```python
# En cas de problème pour importer tensoflow depuis un jupyter
notebook:
# https://jakevdp.github.io/blog/2017/12/05/installing-python-
packages-from-jupyter/

import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np

from sklearn.pipeline import Pipeline
from sklearn.compose import ColumnTransformer
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import MinMaxScaler, OneHotEncoder
from sklearn.metrics import mean_squared_error, mean_absolute_error

from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Input
from tensorflow.keras.callbacks import EarlyStopping, ModelCheckpoint
```

Exploration du dataset

```python
df = pd.read_csv("./winequality.csv")

df
```

{"summary":"{\n \"name\": \"df\",\n \"rows\": 6497,\n \"fields\":
[\n   {\n   \"column\": \"type\",\n   \"properties\": {\n
\"dtype\": \"category\",\n   \"num_unique_values\": 2,\n
\"samples\": [\n   \"red\",\n   \"white\"\n   ],\n
\"semantic_type\": \"\",\n   \"description\": \"\"\n   }\
n   },\n   {\n   \"column\": \"fixed acidity\",\n
\"properties\": {\n   \"dtype\": \"number\",\n   \"std\":
1.296749856526477,\n   \"min\": 3.8,\n   \"max\": 15.9,\n
\"num_unique_values\": 106,\n   \"samples\": [\n   14.3,\n
6.5\n   ],\n   \"semantic_type\": \"\",\n
\"description\": \"\"\n   }\n   },\n   {\n   \"column\":
\"volatile acidity\",\n   \"properties\": {\n   \"dtype\":
\"number\",\n   \"std\": 0.16464902864429282,\n   \"min\":
0.08,\n   \"max\": 1.58,\n   \"num_unique_values\": 187,\n
\"samples\": [\n   0.895,\n   0.655\n   ],\n
\"semantic_type\": \"\",\n   \"description\": \"\"\n   }\
n   },\n   {\n   \"column\": \"citric acid\",\n
\"properties\": {\n   \"dtype\": \"number\",\n   \"std\":
0.14526480053397792,\n   \"min\": 0.0,\n   \"max\": 1.66,\n
\"num_unique_values\": 89,\n   \"samples\": [\n   0.45,\n
0.51\n   ],\n   \"semantic_type\": \"\",\n
\"description\": \"\"\n   }\n   },\n   {\n   \"column\":
\"residual sugar\",\n   \"properties\": {\n   \"dtype\":
```

\"number\",\n        \"std\": 4.7581247426727105,\n        \"min\": 0.6,\n        \"max\": 65.8,\n        \"num_unique_values\": 316,\n        \"samples\": [\n          14.7,\n          4.9\n        ],\n        \"semantic_type\": \"\",\n        \"description\": \"\"\n      }\n    },\n    {\n      \"column\": \"chlorides\",\n      \"properties\": {\n        \"dtype\": \"number\",\n        \"std\": 0.03503602522758981,\n        \"min\": 0.009,\n        \"max\": 0.611,\n        \"num_unique_values\": 214,\n        \"samples\": [\n          0.046,\n          0.387\n        ],\n        \"semantic_type\": \"\",\n        \"description\": \"\"\n      }\n    },\n    {\n      \"column\": \"free sulfur dioxide\",\n      \"properties\": {\n        \"dtype\": \"number\",\n        \"std\": 17.7493997720025,\n        \"min\": 1.0,\n        \"max\": 289.0,\n        \"num_unique_values\": 135,\n        \"samples\": [\n          146.5,\n          64.5\n        ],\n        \"semantic_type\": \"\",\n        \"description\": \"\"\n      }\n    },\n    {\n      \"column\": \"total sulfur dioxide\",\n      \"properties\": {\n        \"dtype\": \"number\",\n        \"std\": 56.52185452263028,\n        \"min\": 6.0,\n        \"max\": 440.0,\n        \"num_unique_values\": 276,\n        \"samples\": [\n          158.0,\n          194.0\n        ],\n        \"semantic_type\": \"\",\n        \"description\": \"\"\n      }\n    },\n    {\n      \"column\": \"density\",\n      \"properties\": {\n        \"dtype\": \"number\",\n        \"std\": 0.002998673003719039,\n        \"min\": 0.98711,\n        \"max\": 1.03898,\n        \"num_unique_values\": 998,\n        \"samples\": [\n          0.99144,\n          0.99734\n        ],\n        \"semantic_type\": \"\",\n        \"description\": \"\"\n      }\n    },\n    {\n      \"column\": \"pH\",\n      \"properties\": {\n        \"dtype\": \"number\",\n        \"std\": 0.1607483065508832,\n        \"min\": 2.72,\n        \"max\": 4.01,\n        \"num_unique_values\": 108,\n        \"samples\": [\n          2.74,\n          3.25\n        ],\n        \"semantic_type\": \"\",\n        \"description\": \"\"\n      }\n    },\n    {\n      \"column\": \"sulphates\",\n      \"properties\": {\n        \"dtype\": \"number\",\n        \"std\": 0.14881412131628377,\n        \"min\": 0.22,\n        \"max\": 2.0,\n        \"num_unique_values\": 111,\n        \"samples\": [\n          1.08,\n          0.55\n        ],\n        \"semantic_type\": \"\",\n        \"description\": \"\"\n      }\n    },\n    {\n      \"column\": \"alcohol\",\n      \"properties\": {\n        \"dtype\": \"number\",\n        \"std\": 1.192711748868981,\n        \"min\": 8.0,\n        \"max\": 14.9,\n        \"num_unique_values\": 111,\n        \"samples\": [\n          12.33333333,\n          11.4\n        ],\n        \"semantic_type\": \"\",\n        \"description\": \"\"\n      }\n    },\n    {\n      \"column\": \"quality\",\n      \"properties\": {\n        \"dtype\": \"number\",\n        \"std\": 0,\n        \"min\": 3,\n        \"max\": 9,\n        \"num_unique_values\": 7,\n        \"samples\": [\n          6,\n          5\n        ],\n        \"semantic_type\": \"\",\n        \"description\": \"\"\n      }\n    }\n  ]\n}","type":"dataframe","variable_name":"df"}

```python
df["type"].value_counts()
```

```
type
white    4898
red      1599
Name: count, dtype: int64
```

```python
df["quality"].value_counts()
```

```
quality
6    2836
5    2138
7    1079
4     216
8     193
3      30
9       5
Name: count, dtype: int64
```

```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6497 entries, 0 to 6496
Data columns (total 13 columns):
 #   Column                Non-Null Count  Dtype
---  ------                --------------  -----
 0   type                  6497 non-null   object
 1   fixed acidity         6487 non-null   float64
 2   volatile acidity      6489 non-null   float64
 3   citric acid           6494 non-null   float64
 4   residual sugar        6495 non-null   float64
 5   chlorides             6495 non-null   float64
 6   free sulfur dioxide   6497 non-null   float64
 7   total sulfur dioxide  6497 non-null   float64
 8   density               6497 non-null   float64
 9   pH                    6488 non-null   float64
 10  sulphates             6493 non-null   float64
 11  alcohol               6497 non-null   float64
 12  quality               6497 non-null   int64
dtypes: float64(11), int64(1), object(1)
memory usage: 660.0+ KB
```

```python
target = "quality"
X = df.drop(target, axis=1)
y = df[target]

X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2)
X_train, X_val, y_train, y_val = train_test_split(X_train, y_train,
test_size=0.25)

print(X_train.shape)
print(X_test.shape)
```

```
print(X_val.shape)
print(y_train.shape)
print(y_test.shape)
print(y_val.shape)

(3897, 12)
(1300, 12)
(1300, 12)
(3897,)
(1300,)
(1300,)

X_train.to_csv("./X_train.csv")
X_val.to_csv("./X_val.csv")
X_test.to_csv("./X_test.csv")
y_train.to_csv("./y_train.csv")
y_val.to_csv("./y_val.csv")
y_test.to_csv("./y_test.csv")

# On normalise les valeurs cibles pour aider le modèle.
# Il faudra choisir pour la couche de sortie la fonction d'activation
sigmoïde
y_train = y_train/10
y_val = y_val/10
y_test = y_test/10
```

Traitement des variables

```
numeric_cols = list(X_train.columns[1:])
numeric_pipeline = Pipeline(steps = [
    ("imputation", SimpleImputer(strategy="mean")),
    ("normalisation", MinMaxScaler()),
])

categorical_cols = ["type"]
categorical_pipeline = Pipeline(steps = [
    ("encodage", OneHotEncoder(drop = "first"))
])

preprocessor = ColumnTransformer(transformers = [
    ("numeric", numeric_pipeline, numeric_cols),
    ("categorical", categorical_pipeline, categorical_cols),
], )

X_train_clean = preprocessor.fit_transform(X_train)
X_val_clean = preprocessor.transform(X_val)
X_test_clean = preprocessor.transform(X_test)

pd.DataFrame(X_train_clean, columns=numeric_cols +
["white"]).to_csv("./X_train_clean.csv")
pd.DataFrame(X_val_clean, columns=numeric_cols +
```

```
["white"]).to_csv("./X_val_clean.csv")
pd.DataFrame(X_test_clean, columns=numeric_cols +
["white"]).to_csv("./X_test_clean.csv")

def plot_history(history):
    fig, axes = plt.subplots(1,2, figsize=(15,6))
    hist_data = history.history
    hist_data["epochs"] = list(range(1, len(history.history["loss"])
+1))

    hist_data = pd.DataFrame(hist_data)
    sns.lineplot(data=hist_data, x="epochs", y="loss", ax=axes[0],
color = "blue")
    sns.lineplot(data=hist_data, x="epochs", y="val_loss", ax=axes[0],
color = "orange")

    sns.lineplot(data=hist_data, x="epochs", y="mae", ax=axes[1],
color = "blue")
    sns.lineplot(data=hist_data, x="epochs", y="val_mae", ax=axes[1],
color = "orange")
```

Création du modèle

```
input_dim = X_train.shape[1]
input_dim
```

```
12
```

Sans fonction

```
model = Sequential()

model.add(Dense(5, input_dim=input_dim, activation="relu"))
model.add(Dense(10, activation="relu"))
model.add(Dense(10, activation="relu"))
```

```
/usr/local/lib/python3.10/dist-packages/keras/src/layers/core/
dense.py:87: UserWarning: Do not pass an `input_shape`/`input_dim`
argument to a layer. When using Sequential models, prefer using an
`Input(shape)` object as the first layer in the model instead.
  super().__init__(activity_regularizer=activity_regularizer,
**kwargs)
```

```
model.add(Dense(1, activation="sigmoid",name="output_layer"))
```

```
model.compile(optimizer = 'rmsprop', loss = "mse", metrics = ["mae",
"mse"])
```

```
model.summary()
```

```
Model: "sequential"
```

```
┌─────────────────────────────────┬─────────────────────────────┐
│ Layer (type)                     │ Output Shape                │
│ Param #                          │                             │
├─────────────────────────────────┼─────────────────────────────┤
│ dense (Dense)                    │ (None, 5)                   │
│ 65                               │                             │
├─────────────────────────────────┼─────────────────────────────┤
│ dense_1 (Dense)                  │ (None, 10)                  │
│ 60                               │                             │
├─────────────────────────────────┼─────────────────────────────┤
│ dense_2 (Dense)                  │ (None, 10)                  │
│ 110                              │                             │
├─────────────────────────────────┼─────────────────────────────┤
│ output_layer (Dense)             │ (None, 1)                   │
│ 11                               │                             │
└─────────────────────────────────┴─────────────────────────────┘

 Total params: 246 (984.00 B)

 Trainable params: 246 (984.00 B)

 Non-trainable params: 0 (0.00 B)

nb_epochs = 500
```

Entraînement

```
history = model.fit(X_train_clean, y_train, epochs=nb_epochs,
validation_data=(X_val_clean, y_val))

Epoch 1/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 3s 4ms/step - loss: 0.0092 - mae: 0.0761
- mse: 0.0092 - val_loss: 0.0069 - val_mae: 0.0631 - val_mse: 0.0069
Epoch 2/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0062 - mae: 0.0606
- mse: 0.0062 - val_loss: 0.0063 - val_mae: 0.0607 - val_mse: 0.0063
Epoch 3/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0057 - mae: 0.0583
- mse: 0.0057 - val_loss: 0.0061 - val_mae: 0.0603 - val_mse: 0.0061
Epoch 4/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0053 - mae: 0.0560
- mse: 0.0053 - val_loss: 0.0061 - val_mae: 0.0596 - val_mse: 0.0061
Epoch 5/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0053 - mae: 0.0561
- mse: 0.0053 - val_loss: 0.0060 - val_mae: 0.0592 - val_mse: 0.0060
```

```
Epoch 6/500
122/122 ──────────────────── 1s 6ms/step - loss: 0.0053 - mae: 0.0565
- mse: 0.0053 - val_loss: 0.0060 - val_mae: 0.0595 - val_mse: 0.0060
Epoch 7/500
122/122 ──────────────────── 2s 9ms/step - loss: 0.0055 - mae: 0.0576
- mse: 0.0055 - val_loss: 0.0060 - val_mae: 0.0589 - val_mse: 0.0060
Epoch 8/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0052 - mae: 0.0556
- mse: 0.0052 - val_loss: 0.0060 - val_mae: 0.0597 - val_mse: 0.0060
Epoch 9/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0053 - mae: 0.0565
- mse: 0.0053 - val_loss: 0.0060 - val_mae: 0.0594 - val_mse: 0.0060
Epoch 10/500
122/122 ──────────────────── 1s 6ms/step - loss: 0.0053 - mae: 0.0563
- mse: 0.0053 - val_loss: 0.0059 - val_mae: 0.0589 - val_mse: 0.0059
Epoch 11/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0052 - mae: 0.0555
- mse: 0.0052 - val_loss: 0.0060 - val_mae: 0.0587 - val_mse: 0.0060
Epoch 12/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0051 - mae: 0.0551
- mse: 0.0051 - val_loss: 0.0059 - val_mae: 0.0587 - val_mse: 0.0059
Epoch 13/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0052 - mae: 0.0553
- mse: 0.0052 - val_loss: 0.0058 - val_mae: 0.0585 - val_mse: 0.0058
Epoch 14/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0055 - mae: 0.0569
- mse: 0.0055 - val_loss: 0.0060 - val_mae: 0.0597 - val_mse: 0.0060
Epoch 15/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0054 - mae: 0.0566
- mse: 0.0054 - val_loss: 0.0058 - val_mae: 0.0586 - val_mse: 0.0058
Epoch 16/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0052 - mae: 0.0559
- mse: 0.0052 - val_loss: 0.0059 - val_mae: 0.0583 - val_mse: 0.0059
Epoch 17/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0052 - mae: 0.0557
- mse: 0.0052 - val_loss: 0.0058 - val_mae: 0.0583 - val_mse: 0.0058
Epoch 18/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0058 - val_mae: 0.0583 - val_mse: 0.0058
Epoch 19/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0051 - mae: 0.0550
- mse: 0.0051 - val_loss: 0.0058 - val_mae: 0.0582 - val_mse: 0.0058
Epoch 20/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0054 - mae: 0.0571
- mse: 0.0054 - val_loss: 0.0058 - val_mae: 0.0581 - val_mse: 0.0058
Epoch 21/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0052 - mae: 0.0560
- mse: 0.0052 - val_loss: 0.0059 - val_mae: 0.0583 - val_mse: 0.0059
Epoch 22/500
```

```
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0051 - mae: 0.0550
- mse: 0.0051 - val_loss: 0.0059 - val_mae: 0.0584 - val_mse: 0.0059
Epoch 23/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0052 - mae: 0.0555
- mse: 0.0052 - val_loss: 0.0058 - val_mae: 0.0582 - val_mse: 0.0058
Epoch 24/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0053 - mae: 0.0557
- mse: 0.0053 - val_loss: 0.0058 - val_mae: 0.0581 - val_mse: 0.0058
Epoch 25/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0053 - mae: 0.0559
- mse: 0.0053 - val_loss: 0.0057 - val_mae: 0.0580 - val_mse: 0.0057
Epoch 26/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0058 - val_mae: 0.0587 - val_mse: 0.0058
Epoch 27/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0053 - mae: 0.0562
- mse: 0.0053 - val_loss: 0.0058 - val_mae: 0.0586 - val_mse: 0.0058
Epoch 28/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0052 - mae: 0.0552
- mse: 0.0052 - val_loss: 0.0058 - val_mae: 0.0586 - val_mse: 0.0058
Epoch 29/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0052 - mae: 0.0559
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0580 - val_mse: 0.0057
Epoch 30/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0053 - mae: 0.0561
- mse: 0.0053 - val_loss: 0.0057 - val_mae: 0.0579 - val_mse: 0.0057
Epoch 31/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0050 - mae: 0.0547
- mse: 0.0050 - val_loss: 0.0057 - val_mae: 0.0580 - val_mse: 0.0057
Epoch 32/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0052 - mae: 0.0558
- mse: 0.0052 - val_loss: 0.0058 - val_mae: 0.0589 - val_mse: 0.0058
Epoch 33/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0052 - mae: 0.0557
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0581 - val_mse: 0.0057
Epoch 34/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0053 - mae: 0.0562
- mse: 0.0053 - val_loss: 0.0058 - val_mae: 0.0591 - val_mse: 0.0058
Epoch 35/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0580 - val_mse: 0.0057
Epoch 36/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0052 - mae: 0.0554
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0580 - val_mse: 0.0057
Epoch 37/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0050 - mae: 0.0545
- mse: 0.0050 - val_loss: 0.0058 - val_mae: 0.0589 - val_mse: 0.0058
Epoch 38/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0053 - mae: 0.0562
```

```
- mse: 0.0053 - val_loss: 0.0059 - val_mae: 0.0597 - val_mse: 0.0059
Epoch 39/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0054 - mae: 0.0566
- mse: 0.0054 - val_loss: 0.0057 - val_mae: 0.0579 - val_mse: 0.0057
Epoch 40/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0051 - mae: 0.0547
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0581 - val_mse: 0.0057
Epoch 41/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0053 - mae: 0.0564
- mse: 0.0053 - val_loss: 0.0057 - val_mae: 0.0580 - val_mse: 0.0057
Epoch 42/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0051 - mae: 0.0550
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0579 - val_mse: 0.0057
Epoch 43/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0051 - mae: 0.0556
- mse: 0.0051 - val_loss: 0.0058 - val_mae: 0.0589 - val_mse: 0.0058
Epoch 44/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0057 - val_mae: 0.0581 - val_mse: 0.0057
Epoch 45/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0051 - mae: 0.0548
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0583 - val_mse: 0.0057
Epoch 46/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0052 - mae: 0.0551
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0584 - val_mse: 0.0057
Epoch 47/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0052 - mae: 0.0559
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0583 - val_mse: 0.0057
Epoch 48/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0053 - mae: 0.0565
- mse: 0.0053 - val_loss: 0.0057 - val_mae: 0.0580 - val_mse: 0.0057
Epoch 49/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0051 - mae: 0.0561
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0581 - val_mse: 0.0057
Epoch 50/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0053 - mae: 0.0565
- mse: 0.0053 - val_loss: 0.0057 - val_mae: 0.0581 - val_mse: 0.0057
Epoch 51/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0548
- mse: 0.0050 - val_loss: 0.0057 - val_mae: 0.0585 - val_mse: 0.0057
Epoch 52/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0055 - mae: 0.0573
- mse: 0.0055 - val_loss: 0.0057 - val_mae: 0.0586 - val_mse: 0.0057
Epoch 53/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0053 - mae: 0.0562
- mse: 0.0053 - val_loss: 0.0058 - val_mae: 0.0589 - val_mse: 0.0058
Epoch 54/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0052 - mae: 0.0556
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0581 - val_mse: 0.0057
```

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Epoch 55/500
122/122 ———————————— 1s 3ms/step - loss: 0.0051 - mae: 0.0553
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0583 - val_mse: 0.0057
Epoch 56/500
122/122 ———————————— 0s 3ms/step - loss: 0.0051 - mae: 0.0552
- mse: 0.0051 - val_loss: 0.0058 - val_mae: 0.0588 - val_mse: 0.0058
Epoch 57/500
122/122 ———————————— 1s 2ms/step - loss: 0.0051 - mae: 0.0555
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0583 - val_mse: 0.0057
Epoch 58/500
122/122 ———————————— 0s 2ms/step - loss: 0.0052 - mae: 0.0558
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0582 - val_mse: 0.0057
Epoch 59/500
122/122 ———————————— 0s 2ms/step - loss: 0.0053 - mae: 0.0563
- mse: 0.0053 - val_loss: 0.0057 - val_mae: 0.0581 - val_mse: 0.0057
Epoch 60/500
122/122 ———————————— 1s 4ms/step - loss: 0.0051 - mae: 0.0552
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0581 - val_mse: 0.0057
Epoch 61/500
122/122 ———————————— 1s 4ms/step - loss: 0.0054 - mae: 0.0566
- mse: 0.0054 - val_loss: 0.0057 - val_mae: 0.0586 - val_mse: 0.0057
Epoch 62/500
122/122 ———————————— 1s 4ms/step - loss: 0.0048 - mae: 0.0543
- mse: 0.0048 - val_loss: 0.0057 - val_mae: 0.0582 - val_mse: 0.0057
Epoch 63/500
122/122 ———————————— 1s 4ms/step - loss: 0.0051 - mae: 0.0554
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0580 - val_mse: 0.0057
Epoch 64/500
122/122 ———————————— 1s 4ms/step - loss: 0.0051 - mae: 0.0554
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0585 - val_mse: 0.0057
Epoch 65/500
122/122 ———————————— 1s 4ms/step - loss: 0.0052 - mae: 0.0559
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0582 - val_mse: 0.0057
Epoch 66/500
122/122 ———————————— 0s 2ms/step - loss: 0.0052 - mae: 0.0562
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0582 - val_mse: 0.0057
Epoch 67/500
122/122 ———————————— 1s 2ms/step - loss: 0.0051 - mae: 0.0557
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0582 - val_mse: 0.0057
Epoch 68/500
122/122 ———————————— 0s 2ms/step - loss: 0.0051 - mae: 0.0551
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0583 - val_mse: 0.0057
Epoch 69/500
122/122 ———————————— 0s 2ms/step - loss: 0.0052 - mae: 0.0556
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0589 - val_mse: 0.0057
Epoch 70/500
122/122 ———————————— 0s 2ms/step - loss: 0.0052 - mae: 0.0555
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0584 - val_mse: 0.0057
Epoch 71/500
```

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122/122 ───────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0058 - val_mae: 0.0591 - val_mse: 0.0058
Epoch 72/500
122/122 ───────────────────── 1s 2ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0058 - val_mae: 0.0585 - val_mse: 0.0058
Epoch 73/500
122/122 ───────────────────── 1s 2ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0585 - val_mse: 0.0057
Epoch 74/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0559
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0583 - val_mse: 0.0057
Epoch 75/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 76/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0557
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0583 - val_mse: 0.0057
Epoch 77/500
122/122 ───────────────────── 1s 2ms/step - loss: 0.0051 - mae: 0.0554
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0582 - val_mse: 0.0057
Epoch 78/500
122/122 ───────────────────── 1s 2ms/step - loss: 0.0051 - mae: 0.0553
- mse: 0.0051 - val_loss: 0.0058 - val_mae: 0.0586 - val_mse: 0.0058
Epoch 79/500
122/122 ───────────────────── 0s 2ms/step - loss: 0.0049 - mae: 0.0542
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 80/500
122/122 ───────────────────── 1s 6ms/step - loss: 0.0052 - mae: 0.0562
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0582 - val_mse: 0.0057
Epoch 81/500
122/122 ───────────────────── 1s 5ms/step - loss: 0.0051 - mae: 0.0560
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0586 - val_mse: 0.0057
Epoch 82/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0555
- mse: 0.0050 - val_loss: 0.0057 - val_mae: 0.0587 - val_mse: 0.0057
Epoch 83/500
122/122 ───────────────────── 1s 5ms/step - loss: 0.0052 - mae: 0.0554
- mse: 0.0052 - val_loss: 0.0058 - val_mae: 0.0593 - val_mse: 0.0058
Epoch 84/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0585 - val_mse: 0.0057
Epoch 85/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0053 - mae: 0.0561
- mse: 0.0053 - val_loss: 0.0057 - val_mae: 0.0582 - val_mse: 0.0057
Epoch 86/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0587 - val_mse: 0.0057
Epoch 87/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0563
```

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- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0586 - val_mse: 0.0057
Epoch 88/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0562
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 89/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0053 - mae: 0.0564
- mse: 0.0053 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 90/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0052 - mae: 0.0562
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 91/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0053 - mae: 0.0563
- mse: 0.0053 - val_loss: 0.0057 - val_mae: 0.0587 - val_mse: 0.0057
Epoch 92/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0553
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 93/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0053 - mae: 0.0567
- mse: 0.0053 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 94/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0054 - mae: 0.0569
- mse: 0.0054 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 95/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0051 - mae: 0.0558
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 96/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0049 - mae: 0.0552
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0583 - val_mse: 0.0057
Epoch 97/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0055 - mae: 0.0577
- mse: 0.0055 - val_loss: 0.0057 - val_mae: 0.0587 - val_mse: 0.0057
Epoch 98/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0048 - mae: 0.0546
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 99/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0552
- mse: 0.0049 - val_loss: 0.0058 - val_mae: 0.0586 - val_mse: 0.0058
Epoch 100/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0052 - mae: 0.0558
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0589 - val_mse: 0.0057
Epoch 101/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0051 - mae: 0.0553
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 102/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0051 - mae: 0.0557
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 103/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0053 - mae: 0.0562
- mse: 0.0053 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
```

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Epoch 104/500
122/122 ──────────────── 1s 2ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 105/500
122/122 ──────────────── 1s 4ms/step - loss: 0.0048 - mae: 0.0545
- mse: 0.0048 - val_loss: 0.0060 - val_mae: 0.0607 - val_mse: 0.0060
Epoch 106/500
122/122 ──────────────── 1s 4ms/step - loss: 0.0051 - mae: 0.0557
- mse: 0.0051 - val_loss: 0.0059 - val_mae: 0.0599 - val_mse: 0.0059
Epoch 107/500
122/122 ──────────────── 1s 4ms/step - loss: 0.0051 - mae: 0.0561
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 108/500
122/122 ──────────────── 1s 5ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0059 - val_mae: 0.0599 - val_mse: 0.0059
Epoch 109/500
122/122 ──────────────── 1s 6ms/step - loss: 0.0051 - mae: 0.0554
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 110/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 111/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0058 - val_mae: 0.0596 - val_mse: 0.0058
Epoch 112/500
122/122 ──────────────── 0s 2ms/step - loss: 0.0050 - mae: 0.0555
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 113/500
122/122 ──────────────── 0s 2ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0589 - val_mse: 0.0057
Epoch 114/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0559
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 115/500
122/122 ──────────────── 0s 2ms/step - loss: 0.0048 - mae: 0.0542
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 116/500
122/122 ──────────────── 0s 3ms/step - loss: 0.0051 - mae: 0.0559
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0583 - val_mse: 0.0057
Epoch 117/500
122/122 ──────────────── 1s 2ms/step - loss: 0.0052 - mae: 0.0559
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 118/500
122/122 ──────────────── 0s 2ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 119/500
122/122 ──────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 120/500
```

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122/122 ──────────────── 0s 2ms/step - loss: 0.0052 - mae: 0.0555
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 121/500
122/122 ──────────────── 1s 2ms/step - loss: 0.0050 - mae: 0.0556
- mse: 0.0050 - val_loss: 0.0057 - val_mae: 0.0586 - val_mse: 0.0057
Epoch 122/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0555
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 123/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0550
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 124/500
122/122 ──────────────── 1s 4ms/step - loss: 0.0050 - mae: 0.0553
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 125/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0560
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 126/500
122/122 ──────────────── 0s 3ms/step - loss: 0.0051 - mae: 0.0556
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 127/500
122/122 ──────────────── 1s 2ms/step - loss: 0.0050 - mae: 0.0555
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 128/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0547
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 129/500
122/122 ──────────────── 1s 5ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 130/500
122/122 ──────────────── 1s 5ms/step - loss: 0.0053 - mae: 0.0565
- mse: 0.0053 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 131/500
122/122 ──────────────── 1s 5ms/step - loss: 0.0053 - mae: 0.0562
- mse: 0.0053 - val_loss: 0.0057 - val_mae: 0.0589 - val_mse: 0.0057
Epoch 132/500
122/122 ──────────────── 1s 2ms/step - loss: 0.0052 - mae: 0.0557
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 133/500
122/122 ──────────────── 0s 2ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 134/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0561
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0587 - val_mse: 0.0057
Epoch 135/500
122/122 ──────────────── 0s 2ms/step - loss: 0.0050 - mae: 0.0546
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0586 - val_mse: 0.0056
Epoch 136/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0563
```

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- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 137/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0559
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0588 - val_mse: 0.0057
Epoch 138/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 139/500
122/122 ──────────────────────── 1s 5ms/step - loss: 0.0047 - mae: 0.0539
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 140/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0556
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 141/500
122/122 ──────────────────────── 1s 2ms/step - loss: 0.0051 - mae: 0.0552
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0589 - val_mse: 0.0057
Epoch 142/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 143/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 144/500
122/122 ──────────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 145/500
122/122 ──────────────────────── 1s 2ms/step - loss: 0.0048 - mae: 0.0550
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 146/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0555
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0587 - val_mse: 0.0057
Epoch 147/500
122/122 ──────────────────────── 1s 4ms/step - loss: 0.0051 - mae: 0.0560
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0588 - val_mse: 0.0057
Epoch 148/500
122/122 ──────────────────────── 1s 4ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 149/500
122/122 ──────────────────────── 1s 5ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 150/500
122/122 ──────────────────────── 1s 4ms/step - loss: 0.0050 - mae: 0.0553
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 151/500
122/122 ──────────────────────── 1s 5ms/step - loss: 0.0050 - mae: 0.0553
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 152/500
122/122 ──────────────────────── 1s 5ms/step - loss: 0.0050 - mae: 0.0548
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
```

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Epoch 153/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0554
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0588 - val_mse: 0.0057
Epoch 154/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0561
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 155/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0553
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 156/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 157/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0560
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 158/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0053 - mae: 0.0566
- mse: 0.0053 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 159/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0050 - mae: 0.0546
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 160/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0057 - val_mae: 0.0583 - val_mse: 0.0057
Epoch 161/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0051 - mae: 0.0558
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 162/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 163/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0557
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 164/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0050 - mae: 0.0547
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 165/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0047 - mae: 0.0537
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 166/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0048 - mae: 0.0546
- mse: 0.0048 - val_loss: 0.0057 - val_mae: 0.0590 - val_mse: 0.0057
Epoch 167/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 168/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0050 - mae: 0.0553
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 169/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0047 - mae: 0.0537
```

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- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 170/500
122/122 ───────────────────── 1s 2ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 171/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0047 - mae: 0.0539
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 172/500
122/122 ───────────────────── 1s 5ms/step - loss: 0.0051 - mae: 0.0554
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 173/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0048 - mae: 0.0541
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 174/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0048 - mae: 0.0540
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0586 - val_mse: 0.0056
Epoch 175/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0048 - mae: 0.0541
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0586 - val_mse: 0.0056
Epoch 176/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0048 - mae: 0.0543
- mse: 0.0048 - val_loss: 0.0057 - val_mae: 0.0590 - val_mse: 0.0057
Epoch 177/500
122/122 ───────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0057 - val_mae: 0.0591 - val_mse: 0.0057
Epoch 178/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0557
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0586 - val_mse: 0.0057
Epoch 179/500
122/122 ───────────────────── 1s 2ms/step - loss: 0.0053 - mae: 0.0563
- mse: 0.0053 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 180/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0557
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0584 - val_mse: 0.0057
Epoch 181/500
122/122 ───────────────────── 0s 3ms/step - loss: 0.0052 - mae: 0.0559
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 182/500
122/122 ───────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0546
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 183/500
122/122 ───────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0057 - val_mae: 0.0591 - val_mse: 0.0057
Epoch 184/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0556
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 185/500
122/122 ───────────────────── 1s 2ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0057 - val_mae: 0.0590 - val_mse: 0.0057
```

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Epoch 186/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0053 - mae: 0.0568
- mse: 0.0053 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 187/500
122/122 ──────────────────────── 1s 2ms/step - loss: 0.0049 - mae: 0.0541
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 188/500
122/122 ──────────────────────── 0s 2ms/step - loss: 0.0049 - mae: 0.0544
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 189/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0552
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 190/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0555
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 191/500
122/122 ──────────────────────── 0s 3ms/step - loss: 0.0051 - mae: 0.0560
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0578 - val_mse: 0.0055
Epoch 192/500
122/122 ──────────────────────── 0s 3ms/step - loss: 0.0051 - mae: 0.0554
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0578 - val_mse: 0.0056
Epoch 193/500
122/122 ──────────────────────── 1s 2ms/step - loss: 0.0051 - mae: 0.0557
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0589 - val_mse: 0.0057
Epoch 194/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0589 - val_mse: 0.0057
Epoch 195/500
122/122 ──────────────────────── 1s 5ms/step - loss: 0.0051 - mae: 0.0556
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 196/500
122/122 ──────────────────────── 1s 4ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 197/500
122/122 ──────────────────────── 1s 4ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 198/500
122/122 ──────────────────────── 1s 4ms/step - loss: 0.0051 - mae: 0.0559
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 199/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0053 - mae: 0.0562
- mse: 0.0053 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 200/500
122/122 ──────────────────────── 0s 3ms/step - loss: 0.0051 - mae: 0.0552
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 201/500
122/122 ──────────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 202/500
```

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122/122 ———————————————— 1s 3ms/step - loss: 0.0049 - mae: 0.0544
- mse: 0.0049 - val_loss: 0.0058 - val_mae: 0.0600 - val_mse: 0.0058
Epoch 203/500
122/122 ———————————————— 1s 2ms/step - loss: 0.0053 - mae: 0.0565
- mse: 0.0053 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 204/500
122/122 ———————————————— 0s 2ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0585 - val_mse: 0.0057
Epoch 205/500
122/122 ———————————————— 0s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0584 - val_mse: 0.0057
Epoch 206/500
122/122 ———————————————— 1s 2ms/step - loss: 0.0051 - mae: 0.0558
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 207/500
122/122 ———————————————— 0s 2ms/step - loss: 0.0051 - mae: 0.0557
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 208/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 209/500
122/122 ———————————————— 0s 3ms/step - loss: 0.0052 - mae: 0.0557
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 210/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0052 - mae: 0.0556
- mse: 0.0052 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 211/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0051 - mae: 0.0556
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 212/500
122/122 ———————————————— 0s 2ms/step - loss: 0.0054 - mae: 0.0568
- mse: 0.0054 - val_loss: 0.0057 - val_mae: 0.0591 - val_mse: 0.0057
Epoch 213/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0051 - mae: 0.0552
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 214/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 215/500
122/122 ———————————————— 1s 2ms/step - loss: 0.0050 - mae: 0.0554
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 216/500
122/122 ———————————————— 0s 2ms/step - loss: 0.0048 - mae: 0.0548
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 217/500
122/122 ———————————————— 1s 2ms/step - loss: 0.0052 - mae: 0.0561
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 218/500
122/122 ———————————————— 0s 2ms/step - loss: 0.0048 - mae: 0.0536
```

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- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 219/500
122/122 ———————————————— 1s 4ms/step - loss: 0.0051 - mae: 0.0560
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 220/500
122/122 ———————————————— 1s 4ms/step - loss: 0.0048 - mae: 0.0543
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 221/500
122/122 ———————————————— 0s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 222/500
122/122 ———————————————— 1s 4ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 223/500
122/122 ———————————————— 1s 5ms/step - loss: 0.0051 - mae: 0.0564
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 224/500
122/122 ———————————————— 1s 4ms/step - loss: 0.0048 - mae: 0.0544
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 225/500
122/122 ———————————————— 0s 2ms/step - loss: 0.0048 - mae: 0.0545
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0588 - val_mse: 0.0056
Epoch 226/500
122/122 ———————————————— 0s 3ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0578 - val_mse: 0.0056
Epoch 227/500
122/122 ———————————————— 0s 2ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 228/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0048 - mae: 0.0543
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0578 - val_mse: 0.0055
Epoch 229/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 230/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 231/500
122/122 ———————————————— 0s 3ms/step - loss: 0.0051 - mae: 0.0554
- mse: 0.0051 - val_loss: 0.0057 - val_mae: 0.0590 - val_mse: 0.0057
Epoch 232/500
122/122 ———————————————— 1s 2ms/step - loss: 0.0050 - mae: 0.0545
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 233/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 234/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0050 - mae: 0.0543
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
```

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Epoch 235/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0051 - mae: 0.0552
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 236/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0049 - mae: 0.0543
- mse: 0.0049 - val_loss: 0.0058 - val_mae: 0.0597 - val_mse: 0.0058
Epoch 237/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0049 - mae: 0.0544
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0590 - val_mse: 0.0057
Epoch 238/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0049 - mae: 0.0551
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 239/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0577 - val_mse: 0.0056
Epoch 240/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0051 - mae: 0.0553
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 241/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0054 - mae: 0.0572
- mse: 0.0054 - val_loss: 0.0056 - val_mae: 0.0588 - val_mse: 0.0056
Epoch 242/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0050 - mae: 0.0546
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 243/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 244/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0050 - mae: 0.0547
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 245/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0047 - mae: 0.0533
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 246/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 247/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0051 - mae: 0.0554
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 248/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 249/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 250/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0050 - mae: 0.0553
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 251/500
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122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 252/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0556
- mse: 0.0052 - val_loss: 0.0057 - val_mae: 0.0591 - val_mse: 0.0057
Epoch 253/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0053 - mae: 0.0564
- mse: 0.0053 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 254/500
122/122 ──────────────────── 0s 4ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 255/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 256/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 257/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 258/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0550
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 259/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0550
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 260/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0548
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 261/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0051 - mae: 0.0547
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0578 - val_mse: 0.0056
Epoch 262/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0048 - mae: 0.0537
- mse: 0.0048 - val_loss: 0.0057 - val_mae: 0.0593 - val_mse: 0.0057
Epoch 263/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0050 - mae: 0.0555
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 264/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 265/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0552
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 266/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 267/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0547
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- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 268/500
122/122 ──────────────────── 1s 6ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0059 - val_mae: 0.0601 - val_mse: 0.0059
Epoch 269/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 270/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 271/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 272/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0548
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 273/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0578 - val_mse: 0.0055
Epoch 274/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0051 - mae: 0.0549
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0586 - val_mse: 0.0056
Epoch 275/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0052 - mae: 0.0563
- mse: 0.0052 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 276/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0048 - mae: 0.0543
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 277/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 278/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0052 - mae: 0.0561
- mse: 0.0052 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 279/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0553
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 280/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0050 - mae: 0.0555
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 281/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0557
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0577 - val_mse: 0.0055
Epoch 282/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0048 - mae: 0.0545
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 283/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0578 - val_mse: 0.0055
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Epoch 284/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0051 - mae: 0.0553
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 285/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0583 - val_mse: 0.0055
Epoch 286/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0551
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 287/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 288/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0048 - mae: 0.0542
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0578 - val_mse: 0.0055
Epoch 289/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0050 - mae: 0.0553
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0578 - val_mse: 0.0055
Epoch 290/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0049 - mae: 0.0543
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 291/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0050 - mae: 0.0555
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0578 - val_mse: 0.0055
Epoch 292/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0051 - mae: 0.0548
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0589 - val_mse: 0.0056
Epoch 293/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0047 - mae: 0.0536
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 294/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 295/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0543
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 296/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 297/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0578 - val_mse: 0.0055
Epoch 298/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0546
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0583 - val_mse: 0.0055
Epoch 299/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0551
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 300/500
```

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122/122 ─────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 301/500
122/122 ─────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0544
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 302/500
122/122 ─────────────────── 1s 3ms/step - loss: 0.0048 - mae: 0.0545
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 303/500
122/122 ─────────────────── 0s 3ms/step - loss: 0.0048 - mae: 0.0546
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 304/500
122/122 ─────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 305/500
122/122 ─────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0553
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 306/500
122/122 ─────────────────── 0s 2ms/step - loss: 0.0051 - mae: 0.0557
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 307/500
122/122 ─────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0556
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 308/500
122/122 ─────────────────── 0s 3ms/step - loss: 0.0051 - mae: 0.0556
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0588 - val_mse: 0.0056
Epoch 309/500
122/122 ─────────────────── 0s 3ms/step - loss: 0.0047 - mae: 0.0543
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 310/500
122/122 ─────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 311/500
122/122 ─────────────────── 1s 4ms/step - loss: 0.0048 - mae: 0.0546
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 312/500
122/122 ─────────────────── 1s 4ms/step - loss: 0.0048 - mae: 0.0541
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 313/500
122/122 ─────────────────── 1s 4ms/step - loss: 0.0048 - mae: 0.0549
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 314/500
122/122 ─────────────────── 1s 4ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 315/500
122/122 ─────────────────── 1s 5ms/step - loss: 0.0047 - mae: 0.0533
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 316/500
122/122 ─────────────────── 0s 4ms/step - loss: 0.0048 - mae: 0.0546
```

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- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 317/500
122/122 ———————————————— 1s 4ms/step - loss: 0.0048 - mae: 0.0549
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 318/500
122/122 ———————————————— 0s 3ms/step - loss: 0.0048 - mae: 0.0541
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 319/500
122/122 ———————————————— 1s 2ms/step - loss: 0.0048 - mae: 0.0546
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 320/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 321/500
122/122 ———————————————— 0s 3ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 322/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 323/500
122/122 ———————————————— 0s 3ms/step - loss: 0.0049 - mae: 0.0544
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 324/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0047 - mae: 0.0540
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 325/500
122/122 ———————————————— 0s 3ms/step - loss: 0.0048 - mae: 0.0539
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 326/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0050 - mae: 0.0556
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 327/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0049 - mae: 0.0552
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 328/500
122/122 ———————————————— 0s 3ms/step - loss: 0.0048 - mae: 0.0545
- mse: 0.0048 - val_loss: 0.0057 - val_mae: 0.0592 - val_mse: 0.0057
Epoch 329/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 330/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0046 - mae: 0.0531
- mse: 0.0046 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 331/500
122/122 ———————————————— 1s 3ms/step - loss: 0.0049 - mae: 0.0551
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 332/500
122/122 ———————————————— 0s 3ms/step - loss: 0.0051 - mae: 0.0557
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
```

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Epoch 333/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0586 - val_mse: 0.0056
Epoch 334/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0550
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 335/500
122/122 ──────────────────── 0s 4ms/step - loss: 0.0049 - mae: 0.0550
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 336/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0049 - mae: 0.0552
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 337/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 338/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0047 - mae: 0.0537
- mse: 0.0047 - val_loss: 0.0057 - val_mae: 0.0594 - val_mse: 0.0057
Epoch 339/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 340/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0049 - mae: 0.0550
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 341/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0047 - mae: 0.0534
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 342/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0557
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 343/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0051 - mae: 0.0559
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 344/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 345/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0560
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 346/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0584 - val_mse: 0.0055
Epoch 347/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0559
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 348/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0048 - mae: 0.0539
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 349/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0048 - mae: 0.0545
```

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- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 350/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0048 - mae: 0.0543
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 351/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0583 - val_mse: 0.0055
Epoch 352/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0050 - mae: 0.0554
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0578 - val_mse: 0.0055
Epoch 353/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0048 - mae: 0.0541
- mse: 0.0048 - val_loss: 0.0057 - val_mae: 0.0587 - val_mse: 0.0057
Epoch 354/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0050 - mae: 0.0557
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 355/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0584 - val_mse: 0.0055
Epoch 356/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0050 - mae: 0.0556
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 357/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0048 - mae: 0.0549
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0584 - val_mse: 0.0055
Epoch 358/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 359/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 360/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0046 - mae: 0.0534
- mse: 0.0046 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 361/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0048 - mae: 0.0543
- mse: 0.0048 - val_loss: 0.0057 - val_mae: 0.0595 - val_mse: 0.0057
Epoch 362/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0048 - mae: 0.0542
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 363/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0050 - mae: 0.0553
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 364/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 365/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0047 - mae: 0.0539
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
```

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Epoch 366/500
122/122 ──────────────────── 0s 2ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0590 - val_mse: 0.0056
Epoch 367/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0551
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0584 - val_mse: 0.0055
Epoch 368/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0556
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 369/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0592 - val_mse: 0.0057
Epoch 370/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0557
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 371/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0550
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 372/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0048 - mae: 0.0544
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0588 - val_mse: 0.0056
Epoch 373/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0584 - val_mse: 0.0055
Epoch 374/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0048 - mae: 0.0541
- mse: 0.0048 - val_loss: 0.0057 - val_mae: 0.0593 - val_mse: 0.0057
Epoch 375/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 376/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0583 - val_mse: 0.0055
Epoch 377/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 378/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0048 - mae: 0.0546
- mse: 0.0048 - val_loss: 0.0057 - val_mae: 0.0586 - val_mse: 0.0057
Epoch 379/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0049 - mae: 0.0551
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 380/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0049 - mae: 0.0552
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 381/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0049 - mae: 0.0554
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0589 - val_mse: 0.0056
Epoch 382/500
```

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122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0048 - mae: 0.0543
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 383/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0592 - val_mse: 0.0057
Epoch 384/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0050 - mae: 0.0555
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0590 - val_mse: 0.0056
Epoch 385/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0047 - mae: 0.0543
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 386/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0047 - mae: 0.0533
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 387/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0047 - mae: 0.0541
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 388/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0052 - mae: 0.0566
- mse: 0.0052 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 389/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0048 - mae: 0.0539
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 390/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0047 - mae: 0.0539
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 391/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0050 - mae: 0.0554
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 392/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 393/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0050 - mae: 0.0546
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 394/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 395/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0048 - mae: 0.0545
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 396/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0049 - mae: 0.0544
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 397/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0048 - mae: 0.0547
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 398/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0048 - mae: 0.0541
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- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 399/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0047 - mae: 0.0536
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0589 - val_mse: 0.0056
Epoch 400/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0048 - mae: 0.0547
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 401/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0590 - val_mse: 0.0056
Epoch 402/500
122/122 ──────────────────── 1s 6ms/step - loss: 0.0048 - mae: 0.0540
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 403/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0583 - val_mse: 0.0055
Epoch 404/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 405/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0047 - mae: 0.0540
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 406/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0049 - mae: 0.0543
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 407/500
122/122 ──────────────────── 1s 2ms/step - loss: 0.0048 - mae: 0.0544
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0586 - val_mse: 0.0056
Epoch 408/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 409/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0584 - val_mse: 0.0055
Epoch 410/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0051 - mae: 0.0559
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 411/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 412/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 413/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 414/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
```

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Epoch 415/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0584 - val_mse: 0.0055
Epoch 416/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0589 - val_mse: 0.0056
Epoch 417/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0046 - mae: 0.0534
- mse: 0.0046 - val_loss: 0.0056 - val_mae: 0.0591 - val_mse: 0.0056
Epoch 418/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0048 - mae: 0.0545
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 419/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0584 - val_mse: 0.0056
Epoch 420/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0047 - mae: 0.0540
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 421/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0048 - mae: 0.0547
- mse: 0.0048 - val_loss: 0.0057 - val_mae: 0.0592 - val_mse: 0.0057
Epoch 422/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0048 - mae: 0.0541
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 423/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0047 - mae: 0.0535
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 424/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0048 - mae: 0.0541
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 425/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0050 - mae: 0.0555
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0588 - val_mse: 0.0056
Epoch 426/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0047 - mae: 0.0535
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 427/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0048 - mae: 0.0542
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 428/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 429/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0050 - mae: 0.0549
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0584 - val_mse: 0.0055
Epoch 430/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0048 - mae: 0.0546
- mse: 0.0048 - val_loss: 0.0058 - val_mae: 0.0589 - val_mse: 0.0058
Epoch 431/500
```

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122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0051 - mae: 0.0554
- mse: 0.0051 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 432/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 433/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0050 - mae: 0.0554
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0584 - val_mse: 0.0055
Epoch 434/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0047 - mae: 0.0537
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 435/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0048 - mae: 0.0545
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 436/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 437/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0048 - mae: 0.0543
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 438/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0049 - mae: 0.0551
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0591 - val_mse: 0.0057
Epoch 439/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0047 - mae: 0.0538
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0583 - val_mse: 0.0055
Epoch 440/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0050 - mae: 0.0554
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 441/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0048 - mae: 0.0542
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 442/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0051 - mae: 0.0551
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 443/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0048 - mae: 0.0537
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 444/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0049 - mae: 0.0541
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 445/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0047 - mae: 0.0537
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 446/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 447/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0047 - mae: 0.0536
```

```
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 448/500
122/122 ──────────────── 1s 4ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0583 - val_mse: 0.0056
Epoch 449/500
122/122 ──────────────── 1s 4ms/step - loss: 0.0050 - mae: 0.0555
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 450/500
122/122 ──────────────── 1s 5ms/step - loss: 0.0049 - mae: 0.0544
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0596 - val_mse: 0.0057
Epoch 451/500
122/122 ──────────────── 1s 4ms/step - loss: 0.0047 - mae: 0.0536
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0583 - val_mse: 0.0055
Epoch 452/500
122/122 ──────────────── 0s 2ms/step - loss: 0.0050 - mae: 0.0551
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0586 - val_mse: 0.0056
Epoch 453/500
122/122 ──────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0544
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 454/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0579 - val_mse: 0.0056
Epoch 455/500
122/122 ──────────────── 1s 4ms/step - loss: 0.0048 - mae: 0.0546
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 456/500
122/122 ──────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 457/500
122/122 ──────────────── 0s 3ms/step - loss: 0.0052 - mae: 0.0565
- mse: 0.0052 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 458/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0548
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 459/500
122/122 ──────────────── 0s 3ms/step - loss: 0.0047 - mae: 0.0540
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 460/500
122/122 ──────────────── 0s 3ms/step - loss: 0.0048 - mae: 0.0544
- mse: 0.0048 - val_loss: 0.0058 - val_mae: 0.0598 - val_mse: 0.0058
Epoch 461/500
122/122 ──────────────── 0s 3ms/step - loss: 0.0048 - mae: 0.0543
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 462/500
122/122 ──────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0059 - val_mae: 0.0604 - val_mse: 0.0059
Epoch 463/500
122/122 ──────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0548
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
```

```
Epoch 464/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0544
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 465/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0582 - val_mse: 0.0056
Epoch 466/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0542
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 467/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0051 - mae: 0.0556
- mse: 0.0051 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 468/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0047 - mae: 0.0540
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 469/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0551
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0591 - val_mse: 0.0056
Epoch 470/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0047 - mae: 0.0532
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 471/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0547
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 472/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0049 - mae: 0.0545
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 473/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0047 - mae: 0.0537
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 474/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0048 - mae: 0.0543
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 475/500
122/122 ──────────────────── 1s 4ms/step - loss: 0.0048 - mae: 0.0537
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0583 - val_mse: 0.0055
Epoch 476/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0052 - mae: 0.0565
- mse: 0.0052 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 477/500
122/122 ──────────────────── 1s 5ms/step - loss: 0.0053 - mae: 0.0565
- mse: 0.0053 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 478/500
122/122 ──────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0583 - val_mse: 0.0055
Epoch 479/500
122/122 ──────────────────── 1s 3ms/step - loss: 0.0049 - mae: 0.0546
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 480/500
```

```
122/122 ───────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 481/500
122/122 ───────────────────── 0s 3ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0057 - val_mae: 0.0585 - val_mse: 0.0057
Epoch 482/500
122/122 ───────────────────── 0s 3ms/step - loss: 0.0048 - mae: 0.0540
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 483/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0047 - mae: 0.0543
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 484/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0046 - mae: 0.0533
- mse: 0.0046 - val_loss: 0.0057 - val_mae: 0.0585 - val_mse: 0.0057
Epoch 485/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0050 - mae: 0.0552
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0583 - val_mse: 0.0055
Epoch 486/500
122/122 ───────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0552
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0581 - val_mse: 0.0056
Epoch 487/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 488/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0047 - mae: 0.0532
- mse: 0.0047 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 489/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0047 - mae: 0.0536
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 490/500
122/122 ───────────────────── 0s 3ms/step - loss: 0.0048 - mae: 0.0544
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 491/500
122/122 ───────────────────── 0s 3ms/step - loss: 0.0049 - mae: 0.0544
- mse: 0.0049 - val_loss: 0.0056 - val_mae: 0.0585 - val_mse: 0.0056
Epoch 492/500
122/122 ───────────────────── 1s 3ms/step - loss: 0.0048 - mae: 0.0546
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 493/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049 - val_loss: 0.0057 - val_mae: 0.0595 - val_mse: 0.0057
Epoch 494/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0045 - mae: 0.0526
- mse: 0.0045 - val_loss: 0.0055 - val_mae: 0.0582 - val_mse: 0.0055
Epoch 495/500
122/122 ───────────────────── 0s 3ms/step - loss: 0.0048 - mae: 0.0546
- mse: 0.0048 - val_loss: 0.0056 - val_mae: 0.0580 - val_mse: 0.0056
Epoch 496/500
122/122 ───────────────────── 1s 4ms/step - loss: 0.0050 - mae: 0.0550
```

```
- mse: 0.0050 - val_loss: 0.0056 - val_mae: 0.0587 - val_mse: 0.0056
Epoch 497/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - loss: 0.0049 - mae: 0.0544
- mse: 0.0049 - val_loss: 0.0055 - val_mae: 0.0581 - val_mse: 0.0055
Epoch 498/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0050 - mae: 0.0550
- mse: 0.0050 - val_loss: 0.0055 - val_mae: 0.0580 - val_mse: 0.0055
Epoch 499/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 5ms/step - loss: 0.0048 - mae: 0.0548
- mse: 0.0048 - val_loss: 0.0055 - val_mae: 0.0579 - val_mse: 0.0055
Epoch 500/500
122/122 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0047 - mae: 0.0535
- mse: 0.0047 - val_loss: 0.0056 - val_mae: 0.0588 - val_mse: 0.0056

plot_history(history)
```
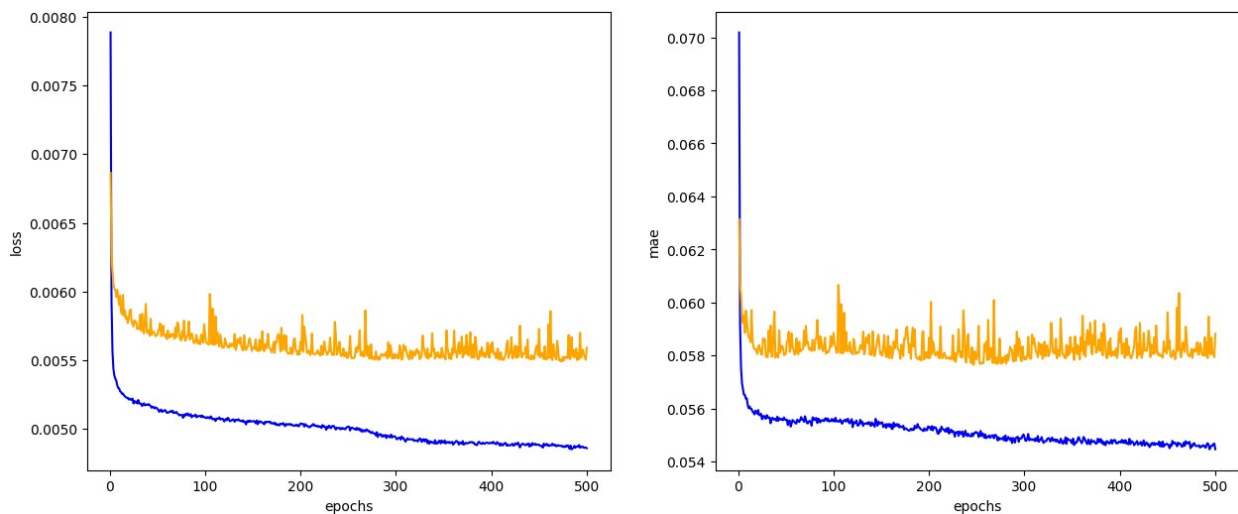

Avec fonction

```python
def create_model(input_dim, nb_hidden_layers=3, nb_units=20,
activation="relu", optimizer="rmsprop", loss="mse", metrics=["mae",
"mse"]):
    model = Sequential()
    model.add(Input(shape=(input_dim,)))
    #model.add(Dense(nb_units, input_dim=input_dim,
activation=activation))
    for i in range(nb_hidden_layers-1):
        model.add(Dense(nb_units, activation=activation))

    model.add(Dense(1, activation="sigmoid"))
    model.compile(optimizer = optimizer, loss = loss, metrics =
metrics)
    model.summary()
    return model
```

```python
model = create_model(
    input_dim=input_dim,
    nb_hidden_layers=4,
    nb_units=12,
    activation="relu",
    optimizer="rmsprop",
    loss="mse",
    metrics=["mae", "mse"]
)
```

Model: "sequential_1"

Layer (type)	Output Shape	Param #
dense_3 (Dense)	(None, 12)	156
dense_4 (Dense)	(None, 12)	156
dense_5 (Dense)	(None, 12)	156
dense_6 (Dense)	(None, 1)	13

 Total params: 481 (1.88 KB)

 Trainable params: 481 (1.88 KB)

 Non-trainable params: 0 (0.00 B)

Entraînement

```python
nb_epochs = 5
history = model.fit(
    X_train_clean,
    y_train,
    epochs=nb_epochs,
    validation_data=(X_val_clean, y_val),
    callbacks = [
        #EarlyStopping(patience=3), # Arrête l'entraînement si le loss
```

```
de diminue pas après 3 époques consécutives
        #ModelCheckpoint("./models") # Sauvegarde les modèles obtenus
à la fin de chaque époque
    ]
)

Epoch 1/5
122/122 ──────────────── 2s 4ms/step - loss: 0.0152 - mae: 0.0973
- mse: 0.0152 - val_loss: 0.0069 - val_mae: 0.0656 - val_mse: 0.0069
Epoch 2/5
122/122 ──────────────── 0s 3ms/step - loss: 0.0062 - mae: 0.0624
- mse: 0.0062 - val_loss: 0.0065 - val_mae: 0.0641 - val_mse: 0.0065
Epoch 3/5
122/122 ──────────────── 1s 3ms/step - loss: 0.0059 - mae: 0.0605
- mse: 0.0059 - val_loss: 0.0063 - val_mae: 0.0630 - val_mse: 0.0063
Epoch 4/5
122/122 ──────────────── 1s 2ms/step - loss: 0.0060 - mae: 0.0608
- mse: 0.0060 - val_loss: 0.0062 - val_mae: 0.0619 - val_mse: 0.0062
Epoch 5/5
122/122 ──────────────── 1s 3ms/step - loss: 0.0053 - mae: 0.0581
- mse: 0.0053 - val_loss: 0.0060 - val_mae: 0.0610 - val_mse: 0.0060
```

```
plot_history(history)
```
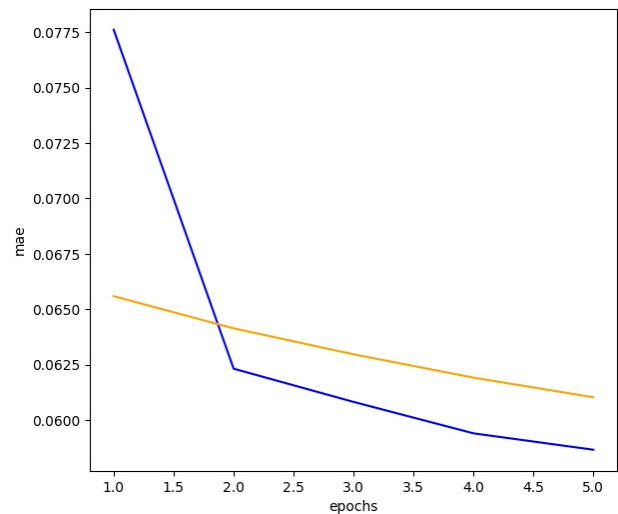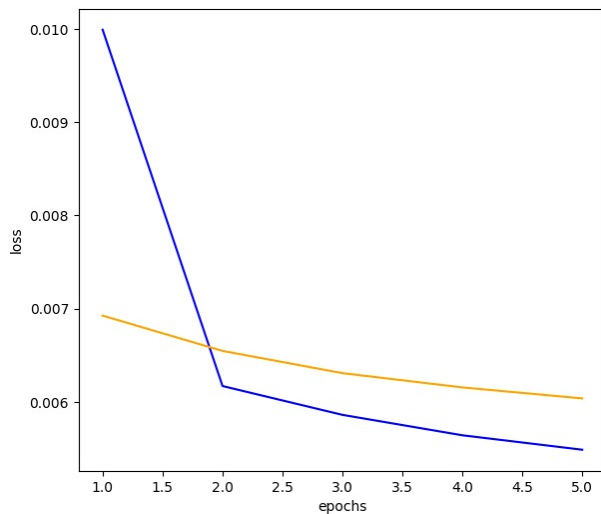

Evaluation du modèle

```
y_pred = model.predict(X_test_clean)
```

```
41/41 ──────────────── 0s 3ms/step
```

```
mean_squared_error(y_pred, y_test)
```

```
0.005549960841891275
```

```
# Le modèle a été entraîné à prédire des notes entre 0 et 10.
# On remultiplie les vecteur y_pred et y_test pour avoir une métrique
interprétable
mean_absolute_error(y_pred*10, y_test*10)

0.58589422922868
```

Compatibilité avec un GridSearchCV

```
!pip install scikeras

Collecting scikeras
  Downloading scikeras-0.13.0-py3-none-any.whl.metadata (3.1 kB)
Requirement already satisfied: keras>=3.2.0 in
/usr/local/lib/python3.10/dist-packages (from scikeras) (3.4.1)
Collecting scikit-learn>=1.4.2 (from scikeras)
  Downloading scikit_learn-1.5.2-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (13 kB)
Requirement already satisfied: absl-py in
/usr/local/lib/python3.10/dist-packages (from keras>=3.2.0->scikeras)
(1.4.0)
Requirement already satisfied: numpy in
/usr/local/lib/python3.10/dist-packages (from keras>=3.2.0->scikeras)
(1.26.4)
Requirement already satisfied: rich in /usr/local/lib/python3.10/dist-
packages (from keras>=3.2.0->scikeras) (13.8.1)
Requirement already satisfied: namex in
/usr/local/lib/python3.10/dist-packages (from keras>=3.2.0->scikeras)
(0.0.8)
Requirement already satisfied: h5py in /usr/local/lib/python3.10/dist-
packages (from keras>=3.2.0->scikeras) (3.11.0)
Requirement already satisfied: optree in
/usr/local/lib/python3.10/dist-packages (from keras>=3.2.0->scikeras)
(0.12.1)
Requirement already satisfied: ml-dtypes in
/usr/local/lib/python3.10/dist-packages (from keras>=3.2.0->scikeras)
(0.4.0)
Requirement already satisfied: packaging in
/usr/local/lib/python3.10/dist-packages (from keras>=3.2.0->scikeras)
(24.1)
Requirement already satisfied: scipy>=1.6.0 in
/usr/local/lib/python3.10/dist-packages (from scikit-learn>=1.4.2-
>scikeras) (1.13.1)
Requirement already satisfied: joblib>=1.2.0 in
/usr/local/lib/python3.10/dist-packages (from scikit-learn>=1.4.2-
>scikeras) (1.4.2)
Requirement already satisfied: threadpoolctl>=3.1.0 in
/usr/local/lib/python3.10/dist-packages (from scikit-learn>=1.4.2-
>scikeras) (3.5.0)
```

```python
from scikeras.wrappers import KerasRegressor

model_keras = KerasRegressor(model=create_model, epochs = 10)

hyperparameters = {
    "model__input_dim": [input_dim],
    "model__activation": ["relu", "sigmoid"],
    "model__nb_hidden_layers": [2,3],
    "model__nb_units": [10, 20],
    "model__optimizer": ["rmsprop", "adam"],
    "model__loss": ["mse"]
}

grid = GridSearchCV(estimator=model_keras, param_grid=hyperparameters,
cv=2)

grid.fit(X_train_clean, y_train)
```

Model: "sequential_2"

Layer (type)	Output Shape	Param #
dense_7 (Dense)	(None, 10)	130

| dense_8 (Dense) | (None, 1) |
11 |

 Total params: 141 (564.00 B)

 Trainable params: 141 (564.00 B)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ———————————————— 2s 4ms/step - loss: 0.0145 - mae: 0.0970 -
mse: 0.0145
Epoch 2/10
61/61 ———————————————— 0s 6ms/step - loss: 0.0081 - mae: 0.0709 -
mse: 0.0081
Epoch 3/10
61/61 ———————————————— 0s 4ms/step - loss: 0.0070 - mae: 0.0636 -
mse: 0.0070
Epoch 4/10
61/61 ———————————————— 0s 3ms/step - loss: 0.0065 - mae: 0.0621 -
mse: 0.0065
Epoch 5/10
61/61 ———————————————— 0s 5ms/step - loss: 0.0056 - mae: 0.0582 -
mse: 0.0056
Epoch 6/10
61/61 ———————————————— 0s 3ms/step - loss: 0.0059 - mae: 0.0595 -
mse: 0.0059
Epoch 7/10
61/61 ———————————————— 0s 5ms/step - loss: 0.0059 - mae: 0.0606 -
mse: 0.0059
Epoch 8/10
61/61 ———————————————— 1s 3ms/step - loss: 0.0059 - mae: 0.0595 -
mse: 0.0059
Epoch 9/10
61/61 ———————————————— 1s 3ms/step - loss: 0.0058 - mae: 0.0597 -
mse: 0.0058
Epoch 10/10
61/61 ———————————————— 0s 3ms/step - loss: 0.0054 - mae: 0.0573 -
mse: 0.0054
61/61 ———————————————— 0s 5ms/step

Model: "sequential_3"

| Layer (type) | Output Shape |
Param # |

```
|                                    |                     |
| dense_9 (Dense)                    | (None, 10)          |
130 |                                |                     |
|                                    |                     |
|                                    |                     |
| dense_10 (Dense)                   | (None, 1)           |
11 |                                 |                     |
|                                    |                     |
```

 Total params: 141 (564.00 B)

 Trainable params: 141 (564.00 B)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0122 - mae: 0.0869 -
mse: 0.0122
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━━ 0s 1ms/step - loss: 0.0070 - mae: 0.0636 -
mse: 0.0070
Epoch 3/10
61/61 ━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0070 - mae: 0.0638 -
mse: 0.0070
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0068 - mae: 0.0640 -
mse: 0.0068
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━ 0s 1ms/step - loss: 0.0064 - mae: 0.0620 -
mse: 0.0064
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0064 - mae: 0.0627 -
mse: 0.0064
Epoch 7/10
61/61 ━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0059 - mae: 0.0614 -
mse: 0.0059
Epoch 8/10
61/61 ━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0059 - mae: 0.0602 -
mse: 0.0059
Epoch 9/10
61/61 ━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0056 - mae: 0.0588 -
mse: 0.0056
Epoch 10/10
61/61 ━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0060 - mae: 0.0602 -
mse: 0.0060
61/61 ━━━━━━━━━━━━━━━━━ 0s 3ms/step

Model: "sequential_4"
```
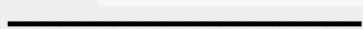
Layer (type)	Output Shape	Param #
dense_11 (Dense)	(None, 10)	130
dense_12 (Dense)	(None, 1)	11

 Total params: 141 (564.00 B)

 Trainable params: 141 (564.00 B)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ──────────────── 1s 1ms/step - loss: 0.0086 - mae: 0.0723 - mse: 0.0086
Epoch 2/10
61/61 ──────────────── 0s 1ms/step - loss: 0.0070 - mae: 0.0656 - mse: 0.0070
Epoch 3/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0062 - mae: 0.0611 - mse: 0.0062
Epoch 4/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0062 - mae: 0.0616 - mse: 0.0062
Epoch 5/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0054 - mae: 0.0575 - mse: 0.0054
Epoch 6/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0058 - mae: 0.0605 - mse: 0.0058
Epoch 7/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0058 - mae: 0.0609 - mse: 0.0058
Epoch 8/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0058 - mae: 0.0606 - mse: 0.0058
Epoch 9/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0056 - mae: 0.0594 - mse: 0.0056
Epoch 10/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0054 - mae: 0.0586 -
```

```
mse: 0.0054
61/61 ───────────────── 0s 2ms/step

Model: "sequential_5"

┌─────────────────────────────┬───────────────────────┐
│ Layer (type)                │ Output Shape          │
│ Param #                     │                       │
├─────────────────────────────┼───────────────────────┤
│ dense_13 (Dense)            │ (None, 10)            │
│ 130                         │                       │
├─────────────────────────────┼───────────────────────┤
│ dense_14 (Dense)            │ (None, 1)             │
│ 11                          │                       │
└─────────────────────────────┴───────────────────────┘

 Total params: 141 (564.00 B)

 Trainable params: 141 (564.00 B)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ───────────────── 1s 1ms/step - loss: 0.0503 - mae: 0.2016 -
mse: 0.0503
Epoch 2/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0086 - mae: 0.0737 -
mse: 0.0086
Epoch 3/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0071 - mae: 0.0660 -
mse: 0.0071
Epoch 4/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0066 - mae: 0.0636 -
mse: 0.0066
Epoch 5/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0067 - mae: 0.0640 -
mse: 0.0067
Epoch 6/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0064 - mae: 0.0622 -
mse: 0.0064
Epoch 7/10
61/61 ───────────────── 0s 1ms/step - loss: 0.0061 - mae: 0.0604 -
mse: 0.0061
Epoch 8/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0058 - mae: 0.0593 -
mse: 0.0058
Epoch 9/10
```

```
61/61 ───────────────── 0s 2ms/step - loss: 0.0062 - mae: 0.0601 -
mse: 0.0062
Epoch 10/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0058 - mae: 0.0601 -
mse: 0.0058
61/61 ───────────────── 1s 2ms/step
```

Model: "sequential_6"

Layer (type)	Output Shape	Param #
dense_15 (Dense)	(None, 20)	260
dense_16 (Dense)	(None, 1)	21

 Total params: 281 (1.10 KB)

 Trainable params: 281 (1.10 KB)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ───────────────── 1s 1ms/step - loss: 0.0081 - mae: 0.0713 -
mse: 0.0081
Epoch 2/10
61/61 ───────────────── 0s 1ms/step - loss: 0.0074 - mae: 0.0656 -
mse: 0.0074
Epoch 3/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0065 - mae: 0.0614 -
mse: 0.0065
Epoch 4/10
61/61 ───────────────── 0s 1ms/step - loss: 0.0062 - mae: 0.0610 -
mse: 0.0062
Epoch 5/10
61/61 ───────────────── 0s 1ms/step - loss: 0.0063 - mae: 0.0617 -
mse: 0.0063
Epoch 6/10
61/61 ───────────────── 0s 1ms/step - loss: 0.0062 - mae: 0.0611 -
mse: 0.0062
Epoch 7/10
61/61 ───────────────── 0s 1ms/step - loss: 0.0057 - mae: 0.0587 -
mse: 0.0057
```

```
Epoch 8/10
61/61 ──────────────── 0s 1ms/step - loss: 0.0063 - mae: 0.0614 -
mse: 0.0063
Epoch 9/10
61/61 ──────────────── 0s 1ms/step - loss: 0.0057 - mae: 0.0592 -
mse: 0.0057
Epoch 10/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0057 - mae: 0.0587 -
mse: 0.0057
61/61 ──────────────── 0s 2ms/step

Model: "sequential_7"
```

Layer (type)	Output Shape	Param #
dense_17 (Dense)	(None, 20)	260
dense_18 (Dense)	(None, 1)	21

```
 Total params: 281 (1.10 KB)

 Trainable params: 281 (1.10 KB)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ──────────────── 1s 2ms/step - loss: 0.0083 - mae: 0.0704 -
mse: 0.0083
Epoch 2/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0076 - mae: 0.0667 -
mse: 0.0076
Epoch 3/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0070 - mae: 0.0651 -
mse: 0.0070
Epoch 4/10
61/61 ──────────────── 0s 1ms/step - loss: 0.0064 - mae: 0.0613 -
mse: 0.0064
Epoch 5/10
61/61 ──────────────── 0s 1ms/step - loss: 0.0060 - mae: 0.0603 -
mse: 0.0060
Epoch 6/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0061 - mae: 0.0597 -
```

```
mse: 0.0061
Epoch 7/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0054 - mae: 0.0571 -
mse: 0.0054
Epoch 8/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0056 - mae: 0.0586 -
mse: 0.0056
Epoch 9/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0058 - mae: 0.0584 -
mse: 0.0058
Epoch 10/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0053 - mae: 0.0570 -
mse: 0.0053
61/61 ──────────────── 0s 3ms/step
```

Model: "sequential_8"

Layer (type)	Output Shape	Param #
dense_19 (Dense)	(None, 20)	260
dense_20 (Dense)	(None, 1)	21

 Total params: 281 (1.10 KB)

 Trainable params: 281 (1.10 KB)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ──────────────── 2s 3ms/step - loss: 0.0074 - mae: 0.0683 -
mse: 0.0074
Epoch 2/10
61/61 ──────────────── 0s 4ms/step - loss: 0.0062 - mae: 0.0619 -
mse: 0.0062
Epoch 3/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0061 - mae: 0.0604 -
mse: 0.0061
Epoch 4/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0057 - mae: 0.0596 -
mse: 0.0057
Epoch 5/10
```

```
61/61 ────────────────── 0s 2ms/step - loss: 0.0057 - mae: 0.0597 -
mse: 0.0057
Epoch 6/10
61/61 ────────────────── 0s 2ms/step - loss: 0.0055 - mae: 0.0581 -
mse: 0.0055
Epoch 7/10
61/61 ────────────────── 0s 2ms/step - loss: 0.0053 - mae: 0.0571 -
mse: 0.0053
Epoch 8/10
61/61 ────────────────── 0s 2ms/step - loss: 0.0052 - mae: 0.0567 -
mse: 0.0052
Epoch 9/10
61/61 ────────────────── 0s 2ms/step - loss: 0.0053 - mae: 0.0572 -
mse: 0.0053
Epoch 10/10
61/61 ────────────────── 0s 3ms/step - loss: 0.0055 - mae: 0.0582 -
mse: 0.0055
61/61 ────────────────── 0s 2ms/step
```

Model: "sequential_9"

Layer (type)	Output Shape	Param #
dense_21 (Dense)	(None, 20)	260
dense_22 (Dense)	(None, 1)	21

 Total params: 281 (1.10 KB)

 Trainable params: 281 (1.10 KB)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ────────────────── 1s 2ms/step - loss: 0.0096 - mae: 0.0771 -
mse: 0.0096
Epoch 2/10
61/61 ────────────────── 0s 2ms/step - loss: 0.0065 - mae: 0.0626 -
mse: 0.0065
Epoch 3/10
61/61 ────────────────── 0s 2ms/step - loss: 0.0059 - mae: 0.0603 -
mse: 0.0059
```

```
Epoch 4/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0061 - mae: 0.0608 -
mse: 0.0061
Epoch 5/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0061 - mae: 0.0604 -
mse: 0.0061
Epoch 6/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0058 - mae: 0.0594 -
mse: 0.0058
Epoch 7/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0056 - mae: 0.0583 -
mse: 0.0056
Epoch 8/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0053 - mae: 0.0571 -
mse: 0.0053
Epoch 9/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0054 - mae: 0.0575 -
mse: 0.0054
Epoch 10/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0052 - mae: 0.0557 -
mse: 0.0052
61/61 ──────────────── 0s 2ms/step
```

Model: "sequential_10"

Layer (type)	Output Shape	Param #
dense_23 (Dense)	(None, 10)	130
dense_24 (Dense)	(None, 10)	110
dense_25 (Dense)	(None, 1)	11

 Total params: 251 (1004.00 B)

 Trainable params: 251 (1004.00 B)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ──────────────── 1s 2ms/step - loss: 0.0137 - mae: 0.0933 -
mse: 0.0137
Epoch 2/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0071 - mae: 0.0659 -
mse: 0.0071
Epoch 3/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0064 - mae: 0.0622 -
mse: 0.0064
Epoch 4/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0062 - mae: 0.0616 -
mse: 0.0062
Epoch 5/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0057 - mae: 0.0591 -
mse: 0.0057
Epoch 6/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0058 - mae: 0.0590 -
mse: 0.0058
Epoch 7/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0056 - mae: 0.0581 -
mse: 0.0056
Epoch 8/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0056 - mae: 0.0583 -
mse: 0.0056
Epoch 9/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0055 - mae: 0.0583 -
mse: 0.0055
Epoch 10/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0055 - mae: 0.0583 -
mse: 0.0055
61/61 ──────────────── 0s 2ms/step

Model: "sequential_11"
```

Layer (type)	Output Shape	Param #
dense_26 (Dense)	(None, 10)	130
dense_27 (Dense)	(None, 10)	110
dense_28 (Dense)	(None, 1)	11

```
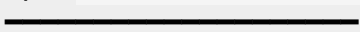 Total params: 251 (1004.00 B)

 Trainable params: 251 (1004.00 B)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ──────────────── 1s 3ms/step - loss: 0.0078 - mae: 0.0696 -
mse: 0.0078
Epoch 2/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0063 - mae: 0.0616 -
mse: 0.0063
Epoch 3/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0062 - mae: 0.0603 -
mse: 0.0062
Epoch 4/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0061 - mae: 0.0601 -
mse: 0.0061
Epoch 5/10
61/61 ──────────────── 0s 4ms/step - loss: 0.0059 - mae: 0.0601 -
mse: 0.0059
Epoch 6/10
61/61 ──────────────── 1s 4ms/step - loss: 0.0058 - mae: 0.0590 -
mse: 0.0058
Epoch 7/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0055 - mae: 0.0579 -
mse: 0.0055
Epoch 8/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0055 - mae: 0.0582 -
mse: 0.0055
Epoch 9/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0052 - mae: 0.0570 -
mse: 0.0052
Epoch 10/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0056 - mae: 0.0585 -
mse: 0.0056
61/61 ──────────────── 0s 2ms/step

Model: "sequential_12"
```

Layer (type)	Output Shape	Param #
dense_29 (Dense)	(None, 10)	130

```
┌─────────────────────────────┬───────────────────────────────┐
│ dense_30 (Dense)            │ (None, 10)                    │
│ 110                         │                               │
├─────────────────────────────┼───────────────────────────────┤
│ dense_31 (Dense)            │ (None, 1)                     │
│ 11                          │                               │
└─────────────────────────────┴───────────────────────────────┘

 Total params: 251 (1004.00 B)

 Trainable params: 251 (1004.00 B)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ──────────────────── 1s 2ms/step - loss: 0.0116 - mae: 0.0850 -
mse: 0.0116
Epoch 2/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0076 - mae: 0.0678 -
mse: 0.0076
Epoch 3/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0074 - mae: 0.0666 -
mse: 0.0074
Epoch 4/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0068 - mae: 0.0644 -
mse: 0.0068
Epoch 5/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0069 - mae: 0.0647 -
mse: 0.0069
Epoch 6/10
61/61 ──────────────────── 0s 3ms/step - loss: 0.0073 - mae: 0.0671 -
mse: 0.0073
Epoch 7/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0066 - mae: 0.0632 -
mse: 0.0066
Epoch 8/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0066 - mae: 0.0635 -
mse: 0.0066
Epoch 9/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0061 - mae: 0.0615 -
mse: 0.0061
Epoch 10/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0057 - mae: 0.0589 -
mse: 0.0057
61/61 ──────────────────── 0s 3ms/step

Model: "sequential_13"
```
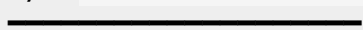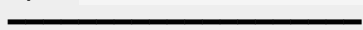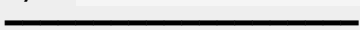
Layer (type)	Output Shape	Param #
dense_32 (Dense)	(None, 10)	130
dense_33 (Dense)	(None, 10)	110
dense_34 (Dense)	(None, 1)	11

 Total params: 251 (1004.00 B)

 Trainable params: 251 (1004.00 B)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0074 - mae: 0.0663 -
mse: 0.0074
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0063 - mae: 0.0614 -
mse: 0.0063
Epoch 3/10
61/61 ━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0060 - mae: 0.0602 -
mse: 0.0060
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0055 - mae: 0.0573 -
mse: 0.0055
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0053 - mae: 0.0573 -
mse: 0.0053
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0054 - mae: 0.0572 -
mse: 0.0054
Epoch 7/10
61/61 ━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0052 - mae: 0.0566 -
mse: 0.0052
Epoch 8/10
61/61 ━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0057 - mae: 0.0584 -
mse: 0.0057
Epoch 9/10
```

```
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0050 - mae: 0.0551 -
mse: 0.0050
Epoch 10/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0053 - mae: 0.0564 -
mse: 0.0053
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step

Model: "sequential_14"
```

Layer (type)	Output Shape	Param #
dense_35 (Dense)	(None, 20)	260
dense_36 (Dense)	(None, 20)	420
dense_37 (Dense)	(None, 1)	21

```
 Total params: 701 (2.74 KB)

 Trainable params: 701 (2.74 KB)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0107 - mae: 0.0827 -
mse: 0.0107
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0062 - mae: 0.0631 -
mse: 0.0062
Epoch 3/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0057 - mae: 0.0598 -
mse: 0.0057
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0053 - mae: 0.0578 -
mse: 0.0053
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - loss: 0.0052 - mae: 0.0572 -
mse: 0.0052
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 6ms/step - loss: 0.0053 - mae: 0.0576 -
```

```
mse: 0.0053
Epoch 7/10
61/61 ──────────────── 0s 5ms/step - loss: 0.0050 - mae: 0.0565 -
mse: 0.0050
Epoch 8/10
61/61 ──────────────── 1s 3ms/step - loss: 0.0055 - mae: 0.0592 -
mse: 0.0055
Epoch 9/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0052 - mae: 0.0575 -
mse: 0.0052
Epoch 10/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0048 - mae: 0.0551 -
mse: 0.0048
61/61 ──────────────── 0s 3ms/step
```

Model: "sequential_15"

Layer (type)	Output Shape	Param #
dense_38 (Dense)	(None, 20)	260
dense_39 (Dense)	(None, 20)	420
dense_40 (Dense)	(None, 1)	21

 Total params: 701 (2.74 KB)

 Trainable params: 701 (2.74 KB)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ──────────────── 1s 2ms/step - loss: 0.0169 - mae: 0.1028 -
mse: 0.0169
Epoch 2/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0072 - mae: 0.0663 -
mse: 0.0072
Epoch 3/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0067 - mae: 0.0631 -
mse: 0.0067
```

```
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0067 - mae: 0.0629 -
mse: 0.0067
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0061 - mae: 0.0601 -
mse: 0.0061
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0058 - mae: 0.0595 -
mse: 0.0058
Epoch 7/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0061 - mae: 0.0608 -
mse: 0.0061
Epoch 8/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0056 - mae: 0.0586 -
mse: 0.0056
Epoch 9/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0049 - mae: 0.0555 -
mse: 0.0049
Epoch 10/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0052 - mae: 0.0577 -
mse: 0.0052
61/61 ━━━━━━━━━━━━━━━━━━ 0s 3ms/step
```

Model: "sequential_16"

Layer (type)	Output Shape	Param #
dense_41 (Dense)	(None, 20)	260
dense_42 (Dense)	(None, 20)	420
dense_43 (Dense)	(None, 1)	21

 Total params: 701 (2.74 KB)

 Trainable params: 701 (2.74 KB)

 Non-trainable params: 0 (0.00 B)

```
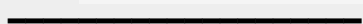Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0080 - mae: 0.0707 -
mse: 0.0080
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0061 - mae: 0.0603 -
mse: 0.0061
Epoch 3/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0058 - mae: 0.0598 -
mse: 0.0058
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0057 - mae: 0.0593 -
mse: 0.0057
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0056 - mae: 0.0585 -
mse: 0.0056
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0053 - mae: 0.0564 -
mse: 0.0053
Epoch 7/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0053 - mae: 0.0575 -
mse: 0.0053
Epoch 8/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0052 - mae: 0.0566 -
mse: 0.0052
Epoch 9/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0050 - mae: 0.0564 -
mse: 0.0050
Epoch 10/10
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0052 - mae: 0.0567 -
mse: 0.0052
61/61 ━━━━━━━━━━━━━━━━━━ 0s 2ms/step
```

Model: "sequential_17"
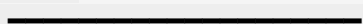
Layer (type)	Output Shape	Param #
dense_44 (Dense)	(None, 20)	260
dense_45 (Dense)	(None, 20)	420
dense_46 (Dense)	(None, 1)	21
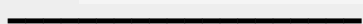
```
└────────────────────┘

 Total params: 701 (2.74 KB)

 Trainable params: 701 (2.74 KB)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ──────────────── 2s 2ms/step - loss: 0.0089 - mae: 0.0757 -
mse: 0.0089
Epoch 2/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0061 - mae: 0.0601 -
mse: 0.0061
Epoch 3/10
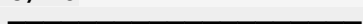61/61 ──────────────── 0s 2ms/step - loss: 0.0057 - mae: 0.0574 -
mse: 0.0057
Epoch 4/10
61/61 ──────────────── 0s 4ms/step - loss: 0.0062 - mae: 0.0604 -
mse: 0.0062
Epoch 5/10
61/61 ──────────────── 1s 5ms/step - loss: 0.0054 - mae: 0.0570 -
mse: 0.0054
Epoch 6/10
61/61 ──────────────── 1s 3ms/step - loss: 0.0053 - mae: 0.0562 -
mse: 0.0053
Epoch 7/10
61/61 ──────────────── 0s 4ms/step - loss: 0.0053 - mae: 0.0561 -
mse: 0.0053
Epoch 8/10
61/61 ──────────────── 0s 4ms/step - loss: 0.0052 - mae: 0.0560 -
mse: 0.0052
Epoch 9/10
61/61 ──────────────── 1s 4ms/step - loss: 0.0049 - mae: 0.0552 -
mse: 0.0049
Epoch 10/10
61/61 ──────────────── 0s 4ms/step - loss: 0.0052 - mae: 0.0555 -
mse: 0.0052
61/61 ──────────────── 0s 2ms/step

Model: "sequential_18"
```
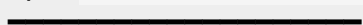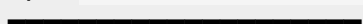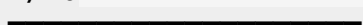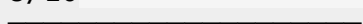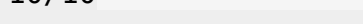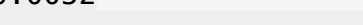
Layer (type)	Output Shape	Param #
dense_47 (Dense)	(None, 10)	130

Layer (type)	Output Shape	
dense_48 (Dense)	(None, 1)	11

 Total params: 141 (564.00 B)

 Trainable params: 141 (564.00 B)

 Non-trainable params: 0 (0.00 B)

```
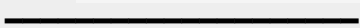Epoch 1/10
61/61 ──────────────────── 1s 2ms/step - loss: 0.0196 - mae: 0.1154 -
mse: 0.0196
Epoch 2/10
61/61 ──────────────────── 0s 1ms/step - loss: 0.0071 - mae: 0.0672 -
mse: 0.0071
Epoch 3/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0070 - mae: 0.0644 -
mse: 0.0070
Epoch 4/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0069 - mae: 0.0636 -
mse: 0.0069
Epoch 5/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0068 - mae: 0.0632 -
mse: 0.0068
Epoch 6/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0065 - mae: 0.0624 -
mse: 0.0065
Epoch 7/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0062 - mae: 0.0604 -
mse: 0.0062
Epoch 8/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0067 - mae: 0.0631 -
mse: 0.0067
Epoch 9/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0063 - mae: 0.0616 -
mse: 0.0063
Epoch 10/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0062 - mae: 0.0611 -
mse: 0.0062
61/61 ──────────────────── 0s 2ms/step
```

Model: "sequential_19"

Layer (type)	Output Shape	
		Param #

```
┌─────────────────────────────┬───────────────────────────┐
│ dense_49 (Dense)            │ (None, 10)                │
│ 130 │                                                     │
├─────────────────────────────┼───────────────────────────┤
│ dense_50 (Dense)            │ (None, 1)                 │
│ 11  │                                                     │
└─────────────────────────────┴───────────────────────────┘

 Total params: 141 (564.00 B)

 Trainable params: 141 (564.00 B)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ───────────────────── 1s 2ms/step - loss: 0.0155 - mae: 0.0976 -
mse: 0.0155
Epoch 2/10
61/61 ───────────────────── 0s 2ms/step - loss: 0.0075 - mae: 0.0680 -
mse: 0.0075
Epoch 3/10
61/61 ───────────────────── 0s 2ms/step - loss: 0.0079 - mae: 0.0676 -
mse: 0.0079
Epoch 4/10
61/61 ───────────────────── 0s 3ms/step - loss: 0.0078 - mae: 0.0679 -
mse: 0.0078
Epoch 5/10
61/61 ───────────────────── 0s 2ms/step - loss: 0.0072 - mae: 0.0652 -
mse: 0.0072
Epoch 6/10
61/61 ───────────────────── 0s 2ms/step - loss: 0.0072 - mae: 0.0654 -
mse: 0.0072
Epoch 7/10
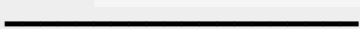61/61 ───────────────────── 0s 2ms/step - loss: 0.0072 - mae: 0.0649 -
mse: 0.0072
Epoch 8/10
61/61 ───────────────────── 0s 2ms/step - loss: 0.0065 - mae: 0.0611 -
mse: 0.0065
Epoch 9/10
61/61 ───────────────────── 0s 2ms/step - loss: 0.0069 - mae: 0.0628 -
mse: 0.0069
Epoch 10/10
61/61 ───────────────────── 0s 2ms/step - loss: 0.0064 - mae: 0.0614 -
mse: 0.0064
61/61 ───────────────────── 0s 2ms/step

Model: "sequential_20"
```
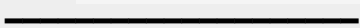
Layer (type)	Output Shape	Param #
dense_51 (Dense)	(None, 10)	130
dense_52 (Dense)	(None, 1)	11

 Total params: 141 (564.00 B)

 Trainable params: 141 (564.00 B)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ───────────────── 1s 2ms/step - loss: 0.0646 - mae: 0.2358 -
mse: 0.0646
Epoch 2/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0195 - mae: 0.1142 -
mse: 0.0195
Epoch 3/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0083 - mae: 0.0750 -
mse: 0.0083
Epoch 4/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0076 - mae: 0.0696 -
mse: 0.0076
Epoch 5/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0074 - mae: 0.0677 -
mse: 0.0074
Epoch 6/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0074 - mae: 0.0674 -
mse: 0.0074
Epoch 7/10
61/61 ───────────────── 0s 3ms/step - loss: 0.0074 - mae: 0.0670 -
mse: 0.0074
Epoch 8/10
61/61 ───────────────── 0s 3ms/step - loss: 0.0072 - mae: 0.0666 -
mse: 0.0072
Epoch 9/10
61/61 ───────────────── 0s 3ms/step - loss: 0.0069 - mae: 0.0646 -
mse: 0.0069
Epoch 10/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0076 - mae: 0.0681 -
```

```
mse: 0.0076
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step

Model: "sequential_21"

┏━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━━━━━━━━━━━━┓
┃ Layer (type)                   ┃ Output Shape               ┃
┃ Param #                        ┃                            ┃
┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━━━━━━┩
│ dense_53 (Dense)               │ (None, 10)                 │
│ 130                            │                            │
├────────────────────────────────┼────────────────────────────┤
│ dense_54 (Dense)               │ (None, 1)                  │
│ 11                             │                            │
└────────────────────────────────┴────────────────────────────┘

 Total params: 141 (564.00 B)

 Trainable params: 141 (564.00 B)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 2s 3ms/step - loss: 0.0228 - mae: 0.1305 -
mse: 0.0228
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 1s 9ms/step - loss: 0.0076 - mae: 0.0665 -
mse: 0.0076
Epoch 3/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0072 - mae: 0.0659 -
mse: 0.0072
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 1s 8ms/step - loss: 0.0071 - mae: 0.0644 -
mse: 0.0071
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0068 - mae: 0.0632 -
mse: 0.0068
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0065 - mae: 0.0635 -
mse: 0.0065
Epoch 7/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - loss: 0.0065 - mae: 0.0622 -
mse: 0.0065
Epoch 8/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 1s 6ms/step - loss: 0.0064 - mae: 0.0616 -
mse: 0.0064
Epoch 9/10
```

```
61/61 ───────────────── 0s 2ms/step - loss: 0.0056 - mae: 0.0590 -
mse: 0.0056
Epoch 10/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0061 - mae: 0.0612 -
mse: 0.0061
61/61 ───────────────── 0s 2ms/step
```

Model: "sequential_22"

Layer (type)	Output Shape	Param #
dense_55 (Dense)	(None, 20)	260
dense_56 (Dense)	(None, 1)	21

 Total params: 281 (1.10 KB)

 Trainable params: 281 (1.10 KB)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ───────────────── 1s 2ms/step - loss: 0.0124 - mae: 0.0893 -
mse: 0.0124
Epoch 2/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0073 - mae: 0.0668 -
mse: 0.0073
Epoch 3/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0064 - mae: 0.0624 -
mse: 0.0064
Epoch 4/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0067 - mae: 0.0634 -
mse: 0.0067
Epoch 5/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0070 - mae: 0.0654 -
mse: 0.0070
Epoch 6/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0067 - mae: 0.0637 -
mse: 0.0067
Epoch 7/10
61/61 ───────────────── 0s 1ms/step - loss: 0.0064 - mae: 0.0624 -
mse: 0.0064
```

```
Epoch 8/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0063 - mae: 0.0624 -
mse: 0.0063
Epoch 9/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0060 - mae: 0.0608 -
mse: 0.0060
Epoch 10/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0064 - mae: 0.0628 -
mse: 0.0064
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step

Model: "sequential_23"
```

Layer (type)	Output Shape	Param #
dense_57 (Dense)	(None, 20)	260
dense_58 (Dense)	(None, 1)	21

```
 Total params: 281 (1.10 KB)

 Trainable params: 281 (1.10 KB)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 1s 1ms/step - loss: 0.0463 - mae: 0.1908 -
mse: 0.0463
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - loss: 0.0080 - mae: 0.0720 -
mse: 0.0080
Epoch 3/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0073 - mae: 0.0672 -
mse: 0.0073
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0075 - mae: 0.0667 -
mse: 0.0075
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 1ms/step - loss: 0.0069 - mae: 0.0641 -
mse: 0.0069
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0066 - mae: 0.0613 -
```

```
mse: 0.0066
Epoch 7/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0063 - mae: 0.0617 -
mse: 0.0063
Epoch 8/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0064 - mae: 0.0626 -
mse: 0.0064
Epoch 9/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0068 - mae: 0.0636 -
mse: 0.0068
Epoch 10/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0060 - mae: 0.0603 -
mse: 0.0060
61/61 ──────────────────── 0s 2ms/step

Model: "sequential_24"
```

Layer (type)	Output Shape	Param #
dense_59 (Dense)	(None, 20)	260
dense_60 (Dense)	(None, 1)	21

```
 Total params: 281 (1.10 KB)

 Trainable params: 281 (1.10 KB)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ──────────────────── 2s 3ms/step - loss: 0.0111 - mae: 0.0816 -
mse: 0.0111
Epoch 2/10
61/61 ──────────────────── 0s 3ms/step - loss: 0.0073 - mae: 0.0665 -
mse: 0.0073
Epoch 3/10
61/61 ──────────────────── 0s 3ms/step - loss: 0.0070 - mae: 0.0648 -
mse: 0.0070
Epoch 4/10
61/61 ──────────────────── 0s 3ms/step - loss: 0.0067 - mae: 0.0637 -
mse: 0.0067
Epoch 5/10
```

```
61/61 ──────────────── 0s 3ms/step - loss: 0.0063 - mae: 0.0619 -
mse: 0.0063
Epoch 6/10
61/61 ──────────────── 0s 4ms/step - loss: 0.0062 - mae: 0.0606 -
mse: 0.0062
Epoch 7/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0066 - mae: 0.0625 -
mse: 0.0066
Epoch 8/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0061 - mae: 0.0608 -
mse: 0.0061
Epoch 9/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0056 - mae: 0.0576 -
mse: 0.0056
Epoch 10/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0064 - mae: 0.0623 -
mse: 0.0064
61/61 ──────────────── 0s 2ms/step
```

Model: "sequential_25"

Layer (type)	Output Shape	Param #
dense_61 (Dense)	(None, 20)	260
dense_62 (Dense)	(None, 1)	21

 Total params: 281 (1.10 KB)

 Trainable params: 281 (1.10 KB)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ──────────────── 1s 2ms/step - loss: 0.0238 - mae: 0.1294 -
mse: 0.0238
Epoch 2/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0078 - mae: 0.0695 -
mse: 0.0078
Epoch 3/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0077 - mae: 0.0679 -
mse: 0.0077
```

```
Epoch 4/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0072 - mae: 0.0668 -
mse: 0.0072
Epoch 5/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0069 - mae: 0.0640 -
mse: 0.0069
Epoch 6/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0070 - mae: 0.0643 -
mse: 0.0070
Epoch 7/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0069 - mae: 0.0638 -
mse: 0.0069
Epoch 8/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0073 - mae: 0.0651 -
mse: 0.0073
Epoch 9/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0067 - mae: 0.0630 -
mse: 0.0067
Epoch 10/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0065 - mae: 0.0621 -
mse: 0.0065
61/61 ──────────────── 0s 2ms/step
```

Model: "sequential_26"

Layer (type)	Output Shape	Param #
dense_63 (Dense)	(None, 10)	130
dense_64 (Dense)	(None, 10)	110
dense_65 (Dense)	(None, 1)	11

 Total params: 251 (1004.00 B)

 Trainable params: 251 (1004.00 B)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ──────────────────── 1s 2ms/step - loss: 0.1106 - mae: 0.3184 -
mse: 0.1106
Epoch 2/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0312 - mae: 0.1541 -
mse: 0.0312
Epoch 3/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0083 - mae: 0.0747 -
mse: 0.0083
Epoch 4/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0075 - mae: 0.0670 -
mse: 0.0075
Epoch 5/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0075 - mae: 0.0683 -
mse: 0.0075
Epoch 6/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0073 - mae: 0.0671 -
mse: 0.0073
Epoch 7/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0072 - mae: 0.0663 -
mse: 0.0072
Epoch 8/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0074 - mae: 0.0680 -
mse: 0.0074
Epoch 9/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0074 - mae: 0.0672 -
mse: 0.0074
Epoch 10/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0075 - mae: 0.0679 -
mse: 0.0075
61/61 ──────────────────── 0s 2ms/step

Model: "sequential_27"
```
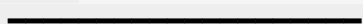
Layer (type)	Output Shape	Param #
dense_66 (Dense)	(None, 10)	130
dense_67 (Dense)	(None, 10)	110
dense_68 (Dense)	(None, 1)	11
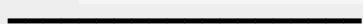
```
 Total params: 251 (1004.00 B)

 Trainable params: 251 (1004.00 B)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - loss: 0.0378 - mae: 0.1731 -
mse: 0.0378
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0089 - mae: 0.0767 -
mse: 0.0089
Epoch 3/10
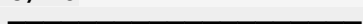61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0077 - mae: 0.0677 -
mse: 0.0077
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0073 - mae: 0.0668 -
mse: 0.0073
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0074 - mae: 0.0669 -
mse: 0.0074
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0075 - mae: 0.0671 -
mse: 0.0075
Epoch 7/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0071 - mae: 0.0656 -
mse: 0.0071
Epoch 8/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 5ms/step - loss: 0.0068 - mae: 0.0642 -
mse: 0.0068
Epoch 9/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 1s 7ms/step - loss: 0.0070 - mae: 0.0650 -
mse: 0.0070
Epoch 10/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0072 - mae: 0.0646 -
mse: 0.0072
61/61 ━━━━━━━━━━━━━━━━━━━━ 1s 7ms/step

Model: "sequential_28"
```
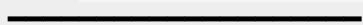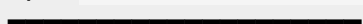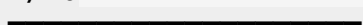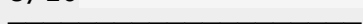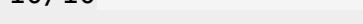
Layer (type)	Output Shape	Param #
dense_69 (Dense)	(None, 10)	130

```
┌─────────────────────────────────┬───────────────────────────┐
│ dense_70 (Dense)                 │ (None, 10)                │
│ 110 │                            │                           │
├─────────────────────────────────┼───────────────────────────┤
│ dense_71 (Dense)                 │ (None, 1)                 │
│ 11 │                             │                           │
└─────────────────────────────────┴───────────────────────────┘
```

 Total params: 251 (1004.00 B)

 Trainable params: 251 (1004.00 B)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 2s 3ms/step - loss: 0.0156 - mae: 0.0996 -
mse: 0.0156
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0076 - mae: 0.0681 -
mse: 0.0076
Epoch 3/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0072 - mae: 0.0661 -
mse: 0.0072
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0078 - mae: 0.0690 -
mse: 0.0078
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0074 - mae: 0.0670 -
mse: 0.0074
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0073 - mae: 0.0664 -
mse: 0.0073
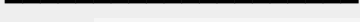Epoch 7/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0070 - mae: 0.0652 -
mse: 0.0070
Epoch 8/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0070 - mae: 0.0666 -
mse: 0.0070
Epoch 9/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0070 - mae: 0.0638 -
mse: 0.0070
Epoch 10/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0073 - mae: 0.0665 -
mse: 0.0073
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step

Model: "sequential_29"
```
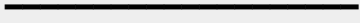
Layer (type)	Output Shape	Param #
dense_72 (Dense)	(None, 10)	130
dense_73 (Dense)	(None, 10)	110
dense_74 (Dense)	(None, 1)	11

 Total params: 251 (1004.00 B)

 Trainable params: 251 (1004.00 B)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 2s 4ms/step - loss: 0.0544 - mae: 0.2152 -
mse: 0.0544
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0157 - mae: 0.0997 -
mse: 0.0157
Epoch 3/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0083 - mae: 0.0747 -
mse: 0.0083
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - loss: 0.0077 - mae: 0.0683 -
mse: 0.0077
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0072 - mae: 0.0664 -
mse: 0.0072
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0078 - mae: 0.0685 -
mse: 0.0078
Epoch 7/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0073 - mae: 0.0664 -
mse: 0.0073
Epoch 8/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0069 - mae: 0.0649 -
mse: 0.0069
Epoch 9/10
```

```
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - loss: 0.0076 - mae: 0.0673 -
mse: 0.0076
Epoch 10/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0074 - mae: 0.0676 -
mse: 0.0074
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step
```

Model: "sequential_30"

Layer (type)	Output Shape	Param #
dense_75 (Dense)	(None, 20)	260
dense_76 (Dense)	(None, 20)	420
dense_77 (Dense)	(None, 1)	21

 Total params: 701 (2.74 KB)

 Trainable params: 701 (2.74 KB)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - loss: 0.0089 - mae: 0.0745 -
mse: 0.0089
Epoch 2/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0074 - mae: 0.0655 -
mse: 0.0074
Epoch 3/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0074 - mae: 0.0671 -
mse: 0.0074
Epoch 4/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 3ms/step - loss: 0.0074 - mae: 0.0661 -
mse: 0.0074
Epoch 5/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - loss: 0.0076 - mae: 0.0672 -
mse: 0.0076
Epoch 6/10
61/61 ━━━━━━━━━━━━━━━━━━━━ 0s 4ms/step - loss: 0.0076 - mae: 0.0682 -
```

```
mse: 0.0076
Epoch 7/10
61/61 ──────────────── 1s 2ms/step - loss: 0.0075 - mae: 0.0682 -
mse: 0.0075
Epoch 8/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0074 - mae: 0.0669 -
mse: 0.0074
Epoch 9/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0071 - mae: 0.0661 -
mse: 0.0071
Epoch 10/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0071 - mae: 0.0651 -
mse: 0.0071
61/61 ──────────────── 0s 3ms/step
```

Model: "sequential_31"

Layer (type)	Output Shape	Param #
dense_78 (Dense)	(None, 20)	260
dense_79 (Dense)	(None, 20)	420
dense_80 (Dense)	(None, 1)	21

 Total params: 701 (2.74 KB)

 Trainable params: 701 (2.74 KB)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ──────────────── 2s 2ms/step - loss: 0.0188 - mae: 0.1089 -
mse: 0.0188
Epoch 2/10
61/61 ──────────────── 0s 2ms/step - loss: 0.0074 - mae: 0.0669 -
mse: 0.0074
Epoch 3/10
61/61 ──────────────── 0s 3ms/step - loss: 0.0072 - mae: 0.0654 -
mse: 0.0072
```

```
Epoch 4/10
61/61 ──────────────────── 0s 3ms/step - loss: 0.0079 - mae: 0.0690 -
mse: 0.0079
Epoch 5/10
61/61 ──────────────────── 0s 3ms/step - loss: 0.0073 - mae: 0.0658 -
mse: 0.0073
Epoch 6/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0074 - mae: 0.0653 -
mse: 0.0074
Epoch 7/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0076 - mae: 0.0679 -
mse: 0.0076
Epoch 8/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0075 - mae: 0.0673 -
mse: 0.0075
Epoch 9/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0071 - mae: 0.0654 -
mse: 0.0071
Epoch 10/10
61/61 ──────────────────── 0s 2ms/step - loss: 0.0073 - mae: 0.0651 -
mse: 0.0073
61/61 ──────────────────── 0s 2ms/step
```

Model: "sequential_32"

Layer (type)	Output Shape	Param #
dense_81 (Dense)	(None, 20)	260
dense_82 (Dense)	(None, 20)	420
dense_83 (Dense)	(None, 1)	21

 Total params: 701 (2.74 KB)

 Trainable params: 701 (2.74 KB)

 Non-trainable params: 0 (0.00 B)

```
Epoch 1/10
61/61 ───────────────── 1s 2ms/step - loss: 0.0080 - mae: 0.0700 -
mse: 0.0080
Epoch 2/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0075 - mae: 0.0675 -
mse: 0.0075
Epoch 3/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0075 - mae: 0.0683 -
mse: 0.0075
Epoch 4/10
61/61 ───────────────── 0s 3ms/step - loss: 0.0070 - mae: 0.0657 -
mse: 0.0070
Epoch 5/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0071 - mae: 0.0645 -
mse: 0.0071
Epoch 6/10
61/61 ───────────────── 0s 3ms/step - loss: 0.0067 - mae: 0.0630 -
mse: 0.0067
Epoch 7/10
61/61 ───────────────── 0s 3ms/step - loss: 0.0068 - mae: 0.0634 -
mse: 0.0068
Epoch 8/10
61/61 ───────────────── 0s 3ms/step - loss: 0.0071 - mae: 0.0647 -
mse: 0.0071
Epoch 9/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0067 - mae: 0.0637 -
mse: 0.0067
Epoch 10/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0065 - mae: 0.0630 -
mse: 0.0065
61/61 ───────────────── 0s 3ms/step

Model: "sequential_33"
```
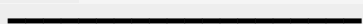
Layer (type)	Output Shape	Param #
dense_84 (Dense)	(None, 20)	260
dense_85 (Dense)	(None, 20)	420
dense_86 (Dense)	(None, 1)	21

```
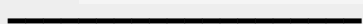 Total params: 701 (2.74 KB)

 Trainable params: 701 (2.74 KB)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
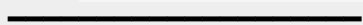61/61 ───────────────── 2s 4ms/step - loss: 0.0123 - mae: 0.0862 -
mse: 0.0123
Epoch 2/10
61/61 ───────────────── 1s 2ms/step - loss: 0.0074 - mae: 0.0672 -
mse: 0.0074
Epoch 3/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0074 - mae: 0.0667 -
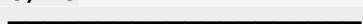mse: 0.0074
Epoch 4/10
61/61 ───────────────── 0s 3ms/step - loss: 0.0072 - mae: 0.0661 -
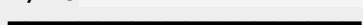mse: 0.0072
Epoch 5/10
61/61 ───────────────── 0s 3ms/step - loss: 0.0073 - mae: 0.0666 -
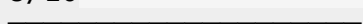mse: 0.0073
Epoch 6/10
61/61 ───────────────── 0s 3ms/step - loss: 0.0070 - mae: 0.0645 -
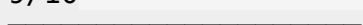mse: 0.0070
Epoch 7/10
61/61 ───────────────── 0s 3ms/step - loss: 0.0072 - mae: 0.0660 -
mse: 0.0072
Epoch 8/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0073 - mae: 0.0649 -
mse: 0.0073
Epoch 9/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0066 - mae: 0.0626 -
mse: 0.0066
Epoch 10/10
61/61 ───────────────── 0s 2ms/step - loss: 0.0067 - mae: 0.0629 -
mse: 0.0067
61/61 ───────────────── 0s 2ms/step

Model: "sequential_34"
```

Layer (type)	Output Shape	Param #
dense_87 (Dense)	(None, 20)	260

```
┌──────────────────────────────┬──────────────────────────┬──────────────┐
│ dense_88 (Dense)             │ (None, 20)               │          420 │
├──────────────────────────────┼──────────────────────────┼──────────────┤
│ dense_89 (Dense)             │ (None, 1)                │           21 │
└──────────────────────────────┴──────────────────────────┴──────────────┘

 Total params: 701 (2.74 KB)

 Trainable params: 701 (2.74 KB)

 Non-trainable params: 0 (0.00 B)

Epoch 1/10
122/122 ──────────────────── 2s 2ms/step - loss: 0.0086 - mae: 0.0718
- mse: 0.0086
Epoch 2/10
122/122 ──────────────────── 0s 3ms/step - loss: 0.0059 - mae: 0.0602
- mse: 0.0059
Epoch 3/10
122/122 ──────────────────── 0s 2ms/step - loss: 0.0054 - mae: 0.0577
- mse: 0.0054
Epoch 4/10
122/122 ──────────────────── 1s 2ms/step - loss: 0.0055 - mae: 0.0583
- mse: 0.0055
Epoch 5/10
122/122 ──────────────────── 0s 2ms/step - loss: 0.0052 - mae: 0.0566
- mse: 0.0052
Epoch 6/10
122/122 ──────────────────── 0s 2ms/step - loss: 0.0054 - mae: 0.0569
- mse: 0.0054
Epoch 7/10
122/122 ──────────────────── 0s 2ms/step - loss: 0.0053 - mae: 0.0569
- mse: 0.0053
Epoch 8/10
122/122 ──────────────────── 0s 2ms/step - loss: 0.0051 - mae: 0.0556
- mse: 0.0051
Epoch 9/10
122/122 ──────────────────── 0s 2ms/step - loss: 0.0051 - mae: 0.0556
- mse: 0.0051
Epoch 10/10
122/122 ──────────────────── 0s 2ms/step - loss: 0.0049 - mae: 0.0549
- mse: 0.0049

GridSearchCV(cv=2,
             estimator=KerasRegressor(epochs=10, model=<function
```

```
create_model at 0x7ea692530e50>),
             param_grid={'model__activation': ['relu', 'sigmoid'],
                         'model__input_dim': [12], 'model__loss':
['mse'],
                         'model__nb_hidden_layers': [2, 3],
                         'model__nb_units': [10, 20],
                         'model__optimizer': ['rmsprop', 'adam']})

# Meilleurs hyperparamètres trouvés
best_params = grid.best_params_
print("Meilleurs paramètres :", best_params)

# Meilleur estimateur (modèle)
best_model = grid.best_estimator_
print("Meilleur modèle :", best_model)

# Meilleur score de validation croisée
best_score = grid.best_score_
print("Meilleur score :", best_score)

Meilleurs paramètres : {'model__activation': 'relu',
'model__input_dim': 12, 'model__loss': 'mse',
'model__nb_hidden_layers': 3, 'model__nb_units': 20,
'model__optimizer': 'adam'}
Meilleur modèle : KerasRegressor(
        model=<function create_model at 0x7ea692530e50>
        build_fn=None
        warm_start=False
        random_state=None
        optimizer=rmsprop
        loss=None
        metrics=None
        batch_size=None
        validation_batch_size=None
        verbose=1
        callbacks=None
        validation_split=0.0
        shuffle=True
        run_eagerly=False
        epochs=10
        model__activation=relu
        model__input_dim=12
        model__loss=mse
        model__nb_hidden_layers=3
        model__nb_units=20
        model__optimizer=adam
)
Meilleur score : 0.30741546442309586
```