International US Foreign Currency Exchange Rates Predictor

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## Blog Post Inspiration and Objectives

In this blog post, I was hoping to investigate using Machine Learning to make a financial prediction system. Initially, I was hoping to imitate the ones used for stock prediction. However, since there were too many tutorials on this topic, I decided to investigate another global, financial factor that governs trade internationally: international currency rates. In the news recently, I have heard rumors of how the international standard of utilizing the US dollar could be compromised with other global powers such as China and India rise in global dominance. Thus, I focused my efforts on analyzing the US currency conversion rates to other countries. With that said, let’s try to analyze this topic with some Machine Learning:

## Data Preprocessing - Cleaning and Analytics

```{python}  
# Import needed libraries  
import numpy as np  
import pandas as pd  
import matplotlib.pyplot as plt  
from tensorflow.keras.models import Sequential  
from tensorflow.keras.optimizers import Adam  
from tensorflow.keras import layers  
from copy import deepcopy  
import datetime as dt  
plt.style.use("fivethirtyeight")  
```

First, we will read and display the initial dataset in our file system for this blog post, downloaded from Kaggle. This dataset contains loads of valuable information such as almost every major world power’s international US currency conversion rate.

```{python}  
# Reading and displaying the initial dataset  
df = pd.read\_csv("datasets/foreign\_exchange\_rates.csv")  
df  
```

|  | Unnamed: 0 | Time Serie | AUSTRALIA - AUSTRALIAN DOLLAR/US$ | EURO AREA - EURO/US$ | NEW ZEALAND - NEW ZELAND DOLLAR/US$ | UNITED KINGDOM - UNITED KINGDOM POUND/US$ | BRAZIL - REAL/US$ | CANADA - CANADIAN DOLLAR/US$ | CHINA - YUAN/US$ | HONG KONG - HONG KONG DOLLAR/US$ | ... | SINGAPORE - SINGAPORE DOLLAR/US$ | DENMARK - DANISH KRONE/US$ | JAPAN - YEN/US$ | MALAYSIA - RINGGIT/US$ | NORWAY - NORWEGIAN KRONE/US$ | SWEDEN - KRONA/US$ | SRI LANKA - SRI LANKAN RUPEE/US$ | SWITZERLAND - FRANC/US$ | TAIWAN - NEW TAIWAN DOLLAR/US$ | THAILAND - BAHT/US$ |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 2000-01-03 | 1.5172 | 0.9847 | 1.9033 | 0.6146 | 1.805 | 1.4465 | 8.2798 | 7.7765 | ... | 1.6563 | 7.329 | 101.7 | 3.8 | 7.964 | 8.443 | 72.3 | 1.5808 | 31.38 | 36.97 |
| 1 | 1 | 2000-01-04 | 1.5239 | 0.97 | 1.9238 | 0.6109 | 1.8405 | 1.4518 | 8.2799 | 7.7775 | ... | 1.6535 | 7.218 | 103.09 | 3.8 | 7.934 | 8.36 | 72.65 | 1.5565 | 30.6 | 37.13 |
| 2 | 2 | 2000-01-05 | 1.5267 | 0.9676 | 1.9339 | 0.6092 | 1.856 | 1.4518 | 8.2798 | 7.778 | ... | 1.656 | 7.208 | 103.77 | 3.8 | 7.935 | 8.353 | 72.95 | 1.5526 | 30.8 | 37.1 |
| 3 | 3 | 2000-01-06 | 1.5291 | 0.9686 | 1.9436 | 0.607 | 1.84 | 1.4571 | 8.2797 | 7.7785 | ... | 1.6655 | 7.2125 | 105.19 | 3.8 | 7.94 | 8.3675 | 72.95 | 1.554 | 31.75 | 37.62 |
| 4 | 4 | 2000-01-07 | 1.5272 | 0.9714 | 1.938 | 0.6104 | 1.831 | 1.4505 | 8.2794 | 7.7783 | ... | 1.6625 | 7.2285 | 105.17 | 3.8 | 7.966 | 8.415 | 73.15 | 1.5623 | 30.85 | 37.3 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 5212 | 5212 | 2019-12-25 | ND | ND | ND | ND | ND | ND | ND | ND | ... | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 5213 | 5213 | 2019-12-26 | 1.4411 | 0.9007 | 1.5002 | 0.7688 | 4.0602 | 1.3124 | 6.9949 | 7.788 | ... | 1.354 | 6.7295 | 109.67 | 4.1337 | 8.8799 | 9.4108 | 181.3 | 0.9808 | 30.11 | 30.15 |
| 5214 | 5214 | 2019-12-27 | 1.4331 | 0.8949 | 1.4919 | 0.7639 | 4.0507 | 1.3073 | 6.9954 | 7.7874 | ... | 1.352 | 6.6829 | 109.47 | 4.126 | 8.8291 | 9.3405 | 181.35 | 0.9741 | 30.09 | 30.14 |
| 5215 | 5215 | 2019-12-30 | 1.4278 | 0.8915 | 1.4846 | 0.761 | 4.0152 | 1.3058 | 6.9864 | 7.7857 | ... | 1.3483 | 6.6589 | 108.85 | 4.1053 | 8.7839 | 9.3145 | 181.6 | 0.9677 | 30.04 | 29.94 |
| 5216 | 5216 | 2019-12-31 | 1.4225 | 0.8907 | 1.4826 | 0.7536 | 4.019 | 1.2962 | 6.9618 | 7.7894 | ... | 1.3446 | 6.6554 | 108.67 | 4.0918 | 8.7823 | 9.3425 | 181.3 | 0.9677 | 29.91 | 29.75 |

For clarity on the constraints and parameters of the working datasets, I went to find high-level exploratory statistics on all of the datasets: shape, information about all of the entries, etc.

```{python}  
# Determining the shape of the initial dataset  
df.shape  
```

(5217, 24)

```{python}  
# Getting a sample of the initial dataset through the seeing the first 10 entries  
# completely in the dataset  
df.head()  
```

|  | Unnamed: 0 | Time Serie | AUSTRALIA - AUSTRALIAN DOLLAR/US$ | EURO AREA - EURO/US$ | NEW ZEALAND - NEW ZELAND DOLLAR/US$ | UNITED KINGDOM - UNITED KINGDOM POUND/US$ | BRAZIL - REAL/US$ | CANADA - CANADIAN DOLLAR/US$ | CHINA - YUAN/US$ | HONG KONG - HONG KONG DOLLAR/US$ | ... | SINGAPORE - SINGAPORE DOLLAR/US$ | DENMARK - DANISH KRONE/US$ | JAPAN - YEN/US$ | MALAYSIA - RINGGIT/US$ | NORWAY - NORWEGIAN KRONE/US$ | SWEDEN - KRONA/US$ | SRI LANKA - SRI LANKAN RUPEE/US$ | SWITZERLAND - FRANC/US$ | TAIWAN - NEW TAIWAN DOLLAR/US$ | THAILAND - BAHT/US$ |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 2000-01-03 | 1.5172 | 0.9847 | 1.9033 | 0.6146 | 1.805 | 1.4465 | 8.2798 | 7.7765 | ... | 1.6563 | 7.329 | 101.7 | 3.8 | 7.964 | 8.443 | 72.3 | 1.5808 | 31.38 | 36.97 |
| 1 | 1 | 2000-01-04 | 1.5239 | 0.97 | 1.9238 | 0.6109 | 1.8405 | 1.4518 | 8.2799 | 7.7775 | ... | 1.6535 | 7.218 | 103.09 | 3.8 | 7.934 | 8.36 | 72.65 | 1.5565 | 30.6 | 37.13 |
| 2 | 2 | 2000-01-05 | 1.5267 | 0.9676 | 1.9339 | 0.6092 | 1.856 | 1.4518 | 8.2798 | 7.778 | ... | 1.656 | 7.208 | 103.77 | 3.8 | 7.935 | 8.353 | 72.95 | 1.5526 | 30.8 | 37.1 |
| 3 | 3 | 2000-01-06 | 1.5291 | 0.9686 | 1.9436 | 0.607 | 1.84 | 1.4571 | 8.2797 | 7.7785 | ... | 1.6655 | 7.2125 | 105.19 | 3.8 | 7.94 | 8.3675 | 72.95 | 1.554 | 31.75 | 37.62 |
| 4 | 4 | 2000-01-07 | 1.5272 | 0.9714 | 1.938 | 0.6104 | 1.831 | 1.4505 | 8.2794 | 7.7783 | ... | 1.6625 | 7.2285 | 105.17 | 3.8 | 7.966 | 8.415 | 73.15 | 1.5623 | 30.85 | 37.3 |

```{python}  
# Figuring out all of the columns (and their names) available for me to use in the dataset  
df.columns  
```

Index(['Unnamed: 0', 'Time Serie', 'AUSTRALIA - AUSTRALIAN DOLLAR/US$',  
 'EURO AREA - EURO/US$', 'NEW ZEALAND - NEW ZELAND DOLLAR/US$',  
 'UNITED KINGDOM - UNITED KINGDOM POUND/US$', 'BRAZIL - REAL/US$',  
 'CANADA - CANADIAN DOLLAR/US$', 'CHINA - YUAN/US$',  
 'HONG KONG - HONG KONG DOLLAR/US$', 'INDIA - INDIAN RUPEE/US$',  
 'KOREA - WON/US$', 'MEXICO - MEXICAN PESO/US$',  
 'SOUTH AFRICA - RAND/US$', 'SINGAPORE - SINGAPORE DOLLAR/US$',  
 'DENMARK - DANISH KRONE/US$', 'JAPAN - YEN/US$',  
 'MALAYSIA - RINGGIT/US$', 'NORWAY - NORWEGIAN KRONE/US$',  
 'SWEDEN - KRONA/US$', 'SRI LANKA - SRI LANKAN RUPEE/US$',  
 'SWITZERLAND - FRANC/US$', 'TAIWAN - NEW TAIWAN DOLLAR/US$',  
 'THAILAND - BAHT/US$'],  
 dtype='object')

```{python}  
# Figuring out the number of duplicated elements in the dataset  
# (could be problematic if not resolved)  
df.duplicated().sum()  
```

0

```{python}  
# Figuring out the number of 'null'/'NaN' elements in the dataset   
# (if NaN filling is needed or not)  
(df.isnull().sum() / df.shape[0]) \* 100  
```

Unnamed: 0 0.0  
Time Serie 0.0  
AUSTRALIA - AUSTRALIAN DOLLAR/US$ 0.0  
EURO AREA - EURO/US$ 0.0  
NEW ZEALAND - NEW ZELAND DOLLAR/US$ 0.0  
UNITED KINGDOM - UNITED KINGDOM POUND/US$ 0.0  
BRAZIL - REAL/US$ 0.0  
CANADA - CANADIAN DOLLAR/US$ 0.0  
CHINA - YUAN/US$ 0.0  
HONG KONG - HONG KONG DOLLAR/US$ 0.0  
INDIA - INDIAN RUPEE/US$ 0.0  
KOREA - WON/US$ 0.0  
MEXICO - MEXICAN PESO/US$ 0.0  
SOUTH AFRICA - RAND/US$ 0.0  
SINGAPORE - SINGAPORE DOLLAR/US$ 0.0  
DENMARK - DANISH KRONE/US$ 0.0  
JAPAN - YEN/US$ 0.0  
MALAYSIA - RINGGIT/US$ 0.0  
NORWAY - NORWEGIAN KRONE/US$ 0.0  
SWEDEN - KRONA/US$ 0.0  
SRI LANKA - SRI LANKAN RUPEE/US$ 0.0  
SWITZERLAND - FRANC/US$ 0.0  
TAIWAN - NEW TAIWAN DOLLAR/US$ 0.0  
THAILAND - BAHT/US$ 0.0  
dtype: float64

```{python}  
# Getting basic information about the dataset  
df.info()  
```

<class 'pandas.core.frame.DataFrame'>  
RangeIndex: 5217 entries, 0 to 5216  
Data columns (total 24 columns):  
 # Column Non-Null Count Dtype   
--- ------ -------------- -----   
 0 Unnamed: 0 5217 non-null int64   
 1 Time Serie 5217 non-null object  
 2 AUSTRALIA - AUSTRALIAN DOLLAR/US$ 5217 non-null object  
 3 EURO AREA - EURO/US$ 5217 non-null object  
 4 NEW ZEALAND - NEW ZELAND DOLLAR/US$ 5217 non-null object  
 5 UNITED KINGDOM - UNITED KINGDOM POUND/US$ 5217 non-null object  
 6 BRAZIL - REAL/US$ 5217 non-null object  
 7 CANADA - CANADIAN DOLLAR/US$ 5217 non-null object  
 8 CHINA - YUAN/US$ 5217 non-null object  
 9 HONG KONG - HONG KONG DOLLAR/US$ 5217 non-null object  
 10 INDIA - INDIAN RUPEE/US$ 5217 non-null object  
 11 KOREA - WON/US$ 5217 non-null object  
 12 MEXICO - MEXICAN PESO/US$ 5217 non-null object  
 13 SOUTH AFRICA - RAND/US$ 5217 non-null object  
 14 SINGAPORE - SINGAPORE DOLLAR/US$ 5217 non-null object  
 15 DENMARK - DANISH KRONE/US$ 5217 non-null object  
 16 JAPAN - YEN/US$ 5217 non-null object  
 17 MALAYSIA - RINGGIT/US$ 5217 non-null object  
 18 NORWAY - NORWEGIAN KRONE/US$ 5217 non-null object  
 19 SWEDEN - KRONA/US$ 5217 non-null object  
 20 SRI LANKA - SRI LANKAN RUPEE/US$ 5217 non-null object  
 21 SWITZERLAND - FRANC/US$ 5217 non-null object  
 22 TAIWAN - NEW TAIWAN DOLLAR/US$ 5217 non-null object  
 23 THAILAND - BAHT/US$ 5217 non-null object  
dtypes: int64(1), object(23)  
memory usage: 978.3+ KB

Additionally, before handing my combined Book dataset over for Machine Learning training and prediction, I need to clean the data prior to the analysis stage: removing duplicates, deleting null/NaN values, fixing types of columns, filling invalid values with suitable alternatives, etc.

```{python}  
# Removing unnecessary/unnamed columns in the dataset  
df = df.drop("Unnamed: 0", axis=1)  
df  
```

|  | Time Serie | AUSTRALIA - AUSTRALIAN DOLLAR/US$ | EURO AREA - EURO/US$ | NEW ZEALAND - NEW ZELAND DOLLAR/US$ | UNITED KINGDOM - UNITED KINGDOM POUND/US$ | BRAZIL - REAL/US$ | CANADA - CANADIAN DOLLAR/US$ | CHINA - YUAN/US$ | HONG KONG - HONG KONG DOLLAR/US$ | INDIA - INDIAN RUPEE/US$ | ... | SINGAPORE - SINGAPORE DOLLAR/US$ | DENMARK - DANISH KRONE/US$ | JAPAN - YEN/US$ | MALAYSIA - RINGGIT/US$ | NORWAY - NORWEGIAN KRONE/US$ | SWEDEN - KRONA/US$ | SRI LANKA - SRI LANKAN RUPEE/US$ | SWITZERLAND - FRANC/US$ | TAIWAN - NEW TAIWAN DOLLAR/US$ | THAILAND - BAHT/US$ |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 2000-01-03 | 1.5172 | 0.9847 | 1.9033 | 0.6146 | 1.805 | 1.4465 | 8.2798 | 7.7765 | 43.55 | ... | 1.6563 | 7.329 | 101.7 | 3.8 | 7.964 | 8.443 | 72.3 | 1.5808 | 31.38 | 36.97 |
| 1 | 2000-01-04 | 1.5239 | 0.97 | 1.9238 | 0.6109 | 1.8405 | 1.4518 | 8.2799 | 7.7775 | 43.55 | ... | 1.6535 | 7.218 | 103.09 | 3.8 | 7.934 | 8.36 | 72.65 | 1.5565 | 30.6 | 37.13 |
| 2 | 2000-01-05 | 1.5267 | 0.9676 | 1.9339 | 0.6092 | 1.856 | 1.4518 | 8.2798 | 7.778 | 43.55 | ... | 1.656 | 7.208 | 103.77 | 3.8 | 7.935 | 8.353 | 72.95 | 1.5526 | 30.8 | 37.1 |
| 3 | 2000-01-06 | 1.5291 | 0.9686 | 1.9436 | 0.607 | 1.84 | 1.4571 | 8.2797 | 7.7785 | 43.55 | ... | 1.6655 | 7.2125 | 105.19 | 3.8 | 7.94 | 8.3675 | 72.95 | 1.554 | 31.75 | 37.62 |
| 4 | 2000-01-07 | 1.5272 | 0.9714 | 1.938 | 0.6104 | 1.831 | 1.4505 | 8.2794 | 7.7783 | 43.55 | ... | 1.6625 | 7.2285 | 105.17 | 3.8 | 7.966 | 8.415 | 73.15 | 1.5623 | 30.85 | 37.3 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 5212 | 2019-12-25 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ... | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 5213 | 2019-12-26 | 1.4411 | 0.9007 | 1.5002 | 0.7688 | 4.0602 | 1.3124 | 6.9949 | 7.788 | 71.28 | ... | 1.354 | 6.7295 | 109.67 | 4.1337 | 8.8799 | 9.4108 | 181.3 | 0.9808 | 30.11 | 30.15 |
| 5214 | 2019-12-27 | 1.4331 | 0.8949 | 1.4919 | 0.7639 | 4.0507 | 1.3073 | 6.9954 | 7.7874 | 71.45 | ... | 1.352 | 6.6829 | 109.47 | 4.126 | 8.8291 | 9.3405 | 181.35 | 0.9741 | 30.09 | 30.14 |
| 5215 | 2019-12-30 | 1.4278 | 0.8915 | 1.4846 | 0.761 | 4.0152 | 1.3058 | 6.9864 | 7.7857 | 71.3 | ... | 1.3483 | 6.6589 | 108.85 | 4.1053 | 8.7839 | 9.3145 | 181.6 | 0.9677 | 30.04 | 29.94 |
| 5216 | 2019-12-31 | 1.4225 | 0.8907 | 1.4826 | 0.7536 | 4.019 | 1.2962 | 6.9618 | 7.7894 | 71.36 | ... | 1.3446 | 6.6554 | 108.67 | 4.0918 | 8.7823 | 9.3425 | 181.3 | 0.9677 | 29.91 | 29.75 |

```{python}  
# Converting the date column into a string representation to a parsable  
# Datetime object (needed for later)  
df = df.rename(columns={"Time Serie": "DATE"})  
  
def str\_to\_datetime(date\_str: str):  
 split = tuple(date\_str.split("-"))  
 year, month, day = int(split[0]), int(split[1]), int(split[2])  
 return dt.datetime(year, month, day)  
  
df["DATE"] = df["DATE"].apply(str\_to\_datetime)  
df["DATE"]  
```

0 2000-01-03  
1 2000-01-04  
2 2000-01-05  
3 2000-01-06  
4 2000-01-07  
 ...   
5212 2019-12-25  
5213 2019-12-26  
5214 2019-12-27  
5215 2019-12-30  
5216 2019-12-31  
Name: DATE, Length: 5217, dtype: datetime64[ns]

As shown below, I had decided to filter out all of the countries except Austrailia, Canada, the United Kingdom, and Switzerland because those countries had the most stable and consistent international currency rates as well as the most comparable (1:1) currency rates with the United States. One additional reason that these countries were selected for this blog post was do the geographical diversity covered most landmass continents across the world, representative of the global market interactions that the United States deals with on a day-to-day basis.

```{python}  
# Making the "Date" column the new index (better identifer/key in dataset)  
# Taking out other countries except Austrailia, Canada, UK, and   
# Switzerland from dataset for Machine Learning blog post  
df.index = df.pop("DATE")  
df = df[["AUSTRALIA - AUSTRALIAN DOLLAR/US$",   
 "CANADA - CANADIAN DOLLAR/US$",  
 "UNITED KINGDOM - UNITED KINGDOM POUND/US$",  
 "SWITZERLAND - FRANC/US$"]]  
df  
```

|  | AUSTRALIA - AUSTRALIAN DOLLAR/US$ | CANADA - CANADIAN DOLLAR/US$ | UNITED KINGDOM - UNITED KINGDOM POUND/US$ | SWITZERLAND - FRANC/US$ |
| --- | --- | --- | --- | --- |
| DATE |  |  |  |  |
| 2000-01-03 | 1.5172 | 1.4465 | 0.6146 | 1.5808 |
| 2000-01-04 | 1.5239 | 1.4518 | 0.6109 | 1.5565 |
| 2000-01-05 | 1.5267 | 1.4518 | 0.6092 | 1.5526 |
| 2000-01-06 | 1.5291 | 1.4571 | 0.607 | 1.554 |
| 2000-01-07 | 1.5272 | 1.4505 | 0.6104 | 1.5623 |
| ... | ... | ... | ... | ... |
| 2019-12-25 | ND | ND | ND | ND |
| 2019-12-26 | 1.4411 | 1.3124 | 0.7688 | 0.9808 |
| 2019-12-27 | 1.4331 | 1.3073 | 0.7639 | 0.9741 |
| 2019-12-30 | 1.4278 | 1.3058 | 0.761 | 0.9677 |
| 2019-12-31 | 1.4225 | 1.2962 | 0.7536 | 0.9677 |

```{python}  
# Converting of all numerical international currency rates to 2-decimal   
# rates (easier to work with for later)  
for col in df:  
 df[col] = df[col].map(lambda entry: entry if entry == "ND" else round(float(entry), 2))  
df  
```

|  | AUSTRALIA - AUSTRALIAN DOLLAR/US$ | CANADA - CANADIAN DOLLAR/US$ | UNITED KINGDOM - UNITED KINGDOM POUND/US$ | SWITZERLAND - FRANC/US$ |
| --- | --- | --- | --- | --- |
| DATE |  |  |  |  |
| 2000-01-03 | 1.52 | 1.45 | 0.61 | 1.58 |
| 2000-01-04 | 1.52 | 1.45 | 0.61 | 1.56 |
| 2000-01-05 | 1.53 | 1.45 | 0.61 | 1.55 |
| 2000-01-06 | 1.53 | 1.46 | 0.61 | 1.55 |
| 2000-01-07 | 1.53 | 1.45 | 0.61 | 1.56 |
| ... | ... | ... | ... | ... |
| 2019-12-25 | ND | ND | ND | ND |
| 2019-12-26 | 1.44 | 1.31 | 0.77 | 0.98 |
| 2019-12-27 | 1.43 | 1.31 | 0.76 | 0.97 |
| 2019-12-30 | 1.43 | 1.31 | 0.76 | 0.97 |
| 2019-12-31 | 1.42 | 1.3 | 0.75 | 0.97 |

```{python}  
# Removing all of the dated rows that contains "ND" as a way to avoid problems   
# when trying to interlay Machine Learning algorithms that require only  
# quantitative data with categorical entries  
nd\_index\_list: set[str] = set()  
for row\_index, \_ in df.iterrows():  
 for col\_entry in df.loc[row\_index]:  
 if col\_entry == "ND":  
 nd\_index\_list.add(row\_index)  
  
df = df.drop(labels=list(nd\_index\_list), axis=0)  
df  
```

|  | AUSTRALIA - AUSTRALIAN DOLLAR/US$ | CANADA - CANADIAN DOLLAR/US$ | UNITED KINGDOM - UNITED KINGDOM POUND/US$ | SWITZERLAND - FRANC/US$ |
| --- | --- | --- | --- | --- |
| DATE |  |  |  |  |
| 2000-01-03 | 1.52 | 1.45 | 0.61 | 1.58 |
| 2000-01-04 | 1.52 | 1.45 | 0.61 | 1.56 |
| 2000-01-05 | 1.53 | 1.45 | 0.61 | 1.55 |
| 2000-01-06 | 1.53 | 1.46 | 0.61 | 1.55 |
| 2000-01-07 | 1.53 | 1.45 | 0.61 | 1.56 |
| ... | ... | ... | ... | ... |
| 2019-12-24 | 1.44 | 1.32 | 0.77 | 0.98 |
| 2019-12-26 | 1.44 | 1.31 | 0.77 | 0.98 |
| 2019-12-27 | 1.43 | 1.31 | 0.76 | 0.97 |
| 2019-12-30 | 1.43 | 1.31 | 0.76 | 0.97 |
| 2019-12-31 | 1.42 | 1.3 | 0.75 | 0.97 |

As shown in the code snippet below, with some online references, the df\_to\_windowed\_df function describes a way to use prediction values. A new international currency rate dataframe is created which includes the rows encompassing the 3 previous dates prior to the current date of when the international currency rate was reported as well as the current rate that day. This would be helpful for later Machine Learning predictions because the previous 3 dates and the current will provide it enough context to make more insightful predictions on the future of the international currency rates between that respective country specified and the United States. Later, as you will see, the 3 previous days are going to be the input and the current currency rate (Target) will be our output.

```{python}  
def df\_to\_windowed\_df(data\_frame: pd.DataFrame, first\_date\_str: str, last\_date\_str: str, n: int, col\_name: str):  
 first\_date = str\_to\_datetime(first\_date\_str)  
 last\_date = str\_to\_datetime(last\_date\_str)  
   
 target\_date = first\_date  
   
 dates: list = []  
 X: list = []  
 Y: list = []  
   
 last\_time = False  
 while True:  
 df\_subset = data\_frame.loc[:target\_date].tail(n + 1)  
   
 if (len(df\_subset) != n + 1):  
 print("Error: Window of size " + str(n) + " is too large for date " + str(target\_date))  
 return  
   
 values = df\_subset[col\_name].to\_numpy()  
 x, y = values[:-1], values[-1]  
   
 dates.append(target\_date)  
 X.append(x)  
 Y.append(y)  
   
 next\_week = data\_frame.loc[target\_date:target\_date + dt.timedelta(days=7)]  
 next\_datetime\_str = str(next\_week.head(2).tail(1).index.values[0])  
 next\_date\_str = next\_datetime\_str.split("T")[0]  
 year\_month\_day = next\_date\_str.split("-")  
 year, month, day = year\_month\_day  
 next\_date = dt.datetime(year=int(year), month=int(month), day=int(day))  
   
 if last\_time:  
 break  
   
 target\_date = next\_date  
 if (target\_date == last\_date):  
 last\_time = True  
   
 returned\_df = pd.DataFrame({})  
 returned\_df["Target Date"] = dates  
   
 X = np.array(X)  
 for i in range(0, n):  
 X[:, i]  
 returned\_df["Target-" + str(n - i)] = X[:, i]  
 returned\_df["Target"] = Y  
   
 return returned\_df   
```

Thus, with the df\_to\_windowed\_df function created, we created one for every country to later use for Machine Learning model training and eventual predictions of future rates: Austrailia, Canada, the United Kingdom, and Switzerland.

```{python}  
# Convert Austrailia's dataframe to a windowed dataframe  
windowed\_df\_austrailia = df\_to\_windowed\_df(data\_frame=df,   
 first\_date\_str="2000-01-06",  
 last\_date\_str="2019-12-31",  
 n=3,  
 col\_name="AUSTRALIA - AUSTRALIAN DOLLAR/US$")  
windowed\_df\_austrailia   
```

|  | Target Date | Target-3 | Target-2 | Target-1 | Target |
| --- | --- | --- | --- | --- | --- |
| 0 | 2000-01-06 | 1.52 | 1.52 | 1.53 | 1.53 |
| 1 | 2000-01-07 | 1.52 | 1.53 | 1.53 | 1.53 |
| 2 | 2000-01-10 | 1.53 | 1.53 | 1.53 | 1.52 |
| 3 | 2000-01-11 | 1.53 | 1.53 | 1.52 | 1.52 |
| 4 | 2000-01-12 | 1.53 | 1.52 | 1.52 | 1.52 |
| ... | ... | ... | ... | ... | ... |
| 5011 | 2019-12-24 | 1.45 | 1.45 | 1.45 | 1.44 |
| 5012 | 2019-12-26 | 1.45 | 1.45 | 1.44 | 1.44 |
| 5013 | 2019-12-27 | 1.45 | 1.44 | 1.44 | 1.43 |
| 5014 | 2019-12-30 | 1.44 | 1.44 | 1.43 | 1.43 |
| 5015 | 2019-12-31 | 1.44 | 1.43 | 1.43 | 1.42 |

```{python}  
# Convert Canada's dataframe to a windowed dataframe  
windowed\_df\_canada = df\_to\_windowed\_df(data\_frame=df,   
 first\_date\_str="2000-01-06",  
 last\_date\_str="2019-12-31",  
 n=3,  
 col\_name="CANADA - CANADIAN DOLLAR/US$")  
windowed\_df\_canada  
```

|  | Target Date | Target-3 | Target-2 | Target-1 | Target |
| --- | --- | --- | --- | --- | --- |
| 0 | 2000-01-06 | 1.45 | 1.45 | 1.45 | 1.46 |
| 1 | 2000-01-07 | 1.45 | 1.45 | 1.46 | 1.45 |
| 2 | 2000-01-10 | 1.45 | 1.46 | 1.45 | 1.46 |
| 3 | 2000-01-11 | 1.46 | 1.45 | 1.46 | 1.46 |
| 4 | 2000-01-12 | 1.45 | 1.46 | 1.46 | 1.46 |
| ... | ... | ... | ... | ... | ... |
| 5011 | 2019-12-24 | 1.31 | 1.32 | 1.32 | 1.32 |
| 5012 | 2019-12-26 | 1.32 | 1.32 | 1.32 | 1.31 |
| 5013 | 2019-12-27 | 1.32 | 1.32 | 1.31 | 1.31 |
| 5014 | 2019-12-30 | 1.32 | 1.31 | 1.31 | 1.31 |
| 5015 | 2019-12-31 | 1.31 | 1.31 | 1.31 | 1.30 |

```{python}  
# Convert United Kingdom's dataframe to a windowed dataframe  
windowed\_df\_united\_kingdom = df\_to\_windowed\_df(data\_frame=df,   
 first\_date\_str="2000-01-06",  
 last\_date\_str="2019-12-31",  
 n=3,  
 col\_name="UNITED KINGDOM - UNITED KINGDOM POUND/US$")  
windowed\_df\_united\_kingdom  
```

|  | Target Date | Target-3 | Target-2 | Target-1 | Target |
| --- | --- | --- | --- | --- | --- |
| 0 | 2000-01-06 | 0.61 | 0.61 | 0.61 | 0.61 |
| 1 | 2000-01-07 | 0.61 | 0.61 | 0.61 | 0.61 |
| 2 | 2000-01-10 | 0.61 | 0.61 | 0.61 | 0.61 |
| 3 | 2000-01-11 | 0.61 | 0.61 | 0.61 | 0.61 |
| 4 | 2000-01-12 | 0.61 | 0.61 | 0.61 | 0.61 |
| ... | ... | ... | ... | ... | ... |
| 5011 | 2019-12-24 | 0.77 | 0.77 | 0.77 | 0.77 |
| 5012 | 2019-12-26 | 0.77 | 0.77 | 0.77 | 0.77 |
| 5013 | 2019-12-27 | 0.77 | 0.77 | 0.77 | 0.76 |
| 5014 | 2019-12-30 | 0.77 | 0.77 | 0.76 | 0.76 |
| 5015 | 2019-12-31 | 0.77 | 0.76 | 0.76 | 0.75 |

```{python}  
# Convert Switzerland's dataframe to a windowed dataframe  
windowed\_df\_switzerland = df\_to\_windowed\_df(data\_frame=df,   
 first\_date\_str="2000-01-06",  
 last\_date\_str="2019-12-31",  
 n=3,  
 col\_name="SWITZERLAND - FRANC/US$")  
windowed\_df\_switzerland  
```

|  | Target Date | Target-3 | Target-2 | Target-1 | Target |
| --- | --- | --- | --- | --- | --- |
| 0 | 2000-01-06 | 1.58 | 1.56 | 1.55 | 1.55 |
| 1 | 2000-01-07 | 1.56 | 1.55 | 1.55 | 1.56 |
| 2 | 2000-01-10 | 1.55 | 1.55 | 1.56 | 1.57 |
| 3 | 2000-01-11 | 1.55 | 1.56 | 1.57 | 1.56 |
| 4 | 2000-01-12 | 1.56 | 1.57 | 1.56 | 1.57 |
| ... | ... | ... | ... | ... | ... |
| 5011 | 2019-12-24 | 0.98 | 0.98 | 0.98 | 0.98 |
| 5012 | 2019-12-26 | 0.98 | 0.98 | 0.98 | 0.98 |
| 5013 | 2019-12-27 | 0.98 | 0.98 | 0.98 | 0.97 |
| 5014 | 2019-12-30 | 0.98 | 0.98 | 0.97 | 0.97 |
| 5015 | 2019-12-31 | 0.98 | 0.97 | 0.97 | 0.97 |

As the Machine Learning model that will be used later in this blog post only accepts numpy arrays, we need to extract each of the following quantities from each respective country’s dataframe: the dates as an np.array, the X-values for input as an 3-dimensional np.array, and the Y-values for output as an np.array. Thus, with some online references, our codebase now has a function called windowed\_df\_to\_date\_X\_y as shown below to account for this needed transformation.

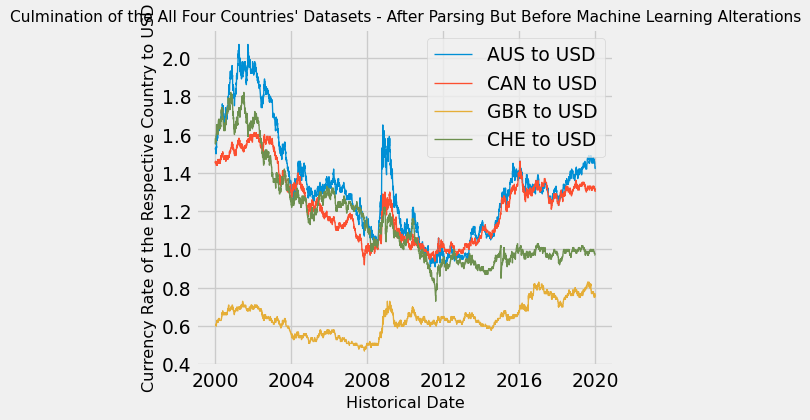
```{python}  
def windowed\_df\_to\_date\_X\_y(windowed\_dataframe: pd.DataFrame):  
 df\_as\_np = windowed\_dataframe.to\_numpy()  
   
 dates = df\_as\_np[:, 0]  
   
 middle\_matrix = df\_as\_np[:, 1:-1]  
 X = middle\_matrix.reshape((len(dates), middle\_matrix.shape[1], 1))  
 Y = df\_as\_np[:, -1]  
   
 return dates, X.astype(np.float32), Y.astype(np.float32)  
  
dates\_austrailia, X\_austrailia, y\_austrailia = windowed\_df\_to\_date\_X\_y(windowed\_dataframe=windowed\_df\_austrailia)  
dates\_canada, X\_canada, y\_canada = windowed\_df\_to\_date\_X\_y(windowed\_dataframe=windowed\_df\_canada)  
dates\_united\_kingdom, X\_united\_kingdom, y\_united\_kingdom = windowed\_df\_to\_date\_X\_y(windowed\_dataframe=windowed\_df\_united\_kingdom)  
dates\_switzerland, X\_switzerland, y\_switzerland = windowed\_df\_to\_date\_X\_y(windowed\_dataframe=windowed\_df\_switzerland)  
  
print(dates\_austrailia.shape, X\_austrailia.shape, y\_austrailia.shape)  
print(dates\_canada.shape, X\_canada.shape, y\_canada.shape)  
print(dates\_united\_kingdom.shape, X\_united\_kingdom.shape, y\_united\_kingdom.shape)  
print(dates\_switzerland.shape, X\_switzerland.shape, y\_switzerland.shape)  
len(windowed\_df\_austrailia), len(windowed\_df\_canada), len(windowed\_df\_united\_kingdom), len(windowed\_df\_switzerland)  
```

(5016,) (5016, 3, 1) (5016,)  
(5016,) (5016, 3, 1) (5016,)  
(5016,) (5016, 3, 1) (5016,)  
(5016,) (5016, 3, 1) (5016,)

(5016, 5016, 5016, 5016)

Here, I am trying to a visualization of the cleaned dataset before we pass it over for Machine Learning training and prediction. To show the rate of change for the International Currency Rates for Austrailia, Canada, the United Kingdom, and Switzerland over the 20-year period as collected in the data set, I put together a line graph as shown below.

```{python}  
# Plotting the each four countries currency rates (per US dollar) from   
# 2000 - 2020  
plt.plot(df.index, df["AUSTRALIA - AUSTRALIAN DOLLAR/US$"], label="AUS to USD", linewidth=1)  
plt.plot(df.index, df[ "CANADA - CANADIAN DOLLAR/US$"], label="CAN to USD", linewidth=1)  
plt.plot(df.index, df["UNITED KINGDOM - UNITED KINGDOM POUND/US$"], label="GBR to USD", linewidth=1)  
plt.plot(df.index, df["SWITZERLAND - FRANC/US$"], label="CHE to USD", linewidth=1)  
  
plt.legend(loc="upper right")  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date", fontsize=12)  
plt.ylabel("Currency Rate of the Respective Country to USD", fontsize=12)  
plt.title("Culmination of the All Four Countries' Datasets - After Parsing But Before Machine Learning Alterations")  
plt.show()  
```



## Machine Learning - Model Training and Evaluation

Great, now we are onto the Machine Learning part of the blog post!

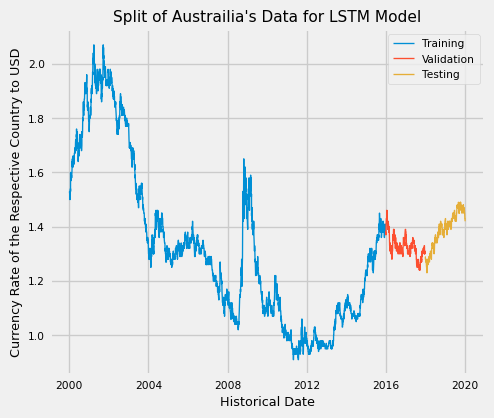
For this blog post, I worked to create Machine Learning models for each country’s dataset separately. I started with Austrailia’s data first (as shown below):

```{python}  
# Getting the location of the 80th and 90th percentile of the number of points   
# in the dataset for later train, vailidation, and test category splitting  
percentile\_80 = int(len(windowed\_df\_austrailia) \* 0.8)  
percentile\_90 = int(len(windowed\_df\_austrailia) \* 0.9)  
percentile\_80, percentile\_90  
```

(4012, 4514)

Since the data (date, X, and y) is split into three np.arrays and to be more efficient, I will manually split Austrailia’s data into train, test, and validation datasets for the Machine Learning model with 80% going to the training dataset, the next 10% going to the validation dataset, and the last 10% going to the test dataset for each np.array respectively. This split should be acceptable because I did not mix-and-match training & validation datasets with my testing datasets, wihch would invalidate my entire Machine Learning model. Additionally, looking at the presented in the validation and testing datasets, the range of these respective datasets have been reached before in my training dataset, meaning I anticipated my model should be able to reasonably predict these expected ranges with considerable accuracy.

```{python}  
# Splitting Austrailia's data into train, test, and validation sets on 3   
# mediums: the X-axis, the y-axis, and the indices (represented by dates)  
dates\_austrailia\_train, X\_austrailia\_train, y\_austrailia\_train = dates\_austrailia[:percentile\_80], X\_austrailia[:percentile\_80], y\_austrailia[:percentile\_80]  
dates\_austrailia\_val, X\_austrailia\_val, y\_austrailia\_val = dates\_austrailia[percentile\_80:percentile\_90], X\_austrailia[percentile\_80:percentile\_90], y\_austrailia[percentile\_80:percentile\_90]  
dates\_austrailia\_test, X\_austrailia\_test, y\_austrailia\_test = dates\_austrailia[percentile\_90:], X\_austrailia[percentile\_90:], y\_austrailia[percentile\_90:]  
  
plt.plot(dates\_austrailia\_train, y\_austrailia\_train, linewidth=1)  
plt.plot(dates\_austrailia\_val, y\_austrailia\_val, linewidth=1)  
plt.plot(dates\_austrailia\_test, y\_austrailia\_test, linewidth=1)  
  
plt.legend(["Training", "Validation", "Testing"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Split of Austrailia's Data for LSTM Model")  
plt.show()  
```



Now, I began to configure the Machine Learning model. We added Sequential layers: an Input layer 3 by 1 because we will have 3 np.arrays of Input and 1 np.array as output, utilize a LSTM (Long Short-Term Memory) layer of 64 neurons, apply 2 levels of dense layers with 32 neurons and folliowing recommendations online to use the RELU (Rectified Linear Unit) Activiation Function, and I followed up with one last dense layer of 1 neuron as our output layer since we are just trying to linearly-predict the next currency-rate on a near-future date. Once I configured the Sequential layers, we are ready to compile the model, utilzing the mean\_square\_error as our minimizing loss function, using the Adam optimizer, and comparing our trained model against our data with the mean\_absolute\_error metric. Lastly, I fitted our model, utilzing our X\_train and Y\_train datasets for fitting with validation from our X\_valid and Y\_valid datasets at 100 epochs.

```{python}  
# Configuring the Machine Learning Tensorflow Model for Austrailia  
austrailia\_model = Sequential([layers.Input((3, 1)),  
 layers.LSTM(64),  
 layers.Dense(32, activation="relu"),  
 layers.Dense(32, activation="relu"),  
 layers.Dense(1)])  
  
austrailia\_model.compile(loss="mse",  
 optimizer=Adam(learning\_rate=0.001),  
 metrics=["mean\_absolute\_error"])  
  
austrailia\_model.fit(X\_austrailia\_train, y\_austrailia\_train, validation\_data=(X\_austrailia\_val, y\_austrailia\_val), epochs=100)  
```

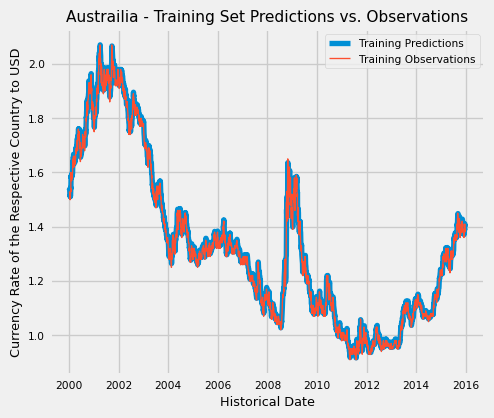
Epoch 1/100  
 1/126 [..............................] - ETA: 3:36 - loss: 1.6578 - mean\_absolute\_error: 1.2592 23/126 [====>.........................] - ETA: 0s - loss: 0.9918 - mean\_absolute\_error: 0.9277 46/126 [=========>....................] - ETA: 0s - loss: 0.5156 - mean\_absolute\_error: 0.5489 70/126 [===============>..............] - ETA: 0s - loss: 0.3424 - mean\_absolute\_error: 0.3870 94/126 [=====================>........] - ETA: 0s - loss: 0.2563 - mean\_absolute\_error: 0.3034118/126 [===========================>..] - ETA: 0s - loss: 0.2049 - mean\_absolute\_error: 0.2523126/126 [==============================] - 2s 5ms/step - loss: 0.1931 - mean\_absolute\_error: 0.2404 - val\_loss: 4.9893e-04 - val\_mean\_absolute\_error: 0.0198  
Epoch 2/100  
 1/126 [..............................] - ETA: 0s - loss: 0.0044 - mean\_absolute\_error: 0.0567 25/126 [====>.........................] - ETA: 0s - loss: 0.0029 - mean\_absolute\_error: 0.0451 50/126 [==========>...................] - ETA: 0s - loss: 0.0025 - mean\_absolute\_error: 0.0424 74/126 [================>.............] - ETA: 0s - loss: 0.0022 - mean\_absolute\_error: 0.0394 97/126 [======================>.......] - ETA: 0s - loss: 0.0020 - mean\_absolute\_error: 0.0366122/126 [============================>.] - ETA: 0s - loss: 0.0017 - mean\_absolute\_error: 0.0340126/126 [==============================] - 0s 2ms/step - loss: 0.0017 - mean\_absolute\_error: 0.0337 - val\_loss: 1.7471e-04 - val\_mean\_absolute\_error: 0.0109  
Epoch 3/100  
 1/126 [..............................] - ETA: 0s - loss: 5.4396e-04 - mean\_absolute\_error: 0.0190 26/126 [=====>........................] - ETA: 0s - loss: 5.6269e-04 - mean\_absolute\_error: 0.0188 50/126 [==========>...................] - ETA: 0s - loss: 5.0604e-04 - mean\_absolute\_error: 0.0179 75/126 [================>.............] - ETA: 0s - loss: 4.6092e-04 - mean\_absolute\_error: 0.0169100/126 [======================>.......] - ETA: 0s - loss: 4.2540e-04 - mean\_absolute\_error: 0.0161123/126 [============================>.] - ETA: 0s - loss: 4.0285e-04 - mean\_absolute\_error: 0.0156126/126 [==============================] - 0s 2ms/step - loss: 3.9954e-04 - mean\_absolute\_error: 0.0155 - val\_loss: 1.2188e-04 - val\_mean\_absolute\_error: 0.0086  
Epoch 4/100  
 1/126 [..............................] - ETA: 0s - loss: 2.7198e-04 - mean\_absolute\_error: 0.0134 26/126 [=====>........................] - ETA: 0s - loss: 2.7937e-04 - mean\_absolute\_error: 0.0123 51/126 [===========>..................] - ETA: 0s - loss: 2.6162e-04 - mean\_absolute\_error: 0.0119 75/126 [================>.............] - ETA: 0s - loss: 2.7198e-04 - mean\_absolute\_error: 0.0120 99/126 [======================>.......] - ETA: 0s - loss: 2.6613e-04 - mean\_absolute\_error: 0.0120123/126 [============================>.] - ETA: 0s - loss: 2.5787e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 2ms/step - loss: 2.6188e-04 - mean\_absolute\_error: 0.0118 - val\_loss: 1.6560e-04 - val\_mean\_absolute\_error: 0.0101  
Epoch 5/100  
 1/126 [..............................] - ETA: 0s - loss: 2.5996e-04 - mean\_absolute\_error: 0.0129 25/126 [====>.........................] - ETA: 0s - loss: 2.4735e-04 - mean\_absolute\_error: 0.0117 49/126 [==========>...................] - ETA: 0s - loss: 2.5188e-04 - mean\_absolute\_error: 0.0117 73/126 [================>.............] - ETA: 0s - loss: 2.6393e-04 - mean\_absolute\_error: 0.0118 97/126 [======================>.......] - ETA: 0s - loss: 2.7070e-04 - mean\_absolute\_error: 0.0119121/126 [===========================>..] - ETA: 0s - loss: 2.6230e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 2ms/step - loss: 2.5953e-04 - mean\_absolute\_error: 0.0117 - val\_loss: 1.8537e-04 - val\_mean\_absolute\_error: 0.0108  
Epoch 6/100  
 1/126 [..............................] - ETA: 0s - loss: 2.1665e-04 - mean\_absolute\_error: 0.0110 26/126 [=====>........................] - ETA: 0s - loss: 3.2367e-04 - mean\_absolute\_error: 0.0126 51/126 [===========>..................] - ETA: 0s - loss: 2.9981e-04 - mean\_absolute\_error: 0.0124 70/126 [===============>..............] - ETA: 0s - loss: 2.8705e-04 - mean\_absolute\_error: 0.0122 91/126 [====================>.........] - ETA: 0s - loss: 2.8072e-04 - mean\_absolute\_error: 0.0121115/126 [==========================>...] - ETA: 0s - loss: 2.6672e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 3ms/step - loss: 2.6473e-04 - mean\_absolute\_error: 0.0118 - val\_loss: 1.5024e-04 - val\_mean\_absolute\_error: 0.0096  
Epoch 7/100  
 1/126 [..............................] - ETA: 0s - loss: 2.8578e-04 - mean\_absolute\_error: 0.0133 25/126 [====>.........................] - ETA: 0s - loss: 2.5997e-04 - mean\_absolute\_error: 0.0118 49/126 [==========>...................] - ETA: 0s - loss: 2.3604e-04 - mean\_absolute\_error: 0.0114 74/126 [================>.............] - ETA: 0s - loss: 2.3960e-04 - mean\_absolute\_error: 0.0114 99/126 [======================>.......] - ETA: 0s - loss: 2.4825e-04 - mean\_absolute\_error: 0.0115123/126 [============================>.] - ETA: 0s - loss: 2.5678e-04 - mean\_absolute\_error: 0.0115126/126 [==============================] - 0s 2ms/step - loss: 2.5518e-04 - mean\_absolute\_error: 0.0115 - val\_loss: 1.3003e-04 - val\_mean\_absolute\_error: 0.0088  
Epoch 8/100  
 1/126 [..............................] - ETA: 0s - loss: 4.0438e-04 - mean\_absolute\_error: 0.0148 25/126 [====>.........................] - ETA: 0s - loss: 3.1952e-04 - mean\_absolute\_error: 0.0126 49/126 [==========>...................] - ETA: 0s - loss: 2.8796e-04 - mean\_absolute\_error: 0.0119 73/126 [================>.............] - ETA: 0s - loss: 2.7687e-04 - mean\_absolute\_error: 0.0118 98/126 [======================>.......] - ETA: 0s - loss: 2.7104e-04 - mean\_absolute\_error: 0.0118122/126 [============================>.] - ETA: 0s - loss: 2.5847e-04 - mean\_absolute\_error: 0.0116126/126 [==============================] - 0s 2ms/step - loss: 2.5631e-04 - mean\_absolute\_error: 0.0116 - val\_loss: 1.4818e-04 - val\_mean\_absolute\_error: 0.0095  
Epoch 9/100  
 1/126 [..............................] - ETA: 0s - loss: 1.7522e-04 - mean\_absolute\_error: 0.0101 24/126 [====>.........................] - ETA: 0s - loss: 2.4113e-04 - mean\_absolute\_error: 0.0114 48/126 [==========>...................] - ETA: 0s - loss: 2.5588e-04 - mean\_absolute\_error: 0.0115 72/126 [================>.............] - ETA: 0s - loss: 2.4593e-04 - mean\_absolute\_error: 0.0114 96/126 [=====================>........] - ETA: 0s - loss: 2.5154e-04 - mean\_absolute\_error: 0.0114120/126 [===========================>..] - ETA: 0s - loss: 2.5654e-04 - mean\_absolute\_error: 0.0115126/126 [==============================] - 0s 2ms/step - loss: 2.5414e-04 - mean\_absolute\_error: 0.0115 - val\_loss: 1.2115e-04 - val\_mean\_absolute\_error: 0.0086  
Epoch 10/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0498e-04 - mean\_absolute\_error: 0.0113 24/126 [====>.........................] - ETA: 0s - loss: 2.8895e-04 - mean\_absolute\_error: 0.0119 48/126 [==========>...................] - ETA: 0s - loss: 2.6773e-04 - mean\_absolute\_error: 0.0120 72/126 [================>.............] - ETA: 0s - loss: 2.6510e-04 - mean\_absolute\_error: 0.0118 96/126 [=====================>........] - ETA: 0s - loss: 2.5838e-04 - mean\_absolute\_error: 0.0117120/126 [===========================>..] - ETA: 0s - loss: 2.5582e-04 - mean\_absolute\_error: 0.0116126/126 [==============================] - 0s 2ms/step - loss: 2.5736e-04 - mean\_absolute\_error: 0.0116 - val\_loss: 1.3137e-04 - val\_mean\_absolute\_error: 0.0092  
Epoch 11/100  
 1/126 [..............................] - ETA: 0s - loss: 3.4319e-04 - mean\_absolute\_error: 0.0155 24/126 [====>.........................] - ETA: 0s - loss: 3.0335e-04 - mean\_absolute\_error: 0.0130 48/126 [==========>...................] - ETA: 0s - loss: 2.8943e-04 - mean\_absolute\_error: 0.0123 71/126 [===============>..............] - ETA: 0s - loss: 2.7760e-04 - mean\_absolute\_error: 0.0121 95/126 [=====================>........] - ETA: 0s - loss: 2.6993e-04 - mean\_absolute\_error: 0.0119119/126 [===========================>..] - ETA: 0s - loss: 2.6620e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 2ms/step - loss: 2.6348e-04 - mean\_absolute\_error: 0.0118 - val\_loss: 1.3532e-04 - val\_mean\_absolute\_error: 0.0090  
Epoch 12/100  
 1/126 [..............................] - ETA: 0s - loss: 1.8568e-04 - mean\_absolute\_error: 0.0113 25/126 [====>.........................] - ETA: 0s - loss: 2.4931e-04 - mean\_absolute\_error: 0.0117 49/126 [==========>...................] - ETA: 0s - loss: 2.5839e-04 - mean\_absolute\_error: 0.0118 73/126 [================>.............] - ETA: 0s - loss: 2.4594e-04 - mean\_absolute\_error: 0.0115 96/126 [=====================>........] - ETA: 0s - loss: 2.5352e-04 - mean\_absolute\_error: 0.0115121/126 [===========================>..] - ETA: 0s - loss: 2.4770e-04 - mean\_absolute\_error: 0.0114126/126 [==============================] - 0s 2ms/step - loss: 2.5350e-04 - mean\_absolute\_error: 0.0115 - val\_loss: 1.2963e-04 - val\_mean\_absolute\_error: 0.0091  
Epoch 13/100  
 1/126 [..............................] - ETA: 0s - loss: 4.2144e-04 - mean\_absolute\_error: 0.0153 25/126 [====>.........................] - ETA: 0s - loss: 2.6567e-04 - mean\_absolute\_error: 0.0122 50/126 [==========>...................] - ETA: 0s - loss: 2.7248e-04 - mean\_absolute\_error: 0.0119 74/126 [================>.............] - ETA: 0s - loss: 2.6482e-04 - mean\_absolute\_error: 0.0116 98/126 [======================>.......] - ETA: 0s - loss: 2.5949e-04 - mean\_absolute\_error: 0.0115121/126 [===========================>..] - ETA: 0s - loss: 2.5716e-04 - mean\_absolute\_error: 0.0115126/126 [==============================] - 0s 2ms/step - loss: 2.5688e-04 - mean\_absolute\_error: 0.0115 - val\_loss: 1.5432e-04 - val\_mean\_absolute\_error: 0.0097  
Epoch 14/100  
 1/126 [..............................] - ETA: 0s - loss: 1.7873e-04 - mean\_absolute\_error: 0.0100 25/126 [====>.........................] - ETA: 0s - loss: 2.3951e-04 - mean\_absolute\_error: 0.0116 49/126 [==========>...................] - ETA: 0s - loss: 2.6646e-04 - mean\_absolute\_error: 0.0119 73/126 [================>.............] - ETA: 0s - loss: 2.6083e-04 - mean\_absolute\_error: 0.0119 96/126 [=====================>........] - ETA: 0s - loss: 2.6315e-04 - mean\_absolute\_error: 0.0118120/126 [===========================>..] - ETA: 0s - loss: 2.6038e-04 - mean\_absolute\_error: 0.0117126/126 [==============================] - 0s 2ms/step - loss: 2.6197e-04 - mean\_absolute\_error: 0.0117 - val\_loss: 1.2492e-04 - val\_mean\_absolute\_error: 0.0087  
Epoch 15/100  
 1/126 [..............................] - ETA: 0s - loss: 3.1282e-04 - mean\_absolute\_error: 0.0147 25/126 [====>.........................] - ETA: 0s - loss: 2.9619e-04 - mean\_absolute\_error: 0.0123 50/126 [==========>...................] - ETA: 0s - loss: 2.8673e-04 - mean\_absolute\_error: 0.0120 75/126 [================>.............] - ETA: 0s - loss: 2.7933e-04 - mean\_absolute\_error: 0.0121 99/126 [======================>.......] - ETA: 0s - loss: 2.6618e-04 - mean\_absolute\_error: 0.0118123/126 [============================>.] - ETA: 0s - loss: 2.5414e-04 - mean\_absolute\_error: 0.0115126/126 [==============================] - 0s 2ms/step - loss: 2.5383e-04 - mean\_absolute\_error: 0.0116 - val\_loss: 1.3747e-04 - val\_mean\_absolute\_error: 0.0091  
Epoch 16/100  
 1/126 [..............................] - ETA: 0s - loss: 3.7034e-04 - mean\_absolute\_error: 0.0139 25/126 [====>.........................] - ETA: 0s - loss: 2.2456e-04 - mean\_absolute\_error: 0.0112 49/126 [==========>...................] - ETA: 0s - loss: 2.7239e-04 - mean\_absolute\_error: 0.0116 73/126 [================>.............] - ETA: 0s - loss: 2.6027e-04 - mean\_absolute\_error: 0.0115 97/126 [======================>.......] - ETA: 0s - loss: 2.6050e-04 - mean\_absolute\_error: 0.0116121/126 [===========================>..] - ETA: 0s - loss: 2.5820e-04 - mean\_absolute\_error: 0.0117126/126 [==============================] - 0s 2ms/step - loss: 2.5798e-04 - mean\_absolute\_error: 0.0116 - val\_loss: 1.3889e-04 - val\_mean\_absolute\_error: 0.0092  
Epoch 17/100  
 1/126 [..............................] - ETA: 0s - loss: 2.2704e-04 - mean\_absolute\_error: 0.0110 26/126 [=====>........................] - ETA: 0s - loss: 2.3536e-04 - mean\_absolute\_error: 0.0110 50/126 [==========>...................] - ETA: 0s - loss: 2.4801e-04 - mean\_absolute\_error: 0.0114 74/126 [================>.............] - ETA: 0s - loss: 2.3968e-04 - mean\_absolute\_error: 0.0114 98/126 [======================>.......] - ETA: 0s - loss: 2.4101e-04 - mean\_absolute\_error: 0.0113122/126 [============================>.] - ETA: 0s - loss: 2.5108e-04 - mean\_absolute\_error: 0.0114126/126 [==============================] - 0s 2ms/step - loss: 2.4943e-04 - mean\_absolute\_error: 0.0114 - val\_loss: 1.3948e-04 - val\_mean\_absolute\_error: 0.0092  
Epoch 18/100  
 1/126 [..............................] - ETA: 0s - loss: 3.6787e-04 - mean\_absolute\_error: 0.0127 25/126 [====>.........................] - ETA: 0s - loss: 2.5078e-04 - mean\_absolute\_error: 0.0115 49/126 [==========>...................] - ETA: 0s - loss: 2.3405e-04 - mean\_absolute\_error: 0.0113 73/126 [================>.............] - ETA: 0s - loss: 2.5037e-04 - mean\_absolute\_error: 0.0114 97/126 [======================>.......] - ETA: 0s - loss: 2.4987e-04 - mean\_absolute\_error: 0.0115121/126 [===========================>..] - ETA: 0s - loss: 2.5342e-04 - mean\_absolute\_error: 0.0115126/126 [==============================] - 0s 2ms/step - loss: 2.5667e-04 - mean\_absolute\_error: 0.0116 - val\_loss: 1.5859e-04 - val\_mean\_absolute\_error: 0.0098  
Epoch 19/100  
 1/126 [..............................] - ETA: 0s - loss: 2.2403e-04 - mean\_absolute\_error: 0.0115 26/126 [=====>........................] - ETA: 0s - loss: 2.3344e-04 - mean\_absolute\_error: 0.0112 50/126 [==========>...................] - ETA: 0s - loss: 2.4853e-04 - mean\_absolute\_error: 0.0116 75/126 [================>.............] - ETA: 0s - loss: 2.6329e-04 - mean\_absolute\_error: 0.0117 99/126 [======================>.......] - ETA: 0s - loss: 2.6353e-04 - mean\_absolute\_error: 0.0115123/126 [============================>.] - ETA: 0s - loss: 2.5323e-04 - mean\_absolute\_error: 0.0114126/126 [==============================] - 0s 2ms/step - loss: 2.5323e-04 - mean\_absolute\_error: 0.0114 - val\_loss: 1.2973e-04 - val\_mean\_absolute\_error: 0.0088  
Epoch 20/100  
 1/126 [..............................] - ETA: 0s - loss: 2.7380e-04 - mean\_absolute\_error: 0.0115 25/126 [====>.........................] - ETA: 0s - loss: 2.8015e-04 - mean\_absolute\_error: 0.0124 50/126 [==========>...................] - ETA: 0s - loss: 2.7831e-04 - mean\_absolute\_error: 0.0123 74/126 [================>.............] - ETA: 0s - loss: 2.8001e-04 - mean\_absolute\_error: 0.0123 98/126 [======================>.......] - ETA: 0s - loss: 2.8149e-04 - mean\_absolute\_error: 0.0123122/126 [============================>.] - ETA: 0s - loss: 2.7726e-04 - mean\_absolute\_error: 0.0122126/126 [==============================] - 0s 2ms/step - loss: 2.7490e-04 - mean\_absolute\_error: 0.0121 - val\_loss: 1.5618e-04 - val\_mean\_absolute\_error: 0.0098  
Epoch 21/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1779e-04 - mean\_absolute\_error: 0.0085 25/126 [====>.........................] - ETA: 0s - loss: 2.5389e-04 - mean\_absolute\_error: 0.0115 49/126 [==========>...................] - ETA: 0s - loss: 2.3086e-04 - mean\_absolute\_error: 0.0112 73/126 [================>.............] - ETA: 0s - loss: 2.4287e-04 - mean\_absolute\_error: 0.0113 97/126 [======================>.......] - ETA: 0s - loss: 2.7468e-04 - mean\_absolute\_error: 0.0120121/126 [===========================>..] - ETA: 0s - loss: 2.8654e-04 - mean\_absolute\_error: 0.0124126/126 [==============================] - 0s 2ms/step - loss: 2.8595e-04 - mean\_absolute\_error: 0.0124 - val\_loss: 1.7959e-04 - val\_mean\_absolute\_error: 0.0106  
Epoch 22/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0275e-04 - mean\_absolute\_error: 0.0112 25/126 [====>.........................] - ETA: 0s - loss: 2.3648e-04 - mean\_absolute\_error: 0.0109 48/126 [==========>...................] - ETA: 0s - loss: 2.5772e-04 - mean\_absolute\_error: 0.0112 72/126 [================>.............] - ETA: 0s - loss: 2.5008e-04 - mean\_absolute\_error: 0.0113 96/126 [=====================>........] - ETA: 0s - loss: 2.5172e-04 - mean\_absolute\_error: 0.0114120/126 [===========================>..] - ETA: 0s - loss: 2.5621e-04 - mean\_absolute\_error: 0.0115126/126 [==============================] - 0s 2ms/step - loss: 2.5413e-04 - mean\_absolute\_error: 0.0115 - val\_loss: 2.2917e-04 - val\_mean\_absolute\_error: 0.0122  
Epoch 23/100  
 1/126 [..............................] - ETA: 0s - loss: 2.9482e-04 - mean\_absolute\_error: 0.0130 23/126 [====>.........................] - ETA: 0s - loss: 2.2725e-04 - mean\_absolute\_error: 0.0115 47/126 [==========>...................] - ETA: 0s - loss: 2.3555e-04 - mean\_absolute\_error: 0.0115 71/126 [===============>..............] - ETA: 0s - loss: 2.4603e-04 - mean\_absolute\_error: 0.0118 95/126 [=====================>........] - ETA: 0s - loss: 2.6185e-04 - mean\_absolute\_error: 0.0118119/126 [===========================>..] - ETA: 0s - loss: 2.6203e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 2ms/step - loss: 2.5916e-04 - mean\_absolute\_error: 0.0117 - val\_loss: 1.1977e-04 - val\_mean\_absolute\_error: 0.0085  
Epoch 24/100  
 1/126 [..............................] - ETA: 0s - loss: 5.0102e-04 - mean\_absolute\_error: 0.0123 25/126 [====>.........................] - ETA: 0s - loss: 2.3276e-04 - mean\_absolute\_error: 0.0112 49/126 [==========>...................] - ETA: 0s - loss: 2.3116e-04 - mean\_absolute\_error: 0.0109 73/126 [================>.............] - ETA: 0s - loss: 2.4593e-04 - mean\_absolute\_error: 0.0113 95/126 [=====================>........] - ETA: 0s - loss: 2.6574e-04 - mean\_absolute\_error: 0.0117120/126 [===========================>..] - ETA: 0s - loss: 2.6071e-04 - mean\_absolute\_error: 0.0117126/126 [==============================] - 0s 2ms/step - loss: 2.6566e-04 - mean\_absolute\_error: 0.0117 - val\_loss: 2.6701e-04 - val\_mean\_absolute\_error: 0.0135  
Epoch 25/100  
 1/126 [..............................] - ETA: 0s - loss: 3.6337e-04 - mean\_absolute\_error: 0.0148 25/126 [====>.........................] - ETA: 0s - loss: 2.2764e-04 - mean\_absolute\_error: 0.0115 48/126 [==========>...................] - ETA: 0s - loss: 2.6566e-04 - mean\_absolute\_error: 0.0117 71/126 [===============>..............] - ETA: 0s - loss: 2.5937e-04 - mean\_absolute\_error: 0.0117 95/126 [=====================>........] - ETA: 0s - loss: 2.6659e-04 - mean\_absolute\_error: 0.0118118/126 [===========================>..] - ETA: 0s - loss: 2.7563e-04 - mean\_absolute\_error: 0.0121126/126 [==============================] - 0s 3ms/step - loss: 2.7143e-04 - mean\_absolute\_error: 0.0120 - val\_loss: 1.2958e-04 - val\_mean\_absolute\_error: 0.0088  
Epoch 26/100  
 1/126 [..............................] - ETA: 0s - loss: 2.3540e-04 - mean\_absolute\_error: 0.0108 25/126 [====>.........................] - ETA: 0s - loss: 2.6741e-04 - mean\_absolute\_error: 0.0118 49/126 [==========>...................] - ETA: 0s - loss: 2.4181e-04 - mean\_absolute\_error: 0.0111 72/126 [================>.............] - ETA: 0s - loss: 2.4891e-04 - mean\_absolute\_error: 0.0112 95/126 [=====================>........] - ETA: 0s - loss: 2.4640e-04 - mean\_absolute\_error: 0.0112118/126 [===========================>..] - ETA: 0s - loss: 2.5134e-04 - mean\_absolute\_error: 0.0114126/126 [==============================] - 0s 2ms/step - loss: 2.5609e-04 - mean\_absolute\_error: 0.0115 - val\_loss: 1.2355e-04 - val\_mean\_absolute\_error: 0.0089  
Epoch 27/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2484e-04 - mean\_absolute\_error: 0.0091 25/126 [====>.........................] - ETA: 0s - loss: 3.1988e-04 - mean\_absolute\_error: 0.0130 48/126 [==========>...................] - ETA: 0s - loss: 2.8756e-04 - mean\_absolute\_error: 0.0120 71/126 [===============>..............] - ETA: 0s - loss: 2.6812e-04 - mean\_absolute\_error: 0.0117 95/126 [=====================>........] - ETA: 0s - loss: 2.6072e-04 - mean\_absolute\_error: 0.0117119/126 [===========================>..] - ETA: 0s - loss: 2.5404e-04 - mean\_absolute\_error: 0.0115126/126 [==============================] - 0s 2ms/step - loss: 2.5926e-04 - mean\_absolute\_error: 0.0116 - val\_loss: 3.2059e-04 - val\_mean\_absolute\_error: 0.0154  
Epoch 28/100  
 1/126 [..............................] - ETA: 0s - loss: 6.7902e-04 - mean\_absolute\_error: 0.0208 25/126 [====>.........................] - ETA: 0s - loss: 2.2352e-04 - mean\_absolute\_error: 0.0111 49/126 [==========>...................] - ETA: 0s - loss: 2.3631e-04 - mean\_absolute\_error: 0.0112 73/126 [================>.............] - ETA: 0s - loss: 2.6594e-04 - mean\_absolute\_error: 0.0121 96/126 [=====================>........] - ETA: 0s - loss: 2.7367e-04 - mean\_absolute\_error: 0.0120119/126 [===========================>..] - ETA: 0s - loss: 2.6607e-04 - mean\_absolute\_error: 0.0117126/126 [==============================] - 0s 2ms/step - loss: 2.6471e-04 - mean\_absolute\_error: 0.0118 - val\_loss: 1.2765e-04 - val\_mean\_absolute\_error: 0.0087  
Epoch 29/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0407e-04 - mean\_absolute\_error: 0.0077 25/126 [====>.........................] - ETA: 0s - loss: 2.8085e-04 - mean\_absolute\_error: 0.0112 48/126 [==========>...................] - ETA: 0s - loss: 2.9216e-04 - mean\_absolute\_error: 0.0115 71/126 [===============>..............] - ETA: 0s - loss: 2.6509e-04 - mean\_absolute\_error: 0.0113 95/126 [=====================>........] - ETA: 0s - loss: 2.6809e-04 - mean\_absolute\_error: 0.0117118/126 [===========================>..] - ETA: 0s - loss: 2.6177e-04 - mean\_absolute\_error: 0.0116126/126 [==============================] - 0s 3ms/step - loss: 2.6038e-04 - mean\_absolute\_error: 0.0117 - val\_loss: 1.2415e-04 - val\_mean\_absolute\_error: 0.0089  
Epoch 30/100  
 1/126 [..............................] - ETA: 0s - loss: 2.7806e-04 - mean\_absolute\_error: 0.0133 25/126 [====>.........................] - ETA: 0s - loss: 2.6948e-04 - mean\_absolute\_error: 0.0121 49/126 [==========>...................] - ETA: 0s - loss: 2.3228e-04 - mean\_absolute\_error: 0.0112 73/126 [================>.............] - ETA: 0s - loss: 2.4712e-04 - mean\_absolute\_error: 0.0114 97/126 [======================>.......] - ETA: 0s - loss: 2.5299e-04 - mean\_absolute\_error: 0.0115121/126 [===========================>..] - ETA: 0s - loss: 2.5999e-04 - mean\_absolute\_error: 0.0116126/126 [==============================] - 0s 2ms/step - loss: 2.6119e-04 - mean\_absolute\_error: 0.0117 - val\_loss: 1.9186e-04 - val\_mean\_absolute\_error: 0.0110  
Epoch 31/100  
 1/126 [..............................] - ETA: 0s - loss: 7.9435e-04 - mean\_absolute\_error: 0.0157 25/126 [====>.........................] - ETA: 0s - loss: 3.0047e-04 - mean\_absolute\_error: 0.0124 49/126 [==========>...................] - ETA: 0s - loss: 2.7068e-04 - mean\_absolute\_error: 0.0120 72/126 [================>.............] - ETA: 0s - loss: 2.7275e-04 - mean\_absolute\_error: 0.0120 96/126 [=====================>........] - ETA: 0s - loss: 2.6296e-04 - mean\_absolute\_error: 0.0118119/126 [===========================>..] - ETA: 0s - loss: 2.6151e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 2ms/step - loss: 2.6015e-04 - mean\_absolute\_error: 0.0118 - val\_loss: 1.4365e-04 - val\_mean\_absolute\_error: 0.0097  
Epoch 32/100  
 1/126 [..............................] - ETA: 0s - loss: 4.2832e-04 - mean\_absolute\_error: 0.0141 24/126 [====>.........................] - ETA: 0s - loss: 2.5574e-04 - mean\_absolute\_error: 0.0115 48/126 [==========>...................] - ETA: 0s - loss: 2.5558e-04 - mean\_absolute\_error: 0.0119 72/126 [================>.............] - ETA: 0s - loss: 2.5656e-04 - mean\_absolute\_error: 0.0119 96/126 [=====================>........] - ETA: 0s - loss: 2.4862e-04 - mean\_absolute\_error: 0.0117120/126 [===========================>..] - ETA: 0s - loss: 2.6894e-04 - mean\_absolute\_error: 0.0120126/126 [==============================] - 0s 2ms/step - loss: 2.6960e-04 - mean\_absolute\_error: 0.0120 - val\_loss: 1.3019e-04 - val\_mean\_absolute\_error: 0.0088  
Epoch 33/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6449e-04 - mean\_absolute\_error: 0.0097 25/126 [====>.........................] - ETA: 0s - loss: 2.5031e-04 - mean\_absolute\_error: 0.0116 49/126 [==========>...................] - ETA: 0s - loss: 2.3484e-04 - mean\_absolute\_error: 0.0112 73/126 [================>.............] - ETA: 0s - loss: 2.5244e-04 - mean\_absolute\_error: 0.0117 97/126 [======================>.......] - ETA: 0s - loss: 2.5193e-04 - mean\_absolute\_error: 0.0116121/126 [===========================>..] - ETA: 0s - loss: 2.5987e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 2ms/step - loss: 2.5893e-04 - mean\_absolute\_error: 0.0118 - val\_loss: 1.3538e-04 - val\_mean\_absolute\_error: 0.0091  
Epoch 34/100  
 1/126 [..............................] - ETA: 0s - loss: 3.0835e-04 - mean\_absolute\_error: 0.0121 26/126 [=====>........................] - ETA: 0s - loss: 3.3682e-04 - mean\_absolute\_error: 0.0133 48/126 [==========>...................] - ETA: 0s - loss: 3.5761e-04 - mean\_absolute\_error: 0.0141 72/126 [================>.............] - ETA: 0s - loss: 3.2164e-04 - mean\_absolute\_error: 0.0133 96/126 [=====================>........] - ETA: 0s - loss: 3.0622e-04 - mean\_absolute\_error: 0.0130120/126 [===========================>..] - ETA: 0s - loss: 2.9843e-04 - mean\_absolute\_error: 0.0127126/126 [==============================] - 0s 2ms/step - loss: 2.9517e-04 - mean\_absolute\_error: 0.0126 - val\_loss: 1.2623e-04 - val\_mean\_absolute\_error: 0.0087  
Epoch 35/100  
 1/126 [..............................] - ETA: 0s - loss: 6.8424e-04 - mean\_absolute\_error: 0.0116 25/126 [====>.........................] - ETA: 0s - loss: 2.7772e-04 - mean\_absolute\_error: 0.0114 49/126 [==========>...................] - ETA: 0s - loss: 2.9920e-04 - mean\_absolute\_error: 0.0120 74/126 [================>.............] - ETA: 0s - loss: 2.7010e-04 - mean\_absolute\_error: 0.0117 98/126 [======================>.......] - ETA: 0s - loss: 2.6095e-04 - mean\_absolute\_error: 0.0116121/126 [===========================>..] - ETA: 0s - loss: 2.5337e-04 - mean\_absolute\_error: 0.0114126/126 [==============================] - 0s 2ms/step - loss: 2.5397e-04 - mean\_absolute\_error: 0.0115 - val\_loss: 1.4791e-04 - val\_mean\_absolute\_error: 0.0095  
Epoch 36/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2770e-04 - mean\_absolute\_error: 0.0090 25/126 [====>.........................] - ETA: 0s - loss: 2.6284e-04 - mean\_absolute\_error: 0.0124 48/126 [==========>...................] - ETA: 0s - loss: 2.6712e-04 - mean\_absolute\_error: 0.0121 72/126 [================>.............] - ETA: 0s - loss: 2.6394e-04 - mean\_absolute\_error: 0.0120 96/126 [=====================>........] - ETA: 0s - loss: 2.7864e-04 - mean\_absolute\_error: 0.0123120/126 [===========================>..] - ETA: 0s - loss: 2.7750e-04 - mean\_absolute\_error: 0.0122126/126 [==============================] - 0s 2ms/step - loss: 2.7640e-04 - mean\_absolute\_error: 0.0122 - val\_loss: 1.7063e-04 - val\_mean\_absolute\_error: 0.0103  
Epoch 37/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9225e-04 - mean\_absolute\_error: 0.0089 25/126 [====>.........................] - ETA: 0s - loss: 3.6547e-04 - mean\_absolute\_error: 0.0139 49/126 [==========>...................] - ETA: 0s - loss: 3.3896e-04 - mean\_absolute\_error: 0.0132 73/126 [================>.............] - ETA: 0s - loss: 3.1696e-04 - mean\_absolute\_error: 0.0130 97/126 [======================>.......] - ETA: 0s - loss: 2.9437e-04 - mean\_absolute\_error: 0.0124120/126 [===========================>..] - ETA: 0s - loss: 2.8264e-04 - mean\_absolute\_error: 0.0122126/126 [==============================] - 0s 2ms/step - loss: 2.8022e-04 - mean\_absolute\_error: 0.0121 - val\_loss: 1.1850e-04 - val\_mean\_absolute\_error: 0.0086  
Epoch 38/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2746e-04 - mean\_absolute\_error: 0.0084 24/126 [====>.........................] - ETA: 0s - loss: 2.8833e-04 - mean\_absolute\_error: 0.0114 48/126 [==========>...................] - ETA: 0s - loss: 2.6423e-04 - mean\_absolute\_error: 0.0114 72/126 [================>.............] - ETA: 0s - loss: 2.6919e-04 - mean\_absolute\_error: 0.0119 96/126 [=====================>........] - ETA: 0s - loss: 2.8639e-04 - mean\_absolute\_error: 0.0124119/126 [===========================>..] - ETA: 0s - loss: 2.7913e-04 - mean\_absolute\_error: 0.0122126/126 [==============================] - 0s 2ms/step - loss: 2.7609e-04 - mean\_absolute\_error: 0.0121 - val\_loss: 1.1563e-04 - val\_mean\_absolute\_error: 0.0084  
Epoch 39/100  
 1/126 [..............................] - ETA: 0s - loss: 1.8605e-04 - mean\_absolute\_error: 0.0114 23/126 [====>.........................] - ETA: 0s - loss: 2.3073e-04 - mean\_absolute\_error: 0.0112 47/126 [==========>...................] - ETA: 0s - loss: 2.6508e-04 - mean\_absolute\_error: 0.0121 71/126 [===============>..............] - ETA: 0s - loss: 2.8036e-04 - mean\_absolute\_error: 0.0122 95/126 [=====================>........] - ETA: 0s - loss: 2.6538e-04 - mean\_absolute\_error: 0.0119119/126 [===========================>..] - ETA: 0s - loss: 2.6594e-04 - mean\_absolute\_error: 0.0119126/126 [==============================] - 0s 2ms/step - loss: 2.6675e-04 - mean\_absolute\_error: 0.0120 - val\_loss: 1.3478e-04 - val\_mean\_absolute\_error: 0.0091  
Epoch 40/100  
 1/126 [..............................] - ETA: 0s - loss: 3.1019e-04 - mean\_absolute\_error: 0.0125 25/126 [====>.........................] - ETA: 0s - loss: 2.5055e-04 - mean\_absolute\_error: 0.0120 49/126 [==========>...................] - ETA: 0s - loss: 3.0666e-04 - mean\_absolute\_error: 0.0134 73/126 [================>.............] - ETA: 0s - loss: 3.6460e-04 - mean\_absolute\_error: 0.0144 97/126 [======================>.......] - ETA: 0s - loss: 3.4220e-04 - mean\_absolute\_error: 0.0140118/126 [===========================>..] - ETA: 0s - loss: 3.2387e-04 - mean\_absolute\_error: 0.0136126/126 [==============================] - 0s 3ms/step - loss: 3.3208e-04 - mean\_absolute\_error: 0.0137 - val\_loss: 6.3470e-04 - val\_mean\_absolute\_error: 0.0229  
Epoch 41/100  
 1/126 [..............................] - ETA: 0s - loss: 5.2883e-04 - mean\_absolute\_error: 0.0201 25/126 [====>.........................] - ETA: 0s - loss: 4.7158e-04 - mean\_absolute\_error: 0.0171 49/126 [==========>...................] - ETA: 0s - loss: 3.7652e-04 - mean\_absolute\_error: 0.0146 72/126 [================>.............] - ETA: 0s - loss: 3.2812e-04 - mean\_absolute\_error: 0.0137 95/126 [=====================>........] - ETA: 0s - loss: 3.1316e-04 - mean\_absolute\_error: 0.0132118/126 [===========================>..] - ETA: 0s - loss: 2.9845e-04 - mean\_absolute\_error: 0.0128126/126 [==============================] - 0s 2ms/step - loss: 3.0620e-04 - mean\_absolute\_error: 0.0129 - val\_loss: 3.1566e-04 - val\_mean\_absolute\_error: 0.0150  
Epoch 42/100  
 1/126 [..............................] - ETA: 0s - loss: 7.3751e-04 - mean\_absolute\_error: 0.0173 24/126 [====>.........................] - ETA: 0s - loss: 4.1449e-04 - mean\_absolute\_error: 0.0154 48/126 [==========>...................] - ETA: 0s - loss: 3.3081e-04 - mean\_absolute\_error: 0.0134 72/126 [================>.............] - ETA: 0s - loss: 3.0646e-04 - mean\_absolute\_error: 0.0127 96/126 [=====================>........] - ETA: 0s - loss: 3.1875e-04 - mean\_absolute\_error: 0.0131120/126 [===========================>..] - ETA: 0s - loss: 2.9724e-04 - mean\_absolute\_error: 0.0127126/126 [==============================] - 0s 2ms/step - loss: 2.9323e-04 - mean\_absolute\_error: 0.0126 - val\_loss: 1.2642e-04 - val\_mean\_absolute\_error: 0.0087  
Epoch 43/100  
 1/126 [..............................] - ETA: 0s - loss: 2.1637e-04 - mean\_absolute\_error: 0.0114 26/126 [=====>........................] - ETA: 0s - loss: 2.6556e-04 - mean\_absolute\_error: 0.0121 50/126 [==========>...................] - ETA: 0s - loss: 2.6200e-04 - mean\_absolute\_error: 0.0119 74/126 [================>.............] - ETA: 0s - loss: 2.4295e-04 - mean\_absolute\_error: 0.0115 98/126 [======================>.......] - ETA: 0s - loss: 2.4654e-04 - mean\_absolute\_error: 0.0114121/126 [===========================>..] - ETA: 0s - loss: 2.6464e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 2ms/step - loss: 2.6893e-04 - mean\_absolute\_error: 0.0120 - val\_loss: 1.2633e-04 - val\_mean\_absolute\_error: 0.0087  
Epoch 44/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5847e-04 - mean\_absolute\_error: 0.0100 24/126 [====>.........................] - ETA: 0s - loss: 2.9253e-04 - mean\_absolute\_error: 0.0124 48/126 [==========>...................] - ETA: 0s - loss: 2.7614e-04 - mean\_absolute\_error: 0.0123 72/126 [================>.............] - ETA: 0s - loss: 2.7602e-04 - mean\_absolute\_error: 0.0120 96/126 [=====================>........] - ETA: 0s - loss: 2.6458e-04 - mean\_absolute\_error: 0.0119120/126 [===========================>..] - ETA: 0s - loss: 2.7228e-04 - mean\_absolute\_error: 0.0122126/126 [==============================] - 0s 2ms/step - loss: 2.7213e-04 - mean\_absolute\_error: 0.0122 - val\_loss: 1.4534e-04 - val\_mean\_absolute\_error: 0.0098  
Epoch 45/100  
 1/126 [..............................] - ETA: 0s - loss: 2.1322e-04 - mean\_absolute\_error: 0.0119 25/126 [====>.........................] - ETA: 0s - loss: 2.2311e-04 - mean\_absolute\_error: 0.0111 49/126 [==========>...................] - ETA: 0s - loss: 2.5331e-04 - mean\_absolute\_error: 0.0115 73/126 [================>.............] - ETA: 0s - loss: 2.4927e-04 - mean\_absolute\_error: 0.0115 96/126 [=====================>........] - ETA: 0s - loss: 2.5385e-04 - mean\_absolute\_error: 0.0115119/126 [===========================>..] - ETA: 0s - loss: 2.6695e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 2ms/step - loss: 2.6471e-04 - mean\_absolute\_error: 0.0117 - val\_loss: 1.3103e-04 - val\_mean\_absolute\_error: 0.0089  
Epoch 46/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0301e-04 - mean\_absolute\_error: 0.0114 25/126 [====>.........................] - ETA: 0s - loss: 3.4699e-04 - mean\_absolute\_error: 0.0140 47/126 [==========>...................] - ETA: 0s - loss: 3.0794e-04 - mean\_absolute\_error: 0.0130 70/126 [===============>..............] - ETA: 0s - loss: 2.7875e-04 - mean\_absolute\_error: 0.0124 93/126 [=====================>........] - ETA: 0s - loss: 2.6839e-04 - mean\_absolute\_error: 0.0122117/126 [==========================>...] - ETA: 0s - loss: 2.6570e-04 - mean\_absolute\_error: 0.0120126/126 [==============================] - 0s 3ms/step - loss: 2.6407e-04 - mean\_absolute\_error: 0.0120 - val\_loss: 1.3131e-04 - val\_mean\_absolute\_error: 0.0092  
Epoch 47/100  
 1/126 [..............................] - ETA: 0s - loss: 2.9177e-04 - mean\_absolute\_error: 0.0124 25/126 [====>.........................] - ETA: 0s - loss: 2.0567e-04 - mean\_absolute\_error: 0.0108 49/126 [==========>...................] - ETA: 0s - loss: 2.2490e-04 - mean\_absolute\_error: 0.0110 73/126 [================>.............] - ETA: 0s - loss: 2.2434e-04 - mean\_absolute\_error: 0.0109 96/126 [=====================>........] - ETA: 0s - loss: 2.1201e-04 - mean\_absolute\_error: 0.0106120/126 [===========================>..] - ETA: 0s - loss: 2.3018e-04 - mean\_absolute\_error: 0.0109126/126 [==============================] - 0s 2ms/step - loss: 2.3149e-04 - mean\_absolute\_error: 0.0110 - val\_loss: 1.1902e-04 - val\_mean\_absolute\_error: 0.0087  
Epoch 48/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5553e-04 - mean\_absolute\_error: 0.0095 25/126 [====>.........................] - ETA: 0s - loss: 2.8332e-04 - mean\_absolute\_error: 0.0116 47/126 [==========>...................] - ETA: 0s - loss: 2.8527e-04 - mean\_absolute\_error: 0.0120 71/126 [===============>..............] - ETA: 0s - loss: 2.7609e-04 - mean\_absolute\_error: 0.0119 93/126 [=====================>........] - ETA: 0s - loss: 2.6840e-04 - mean\_absolute\_error: 0.0120116/126 [==========================>...] - ETA: 0s - loss: 2.7125e-04 - mean\_absolute\_error: 0.0119126/126 [==============================] - 0s 3ms/step - loss: 2.7388e-04 - mean\_absolute\_error: 0.0120 - val\_loss: 1.9193e-04 - val\_mean\_absolute\_error: 0.0111  
Epoch 49/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1005e-04 - mean\_absolute\_error: 0.0087 24/126 [====>.........................] - ETA: 0s - loss: 2.1980e-04 - mean\_absolute\_error: 0.0112 47/126 [==========>...................] - ETA: 0s - loss: 2.5442e-04 - mean\_absolute\_error: 0.0117 71/126 [===============>..............] - ETA: 0s - loss: 2.4833e-04 - mean\_absolute\_error: 0.0115 95/126 [=====================>........] - ETA: 0s - loss: 2.4694e-04 - mean\_absolute\_error: 0.0114119/126 [===========================>..] - ETA: 0s - loss: 2.4048e-04 - mean\_absolute\_error: 0.0112126/126 [==============================] - 0s 2ms/step - loss: 2.4190e-04 - mean\_absolute\_error: 0.0113 - val\_loss: 1.7342e-04 - val\_mean\_absolute\_error: 0.0105  
Epoch 50/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1093e-04 - mean\_absolute\_error: 0.0088 25/126 [====>.........................] - ETA: 0s - loss: 2.5567e-04 - mean\_absolute\_error: 0.0119 49/126 [==========>...................] - ETA: 0s - loss: 2.3709e-04 - mean\_absolute\_error: 0.0114 73/126 [================>.............] - ETA: 0s - loss: 2.6942e-04 - mean\_absolute\_error: 0.0121 97/126 [======================>.......] - ETA: 0s - loss: 2.7348e-04 - mean\_absolute\_error: 0.0122119/126 [===========================>..] - ETA: 0s - loss: 2.6439e-04 - mean\_absolute\_error: 0.0120126/126 [==============================] - 0s 2ms/step - loss: 2.6754e-04 - mean\_absolute\_error: 0.0120 - val\_loss: 2.1313e-04 - val\_mean\_absolute\_error: 0.0118  
Epoch 51/100  
 1/126 [..............................] - ETA: 0s - loss: 2.3850e-04 - mean\_absolute\_error: 0.0119 25/126 [====>.........................] - ETA: 0s - loss: 2.6210e-04 - mean\_absolute\_error: 0.0120 49/126 [==========>...................] - ETA: 0s - loss: 2.4544e-04 - mean\_absolute\_error: 0.0116 73/126 [================>.............] - ETA: 0s - loss: 2.4833e-04 - mean\_absolute\_error: 0.0116 97/126 [======================>.......] - ETA: 0s - loss: 2.5734e-04 - mean\_absolute\_error: 0.0117121/126 [===========================>..] - ETA: 0s - loss: 2.5957e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 2ms/step - loss: 2.6162e-04 - mean\_absolute\_error: 0.0119 - val\_loss: 3.5391e-04 - val\_mean\_absolute\_error: 0.0162  
Epoch 52/100  
 1/126 [..............................] - ETA: 0s - loss: 3.4765e-04 - mean\_absolute\_error: 0.0161 25/126 [====>.........................] - ETA: 0s - loss: 3.1572e-04 - mean\_absolute\_error: 0.0133 49/126 [==========>...................] - ETA: 0s - loss: 2.5776e-04 - mean\_absolute\_error: 0.0117 72/126 [================>.............] - ETA: 0s - loss: 2.7173e-04 - mean\_absolute\_error: 0.0122 96/126 [=====================>........] - ETA: 0s - loss: 3.0094e-04 - mean\_absolute\_error: 0.0129120/126 [===========================>..] - ETA: 0s - loss: 2.8487e-04 - mean\_absolute\_error: 0.0125126/126 [==============================] - 0s 2ms/step - loss: 2.8515e-04 - mean\_absolute\_error: 0.0125 - val\_loss: 1.9901e-04 - val\_mean\_absolute\_error: 0.0117  
Epoch 53/100  
 1/126 [..............................] - ETA: 0s - loss: 3.0622e-04 - mean\_absolute\_error: 0.0126 25/126 [====>.........................] - ETA: 0s - loss: 3.0257e-04 - mean\_absolute\_error: 0.0124 49/126 [==========>...................] - ETA: 0s - loss: 2.6924e-04 - mean\_absolute\_error: 0.0117 73/126 [================>.............] - ETA: 0s - loss: 2.4771e-04 - mean\_absolute\_error: 0.0113 96/126 [=====================>........] - ETA: 0s - loss: 2.3554e-04 - mean\_absolute\_error: 0.0111120/126 [===========================>..] - ETA: 0s - loss: 2.3123e-04 - mean\_absolute\_error: 0.0111126/126 [==============================] - 0s 2ms/step - loss: 2.3373e-04 - mean\_absolute\_error: 0.0111 - val\_loss: 2.7675e-04 - val\_mean\_absolute\_error: 0.0139  
Epoch 54/100  
 1/126 [..............................] - ETA: 0s - loss: 4.4047e-04 - mean\_absolute\_error: 0.0175 25/126 [====>.........................] - ETA: 0s - loss: 3.5715e-04 - mean\_absolute\_error: 0.0146 49/126 [==========>...................] - ETA: 0s - loss: 3.1672e-04 - mean\_absolute\_error: 0.0134 73/126 [================>.............] - ETA: 0s - loss: 2.8730e-04 - mean\_absolute\_error: 0.0126 97/126 [======================>.......] - ETA: 0s - loss: 2.7482e-04 - mean\_absolute\_error: 0.0121121/126 [===========================>..] - ETA: 0s - loss: 2.6444e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 2ms/step - loss: 2.6385e-04 - mean\_absolute\_error: 0.0118 - val\_loss: 1.8804e-04 - val\_mean\_absolute\_error: 0.0113  
Epoch 55/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4246e-04 - mean\_absolute\_error: 0.0100 25/126 [====>.........................] - ETA: 0s - loss: 3.7836e-04 - mean\_absolute\_error: 0.0146 48/126 [==========>...................] - ETA: 0s - loss: 3.4172e-04 - mean\_absolute\_error: 0.0142 72/126 [================>.............] - ETA: 0s - loss: 3.1128e-04 - mean\_absolute\_error: 0.0132 96/126 [=====================>........] - ETA: 0s - loss: 3.1514e-04 - mean\_absolute\_error: 0.0132120/126 [===========================>..] - ETA: 0s - loss: 3.1194e-04 - mean\_absolute\_error: 0.0132126/126 [==============================] - 0s 2ms/step - loss: 3.1031e-04 - mean\_absolute\_error: 0.0132 - val\_loss: 1.0861e-04 - val\_mean\_absolute\_error: 0.0082  
Epoch 56/100  
 1/126 [..............................] - ETA: 0s - loss: 2.7762e-04 - mean\_absolute\_error: 0.0118 25/126 [====>.........................] - ETA: 0s - loss: 2.7809e-04 - mean\_absolute\_error: 0.0121 49/126 [==========>...................] - ETA: 0s - loss: 2.5781e-04 - mean\_absolute\_error: 0.0120 73/126 [================>.............] - ETA: 0s - loss: 2.4485e-04 - mean\_absolute\_error: 0.0117 97/126 [======================>.......] - ETA: 0s - loss: 2.3865e-04 - mean\_absolute\_error: 0.0114121/126 [===========================>..] - ETA: 0s - loss: 2.4496e-04 - mean\_absolute\_error: 0.0114126/126 [==============================] - 0s 2ms/step - loss: 2.4677e-04 - mean\_absolute\_error: 0.0115 - val\_loss: 1.1391e-04 - val\_mean\_absolute\_error: 0.0083  
Epoch 57/100  
 1/126 [..............................] - ETA: 0s - loss: 1.7790e-04 - mean\_absolute\_error: 0.0100 25/126 [====>.........................] - ETA: 0s - loss: 3.2418e-04 - mean\_absolute\_error: 0.0128 49/126 [==========>...................] - ETA: 0s - loss: 2.7519e-04 - mean\_absolute\_error: 0.0119 73/126 [================>.............] - ETA: 0s - loss: 2.5714e-04 - mean\_absolute\_error: 0.0116 96/126 [=====================>........] - ETA: 0s - loss: 2.5035e-04 - mean\_absolute\_error: 0.0115120/126 [===========================>..] - ETA: 0s - loss: 2.4926e-04 - mean\_absolute\_error: 0.0114126/126 [==============================] - 0s 2ms/step - loss: 2.4792e-04 - mean\_absolute\_error: 0.0114 - val\_loss: 1.2409e-04 - val\_mean\_absolute\_error: 0.0087  
Epoch 58/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3688e-04 - mean\_absolute\_error: 0.0102 25/126 [====>.........................] - ETA: 0s - loss: 2.6898e-04 - mean\_absolute\_error: 0.0120 49/126 [==========>...................] - ETA: 0s - loss: 2.9025e-04 - mean\_absolute\_error: 0.0125 71/126 [===============>..............] - ETA: 0s - loss: 2.6969e-04 - mean\_absolute\_error: 0.0121 94/126 [=====================>........] - ETA: 0s - loss: 2.6058e-04 - mean\_absolute\_error: 0.0118118/126 [===========================>..] - ETA: 0s - loss: 2.4942e-04 - mean\_absolute\_error: 0.0116126/126 [==============================] - 0s 3ms/step - loss: 2.5281e-04 - mean\_absolute\_error: 0.0116 - val\_loss: 1.1202e-04 - val\_mean\_absolute\_error: 0.0082  
Epoch 59/100  
 1/126 [..............................] - ETA: 0s - loss: 3.4186e-04 - mean\_absolute\_error: 0.0143 24/126 [====>.........................] - ETA: 0s - loss: 2.3921e-04 - mean\_absolute\_error: 0.0108 48/126 [==========>...................] - ETA: 0s - loss: 2.3504e-04 - mean\_absolute\_error: 0.0109 72/126 [================>.............] - ETA: 0s - loss: 2.7726e-04 - mean\_absolute\_error: 0.0122 95/126 [=====================>........] - ETA: 0s - loss: 2.7317e-04 - mean\_absolute\_error: 0.0122119/126 [===========================>..] - ETA: 0s - loss: 2.7791e-04 - mean\_absolute\_error: 0.0122126/126 [==============================] - 0s 2ms/step - loss: 2.7533e-04 - mean\_absolute\_error: 0.0122 - val\_loss: 3.5366e-04 - val\_mean\_absolute\_error: 0.0165  
Epoch 60/100  
 1/126 [..............................] - ETA: 0s - loss: 5.3045e-04 - mean\_absolute\_error: 0.0188 24/126 [====>.........................] - ETA: 0s - loss: 2.6160e-04 - mean\_absolute\_error: 0.0123 43/126 [=========>....................] - ETA: 0s - loss: 2.8466e-04 - mean\_absolute\_error: 0.0128 66/126 [==============>...............] - ETA: 0s - loss: 2.7331e-04 - mean\_absolute\_error: 0.0124 89/126 [====================>.........] - ETA: 0s - loss: 2.7072e-04 - mean\_absolute\_error: 0.0121112/126 [=========================>....] - ETA: 0s - loss: 2.7274e-04 - mean\_absolute\_error: 0.0120126/126 [==============================] - 0s 3ms/step - loss: 2.7335e-04 - mean\_absolute\_error: 0.0122 - val\_loss: 3.2255e-04 - val\_mean\_absolute\_error: 0.0156  
Epoch 61/100  
 1/126 [..............................] - ETA: 0s - loss: 3.8366e-04 - mean\_absolute\_error: 0.0163 25/126 [====>.........................] - ETA: 0s - loss: 2.7007e-04 - mean\_absolute\_error: 0.0124 47/126 [==========>...................] - ETA: 0s - loss: 2.7110e-04 - mean\_absolute\_error: 0.0122 71/126 [===============>..............] - ETA: 0s - loss: 2.5759e-04 - mean\_absolute\_error: 0.0119 94/126 [=====================>........] - ETA: 0s - loss: 2.4274e-04 - mean\_absolute\_error: 0.0116117/126 [==========================>...] - ETA: 0s - loss: 2.5716e-04 - mean\_absolute\_error: 0.0119126/126 [==============================] - 0s 3ms/step - loss: 2.5789e-04 - mean\_absolute\_error: 0.0119 - val\_loss: 2.1415e-04 - val\_mean\_absolute\_error: 0.0122  
Epoch 62/100  
 1/126 [..............................] - ETA: 0s - loss: 4.7965e-04 - mean\_absolute\_error: 0.0161 25/126 [====>.........................] - ETA: 0s - loss: 4.3431e-04 - mean\_absolute\_error: 0.0169 48/126 [==========>...................] - ETA: 0s - loss: 3.5462e-04 - mean\_absolute\_error: 0.0146 71/126 [===============>..............] - ETA: 0s - loss: 3.3056e-04 - mean\_absolute\_error: 0.0138 94/126 [=====================>........] - ETA: 0s - loss: 3.0788e-04 - mean\_absolute\_error: 0.0132117/126 [==========================>...] - ETA: 0s - loss: 2.9221e-04 - mean\_absolute\_error: 0.0127126/126 [==============================] - 0s 3ms/step - loss: 2.9143e-04 - mean\_absolute\_error: 0.0126 - val\_loss: 1.4043e-04 - val\_mean\_absolute\_error: 0.0093  
Epoch 63/100  
 1/126 [..............................] - ETA: 0s - loss: 2.2263e-04 - mean\_absolute\_error: 0.0116 24/126 [====>.........................] - ETA: 0s - loss: 2.4054e-04 - mean\_absolute\_error: 0.0110 47/126 [==========>...................] - ETA: 0s - loss: 2.5225e-04 - mean\_absolute\_error: 0.0118 71/126 [===============>..............] - ETA: 0s - loss: 2.4068e-04 - mean\_absolute\_error: 0.0114 95/126 [=====================>........] - ETA: 0s - loss: 2.3153e-04 - mean\_absolute\_error: 0.0111118/126 [===========================>..] - ETA: 0s - loss: 2.3232e-04 - mean\_absolute\_error: 0.0111126/126 [==============================] - 0s 3ms/step - loss: 2.3220e-04 - mean\_absolute\_error: 0.0111 - val\_loss: 4.0939e-04 - val\_mean\_absolute\_error: 0.0178  
Epoch 64/100  
 1/126 [..............................] - ETA: 0s - loss: 6.2497e-04 - mean\_absolute\_error: 0.0198 25/126 [====>.........................] - ETA: 0s - loss: 2.8105e-04 - mean\_absolute\_error: 0.0118 49/126 [==========>...................] - ETA: 0s - loss: 2.7586e-04 - mean\_absolute\_error: 0.0121 73/126 [================>.............] - ETA: 0s - loss: 2.7873e-04 - mean\_absolute\_error: 0.0121 97/126 [======================>.......] - ETA: 0s - loss: 2.5920e-04 - mean\_absolute\_error: 0.0117121/126 [===========================>..] - ETA: 0s - loss: 2.5066e-04 - mean\_absolute\_error: 0.0115126/126 [==============================] - 0s 2ms/step - loss: 2.4893e-04 - mean\_absolute\_error: 0.0115 - val\_loss: 2.2593e-04 - val\_mean\_absolute\_error: 0.0126  
Epoch 65/100  
 1/126 [..............................] - ETA: 0s - loss: 3.2346e-04 - mean\_absolute\_error: 0.0149 24/126 [====>.........................] - ETA: 0s - loss: 2.4138e-04 - mean\_absolute\_error: 0.0117 47/126 [==========>...................] - ETA: 0s - loss: 3.0116e-04 - mean\_absolute\_error: 0.0132 71/126 [===============>..............] - ETA: 0s - loss: 2.8332e-04 - mean\_absolute\_error: 0.0126 94/126 [=====================>........] - ETA: 0s - loss: 2.6915e-04 - mean\_absolute\_error: 0.0123118/126 [===========================>..] - ETA: 0s - loss: 2.7253e-04 - mean\_absolute\_error: 0.0122126/126 [==============================] - 0s 3ms/step - loss: 2.7341e-04 - mean\_absolute\_error: 0.0122 - val\_loss: 1.8011e-04 - val\_mean\_absolute\_error: 0.0110  
Epoch 66/100  
 1/126 [..............................] - ETA: 0s - loss: 1.7367e-04 - mean\_absolute\_error: 0.0103 26/126 [=====>........................] - ETA: 0s - loss: 2.8766e-04 - mean\_absolute\_error: 0.0123 50/126 [==========>...................] - ETA: 0s - loss: 2.5020e-04 - mean\_absolute\_error: 0.0117 72/126 [================>.............] - ETA: 0s - loss: 2.4097e-04 - mean\_absolute\_error: 0.0112 95/126 [=====================>........] - ETA: 0s - loss: 2.3831e-04 - mean\_absolute\_error: 0.0112119/126 [===========================>..] - ETA: 0s - loss: 2.2966e-04 - mean\_absolute\_error: 0.0110126/126 [==============================] - 0s 3ms/step - loss: 2.3032e-04 - mean\_absolute\_error: 0.0110 - val\_loss: 1.1118e-04 - val\_mean\_absolute\_error: 0.0082  
Epoch 67/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5305e-04 - mean\_absolute\_error: 0.0098 25/126 [====>.........................] - ETA: 0s - loss: 1.9099e-04 - mean\_absolute\_error: 0.0101 48/126 [==========>...................] - ETA: 0s - loss: 2.5197e-04 - mean\_absolute\_error: 0.0117 70/126 [===============>..............] - ETA: 0s - loss: 2.4332e-04 - mean\_absolute\_error: 0.0115 94/126 [=====================>........] - ETA: 0s - loss: 2.3558e-04 - mean\_absolute\_error: 0.0112118/126 [===========================>..] - ETA: 0s - loss: 2.3568e-04 - mean\_absolute\_error: 0.0111126/126 [==============================] - 0s 3ms/step - loss: 2.4013e-04 - mean\_absolute\_error: 0.0113 - val\_loss: 1.0449e-04 - val\_mean\_absolute\_error: 0.0080  
Epoch 68/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9790e-04 - mean\_absolute\_error: 0.0108 25/126 [====>.........................] - ETA: 0s - loss: 2.3072e-04 - mean\_absolute\_error: 0.0104 48/126 [==========>...................] - ETA: 0s - loss: 2.4959e-04 - mean\_absolute\_error: 0.0112 72/126 [================>.............] - ETA: 0s - loss: 2.2922e-04 - mean\_absolute\_error: 0.0110 95/126 [=====================>........] - ETA: 0s - loss: 2.2624e-04 - mean\_absolute\_error: 0.0108119/126 [===========================>..] - ETA: 0s - loss: 2.4286e-04 - mean\_absolute\_error: 0.0114126/126 [==============================] - 0s 2ms/step - loss: 2.4541e-04 - mean\_absolute\_error: 0.0114 - val\_loss: 1.0934e-04 - val\_mean\_absolute\_error: 0.0081  
Epoch 69/100  
 1/126 [..............................] - ETA: 0s - loss: 3.1989e-04 - mean\_absolute\_error: 0.0113 26/126 [=====>........................] - ETA: 0s - loss: 1.8804e-04 - mean\_absolute\_error: 0.0101 50/126 [==========>...................] - ETA: 0s - loss: 2.3337e-04 - mean\_absolute\_error: 0.0111 73/126 [================>.............] - ETA: 0s - loss: 2.3650e-04 - mean\_absolute\_error: 0.0112 96/126 [=====================>........] - ETA: 0s - loss: 2.3523e-04 - mean\_absolute\_error: 0.0111119/126 [===========================>..] - ETA: 0s - loss: 2.2990e-04 - mean\_absolute\_error: 0.0110126/126 [==============================] - 0s 2ms/step - loss: 2.2882e-04 - mean\_absolute\_error: 0.0110 - val\_loss: 1.3561e-04 - val\_mean\_absolute\_error: 0.0091  
Epoch 70/100  
 1/126 [..............................] - ETA: 0s - loss: 3.0744e-04 - mean\_absolute\_error: 0.0119 25/126 [====>.........................] - ETA: 0s - loss: 1.9060e-04 - mean\_absolute\_error: 0.0103 49/126 [==========>...................] - ETA: 0s - loss: 2.0960e-04 - mean\_absolute\_error: 0.0106 72/126 [================>.............] - ETA: 0s - loss: 2.0954e-04 - mean\_absolute\_error: 0.0106 95/126 [=====================>........] - ETA: 0s - loss: 2.3760e-04 - mean\_absolute\_error: 0.0111119/126 [===========================>..] - ETA: 0s - loss: 2.3103e-04 - mean\_absolute\_error: 0.0110126/126 [==============================] - 0s 2ms/step - loss: 2.3074e-04 - mean\_absolute\_error: 0.0110 - val\_loss: 1.0523e-04 - val\_mean\_absolute\_error: 0.0079  
Epoch 71/100  
 1/126 [..............................] - ETA: 0s - loss: 9.8105e-05 - mean\_absolute\_error: 0.0080 25/126 [====>.........................] - ETA: 0s - loss: 2.1701e-04 - mean\_absolute\_error: 0.0111 49/126 [==========>...................] - ETA: 0s - loss: 2.4190e-04 - mean\_absolute\_error: 0.0115 72/126 [================>.............] - ETA: 0s - loss: 2.5969e-04 - mean\_absolute\_error: 0.0117 95/126 [=====================>........] - ETA: 0s - loss: 2.5366e-04 - mean\_absolute\_error: 0.0117119/126 [===========================>..] - ETA: 0s - loss: 2.5416e-04 - mean\_absolute\_error: 0.0117126/126 [==============================] - 0s 3ms/step - loss: 2.5152e-04 - mean\_absolute\_error: 0.0117 - val\_loss: 1.4820e-04 - val\_mean\_absolute\_error: 0.0099  
Epoch 72/100  
 1/126 [..............................] - ETA: 0s - loss: 2.4616e-04 - mean\_absolute\_error: 0.0132 25/126 [====>.........................] - ETA: 0s - loss: 2.0931e-04 - mean\_absolute\_error: 0.0109 49/126 [==========>...................] - ETA: 0s - loss: 2.2020e-04 - mean\_absolute\_error: 0.0108 73/126 [================>.............] - ETA: 0s - loss: 2.2840e-04 - mean\_absolute\_error: 0.0111 96/126 [=====================>........] - ETA: 0s - loss: 2.2084e-04 - mean\_absolute\_error: 0.0108117/126 [==========================>...] - ETA: 0s - loss: 2.2606e-04 - mean\_absolute\_error: 0.0109126/126 [==============================] - 0s 3ms/step - loss: 2.2472e-04 - mean\_absolute\_error: 0.0109 - val\_loss: 2.0216e-04 - val\_mean\_absolute\_error: 0.0116  
Epoch 73/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9022e-04 - mean\_absolute\_error: 0.0119 25/126 [====>.........................] - ETA: 0s - loss: 2.2882e-04 - mean\_absolute\_error: 0.0108 48/126 [==========>...................] - ETA: 0s - loss: 2.3272e-04 - mean\_absolute\_error: 0.0110 72/126 [================>.............] - ETA: 0s - loss: 2.4523e-04 - mean\_absolute\_error: 0.0115 95/126 [=====================>........] - ETA: 0s - loss: 2.5087e-04 - mean\_absolute\_error: 0.0116119/126 [===========================>..] - ETA: 0s - loss: 2.3822e-04 - mean\_absolute\_error: 0.0112126/126 [==============================] - 0s 3ms/step - loss: 2.3683e-04 - mean\_absolute\_error: 0.0112 - val\_loss: 1.0118e-04 - val\_mean\_absolute\_error: 0.0079  
Epoch 74/100  
 1/126 [..............................] - ETA: 0s - loss: 2.3020e-04 - mean\_absolute\_error: 0.0100 26/126 [=====>........................] - ETA: 0s - loss: 2.4178e-04 - mean\_absolute\_error: 0.0109 50/126 [==========>...................] - ETA: 0s - loss: 2.3493e-04 - mean\_absolute\_error: 0.0109 73/126 [================>.............] - ETA: 0s - loss: 2.2606e-04 - mean\_absolute\_error: 0.0109 96/126 [=====================>........] - ETA: 0s - loss: 2.2081e-04 - mean\_absolute\_error: 0.0107119/126 [===========================>..] - ETA: 0s - loss: 2.2027e-04 - mean\_absolute\_error: 0.0108126/126 [==============================] - 0s 2ms/step - loss: 2.1803e-04 - mean\_absolute\_error: 0.0108 - val\_loss: 1.0696e-04 - val\_mean\_absolute\_error: 0.0080  
Epoch 75/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1209e-04 - mean\_absolute\_error: 0.0085 25/126 [====>.........................] - ETA: 0s - loss: 2.5023e-04 - mean\_absolute\_error: 0.0114 48/126 [==========>...................] - ETA: 0s - loss: 2.4269e-04 - mean\_absolute\_error: 0.0114 72/126 [================>.............] - ETA: 0s - loss: 2.5346e-04 - mean\_absolute\_error: 0.0116 96/126 [=====================>........] - ETA: 0s - loss: 2.4342e-04 - mean\_absolute\_error: 0.0113120/126 [===========================>..] - ETA: 0s - loss: 2.3187e-04 - mean\_absolute\_error: 0.0111126/126 [==============================] - 0s 2ms/step - loss: 2.2839e-04 - mean\_absolute\_error: 0.0110 - val\_loss: 1.2610e-04 - val\_mean\_absolute\_error: 0.0090  
Epoch 76/100  
 1/126 [..............................] - ETA: 0s - loss: 1.8708e-04 - mean\_absolute\_error: 0.0103 25/126 [====>.........................] - ETA: 0s - loss: 2.5264e-04 - mean\_absolute\_error: 0.0115 48/126 [==========>...................] - ETA: 0s - loss: 2.3500e-04 - mean\_absolute\_error: 0.0112 71/126 [===============>..............] - ETA: 0s - loss: 2.1708e-04 - mean\_absolute\_error: 0.0109 95/126 [=====================>........] - ETA: 0s - loss: 2.1617e-04 - mean\_absolute\_error: 0.0109115/126 [==========================>...] - ETA: 0s - loss: 2.3426e-04 - mean\_absolute\_error: 0.0113126/126 [==============================] - 0s 3ms/step - loss: 2.4790e-04 - mean\_absolute\_error: 0.0116 - val\_loss: 1.3768e-04 - val\_mean\_absolute\_error: 0.0095  
Epoch 77/100  
 1/126 [..............................] - ETA: 0s - loss: 2.6067e-04 - mean\_absolute\_error: 0.0131 23/126 [====>.........................] - ETA: 0s - loss: 2.1527e-04 - mean\_absolute\_error: 0.0113 45/126 [=========>....................] - ETA: 0s - loss: 2.2239e-04 - mean\_absolute\_error: 0.0109 67/126 [==============>...............] - ETA: 0s - loss: 2.5395e-04 - mean\_absolute\_error: 0.0116 88/126 [===================>..........] - ETA: 0s - loss: 2.3930e-04 - mean\_absolute\_error: 0.0112109/126 [========================>.....] - ETA: 0s - loss: 2.4119e-04 - mean\_absolute\_error: 0.0113126/126 [==============================] - 0s 3ms/step - loss: 2.4689e-04 - mean\_absolute\_error: 0.0115 - val\_loss: 1.5802e-04 - val\_mean\_absolute\_error: 0.0100  
Epoch 78/100  
 1/126 [..............................] - ETA: 0s - loss: 3.1647e-04 - mean\_absolute\_error: 0.0133 22/126 [====>.........................] - ETA: 0s - loss: 3.8230e-04 - mean\_absolute\_error: 0.0151 44/126 [=========>....................] - ETA: 0s - loss: 3.7572e-04 - mean\_absolute\_error: 0.0152 65/126 [==============>...............] - ETA: 0s - loss: 3.2011e-04 - mean\_absolute\_error: 0.0137 86/126 [===================>..........] - ETA: 0s - loss: 2.9342e-04 - mean\_absolute\_error: 0.0129110/126 [=========================>....] - ETA: 0s - loss: 2.6537e-04 - mean\_absolute\_error: 0.0122126/126 [==============================] - 0s 3ms/step - loss: 2.6871e-04 - mean\_absolute\_error: 0.0121 - val\_loss: 1.0350e-04 - val\_mean\_absolute\_error: 0.0080  
Epoch 79/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9676e-04 - mean\_absolute\_error: 0.0114 25/126 [====>.........................] - ETA: 0s - loss: 2.2925e-04 - mean\_absolute\_error: 0.0109 49/126 [==========>...................] - ETA: 0s - loss: 2.1212e-04 - mean\_absolute\_error: 0.0105 73/126 [================>.............] - ETA: 0s - loss: 2.4261e-04 - mean\_absolute\_error: 0.0112 96/126 [=====================>........] - ETA: 0s - loss: 2.4350e-04 - mean\_absolute\_error: 0.0112120/126 [===========================>..] - ETA: 0s - loss: 2.4184e-04 - mean\_absolute\_error: 0.0113126/126 [==============================] - 0s 2ms/step - loss: 2.4228e-04 - mean\_absolute\_error: 0.0113 - val\_loss: 1.1469e-04 - val\_mean\_absolute\_error: 0.0083  
Epoch 80/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3510e-04 - mean\_absolute\_error: 0.0093 24/126 [====>.........................] - ETA: 0s - loss: 2.3528e-04 - mean\_absolute\_error: 0.0105 48/126 [==========>...................] - ETA: 0s - loss: 2.3201e-04 - mean\_absolute\_error: 0.0107 71/126 [===============>..............] - ETA: 0s - loss: 2.2805e-04 - mean\_absolute\_error: 0.0107 95/126 [=====================>........] - ETA: 0s - loss: 2.0974e-04 - mean\_absolute\_error: 0.0103118/126 [===========================>..] - ETA: 0s - loss: 2.1402e-04 - mean\_absolute\_error: 0.0105126/126 [==============================] - 0s 3ms/step - loss: 2.1462e-04 - mean\_absolute\_error: 0.0106 - val\_loss: 1.4443e-04 - val\_mean\_absolute\_error: 0.0095  
Epoch 81/100  
 1/126 [..............................] - ETA: 0s - loss: 2.1383e-04 - mean\_absolute\_error: 0.0108 24/126 [====>.........................] - ETA: 0s - loss: 2.4794e-04 - mean\_absolute\_error: 0.0113 48/126 [==========>...................] - ETA: 0s - loss: 2.3445e-04 - mean\_absolute\_error: 0.0108 72/126 [================>.............] - ETA: 0s - loss: 2.2208e-04 - mean\_absolute\_error: 0.0107 96/126 [=====================>........] - ETA: 0s - loss: 2.2845e-04 - mean\_absolute\_error: 0.0110119/126 [===========================>..] - ETA: 0s - loss: 2.2618e-04 - mean\_absolute\_error: 0.0110126/126 [==============================] - 0s 2ms/step - loss: 2.2948e-04 - mean\_absolute\_error: 0.0111 - val\_loss: 1.6537e-04 - val\_mean\_absolute\_error: 0.0106  
Epoch 82/100  
 1/126 [..............................] - ETA: 0s - loss: 2.6112e-04 - mean\_absolute\_error: 0.0129 24/126 [====>.........................] - ETA: 0s - loss: 2.7510e-04 - mean\_absolute\_error: 0.0120 47/126 [==========>...................] - ETA: 0s - loss: 2.3381e-04 - mean\_absolute\_error: 0.0113 70/126 [===============>..............] - ETA: 0s - loss: 2.2572e-04 - mean\_absolute\_error: 0.0109 94/126 [=====================>........] - ETA: 0s - loss: 2.2355e-04 - mean\_absolute\_error: 0.0111117/126 [==========================>...] - ETA: 0s - loss: 2.2601e-04 - mean\_absolute\_error: 0.0110126/126 [==============================] - 0s 3ms/step - loss: 2.2522e-04 - mean\_absolute\_error: 0.0110 - val\_loss: 2.3496e-04 - val\_mean\_absolute\_error: 0.0128  
Epoch 83/100  
 1/126 [..............................] - ETA: 0s - loss: 9.6214e-04 - mean\_absolute\_error: 0.0206 25/126 [====>.........................] - ETA: 0s - loss: 2.8380e-04 - mean\_absolute\_error: 0.0119 48/126 [==========>...................] - ETA: 0s - loss: 2.6076e-04 - mean\_absolute\_error: 0.0118 72/126 [================>.............] - ETA: 0s - loss: 2.5731e-04 - mean\_absolute\_error: 0.0118 96/126 [=====================>........] - ETA: 0s - loss: 2.3483e-04 - mean\_absolute\_error: 0.0113120/126 [===========================>..] - ETA: 0s - loss: 2.3155e-04 - mean\_absolute\_error: 0.0113126/126 [==============================] - 0s 2ms/step - loss: 2.3422e-04 - mean\_absolute\_error: 0.0113 - val\_loss: 9.7022e-05 - val\_mean\_absolute\_error: 0.0077  
Epoch 84/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2661e-04 - mean\_absolute\_error: 0.0084 25/126 [====>.........................] - ETA: 0s - loss: 2.5420e-04 - mean\_absolute\_error: 0.0120 48/126 [==========>...................] - ETA: 0s - loss: 2.1276e-04 - mean\_absolute\_error: 0.0109 71/126 [===============>..............] - ETA: 0s - loss: 2.6043e-04 - mean\_absolute\_error: 0.0121 95/126 [=====================>........] - ETA: 0s - loss: 2.5982e-04 - mean\_absolute\_error: 0.0120119/126 [===========================>..] - ETA: 0s - loss: 2.4732e-04 - mean\_absolute\_error: 0.0115126/126 [==============================] - 0s 2ms/step - loss: 2.4613e-04 - mean\_absolute\_error: 0.0115 - val\_loss: 9.7204e-05 - val\_mean\_absolute\_error: 0.0077  
Epoch 85/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6407e-04 - mean\_absolute\_error: 0.0095 25/126 [====>.........................] - ETA: 0s - loss: 1.9006e-04 - mean\_absolute\_error: 0.0102 49/126 [==========>...................] - ETA: 0s - loss: 1.8399e-04 - mean\_absolute\_error: 0.0099 72/126 [================>.............] - ETA: 0s - loss: 1.7832e-04 - mean\_absolute\_error: 0.0098 96/126 [=====================>........] - ETA: 0s - loss: 1.9906e-04 - mean\_absolute\_error: 0.0102120/126 [===========================>..] - ETA: 0s - loss: 1.9932e-04 - mean\_absolute\_error: 0.0102126/126 [==============================] - 0s 2ms/step - loss: 2.0308e-04 - mean\_absolute\_error: 0.0103 - val\_loss: 3.7980e-04 - val\_mean\_absolute\_error: 0.0173  
Epoch 86/100  
 1/126 [..............................] - ETA: 0s - loss: 5.9315e-04 - mean\_absolute\_error: 0.0189 25/126 [====>.........................] - ETA: 0s - loss: 2.5107e-04 - mean\_absolute\_error: 0.0115 48/126 [==========>...................] - ETA: 0s - loss: 2.1342e-04 - mean\_absolute\_error: 0.0106 72/126 [================>.............] - ETA: 0s - loss: 1.9765e-04 - mean\_absolute\_error: 0.0103 95/126 [=====================>........] - ETA: 0s - loss: 2.1654e-04 - mean\_absolute\_error: 0.0106119/126 [===========================>..] - ETA: 0s - loss: 2.0811e-04 - mean\_absolute\_error: 0.0104126/126 [==============================] - 0s 2ms/step - loss: 2.0986e-04 - mean\_absolute\_error: 0.0104 - val\_loss: 9.5767e-05 - val\_mean\_absolute\_error: 0.0076  
Epoch 87/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5677e-04 - mean\_absolute\_error: 0.0065 24/126 [====>.........................] - ETA: 0s - loss: 1.5235e-04 - mean\_absolute\_error: 0.0090 47/126 [==========>...................] - ETA: 0s - loss: 2.0722e-04 - mean\_absolute\_error: 0.0104 71/126 [===============>..............] - ETA: 0s - loss: 2.1166e-04 - mean\_absolute\_error: 0.0106 93/126 [=====================>........] - ETA: 0s - loss: 2.0845e-04 - mean\_absolute\_error: 0.0105117/126 [==========================>...] - ETA: 0s - loss: 2.1588e-04 - mean\_absolute\_error: 0.0107126/126 [==============================] - 0s 3ms/step - loss: 2.1192e-04 - mean\_absolute\_error: 0.0106 - val\_loss: 1.0877e-04 - val\_mean\_absolute\_error: 0.0081  
Epoch 88/100  
 1/126 [..............................] - ETA: 0s - loss: 8.9482e-05 - mean\_absolute\_error: 0.0076 24/126 [====>.........................] - ETA: 0s - loss: 1.9072e-04 - mean\_absolute\_error: 0.0104 48/126 [==========>...................] - ETA: 0s - loss: 2.3262e-04 - mean\_absolute\_error: 0.0112 71/126 [===============>..............] - ETA: 0s - loss: 2.2447e-04 - mean\_absolute\_error: 0.0110 95/126 [=====================>........] - ETA: 0s - loss: 2.2049e-04 - mean\_absolute\_error: 0.0109119/126 [===========================>..] - ETA: 0s - loss: 2.1887e-04 - mean\_absolute\_error: 0.0108126/126 [==============================] - 0s 2ms/step - loss: 2.1461e-04 - mean\_absolute\_error: 0.0107 - val\_loss: 1.4075e-04 - val\_mean\_absolute\_error: 0.0097  
Epoch 89/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0646e-04 - mean\_absolute\_error: 0.0117 24/126 [====>.........................] - ETA: 0s - loss: 2.4693e-04 - mean\_absolute\_error: 0.0109 47/126 [==========>...................] - ETA: 0s - loss: 2.1864e-04 - mean\_absolute\_error: 0.0107 71/126 [===============>..............] - ETA: 0s - loss: 2.2433e-04 - mean\_absolute\_error: 0.0111 94/126 [=====================>........] - ETA: 0s - loss: 2.2132e-04 - mean\_absolute\_error: 0.0110117/126 [==========================>...] - ETA: 0s - loss: 2.2794e-04 - mean\_absolute\_error: 0.0111126/126 [==============================] - 0s 3ms/step - loss: 2.2985e-04 - mean\_absolute\_error: 0.0111 - val\_loss: 1.2762e-04 - val\_mean\_absolute\_error: 0.0091  
Epoch 90/100  
 1/126 [..............................] - ETA: 0s - loss: 1.8668e-04 - mean\_absolute\_error: 0.0108 24/126 [====>.........................] - ETA: 0s - loss: 1.6451e-04 - mean\_absolute\_error: 0.0098 43/126 [=========>....................] - ETA: 0s - loss: 1.8465e-04 - mean\_absolute\_error: 0.0102 63/126 [==============>...............] - ETA: 0s - loss: 1.9319e-04 - mean\_absolute\_error: 0.0103 83/126 [==================>...........] - ETA: 0s - loss: 1.9961e-04 - mean\_absolute\_error: 0.0104104/126 [=======================>......] - ETA: 0s - loss: 2.1475e-04 - mean\_absolute\_error: 0.0109126/126 [==============================] - ETA: 0s - loss: 2.3118e-04 - mean\_absolute\_error: 0.0113126/126 [==============================] - 0s 3ms/step - loss: 2.3118e-04 - mean\_absolute\_error: 0.0113 - val\_loss: 2.5525e-04 - val\_mean\_absolute\_error: 0.0135  
Epoch 91/100  
 1/126 [..............................] - ETA: 0s - loss: 3.5544e-04 - mean\_absolute\_error: 0.0147 26/126 [=====>........................] - ETA: 0s - loss: 2.1580e-04 - mean\_absolute\_error: 0.0105 50/126 [==========>...................] - ETA: 0s - loss: 1.9959e-04 - mean\_absolute\_error: 0.0100 74/126 [================>.............] - ETA: 0s - loss: 2.3661e-04 - mean\_absolute\_error: 0.0110 97/126 [======================>.......] - ETA: 0s - loss: 2.2809e-04 - mean\_absolute\_error: 0.0109121/126 [===========================>..] - ETA: 0s - loss: 2.1444e-04 - mean\_absolute\_error: 0.0106126/126 [==============================] - 0s 2ms/step - loss: 2.1466e-04 - mean\_absolute\_error: 0.0106 - val\_loss: 9.8640e-05 - val\_mean\_absolute\_error: 0.0077  
Epoch 92/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2881e-04 - mean\_absolute\_error: 0.0086 25/126 [====>.........................] - ETA: 0s - loss: 2.0950e-04 - mean\_absolute\_error: 0.0112 49/126 [==========>...................] - ETA: 0s - loss: 1.9222e-04 - mean\_absolute\_error: 0.0104 72/126 [================>.............] - ETA: 0s - loss: 1.9765e-04 - mean\_absolute\_error: 0.0104 95/126 [=====================>........] - ETA: 0s - loss: 2.0636e-04 - mean\_absolute\_error: 0.0106119/126 [===========================>..] - ETA: 0s - loss: 2.0265e-04 - mean\_absolute\_error: 0.0103126/126 [==============================] - 0s 3ms/step - loss: 2.0112e-04 - mean\_absolute\_error: 0.0103 - val\_loss: 1.2076e-04 - val\_mean\_absolute\_error: 0.0089  
Epoch 93/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6707e-04 - mean\_absolute\_error: 0.0098 25/126 [====>.........................] - ETA: 0s - loss: 3.2015e-04 - mean\_absolute\_error: 0.0123 48/126 [==========>...................] - ETA: 0s - loss: 2.7488e-04 - mean\_absolute\_error: 0.0120 71/126 [===============>..............] - ETA: 0s - loss: 2.4877e-04 - mean\_absolute\_error: 0.0116 94/126 [=====================>........] - ETA: 0s - loss: 2.2944e-04 - mean\_absolute\_error: 0.0112118/126 [===========================>..] - ETA: 0s - loss: 2.1799e-04 - mean\_absolute\_error: 0.0108126/126 [==============================] - 0s 3ms/step - loss: 2.1517e-04 - mean\_absolute\_error: 0.0108 - val\_loss: 1.9778e-04 - val\_mean\_absolute\_error: 0.0116  
Epoch 94/100  
 1/126 [..............................] - ETA: 0s - loss: 2.6664e-04 - mean\_absolute\_error: 0.0137 25/126 [====>.........................] - ETA: 0s - loss: 2.9641e-04 - mean\_absolute\_error: 0.0124 49/126 [==========>...................] - ETA: 0s - loss: 2.4201e-04 - mean\_absolute\_error: 0.0113 72/126 [================>.............] - ETA: 0s - loss: 2.3695e-04 - mean\_absolute\_error: 0.0111 96/126 [=====================>........] - ETA: 0s - loss: 2.2020e-04 - mean\_absolute\_error: 0.0108119/126 [===========================>..] - ETA: 0s - loss: 2.1504e-04 - mean\_absolute\_error: 0.0107126/126 [==============================] - 0s 2ms/step - loss: 2.1367e-04 - mean\_absolute\_error: 0.0107 - val\_loss: 9.1613e-05 - val\_mean\_absolute\_error: 0.0074  
Epoch 95/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9555e-04 - mean\_absolute\_error: 0.0107 25/126 [====>.........................] - ETA: 0s - loss: 2.1202e-04 - mean\_absolute\_error: 0.0107 48/126 [==========>...................] - ETA: 0s - loss: 2.1188e-04 - mean\_absolute\_error: 0.0107 72/126 [================>.............] - ETA: 0s - loss: 1.9288e-04 - mean\_absolute\_error: 0.0102 96/126 [=====================>........] - ETA: 0s - loss: 2.0197e-04 - mean\_absolute\_error: 0.0104120/126 [===========================>..] - ETA: 0s - loss: 1.9866e-04 - mean\_absolute\_error: 0.0103126/126 [==============================] - 0s 2ms/step - loss: 2.0186e-04 - mean\_absolute\_error: 0.0104 - val\_loss: 9.8535e-05 - val\_mean\_absolute\_error: 0.0077  
Epoch 96/100  
 1/126 [..............................] - ETA: 0s - loss: 2.6356e-04 - mean\_absolute\_error: 0.0106 24/126 [====>.........................] - ETA: 0s - loss: 2.0054e-04 - mean\_absolute\_error: 0.0104 48/126 [==========>...................] - ETA: 0s - loss: 2.1490e-04 - mean\_absolute\_error: 0.0104 72/126 [================>.............] - ETA: 0s - loss: 2.0830e-04 - mean\_absolute\_error: 0.0101 95/126 [=====================>........] - ETA: 0s - loss: 1.9693e-04 - mean\_absolute\_error: 0.0099118/126 [===========================>..] - ETA: 0s - loss: 1.9796e-04 - mean\_absolute\_error: 0.0101126/126 [==============================] - 0s 2ms/step - loss: 2.0550e-04 - mean\_absolute\_error: 0.0103 - val\_loss: 9.7096e-05 - val\_mean\_absolute\_error: 0.0078  
Epoch 97/100  
 1/126 [..............................] - ETA: 0s - loss: 7.6397e-05 - mean\_absolute\_error: 0.0070 26/126 [=====>........................] - ETA: 0s - loss: 2.3897e-04 - mean\_absolute\_error: 0.0114 48/126 [==========>...................] - ETA: 0s - loss: 2.1930e-04 - mean\_absolute\_error: 0.0107 71/126 [===============>..............] - ETA: 0s - loss: 2.0308e-04 - mean\_absolute\_error: 0.0102 95/126 [=====================>........] - ETA: 0s - loss: 2.0129e-04 - mean\_absolute\_error: 0.0102119/126 [===========================>..] - ETA: 0s - loss: 2.0153e-04 - mean\_absolute\_error: 0.0102126/126 [==============================] - 0s 2ms/step - loss: 2.0307e-04 - mean\_absolute\_error: 0.0103 - val\_loss: 1.1891e-04 - val\_mean\_absolute\_error: 0.0086  
Epoch 98/100  
 1/126 [..............................] - ETA: 0s - loss: 2.4779e-04 - mean\_absolute\_error: 0.0108 25/126 [====>.........................] - ETA: 0s - loss: 1.7154e-04 - mean\_absolute\_error: 0.0097 49/126 [==========>...................] - ETA: 0s - loss: 2.2310e-04 - mean\_absolute\_error: 0.0107 72/126 [================>.............] - ETA: 0s - loss: 2.2105e-04 - mean\_absolute\_error: 0.0109 94/126 [=====================>........] - ETA: 0s - loss: 2.0196e-04 - mean\_absolute\_error: 0.0103116/126 [==========================>...] - ETA: 0s - loss: 2.0091e-04 - mean\_absolute\_error: 0.0102126/126 [==============================] - 0s 3ms/step - loss: 2.0842e-04 - mean\_absolute\_error: 0.0105 - val\_loss: 1.8354e-04 - val\_mean\_absolute\_error: 0.0113  
Epoch 99/100  
 1/126 [..............................] - ETA: 0s - loss: 2.1911e-04 - mean\_absolute\_error: 0.0112 25/126 [====>.........................] - ETA: 0s - loss: 2.0896e-04 - mean\_absolute\_error: 0.0112 46/126 [=========>....................] - ETA: 0s - loss: 2.1313e-04 - mean\_absolute\_error: 0.0112 70/126 [===============>..............] - ETA: 0s - loss: 2.1646e-04 - mean\_absolute\_error: 0.0108 94/126 [=====================>........] - ETA: 0s - loss: 2.1685e-04 - mean\_absolute\_error: 0.0108117/126 [==========================>...] - ETA: 0s - loss: 2.3830e-04 - mean\_absolute\_error: 0.0114126/126 [==============================] - 0s 3ms/step - loss: 2.3510e-04 - mean\_absolute\_error: 0.0113 - val\_loss: 9.4492e-05 - val\_mean\_absolute\_error: 0.0075  
Epoch 100/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3047e-04 - mean\_absolute\_error: 0.0085 25/126 [====>.........................] - ETA: 0s - loss: 3.1063e-04 - mean\_absolute\_error: 0.0137 49/126 [==========>...................] - ETA: 0s - loss: 3.2165e-04 - mean\_absolute\_error: 0.0138 72/126 [================>.............] - ETA: 0s - loss: 2.9718e-04 - mean\_absolute\_error: 0.0131 96/126 [=====================>........] - ETA: 0s - loss: 2.7650e-04 - mean\_absolute\_error: 0.0125120/126 [===========================>..] - ETA: 0s - loss: 2.6047e-04 - mean\_absolute\_error: 0.0121126/126 [==============================] - 0s 2ms/step - loss: 2.5927e-04 - mean\_absolute\_error: 0.0121 - val\_loss: 1.4378e-04 - val\_mean\_absolute\_error: 0.0098

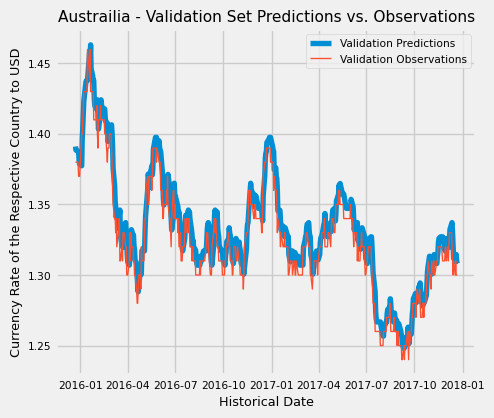
<keras.src.callbacks.History at 0x267df82eed0>

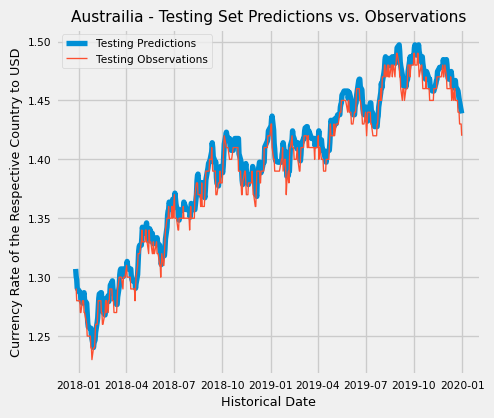
After the training and fitting of the Machine Learning model for Austrailia, I tried to create visualizations comparing the model against the country’s training dataset, validation dataset, but most importantly the testing dataset (as shown below in the line graphs). Note that the darker and thicker blue lines represent the prediction model’s projections and the thinner red lines is the observed/gathered data.

```{python}  
# Testing the Machine Learning Model prediction for Austrailia with the train,   
# validation, and test sets  
# Most important is the test set prediction as this tests the effectiveness  
# of the Machine Learning model on data it has not seen before   
austrailia\_train\_pred = austrailia\_model.predict(X\_austrailia\_train).flatten()  
  
plt.plot(dates\_austrailia\_train, austrailia\_train\_pred, linewidth=4)  
plt.plot(dates\_austrailia\_train, y\_austrailia\_train, linewidth=1)  
plt.legend(["Training Predictions", "Training Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Austrailia - Training Set Predictions vs. Observations")  
plt.show()  
  
austrailia\_val\_pred = austrailia\_model.predict(X\_austrailia\_val).flatten()  
  
plt.plot(dates\_austrailia\_val, austrailia\_val\_pred, linewidth=4)  
plt.plot(dates\_austrailia\_val, y\_austrailia\_val, linewidth=1)  
plt.legend(["Validation Predictions", "Validation Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Austrailia - Validation Set Predictions vs. Observations")  
plt.show()  
  
austrailia\_test\_pred = austrailia\_model.predict(X\_austrailia\_test).flatten()  
  
plt.plot(dates\_austrailia\_test, austrailia\_test\_pred, linewidth=4)  
plt.plot(dates\_austrailia\_test, y\_austrailia\_test, linewidth=1)  
plt.legend(["Testing Predictions", "Testing Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Austrailia - Testing Set Predictions vs. Observations")  
plt.show()  
```

1/126 [..............................] - ETA: 42s 44/126 [=========>....................] - ETA: 0s 89/126 [====================>.........] - ETA: 0s126/126 [==============================] - 0s 1ms/step  
 1/16 [>.............................] - ETA: 0s16/16 [==============================] - 0s 1ms/step  
 1/16 [>.............................] - ETA: 0s16/16 [==============================] - 0s 1ms/step

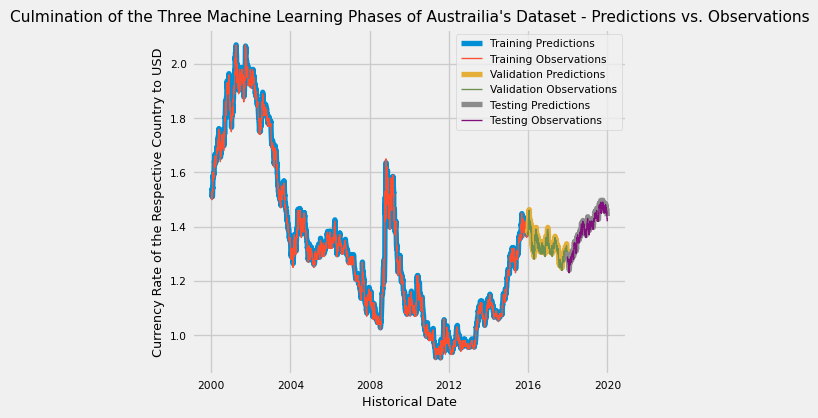






Through careful consideration of all of the prediction-based vs. observation-based contrast visualizations together, I consolidated all of graphics into one singular visualization for you to see below to get a more general perspective of the effectiveness of the Machine Learning model at training and fitting towards predicting Austrailia’s international currency rate with the United States.

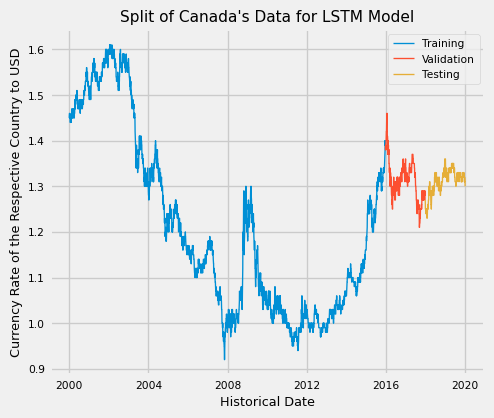
```{python}  
# Plotting Austrailia's observational (reference) data with the predictions of   
# its Machine Learning Model (as a way to visually inspect the effectiveness of   
# the model)   
plt.plot(dates\_austrailia\_train, austrailia\_train\_pred, linewidth=4)  
plt.plot(dates\_austrailia\_train, y\_austrailia\_train, linewidth=1)  
plt.plot(dates\_austrailia\_val, austrailia\_val\_pred, linewidth=4)  
plt.plot(dates\_austrailia\_val, y\_austrailia\_val, linewidth=1)  
plt.plot(dates\_austrailia\_test, austrailia\_test\_pred, linewidth=4)  
plt.plot(dates\_austrailia\_test, y\_austrailia\_test, linewidth=1)  
  
plt.legend(["Training Predictions",  
 "Training Observations",  
 "Validation Predictions",  
 "Validation Observations",  
 "Testing Predictions",  
 "Testing Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Culmination of the Three Machine Learning Phases of Austrailia's Dataset - Predictions vs. Observations")  
plt.show()  
```



Once Austraila’s data was completely trained and visualized, I worked on Canada’s data (as shown below):

Since the data (date, X, and y) is split into three np.arrays and to be more efficient, I will manually split Canada’s data into train, test, and validation datasets for the Machine Learning model with 80% going to the training dataset, the next 10% going to the validation dataset, and the last 10% going to the test dataset for each np.array respectively.

```{python}  
# Splitting Canada's data into train, test, and validation sets on 3 mediums:   
# the X-axis, the y-axis, and the indices (represented by dates)  
dates\_canada\_train, X\_canada\_train, y\_canada\_train = dates\_canada[:percentile\_80], X\_canada[:percentile\_80], y\_canada[:percentile\_80]  
dates\_canada\_val, X\_canada\_val, y\_canada\_val = dates\_canada[percentile\_80:percentile\_90], X\_canada[percentile\_80:percentile\_90], y\_canada[percentile\_80:percentile\_90]  
dates\_canada\_test, X\_canada\_test, y\_canada\_test = dates\_canada[percentile\_90:], X\_canada[percentile\_90:], y\_canada[percentile\_90:]  
  
plt.plot(dates\_canada\_train, y\_canada\_train, linewidth=1)  
plt.plot(dates\_canada\_val, y\_canada\_val, linewidth=1)  
plt.plot(dates\_canada\_test, y\_canada\_test, linewidth=1)  
  
plt.legend(["Training", "Validation", "Testing"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Split of Canada's Data for LSTM Model")  
plt.show()  
```



Now, I began to configure the Machine Learning model. We added Sequential layers: an Input layer 3 by 1 because we will have 3 np.arrays of Input and 1 np.array as output, utilize a LSTM (Long Short-Term Memory) layer of 64 neurons, apply 2 levels of dense layers with 32 neurons and folliowing recommendations online to use the RELU (Rectified Linear Unit) Activiation Function, and I followed up with one last dense layer of 1 neuron as our output layer since we are just trying to linearly-predict the next currency-rate on a near-future date. Once I configured the Sequential layers, we are ready to compile the model, utilzing the mean\_square\_error as our minimizing loss function, using the Adam optimizer, and comparing our trained model against our data with the mean\_absolute\_error metric. Lastly, I fitted our model, utilzing our X\_train and Y\_train datasets for fitting with validation from our X\_valid and Y\_valid datasets at 100 epochs.

```{python}  
# Configuring the Machine Learning Tensorflow Model for Canada  
canada\_model = Sequential([layers.Input((3, 1)),  
 layers.LSTM(64),  
 layers.Dense(32, activation="relu"),  
 layers.Dense(32, activation="relu"),  
 layers.Dense(1)])  
  
canada\_model.compile(loss="mse",  
 optimizer=Adam(learning\_rate=0.001),  
 metrics=["mean\_absolute\_error"])  
  
canada\_model.fit(X\_canada\_train, y\_canada\_train, validation\_data=(X\_canada\_val, y\_canada\_val), epochs=100)  
```

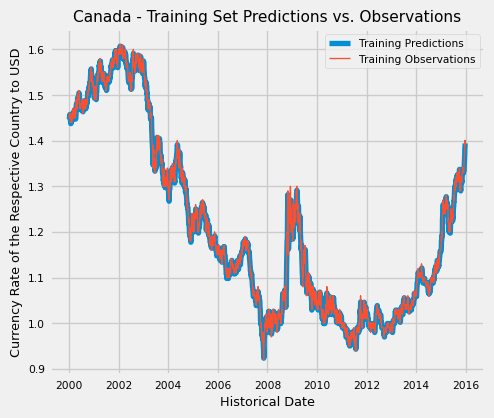
Epoch 1/100  
 1/126 [..............................] - ETA: 3:39 - loss: 1.5165 - mean\_absolute\_error: 1.2171 23/126 [====>.........................] - ETA: 0s - loss: 0.7380 - mean\_absolute\_error: 0.8199 47/126 [==========>...................] - ETA: 0s - loss: 0.3794 - mean\_absolute\_error: 0.4843 71/126 [===============>..............] - ETA: 0s - loss: 0.2528 - mean\_absolute\_error: 0.3387 95/126 [=====================>........] - ETA: 0s - loss: 0.1895 - mean\_absolute\_error: 0.2633119/126 [===========================>..] - ETA: 0s - loss: 0.1516 - mean\_absolute\_error: 0.2177126/126 [==============================] - 2s 5ms/step - loss: 0.1440 - mean\_absolute\_error: 0.2084 - val\_loss: 3.7276e-04 - val\_mean\_absolute\_error: 0.0160  
Epoch 2/100  
 1/126 [..............................] - ETA: 0s - loss: 0.0016 - mean\_absolute\_error: 0.0349 26/126 [=====>........................] - ETA: 0s - loss: 0.0014 - mean\_absolute\_error: 0.0333 51/126 [===========>..................] - ETA: 0s - loss: 0.0013 - mean\_absolute\_error: 0.0320 75/126 [================>.............] - ETA: 0s - loss: 0.0013 - mean\_absolute\_error: 0.0310100/126 [======================>.......] - ETA: 0s - loss: 0.0012 - mean\_absolute\_error: 0.0299124/126 [============================>.] - ETA: 0s - loss: 0.0011 - mean\_absolute\_error: 0.0288126/126 [==============================] - 0s 2ms/step - loss: 0.0011 - mean\_absolute\_error: 0.0288 - val\_loss: 2.5648e-04 - val\_mean\_absolute\_error: 0.0132  
Epoch 3/100  
 1/126 [..............................] - ETA: 0s - loss: 6.9545e-04 - mean\_absolute\_error: 0.0221 24/126 [====>.........................] - ETA: 0s - loss: 6.5636e-04 - mean\_absolute\_error: 0.0222 49/126 [==========>...................] - ETA: 0s - loss: 5.8997e-04 - mean\_absolute\_error: 0.0209 73/126 [================>.............] - ETA: 0s - loss: 5.4778e-04 - mean\_absolute\_error: 0.0201 97/126 [======================>.......] - ETA: 0s - loss: 5.0122e-04 - mean\_absolute\_error: 0.0191121/126 [===========================>..] - ETA: 0s - loss: 4.6290e-04 - mean\_absolute\_error: 0.0183126/126 [==============================] - 0s 2ms/step - loss: 4.5420e-04 - mean\_absolute\_error: 0.0181 - val\_loss: 1.3251e-04 - val\_mean\_absolute\_error: 0.0091  
Epoch 4/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9816e-04 - mean\_absolute\_error: 0.0121 25/126 [====>.........................] - ETA: 0s - loss: 2.4472e-04 - mean\_absolute\_error: 0.0131 49/126 [==========>...................] - ETA: 0s - loss: 2.3117e-04 - mean\_absolute\_error: 0.0126 74/126 [================>.............] - ETA: 0s - loss: 2.1065e-04 - mean\_absolute\_error: 0.0120 98/126 [======================>.......] - ETA: 0s - loss: 1.9166e-04 - mean\_absolute\_error: 0.0113123/126 [============================>.] - ETA: 0s - loss: 1.8050e-04 - mean\_absolute\_error: 0.0109126/126 [==============================] - 0s 2ms/step - loss: 1.7984e-04 - mean\_absolute\_error: 0.0109 - val\_loss: 1.2670e-04 - val\_mean\_absolute\_error: 0.0090  
Epoch 5/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2902e-04 - mean\_absolute\_error: 0.0092 25/126 [====>.........................] - ETA: 0s - loss: 1.0165e-04 - mean\_absolute\_error: 0.0079 49/126 [==========>...................] - ETA: 0s - loss: 1.0831e-04 - mean\_absolute\_error: 0.0082 73/126 [================>.............] - ETA: 0s - loss: 1.1055e-04 - mean\_absolute\_error: 0.0082 97/126 [======================>.......] - ETA: 0s - loss: 1.0971e-04 - mean\_absolute\_error: 0.0081121/126 [===========================>..] - ETA: 0s - loss: 1.0747e-04 - mean\_absolute\_error: 0.0080126/126 [==============================] - 0s 2ms/step - loss: 1.0709e-04 - mean\_absolute\_error: 0.0080 - val\_loss: 1.1330e-04 - val\_mean\_absolute\_error: 0.0084  
Epoch 6/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0200e-04 - mean\_absolute\_error: 0.0074 26/126 [=====>........................] - ETA: 0s - loss: 9.6588e-05 - mean\_absolute\_error: 0.0074 51/126 [===========>..................] - ETA: 0s - loss: 9.8214e-05 - mean\_absolute\_error: 0.0075 76/126 [=================>............] - ETA: 0s - loss: 9.5444e-05 - mean\_absolute\_error: 0.0075 99/126 [======================>.......] - ETA: 0s - loss: 9.5554e-05 - mean\_absolute\_error: 0.0074123/126 [============================>.] - ETA: 0s - loss: 9.5250e-05 - mean\_absolute\_error: 0.0074126/126 [==============================] - 0s 2ms/step - loss: 9.5556e-05 - mean\_absolute\_error: 0.0074 - val\_loss: 1.1735e-04 - val\_mean\_absolute\_error: 0.0086  
Epoch 7/100  
 1/126 [..............................] - ETA: 0s - loss: 6.3206e-05 - mean\_absolute\_error: 0.0054 26/126 [=====>........................] - ETA: 0s - loss: 9.2934e-05 - mean\_absolute\_error: 0.0073 50/126 [==========>...................] - ETA: 0s - loss: 9.6372e-05 - mean\_absolute\_error: 0.0074 74/126 [================>.............] - ETA: 0s - loss: 9.4524e-05 - mean\_absolute\_error: 0.0073 98/126 [======================>.......] - ETA: 0s - loss: 9.5588e-05 - mean\_absolute\_error: 0.0074122/126 [============================>.] - ETA: 0s - loss: 9.5531e-05 - mean\_absolute\_error: 0.0074126/126 [==============================] - 0s 2ms/step - loss: 9.5195e-05 - mean\_absolute\_error: 0.0073 - val\_loss: 1.0717e-04 - val\_mean\_absolute\_error: 0.0080  
Epoch 8/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1198e-04 - mean\_absolute\_error: 0.0086 26/126 [=====>........................] - ETA: 0s - loss: 9.6285e-05 - mean\_absolute\_error: 0.0075 51/126 [===========>..................] - ETA: 0s - loss: 9.4837e-05 - mean\_absolute\_error: 0.0074 75/126 [================>.............] - ETA: 0s - loss: 9.2504e-05 - mean\_absolute\_error: 0.0073 99/126 [======================>.......] - ETA: 0s - loss: 9.2848e-05 - mean\_absolute\_error: 0.0073124/126 [============================>.] - ETA: 0s - loss: 9.4548e-05 - mean\_absolute\_error: 0.0073126/126 [==============================] - 0s 2ms/step - loss: 9.4238e-05 - mean\_absolute\_error: 0.0073 - val\_loss: 1.2343e-04 - val\_mean\_absolute\_error: 0.0089  
Epoch 9/100  
 1/126 [..............................] - ETA: 0s - loss: 9.9251e-05 - mean\_absolute\_error: 0.0078 25/126 [====>.........................] - ETA: 0s - loss: 8.8113e-05 - mean\_absolute\_error: 0.0071 49/126 [==========>...................] - ETA: 0s - loss: 8.8249e-05 - mean\_absolute\_error: 0.0071 73/126 [================>.............] - ETA: 0s - loss: 9.2567e-05 - mean\_absolute\_error: 0.0072 97/126 [======================>.......] - ETA: 0s - loss: 9.3558e-05 - mean\_absolute\_error: 0.0073120/126 [===========================>..] - ETA: 0s - loss: 9.4845e-05 - mean\_absolute\_error: 0.0073126/126 [==============================] - 0s 2ms/step - loss: 9.4016e-05 - mean\_absolute\_error: 0.0073 - val\_loss: 1.3391e-04 - val\_mean\_absolute\_error: 0.0093  
Epoch 10/100  
 1/126 [..............................] - ETA: 0s - loss: 7.8835e-05 - mean\_absolute\_error: 0.0069 26/126 [=====>........................] - ETA: 0s - loss: 1.0742e-04 - mean\_absolute\_error: 0.0078 50/126 [==========>...................] - ETA: 0s - loss: 9.4943e-05 - mean\_absolute\_error: 0.0074 74/126 [================>.............] - ETA: 0s - loss: 9.6977e-05 - mean\_absolute\_error: 0.0074 98/126 [======================>.......] - ETA: 0s - loss: 9.6134e-05 - mean\_absolute\_error: 0.0074122/126 [============================>.] - ETA: 0s - loss: 9.5809e-05 - mean\_absolute\_error: 0.0074126/126 [==============================] - 0s 2ms/step - loss: 9.6215e-05 - mean\_absolute\_error: 0.0074 - val\_loss: 1.0546e-04 - val\_mean\_absolute\_error: 0.0079  
Epoch 11/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4452e-04 - mean\_absolute\_error: 0.0078 26/126 [=====>........................] - ETA: 0s - loss: 1.0379e-04 - mean\_absolute\_error: 0.0074 50/126 [==========>...................] - ETA: 0s - loss: 1.0170e-04 - mean\_absolute\_error: 0.0075 73/126 [================>.............] - ETA: 0s - loss: 9.6436e-05 - mean\_absolute\_error: 0.0073 97/126 [======================>.......] - ETA: 0s - loss: 9.7978e-05 - mean\_absolute\_error: 0.0074121/126 [===========================>..] - ETA: 0s - loss: 9.5419e-05 - mean\_absolute\_error: 0.0074126/126 [==============================] - 0s 2ms/step - loss: 9.5365e-05 - mean\_absolute\_error: 0.0073 - val\_loss: 1.0784e-04 - val\_mean\_absolute\_error: 0.0081  
Epoch 12/100  
 1/126 [..............................] - ETA: 0s - loss: 7.8708e-05 - mean\_absolute\_error: 0.0066 26/126 [=====>........................] - ETA: 0s - loss: 1.0791e-04 - mean\_absolute\_error: 0.0079 50/126 [==========>...................] - ETA: 0s - loss: 9.9068e-05 - mean\_absolute\_error: 0.0075 74/126 [================>.............] - ETA: 0s - loss: 9.6690e-05 - mean\_absolute\_error: 0.0074 99/126 [======================>.......] - ETA: 0s - loss: 9.5788e-05 - mean\_absolute\_error: 0.0074123/126 [============================>.] - ETA: 0s - loss: 9.4430e-05 - mean\_absolute\_error: 0.0073126/126 [==============================] - 0s 2ms/step - loss: 9.5017e-05 - mean\_absolute\_error: 0.0073 - val\_loss: 1.0606e-04 - val\_mean\_absolute\_error: 0.0079  
Epoch 13/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0619e-04 - mean\_absolute\_error: 0.0078 26/126 [=====>........................] - ETA: 0s - loss: 9.8858e-05 - mean\_absolute\_error: 0.0076 51/126 [===========>..................] - ETA: 0s - loss: 9.7603e-05 - mean\_absolute\_error: 0.0076 75/126 [================>.............] - ETA: 0s - loss: 9.7128e-05 - mean\_absolute\_error: 0.0075 99/126 [======================>.......] - ETA: 0s - loss: 9.7018e-05 - mean\_absolute\_error: 0.0075122/126 [============================>.] - ETA: 0s - loss: 9.5781e-05 - mean\_absolute\_error: 0.0074126/126 [==============================] - 0s 2ms/step - loss: 9.6343e-05 - mean\_absolute\_error: 0.0074 - val\_loss: 1.0796e-04 - val\_mean\_absolute\_error: 0.0081  
Epoch 14/100  
 1/126 [..............................] - ETA: 0s - loss: 8.0366e-05 - mean\_absolute\_error: 0.0072 25/126 [====>.........................] - ETA: 0s - loss: 9.3032e-05 - mean\_absolute\_error: 0.0072 50/126 [==========>...................] - ETA: 0s - loss: 9.4512e-05 - mean\_absolute\_error: 0.0073 74/126 [================>.............] - ETA: 0s - loss: 9.3449e-05 - mean\_absolute\_error: 0.0074 99/126 [======================>.......] - ETA: 0s - loss: 9.7441e-05 - mean\_absolute\_error: 0.0075124/126 [============================>.] - ETA: 0s - loss: 9.6451e-05 - mean\_absolute\_error: 0.0074126/126 [==============================] - 0s 2ms/step - loss: 9.6470e-05 - mean\_absolute\_error: 0.0074 - val\_loss: 1.0942e-04 - val\_mean\_absolute\_error: 0.0082  
Epoch 15/100  
 1/126 [..............................] - ETA: 0s - loss: 7.1976e-05 - mean\_absolute\_error: 0.0064 26/126 [=====>........................] - ETA: 0s - loss: 9.8383e-05 - mean\_absolute\_error: 0.0072 50/126 [==========>...................] - ETA: 0s - loss: 1.0081e-04 - mean\_absolute\_error: 0.0074 74/126 [================>.............] - ETA: 0s - loss: 9.5671e-05 - mean\_absolute\_error: 0.0073 99/126 [======================>.......] - ETA: 0s - loss: 9.5573e-05 - mean\_absolute\_error: 0.0073123/126 [============================>.] - ETA: 0s - loss: 9.3996e-05 - mean\_absolute\_error: 0.0073126/126 [==============================] - 0s 2ms/step - loss: 9.4805e-05 - mean\_absolute\_error: 0.0073 - val\_loss: 1.0592e-04 - val\_mean\_absolute\_error: 0.0080  
Epoch 16/100  
 1/126 [..............................] - ETA: 0s - loss: 5.1964e-05 - mean\_absolute\_error: 0.0056 25/126 [====>.........................] - ETA: 0s - loss: 9.6855e-05 - mean\_absolute\_error: 0.0073 49/126 [==========>...................] - ETA: 0s - loss: 9.9987e-05 - mean\_absolute\_error: 0.0075 73/126 [================>.............] - ETA: 0s - loss: 9.9090e-05 - mean\_absolute\_error: 0.0075 97/126 [======================>.......] - ETA: 0s - loss: 9.8551e-05 - mean\_absolute\_error: 0.0075121/126 [===========================>..] - ETA: 0s - loss: 9.7704e-05 - mean\_absolute\_error: 0.0075126/126 [==============================] - 0s 2ms/step - loss: 9.8589e-05 - mean\_absolute\_error: 0.0075 - val\_loss: 1.3558e-04 - val\_mean\_absolute\_error: 0.0093  
Epoch 17/100  
 1/126 [..............................] - ETA: 0s - loss: 8.9017e-05 - mean\_absolute\_error: 0.0071 25/126 [====>.........................] - ETA: 0s - loss: 9.4539e-05 - mean\_absolute\_error: 0.0075 49/126 [==========>...................] - ETA: 0s - loss: 9.8046e-05 - mean\_absolute\_error: 0.0074 74/126 [================>.............] - ETA: 0s - loss: 9.8597e-05 - mean\_absolute\_error: 0.0075 98/126 [======================>.......] - ETA: 0s - loss: 9.6004e-05 - mean\_absolute\_error: 0.0074122/126 [============================>.] - ETA: 0s - loss: 9.6418e-05 - mean\_absolute\_error: 0.0074126/126 [==============================] - 0s 2ms/step - loss: 9.6521e-05 - mean\_absolute\_error: 0.0074 - val\_loss: 1.3820e-04 - val\_mean\_absolute\_error: 0.0094  
Epoch 18/100  
 1/126 [..............................] - ETA: 0s - loss: 9.5848e-05 - mean\_absolute\_error: 0.0077 26/126 [=====>........................] - ETA: 0s - loss: 9.9447e-05 - mean\_absolute\_error: 0.0076 50/126 [==========>...................] - ETA: 0s - loss: 9.9319e-05 - mean\_absolute\_error: 0.0076 74/126 [================>.............] - ETA: 0s - loss: 9.4774e-05 - mean\_absolute\_error: 0.0074 98/126 [======================>.......] - ETA: 0s - loss: 9.9848e-05 - mean\_absolute\_error: 0.0075122/126 [============================>.] - ETA: 0s - loss: 9.9259e-05 - mean\_absolute\_error: 0.0075126/126 [==============================] - 0s 2ms/step - loss: 9.9242e-05 - mean\_absolute\_error: 0.0075 - val\_loss: 1.2265e-04 - val\_mean\_absolute\_error: 0.0088  
Epoch 19/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0033e-04 - mean\_absolute\_error: 0.0078 25/126 [====>.........................] - ETA: 0s - loss: 9.6785e-05 - mean\_absolute\_error: 0.0073 47/126 [==========>...................] - ETA: 0s - loss: 1.0610e-04 - mean\_absolute\_error: 0.0077 67/126 [==============>...............] - ETA: 0s - loss: 9.9325e-05 - mean\_absolute\_error: 0.0075 81/126 [==================>...........] - ETA: 0s - loss: 9.8920e-05 - mean\_absolute\_error: 0.0075 98/126 [======================>.......] - ETA: 0s - loss: 9.9635e-05 - mean\_absolute\_error: 0.0075113/126 [=========================>....] - ETA: 0s - loss: 1.0138e-04 - mean\_absolute\_error: 0.0076126/126 [==============================] - 0s 3ms/step - loss: 1.0030e-04 - mean\_absolute\_error: 0.0076 - val\_loss: 1.0885e-04 - val\_mean\_absolute\_error: 0.0081  
Epoch 20/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1370e-04 - mean\_absolute\_error: 0.0085 26/126 [=====>........................] - ETA: 0s - loss: 9.2146e-05 - mean\_absolute\_error: 0.0072 51/126 [===========>..................] - ETA: 0s - loss: 9.7870e-05 - mean\_absolute\_error: 0.0074 75/126 [================>.............] - ETA: 0s - loss: 9.7782e-05 - mean\_absolute\_error: 0.0074 98/126 [======================>.......] - ETA: 0s - loss: 9.7265e-05 - mean\_absolute\_error: 0.0074124/126 [============================>.] - ETA: 0s - loss: 9.4438e-05 - mean\_absolute\_error: 0.0073126/126 [==============================] - 0s 2ms/step - loss: 9.4170e-05 - mean\_absolute\_error: 0.0073 - val\_loss: 1.1651e-04 - val\_mean\_absolute\_error: 0.0085  
Epoch 21/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4692e-04 - mean\_absolute\_error: 0.0085 26/126 [=====>........................] - ETA: 0s - loss: 1.1417e-04 - mean\_absolute\_error: 0.0079 50/126 [==========>...................] - ETA: 0s - loss: 1.0872e-04 - mean\_absolute\_error: 0.0078 74/126 [================>.............] - ETA: 0s - loss: 1.0591e-04 - mean\_absolute\_error: 0.0079 99/126 [======================>.......] - ETA: 0s - loss: 1.0390e-04 - mean\_absolute\_error: 0.0078123/126 [============================>.] - ETA: 0s - loss: 1.0294e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 3ms/step - loss: 1.0308e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.0636e-04 - val\_mean\_absolute\_error: 0.0081  
Epoch 22/100  
 1/126 [..............................] - ETA: 0s - loss: 7.8271e-05 - mean\_absolute\_error: 0.0071 24/126 [====>.........................] - ETA: 0s - loss: 9.6081e-05 - mean\_absolute\_error: 0.0074 48/126 [==========>...................] - ETA: 0s - loss: 1.0151e-04 - mean\_absolute\_error: 0.0075 72/126 [================>.............] - ETA: 0s - loss: 1.0013e-04 - mean\_absolute\_error: 0.0076 96/126 [=====================>........] - ETA: 0s - loss: 1.0008e-04 - mean\_absolute\_error: 0.0076120/126 [===========================>..] - ETA: 0s - loss: 1.0246e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0346e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.3203e-04 - val\_mean\_absolute\_error: 0.0092  
Epoch 23/100  
 1/126 [..............................] - ETA: 0s - loss: 8.4591e-05 - mean\_absolute\_error: 0.0074 26/126 [=====>........................] - ETA: 0s - loss: 1.1212e-04 - mean\_absolute\_error: 0.0079 49/126 [==========>...................] - ETA: 0s - loss: 1.1325e-04 - mean\_absolute\_error: 0.0080 73/126 [================>.............] - ETA: 0s - loss: 1.0624e-04 - mean\_absolute\_error: 0.0078 98/126 [======================>.......] - ETA: 0s - loss: 1.0324e-04 - mean\_absolute\_error: 0.0077122/126 [============================>.] - ETA: 0s - loss: 9.9467e-05 - mean\_absolute\_error: 0.0075126/126 [==============================] - 0s 2ms/step - loss: 9.9134e-05 - mean\_absolute\_error: 0.0075 - val\_loss: 1.1154e-04 - val\_mean\_absolute\_error: 0.0083  
Epoch 24/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4083e-04 - mean\_absolute\_error: 0.0079 25/126 [====>.........................] - ETA: 0s - loss: 9.7008e-05 - mean\_absolute\_error: 0.0074 50/126 [==========>...................] - ETA: 0s - loss: 1.0127e-04 - mean\_absolute\_error: 0.0078 74/126 [================>.............] - ETA: 0s - loss: 1.0341e-04 - mean\_absolute\_error: 0.0078 98/126 [======================>.......] - ETA: 0s - loss: 1.0042e-04 - mean\_absolute\_error: 0.0077122/126 [============================>.] - ETA: 0s - loss: 9.9993e-05 - mean\_absolute\_error: 0.0076126/126 [==============================] - 0s 2ms/step - loss: 9.9629e-05 - mean\_absolute\_error: 0.0076 - val\_loss: 1.0787e-04 - val\_mean\_absolute\_error: 0.0080  
Epoch 25/100  
 1/126 [..............................] - ETA: 0s - loss: 8.4186e-05 - mean\_absolute\_error: 0.0075 25/126 [====>.........................] - ETA: 0s - loss: 9.2387e-05 - mean\_absolute\_error: 0.0073 50/126 [==========>...................] - ETA: 0s - loss: 1.0376e-04 - mean\_absolute\_error: 0.0076 74/126 [================>.............] - ETA: 0s - loss: 1.0408e-04 - mean\_absolute\_error: 0.0077 98/126 [======================>.......] - ETA: 0s - loss: 1.0039e-04 - mean\_absolute\_error: 0.0075122/126 [============================>.] - ETA: 0s - loss: 9.9437e-05 - mean\_absolute\_error: 0.0075126/126 [==============================] - 0s 2ms/step - loss: 1.0006e-04 - mean\_absolute\_error: 0.0076 - val\_loss: 1.9398e-04 - val\_mean\_absolute\_error: 0.0115  
Epoch 26/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3241e-04 - mean\_absolute\_error: 0.0093 25/126 [====>.........................] - ETA: 0s - loss: 1.3816e-04 - mean\_absolute\_error: 0.0090 49/126 [==========>...................] - ETA: 0s - loss: 1.2719e-04 - mean\_absolute\_error: 0.0086 73/126 [================>.............] - ETA: 0s - loss: 1.1486e-04 - mean\_absolute\_error: 0.0081 97/126 [======================>.......] - ETA: 0s - loss: 1.0872e-04 - mean\_absolute\_error: 0.0079121/126 [===========================>..] - ETA: 0s - loss: 1.0877e-04 - mean\_absolute\_error: 0.0080126/126 [==============================] - 0s 2ms/step - loss: 1.0995e-04 - mean\_absolute\_error: 0.0080 - val\_loss: 1.3034e-04 - val\_mean\_absolute\_error: 0.0090  
Epoch 27/100  
 1/126 [..............................] - ETA: 0s - loss: 7.6690e-05 - mean\_absolute\_error: 0.0071 25/126 [====>.........................] - ETA: 0s - loss: 9.6971e-05 - mean\_absolute\_error: 0.0075 49/126 [==========>...................] - ETA: 0s - loss: 1.0034e-04 - mean\_absolute\_error: 0.0076 73/126 [================>.............] - ETA: 0s - loss: 9.8655e-05 - mean\_absolute\_error: 0.0075 96/126 [=====================>........] - ETA: 0s - loss: 1.0061e-04 - mean\_absolute\_error: 0.0075120/126 [===========================>..] - ETA: 0s - loss: 1.0108e-04 - mean\_absolute\_error: 0.0076126/126 [==============================] - 0s 2ms/step - loss: 1.0105e-04 - mean\_absolute\_error: 0.0076 - val\_loss: 1.1206e-04 - val\_mean\_absolute\_error: 0.0083  
Epoch 28/100  
 1/126 [..............................] - ETA: 0s - loss: 7.4997e-05 - mean\_absolute\_error: 0.0072 25/126 [====>.........................] - ETA: 0s - loss: 8.8089e-05 - mean\_absolute\_error: 0.0072 49/126 [==========>...................] - ETA: 0s - loss: 9.0135e-05 - mean\_absolute\_error: 0.0073 73/126 [================>.............] - ETA: 0s - loss: 9.5155e-05 - mean\_absolute\_error: 0.0074 95/126 [=====================>........] - ETA: 0s - loss: 1.0396e-04 - mean\_absolute\_error: 0.0078111/126 [=========================>....] - ETA: 0s - loss: 1.0349e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 3ms/step - loss: 1.0310e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.1589e-04 - val\_mean\_absolute\_error: 0.0085  
Epoch 29/100  
 1/126 [..............................] - ETA: 0s - loss: 9.7921e-05 - mean\_absolute\_error: 0.0082 26/126 [=====>........................] - ETA: 0s - loss: 1.0658e-04 - mean\_absolute\_error: 0.0080 50/126 [==========>...................] - ETA: 0s - loss: 1.0628e-04 - mean\_absolute\_error: 0.0079 73/126 [================>.............] - ETA: 0s - loss: 1.0375e-04 - mean\_absolute\_error: 0.0078 96/126 [=====================>........] - ETA: 0s - loss: 1.0161e-04 - mean\_absolute\_error: 0.0077121/126 [===========================>..] - ETA: 0s - loss: 1.0248e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0211e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.1680e-04 - val\_mean\_absolute\_error: 0.0086  
Epoch 30/100  
 1/126 [..............................] - ETA: 0s - loss: 5.8923e-05 - mean\_absolute\_error: 0.0059 26/126 [=====>........................] - ETA: 0s - loss: 8.4825e-05 - mean\_absolute\_error: 0.0071 48/126 [==========>...................] - ETA: 0s - loss: 9.4173e-05 - mean\_absolute\_error: 0.0075 71/126 [===============>..............] - ETA: 0s - loss: 9.7557e-05 - mean\_absolute\_error: 0.0075 96/126 [=====================>........] - ETA: 0s - loss: 1.0101e-04 - mean\_absolute\_error: 0.0077120/126 [===========================>..] - ETA: 0s - loss: 1.0261e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0231e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.0485e-04 - val\_mean\_absolute\_error: 0.0080  
Epoch 31/100  
 1/126 [..............................] - ETA: 0s - loss: 6.9211e-05 - mean\_absolute\_error: 0.0068 26/126 [=====>........................] - ETA: 0s - loss: 9.6328e-05 - mean\_absolute\_error: 0.0073 50/126 [==========>...................] - ETA: 0s - loss: 9.8758e-05 - mean\_absolute\_error: 0.0075 75/126 [================>.............] - ETA: 0s - loss: 9.8573e-05 - mean\_absolute\_error: 0.0075100/126 [======================>.......] - ETA: 0s - loss: 9.8052e-05 - mean\_absolute\_error: 0.0075124/126 [============================>.] - ETA: 0s - loss: 9.8048e-05 - mean\_absolute\_error: 0.0075126/126 [==============================] - 0s 2ms/step - loss: 9.9206e-05 - mean\_absolute\_error: 0.0075 - val\_loss: 1.3879e-04 - val\_mean\_absolute\_error: 0.0093  
Epoch 32/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6398e-04 - mean\_absolute\_error: 0.0110 26/126 [=====>........................] - ETA: 0s - loss: 1.4129e-04 - mean\_absolute\_error: 0.0093 51/126 [===========>..................] - ETA: 0s - loss: 1.2792e-04 - mean\_absolute\_error: 0.0088 76/126 [=================>............] - ETA: 0s - loss: 1.2132e-04 - mean\_absolute\_error: 0.0085101/126 [=======================>......] - ETA: 0s - loss: 1.2181e-04 - mean\_absolute\_error: 0.0085125/126 [============================>.] - ETA: 0s - loss: 1.1746e-04 - mean\_absolute\_error: 0.0083126/126 [==============================] - 0s 2ms/step - loss: 1.1736e-04 - mean\_absolute\_error: 0.0083 - val\_loss: 1.2468e-04 - val\_mean\_absolute\_error: 0.0088  
Epoch 33/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0212e-04 - mean\_absolute\_error: 0.0084 26/126 [=====>........................] - ETA: 0s - loss: 1.1920e-04 - mean\_absolute\_error: 0.0084 50/126 [==========>...................] - ETA: 0s - loss: 1.0660e-04 - mean\_absolute\_error: 0.0080 74/126 [================>.............] - ETA: 0s - loss: 1.0240e-04 - mean\_absolute\_error: 0.0078 97/126 [======================>.......] - ETA: 0s - loss: 1.0353e-04 - mean\_absolute\_error: 0.0077121/126 [===========================>..] - ETA: 0s - loss: 1.0477e-04 - mean\_absolute\_error: 0.0079126/126 [==============================] - 0s 2ms/step - loss: 1.0491e-04 - mean\_absolute\_error: 0.0079 - val\_loss: 1.0814e-04 - val\_mean\_absolute\_error: 0.0082  
Epoch 34/100  
 1/126 [..............................] - ETA: 0s - loss: 6.5324e-05 - mean\_absolute\_error: 0.0063 25/126 [====>.........................] - ETA: 0s - loss: 8.7437e-05 - mean\_absolute\_error: 0.0071 50/126 [==========>...................] - ETA: 0s - loss: 9.6709e-05 - mean\_absolute\_error: 0.0075 74/126 [================>.............] - ETA: 0s - loss: 1.0137e-04 - mean\_absolute\_error: 0.0076 98/126 [======================>.......] - ETA: 0s - loss: 1.0424e-04 - mean\_absolute\_error: 0.0077122/126 [============================>.] - ETA: 0s - loss: 1.0232e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0207e-04 - mean\_absolute\_error: 0.0076 - val\_loss: 1.1549e-04 - val\_mean\_absolute\_error: 0.0085  
Epoch 35/100  
 1/126 [..............................] - ETA: 0s - loss: 9.3068e-05 - mean\_absolute\_error: 0.0078 26/126 [=====>........................] - ETA: 0s - loss: 9.9616e-05 - mean\_absolute\_error: 0.0075 50/126 [==========>...................] - ETA: 0s - loss: 9.5864e-05 - mean\_absolute\_error: 0.0074 74/126 [================>.............] - ETA: 0s - loss: 9.8465e-05 - mean\_absolute\_error: 0.0075 98/126 [======================>.......] - ETA: 0s - loss: 1.0432e-04 - mean\_absolute\_error: 0.0077122/126 [============================>.] - ETA: 0s - loss: 1.0090e-04 - mean\_absolute\_error: 0.0076126/126 [==============================] - 0s 2ms/step - loss: 1.0064e-04 - mean\_absolute\_error: 0.0076 - val\_loss: 1.0393e-04 - val\_mean\_absolute\_error: 0.0079  
Epoch 36/100  
 1/126 [..............................] - ETA: 0s - loss: 3.9353e-05 - mean\_absolute\_error: 0.0055 25/126 [====>.........................] - ETA: 0s - loss: 9.9522e-05 - mean\_absolute\_error: 0.0076 49/126 [==========>...................] - ETA: 0s - loss: 1.1486e-04 - mean\_absolute\_error: 0.0083 73/126 [================>.............] - ETA: 0s - loss: 1.4444e-04 - mean\_absolute\_error: 0.0094 98/126 [======================>.......] - ETA: 0s - loss: 1.4328e-04 - mean\_absolute\_error: 0.0094120/126 [===========================>..] - ETA: 0s - loss: 1.3476e-04 - mean\_absolute\_error: 0.0091126/126 [==============================] - 0s 2ms/step - loss: 1.3339e-04 - mean\_absolute\_error: 0.0090 - val\_loss: 1.3369e-04 - val\_mean\_absolute\_error: 0.0093  
Epoch 37/100  
 1/126 [..............................] - ETA: 0s - loss: 9.2032e-05 - mean\_absolute\_error: 0.0076 25/126 [====>.........................] - ETA: 0s - loss: 9.9610e-05 - mean\_absolute\_error: 0.0077 49/126 [==========>...................] - ETA: 0s - loss: 1.0214e-04 - mean\_absolute\_error: 0.0076 73/126 [================>.............] - ETA: 0s - loss: 1.0171e-04 - mean\_absolute\_error: 0.0076 96/126 [=====================>........] - ETA: 0s - loss: 1.0266e-04 - mean\_absolute\_error: 0.0077121/126 [===========================>..] - ETA: 0s - loss: 1.0185e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0157e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.0552e-04 - val\_mean\_absolute\_error: 0.0080  
Epoch 38/100  
 1/126 [..............................] - ETA: 0s - loss: 5.1984e-05 - mean\_absolute\_error: 0.0060 26/126 [=====>........................] - ETA: 0s - loss: 9.3840e-05 - mean\_absolute\_error: 0.0073 50/126 [==========>...................] - ETA: 0s - loss: 1.0914e-04 - mean\_absolute\_error: 0.0080 74/126 [================>.............] - ETA: 0s - loss: 1.1025e-04 - mean\_absolute\_error: 0.0080 98/126 [======================>.......] - ETA: 0s - loss: 1.2002e-04 - mean\_absolute\_error: 0.0085122/126 [============================>.] - ETA: 0s - loss: 1.2310e-04 - mean\_absolute\_error: 0.0086126/126 [==============================] - 0s 2ms/step - loss: 1.2245e-04 - mean\_absolute\_error: 0.0086 - val\_loss: 1.1533e-04 - val\_mean\_absolute\_error: 0.0085  
Epoch 39/100  
 1/126 [..............................] - ETA: 0s - loss: 8.6742e-05 - mean\_absolute\_error: 0.0084 26/126 [=====>........................] - ETA: 0s - loss: 1.0559e-04 - mean\_absolute\_error: 0.0079 50/126 [==========>...................] - ETA: 0s - loss: 1.0631e-04 - mean\_absolute\_error: 0.0080 75/126 [================>.............] - ETA: 0s - loss: 1.0521e-04 - mean\_absolute\_error: 0.0078100/126 [======================>.......] - ETA: 0s - loss: 1.0900e-04 - mean\_absolute\_error: 0.0080124/126 [============================>.] - ETA: 0s - loss: 1.0728e-04 - mean\_absolute\_error: 0.0079126/126 [==============================] - 0s 2ms/step - loss: 1.0744e-04 - mean\_absolute\_error: 0.0079 - val\_loss: 1.8473e-04 - val\_mean\_absolute\_error: 0.0110  
Epoch 40/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6647e-04 - mean\_absolute\_error: 0.0106 25/126 [====>.........................] - ETA: 0s - loss: 1.0412e-04 - mean\_absolute\_error: 0.0077 49/126 [==========>...................] - ETA: 0s - loss: 9.5078e-05 - mean\_absolute\_error: 0.0075 73/126 [================>.............] - ETA: 0s - loss: 9.8324e-05 - mean\_absolute\_error: 0.0076 97/126 [======================>.......] - ETA: 0s - loss: 1.0679e-04 - mean\_absolute\_error: 0.0079120/126 [===========================>..] - ETA: 0s - loss: 1.0828e-04 - mean\_absolute\_error: 0.0079126/126 [==============================] - 0s 2ms/step - loss: 1.0615e-04 - mean\_absolute\_error: 0.0078 - val\_loss: 1.0338e-04 - val\_mean\_absolute\_error: 0.0078  
Epoch 41/100  
 1/126 [..............................] - ETA: 0s - loss: 4.1504e-05 - mean\_absolute\_error: 0.0049 26/126 [=====>........................] - ETA: 0s - loss: 1.1252e-04 - mean\_absolute\_error: 0.0082 51/126 [===========>..................] - ETA: 0s - loss: 1.2009e-04 - mean\_absolute\_error: 0.0084 74/126 [================>.............] - ETA: 0s - loss: 1.1236e-04 - mean\_absolute\_error: 0.0081 97/126 [======================>.......] - ETA: 0s - loss: 1.1314e-04 - mean\_absolute\_error: 0.0082120/126 [===========================>..] - ETA: 0s - loss: 1.1179e-04 - mean\_absolute\_error: 0.0081126/126 [==============================] - 0s 2ms/step - loss: 1.1162e-04 - mean\_absolute\_error: 0.0081 - val\_loss: 1.0268e-04 - val\_mean\_absolute\_error: 0.0079  
Epoch 42/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0338e-04 - mean\_absolute\_error: 0.0066 25/126 [====>.........................] - ETA: 0s - loss: 8.6617e-05 - mean\_absolute\_error: 0.0072 49/126 [==========>...................] - ETA: 0s - loss: 8.8273e-05 - mean\_absolute\_error: 0.0072 73/126 [================>.............] - ETA: 0s - loss: 1.0096e-04 - mean\_absolute\_error: 0.0077 96/126 [=====================>........] - ETA: 0s - loss: 1.0384e-04 - mean\_absolute\_error: 0.0078120/126 [===========================>..] - ETA: 0s - loss: 1.0773e-04 - mean\_absolute\_error: 0.0079126/126 [==============================] - 0s 2ms/step - loss: 1.0850e-04 - mean\_absolute\_error: 0.0080 - val\_loss: 1.1003e-04 - val\_mean\_absolute\_error: 0.0082  
Epoch 43/100  
 1/126 [..............................] - ETA: 0s - loss: 8.1186e-05 - mean\_absolute\_error: 0.0064 25/126 [====>.........................] - ETA: 0s - loss: 9.0864e-05 - mean\_absolute\_error: 0.0071 48/126 [==========>...................] - ETA: 0s - loss: 9.6936e-05 - mean\_absolute\_error: 0.0073 72/126 [================>.............] - ETA: 0s - loss: 1.0209e-04 - mean\_absolute\_error: 0.0075 97/126 [======================>.......] - ETA: 0s - loss: 1.0406e-04 - mean\_absolute\_error: 0.0076121/126 [===========================>..] - ETA: 0s - loss: 1.0252e-04 - mean\_absolute\_error: 0.0076126/126 [==============================] - 0s 2ms/step - loss: 1.0171e-04 - mean\_absolute\_error: 0.0076 - val\_loss: 1.0822e-04 - val\_mean\_absolute\_error: 0.0082  
Epoch 44/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1159e-04 - mean\_absolute\_error: 0.0081 26/126 [=====>........................] - ETA: 0s - loss: 8.5646e-05 - mean\_absolute\_error: 0.0070 48/126 [==========>...................] - ETA: 0s - loss: 8.4351e-05 - mean\_absolute\_error: 0.0070 72/126 [================>.............] - ETA: 0s - loss: 9.6494e-05 - mean\_absolute\_error: 0.0074 97/126 [======================>.......] - ETA: 0s - loss: 9.6728e-05 - mean\_absolute\_error: 0.0074121/126 [===========================>..] - ETA: 0s - loss: 9.7293e-05 - mean\_absolute\_error: 0.0075126/126 [==============================] - 0s 2ms/step - loss: 9.7345e-05 - mean\_absolute\_error: 0.0075 - val\_loss: 1.9144e-04 - val\_mean\_absolute\_error: 0.0112  
Epoch 45/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4887e-04 - mean\_absolute\_error: 0.0103 20/126 [===>..........................] - ETA: 0s - loss: 1.3340e-04 - mean\_absolute\_error: 0.0087 40/126 [========>.....................] - ETA: 0s - loss: 1.1706e-04 - mean\_absolute\_error: 0.0083 65/126 [==============>...............] - ETA: 0s - loss: 1.0938e-04 - mean\_absolute\_error: 0.0080 89/126 [====================>.........] - ETA: 0s - loss: 1.0948e-04 - mean\_absolute\_error: 0.0081114/126 [==========================>...] - ETA: 0s - loss: 1.0675e-04 - mean\_absolute\_error: 0.0079126/126 [==============================] - 0s 3ms/step - loss: 1.0668e-04 - mean\_absolute\_error: 0.0079 - val\_loss: 1.0151e-04 - val\_mean\_absolute\_error: 0.0077  
Epoch 46/100  
 1/126 [..............................] - ETA: 0s - loss: 6.1764e-05 - mean\_absolute\_error: 0.0067 26/126 [=====>........................] - ETA: 0s - loss: 8.2368e-05 - mean\_absolute\_error: 0.0069 51/126 [===========>..................] - ETA: 0s - loss: 9.7667e-05 - mean\_absolute\_error: 0.0076 74/126 [================>.............] - ETA: 0s - loss: 9.8811e-05 - mean\_absolute\_error: 0.0075 98/126 [======================>.......] - ETA: 0s - loss: 1.0628e-04 - mean\_absolute\_error: 0.0078122/126 [============================>.] - ETA: 0s - loss: 1.0388e-04 - mean\_absolute\_error: 0.0078126/126 [==============================] - 0s 2ms/step - loss: 1.0359e-04 - mean\_absolute\_error: 0.0078 - val\_loss: 1.4519e-04 - val\_mean\_absolute\_error: 0.0097  
Epoch 47/100  
 1/126 [..............................] - ETA: 0s - loss: 8.5264e-05 - mean\_absolute\_error: 0.0077 25/126 [====>.........................] - ETA: 0s - loss: 1.2868e-04 - mean\_absolute\_error: 0.0087 48/126 [==========>...................] - ETA: 0s - loss: 1.1970e-04 - mean\_absolute\_error: 0.0084 72/126 [================>.............] - ETA: 0s - loss: 1.1311e-04 - mean\_absolute\_error: 0.0081 97/126 [======================>.......] - ETA: 0s - loss: 1.2760e-04 - mean\_absolute\_error: 0.0087122/126 [============================>.] - ETA: 0s - loss: 1.2669e-04 - mean\_absolute\_error: 0.0087126/126 [==============================] - 0s 2ms/step - loss: 1.2581e-04 - mean\_absolute\_error: 0.0087 - val\_loss: 1.8656e-04 - val\_mean\_absolute\_error: 0.0113  
Epoch 48/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0292e-04 - mean\_absolute\_error: 0.0086 26/126 [=====>........................] - ETA: 0s - loss: 1.3410e-04 - mean\_absolute\_error: 0.0091 50/126 [==========>...................] - ETA: 0s - loss: 1.3030e-04 - mean\_absolute\_error: 0.0089 73/126 [================>.............] - ETA: 0s - loss: 1.2040e-04 - mean\_absolute\_error: 0.0084 97/126 [======================>.......] - ETA: 0s - loss: 1.2479e-04 - mean\_absolute\_error: 0.0086122/126 [============================>.] - ETA: 0s - loss: 1.1990e-04 - mean\_absolute\_error: 0.0085126/126 [==============================] - 0s 2ms/step - loss: 1.2027e-04 - mean\_absolute\_error: 0.0085 - val\_loss: 1.2342e-04 - val\_mean\_absolute\_error: 0.0089  
Epoch 49/100  
 1/126 [..............................] - ETA: 0s - loss: 9.7669e-05 - mean\_absolute\_error: 0.0068 26/126 [=====>........................] - ETA: 0s - loss: 1.2678e-04 - mean\_absolute\_error: 0.0086 50/126 [==========>...................] - ETA: 0s - loss: 1.1996e-04 - mean\_absolute\_error: 0.0085 74/126 [================>.............] - ETA: 0s - loss: 1.1690e-04 - mean\_absolute\_error: 0.0082 96/126 [=====================>........] - ETA: 0s - loss: 1.1419e-04 - mean\_absolute\_error: 0.0081120/126 [===========================>..] - ETA: 0s - loss: 1.0897e-04 - mean\_absolute\_error: 0.0080126/126 [==============================] - 0s 2ms/step - loss: 1.0828e-04 - mean\_absolute\_error: 0.0079 - val\_loss: 1.0341e-04 - val\_mean\_absolute\_error: 0.0080  
Epoch 50/100  
 1/126 [..............................] - ETA: 0s - loss: 5.8828e-05 - mean\_absolute\_error: 0.0055 26/126 [=====>........................] - ETA: 0s - loss: 1.0827e-04 - mean\_absolute\_error: 0.0077 50/126 [==========>...................] - ETA: 0s - loss: 1.1485e-04 - mean\_absolute\_error: 0.0081 73/126 [================>.............] - ETA: 0s - loss: 1.1148e-04 - mean\_absolute\_error: 0.0081 97/126 [======================>.......] - ETA: 0s - loss: 1.0871e-04 - mean\_absolute\_error: 0.0080121/126 [===========================>..] - ETA: 0s - loss: 1.0432e-04 - mean\_absolute\_error: 0.0078126/126 [==============================] - 0s 2ms/step - loss: 1.0502e-04 - mean\_absolute\_error: 0.0078 - val\_loss: 1.4422e-04 - val\_mean\_absolute\_error: 0.0095  
Epoch 51/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9749e-04 - mean\_absolute\_error: 0.0104 26/126 [=====>........................] - ETA: 0s - loss: 9.9035e-05 - mean\_absolute\_error: 0.0076 50/126 [==========>...................] - ETA: 0s - loss: 1.0026e-04 - mean\_absolute\_error: 0.0077 74/126 [================>.............] - ETA: 0s - loss: 1.2184e-04 - mean\_absolute\_error: 0.0086 98/126 [======================>.......] - ETA: 0s - loss: 1.2586e-04 - mean\_absolute\_error: 0.0087121/126 [===========================>..] - ETA: 0s - loss: 1.2441e-04 - mean\_absolute\_error: 0.0086126/126 [==============================] - 0s 2ms/step - loss: 1.2347e-04 - mean\_absolute\_error: 0.0086 - val\_loss: 1.8808e-04 - val\_mean\_absolute\_error: 0.0113  
Epoch 52/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5756e-04 - mean\_absolute\_error: 0.0107 26/126 [=====>........................] - ETA: 0s - loss: 1.0522e-04 - mean\_absolute\_error: 0.0079 49/126 [==========>...................] - ETA: 0s - loss: 1.0412e-04 - mean\_absolute\_error: 0.0079 74/126 [================>.............] - ETA: 0s - loss: 1.0453e-04 - mean\_absolute\_error: 0.0078 98/126 [======================>.......] - ETA: 0s - loss: 1.0049e-04 - mean\_absolute\_error: 0.0077122/126 [============================>.] - ETA: 0s - loss: 1.0250e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0535e-04 - mean\_absolute\_error: 0.0078 - val\_loss: 2.5340e-04 - val\_mean\_absolute\_error: 0.0133  
Epoch 53/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9575e-04 - mean\_absolute\_error: 0.0115 26/126 [=====>........................] - ETA: 0s - loss: 9.9981e-05 - mean\_absolute\_error: 0.0078 51/126 [===========>..................] - ETA: 0s - loss: 9.5720e-05 - mean\_absolute\_error: 0.0075 76/126 [=================>............] - ETA: 0s - loss: 1.0381e-04 - mean\_absolute\_error: 0.0078100/126 [======================>.......] - ETA: 0s - loss: 1.0657e-04 - mean\_absolute\_error: 0.0080123/126 [============================>.] - ETA: 0s - loss: 1.1879e-04 - mean\_absolute\_error: 0.0084126/126 [==============================] - 0s 2ms/step - loss: 1.1907e-04 - mean\_absolute\_error: 0.0084 - val\_loss: 1.3091e-04 - val\_mean\_absolute\_error: 0.0092  
Epoch 54/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1086e-04 - mean\_absolute\_error: 0.0087 26/126 [=====>........................] - ETA: 0s - loss: 9.0856e-05 - mean\_absolute\_error: 0.0073 50/126 [==========>...................] - ETA: 0s - loss: 1.2460e-04 - mean\_absolute\_error: 0.0085 74/126 [================>.............] - ETA: 0s - loss: 1.2277e-04 - mean\_absolute\_error: 0.0086 99/126 [======================>.......] - ETA: 0s - loss: 1.2288e-04 - mean\_absolute\_error: 0.0085123/126 [============================>.] - ETA: 0s - loss: 1.2006e-04 - mean\_absolute\_error: 0.0084126/126 [==============================] - 0s 2ms/step - loss: 1.1981e-04 - mean\_absolute\_error: 0.0084 - val\_loss: 9.9957e-05 - val\_mean\_absolute\_error: 0.0077  
Epoch 55/100  
 1/126 [..............................] - ETA: 0s - loss: 6.4890e-05 - mean\_absolute\_error: 0.0065 20/126 [===>..........................] - ETA: 0s - loss: 9.9139e-05 - mean\_absolute\_error: 0.0077 44/126 [=========>....................] - ETA: 0s - loss: 1.0224e-04 - mean\_absolute\_error: 0.0077 68/126 [===============>..............] - ETA: 0s - loss: 1.0986e-04 - mean\_absolute\_error: 0.0080 93/126 [=====================>........] - ETA: 0s - loss: 1.0743e-04 - mean\_absolute\_error: 0.0079118/126 [===========================>..] - ETA: 0s - loss: 1.0316e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0235e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.0802e-04 - val\_mean\_absolute\_error: 0.0082  
Epoch 56/100  
 1/126 [..............................] - ETA: 0s - loss: 9.7912e-05 - mean\_absolute\_error: 0.0071 25/126 [====>.........................] - ETA: 0s - loss: 1.0016e-04 - mean\_absolute\_error: 0.0075 50/126 [==========>...................] - ETA: 0s - loss: 9.3998e-05 - mean\_absolute\_error: 0.0073 74/126 [================>.............] - ETA: 0s - loss: 1.0011e-04 - mean\_absolute\_error: 0.0076 99/126 [======================>.......] - ETA: 0s - loss: 1.0431e-04 - mean\_absolute\_error: 0.0078124/126 [============================>.] - ETA: 0s - loss: 1.0620e-04 - mean\_absolute\_error: 0.0079126/126 [==============================] - 0s 2ms/step - loss: 1.0588e-04 - mean\_absolute\_error: 0.0079 - val\_loss: 1.0324e-04 - val\_mean\_absolute\_error: 0.0079  
Epoch 57/100  
 1/126 [..............................] - ETA: 0s - loss: 7.4018e-05 - mean\_absolute\_error: 0.0071 25/126 [====>.........................] - ETA: 0s - loss: 1.0714e-04 - mean\_absolute\_error: 0.0079 49/126 [==========>...................] - ETA: 0s - loss: 1.0563e-04 - mean\_absolute\_error: 0.0078 73/126 [================>.............] - ETA: 0s - loss: 1.0894e-04 - mean\_absolute\_error: 0.0079 98/126 [======================>.......] - ETA: 0s - loss: 1.0459e-04 - mean\_absolute\_error: 0.0078123/126 [============================>.] - ETA: 0s - loss: 1.0264e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0320e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.2493e-04 - val\_mean\_absolute\_error: 0.0090  
Epoch 58/100  
 1/126 [..............................] - ETA: 0s - loss: 7.2926e-05 - mean\_absolute\_error: 0.0069 26/126 [=====>........................] - ETA: 0s - loss: 1.6123e-04 - mean\_absolute\_error: 0.0102 50/126 [==========>...................] - ETA: 0s - loss: 1.5253e-04 - mean\_absolute\_error: 0.0098 74/126 [================>.............] - ETA: 0s - loss: 1.4649e-04 - mean\_absolute\_error: 0.0095 99/126 [======================>.......] - ETA: 0s - loss: 1.3526e-04 - mean\_absolute\_error: 0.0090123/126 [============================>.] - ETA: 0s - loss: 1.2856e-04 - mean\_absolute\_error: 0.0088126/126 [==============================] - 0s 2ms/step - loss: 1.2846e-04 - mean\_absolute\_error: 0.0088 - val\_loss: 1.2497e-04 - val\_mean\_absolute\_error: 0.0090  
Epoch 59/100  
 1/126 [..............................] - ETA: 0s - loss: 3.6761e-05 - mean\_absolute\_error: 0.0049 27/126 [=====>........................] - ETA: 0s - loss: 9.5549e-05 - mean\_absolute\_error: 0.0074 52/126 [===========>..................] - ETA: 0s - loss: 9.1173e-05 - mean\_absolute\_error: 0.0072 77/126 [=================>............] - ETA: 0s - loss: 9.2069e-05 - mean\_absolute\_error: 0.0073102/126 [=======================>......] - ETA: 0s - loss: 8.9977e-05 - mean\_absolute\_error: 0.0072126/126 [==============================] - 0s 2ms/step - loss: 9.6541e-05 - mean\_absolute\_error: 0.0074 - val\_loss: 2.3858e-04 - val\_mean\_absolute\_error: 0.0131  
Epoch 60/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3220e-04 - mean\_absolute\_error: 0.0100 26/126 [=====>........................] - ETA: 0s - loss: 1.6153e-04 - mean\_absolute\_error: 0.0101 50/126 [==========>...................] - ETA: 0s - loss: 1.3892e-04 - mean\_absolute\_error: 0.0091 74/126 [================>.............] - ETA: 0s - loss: 1.2669e-04 - mean\_absolute\_error: 0.0086 97/126 [======================>.......] - ETA: 0s - loss: 1.2012e-04 - mean\_absolute\_error: 0.0084122/126 [============================>.] - ETA: 0s - loss: 1.1354e-04 - mean\_absolute\_error: 0.0081126/126 [==============================] - 0s 2ms/step - loss: 1.1308e-04 - mean\_absolute\_error: 0.0081 - val\_loss: 1.0531e-04 - val\_mean\_absolute\_error: 0.0080  
Epoch 61/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0252e-04 - mean\_absolute\_error: 0.0086 26/126 [=====>........................] - ETA: 0s - loss: 1.0193e-04 - mean\_absolute\_error: 0.0076 50/126 [==========>...................] - ETA: 0s - loss: 1.0123e-04 - mean\_absolute\_error: 0.0077 75/126 [================>.............] - ETA: 0s - loss: 9.8588e-05 - mean\_absolute\_error: 0.0075 99/126 [======================>.......] - ETA: 0s - loss: 9.4154e-05 - mean\_absolute\_error: 0.0074124/126 [============================>.] - ETA: 0s - loss: 1.0908e-04 - mean\_absolute\_error: 0.0080126/126 [==============================] - 0s 2ms/step - loss: 1.0946e-04 - mean\_absolute\_error: 0.0080 - val\_loss: 1.8665e-04 - val\_mean\_absolute\_error: 0.0111  
Epoch 62/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3384e-04 - mean\_absolute\_error: 0.0097 25/126 [====>.........................] - ETA: 0s - loss: 8.8359e-05 - mean\_absolute\_error: 0.0072 49/126 [==========>...................] - ETA: 0s - loss: 1.0761e-04 - mean\_absolute\_error: 0.0080 73/126 [================>.............] - ETA: 0s - loss: 1.0641e-04 - mean\_absolute\_error: 0.0079 95/126 [=====================>........] - ETA: 0s - loss: 1.0319e-04 - mean\_absolute\_error: 0.0077118/126 [===========================>..] - ETA: 0s - loss: 1.0322e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 3ms/step - loss: 1.0205e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.0414e-04 - val\_mean\_absolute\_error: 0.0079  
Epoch 63/100  
 1/126 [..............................] - ETA: 0s - loss: 5.6558e-05 - mean\_absolute\_error: 0.0058 26/126 [=====>........................] - ETA: 0s - loss: 9.1932e-05 - mean\_absolute\_error: 0.0076 49/126 [==========>...................] - ETA: 0s - loss: 1.1041e-04 - mean\_absolute\_error: 0.0082 71/126 [===============>..............] - ETA: 0s - loss: 1.2864e-04 - mean\_absolute\_error: 0.0088 95/126 [=====================>........] - ETA: 0s - loss: 1.2867e-04 - mean\_absolute\_error: 0.0088119/126 [===========================>..] - ETA: 0s - loss: 1.2455e-04 - mean\_absolute\_error: 0.0087126/126 [==============================] - 0s 2ms/step - loss: 1.2380e-04 - mean\_absolute\_error: 0.0086 - val\_loss: 1.1107e-04 - val\_mean\_absolute\_error: 0.0084  
Epoch 64/100  
 1/126 [..............................] - ETA: 0s - loss: 8.1292e-05 - mean\_absolute\_error: 0.0074 25/126 [====>.........................] - ETA: 0s - loss: 1.6859e-04 - mean\_absolute\_error: 0.0101 49/126 [==========>...................] - ETA: 0s - loss: 1.3391e-04 - mean\_absolute\_error: 0.0089 73/126 [================>.............] - ETA: 0s - loss: 1.1979e-04 - mean\_absolute\_error: 0.0083 97/126 [======================>.......] - ETA: 0s - loss: 1.1568e-04 - mean\_absolute\_error: 0.0082120/126 [===========================>..] - ETA: 0s - loss: 1.1523e-04 - mean\_absolute\_error: 0.0082126/126 [==============================] - 0s 2ms/step - loss: 1.1370e-04 - mean\_absolute\_error: 0.0081 - val\_loss: 9.7253e-05 - val\_mean\_absolute\_error: 0.0076  
Epoch 65/100  
 1/126 [..............................] - ETA: 0s - loss: 6.8762e-05 - mean\_absolute\_error: 0.0074 27/126 [=====>........................] - ETA: 0s - loss: 1.2253e-04 - mean\_absolute\_error: 0.0087 52/126 [===========>..................] - ETA: 0s - loss: 1.0763e-04 - mean\_absolute\_error: 0.0081 76/126 [=================>............] - ETA: 0s - loss: 1.0953e-04 - mean\_absolute\_error: 0.0080101/126 [=======================>......] - ETA: 0s - loss: 1.0615e-04 - mean\_absolute\_error: 0.0079126/126 [==============================] - ETA: 0s - loss: 1.0465e-04 - mean\_absolute\_error: 0.0078126/126 [==============================] - 0s 2ms/step - loss: 1.0465e-04 - mean\_absolute\_error: 0.0078 - val\_loss: 9.7448e-05 - val\_mean\_absolute\_error: 0.0076  
Epoch 66/100  
 1/126 [..............................] - ETA: 0s - loss: 8.0818e-05 - mean\_absolute\_error: 0.0066 26/126 [=====>........................] - ETA: 0s - loss: 1.0940e-04 - mean\_absolute\_error: 0.0080 50/126 [==========>...................] - ETA: 0s - loss: 9.6443e-05 - mean\_absolute\_error: 0.0075 74/126 [================>.............] - ETA: 0s - loss: 9.8621e-05 - mean\_absolute\_error: 0.0076 99/126 [======================>.......] - ETA: 0s - loss: 9.8374e-05 - mean\_absolute\_error: 0.0076123/126 [============================>.] - ETA: 0s - loss: 1.0010e-04 - mean\_absolute\_error: 0.0076126/126 [==============================] - 0s 2ms/step - loss: 9.9697e-05 - mean\_absolute\_error: 0.0076 - val\_loss: 1.0009e-04 - val\_mean\_absolute\_error: 0.0078  
Epoch 67/100  
 1/126 [..............................] - ETA: 0s - loss: 9.2317e-05 - mean\_absolute\_error: 0.0080 25/126 [====>.........................] - ETA: 0s - loss: 1.2256e-04 - mean\_absolute\_error: 0.0084 50/126 [==========>...................] - ETA: 0s - loss: 1.1286e-04 - mean\_absolute\_error: 0.0081 74/126 [================>.............] - ETA: 0s - loss: 1.1321e-04 - mean\_absolute\_error: 0.0083 99/126 [======================>.......] - ETA: 0s - loss: 1.1206e-04 - mean\_absolute\_error: 0.0082123/126 [============================>.] - ETA: 0s - loss: 1.0986e-04 - mean\_absolute\_error: 0.0081126/126 [==============================] - 0s 2ms/step - loss: 1.1048e-04 - mean\_absolute\_error: 0.0082 - val\_loss: 1.7559e-04 - val\_mean\_absolute\_error: 0.0109  
Epoch 68/100  
 1/126 [..............................] - ETA: 0s - loss: 1.7349e-04 - mean\_absolute\_error: 0.0112 26/126 [=====>........................] - ETA: 0s - loss: 1.2443e-04 - mean\_absolute\_error: 0.0087 52/126 [===========>..................] - ETA: 0s - loss: 1.1483e-04 - mean\_absolute\_error: 0.0083 77/126 [=================>............] - ETA: 0s - loss: 1.1344e-04 - mean\_absolute\_error: 0.0083102/126 [=======================>......] - ETA: 0s - loss: 1.1111e-04 - mean\_absolute\_error: 0.0082126/126 [==============================] - ETA: 0s - loss: 1.0812e-04 - mean\_absolute\_error: 0.0080126/126 [==============================] - 0s 2ms/step - loss: 1.0812e-04 - mean\_absolute\_error: 0.0080 - val\_loss: 1.1615e-04 - val\_mean\_absolute\_error: 0.0086  
Epoch 69/100  
 1/126 [..............................] - ETA: 0s - loss: 6.6305e-05 - mean\_absolute\_error: 0.0067 25/126 [====>.........................] - ETA: 0s - loss: 8.7763e-05 - mean\_absolute\_error: 0.0073 49/126 [==========>...................] - ETA: 0s - loss: 9.1798e-05 - mean\_absolute\_error: 0.0074 74/126 [================>.............] - ETA: 0s - loss: 9.6661e-05 - mean\_absolute\_error: 0.0075 99/126 [======================>.......] - ETA: 0s - loss: 1.0326e-04 - mean\_absolute\_error: 0.0078123/126 [============================>.] - ETA: 0s - loss: 1.0429e-04 - mean\_absolute\_error: 0.0078126/126 [==============================] - 0s 2ms/step - loss: 1.0387e-04 - mean\_absolute\_error: 0.0078 - val\_loss: 1.5400e-04 - val\_mean\_absolute\_error: 0.0102  
Epoch 70/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0748e-04 - mean\_absolute\_error: 0.0121 26/126 [=====>........................] - ETA: 0s - loss: 1.1508e-04 - mean\_absolute\_error: 0.0084 51/126 [===========>..................] - ETA: 0s - loss: 9.7945e-05 - mean\_absolute\_error: 0.0076 75/126 [================>.............] - ETA: 0s - loss: 9.9221e-05 - mean\_absolute\_error: 0.0076 99/126 [======================>.......] - ETA: 0s - loss: 1.0149e-04 - mean\_absolute\_error: 0.0077123/126 [============================>.] - ETA: 0s - loss: 1.0153e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0208e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 2.8646e-04 - val\_mean\_absolute\_error: 0.0144  
Epoch 71/100  
 1/126 [..............................] - ETA: 0s - loss: 3.0337e-04 - mean\_absolute\_error: 0.0155 26/126 [=====>........................] - ETA: 0s - loss: 1.1948e-04 - mean\_absolute\_error: 0.0083 51/126 [===========>..................] - ETA: 0s - loss: 1.4074e-04 - mean\_absolute\_error: 0.0092 75/126 [================>.............] - ETA: 0s - loss: 1.2752e-04 - mean\_absolute\_error: 0.0087 98/126 [======================>.......] - ETA: 0s - loss: 1.2503e-04 - mean\_absolute\_error: 0.0087123/126 [============================>.] - ETA: 0s - loss: 1.1793e-04 - mean\_absolute\_error: 0.0083126/126 [==============================] - 0s 2ms/step - loss: 1.1762e-04 - mean\_absolute\_error: 0.0083 - val\_loss: 1.6703e-04 - val\_mean\_absolute\_error: 0.0107  
Epoch 72/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6837e-04 - mean\_absolute\_error: 0.0095 27/126 [=====>........................] - ETA: 0s - loss: 1.3048e-04 - mean\_absolute\_error: 0.0090 50/126 [==========>...................] - ETA: 0s - loss: 1.1894e-04 - mean\_absolute\_error: 0.0085 75/126 [================>.............] - ETA: 0s - loss: 1.1380e-04 - mean\_absolute\_error: 0.0083 99/126 [======================>.......] - ETA: 0s - loss: 1.0809e-04 - mean\_absolute\_error: 0.0081124/126 [============================>.] - ETA: 0s - loss: 1.0790e-04 - mean\_absolute\_error: 0.0080126/126 [==============================] - 0s 2ms/step - loss: 1.0746e-04 - mean\_absolute\_error: 0.0080 - val\_loss: 9.8189e-05 - val\_mean\_absolute\_error: 0.0078  
Epoch 73/100  
 1/126 [..............................] - ETA: 0s - loss: 6.1298e-05 - mean\_absolute\_error: 0.0063 25/126 [====>.........................] - ETA: 0s - loss: 8.8187e-05 - mean\_absolute\_error: 0.0072 48/126 [==========>...................] - ETA: 0s - loss: 9.4670e-05 - mean\_absolute\_error: 0.0074 72/126 [================>.............] - ETA: 0s - loss: 8.8785e-05 - mean\_absolute\_error: 0.0072 96/126 [=====================>........] - ETA: 0s - loss: 9.2583e-05 - mean\_absolute\_error: 0.0073119/126 [===========================>..] - ETA: 0s - loss: 9.3379e-05 - mean\_absolute\_error: 0.0073126/126 [==============================] - 0s 2ms/step - loss: 9.5654e-05 - mean\_absolute\_error: 0.0074 - val\_loss: 1.4479e-04 - val\_mean\_absolute\_error: 0.0095  
Epoch 74/100  
 1/126 [..............................] - ETA: 0s - loss: 9.2792e-05 - mean\_absolute\_error: 0.0083 26/126 [=====>........................] - ETA: 0s - loss: 1.2836e-04 - mean\_absolute\_error: 0.0089 50/126 [==========>...................] - ETA: 0s - loss: 1.1960e-04 - mean\_absolute\_error: 0.0085 74/126 [================>.............] - ETA: 0s - loss: 1.1197e-04 - mean\_absolute\_error: 0.0081 98/126 [======================>.......] - ETA: 0s - loss: 1.1384e-04 - mean\_absolute\_error: 0.0082122/126 [============================>.] - ETA: 0s - loss: 1.1263e-04 - mean\_absolute\_error: 0.0082126/126 [==============================] - 0s 2ms/step - loss: 1.1156e-04 - mean\_absolute\_error: 0.0081 - val\_loss: 1.0476e-04 - val\_mean\_absolute\_error: 0.0080  
Epoch 75/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1517e-04 - mean\_absolute\_error: 0.0088 26/126 [=====>........................] - ETA: 0s - loss: 1.3707e-04 - mean\_absolute\_error: 0.0090 51/126 [===========>..................] - ETA: 0s - loss: 1.1771e-04 - mean\_absolute\_error: 0.0083 76/126 [=================>............] - ETA: 0s - loss: 1.1250e-04 - mean\_absolute\_error: 0.0082101/126 [=======================>......] - ETA: 0s - loss: 1.1177e-04 - mean\_absolute\_error: 0.0081124/126 [============================>.] - ETA: 0s - loss: 1.0811e-04 - mean\_absolute\_error: 0.0080126/126 [==============================] - 0s 2ms/step - loss: 1.0798e-04 - mean\_absolute\_error: 0.0080 - val\_loss: 1.4318e-04 - val\_mean\_absolute\_error: 0.0095  
Epoch 76/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2860e-04 - mean\_absolute\_error: 0.0099 25/126 [====>.........................] - ETA: 0s - loss: 9.8828e-05 - mean\_absolute\_error: 0.0074 50/126 [==========>...................] - ETA: 0s - loss: 1.2160e-04 - mean\_absolute\_error: 0.0084 74/126 [================>.............] - ETA: 0s - loss: 1.1364e-04 - mean\_absolute\_error: 0.0081 98/126 [======================>.......] - ETA: 0s - loss: 1.1249e-04 - mean\_absolute\_error: 0.0081122/126 [============================>.] - ETA: 0s - loss: 1.1154e-04 - mean\_absolute\_error: 0.0081126/126 [==============================] - 0s 2ms/step - loss: 1.1223e-04 - mean\_absolute\_error: 0.0081 - val\_loss: 9.4930e-05 - val\_mean\_absolute\_error: 0.0074  
Epoch 77/100  
 1/126 [..............................] - ETA: 0s - loss: 7.5756e-05 - mean\_absolute\_error: 0.0067 26/126 [=====>........................] - ETA: 0s - loss: 9.5584e-05 - mean\_absolute\_error: 0.0071 50/126 [==========>...................] - ETA: 0s - loss: 9.5221e-05 - mean\_absolute\_error: 0.0073 74/126 [================>.............] - ETA: 0s - loss: 9.2264e-05 - mean\_absolute\_error: 0.0072 97/126 [======================>.......] - ETA: 0s - loss: 9.4035e-05 - mean\_absolute\_error: 0.0073121/126 [===========================>..] - ETA: 0s - loss: 9.2179e-05 - mean\_absolute\_error: 0.0073126/126 [==============================] - 0s 2ms/step - loss: 9.2324e-05 - mean\_absolute\_error: 0.0073 - val\_loss: 1.1328e-04 - val\_mean\_absolute\_error: 0.0085  
Epoch 78/100  
 1/126 [..............................] - ETA: 0s - loss: 9.3221e-05 - mean\_absolute\_error: 0.0067 26/126 [=====>........................] - ETA: 0s - loss: 1.0234e-04 - mean\_absolute\_error: 0.0080 51/126 [===========>..................] - ETA: 0s - loss: 9.3009e-05 - mean\_absolute\_error: 0.0075 75/126 [================>.............] - ETA: 0s - loss: 9.8651e-05 - mean\_absolute\_error: 0.0076100/126 [======================>.......] - ETA: 0s - loss: 9.8502e-05 - mean\_absolute\_error: 0.0076124/126 [============================>.] - ETA: 0s - loss: 1.0091e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0117e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.4823e-04 - val\_mean\_absolute\_error: 0.0099  
Epoch 79/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0462e-04 - mean\_absolute\_error: 0.0080 26/126 [=====>........................] - ETA: 0s - loss: 1.3528e-04 - mean\_absolute\_error: 0.0092 51/126 [===========>..................] - ETA: 0s - loss: 1.2740e-04 - mean\_absolute\_error: 0.0088 75/126 [================>.............] - ETA: 0s - loss: 1.2418e-04 - mean\_absolute\_error: 0.0086100/126 [======================>.......] - ETA: 0s - loss: 1.1461e-04 - mean\_absolute\_error: 0.0082124/126 [============================>.] - ETA: 0s - loss: 1.0931e-04 - mean\_absolute\_error: 0.0081126/126 [==============================] - 0s 2ms/step - loss: 1.0931e-04 - mean\_absolute\_error: 0.0080 - val\_loss: 1.0086e-04 - val\_mean\_absolute\_error: 0.0078  
Epoch 80/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0648e-04 - mean\_absolute\_error: 0.0087 25/126 [====>.........................] - ETA: 0s - loss: 8.7615e-05 - mean\_absolute\_error: 0.0071 49/126 [==========>...................] - ETA: 0s - loss: 1.0219e-04 - mean\_absolute\_error: 0.0077 73/126 [================>.............] - ETA: 0s - loss: 1.2829e-04 - mean\_absolute\_error: 0.0087 98/126 [======================>.......] - ETA: 0s - loss: 1.3634e-04 - mean\_absolute\_error: 0.0090122/126 [============================>.] - ETA: 0s - loss: 1.3670e-04 - mean\_absolute\_error: 0.0090126/126 [==============================] - 0s 2ms/step - loss: 1.3715e-04 - mean\_absolute\_error: 0.0091 - val\_loss: 9.8366e-05 - val\_mean\_absolute\_error: 0.0077  
Epoch 81/100  
 1/126 [..............................] - ETA: 0s - loss: 3.4121e-05 - mean\_absolute\_error: 0.0048 25/126 [====>.........................] - ETA: 0s - loss: 1.3279e-04 - mean\_absolute\_error: 0.0089 49/126 [==========>...................] - ETA: 0s - loss: 1.1835e-04 - mean\_absolute\_error: 0.0083 72/126 [================>.............] - ETA: 0s - loss: 1.0726e-04 - mean\_absolute\_error: 0.0079 97/126 [======================>.......] - ETA: 0s - loss: 1.0115e-04 - mean\_absolute\_error: 0.0076121/126 [===========================>..] - ETA: 0s - loss: 1.0955e-04 - mean\_absolute\_error: 0.0080126/126 [==============================] - 0s 2ms/step - loss: 1.0943e-04 - mean\_absolute\_error: 0.0080 - val\_loss: 1.0875e-04 - val\_mean\_absolute\_error: 0.0081  
Epoch 82/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0016e-04 - mean\_absolute\_error: 0.0083 25/126 [====>.........................] - ETA: 0s - loss: 9.0339e-05 - mean\_absolute\_error: 0.0074 46/126 [=========>....................] - ETA: 0s - loss: 9.2397e-05 - mean\_absolute\_error: 0.0073 70/126 [===============>..............] - ETA: 0s - loss: 1.0601e-04 - mean\_absolute\_error: 0.0079 94/126 [=====================>........] - ETA: 0s - loss: 1.0804e-04 - mean\_absolute\_error: 0.0080118/126 [===========================>..] - ETA: 0s - loss: 1.0548e-04 - mean\_absolute\_error: 0.0079126/126 [==============================] - 0s 2ms/step - loss: 1.0426e-04 - mean\_absolute\_error: 0.0078 - val\_loss: 9.6105e-05 - val\_mean\_absolute\_error: 0.0076  
Epoch 83/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0835e-04 - mean\_absolute\_error: 0.0095 26/126 [=====>........................] - ETA: 0s - loss: 8.5987e-05 - mean\_absolute\_error: 0.0070 50/126 [==========>...................] - ETA: 0s - loss: 8.3614e-05 - mean\_absolute\_error: 0.0070 73/126 [================>.............] - ETA: 0s - loss: 8.7267e-05 - mean\_absolute\_error: 0.0072 97/126 [======================>.......] - ETA: 0s - loss: 9.4534e-05 - mean\_absolute\_error: 0.0075122/126 [============================>.] - ETA: 0s - loss: 1.0507e-04 - mean\_absolute\_error: 0.0079126/126 [==============================] - 0s 2ms/step - loss: 1.0626e-04 - mean\_absolute\_error: 0.0080 - val\_loss: 3.0108e-04 - val\_mean\_absolute\_error: 0.0149  
Epoch 84/100  
 1/126 [..............................] - ETA: 0s - loss: 2.7254e-04 - mean\_absolute\_error: 0.0142 26/126 [=====>........................] - ETA: 0s - loss: 1.9797e-04 - mean\_absolute\_error: 0.0116 50/126 [==========>...................] - ETA: 0s - loss: 1.5222e-04 - mean\_absolute\_error: 0.0098 74/126 [================>.............] - ETA: 0s - loss: 1.3705e-04 - mean\_absolute\_error: 0.0092 98/126 [======================>.......] - ETA: 0s - loss: 1.3058e-04 - mean\_absolute\_error: 0.0089121/126 [===========================>..] - ETA: 0s - loss: 1.2802e-04 - mean\_absolute\_error: 0.0088126/126 [==============================] - 0s 2ms/step - loss: 1.2809e-04 - mean\_absolute\_error: 0.0088 - val\_loss: 2.0995e-04 - val\_mean\_absolute\_error: 0.0119  
Epoch 85/100  
 1/126 [..............................] - ETA: 0s - loss: 2.5505e-04 - mean\_absolute\_error: 0.0142 25/126 [====>.........................] - ETA: 0s - loss: 1.0838e-04 - mean\_absolute\_error: 0.0080 49/126 [==========>...................] - ETA: 0s - loss: 9.5025e-05 - mean\_absolute\_error: 0.0074 74/126 [================>.............] - ETA: 0s - loss: 8.9944e-05 - mean\_absolute\_error: 0.0072 99/126 [======================>.......] - ETA: 0s - loss: 9.5533e-05 - mean\_absolute\_error: 0.0075123/126 [============================>.] - ETA: 0s - loss: 9.8155e-05 - mean\_absolute\_error: 0.0076126/126 [==============================] - 0s 2ms/step - loss: 9.9519e-05 - mean\_absolute\_error: 0.0077 - val\_loss: 1.5172e-04 - val\_mean\_absolute\_error: 0.0098  
Epoch 86/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3087e-04 - mean\_absolute\_error: 0.0097 25/126 [====>.........................] - ETA: 0s - loss: 8.6826e-05 - mean\_absolute\_error: 0.0071 49/126 [==========>...................] - ETA: 0s - loss: 1.0255e-04 - mean\_absolute\_error: 0.0078 73/126 [================>.............] - ETA: 0s - loss: 9.5295e-05 - mean\_absolute\_error: 0.0074 98/126 [======================>.......] - ETA: 0s - loss: 9.5447e-05 - mean\_absolute\_error: 0.0075123/126 [============================>.] - ETA: 0s - loss: 1.0205e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0205e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.0110e-04 - val\_mean\_absolute\_error: 0.0078  
Epoch 87/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4570e-04 - mean\_absolute\_error: 0.0087 26/126 [=====>........................] - ETA: 0s - loss: 1.0622e-04 - mean\_absolute\_error: 0.0078 50/126 [==========>...................] - ETA: 0s - loss: 1.0177e-04 - mean\_absolute\_error: 0.0077 73/126 [================>.............] - ETA: 0s - loss: 9.2804e-05 - mean\_absolute\_error: 0.0074 98/126 [======================>.......] - ETA: 0s - loss: 8.8221e-05 - mean\_absolute\_error: 0.0072123/126 [============================>.] - ETA: 0s - loss: 8.9834e-05 - mean\_absolute\_error: 0.0072126/126 [==============================] - 0s 2ms/step - loss: 8.9575e-05 - mean\_absolute\_error: 0.0072 - val\_loss: 1.6016e-04 - val\_mean\_absolute\_error: 0.0102  
Epoch 88/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1252e-04 - mean\_absolute\_error: 0.0087 26/126 [=====>........................] - ETA: 0s - loss: 1.1441e-04 - mean\_absolute\_error: 0.0084 51/126 [===========>..................] - ETA: 0s - loss: 9.9055e-05 - mean\_absolute\_error: 0.0077 76/126 [=================>............] - ETA: 0s - loss: 1.1466e-04 - mean\_absolute\_error: 0.0083 99/126 [======================>.......] - ETA: 0s - loss: 1.1547e-04 - mean\_absolute\_error: 0.0083121/126 [===========================>..] - ETA: 0s - loss: 1.1045e-04 - mean\_absolute\_error: 0.0081126/126 [==============================] - 0s 2ms/step - loss: 1.1031e-04 - mean\_absolute\_error: 0.0081 - val\_loss: 2.7904e-04 - val\_mean\_absolute\_error: 0.0143  
Epoch 89/100  
 1/126 [..............................] - ETA: 0s - loss: 2.6275e-04 - mean\_absolute\_error: 0.0130 26/126 [=====>........................] - ETA: 0s - loss: 1.1663e-04 - mean\_absolute\_error: 0.0083 50/126 [==========>...................] - ETA: 0s - loss: 1.0304e-04 - mean\_absolute\_error: 0.0076 74/126 [================>.............] - ETA: 0s - loss: 9.9817e-05 - mean\_absolute\_error: 0.0075 99/126 [======================>.......] - ETA: 0s - loss: 9.8948e-05 - mean\_absolute\_error: 0.0075123/126 [============================>.] - ETA: 0s - loss: 9.7529e-05 - mean\_absolute\_error: 0.0075126/126 [==============================] - 0s 2ms/step - loss: 9.7675e-05 - mean\_absolute\_error: 0.0075 - val\_loss: 1.2227e-04 - val\_mean\_absolute\_error: 0.0087  
Epoch 90/100  
 1/126 [..............................] - ETA: 0s - loss: 8.8447e-05 - mean\_absolute\_error: 0.0078 25/126 [====>.........................] - ETA: 0s - loss: 8.7134e-05 - mean\_absolute\_error: 0.0073 49/126 [==========>...................] - ETA: 0s - loss: 8.5650e-05 - mean\_absolute\_error: 0.0070 72/126 [================>.............] - ETA: 0s - loss: 8.6445e-05 - mean\_absolute\_error: 0.0071 96/126 [=====================>........] - ETA: 0s - loss: 9.0753e-05 - mean\_absolute\_error: 0.0072119/126 [===========================>..] - ETA: 0s - loss: 9.1342e-05 - mean\_absolute\_error: 0.0072126/126 [==============================] - 0s 3ms/step - loss: 9.1127e-05 - mean\_absolute\_error: 0.0072 - val\_loss: 9.1887e-05 - val\_mean\_absolute\_error: 0.0073  
Epoch 91/100  
 1/126 [..............................] - ETA: 0s - loss: 9.5427e-05 - mean\_absolute\_error: 0.0081 23/126 [====>.........................] - ETA: 0s - loss: 1.2624e-04 - mean\_absolute\_error: 0.0090 46/126 [=========>....................] - ETA: 0s - loss: 1.1298e-04 - mean\_absolute\_error: 0.0083 71/126 [===============>..............] - ETA: 0s - loss: 1.0780e-04 - mean\_absolute\_error: 0.0080 95/126 [=====================>........] - ETA: 0s - loss: 1.0198e-04 - mean\_absolute\_error: 0.0078119/126 [===========================>..] - ETA: 0s - loss: 1.0235e-04 - mean\_absolute\_error: 0.0077126/126 [==============================] - 0s 2ms/step - loss: 1.0211e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 1.0102e-04 - val\_mean\_absolute\_error: 0.0078  
Epoch 92/100  
 1/126 [..............................] - ETA: 0s - loss: 8.4191e-05 - mean\_absolute\_error: 0.0069 26/126 [=====>........................] - ETA: 0s - loss: 1.2130e-04 - mean\_absolute\_error: 0.0084 50/126 [==========>...................] - ETA: 0s - loss: 1.0726e-04 - mean\_absolute\_error: 0.0079 74/126 [================>.............] - ETA: 0s - loss: 1.0318e-04 - mean\_absolute\_error: 0.0077 99/126 [======================>.......] - ETA: 0s - loss: 1.0356e-04 - mean\_absolute\_error: 0.0078123/126 [============================>.] - ETA: 0s - loss: 1.1787e-04 - mean\_absolute\_error: 0.0083126/126 [==============================] - 0s 2ms/step - loss: 1.1987e-04 - mean\_absolute\_error: 0.0084 - val\_loss: 1.1723e-04 - val\_mean\_absolute\_error: 0.0087  
Epoch 93/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2088e-04 - mean\_absolute\_error: 0.0078 26/126 [=====>........................] - ETA: 0s - loss: 1.7994e-04 - mean\_absolute\_error: 0.0105 50/126 [==========>...................] - ETA: 0s - loss: 1.3490e-04 - mean\_absolute\_error: 0.0089 74/126 [================>.............] - ETA: 0s - loss: 1.1634e-04 - mean\_absolute\_error: 0.0082 99/126 [======================>.......] - ETA: 0s - loss: 1.1127e-04 - mean\_absolute\_error: 0.0080123/126 [============================>.] - ETA: 0s - loss: 1.1302e-04 - mean\_absolute\_error: 0.0081126/126 [==============================] - 0s 2ms/step - loss: 1.1322e-04 - mean\_absolute\_error: 0.0081 - val\_loss: 1.5132e-04 - val\_mean\_absolute\_error: 0.0101  
Epoch 94/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6859e-04 - mean\_absolute\_error: 0.0107 24/126 [====>.........................] - ETA: 0s - loss: 1.3333e-04 - mean\_absolute\_error: 0.0089 48/126 [==========>...................] - ETA: 0s - loss: 1.4591e-04 - mean\_absolute\_error: 0.0096 72/126 [================>.............] - ETA: 0s - loss: 1.3699e-04 - mean\_absolute\_error: 0.0092 97/126 [======================>.......] - ETA: 0s - loss: 1.2295e-04 - mean\_absolute\_error: 0.0086121/126 [===========================>..] - ETA: 0s - loss: 1.2443e-04 - mean\_absolute\_error: 0.0087126/126 [==============================] - 0s 2ms/step - loss: 1.2319e-04 - mean\_absolute\_error: 0.0086 - val\_loss: 1.4414e-04 - val\_mean\_absolute\_error: 0.0096  
Epoch 95/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4739e-04 - mean\_absolute\_error: 0.0108 25/126 [====>.........................] - ETA: 0s - loss: 1.5698e-04 - mean\_absolute\_error: 0.0100 49/126 [==========>...................] - ETA: 0s - loss: 1.2984e-04 - mean\_absolute\_error: 0.0088 74/126 [================>.............] - ETA: 0s - loss: 1.2359e-04 - mean\_absolute\_error: 0.0086 99/126 [======================>.......] - ETA: 0s - loss: 1.1779e-04 - mean\_absolute\_error: 0.0084122/126 [============================>.] - ETA: 0s - loss: 1.1007e-04 - mean\_absolute\_error: 0.0081126/126 [==============================] - 0s 2ms/step - loss: 1.1023e-04 - mean\_absolute\_error: 0.0081 - val\_loss: 1.3398e-04 - val\_mean\_absolute\_error: 0.0092  
Epoch 96/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5259e-04 - mean\_absolute\_error: 0.0104 26/126 [=====>........................] - ETA: 0s - loss: 1.1807e-04 - mean\_absolute\_error: 0.0087 50/126 [==========>...................] - ETA: 0s - loss: 1.2467e-04 - mean\_absolute\_error: 0.0088 74/126 [================>.............] - ETA: 0s - loss: 1.1744e-04 - mean\_absolute\_error: 0.0085 98/126 [======================>.......] - ETA: 0s - loss: 1.0800e-04 - mean\_absolute\_error: 0.0081122/126 [============================>.] - ETA: 0s - loss: 1.1018e-04 - mean\_absolute\_error: 0.0082126/126 [==============================] - 0s 2ms/step - loss: 1.1181e-04 - mean\_absolute\_error: 0.0082 - val\_loss: 9.3072e-05 - val\_mean\_absolute\_error: 0.0075  
Epoch 97/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2662e-04 - mean\_absolute\_error: 0.0085 25/126 [====>.........................] - ETA: 0s - loss: 1.0923e-04 - mean\_absolute\_error: 0.0081 48/126 [==========>...................] - ETA: 0s - loss: 1.0103e-04 - mean\_absolute\_error: 0.0077 72/126 [================>.............] - ETA: 0s - loss: 9.6084e-05 - mean\_absolute\_error: 0.0074 95/126 [=====================>........] - ETA: 0s - loss: 9.5844e-05 - mean\_absolute\_error: 0.0075118/126 [===========================>..] - ETA: 0s - loss: 9.7182e-05 - mean\_absolute\_error: 0.0075126/126 [==============================] - 0s 2ms/step - loss: 9.6271e-05 - mean\_absolute\_error: 0.0075 - val\_loss: 1.0187e-04 - val\_mean\_absolute\_error: 0.0078  
Epoch 98/100  
 1/126 [..............................] - ETA: 0s - loss: 7.9324e-05 - mean\_absolute\_error: 0.0073 26/126 [=====>........................] - ETA: 0s - loss: 8.7075e-05 - mean\_absolute\_error: 0.0071 51/126 [===========>..................] - ETA: 0s - loss: 8.9371e-05 - mean\_absolute\_error: 0.0071 74/126 [================>.............] - ETA: 0s - loss: 8.8680e-05 - mean\_absolute\_error: 0.0072 98/126 [======================>.......] - ETA: 0s - loss: 8.9679e-05 - mean\_absolute\_error: 0.0073122/126 [============================>.] - ETA: 0s - loss: 9.2569e-05 - mean\_absolute\_error: 0.0073126/126 [==============================] - 0s 2ms/step - loss: 9.2268e-05 - mean\_absolute\_error: 0.0073 - val\_loss: 9.4751e-05 - val\_mean\_absolute\_error: 0.0075  
Epoch 99/100  
 1/126 [..............................] - ETA: 0s - loss: 9.7767e-05 - mean\_absolute\_error: 0.0068 25/126 [====>.........................] - ETA: 0s - loss: 1.1106e-04 - mean\_absolute\_error: 0.0081 50/126 [==========>...................] - ETA: 0s - loss: 9.4444e-05 - mean\_absolute\_error: 0.0075 74/126 [================>.............] - ETA: 0s - loss: 9.3291e-05 - mean\_absolute\_error: 0.0073 99/126 [======================>.......] - ETA: 0s - loss: 9.1221e-05 - mean\_absolute\_error: 0.0072123/126 [============================>.] - ETA: 0s - loss: 9.9343e-05 - mean\_absolute\_error: 0.0076126/126 [==============================] - 0s 2ms/step - loss: 1.0039e-04 - mean\_absolute\_error: 0.0077 - val\_loss: 2.5465e-04 - val\_mean\_absolute\_error: 0.0135  
Epoch 100/100  
 1/126 [..............................] - ETA: 0s - loss: 2.4245e-04 - mean\_absolute\_error: 0.0132 26/126 [=====>........................] - ETA: 0s - loss: 1.4184e-04 - mean\_absolute\_error: 0.0093 50/126 [==========>...................] - ETA: 0s - loss: 1.3243e-04 - mean\_absolute\_error: 0.0090 74/126 [================>.............] - ETA: 0s - loss: 1.2305e-04 - mean\_absolute\_error: 0.0085 98/126 [======================>.......] - ETA: 0s - loss: 1.1273e-04 - mean\_absolute\_error: 0.0081122/126 [============================>.] - ETA: 0s - loss: 1.0682e-04 - mean\_absolute\_error: 0.0079126/126 [==============================] - 0s 2ms/step - loss: 1.0532e-04 - mean\_absolute\_error: 0.0078 - val\_loss: 9.4927e-05 - val\_mean\_absolute\_error: 0.0076

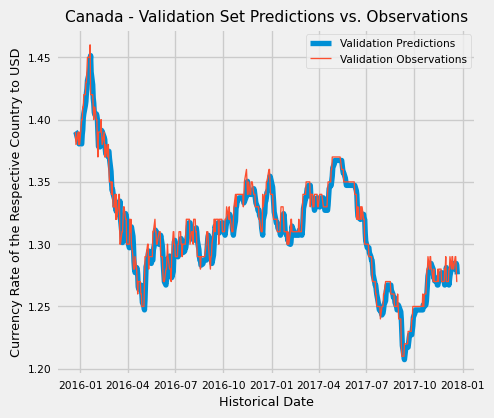
<keras.src.callbacks.History at 0x267cdba3550>

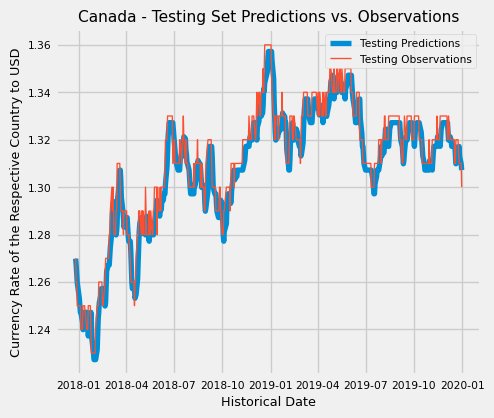
After the training and fitting of the Machine Learning model for Canada, I tried to create visualizations comparing the model against the country’s training dataset, validation dataset, but most importantly the testing dataset (as shown below in the line graphs). Note that the darker and thicker blue lines represent the prediction model’s projections and the thinner red lines is the observed/gathered data.

```{python}  
# Testing the Machine Learning Model prediction for Austrailia with the train,   
# validation, and test sets  
# Most important is the test set prediction as this tests the effectiveness  
# of the Machine Learning model on data it has not seen before   
canada\_train\_pred = canada\_model.predict(X\_canada\_train).flatten()  
  
plt.plot(dates\_canada\_train, canada\_train\_pred, linewidth=4)  
plt.plot(dates\_canada\_train, y\_canada\_train, linewidth=1)  
plt.legend(["Training Predictions", "Training Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Canada - Training Set Predictions vs. Observations")  
plt.show()  
  
canada\_val\_pred = canada\_model.predict(X\_canada\_val).flatten()  
  
plt.plot(dates\_canada\_val, canada\_val\_pred, linewidth=4)  
plt.plot(dates\_canada\_val, y\_canada\_val, linewidth=1)  
plt.legend(["Validation Predictions", "Validation Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Canada - Validation Set Predictions vs. Observations")  
plt.show()  
  
canada\_test\_pred = canada\_model.predict(X\_canada\_test).flatten()  
  
plt.plot(dates\_canada\_test, canada\_test\_pred, linewidth=4)  
plt.plot(dates\_canada\_test, y\_canada\_test, linewidth=1)  
plt.legend(["Testing Predictions", "Testing Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Canada - Testing Set Predictions vs. Observations")  
plt.show()  
```

1/126 [..............................] - ETA: 42s 47/126 [==========>...................] - ETA: 0s 94/126 [=====================>........] - ETA: 0s126/126 [==============================] - 0s 1ms/step  
 1/16 [>.............................] - ETA: 0s16/16 [==============================] - 0s 1ms/step  
 1/16 [>.............................] - ETA: 0s16/16 [==============================] - 0s 1ms/step

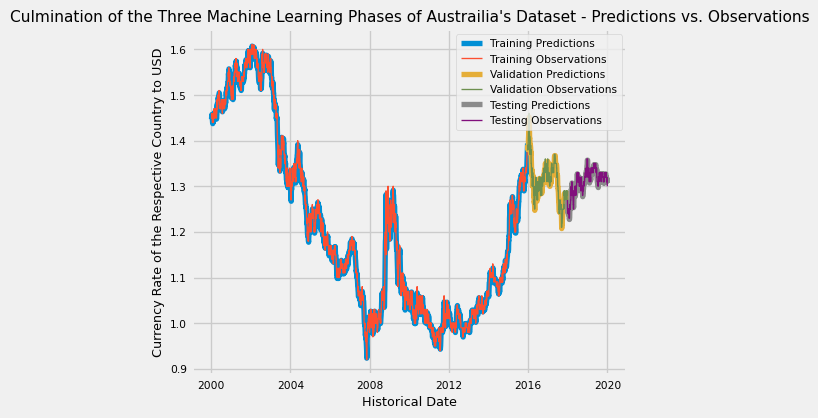






Through careful consideration of all of the prediction-based vs. observation-based contrast visualizations together, I consolidated all of graphics into one singular visualization for you to see below to get a more general perspective of the effectiveness of the Machine Learning model at training and fitting towards predicting Canada’s international currency rate with the United States.

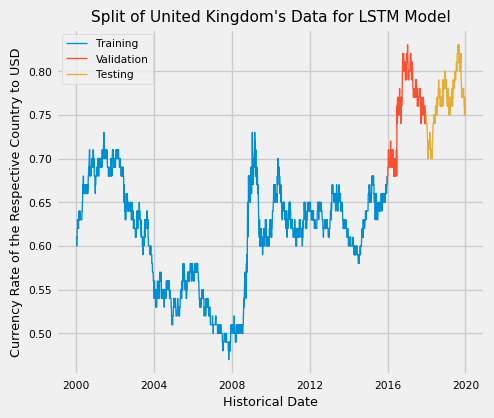
```{python}  
# Plotting Canada's observational (reference) data with the predictions of its   
# Machine Learning Model (as a way to visually inspect the effectiveness of the   
# model)   
plt.plot(dates\_canada\_train, canada\_train\_pred, linewidth=4)  
plt.plot(dates\_canada\_train, y\_canada\_train, linewidth=1)  
plt.plot(dates\_canada\_val, canada\_val\_pred, linewidth=4)  
plt.plot(dates\_canada\_val, y\_canada\_val, linewidth=1)  
plt.plot(dates\_canada\_test, canada\_test\_pred, linewidth=4)  
plt.plot(dates\_canada\_test, y\_canada\_test, linewidth=1)  
  
plt.legend(["Training Predictions",  
 "Training Observations",  
 "Validation Predictions",  
 "Validation Observations",  
 "Testing Predictions",  
 "Testing Observations"], loc="upper right")  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Culmination of the Three Machine Learning Phases of Austrailia's Dataset - Predictions vs. Observations")  
plt.show()  
```



Then, I worked on the United Kingdom’s data (as shown below):

Since the data (date, X, and y) is split into three np.arrays and to be more efficient, I will manually split the United Kingdom’s data into train, test, and validation datasets for the Machine Learning model with 80% going to the training dataset, the next 10% going to the validation dataset, and the last 10% going to the test dataset for each np.array respectively.

```{python}  
# Splitting United Kingdom's data into train, test, and validation sets on 3   
# mediums: the X-axis, the y-axis, and the indices (represented by dates)  
dates\_united\_kingdom\_train, X\_united\_kingdom\_train, y\_united\_kingdom\_train = dates\_united\_kingdom[:percentile\_80], X\_united\_kingdom[:percentile\_80], y\_united\_kingdom[:percentile\_80]  
dates\_united\_kingdom\_val, X\_united\_kingdom\_val, y\_united\_kingdom\_val = dates\_united\_kingdom[percentile\_80:percentile\_90], X\_united\_kingdom[percentile\_80:percentile\_90], y\_united\_kingdom[percentile\_80:percentile\_90]  
dates\_united\_kingdom\_test, X\_united\_kingdom\_test, y\_united\_kingdom\_test = dates\_united\_kingdom[percentile\_90:], X\_united\_kingdom[percentile\_90:], y\_united\_kingdom[percentile\_90:]  
  
plt.plot(dates\_united\_kingdom\_train, y\_united\_kingdom\_train, linewidth=1)  
plt.plot(dates\_united\_kingdom\_val, y\_united\_kingdom\_val, linewidth=1)  
plt.plot(dates\_united\_kingdom\_test, y\_united\_kingdom\_test, linewidth=1)  
  
plt.legend(["Training", "Validation", "Testing"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Split of United Kingdom's Data for LSTM Model")  
plt.show()  
```



Now, I began to configure the Machine Learning model. We added Sequential layers: an Input layer 3 by 1 because we will have 3 np.arrays of Input and 1 np.array as output, utilize a LSTM (Long Short-Term Memory) layer of 64 neurons, apply 2 levels of dense layers with 32 neurons and folliowing recommendations online to use the RELU (Rectified Linear Unit) Activiation Function, and I followed up with one last dense layer of 1 neuron as our output layer since we are just trying to linearly-predict the next currency-rate on a near-future date. Once I configured the Sequential layers, we are ready to compile the model, utilzing the mean\_square\_error as our minimizing loss function, using the Adam optimizer, and comparing our trained model against our data with the mean\_absolute\_error metric. Lastly, I fitted our model, utilzing our X\_train and Y\_train datasets for fitting with validation from our X\_valid and Y\_valid datasets at 100 epochs.

```{python}  
# Configuring the Machine Learning Tensorflow Model for United Kingdom  
united\_kingdom\_model = Sequential([layers.Input((3, 1)),  
 layers.LSTM(64),  
 layers.Dense(32, activation="relu"),  
 layers.Dense(32, activation="relu"),  
 layers.Dense(1)])  
  
united\_kingdom\_model.compile(loss="mse",  
 optimizer=Adam(learning\_rate=0.001),  
 metrics=["mean\_absolute\_error"])  
  
united\_kingdom\_model.fit(X\_united\_kingdom\_train, y\_united\_kingdom\_train, validation\_data=(X\_united\_kingdom\_val, y\_united\_kingdom\_val), epochs=100)  
```

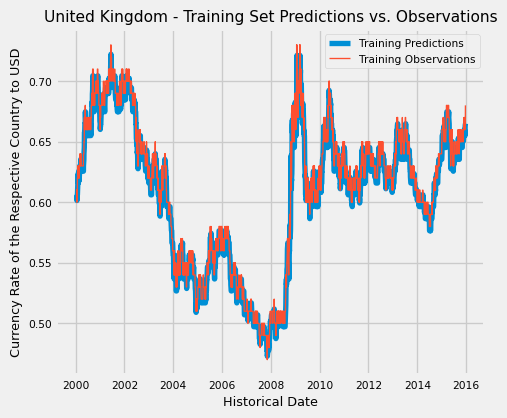
Epoch 1/100  
 1/126 [..............................] - ETA: 3:41 - loss: 0.3293 - mean\_absolute\_error: 0.5709 25/126 [====>.........................] - ETA: 0s - loss: 0.1456 - mean\_absolute\_error: 0.3436 50/126 [==========>...................] - ETA: 0s - loss: 0.0754 - mean\_absolute\_error: 0.2019 75/126 [================>.............] - ETA: 0s - loss: 0.0506 - mean\_absolute\_error: 0.1433100/126 [======================>.......] - ETA: 0s - loss: 0.0381 - mean\_absolute\_error: 0.1124126/126 [==============================] - ETA: 0s - loss: 0.0305 - mean\_absolute\_error: 0.0935126/126 [==============================] - 2s 5ms/step - loss: 0.0305 - mean\_absolute\_error: 0.0935 - val\_loss: 0.0027 - val\_mean\_absolute\_error: 0.0493  
Epoch 2/100  
 1/126 [..............................] - ETA: 0s - loss: 4.2463e-04 - mean\_absolute\_error: 0.0154 27/126 [=====>........................] - ETA: 0s - loss: 5.0232e-04 - mean\_absolute\_error: 0.0180 53/126 [===========>..................] - ETA: 0s - loss: 5.0109e-04 - mean\_absolute\_error: 0.0180 79/126 [=================>............] - ETA: 0s - loss: 5.0035e-04 - mean\_absolute\_error: 0.0181105/126 [========================>.....] - ETA: 0s - loss: 4.8379e-04 - mean\_absolute\_error: 0.0179126/126 [==============================] - 0s 2ms/step - loss: 4.6890e-04 - mean\_absolute\_error: 0.0176 - val\_loss: 0.0022 - val\_mean\_absolute\_error: 0.0442  
Epoch 3/100  
 1/126 [..............................] - ETA: 0s - loss: 4.7958e-04 - mean\_absolute\_error: 0.0181 26/126 [=====>........................] - ETA: 0s - loss: 3.7655e-04 - mean\_absolute\_error: 0.0158 52/126 [===========>..................] - ETA: 0s - loss: 3.6296e-04 - mean\_absolute\_error: 0.0155 77/126 [=================>............] - ETA: 0s - loss: 3.5696e-04 - mean\_absolute\_error: 0.0153102/126 [=======================>......] - ETA: 0s - loss: 3.5067e-04 - mean\_absolute\_error: 0.0152126/126 [==============================] - 0s 2ms/step - loss: 3.3906e-04 - mean\_absolute\_error: 0.0149 - val\_loss: 0.0017 - val\_mean\_absolute\_error: 0.0390  
Epoch 4/100  
 1/126 [..............................] - ETA: 0s - loss: 2.2868e-04 - mean\_absolute\_error: 0.0123 27/126 [=====>........................] - ETA: 0s - loss: 2.6062e-04 - mean\_absolute\_error: 0.0131 53/126 [===========>..................] - ETA: 0s - loss: 2.4205e-04 - mean\_absolute\_error: 0.0126 79/126 [=================>............] - ETA: 0s - loss: 2.2790e-04 - mean\_absolute\_error: 0.0122105/126 [========================>.....] - ETA: 0s - loss: 2.1633e-04 - mean\_absolute\_error: 0.0118126/126 [==============================] - 0s 2ms/step - loss: 2.1038e-04 - mean\_absolute\_error: 0.0117 - val\_loss: 6.8429e-04 - val\_mean\_absolute\_error: 0.0243  
Epoch 5/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1977e-04 - mean\_absolute\_error: 0.0090 27/126 [=====>........................] - ETA: 0s - loss: 1.3333e-04 - mean\_absolute\_error: 0.0093 53/126 [===========>..................] - ETA: 0s - loss: 1.3002e-04 - mean\_absolute\_error: 0.0091 78/126 [=================>............] - ETA: 0s - loss: 1.2556e-04 - mean\_absolute\_error: 0.0089103/126 [=======================>......] - ETA: 0s - loss: 1.1734e-04 - mean\_absolute\_error: 0.0086126/126 [==============================] - 0s 2ms/step - loss: 1.1125e-04 - mean\_absolute\_error: 0.0084 - val\_loss: 2.2518e-04 - val\_mean\_absolute\_error: 0.0129  
Epoch 6/100  
 1/126 [..............................] - ETA: 0s - loss: 6.2792e-05 - mean\_absolute\_error: 0.0064 28/126 [=====>........................] - ETA: 0s - loss: 7.6122e-05 - mean\_absolute\_error: 0.0068 55/126 [============>.................] - ETA: 0s - loss: 7.2733e-05 - mean\_absolute\_error: 0.0067 80/126 [==================>...........] - ETA: 0s - loss: 6.8240e-05 - mean\_absolute\_error: 0.0065107/126 [========================>.....] - ETA: 0s - loss: 6.2799e-05 - mean\_absolute\_error: 0.0062126/126 [==============================] - 0s 2ms/step - loss: 5.9737e-05 - mean\_absolute\_error: 0.0060 - val\_loss: 1.0090e-04 - val\_mean\_absolute\_error: 0.0077  
Epoch 7/100  
 1/126 [..............................] - ETA: 0s - loss: 6.0814e-05 - mean\_absolute\_error: 0.0054 23/126 [====>.........................] - ETA: 0s - loss: 5.0535e-05 - mean\_absolute\_error: 0.0053 42/126 [=========>....................] - ETA: 0s - loss: 4.7288e-05 - mean\_absolute\_error: 0.0051 64/126 [==============>...............] - ETA: 0s - loss: 4.4593e-05 - mean\_absolute\_error: 0.0050 85/126 [===================>..........] - ETA: 0s - loss: 4.1753e-05 - mean\_absolute\_error: 0.0048106/126 [========================>.....] - ETA: 0s - loss: 4.1345e-05 - mean\_absolute\_error: 0.0048126/126 [==============================] - 0s 3ms/step - loss: 4.0759e-05 - mean\_absolute\_error: 0.0048 - val\_loss: 6.6449e-05 - val\_mean\_absolute\_error: 0.0055  
Epoch 8/100  
 1/126 [..............................] - ETA: 0s - loss: 2.5306e-05 - mean\_absolute\_error: 0.0040 27/126 [=====>........................] - ETA: 0s - loss: 3.7761e-05 - mean\_absolute\_error: 0.0046 52/126 [===========>..................] - ETA: 0s - loss: 3.5799e-05 - mean\_absolute\_error: 0.0045 77/126 [=================>............] - ETA: 0s - loss: 3.5437e-05 - mean\_absolute\_error: 0.0044102/126 [=======================>......] - ETA: 0s - loss: 3.4484e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.5556e-05 - mean\_absolute\_error: 0.0043 - val\_loss: 7.0749e-05 - val\_mean\_absolute\_error: 0.0060  
Epoch 9/100  
 1/126 [..............................] - ETA: 0s - loss: 3.3334e-05 - mean\_absolute\_error: 0.0041 26/126 [=====>........................] - ETA: 0s - loss: 3.8203e-05 - mean\_absolute\_error: 0.0043 51/126 [===========>..................] - ETA: 0s - loss: 3.4758e-05 - mean\_absolute\_error: 0.0041 75/126 [================>.............] - ETA: 0s - loss: 3.4682e-05 - mean\_absolute\_error: 0.0042100/126 [======================>.......] - ETA: 0s - loss: 3.4606e-05 - mean\_absolute\_error: 0.0042125/126 [============================>.] - ETA: 0s - loss: 3.4375e-05 - mean\_absolute\_error: 0.0042126/126 [==============================] - 0s 2ms/step - loss: 3.4388e-05 - mean\_absolute\_error: 0.0042 - val\_loss: 7.1191e-05 - val\_mean\_absolute\_error: 0.0060  
Epoch 10/100  
 1/126 [..............................] - ETA: 0s - loss: 2.3439e-05 - mean\_absolute\_error: 0.0033 26/126 [=====>........................] - ETA: 0s - loss: 3.4839e-05 - mean\_absolute\_error: 0.0041 52/126 [===========>..................] - ETA: 0s - loss: 3.4185e-05 - mean\_absolute\_error: 0.0042 76/126 [=================>............] - ETA: 0s - loss: 3.3934e-05 - mean\_absolute\_error: 0.0042101/126 [=======================>......] - ETA: 0s - loss: 3.5645e-05 - mean\_absolute\_error: 0.0043126/126 [==============================] - 0s 2ms/step - loss: 3.5892e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 7.7761e-05 - val\_mean\_absolute\_error: 0.0065  
Epoch 11/100  
 1/126 [..............................] - ETA: 0s - loss: 5.4391e-05 - mean\_absolute\_error: 0.0047 27/126 [=====>........................] - ETA: 0s - loss: 4.1622e-05 - mean\_absolute\_error: 0.0047 53/126 [===========>..................] - ETA: 0s - loss: 3.8140e-05 - mean\_absolute\_error: 0.0045 77/126 [=================>............] - ETA: 0s - loss: 3.6985e-05 - mean\_absolute\_error: 0.0045102/126 [=======================>......] - ETA: 0s - loss: 3.5977e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.6535e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 1.1892e-04 - val\_mean\_absolute\_error: 0.0089  
Epoch 12/100  
 1/126 [..............................] - ETA: 0s - loss: 3.7615e-05 - mean\_absolute\_error: 0.0053 26/126 [=====>........................] - ETA: 0s - loss: 3.7129e-05 - mean\_absolute\_error: 0.0045 51/126 [===========>..................] - ETA: 0s - loss: 3.7710e-05 - mean\_absolute\_error: 0.0045 76/126 [=================>............] - ETA: 0s - loss: 3.6711e-05 - mean\_absolute\_error: 0.0045101/126 [=======================>......] - ETA: 0s - loss: 3.5647e-05 - mean\_absolute\_error: 0.0043126/126 [==============================] - ETA: 0s - loss: 3.6563e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.6563e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 6.9180e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 13/100  
 1/126 [..............................] - ETA: 0s - loss: 3.4458e-05 - mean\_absolute\_error: 0.0048 27/126 [=====>........................] - ETA: 0s - loss: 3.3979e-05 - mean\_absolute\_error: 0.0042 52/126 [===========>..................] - ETA: 0s - loss: 3.2093e-05 - mean\_absolute\_error: 0.0041 78/126 [=================>............] - ETA: 0s - loss: 3.2901e-05 - mean\_absolute\_error: 0.0042103/126 [=======================>......] - ETA: 0s - loss: 3.4014e-05 - mean\_absolute\_error: 0.0042126/126 [==============================] - 0s 2ms/step - loss: 3.4548e-05 - mean\_absolute\_error: 0.0042 - val\_loss: 7.7190e-05 - val\_mean\_absolute\_error: 0.0065  
Epoch 14/100  
 1/126 [..............................] - ETA: 0s - loss: 3.5389e-05 - mean\_absolute\_error: 0.0042 25/126 [====>.........................] - ETA: 0s - loss: 3.3287e-05 - mean\_absolute\_error: 0.0041 50/126 [==========>...................] - ETA: 0s - loss: 3.4759e-05 - mean\_absolute\_error: 0.0042 76/126 [=================>............] - ETA: 0s - loss: 3.4835e-05 - mean\_absolute\_error: 0.0042102/126 [=======================>......] - ETA: 0s - loss: 3.4681e-05 - mean\_absolute\_error: 0.0042126/126 [==============================] - 0s 2ms/step - loss: 3.5088e-05 - mean\_absolute\_error: 0.0043 - val\_loss: 7.5098e-05 - val\_mean\_absolute\_error: 0.0064  
Epoch 15/100  
 1/126 [..............................] - ETA: 0s - loss: 3.3720e-05 - mean\_absolute\_error: 0.0041 26/126 [=====>........................] - ETA: 0s - loss: 3.3286e-05 - mean\_absolute\_error: 0.0042 52/126 [===========>..................] - ETA: 0s - loss: 3.3060e-05 - mean\_absolute\_error: 0.0042 77/126 [=================>............] - ETA: 0s - loss: 3.4746e-05 - mean\_absolute\_error: 0.0043102/126 [=======================>......] - ETA: 0s - loss: 3.7960e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.7045e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 7.0076e-05 - val\_mean\_absolute\_error: 0.0060  
Epoch 16/100  
 1/126 [..............................] - ETA: 0s - loss: 2.6924e-05 - mean\_absolute\_error: 0.0041 26/126 [=====>........................] - ETA: 0s - loss: 3.6884e-05 - mean\_absolute\_error: 0.0043 50/126 [==========>...................] - ETA: 0s - loss: 3.5608e-05 - mean\_absolute\_error: 0.0042 76/126 [=================>............] - ETA: 0s - loss: 3.4255e-05 - mean\_absolute\_error: 0.0042102/126 [=======================>......] - ETA: 0s - loss: 3.3543e-05 - mean\_absolute\_error: 0.0042126/126 [==============================] - 0s 2ms/step - loss: 3.4716e-05 - mean\_absolute\_error: 0.0042 - val\_loss: 8.5585e-05 - val\_mean\_absolute\_error: 0.0071  
Epoch 17/100  
 1/126 [..............................] - ETA: 0s - loss: 3.7134e-05 - mean\_absolute\_error: 0.0046 26/126 [=====>........................] - ETA: 0s - loss: 3.7891e-05 - mean\_absolute\_error: 0.0045 52/126 [===========>..................] - ETA: 0s - loss: 3.8997e-05 - mean\_absolute\_error: 0.0045 78/126 [=================>............] - ETA: 0s - loss: 3.7174e-05 - mean\_absolute\_error: 0.0045103/126 [=======================>......] - ETA: 0s - loss: 3.5877e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.5513e-05 - mean\_absolute\_error: 0.0043 - val\_loss: 7.9631e-05 - val\_mean\_absolute\_error: 0.0067  
Epoch 18/100  
 1/126 [..............................] - ETA: 0s - loss: 4.2684e-05 - mean\_absolute\_error: 0.0048 27/126 [=====>........................] - ETA: 0s - loss: 3.3368e-05 - mean\_absolute\_error: 0.0042 53/126 [===========>..................] - ETA: 0s - loss: 3.8282e-05 - mean\_absolute\_error: 0.0044 79/126 [=================>............] - ETA: 0s - loss: 3.8073e-05 - mean\_absolute\_error: 0.0045105/126 [========================>.....] - ETA: 0s - loss: 3.8395e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - 0s 2ms/step - loss: 3.7659e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 9.8022e-05 - val\_mean\_absolute\_error: 0.0078  
Epoch 19/100  
 1/126 [..............................] - ETA: 0s - loss: 3.3492e-05 - mean\_absolute\_error: 0.0045 27/126 [=====>........................] - ETA: 0s - loss: 3.2045e-05 - mean\_absolute\_error: 0.0042 53/126 [===========>..................] - ETA: 0s - loss: 3.5124e-05 - mean\_absolute\_error: 0.0044 77/126 [=================>............] - ETA: 0s - loss: 3.5662e-05 - mean\_absolute\_error: 0.0044102/126 [=======================>......] - ETA: 0s - loss: 3.5251e-05 - mean\_absolute\_error: 0.0043126/126 [==============================] - 0s 2ms/step - loss: 3.6170e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 6.8819e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 20/100  
 1/126 [..............................] - ETA: 0s - loss: 3.4244e-05 - mean\_absolute\_error: 0.0043 27/126 [=====>........................] - ETA: 0s - loss: 3.7383e-05 - mean\_absolute\_error: 0.0046 53/126 [===========>..................] - ETA: 0s - loss: 3.6458e-05 - mean\_absolute\_error: 0.0045 78/126 [=================>............] - ETA: 0s - loss: 3.7888e-05 - mean\_absolute\_error: 0.0046104/126 [=======================>......] - ETA: 0s - loss: 3.9088e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - 0s 2ms/step - loss: 3.9511e-05 - mean\_absolute\_error: 0.0047 - val\_loss: 7.0928e-05 - val\_mean\_absolute\_error: 0.0061  
Epoch 21/100  
 1/126 [..............................] - ETA: 0s - loss: 3.2061e-05 - mean\_absolute\_error: 0.0041 28/126 [=====>........................] - ETA: 0s - loss: 3.8991e-05 - mean\_absolute\_error: 0.0044 54/126 [===========>..................] - ETA: 0s - loss: 3.7281e-05 - mean\_absolute\_error: 0.0044 80/126 [==================>...........] - ETA: 0s - loss: 3.8267e-05 - mean\_absolute\_error: 0.0045106/126 [========================>.....] - ETA: 0s - loss: 3.6725e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.6382e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 6.9604e-05 - val\_mean\_absolute\_error: 0.0059  
Epoch 22/100  
 1/126 [..............................] - ETA: 0s - loss: 2.4052e-05 - mean\_absolute\_error: 0.0037 28/126 [=====>........................] - ETA: 0s - loss: 3.3816e-05 - mean\_absolute\_error: 0.0042 53/126 [===========>..................] - ETA: 0s - loss: 3.5691e-05 - mean\_absolute\_error: 0.0044 79/126 [=================>............] - ETA: 0s - loss: 3.5014e-05 - mean\_absolute\_error: 0.0044105/126 [========================>.....] - ETA: 0s - loss: 3.7546e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.7705e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 6.9920e-05 - val\_mean\_absolute\_error: 0.0060  
Epoch 23/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9465e-05 - mean\_absolute\_error: 0.0032 27/126 [=====>........................] - ETA: 0s - loss: 3.3079e-05 - mean\_absolute\_error: 0.0043 52/126 [===========>..................] - ETA: 0s - loss: 3.4760e-05 - mean\_absolute\_error: 0.0044 76/126 [=================>............] - ETA: 0s - loss: 3.6726e-05 - mean\_absolute\_error: 0.0044102/126 [=======================>......] - ETA: 0s - loss: 3.8104e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.7248e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 1.4094e-04 - val\_mean\_absolute\_error: 0.0099  
Epoch 24/100  
 1/126 [..............................] - ETA: 0s - loss: 4.8435e-05 - mean\_absolute\_error: 0.0058 27/126 [=====>........................] - ETA: 0s - loss: 4.3476e-05 - mean\_absolute\_error: 0.0051 53/126 [===========>..................] - ETA: 0s - loss: 3.8610e-05 - mean\_absolute\_error: 0.0048 78/126 [=================>............] - ETA: 0s - loss: 3.7935e-05 - mean\_absolute\_error: 0.0047104/126 [=======================>......] - ETA: 0s - loss: 3.8566e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - 0s 2ms/step - loss: 4.1560e-05 - mean\_absolute\_error: 0.0048 - val\_loss: 8.7703e-05 - val\_mean\_absolute\_error: 0.0072  
Epoch 25/100  
 1/126 [..............................] - ETA: 0s - loss: 3.8479e-05 - mean\_absolute\_error: 0.0050 27/126 [=====>........................] - ETA: 0s - loss: 3.4054e-05 - mean\_absolute\_error: 0.0044 53/126 [===========>..................] - ETA: 0s - loss: 3.7363e-05 - mean\_absolute\_error: 0.0046 78/126 [=================>............] - ETA: 0s - loss: 3.6842e-05 - mean\_absolute\_error: 0.0045104/126 [=======================>......] - ETA: 0s - loss: 3.6955e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.6956e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 6.8852e-05 - val\_mean\_absolute\_error: 0.0057  
Epoch 26/100  
 1/126 [..............................] - ETA: 0s - loss: 3.9773e-05 - mean\_absolute\_error: 0.0051 27/126 [=====>........................] - ETA: 0s - loss: 3.7616e-05 - mean\_absolute\_error: 0.0046 52/126 [===========>..................] - ETA: 0s - loss: 3.8804e-05 - mean\_absolute\_error: 0.0046 77/126 [=================>............] - ETA: 0s - loss: 3.7858e-05 - mean\_absolute\_error: 0.0046100/126 [======================>.......] - ETA: 0s - loss: 3.6706e-05 - mean\_absolute\_error: 0.0044125/126 [============================>.] - ETA: 0s - loss: 3.7126e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.7168e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 8.2658e-05 - val\_mean\_absolute\_error: 0.0069  
Epoch 27/100  
 1/126 [..............................] - ETA: 0s - loss: 4.1803e-05 - mean\_absolute\_error: 0.0042 27/126 [=====>........................] - ETA: 0s - loss: 4.4964e-05 - mean\_absolute\_error: 0.0050 52/126 [===========>..................] - ETA: 0s - loss: 3.8737e-05 - mean\_absolute\_error: 0.0047 76/126 [=================>............] - ETA: 0s - loss: 3.8862e-05 - mean\_absolute\_error: 0.0046101/126 [=======================>......] - ETA: 0s - loss: 3.9211e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - ETA: 0s - loss: 3.8498e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - 0s 2ms/step - loss: 3.8498e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 1.1597e-04 - val\_mean\_absolute\_error: 0.0087  
Epoch 28/100  
 1/126 [..............................] - ETA: 0s - loss: 6.1848e-05 - mean\_absolute\_error: 0.0066 27/126 [=====>........................] - ETA: 0s - loss: 4.8155e-05 - mean\_absolute\_error: 0.0055 52/126 [===========>..................] - ETA: 0s - loss: 4.3457e-05 - mean\_absolute\_error: 0.0051 78/126 [=================>............] - ETA: 0s - loss: 4.1152e-05 - mean\_absolute\_error: 0.0048103/126 [=======================>......] - ETA: 0s - loss: 4.2202e-05 - mean\_absolute\_error: 0.0049126/126 [==============================] - 0s 2ms/step - loss: 4.1125e-05 - mean\_absolute\_error: 0.0049 - val\_loss: 8.9938e-05 - val\_mean\_absolute\_error: 0.0074  
Epoch 29/100  
 1/126 [..............................] - ETA: 0s - loss: 2.6613e-05 - mean\_absolute\_error: 0.0035 28/126 [=====>........................] - ETA: 0s - loss: 3.9578e-05 - mean\_absolute\_error: 0.0047 53/126 [===========>..................] - ETA: 0s - loss: 4.8792e-05 - mean\_absolute\_error: 0.0053 79/126 [=================>............] - ETA: 0s - loss: 4.6088e-05 - mean\_absolute\_error: 0.0052104/126 [=======================>......] - ETA: 0s - loss: 4.4889e-05 - mean\_absolute\_error: 0.0051126/126 [==============================] - 0s 2ms/step - loss: 4.3578e-05 - mean\_absolute\_error: 0.0050 - val\_loss: 6.9233e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 30/100  
 1/126 [..............................] - ETA: 0s - loss: 4.6142e-05 - mean\_absolute\_error: 0.0057 26/126 [=====>........................] - ETA: 0s - loss: 3.7381e-05 - mean\_absolute\_error: 0.0048 50/126 [==========>...................] - ETA: 0s - loss: 3.6406e-05 - mean\_absolute\_error: 0.0046 75/126 [================>.............] - ETA: 0s - loss: 3.7238e-05 - mean\_absolute\_error: 0.0045101/126 [=======================>......] - ETA: 0s - loss: 3.8756e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - ETA: 0s - loss: 3.7829e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - 0s 2ms/step - loss: 3.7829e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 9.6558e-05 - val\_mean\_absolute\_error: 0.0078  
Epoch 31/100  
 1/126 [..............................] - ETA: 0s - loss: 4.6215e-05 - mean\_absolute\_error: 0.0052 27/126 [=====>........................] - ETA: 0s - loss: 3.8325e-05 - mean\_absolute\_error: 0.0045 52/126 [===========>..................] - ETA: 0s - loss: 3.6439e-05 - mean\_absolute\_error: 0.0044 78/126 [=================>............] - ETA: 0s - loss: 4.0769e-05 - mean\_absolute\_error: 0.0047104/126 [=======================>......] - ETA: 0s - loss: 4.2694e-05 - mean\_absolute\_error: 0.0049126/126 [==============================] - 0s 2ms/step - loss: 4.1733e-05 - mean\_absolute\_error: 0.0049 - val\_loss: 7.9627e-05 - val\_mean\_absolute\_error: 0.0068  
Epoch 32/100  
 1/126 [..............................] - ETA: 0s - loss: 3.4570e-05 - mean\_absolute\_error: 0.0042 26/126 [=====>........................] - ETA: 0s - loss: 4.4095e-05 - mean\_absolute\_error: 0.0051 52/126 [===========>..................] - ETA: 0s - loss: 4.6453e-05 - mean\_absolute\_error: 0.0052 77/126 [=================>............] - ETA: 0s - loss: 4.4501e-05 - mean\_absolute\_error: 0.0051102/126 [=======================>......] - ETA: 0s - loss: 4.3296e-05 - mean\_absolute\_error: 0.0050126/126 [==============================] - 0s 2ms/step - loss: 4.1705e-05 - mean\_absolute\_error: 0.0049 - val\_loss: 7.3147e-05 - val\_mean\_absolute\_error: 0.0061  
Epoch 33/100  
 1/126 [..............................] - ETA: 0s - loss: 7.6769e-05 - mean\_absolute\_error: 0.0063 27/126 [=====>........................] - ETA: 0s - loss: 3.8483e-05 - mean\_absolute\_error: 0.0048 52/126 [===========>..................] - ETA: 0s - loss: 4.2542e-05 - mean\_absolute\_error: 0.0050 77/126 [=================>............] - ETA: 0s - loss: 4.2388e-05 - mean\_absolute\_error: 0.0050102/126 [=======================>......] - ETA: 0s - loss: 4.0793e-05 - mean\_absolute\_error: 0.0048126/126 [==============================] - 0s 2ms/step - loss: 4.0500e-05 - mean\_absolute\_error: 0.0048 - val\_loss: 8.1680e-05 - val\_mean\_absolute\_error: 0.0069  
Epoch 34/100  
 1/126 [..............................] - ETA: 0s - loss: 4.4227e-05 - mean\_absolute\_error: 0.0049 27/126 [=====>........................] - ETA: 0s - loss: 4.5244e-05 - mean\_absolute\_error: 0.0052 52/126 [===========>..................] - ETA: 0s - loss: 4.3340e-05 - mean\_absolute\_error: 0.0050 77/126 [=================>............] - ETA: 0s - loss: 4.0090e-05 - mean\_absolute\_error: 0.0047 99/126 [======================>.......] - ETA: 0s - loss: 3.9330e-05 - mean\_absolute\_error: 0.0046124/126 [============================>.] - ETA: 0s - loss: 3.8858e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - 0s 2ms/step - loss: 3.9006e-05 - mean\_absolute\_error: 0.0047 - val\_loss: 6.9831e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 35/100  
 1/126 [..............................] - ETA: 0s - loss: 5.5081e-05 - mean\_absolute\_error: 0.0054 27/126 [=====>........................] - ETA: 0s - loss: 3.3644e-05 - mean\_absolute\_error: 0.0044 52/126 [===========>..................] - ETA: 0s - loss: 3.5360e-05 - mean\_absolute\_error: 0.0044 77/126 [=================>............] - ETA: 0s - loss: 4.0718e-05 - mean\_absolute\_error: 0.0048102/126 [=======================>......] - ETA: 0s - loss: 4.1868e-05 - mean\_absolute\_error: 0.0048126/126 [==============================] - 0s 2ms/step - loss: 4.5176e-05 - mean\_absolute\_error: 0.0051 - val\_loss: 7.7940e-05 - val\_mean\_absolute\_error: 0.0066  
Epoch 36/100  
 1/126 [..............................] - ETA: 0s - loss: 3.6660e-05 - mean\_absolute\_error: 0.0049 27/126 [=====>........................] - ETA: 0s - loss: 4.0574e-05 - mean\_absolute\_error: 0.0049 53/126 [===========>..................] - ETA: 0s - loss: 4.0491e-05 - mean\_absolute\_error: 0.0049 79/126 [=================>............] - ETA: 0s - loss: 4.4338e-05 - mean\_absolute\_error: 0.0052105/126 [========================>.....] - ETA: 0s - loss: 4.3039e-05 - mean\_absolute\_error: 0.0051126/126 [==============================] - 0s 2ms/step - loss: 4.3348e-05 - mean\_absolute\_error: 0.0051 - val\_loss: 6.7969e-05 - val\_mean\_absolute\_error: 0.0057  
Epoch 37/100  
 1/126 [..............................] - ETA: 0s - loss: 4.5450e-05 - mean\_absolute\_error: 0.0049 26/126 [=====>........................] - ETA: 0s - loss: 4.4306e-05 - mean\_absolute\_error: 0.0051 51/126 [===========>..................] - ETA: 0s - loss: 3.9784e-05 - mean\_absolute\_error: 0.0048 77/126 [=================>............] - ETA: 0s - loss: 3.9736e-05 - mean\_absolute\_error: 0.0048103/126 [=======================>......] - ETA: 0s - loss: 3.8821e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - 0s 2ms/step - loss: 3.9996e-05 - mean\_absolute\_error: 0.0047 - val\_loss: 1.0477e-04 - val\_mean\_absolute\_error: 0.0082  
Epoch 38/100  
 1/126 [..............................] - ETA: 0s - loss: 5.5488e-05 - mean\_absolute\_error: 0.0058 27/126 [=====>........................] - ETA: 0s - loss: 3.7057e-05 - mean\_absolute\_error: 0.0044 53/126 [===========>..................] - ETA: 0s - loss: 4.0469e-05 - mean\_absolute\_error: 0.0046 79/126 [=================>............] - ETA: 0s - loss: 3.9355e-05 - mean\_absolute\_error: 0.0046104/126 [=======================>......] - ETA: 0s - loss: 3.7717e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.6704e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 9.9957e-05 - val\_mean\_absolute\_error: 0.0080  
Epoch 39/100  
 1/126 [..............................] - ETA: 0s - loss: 3.6392e-05 - mean\_absolute\_error: 0.0049 27/126 [=====>........................] - ETA: 0s - loss: 3.7123e-05 - mean\_absolute\_error: 0.0044 53/126 [===========>..................] - ETA: 0s - loss: 3.9256e-05 - mean\_absolute\_error: 0.0046 79/126 [=================>............] - ETA: 0s - loss: 3.8336e-05 - mean\_absolute\_error: 0.0045105/126 [========================>.....] - ETA: 0s - loss: 3.8346e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - 0s 2ms/step - loss: 3.8657e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 7.0544e-05 - val\_mean\_absolute\_error: 0.0061  
Epoch 40/100  
 1/126 [..............................] - ETA: 0s - loss: 3.6360e-05 - mean\_absolute\_error: 0.0042 27/126 [=====>........................] - ETA: 0s - loss: 3.3964e-05 - mean\_absolute\_error: 0.0041 52/126 [===========>..................] - ETA: 0s - loss: 3.5673e-05 - mean\_absolute\_error: 0.0043 78/126 [=================>............] - ETA: 0s - loss: 4.0839e-05 - mean\_absolute\_error: 0.0047103/126 [=======================>......] - ETA: 0s - loss: 4.1243e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - 0s 2ms/step - loss: 3.9713e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 6.5101e-05 - val\_mean\_absolute\_error: 0.0055  
Epoch 41/100  
 1/126 [..............................] - ETA: 0s - loss: 6.4972e-05 - mean\_absolute\_error: 0.0059 27/126 [=====>........................] - ETA: 0s - loss: 4.1500e-05 - mean\_absolute\_error: 0.0049 53/126 [===========>..................] - ETA: 0s - loss: 4.9460e-05 - mean\_absolute\_error: 0.0055 77/126 [=================>............] - ETA: 0s - loss: 5.1647e-05 - mean\_absolute\_error: 0.0056103/126 [=======================>......] - ETA: 0s - loss: 4.8131e-05 - mean\_absolute\_error: 0.0053126/126 [==============================] - 0s 2ms/step - loss: 4.7032e-05 - mean\_absolute\_error: 0.0053 - val\_loss: 6.4248e-05 - val\_mean\_absolute\_error: 0.0056  
Epoch 42/100  
 1/126 [..............................] - ETA: 0s - loss: 3.4075e-05 - mean\_absolute\_error: 0.0045 28/126 [=====>........................] - ETA: 0s - loss: 3.7982e-05 - mean\_absolute\_error: 0.0045 54/126 [===========>..................] - ETA: 0s - loss: 3.7842e-05 - mean\_absolute\_error: 0.0046 79/126 [=================>............] - ETA: 0s - loss: 3.7114e-05 - mean\_absolute\_error: 0.0045104/126 [=======================>......] - ETA: 0s - loss: 3.7333e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.7149e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 8.3160e-05 - val\_mean\_absolute\_error: 0.0068  
Epoch 43/100  
 1/126 [..............................] - ETA: 0s - loss: 9.3464e-05 - mean\_absolute\_error: 0.0072 28/126 [=====>........................] - ETA: 0s - loss: 4.9846e-05 - mean\_absolute\_error: 0.0054 54/126 [===========>..................] - ETA: 0s - loss: 5.1265e-05 - mean\_absolute\_error: 0.0055 80/126 [==================>...........] - ETA: 0s - loss: 4.6308e-05 - mean\_absolute\_error: 0.0051105/126 [========================>.....] - ETA: 0s - loss: 4.4067e-05 - mean\_absolute\_error: 0.0050126/126 [==============================] - 0s 2ms/step - loss: 4.2987e-05 - mean\_absolute\_error: 0.0050 - val\_loss: 7.2288e-05 - val\_mean\_absolute\_error: 0.0061  
Epoch 44/100  
 1/126 [..............................] - ETA: 0s - loss: 3.7142e-05 - mean\_absolute\_error: 0.0050 26/126 [=====>........................] - ETA: 0s - loss: 3.9936e-05 - mean\_absolute\_error: 0.0048 51/126 [===========>..................] - ETA: 0s - loss: 3.9074e-05 - mean\_absolute\_error: 0.0046 77/126 [=================>............] - ETA: 0s - loss: 3.9081e-05 - mean\_absolute\_error: 0.0046102/126 [=======================>......] - ETA: 0s - loss: 3.9845e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - 0s 2ms/step - loss: 3.8940e-05 - mean\_absolute\_error: 0.0047 - val\_loss: 1.0917e-04 - val\_mean\_absolute\_error: 0.0081  
Epoch 45/100  
 1/126 [..............................] - ETA: 0s - loss: 6.1355e-05 - mean\_absolute\_error: 0.0056 27/126 [=====>........................] - ETA: 0s - loss: 4.1727e-05 - mean\_absolute\_error: 0.0049 53/126 [===========>..................] - ETA: 0s - loss: 3.9923e-05 - mean\_absolute\_error: 0.0047 79/126 [=================>............] - ETA: 0s - loss: 3.9341e-05 - mean\_absolute\_error: 0.0047105/126 [========================>.....] - ETA: 0s - loss: 3.7922e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - 0s 2ms/step - loss: 3.8067e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 8.6440e-05 - val\_mean\_absolute\_error: 0.0073  
Epoch 46/100  
 1/126 [..............................] - ETA: 0s - loss: 5.0405e-05 - mean\_absolute\_error: 0.0064 27/126 [=====>........................] - ETA: 0s - loss: 4.1809e-05 - mean\_absolute\_error: 0.0050 53/126 [===========>..................] - ETA: 0s - loss: 4.4949e-05 - mean\_absolute\_error: 0.0053 78/126 [=================>............] - ETA: 0s - loss: 4.4487e-05 - mean\_absolute\_error: 0.0052103/126 [=======================>......] - ETA: 0s - loss: 4.1258e-05 - mean\_absolute\_error: 0.0049126/126 [==============================] - 0s 2ms/step - loss: 4.1655e-05 - mean\_absolute\_error: 0.0050 - val\_loss: 7.2175e-05 - val\_mean\_absolute\_error: 0.0063  
Epoch 47/100  
 1/126 [..............................] - ETA: 0s - loss: 5.2912e-05 - mean\_absolute\_error: 0.0063 26/126 [=====>........................] - ETA: 0s - loss: 4.3321e-05 - mean\_absolute\_error: 0.0052 52/126 [===========>..................] - ETA: 0s - loss: 4.0493e-05 - mean\_absolute\_error: 0.0049 77/126 [=================>............] - ETA: 0s - loss: 4.0189e-05 - mean\_absolute\_error: 0.0048102/126 [=======================>......] - ETA: 0s - loss: 3.8799e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - 0s 2ms/step - loss: 3.8216e-05 - mean\_absolute\_error: 0.0047 - val\_loss: 9.8299e-05 - val\_mean\_absolute\_error: 0.0076  
Epoch 48/100  
 1/126 [..............................] - ETA: 0s - loss: 3.0885e-05 - mean\_absolute\_error: 0.0046 27/126 [=====>........................] - ETA: 0s - loss: 3.9609e-05 - mean\_absolute\_error: 0.0046 51/126 [===========>..................] - ETA: 0s - loss: 4.1187e-05 - mean\_absolute\_error: 0.0048 77/126 [=================>............] - ETA: 0s - loss: 4.1098e-05 - mean\_absolute\_error: 0.0048103/126 [=======================>......] - ETA: 0s - loss: 4.1174e-05 - mean\_absolute\_error: 0.0048126/126 [==============================] - 0s 2ms/step - loss: 4.0013e-05 - mean\_absolute\_error: 0.0048 - val\_loss: 7.8279e-05 - val\_mean\_absolute\_error: 0.0068  
Epoch 49/100  
 1/126 [..............................] - ETA: 0s - loss: 2.1504e-05 - mean\_absolute\_error: 0.0040 27/126 [=====>........................] - ETA: 0s - loss: 3.7417e-05 - mean\_absolute\_error: 0.0046 52/126 [===========>..................] - ETA: 0s - loss: 3.4543e-05 - mean\_absolute\_error: 0.0044 76/126 [=================>............] - ETA: 0s - loss: 3.5778e-05 - mean\_absolute\_error: 0.0044101/126 [=======================>......] - ETA: 0s - loss: 3.7434e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - ETA: 0s - loss: 3.6882e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.6882e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 6.5595e-05 - val\_mean\_absolute\_error: 0.0057  
Epoch 50/100  
 1/126 [..............................] - ETA: 0s - loss: 2.5531e-05 - mean\_absolute\_error: 0.0038 27/126 [=====>........................] - ETA: 0s - loss: 4.0034e-05 - mean\_absolute\_error: 0.0046 53/126 [===========>..................] - ETA: 0s - loss: 3.6204e-05 - mean\_absolute\_error: 0.0044 79/126 [=================>............] - ETA: 0s - loss: 3.4337e-05 - mean\_absolute\_error: 0.0043104/126 [=======================>......] - ETA: 0s - loss: 3.5968e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.7080e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 1.1047e-04 - val\_mean\_absolute\_error: 0.0086  
Epoch 51/100  
 1/126 [..............................] - ETA: 0s - loss: 7.3616e-05 - mean\_absolute\_error: 0.0074 26/126 [=====>........................] - ETA: 0s - loss: 5.3917e-05 - mean\_absolute\_error: 0.0058 50/126 [==========>...................] - ETA: 0s - loss: 4.8660e-05 - mean\_absolute\_error: 0.0055 75/126 [================>.............] - ETA: 0s - loss: 4.7280e-05 - mean\_absolute\_error: 0.0053100/126 [======================>.......] - ETA: 0s - loss: 4.4533e-05 - mean\_absolute\_error: 0.0051125/126 [============================>.] - ETA: 0s - loss: 4.2354e-05 - mean\_absolute\_error: 0.0050126/126 [==============================] - 0s 2ms/step - loss: 4.2289e-05 - mean\_absolute\_error: 0.0050 - val\_loss: 7.9627e-05 - val\_mean\_absolute\_error: 0.0069  
Epoch 52/100  
 1/126 [..............................] - ETA: 0s - loss: 4.3175e-05 - mean\_absolute\_error: 0.0058 27/126 [=====>........................] - ETA: 0s - loss: 3.8856e-05 - mean\_absolute\_error: 0.0046 53/126 [===========>..................] - ETA: 0s - loss: 3.7599e-05 - mean\_absolute\_error: 0.0044 79/126 [=================>............] - ETA: 0s - loss: 3.5395e-05 - mean\_absolute\_error: 0.0043105/126 [========================>.....] - ETA: 0s - loss: 3.6819e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.6395e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 6.8494e-05 - val\_mean\_absolute\_error: 0.0059  
Epoch 53/100  
 1/126 [..............................] - ETA: 0s - loss: 4.4280e-05 - mean\_absolute\_error: 0.0052 28/126 [=====>........................] - ETA: 0s - loss: 4.3203e-05 - mean\_absolute\_error: 0.0050 53/126 [===========>..................] - ETA: 0s - loss: 5.2527e-05 - mean\_absolute\_error: 0.0057 78/126 [=================>............] - ETA: 0s - loss: 5.1272e-05 - mean\_absolute\_error: 0.0057104/126 [=======================>......] - ETA: 0s - loss: 4.8998e-05 - mean\_absolute\_error: 0.0055126/126 [==============================] - 0s 2ms/step - loss: 4.9719e-05 - mean\_absolute\_error: 0.0055 - val\_loss: 6.5108e-05 - val\_mean\_absolute\_error: 0.0057  
Epoch 54/100  
 1/126 [..............................] - ETA: 0s - loss: 2.1323e-05 - mean\_absolute\_error: 0.0029 25/126 [====>.........................] - ETA: 0s - loss: 3.8637e-05 - mean\_absolute\_error: 0.0044 49/126 [==========>...................] - ETA: 0s - loss: 4.6554e-05 - mean\_absolute\_error: 0.0052 74/126 [================>.............] - ETA: 0s - loss: 4.2051e-05 - mean\_absolute\_error: 0.0049 99/126 [======================>.......] - ETA: 0s - loss: 4.1028e-05 - mean\_absolute\_error: 0.0048123/126 [============================>.] - ETA: 0s - loss: 4.1775e-05 - mean\_absolute\_error: 0.0049126/126 [==============================] - 0s 2ms/step - loss: 4.1756e-05 - mean\_absolute\_error: 0.0049 - val\_loss: 8.0958e-05 - val\_mean\_absolute\_error: 0.0067  
Epoch 55/100  
 1/126 [..............................] - ETA: 0s - loss: 5.2601e-05 - mean\_absolute\_error: 0.0057 25/126 [====>.........................] - ETA: 0s - loss: 3.7408e-05 - mean\_absolute\_error: 0.0044 50/126 [==========>...................] - ETA: 0s - loss: 3.3977e-05 - mean\_absolute\_error: 0.0042 75/126 [================>.............] - ETA: 0s - loss: 3.4948e-05 - mean\_absolute\_error: 0.0043100/126 [======================>.......] - ETA: 0s - loss: 3.8025e-05 - mean\_absolute\_error: 0.0046125/126 [============================>.] - ETA: 0s - loss: 4.0590e-05 - mean\_absolute\_error: 0.0048126/126 [==============================] - 0s 2ms/step - loss: 4.0532e-05 - mean\_absolute\_error: 0.0048 - val\_loss: 1.0499e-04 - val\_mean\_absolute\_error: 0.0083  
Epoch 56/100  
 1/126 [..............................] - ETA: 0s - loss: 6.4022e-05 - mean\_absolute\_error: 0.0069 27/126 [=====>........................] - ETA: 0s - loss: 4.4121e-05 - mean\_absolute\_error: 0.0052 51/126 [===========>..................] - ETA: 0s - loss: 4.0343e-05 - mean\_absolute\_error: 0.0050 75/126 [================>.............] - ETA: 0s - loss: 4.0797e-05 - mean\_absolute\_error: 0.0049100/126 [======================>.......] - ETA: 0s - loss: 3.9664e-05 - mean\_absolute\_error: 0.0048125/126 [============================>.] - ETA: 0s - loss: 3.8035e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - 0s 2ms/step - loss: 3.7962e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 7.3358e-05 - val\_mean\_absolute\_error: 0.0062  
Epoch 57/100  
 1/126 [..............................] - ETA: 0s - loss: 6.6494e-05 - mean\_absolute\_error: 0.0052 26/126 [=====>........................] - ETA: 0s - loss: 3.4536e-05 - mean\_absolute\_error: 0.0044 51/126 [===========>..................] - ETA: 0s - loss: 3.7259e-05 - mean\_absolute\_error: 0.0046 76/126 [=================>............] - ETA: 0s - loss: 3.5253e-05 - mean\_absolute\_error: 0.0044101/126 [=======================>......] - ETA: 0s - loss: 3.4511e-05 - mean\_absolute\_error: 0.0043126/126 [==============================] - ETA: 0s - loss: 3.5809e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.5809e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 7.8542e-05 - val\_mean\_absolute\_error: 0.0069  
Epoch 58/100  
 1/126 [..............................] - ETA: 0s - loss: 4.3743e-05 - mean\_absolute\_error: 0.0055 23/126 [====>.........................] - ETA: 0s - loss: 3.3597e-05 - mean\_absolute\_error: 0.0044 42/126 [=========>....................] - ETA: 0s - loss: 3.6695e-05 - mean\_absolute\_error: 0.0047 64/126 [==============>...............] - ETA: 0s - loss: 3.7623e-05 - mean\_absolute\_error: 0.0045 90/126 [====================>.........] - ETA: 0s - loss: 3.5759e-05 - mean\_absolute\_error: 0.0044115/126 [==========================>...] - ETA: 0s - loss: 3.6137e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 3ms/step - loss: 3.5835e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 6.1531e-05 - val\_mean\_absolute\_error: 0.0053  
Epoch 59/100  
 1/126 [..............................] - ETA: 0s - loss: 5.0473e-05 - mean\_absolute\_error: 0.0049 27/126 [=====>........................] - ETA: 0s - loss: 3.6697e-05 - mean\_absolute\_error: 0.0047 53/126 [===========>..................] - ETA: 0s - loss: 3.4051e-05 - mean\_absolute\_error: 0.0044 78/126 [=================>............] - ETA: 0s - loss: 3.5447e-05 - mean\_absolute\_error: 0.0045102/126 [=======================>......] - ETA: 0s - loss: 3.5728e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.5975e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 8.3093e-05 - val\_mean\_absolute\_error: 0.0069  
Epoch 60/100  
 1/126 [..............................] - ETA: 0s - loss: 5.2843e-05 - mean\_absolute\_error: 0.0059 21/126 [====>.........................] - ETA: 0s - loss: 3.3187e-05 - mean\_absolute\_error: 0.0043 42/126 [=========>....................] - ETA: 0s - loss: 3.7684e-05 - mean\_absolute\_error: 0.0046 63/126 [==============>...............] - ETA: 0s - loss: 3.9911e-05 - mean\_absolute\_error: 0.0048 81/126 [==================>...........] - ETA: 0s - loss: 4.0394e-05 - mean\_absolute\_error: 0.0048101/126 [=======================>......] - ETA: 0s - loss: 3.9275e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - ETA: 0s - loss: 4.1212e-05 - mean\_absolute\_error: 0.0049126/126 [==============================] - 0s 3ms/step - loss: 4.1212e-05 - mean\_absolute\_error: 0.0049 - val\_loss: 1.1322e-04 - val\_mean\_absolute\_error: 0.0088  
Epoch 61/100  
 1/126 [..............................] - ETA: 0s - loss: 5.1712e-05 - mean\_absolute\_error: 0.0060 27/126 [=====>........................] - ETA: 0s - loss: 4.3482e-05 - mean\_absolute\_error: 0.0050 52/126 [===========>..................] - ETA: 0s - loss: 3.9883e-05 - mean\_absolute\_error: 0.0048 76/126 [=================>............] - ETA: 0s - loss: 4.1437e-05 - mean\_absolute\_error: 0.0048102/126 [=======================>......] - ETA: 0s - loss: 4.2717e-05 - mean\_absolute\_error: 0.0049126/126 [==============================] - 0s 2ms/step - loss: 4.1337e-05 - mean\_absolute\_error: 0.0048 - val\_loss: 6.7437e-05 - val\_mean\_absolute\_error: 0.0059  
Epoch 62/100  
 1/126 [..............................] - ETA: 0s - loss: 2.7113e-05 - mean\_absolute\_error: 0.0041 27/126 [=====>........................] - ETA: 0s - loss: 2.8428e-05 - mean\_absolute\_error: 0.0039 53/126 [===========>..................] - ETA: 0s - loss: 2.9770e-05 - mean\_absolute\_error: 0.0040 79/126 [=================>............] - ETA: 0s - loss: 3.3027e-05 - mean\_absolute\_error: 0.0042105/126 [========================>.....] - ETA: 0s - loss: 3.4390e-05 - mean\_absolute\_error: 0.0043126/126 [==============================] - 0s 2ms/step - loss: 3.5203e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 6.4998e-05 - val\_mean\_absolute\_error: 0.0057  
Epoch 63/100  
 1/126 [..............................] - ETA: 0s - loss: 3.5585e-05 - mean\_absolute\_error: 0.0039 26/126 [=====>........................] - ETA: 0s - loss: 3.6054e-05 - mean\_absolute\_error: 0.0043 52/126 [===========>..................] - ETA: 0s - loss: 3.3634e-05 - mean\_absolute\_error: 0.0041 77/126 [=================>............] - ETA: 0s - loss: 4.3698e-05 - mean\_absolute\_error: 0.0049102/126 [=======================>......] - ETA: 0s - loss: 4.2255e-05 - mean\_absolute\_error: 0.0049126/126 [==============================] - ETA: 0s - loss: 4.1670e-05 - mean\_absolute\_error: 0.0048126/126 [==============================] - 0s 2ms/step - loss: 4.1670e-05 - mean\_absolute\_error: 0.0048 - val\_loss: 1.0056e-04 - val\_mean\_absolute\_error: 0.0078  
Epoch 64/100  
 1/126 [..............................] - ETA: 0s - loss: 3.3397e-05 - mean\_absolute\_error: 0.0050 27/126 [=====>........................] - ETA: 0s - loss: 3.5081e-05 - mean\_absolute\_error: 0.0045 52/126 [===========>..................] - ETA: 0s - loss: 3.3360e-05 - mean\_absolute\_error: 0.0044 77/126 [=================>............] - ETA: 0s - loss: 3.5998e-05 - mean\_absolute\_error: 0.0045102/126 [=======================>......] - ETA: 0s - loss: 3.8983e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - ETA: 0s - loss: 4.1359e-05 - mean\_absolute\_error: 0.0049126/126 [==============================] - 0s 2ms/step - loss: 4.1359e-05 - mean\_absolute\_error: 0.0049 - val\_loss: 6.6486e-05 - val\_mean\_absolute\_error: 0.0060  
Epoch 65/100  
 1/126 [..............................] - ETA: 0s - loss: 3.8591e-05 - mean\_absolute\_error: 0.0052 22/126 [====>.........................] - ETA: 0s - loss: 4.0222e-05 - mean\_absolute\_error: 0.0048 46/126 [=========>....................] - ETA: 0s - loss: 4.7589e-05 - mean\_absolute\_error: 0.0054 72/126 [================>.............] - ETA: 0s - loss: 4.4952e-05 - mean\_absolute\_error: 0.0051 91/126 [====================>.........] - ETA: 0s - loss: 4.2848e-05 - mean\_absolute\_error: 0.0049115/126 [==========================>...] - ETA: 0s - loss: 4.0643e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - 0s 3ms/step - loss: 4.0313e-05 - mean\_absolute\_error: 0.0047 - val\_loss: 7.1794e-05 - val\_mean\_absolute\_error: 0.0062  
Epoch 66/100  
 1/126 [..............................] - ETA: 0s - loss: 2.4565e-05 - mean\_absolute\_error: 0.0037 25/126 [====>.........................] - ETA: 0s - loss: 3.3631e-05 - mean\_absolute\_error: 0.0043 49/126 [==========>...................] - ETA: 0s - loss: 3.6373e-05 - mean\_absolute\_error: 0.0046 74/126 [================>.............] - ETA: 0s - loss: 3.6912e-05 - mean\_absolute\_error: 0.0045 93/126 [=====================>........] - ETA: 0s - loss: 3.6181e-05 - mean\_absolute\_error: 0.0045108/126 [========================>.....] - ETA: 0s - loss: 3.7125e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 3ms/step - loss: 3.7349e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 5.9718e-05 - val\_mean\_absolute\_error: 0.0053  
Epoch 67/100  
 1/126 [..............................] - ETA: 0s - loss: 3.4474e-05 - mean\_absolute\_error: 0.0044 26/126 [=====>........................] - ETA: 0s - loss: 3.8155e-05 - mean\_absolute\_error: 0.0047 51/126 [===========>..................] - ETA: 0s - loss: 3.4729e-05 - mean\_absolute\_error: 0.0042 77/126 [=================>............] - ETA: 0s - loss: 3.7590e-05 - mean\_absolute\_error: 0.0045102/126 [=======================>......] - ETA: 0s - loss: 3.6616e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.7149e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 6.4879e-05 - val\_mean\_absolute\_error: 0.0057  
Epoch 68/100  
 1/126 [..............................] - ETA: 0s - loss: 5.1381e-05 - mean\_absolute\_error: 0.0057 25/126 [====>.........................] - ETA: 0s - loss: 3.4818e-05 - mean\_absolute\_error: 0.0045 50/126 [==========>...................] - ETA: 0s - loss: 3.5269e-05 - mean\_absolute\_error: 0.0045 75/126 [================>.............] - ETA: 0s - loss: 3.6704e-05 - mean\_absolute\_error: 0.0047100/126 [======================>.......] - ETA: 0s - loss: 3.5036e-05 - mean\_absolute\_error: 0.0045125/126 [============================>.] - ETA: 0s - loss: 3.7374e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - 0s 2ms/step - loss: 3.7370e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 6.8820e-05 - val\_mean\_absolute\_error: 0.0062  
Epoch 69/100  
 1/126 [..............................] - ETA: 0s - loss: 2.7235e-05 - mean\_absolute\_error: 0.0045 27/126 [=====>........................] - ETA: 0s - loss: 3.9938e-05 - mean\_absolute\_error: 0.0048 52/126 [===========>..................] - ETA: 0s - loss: 4.2602e-05 - mean\_absolute\_error: 0.0051 76/126 [=================>............] - ETA: 0s - loss: 4.1929e-05 - mean\_absolute\_error: 0.0050100/126 [======================>.......] - ETA: 0s - loss: 4.0790e-05 - mean\_absolute\_error: 0.0049125/126 [============================>.] - ETA: 0s - loss: 4.1479e-05 - mean\_absolute\_error: 0.0050126/126 [==============================] - 0s 2ms/step - loss: 4.1554e-05 - mean\_absolute\_error: 0.0050 - val\_loss: 5.9241e-05 - val\_mean\_absolute\_error: 0.0052  
Epoch 70/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0540e-05 - mean\_absolute\_error: 0.0032 27/126 [=====>........................] - ETA: 0s - loss: 5.1614e-05 - mean\_absolute\_error: 0.0056 52/126 [===========>..................] - ETA: 0s - loss: 4.6100e-05 - mean\_absolute\_error: 0.0053 76/126 [=================>............] - ETA: 0s - loss: 4.2187e-05 - mean\_absolute\_error: 0.0050100/126 [======================>.......] - ETA: 0s - loss: 4.0895e-05 - mean\_absolute\_error: 0.0048125/126 [============================>.] - ETA: 0s - loss: 3.9513e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - 0s 2ms/step - loss: 3.9450e-05 - mean\_absolute\_error: 0.0047 - val\_loss: 5.9424e-05 - val\_mean\_absolute\_error: 0.0053  
Epoch 71/100  
 1/126 [..............................] - ETA: 0s - loss: 2.5435e-05 - mean\_absolute\_error: 0.0034 26/126 [=====>........................] - ETA: 0s - loss: 3.5787e-05 - mean\_absolute\_error: 0.0044 51/126 [===========>..................] - ETA: 0s - loss: 3.3676e-05 - mean\_absolute\_error: 0.0043 76/126 [=================>............] - ETA: 0s - loss: 3.4078e-05 - mean\_absolute\_error: 0.0043101/126 [=======================>......] - ETA: 0s - loss: 3.5899e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.7674e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 7.9798e-05 - val\_mean\_absolute\_error: 0.0067  
Epoch 72/100  
 1/126 [..............................] - ETA: 0s - loss: 4.6047e-05 - mean\_absolute\_error: 0.0057 23/126 [====>.........................] - ETA: 0s - loss: 3.7058e-05 - mean\_absolute\_error: 0.0046 48/126 [==========>...................] - ETA: 0s - loss: 3.5672e-05 - mean\_absolute\_error: 0.0045 73/126 [================>.............] - ETA: 0s - loss: 3.7414e-05 - mean\_absolute\_error: 0.0046 98/126 [======================>.......] - ETA: 0s - loss: 3.7142e-05 - mean\_absolute\_error: 0.0046124/126 [============================>.] - ETA: 0s - loss: 3.7494e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - 0s 2ms/step - loss: 3.7220e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 6.1855e-05 - val\_mean\_absolute\_error: 0.0055  
Epoch 73/100  
 1/126 [..............................] - ETA: 0s - loss: 2.5213e-05 - mean\_absolute\_error: 0.0039 25/126 [====>.........................] - ETA: 0s - loss: 3.9394e-05 - mean\_absolute\_error: 0.0048 49/126 [==========>...................] - ETA: 0s - loss: 4.3700e-05 - mean\_absolute\_error: 0.0051 75/126 [================>.............] - ETA: 0s - loss: 4.9312e-05 - mean\_absolute\_error: 0.0055100/126 [======================>.......] - ETA: 0s - loss: 4.6094e-05 - mean\_absolute\_error: 0.0052123/126 [============================>.] - ETA: 0s - loss: 4.3317e-05 - mean\_absolute\_error: 0.0050126/126 [==============================] - 0s 2ms/step - loss: 4.3017e-05 - mean\_absolute\_error: 0.0050 - val\_loss: 5.9693e-05 - val\_mean\_absolute\_error: 0.0055  
Epoch 74/100  
 1/126 [..............................] - ETA: 0s - loss: 3.1705e-05 - mean\_absolute\_error: 0.0044 27/126 [=====>........................] - ETA: 0s - loss: 3.5072e-05 - mean\_absolute\_error: 0.0042 52/126 [===========>..................] - ETA: 0s - loss: 3.5649e-05 - mean\_absolute\_error: 0.0043 77/126 [=================>............] - ETA: 0s - loss: 3.3870e-05 - mean\_absolute\_error: 0.0043100/126 [======================>.......] - ETA: 0s - loss: 3.5825e-05 - mean\_absolute\_error: 0.0045124/126 [============================>.] - ETA: 0s - loss: 3.9984e-05 - mean\_absolute\_error: 0.0048126/126 [==============================] - 0s 2ms/step - loss: 3.9827e-05 - mean\_absolute\_error: 0.0048 - val\_loss: 1.1442e-04 - val\_mean\_absolute\_error: 0.0089  
Epoch 75/100  
 1/126 [..............................] - ETA: 0s - loss: 9.1375e-05 - mean\_absolute\_error: 0.0085 26/126 [=====>........................] - ETA: 0s - loss: 3.5402e-05 - mean\_absolute\_error: 0.0044 50/126 [==========>...................] - ETA: 0s - loss: 3.5546e-05 - mean\_absolute\_error: 0.0044 74/126 [================>.............] - ETA: 0s - loss: 4.0739e-05 - mean\_absolute\_error: 0.0048 99/126 [======================>.......] - ETA: 0s - loss: 4.0097e-05 - mean\_absolute\_error: 0.0047123/126 [============================>.] - ETA: 0s - loss: 3.9166e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - 0s 2ms/step - loss: 3.8966e-05 - mean\_absolute\_error: 0.0047 - val\_loss: 5.7834e-05 - val\_mean\_absolute\_error: 0.0052  
Epoch 76/100  
 1/126 [..............................] - ETA: 0s - loss: 3.4069e-05 - mean\_absolute\_error: 0.0042 25/126 [====>.........................] - ETA: 0s - loss: 3.0170e-05 - mean\_absolute\_error: 0.0040 49/126 [==========>...................] - ETA: 0s - loss: 3.2404e-05 - mean\_absolute\_error: 0.0041 75/126 [================>.............] - ETA: 0s - loss: 3.1941e-05 - mean\_absolute\_error: 0.0041100/126 [======================>.......] - ETA: 0s - loss: 3.2505e-05 - mean\_absolute\_error: 0.0041124/126 [============================>.] - ETA: 0s - loss: 3.2712e-05 - mean\_absolute\_error: 0.0042126/126 [==============================] - 0s 2ms/step - loss: 3.2702e-05 - mean\_absolute\_error: 0.0042 - val\_loss: 5.8217e-05 - val\_mean\_absolute\_error: 0.0051  
Epoch 77/100  
 1/126 [..............................] - ETA: 0s - loss: 4.3821e-05 - mean\_absolute\_error: 0.0051 26/126 [=====>........................] - ETA: 0s - loss: 2.9990e-05 - mean\_absolute\_error: 0.0040 51/126 [===========>..................] - ETA: 0s - loss: 3.3947e-05 - mean\_absolute\_error: 0.0043 76/126 [=================>............] - ETA: 0s - loss: 3.4947e-05 - mean\_absolute\_error: 0.0044101/126 [=======================>......] - ETA: 0s - loss: 3.5433e-05 - mean\_absolute\_error: 0.0045125/126 [============================>.] - ETA: 0s - loss: 3.6931e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - 0s 2ms/step - loss: 3.6881e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 7.9976e-05 - val\_mean\_absolute\_error: 0.0068  
Epoch 78/100  
 1/126 [..............................] - ETA: 0s - loss: 3.9066e-05 - mean\_absolute\_error: 0.0047 14/126 [==>...........................] - ETA: 0s - loss: 4.1958e-05 - mean\_absolute\_error: 0.0049 30/126 [======>.......................] - ETA: 0s - loss: 4.0951e-05 - mean\_absolute\_error: 0.0049 56/126 [============>.................] - ETA: 0s - loss: 4.1054e-05 - mean\_absolute\_error: 0.0048 80/126 [==================>...........] - ETA: 0s - loss: 4.0994e-05 - mean\_absolute\_error: 0.0049105/126 [========================>.....] - ETA: 0s - loss: 3.9941e-05 - mean\_absolute\_error: 0.0048126/126 [==============================] - 0s 3ms/step - loss: 3.9084e-05 - mean\_absolute\_error: 0.0047 - val\_loss: 6.8097e-05 - val\_mean\_absolute\_error: 0.0060  
Epoch 79/100  
 1/126 [..............................] - ETA: 0s - loss: 2.7921e-05 - mean\_absolute\_error: 0.0041 21/126 [====>.........................] - ETA: 0s - loss: 3.4061e-05 - mean\_absolute\_error: 0.0044 41/126 [========>.....................] - ETA: 0s - loss: 3.7079e-05 - mean\_absolute\_error: 0.0047 61/126 [=============>................] - ETA: 0s - loss: 3.5513e-05 - mean\_absolute\_error: 0.0046 83/126 [==================>...........] - ETA: 0s - loss: 3.4810e-05 - mean\_absolute\_error: 0.0044107/126 [========================>.....] - ETA: 0s - loss: 3.4897e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 3ms/step - loss: 3.6728e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 5.8003e-05 - val\_mean\_absolute\_error: 0.0053  
Epoch 80/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5426e-05 - mean\_absolute\_error: 0.0025 27/126 [=====>........................] - ETA: 0s - loss: 4.0493e-05 - mean\_absolute\_error: 0.0048 52/126 [===========>..................] - ETA: 0s - loss: 3.8675e-05 - mean\_absolute\_error: 0.0047 76/126 [=================>............] - ETA: 0s - loss: 3.7502e-05 - mean\_absolute\_error: 0.0046101/126 [=======================>......] - ETA: 0s - loss: 3.6967e-05 - mean\_absolute\_error: 0.0045125/126 [============================>.] - ETA: 0s - loss: 3.6765e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.6730e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 6.9613e-05 - val\_mean\_absolute\_error: 0.0064  
Epoch 81/100  
 1/126 [..............................] - ETA: 0s - loss: 4.3947e-05 - mean\_absolute\_error: 0.0056 26/126 [=====>........................] - ETA: 0s - loss: 3.6335e-05 - mean\_absolute\_error: 0.0047 51/126 [===========>..................] - ETA: 0s - loss: 3.5145e-05 - mean\_absolute\_error: 0.0045 75/126 [================>.............] - ETA: 0s - loss: 3.4386e-05 - mean\_absolute\_error: 0.0044100/126 [======================>.......] - ETA: 0s - loss: 3.5234e-05 - mean\_absolute\_error: 0.0045125/126 [============================>.] - ETA: 0s - loss: 3.5993e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.5939e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 6.2742e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 82/100  
 1/126 [..............................] - ETA: 0s - loss: 2.5871e-05 - mean\_absolute\_error: 0.0037 27/126 [=====>........................] - ETA: 0s - loss: 3.3392e-05 - mean\_absolute\_error: 0.0043 52/126 [===========>..................] - ETA: 0s - loss: 3.6475e-05 - mean\_absolute\_error: 0.0045 76/126 [=================>............] - ETA: 0s - loss: 3.7489e-05 - mean\_absolute\_error: 0.0046101/126 [=======================>......] - ETA: 0s - loss: 3.7862e-05 - mean\_absolute\_error: 0.0046125/126 [============================>.] - ETA: 0s - loss: 3.7013e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.6968e-05 - mean\_absolute\_error: 0.0045 - val\_loss: 7.7062e-05 - val\_mean\_absolute\_error: 0.0066  
Epoch 83/100  
 1/126 [..............................] - ETA: 0s - loss: 5.1533e-05 - mean\_absolute\_error: 0.0059 24/126 [====>.........................] - ETA: 0s - loss: 3.0588e-05 - mean\_absolute\_error: 0.0040 49/126 [==========>...................] - ETA: 0s - loss: 4.0378e-05 - mean\_absolute\_error: 0.0048 72/126 [================>.............] - ETA: 0s - loss: 4.7570e-05 - mean\_absolute\_error: 0.0053 94/126 [=====================>........] - ETA: 0s - loss: 4.6571e-05 - mean\_absolute\_error: 0.0052120/126 [===========================>..] - ETA: 0s - loss: 4.6190e-05 - mean\_absolute\_error: 0.0052126/126 [==============================] - 0s 2ms/step - loss: 4.5857e-05 - mean\_absolute\_error: 0.0052 - val\_loss: 5.9351e-05 - val\_mean\_absolute\_error: 0.0053  
Epoch 84/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0191e-05 - mean\_absolute\_error: 0.0033 27/126 [=====>........................] - ETA: 0s - loss: 3.2071e-05 - mean\_absolute\_error: 0.0042 52/126 [===========>..................] - ETA: 0s - loss: 3.1490e-05 - mean\_absolute\_error: 0.0042 77/126 [=================>............] - ETA: 0s - loss: 3.5449e-05 - mean\_absolute\_error: 0.0045102/126 [=======================>......] - ETA: 0s - loss: 3.4414e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.5145e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 6.0156e-05 - val\_mean\_absolute\_error: 0.0054  
Epoch 85/100  
 1/126 [..............................] - ETA: 0s - loss: 2.8298e-05 - mean\_absolute\_error: 0.0038 26/126 [=====>........................] - ETA: 0s - loss: 2.4610e-05 - mean\_absolute\_error: 0.0035 51/126 [===========>..................] - ETA: 0s - loss: 2.8605e-05 - mean\_absolute\_error: 0.0039 76/126 [=================>............] - ETA: 0s - loss: 3.0715e-05 - mean\_absolute\_error: 0.0041101/126 [=======================>......] - ETA: 0s - loss: 3.2443e-05 - mean\_absolute\_error: 0.0041126/126 [==============================] - ETA: 0s - loss: 3.5820e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.5820e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 6.5206e-05 - val\_mean\_absolute\_error: 0.0061  
Epoch 86/100  
 1/126 [..............................] - ETA: 0s - loss: 4.6258e-05 - mean\_absolute\_error: 0.0054 26/126 [=====>........................] - ETA: 0s - loss: 3.9725e-05 - mean\_absolute\_error: 0.0048 51/126 [===========>..................] - ETA: 0s - loss: 4.3012e-05 - mean\_absolute\_error: 0.0050 74/126 [================>.............] - ETA: 0s - loss: 4.0554e-05 - mean\_absolute\_error: 0.0049 99/126 [======================>.......] - ETA: 0s - loss: 4.0218e-05 - mean\_absolute\_error: 0.0048123/126 [============================>.] - ETA: 0s - loss: 3.8675e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - 0s 2ms/step - loss: 3.8385e-05 - mean\_absolute\_error: 0.0047 - val\_loss: 6.1572e-05 - val\_mean\_absolute\_error: 0.0056  
Epoch 87/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2015e-05 - mean\_absolute\_error: 0.0026 26/126 [=====>........................] - ETA: 0s - loss: 3.8289e-05 - mean\_absolute\_error: 0.0045 51/126 [===========>..................] - ETA: 0s - loss: 4.8221e-05 - mean\_absolute\_error: 0.0053 75/126 [================>.............] - ETA: 0s - loss: 4.7140e-05 - mean\_absolute\_error: 0.0053 98/126 [======================>.......] - ETA: 0s - loss: 4.4489e-05 - mean\_absolute\_error: 0.0051123/126 [============================>.] - ETA: 0s - loss: 4.6011e-05 - mean\_absolute\_error: 0.0053126/126 [==============================] - 0s 2ms/step - loss: 4.5858e-05 - mean\_absolute\_error: 0.0053 - val\_loss: 6.8601e-05 - val\_mean\_absolute\_error: 0.0061  
Epoch 88/100  
 1/126 [..............................] - ETA: 0s - loss: 2.5765e-05 - mean\_absolute\_error: 0.0039 26/126 [=====>........................] - ETA: 0s - loss: 3.6331e-05 - mean\_absolute\_error: 0.0047 51/126 [===========>..................] - ETA: 0s - loss: 3.5336e-05 - mean\_absolute\_error: 0.0045 76/126 [=================>............] - ETA: 0s - loss: 3.4670e-05 - mean\_absolute\_error: 0.0043102/126 [=======================>......] - ETA: 0s - loss: 3.5350e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.4830e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 6.9533e-05 - val\_mean\_absolute\_error: 0.0064  
Epoch 89/100  
 1/126 [..............................] - ETA: 0s - loss: 3.4218e-05 - mean\_absolute\_error: 0.0048 26/126 [=====>........................] - ETA: 0s - loss: 3.6169e-05 - mean\_absolute\_error: 0.0048 50/126 [==========>...................] - ETA: 0s - loss: 3.9076e-05 - mean\_absolute\_error: 0.0050 75/126 [================>.............] - ETA: 0s - loss: 3.8391e-05 - mean\_absolute\_error: 0.0048100/126 [======================>.......] - ETA: 0s - loss: 3.6317e-05 - mean\_absolute\_error: 0.0046125/126 [============================>.] - ETA: 0s - loss: 3.9948e-05 - mean\_absolute\_error: 0.0048126/126 [==============================] - 0s 2ms/step - loss: 4.0057e-05 - mean\_absolute\_error: 0.0048 - val\_loss: 6.6213e-05 - val\_mean\_absolute\_error: 0.0059  
Epoch 90/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6153e-05 - mean\_absolute\_error: 0.0030 26/126 [=====>........................] - ETA: 0s - loss: 3.3968e-05 - mean\_absolute\_error: 0.0046 51/126 [===========>..................] - ETA: 0s - loss: 3.3693e-05 - mean\_absolute\_error: 0.0045 77/126 [=================>............] - ETA: 0s - loss: 3.3248e-05 - mean\_absolute\_error: 0.0044102/126 [=======================>......] - ETA: 0s - loss: 3.4604e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - ETA: 0s - loss: 3.8011e-05 - mean\_absolute\_error: 0.0047126/126 [==============================] - 0s 2ms/step - loss: 3.8011e-05 - mean\_absolute\_error: 0.0047 - val\_loss: 1.0403e-04 - val\_mean\_absolute\_error: 0.0081  
Epoch 91/100  
 1/126 [..............................] - ETA: 0s - loss: 7.0741e-05 - mean\_absolute\_error: 0.0063 25/126 [====>.........................] - ETA: 0s - loss: 4.1855e-05 - mean\_absolute\_error: 0.0050 50/126 [==========>...................] - ETA: 0s - loss: 3.8738e-05 - mean\_absolute\_error: 0.0047 75/126 [================>.............] - ETA: 0s - loss: 3.8482e-05 - mean\_absolute\_error: 0.0046100/126 [======================>.......] - ETA: 0s - loss: 3.7257e-05 - mean\_absolute\_error: 0.0045124/126 [============================>.] - ETA: 0s - loss: 3.7524e-05 - mean\_absolute\_error: 0.0045126/126 [==============================] - 0s 2ms/step - loss: 3.7520e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 6.6155e-05 - val\_mean\_absolute\_error: 0.0059  
Epoch 92/100  
 1/126 [..............................] - ETA: 0s - loss: 3.0133e-05 - mean\_absolute\_error: 0.0043 26/126 [=====>........................] - ETA: 0s - loss: 3.2166e-05 - mean\_absolute\_error: 0.0042 51/126 [===========>..................] - ETA: 0s - loss: 3.8722e-05 - mean\_absolute\_error: 0.0047 75/126 [================>.............] - ETA: 0s - loss: 4.4164e-05 - mean\_absolute\_error: 0.0051 99/126 [======================>.......] - ETA: 0s - loss: 4.4287e-05 - mean\_absolute\_error: 0.0051124/126 [============================>.] - ETA: 0s - loss: 4.3737e-05 - mean\_absolute\_error: 0.0051126/126 [==============================] - 0s 2ms/step - loss: 4.3778e-05 - mean\_absolute\_error: 0.0051 - val\_loss: 9.5066e-05 - val\_mean\_absolute\_error: 0.0076  
Epoch 93/100  
 1/126 [..............................] - ETA: 0s - loss: 5.0121e-05 - mean\_absolute\_error: 0.0058 26/126 [=====>........................] - ETA: 0s - loss: 4.4332e-05 - mean\_absolute\_error: 0.0052 52/126 [===========>..................] - ETA: 0s - loss: 3.9104e-05 - mean\_absolute\_error: 0.0046 76/126 [=================>............] - ETA: 0s - loss: 3.7342e-05 - mean\_absolute\_error: 0.0045 98/126 [======================>.......] - ETA: 0s - loss: 3.5793e-05 - mean\_absolute\_error: 0.0044122/126 [============================>.] - ETA: 0s - loss: 3.4471e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - 0s 2ms/step - loss: 3.4695e-05 - mean\_absolute\_error: 0.0044 - val\_loss: 5.5678e-05 - val\_mean\_absolute\_error: 0.0050  
Epoch 94/100  
 1/126 [..............................] - ETA: 0s - loss: 1.7360e-05 - mean\_absolute\_error: 0.0028 25/126 [====>.........................] - ETA: 0s - loss: 5.6128e-05 - mean\_absolute\_error: 0.0059 50/126 [==========>...................] - ETA: 0s - loss: 5.1663e-05 - mean\_absolute\_error: 0.0057 74/126 [================>.............] - ETA: 0s - loss: 4.6275e-05 - mean\_absolute\_error: 0.0053 99/126 [======================>.......] - ETA: 0s - loss: 4.2870e-05 - mean\_absolute\_error: 0.0050124/126 [============================>.] - ETA: 0s - loss: 4.0630e-05 - mean\_absolute\_error: 0.0048126/126 [==============================] - 0s 2ms/step - loss: 4.0494e-05 - mean\_absolute\_error: 0.0048 - val\_loss: 5.6762e-05 - val\_mean\_absolute\_error: 0.0052  
Epoch 95/100  
 1/126 [..............................] - ETA: 0s - loss: 2.5586e-05 - mean\_absolute\_error: 0.0038 26/126 [=====>........................] - ETA: 0s - loss: 3.4354e-05 - mean\_absolute\_error: 0.0044 51/126 [===========>..................] - ETA: 0s - loss: 3.4480e-05 - mean\_absolute\_error: 0.0044 76/126 [=================>............] - ETA: 0s - loss: 3.5817e-05 - mean\_absolute\_error: 0.0044100/126 [======================>.......] - ETA: 0s - loss: 3.3984e-05 - mean\_absolute\_error: 0.0043125/126 [============================>.] - ETA: 0s - loss: 3.3656e-05 - mean\_absolute\_error: 0.0043126/126 [==============================] - 0s 2ms/step - loss: 3.3686e-05 - mean\_absolute\_error: 0.0043 - val\_loss: 5.5442e-05 - val\_mean\_absolute\_error: 0.0050  
Epoch 96/100  
 1/126 [..............................] - ETA: 0s - loss: 2.8165e-05 - mean\_absolute\_error: 0.0038 26/126 [=====>........................] - ETA: 0s - loss: 3.1523e-05 - mean\_absolute\_error: 0.0040 50/126 [==========>...................] - ETA: 0s - loss: 3.0695e-05 - mean\_absolute\_error: 0.0040 75/126 [================>.............] - ETA: 0s - loss: 3.5610e-05 - mean\_absolute\_error: 0.0043100/126 [======================>.......] - ETA: 0s - loss: 3.7082e-05 - mean\_absolute\_error: 0.0045125/126 [============================>.] - ETA: 0s - loss: 3.7979e-05 - mean\_absolute\_error: 0.0046126/126 [==============================] - 0s 2ms/step - loss: 3.7970e-05 - mean\_absolute\_error: 0.0046 - val\_loss: 5.5860e-05 - val\_mean\_absolute\_error: 0.0051  
Epoch 97/100  
 1/126 [..............................] - ETA: 0s - loss: 2.8933e-05 - mean\_absolute\_error: 0.0040 25/126 [====>.........................] - ETA: 0s - loss: 3.4192e-05 - mean\_absolute\_error: 0.0042 50/126 [==========>...................] - ETA: 0s - loss: 3.9928e-05 - mean\_absolute\_error: 0.0046 75/126 [================>.............] - ETA: 0s - loss: 3.5944e-05 - mean\_absolute\_error: 0.0044100/126 [======================>.......] - ETA: 0s - loss: 3.5008e-05 - mean\_absolute\_error: 0.0044124/126 [============================>.] - ETA: 0s - loss: 3.3999e-05 - mean\_absolute\_error: 0.0043126/126 [==============================] - 0s 2ms/step - loss: 3.4059e-05 - mean\_absolute\_error: 0.0043 - val\_loss: 6.7524e-05 - val\_mean\_absolute\_error: 0.0061  
Epoch 98/100  
 1/126 [..............................] - ETA: 0s - loss: 4.4259e-05 - mean\_absolute\_error: 0.0050 26/126 [=====>........................] - ETA: 0s - loss: 3.8631e-05 - mean\_absolute\_error: 0.0046 51/126 [===========>..................] - ETA: 0s - loss: 3.7053e-05 - mean\_absolute\_error: 0.0046 76/126 [=================>............] - ETA: 0s - loss: 3.5934e-05 - mean\_absolute\_error: 0.0045101/126 [=======================>......] - ETA: 0s - loss: 3.4760e-05 - mean\_absolute\_error: 0.0044126/126 [==============================] - ETA: 0s - loss: 3.3876e-05 - mean\_absolute\_error: 0.0043126/126 [==============================] - 0s 2ms/step - loss: 3.3876e-05 - mean\_absolute\_error: 0.0043 - val\_loss: 5.4745e-05 - val\_mean\_absolute\_error: 0.0050  
Epoch 99/100  
 1/126 [..............................] - ETA: 0s - loss: 2.7988e-05 - mean\_absolute\_error: 0.0036 26/126 [=====>........................] - ETA: 0s - loss: 3.2805e-05 - mean\_absolute\_error: 0.0043 51/126 [===========>..................] - ETA: 0s - loss: 3.1441e-05 - mean\_absolute\_error: 0.0040 77/126 [=================>............] - ETA: 0s - loss: 3.1668e-05 - mean\_absolute\_error: 0.0040102/126 [=======================>......] - ETA: 0s - loss: 3.1211e-05 - mean\_absolute\_error: 0.0040126/126 [==============================] - 0s 2ms/step - loss: 3.1222e-05 - mean\_absolute\_error: 0.0040 - val\_loss: 1.3944e-04 - val\_mean\_absolute\_error: 0.0101  
Epoch 100/100  
 1/126 [..............................] - ETA: 0s - loss: 8.0537e-05 - mean\_absolute\_error: 0.0084 27/126 [=====>........................] - ETA: 0s - loss: 4.1653e-05 - mean\_absolute\_error: 0.0050 51/126 [===========>..................] - ETA: 0s - loss: 4.1540e-05 - mean\_absolute\_error: 0.0050 75/126 [================>.............] - ETA: 0s - loss: 3.7765e-05 - mean\_absolute\_error: 0.0047101/126 [=======================>......] - ETA: 0s - loss: 3.8652e-05 - mean\_absolute\_error: 0.0048125/126 [============================>.] - ETA: 0s - loss: 4.0999e-05 - mean\_absolute\_error: 0.0049126/126 [==============================] - 0s 2ms/step - loss: 4.0983e-05 - mean\_absolute\_error: 0.0049 - val\_loss: 8.6371e-05 - val\_mean\_absolute\_error: 0.0072

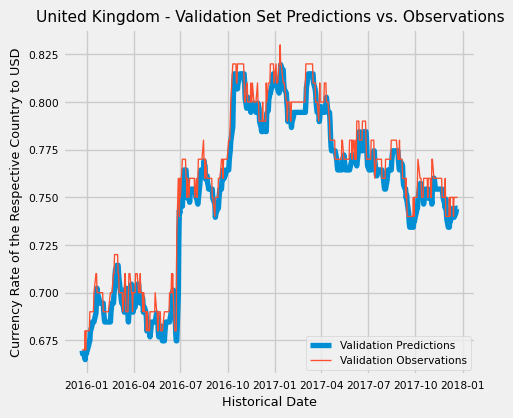
<keras.src.callbacks.History at 0x267daa39ad0>

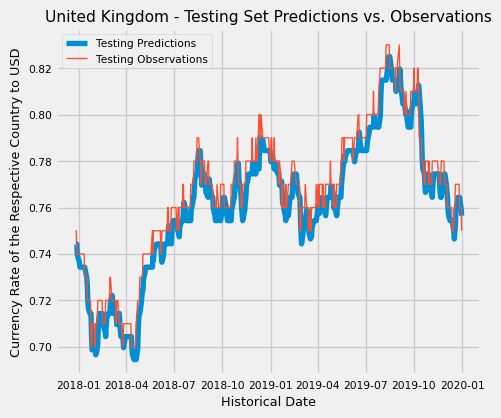
After the training and fitting of the Machine Learning model for the United Kingdom, I tried to create visualizations comparing the model against the country’s training dataset, validation dataset, but most importantly the testing dataset (as shown below in the line graphs). Note that the darker and thicker blue lines represent the prediction model’s projections and the thinner red lines is the observed/gathered data.

```{python}  
# Testing the Machine Learning Model prediction for United Kingdom with the train,   
# validation, and test sets  
# Most important is the test set prediction as this tests the effectiveness  
# of the Machine Learning model on data it has not seen before   
united\_kingdom\_train\_pred = united\_kingdom\_model.predict(X\_united\_kingdom\_train).flatten()  
  
plt.plot(dates\_united\_kingdom\_train, united\_kingdom\_train\_pred, linewidth=4)  
plt.plot(dates\_united\_kingdom\_train, y\_united\_kingdom\_train, linewidth=1)  
plt.legend(["Training Predictions", "Training Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("United Kingdom - Training Set Predictions vs. Observations")  
plt.show()  
  
united\_kingdom\_val\_pred = united\_kingdom\_model.predict(X\_united\_kingdom\_val).flatten()  
  
plt.plot(dates\_united\_kingdom\_val, united\_kingdom\_val\_pred, linewidth=4)  
plt.plot(dates\_united\_kingdom\_val, y\_united\_kingdom\_val, linewidth=1)  
plt.legend(["Validation Predictions", "Validation Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("United Kingdom - Validation Set Predictions vs. Observations")  
plt.show()  
  
united\_kingdom\_test\_pred = united\_kingdom\_model.predict(X\_united\_kingdom\_test).flatten()  
  
plt.plot(dates\_united\_kingdom\_test, united\_kingdom\_test\_pred, linewidth=4)  
plt.plot(dates\_united\_kingdom\_test, y\_united\_kingdom\_test, linewidth=1)  
plt.legend(["Testing Predictions", "Testing Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("United Kingdom - Testing Set Predictions vs. Observations")  
plt.show()  
```

1/126 [..............................] - ETA: 42s 49/126 [==========>...................] - ETA: 0s 97/126 [======================>.......] - ETA: 0s126/126 [==============================] - 0s 1ms/step  
 1/16 [>.............................] - ETA: 0s16/16 [==============================] - 0s 1ms/step  
 1/16 [>.............................] - ETA: 0s16/16 [==============================] - 0s 1ms/step

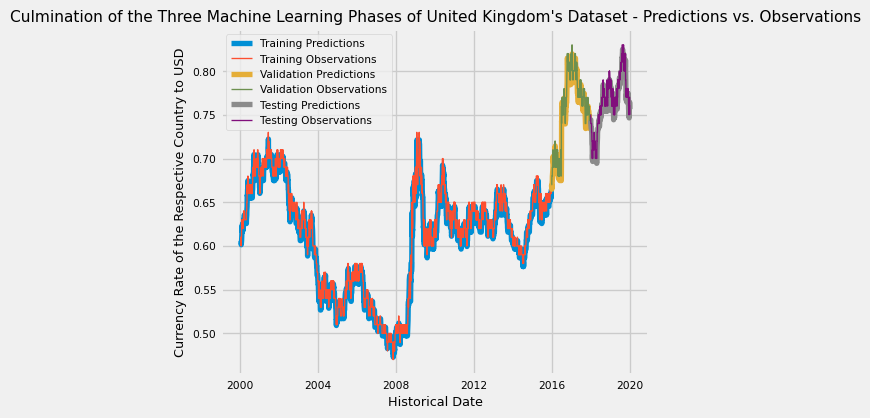






Through careful consideration of all of the prediction-based vs. observation-based contrast visualizations together, I consolidated all of graphics into one singular visualization for you to see below to get a more general perspective of the effectiveness of the Machine Learning model at training and fitting towards predicting the United Kingdom’s international currency rate with the United States.

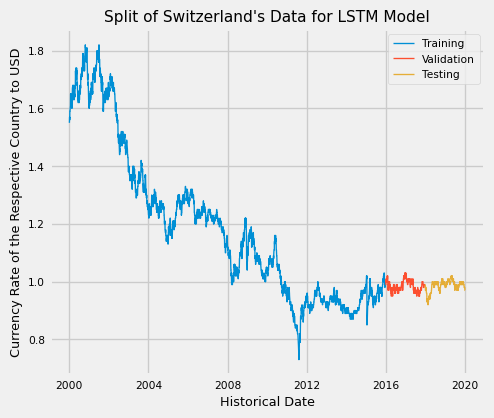
```{python}  
# Plotting United Kingdom's observational (reference) data with the predictions   
# of its Machine Learning Model (as a way to visually inspect the effectiveness   
# of the model)   
plt.plot(dates\_united\_kingdom\_train, united\_kingdom\_train\_pred, linewidth=4)  
plt.plot(dates\_united\_kingdom\_train, y\_united\_kingdom\_train, linewidth=1)  
plt.plot(dates\_united\_kingdom\_val, united\_kingdom\_val\_pred, linewidth=4)  
plt.plot(dates\_united\_kingdom\_val, y\_united\_kingdom\_val, linewidth=1)  
plt.plot(dates\_united\_kingdom\_test, united\_kingdom\_test\_pred, linewidth=4)  
plt.plot(dates\_united\_kingdom\_test, y\_united\_kingdom\_test, linewidth=1)  
  
plt.legend(["Training Predictions",  
 "Training Observations",  
 "Validation Predictions",  
 "Validation Observations",  
 "Testing Predictions",  
 "Testing Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Culmination of the Three Machine Learning Phases of United Kingdom's Dataset - Predictions vs. Observations")  
plt.show()  
```



Lastly, I worked on Switzerland’s data (as shown below):

Since the data (date, X, and y) is split into three np.arrays and to be more efficient, I will manually split Switzerland’s data into train, test, and validation datasets for the Machine Learning model with 80% going to the training dataset, the next 10% going to the validation dataset, and the last 10% going to the test dataset for each np.array respectively.

```{python}  
# Splitting Switzerland's data into train, test, and validation sets on 3   
# mediums: the X-axis, the y-axis, and the indices (represented by dates)  
dates\_switzerland\_train, X\_switzerland\_train, y\_switzerland\_train = dates\_switzerland[:percentile\_80], X\_switzerland[:percentile\_80], y\_switzerland[:percentile\_80]  
dates\_switzerland\_val, X\_switzerland\_val, y\_switzerland\_val = dates\_switzerland[percentile\_80:percentile\_90], X\_switzerland[percentile\_80:percentile\_90], y\_switzerland[percentile\_80:percentile\_90]  
dates\_switzerland\_test, X\_switzerland\_test, y\_switzerland\_test = dates\_switzerland[percentile\_90:], X\_switzerland[percentile\_90:], y\_switzerland[percentile\_90:]  
  
plt.plot(dates\_switzerland\_train, y\_switzerland\_train, linewidth=1)  
plt.plot(dates\_switzerland\_val, y\_switzerland\_val, linewidth=1)  
plt.plot(dates\_switzerland\_test, y\_switzerland\_test, linewidth=1)  
  
plt.legend(["Training", "Validation", "Testing"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Split of Switzerland's Data for LSTM Model")  
plt.show()  
```



Now, I began to configure the Machine Learning model. We added Sequential layers: an Input layer 3 by 1 because we will have 3 np.arrays of Input and 1 np.array as output, utilize a LSTM (Long Short-Term Memory) layer of 64 neurons, apply 2 levels of dense layers with 32 neurons and folliowing recommendations online to use the RELU (Rectified Linear Unit) Activiation Function, and I followed up with one last dense layer of 1 neuron as our output layer since we are just trying to linearly-predict the next currency-rate on a near-future date. Once I configured the Sequential layers, we are ready to compile the model, utilzing the mean\_square\_error as our minimizing loss function, using the Adam optimizer, and comparing our trained model against our data with the mean\_absolute\_error metric. Lastly, I fitted our model, utilzing our X\_train and Y\_train datasets for fitting with validation from our X\_valid and Y\_valid datasets at 100 epochs.

```{python}  
# Configuring the Machine Learning Tensorflow Model for Switzerland  
switzerland\_model = Sequential([layers.Input((3, 1)),  
 layers.LSTM(64),  
 layers.Dense(32, activation="relu"),  
 layers.Dense(32, activation="relu"),  
 layers.Dense(1)])  
  
switzerland\_model.compile(loss="mse",  
 optimizer=Adam(learning\_rate=0.001),  
 metrics=["mean\_absolute\_error"])  
  
switzerland\_model.fit(X\_switzerland\_train, y\_switzerland\_train, validation\_data=(X\_switzerland\_val, y\_switzerland\_val), epochs=100)  
```

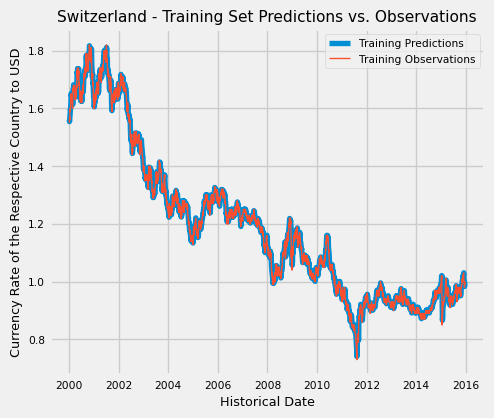
Epoch 1/100  
 1/126 [..............................] - ETA: 3:40 - loss: 1.7467 - mean\_absolute\_error: 1.2880 25/126 [====>.........................] - ETA: 0s - loss: 1.0172 - mean\_absolute\_error: 0.9650 50/126 [==========>...................] - ETA: 0s - loss: 0.5479 - mean\_absolute\_error: 0.5975 76/126 [=================>............] - ETA: 0s - loss: 0.3635 - mean\_absolute\_error: 0.4180100/126 [======================>.......] - ETA: 0s - loss: 0.2775 - mean\_absolute\_error: 0.3321126/126 [==============================] - ETA: 0s - loss: 0.2221 - mean\_absolute\_error: 0.2752126/126 [==============================] - 2s 5ms/step - loss: 0.2221 - mean\_absolute\_error: 0.2752 - val\_loss: 0.0030 - val\_mean\_absolute\_error: 0.0544  
Epoch 2/100  
 1/126 [..............................] - ETA: 0s - loss: 0.0042 - mean\_absolute\_error: 0.0562 28/126 [=====>........................] - ETA: 0s - loss: 0.0032 - mean\_absolute\_error: 0.0468 55/126 [============>.................] - ETA: 0s - loss: 0.0028 - mean\_absolute\_error: 0.0436 82/126 [==================>...........] - ETA: 0s - loss: 0.0024 - mean\_absolute\_error: 0.0407108/126 [========================>.....] - ETA: 0s - loss: 0.0021 - mean\_absolute\_error: 0.0378126/126 [==============================] - 0s 2ms/step - loss: 0.0020 - mean\_absolute\_error: 0.0361 - val\_loss: 7.5241e-04 - val\_mean\_absolute\_error: 0.0265  
Epoch 3/100  
 1/126 [..............................] - ETA: 0s - loss: 7.7552e-04 - mean\_absolute\_error: 0.0223 27/126 [=====>........................] - ETA: 0s - loss: 6.3298e-04 - mean\_absolute\_error: 0.0207 52/126 [===========>..................] - ETA: 0s - loss: 5.7639e-04 - mean\_absolute\_error: 0.0194 77/126 [=================>............] - ETA: 0s - loss: 4.9604e-04 - mean\_absolute\_error: 0.0179102/126 [=======================>......] - ETA: 0s - loss: 4.3164e-04 - mean\_absolute\_error: 0.0165126/126 [==============================] - 0s 2ms/step - loss: 3.8925e-04 - mean\_absolute\_error: 0.0156 - val\_loss: 9.7330e-05 - val\_mean\_absolute\_error: 0.0081  
Epoch 4/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9624e-04 - mean\_absolute\_error: 0.0105 28/126 [=====>........................] - ETA: 0s - loss: 1.8080e-04 - mean\_absolute\_error: 0.0107 53/126 [===========>..................] - ETA: 0s - loss: 1.8564e-04 - mean\_absolute\_error: 0.0105 78/126 [=================>............] - ETA: 0s - loss: 1.7593e-04 - mean\_absolute\_error: 0.0102103/126 [=======================>......] - ETA: 0s - loss: 1.7325e-04 - mean\_absolute\_error: 0.0100126/126 [==============================] - 0s 2ms/step - loss: 1.7071e-04 - mean\_absolute\_error: 0.0100 - val\_loss: 5.0583e-05 - val\_mean\_absolute\_error: 0.0056  
Epoch 5/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4651e-04 - mean\_absolute\_error: 0.0091 26/126 [=====>........................] - ETA: 0s - loss: 1.5950e-04 - mean\_absolute\_error: 0.0094 51/126 [===========>..................] - ETA: 0s - loss: 1.5902e-04 - mean\_absolute\_error: 0.0095 76/126 [=================>............] - ETA: 0s - loss: 1.5435e-04 - mean\_absolute\_error: 0.0094102/126 [=======================>......] - ETA: 0s - loss: 1.5943e-04 - mean\_absolute\_error: 0.0095126/126 [==============================] - 0s 2ms/step - loss: 1.6131e-04 - mean\_absolute\_error: 0.0096 - val\_loss: 6.3982e-05 - val\_mean\_absolute\_error: 0.0065  
Epoch 6/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3496e-04 - mean\_absolute\_error: 0.0094 26/126 [=====>........................] - ETA: 0s - loss: 1.5066e-04 - mean\_absolute\_error: 0.0095 52/126 [===========>..................] - ETA: 0s - loss: 1.5108e-04 - mean\_absolute\_error: 0.0095 77/126 [=================>............] - ETA: 0s - loss: 1.5245e-04 - mean\_absolute\_error: 0.0095102/126 [=======================>......] - ETA: 0s - loss: 1.5632e-04 - mean\_absolute\_error: 0.0095126/126 [==============================] - 0s 2ms/step - loss: 1.6172e-04 - mean\_absolute\_error: 0.0096 - val\_loss: 4.9661e-05 - val\_mean\_absolute\_error: 0.0055  
Epoch 7/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4619e-04 - mean\_absolute\_error: 0.0094 27/126 [=====>........................] - ETA: 0s - loss: 1.5371e-04 - mean\_absolute\_error: 0.0095 51/126 [===========>..................] - ETA: 0s - loss: 1.5844e-04 - mean\_absolute\_error: 0.0096 76/126 [=================>............] - ETA: 0s - loss: 1.6452e-04 - mean\_absolute\_error: 0.0097101/126 [=======================>......] - ETA: 0s - loss: 1.6110e-04 - mean\_absolute\_error: 0.0097126/126 [==============================] - ETA: 0s - loss: 1.6319e-04 - mean\_absolute\_error: 0.0097126/126 [==============================] - 0s 2ms/step - loss: 1.6319e-04 - mean\_absolute\_error: 0.0097 - val\_loss: 5.0230e-05 - val\_mean\_absolute\_error: 0.0055  
Epoch 8/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5447e-04 - mean\_absolute\_error: 0.0093 27/126 [=====>........................] - ETA: 0s - loss: 1.4541e-04 - mean\_absolute\_error: 0.0092 53/126 [===========>..................] - ETA: 0s - loss: 1.6015e-04 - mean\_absolute\_error: 0.0094 78/126 [=================>............] - ETA: 0s - loss: 1.5345e-04 - mean\_absolute\_error: 0.0093104/126 [=======================>......] - ETA: 0s - loss: 1.5969e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.5962e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 5.3220e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 9/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3225e-04 - mean\_absolute\_error: 0.0091 27/126 [=====>........................] - ETA: 0s - loss: 1.5321e-04 - mean\_absolute\_error: 0.0096 52/126 [===========>..................] - ETA: 0s - loss: 1.4806e-04 - mean\_absolute\_error: 0.0094 76/126 [=================>............] - ETA: 0s - loss: 1.4981e-04 - mean\_absolute\_error: 0.0094102/126 [=======================>......] - ETA: 0s - loss: 1.5719e-04 - mean\_absolute\_error: 0.0095126/126 [==============================] - 0s 2ms/step - loss: 1.6543e-04 - mean\_absolute\_error: 0.0097 - val\_loss: 6.0666e-05 - val\_mean\_absolute\_error: 0.0063  
Epoch 10/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9075e-04 - mean\_absolute\_error: 0.0102 26/126 [=====>........................] - ETA: 0s - loss: 1.8900e-04 - mean\_absolute\_error: 0.0103 52/126 [===========>..................] - ETA: 0s - loss: 1.7333e-04 - mean\_absolute\_error: 0.0100 78/126 [=================>............] - ETA: 0s - loss: 1.7086e-04 - mean\_absolute\_error: 0.0100104/126 [=======================>......] - ETA: 0s - loss: 1.6777e-04 - mean\_absolute\_error: 0.0099126/126 [==============================] - 0s 2ms/step - loss: 1.6583e-04 - mean\_absolute\_error: 0.0097 - val\_loss: 4.9414e-05 - val\_mean\_absolute\_error: 0.0054  
Epoch 11/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4975e-04 - mean\_absolute\_error: 0.0100 26/126 [=====>........................] - ETA: 0s - loss: 1.7915e-04 - mean\_absolute\_error: 0.0093 51/126 [===========>..................] - ETA: 0s - loss: 1.6306e-04 - mean\_absolute\_error: 0.0092 77/126 [=================>............] - ETA: 0s - loss: 1.6192e-04 - mean\_absolute\_error: 0.0094102/126 [=======================>......] - ETA: 0s - loss: 1.7043e-04 - mean\_absolute\_error: 0.0098126/126 [==============================] - 0s 2ms/step - loss: 1.6719e-04 - mean\_absolute\_error: 0.0097 - val\_loss: 6.9471e-05 - val\_mean\_absolute\_error: 0.0068  
Epoch 12/100  
 1/126 [..............................] - ETA: 0s - loss: 2.5527e-04 - mean\_absolute\_error: 0.0116 27/126 [=====>........................] - ETA: 0s - loss: 1.6126e-04 - mean\_absolute\_error: 0.0094 52/126 [===========>..................] - ETA: 0s - loss: 1.5595e-04 - mean\_absolute\_error: 0.0094 77/126 [=================>............] - ETA: 0s - loss: 1.5805e-04 - mean\_absolute\_error: 0.0095101/126 [=======================>......] - ETA: 0s - loss: 1.5512e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - ETA: 0s - loss: 1.5610e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.5610e-04 - mean\_absolute\_error: 0.0094 - val\_loss: 4.9631e-05 - val\_mean\_absolute\_error: 0.0054  
Epoch 13/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1262e-04 - mean\_absolute\_error: 0.0082 28/126 [=====>........................] - ETA: 0s - loss: 1.5391e-04 - mean\_absolute\_error: 0.0096 54/126 [===========>..................] - ETA: 0s - loss: 1.4797e-04 - mean\_absolute\_error: 0.0094 77/126 [=================>............] - ETA: 0s - loss: 1.5046e-04 - mean\_absolute\_error: 0.0093101/126 [=======================>......] - ETA: 0s - loss: 1.5141e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.5448e-04 - mean\_absolute\_error: 0.0093 - val\_loss: 4.9413e-05 - val\_mean\_absolute\_error: 0.0054  
Epoch 14/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4426e-04 - mean\_absolute\_error: 0.0090 26/126 [=====>........................] - ETA: 0s - loss: 1.6362e-04 - mean\_absolute\_error: 0.0093 51/126 [===========>..................] - ETA: 0s - loss: 1.6030e-04 - mean\_absolute\_error: 0.0093 76/126 [=================>............] - ETA: 0s - loss: 1.5372e-04 - mean\_absolute\_error: 0.0093101/126 [=======================>......] - ETA: 0s - loss: 1.5443e-04 - mean\_absolute\_error: 0.0093126/126 [==============================] - ETA: 0s - loss: 1.5659e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.5659e-04 - mean\_absolute\_error: 0.0094 - val\_loss: 5.8484e-05 - val\_mean\_absolute\_error: 0.0061  
Epoch 15/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5862e-04 - mean\_absolute\_error: 0.0110 26/126 [=====>........................] - ETA: 0s - loss: 1.5441e-04 - mean\_absolute\_error: 0.0096 51/126 [===========>..................] - ETA: 0s - loss: 1.4744e-04 - mean\_absolute\_error: 0.0094 76/126 [=================>............] - ETA: 0s - loss: 1.5385e-04 - mean\_absolute\_error: 0.0094101/126 [=======================>......] - ETA: 0s - loss: 1.5072e-04 - mean\_absolute\_error: 0.0093126/126 [==============================] - 0s 2ms/step - loss: 1.5997e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 5.6348e-05 - val\_mean\_absolute\_error: 0.0060  
Epoch 16/100  
 1/126 [..............................] - ETA: 0s - loss: 9.8890e-05 - mean\_absolute\_error: 0.0074 27/126 [=====>........................] - ETA: 0s - loss: 1.4956e-04 - mean\_absolute\_error: 0.0094 53/126 [===========>..................] - ETA: 0s - loss: 1.4854e-04 - mean\_absolute\_error: 0.0093 78/126 [=================>............] - ETA: 0s - loss: 1.4963e-04 - mean\_absolute\_error: 0.0092103/126 [=======================>......] - ETA: 0s - loss: 1.5357e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - 0s 2ms/step - loss: 1.5487e-04 - mean\_absolute\_error: 0.0093 - val\_loss: 5.3577e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 17/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0928e-04 - mean\_absolute\_error: 0.0082 27/126 [=====>........................] - ETA: 0s - loss: 1.4982e-04 - mean\_absolute\_error: 0.0093 51/126 [===========>..................] - ETA: 0s - loss: 1.4331e-04 - mean\_absolute\_error: 0.0091 77/126 [=================>............] - ETA: 0s - loss: 1.4808e-04 - mean\_absolute\_error: 0.0091102/126 [=======================>......] - ETA: 0s - loss: 1.5662e-04 - mean\_absolute\_error: 0.0093126/126 [==============================] - 0s 2ms/step - loss: 1.5213e-04 - mean\_absolute\_error: 0.0092 - val\_loss: 5.6069e-05 - val\_mean\_absolute\_error: 0.0060  
Epoch 18/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3095e-04 - mean\_absolute\_error: 0.0089 27/126 [=====>........................] - ETA: 0s - loss: 1.5163e-04 - mean\_absolute\_error: 0.0094 51/126 [===========>..................] - ETA: 0s - loss: 1.4730e-04 - mean\_absolute\_error: 0.0093 77/126 [=================>............] - ETA: 0s - loss: 1.4827e-04 - mean\_absolute\_error: 0.0091103/126 [=======================>......] - ETA: 0s - loss: 1.4895e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - 0s 2ms/step - loss: 1.5445e-04 - mean\_absolute\_error: 0.0093 - val\_loss: 5.9463e-05 - val\_mean\_absolute\_error: 0.0062  
Epoch 19/100  
 1/126 [..............................] - ETA: 0s - loss: 9.2402e-05 - mean\_absolute\_error: 0.0078 27/126 [=====>........................] - ETA: 0s - loss: 1.4462e-04 - mean\_absolute\_error: 0.0092 53/126 [===========>..................] - ETA: 0s - loss: 1.3754e-04 - mean\_absolute\_error: 0.0091 78/126 [=================>............] - ETA: 0s - loss: 1.4612e-04 - mean\_absolute\_error: 0.0093102/126 [=======================>......] - ETA: 0s - loss: 1.4555e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - 0s 2ms/step - loss: 1.5750e-04 - mean\_absolute\_error: 0.0094 - val\_loss: 6.8510e-05 - val\_mean\_absolute\_error: 0.0067  
Epoch 20/100  
 1/126 [..............................] - ETA: 0s - loss: 2.4622e-04 - mean\_absolute\_error: 0.0112 26/126 [=====>........................] - ETA: 0s - loss: 1.5907e-04 - mean\_absolute\_error: 0.0098 51/126 [===========>..................] - ETA: 0s - loss: 1.5971e-04 - mean\_absolute\_error: 0.0097 76/126 [=================>............] - ETA: 0s - loss: 1.7252e-04 - mean\_absolute\_error: 0.0098100/126 [======================>.......] - ETA: 0s - loss: 1.6565e-04 - mean\_absolute\_error: 0.0097122/126 [============================>.] - ETA: 0s - loss: 1.5960e-04 - mean\_absolute\_error: 0.0095126/126 [==============================] - 0s 2ms/step - loss: 1.5878e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 7.3605e-05 - val\_mean\_absolute\_error: 0.0070  
Epoch 21/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9625e-04 - mean\_absolute\_error: 0.0109 26/126 [=====>........................] - ETA: 0s - loss: 1.8209e-04 - mean\_absolute\_error: 0.0108 50/126 [==========>...................] - ETA: 0s - loss: 1.7433e-04 - mean\_absolute\_error: 0.0101 75/126 [================>.............] - ETA: 0s - loss: 1.7798e-04 - mean\_absolute\_error: 0.0100100/126 [======================>.......] - ETA: 0s - loss: 1.6854e-04 - mean\_absolute\_error: 0.0098125/126 [============================>.] - ETA: 0s - loss: 1.5999e-04 - mean\_absolute\_error: 0.0095126/126 [==============================] - 0s 2ms/step - loss: 1.5976e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 5.1830e-05 - val\_mean\_absolute\_error: 0.0057  
Epoch 22/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2605e-04 - mean\_absolute\_error: 0.0086 26/126 [=====>........................] - ETA: 0s - loss: 1.4236e-04 - mean\_absolute\_error: 0.0093 51/126 [===========>..................] - ETA: 0s - loss: 1.3983e-04 - mean\_absolute\_error: 0.0091 77/126 [=================>............] - ETA: 0s - loss: 1.5355e-04 - mean\_absolute\_error: 0.0092102/126 [=======================>......] - ETA: 0s - loss: 1.6832e-04 - mean\_absolute\_error: 0.0097125/126 [============================>.] - ETA: 0s - loss: 1.6171e-04 - mean\_absolute\_error: 0.0095126/126 [==============================] - 0s 2ms/step - loss: 1.6146e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 5.8899e-05 - val\_mean\_absolute\_error: 0.0062  
Epoch 23/100  
 1/126 [..............................] - ETA: 0s - loss: 8.9025e-05 - mean\_absolute\_error: 0.0074 27/126 [=====>........................] - ETA: 0s - loss: 1.3853e-04 - mean\_absolute\_error: 0.0089 52/126 [===========>..................] - ETA: 0s - loss: 1.3503e-04 - mean\_absolute\_error: 0.0087 75/126 [================>.............] - ETA: 0s - loss: 1.4268e-04 - mean\_absolute\_error: 0.0089100/126 [======================>.......] - ETA: 0s - loss: 1.4915e-04 - mean\_absolute\_error: 0.0090126/126 [==============================] - ETA: 0s - loss: 1.4823e-04 - mean\_absolute\_error: 0.0090126/126 [==============================] - 0s 2ms/step - loss: 1.4823e-04 - mean\_absolute\_error: 0.0090 - val\_loss: 5.3540e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 24/100  
 1/126 [..............................] - ETA: 0s - loss: 7.5126e-04 - mean\_absolute\_error: 0.0136 27/126 [=====>........................] - ETA: 0s - loss: 1.9159e-04 - mean\_absolute\_error: 0.0097 51/126 [===========>..................] - ETA: 0s - loss: 1.7010e-04 - mean\_absolute\_error: 0.0094 77/126 [=================>............] - ETA: 0s - loss: 1.5836e-04 - mean\_absolute\_error: 0.0092102/126 [=======================>......] - ETA: 0s - loss: 1.5367e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - 0s 2ms/step - loss: 1.4825e-04 - mean\_absolute\_error: 0.0091 - val\_loss: 5.4517e-05 - val\_mean\_absolute\_error: 0.0059  
Epoch 25/100  
 1/126 [..............................] - ETA: 0s - loss: 7.7430e-05 - mean\_absolute\_error: 0.0070 27/126 [=====>........................] - ETA: 0s - loss: 1.5423e-04 - mean\_absolute\_error: 0.0090 52/126 [===========>..................] - ETA: 0s - loss: 1.4945e-04 - mean\_absolute\_error: 0.0091 78/126 [=================>............] - ETA: 0s - loss: 1.5509e-04 - mean\_absolute\_error: 0.0092103/126 [=======================>......] - ETA: 0s - loss: 1.6133e-04 - mean\_absolute\_error: 0.0095126/126 [==============================] - 0s 2ms/step - loss: 1.5848e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 1.0050e-04 - val\_mean\_absolute\_error: 0.0083  
Epoch 26/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0404e-04 - mean\_absolute\_error: 0.0120 27/126 [=====>........................] - ETA: 0s - loss: 1.4169e-04 - mean\_absolute\_error: 0.0089 51/126 [===========>..................] - ETA: 0s - loss: 1.4424e-04 - mean\_absolute\_error: 0.0091 77/126 [=================>............] - ETA: 0s - loss: 1.4023e-04 - mean\_absolute\_error: 0.0090103/126 [=======================>......] - ETA: 0s - loss: 1.5344e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.5616e-04 - mean\_absolute\_error: 0.0094 - val\_loss: 5.5225e-05 - val\_mean\_absolute\_error: 0.0060  
Epoch 27/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5830e-04 - mean\_absolute\_error: 0.0092 28/126 [=====>........................] - ETA: 0s - loss: 1.5423e-04 - mean\_absolute\_error: 0.0093 55/126 [============>.................] - ETA: 0s - loss: 1.6453e-04 - mean\_absolute\_error: 0.0098 80/126 [==================>...........] - ETA: 0s - loss: 1.8311e-04 - mean\_absolute\_error: 0.0102106/126 [========================>.....] - ETA: 0s - loss: 1.7090e-04 - mean\_absolute\_error: 0.0099126/126 [==============================] - 0s 2ms/step - loss: 1.6924e-04 - mean\_absolute\_error: 0.0099 - val\_loss: 5.4539e-05 - val\_mean\_absolute\_error: 0.0059  
Epoch 28/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9826e-04 - mean\_absolute\_error: 0.0113 26/126 [=====>........................] - ETA: 0s - loss: 1.3384e-04 - mean\_absolute\_error: 0.0088 52/126 [===========>..................] - ETA: 0s - loss: 1.4452e-04 - mean\_absolute\_error: 0.0092 77/126 [=================>............] - ETA: 0s - loss: 1.5791e-04 - mean\_absolute\_error: 0.0094102/126 [=======================>......] - ETA: 0s - loss: 1.5636e-04 - mean\_absolute\_error: 0.0093126/126 [==============================] - 0s 2ms/step - loss: 1.5548e-04 - mean\_absolute\_error: 0.0093 - val\_loss: 1.0392e-04 - val\_mean\_absolute\_error: 0.0084  
Epoch 29/100  
 1/126 [..............................] - ETA: 0s - loss: 3.3647e-04 - mean\_absolute\_error: 0.0147 27/126 [=====>........................] - ETA: 0s - loss: 1.9966e-04 - mean\_absolute\_error: 0.0112 53/126 [===========>..................] - ETA: 0s - loss: 1.7252e-04 - mean\_absolute\_error: 0.0102 77/126 [=================>............] - ETA: 0s - loss: 1.6266e-04 - mean\_absolute\_error: 0.0098103/126 [=======================>......] - ETA: 0s - loss: 1.5982e-04 - mean\_absolute\_error: 0.0096126/126 [==============================] - 0s 2ms/step - loss: 1.6198e-04 - mean\_absolute\_error: 0.0096 - val\_loss: 1.0358e-04 - val\_mean\_absolute\_error: 0.0085  
Epoch 30/100  
 1/126 [..............................] - ETA: 0s - loss: 2.7834e-04 - mean\_absolute\_error: 0.0134 27/126 [=====>........................] - ETA: 0s - loss: 1.6152e-04 - mean\_absolute\_error: 0.0098 52/126 [===========>..................] - ETA: 0s - loss: 1.5836e-04 - mean\_absolute\_error: 0.0096 78/126 [=================>............] - ETA: 0s - loss: 1.5333e-04 - mean\_absolute\_error: 0.0093103/126 [=======================>......] - ETA: 0s - loss: 1.6116e-04 - mean\_absolute\_error: 0.0095126/126 [==============================] - 0s 2ms/step - loss: 1.5725e-04 - mean\_absolute\_error: 0.0094 - val\_loss: 8.2375e-05 - val\_mean\_absolute\_error: 0.0075  
Epoch 31/100  
 1/126 [..............................] - ETA: 0s - loss: 1.7049e-04 - mean\_absolute\_error: 0.0091 27/126 [=====>........................] - ETA: 0s - loss: 1.8875e-04 - mean\_absolute\_error: 0.0101 52/126 [===========>..................] - ETA: 0s - loss: 1.6676e-04 - mean\_absolute\_error: 0.0096 77/126 [=================>............] - ETA: 0s - loss: 1.5922e-04 - mean\_absolute\_error: 0.0093102/126 [=======================>......] - ETA: 0s - loss: 1.5793e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.5491e-04 - mean\_absolute\_error: 0.0094 - val\_loss: 7.3192e-05 - val\_mean\_absolute\_error: 0.0070  
Epoch 32/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0916e-04 - mean\_absolute\_error: 0.0082 27/126 [=====>........................] - ETA: 0s - loss: 1.8334e-04 - mean\_absolute\_error: 0.0094 53/126 [===========>..................] - ETA: 0s - loss: 1.5895e-04 - mean\_absolute\_error: 0.0091 79/126 [=================>............] - ETA: 0s - loss: 1.5045e-04 - mean\_absolute\_error: 0.0090105/126 [========================>.....] - ETA: 0s - loss: 1.4713e-04 - mean\_absolute\_error: 0.0090126/126 [==============================] - 0s 2ms/step - loss: 1.4669e-04 - mean\_absolute\_error: 0.0090 - val\_loss: 7.5663e-05 - val\_mean\_absolute\_error: 0.0071  
Epoch 33/100  
 1/126 [..............................] - ETA: 0s - loss: 2.2872e-04 - mean\_absolute\_error: 0.0113 26/126 [=====>........................] - ETA: 0s - loss: 1.6761e-04 - mean\_absolute\_error: 0.0093 51/126 [===========>..................] - ETA: 0s - loss: 1.6558e-04 - mean\_absolute\_error: 0.0095 76/126 [=================>............] - ETA: 0s - loss: 1.5735e-04 - mean\_absolute\_error: 0.0092102/126 [=======================>......] - ETA: 0s - loss: 1.6305e-04 - mean\_absolute\_error: 0.0096126/126 [==============================] - 0s 2ms/step - loss: 1.6284e-04 - mean\_absolute\_error: 0.0096 - val\_loss: 5.4461e-05 - val\_mean\_absolute\_error: 0.0059  
Epoch 34/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0207e-04 - mean\_absolute\_error: 0.0072 28/126 [=====>........................] - ETA: 0s - loss: 1.3225e-04 - mean\_absolute\_error: 0.0087 51/126 [===========>..................] - ETA: 0s - loss: 1.3153e-04 - mean\_absolute\_error: 0.0087 77/126 [=================>............] - ETA: 0s - loss: 1.4267e-04 - mean\_absolute\_error: 0.0089103/126 [=======================>......] - ETA: 0s - loss: 1.5352e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.5669e-04 - mean\_absolute\_error: 0.0094 - val\_loss: 6.9635e-05 - val\_mean\_absolute\_error: 0.0068  
Epoch 35/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1342e-04 - mean\_absolute\_error: 0.0082 26/126 [=====>........................] - ETA: 0s - loss: 1.7454e-04 - mean\_absolute\_error: 0.0100 52/126 [===========>..................] - ETA: 0s - loss: 2.0394e-04 - mean\_absolute\_error: 0.0108 78/126 [=================>............] - ETA: 0s - loss: 1.8776e-04 - mean\_absolute\_error: 0.0104103/126 [=======================>......] - ETA: 0s - loss: 1.7878e-04 - mean\_absolute\_error: 0.0100126/126 [==============================] - 0s 2ms/step - loss: 1.8484e-04 - mean\_absolute\_error: 0.0103 - val\_loss: 8.4187e-05 - val\_mean\_absolute\_error: 0.0076  
Epoch 36/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3961e-04 - mean\_absolute\_error: 0.0091 28/126 [=====>........................] - ETA: 0s - loss: 1.6926e-04 - mean\_absolute\_error: 0.0099 53/126 [===========>..................] - ETA: 0s - loss: 1.5829e-04 - mean\_absolute\_error: 0.0096 79/126 [=================>............] - ETA: 0s - loss: 1.6187e-04 - mean\_absolute\_error: 0.0096104/126 [=======================>......] - ETA: 0s - loss: 1.6220e-04 - mean\_absolute\_error: 0.0096126/126 [==============================] - 0s 2ms/step - loss: 1.5660e-04 - mean\_absolute\_error: 0.0094 - val\_loss: 5.3363e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 37/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1163e-04 - mean\_absolute\_error: 0.0087 27/126 [=====>........................] - ETA: 0s - loss: 1.7798e-04 - mean\_absolute\_error: 0.0104 51/126 [===========>..................] - ETA: 0s - loss: 1.7350e-04 - mean\_absolute\_error: 0.0101 76/126 [=================>............] - ETA: 0s - loss: 1.6847e-04 - mean\_absolute\_error: 0.0098101/126 [=======================>......] - ETA: 0s - loss: 1.6078e-04 - mean\_absolute\_error: 0.0096126/126 [==============================] - ETA: 0s - loss: 1.7445e-04 - mean\_absolute\_error: 0.0100126/126 [==============================] - 0s 2ms/step - loss: 1.7445e-04 - mean\_absolute\_error: 0.0100 - val\_loss: 9.4610e-05 - val\_mean\_absolute\_error: 0.0081  
Epoch 38/100  
 1/126 [..............................] - ETA: 0s - loss: 1.8545e-04 - mean\_absolute\_error: 0.0108 27/126 [=====>........................] - ETA: 0s - loss: 1.4552e-04 - mean\_absolute\_error: 0.0093 54/126 [===========>..................] - ETA: 0s - loss: 1.6051e-04 - mean\_absolute\_error: 0.0095 79/126 [=================>............] - ETA: 0s - loss: 1.5927e-04 - mean\_absolute\_error: 0.0094104/126 [=======================>......] - ETA: 0s - loss: 1.6200e-04 - mean\_absolute\_error: 0.0096126/126 [==============================] - 0s 2ms/step - loss: 1.7274e-04 - mean\_absolute\_error: 0.0100 - val\_loss: 1.3452e-04 - val\_mean\_absolute\_error: 0.0098  
Epoch 39/100  
 1/126 [..............................] - ETA: 0s - loss: 2.5436e-04 - mean\_absolute\_error: 0.0126 27/126 [=====>........................] - ETA: 0s - loss: 2.4407e-04 - mean\_absolute\_error: 0.0119 53/126 [===========>..................] - ETA: 0s - loss: 1.9877e-04 - mean\_absolute\_error: 0.0107 79/126 [=================>............] - ETA: 0s - loss: 1.8296e-04 - mean\_absolute\_error: 0.0103103/126 [=======================>......] - ETA: 0s - loss: 1.7072e-04 - mean\_absolute\_error: 0.0100126/126 [==============================] - 0s 2ms/step - loss: 1.7202e-04 - mean\_absolute\_error: 0.0099 - val\_loss: 5.0478e-05 - val\_mean\_absolute\_error: 0.0056  
Epoch 40/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3720e-04 - mean\_absolute\_error: 0.0092 26/126 [=====>........................] - ETA: 0s - loss: 1.5246e-04 - mean\_absolute\_error: 0.0089 52/126 [===========>..................] - ETA: 0s - loss: 1.5347e-04 - mean\_absolute\_error: 0.0092 77/126 [=================>............] - ETA: 0s - loss: 1.5180e-04 - mean\_absolute\_error: 0.0092101/126 [=======================>......] - ETA: 0s - loss: 1.5299e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - ETA: 0s - loss: 1.5028e-04 - mean\_absolute\_error: 0.0091126/126 [==============================] - 0s 2ms/step - loss: 1.5028e-04 - mean\_absolute\_error: 0.0091 - val\_loss: 5.3527e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 41/100  
 1/126 [..............................] - ETA: 0s - loss: 6.5196e-05 - mean\_absolute\_error: 0.0069 26/126 [=====>........................] - ETA: 0s - loss: 1.5250e-04 - mean\_absolute\_error: 0.0095 51/126 [===========>..................] - ETA: 0s - loss: 1.4879e-04 - mean\_absolute\_error: 0.0093 76/126 [=================>............] - ETA: 0s - loss: 1.6621e-04 - mean\_absolute\_error: 0.0099102/126 [=======================>......] - ETA: 0s - loss: 1.6444e-04 - mean\_absolute\_error: 0.0098126/126 [==============================] - 0s 2ms/step - loss: 1.8119e-04 - mean\_absolute\_error: 0.0102 - val\_loss: 8.9196e-05 - val\_mean\_absolute\_error: 0.0078  
Epoch 42/100  
 1/126 [..............................] - ETA: 0s - loss: 1.8956e-04 - mean\_absolute\_error: 0.0116 27/126 [=====>........................] - ETA: 0s - loss: 1.6634e-04 - mean\_absolute\_error: 0.0101 52/126 [===========>..................] - ETA: 0s - loss: 1.6882e-04 - mean\_absolute\_error: 0.0101 77/126 [=================>............] - ETA: 0s - loss: 1.8171e-04 - mean\_absolute\_error: 0.0104103/126 [=======================>......] - ETA: 0s - loss: 1.9047e-04 - mean\_absolute\_error: 0.0105126/126 [==============================] - 0s 2ms/step - loss: 1.8987e-04 - mean\_absolute\_error: 0.0105 - val\_loss: 8.6958e-05 - val\_mean\_absolute\_error: 0.0077  
Epoch 43/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5082e-04 - mean\_absolute\_error: 0.0096 26/126 [=====>........................] - ETA: 0s - loss: 1.2081e-04 - mean\_absolute\_error: 0.0084 50/126 [==========>...................] - ETA: 0s - loss: 1.3109e-04 - mean\_absolute\_error: 0.0087 75/126 [================>.............] - ETA: 0s - loss: 1.4960e-04 - mean\_absolute\_error: 0.0092100/126 [======================>.......] - ETA: 0s - loss: 1.5707e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - ETA: 0s - loss: 1.6965e-04 - mean\_absolute\_error: 0.0098126/126 [==============================] - 0s 2ms/step - loss: 1.6965e-04 - mean\_absolute\_error: 0.0098 - val\_loss: 7.2969e-05 - val\_mean\_absolute\_error: 0.0070  
Epoch 44/100  
 1/126 [..............................] - ETA: 0s - loss: 1.7352e-04 - mean\_absolute\_error: 0.0106 26/126 [=====>........................] - ETA: 0s - loss: 1.3961e-04 - mean\_absolute\_error: 0.0090 52/126 [===========>..................] - ETA: 0s - loss: 1.3181e-04 - mean\_absolute\_error: 0.0088 77/126 [=================>............] - ETA: 0s - loss: 1.4087e-04 - mean\_absolute\_error: 0.0091102/126 [=======================>......] - ETA: 0s - loss: 1.6125e-04 - mean\_absolute\_error: 0.0096126/126 [==============================] - 0s 2ms/step - loss: 1.6155e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 8.5619e-05 - val\_mean\_absolute\_error: 0.0076  
Epoch 45/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5625e-04 - mean\_absolute\_error: 0.0098 28/126 [=====>........................] - ETA: 0s - loss: 1.6046e-04 - mean\_absolute\_error: 0.0093 52/126 [===========>..................] - ETA: 0s - loss: 1.5169e-04 - mean\_absolute\_error: 0.0093 77/126 [=================>............] - ETA: 0s - loss: 1.5950e-04 - mean\_absolute\_error: 0.0094102/126 [=======================>......] - ETA: 0s - loss: 1.6061e-04 - mean\_absolute\_error: 0.0095126/126 [==============================] - 0s 2ms/step - loss: 1.5679e-04 - mean\_absolute\_error: 0.0094 - val\_loss: 5.5018e-05 - val\_mean\_absolute\_error: 0.0059  
Epoch 46/100  
 1/126 [..............................] - ETA: 0s - loss: 2.1802e-04 - mean\_absolute\_error: 0.0106 27/126 [=====>........................] - ETA: 0s - loss: 1.4150e-04 - mean\_absolute\_error: 0.0089 53/126 [===========>..................] - ETA: 0s - loss: 1.4624e-04 - mean\_absolute\_error: 0.0093 79/126 [=================>............] - ETA: 0s - loss: 1.8806e-04 - mean\_absolute\_error: 0.0104104/126 [=======================>......] - ETA: 0s - loss: 1.9628e-04 - mean\_absolute\_error: 0.0107126/126 [==============================] - 0s 2ms/step - loss: 1.8726e-04 - mean\_absolute\_error: 0.0104 - val\_loss: 1.0965e-04 - val\_mean\_absolute\_error: 0.0087  
Epoch 47/100  
 1/126 [..............................] - ETA: 0s - loss: 2.2281e-04 - mean\_absolute\_error: 0.0117 28/126 [=====>........................] - ETA: 0s - loss: 1.5956e-04 - mean\_absolute\_error: 0.0093 54/126 [===========>..................] - ETA: 0s - loss: 1.5467e-04 - mean\_absolute\_error: 0.0093 79/126 [=================>............] - ETA: 0s - loss: 1.5307e-04 - mean\_absolute\_error: 0.0093104/126 [=======================>......] - ETA: 0s - loss: 1.4613e-04 - mean\_absolute\_error: 0.0091126/126 [==============================] - 0s 2ms/step - loss: 1.5915e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 8.5962e-05 - val\_mean\_absolute\_error: 0.0076  
Epoch 48/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0475e-04 - mean\_absolute\_error: 0.0121 26/126 [=====>........................] - ETA: 0s - loss: 2.1180e-04 - mean\_absolute\_error: 0.0114 51/126 [===========>..................] - ETA: 0s - loss: 1.8148e-04 - mean\_absolute\_error: 0.0104 75/126 [================>.............] - ETA: 0s - loss: 1.7543e-04 - mean\_absolute\_error: 0.0103100/126 [======================>.......] - ETA: 0s - loss: 1.8186e-04 - mean\_absolute\_error: 0.0102126/126 [==============================] - ETA: 0s - loss: 1.7012e-04 - mean\_absolute\_error: 0.0099126/126 [==============================] - 0s 2ms/step - loss: 1.7012e-04 - mean\_absolute\_error: 0.0099 - val\_loss: 8.0037e-05 - val\_mean\_absolute\_error: 0.0074  
Epoch 49/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1453e-04 - mean\_absolute\_error: 0.0085 27/126 [=====>........................] - ETA: 0s - loss: 1.4047e-04 - mean\_absolute\_error: 0.0086 52/126 [===========>..................] - ETA: 0s - loss: 1.5195e-04 - mean\_absolute\_error: 0.0092 78/126 [=================>............] - ETA: 0s - loss: 1.5778e-04 - mean\_absolute\_error: 0.0093103/126 [=======================>......] - ETA: 0s - loss: 1.5865e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.5501e-04 - mean\_absolute\_error: 0.0093 - val\_loss: 1.1527e-04 - val\_mean\_absolute\_error: 0.0090  
Epoch 50/100  
 1/126 [..............................] - ETA: 0s - loss: 3.0604e-04 - mean\_absolute\_error: 0.0145 27/126 [=====>........................] - ETA: 0s - loss: 2.3660e-04 - mean\_absolute\_error: 0.0118 53/126 [===========>..................] - ETA: 0s - loss: 2.0699e-04 - mean\_absolute\_error: 0.0108 78/126 [=================>............] - ETA: 0s - loss: 1.8431e-04 - mean\_absolute\_error: 0.0103103/126 [=======================>......] - ETA: 0s - loss: 1.7875e-04 - mean\_absolute\_error: 0.0102126/126 [==============================] - 0s 2ms/step - loss: 1.7184e-04 - mean\_absolute\_error: 0.0099 - val\_loss: 7.5253e-05 - val\_mean\_absolute\_error: 0.0071  
Epoch 51/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4438e-04 - mean\_absolute\_error: 0.0096 26/126 [=====>........................] - ETA: 0s - loss: 1.3474e-04 - mean\_absolute\_error: 0.0091 51/126 [===========>..................] - ETA: 0s - loss: 1.4120e-04 - mean\_absolute\_error: 0.0091 75/126 [================>.............] - ETA: 0s - loss: 1.5125e-04 - mean\_absolute\_error: 0.0091101/126 [=======================>......] - ETA: 0s - loss: 1.5251e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - 0s 2ms/step - loss: 1.4878e-04 - mean\_absolute\_error: 0.0091 - val\_loss: 4.7423e-05 - val\_mean\_absolute\_error: 0.0052  
Epoch 52/100  
 1/126 [..............................] - ETA: 0s - loss: 6.4759e-05 - mean\_absolute\_error: 0.0062 27/126 [=====>........................] - ETA: 0s - loss: 1.7853e-04 - mean\_absolute\_error: 0.0097 53/126 [===========>..................] - ETA: 0s - loss: 1.7042e-04 - mean\_absolute\_error: 0.0096 78/126 [=================>............] - ETA: 0s - loss: 1.6224e-04 - mean\_absolute\_error: 0.0094103/126 [=======================>......] - ETA: 0s - loss: 1.5589e-04 - mean\_absolute\_error: 0.0093126/126 [==============================] - 0s 2ms/step - loss: 1.4825e-04 - mean\_absolute\_error: 0.0091 - val\_loss: 6.2168e-05 - val\_mean\_absolute\_error: 0.0063  
Epoch 53/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0047e-04 - mean\_absolute\_error: 0.0083 27/126 [=====>........................] - ETA: 0s - loss: 1.4260e-04 - mean\_absolute\_error: 0.0090 52/126 [===========>..................] - ETA: 0s - loss: 1.4992e-04 - mean\_absolute\_error: 0.0092 77/126 [=================>............] - ETA: 0s - loss: 1.6312e-04 - mean\_absolute\_error: 0.0094103/126 [=======================>......] - ETA: 0s - loss: 1.5740e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.5080e-04 - mean\_absolute\_error: 0.0092 - val\_loss: 6.4304e-05 - val\_mean\_absolute\_error: 0.0065  
Epoch 54/100  
 1/126 [..............................] - ETA: 0s - loss: 1.8249e-04 - mean\_absolute\_error: 0.0103 27/126 [=====>........................] - ETA: 0s - loss: 1.7432e-04 - mean\_absolute\_error: 0.0097 53/126 [===========>..................] - ETA: 0s - loss: 1.9189e-04 - mean\_absolute\_error: 0.0102 77/126 [=================>............] - ETA: 0s - loss: 1.7521e-04 - mean\_absolute\_error: 0.0099100/126 [======================>.......] - ETA: 0s - loss: 1.6491e-04 - mean\_absolute\_error: 0.0096126/126 [==============================] - ETA: 0s - loss: 1.5928e-04 - mean\_absolute\_error: 0.0095126/126 [==============================] - 0s 2ms/step - loss: 1.5928e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 4.8448e-05 - val\_mean\_absolute\_error: 0.0055  
Epoch 55/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1029e-04 - mean\_absolute\_error: 0.0083 27/126 [=====>........................] - ETA: 0s - loss: 1.2608e-04 - mean\_absolute\_error: 0.0087 53/126 [===========>..................] - ETA: 0s - loss: 1.3519e-04 - mean\_absolute\_error: 0.0089 79/126 [=================>............] - ETA: 0s - loss: 1.4326e-04 - mean\_absolute\_error: 0.0090104/126 [=======================>......] - ETA: 0s - loss: 1.5291e-04 - mean\_absolute\_error: 0.0091126/126 [==============================] - 0s 2ms/step - loss: 1.5002e-04 - mean\_absolute\_error: 0.0092 - val\_loss: 5.4608e-05 - val\_mean\_absolute\_error: 0.0059  
Epoch 56/100  
 1/126 [..............................] - ETA: 0s - loss: 8.1203e-05 - mean\_absolute\_error: 0.0072 26/126 [=====>........................] - ETA: 0s - loss: 1.4736e-04 - mean\_absolute\_error: 0.0089 51/126 [===========>..................] - ETA: 0s - loss: 1.4072e-04 - mean\_absolute\_error: 0.0085 76/126 [=================>............] - ETA: 0s - loss: 1.6234e-04 - mean\_absolute\_error: 0.0094102/126 [=======================>......] - ETA: 0s - loss: 1.8609e-04 - mean\_absolute\_error: 0.0103126/126 [==============================] - 0s 2ms/step - loss: 1.8740e-04 - mean\_absolute\_error: 0.0104 - val\_loss: 6.0325e-05 - val\_mean\_absolute\_error: 0.0062  
Epoch 57/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2300e-04 - mean\_absolute\_error: 0.0089 26/126 [=====>........................] - ETA: 0s - loss: 1.2763e-04 - mean\_absolute\_error: 0.0087 51/126 [===========>..................] - ETA: 0s - loss: 1.3779e-04 - mean\_absolute\_error: 0.0091 76/126 [=================>............] - ETA: 0s - loss: 1.3568e-04 - mean\_absolute\_error: 0.0089101/126 [=======================>......] - ETA: 0s - loss: 1.4210e-04 - mean\_absolute\_error: 0.0089125/126 [============================>.] - ETA: 0s - loss: 1.4190e-04 - mean\_absolute\_error: 0.0089126/126 [==============================] - 0s 2ms/step - loss: 1.4188e-04 - mean\_absolute\_error: 0.0089 - val\_loss: 6.3209e-05 - val\_mean\_absolute\_error: 0.0064  
Epoch 58/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4030e-04 - mean\_absolute\_error: 0.0092 26/126 [=====>........................] - ETA: 0s - loss: 1.3511e-04 - mean\_absolute\_error: 0.0087 51/126 [===========>..................] - ETA: 0s - loss: 1.4026e-04 - mean\_absolute\_error: 0.0087 77/126 [=================>............] - ETA: 0s - loss: 1.4463e-04 - mean\_absolute\_error: 0.0088102/126 [=======================>......] - ETA: 0s - loss: 1.4337e-04 - mean\_absolute\_error: 0.0088126/126 [==============================] - 0s 2ms/step - loss: 1.3887e-04 - mean\_absolute\_error: 0.0088 - val\_loss: 5.4610e-05 - val\_mean\_absolute\_error: 0.0059  
Epoch 59/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4349e-04 - mean\_absolute\_error: 0.0095 27/126 [=====>........................] - ETA: 0s - loss: 2.1952e-04 - mean\_absolute\_error: 0.0114 52/126 [===========>..................] - ETA: 0s - loss: 1.9322e-04 - mean\_absolute\_error: 0.0106 78/126 [=================>............] - ETA: 0s - loss: 1.8641e-04 - mean\_absolute\_error: 0.0104103/126 [=======================>......] - ETA: 0s - loss: 1.7575e-04 - mean\_absolute\_error: 0.0101126/126 [==============================] - 0s 2ms/step - loss: 1.7460e-04 - mean\_absolute\_error: 0.0101 - val\_loss: 6.2556e-05 - val\_mean\_absolute\_error: 0.0064  
Epoch 60/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6053e-04 - mean\_absolute\_error: 0.0107 27/126 [=====>........................] - ETA: 0s - loss: 1.5965e-04 - mean\_absolute\_error: 0.0088 52/126 [===========>..................] - ETA: 0s - loss: 1.5046e-04 - mean\_absolute\_error: 0.0089 77/126 [=================>............] - ETA: 0s - loss: 1.5350e-04 - mean\_absolute\_error: 0.0091102/126 [=======================>......] - ETA: 0s - loss: 1.5142e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - 0s 2ms/step - loss: 1.5315e-04 - mean\_absolute\_error: 0.0093 - val\_loss: 8.7104e-05 - val\_mean\_absolute\_error: 0.0077  
Epoch 61/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6089e-04 - mean\_absolute\_error: 0.0105 26/126 [=====>........................] - ETA: 0s - loss: 1.4391e-04 - mean\_absolute\_error: 0.0086 49/126 [==========>...................] - ETA: 0s - loss: 1.3816e-04 - mean\_absolute\_error: 0.0087 75/126 [================>.............] - ETA: 0s - loss: 1.5242e-04 - mean\_absolute\_error: 0.0093100/126 [======================>.......] - ETA: 0s - loss: 1.4648e-04 - mean\_absolute\_error: 0.0091125/126 [============================>.] - ETA: 0s - loss: 1.4917e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - 0s 2ms/step - loss: 1.4906e-04 - mean\_absolute\_error: 0.0092 - val\_loss: 6.3422e-05 - val\_mean\_absolute\_error: 0.0064  
Epoch 62/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1513e-04 - mean\_absolute\_error: 0.0090 27/126 [=====>........................] - ETA: 0s - loss: 1.3337e-04 - mean\_absolute\_error: 0.0089 52/126 [===========>..................] - ETA: 0s - loss: 1.4825e-04 - mean\_absolute\_error: 0.0093 77/126 [=================>............] - ETA: 0s - loss: 1.5198e-04 - mean\_absolute\_error: 0.0095102/126 [=======================>......] - ETA: 0s - loss: 1.5982e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.5304e-04 - mean\_absolute\_error: 0.0093 - val\_loss: 4.8984e-05 - val\_mean\_absolute\_error: 0.0055  
Epoch 63/100  
 1/126 [..............................] - ETA: 0s - loss: 9.8624e-05 - mean\_absolute\_error: 0.0075 27/126 [=====>........................] - ETA: 0s - loss: 1.8118e-04 - mean\_absolute\_error: 0.0100 52/126 [===========>..................] - ETA: 0s - loss: 1.7560e-04 - mean\_absolute\_error: 0.0100 78/126 [=================>............] - ETA: 0s - loss: 1.5649e-04 - mean\_absolute\_error: 0.0095104/126 [=======================>......] - ETA: 0s - loss: 1.5218e-04 - mean\_absolute\_error: 0.0093126/126 [==============================] - 0s 2ms/step - loss: 1.4702e-04 - mean\_absolute\_error: 0.0091 - val\_loss: 1.7830e-04 - val\_mean\_absolute\_error: 0.0118  
Epoch 64/100  
 1/126 [..............................] - ETA: 0s - loss: 5.2119e-04 - mean\_absolute\_error: 0.0172 23/126 [====>.........................] - ETA: 0s - loss: 1.7428e-04 - mean\_absolute\_error: 0.0094 48/126 [==========>...................] - ETA: 0s - loss: 1.6674e-04 - mean\_absolute\_error: 0.0094 74/126 [================>.............] - ETA: 0s - loss: 1.5144e-04 - mean\_absolute\_error: 0.0091 99/126 [======================>.......] - ETA: 0s - loss: 1.5266e-04 - mean\_absolute\_error: 0.0092125/126 [============================>.] - ETA: 0s - loss: 1.4678e-04 - mean\_absolute\_error: 0.0090126/126 [==============================] - 0s 2ms/step - loss: 1.4662e-04 - mean\_absolute\_error: 0.0090 - val\_loss: 6.3553e-05 - val\_mean\_absolute\_error: 0.0065  
Epoch 65/100  
 1/126 [..............................] - ETA: 0s - loss: 2.2064e-04 - mean\_absolute\_error: 0.0124 25/126 [====>.........................] - ETA: 0s - loss: 1.3893e-04 - mean\_absolute\_error: 0.0090 50/126 [==========>...................] - ETA: 0s - loss: 1.8192e-04 - mean\_absolute\_error: 0.0102 75/126 [================>.............] - ETA: 0s - loss: 1.6439e-04 - mean\_absolute\_error: 0.0096100/126 [======================>.......] - ETA: 0s - loss: 1.6655e-04 - mean\_absolute\_error: 0.0096126/126 [==============================] - ETA: 0s - loss: 1.6271e-04 - mean\_absolute\_error: 0.0095126/126 [==============================] - 0s 2ms/step - loss: 1.6271e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 6.8359e-05 - val\_mean\_absolute\_error: 0.0068  
Epoch 66/100  
 1/126 [..............................] - ETA: 0s - loss: 1.0942e-04 - mean\_absolute\_error: 0.0078 27/126 [=====>........................] - ETA: 0s - loss: 1.4414e-04 - mean\_absolute\_error: 0.0092 53/126 [===========>..................] - ETA: 0s - loss: 1.4612e-04 - mean\_absolute\_error: 0.0091 78/126 [=================>............] - ETA: 0s - loss: 1.5192e-04 - mean\_absolute\_error: 0.0093103/126 [=======================>......] - ETA: 0s - loss: 1.5564e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.6263e-04 - mean\_absolute\_error: 0.0097 - val\_loss: 1.4332e-04 - val\_mean\_absolute\_error: 0.0102  
Epoch 67/100  
 1/126 [..............................] - ETA: 0s - loss: 2.9881e-04 - mean\_absolute\_error: 0.0139 27/126 [=====>........................] - ETA: 0s - loss: 1.9034e-04 - mean\_absolute\_error: 0.0108 52/126 [===========>..................] - ETA: 0s - loss: 1.8649e-04 - mean\_absolute\_error: 0.0102 76/126 [=================>............] - ETA: 0s - loss: 2.0211e-04 - mean\_absolute\_error: 0.0108102/126 [=======================>......] - ETA: 0s - loss: 2.0259e-04 - mean\_absolute\_error: 0.0109126/126 [==============================] - 0s 2ms/step - loss: 1.9051e-04 - mean\_absolute\_error: 0.0106 - val\_loss: 1.6246e-04 - val\_mean\_absolute\_error: 0.0111  
Epoch 68/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9030e-04 - mean\_absolute\_error: 0.0113 26/126 [=====>........................] - ETA: 0s - loss: 1.4963e-04 - mean\_absolute\_error: 0.0094 51/126 [===========>..................] - ETA: 0s - loss: 1.3789e-04 - mean\_absolute\_error: 0.0089 76/126 [=================>............] - ETA: 0s - loss: 1.3677e-04 - mean\_absolute\_error: 0.0089101/126 [=======================>......] - ETA: 0s - loss: 1.3710e-04 - mean\_absolute\_error: 0.0088126/126 [==============================] - 0s 2ms/step - loss: 1.4160e-04 - mean\_absolute\_error: 0.0089 - val\_loss: 4.5493e-05 - val\_mean\_absolute\_error: 0.0051  
Epoch 69/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4080e-04 - mean\_absolute\_error: 0.0087 27/126 [=====>........................] - ETA: 0s - loss: 1.3438e-04 - mean\_absolute\_error: 0.0085 52/126 [===========>..................] - ETA: 0s - loss: 1.4620e-04 - mean\_absolute\_error: 0.0088 77/126 [=================>............] - ETA: 0s - loss: 1.4257e-04 - mean\_absolute\_error: 0.0089104/126 [=======================>......] - ETA: 0s - loss: 1.4040e-04 - mean\_absolute\_error: 0.0089126/126 [==============================] - 0s 2ms/step - loss: 1.4002e-04 - mean\_absolute\_error: 0.0088 - val\_loss: 4.8483e-05 - val\_mean\_absolute\_error: 0.0055  
Epoch 70/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5127e-04 - mean\_absolute\_error: 0.0100 27/126 [=====>........................] - ETA: 0s - loss: 1.3394e-04 - mean\_absolute\_error: 0.0091 52/126 [===========>..................] - ETA: 0s - loss: 1.3719e-04 - mean\_absolute\_error: 0.0090 77/126 [=================>............] - ETA: 0s - loss: 1.4197e-04 - mean\_absolute\_error: 0.0090103/126 [=======================>......] - ETA: 0s - loss: 1.4153e-04 - mean\_absolute\_error: 0.0090126/126 [==============================] - 0s 2ms/step - loss: 1.4725e-04 - mean\_absolute\_error: 0.0092 - val\_loss: 4.6130e-05 - val\_mean\_absolute\_error: 0.0053  
Epoch 71/100  
 1/126 [..............................] - ETA: 0s - loss: 6.6478e-05 - mean\_absolute\_error: 0.0063 27/126 [=====>........................] - ETA: 0s - loss: 2.2841e-04 - mean\_absolute\_error: 0.0116 52/126 [===========>..................] - ETA: 0s - loss: 1.9902e-04 - mean\_absolute\_error: 0.0106 77/126 [=================>............] - ETA: 0s - loss: 1.7055e-04 - mean\_absolute\_error: 0.0098101/126 [=======================>......] - ETA: 0s - loss: 1.6411e-04 - mean\_absolute\_error: 0.0097126/126 [==============================] - 0s 2ms/step - loss: 1.5964e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 4.5208e-05 - val\_mean\_absolute\_error: 0.0051  
Epoch 72/100  
 1/126 [..............................] - ETA: 0s - loss: 1.3178e-04 - mean\_absolute\_error: 0.0084 26/126 [=====>........................] - ETA: 0s - loss: 1.4304e-04 - mean\_absolute\_error: 0.0094 51/126 [===========>..................] - ETA: 0s - loss: 1.3444e-04 - mean\_absolute\_error: 0.0090 76/126 [=================>............] - ETA: 0s - loss: 1.4445e-04 - mean\_absolute\_error: 0.0091102/126 [=======================>......] - ETA: 0s - loss: 1.4159e-04 - mean\_absolute\_error: 0.0091126/126 [==============================] - 0s 2ms/step - loss: 1.4573e-04 - mean\_absolute\_error: 0.0091 - val\_loss: 8.5293e-05 - val\_mean\_absolute\_error: 0.0076  
Epoch 73/100  
 1/126 [..............................] - ETA: 0s - loss: 1.7522e-04 - mean\_absolute\_error: 0.0107 28/126 [=====>........................] - ETA: 0s - loss: 1.5494e-04 - mean\_absolute\_error: 0.0096 53/126 [===========>..................] - ETA: 0s - loss: 1.3967e-04 - mean\_absolute\_error: 0.0089 78/126 [=================>............] - ETA: 0s - loss: 1.3518e-04 - mean\_absolute\_error: 0.0088104/126 [=======================>......] - ETA: 0s - loss: 1.3424e-04 - mean\_absolute\_error: 0.0087126/126 [==============================] - 0s 2ms/step - loss: 1.4968e-04 - mean\_absolute\_error: 0.0092 - val\_loss: 1.9603e-04 - val\_mean\_absolute\_error: 0.0124  
Epoch 74/100  
 1/126 [..............................] - ETA: 0s - loss: 5.0975e-04 - mean\_absolute\_error: 0.0186 28/126 [=====>........................] - ETA: 0s - loss: 1.9695e-04 - mean\_absolute\_error: 0.0109 53/126 [===========>..................] - ETA: 0s - loss: 1.8529e-04 - mean\_absolute\_error: 0.0104 79/126 [=================>............] - ETA: 0s - loss: 1.6982e-04 - mean\_absolute\_error: 0.0100105/126 [========================>.....] - ETA: 0s - loss: 1.7092e-04 - mean\_absolute\_error: 0.0099126/126 [==============================] - 0s 2ms/step - loss: 1.6890e-04 - mean\_absolute\_error: 0.0099 - val\_loss: 5.0307e-05 - val\_mean\_absolute\_error: 0.0056  
Epoch 75/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1869e-04 - mean\_absolute\_error: 0.0091 26/126 [=====>........................] - ETA: 0s - loss: 1.4429e-04 - mean\_absolute\_error: 0.0088 52/126 [===========>..................] - ETA: 0s - loss: 1.4500e-04 - mean\_absolute\_error: 0.0088 77/126 [=================>............] - ETA: 0s - loss: 1.6373e-04 - mean\_absolute\_error: 0.0096102/126 [=======================>......] - ETA: 0s - loss: 1.6173e-04 - mean\_absolute\_error: 0.0096126/126 [==============================] - 0s 2ms/step - loss: 1.5335e-04 - mean\_absolute\_error: 0.0094 - val\_loss: 4.6065e-05 - val\_mean\_absolute\_error: 0.0053  
Epoch 76/100  
 1/126 [..............................] - ETA: 0s - loss: 8.0710e-05 - mean\_absolute\_error: 0.0073 27/126 [=====>........................] - ETA: 0s - loss: 1.4011e-04 - mean\_absolute\_error: 0.0086 52/126 [===========>..................] - ETA: 0s - loss: 1.5989e-04 - mean\_absolute\_error: 0.0093 78/126 [=================>............] - ETA: 0s - loss: 1.5049e-04 - mean\_absolute\_error: 0.0091102/126 [=======================>......] - ETA: 0s - loss: 1.4899e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - 0s 2ms/step - loss: 1.4539e-04 - mean\_absolute\_error: 0.0091 - val\_loss: 7.0409e-05 - val\_mean\_absolute\_error: 0.0069  
Epoch 77/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4659e-04 - mean\_absolute\_error: 0.0093 26/126 [=====>........................] - ETA: 0s - loss: 1.1326e-04 - mean\_absolute\_error: 0.0082 51/126 [===========>..................] - ETA: 0s - loss: 1.4417e-04 - mean\_absolute\_error: 0.0092 77/126 [=================>............] - ETA: 0s - loss: 1.4321e-04 - mean\_absolute\_error: 0.0089103/126 [=======================>......] - ETA: 0s - loss: 1.3622e-04 - mean\_absolute\_error: 0.0087126/126 [==============================] - 0s 2ms/step - loss: 1.3419e-04 - mean\_absolute\_error: 0.0087 - val\_loss: 6.0045e-05 - val\_mean\_absolute\_error: 0.0063  
Epoch 78/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6402e-04 - mean\_absolute\_error: 0.0097 27/126 [=====>........................] - ETA: 0s - loss: 1.6446e-04 - mean\_absolute\_error: 0.0093 51/126 [===========>..................] - ETA: 0s - loss: 1.5413e-04 - mean\_absolute\_error: 0.0091 73/126 [================>.............] - ETA: 0s - loss: 1.5203e-04 - mean\_absolute\_error: 0.0092 97/126 [======================>.......] - ETA: 0s - loss: 1.5347e-04 - mean\_absolute\_error: 0.0093121/126 [===========================>..] - ETA: 0s - loss: 1.4832e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - 0s 2ms/step - loss: 1.4683e-04 - mean\_absolute\_error: 0.0092 - val\_loss: 4.6429e-05 - val\_mean\_absolute\_error: 0.0053  
Epoch 79/100  
 1/126 [..............................] - ETA: 0s - loss: 1.1001e-04 - mean\_absolute\_error: 0.0084 27/126 [=====>........................] - ETA: 0s - loss: 1.4013e-04 - mean\_absolute\_error: 0.0087 52/126 [===========>..................] - ETA: 0s - loss: 1.3849e-04 - mean\_absolute\_error: 0.0088 78/126 [=================>............] - ETA: 0s - loss: 1.3874e-04 - mean\_absolute\_error: 0.0088103/126 [=======================>......] - ETA: 0s - loss: 1.4379e-04 - mean\_absolute\_error: 0.0089126/126 [==============================] - 0s 2ms/step - loss: 1.4432e-04 - mean\_absolute\_error: 0.0090 - val\_loss: 4.4813e-05 - val\_mean\_absolute\_error: 0.0052  
Epoch 80/100  
 1/126 [..............................] - ETA: 0s - loss: 9.7595e-05 - mean\_absolute\_error: 0.0077 28/126 [=====>........................] - ETA: 0s - loss: 1.3681e-04 - mean\_absolute\_error: 0.0089 54/126 [===========>..................] - ETA: 0s - loss: 1.5879e-04 - mean\_absolute\_error: 0.0092 79/126 [=================>............] - ETA: 0s - loss: 1.4877e-04 - mean\_absolute\_error: 0.0090104/126 [=======================>......] - ETA: 0s - loss: 1.3809e-04 - mean\_absolute\_error: 0.0088126/126 [==============================] - 0s 2ms/step - loss: 1.3523e-04 - mean\_absolute\_error: 0.0087 - val\_loss: 9.0966e-05 - val\_mean\_absolute\_error: 0.0079  
Epoch 81/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0630e-04 - mean\_absolute\_error: 0.0118 27/126 [=====>........................] - ETA: 0s - loss: 1.5884e-04 - mean\_absolute\_error: 0.0098 53/126 [===========>..................] - ETA: 0s - loss: 1.8530e-04 - mean\_absolute\_error: 0.0106 79/126 [=================>............] - ETA: 0s - loss: 1.6930e-04 - mean\_absolute\_error: 0.0101103/126 [=======================>......] - ETA: 0s - loss: 1.6283e-04 - mean\_absolute\_error: 0.0097126/126 [==============================] - 0s 2ms/step - loss: 1.5750e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 5.0269e-05 - val\_mean\_absolute\_error: 0.0056  
Epoch 82/100  
 1/126 [..............................] - ETA: 0s - loss: 9.6826e-05 - mean\_absolute\_error: 0.0073 26/126 [=====>........................] - ETA: 0s - loss: 1.2578e-04 - mean\_absolute\_error: 0.0086 51/126 [===========>..................] - ETA: 0s - loss: 1.2776e-04 - mean\_absolute\_error: 0.0085 76/126 [=================>............] - ETA: 0s - loss: 1.3064e-04 - mean\_absolute\_error: 0.0086102/126 [=======================>......] - ETA: 0s - loss: 1.3416e-04 - mean\_absolute\_error: 0.0086126/126 [==============================] - 0s 2ms/step - loss: 1.3393e-04 - mean\_absolute\_error: 0.0087 - val\_loss: 4.3860e-05 - val\_mean\_absolute\_error: 0.0050  
Epoch 83/100  
 1/126 [..............................] - ETA: 0s - loss: 1.5961e-04 - mean\_absolute\_error: 0.0102 27/126 [=====>........................] - ETA: 0s - loss: 1.4172e-04 - mean\_absolute\_error: 0.0087 52/126 [===========>..................] - ETA: 0s - loss: 1.4182e-04 - mean\_absolute\_error: 0.0089 78/126 [=================>............] - ETA: 0s - loss: 1.3459e-04 - mean\_absolute\_error: 0.0088103/126 [=======================>......] - ETA: 0s - loss: 1.3612e-04 - mean\_absolute\_error: 0.0089126/126 [==============================] - 0s 2ms/step - loss: 1.4473e-04 - mean\_absolute\_error: 0.0091 - val\_loss: 1.6258e-04 - val\_mean\_absolute\_error: 0.0112  
Epoch 84/100  
 1/126 [..............................] - ETA: 0s - loss: 3.5047e-04 - mean\_absolute\_error: 0.0154 26/126 [=====>........................] - ETA: 0s - loss: 2.1138e-04 - mean\_absolute\_error: 0.0104 52/126 [===========>..................] - ETA: 0s - loss: 1.6517e-04 - mean\_absolute\_error: 0.0095 75/126 [================>.............] - ETA: 0s - loss: 1.4752e-04 - mean\_absolute\_error: 0.0090100/126 [======================>.......] - ETA: 0s - loss: 1.4435e-04 - mean\_absolute\_error: 0.0090125/126 [============================>.] - ETA: 0s - loss: 1.5277e-04 - mean\_absolute\_error: 0.0093126/126 [==============================] - 0s 2ms/step - loss: 1.5242e-04 - mean\_absolute\_error: 0.0093 - val\_loss: 1.5200e-04 - val\_mean\_absolute\_error: 0.0108  
Epoch 85/100  
 1/126 [..............................] - ETA: 0s - loss: 2.0214e-04 - mean\_absolute\_error: 0.0123 27/126 [=====>........................] - ETA: 0s - loss: 1.7822e-04 - mean\_absolute\_error: 0.0102 53/126 [===========>..................] - ETA: 0s - loss: 1.5324e-04 - mean\_absolute\_error: 0.0095 79/126 [=================>............] - ETA: 0s - loss: 1.4359e-04 - mean\_absolute\_error: 0.0092104/126 [=======================>......] - ETA: 0s - loss: 1.5927e-04 - mean\_absolute\_error: 0.0097126/126 [==============================] - 0s 2ms/step - loss: 1.5512e-04 - mean\_absolute\_error: 0.0095 - val\_loss: 7.5228e-05 - val\_mean\_absolute\_error: 0.0071  
Epoch 86/100  
 1/126 [..............................] - ETA: 0s - loss: 9.5915e-05 - mean\_absolute\_error: 0.0079 28/126 [=====>........................] - ETA: 0s - loss: 1.1763e-04 - mean\_absolute\_error: 0.0081 54/126 [===========>..................] - ETA: 0s - loss: 1.5515e-04 - mean\_absolute\_error: 0.0094 80/126 [==================>...........] - ETA: 0s - loss: 1.5465e-04 - mean\_absolute\_error: 0.0093106/126 [========================>.....] - ETA: 0s - loss: 1.5020e-04 - mean\_absolute\_error: 0.0093126/126 [==============================] - 0s 2ms/step - loss: 1.4893e-04 - mean\_absolute\_error: 0.0093 - val\_loss: 4.4586e-05 - val\_mean\_absolute\_error: 0.0052  
Epoch 87/100  
 1/126 [..............................] - ETA: 0s - loss: 6.5232e-05 - mean\_absolute\_error: 0.0063 27/126 [=====>........................] - ETA: 0s - loss: 1.3877e-04 - mean\_absolute\_error: 0.0090 51/126 [===========>..................] - ETA: 0s - loss: 1.5463e-04 - mean\_absolute\_error: 0.0093 76/126 [=================>............] - ETA: 0s - loss: 1.4407e-04 - mean\_absolute\_error: 0.0090102/126 [=======================>......] - ETA: 0s - loss: 1.4041e-04 - mean\_absolute\_error: 0.0088126/126 [==============================] - 0s 2ms/step - loss: 1.3550e-04 - mean\_absolute\_error: 0.0087 - val\_loss: 7.6183e-05 - val\_mean\_absolute\_error: 0.0072  
Epoch 88/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6585e-04 - mean\_absolute\_error: 0.0102 27/126 [=====>........................] - ETA: 0s - loss: 1.4142e-04 - mean\_absolute\_error: 0.0088 52/126 [===========>..................] - ETA: 0s - loss: 1.3482e-04 - mean\_absolute\_error: 0.0087 75/126 [================>.............] - ETA: 0s - loss: 1.3447e-04 - mean\_absolute\_error: 0.0088100/126 [======================>.......] - ETA: 0s - loss: 1.3724e-04 - mean\_absolute\_error: 0.0089125/126 [============================>.] - ETA: 0s - loss: 1.3987e-04 - mean\_absolute\_error: 0.0090126/126 [==============================] - 0s 2ms/step - loss: 1.3982e-04 - mean\_absolute\_error: 0.0090 - val\_loss: 1.3029e-04 - val\_mean\_absolute\_error: 0.0099  
Epoch 89/100  
 1/126 [..............................] - ETA: 0s - loss: 3.7111e-04 - mean\_absolute\_error: 0.0161 26/126 [=====>........................] - ETA: 0s - loss: 1.7067e-04 - mean\_absolute\_error: 0.0101 50/126 [==========>...................] - ETA: 0s - loss: 1.6163e-04 - mean\_absolute\_error: 0.0098 76/126 [=================>............] - ETA: 0s - loss: 1.7386e-04 - mean\_absolute\_error: 0.0100101/126 [=======================>......] - ETA: 0s - loss: 1.6051e-04 - mean\_absolute\_error: 0.0096126/126 [==============================] - ETA: 0s - loss: 1.5371e-04 - mean\_absolute\_error: 0.0094126/126 [==============================] - 0s 2ms/step - loss: 1.5371e-04 - mean\_absolute\_error: 0.0094 - val\_loss: 5.4783e-05 - val\_mean\_absolute\_error: 0.0060  
Epoch 90/100  
 1/126 [..............................] - ETA: 0s - loss: 1.2590e-04 - mean\_absolute\_error: 0.0082 27/126 [=====>........................] - ETA: 0s - loss: 1.1682e-04 - mean\_absolute\_error: 0.0084 52/126 [===========>..................] - ETA: 0s - loss: 1.2005e-04 - mean\_absolute\_error: 0.0084 78/126 [=================>............] - ETA: 0s - loss: 1.3407e-04 - mean\_absolute\_error: 0.0087103/126 [=======================>......] - ETA: 0s - loss: 1.3243e-04 - mean\_absolute\_error: 0.0086126/126 [==============================] - 0s 2ms/step - loss: 1.3787e-04 - mean\_absolute\_error: 0.0088 - val\_loss: 9.6457e-05 - val\_mean\_absolute\_error: 0.0082  
Epoch 91/100  
 1/126 [..............................] - ETA: 0s - loss: 1.9202e-04 - mean\_absolute\_error: 0.0119 27/126 [=====>........................] - ETA: 0s - loss: 1.5866e-04 - mean\_absolute\_error: 0.0092 52/126 [===========>..................] - ETA: 0s - loss: 1.3856e-04 - mean\_absolute\_error: 0.0089 77/126 [=================>............] - ETA: 0s - loss: 1.3054e-04 - mean\_absolute\_error: 0.0086102/126 [=======================>......] - ETA: 0s - loss: 1.3366e-04 - mean\_absolute\_error: 0.0086126/126 [==============================] - ETA: 0s - loss: 1.3745e-04 - mean\_absolute\_error: 0.0088126/126 [==============================] - 0s 2ms/step - loss: 1.3745e-04 - mean\_absolute\_error: 0.0088 - val\_loss: 5.2311e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 92/100  
 1/126 [..............................] - ETA: 0s - loss: 1.8936e-04 - mean\_absolute\_error: 0.0106 26/126 [=====>........................] - ETA: 0s - loss: 1.4561e-04 - mean\_absolute\_error: 0.0093 51/126 [===========>..................] - ETA: 0s - loss: 1.5333e-04 - mean\_absolute\_error: 0.0090 76/126 [=================>............] - ETA: 0s - loss: 1.4702e-04 - mean\_absolute\_error: 0.0090100/126 [======================>.......] - ETA: 0s - loss: 1.4923e-04 - mean\_absolute\_error: 0.0092125/126 [============================>.] - ETA: 0s - loss: 1.4317e-04 - mean\_absolute\_error: 0.0091126/126 [==============================] - 0s 2ms/step - loss: 1.4292e-04 - mean\_absolute\_error: 0.0091 - val\_loss: 4.4935e-05 - val\_mean\_absolute\_error: 0.0052  
Epoch 93/100  
 1/126 [..............................] - ETA: 0s - loss: 1.4107e-04 - mean\_absolute\_error: 0.0093 26/126 [=====>........................] - ETA: 0s - loss: 1.0965e-04 - mean\_absolute\_error: 0.0081 52/126 [===========>..................] - ETA: 0s - loss: 1.4674e-04 - mean\_absolute\_error: 0.0090 78/126 [=================>............] - ETA: 0s - loss: 1.4033e-04 - mean\_absolute\_error: 0.0090104/126 [=======================>......] - ETA: 0s - loss: 1.4101e-04 - mean\_absolute\_error: 0.0091126/126 [==============================] - 0s 2ms/step - loss: 1.4875e-04 - mean\_absolute\_error: 0.0092 - val\_loss: 1.9515e-04 - val\_mean\_absolute\_error: 0.0125  
Epoch 94/100  
 1/126 [..............................] - ETA: 0s - loss: 3.7454e-04 - mean\_absolute\_error: 0.0171 27/126 [=====>........................] - ETA: 0s - loss: 1.5376e-04 - mean\_absolute\_error: 0.0092 52/126 [===========>..................] - ETA: 0s - loss: 1.4456e-04 - mean\_absolute\_error: 0.0090 77/126 [=================>............] - ETA: 0s - loss: 1.4462e-04 - mean\_absolute\_error: 0.0092103/126 [=======================>......] - ETA: 0s - loss: 1.4312e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - 0s 2ms/step - loss: 1.3968e-04 - mean\_absolute\_error: 0.0089 - val\_loss: 4.3641e-05 - val\_mean\_absolute\_error: 0.0051  
Epoch 95/100  
 1/126 [..............................] - ETA: 0s - loss: 9.8860e-05 - mean\_absolute\_error: 0.0081 26/126 [=====>........................] - ETA: 0s - loss: 1.4445e-04 - mean\_absolute\_error: 0.0087 51/126 [===========>..................] - ETA: 0s - loss: 1.3669e-04 - mean\_absolute\_error: 0.0087 77/126 [=================>............] - ETA: 0s - loss: 1.3830e-04 - mean\_absolute\_error: 0.0087102/126 [=======================>......] - ETA: 0s - loss: 1.2969e-04 - mean\_absolute\_error: 0.0085126/126 [==============================] - 0s 2ms/step - loss: 1.3633e-04 - mean\_absolute\_error: 0.0088 - val\_loss: 8.2658e-05 - val\_mean\_absolute\_error: 0.0076  
Epoch 96/100  
 1/126 [..............................] - ETA: 0s - loss: 1.6761e-04 - mean\_absolute\_error: 0.0101 27/126 [=====>........................] - ETA: 0s - loss: 1.5902e-04 - mean\_absolute\_error: 0.0097 52/126 [===========>..................] - ETA: 0s - loss: 1.6548e-04 - mean\_absolute\_error: 0.0099 77/126 [=================>............] - ETA: 0s - loss: 1.5997e-04 - mean\_absolute\_error: 0.0095103/126 [=======================>......] - ETA: 0s - loss: 1.4909e-04 - mean\_absolute\_error: 0.0092126/126 [==============================] - 0s 2ms/step - loss: 1.4879e-04 - mean\_absolute\_error: 0.0093 - val\_loss: 5.2880e-05 - val\_mean\_absolute\_error: 0.0058  
Epoch 97/100  
 1/126 [..............................] - ETA: 0s - loss: 1.7314e-04 - mean\_absolute\_error: 0.0111 25/126 [====>.........................] - ETA: 0s - loss: 1.0947e-04 - mean\_absolute\_error: 0.0080 50/126 [==========>...................] - ETA: 0s - loss: 1.4228e-04 - mean\_absolute\_error: 0.0090 75/126 [================>.............] - ETA: 0s - loss: 1.3188e-04 - mean\_absolute\_error: 0.0087101/126 [=======================>......] - ETA: 0s - loss: 1.2563e-04 - mean\_absolute\_error: 0.0085125/126 [============================>.] - ETA: 0s - loss: 1.3193e-04 - mean\_absolute\_error: 0.0087126/126 [==============================] - 0s 2ms/step - loss: 1.3288e-04 - mean\_absolute\_error: 0.0087 - val\_loss: 6.0370e-05 - val\_mean\_absolute\_error: 0.0063  
Epoch 98/100  
 1/126 [..............................] - ETA: 0s - loss: 9.1066e-05 - mean\_absolute\_error: 0.0074 26/126 [=====>........................] - ETA: 0s - loss: 1.2267e-04 - mean\_absolute\_error: 0.0084 52/126 [===========>..................] - ETA: 0s - loss: 1.2460e-04 - mean\_absolute\_error: 0.0085 78/126 [=================>............] - ETA: 0s - loss: 1.2754e-04 - mean\_absolute\_error: 0.0087103/126 [=======================>......] - ETA: 0s - loss: 1.3128e-04 - mean\_absolute\_error: 0.0088126/126 [==============================] - 0s 2ms/step - loss: 1.3152e-04 - mean\_absolute\_error: 0.0086 - val\_loss: 5.6312e-05 - val\_mean\_absolute\_error: 0.0061  
Epoch 99/100  
 1/126 [..............................] - ETA: 0s - loss: 8.2819e-05 - mean\_absolute\_error: 0.0076 27/126 [=====>........................] - ETA: 0s - loss: 1.4388e-04 - mean\_absolute\_error: 0.0087 52/126 [===========>..................] - ETA: 0s - loss: 1.3608e-04 - mean\_absolute\_error: 0.0087 77/126 [=================>............] - ETA: 0s - loss: 1.2949e-04 - mean\_absolute\_error: 0.0086102/126 [=======================>......] - ETA: 0s - loss: 1.3859e-04 - mean\_absolute\_error: 0.0089126/126 [==============================] - 0s 2ms/step - loss: 1.3889e-04 - mean\_absolute\_error: 0.0089 - val\_loss: 4.2460e-05 - val\_mean\_absolute\_error: 0.0050  
Epoch 100/100  
 1/126 [..............................] - ETA: 0s - loss: 8.4130e-05 - mean\_absolute\_error: 0.0076 27/126 [=====>........................] - ETA: 0s - loss: 1.3873e-04 - mean\_absolute\_error: 0.0088 52/126 [===========>..................] - ETA: 0s - loss: 1.2313e-04 - mean\_absolute\_error: 0.0084 77/126 [=================>............] - ETA: 0s - loss: 1.2227e-04 - mean\_absolute\_error: 0.0084103/126 [=======================>......] - ETA: 0s - loss: 1.3151e-04 - mean\_absolute\_error: 0.0088126/126 [==============================] - 0s 2ms/step - loss: 1.4165e-04 - mean\_absolute\_error: 0.0090 - val\_loss: 4.2463e-05 - val\_mean\_absolute\_error: 0.0050

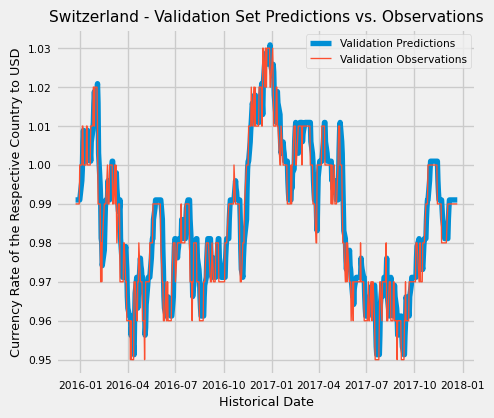
<keras.src.callbacks.History at 0x267e0418490>

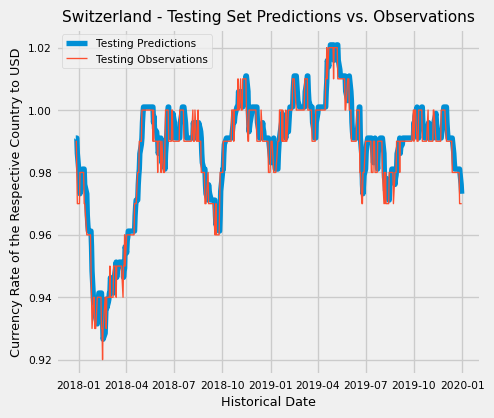
After the training and fitting of the Machine Learning model for Switzerland, I tried to create visualizations comparing the model against the country’s training dataset, validation dataset, but most importantly the testing dataset (as shown below in the line graphs). Note that the darker and thicker blue lines represent the prediction model’s projections and the thinner red lines is the observed/gathered data.

```{python}  
# Testing the Machine Learning Model prediction for Switzerland with the train,   
# validation, and test sets  
# Most important is the test set prediction as this tests the effectiveness  
# of the Machine Learning model on data it has not seen before   
switzerland\_train\_pred = switzerland\_model.predict(X\_switzerland\_train).flatten()  
  
plt.plot(dates\_switzerland\_train, switzerland\_train\_pred, linewidth=4)  
plt.plot(dates\_switzerland\_train, y\_switzerland\_train, linewidth=1)  
plt.legend(["Training Predictions", "Training Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Switzerland - Training Set Predictions vs. Observations")  
plt.show()  
  
switzerland\_val\_pred = switzerland\_model.predict(X\_switzerland\_val).flatten()  
  
plt.plot(dates\_switzerland\_val, switzerland\_val\_pred, linewidth=4)  
plt.plot(dates\_switzerland\_val, y\_switzerland\_val, linewidth=1)  
plt.legend(["Validation Predictions", "Validation Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Switzerland - Validation Set Predictions vs. Observations")  
plt.show()  
  
switzerland\_test\_pred = switzerland\_model.predict(X\_switzerland\_test).flatten()  
  
plt.plot(dates\_switzerland\_test, switzerland\_test\_pred, linewidth=4)  
plt.plot(dates\_switzerland\_test, y\_switzerland\_test, linewidth=1)  
plt.legend(["Testing Predictions", "Testing Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Switzerland - Testing Set Predictions vs. Observations")  
plt.show()  
```

1/126 [..............................] - ETA: 41s 47/126 [==========>...................] - ETA: 0s 96/126 [=====================>........] - ETA: 0s126/126 [==============================] - 0s 1ms/step  
 1/16 [>.............................] - ETA: 0s16/16 [==============================] - 0s 1ms/step  
 1/16 [>.............................] - ETA: 0s16/16 [==============================] - 0s 1ms/step

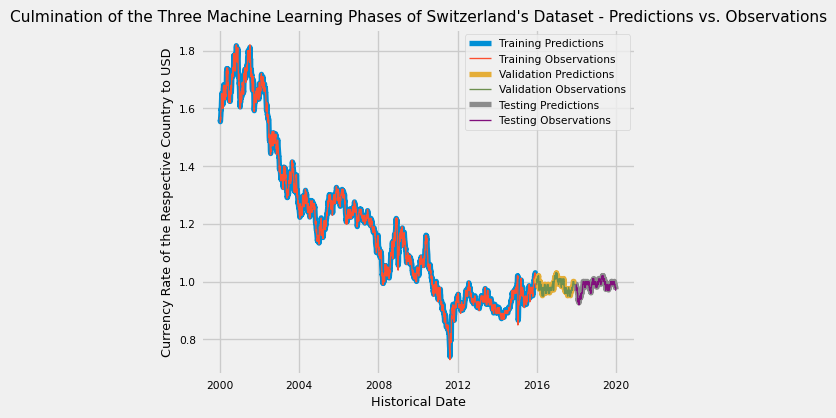






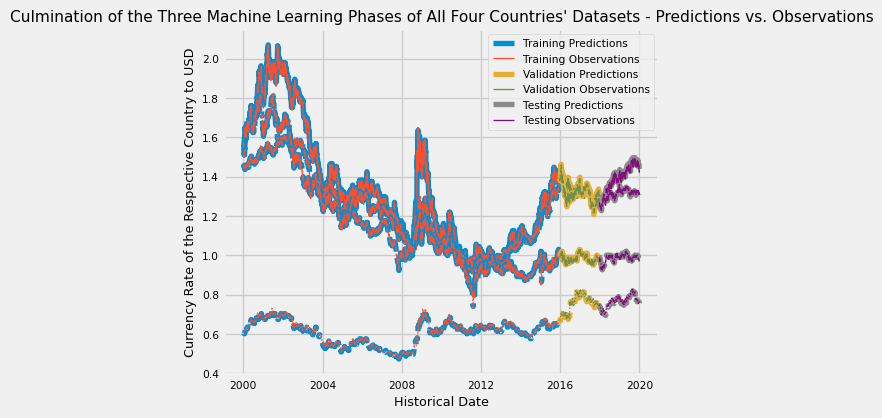
Through careful consideration of all of the prediction-based vs. observation-based contrast visualizations together, I consolidated all of graphics into one singular visualization for you to see below to get a more general perspective of the effectiveness of the Machine Learning model at training and fitting towards predicting Switzerland’s international currency rate with the United States.

```{python}  
# Plotting Switzerland's observational (reference) data with the predictions   
# of its Machine Learning Model (as a way to visually inspect the effectiveness   
# of the model)   
plt.plot(dates\_switzerland\_train, switzerland\_train\_pred, linewidth=4)  
plt.plot(dates\_switzerland\_train, y\_switzerland\_train, linewidth=1)  
plt.plot(dates\_switzerland\_val, switzerland\_val\_pred, linewidth=4)  
plt.plot(dates\_switzerland\_val, y\_switzerland\_val, linewidth=1)  
plt.plot(dates\_switzerland\_test, switzerland\_test\_pred, linewidth=4)  
plt.plot(dates\_switzerland\_test, y\_switzerland\_test, linewidth=1)  
  
plt.legend(["Training Predictions",  
 "Training Observations",  
 "Validation Predictions",  
 "Validation Observations",  
 "Testing Predictions",  
 "Testing Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Culmination of the Three Machine Learning Phases of Switzerland's Dataset - Predictions vs. Observations")  
plt.show()  
```



To put it all together, I made one large visualization to encompass all 4 countries’ Machine Learning model prediction-based vs. observation-based visualizations - Austrailia, Canada, the United Kingdom, and Switzerland as shown below.

```{python}  
# Plotting all countries' observational (reference) data with the predictions   
# of its Machine Learning Model (as a way to visually inspect the effectiveness   
# of the model in an overall sense)   
plt.plot(dates\_austrailia\_train, austrailia\_train\_pred, linewidth=4, linestyle="solid")  
plt.plot(dates\_austrailia\_train, y\_austrailia\_train, linewidth=1, linestyle="solid")  
plt.plot(dates\_austrailia\_val, austrailia\_val\_pred, linewidth=4, linestyle="solid")  
plt.plot(dates\_austrailia\_val, y\_austrailia\_val, linewidth=1, linestyle="solid")  
plt.plot(dates\_austrailia\_test, austrailia\_test\_pred, linewidth=4, linestyle="solid")  
plt.plot(dates\_austrailia\_test, y\_austrailia\_test, linewidth=1, linestyle="solid")  
  
plt.plot(dates\_canada\_train, canada\_train\_pred, linewidth=4, linestyle="dashed")  
plt.plot(dates\_canada\_train, y\_canada\_train, linewidth=1, linestyle="dashed")  
plt.plot(dates\_canada\_val, canada\_val\_pred, linewidth=4, linestyle="dashed")  
plt.plot(dates\_canada\_val, y\_canada\_val, linewidth=1, linestyle="dashed")  
plt.plot(dates\_canada\_test, canada\_test\_pred, linewidth=4, linestyle="dashed")  
plt.plot(dates\_canada\_test, y\_canada\_test, linewidth=1, linestyle="dashed")  
  
plt.plot(dates\_united\_kingdom\_train, united\_kingdom\_train\_pred, linewidth=4, linestyle="dotted")  
plt.plot(dates\_united\_kingdom\_train, y\_united\_kingdom\_train, linewidth=1, linestyle="dotted")  
plt.plot(dates\_united\_kingdom\_val, united\_kingdom\_val\_pred, linewidth=4, linestyle="dotted")  
plt.plot(dates\_united\_kingdom\_val, y\_united\_kingdom\_val, linewidth=1, linestyle="dotted")  
plt.plot(dates\_united\_kingdom\_test, united\_kingdom\_test\_pred, linewidth=4, linestyle="dotted")  
plt.plot(dates\_united\_kingdom\_test, y\_united\_kingdom\_test, linewidth=1, linestyle="dotted")  
  
plt.plot(dates\_switzerland\_train, switzerland\_train\_pred, linewidth=4, linestyle="dashdot")  
plt.plot(dates\_switzerland\_train, y\_switzerland\_train, linewidth=1, linestyle="dashdot")  
plt.plot(dates\_switzerland\_val, switzerland\_val\_pred, linewidth=4, linestyle="dashdot")  
plt.plot(dates\_switzerland\_val, y\_switzerland\_val, linewidth=1, linestyle="dashdot")  
plt.plot(dates\_switzerland\_test, switzerland\_test\_pred, linewidth=4, linestyle="dashdot")  
plt.plot(dates\_switzerland\_test, y\_switzerland\_test, linewidth=1, linestyle="dashdot")  
  
plt.legend(["Training Predictions",  
 "Training Observations",  
 "Validation Predictions",  
 "Validation Observations",  
 "Testing Predictions",  
 "Testing Observations"])  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Culmination of the Three Machine Learning Phases of All Four Countries' Datasets - Predictions vs. Observations")  
plt.show()  
```



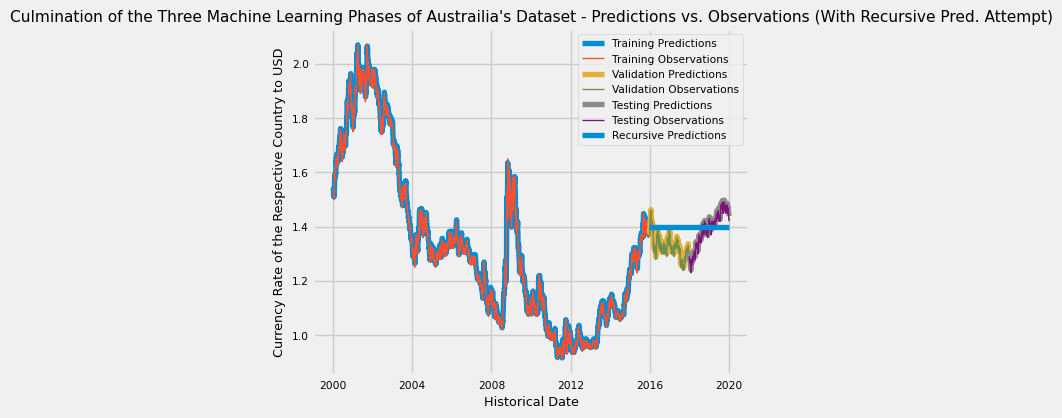
Ultimately, here is the moment of truth: I tried to recursively predict Austrailia’s future expected projection on its international currency rate between the United States through using my LSTM prediction model as shown below. By using the data from the training dataset for Austrailia, I tried to contrast the effectiveness of the model by constrasting its projection to the actual validation and testing data results. However, unfortunately, it did not predict as well as I hoped, but this was a good experiment, nonetheless.

```{python}  
# Attempt at using the model to predict into the future for Austrailia's currency   
# rate  
recursive\_pred: list = []  
recursive\_dates = np.concatenate([dates\_austrailia\_val, dates\_austrailia\_test])  
  
for target\_date in recursive\_dates:  
 last\_window = deepcopy(X\_austrailia\_train[-1])  
 next\_pred = austrailia\_model.predict(np.array([last\_window])).flatten()  
 recursive\_pred.append(next\_pred)  
 last\_window[-1] = next\_pred  
```

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To visualize the results of my recursive prediction that I completed, I added these results to the previous large visualization that encompassed all 4 countries’ Machine Learning model prediction-based vs. observation-based visualizations - Austrailia, Canada, the United Kingdom, and Switzerland as shown below.

```{python}  
# Plotting all countries' observational (reference) data with the predictions   
# of its Machine Learning Model (as a way to visually inspect the effectiveness   
# of the model in an overall sense) along with the new recursive prediction  
# results  
plt.plot(dates\_austrailia\_train, austrailia\_train\_pred, linewidth=4, linestyle="solid")  
plt.plot(dates\_austrailia\_train, y\_austrailia\_train, linewidth=1, linestyle="solid")  
plt.plot(dates\_austrailia\_val, austrailia\_val\_pred, linewidth=4, linestyle="solid")  
plt.plot(dates\_austrailia\_val, y\_austrailia\_val, linewidth=1, linestyle="solid")  
plt.plot(dates\_austrailia\_test, austrailia\_test\_pred, linewidth=4, linestyle="solid")  
plt.plot(dates\_austrailia\_test, y\_austrailia\_test, linewidth=1, linestyle="solid")  
plt.plot(recursive\_dates, recursive\_pred, linewidth=4, linestyle="solid")  
  
plt.legend(["Training Predictions",  
 "Training Observations",  
 "Validation Predictions",  
 "Validation Observations",  
 "Testing Predictions",  
 "Testing Observations",  
 "Recursive Predictions"], loc="upper right")  
plt.rcParams["font.size"] = 8  
plt.tight\_layout()  
plt.xlabel("Historical Date")  
plt.ylabel("Currency Rate of the Respective Country to USD")  
plt.title("Culmination of the Three Machine Learning Phases of Austrailia's Dataset - Predictions vs. Observations (With Recursive Pred. Attempt)")  
plt.show()  
```



## Conclusions

* Returning to my attempt to test the ability for my Machine Learning model to predict the International Currency rates for Austrailia from just the range of my training dataset as shown above, I felt that its prediction was acceptable in my opinion giving the averaging across the currency rate values in my validation and testing datasets would have proven to be considerably close in its precision.
* Thus, I reached the conclusion that my International Currency Predictor would not be a viable Machine Learning model for any real-life applications. This Machine Learning model raised a valuable point - financial market prediction is a difficult endeavor to accurately predict. From a more general point of view, this International Currency Maching Learning prediction model is not totally inaccurate or untrustworthy but rather it is only on the micro-scale. These financial predictions do not always account for current events in that respective country such as changing domestic or international relations or constantly changing socioeconomic trends which could significantly sway market confidence and impact currency rate fluctuation. Consequently, economists often have to look at larger economic trends across several decades in order to make more educated predictions.
* Ultimately, I learned a great deal about the complexities of financial prediction and usage of Machine Learning models as an attempt to solve this issue. Even though my model was not as successful at predicting as I would have hoped, I am interested to see the future of Machine Learning as it soon dominates these economic sub-field and continues to rise in its relevance by being a pivotal talking point for the future and applied soon enough to other sectors of our society.

## Reference Sources and Citations (IEEE Format)

To complete this blog post, I used the following online sources as references for developing this:

[1] US International Exchange Rates Dataset:

* B. Ferreira, “Foreign Exchange Rates 2000-2019”, 2019. [Online]. Available: https://www.kaggle.com/datasets/brunotly/foreign-exchange-rates-per-dollar-20002019. [Accessed: 04-Sep.-2023].

[2] Tutorial on Basics of LSTM and Prediction & Forecasting in Machine Learning:

* G. Hogg, “Stock Price Prediction & Forecasting with LSTM Neural Networks in Python”, *YouTube*, 26-Mar.-2022. [Online.] Available: https://www.youtube.com/watch?v=CbTU92pbDKw. [Accessed: 06-Sep.-2023].