D                             0
Service (% GDP)                 0
Unemployment                    0
Population                      0
Land                            0
Continent Name                  0
Export                          0
Import                          0
Education Expenditure           0
Health Expenditure              0
Net Trade                       0
GDP Per Capita                  0
Population Density              0
dtype: int64
```

```
<ipython-input-9-75d43282897e>:19: FutureWarning: DataFrame.fillna with 'method' is deprecated and will raise in a future versio
n. Use obj.ffill() or obj.bfill() instead.
  df3.fillna(method='ffill', inplace=True)  # Forward fill
<ipython-input-9-75d43282897e>:20: FutureWarning: DataFrame.fillna with 'method' is deprecated and will raise in a future versio
n. Use obj.ffill() or obj.bfill() instead.
  df3.fillna(method='bfill', inplace=True)  # Backward fill
```

In [10]:
```
# List of numerical columns
numerical_columns = [
    'Agriculture (% GDP)', 'Ease of Doing Business', 'Education Expenditure (% GDP)',
    'Export (% GDP)', 'GDP', 'Health Expenditure (% GDP)', 'Import (% GDP)',
    'Industry (% GDP)', 'Inflation Rate', 'R&D', 'Service (% GDP)', 'Unemployment',
    'Population', 'Land', 'Export', 'Import', 'Education Expenditure',
    'Health Expenditure', 'Net Trade', 'GDP Per Capita', 'Population Density'
]

# Function to identify outliers using IQR
def identify_outliers(df, col):
    Q1 = df[col].quantile(0.25)
    Q3 = df[col].quantile(0.75)
    IQR = Q3 - Q1
    lower_bound = Q1 - 1.5 * IQR
    upper_bound = Q3 + 1.5 * IQR
    return df[(df[col] < lower_bound) | (df[col] > upper_bound)]

from scipy import stats

# Function to identify outliers using Z-Score
def identify_outliers_zscore(df, col):
    z_scores = np.abs(stats.zscore(df[col].dropna()))
    return df[z_scores > 3]

# Function to handle outliers using Z-Score
def handle_outliers_zscore(df, col):
    z_scores = np.abs(stats.zscore(df[col].dropna()))
    df[col] = np.where(z_scores > 3, df[col].median(), df[col])

# Identify and count outliers for each column before handling
outliers_info_before_z = {}
for col in numerical_columns:
    outliers = identify_outliers_zscore(df3, col)
    outliers_info_before_z[col] = len(outliers)

# Print number of outliers for each column before handling
print("Number of outliers in each column before Z-Score handling:")
for col, count in outliers_info_before_z.items():
    print(f"{col}: {count} outliers")

# Handle outliers using Z-Score
for col in numerical_columns:
```

```
    handle_outliers_zscore(df3, col)

# Identify and count outliers for each column after handling
outliers_info_after_z = {}
for col in numerical_columns:
    outliers = identify_outliers_zscore(df3, col)
    outliers_info_after_z[col] = len(outliers)

# Print number of outliers for each column after handling
print("\nNumber of outliers in each column after Z-Score handling:")
for col, count in outliers_info_after_z.items():
    print(f"{col}: {count} outliers")
```

```
Number of outliers in each column before Z-Score handling:
Agriculture (% GDP): 0 outliers
Ease of Doing Business: 46 outliers
Education Expenditure (% GDP): 43 outliers
Export (% GDP): 0 outliers
GDP: 69 outliers
Health Expenditure (% GDP): 0 outliers
Import (% GDP): 0 outliers
Industry (% GDP): 253 outliers
Inflation Rate: 34 outliers
R&D: 0 outliers
Service (% GDP): 14 outliers
Unemployment: 0 outliers
Population: 0 outliers
Land: 7 outliers
Export: 460 outliers
Import: 460 outliers
Education Expenditure: 414 outliers
Health Expenditure: 0 outliers
Net Trade: 0 outliers
GDP Per Capita: 69 outliers
Population Density: 53 outliers

Number of outliers in each column after Z-Score handling:
Agriculture (% GDP): 0 outliers
Ease of Doing Business: 0 outliers
Education Expenditure (% GDP): 14 outliers
Export (% GDP): 0 outliers
GDP: 2 outliers
Health Expenditure (% GDP): 0 outliers
Import (% GDP): 0 outliers
Industry (% GDP): 29 outliers
Inflation Rate: 27 outliers
R&D: 0 outliers
Service (% GDP): 4 outliers
Unemployment: 0 outliers
Population: 0 outliers
Land: 0 outliers
Export: 1 outliers
Import: 1 outliers
Education Expenditure: 2 outliers
Health Expenditure: 0 outliers
Net Trade: 0 outliers
```

```
GDP Per Capita: 0 outliers
Population Density: 46 outliers
```

In [11]:

```python
import pandas as pd
from sklearn.preprocessing import MinMaxScaler
# Drop irrelevant columns
df3 = df3.drop(columns=['Continent Name', 'Country Code'])

# One-hot encode the 'Country Name' column
df_encoded = pd.get_dummies(df3, columns=['Country Name'])

# Identify numeric columns for normalization
numeric_cols = df_encoded.select_dtypes(include=['float64', 'int64']).columns

# Exclude columns that should not be normalized
cols_to_normalize = numeric_cols.difference(['Year', 'GDP', 'GDP Per Capita'])

# Initialize MinMaxScaler
scaler = MinMaxScaler()

# Normalize selected columns
df_encoded[cols_to_normalize] = scaler.fit_transform(df_encoded[cols_to_normalize])

# Split the dataset into features and labels
X = df_encoded.drop(columns=['GDP', 'GDP Per Capita'])
y_gdp = df_encoded['GDP']
y_gdp_per_capita = df_encoded['GDP Per Capita']

# Optional: Display the first few rows of the processed dataset
print(X.head())
print(y_gdp.head())
print(y_gdp_per_capita.head())
```

```
   Year  Agriculture (% GDP)  Ease of Doing Business  \
0  2000             0.764381                0.186992   
1  2001             0.764381                0.186992   
2  2002             0.839586                0.186992   
3  2003             0.832516                0.186992   
4  2004             0.781496                0.186992   

   Education Expenditure (% GDP)  Export (% GDP)  Health Expenditure (% GDP)  \
0                       0.460627             0.0                    0.767258   
1                       0.460627             0.0                    0.767258   
2                       0.460627             0.0                    0.726743   
3                       0.460627             0.0                    0.711478   
4                       0.460627             0.0                    0.737387   

   Import (% GDP)  Industry (% GDP)  Inflation Rate  R&D  ...  \
0             0.0          0.553659        0.456583  0.0  ...   
1             0.0          0.553659        0.456583  0.0  ...   
2             0.0          0.599201        0.456583  0.0  ...   
3             0.0          0.584812        0.456583  0.0  ...   
4             0.0          0.628714        0.456583  0.0  ...   

   Country Name_Uruguay  Country Name_Uzbekistan  Country Name_Vanuatu  \
0                 False                    False                 False   
1                 False                    False                 False   
2                 False                    False                 False   
3                 False                    False                 False   
4                 False                    False                 False   

   Country Name_Venezuela, RB  Country Name_Vietnam  \
0                       False                 False   
1                       False                 False   
2                       False                 False   
3                       False                 False   
4                       False                 False   

   Country Name_Virgin Islands (U.S.)  Country Name_West Bank and Gaza  \
0                               False                            False   
1                               False                            False   
2                               False                            False   
3                               False                            False   
4                               False                            False   

   Country Name_Yemen, Rep.  Country Name_Zambia  Country Name_Zimbabwe  
0                     False                False                  False  
```

```
1                     False              False                  False
2                     False              False                  False
3                     False              False                  False
4                     False              False                  False

[5 rows x 235 columns]
0    23.373120
1    23.373120
2    22.072438
3    22.236082
4    22.375921
Name: GDP, dtype: float64
0    6.586373
1    6.578958
2    5.217827
3    5.305603
4    5.405635
Name: GDP Per Capita, dtype: float64
```

In [12]:

```
# Ensure features are a numpy array
X_np = np.array(X)
```

In [13]:

```
import seaborn as sns
from sklearn.preprocessing import MinMaxScaler
from sklearn.model_selection import train_test_split
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, LSTM, Dropout
from tensorflow.keras.optimizers import Adam

# To ignore warnings
import warnings
warnings.filterwarnings("ignore")
```

In [14]:

```
# Reshape the features for LSTM
X_lstm = np.reshape(X_np, (X.shape[0], X.shape[1], 1)).astype('float32') # Convert to float32

# Split data into training and testing
X_train, X_test, y_train, y_test = train_test_split(X_lstm, y_gdp.astype('float32'), test_size=0.2, random_state=42) # Convert y_

# Building the LSTM Model
model_gdp = Sequential()
model_gdp.add(LSTM(50, return_sequences=True, input_shape=(X_train.shape[1], 1)))
model_gdp.add(Dropout(0.2))
```

```
model_gdp.add(LSTM(50, return_sequences=False))
model_gdp.add(Dropout(0.2))
model_gdp.add(Dense(25))
model_gdp.add(Dense(1))

# Compile the model
model_gdp.compile(optimizer=Adam(learning_rate=0.001), loss='mean_squared_error')

# Train the model
model_gdp.fit(X_train, y_train, batch_size=32, epochs=500)

# Predicting GDP
pred_gdp = model_gdp.predict(X_test)
```

```
Epoch 1/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 6s 16ms/step - loss: 247.3952
Epoch 2/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 9.2256
Epoch 3/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 8.7127
Epoch 4/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 9.2279
Epoch 5/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 8.9232
Epoch 6/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 8.8850
Epoch 7/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 8.8823
Epoch 8/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 25ms/step - loss: 8.0734
Epoch 9/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.9588
Epoch 10/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 8.8221
Epoch 11/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 8.3923
Epoch 12/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 8.4267
Epoch 13/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 8.5771
Epoch 14/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 8.7594
Epoch 15/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 8.1593
Epoch 16/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 8.6375
Epoch 17/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 34ms/step - loss: 8.4753
Epoch 18/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 8.5389
Epoch 19/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 8.5458
Epoch 20/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 8.2659
Epoch 21/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - loss: 8.1026
Epoch 22/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 20ms/step - loss: 8.4744
```

```
Epoch 23/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.2691
Epoch 24/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 8.5246
Epoch 25/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.3761
Epoch 26/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 8.0406
Epoch 27/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 7.9377
Epoch 28/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.8197
Epoch 29/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.8194
Epoch 30/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.4309
Epoch 31/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 7.7442
Epoch 32/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 8.1259
Epoch 33/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 7.8281
Epoch 34/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.0249
Epoch 35/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 7.7735
Epoch 36/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 8.2193
Epoch 37/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.9213
Epoch 38/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.8296
Epoch 39/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.8206
Epoch 40/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.5482
Epoch 41/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 7.8795
Epoch 42/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 7.6330
Epoch 43/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 7.5068
Epoch 44/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.6622
```

```
Epoch 45/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.4096
Epoch 46/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 7.3548
Epoch 47/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 7.4440
Epoch 48/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.4263
Epoch 49/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 7.3942
Epoch 50/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 7.0874
Epoch 51/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.3641
Epoch 52/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 6.9077
Epoch 53/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 6.9507
Epoch 54/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.9826
Epoch 55/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 7.1061
Epoch 56/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 7.3396
Epoch 57/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 6.8923
Epoch 58/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 6.9270
Epoch 59/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.8454
Epoch 60/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.7574
Epoch 61/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 7.1090
Epoch 62/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 6.9041
Epoch 63/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.4952
Epoch 64/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.6987
Epoch 65/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.8577
Epoch 66/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.5151
```

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Epoch 67/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 6.5754
Epoch 68/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.4001
Epoch 69/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 6.4457
Epoch 70/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.5381
Epoch 71/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.5283
Epoch 72/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 6.4241
Epoch 73/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 6.0843
Epoch 74/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.3223
Epoch 75/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.4547
Epoch 76/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 6.2727
Epoch 77/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 6.4767
Epoch 78/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.4941
Epoch 79/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.2451
Epoch 80/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.0320
Epoch 81/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 6.3162
Epoch 82/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 6.2849
Epoch 83/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 6.3094
Epoch 84/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.3142
Epoch 85/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 5.9949
Epoch 86/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.0751
Epoch 87/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.1884
Epoch 88/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 6.0339
```

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Epoch 89/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 5.8235
Epoch 90/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.0537
Epoch 91/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.9937
Epoch 92/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 6.3718
Epoch 93/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 5.9809
Epoch 94/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.7018
Epoch 95/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.9216
Epoch 96/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.1651
Epoch 97/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.9241
Epoch 98/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 5.9818
Epoch 99/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 5.8953
Epoch 100/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 5.9666
Epoch 101/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 5.8021
Epoch 102/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 5.7929
Epoch 103/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 5.7702
Epoch 104/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 5.8305
Epoch 105/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.9620
Epoch 106/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.8931
Epoch 107/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 5.9306
Epoch 108/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.7494
Epoch 109/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 5.7913
Epoch 110/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 5.6870
```

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Epoch 111/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.1610
Epoch 112/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.0513
Epoch 113/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 1.3885
Epoch 114/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 1.4495
Epoch 115/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 1.4570
Epoch 116/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.9684
Epoch 117/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.0942
Epoch 118/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.9170
Epoch 119/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.9143
Epoch 120/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 1.2692
Epoch 121/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 1.0012
Epoch 122/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 1.1030
Epoch 123/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.3179
Epoch 124/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.0048
Epoch 125/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.7350
Epoch 126/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.6992
Epoch 127/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.6867
Epoch 128/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.6654
Epoch 129/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.8890
Epoch 130/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.8227
Epoch 131/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.7960
Epoch 132/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 0.8292
```

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Epoch 133/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.6337
Epoch 134/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.6284
Epoch 135/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.7096
Epoch 136/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.5391
Epoch 137/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.6609
Epoch 138/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5487
Epoch 139/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.6801
Epoch 140/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.8296
Epoch 141/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.8403
Epoch 142/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.5187
Epoch 143/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.4689
Epoch 144/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5767
Epoch 145/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.5224
Epoch 146/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.4421
Epoch 147/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.4864
Epoch 148/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 0.4780
Epoch 149/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.8829
Epoch 150/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.2255
Epoch 151/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.4465
Epoch 152/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.4805
Epoch 153/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.9332
Epoch 154/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.5483
```

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Epoch 155/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5712
Epoch 156/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.4057
Epoch 157/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.4269
Epoch 158/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3892
Epoch 159/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3904
Epoch 160/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.4600
Epoch 161/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.3522
Epoch 162/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.5979
Epoch 163/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 4.7109
Epoch 164/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.7212
Epoch 165/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5770
Epoch 166/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4874
Epoch 167/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.4519
Epoch 168/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4520
Epoch 169/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4770
Epoch 170/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4024
Epoch 171/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.3816
Epoch 172/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.3607
Epoch 173/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.3557
Epoch 174/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3654
Epoch 175/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3367
Epoch 176/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3259
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Epoch 177/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3503
Epoch 178/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.4251
Epoch 179/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 0.3659
Epoch 180/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4946
Epoch 181/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3523
Epoch 182/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.3981
Epoch 183/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.3205
Epoch 184/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 0.3764
Epoch 185/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3310
Epoch 186/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.2923
Epoch 187/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.3115
Epoch 188/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 0.3223
Epoch 189/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2894
Epoch 190/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3301
Epoch 191/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2706
Epoch 192/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2777
Epoch 193/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.5085
Epoch 194/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2466
Epoch 195/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2453
Epoch 196/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2750
Epoch 197/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2317
Epoch 198/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2768
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Epoch 199/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2254
Epoch 200/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3441
Epoch 201/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2810
Epoch 202/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2543
Epoch 203/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2755
Epoch 204/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 1.8659
Epoch 205/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3069
Epoch 206/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2313
Epoch 207/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.3071
Epoch 208/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2141
Epoch 209/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2417
Epoch 210/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2879
Epoch 211/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2166
Epoch 212/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2696
Epoch 213/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2087
Epoch 214/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.3168
Epoch 215/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2956
Epoch 216/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2767
Epoch 217/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.2294
Epoch 218/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.2534
Epoch 219/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2118
Epoch 220/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 0.1910
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Epoch 221/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2223
Epoch 222/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2106
Epoch 223/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1994
Epoch 224/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.2883
Epoch 225/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1985
Epoch 226/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.7087
Epoch 227/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.7216
Epoch 228/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3582
Epoch 229/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2885
Epoch 230/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.3033
Epoch 231/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2793
Epoch 232/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2871
Epoch 233/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.3209
Epoch 234/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2637
Epoch 235/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3171
Epoch 236/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2791
Epoch 237/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2764
Epoch 238/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2006
Epoch 239/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2284
Epoch 240/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.2068
Epoch 241/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1964
Epoch 242/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.2925
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Epoch 243/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.2141
Epoch 244/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.2255
Epoch 245/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1864
Epoch 246/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1811
Epoch 247/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1914
Epoch 248/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1779
Epoch 249/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2008
Epoch 250/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2364
Epoch 251/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2451
Epoch 252/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2433
Epoch 253/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1773
Epoch 254/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2410
Epoch 255/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.2194
Epoch 256/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1612
Epoch 257/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1977
Epoch 258/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1680
Epoch 259/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1855
Epoch 260/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.9854
Epoch 261/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1689
Epoch 262/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1570
Epoch 263/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1530
Epoch 264/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1320
```

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Epoch 265/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1310
Epoch 266/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1544
Epoch 267/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1409
Epoch 268/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1613
Epoch 269/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1503
Epoch 270/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1570
Epoch 271/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2128
Epoch 272/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1319
Epoch 273/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1525
Epoch 274/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1928
Epoch 275/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1589
Epoch 276/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.1292
Epoch 277/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1819
Epoch 278/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 5.3923
Epoch 279/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4050
Epoch 280/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3133
Epoch 281/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2962
Epoch 282/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2179
Epoch 283/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2218
Epoch 284/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2255
Epoch 285/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1798
Epoch 286/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1831
```

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Epoch 287/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1623
Epoch 288/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.2101
Epoch 289/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1507
Epoch 290/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1995
Epoch 291/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1562
Epoch 292/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1680
Epoch 293/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2162
Epoch 294/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1513
Epoch 295/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1880
Epoch 296/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2669
Epoch 297/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 23ms/step - loss: 0.1419
Epoch 298/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1424
Epoch 299/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1493
Epoch 300/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1665
Epoch 301/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1811
Epoch 302/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1903
Epoch 303/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 0.1631
Epoch 304/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3680
Epoch 305/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2080
Epoch 306/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1444
Epoch 307/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1900
Epoch 308/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1617
```

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Epoch 309/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4335
Epoch 310/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1432
Epoch 311/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1358
Epoch 312/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1372
Epoch 313/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1143
Epoch 314/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1265
Epoch 315/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1608
Epoch 316/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.2501
Epoch 317/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1946
Epoch 318/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1471
Epoch 319/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1652
Epoch 320/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1887
Epoch 321/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1460
Epoch 322/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1568
Epoch 323/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1373
Epoch 324/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1731
Epoch 325/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1378
Epoch 326/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.5589
Epoch 327/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1581
Epoch 328/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1236
Epoch 329/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1382
Epoch 330/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1357
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Epoch 331/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1590
Epoch 332/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1310
Epoch 333/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1048
Epoch 334/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3335
Epoch 335/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1249
Epoch 336/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1256
Epoch 337/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1038
Epoch 338/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.1511
Epoch 339/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.1678
Epoch 340/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1261
Epoch 341/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1508
Epoch 342/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1957
Epoch 343/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 1.4057
Epoch 344/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1281
Epoch 345/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1716
Epoch 346/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1345
Epoch 347/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1377
Epoch 348/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1248
Epoch 349/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1273
Epoch 350/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1068
Epoch 351/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1153
Epoch 352/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.8932
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Epoch 353/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1225
Epoch 354/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1261
Epoch 355/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1092
Epoch 356/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1175
Epoch 357/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1112
Epoch 358/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1084
Epoch 359/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1183
Epoch 360/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1381
Epoch 361/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1348
Epoch 362/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1444
Epoch 363/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1450
Epoch 364/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1102
Epoch 365/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1196
Epoch 366/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1040
Epoch 367/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1196
Epoch 368/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1949
Epoch 369/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1084
Epoch 370/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1099
Epoch 371/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 4.0592
Epoch 372/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.1068
Epoch 373/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 1.1548
Epoch 374/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4252
```

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Epoch 375/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.4681
Epoch 376/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.3725
Epoch 377/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3145
Epoch 378/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3840
Epoch 379/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3189
Epoch 380/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3424
Epoch 381/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.3041
Epoch 382/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.2468
Epoch 383/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2320
Epoch 384/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2580
Epoch 385/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2590
Epoch 386/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2514
Epoch 387/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2142
Epoch 388/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1592
Epoch 389/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1808
Epoch 390/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1741
Epoch 391/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1685
Epoch 392/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1781
Epoch 393/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2300
Epoch 394/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1629
Epoch 395/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1608
Epoch 396/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2380
```

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Epoch 397/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1718
Epoch 398/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1610
Epoch 399/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1371
Epoch 400/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1354
Epoch 401/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1357
Epoch 402/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1468
Epoch 403/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1472
Epoch 404/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1260
Epoch 405/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1648
Epoch 406/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1369
Epoch 407/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1314
Epoch 408/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1602
Epoch 409/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1944
Epoch 410/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1332
Epoch 411/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1283
Epoch 412/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1445
Epoch 413/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1226
Epoch 414/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1158
Epoch 415/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1471
Epoch 416/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1440
Epoch 417/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1354
Epoch 418/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1248
```

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Epoch 419/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1402
Epoch 420/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3399
Epoch 421/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2733
Epoch 422/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1494
Epoch 423/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1472
Epoch 424/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1305
Epoch 425/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1290
Epoch 426/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1299
Epoch 427/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1611
Epoch 428/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1345
Epoch 429/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1238
Epoch 430/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1462
Epoch 431/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1333
Epoch 432/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 18ms/step - loss: 0.1396
Epoch 433/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1194
Epoch 434/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3360
Epoch 435/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1418
Epoch 436/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1453
Epoch 437/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1131
Epoch 438/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1403
Epoch 439/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1206
Epoch 440/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1310
```

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Epoch 441/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1184
Epoch 442/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1548
Epoch 443/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1707
Epoch 444/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1600
Epoch 445/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1095
Epoch 446/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1394
Epoch 447/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1135
Epoch 448/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1101
Epoch 449/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1484
Epoch 450/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1330
Epoch 451/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1461
Epoch 452/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2305
Epoch 453/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1391
Epoch 454/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1751
Epoch 455/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1244
Epoch 456/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1211
Epoch 457/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1590
Epoch 458/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2172
Epoch 459/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1275
Epoch 460/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1253
Epoch 461/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1195
Epoch 462/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1088
```

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Epoch 463/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1417
Epoch 464/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.8703
Epoch 465/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1584
Epoch 466/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 18ms/step - loss: 0.1526
Epoch 467/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1530
Epoch 468/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1271
Epoch 469/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1025
Epoch 470/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.1253
Epoch 471/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1050
Epoch 472/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1482
Epoch 473/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1210
Epoch 474/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0988
Epoch 475/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1233
Epoch 476/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1012
Epoch 477/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1258
Epoch 478/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1388
Epoch 479/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0889
Epoch 480/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.0992
Epoch 481/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1008
Epoch 482/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0916
Epoch 483/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1448
Epoch 484/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1263
```

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Epoch 485/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1077
Epoch 486/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1186
Epoch 487/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1087
Epoch 488/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0982
Epoch 489/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1113
Epoch 490/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1037
Epoch 491/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 1.4874
Epoch 492/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.3942
Epoch 493/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1447
Epoch 494/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1395
Epoch 495/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1562
Epoch 496/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1228
Epoch 497/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1293
Epoch 498/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1372
Epoch 499/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1470
Epoch 500/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1523
32/32 ━━━━━━━━━━━━━━━━━━━━ 1s 12ms/step
```

In [15]:

```
# Split data into training and testing for GDP Per Capita
X_train_pc, X_test_pc, y_train_pc, y_test_pc = train_test_split(X_lstm, y_gdp_per_capita, test_size=0.2, random_state=42)

# Building the LSTM Model
model_gdp_pc = Sequential()
model_gdp_pc.add(LSTM(50, return_sequences=True, input_shape=(X_train_pc.shape[1], 1)))
model_gdp_pc.add(Dropout(0.2))
model_gdp_pc.add(LSTM(50, return_sequences=False))
model_gdp_pc.add(Dropout(0.2))
model_gdp_pc.add(Dense(25))
```

```
model_gdp_pc.add(Dense(1))

# Compile the model
model_gdp_pc.compile(optimizer=Adam(learning_rate=0.001), loss='mean_squared_error')

# Train the model
model_gdp_pc.fit(X_train_pc, y_train_pc, batch_size=32, epochs=500)

# Predicting GDP Per Capita
pred_gdp_pc = model_gdp_pc.predict(X_test_pc)
```

```
Epoch 1/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 20ms/step - loss: 27.4917
Epoch 2/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 2.9432
Epoch 3/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.7936
Epoch 4/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.8612
Epoch 5/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.8951
Epoch 6/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 2.8118
Epoch 7/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.8858
Epoch 8/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.8678
Epoch 9/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 2.8209
Epoch 10/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.7625
Epoch 11/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.7313
Epoch 12/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.8288
Epoch 13/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.7651
Epoch 14/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.8090
Epoch 15/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.7918
Epoch 16/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.7776
Epoch 17/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.8912
Epoch 18/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.7358
Epoch 19/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.7697
Epoch 20/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.7632
Epoch 21/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.7048
Epoch 22/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 2.8943
```

```
Epoch 23/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.6814
Epoch 24/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.7112
Epoch 25/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 2.7009
Epoch 26/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 2.7579
Epoch 27/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.6203
Epoch 28/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.6115
Epoch 29/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 2.7116
Epoch 30/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.6306
Epoch 31/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.5945
Epoch 32/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.7535
Epoch 33/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.6546
Epoch 34/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.6411
Epoch 35/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.5880
Epoch 36/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.5145
Epoch 37/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.5827
Epoch 38/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 2.5863
Epoch 39/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.5400
Epoch 40/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.5471
Epoch 41/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.4888
Epoch 42/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.6560
Epoch 43/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.5479
Epoch 44/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.4905
```

```
Epoch 45/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.4567
Epoch 46/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.5394
Epoch 47/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.5131
Epoch 48/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.4896
Epoch 49/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 3.0256
Epoch 50/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.8009
Epoch 51/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.6400
Epoch 52/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.5567
Epoch 53/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 2.4561
Epoch 54/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.4818
Epoch 55/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.4807
Epoch 56/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.4387
Epoch 57/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.5367
Epoch 58/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.3740
Epoch 59/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.5075
Epoch 60/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4162
Epoch 61/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.4183
Epoch 62/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.4768
Epoch 63/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.3808
Epoch 64/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.5068
Epoch 65/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.4523
Epoch 66/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.3890
```

```
Epoch 67/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 2.4420
Epoch 68/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.3262
Epoch 69/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3340
Epoch 70/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.4323
Epoch 71/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.3839
Epoch 72/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.4123
Epoch 73/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.4121
Epoch 74/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.4154
Epoch 75/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3716
Epoch 76/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4196
Epoch 77/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4288
Epoch 78/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 2.3606
Epoch 79/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.4305
Epoch 80/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4108
Epoch 81/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.4235
Epoch 82/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4326
Epoch 83/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 2.3248
Epoch 84/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.4256
Epoch 85/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.4019
Epoch 86/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.3553
Epoch 87/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.4319
Epoch 88/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.3000
```

```
Epoch 89/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 2.4691
Epoch 90/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.3638
Epoch 91/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.4044
Epoch 92/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.4210
Epoch 93/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4268
Epoch 94/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.3425
Epoch 95/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 2.4313
Epoch 96/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4381
Epoch 97/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3672
Epoch 98/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3500
Epoch 99/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 2.4033
Epoch 100/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 2.4213
Epoch 101/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3339
Epoch 102/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.4548
Epoch 103/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3422
Epoch 104/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4687
Epoch 105/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.3821
Epoch 106/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 2.4294
Epoch 107/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.3388
Epoch 108/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.2741
Epoch 109/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.3734
Epoch 110/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 2.3843
```

```
Epoch 111/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4131
Epoch 112/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3639
Epoch 113/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4181
Epoch 114/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 2.4427
Epoch 115/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.3449
Epoch 116/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3823
Epoch 117/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3682
Epoch 118/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3903
Epoch 119/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3471
Epoch 120/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.3618
Epoch 121/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3746
Epoch 122/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3729
Epoch 123/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3950
Epoch 124/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3738
Epoch 125/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.3929
Epoch 126/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 2.4241
Epoch 127/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4218
Epoch 128/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4120
Epoch 129/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.3864
Epoch 130/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 2.3646
Epoch 131/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 2.4253
Epoch 132/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3783
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Epoch 133/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.4140
Epoch 134/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4235
Epoch 135/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3450
Epoch 136/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.3977
Epoch 137/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.3536
Epoch 138/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4564
Epoch 139/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3863
Epoch 140/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 2.2712
Epoch 141/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3252
Epoch 142/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.4414
Epoch 143/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4444
Epoch 144/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.2995
Epoch 145/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.3955
Epoch 146/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 2.3994
Epoch 147/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4263
Epoch 148/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3391
Epoch 149/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4054
Epoch 150/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 2.4050
Epoch 151/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.3037
Epoch 152/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4304
Epoch 153/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3072
Epoch 154/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.4005
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Epoch 155/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3807
Epoch 156/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.3234
Epoch 157/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.4123
Epoch 158/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3988
Epoch 159/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3938
Epoch 160/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 2.4224
Epoch 161/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.4248
Epoch 162/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3830
Epoch 163/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.4343
Epoch 164/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.4537
Epoch 165/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4361
Epoch 166/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 2.4346
Epoch 167/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3691
Epoch 168/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3925
Epoch 169/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3585
Epoch 170/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4151
Epoch 171/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 2.4293
Epoch 172/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3422
Epoch 173/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4021
Epoch 174/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3187
Epoch 175/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3639
Epoch 176/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.3862
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Epoch 177/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 18ms/step - loss: 2.3867
Epoch 178/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.2939
Epoch 179/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3701
Epoch 180/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 2.3129
Epoch 181/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.3695
Epoch 182/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.3860
Epoch 183/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.3837
Epoch 184/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3606
Epoch 185/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.4356
Epoch 186/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.3510
Epoch 187/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.4003
Epoch 188/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3145
Epoch 189/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3558
Epoch 190/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 2.4056
Epoch 191/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.3333
Epoch 192/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3054
Epoch 193/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.2565
Epoch 194/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.2907
Epoch 195/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.3493
Epoch 196/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.2892
Epoch 197/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.3443
Epoch 198/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.2648
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Epoch 199/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.2156
Epoch 200/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.2800
Epoch 201/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.3421
Epoch 202/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.2125
Epoch 203/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.2898
Epoch 204/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.2452
Epoch 205/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.2560
Epoch 206/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.2329
Epoch 207/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.5391
Epoch 208/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.5184
Epoch 209/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3717
Epoch 210/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 2.3803
Epoch 211/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.4153
Epoch 212/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4244
Epoch 213/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.5038
Epoch 214/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 2.3387
Epoch 215/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 2.4610
Epoch 216/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4797
Epoch 217/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3697
Epoch 218/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4568
Epoch 219/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4123
Epoch 220/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 2.2480
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Epoch 221/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 2.2430
Epoch 222/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.2676
Epoch 223/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.3374
Epoch 224/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.1194
Epoch 225/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 1.8975
Epoch 226/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 1.6704
Epoch 227/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 1.5898
Epoch 228/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.2772
Epoch 229/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 1.4846
Epoch 230/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 1.1684
Epoch 231/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 1.0416
Epoch 232/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 1.0839
Epoch 233/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 1.0811
Epoch 234/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 1.0832
Epoch 235/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.9961
Epoch 236/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.9256
Epoch 237/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.8960
Epoch 238/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.9617
Epoch 239/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.9774
Epoch 240/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.9902
Epoch 241/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.8443
Epoch 242/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.8609
```

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Epoch 243/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.9354
Epoch 244/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.8529
Epoch 245/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.8084
Epoch 246/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.9850
Epoch 247/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.8334
Epoch 248/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.8710
Epoch 249/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.8544
Epoch 250/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.7968
Epoch 251/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 1.9135
Epoch 252/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 1.1579
Epoch 253/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.8898
Epoch 254/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.7769
Epoch 255/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.6642
Epoch 256/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.8220
Epoch 257/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.6541
Epoch 258/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.5848
Epoch 259/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.5938
Epoch 260/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.5404
Epoch 261/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.6255
Epoch 262/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.5154
Epoch 263/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.5223
Epoch 264/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.6981
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Epoch 265/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.6523
Epoch 266/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.4854
Epoch 267/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.5511
Epoch 268/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.5157
Epoch 269/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.5427
Epoch 270/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.4812
Epoch 271/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4953
Epoch 272/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.5080
Epoch 273/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.4460
Epoch 274/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.4598
Epoch 275/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.5118
Epoch 276/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.5832
Epoch 277/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4782
Epoch 278/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4736
Epoch 279/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4176
Epoch 280/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.4458
Epoch 281/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 18ms/step - loss: 0.4027
Epoch 282/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4838
Epoch 283/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.4209
Epoch 284/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.4955
Epoch 285/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.3784
Epoch 286/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4654
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Epoch 287/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.5012
Epoch 288/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.4090
Epoch 289/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.3522
Epoch 290/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.4240
Epoch 291/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4211
Epoch 292/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.4503
Epoch 293/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.4287
Epoch 294/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3457
Epoch 295/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3465
Epoch 296/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3455
Epoch 297/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4617
Epoch 298/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.3378
Epoch 299/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.3389
Epoch 300/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.4215
Epoch 301/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3167
Epoch 302/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3849
Epoch 303/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.3514
Epoch 304/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.3893
Epoch 305/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2987
Epoch 306/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4035
Epoch 307/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.4264
Epoch 308/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.2901
```

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Epoch 309/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2991
Epoch 310/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.2638
Epoch 311/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2709
Epoch 312/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2311
Epoch 313/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2412
Epoch 314/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.2265
Epoch 315/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2362
Epoch 316/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3403
Epoch 317/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2369
Epoch 318/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2530
Epoch 319/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2213
Epoch 320/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2349
Epoch 321/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2646
Epoch 322/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2292
Epoch 323/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.2362
Epoch 324/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2094
Epoch 325/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2286
Epoch 326/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.2346
Epoch 327/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2216
Epoch 328/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 18ms/step - loss: 0.2207
Epoch 329/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1855
Epoch 330/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2346
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Epoch 331/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.2263
Epoch 332/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1808
Epoch 333/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2190
Epoch 334/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2000
Epoch 335/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1596
Epoch 336/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2010
Epoch 337/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2156
Epoch 338/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1685
Epoch 339/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1727
Epoch 340/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2029
Epoch 341/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2076
Epoch 342/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1800
Epoch 343/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1947
Epoch 344/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1892
Epoch 345/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1467
Epoch 346/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1791
Epoch 347/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1525
Epoch 348/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1726
Epoch 349/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2226
Epoch 350/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1592
Epoch 351/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1786
Epoch 352/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1569
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Epoch 353/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2058
Epoch 354/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1642
Epoch 355/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1952
Epoch 356/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1442
Epoch 357/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1553
Epoch 358/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1782
Epoch 359/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1568
Epoch 360/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1363
Epoch 361/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1560
Epoch 362/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1435
Epoch 363/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1378
Epoch 364/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1286
Epoch 365/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1481
Epoch 366/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 35ms/step - loss: 0.1504
Epoch 367/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 26ms/step - loss: 0.1813
Epoch 368/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1908
Epoch 369/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.6201
Epoch 370/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1678
Epoch 371/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2096
Epoch 372/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1359
Epoch 373/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1469
Epoch 374/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2175
```

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Epoch 375/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1705
Epoch 376/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1774
Epoch 377/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1447
Epoch 378/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1430
Epoch 379/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.2563
Epoch 380/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2197
Epoch 381/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1558
Epoch 382/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - loss: 0.1411
Epoch 383/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - loss: 0.1383
Epoch 384/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 21ms/step - loss: 0.1511
Epoch 385/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1703
Epoch 386/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1529
Epoch 387/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1459
Epoch 388/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0954
Epoch 389/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1466
Epoch 390/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1821
Epoch 391/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1679
Epoch 392/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1635
Epoch 393/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1209
Epoch 394/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1289
Epoch 395/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1239
Epoch 396/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1183
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Epoch 397/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1080
Epoch 398/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1174
Epoch 399/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1837
Epoch 400/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1330
Epoch 401/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1363
Epoch 402/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1353
Epoch 403/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1454
Epoch 404/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1554
Epoch 405/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1020
Epoch 406/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1551
Epoch 407/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1073
Epoch 408/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1209
Epoch 409/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1684
Epoch 410/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1653
Epoch 411/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1025
Epoch 412/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1211
Epoch 413/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.1208
Epoch 414/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - loss: 0.1582
Epoch 415/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 18ms/step - loss: 0.0987
Epoch 416/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1611
Epoch 417/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0980
Epoch 418/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1205
```

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Epoch 419/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1005
Epoch 420/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1108
Epoch 421/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1240
Epoch 422/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1064
Epoch 423/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0989
Epoch 424/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1265
Epoch 425/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1117
Epoch 426/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1238
Epoch 427/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1101
Epoch 428/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 18ms/step - loss: 0.1042
Epoch 429/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1099
Epoch 430/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1274
Epoch 431/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0931
Epoch 432/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1502
Epoch 433/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0929
Epoch 434/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1772
Epoch 435/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1003
Epoch 436/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - loss: 0.1448
Epoch 437/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0811
Epoch 438/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0764
Epoch 439/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1062
Epoch 440/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0783
```

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Epoch 441/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.3835
Epoch 442/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0916
Epoch 443/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0886
Epoch 444/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0871
Epoch 445/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1147
Epoch 446/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0996
Epoch 447/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1055
Epoch 448/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1009
Epoch 449/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1058
Epoch 450/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1159
Epoch 451/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0843
Epoch 452/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0862
Epoch 453/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0860
Epoch 454/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1266
Epoch 455/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1285
Epoch 456/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1064
Epoch 457/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1375
Epoch 458/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1756
Epoch 459/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0782
Epoch 460/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.0797
Epoch 461/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0835
Epoch 462/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0979
```

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Epoch 463/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0734
Epoch 464/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0781
Epoch 465/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1427
Epoch 466/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0663
Epoch 467/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0688
Epoch 468/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0697
Epoch 469/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0893
Epoch 470/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1253
Epoch 471/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0640
Epoch 472/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0704
Epoch 473/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0970
Epoch 474/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0885
Epoch 475/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 18ms/step - loss: 0.0969
Epoch 476/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0798
Epoch 477/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0759
Epoch 478/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0854
Epoch 479/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0809
Epoch 480/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0971
Epoch 481/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0863
Epoch 482/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0683
Epoch 483/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2538
Epoch 484/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1124
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Epoch 485/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0751
Epoch 486/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0595
Epoch 487/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0697
Epoch 488/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1072
Epoch 489/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2016
Epoch 490/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0797
Epoch 491/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0645
Epoch 492/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0688
Epoch 493/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0661
Epoch 494/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1054
Epoch 495/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0818
Epoch 496/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1201
Epoch 497/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.0616
Epoch 498/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0655
Epoch 499/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - loss: 0.0594
Epoch 500/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 18ms/step - loss: 0.0910
32/32 ━━━━━━━━━━━━━━━━━━━━ 1s 13ms/step
```

In [16]:

```python
from sklearn.metrics import mean_squared_error, r2_score

# Evaluating GDP Model
mse_gdp = mean_squared_error(y_test, pred_gdp)
r2_gdp = r2_score(y_test, pred_gdp)
print(f"GDP Model - MSE: {mse_gdp}, R2: {r2_gdp}")

# Evaluating GDP Per Capita Model
mse_gdp_pc = mean_squared_error(y_test_pc, pred_gdp_pc)
```

```
r2_gdp_pc = r2_score(y_test_pc, pred_gdp_pc)
print(f"GDP Per Capita Model - MSE: {mse_gdp_pc}, R2: {r2_gdp_pc}")
```

```
GDP Model - MSE: 0.04693979024887085, R2: 0.9914343995142781
GDP Per Capita Model - MSE: 0.030671848354972584, R2: 0.9873810983418025
```

These results indicate the performance of Long Short-Term Memory (LSTM) model for two different GDP-related predictions.

1. **GDP Model:**

   - **Mean Squared Error (MSE):** 0.0469
   - **R-squared (R^2):** 0.9914

   The MSE of 0.0469 is relatively low, suggesting that the model's predictions are close to the actual values, with minimal error. An R^2 value of 0.9914 is very high, indicating that approximately 99.14% of the variance in GDP can be explained by the model. This means your model has a strong fit to the GDP data.

2. **GDP Per Capita Model:**

   - **Mean Squared Error (MSE):** 0.0307
   - **R-squared (R^2):** 0.9874

   Similarly, the MSE of 0.0307 is low, showing that the model is making accurate predictions with minimal error. The R^2 value of 0.9874 is also very high, meaning that about 98.74% of the variance in GDP per capita is explained by the model. This indicates a strong fit to the GDP per capita data as well.

Summary:

- Both models exhibit excellent performance, with very high R^2 values indicating that they are well-suited to predict GDP and GDP per capita.
- The low MSE values for both models show that the predictions are close to the actual values, confirming the models' accuracy and reliability.

In [17]:
```
import matplotlib.pyplot as plt

# Define the metrics for each model
models = ['GDP Model', 'GDP Per Capita Model']
mse_values = [mse_gdp, mse_gdp_pc]
r2_values = [r2_gdp, r2_gdp_pc]

# Create a figure and axis
fig, ax1 = plt.subplots(figsize=(10, 6))
```

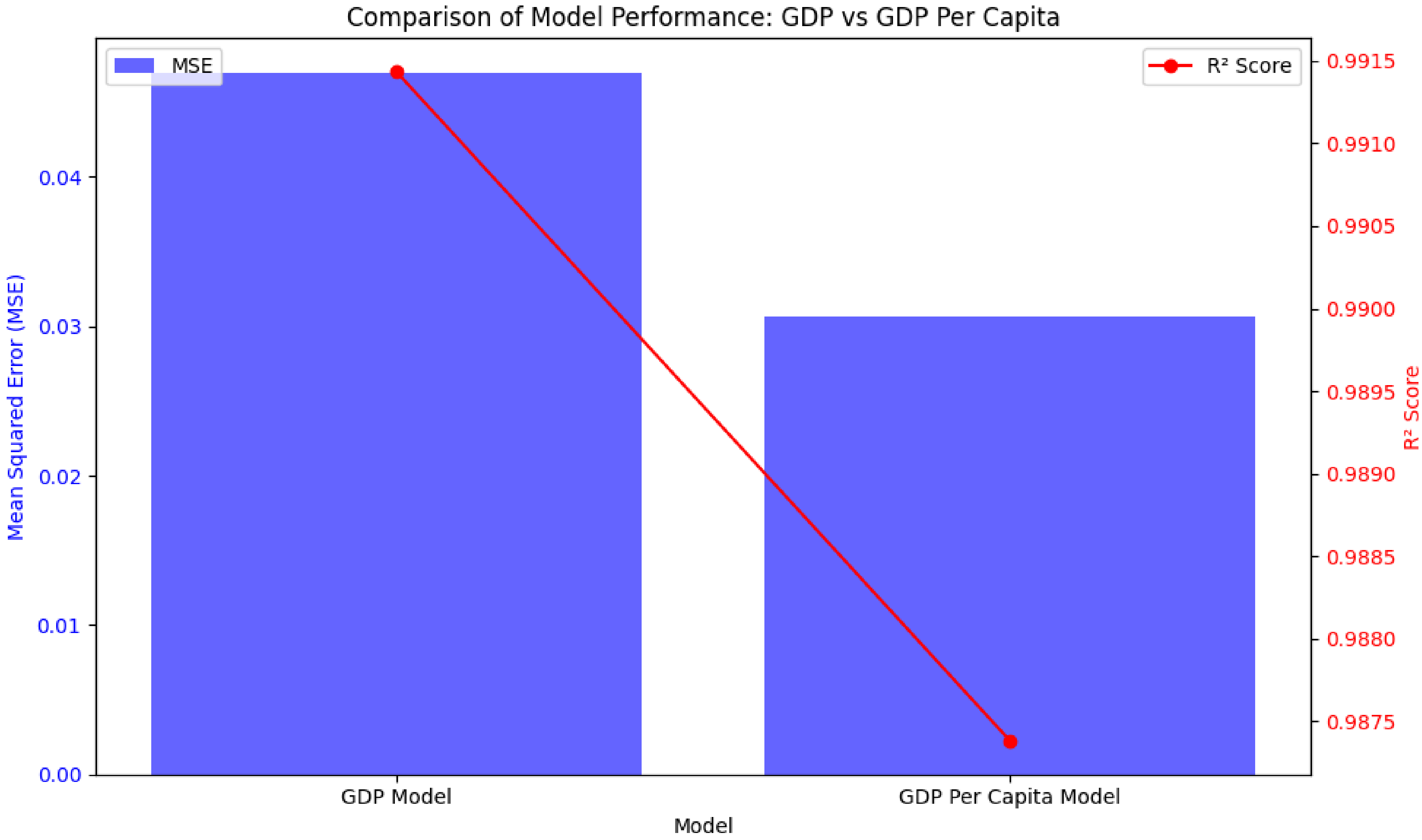
```
# Plot MSE
ax1.bar(models, mse_values, color='blue', alpha=0.6, label='MSE')
ax1.set_xlabel('Model')
ax1.set_ylabel('Mean Squared Error (MSE)', color='blue')
ax1.tick_params(axis='y', labelcolor='blue')

# Create a second y-axis to plot R² scores
ax2 = ax1.twinx()
ax2.plot(models, r2_values, color='red', marker='o', label='R² Score')
ax2.set_ylabel('R² Score', color='red')
ax2.tick_params(axis='y', labelcolor='red')

# Add titles and labels
plt.title('Comparison of Model Performance: GDP vs GDP Per Capita')
fig.tight_layout()

# Add legends
ax1.legend(loc='upper left')
ax2.legend(loc='upper right')

# Show the plot
plt.show()
```



The graph presents a comparative analysis of two models—one based on GDP and the other on GDP Per Capita. The performance metrics shown are Mean Squared Error (MSE) and R^2 Score.

Interpretation:

1. **MSE (Mean Squared Error):**

- Represented by the blue bars on the left y-axis.
- The GDP Model has a higher MSE than the GDP Per Capita Model, indicating that the GDP Model has higher errors in its predictions.
- The lower MSE in the GDP Per Capita Model suggests it is more accurate in predicting the target variable.

2. **R^2 Score:**

- Represented by the red line on the right y-axis.
- The GDP Model has a slightly higher R^2 score than the GDP Per Capita Model, indicating that it explains slightly more variance in the data.
- The downward trend in the R^2 score from the GDP Model to the GDP Per Capita Model suggests that while the GDP Per Capita Model has lower errors (better MSE), it slightly sacrifices the explained variance.

Conclusion:

- **Trade-off Between MSE and R^2:** The plot indicates a trade-off where the GDP Per Capita Model reduces prediction errors (lower MSE) at the cost of a small decrease in the proportion of variance explained (lower R^2 score). This suggests that depending on the application, one might prefer the GDP Per Capita Model for its accuracy or the GDP Model for its explanatory power.

This visual helps in understanding which model might be more suitable depending on the specific goals of the analysis, whether it’s minimizing error or maximizing the explained variance.