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

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)

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	N
1	Afghanistan	AFG	2001	27.501127	40.717968	13.670101	NaN	1.415197e+10	10.902580	NaN	...	19688632.0	652860.0	Asia	N
2	Afghanistan	AFG	2002	38.627892	40.717968	13.670101	NaN	3.854235e+09	9.443391	NaN	...	21000256.0	652860.0	Asia	N
3	Afghanistan	AFG	2003	37.418855	40.717968	13.670101	NaN	4.539497e+09	8.941258	NaN	...	22645130.0	652860.0	Asia	N
4	Afghanistan	AFG	2004	29.721067	40.717968	13.670101	NaN	5.220825e+09	9.808474	NaN	...	23553551.0	652860.0	Asia	N

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	...	8.1
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()
```

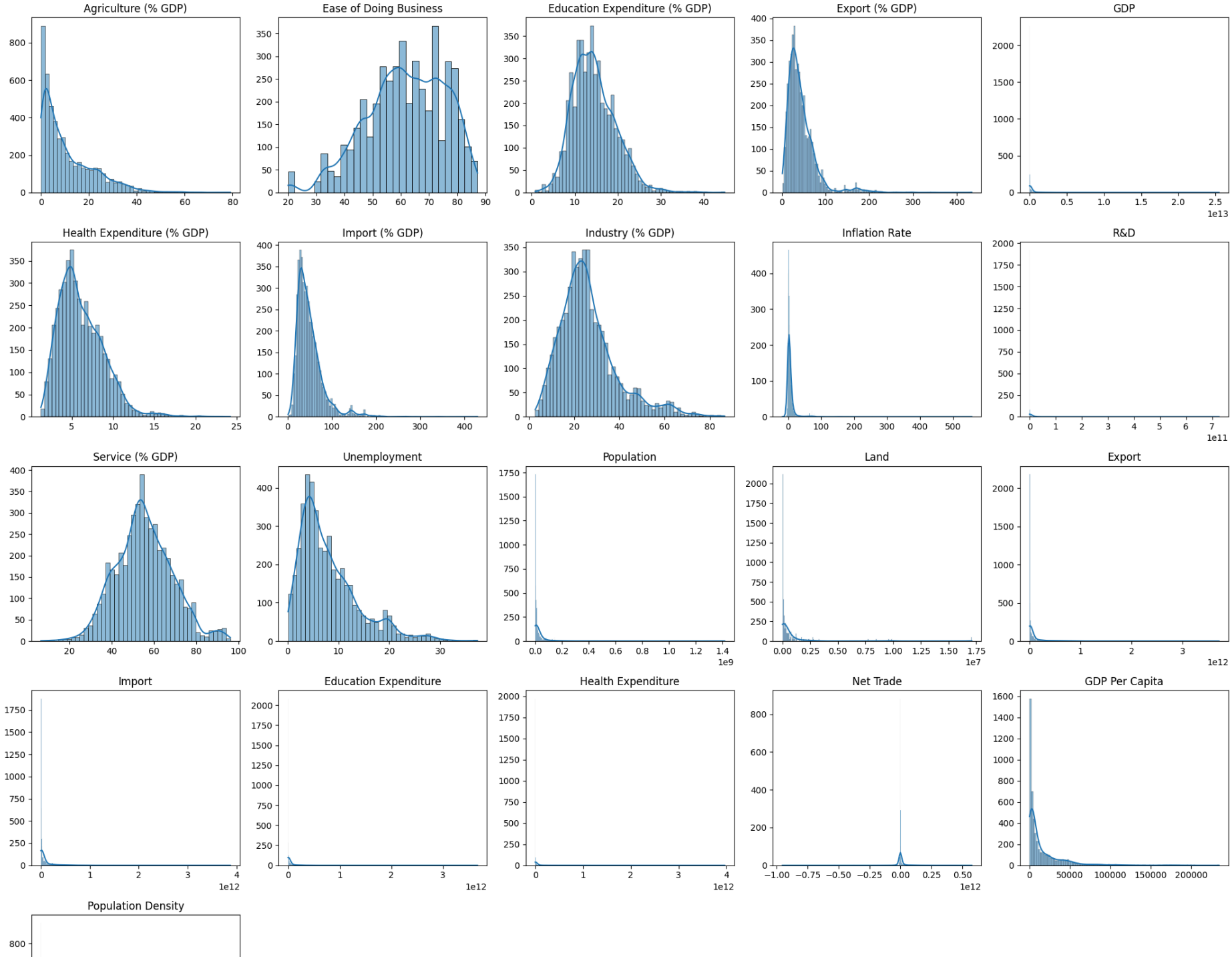
Out[6]:

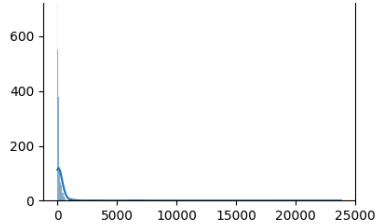
	0
Country Name	0
Country Code	0
Year	0
Agriculture (% GDP)	276
Ease of Doing Business	598
Education Expenditure (% GDP)	368
Export (% GDP)	460
GDP	69
Health Expenditure (% GDP)	575
Import (% GDP)	460
Industry (% GDP)	253
Inflation Rate	552
R&D	1518
Service (% GDP)	299
Unemployment	667
Population	0
Land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

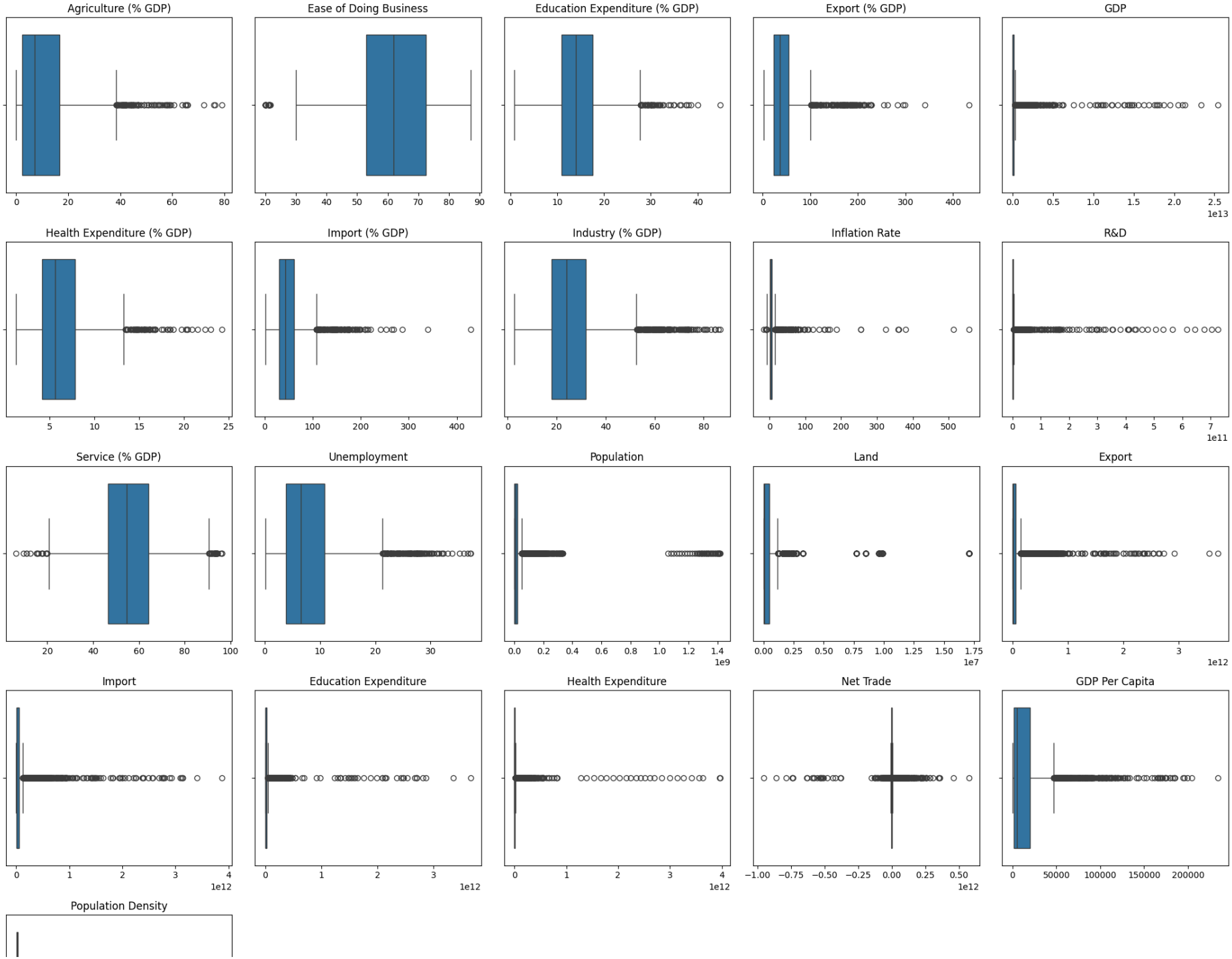
	0
Population Density	0

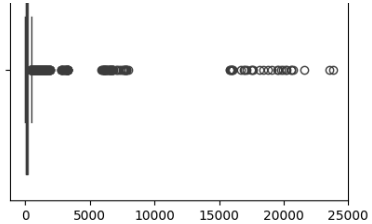
dtype: int64

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()
```

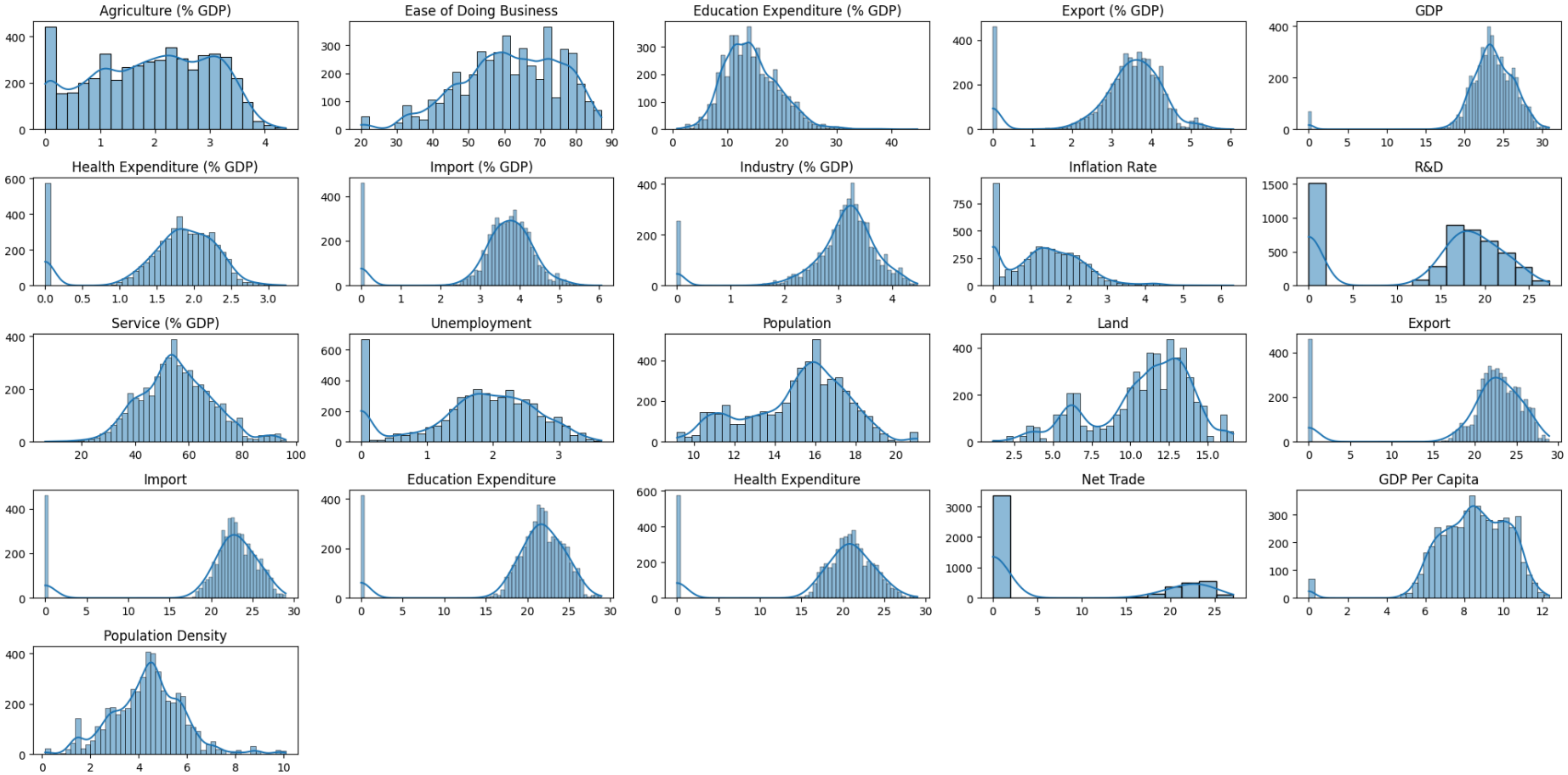

Agriculture (% GDP)
Ease of Doing Business
Education Expenditure (% GDP)
Export (% GDP)
GDP
1e13
Health Expenditure (% GDP)
Import (% GDP)
Industry (% GDP)
Inflation Rate
R&D
1e11
Service (% GDP)
Unemployment
Population
1e9
Land
1e7
Export
1e12
Import
1e12
Education Expenditure
1e12
Health Expenditure
1e12
Net Trade
1e12
GDP Per Capita
Population Density


600
400
200
0
0
5000
10000
15000
20000
25000


Agriculture (% GDP)
Ease of Doing Business
Education Expenditure (% GDP)
Export (% GDP)
GDP
1e13
Health Expenditure (% GDP)
Import (% GDP)
Industry (% GDP)
Inflation Rate
R&D
1e11
Service (% GDP)
Unemployment
Population
1e9
Land
1e7
Export
1e12
Import
1e12
Education Expenditure
1e12
Health Expenditure
1e12
Net Trade
1e12
GDP Per Capita
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:
```

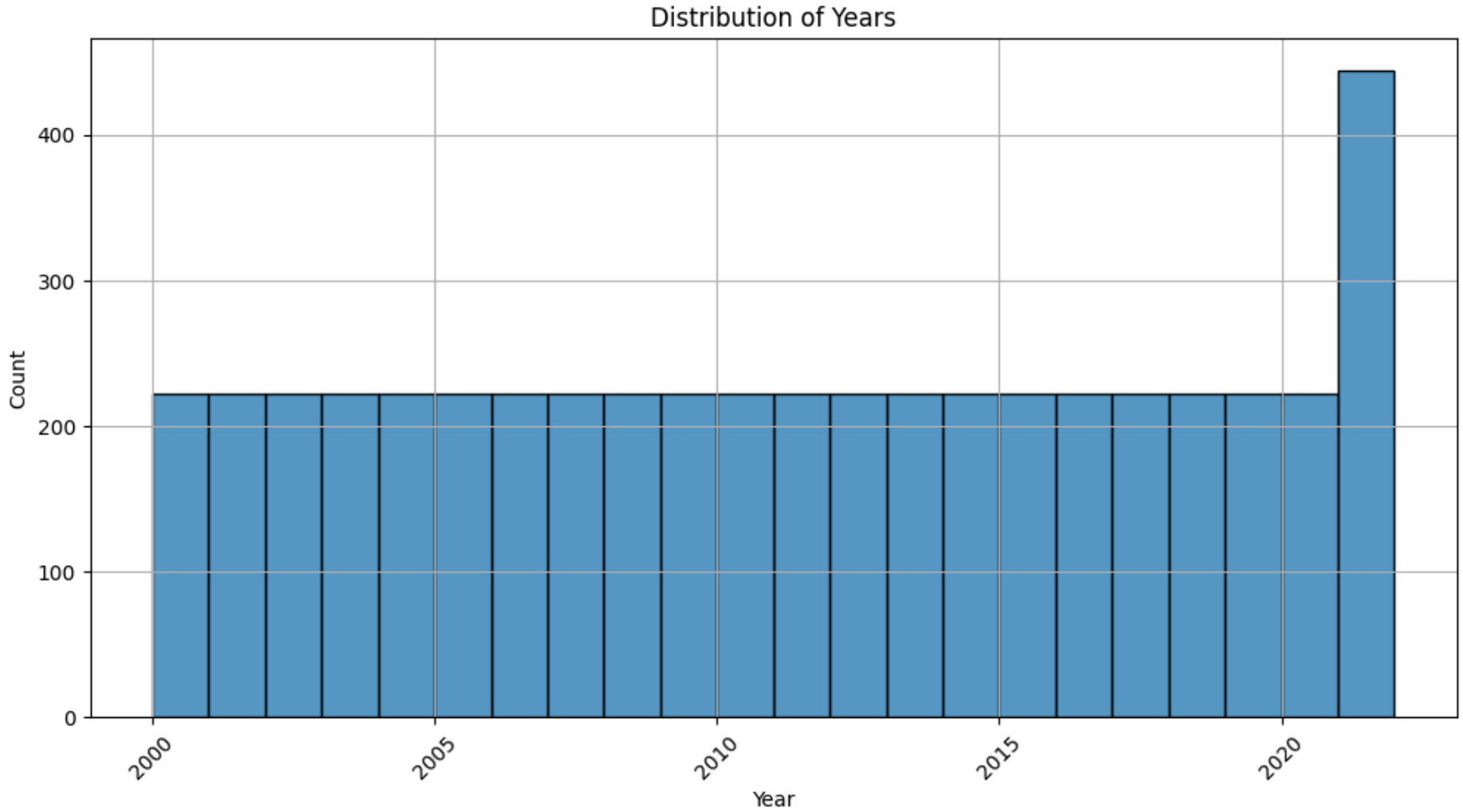
```
    handle_outliers_zscore(df3, col)

# 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
```

Distribution of years

In [11]:
```
# Distribution of Years
plt.figure(figsize=(12, 6))
sns.histplot(df3['Year'], bins=range(int(df3['Year'].min()), int(df3['Year'].max()) + 1), edgecolor='black', kde=False)
plt.title('Distribution of Years')
plt.xlabel('Year')
plt.ylabel('Count')
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```

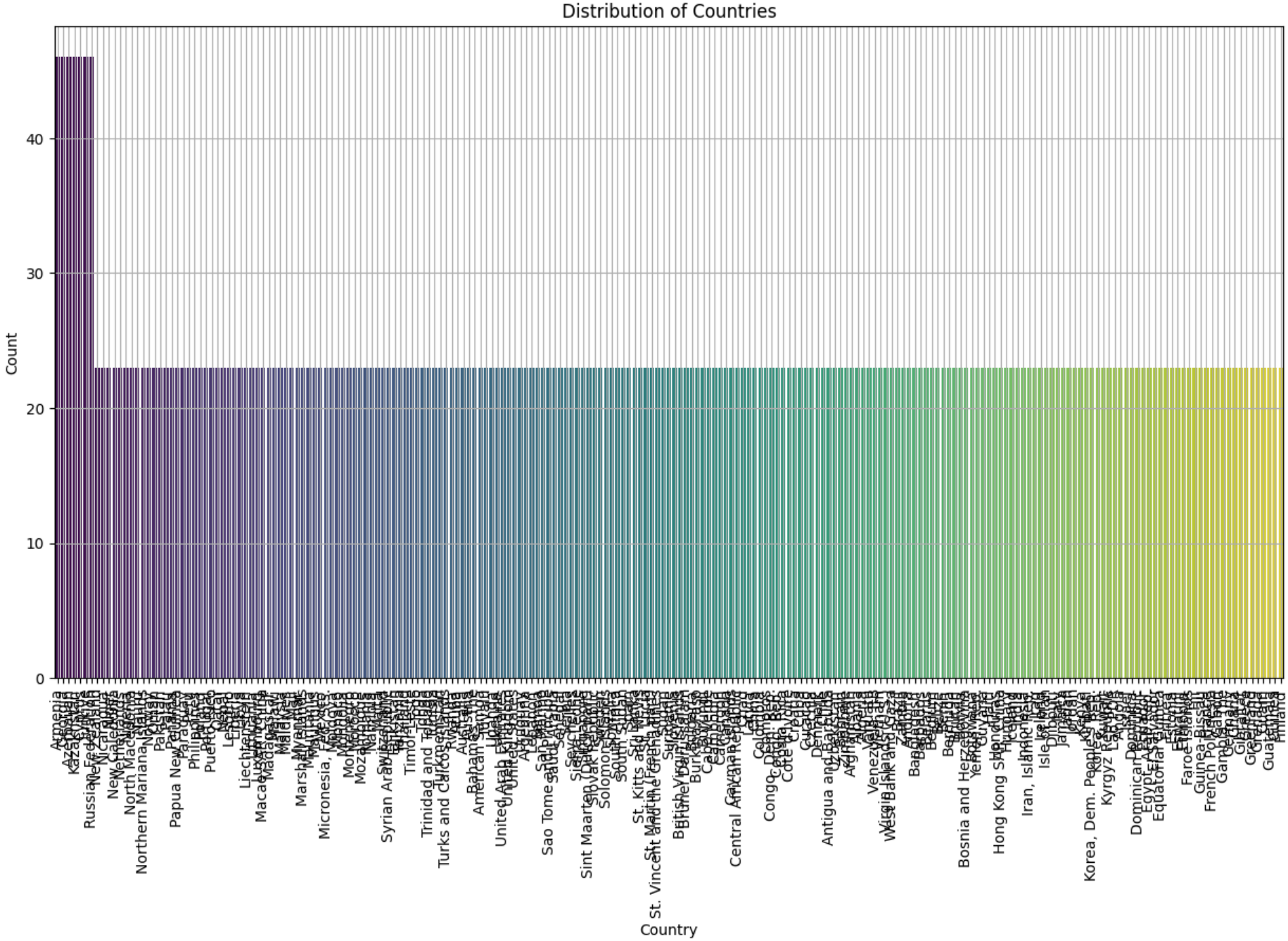


Distribution of countries

In [12]:
```
# Distribution of Countries
plt.figure(figsize=(15, 8))
country_counts = df3['Country Name'].value_counts()
sns.barplot(x=country_counts.index, y=country_counts.values, palette='viridis')
plt.title('Distribution of Countries')
plt.xlabel('Country')
plt.ylabel('Count')
```

```
plt.xticks(rotation=90)
plt.grid(True)
```

```
<ipython-input-12-34e36272af87>:4: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set
`legend=False` for the same effect.

  sns.barplot(x=country_counts.index, y=country_counts.values, palette='viridis')
```



prediction of GDP using LSTM

In [13]:
```
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 [17]:

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

In [18]:

```
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 [19]:

```
# 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: 235.9977
Epoch 2/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.9781
Epoch 3/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 8.8091
Epoch 4/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 9.2222
Epoch 5/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.7824
Epoch 6/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 8.0938
Epoch 7/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 9.1450
Epoch 8/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 9.0453
Epoch 9/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 8.3923
Epoch 10/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 8.5081
Epoch 11/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.2525
Epoch 12/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.1593
Epoch 13/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 8.5687
Epoch 14/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 8.2463
Epoch 15/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.5876
Epoch 16/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 8.7511
Epoch 17/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.3486
Epoch 18/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 8.6350
Epoch 19/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 8.4195
Epoch 20/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 8.3031
Epoch 21/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.2844
Epoch 22/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.6129
```

```
Epoch 23/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 8.0915
Epoch 24/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 8.2719
Epoch 25/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.9769
Epoch 26/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.5270
Epoch 27/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 7.9506
Epoch 28/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 8.1330
Epoch 29/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 7.8956
Epoch 30/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 7.6704
Epoch 31/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.0634
Epoch 32/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 8.4011
Epoch 33/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 7.9441
Epoch 34/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 7.7408
Epoch 35/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.6763
Epoch 36/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 7.7090
Epoch 37/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 8.2410
Epoch 38/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 7.6811
Epoch 39/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 7.6990
Epoch 40/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 7.4474
Epoch 41/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.3850
Epoch 42/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 7.7085
Epoch 43/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 7.3831
Epoch 44/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 7.4175
```

```
Epoch 45/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.5393
Epoch 46/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.4761
Epoch 47/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 7.4554
Epoch 48/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 7.2335
Epoch 49/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 7.2080
Epoch 50/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.8750
Epoch 51/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 7.0667
Epoch 52/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.8400
Epoch 53/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.2043
Epoch 54/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 6.8291
Epoch 55/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 6.7096
Epoch 56/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 7.0535
Epoch 57/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.8986
Epoch 58/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.7124
Epoch 59/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.6658
Epoch 60/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 6.8152
Epoch 61/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.6647
Epoch 62/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.5565
Epoch 63/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.5103
Epoch 64/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.5144
Epoch 65/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 6.5196
Epoch 66/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 6.4016
```

```
Epoch 67/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.6697
Epoch 68/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.3339
Epoch 69/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.2898
Epoch 70/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 6.3946
Epoch 71/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 6.4253
Epoch 72/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.2777
Epoch 73/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.1939
Epoch 74/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 5.9736
Epoch 75/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 6.0785
Epoch 76/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.2189
Epoch 77/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.2463
Epoch 78/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 5.9299
Epoch 79/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.1000
Epoch 80/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 5.9657
Epoch 81/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 6.2399
Epoch 82/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.7385
Epoch 83/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.3894
Epoch 84/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.0580
Epoch 85/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 5.5911
Epoch 86/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 5.7847
Epoch 87/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.0209
Epoch 88/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 5.9718
```

```
Epoch 89/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.0394
Epoch 90/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 5.9152
Epoch 91/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 5.7883
Epoch 92/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 5.9152
Epoch 93/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.8533
Epoch 94/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 5.9360
Epoch 95/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 5.7322
Epoch 96/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 5.5098
Epoch 97/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 6.0960
Epoch 98/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.5860
Epoch 99/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 6.0365
Epoch 100/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.9921
Epoch 101/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 6.0872
Epoch 102/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 5.7156
Epoch 103/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 5.9084
Epoch 104/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 5.6888
Epoch 105/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 5.6877
Epoch 106/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 6.1812
Epoch 107/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 3.5527
Epoch 108/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.9169
Epoch 109/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.4328
Epoch 110/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 1.6283
```

```
Epoch 111/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 1.6334
Epoch 112/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.1396
Epoch 113/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.3006
Epoch 114/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 1.9545
Epoch 115/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 1.4666
Epoch 116/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.5102
Epoch 117/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.7300
Epoch 118/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 1.4141
Epoch 119/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 1.4184
Epoch 120/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 1.6691
Epoch 121/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 1.2675
Epoch 122/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.2536
Epoch 123/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.3777
Epoch 124/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.2245
Epoch 125/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 1.4756
Epoch 126/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 1.5835
Epoch 127/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.3569
Epoch 128/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.1173
Epoch 129/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.1608
Epoch 130/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 1.1271
Epoch 131/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 1.1611
Epoch 132/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 1.1584
```

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Epoch 133/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.1591
Epoch 134/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 1.0173
Epoch 135/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.9733
Epoch 136/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 1.1000
Epoch 137/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.8056
Epoch 138/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 1.0430
Epoch 139/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.9969
Epoch 140/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.8996
Epoch 141/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.7623
Epoch 142/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.7745
Epoch 143/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 0.6777
Epoch 144/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.6984
Epoch 145/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.5606
Epoch 146/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.5206
Epoch 147/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.5248
Epoch 148/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5690
Epoch 149/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.6088
Epoch 150/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5939
Epoch 151/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4622
Epoch 152/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.4473
Epoch 153/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.5071
Epoch 154/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5468
```

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Epoch 155/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5546
Epoch 156/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.3899
Epoch 157/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4897
Epoch 158/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.4142
Epoch 159/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 0.4020
Epoch 160/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4815
Epoch 161/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3960
Epoch 162/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4575
Epoch 163/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.4205
Epoch 164/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4926
Epoch 165/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 1.9833
Epoch 166/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.4226
Epoch 167/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.4560
Epoch 168/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.3763
Epoch 169/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.3343
Epoch 170/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3925
Epoch 171/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.4112
Epoch 172/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.3601
Epoch 173/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.3977
Epoch 174/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.3539
Epoch 175/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3495
Epoch 176/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.7006
```

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Epoch 177/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 1.1292
Epoch 178/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.5498
Epoch 179/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.4350
Epoch 180/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.7233
Epoch 181/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3490
Epoch 182/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.4469
Epoch 183/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.3819
Epoch 184/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3452
Epoch 185/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5080
Epoch 186/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3254
Epoch 187/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.4206
Epoch 188/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.3569
Epoch 189/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.4340
Epoch 190/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4802
Epoch 191/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4389
Epoch 192/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.4418
Epoch 193/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3186
Epoch 194/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.3367
Epoch 195/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.3202
Epoch 196/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3415
Epoch 197/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.9266
Epoch 198/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.5730
```

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Epoch 199/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.3134
Epoch 200/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3050
Epoch 201/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3488
Epoch 202/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.2854
Epoch 203/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2691
Epoch 204/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.3697
Epoch 205/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.2882
Epoch 206/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4037
Epoch 207/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.7594
Epoch 208/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.7058
Epoch 209/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.4540
Epoch 210/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3939
Epoch 211/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4345
Epoch 212/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5529
Epoch 213/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.3489
Epoch 214/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.3397
Epoch 215/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.3729
Epoch 216/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4873
Epoch 217/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3238
Epoch 218/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4074
Epoch 219/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.5826
Epoch 220/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.9263
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Epoch 221/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.6907
Epoch 222/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4318
Epoch 223/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2987
Epoch 224/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.3899
Epoch 225/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.3848
Epoch 226/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2490
Epoch 227/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2515
Epoch 228/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2387
Epoch 229/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3031
Epoch 230/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2613
Epoch 231/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.3533
Epoch 232/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2630
Epoch 233/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.2769
Epoch 234/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.2944
Epoch 235/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2669
Epoch 236/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2706
Epoch 237/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 0.2569
Epoch 238/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2085
Epoch 239/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2820
Epoch 240/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2394
Epoch 241/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.3074
Epoch 242/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2896
```

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Epoch 243/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.2115
Epoch 244/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2409
Epoch 245/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2441
Epoch 246/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2585
Epoch 247/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 3.0929
Epoch 248/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.6822
Epoch 249/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4255
Epoch 250/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.3507
Epoch 251/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.3361
Epoch 252/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2896
Epoch 253/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3724
Epoch 254/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2640
Epoch 255/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.3305
Epoch 256/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3372
Epoch 257/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2509
Epoch 258/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2538
Epoch 259/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.3354
Epoch 260/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.2538
Epoch 261/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2572
Epoch 262/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3254
Epoch 263/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2354
Epoch 264/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.3726
```

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Epoch 265/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2169
Epoch 266/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2760
Epoch 267/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2030
Epoch 268/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2486
Epoch 269/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2008
Epoch 270/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1924
Epoch 271/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.2248
Epoch 272/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.6620
Epoch 273/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2070
Epoch 274/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2320
Epoch 275/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.2055
Epoch 276/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.3169
Epoch 277/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1816
Epoch 278/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2301
Epoch 279/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2843
Epoch 280/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1855
Epoch 281/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1821
Epoch 282/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1968
Epoch 283/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1848
Epoch 284/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1867
Epoch 285/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1808
Epoch 286/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.2054
```

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Epoch 287/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3275
Epoch 288/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2406
Epoch 289/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.3457
Epoch 290/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.3487
Epoch 291/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2262
Epoch 292/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2104
Epoch 293/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1869
Epoch 294/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2880
Epoch 295/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1918
Epoch 296/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1611
Epoch 297/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2112
Epoch 298/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2135
Epoch 299/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1641
Epoch 300/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.1855
Epoch 301/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1938
Epoch 302/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 3.4213
Epoch 303/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.5880
Epoch 304/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.4062
Epoch 305/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.3548
Epoch 306/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.3861
Epoch 307/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2657
Epoch 308/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1896
```

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Epoch 309/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.2405
Epoch 310/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2020
Epoch 311/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2454
Epoch 312/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1873
Epoch 313/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1945
Epoch 314/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2268
Epoch 315/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.2119
Epoch 316/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2068
Epoch 317/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2087
Epoch 318/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2248
Epoch 319/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.2212
Epoch 320/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2001
Epoch 321/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1858
Epoch 322/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.5631
Epoch 323/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 1.5562
Epoch 324/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.7615
Epoch 325/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.5795
Epoch 326/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.5679
Epoch 327/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.5959
Epoch 328/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.5196
Epoch 329/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4830
Epoch 330/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.5905
```

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Epoch 331/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3901
Epoch 332/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3831
Epoch 333/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.4636
Epoch 334/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.2854
Epoch 335/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3689
Epoch 336/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3102
Epoch 337/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.3840
Epoch 338/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.5483
Epoch 339/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.5987
Epoch 340/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2661
Epoch 341/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.2669
Epoch 342/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.3071
Epoch 343/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.2592
Epoch 344/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2244
Epoch 345/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2154
Epoch 346/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.2428
Epoch 347/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2122
Epoch 348/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3690
Epoch 349/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2317
Epoch 350/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.2003
Epoch 351/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2122
Epoch 352/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.2127
```

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Epoch 353/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2926
Epoch 354/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3763
Epoch 355/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.3279
Epoch 356/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.3127
Epoch 357/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1884
Epoch 358/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2129
Epoch 359/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2560
Epoch 360/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2080
Epoch 361/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2502
Epoch 362/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 18ms/step - loss: 0.2120
Epoch 363/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2576
Epoch 364/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.2155
Epoch 365/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - loss: 0.1871
Epoch 366/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1722
Epoch 367/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1796
Epoch 368/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3592
Epoch 369/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1996
Epoch 370/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1771
Epoch 371/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1936
Epoch 372/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1941
Epoch 373/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1881
Epoch 374/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2082
```

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Epoch 375/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2169
Epoch 376/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1570
Epoch 377/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2492
Epoch 378/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.1767
Epoch 379/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.2370
Epoch 380/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1679
Epoch 381/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1785
Epoch 382/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1731
Epoch 383/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1659
Epoch 384/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - loss: 0.1761
Epoch 385/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1653
Epoch 386/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1428
Epoch 387/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1639
Epoch 388/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1463
Epoch 389/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1633
Epoch 390/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 18ms/step - loss: 0.2283
Epoch 391/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2003
Epoch 392/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.5767
Epoch 393/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.3772
Epoch 394/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1713
Epoch 395/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 18ms/step - loss: 0.1850
Epoch 396/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1377
```

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Epoch 397/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1596
Epoch 398/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1509
Epoch 399/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 18ms/step - loss: 0.3844
Epoch 400/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1950
Epoch 401/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2513
Epoch 402/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.2270
Epoch 403/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1311
Epoch 404/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1812
Epoch 405/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1680
Epoch 406/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2078
Epoch 407/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1351
Epoch 408/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1484
Epoch 409/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1494
Epoch 410/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1668
Epoch 411/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2287
Epoch 412/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1810
Epoch 413/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2178
Epoch 414/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1335
Epoch 415/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1210
Epoch 416/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1485
Epoch 417/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1792
Epoch 418/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1582
```

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Epoch 419/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1348
Epoch 420/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1488
Epoch 421/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2396
Epoch 422/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1375
Epoch 423/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1411
Epoch 424/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1769
Epoch 425/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1446
Epoch 426/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1262
Epoch 427/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.5500
Epoch 428/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1934
Epoch 429/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1307
Epoch 430/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1630
Epoch 431/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1540
Epoch 432/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1158
Epoch 433/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1401
Epoch 434/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 18ms/step - loss: 0.1336
Epoch 435/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1331
Epoch 436/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4997
Epoch 437/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.3137
Epoch 438/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 18ms/step - loss: 0.1278
Epoch 439/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1229
Epoch 440/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1218
```

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Epoch 441/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1287
Epoch 442/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1324
Epoch 443/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1495
Epoch 444/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1368
Epoch 445/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1214
Epoch 446/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1484
Epoch 447/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1408
Epoch 448/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1432
Epoch 449/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1163
Epoch 450/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1491
Epoch 451/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.1308
Epoch 452/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1807
Epoch 453/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1491
Epoch 454/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1507
Epoch 455/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1414
Epoch 456/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 3.0383
Epoch 457/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 24ms/step - loss: 0.6830
Epoch 458/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.4188
Epoch 459/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.4677
Epoch 460/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.3970
Epoch 461/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2543
Epoch 462/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2664
```

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Epoch 463/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2330
Epoch 464/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.3136
Epoch 465/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2236
Epoch 466/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.2524
Epoch 467/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2130
Epoch 468/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1972
Epoch 469/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.2415
Epoch 470/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2703
Epoch 471/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1838
Epoch 472/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2124
Epoch 473/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1879
Epoch 474/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1916
Epoch 475/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.2404
Epoch 476/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.2412
Epoch 477/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1794
Epoch 478/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1953
Epoch 479/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.2314
Epoch 480/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1744
Epoch 481/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1765
Epoch 482/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.2007
Epoch 483/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2691
Epoch 484/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2040
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Epoch 485/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1930
Epoch 486/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1837
Epoch 487/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.1853
Epoch 488/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1720
Epoch 489/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.2560
Epoch 490/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1497
Epoch 491/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1939
Epoch 492/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1603
Epoch 493/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1945
Epoch 494/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.1422
Epoch 495/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1777
Epoch 496/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1463
Epoch 497/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1627
Epoch 498/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1463
Epoch 499/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.2440
Epoch 500/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 18ms/step - loss: 0.1751
32/32 ━━━━━━━━━━━━━━━━━━━━ 1s 12ms/step
```

Prediction of GDP percapita using LSTM

In [20]:

```
# 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 16ms/step - loss: 27.1880
Epoch 2/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.8978
Epoch 3/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.8598
Epoch 4/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.7854
Epoch 5/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.9397
Epoch 6/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 2.8046
Epoch 7/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.7810
Epoch 8/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.8858
Epoch 9/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.8192
Epoch 10/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 2.7920
Epoch 11/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 2.8695
Epoch 12/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.8582
Epoch 13/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.7735
Epoch 14/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.7655
Epoch 15/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.8203
Epoch 16/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 2.7513
Epoch 17/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 2.7979
Epoch 18/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.8268
Epoch 19/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.6733
Epoch 20/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.6781
Epoch 21/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.5963
Epoch 22/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.7373
```

```
Epoch 23/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.7526
Epoch 24/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.6473
Epoch 25/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 2.6444
Epoch 26/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.6056
Epoch 27/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.6313
Epoch 28/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.7099
Epoch 29/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.5635
Epoch 30/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 2.5662
Epoch 31/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 2.6061
Epoch 32/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.6527
Epoch 33/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.5605
Epoch 34/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 2.4725
Epoch 35/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.6178
Epoch 36/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 2.5525
Epoch 37/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.5274
Epoch 38/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 2.6013
Epoch 39/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.5058
Epoch 40/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.5343
Epoch 41/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.4821
Epoch 42/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.5892
Epoch 43/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.4997
Epoch 44/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 2.5808
```

```
Epoch 45/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 2.5283
Epoch 46/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.5354
Epoch 47/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.4789
Epoch 48/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 2.4227
Epoch 49/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.4807
Epoch 50/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.5264
Epoch 51/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.5190
Epoch 52/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.5598
Epoch 53/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.4689
Epoch 54/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.4427
Epoch 55/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.5170
Epoch 56/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4264
Epoch 57/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 2.4438
Epoch 58/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.5405
Epoch 59/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.4530
Epoch 60/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 2.4439
Epoch 61/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.4591
Epoch 62/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.5030
Epoch 63/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 2.4599
Epoch 64/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 2.5547
Epoch 65/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.4031
Epoch 66/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4585
```

```
Epoch 67/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4339
Epoch 68/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.3683
Epoch 69/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 2.3586
Epoch 70/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 2.4501
Epoch 71/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.2858
Epoch 72/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 2.3905
Epoch 73/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.3488
Epoch 74/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 2.3147
Epoch 75/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 2.2894
Epoch 76/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.2776
Epoch 77/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.3987
Epoch 78/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.3154
Epoch 79/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.3992
Epoch 80/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 2.1797
Epoch 81/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 2.5228
Epoch 82/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.3837
Epoch 83/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 2.2416
Epoch 84/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 1.9677
Epoch 85/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 1.6403
Epoch 86/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.7352
Epoch 87/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 0.6875
Epoch 88/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5656
```

```
Epoch 89/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5332
Epoch 90/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.4897
Epoch 91/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.4900
Epoch 92/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4074
Epoch 93/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.5089
Epoch 94/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4245
Epoch 95/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.4113
Epoch 96/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.4460
Epoch 97/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 0.3849
Epoch 98/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3881
Epoch 99/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3946
Epoch 100/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.4026
Epoch 101/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.3470
Epoch 102/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3523
Epoch 103/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.3402
Epoch 104/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.3235
Epoch 105/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.3216
Epoch 106/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2936
Epoch 107/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 16ms/step - loss: 0.3258
Epoch 108/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3064
Epoch 109/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.4582
Epoch 110/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.3807
```

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Epoch 111/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 0.2916
Epoch 112/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2675
Epoch 113/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2597
Epoch 114/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.3421
Epoch 115/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.2630
Epoch 116/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2796
Epoch 117/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2891
Epoch 118/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.3115
Epoch 119/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.2625
Epoch 120/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.2875
Epoch 121/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2567
Epoch 122/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.2354
Epoch 123/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.2183
Epoch 124/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.2316
Epoch 125/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.2155
Epoch 126/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2296
Epoch 127/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1986
Epoch 128/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.2070
Epoch 129/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2326
Epoch 130/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1903
Epoch 131/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2297
Epoch 132/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1871
```

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Epoch 133/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1684
Epoch 134/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.2266
Epoch 135/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1700
Epoch 136/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1864
Epoch 137/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1875
Epoch 138/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1619
Epoch 139/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.3064
Epoch 140/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1746
Epoch 141/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.1939
Epoch 142/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1837
Epoch 143/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1747
Epoch 144/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1606
Epoch 145/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2031
Epoch 146/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1621
Epoch 147/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1661
Epoch 148/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1365
Epoch 149/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.1618
Epoch 150/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1319
Epoch 151/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1401
Epoch 152/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1272
Epoch 153/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1540
Epoch 154/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1737
```

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Epoch 155/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1283
Epoch 156/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1267
Epoch 157/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1852
Epoch 158/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.8028
Epoch 159/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.2134
Epoch 160/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.1506
Epoch 161/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1285
Epoch 162/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1138
Epoch 163/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1269
Epoch 164/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1164
Epoch 165/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1054
Epoch 166/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 0.1205
Epoch 167/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1210
Epoch 168/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1256
Epoch 169/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.1175
Epoch 170/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.1211
Epoch 171/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1332
Epoch 172/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1080
Epoch 173/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1101
Epoch 174/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1055
Epoch 175/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.1186
Epoch 176/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1086
```

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Epoch 177/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1113
Epoch 178/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1107
Epoch 179/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0855
Epoch 180/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1181
Epoch 181/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0894
Epoch 182/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1110
Epoch 183/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1236
Epoch 184/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.0840
Epoch 185/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0981
Epoch 186/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1133
Epoch 187/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1162
Epoch 188/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.0880
Epoch 189/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1046
Epoch 190/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0902
Epoch 191/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.0819
Epoch 192/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0960
Epoch 193/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0944
Epoch 194/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.0796
Epoch 195/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.0735
Epoch 196/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0779
Epoch 197/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0833
Epoch 198/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1017
```

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Epoch 199/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.0880
Epoch 200/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0773
Epoch 201/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0757
Epoch 202/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.0949
Epoch 203/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0839
Epoch 204/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0685
Epoch 205/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0629
Epoch 206/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.1380
Epoch 207/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1068
Epoch 208/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0849
Epoch 209/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.0846
Epoch 210/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0929
Epoch 211/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0682
Epoch 212/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0604
Epoch 213/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1315
Epoch 214/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1324
Epoch 215/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0797
Epoch 216/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0769
Epoch 217/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0660
Epoch 218/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.0553
Epoch 219/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0667
Epoch 220/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.2492
```

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Epoch 221/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.1446
Epoch 222/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1007
Epoch 223/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0664
Epoch 224/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0668
Epoch 225/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0605
Epoch 226/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0659
Epoch 227/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0564
Epoch 228/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0656
Epoch 229/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0600
Epoch 230/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0597
Epoch 231/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0647
Epoch 232/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0867
Epoch 233/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1691
Epoch 234/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.0594
Epoch 235/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0551
Epoch 236/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0586
Epoch 237/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0676
Epoch 238/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0572
Epoch 239/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0593
Epoch 240/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 18ms/step - loss: 0.0694
Epoch 241/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 1.9941
Epoch 242/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.4540
```

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Epoch 243/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.2960
Epoch 244/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.2943
Epoch 245/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.1784
Epoch 246/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1688
Epoch 247/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1681
Epoch 248/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1498
Epoch 249/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1060
Epoch 250/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1025
Epoch 251/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 15ms/step - loss: 0.1212
Epoch 252/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1026
Epoch 253/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0870
Epoch 254/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0912
Epoch 255/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0939
Epoch 256/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0682
Epoch 257/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0870
Epoch 258/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0737
Epoch 259/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0882
Epoch 260/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0620
Epoch 261/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0629
Epoch 262/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1153
Epoch 263/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0746
Epoch 264/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0655
```

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Epoch 265/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0650
Epoch 266/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0758
Epoch 267/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0823
Epoch 268/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0715
Epoch 269/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0735
Epoch 270/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0832
Epoch 271/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.0772
Epoch 272/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0706
Epoch 273/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0627
Epoch 274/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0631
Epoch 275/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0754
Epoch 276/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0723
Epoch 277/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0664
Epoch 278/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0637
Epoch 279/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0768
Epoch 280/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0761
Epoch 281/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0776
Epoch 282/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0661
Epoch 283/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0515
Epoch 284/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0615
Epoch 285/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0557
Epoch 286/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0587
```

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Epoch 287/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0590
Epoch 288/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 15ms/step - loss: 0.0776
Epoch 289/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0743
Epoch 290/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0609
Epoch 291/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0724
Epoch 292/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.0588
Epoch 293/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0649
Epoch 294/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0577
Epoch 295/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0582
Epoch 296/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.0644
Epoch 297/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.3181
Epoch 298/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.8779
Epoch 299/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0651
Epoch 300/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0571
Epoch 301/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0713
Epoch 302/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0532
Epoch 303/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0531
Epoch 304/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0500
Epoch 305/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0512
Epoch 306/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0613
Epoch 307/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.0522
Epoch 308/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0476
```

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Epoch 309/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0476
Epoch 310/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0474
Epoch 311/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0443
Epoch 312/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.0475
Epoch 313/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0528
Epoch 314/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0452
Epoch 315/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0535
Epoch 316/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0463
Epoch 317/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.1076
Epoch 318/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0524
Epoch 319/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0485
Epoch 320/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0453
Epoch 321/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0478
Epoch 322/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0486
Epoch 323/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0532
Epoch 324/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0572
Epoch 325/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 1.4360
Epoch 326/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3049
Epoch 327/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1705
Epoch 328/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1667
Epoch 329/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0975
Epoch 330/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0906
```

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Epoch 331/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0903
Epoch 332/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0815
Epoch 333/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0657
Epoch 334/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.0736
Epoch 335/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0658
Epoch 336/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.0599
Epoch 337/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0907
Epoch 338/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0724
Epoch 339/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.0729
Epoch 340/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0689
Epoch 341/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0554
Epoch 342/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0520
Epoch 343/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0626
Epoch 344/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0515
Epoch 345/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0655
Epoch 346/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0756
Epoch 347/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0540
Epoch 348/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0552
Epoch 349/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.0518
Epoch 350/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0550
Epoch 351/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0658
Epoch 352/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0516
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Epoch 353/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0482
Epoch 354/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0508
Epoch 355/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0517
Epoch 356/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0618
Epoch 357/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0531
Epoch 358/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0461
Epoch 359/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0426
Epoch 360/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0549
Epoch 361/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.0564
Epoch 362/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0577
Epoch 363/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0539
Epoch 364/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0552
Epoch 365/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0695
Epoch 366/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0492
Epoch 367/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0618
Epoch 368/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0752
Epoch 369/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0523
Epoch 370/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0432
Epoch 371/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0437
Epoch 372/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0439
Epoch 373/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0408
Epoch 374/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0831
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Epoch 375/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0462
Epoch 376/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.0532
Epoch 377/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0501
Epoch 378/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0461
Epoch 379/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0421
Epoch 380/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0456
Epoch 381/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0531
Epoch 382/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0495
Epoch 383/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0436
Epoch 384/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.0451
Epoch 385/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0508
Epoch 386/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0815
Epoch 387/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0489
Epoch 388/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0382
Epoch 389/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0676
Epoch 390/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0496
Epoch 391/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0813
Epoch 392/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.4025
Epoch 393/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1786
Epoch 394/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0975
Epoch 395/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0606
Epoch 396/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0517
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Epoch 397/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0423
Epoch 398/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0452
Epoch 399/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.0465
Epoch 400/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0511
Epoch 401/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.0759
Epoch 402/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0533
Epoch 403/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0423
Epoch 404/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0513
Epoch 405/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0420
Epoch 406/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0451
Epoch 407/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0383
Epoch 408/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0382
Epoch 409/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0461
Epoch 410/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0449
Epoch 411/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0617
Epoch 412/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0687
Epoch 413/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0470
Epoch 414/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0385
Epoch 415/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0487
Epoch 416/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0371
Epoch 417/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0354
Epoch 418/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0371
```

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Epoch 419/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0409
Epoch 420/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.0553
Epoch 421/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0351
Epoch 422/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0487
Epoch 423/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0454
Epoch 424/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0592
Epoch 425/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0463
Epoch 426/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0709
Epoch 427/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0419
Epoch 428/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0309
Epoch 429/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 18ms/step - loss: 0.0501
Epoch 430/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 21ms/step - loss: 0.0351
Epoch 431/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0864
Epoch 432/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.3870
Epoch 433/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0419
Epoch 434/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0338
Epoch 435/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0417
Epoch 436/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 18ms/step - loss: 0.0388
Epoch 437/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0356
Epoch 438/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0401
Epoch 439/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0406
Epoch 440/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.0297
```

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Epoch 441/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0310
Epoch 442/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0359
Epoch 443/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0351
Epoch 444/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1273
Epoch 445/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0354
Epoch 446/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.0317
Epoch 447/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0369
Epoch 448/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0470
Epoch 449/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0383
Epoch 450/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0418
Epoch 451/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0396
Epoch 452/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0426
Epoch 453/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0337
Epoch 454/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0472
Epoch 455/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0374
Epoch 456/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0384
Epoch 457/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0350
Epoch 458/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0340
Epoch 459/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0520
Epoch 460/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1320
Epoch 461/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0335
Epoch 462/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 19ms/step - loss: 0.0432
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Epoch 463/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0337
Epoch 464/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0329
Epoch 465/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0325
Epoch 466/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0565
Epoch 467/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0296
Epoch 468/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0317
Epoch 469/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0315
Epoch 470/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0357
Epoch 471/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.1189
Epoch 472/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0507
Epoch 473/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0347
Epoch 474/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0359
Epoch 475/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0382
Epoch 476/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0510
Epoch 477/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 17ms/step - loss: 0.0306
Epoch 478/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0324
Epoch 479/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0322
Epoch 480/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0466
Epoch 481/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0579
Epoch 482/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0383
Epoch 483/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 19ms/step - loss: 0.0394
Epoch 484/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0368
```

```
Epoch 485/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0403
Epoch 486/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.1091
Epoch 487/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 17ms/step - loss: 0.0636
Epoch 488/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 23ms/step - loss: 0.0366
Epoch 489/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.0401
Epoch 490/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0318
Epoch 491/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 16ms/step - loss: 0.0303
Epoch 492/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0347
Epoch 493/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 20ms/step - loss: 0.0311
Epoch 494/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 5s 17ms/step - loss: 0.0452
Epoch 495/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0279
Epoch 496/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0997
Epoch 497/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 3s 22ms/step - loss: 0.0357
Epoch 498/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 4s 17ms/step - loss: 0.0313
Epoch 499/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0291
Epoch 500/500
128/128 ━━━━━━━━━━━━━━━━━━━━ 2s 16ms/step - loss: 0.0354
32/32 ━━━━━━━━━━━━━━━━━━━━ 0s 11ms/step
```

Evaluating the models

In [21]:
```
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: 0.10121995210647583, R2: 0.9815293243655732
GDP Per Capita Model - MSE: 0.040257730230484914, R2: 0.9834373092589194
```

ANN

In [27]:

```
from keras.models import Sequential
from keras.layers import Dense, Dropout

# Initialize ANN model
model_ann = Sequential()
model_ann.add(Dense(64, input_dim=X_train.shape[1], activation='linear'))
model_ann.add(Dropout(0.2))
model_ann.add(Dense(32, activation='linear'))
model_ann.add(Dropout(0.2))
model_ann.add(Dense(16, activation='linear'))
model_ann.add(Dense(1, activation='linear'))  # Output layer with linear activation

# Compile the model
model_ann.compile(optimizer='adam', loss='mean_squared_error')

# Train the model
history = model_ann.fit(X_train, y_train, batch_size=32, epochs=300, validation_split=0.1)
```

```
Epoch 1/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 4s 16ms/step - loss: 22883.6855 - val_loss: 17.7920
Epoch 2/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1706.3075 - val_loss: 16.2828
Epoch 3/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 570.0612 - val_loss: 5.7134
Epoch 4/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 237.2245 - val_loss: 6.3353
Epoch 5/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 108.6022 - val_loss: 5.7398
Epoch 6/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 60.7072 - val_loss: 5.6649
Epoch 7/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 42.7685 - val_loss: 5.6845
Epoch 8/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 33.4964 - val_loss: 5.7858
Epoch 9/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 28.2569 - val_loss: 6.8331
Epoch 10/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 25.2315 - val_loss: 8.0323
Epoch 11/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 24.2701 - val_loss: 5.8855
Epoch 12/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 23.6011 - val_loss: 5.6993
Epoch 13/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 22.2444 - val_loss: 5.8460
Epoch 14/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 22.8425 - val_loss: 5.7045
Epoch 15/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 22.4202 - val_loss: 6.8265
Epoch 16/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 21.8601 - val_loss: 6.0237
Epoch 17/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 19.9383 - val_loss: 8.0620
Epoch 18/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 19.9387 - val_loss: 5.7323
Epoch 19/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 20.1932 - val_loss: 5.7195
Epoch 20/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 18.6649 - val_loss: 5.7510
Epoch 21/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 19.0671 - val_loss: 6.4955
Epoch 22/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 19.4563 - val_loss: 10.7033
```

```
Epoch 23/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 21.8202 - val_loss: 6.0016
Epoch 24/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 18.0852 - val_loss: 5.7788
Epoch 25/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 17.8285 - val_loss: 5.8110
Epoch 26/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 18.6429 - val_loss: 6.4809
Epoch 27/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 18.3328 - val_loss: 5.8841
Epoch 28/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 17.5930 - val_loss: 6.0485
Epoch 29/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 17.9451 - val_loss: 6.8191
Epoch 30/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 18.3579 - val_loss: 8.8661
Epoch 31/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 19.2051 - val_loss: 8.5799
Epoch 32/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 18.2497 - val_loss: 5.7388
Epoch 33/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 16.7707 - val_loss: 14.1895
Epoch 34/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 17.7590 - val_loss: 6.5002
Epoch 35/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 17.0459 - val_loss: 5.8804
Epoch 36/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - loss: 16.7690 - val_loss: 8.9083
Epoch 37/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - loss: 18.1734 - val_loss: 6.6885
Epoch 38/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 16.7760 - val_loss: 5.8628
Epoch 39/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 16.1608 - val_loss: 7.6383
Epoch 40/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - loss: 15.8714 - val_loss: 10.4354
Epoch 41/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 17.5792 - val_loss: 5.6427
Epoch 42/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 15.6083 - val_loss: 5.8795
Epoch 43/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 15.5530 - val_loss: 7.8061
Epoch 44/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 15.7354 - val_loss: 18.1861
```

```
Epoch 45/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 17.2275 - val_loss: 6.5677
Epoch 46/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 14.5137 - val_loss: 5.5916
Epoch 47/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 16.7233 - val_loss: 9.7923
Epoch 48/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 19.0901 - val_loss: 14.7071
Epoch 49/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 16.8691 - val_loss: 5.6693
Epoch 50/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 15.9957 - val_loss: 6.7935
Epoch 51/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 14.8285 - val_loss: 8.1823
Epoch 52/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 14.6194 - val_loss: 9.1551
Epoch 53/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 15.5310 - val_loss: 6.5576
Epoch 54/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 13.6880 - val_loss: 7.2257
Epoch 55/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 14.2815 - val_loss: 6.2161
Epoch 56/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 14.7294 - val_loss: 13.5383
Epoch 57/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 14.3093 - val_loss: 9.8611
Epoch 58/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 13.5094 - val_loss: 8.9730
Epoch 59/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 14.0211 - val_loss: 5.4970
Epoch 60/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 12.8469 - val_loss: 5.3551
Epoch 61/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 13.0476 - val_loss: 5.9279
Epoch 62/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 14.0171 - val_loss: 9.5994
Epoch 63/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 14.1025 - val_loss: 5.3539
Epoch 64/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 13.3679 - val_loss: 5.9166
Epoch 65/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 11.4589 - val_loss: 5.8247
Epoch 66/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 13.6800 - val_loss: 7.4754
```

```
Epoch 67/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 11.3198 - val_loss: 4.9464
Epoch 68/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 11.4104 - val_loss: 5.1959
Epoch 69/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 11.7726 - val_loss: 4.7440
Epoch 70/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 11.1750 - val_loss: 4.9029
Epoch 71/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 10.7680 - val_loss: 5.3752
Epoch 72/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 10.4607 - val_loss: 4.7600
Epoch 73/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 9.9299 - val_loss: 5.8395
Epoch 74/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 10.5624 - val_loss: 3.4932
Epoch 75/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 9.3106 - val_loss: 5.2892
Epoch 76/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 8.9398 - val_loss: 2.8834
Epoch 77/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 7.7264 - val_loss: 2.0169
Epoch 78/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 7.2662 - val_loss: 3.0657
Epoch 79/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 7.1175 - val_loss: 1.4455
Epoch 80/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 6.5199 - val_loss: 2.1700
Epoch 81/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 5.7773 - val_loss: 0.9450
Epoch 82/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 6.3798 - val_loss: 0.8070
Epoch 83/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 5.7164 - val_loss: 1.1212
Epoch 84/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 5.0634 - val_loss: 0.7092
Epoch 85/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 4.4626 - val_loss: 0.7381
Epoch 86/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 4.8587 - val_loss: 0.9391
Epoch 87/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 4.1970 - val_loss: 0.5677
Epoch 88/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 4.3550 - val_loss: 0.5140
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Epoch 89/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 4.3071 - val_loss: 0.7991
Epoch 90/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 4.1127 - val_loss: 0.8625
Epoch 91/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 4.0423 - val_loss: 1.3754
Epoch 92/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 3.8637 - val_loss: 0.4736
Epoch 93/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 3.7022 - val_loss: 0.6593
Epoch 94/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 3.2022 - val_loss: 0.3607
Epoch 95/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 3.2567 - val_loss: 0.6674
Epoch 96/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 3.6744 - val_loss: 0.5488
Epoch 97/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.8098 - val_loss: 0.8286
Epoch 98/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.8976 - val_loss: 0.6517
Epoch 99/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.7679 - val_loss: 0.4608
Epoch 100/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.9697 - val_loss: 0.7292
Epoch 101/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.6984 - val_loss: 0.4851
Epoch 102/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.6077 - val_loss: 0.2870
Epoch 103/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.6774 - val_loss: 1.1614
Epoch 104/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.6630 - val_loss: 0.2761
Epoch 105/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.2299 - val_loss: 0.1862
Epoch 106/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.1168 - val_loss: 0.5425
Epoch 107/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.2593 - val_loss: 0.1772
Epoch 108/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.1634 - val_loss: 3.1993
Epoch 109/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.4987 - val_loss: 0.5638
Epoch 110/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.0872 - val_loss: 0.1780
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Epoch 111/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.8010 - val_loss: 0.2162
Epoch 112/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.9449 - val_loss: 0.2328
Epoch 113/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.8808 - val_loss: 0.4633
Epoch 114/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.9033 - val_loss: 0.2784
Epoch 115/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.7843 - val_loss: 0.4934
Epoch 116/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.5109 - val_loss: 0.1635
Epoch 117/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.6289 - val_loss: 0.2349
Epoch 118/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.4830 - val_loss: 0.1604
Epoch 119/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.3185 - val_loss: 0.1407
Epoch 120/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.2346 - val_loss: 0.4606
Epoch 121/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.4837 - val_loss: 0.1668
Epoch 122/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.1211 - val_loss: 0.3776
Epoch 123/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.1891 - val_loss: 0.2085
Epoch 124/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.0592 - val_loss: 0.3377
Epoch 125/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.9710 - val_loss: 0.1383
Epoch 126/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.8557 - val_loss: 0.1298
Epoch 127/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.9677 - val_loss: 0.2230
Epoch 128/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.8050 - val_loss: 0.1532
Epoch 129/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.7943 - val_loss: 0.3444
Epoch 130/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.6531 - val_loss: 0.2661
Epoch 131/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.6741 - val_loss: 0.4533
Epoch 132/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.6845 - val_loss: 0.1058
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Epoch 133/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.5523 - val_loss: 0.1106
Epoch 134/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.5452 - val_loss: 0.2702
Epoch 135/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.4960 - val_loss: 0.1033
Epoch 136/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.5157 - val_loss: 0.1192
Epoch 137/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.4691 - val_loss: 0.1473
Epoch 138/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.4248 - val_loss: 0.2234
Epoch 139/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.4196 - val_loss: 0.2385
Epoch 140/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.4399 - val_loss: 0.1051
Epoch 141/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3176 - val_loss: 0.0986
Epoch 142/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3318 - val_loss: 0.1249
Epoch 143/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2971 - val_loss: 0.1215
Epoch 144/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2684 - val_loss: 0.1815
Epoch 145/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3048 - val_loss: 0.1936
Epoch 146/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3059 - val_loss: 0.3089
Epoch 147/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3114 - val_loss: 0.1621
Epoch 148/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2651 - val_loss: 0.2532
Epoch 149/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3358 - val_loss: 0.3753
Epoch 150/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2989 - val_loss: 0.1330
Epoch 151/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2159 - val_loss: 0.0961
Epoch 152/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2706 - val_loss: 0.2005
Epoch 153/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2928 - val_loss: 0.1340
Epoch 154/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2499 - val_loss: 0.1078
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Epoch 155/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2823 - val_loss: 0.1232
Epoch 156/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2328 - val_loss: 0.1904
Epoch 157/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2644 - val_loss: 0.1848
Epoch 158/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2548 - val_loss: 0.1659
Epoch 159/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2520 - val_loss: 0.1514
Epoch 160/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2377 - val_loss: 0.1787
Epoch 161/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3759 - val_loss: 0.1445
Epoch 162/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2356 - val_loss: 0.0885
Epoch 163/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2179 - val_loss: 0.0906
Epoch 164/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2256 - val_loss: 0.1381
Epoch 165/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2549 - val_loss: 0.1024
Epoch 166/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2523 - val_loss: 0.1256
Epoch 167/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2402 - val_loss: 0.1221
Epoch 168/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2340 - val_loss: 0.1406
Epoch 169/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.2385 - val_loss: 0.1107
Epoch 170/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.3072 - val_loss: 0.0961
Epoch 171/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.2352 - val_loss: 0.0903
Epoch 172/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.2181 - val_loss: 0.1894
Epoch 173/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.2679 - val_loss: 0.0861
Epoch 174/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.2137 - val_loss: 0.1535
Epoch 175/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2384 - val_loss: 0.1955
Epoch 176/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2353 - val_loss: 0.1978
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Epoch 177/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2657 - val_loss: 0.1967
Epoch 178/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2470 - val_loss: 0.1653
Epoch 179/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2648 - val_loss: 0.2112
Epoch 180/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2707 - val_loss: 0.2413
Epoch 181/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3213 - val_loss: 0.1165
Epoch 182/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2483 - val_loss: 0.3025
Epoch 183/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3881 - val_loss: 0.1684
Epoch 184/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2503 - val_loss: 0.2088
Epoch 185/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2638 - val_loss: 0.1901
Epoch 186/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2492 - val_loss: 0.1181
Epoch 187/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1956 - val_loss: 0.2224
Epoch 188/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2495 - val_loss: 0.1291
Epoch 189/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2809 - val_loss: 0.2859
Epoch 190/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2984 - val_loss: 0.1724
Epoch 191/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2362 - val_loss: 0.4861
Epoch 192/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3007 - val_loss: 0.0869
Epoch 193/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2086 - val_loss: 0.1098
Epoch 194/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2467 - val_loss: 0.2539
Epoch 195/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2492 - val_loss: 0.2281
Epoch 196/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2327 - val_loss: 0.1687
Epoch 197/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2171 - val_loss: 0.1555
Epoch 198/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3351 - val_loss: 0.1172
```

```
Epoch 199/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2811 - val_loss: 0.0928
Epoch 200/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1845 - val_loss: 0.1042
Epoch 201/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2312 - val_loss: 0.1539
Epoch 202/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2792 - val_loss: 0.1521
Epoch 203/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2412 - val_loss: 0.0995
Epoch 204/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1905 - val_loss: 0.1138
Epoch 205/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2736 - val_loss: 0.1885
Epoch 206/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2540 - val_loss: 0.1000
Epoch 207/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2005 - val_loss: 0.1018
Epoch 208/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2204 - val_loss: 0.0705
Epoch 209/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2172 - val_loss: 0.3175
Epoch 210/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2480 - val_loss: 0.1062
Epoch 211/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.2084 - val_loss: 0.1196
Epoch 212/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.2738 - val_loss: 0.1143
Epoch 213/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.2058 - val_loss: 0.1346
Epoch 214/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.2836 - val_loss: 0.1223
Epoch 215/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.2605 - val_loss: 0.1927
Epoch 216/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2513 - val_loss: 0.2403
Epoch 217/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2854 - val_loss: 0.1306
Epoch 218/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2084 - val_loss: 0.0732
Epoch 219/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2129 - val_loss: 0.0782
Epoch 220/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2071 - val_loss: 0.1533
```

```
Epoch 221/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1974 - val_loss: 0.1861
Epoch 222/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2152 - val_loss: 0.1069
Epoch 223/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2518 - val_loss: 0.1516
Epoch 224/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2176 - val_loss: 0.0830
Epoch 225/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2050 - val_loss: 0.1329
Epoch 226/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3321 - val_loss: 0.0759
Epoch 227/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1736 - val_loss: 0.0778
Epoch 228/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1930 - val_loss: 0.1022
Epoch 229/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2282 - val_loss: 0.1133
Epoch 230/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1982 - val_loss: 0.1641
Epoch 231/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2075 - val_loss: 0.0798
Epoch 232/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1952 - val_loss: 0.0852
Epoch 233/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2199 - val_loss: 0.0895
Epoch 234/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2168 - val_loss: 0.1033
Epoch 235/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2728 - val_loss: 0.1432
Epoch 236/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2136 - val_loss: 0.1306
Epoch 237/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2098 - val_loss: 0.0676
Epoch 238/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2299 - val_loss: 0.0870
Epoch 239/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2073 - val_loss: 0.0806
Epoch 240/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1601 - val_loss: 0.1867
Epoch 241/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2552 - val_loss: 0.0727
Epoch 242/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1815 - val_loss: 0.2005
```

```
Epoch 243/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3181 - val_loss: 0.0665
Epoch 244/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1784 - val_loss: 0.0941
Epoch 245/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2289 - val_loss: 0.0950
Epoch 246/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2014 - val_loss: 0.1516
Epoch 247/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2253 - val_loss: 0.1225
Epoch 248/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2252 - val_loss: 0.0685
Epoch 249/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1686 - val_loss: 0.0729
Epoch 250/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2131 - val_loss: 0.0773
Epoch 251/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2019 - val_loss: 0.0829
Epoch 252/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.2574 - val_loss: 0.2335
Epoch 253/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.2419 - val_loss: 0.1022
Epoch 254/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.2322 - val_loss: 0.0829
Epoch 255/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.1825 - val_loss: 0.1086
Epoch 256/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.1972 - val_loss: 0.0667
Epoch 257/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2398 - val_loss: 0.0861
Epoch 258/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1827 - val_loss: 0.0773
Epoch 259/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1802 - val_loss: 0.0672
Epoch 260/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1825 - val_loss: 0.0626
Epoch 261/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2373 - val_loss: 0.0978
Epoch 262/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2299 - val_loss: 0.1308
Epoch 263/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2402 - val_loss: 0.0802
Epoch 264/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2392 - val_loss: 0.0655
```

```
Epoch 265/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1596 - val_loss: 0.0879
Epoch 266/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2412 - val_loss: 0.2730
Epoch 267/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1963 - val_loss: 0.1027
Epoch 268/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2077 - val_loss: 0.0627
Epoch 269/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1787 - val_loss: 0.2001
Epoch 270/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2221 - val_loss: 0.0945
Epoch 271/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2287 - val_loss: 0.1301
Epoch 272/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1988 - val_loss: 0.1305
Epoch 273/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2014 - val_loss: 0.1371
Epoch 274/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1926 - val_loss: 0.0765
Epoch 275/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1838 - val_loss: 0.1496
Epoch 276/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2487 - val_loss: 0.0921
Epoch 277/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2244 - val_loss: 0.0813
Epoch 278/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2043 - val_loss: 0.1528
Epoch 279/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2061 - val_loss: 0.2581
Epoch 280/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1910 - val_loss: 0.0862
Epoch 281/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2007 - val_loss: 0.1102
Epoch 282/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2057 - val_loss: 0.0619
Epoch 283/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1965 - val_loss: 0.0644
Epoch 284/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1845 - val_loss: 0.0705
Epoch 285/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2228 - val_loss: 0.1361
Epoch 286/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1905 - val_loss: 0.1174
```

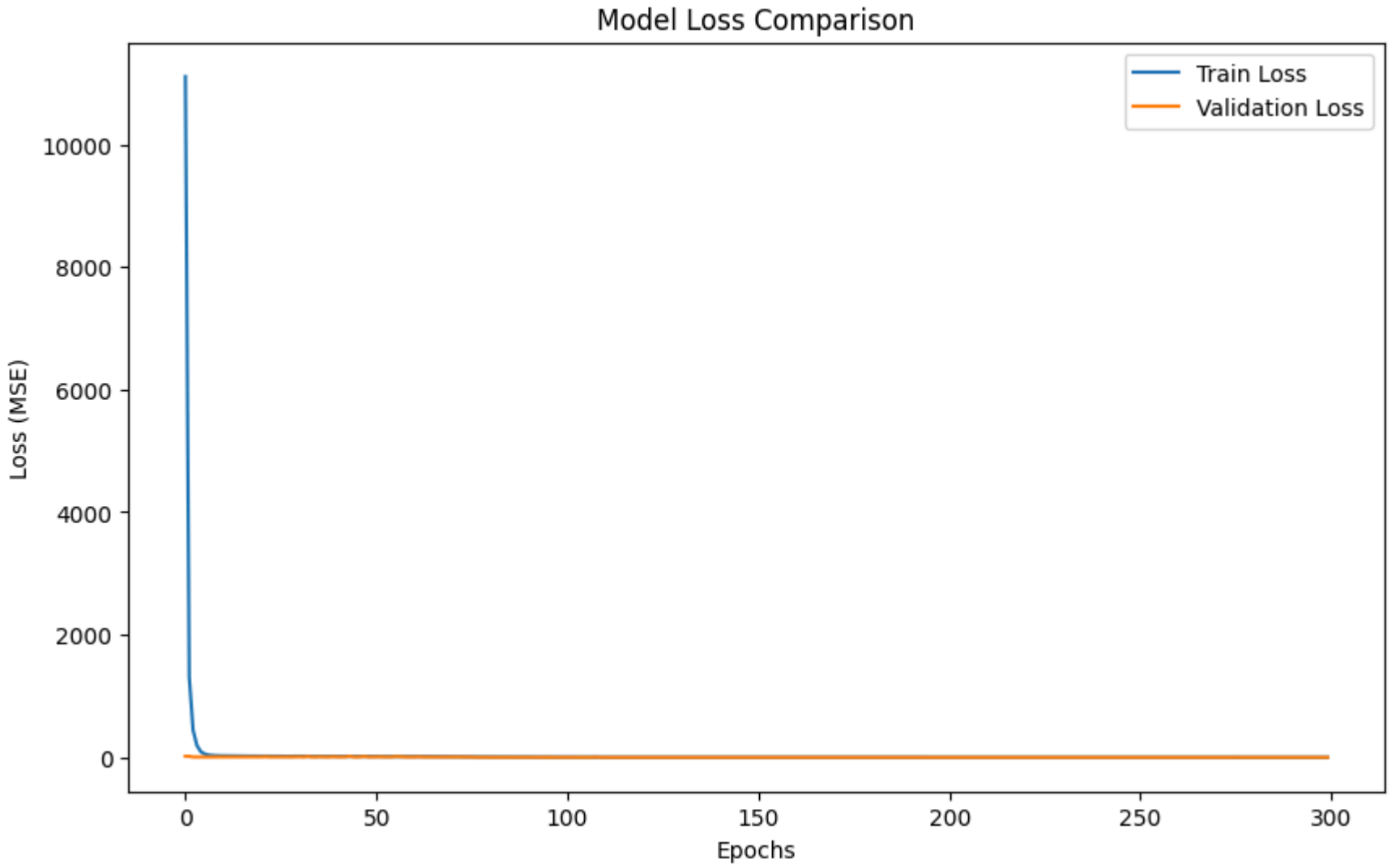
```
Epoch 287/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1737 - val_loss: 0.0665
Epoch 288/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2186 - val_loss: 0.0961
Epoch 289/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1770 - val_loss: 0.0607
Epoch 290/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1772 - val_loss: 0.1296
Epoch 291/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.2436 - val_loss: 0.1158
Epoch 292/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.2136 - val_loss: 0.1610
Epoch 293/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.2083 - val_loss: 0.1542
Epoch 294/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.1859 - val_loss: 0.0580
Epoch 295/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.1500 - val_loss: 0.0872
Epoch 296/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2201 - val_loss: 0.1310
Epoch 297/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1857 - val_loss: 0.2838
Epoch 298/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2018 - val_loss: 0.0559
Epoch 299/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1787 - val_loss: 0.0728
Epoch 300/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2164 - val_loss: 0.0726
```

In [23]:

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

# Predicting GDP
pred_gdp_ann = model_ann.predict(X_test)

# Evaluate the model
mse_ann = mean_squared_error(y_test, pred_gdp_ann)
r2_ann = r2_score(y_test, pred_gdp_ann)

print(f'ANN Mean Squared Error: {mse_ann}')
print(f'ANN R-squared: {r2_ann}')
```

```
32/32 ━━━━━━━━━━━━━━━━━━━━ 0s 9ms/step
ANN Mean Squared Error: 0.09448899328708649
ANN R-squared: 0.9827575945876418
```

In [28]:
```
import matplotlib.pyplot as plt

# Plot training & validation loss values
plt.figure(figsize=(10, 6))
plt.plot(history.history['loss'], label='Train Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.title('Model Loss Comparison')
plt.xlabel('Epochs')
plt.ylabel('Loss (MSE)')
plt.legend()
plt.show()
```



In [26]:
```
# Building the ANN Model for GDP Per Capita
model_gdp_per_capita = Sequential()
model_gdp_per_capita.add(Dense(64, activation='relu', input_shape=(X_train.shape[1],)))
model_gdp_per_capita.add(Dense(32, activation='relu'))
model_gdp_per_capita.add(Dense(16, activation='relu'))
model_gdp_per_capita.add(Dense(1, activation='linear'))  # Output layer for regression

# Compiling the model
model_gdp_per_capita.compile(optimizer='adam', loss='mean_squared_error')
```

```python
# Training the model
history1= model_gdp_per_capita.fit(X_train, y_train, epochs=300, batch_size=32, validation_split=0.1)

# Predicting GDP Per Capita
pred_gdp_per_capita = model_gdp_per_capita.predict(X_test)

# Evaluating the model
mse_gdp_per_capita = mean_squared_error(y_test, pred_gdp_per_capita)
r2_gdp_per_capita = r2_score(y_test, pred_gdp_per_capita)

print(f"GDP Per Capita Model - MSE: {mse_gdp_per_capita}, R2: {r2_gdp_per_capita}")
```

```
Epoch 1/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 2s 8ms/step - loss: 1065.1995 - val_loss: 5.6769
Epoch 2/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 5.6899 - val_loss: 5.4566
Epoch 3/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 5.3975 - val_loss: 5.2846
Epoch 4/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 5.3719 - val_loss: 5.2177
Epoch 5/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 5.0048 - val_loss: 5.3162
Epoch 6/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 4.7262 - val_loss: 4.7697
Epoch 7/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 4.5465 - val_loss: 5.2849
Epoch 8/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 4.5411 - val_loss: 4.6368
Epoch 9/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 4.3168 - val_loss: 4.0303
Epoch 10/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 3.7859 - val_loss: 3.6055
Epoch 11/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 3.5758 - val_loss: 4.0826
Epoch 12/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 3.2807 - val_loss: 3.1284
Epoch 13/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 3.2528 - val_loss: 2.9235
Epoch 14/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.9596 - val_loss: 4.6127
Epoch 15/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 3.0367 - val_loss: 2.3723
Epoch 16/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.5256 - val_loss: 2.3243
Epoch 17/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.2668 - val_loss: 2.0748
Epoch 18/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.0845 - val_loss: 1.7938
Epoch 19/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 2.0400 - val_loss: 1.5046
Epoch 20/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.5947 - val_loss: 1.3274
Epoch 21/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.3007 - val_loss: 1.1606
Epoch 22/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 1.3147 - val_loss: 1.0338
```

```
Epoch 23/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.9630 - val_loss: 1.0882
Epoch 24/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.8777 - val_loss: 0.8015
Epoch 25/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.8294 - val_loss: 0.7302
Epoch 26/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.6764 - val_loss: 0.7463
Epoch 27/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.5889 - val_loss: 0.5457
Epoch 28/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.6153 - val_loss: 0.4676
Epoch 29/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.4774 - val_loss: 0.4163
Epoch 30/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.4267 - val_loss: 0.5614
Epoch 31/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.4679 - val_loss: 0.3560
Epoch 32/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.3890 - val_loss: 0.3444
Epoch 33/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.3341 - val_loss: 0.2617
Epoch 34/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.3521 - val_loss: 0.4486
Epoch 35/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2914 - val_loss: 0.3569
Epoch 36/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2886 - val_loss: 0.3594
Epoch 37/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3354 - val_loss: 0.2131
Epoch 38/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2268 - val_loss: 0.2040
Epoch 39/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2162 - val_loss: 0.3404
Epoch 40/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2872 - val_loss: 0.1931
Epoch 41/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2159 - val_loss: 0.1594
Epoch 42/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1977 - val_loss: 0.1579
Epoch 43/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1794 - val_loss: 0.3476
Epoch 44/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1882 - val_loss: 0.1834
```

```
Epoch 45/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2213 - val_loss: 0.1818
Epoch 46/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1792 - val_loss: 0.2293
Epoch 47/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2069 - val_loss: 0.1573
Epoch 48/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1757 - val_loss: 0.1481
Epoch 49/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1950 - val_loss: 0.1359
Epoch 50/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2355 - val_loss: 0.1961
Epoch 51/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2489 - val_loss: 0.2457
Epoch 52/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1597 - val_loss: 0.1498
Epoch 53/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1718 - val_loss: 0.1873
Epoch 54/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2337 - val_loss: 0.4402
Epoch 55/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3117 - val_loss: 0.1054
Epoch 56/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1965 - val_loss: 0.1538
Epoch 57/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2468 - val_loss: 0.1079
Epoch 58/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1460 - val_loss: 0.1344
Epoch 59/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2193 - val_loss: 0.1003
Epoch 60/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1473 - val_loss: 0.0975
Epoch 61/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1374 - val_loss: 0.1376
Epoch 62/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.3065 - val_loss: 0.1081
Epoch 63/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1171 - val_loss: 0.1438
Epoch 64/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1655 - val_loss: 0.1782
Epoch 65/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1762 - val_loss: 0.5592
Epoch 66/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1993 - val_loss: 0.0982
```

```
Epoch 67/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1177 - val_loss: 0.0974
Epoch 68/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1664 - val_loss: 0.2297
Epoch 69/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2033 - val_loss: 0.2867
Epoch 70/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1973 - val_loss: 0.1321
Epoch 71/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1455 - val_loss: 0.1181
Epoch 72/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1569 - val_loss: 0.4005
Epoch 73/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2051 - val_loss: 0.3497
Epoch 74/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.1794 - val_loss: 0.0825
Epoch 75/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.2181 - val_loss: 0.0828
Epoch 76/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.1687 - val_loss: 0.3235
Epoch 77/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.2325 - val_loss: 0.1010
Epoch 78/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2322 - val_loss: 0.1205
Epoch 79/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1913 - val_loss: 0.0860
Epoch 80/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2196 - val_loss: 0.0864
Epoch 81/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1566 - val_loss: 0.1789
Epoch 82/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1906 - val_loss: 0.0805
Epoch 83/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1490 - val_loss: 0.1732
Epoch 84/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1538 - val_loss: 0.1790
Epoch 85/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1414 - val_loss: 0.0948
Epoch 86/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2351 - val_loss: 0.0897
Epoch 87/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1576 - val_loss: 0.2517
Epoch 88/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1637 - val_loss: 0.1125
```

```
Epoch 89/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1003 - val_loss: 0.0784
Epoch 90/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1410 - val_loss: 0.1551
Epoch 91/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1629 - val_loss: 0.0778
Epoch 92/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1356 - val_loss: 0.0969
Epoch 93/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1508 - val_loss: 0.1976
Epoch 94/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1426 - val_loss: 0.5822
Epoch 95/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1863 - val_loss: 0.0748
Epoch 96/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1453 - val_loss: 0.2288
Epoch 97/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1133 - val_loss: 0.1475
Epoch 98/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1108 - val_loss: 0.3506
Epoch 99/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2193 - val_loss: 0.1095
Epoch 100/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1167 - val_loss: 0.1153
Epoch 101/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1671 - val_loss: 0.1053
Epoch 102/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0921 - val_loss: 0.0747
Epoch 103/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1454 - val_loss: 0.1782
Epoch 104/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1287 - val_loss: 0.1034
Epoch 105/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1173 - val_loss: 0.1140
Epoch 106/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2193 - val_loss: 0.1138
Epoch 107/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1328 - val_loss: 0.0917
Epoch 108/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1190 - val_loss: 0.1377
Epoch 109/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1482 - val_loss: 0.3416
Epoch 110/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1059 - val_loss: 0.0978
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Epoch 111/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1486 - val_loss: 0.0776
Epoch 112/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1131 - val_loss: 0.0974
Epoch 113/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1269 - val_loss: 0.0971
Epoch 114/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1520 - val_loss: 0.0901
Epoch 115/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1146 - val_loss: 0.1161
Epoch 116/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.1200 - val_loss: 0.0654
Epoch 117/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.1503 - val_loss: 0.1881
Epoch 118/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.1466 - val_loss: 0.1065
Epoch 119/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0939 - val_loss: 0.0642
Epoch 120/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.1046 - val_loss: 0.0700
Epoch 121/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.1579 - val_loss: 0.1477
Epoch 122/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1484 - val_loss: 0.3770
Epoch 123/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1223 - val_loss: 0.2040
Epoch 124/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1098 - val_loss: 0.1911
Epoch 125/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1482 - val_loss: 0.0734
Epoch 126/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1020 - val_loss: 0.0682
Epoch 127/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0949 - val_loss: 0.0928
Epoch 128/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1127 - val_loss: 0.1295
Epoch 129/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1748 - val_loss: 0.0626
Epoch 130/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0737 - val_loss: 0.1072
Epoch 131/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1538 - val_loss: 0.0778
Epoch 132/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0756 - val_loss: 0.0642
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Epoch 133/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.4153 - val_loss: 0.0614
Epoch 134/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1071 - val_loss: 0.0614
Epoch 135/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0826 - val_loss: 0.0635
Epoch 136/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0968 - val_loss: 0.0592
Epoch 137/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1062 - val_loss: 0.0646
Epoch 138/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0955 - val_loss: 0.0601
Epoch 139/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0982 - val_loss: 0.0687
Epoch 140/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.2881 - val_loss: 0.0768
Epoch 141/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0724 - val_loss: 0.2722
Epoch 142/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1106 - val_loss: 0.1458
Epoch 143/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1165 - val_loss: 0.0627
Epoch 144/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0993 - val_loss: 0.3294
Epoch 145/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1001 - val_loss: 0.1257
Epoch 146/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1147 - val_loss: 0.3617
Epoch 147/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1707 - val_loss: 0.0843
Epoch 148/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0974 - val_loss: 0.0900
Epoch 149/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0856 - val_loss: 0.0717
Epoch 150/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1078 - val_loss: 0.0600
Epoch 151/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1080 - val_loss: 0.0825
Epoch 152/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0904 - val_loss: 0.0659
Epoch 153/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0950 - val_loss: 0.1200
Epoch 154/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0754 - val_loss: 0.0709
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Epoch 155/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1171 - val_loss: 0.1130
Epoch 156/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0970 - val_loss: 0.2231
Epoch 157/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1456 - val_loss: 0.0612
Epoch 158/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0805 - val_loss: 0.0650
Epoch 159/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.1047 - val_loss: 0.1157
Epoch 160/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.1109 - val_loss: 0.0728
Epoch 161/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0935 - val_loss: 0.1104
Epoch 162/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.1102 - val_loss: 0.1106
Epoch 163/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1856 - val_loss: 0.0681
Epoch 164/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0683 - val_loss: 0.1903
Epoch 165/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1268 - val_loss: 0.1165
Epoch 166/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0665 - val_loss: 0.0746
Epoch 167/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0893 - val_loss: 0.0666
Epoch 168/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1187 - val_loss: 0.1127
Epoch 169/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1007 - val_loss: 0.0794
Epoch 170/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0972 - val_loss: 0.0847
Epoch 171/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0738 - val_loss: 0.0739
Epoch 172/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0764 - val_loss: 0.0585
Epoch 173/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0839 - val_loss: 0.0740
Epoch 174/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0949 - val_loss: 0.0580
Epoch 175/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0800 - val_loss: 0.1553
Epoch 176/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0733 - val_loss: 0.0732
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Epoch 177/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0800 - val_loss: 0.0509
Epoch 178/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0857 - val_loss: 0.4668
Epoch 179/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1571 - val_loss: 0.0681
Epoch 180/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1180 - val_loss: 0.0520
Epoch 181/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1045 - val_loss: 0.1466
Epoch 182/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1241 - val_loss: 0.0557
Epoch 183/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0866 - val_loss: 0.0544
Epoch 184/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0637 - val_loss: 0.0789
Epoch 185/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0729 - val_loss: 0.0494
Epoch 186/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0787 - val_loss: 0.0738
Epoch 187/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0889 - val_loss: 0.1016
Epoch 188/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0876 - val_loss: 0.1213
Epoch 189/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0800 - val_loss: 0.1445
Epoch 190/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1158 - val_loss: 0.0685
Epoch 191/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0942 - val_loss: 0.1562
Epoch 192/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0908 - val_loss: 0.0689
Epoch 193/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1077 - val_loss: 0.0629
Epoch 194/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0863 - val_loss: 0.0958
Epoch 195/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0648 - val_loss: 0.0932
Epoch 196/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0550 - val_loss: 0.0783
Epoch 197/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0808 - val_loss: 0.4686
Epoch 198/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1073 - val_loss: 0.0549
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Epoch 199/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0720 - val_loss: 0.0767
Epoch 200/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0783 - val_loss: 0.2119
Epoch 201/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.1115 - val_loss: 0.1654
Epoch 202/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0559 - val_loss: 0.0596
Epoch 203/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0678 - val_loss: 0.1186
Epoch 204/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0748 - val_loss: 0.1202
Epoch 205/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0591 - val_loss: 0.0458
Epoch 206/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0891 - val_loss: 0.1428
Epoch 207/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0664 - val_loss: 0.0553
Epoch 208/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0594 - val_loss: 0.0662
Epoch 209/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0792 - val_loss: 0.0790
Epoch 210/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0753 - val_loss: 0.1144
Epoch 211/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1168 - val_loss: 0.1226
Epoch 212/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1601 - val_loss: 0.1910
Epoch 213/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0697 - val_loss: 0.0478
Epoch 214/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0574 - val_loss: 0.1202
Epoch 215/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0803 - val_loss: 0.0749
Epoch 216/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0583 - val_loss: 0.0491
Epoch 217/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0954 - val_loss: 0.1202
Epoch 218/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0827 - val_loss: 0.0544
Epoch 219/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0760 - val_loss: 0.0562
Epoch 220/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0688 - val_loss: 0.0430
```

```
Epoch 221/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0499 - val_loss: 0.1172
Epoch 222/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0808 - val_loss: 0.0542
Epoch 223/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0876 - val_loss: 0.1066
Epoch 224/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0671 - val_loss: 0.0602
Epoch 225/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0606 - val_loss: 0.1474
Epoch 226/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.9345 - val_loss: 0.1022
Epoch 227/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0762 - val_loss: 0.0498
Epoch 228/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0536 - val_loss: 0.0956
Epoch 229/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0583 - val_loss: 0.0940
Epoch 230/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0524 - val_loss: 0.0880
Epoch 231/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0507 - val_loss: 0.0682
Epoch 232/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0473 - val_loss: 0.0984
Epoch 233/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0415 - val_loss: 0.0714
Epoch 234/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0480 - val_loss: 0.2995
Epoch 235/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1232 - val_loss: 0.0428
Epoch 236/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0695 - val_loss: 0.0499
Epoch 237/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0696 - val_loss: 0.0525
Epoch 238/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0536 - val_loss: 0.1071
Epoch 239/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0916 - val_loss: 0.0773
Epoch 240/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0647 - val_loss: 0.0862
Epoch 241/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0607 - val_loss: 0.1020
Epoch 242/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0684 - val_loss: 0.0417
```

```
Epoch 243/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0491 - val_loss: 0.0927
Epoch 244/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0860 - val_loss: 0.0450
Epoch 245/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0727 - val_loss: 0.0544
Epoch 246/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.1070 - val_loss: 0.1259
Epoch 247/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1269 - val_loss: 0.0430
Epoch 248/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0666 - val_loss: 0.0443
Epoch 249/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0819 - val_loss: 0.0449
Epoch 250/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0447 - val_loss: 0.0487
Epoch 251/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0635 - val_loss: 0.0534
Epoch 252/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0673 - val_loss: 0.0657
Epoch 253/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0557 - val_loss: 0.1986
Epoch 254/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1054 - val_loss: 0.0636
Epoch 255/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0841 - val_loss: 0.0550
Epoch 256/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0512 - val_loss: 0.0520
Epoch 257/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0524 - val_loss: 0.1604
Epoch 258/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0677 - val_loss: 0.1690
Epoch 259/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1226 - val_loss: 0.0380
Epoch 260/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0478 - val_loss: 0.0802
Epoch 261/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0731 - val_loss: 0.0415
Epoch 262/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0511 - val_loss: 0.0657
Epoch 263/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0580 - val_loss: 0.0987
Epoch 264/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0534 - val_loss: 0.0535
```

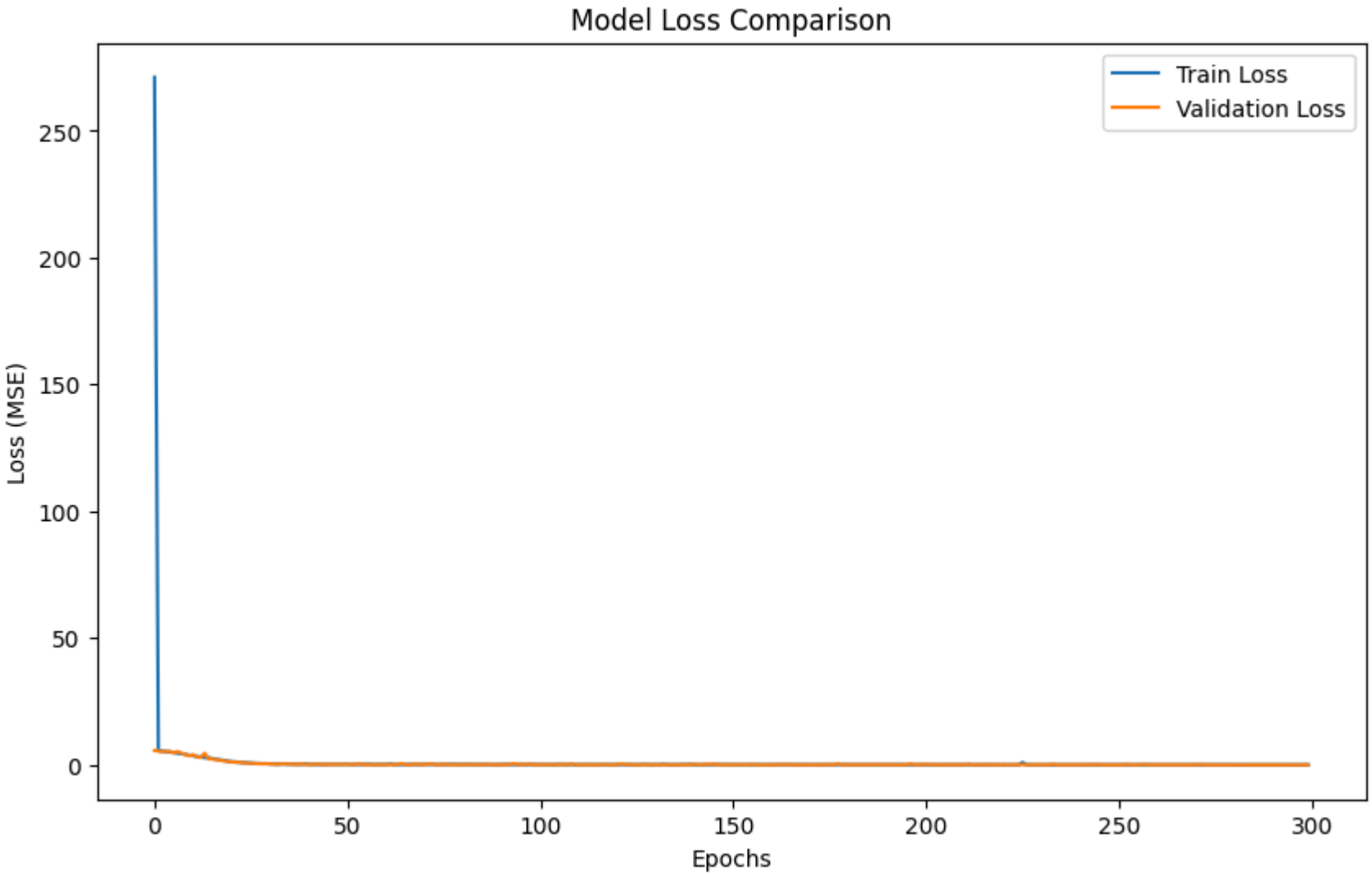
```
Epoch 265/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0650 - val_loss: 0.0754
Epoch 266/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0849 - val_loss: 0.0569
Epoch 267/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0535 - val_loss: 0.0418
Epoch 268/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0678 - val_loss: 0.0791
Epoch 269/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0492 - val_loss: 0.0398
Epoch 270/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0705 - val_loss: 0.0871
Epoch 271/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0513 - val_loss: 0.1574
Epoch 272/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0771 - val_loss: 0.1309
Epoch 273/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0681 - val_loss: 0.0528
Epoch 274/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0941 - val_loss: 0.0403
Epoch 275/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0677 - val_loss: 0.0418
Epoch 276/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0568 - val_loss: 0.0395
Epoch 277/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0554 - val_loss: 0.0412
Epoch 278/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0523 - val_loss: 0.0444
Epoch 279/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0784 - val_loss: 0.0363
Epoch 280/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0643 - val_loss: 0.0411
Epoch 281/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0544 - val_loss: 0.0811
Epoch 282/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0661 - val_loss: 0.0690
Epoch 283/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0512 - val_loss: 0.0446
Epoch 284/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0627 - val_loss: 0.0429
Epoch 285/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0634 - val_loss: 0.0915
Epoch 286/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0540 - val_loss: 0.0495
```

```
Epoch 287/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0486 - val_loss: 0.0573
Epoch 288/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0523 - val_loss: 0.0371
Epoch 289/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0542 - val_loss: 0.0409
Epoch 290/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0583 - val_loss: 0.0539
Epoch 291/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0471 - val_loss: 0.0347
Epoch 292/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0641 - val_loss: 0.1143
Epoch 293/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0529 - val_loss: 0.0462
Epoch 294/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0503 - val_loss: 0.0386
Epoch 295/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0686 - val_loss: 0.0448
Epoch 296/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0597 - val_loss: 0.0530
Epoch 297/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0543 - val_loss: 0.0437
Epoch 298/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0487 - val_loss: 0.0586
Epoch 299/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.1048 - val_loss: 0.0567
Epoch 300/300
115/115 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0495 - val_loss: 0.0332
32/32 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step
GDP Per Capita Model - MSE: 0.02692263200879097, R2: 0.9950871422644507
```

In [29]:

```python
import matplotlib.pyplot as plt

# Plot training & validation loss values
plt.figure(figsize=(10, 6))
plt.plot(history1.history['loss'], label='Train Loss')
plt.plot(history1.history['val_loss'], label='Validation Loss')
plt.title('Model Loss Comparison')
plt.xlabel('Epochs')
plt.ylabel('Loss (MSE)')
plt.legend()
plt.show()
```



In [30]:
```
import matplotlib.pyplot as plt

# Define the metrics for each model
models = ['GDP Model', 'GDP Per Capita Model']
mse_values = [mse_ann, mse_gdp_per_capita]
r2_values = [r2_ann, r2_gdp_per_capita]

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

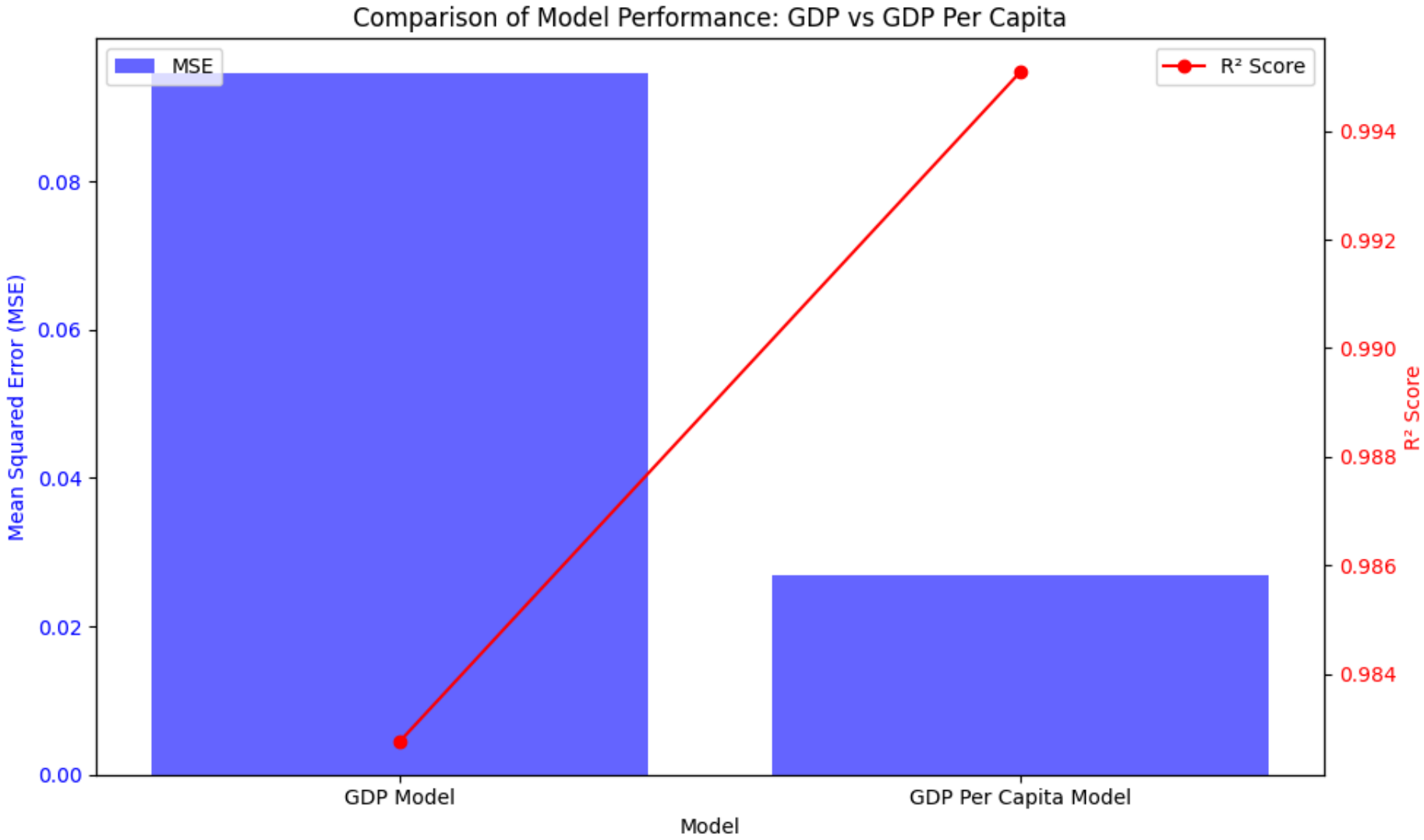
```
# Plot MSE
ax1.bar(models, mse_values, color='blue', alpha=0.6, label='MSE')
ax1.set_xlabel('Model')
ax1.set_ylabel('Mean Squared Error (MSE)', color='blue')
ax1.tick_params(axis='y', labelcolor='blue')

# 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()
```



In [31]:
```
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))
```

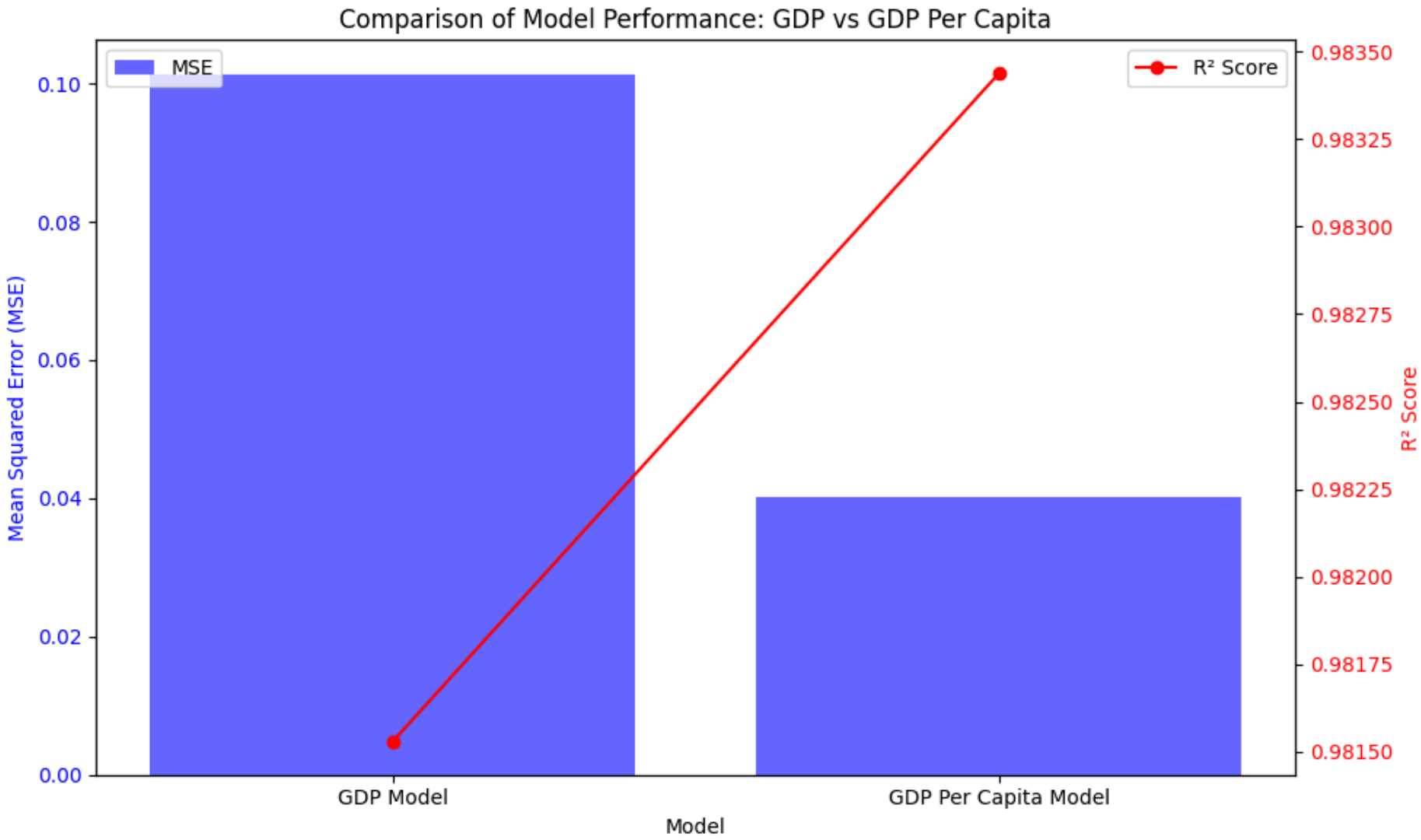
```
# Plot MSE
ax1.bar(models, mse_values, color='blue', alpha=0.6, label='MSE')
ax1.set_xlabel('Model')
ax1.set_ylabel('Mean Squared Error (MSE)', color='blue')
ax1.tick_params(axis='y', labelcolor='blue')

# 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()
```



In [32]:
```
import matplotlib.pyplot as plt
# Define the metrics for each model
models = ['LSTM GDP', 'LSTM GDP Per Capita', 'ANN GDP', 'ANN GDP Per Capita']
mse_values = [mse_gdp, mse_gdp_pc, mse_ann, mse_gdp_per_capita]
r2_values = [r2_gdp, r2_gdp_pc, r2_ann, r2_gdp_per_capita]

# Create a figure and axis
fig, ax1 = plt.subplots(figsize=(12, 6))
```

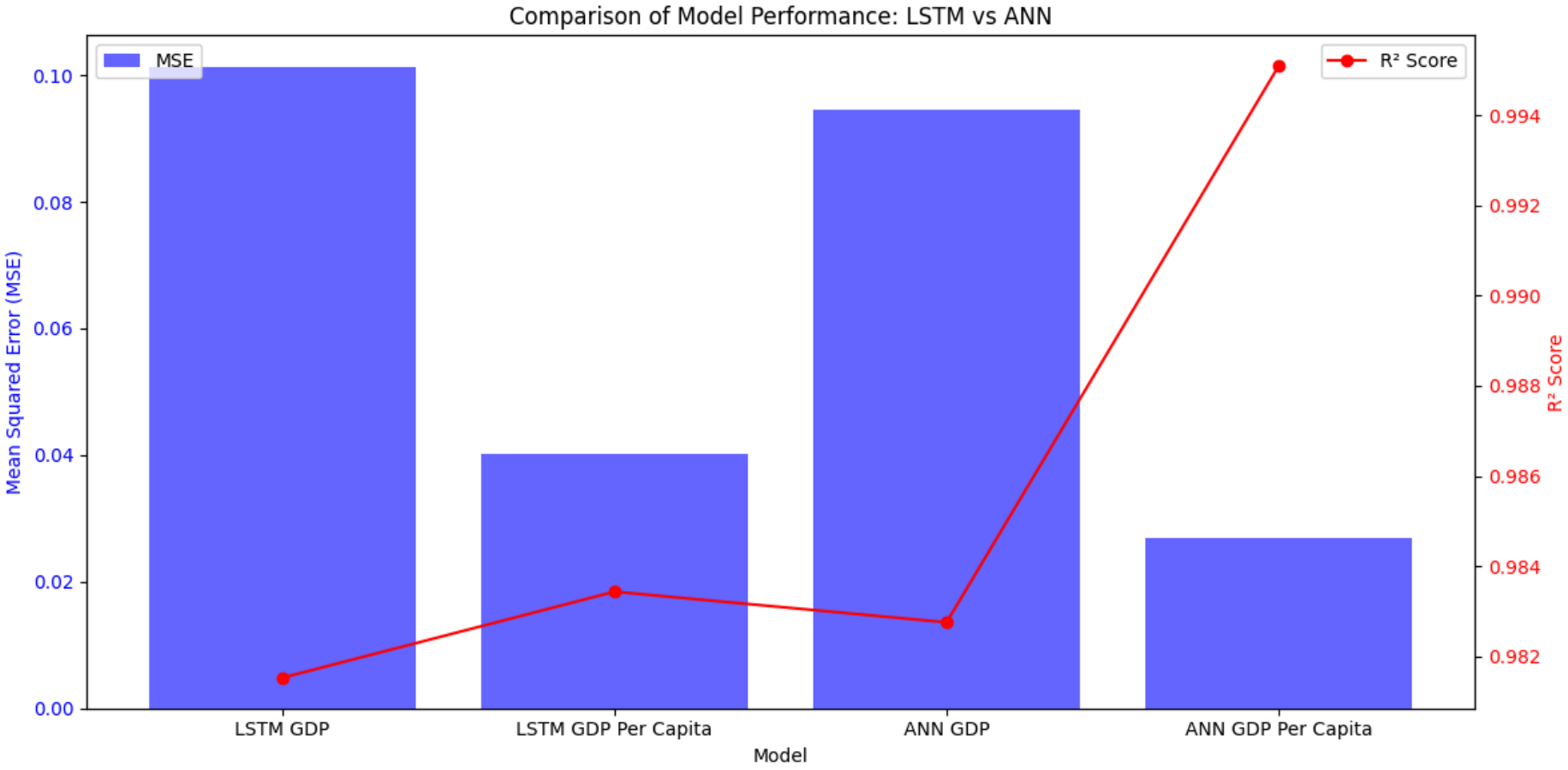
```
# Plot MSE
ax1.bar(models, mse_values, color='blue', alpha=0.6, label='MSE')
ax1.set_xlabel('Model')
ax1.set_ylabel('Mean Squared Error (MSE)', color='blue')
ax1.tick_params(axis='y', labelcolor='blue')

# 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: LSTM vs ANN')
fig.tight_layout()

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

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


Comparison of Model Performance: LSTM vs ANN
MSE
R² Score
Mean Squared Error (MSE)
R² Score
0.10
0.08
0.06
0.04
0.02
0.00
0.994
0.992
0.990
0.988
0.986
0.984
0.982
LSTM GDP
LSTM GDP Per Capita
ANN GDP
ANN GDP Per Capita
Model