```
In [2]: import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt
        import seaborn as sns

        %matplotlib inline
        sns.set_style("whitegrid")
```

```
In [3]: import os
        print(os.getcwd())
```

```
C:\Users\khush\Downloads
```

```
In [4]: import pandas as pd

        data = pd.read_csv(r"C:\Users\khush\Downloads\creditcard.csv")
        print(data.head())
```

```
   Time        V1        V2        V3        V4        V5        V6        V7  \
0   0.0 -1.359807 -0.072781  2.536347  1.378155 -0.338321  0.462388  0.239599
1   0.0  1.191857  0.266151  0.166480  0.448154  0.060018 -0.082361 -0.078803
2   1.0 -1.358354 -1.340163  1.773209  0.379780 -0.503198  1.800499  0.791461
3   1.0 -0.966272 -0.185226  1.792993 -0.863291 -0.010309  1.247203  0.237609
4   2.0 -1.158233  0.877737  1.548718  0.403034 -0.407193  0.095921  0.592941

         V8        V9  ...       V21       V22       V23       V24       V25  \
0  0.098698  0.363787  ... -0.018307  0.277838 -0.110474  0.066928  0.128539
1  0.085102 -0.255425  ... -0.225775 -0.638672  0.101288 -0.339846  0.167170
2  0.247676 -1.514654  ...  0.247998  0.771679  0.909412 -0.689281 -0.327642
3  0.377436 -1.387024  ... -0.108300  0.005274 -0.190321 -1.175575  0.647376
4 -0.270533  0.817739  ... -0.009431  0.798278 -0.137458  0.141267 -0.206010

        V26       V27       V28  Amount  Class
0 -0.189115  0.133558 -0.021053  149.62      0
1  0.125895 -0.008983  0.014724    2.69      0
2 -0.139097 -0.055353 -0.059752  378.66      0
3 -0.221929  0.062723  0.061458  123.50      0
4  0.502292  0.219422  0.215153   69.99      0

[5 rows x 31 columns]
```

2. Exploratory Data Analysis

```
In [5]: data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 284807 entries, 0 to 284806
Data columns (total 31 columns):
 #   Column  Non-Null Count   Dtype
---  ------  --------------   -----
 0   Time    284807 non-null  float64
 1   V1      284807 non-null  float64
 2   V2      284807 non-null  float64
 3   V3      284807 non-null  float64
 4   V4      284807 non-null  float64
 5   V5      284807 non-null  float64
 6   V6      284807 non-null  float64
 7   V7      284807 non-null  float64
 8   V8      284807 non-null  float64
 9   V9      284807 non-null  float64
 10  V10     284807 non-null  float64
 11  V11     284807 non-null  float64
 12  V12     284807 non-null  float64
 13  V13     284807 non-null  float64
 14  V14     284807 non-null  float64
 15  V15     284807 non-null  float64
 16  V16     284807 non-null  float64
 17  V17     284807 non-null  float64
 18  V18     284807 non-null  float64
 19  V19     284807 non-null  float64
 20  V20     284807 non-null  float64
 21  V21     284807 non-null  float64
 22  V22     284807 non-null  float64
 23  V23     284807 non-null  float64
 24  V24     284807 non-null  float64
 25  V25     284807 non-null  float64
 26  V26     284807 non-null  float64
 27  V27     284807 non-null  float64
 28  V28     284807 non-null  float64
 29  Amount  284807 non-null  float64
 30  Class   284807 non-null  int64
dtypes: float64(30), int64(1)
memory usage: 67.4 MB
```

In [6]:
```python
pd.set_option("display.float", "{:.2f}".format)
data.describe()
```

Out[6]:

	Time	V1	V2	V3	V4	V5	V6	V7
count	284807.00	284807.00	284807.00	284807.00	284807.00	284807.00	284807.00	284807.00	284
mean	94813.86	0.00	0.00	-0.00	0.00	0.00	0.00	-0.00
std	47488.15	1.96	1.65	1.52	1.42	1.38	1.33	1.24
min	0.00	-56.41	-72.72	-48.33	-5.68	-113.74	-26.16	-43.56
25%	54201.50	-0.92	-0.60	-0.89	-0.85	-0.69	-0.77	-0.55
50%	84692.00	0.02	0.07	0.18	-0.02	-0.05	-0.27	0.04
75%	139320.50	1.32	0.80	1.03	0.74	0.61	0.40	0.57
max	172792.00	2.45	22.06	9.38	16.88	34.80	73.30	120.59

8 rows × 31 columns

Let us now check the missing values in the dataset

```
In [7]:   data.isnull().sum().sum()
```

```
Out[7]:   0
```

```
In [8]:   data.columns
```

```
Out[8]:   Index(['Time', 'V1', 'V2', 'V3', 'V4', 'V5', 'V6', 'V7', 'V8', 'V9', 'V10',
                 'V11', 'V12', 'V13', 'V14', 'V15', 'V16', 'V17', 'V18', 'V19', 'V20',
                 'V21', 'V22', 'V23', 'V24', 'V25', 'V26', 'V27', 'V28', 'Amount',
                 'Class'],
                dtype='object')
```

The only non-transformed variables to work with are:

- `Time`
- `Amount`
- `Class` (1: fraud, 0: not_fraud)

```
In [9]:   LABELS = ["Normal", "Fraud"]

          count_classes = pd.value_counts(data['Class'], sort = True)
          count_classes.plot(kind = 'bar', rot=0)
          plt.title("Transaction Class Distribution")
          plt.xticks(range(2), LABELS)
          plt.xlabel("Class")
          plt.ylabel("Frequency");
```
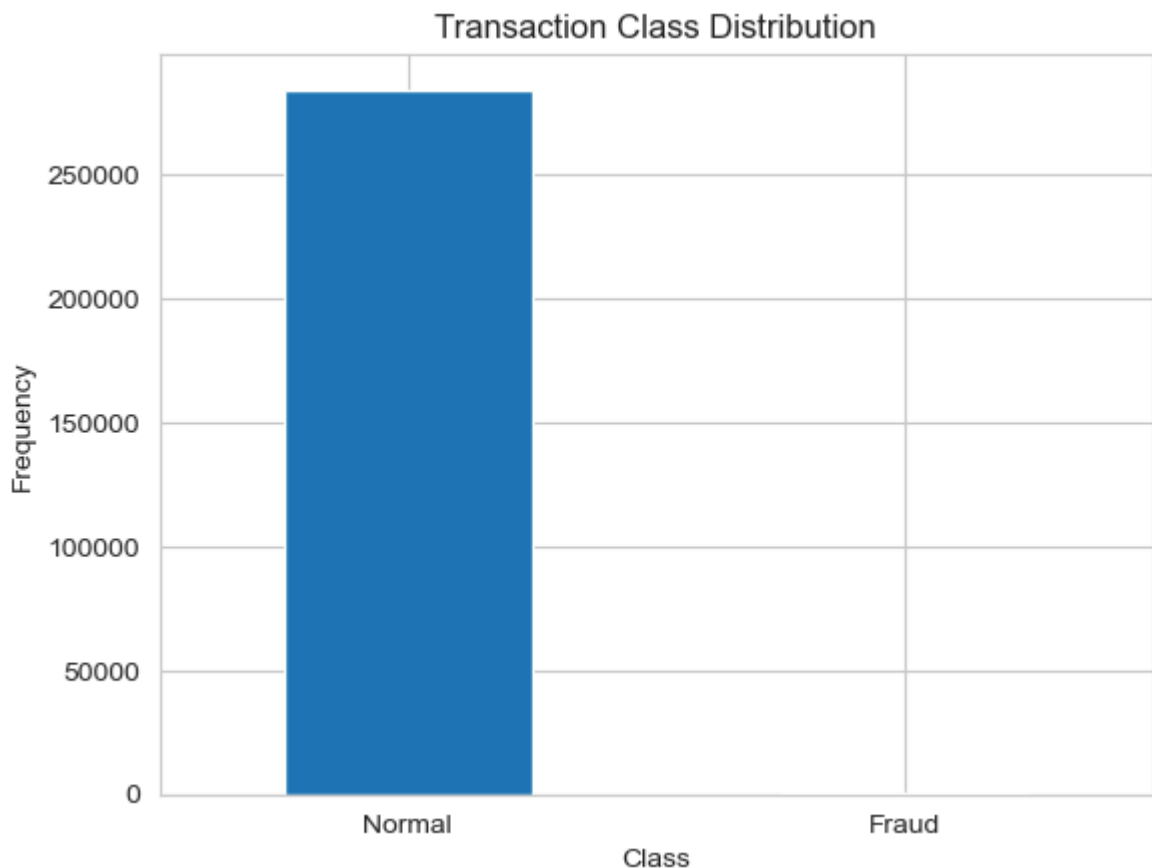


```
In [10]:  data.Class.value_counts()
```

```
Out[10]:  0    284315
          1       492
          Name: Class, dtype: int64
```

Determine the number of fraud and valid transactions in the entire dataset.

```
In [11]:  fraud = data[data['Class']==1]
          normal = data[data['Class']==0]

          print(f"Shape of Fraudulant transactions: {fraud.shape}")
          print(f"Shape of Non-Fraudulant transactions: {normal.shape}")
```

```
Shape of Fraudulant transactions: (492, 31)
Shape of Non-Fraudulant transactions: (284315, 31)
```

How different are the amount of money used in different transaction classes?

```
In [12]:  pd.concat([fraud.Amount.describe(), normal.Amount.describe()], axis=1)
```

Out[12]:

	Amount	Amount
count	492.00	284315.00
mean	122.21	88.29
std	256.68	250.11
min	0.00	0.00
25%	1.00	5.65
50%	9.25	22.00
75%	105.89	77.05
max	2125.87	25691.16

Do fraudulent transactions occur more often during certain time frame ?

```
In [13]:  pd.concat([fraud.Time.describe(), normal.Time.describe()], axis=1)
```

Out[13]:

	Time	Time
count	492.00	284315.00
mean	80746.81	94838.20
std	47835.37	47484.02
min	406.00	0.00
25%	41241.50	54230.00
50%	75568.50	84711.00
75%	128483.00	139333.00
max	170348.00	172792.00

```
In [14]:  # plot the time feature
          plt.figure(figsize=(10,8))

          plt.subplot(2, 2, 1)
          plt.title('Time Distribution (Seconds)')

          sns.distplot(data['Time'], color='blue');

          #plot the amount feature
```

```python
plt.subplot(2, 2, 2)
plt.title('Distribution of Amount')
sns.distplot(data['Amount'],color='blue');
```

```
C:\Users\khush\AppData\Local\Temp\ipykernel_16316\2104970554.py:7: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(data['Time'], color='blue');
C:\Users\khush\AppData\Local\Temp\ipykernel_16316\2104970554.py:12: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(data['Amount'],color='blue');
```
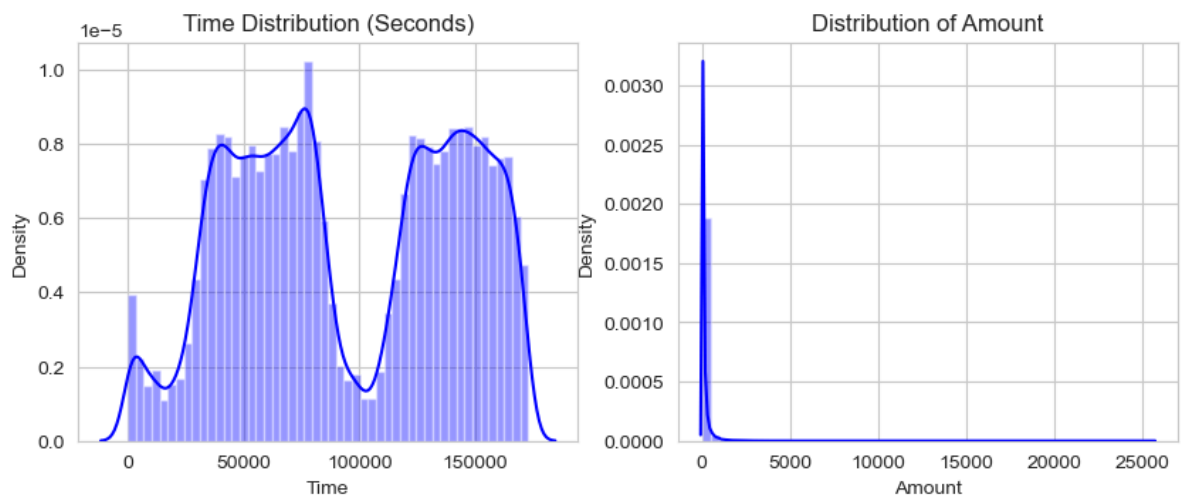

In [15]:
```python
# data[data.Class == 0].Time.hist(bins=35, color='blue', alpha=0.6)
plt.figure(figsize=(12, 10))

plt.subplot(2, 2, 1)
data[data.Class == 1].Time.hist(bins=35, color='blue', alpha=0.6, label="Fraudulant
plt.legend()

plt.subplot(2, 2, 2)
data[data.Class == 0].Time.hist(bins=35, color='blue', alpha=0.6, label="Non Fraudu
plt.legend()
```
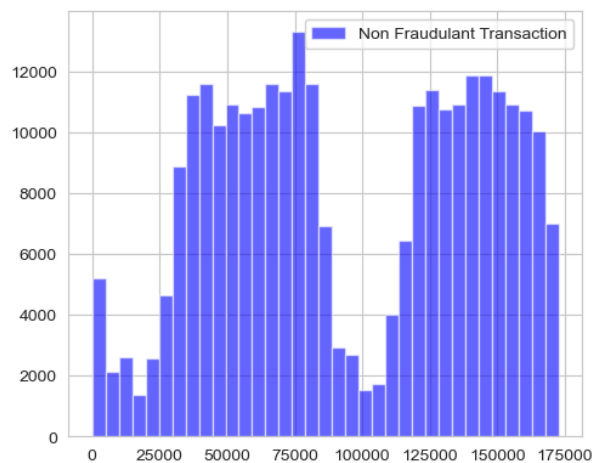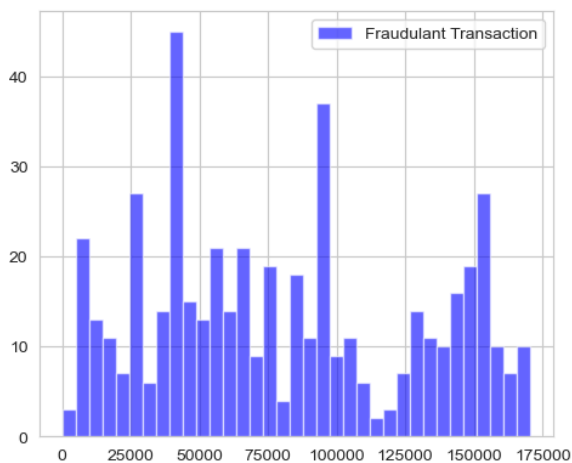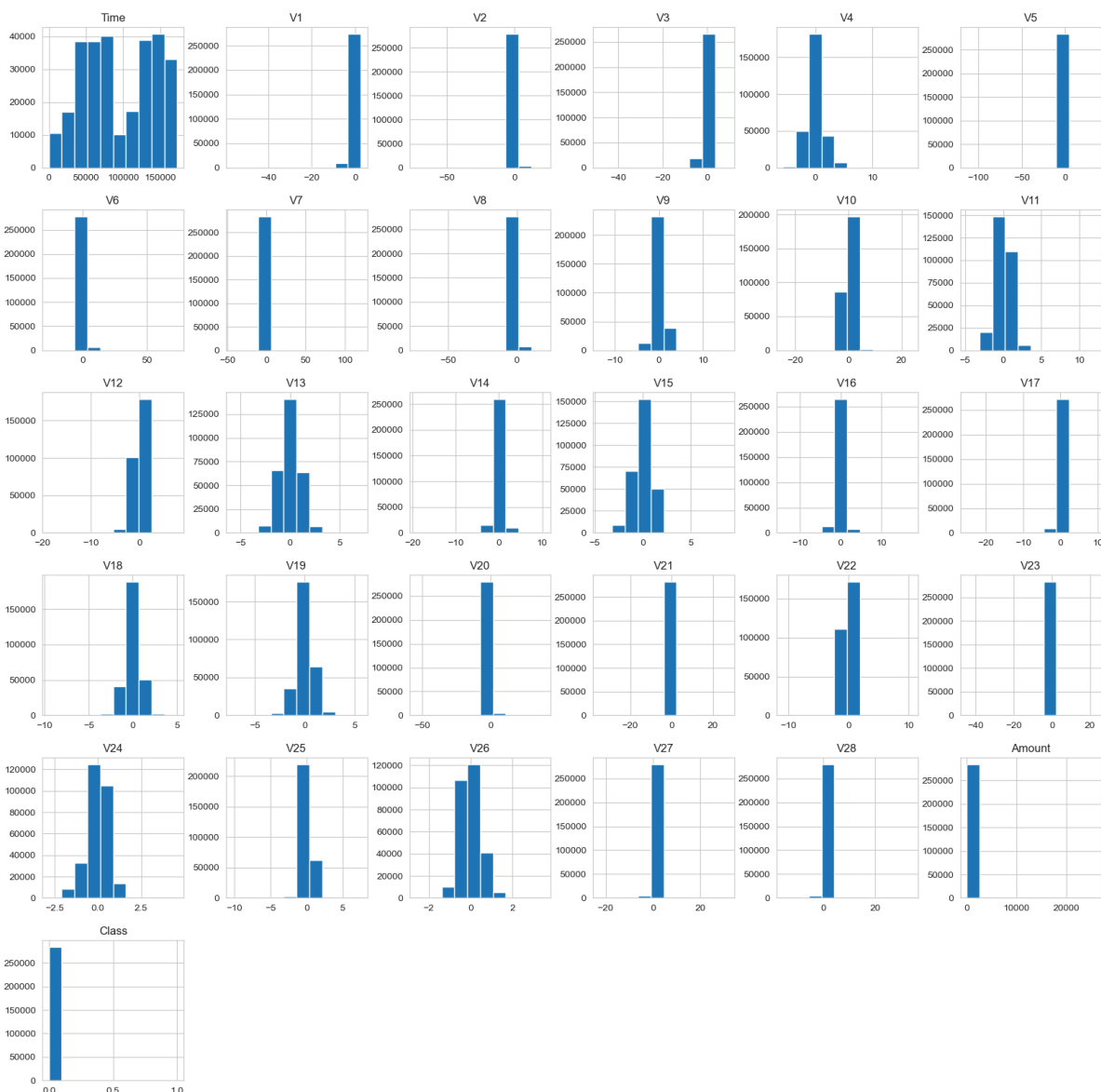
Out[15]:
```
<matplotlib.legend.Legend at 0x298834b7b50>
```
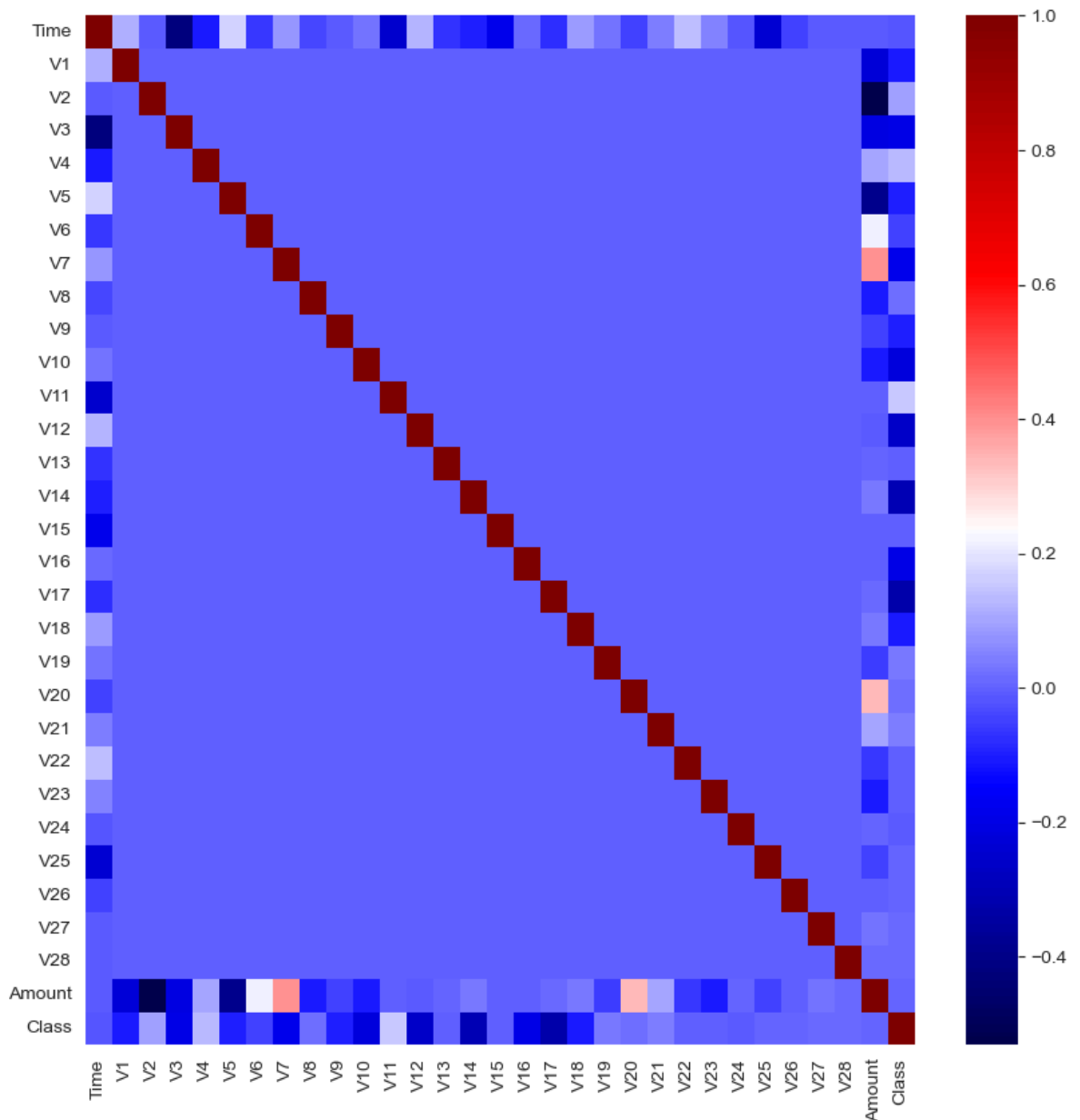
```
In [16]:    data.hist(figsize=(20, 20));
```



```
In [17]:    # heatmap to find any high correlations

            plt.figure(figsize=(10,10))
            sns.heatmap(data=data.corr(), cmap="seismic")
            plt.show();
```

Highest correlations come from:

```
- Time & V3 (-0.42)
- Amount & V2 (-0.53)
- Amount & V4 (0.4)
```

- While these correlations are high, I don't expect it to run the risk of multicollinearity.

- The correlation matrix shows also that none of the V1 to V28 PCA components have any correlation to each other however if we observe Class has some form positive and negative correlations with the V components but has no correlation with Time and Amount.

3. Data Pre-processing

`Time` and `Amount` should be scaled as the other columns.

```python
In [18]:   from sklearn.model_selection import train_test_split
           from sklearn.preprocessing import StandardScaler

           scalar = StandardScaler()

           X = data.drop('Class', axis=1)
           y = data.Class

           X_train_v, X_test, y_train_v, y_test = train_test_split(X, y,
                                                    test_size=0.3, random_state=42)
           X_train, X_validate, y_train, y_validate = train_test_split(X_train_v, y_train_v,
                                                    test_size=0.2, random_s

           X_train = scalar.fit_transform(X_train)
           X_validate = scalar.transform(X_validate)
           X_test = scalar.transform(X_test)

           w_p = y_train.value_counts()[0] / len(y_train)
           w_n = y_train.value_counts()[1] / len(y_train)

           print(f"Fraudulant transaction weight: {w_n}")
           print(f"Non-Fraudulant transaction weight: {w_p}")
```

```
Fraudulant transaction weight: 0.0017994745785028623
Non-Fraudulant transaction weight: 0.9982005254214972
```

```python
In [19]:   print(f"TRAINING: X_train: {X_train.shape}, y_train: {y_train.shape}\n{'_'*55}")
           print(f"VALIDATION: X_validate: {X_validate.shape}, y_validate: {y_validate.shape}\
           print(f"TESTING: X_test: {X_test.shape}, y_test: {y_test.shape}")
```

```
TRAINING: X_train: (159491, 30), y_train: (159491,)
_____
VALIDATION: X_validate: (39873, 30), y_validate: (39873,)
_____
TESTING: X_test: (85443, 30), y_test: (85443,)
```

```python
In [20]:   from sklearn.metrics import accuracy_score, confusion_matrix, classification_report

           def print_score(label, prediction, train=True):
               if train:
                   clf_report = pd.DataFrame(classification_report(label, prediction, output_d
                   print("Train Result:\n================================================")
                   print(f"Accuracy Score: {accuracy_score(label, prediction) * 100:.2f}%")
                   print("_____")
                   print(f"Classification Report:\n{clf_report}")
                   print("_____")
                   print(f"Confusion Matrix: \n {confusion_matrix(y_train, prediction)}\n")

               elif train==False:
                   clf_report = pd.DataFrame(classification_report(label, prediction, output_d
                   print("Test Result:\n================================================")
                   print(f"Accuracy Score: {accuracy_score(label, prediction) * 100:.2f}%")
                   print("_____")
                   print(f"Classification Report:\n{clf_report}")
                   print("_____")
                   print(f"Confusion Matrix: \n {confusion_matrix(label, prediction)}\n")
```

4. Model Building

4. 1. Artificial Neural Network (ANNs)

In [21]:
```python
from imblearn.over_sampling import SMOTE

# Resampling the minority class. The strategy can be changed as required.

sm = SMOTE(sampling_strategy='minority', random_state=42)

# Fit the model to generate the data.

X_smote, y_smote = sm.fit_resample(data.drop('Class', axis=1), data['Class'])
smote_df = pd.concat([pd.DataFrame(X_smote), pd.DataFrame(y_smote)], axis=1)
X_smote.shape
```

Out[21]: (568630, 30)

In [22]:
```python
from tensorflow import keras

model = keras.Sequential([
    keras.layers.Dense(256, activation='relu', input_shape=(X_train.shape[-1],)),
    keras.layers.BatchNormalization(),
    keras.layers.Dropout(0.3),
    keras.layers.Dense(256, activation='relu'),
    keras.layers.BatchNormalization(),
    keras.layers.Dropout(0.3),
    keras.layers.Dense(256, activation='relu'),
    keras.layers.BatchNormalization(),
    keras.layers.Dropout(0.3),
    keras.layers.Dense(1, activation='sigmoid'),
])

model.summary()
```

```
C:\Users\khush\anaconda3\lib\site-packages\keras\src\layers\core\dense.py:87: User
Warning: 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: "sequential"

Layer (type)	Output Shape	
dense (Dense)	(None, 256)	
batch_normalization (BatchNormalization)	(None, 256)	
dropout (Dropout)	(None, 256)	
dense_1 (Dense)	(None, 256)	
batch_normalization_1 (BatchNormalization)	(None, 256)	
dropout_1 (Dropout)	(None, 256)	
dense_2 (Dense)	(None, 256)	
batch_normalization_2 (BatchNormalization)	(None, 256)	
dropout_2 (Dropout)	(None, 256)	
dense_3 (Dense)	(None, 1)	

Total params: 142,849 (558.00 KB)

Trainable params: 141,313 (552.00 KB)

In [23]:
```python
import keras

METRICS = [
    keras.metrics.FalseNegatives(name='fn'),
    keras.metrics.FalsePositives(name='fp'),
    keras.metrics.TrueNegatives(name='tn'),
    keras.metrics.TruePositives(name='tp'),
    keras.metrics.Precision(name='precision'),
    keras.metrics.Recall(name='recall')
]

model.compile(optimizer=keras.optimizers.Adam(1e-3), loss='binary_crossentropy', me

# Change the file extension to .keras
callbacks = [keras.callbacks.ModelCheckpoint('fraud_model_at_epoch_{epoch}.keras')]

class_weight = {0: w_p, 1: w_n}

r = model.fit(
    X_train, y_train,
    validation_data=(X_validate, y_validate),
    batch_size=2048,
    epochs=300,
    # class_weight=class_weight,
    callbacks=callbacks,
)
```

```
Epoch 1/300
78/78 ───────────────────────── 6s 34ms/step - fn: 24.8608 - fp: 20949.1016 - loss: 0.6
440 - precision: 0.0053 - recall: 0.8351 - tn: 60789.5430 - tp: 124.1646 - val_fn:
13.0000 - val_fp: 14.0000 - val_loss: 0.1694 - val_precision: 0.8000 - val_recall:
0.8116 - val_tn: 39790.0000 - val_tp: 56.0000
Epoch 2/300
78/78 ───────────────────────── 2s 23ms/step - fn: 47.0886 - fp: 376.9747 - loss: 0.141
8 - precision: 0.2002 - recall: 0.7150 - tn: 81357.8516 - tp: 105.7595 - val_fn: 2
1.0000 - val_fp: 10.0000 - val_loss: 0.0390 - val_precision: 0.8276 - val_recall:
0.6957 - val_tn: 39794.0000 - val_tp: 48.0000
Epoch 3/300
78/78 ───────────────────────── 4s 56ms/step - fn: 48.9240 - fp: 71.6076 - loss: 0.0413
 - precision: 0.6299 - recall: 0.6776 - tn: 81656.4688 - tp: 110.6709 - val_fn: 14.
0000 - val_fp: 12.0000 - val_loss: 0.0172 - val_precision: 0.8209 - val_recall: 0.
7971 - val_tn: 39792.0000 - val_tp: 55.0000
Epoch 4/300
78/78 ───────────────────────── 2s 27ms/step - fn: 44.7342 - fp: 47.4051 - loss: 0.0228
 - precision: 0.7050 - recall: 0.7168 - tn: 81692.3438 - tp: 103.1899 - val_fn: 14.
0000 - val_fp: 14.0000 - val_loss: 0.0147 - val_precision: 0.7971 - val_recall: 0.
7971 - val_tn: 39790.0000 - val_tp: 55.0000
Epoch 5/300
78/78 ───────────────────────── 2s 22ms/step - fn: 45.1392 - fp: 36.7975 - loss: 0.0174
 - precision: 0.7113 - recall: 0.6850 - tn: 81705.3516 - tp: 100.3797 - val_fn: 13.
0000 - val_fp: 14.0000 - val_loss: 0.0130 - val_precision: 0.8000 - val_recall: 0.
8116 - val_tn: 39790.0000 - val_tp: 56.0000
Epoch 6/300
78/78 ───────────────────────── 2s 26ms/step - fn: 46.7722 - fp: 32.0253 - loss: 0.0145
 - precision: 0.7755 - recall: 0.6845 - tn: 81705.7969 - tp: 103.0760 - val_fn: 14.
0000 - val_fp: 14.0000 - val_loss: 0.0098 - val_precision: 0.7971 - val_recall: 0.
7971 - val_tn: 39790.0000 - val_tp: 55.0000
Epoch 7/300
78/78 ───────────────────────── 2s 24ms/step - fn: 49.0127 - fp: 23.8734 - loss: 0.0118
 - precision: 0.8043 - recall: 0.6668 - tn: 81719.8203 - tp: 94.9620 - val_fn: 13.0
000 - val_fp: 14.0000 - val_loss: 0.0130 - val_precision: 0.8000 - val_recall: 0.8
116 - val_tn: 39790.0000 - val_tp: 56.0000
Epoch 8/300
78/78 ───────────────────────── 2s 23ms/step - fn: 43.6709 - fp: 21.9747 - loss: 0.0084
 - precision: 0.8416 - recall: 0.7517 - tn: 81712.2812 - tp: 109.7468 - val_fn: 13.
0000 - val_fp: 14.0000 - val_loss: 0.0122 - val_precision: 0.8000 - val_recall: 0.
8116 - val_tn: 39790.0000 - val_tp: 56.0000
Epoch 9/300
78/78 ───────────────────────── 2s 26ms/step - fn: 46.5190 - fp: 24.6582 - loss: 0.0123
 - precision: 0.8029 - recall: 0.7008 - tn: 81711.3672 - tp: 105.1266 - val_fn: 15.
0000 - val_fp: 12.0000 - val_loss: 0.0065 - val_precision: 0.8182 - val_recall: 0.
7826 - val_tn: 39792.0000 - val_tp: 54.0000
Epoch 10/300
78/78 ───────────────────────── 2s 27ms/step - fn: 48.4177 - fp: 16.5570 - loss: 0.0085
 - precision: 0.8136 - recall: 0.6498 - tn: 81730.4531 - tp: 92.2405 - val_fn: 16.0
000 - val_fp: 11.0000 - val_loss: 0.0056 - val_precision: 0.8281 - val_recall: 0.7
681 - val_tn: 39793.0000 - val_tp: 53.0000
Epoch 11/300
78/78 ───────────────────────── 2s 28ms/step - fn: 54.1646 - fp: 19.4684 - loss: 0.0065
 - precision: 0.8096 - recall: 0.6612 - tn: 81713.3828 - tp: 100.6582 - val_fn: 15.
0000 - val_fp: 11.0000 - val_loss: 0.0064 - val_precision: 0.8308 - val_recall: 0.
7826 - val_tn: 39793.0000 - val_tp: 54.0000
Epoch 12/300
78/78 ───────────────────────── 2s 24ms/step - fn: 53.3671 - fp: 16.2911 - loss: 0.0065
 - precision: 0.8464 - recall: 0.6279 - tn: 81722.3672 - tp: 95.6456 - val_fn: 18.0
000 - val_fp: 13.0000 - val_loss: 0.0051 - val_precision: 0.7969 - val_recall: 0.7
391 - val_tn: 39791.0000 - val_tp: 51.0000
Epoch 13/300
78/78 ───────────────────────── 2s 23ms/step - fn: 50.3671 - fp: 16.0506 - loss: 0.0049
 - precision: 0.8687 - recall: 0.6574 - tn: 81720.9609 - tp: 100.2911 - val_fn: 13.
0000 - val_fp: 14.0000 - val_loss: 0.0057 - val_precision: 0.8000 - val_recall: 0.
```

8116 - val_tn: 39790.0000 - val_tp: 56.0000
Epoch 14/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 24ms/step - fn: 42.3544 - fp: 13.4177 - loss: 0.0045
- precision: 0.8620 - recall: 0.7158 - tn: 81729.0859 - tp: 102.8101 - val_fn: 14.
0000 - val_fp: 11.0000 - val_loss: 0.0052 - val_precision: 0.8333 - val_recall: 0.
7971 - val_tn: 39793.0000 - val_tp: 55.0000
Epoch 15/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 27ms/step - fn: 42.5949 - fp: 12.1646 - loss: 0.0045
- precision: 0.8840 - recall: 0.7150 - tn: 81730.2188 - tp: 102.6962 - val_fn: 19.
0000 - val_fp: 9.0000 - val_loss: 0.0050 - val_precision: 0.8475 - val_recall: 0.7
246 - val_tn: 39795.0000 - val_tp: 50.0000
Epoch 16/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 28ms/step - fn: 41.5823 - fp: 12.2658 - loss: 0.0031
- precision: 0.9158 - recall: 0.7379 - tn: 81730.2031 - tp: 103.6203 - val_fn: 18.
0000 - val_fp: 8.0000 - val_loss: 0.0045 - val_precision: 0.8644 - val_recall: 0.7
391 - val_tn: 39796.0000 - val_tp: 51.0000
Epoch 17/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 25ms/step - fn: 48.7468 - fp: 13.3924 - loss: 0.0040
- precision: 0.8782 - recall: 0.6837 - tn: 81720.9609 - tp: 104.5696 - val_fn: 15.
0000 - val_fp: 8.0000 - val_loss: 0.0046 - val_precision: 0.8710 - val_recall: 0.7
826 - val_tn: 39796.0000 - val_tp: 54.0000
Epoch 18/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 23ms/step - fn: 39.8354 - fp: 13.0759 - loss: 0.0034
- precision: 0.9006 - recall: 0.7430 - tn: 81730.5938 - tp: 104.1646 - val_fn: 15.
0000 - val_fp: 9.0000 - val_loss: 0.0047 - val_precision: 0.8571 - val_recall: 0.7
826 - val_tn: 39795.0000 - val_tp: 54.0000
Epoch 19/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 24ms/step - fn: 38.1519 - fp: 10.6203 - loss: 0.0034
- precision: 0.8979 - recall: 0.7498 - tn: 81734.1484 - tp: 104.7468 - val_fn: 21.
0000 - val_fp: 6.0000 - val_loss: 0.0043 - val_precision: 0.8889 - val_recall: 0.6
957 - val_tn: 39798.0000 - val_tp: 48.0000
Epoch 20/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 24ms/step - fn: 43.3797 - fp: 10.7215 - loss: 0.0038
- precision: 0.8976 - recall: 0.6779 - tn: 81731.4141 - tp: 102.1519 - val_fn: 19.
0000 - val_fp: 6.0000 - val_loss: 0.0041 - val_precision: 0.8929 - val_recall: 0.7
246 - val_tn: 39798.0000 - val_tp: 50.0000
Epoch 21/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 26ms/step - fn: 45.3291 - fp: 12.9873 - loss: 0.0036
- precision: 0.8811 - recall: 0.6705 - tn: 81726.2656 - tp: 103.0886 - val_fn: 20.
0000 - val_fp: 6.0000 - val_loss: 0.0043 - val_precision: 0.8909 - val_recall: 0.7
101 - val_tn: 39798.0000 - val_tp: 49.0000
Epoch 22/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 24ms/step - fn: 38.9240 - fp: 11.1646 - loss: 0.0032
- precision: 0.9121 - recall: 0.7318 - tn: 81729.3203 - tp: 108.2658 - val_fn: 14.
0000 - val_fp: 9.0000 - val_loss: 0.0044 - val_precision: 0.8594 - val_recall: 0.7
971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 23/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 23ms/step - fn: 33.4304 - fp: 8.2532 - loss: 0.0034
- precision: 0.9363 - recall: 0.7908 - tn: 81724.2188 - tp: 121.7721 - val_fn: 15.
0000 - val_fp: 8.0000 - val_loss: 0.0044 - val_precision: 0.8710 - val_recall: 0.7
826 - val_tn: 39796.0000 - val_tp: 54.0000
Epoch 24/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 23ms/step - fn: 33.5316 - fp: 11.9367 - loss: 0.0030
- precision: 0.8952 - recall: 0.7617 - tn: 81733.2031 - tp: 109.0000 - val_fn: 12.
0000 - val_fp: 12.0000 - val_loss: 0.0047 - val_precision: 0.8261 - val_recall: 0.
8261 - val_tn: 39792.0000 - val_tp: 57.0000
Epoch 25/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 24ms/step - fn: 41.1772 - fp: 11.5949 - loss: 0.0036
- precision: 0.8824 - recall: 0.7154 - tn: 81730.0469 - tp: 104.8481 - val_fn: 13.
0000 - val_fp: 12.0000 - val_loss: 0.0052 - val_precision: 0.8235 - val_recall: 0.
8116 - val_tn: 39792.0000 - val_tp: 56.0000
Epoch 26/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 24ms/step - fn: 38.7342 - fp: 11.5949 - loss: 0.0031
- precision: 0.9091 - recall: 0.7529 - tn: 81722.6328 - tp: 114.7089 - val_fn: 18.

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0000 - val_fp: 8.0000 - val_loss: 0.0044 - val_precision: 0.8644 - val_recall: 0.7
391 - val_tn: 39796.0000 - val_tp: 51.0000
Epoch 27/300
78/78 ──────────────────────── 2s 24ms/step - fn: 37.4430 - fp: 12.4177 - loss: 0.0025
- precision: 0.9064 - recall: 0.7533 - tn: 81724.8125 - tp: 113.0000 - val_fn: 12.
0000 - val_fp: 12.0000 - val_loss: 0.0053 - val_precision: 0.8261 - val_recall: 0.
8261 - val_tn: 39792.0000 - val_tp: 57.0000
Epoch 28/300
78/78 ──────────────────────── 2s 25ms/step - fn: 32.2658 - fp: 13.7722 - loss: 0.0029
- precision: 0.8894 - recall: 0.8003 - tn: 81723.0859 - tp: 118.5443 - val_fn: 14.
0000 - val_fp: 9.0000 - val_loss: 0.0043 - val_precision: 0.8594 - val_recall: 0.7
971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 29/300
78/78 ──────────────────────── 2s 23ms/step - fn: 30.1899 - fp: 7.3924 - loss: 0.0023
- precision: 0.9423 - recall: 0.8043 - tn: 81728.5469 - tp: 121.5443 - val_fn: 13.
0000 - val_fp: 9.0000 - val_loss: 0.0047 - val_precision: 0.8615 - val_recall: 0.8
116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 30/300
78/78 ──────────────────────── 2s 23ms/step - fn: 34.0380 - fp: 11.5949 - loss: 0.0029
- precision: 0.9013 - recall: 0.7703 - tn: 81727.4062 - tp: 114.6329 - val_fn: 14.
0000 - val_fp: 7.0000 - val_loss: 0.0045 - val_precision: 0.8871 - val_recall: 0.7
971 - val_tn: 39797.0000 - val_tp: 55.0000
Epoch 31/300
78/78 ──────────────────────── 2s 23ms/step - fn: 29.9241 - fp: 9.5316 - loss: 0.0021
- precision: 0.9285 - recall: 0.8114 - tn: 81729.7734 - tp: 118.4430 - val_fn: 22.
0000 - val_fp: 6.0000 - val_loss: 0.0044 - val_precision: 0.8868 - val_recall: 0.6
812 - val_tn: 39798.0000 - val_tp: 47.0000
Epoch 32/300
78/78 ──────────────────────── 2s 26ms/step - fn: 35.5063 - fp: 14.5190 - loss: 0.0024
- precision: 0.8785 - recall: 0.7351 - tn: 81730.0859 - tp: 107.5570 - val_fn: 14.
0000 - val_fp: 9.0000 - val_loss: 0.0048 - val_precision: 0.8594 - val_recall: 0.7
971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 33/300
78/78 ──────────────────────── 2s 22ms/step - fn: 36.8734 - fp: 12.1266 - loss: 0.0023
- precision: 0.9020 - recall: 0.7522 - tn: 81728.9844 - tp: 109.6835 - val_fn: 15.
0000 - val_fp: 6.0000 - val_loss: 0.0046 - val_precision: 0.9000 - val_recall: 0.7
826 - val_tn: 39798.0000 - val_tp: 54.0000
Epoch 34/300
78/78 ──────────────────────── 2s 24ms/step - fn: 39.6329 - fp: 13.6329 - loss: 0.0021
- precision: 0.8897 - recall: 0.7496 - tn: 81725.8828 - tp: 108.5190 - val_fn: 16.
0000 - val_fp: 6.0000 - val_loss: 0.0045 - val_precision: 0.8983 - val_recall: 0.7
681 - val_tn: 39798.0000 - val_tp: 53.0000
Epoch 35/300
78/78 ──────────────────────── 2s 24ms/step - fn: 34.2911 - fp: 8.0380 - loss: 0.0024
- precision: 0.9427 - recall: 0.7575 - tn: 81732.8984 - tp: 112.4430 - val_fn: 14.
0000 - val_fp: 6.0000 - val_loss: 0.0044 - val_precision: 0.9016 - val_recall: 0.7
971 - val_tn: 39798.0000 - val_tp: 55.0000
Epoch 36/300
78/78 ──────────────────────── 2s 23ms/step - fn: 34.9114 - fp: 7.3671 - loss: 0.0027
- precision: 0.9427 - recall: 0.7459 - tn: 81733.2266 - tp: 112.1646 - val_fn: 15.
0000 - val_fp: 7.0000 - val_loss: 0.0049 - val_precision: 0.8852 - val_recall: 0.7
826 - val_tn: 39797.0000 - val_tp: 54.0000
Epoch 37/300
78/78 ──────────────────────── 3s 36ms/step - fn: 28.7848 - fp: 7.6962 - loss: 0.0018
- precision: 0.9421 - recall: 0.8042 - tn: 81726.5859 - tp: 124.6076 - val_fn: 18.
0000 - val_fp: 5.0000 - val_loss: 0.0048 - val_precision: 0.9107 - val_recall: 0.7
391 - val_tn: 39799.0000 - val_tp: 51.0000
Epoch 38/300
78/78 ──────────────────────── 3s 37ms/step - fn: 33.7595 - fp: 9.1646 - loss: 0.0023
- precision: 0.9354 - recall: 0.7846 - tn: 81723.3672 - tp: 121.3797 - val_fn: 13.
0000 - val_fp: 9.0000 - val_loss: 0.0049 - val_precision: 0.8615 - val_recall: 0.8
116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 39/300
78/78 ──────────────────────── 2s 24ms/step - fn: 27.8228 - fp: 7.8481 - loss: 0.0019
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            - precision: 0.9236 - recall: 0.8035 - tn: 81735.0781 - tp: 116.9240 - val_fn: 15.
            0000 - val_fp: 6.0000 - val_loss: 0.0045 - val_precision: 0.9000 - val_recall: 0.7
            826 - val_tn: 39798.0000 - val_tp: 54.0000
            Epoch 40/300
            78/78 ───────────────────────── 2s 22ms/step - fn: 30.3544 - fp: 8.2658 - loss: 0.0022
            - precision: 0.9344 - recall: 0.7776 - tn: 81735.5078 - tp: 113.5443 - val_fn: 14.
            0000 - val_fp: 7.0000 - val_loss: 0.0044 - val_precision: 0.8871 - val_recall: 0.7
            971 - val_tn: 39797.0000 - val_tp: 55.0000
            Epoch 41/300
            78/78 ───────────────────────── 2s 24ms/step - fn: 24.7722 - fp: 9.3924 - loss: 0.0017
            - precision: 0.9319 - recall: 0.8465 - tn: 81728.0391 - tp: 125.4684 - val_fn: 17.
            0000 - val_fp: 7.0000 - val_loss: 0.0045 - val_precision: 0.8814 - val_recall: 0.7
            536 - val_tn: 39797.0000 - val_tp: 52.0000
            Epoch 42/300
            78/78 ───────────────────────── 2s 22ms/step - fn: 24.3924 - fp: 7.8608 - loss: 0.0016
            - precision: 0.9382 - recall: 0.8379 - tn: 81736.2266 - tp: 119.1899 - val_fn: 16.
            0000 - val_fp: 7.0000 - val_loss: 0.0045 - val_precision: 0.8833 - val_recall: 0.7
            681 - val_tn: 39797.0000 - val_tp: 53.0000
            Epoch 43/300
            78/78 ───────────────────────── 2s 24ms/step - fn: 26.0633 - fp: 12.6329 - loss: 0.0018
            - precision: 0.9038 - recall: 0.8283 - tn: 81722.4297 - tp: 126.5443 - val_fn: 14.
            0000 - val_fp: 6.0000 - val_loss: 0.0045 - val_precision: 0.9016 - val_recall: 0.7
            971 - val_tn: 39798.0000 - val_tp: 55.0000
            Epoch 44/300
            78/78 ───────────────────────── 2s 25ms/step - fn: 31.7848 - fp: 10.8354 - loss: 0.0019
            - precision: 0.9154 - recall: 0.7788 - tn: 81720.7188 - tp: 124.3291 - val_fn: 14.
            0000 - val_fp: 8.0000 - val_loss: 0.0048 - val_precision: 0.8730 - val_recall: 0.7
            971 - val_tn: 39796.0000 - val_tp: 55.0000
            Epoch 45/300
            78/78 ───────────────────────── 2s 23ms/step - fn: 30.4304 - fp: 10.1519 - loss: 0.0017
            - precision: 0.9235 - recall: 0.7830 - tn: 81735.8359 - tp: 111.2532 - val_fn: 16.
            0000 - val_fp: 7.0000 - val_loss: 0.0046 - val_precision: 0.8833 - val_recall: 0.7
            681 - val_tn: 39797.0000 - val_tp: 53.0000
            Epoch 46/300
            78/78 ───────────────────────── 2s 23ms/step - fn: 29.7848 - fp: 7.3291 - loss: 0.0019
            - precision: 0.9614 - recall: 0.7991 - tn: 81726.2812 - tp: 124.2785 - val_fn: 15.
            0000 - val_fp: 7.0000 - val_loss: 0.0046 - val_precision: 0.8852 - val_recall: 0.7
            826 - val_tn: 39797.0000 - val_tp: 54.0000
            Epoch 47/300
            78/78 ───────────────────────── 2s 27ms/step - fn: 23.3544 - fp: 7.5190 - loss: 0.0016
            - precision: 0.9438 - recall: 0.8463 - tn: 81734.4453 - tp: 122.3544 - val_fn: 14.
            0000 - val_fp: 7.0000 - val_loss: 0.0044 - val_precision: 0.8871 - val_recall: 0.7
            971 - val_tn: 39797.0000 - val_tp: 55.0000
            Epoch 48/300
            78/78 ───────────────────────── 2s 30ms/step - fn: 26.8481 - fp: 8.9747 - loss: 0.0015
            - precision: 0.9433 - recall: 0.8387 - tn: 81723.4453 - tp: 128.4051 - val_fn: 13.
            0000 - val_fp: 7.0000 - val_loss: 0.0045 - val_precision: 0.8889 - val_recall: 0.8
            116 - val_tn: 39797.0000 - val_tp: 56.0000
            Epoch 49/300
            78/78 ───────────────────────── 2s 25ms/step - fn: 28.4557 - fp: 9.1899 - loss: 0.0018
            - precision: 0.9291 - recall: 0.8070 - tn: 81726.7969 - tp: 123.2279 - val_fn: 15.
            0000 - val_fp: 7.0000 - val_loss: 0.0047 - val_precision: 0.8852 - val_recall: 0.7
            826 - val_tn: 39797.0000 - val_tp: 54.0000
            Epoch 50/300
            78/78 ───────────────────────── 2s 26ms/step - fn: 29.2658 - fp: 10.5443 - loss: 0.0019
            - precision: 0.9128 - recall: 0.7969 - tn: 81733.9531 - tp: 113.9114 - val_fn: 14.
            0000 - val_fp: 7.0000 - val_loss: 0.0048 - val_precision: 0.8871 - val_recall: 0.7
            971 - val_tn: 39797.0000 - val_tp: 55.0000
            Epoch 51/300
            78/78 ───────────────────────── 2s 25ms/step - fn: 22.7722 - fp: 7.4304 - loss: 0.0021
            - precision: 0.9434 - recall: 0.8604 - tn: 81731.8203 - tp: 125.6456 - val_fn: 14.
            0000 - val_fp: 7.0000 - val_loss: 0.0043 - val_precision: 0.8871 - val_recall: 0.7
            971 - val_tn: 39797.0000 - val_tp: 55.0000
            Epoch 52/300
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78/78 ───────────────── **2s** 23ms/step - fn: 24.3671 - fp: 5.7215 - loss: 0.0016
- precision: 0.9611 - recall: 0.8363 - tn: 81727.7969 - tp: 129.7848 - val_fn: 13.
0000 - val_fp: 6.0000 - val_loss: 0.0044 - val_precision: 0.9032 - val_recall: 0.8
116 - val_tn: 39798.0000 - val_tp: 56.0000
Epoch 53/300
78/78 ───────────────── **2s** 24ms/step - fn: 23.3671 - fp: 4.8354 - loss: 0.0012
- precision: 0.9702 - recall: 0.8366 - tn: 81737.8516 - tp: 121.6203 - val_fn: 16.
0000 - val_fp: 8.0000 - val_loss: 0.0049 - val_precision: 0.8689 - val_recall: 0.7
681 - val_tn: 39796.0000 - val_tp: 53.0000
Epoch 54/300
78/78 ───────────────── **2s** 22ms/step - fn: 27.1392 - fp: 8.2025 - loss: 0.0017
- precision: 0.9312 - recall: 0.8178 - tn: 81729.0156 - tp: 123.3165 - val_fn: 16.
0000 - val_fp: 9.0000 - val_loss: 0.0049 - val_precision: 0.8548 - val_recall: 0.7
681 - val_tn: 39795.0000 - val_tp: 53.0000
Epoch 55/300
78/78 ───────────────── **2s** 22ms/step - fn: 21.2405 - fp: 6.6582 - loss: 0.0010
- precision: 0.9554 - recall: 0.8691 - tn: 81734.2188 - tp: 125.5570 - val_fn: 14.
0000 - val_fp: 7.0000 - val_loss: 0.0048 - val_precision: 0.8871 - val_recall: 0.7
971 - val_tn: 39797.0000 - val_tp: 55.0000
Epoch 56/300
78/78 ───────────────── **2s** 22ms/step - fn: 22.6582 - fp: 7.1772 - loss: 0.0013
- precision: 0.9519 - recall: 0.8548 - tn: 81731.2656 - tp: 126.5696 - val_fn: 13.
0000 - val_fp: 11.0000 - val_loss: 0.0048 - val_precision: 0.8358 - val_recall: 0.
8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 57/300
78/78 ───────────────── **2s** 21ms/step - fn: 23.3924 - fp: 7.4557 - loss: 0.0015
- precision: 0.9441 - recall: 0.8453 - tn: 81734.5078 - tp: 122.3165 - val_fn: 13.
0000 - val_fp: 9.0000 - val_loss: 0.0048 - val_precision: 0.8615 - val_recall: 0.8
116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 58/300
78/78 ───────────────── **2s** 22ms/step - fn: 25.2911 - fp: 11.9114 - loss: 0.0018
- precision: 0.9135 - recall: 0.8351 - tn: 81723.4141 - tp: 127.0506 - val_fn: 13.
0000 - val_fp: 11.0000 - val_loss: 0.0055 - val_precision: 0.8358 - val_recall: 0.
8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 59/300
78/78 ───────────────── **2s** 20ms/step - fn: 22.3544 - fp: 8.7722 - loss: 0.0017
- precision: 0.9238 - recall: 0.8206 - tn: 81738.5078 - tp: 118.0380 - val_fn: 15.
0000 - val_fp: 8.0000 - val_loss: 0.0046 - val_precision: 0.8710 - val_recall: 0.7
826 - val_tn: 39796.0000 - val_tp: 54.0000
Epoch 60/300
78/78 ───────────────── **2s** 20ms/step - fn: 22.8101 - fp: 10.6329 - loss: 0.0013
- precision: 0.9239 - recall: 0.8584 - tn: 81723.4141 - tp: 130.8101 - val_fn: 13.
0000 - val_fp: 8.0000 - val_loss: 0.0057 - val_precision: 0.8750 - val_recall: 0.8
116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 61/300
78/78 ───────────────── **2s** 22ms/step - fn: 16.8354 - fp: 3.4810 - loss: 0.0010
- precision: 0.9816 - recall: 0.8973 - tn: 81739.6797 - tp: 127.6709 - val_fn: 13.
0000 - val_fp: 8.0000 - val_loss: 0.0054 - val_precision: 0.8750 - val_recall: 0.8
116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 62/300
78/78 ───────────────── **2s** 22ms/step - fn: 21.3671 - fp: 6.2278 - loss: 0.0011
- precision: 0.9633 - recall: 0.8743 - tn: 81732.9531 - tp: 127.1266 - val_fn: 13.
0000 - val_fp: 8.0000 - val_loss: 0.0053 - val_precision: 0.8750 - val_recall: 0.8
116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 63/300
78/78 ───────────────── **2s** 22ms/step - fn: 18.7595 - fp: 6.6203 - loss: 0.0011
- precision: 0.9600 - recall: 0.8698 - tn: 81730.7109 - tp: 131.5823 - val_fn: 13.
0000 - val_fp: 11.0000 - val_loss: 0.0057 - val_precision: 0.8358 - val_recall: 0.
8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 64/300
78/78 ───────────────── **2s** 22ms/step - fn: 24.4177 - fp: 11.9620 - loss: 0.0017
- precision: 0.8907 - recall: 0.8389 - tn: 81727.0469 - tp: 124.2405 - val_fn: 14.
0000 - val_fp: 10.0000 - val_loss: 0.0056 - val_precision: 0.8462 - val_recall: 0.
7971 - val_tn: 39794.0000 - val_tp: 55.0000

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Epoch 65/300
78/78 ───────────────────── 2s 22ms/step - fn: 21.3165 - fp: 9.1519 - loss: 0.0013
- precision: 0.9325 - recall: 0.8708 - tn: 81723.3438 - tp: 133.8608 - val_fn: 14.
0000 - val_fp: 9.0000 - val_loss: 0.0057 - val_precision: 0.8594 - val_recall: 0.7
971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 66/300
78/78 ───────────────────── 2s 22ms/step - fn: 19.2785 - fp: 4.9367 - loss: 0.0010
- precision: 0.9673 - recall: 0.8621 - tn: 81740.7109 - tp: 122.7468 - val_fn: 13.
0000 - val_fp: 11.0000 - val_loss: 0.0058 - val_precision: 0.8358 - val_recall: 0.
8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 67/300
78/78 ───────────────────── 2s 22ms/step - fn: 20.3418 - fp: 8.7722 - loss: 0.0013
- precision: 0.9348 - recall: 0.8773 - tn: 81729.3281 - tp: 129.2278 - val_fn: 15.
0000 - val_fp: 6.0000 - val_loss: 0.0048 - val_precision: 0.9000 - val_recall: 0.7
826 - val_tn: 39798.0000 - val_tp: 54.0000
Epoch 68/300
78/78 ───────────────────── 2s 23ms/step - fn: 21.1266 - fp: 5.1519 - loss: 0.0010
- precision: 0.9707 - recall: 0.8791 - tn: 81723.7344 - tp: 137.6582 - val_fn: 14.
0000 - val_fp: 9.0000 - val_loss: 0.0052 - val_precision: 0.8594 - val_recall: 0.7
971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 69/300
78/78 ───────────────────── 2s 24ms/step - fn: 18.4051 - fp: 6.1392 - loss: 0.0012
- precision: 0.9450 - recall: 0.8665 - tn: 81736.6562 - tp: 126.4684 - val_fn: 13.
0000 - val_fp: 7.0000 - val_loss: 0.0048 - val_precision: 0.8889 - val_recall: 0.8
116 - val_tn: 39797.0000 - val_tp: 56.0000
Epoch 70/300
78/78 ───────────────────── 2s 26ms/step - fn: 20.9747 - fp: 8.0506 - loss: 0.0013
- precision: 0.9439 - recall: 0.8557 - tn: 81731.8828 - tp: 126.7595 - val_fn: 14.
0000 - val_fp: 7.0000 - val_loss: 0.0048 - val_precision: 0.8871 - val_recall: 0.7
971 - val_tn: 39797.0000 - val_tp: 55.0000
Epoch 71/300
78/78 ───────────────────── 2s 23ms/step - fn: 17.1899 - fp: 5.2532 - loss: 0.0010
- precision: 0.9667 - recall: 0.8787 - tn: 81733.5938 - tp: 131.6329 - val_fn: 13.
0000 - val_fp: 9.0000 - val_loss: 0.0051 - val_precision: 0.8615 - val_recall: 0.8
116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 72/300
78/78 ───────────────────── 2s 25ms/step - fn: 13.5063 - fp: 9.2658 - loss: 9.2573e
-04 - precision: 0.9288 - recall: 0.9058 - tn: 81734.3047 - tp: 130.5949 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0057 - val_precision: 0.8750 - val_recall:
0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 73/300
78/78 ───────────────────── 2s 28ms/step - fn: 19.7215 - fp: 5.1772 - loss: 0.0011
- precision: 0.9707 - recall: 0.8649 - tn: 81739.5703 - tp: 123.2025 - val_fn: 13.
0000 - val_fp: 14.0000 - val_loss: 0.0056 - val_precision: 0.8000 - val_recall: 0.
8116 - val_tn: 39790.0000 - val_tp: 56.0000
Epoch 74/300
78/78 ───────────────────── 2s 30ms/step - fn: 15.2025 - fp: 9.3165 - loss: 0.0013
- precision: 0.9420 - recall: 0.9160 - tn: 81731.5156 - tp: 131.6329 - val_fn: 14.
0000 - val_fp: 9.0000 - val_loss: 0.0075 - val_precision: 0.8594 - val_recall: 0.7
971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 75/300
78/78 ───────────────────── 3s 36ms/step - fn: 19.8608 - fp: 7.2911 - loss: 8.9109e
-04 - precision: 0.9468 - recall: 0.8739 - tn: 81741.5938 - tp: 118.9240 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0074 - val_precision: 0.8750 - val_recall:
0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 76/300
78/78 ───────────────────── 2s 30ms/step - fn: 20.6456 - fp: 9.6709 - loss: 0.0011
- precision: 0.9213 - recall: 0.8617 - tn: 81736.9844 - tp: 120.3671 - val_fn: 13.
0000 - val_fp: 8.0000 - val_loss: 0.0068 - val_precision: 0.8750 - val_recall: 0.8
116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 77/300
78/78 ───────────────────── 2s 30ms/step - fn: 20.8987 - fp: 7.3924 - loss: 0.0011
- precision: 0.9488 - recall: 0.8637 - tn: 81727.1250 - tp: 132.2532 - val_fn: 13.
0000 - val_fp: 6.0000 - val_loss: 0.0065 - val_precision: 0.9032 - val_recall: 0.8
```

116 - val_tn: 39798.0000 - val_tp: 56.0000
Epoch 78/300
78/78 ──────────────── **2s** 28ms/step - fn: 22.3797 - fp: 7.8228 - loss: 0.0012
- precision: 0.9400 - recall: 0.8286 - tn: 81733.6172 - tp: 123.8481 - val_fn: 14.
0000 - val_fp: 11.0000 - val_loss: 0.0069 - val_precision: 0.8333 - val_recall: 0.
7971 - val_tn: 39793.0000 - val_tp: 55.0000
Epoch 79/300
78/78 ──────────────── **3s** 33ms/step - fn: 15.6582 - fp: 6.9494 - loss: 9.9007e
-04 - precision: 0.9542 - recall: 0.9058 - tn: 81731.4141 - tp: 133.6456 - val_fn:
14.0000 - val_fp: 9.0000 - val_loss: 0.0064 - val_precision: 0.8594 - val_recall:
0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 80/300
78/78 ──────────────── **2s** 30ms/step - fn: 17.2025 - fp: 7.8987 - loss: 0.0011
- precision: 0.9482 - recall: 0.9072 - tn: 81723.9141 - tp: 138.6582 - val_fn: 15.
0000 - val_fp: 9.0000 - val_loss: 0.0058 - val_precision: 0.8571 - val_recall: 0.7
826 - val_tn: 39795.0000 - val_tp: 54.0000
Epoch 81/300
78/78 ──────────────── **2s** 30ms/step - fn: 21.2152 - fp: 9.1646 - loss: 0.0011
- precision: 0.9234 - recall: 0.8604 - tn: 81731.7812 - tp: 125.5063 - val_fn: 14.
0000 - val_fp: 10.0000 - val_loss: 0.0064 - val_precision: 0.8462 - val_recall: 0.
7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 82/300
78/78 ──────────────── **2s** 26ms/step - fn: 13.6962 - fp: 5.1139 - loss: 7.4050e
-04 - precision: 0.9682 - recall: 0.9121 - tn: 81738.8125 - tp: 130.0506 - val_fn:
16.0000 - val_fp: 8.0000 - val_loss: 0.0060 - val_precision: 0.8689 - val_recall:
0.7681 - val_tn: 39796.0000 - val_tp: 53.0000
Epoch 83/300
78/78 ──────────────── **2s** 28ms/step - fn: 15.2532 - fp: 4.8354 - loss: 7.7777e
-04 - precision: 0.9739 - recall: 0.8934 - tn: 81738.4297 - tp: 129.1519 - val_fn:
15.0000 - val_fp: 8.0000 - val_loss: 0.0064 - val_precision: 0.8710 - val_recall:
0.7826 - val_tn: 39796.0000 - val_tp: 54.0000
Epoch 84/300
78/78 ──────────────── **2s** 28ms/step - fn: 16.8861 - fp: 6.2278 - loss: 8.4253e
-04 - precision: 0.9604 - recall: 0.8928 - tn: 81727.4297 - tp: 137.1266 - val_fn:
13.0000 - val_fp: 12.0000 - val_loss: 0.0062 - val_precision: 0.8235 - val_recall:
0.8116 - val_tn: 39792.0000 - val_tp: 56.0000
Epoch 85/300
78/78 ──────────────── **3s** 32ms/step - fn: 16.7089 - fp: 3.9367 - loss: 9.4456e
-04 - precision: 0.9690 - recall: 0.8798 - tn: 81730.8125 - tp: 136.2152 - val_fn:
15.0000 - val_fp: 10.0000 - val_loss: 0.0059 - val_precision: 0.8438 - val_recall:
0.7826 - val_tn: 39794.0000 - val_tp: 54.0000
Epoch 86/300
78/78 ──────────────── **3s** 33ms/step - fn: 14.5696 - fp: 6.7468 - loss: 9.7866e
-04 - precision: 0.9544 - recall: 0.9083 - tn: 81731.1875 - tp: 135.1646 - val_fn:
15.0000 - val_fp: 8.0000 - val_loss: 0.0059 - val_precision: 0.8710 - val_recall:
0.7826 - val_tn: 39796.0000 - val_tp: 54.0000
Epoch 87/300
78/78 ──────────────── **2s** 29ms/step - fn: 17.0253 - fp: 4.6835 - loss: 0.0012
- precision: 0.9737 - recall: 0.8842 - tn: 81730.4922 - tp: 135.4684 - val_fn: 15.
0000 - val_fp: 9.0000 - val_loss: 0.0064 - val_precision: 0.8571 - val_recall: 0.7
826 - val_tn: 39795.0000 - val_tp: 54.0000
Epoch 88/300
78/78 ──────────────── **2s** 27ms/step - fn: 16.8481 - fp: 5.0253 - loss: 8.7697e
-04 - precision: 0.9695 - recall: 0.8879 - tn: 81728.3047 - tp: 137.4937 - val_fn:
14.0000 - val_fp: 9.0000 - val_loss: 0.0069 - val_precision: 0.8594 - val_recall:
0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 89/300
78/78 ──────────────── **2s** 29ms/step - fn: 18.7595 - fp: 7.4051 - loss: 8.7944e
-04 - precision: 0.9490 - recall: 0.8615 - tn: 81732.7344 - tp: 128.7722 - val_fn:
14.0000 - val_fp: 12.0000 - val_loss: 0.0067 - val_precision: 0.8209 - val_recall:
0.7971 - val_tn: 39792.0000 - val_tp: 55.0000
Epoch 90/300
78/78 ──────────────── **2s** 26ms/step - fn: 11.7089 - fp: 5.3291 - loss: 5.8877e
-04 - precision: 0.9705 - recall: 0.9344 - tn: 81734.7734 - tp: 135.8608 - val_fn:

15.0000 - val_fp: 9.0000 - val_loss: 0.0066 - val_precision: 0.8571 - val_recall:
0.7826 - val_tn: 39795.0000 - val_tp: 54.0000
Epoch 91/300
78/78 ───────────────── **2s** 23ms/step - fn: 14.3038 - fp: 6.9367 - loss: 9.3946e
-04 - precision: 0.9432 - recall: 0.9066 - tn: 81737.9141 - tp: 128.5190 - val_fn:
14.0000 - val_fp: 10.0000 - val_loss: 0.0071 - val_precision: 0.8462 - val_recall:
0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 92/300
78/78 ───────────────── **2s** 21ms/step - fn: 13.5949 - fp: 7.5443 - loss: 8.8395e
-04 - precision: 0.9486 - recall: 0.9148 - tn: 81733.1406 - tp: 133.3924 - val_fn:
14.0000 - val_fp: 10.0000 - val_loss: 0.0068 - val_precision: 0.8462 - val_recall:
0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 93/300
78/78 ───────────────── **2s** 25ms/step - fn: 14.0506 - fp: 6.9494 - loss: 0.0011
- precision: 0.9350 - recall: 0.8930 - tn: 81729.1406 - tp: 137.5316 - val_fn: 14.
0000 - val_fp: 8.0000 - val_loss: 0.0063 - val_precision: 0.8730 - val_recall: 0.7
971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 94/300
78/78 ───────────────── **2s** 23ms/step - fn: 19.0633 - fp: 6.6076 - loss: 8.3647e
-04 - precision: 0.9617 - recall: 0.8556 - tn: 81733.2891 - tp: 128.7089 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0071 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 95/300
78/78 ───────────────── **2s** 22ms/step - fn: 12.1139 - fp: 6.5570 - loss: 5.4852e
-04 - precision: 0.9424 - recall: 0.9180 - tn: 81737.5078 - tp: 131.4937 - val_fn:
15.0000 - val_fp: 8.0000 - val_loss: 0.0063 - val_precision: 0.8710 - val_recall:
0.7826 - val_tn: 39796.0000 - val_tp: 54.0000
Epoch 96/300
78/78 ───────────────── **2s** 23ms/step - fn: 13.8101 - fp: 8.8101 - loss: 9.0348e
-04 - precision: 0.9430 - recall: 0.9093 - tn: 81735.4297 - tp: 129.6203 - val_fn:
13.0000 - val_fp: 13.0000 - val_loss: 0.0071 - val_precision: 0.8116 - val_recall:
0.8116 - val_tn: 39791.0000 - val_tp: 56.0000
Epoch 97/300
78/78 ───────────────── **2s** 29ms/step - fn: 17.0127 - fp: 5.7215 - loss: 0.0011
- precision: 0.9454 - recall: 0.8772 - tn: 81731.4922 - tp: 133.4430 - val_fn: 13.
0000 - val_fp: 11.0000 - val_loss: 0.0067 - val_precision: 0.8358 - val_recall: 0.
8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 98/300
78/78 ───────────────── **2s** 30ms/step - fn: 16.3544 - fp: 7.8608 - loss: 9.5361e
-04 - precision: 0.9396 - recall: 0.8823 - tn: 81728.3828 - tp: 135.0759 - val_fn:
15.0000 - val_fp: 12.0000 - val_loss: 0.0064 - val_precision: 0.8182 - val_recall:
0.7826 - val_tn: 39792.0000 - val_tp: 54.0000
Epoch 99/300
78/78 ───────────────── **2s** 26ms/step - fn: 13.5063 - fp: 3.4304 - loss: 7.7909e
-04 - precision: 0.9762 - recall: 0.9039 - tn: 81734.2188 - tp: 136.5190 - val_fn:
13.0000 - val_fp: 9.0000 - val_loss: 0.0063 - val_precision: 0.8615 - val_recall:
0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 100/300
78/78 ───────────────── **2s** 25ms/step - fn: 12.1646 - fp: 5.1646 - loss: 6.7154e
-04 - precision: 0.9705 - recall: 0.9301 - tn: 81732.4062 - tp: 137.9367 - val_fn:
13.0000 - val_fp: 9.0000 - val_loss: 0.0066 - val_precision: 0.8615 - val_recall:
0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 101/300
78/78 ───────────────── **2s** 24ms/step - fn: 10.4177 - fp: 3.5190 - loss: 6.5172e
-04 - precision: 0.9798 - recall: 0.9312 - tn: 81740.4062 - tp: 133.3291 - val_fn:
13.0000 - val_fp: 12.0000 - val_loss: 0.0067 - val_precision: 0.8235 - val_recall:
0.8116 - val_tn: 39792.0000 - val_tp: 56.0000
Epoch 102/300
78/78 ───────────────── **2s** 27ms/step - fn: 11.0633 - fp: 4.4810 - loss: 6.9979e
-04 - precision: 0.9646 - recall: 0.9236 - tn: 81734.3203 - tp: 137.8101 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0066 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 103/300
78/78 ───────────────── **2s** 23ms/step - fn: 16.6203 - fp: 7.7468 - loss: 0.0012

- precision: 0.9416 - recall: 0.8833 - tn: 81725.3828 - tp: 137.9241 - val_fn: 14.
0000 - val_fp: 10.0000 - val_loss: 0.0066 - val_precision: 0.8462 - val_recall: 0.
7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 104/300
78/78 ──────────────── 2s 29ms/step - fn: 12.9620 - fp: 4.6329 - loss: 7.0353e
-04 - precision: 0.9711 - recall: 0.9198 - tn: 81735.7734 - tp: 134.3038 - val_fn:
15.0000 - val_fp: 10.0000 - val_loss: 0.0062 - val_precision: 0.8438 - val_recall:
0.7826 - val_tn: 39794.0000 - val_tp: 54.0000
Epoch 105/300
78/78 ──────────────── 2s 24ms/step - fn: 17.7468 - fp: 6.0127 - loss: 6.9270e
-04 - precision: 0.9664 - recall: 0.8784 - tn: 81725.1172 - tp: 138.7975 - val_fn:
14.0000 - val_fp: 10.0000 - val_loss: 0.0066 - val_precision: 0.8462 - val_recall:
0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 106/300
78/78 ──────────────── 2s 22ms/step - fn: 12.0759 - fp: 5.6076 - loss: 5.7034e
-04 - precision: 0.9628 - recall: 0.9316 - tn: 81740.6562 - tp: 129.3291 - val_fn:
14.0000 - val_fp: 10.0000 - val_loss: 0.0066 - val_precision: 0.8462 - val_recall:
0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 107/300
78/78 ──────────────── 2s 24ms/step - fn: 14.8481 - fp: 8.1013 - loss: 9.4616e
-04 - precision: 0.9355 - recall: 0.8805 - tn: 81733.1172 - tp: 131.6076 - val_fn:
14.0000 - val_fp: 10.0000 - val_loss: 0.0065 - val_precision: 0.8462 - val_recall:
0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 108/300
78/78 ──────────────── 2s 23ms/step - fn: 12.3165 - fp: 8.2532 - loss: 7.9425e
-04 - precision: 0.9460 - recall: 0.9150 - tn: 81730.0234 - tp: 137.0759 - val_fn:
13.0000 - val_fp: 7.0000 - val_loss: 0.0060 - val_precision: 0.8889 - val_recall:
0.8116 - val_tn: 39797.0000 - val_tp: 56.0000
Epoch 109/300
78/78 ──────────────── 2s 22ms/step - fn: 15.9873 - fp: 9.9873 - loss: 7.5523e
-04 - precision: 0.9264 - recall: 0.8852 - tn: 81730.1641 - tp: 131.5316 - val_fn:
14.0000 - val_fp: 8.0000 - val_loss: 0.0065 - val_precision: 0.8730 - val_recall:
0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 110/300
78/78 ──────────────── 2s 25ms/step - fn: 13.4430 - fp: 5.5063 - loss: 9.0336e
-04 - precision: 0.9525 - recall: 0.9022 - tn: 81736.6094 - tp: 132.1139 - val_fn:
14.0000 - val_fp: 8.0000 - val_loss: 0.0062 - val_precision: 0.8730 - val_recall:
0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 111/300
78/78 ──────────────── 2s 24ms/step - fn: 11.2911 - fp: 4.5570 - loss: 5.8041e
-04 - precision: 0.9737 - recall: 0.9222 - tn: 81739.6719 - tp: 132.1519 - val_fn:
15.0000 - val_fp: 12.0000 - val_loss: 0.0065 - val_precision: 0.8182 - val_recall:
0.7826 - val_tn: 39792.0000 - val_tp: 54.0000
Epoch 112/300
78/78 ──────────────── 2s 24ms/step - fn: 14.7468 - fp: 5.0380 - loss: 8.0254e
-04 - precision: 0.9616 - recall: 0.8917 - tn: 81738.6797 - tp: 129.2025 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0067 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 113/300
78/78 ──────────────── 2s 23ms/step - fn: 6.3671 - fp: 4.9114 - loss: 4.7235e-
04 - precision: 0.9648 - recall: 0.9687 - tn: 81733.5078 - tp: 142.8861 - val_fn:
13.0000 - val_fp: 12.0000 - val_loss: 0.0068 - val_precision: 0.8235 - val_recall:
0.8116 - val_tn: 39792.0000 - val_tp: 56.0000
Epoch 114/300
78/78 ──────────────── 2s 24ms/step - fn: 9.7722 - fp: 3.8481 - loss: 4.1157e-
04 - precision: 0.9461 - recall: 0.9149 - tn: 81741.1484 - tp: 132.8987 - val_fn:
13.0000 - val_fp: 9.0000 - val_loss: 0.0065 - val_precision: 0.8615 - val_recall:
0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 115/300
78/78 ──────────────── 2s 22ms/step - fn: 12.4177 - fp: 8.9747 - loss: 7.0838e
-04 - precision: 0.9258 - recall: 0.9279 - tn: 81730.7109 - tp: 135.5696 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0067 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 116/300

78/78 ──────────────── **2s** 21ms/step - fn: 10.6709 - fp: 6.4430 - loss: 6.4490e -04 - precision: 0.9583 - recall: 0.9330 - tn: 81730.1875 - tp: 140.3671 - val_fn: 14.0000 - val_fp: 10.0000 - val_loss: 0.0067 - val_precision: 0.8462 - val_recall: 0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 117/300
78/78 ──────────────── **2s** 21ms/step - fn: 12.2911 - fp: 8.0127 - loss: 6.1631e -04 - precision: 0.9393 - recall: 0.9235 - tn: 81739.7969 - tp: 127.5696 - val_fn: 15.0000 - val_fp: 8.0000 - val_loss: 0.0061 - val_precision: 0.8710 - val_recall: 0.7826 - val_tn: 39796.0000 - val_tp: 54.0000
Epoch 118/300
78/78 ──────────────── **2s** 21ms/step - fn: 9.7468 - fp: 6.2532 - loss: 5.6101e- 04 - precision: 0.9582 - recall: 0.9295 - tn: 81735.8516 - tp: 135.8228 - val_fn: 15.0000 - val_fp: 10.0000 - val_loss: 0.0064 - val_precision: 0.8438 - val_recall: 0.7826 - val_tn: 39794.0000 - val_tp: 54.0000
Epoch 119/300
78/78 ──────────────── **2s** 21ms/step - fn: 10.8987 - fp: 5.4810 - loss: 6.9092e -04 - precision: 0.9647 - recall: 0.9136 - tn: 81730.9531 - tp: 140.3418 - val_fn: 14.0000 - val_fp: 8.0000 - val_loss: 0.0061 - val_precision: 0.8730 - val_recall: 0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 120/300
78/78 ──────────────── **2s** 21ms/step - fn: 9.3038 - fp: 5.3544 - loss: 5.9877e- 04 - precision: 0.9583 - recall: 0.9459 - tn: 81732.2422 - tp: 140.7722 - val_fn: 15.0000 - val_fp: 10.0000 - val_loss: 0.0060 - val_precision: 0.8438 - val_recall: 0.7826 - val_tn: 39794.0000 - val_tp: 54.0000
Epoch 121/300
78/78 ──────────────── **2s** 25ms/step - fn: 12.8861 - fp: 5.8354 - loss: 6.0509e -04 - precision: 0.9623 - recall: 0.9232 - tn: 81733.4531 - tp: 135.4937 - val_fn: 14.0000 - val_fp: 10.0000 - val_loss: 0.0061 - val_precision: 0.8462 - val_recall: 0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 122/300
78/78 ──────────────── **2s** 24ms/step - fn: 10.3418 - fp: 5.2025 - loss: 6.4847e -04 - precision: 0.9560 - recall: 0.9339 - tn: 81736.0625 - tp: 136.0633 - val_fn: 17.0000 - val_fp: 8.0000 - val_loss: 0.0060 - val_precision: 0.8667 - val_recall: 0.7536 - val_tn: 39796.0000 - val_tp: 52.0000
Epoch 123/300
78/78 ──────────────── **2s** 22ms/step - fn: 10.0380 - fp: 6.5823 - loss: 5.7856e -04 - precision: 0.9362 - recall: 0.9247 - tn: 81741.7109 - tp: 129.3418 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0066 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 124/300
78/78 ──────────────── **2s** 21ms/step - fn: 9.6962 - fp: 6.0506 - loss: 5.6204e- 04 - precision: 0.9452 - recall: 0.9381 - tn: 81734.8828 - tp: 137.0380 - val_fn: 13.0000 - val_fp: 9.0000 - val_loss: 0.0067 - val_precision: 0.8615 - val_recall: 0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 125/300
78/78 ──────────────── **2s** 24ms/step - fn: 11.4557 - fp: 6.5063 - loss: 6.1316e -04 - precision: 0.9573 - recall: 0.9323 - tn: 81731.3281 - tp: 138.3797 - val_fn: 13.0000 - val_fp: 12.0000 - val_loss: 0.0069 - val_precision: 0.8235 - val_recall: 0.8116 - val_tn: 39792.0000 - val_tp: 56.0000
Epoch 126/300
78/78 ──────────────── **2s** 21ms/step - fn: 7.3797 - fp: 3.9114 - loss: 4.9812e- 04 - precision: 0.9783 - recall: 0.9402 - tn: 81736.0625 - tp: 140.3165 - val_fn: 15.0000 - val_fp: 7.0000 - val_loss: 0.0066 - val_precision: 0.8852 - val_recall: 0.7826 - val_tn: 39797.0000 - val_tp: 54.0000
Epoch 127/300
78/78 ──────────────── **2s** 21ms/step - fn: 13.4051 - fp: 4.4430 - loss: 6.1152e -04 - precision: 0.9745 - recall: 0.9017 - tn: 81728.8594 - tp: 140.9620 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0066 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 128/300
78/78 ──────────────── **2s** 20ms/step - fn: 5.6076 - fp: 5.1392 - loss: 4.3428e- 04 - precision: 0.9655 - recall: 0.9603 - tn: 81736.1875 - tp: 140.7342 - val_fn: 15.0000 - val_fp: 8.0000 - val_loss: 0.0064 - val_precision: 0.8710 - val_recall: 0.7826 - val_tn: 39796.0000 - val_tp: 54.0000

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Epoch 129/300
78/78 ──────────────────────── 2s 24ms/step - fn: 9.6835 - fp: 3.9367 - loss: 7.0070e-
04 - precision: 0.9587 - recall: 0.9098 - tn: 81737.2656 - tp: 136.7848 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0066 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 130/300
78/78 ──────────────────────── 2s 25ms/step - fn: 11.6709 - fp: 4.2025 - loss: 5.1847e
-04 - precision: 0.9775 - recall: 0.9344 - tn: 81727.7969 - tp: 144.0000 - val_fn:
14.0000 - val_fp: 11.0000 - val_loss: 0.0068 - val_precision: 0.8333 - val_recall:
0.7971 - val_tn: 39793.0000 - val_tp: 55.0000
Epoch 131/300
78/78 ──────────────────────── 2s 27ms/step - fn: 7.2532 - fp: 7.1392 - loss: 4.4678e-
04 - precision: 0.9391 - recall: 0.9490 - tn: 81731.3906 - tp: 141.8861 - val_fn:
14.0000 - val_fp: 12.0000 - val_loss: 0.0066 - val_precision: 0.8209 - val_recall:
0.7971 - val_tn: 39792.0000 - val_tp: 55.0000
Epoch 132/300
78/78 ──────────────────────── 2s 24ms/step - fn: 7.2785 - fp: 5.8987 - loss: 4.5583e-
04 - precision: 0.9629 - recall: 0.9586 - tn: 81734.6484 - tp: 139.8481 - val_fn:
14.0000 - val_fp: 10.0000 - val_loss: 0.0068 - val_precision: 0.8462 - val_recall:
0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 133/300
78/78 ──────────────────────── 2s 21ms/step - fn: 7.6582 - fp: 3.2152 - loss: 3.9183e-
04 - precision: 0.9803 - recall: 0.9527 - tn: 81743.6172 - tp: 133.1772 - val_fn:
14.0000 - val_fp: 9.0000 - val_loss: 0.0068 - val_precision: 0.8594 - val_recall:
0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 134/300
78/78 ──────────────────────── 2s 21ms/step - fn: 9.5443 - fp: 5.4051 - loss: 6.4573e-
04 - precision: 0.9538 - recall: 0.9433 - tn: 81740.2422 - tp: 132.4810 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0066 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 135/300
78/78 ──────────────────────── 2s 21ms/step - fn: 11.5949 - fp: 6.8987 - loss: 6.0085e
-04 - precision: 0.9438 - recall: 0.9201 - tn: 81737.4062 - tp: 131.7722 - val_fn:
13.0000 - val_fp: 9.0000 - val_loss: 0.0063 - val_precision: 0.8615 - val_recall:
0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 136/300
78/78 ──────────────────────── 2s 21ms/step - fn: 6.9367 - fp: 3.5696 - loss: 3.6214e-
04 - precision: 0.9766 - recall: 0.9558 - tn: 81751.5859 - tp: 125.5823 - val_fn:
14.0000 - val_fp: 8.0000 - val_loss: 0.0064 - val_precision: 0.8730 - val_recall:
0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 137/300
78/78 ──────────────────────── 2s 21ms/step - fn: 8.2025 - fp: 5.3797 - loss: 5.0640e-
04 - precision: 0.9706 - recall: 0.9507 - tn: 81728.9531 - tp: 145.1392 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0067 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 138/300
78/78 ──────────────────────── 2s 21ms/step - fn: 7.2405 - fp: 4.5949 - loss: 4.0894e-
04 - precision: 0.9677 - recall: 0.9624 - tn: 81731.1172 - tp: 144.7215 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0067 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 139/300
78/78 ──────────────────────── 2s 25ms/step - fn: 11.5570 - fp: 6.6709 - loss: 6.5767e
-04 - precision: 0.9560 - recall: 0.9250 - tn: 81732.7109 - tp: 136.7342 - val_fn:
13.0000 - val_fp: 13.0000 - val_loss: 0.0070 - val_precision: 0.8116 - val_recall:
0.8116 - val_tn: 39791.0000 - val_tp: 56.0000
Epoch 140/300
78/78 ──────────────────────── 2s 25ms/step - fn: 7.0506 - fp: 4.3418 - loss: 4.2114e-
04 - precision: 0.9710 - recall: 0.9538 - tn: 81736.7812 - tp: 139.4937 - val_fn:
14.0000 - val_fp: 8.0000 - val_loss: 0.0061 - val_precision: 0.8730 - val_recall:
0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 141/300
78/78 ──────────────────────── 2s 22ms/step - fn: 8.3418 - fp: 3.5316 - loss: 4.9675e-
04 - precision: 0.9751 - recall: 0.9422 - tn: 81741.2500 - tp: 134.5443 - val_fn:
14.0000 - val_fp: 7.0000 - val_loss: 0.0062 - val_precision: 0.8871 - val_recall:
```

0.7971 - val_tn: 39797.0000 - val_tp: 55.0000
Epoch 142/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 25ms/step - fn: 6.4684 - fp: 3.4304 - loss: 3.9123e-04 - precision: 0.9806 - recall: 0.9502 - tn: 81734.1797 - tp: 143.5949 - val_fn: 15.0000 - val_fp: 11.0000 - val_loss: 0.0067 - val_precision: 0.8308 - val_recall: 0.7826 - val_tn: 39793.0000 - val_tp: 54.0000
Epoch 143/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 26ms/step - fn: 6.8734 - fp: 2.1392 - loss: 3.7524e-04 - precision: 0.9878 - recall: 0.9643 - tn: 81738.5547 - tp: 140.1013 - val_fn: 15.0000 - val_fp: 7.0000 - val_loss: 0.0068 - val_precision: 0.8852 - val_recall: 0.7826 - val_tn: 39797.0000 - val_tp: 54.0000
Epoch 144/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 23ms/step - fn: 7.0127 - fp: 5.4557 - loss: 4.4389e-04 - precision: 0.9552 - recall: 0.9460 - tn: 81735.6094 - tp: 139.5949 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0068 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 145/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 24ms/step - fn: 9.7595 - fp: 4.0633 - loss: 3.8884e-04 - precision: 0.9780 - recall: 0.9197 - tn: 81747.7500 - tp: 126.1013 - val_fn: 13.0000 - val_fp: 11.0000 - val_loss: 0.0068 - val_precision: 0.8358 - val_recall: 0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 146/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 29ms/step - fn: 7.5696 - fp: 5.6456 - loss: 7.2549e-04 - precision: 0.9594 - recall: 0.9469 - tn: 81736.9375 - tp: 137.5190 - val_fn: 14.0000 - val_fp: 11.0000 - val_loss: 0.0066 - val_precision: 0.8333 - val_recall: 0.7971 - val_tn: 39793.0000 - val_tp: 55.0000
Epoch 147/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 30ms/step - fn: 6.0759 - fp: 3.8861 - loss: 3.2451e-04 - precision: 0.9774 - recall: 0.9636 - tn: 81739.2031 - tp: 138.5063 - val_fn: 16.0000 - val_fp: 10.0000 - val_loss: 0.0067 - val_precision: 0.8413 - val_recall: 0.7681 - val_tn: 39794.0000 - val_tp: 53.0000
Epoch 148/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 27ms/step - fn: 8.3671 - fp: 5.0633 - loss: 4.7730e-04 - precision: 0.9663 - recall: 0.9546 - tn: 81732.5938 - tp: 141.6456 - val_fn: 14.0000 - val_fp: 11.0000 - val_loss: 0.0064 - val_precision: 0.8333 - val_recall: 0.7971 - val_tn: 39793.0000 - val_tp: 55.0000
Epoch 149/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 25ms/step - fn: 12.0506 - fp: 4.0127 - loss: 6.6309e-04 - precision: 0.9704 - recall: 0.8927 - tn: 81740.8203 - tp: 130.7848 - val_fn: 13.0000 - val_fp: 10.0000 - val_loss: 0.0067 - val_precision: 0.8485 - val_recall: 0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 150/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 26ms/step - fn: 7.1646 - fp: 2.3038 - loss: 4.3589e-04 - precision: 0.9876 - recall: 0.9457 - tn: 81729.3906 - tp: 148.8101 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0067 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 151/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 25ms/step - fn: 8.5063 - fp: 6.5443 - loss: 5.6572e-04 - precision: 0.9539 - recall: 0.9468 - tn: 81734.6719 - tp: 137.9494 - val_fn: 13.0000 - val_fp: 9.0000 - val_loss: 0.0067 - val_precision: 0.8615 - val_recall: 0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 152/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 21ms/step - fn: 6.1266 - fp: 4.7468 - loss: 3.4756e-04 - precision: 0.9688 - recall: 0.9659 - tn: 81732.6719 - tp: 144.1266 - val_fn: 14.0000 - val_fp: 7.0000 - val_loss: 0.0066 - val_precision: 0.8871 - val_recall: 0.7971 - val_tn: 39797.0000 - val_tp: 55.0000
Epoch 153/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 24ms/step - fn: 6.6835 - fp: 2.4684 - loss: 2.9673e-04 - precision: 0.9872 - recall: 0.9618 - tn: 81742.0625 - tp: 136.4557 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0063 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 154/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **3s** 33ms/step - fn: 6.3671 - fp: 4.5443 - loss: 4.8643e-04 - precision: 0.9667 - recall: 0.9618 - tn: 81735.2500 - tp: 141.5063 - val_fn:

15.0000 - val_fp: 10.0000 - val_loss: 0.0066 - val_precision: 0.8438 - val_recall: 0.7826 - val_tn: 39794.0000 - val_tp: 54.0000
Epoch 155/300
78/78 ─────────────────── **2s** 30ms/step - fn: 10.9873 - fp: 3.9367 - loss: 6.1451e-04 - precision: 0.9661 - recall: 0.9183 - tn: 81741.7578 - tp: 130.9873 - val_fn: 13.0000 - val_fp: 10.0000 - val_loss: 0.0065 - val_precision: 0.8485 - val_recall: 0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 156/300
78/78 ─────────────────── **2s** 23ms/step - fn: 5.0380 - fp: 4.1139 - loss: 2.8616e-04 - precision: 0.9760 - recall: 0.9719 - tn: 81736.4531 - tp: 142.0633 - val_fn: 14.0000 - val_fp: 7.0000 - val_loss: 0.0067 - val_precision: 0.8871 - val_recall: 0.7971 - val_tn: 39797.0000 - val_tp: 55.0000
Epoch 157/300
78/78 ─────────────────── **2s** 21ms/step - fn: 8.8734 - fp: 6.3671 - loss: 4.8802e-04 - precision: 0.9587 - recall: 0.9424 - tn: 81730.6484 - tp: 141.7848 - val_fn: 13.0000 - val_fp: 11.0000 - val_loss: 0.0069 - val_precision: 0.8358 - val_recall: 0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 158/300
78/78 ─────────────────── **2s** 21ms/step - fn: 9.0506 - fp: 5.0127 - loss: 5.2776e-04 - precision: 0.9624 - recall: 0.9429 - tn: 81739.9766 - tp: 133.6329 - val_fn: 13.0000 - val_fp: 11.0000 - val_loss: 0.0064 - val_precision: 0.8358 - val_recall: 0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 159/300
78/78 ─────────────────── **2s** 24ms/step - fn: 5.3924 - fp: 4.6582 - loss: 3.4508e-04 - precision: 0.9722 - recall: 0.9714 - tn: 81729.0391 - tp: 148.5823 - val_fn: 14.0000 - val_fp: 8.0000 - val_loss: 0.0065 - val_precision: 0.8730 - val_recall: 0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 160/300
78/78 ─────────────────── **2s** 25ms/step - fn: 6.0506 - fp: 2.1392 - loss: 2.8475e-04 - precision: 0.9899 - recall: 0.9630 - tn: 81726.3203 - tp: 153.1646 - val_fn: 13.0000 - val_fp: 11.0000 - val_loss: 0.0070 - val_precision: 0.8358 - val_recall: 0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 161/300
78/78 ─────────────────── **2s** 23ms/step - fn: 7.3671 - fp: 4.8481 - loss: 5.2639e-04 - precision: 0.9645 - recall: 0.9503 - tn: 81744.4062 - tp: 131.0506 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0069 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 162/300
78/78 ─────────────────── **2s** 24ms/step - fn: 8.0380 - fp: 4.4051 - loss: 3.8812e-04 - precision: 0.9668 - recall: 0.9461 - tn: 81740.3906 - tp: 134.8354 - val_fn: 15.0000 - val_fp: 9.0000 - val_loss: 0.0069 - val_precision: 0.8571 - val_recall: 0.7826 - val_tn: 39795.0000 - val_tp: 54.0000
Epoch 163/300
78/78 ─────────────────── **2s** 22ms/step - fn: 5.6329 - fp: 2.6329 - loss: 2.5169e-04 - precision: 0.9861 - recall: 0.9620 - tn: 81745.6562 - tp: 133.7468 - val_fn: 14.0000 - val_fp: 10.0000 - val_loss: 0.0067 - val_precision: 0.8462 - val_recall: 0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 164/300
78/78 ─────────────────── **2s** 22ms/step - fn: 5.1139 - fp: 2.7722 - loss: 3.6021e-04 - precision: 0.9836 - recall: 0.9712 - tn: 81740.4453 - tp: 139.3418 - val_fn: 13.0000 - val_fp: 9.0000 - val_loss: 0.0067 - val_precision: 0.8615 - val_recall: 0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 165/300
78/78 ─────────────────── **2s** 23ms/step - fn: 9.1392 - fp: 3.1266 - loss: 5.1760e-04 - precision: 0.9807 - recall: 0.9369 - tn: 81727.8516 - tp: 147.5570 - val_fn: 13.0000 - val_fp: 10.0000 - val_loss: 0.0065 - val_precision: 0.8485 - val_recall: 0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 166/300
78/78 ─────────────────── **2s** 23ms/step - fn: 8.6582 - fp: 1.9620 - loss: 3.6925e-04 - precision: 0.9908 - recall: 0.9457 - tn: 81742.4922 - tp: 134.5570 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0068 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 167/300
78/78 ─────────────────── **2s** 26ms/step - fn: 8.8481 - fp: 3.0253 - loss: 3.5336e-

04 - precision: 0.9840 - recall: 0.9510 - tn: 81737.2422 - tp: 138.5570 - val_fn: 16.0000 - val_fp: 11.0000 - val_loss: 0.0066 - val_precision: 0.8281 - val_recall: 0.7681 - val_tn: 39793.0000 - val_tp: 53.0000
Epoch 168/300
78/78 ———————————————— **2s** 24ms/step - fn: 4.1266 - fp: 3.8861 - loss: 2.3329e-04 - precision: 0.9790 - recall: 0.9759 - tn: 81735.6797 - tp: 143.9747 - val_fn: 16.0000 - val_fp: 9.0000 - val_loss: 0.0065 - val_precision: 0.8548 - val_recall: 0.7681 - val_tn: 39795.0000 - val_tp: 53.0000
Epoch 169/300
78/78 ———————————————— **2s** 23ms/step - fn: 7.5190 - fp: 5.7595 - loss: 4.0475e-04 - precision: 0.9643 - recall: 0.9483 - tn: 81735.4688 - tp: 138.9241 - val_fn: 13.0000 - val_fp: 9.0000 - val_loss: 0.0067 - val_precision: 0.8615 - val_recall: 0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 170/300
78/78 ———————————————— **2s** 22ms/step - fn: 4.0633 - fp: 2.5316 - loss: 1.9777e-04 - precision: 0.9860 - recall: 0.9792 - tn: 81740.1641 - tp: 140.9114 - val_fn: 13.0000 - val_fp: 10.0000 - val_loss: 0.0070 - val_precision: 0.8485 - val_recall: 0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 171/300
78/78 ———————————————— **2s** 25ms/step - fn: 7.3165 - fp: 5.6076 - loss: 4.0062e-04 - precision: 0.9624 - recall: 0.9493 - tn: 81741.8359 - tp: 132.9114 - val_fn: 13.0000 - val_fp: 12.0000 - val_loss: 0.0066 - val_precision: 0.8235 - val_recall: 0.8116 - val_tn: 39792.0000 - val_tp: 56.0000
Epoch 172/300
78/78 ———————————————— **2s** 25ms/step - fn: 8.5949 - fp: 5.7595 - loss: 3.2739e-04 - precision: 0.9666 - recall: 0.9505 - tn: 81736.5156 - tp: 136.7975 - val_fn: 13.0000 - val_fp: 9.0000 - val_loss: 0.0065 - val_precision: 0.8615 - val_recall: 0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 173/300
78/78 ———————————————— **2s** 24ms/step - fn: 6.3291 - fp: 4.6203 - loss: 3.9415e-04 - precision: 0.9728 - recall: 0.9663 - tn: 81723.5078 - tp: 153.2152 - val_fn: 12.0000 - val_fp: 9.0000 - val_loss: 0.0065 - val_precision: 0.8636 - val_recall: 0.8261 - val_tn: 39795.0000 - val_tp: 57.0000
Epoch 174/300
78/78 ———————————————— **2s** 23ms/step - fn: 7.0127 - fp: 5.4177 - loss: 4.0603e-04 - precision: 0.9634 - recall: 0.9609 - tn: 81733.8594 - tp: 141.3797 - val_fn: 13.0000 - val_fp: 13.0000 - val_loss: 0.0069 - val_precision: 0.8116 - val_recall: 0.8116 - val_tn: 39791.0000 - val_tp: 56.0000
Epoch 175/300
78/78 ———————————————— **2s** 21ms/step - fn: 8.4430 - fp: 5.3797 - loss: 5.1510e-04 - precision: 0.9650 - recall: 0.9457 - tn: 81735.1016 - tp: 138.7468 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0068 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 176/300
78/78 ———————————————— **2s** 21ms/step - fn: 6.9747 - fp: 5.1392 - loss: 5.0888e-04 - precision: 0.9627 - recall: 0.9475 - tn: 81733.7188 - tp: 141.8354 - val_fn: 16.0000 - val_fp: 11.0000 - val_loss: 0.0066 - val_precision: 0.8281 - val_recall: 0.7681 - val_tn: 39793.0000 - val_tp: 53.0000
Epoch 177/300
78/78 ———————————————— **2s** 21ms/step - fn: 6.9873 - fp: 4.5190 - loss: 3.4397e-04 - precision: 0.9717 - recall: 0.9536 - tn: 81743.3203 - tp: 132.8481 - val_fn: 13.0000 - val_fp: 10.0000 - val_loss: 0.0069 - val_precision: 0.8485 - val_recall: 0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 178/300
78/78 ———————————————— **2s** 21ms/step - fn: 5.7848 - fp: 4.7342 - loss: 3.0244e-04 - precision: 0.9699 - recall: 0.9640 - tn: 81730.2891 - tp: 146.8608 - val_fn: 13.0000 - val_fp: 9.0000 - val_loss: 0.0066 - val_precision: 0.8615 - val_recall: 0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 179/300
78/78 ———————————————— **2s** 21ms/step - fn: 8.1013 - fp: 2.5949 - loss: 3.4030e-04 - precision: 0.9851 - recall: 0.9359 - tn: 81736.7188 - tp: 140.2532 - val_fn: 13.0000 - val_fp: 11.0000 - val_loss: 0.0070 - val_precision: 0.8358 - val_recall: 0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 180/300

78/78 ──────────────── **2s** 21ms/step - fn: 4.7468 - fp: 3.3544 - loss: 2.5943e-04 - precision: 0.9789 - recall: 0.9668 - tn: 81742.7812 - tp: 136.7848 - val_fn: 14.0000 - val_fp: 11.0000 - val_loss: 0.0067 - val_precision: 0.8333 - val_recall: 0.7971 - val_tn: 39793.0000 - val_tp: 55.0000
Epoch 181/300
78/78 ──────────────── **2s** 21ms/step - fn: 7.1139 - fp: 5.3291 - loss: 3.7977e-04 - precision: 0.9587 - recall: 0.9575 - tn: 81735.0000 - tp: 140.2278 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0069 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 182/300
78/78 ──────────────── **2s** 24ms/step - fn: 5.9494 - fp: 2.3671 - loss: 3.2807e-04 - precision: 0.9869 - recall: 0.9598 - tn: 81731.1172 - tp: 148.2405 - val_fn: 15.0000 - val_fp: 9.0000 - val_loss: 0.0066 - val_precision: 0.8571 - val_recall: 0.7826 - val_tn: 39795.0000 - val_tp: 54.0000
Epoch 183/300
78/78 ──────────────── **2s** 24ms/step - fn: 5.8861 - fp: 3.7975 - loss: 3.8514e-04 - precision: 0.9765 - recall: 0.9577 - tn: 81735.0156 - tp: 142.9747 - val_fn: 13.0000 - val_fp: 12.0000 - val_loss: 0.0068 - val_precision: 0.8235 - val_recall: 0.8116 - val_tn: 39792.0000 - val_tp: 56.0000
Epoch 184/300
78/78 ──────────────── **2s** 27ms/step - fn: 7.4304 - fp: 5.1013 - loss: 5.2048e-04 - precision: 0.9612 - recall: 0.9417 - tn: 81739.2656 - tp: 135.8734 - val_fn: 14.0000 - val_fp: 10.0000 - val_loss: 0.0067 - val_precision: 0.8462 - val_recall: 0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 185/300
78/78 ──────────────── **2s** 28ms/step - fn: 3.6076 - fp: 2.4810 - loss: 2.2764e-04 - precision: 0.9889 - recall: 0.9803 - tn: 81734.8516 - tp: 146.7342 - val_fn: 14.0000 - val_fp: 8.0000 - val_loss: 0.0065 - val_precision: 0.8730 - val_recall: 0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 186/300
78/78 ──────────────── **2s** 22ms/step - fn: 7.5316 - fp: 3.5949 - loss: 3.8977e-04 - precision: 0.9785 - recall: 0.9449 - tn: 81736.2031 - tp: 140.3418 - val_fn: 14.0000 - val_fp: 10.0000 - val_loss: 0.0066 - val_precision: 0.8462 - val_recall: 0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 187/300
78/78 ──────────────── **2s** 22ms/step - fn: 5.0000 - fp: 2.4937 - loss: 3.2272e-04 - precision: 0.9799 - recall: 0.9606 - tn: 81734.4297 - tp: 145.7468 - val_fn: 13.0000 - val_fp: 10.0000 - val_loss: 0.0067 - val_precision: 0.8485 - val_recall: 0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 188/300
78/78 ──────────────── **2s** 20ms/step - fn: 3.9114 - fp: 3.1646 - loss: 3.0844e-04 - precision: 0.9643 - recall: 0.9777 - tn: 81745.5469 - tp: 135.0506 - val_fn: 13.0000 - val_fp: 8.0000 - val_loss: 0.0071 - val_precision: 0.8750 - val_recall: 0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 189/300
78/78 ──────────────── **2s** 21ms/step - fn: 6.4684 - fp: 3.2405 - loss: 3.8112e-04 - precision: 0.9801 - recall: 0.9631 - tn: 81736.1016 - tp: 141.8608 - val_fn: 13.0000 - val_fp: 9.0000 - val_loss: 0.0069 - val_precision: 0.8615 - val_recall: 0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 190/300
78/78 ──────────────── **2s** 23ms/step - fn: 7.3924 - fp: 6.3038 - loss: 6.4403e-04 - precision: 0.9486 - recall: 0.9369 - tn: 81742.0625 - tp: 131.9114 - val_fn: 14.0000 - val_fp: 12.0000 - val_loss: 0.0071 - val_precision: 0.8209 - val_recall: 0.7971 - val_tn: 39792.0000 - val_tp: 55.0000
Epoch 191/300
78/78 ──────────────── **2s** 24ms/step - fn: 6.3291 - fp: 2.4304 - loss: 3.6057e-04 - precision: 0.9846 - recall: 0.9622 - tn: 81731.2891 - tp: 147.6203 - val_fn: 13.0000 - val_fp: 7.0000 - val_loss: 0.0067 - val_precision: 0.8889 - val_recall: 0.8116 - val_tn: 39797.0000 - val_tp: 56.0000
Epoch 192/300
78/78 ──────────────── **2s** 23ms/step - fn: 8.6835 - fp: 5.3418 - loss: 4.2409e-04 - precision: 0.9713 - recall: 0.9371 - tn: 81726.6562 - tp: 146.9873 - val_fn: 13.0000 - val_fp: 11.0000 - val_loss: 0.0072 - val_precision: 0.8358 - val_recall: 0.8116 - val_tn: 39793.0000 - val_tp: 56.0000

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Epoch 193/300
78/78 ————————————————— 2s 21ms/step - fn: 5.3291 - fp: 2.7089 - loss: 3.2349e-
04 - precision: 0.9856 - recall: 0.9684 - tn: 81728.5156 - tp: 151.1139 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0068 - val_precision: 0.8750 - val_recall:
0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 194/300
78/78 ————————————————— 2s 21ms/step - fn: 6.0127 - fp: 2.9494 - loss: 3.4234e-
04 - precision: 0.9841 - recall: 0.9632 - tn: 81735.7500 - tp: 142.9620 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0069 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 195/300
78/78 ————————————————— 2s 21ms/step - fn: 3.3797 - fp: 1.6582 - loss: 1.7549e-
04 - precision: 0.9773 - recall: 0.9818 - tn: 81740.9531 - tp: 141.6835 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0069 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 196/300
78/78 ————————————————— 2s 21ms/step - fn: 3.6076 - fp: 2.6076 - loss: 2.7993e-
04 - precision: 0.9853 - recall: 0.9809 - tn: 81734.0391 - tp: 147.4177 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0071 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 197/300
78/78 ————————————————— 2s 21ms/step - fn: 5.0253 - fp: 0.8354 - loss: 2.3362e-
04 - precision: 0.9962 - recall: 0.9596 - tn: 81742.2188 - tp: 139.5949 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0072 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 198/300
78/78 ————————————————— 2s 21ms/step - fn: 3.7468 - fp: 2.4051 - loss: 2.1792e-
04 - precision: 0.9742 - recall: 0.9686 - tn: 81738.3516 - tp: 143.1646 - val_fn:
14.0000 - val_fp: 10.0000 - val_loss: 0.0071 - val_precision: 0.8462 - val_recall:
0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 199/300
78/78 ————————————————— 2s 23ms/step - fn: 4.8228 - fp: 2.9747 - loss: 3.2180e-
04 - precision: 0.9833 - recall: 0.9713 - tn: 81736.7188 - tp: 143.1519 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0071 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 200/300
78/78 ————————————————— 2s 29ms/step - fn: 6.7722 - fp: 1.7848 - loss: 2.9302e-
04 - precision: 0.9910 - recall: 0.9478 - tn: 81738.8516 - tp: 140.2658 - val_fn:
14.0000 - val_fp: 9.0000 - val_loss: 0.0079 - val_precision: 0.8594 - val_recall:
0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 201/300
78/78 ————————————————— 2s 26ms/step - fn: 7.1266 - fp: 3.3924 - loss: 6.3532e-
04 - precision: 0.9725 - recall: 0.9485 - tn: 81736.1875 - tp: 140.9620 - val_fn:
14.0000 - val_fp: 9.0000 - val_loss: 0.0081 - val_precision: 0.8594 - val_recall:
0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 202/300
78/78 ————————————————— 2s 27ms/step - fn: 6.5443 - fp: 3.0253 - loss: 2.9712e-
04 - precision: 0.9776 - recall: 0.9535 - tn: 81736.7812 - tp: 141.3165 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0078 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 203/300
78/78 ————————————————— 2s 22ms/step - fn: 5.3418 - fp: 3.4304 - loss: 2.6348e-
04 - precision: 0.9822 - recall: 0.9659 - tn: 81738.1484 - tp: 140.7468 - val_fn:
13.0000 - val_fp: 9.0000 - val_loss: 0.0080 - val_precision: 0.8615 - val_recall:
0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 204/300
78/78 ————————————————— 2s 22ms/step - fn: 7.0127 - fp: 3.3797 - loss: 3.9479e-
04 - precision: 0.9775 - recall: 0.9492 - tn: 81737.1016 - tp: 140.1772 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0077 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 205/300
78/78 ————————————————— 2s 24ms/step - fn: 3.9747 - fp: 3.3797 - loss: 2.8046e-
04 - precision: 0.9702 - recall: 0.9696 - tn: 81730.2812 - tp: 150.0380 - val_fn:
12.0000 - val_fp: 8.0000 - val_loss: 0.0074 - val_precision: 0.8769 - val_recall:
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0.8261 - val_tn: 39796.0000 - val_tp: 57.0000
Epoch 206/300
78/78 ──────────────── **2s** 22ms/step - fn: 3.9873 - fp: 4.2278 - loss: 2.5108e-
04 - precision: 0.9711 - recall: 0.9762 - tn: 81732.0781 - tp: 147.3797 - val_fn:
13.0000 - val_fp: 7.0000 - val_loss: 0.0073 - val_precision: 0.8889 - val_recall:
0.8116 - val_tn: 39797.0000 - val_tp: 56.0000
Epoch 207/300
78/78 ──────────────── **2s** 20ms/step - fn: 5.2152 - fp: 1.5443 - loss: 3.0557e-
04 - precision: 0.9923 - recall: 0.9532 - tn: 81743.6562 - tp: 137.2532 - val_fn:
14.0000 - val_fp: 8.0000 - val_loss: 0.0070 - val_precision: 0.8730 - val_recall:
0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 208/300
78/78 ──────────────── **2s** 22ms/step - fn: 4.7848 - fp: 3.2025 - loss: 3.3335e-
04 - precision: 0.9774 - recall: 0.9734 - tn: 81739.3516 - tp: 140.3291 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0076 - val_precision: 0.8750 - val_recall:
0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 209/300
78/78 ──────────────── **2s** 21ms/step - fn: 4.9873 - fp: 2.1013 - loss: 3.4704e-
04 - precision: 0.9854 - recall: 0.9533 - tn: 81748.9141 - tp: 131.6709 - val_fn:
15.0000 - val_fp: 10.0000 - val_loss: 0.0079 - val_precision: 0.8438 - val_recall:
0.7826 - val_tn: 39794.0000 - val_tp: 54.0000
Epoch 210/300
78/78 ──────────────── **2s** 21ms/step - fn: 3.7215 - fp: 2.7975 - loss: 3.0369e-
04 - precision: 0.9822 - recall: 0.9770 - tn: 81740.7969 - tp: 140.3544 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0075 - val_precision: 0.8750 - val_recall:
0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 211/300
78/78 ──────────────── **2s** 22ms/step - fn: 4.6456 - fp: 3.2405 - loss: 4.1623e-
04 - precision: 0.9824 - recall: 0.9686 - tn: 81737.9531 - tp: 141.8354 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0076 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 212/300
78/78 ──────────────── **2s** 22ms/step - fn: 5.9114 - fp: 4.2785 - loss: 2.9734e-
04 - precision: 0.9773 - recall: 0.9642 - tn: 81735.0469 - tp: 142.4304 - val_fn:
14.0000 - val_fp: 11.0000 - val_loss: 0.0076 - val_precision: 0.8333 - val_recall:
0.7971 - val_tn: 39793.0000 - val_tp: 55.0000
Epoch 213/300
78/78 ──────────────── **2s** 23ms/step - fn: 4.8228 - fp: 1.3671 - loss: 3.4221e-
04 - precision: 0.9894 - recall: 0.9734 - tn: 81727.4531 - tp: 154.0253 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0077 - val_precision: 0.8750 - val_recall:
0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 214/300
78/78 ──────────────── **2s** 25ms/step - fn: 4.7595 - fp: 3.1519 - loss: 3.0934e-
04 - precision: 0.9834 - recall: 0.9736 - tn: 81738.5547 - tp: 141.2025 - val_fn:
16.0000 - val_fp: 10.0000 - val_loss: 0.0081 - val_precision: 0.8413 - val_recall:
0.7681 - val_tn: 39794.0000 - val_tp: 53.0000
Epoch 215/300
78/78 ──────────────── **2s** 25ms/step - fn: 5.7089 - fp: 2.9114 - loss: 3.8202e-
04 - precision: 0.9753 - recall: 0.9576 - tn: 81729.6719 - tp: 149.3797 - val_fn:
14.0000 - val_fp: 11.0000 - val_loss: 0.0079 - val_precision: 0.8333 - val_recall:
0.7971 - val_tn: 39793.0000 - val_tp: 55.0000
Epoch 216/300
78/78 ──────────────── **2s** 27ms/step - fn: 4.0633 - fp: 2.1772 - loss: 2.4917e-
04 - precision: 0.9804 - recall: 0.9724 - tn: 81737.4922 - tp: 143.9367 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0079 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 217/300
78/78 ──────────────── **2s** 28ms/step - fn: 2.1646 - fp: 2.3418 - loss: 2.0158e-
04 - precision: 0.9878 - recall: 0.9900 - tn: 81741.2812 - tp: 141.8861 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0078 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 218/300
78/78 ──────────────── **2s** 28ms/step - fn: 3.7848 - fp: 3.5190 - loss: 2.6055e-
04 - precision: 0.9722 - recall: 0.9822 - tn: 81739.4922 - tp: 140.8734 - val_fn:

13.0000 - val_fp: 11.0000 - val_loss: 0.0077 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 219/300
78/78 ———————————————— **2s** 29ms/step - fn: 4.0253 - fp: 3.7975 - loss: 3.2922e-
04 - precision: 0.9663 - recall: 0.9760 - tn: 81742.8516 - tp: 137.0000 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0075 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 220/300
78/78 ———————————————— **2s** 27ms/step - fn: 2.8228 - fp: 1.1266 - loss: 1.4890e-
04 - precision: 0.9946 - recall: 0.9806 - tn: 81738.6719 - tp: 145.0506 - val_fn:
12.0000 - val_fp: 11.0000 - val_loss: 0.0076 - val_precision: 0.8382 - val_recall:
0.8261 - val_tn: 39793.0000 - val_tp: 57.0000
Epoch 221/300
78/78 ———————————————— **2s** 29ms/step - fn: 3.9241 - fp: 1.3291 - loss: 1.9112e-
04 - precision: 0.9930 - recall: 0.9732 - tn: 81733.3828 - tp: 149.0380 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0076 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 222/300
78/78 ———————————————— **2s** 30ms/step - fn: 2.5316 - fp: 3.6835 - loss: 2.2456e-
04 - precision: 0.9629 - recall: 0.9869 - tn: 81742.7109 - tp: 138.7468 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0078 - val_precision: 0.8750 - val_recall:
0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 223/300
78/78 ———————————————— **2s** 25ms/step - fn: 5.0506 - fp: 4.4304 - loss: 4.0061e-
04 - precision: 0.9717 - recall: 0.9547 - tn: 81735.9375 - tp: 142.2532 - val_fn:
15.0000 - val_fp: 10.0000 - val_loss: 0.0078 - val_precision: 0.8438 - val_recall:
0.7826 - val_tn: 39794.0000 - val_tp: 54.0000
Epoch 224/300
78/78 ———————————————— **2s** 21ms/step - fn: 5.3038 - fp: 2.0000 - loss: 2.6714e-
04 - precision: 0.9894 - recall: 0.9652 - tn: 81740.7344 - tp: 139.6329 - val_fn:
12.0000 - val_fp: 13.0000 - val_loss: 0.0084 - val_precision: 0.8143 - val_recall:
0.8261 - val_tn: 39791.0000 - val_tp: 57.0000
Epoch 225/300
78/78 ———————————————— **2s** 23ms/step - fn: 6.7595 - fp: 7.9747 - loss: 4.8076e-
04 - precision: 0.9408 - recall: 0.9607 - tn: 81731.0469 - tp: 141.8861 - val_fn:
12.0000 - val_fp: 14.0000 - val_loss: 0.0076 - val_precision: 0.8028 - val_recall:
0.8261 - val_tn: 39790.0000 - val_tp: 57.0000
Epoch 226/300
78/78 ———————————————— **2s** 22ms/step - fn: 5.7468 - fp: 2.9114 - loss: 3.4472e-
04 - precision: 0.9791 - recall: 0.9672 - tn: 81733.1172 - tp: 145.8987 - val_fn:
14.0000 - val_fp: 11.0000 - val_loss: 0.0072 - val_precision: 0.8333 - val_recall:
0.7971 - val_tn: 39793.0000 - val_tp: 55.0000
Epoch 227/300
78/78 ———————————————— **2s** 22ms/step - fn: 5.4810 - fp: 2.9494 - loss: 2.1191e-
04 - precision: 0.9836 - recall: 0.9668 - tn: 81735.8984 - tp: 143.3418 - val_fn:
12.0000 - val_fp: 6.0000 - val_loss: 0.0071 - val_precision: 0.9048 - val_recall:
0.8261 - val_tn: 39798.0000 - val_tp: 57.0000
Epoch 228/300
78/78 ———————————————— **2s** 23ms/step - fn: 5.8861 - fp: 1.1646 - loss: 2.6700e-
04 - precision: 0.9939 - recall: 0.9469 - tn: 81744.0625 - tp: 136.5570 - val_fn:
12.0000 - val_fp: 10.0000 - val_loss: 0.0071 - val_precision: 0.8507 - val_recall:
0.8261 - val_tn: 39794.0000 - val_tp: 57.0000
Epoch 229/300
78/78 ———————————————— **2s** 25ms/step - fn: 6.4304 - fp: 3.6329 - loss: 2.8402e-
04 - precision: 0.9801 - recall: 0.9614 - tn: 81747.0234 - tp: 130.5823 - val_fn:
15.0000 - val_fp: 10.0000 - val_loss: 0.0069 - val_precision: 0.8438 - val_recall:
0.7826 - val_tn: 39794.0000 - val_tp: 54.0000
Epoch 230/300
78/78 ———————————————— **2s** 26ms/step - fn: 6.3038 - fp: 2.7595 - loss: 2.9254e-
04 - precision: 0.9668 - recall: 0.9436 - tn: 81741.3906 - tp: 137.2152 - val_fn:
15.0000 - val_fp: 9.0000 - val_loss: 0.0069 - val_precision: 0.8571 - val_recall:
0.7826 - val_tn: 39795.0000 - val_tp: 54.0000
Epoch 231/300
78/78 ———————————————— **2s** 27ms/step - fn: 4.9873 - fp: 2.5823 - loss: 2.4654e-

04 - precision: 0.9850 - recall: 0.9656 - tn: 81737.2422 - tp: 142.8608 - val_fn: 12.0000 - val_fp: 9.0000 - val_loss: 0.0072 - val_precision: 0.8636 - val_recall: 0.8261 - val_tn: 39795.0000 - val_tp: 57.0000
Epoch 232/300
78/78 ──────────────── 2s 24ms/step - fn: 5.2785 - fp: 5.2658 - loss: 4.7134e-04 - precision: 0.9593 - recall: 0.9686 - tn: 81726.5547 - tp: 150.5696 - val_fn: 14.0000 - val_fp: 8.0000 - val_loss: 0.0071 - val_precision: 0.8730 - val_recall: 0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 233/300
78/78 ──────────────── 2s 23ms/step - fn: 4.4430 - fp: 3.6709 - loss: 1.9509e-04 - precision: 0.9793 - recall: 0.9722 - tn: 81735.9141 - tp: 143.6456 - val_fn: 13.0000 - val_fp: 7.0000 - val_loss: 0.0071 - val_precision: 0.8889 - val_recall: 0.8116 - val_tn: 39797.0000 - val_tp: 56.0000
Epoch 234/300
78/78 ──────────────── 2s 24ms/step - fn: 4.1013 - fp: 3.5316 - loss: 2.4326e-04 - precision: 0.9803 - recall: 0.9750 - tn: 81731.6719 - tp: 148.3671 - val_fn: 13.0000 - val_fp: 8.0000 - val_loss: 0.0074 - val_precision: 0.8750 - val_recall: 0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 235/300
78/78 ──────────────── 2s 24ms/step - fn: 7.1013 - fp: 4.8987 - loss: 4.0765e-04 - precision: 0.9691 - recall: 0.9422 - tn: 81741.6562 - tp: 134.0127 - val_fn: 16.0000 - val_fp: 6.0000 - val_loss: 0.0071 - val_precision: 0.8983 - val_recall: 0.7681 - val_tn: 39798.0000 - val_tp: 53.0000
Epoch 236/300
78/78 ──────────────── 3s 30ms/step - fn: 5.1139 - fp: 3.7342 - loss: 4.3798e-04 - precision: 0.9715 - recall: 0.9510 - tn: 81730.7109 - tp: 148.1139 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0073 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 237/300
78/78 ──────────────── 2s 30ms/step - fn: 5.3544 - fp: 0.5823 - loss: 3.8734e-04 - precision: 0.9976 - recall: 0.9520 - tn: 81732.6172 - tp: 149.1139 - val_fn: 14.0000 - val_fp: 8.0000 - val_loss: 0.0075 - val_precision: 0.8730 - val_recall: 0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 238/300
78/78 ──────────────── 2s 27ms/step - fn: 2.9620 - fp: 1.9873 - loss: 1.7842e-04 - precision: 0.9900 - recall: 0.9839 - tn: 81735.8359 - tp: 146.8861 - val_fn: 14.0000 - val_fp: 6.0000 - val_loss: 0.0074 - val_precision: 0.9016 - val_recall: 0.7971 - val_tn: 39798.0000 - val_tp: 55.0000
Epoch 239/300
78/78 ──────────────── 2s 27ms/step - fn: 6.3165 - fp: 3.4430 - loss: 4.4394e-04 - precision: 0.9745 - recall: 0.9575 - tn: 81732.2500 - tp: 145.6582 - val_fn: 14.0000 - val_fp: 10.0000 - val_loss: 0.0071 - val_precision: 0.8462 - val_recall: 0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 240/300
78/78 ──────────────── 3s 28ms/step - fn: 4.7975 - fp: 3.1266 - loss: 4.0588e-04 - precision: 0.9769 - recall: 0.9616 - tn: 81743.7734 - tp: 135.9747 - val_fn: 13.0000 - val_fp: 10.0000 - val_loss: 0.0076 - val_precision: 0.8485 - val_recall: 0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 241/300
78/78 ──────────────── 2s 22ms/step - fn: 4.6203 - fp: 4.2025 - loss: 3.4362e-04 - precision: 0.9722 - recall: 0.9744 - tn: 81733.4141 - tp: 145.4304 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0070 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 242/300
78/78 ──────────────── 2s 24ms/step - fn: 2.7342 - fp: 1.4557 - loss: 1.2770e-04 - precision: 0.9938 - recall: 0.9875 - tn: 81740.9219 - tp: 142.5570 - val_fn: 14.0000 - val_fp: 9.0000 - val_loss: 0.0073 - val_precision: 0.8594 - val_recall: 0.7971 - val_tn: 39795.0000 - val_tp: 55.0000
Epoch 243/300
78/78 ──────────────── 3s 33ms/step - fn: 6.0000 - fp: 4.3038 - loss: 3.3635e-04 - precision: 0.9635 - recall: 0.9545 - tn: 81738.5312 - tp: 138.8354 - val_fn: 14.0000 - val_fp: 10.0000 - val_loss: 0.0071 - val_precision: 0.8462 - val_recall: 0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 244/300

78/78 ──────────────────── **2s** 23ms/step - fn: 3.8481 - fp: 2.3544 - loss: 2.0149e-04 - precision: 0.9864 - recall: 0.9734 - tn: 81738.8984 - tp: 142.5696 - val_fn: 13.0000 - val_fp: 10.0000 - val_loss: 0.0073 - val_precision: 0.8485 - val_recall: 0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 245/300
78/78 ──────────────────── **2s** 28ms/step - fn: 2.9241 - fp: 3.3291 - loss: 1.8370e-04 - precision: 0.9805 - recall: 0.9815 - tn: 81733.5547 - tp: 147.8608 - val_fn: 13.0000 - val_fp: 8.0000 - val_loss: 0.0074 - val_precision: 0.8750 - val_recall: 0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 246/300
78/78 ──────────────────── **2s** 23ms/step - fn: 3.4937 - fp: 1.2405 - loss: 1.6345e-04 - precision: 0.9934 - recall: 0.9775 - tn: 81749.5469 - tp: 133.3924 - val_fn: 12.0000 - val_fp: 9.0000 - val_loss: 0.0078 - val_precision: 0.8636 - val_recall: 0.8261 - val_tn: 39795.0000 - val_tp: 57.0000
Epoch 247/300
78/78 ──────────────────── **2s** 21ms/step - fn: 1.8734 - fp: 1.1519 - loss: 1.1524e-04 - precision: 0.9914 - recall: 0.9909 - tn: 81743.3672 - tp: 141.2785 - val_fn: 12.0000 - val_fp: 11.0000 - val_loss: 0.0080 - val_precision: 0.8382 - val_recall: 0.8261 - val_tn: 39793.0000 - val_tp: 57.0000
Epoch 248/300
78/78 ──────────────────── **2s** 23ms/step - fn: 3.8228 - fp: 3.1139 - loss: 2.2754e-04 - precision: 0.9762 - recall: 0.9790 - tn: 81735.0156 - tp: 145.7215 - val_fn: 13.0000 - val_fp: 11.0000 - val_loss: 0.0078 - val_precision: 0.8358 - val_recall: 0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 249/300
78/78 ──────────────────── **2s** 21ms/step - fn: 3.1139 - fp: 2.3038 - loss: 2.1489e-04 - precision: 0.9874 - recall: 0.9817 - tn: 81735.3672 - tp: 146.8861 - val_fn: 12.0000 - val_fp: 11.0000 - val_loss: 0.0072 - val_precision: 0.8382 - val_recall: 0.8261 - val_tn: 39793.0000 - val_tp: 57.0000
Epoch 250/300
78/78 ──────────────────── **2s** 23ms/step - fn: 6.1013 - fp: 5.1646 - loss: 3.6425e-04 - precision: 0.9681 - recall: 0.9658 - tn: 81728.0781 - tp: 148.3291 - val_fn: 12.0000 - val_fp: 14.0000 - val_loss: 0.0076 - val_precision: 0.8028 - val_recall: 0.8261 - val_tn: 39790.0000 - val_tp: 57.0000
Epoch 251/300
78/78 ──────────────────── **2s** 23ms/step - fn: 7.4937 - fp: 5.5443 - loss: 3.8015e-04 - precision: 0.9535 - recall: 0.9472 - tn: 81728.3047 - tp: 146.3291 - val_fn: 13.0000 - val_fp: 7.0000 - val_loss: 0.0075 - val_precision: 0.8889 - val_recall: 0.8116 - val_tn: 39797.0000 - val_tp: 56.0000
Epoch 252/300
78/78 ──────────────────── **2s** 24ms/step - fn: 3.5823 - fp: 2.9494 - loss: 2.4580e-04 - precision: 0.9832 - recall: 0.9826 - tn: 81734.6172 - tp: 146.5190 - val_fn: 15.0000 - val_fp: 10.0000 - val_loss: 0.0071 - val_precision: 0.8438 - val_recall: 0.7826 - val_tn: 39794.0000 - val_tp: 54.0000
Epoch 253/300
78/78 ──────────────────── **2s** 24ms/step - fn: 10.7215 - fp: 5.1139 - loss: 5.0183e-04 - precision: 0.9720 - recall: 0.9230 - tn: 81738.3828 - tp: 133.4557 - val_fn: 13.0000 - val_fp: 10.0000 - val_loss: 0.0070 - val_precision: 0.8485 - val_recall: 0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 254/300
78/78 ──────────────────── **2s** 23ms/step - fn: 3.3797 - fp: 2.6456 - loss: 1.7435e-04 - precision: 0.9867 - recall: 0.9820 - tn: 81745.2656 - tp: 136.3797 - val_fn: 12.0000 - val_fp: 13.0000 - val_loss: 0.0075 - val_precision: 0.8143 - val_recall: 0.8261 - val_tn: 39791.0000 - val_tp: 57.0000
Epoch 255/300
78/78 ──────────────────── **2s** 23ms/step - fn: 6.5570 - fp: 5.3038 - loss: 4.0300e-04 - precision: 0.9647 - recall: 0.9606 - tn: 81732.5859 - tp: 143.2278 - val_fn: 13.0000 - val_fp: 11.0000 - val_loss: 0.0073 - val_precision: 0.8358 - val_recall: 0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 256/300
78/78 ──────────────────── **2s** 23ms/step - fn: 5.7595 - fp: 3.0253 - loss: 3.2924e-04 - precision: 0.9828 - recall: 0.9687 - tn: 81735.8594 - tp: 143.0253 - val_fn: 13.0000 - val_fp: 11.0000 - val_loss: 0.0068 - val_precision: 0.8358 - val_recall: 0.8116 - val_tn: 39793.0000 - val_tp: 56.0000

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Epoch 257/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 23ms/step - fn: 3.1392 - fp: 3.4304 - loss: 2.3492e-
04 - precision: 0.9813 - recall: 0.9835 - tn: 81735.8359 - tp: 145.2658 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0070 - val_precision: 0.8750 - val_recall:
0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 258/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 22ms/step - fn: 6.5063 - fp: 4.1519 - loss: 3.7427e-
04 - precision: 0.9669 - recall: 0.9365 - tn: 81726.5703 - tp: 150.4430 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0070 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 259/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 23ms/step - fn: 7.7595 - fp: 3.6329 - loss: 3.6200e-
04 - precision: 0.9791 - recall: 0.9402 - tn: 81737.6797 - tp: 138.5949 - val_fn:
14.0000 - val_fp: 11.0000 - val_loss: 0.0069 - val_precision: 0.8333 - val_recall:
0.7971 - val_tn: 39793.0000 - val_tp: 55.0000
Epoch 260/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 23ms/step - fn: 5.9241 - fp: 1.7468 - loss: 3.6106e-
04 - precision: 0.9920 - recall: 0.9566 - tn: 81733.9766 - tp: 146.0253 - val_fn:
13.0000 - val_fp: 12.0000 - val_loss: 0.0071 - val_precision: 0.8235 - val_recall:
0.8116 - val_tn: 39792.0000 - val_tp: 56.0000
Epoch 261/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 23ms/step - fn: 3.4177 - fp: 3.0000 - loss: 2.4742e-
04 - precision: 0.9816 - recall: 0.9797 - tn: 81736.0469 - tp: 145.2025 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0067 - val_precision: 0.8750 - val_recall:
0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 262/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 22ms/step - fn: 2.1772 - fp: 2.3924 - loss: 1.5917e-
04 - precision: 0.9878 - recall: 0.9885 - tn: 81732.4531 - tp: 150.6456 - val_fn:
15.0000 - val_fp: 9.0000 - val_loss: 0.0067 - val_precision: 0.8571 - val_recall:
0.7826 - val_tn: 39795.0000 - val_tp: 54.0000
Epoch 263/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 23ms/step - fn: 3.3544 - fp: 1.5696 - loss: 3.1808e-
04 - precision: 0.9891 - recall: 0.9670 - tn: 81746.7344 - tp: 136.0127 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0071 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 264/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 23ms/step - fn: 4.4304 - fp: 6.1772 - loss: 2.6115e-
04 - precision: 0.9311 - recall: 0.9592 - tn: 81728.3906 - tp: 148.6709 - val_fn:
13.0000 - val_fp: 12.0000 - val_loss: 0.0073 - val_precision: 0.8235 - val_recall:
0.8116 - val_tn: 39792.0000 - val_tp: 56.0000
Epoch 265/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 25ms/step - fn: 3.0633 - fp: 1.6203 - loss: 1.9185e-
04 - precision: 0.9828 - recall: 0.9821 - tn: 81749.3438 - tp: 133.6456 - val_fn:
13.0000 - val_fp: 11.0000 - val_loss: 0.0073 - val_precision: 0.8358 - val_recall:
0.8116 - val_tn: 39793.0000 - val_tp: 56.0000
Epoch 266/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 29ms/step - fn: 3.6076 - fp: 2.8987 - loss: 1.8996e-
04 - precision: 0.9834 - recall: 0.9808 - tn: 81728.5859 - tp: 152.5823 - val_fn:
14.0000 - val_fp: 8.0000 - val_loss: 0.0072 - val_precision: 0.8730 - val_recall:
0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 267/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 30ms/step - fn: 4.0000 - fp: 2.1139 - loss: 2.4067e-
04 - precision: 0.9853 - recall: 0.9740 - tn: 81739.5938 - tp: 141.9620 - val_fn:
15.0000 - val_fp: 5.0000 - val_loss: 0.0068 - val_precision: 0.9153 - val_recall:
0.7826 - val_tn: 39799.0000 - val_tp: 54.0000
Epoch 268/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 3s 37ms/step - fn: 3.5570 - fp: 1.1772 - loss: 2.5531e-
04 - precision: 0.9945 - recall: 0.9795 - tn: 81738.0000 - tp: 144.9367 - val_fn:
14.0000 - val_fp: 8.0000 - val_loss: 0.0071 - val_precision: 0.8730 - val_recall:
0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 269/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 29ms/step - fn: 2.8861 - fp: 1.5063 - loss: 1.7720e-
04 - precision: 0.9933 - recall: 0.9856 - tn: 81736.2422 - tp: 147.0380 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0071 - val_precision: 0.8750 - val_recall:
```

0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 270/300
78/78 ──────────────────── **2s** 24ms/step - fn: 4.8861 - fp: 3.9873 - loss: 4.8546e-04 - precision: 0.9702 - recall: 0.9730 - tn: 81738.6172 - tp: 140.1772 - val_fn: 12.0000 - val_fp: 9.0000 - val_loss: 0.0069 - val_precision: 0.8636 - val_recall: 0.8261 - val_tn: 39795.0000 - val_tp: 57.0000
Epoch 271/300
78/78 ──────────────────── **2s** 25ms/step - fn: 3.1772 - fp: 2.5949 - loss: 2.0190e-04 - precision: 0.9849 - recall: 0.9850 - tn: 81735.5859 - tp: 146.3165 - val_fn: 13.0000 - val_fp: 9.0000 - val_loss: 0.0067 - val_precision: 0.8615 - val_recall: 0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 272/300
78/78 ──────────────────── **2s** 24ms/step - fn: 1.7468 - fp: 1.5696 - loss: 1.7468e-04 - precision: 0.9845 - recall: 0.9901 - tn: 81747.8984 - tp: 136.4557 - val_fn: 13.0000 - val_fp: 8.0000 - val_loss: 0.0065 - val_precision: 0.8750 - val_recall: 0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 273/300
78/78 ──────────────────── **2s** 24ms/step - fn: 2.7089 - fp: 0.8228 - loss: 1.7339e-04 - precision: 0.9940 - recall: 0.9827 - tn: 81744.1641 - tp: 139.9747 - val_fn: 13.0000 - val_fp: 10.0000 - val_loss: 0.0065 - val_precision: 0.8485 - val_recall: 0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 274/300
78/78 ──────────────────── **2s** 22ms/step - fn: 4.5316 - fp: 2.1772 - loss: 1.6606e-04 - precision: 0.9845 - recall: 0.9736 - tn: 81738.3047 - tp: 142.6582 - val_fn: 13.0000 - val_fp: 8.0000 - val_loss: 0.0068 - val_precision: 0.8750 - val_recall: 0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 275/300
78/78 ──────────────────── **2s** 23ms/step - fn: 2.5063 - fp: 2.0506 - loss: 2.3937e-04 - precision: 0.9812 - recall: 0.9864 - tn: 81737.8594 - tp: 145.2532 - val_fn: 13.0000 - val_fp: 8.0000 - val_loss: 0.0067 - val_precision: 0.8750 - val_recall: 0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 276/300
78/78 ──────────────────── **2s** 22ms/step - fn: 2.0506 - fp: 3.1392 - loss: 1.7475e-04 - precision: 0.9783 - recall: 0.9872 - tn: 81732.0391 - tp: 150.4430 - val_fn: 12.0000 - val_fp: 11.0000 - val_loss: 0.0071 - val_precision: 0.8382 - val_recall: 0.8261 - val_tn: 39793.0000 - val_tp: 57.0000
Epoch 277/300
78/78 ──────────────────── **2s** 22ms/step - fn: 3.0759 - fp: 5.8481 - loss: 2.9597e-04 - precision: 0.9595 - recall: 0.9809 - tn: 81729.2812 - tp: 149.4684 - val_fn: 13.0000 - val_fp: 9.0000 - val_loss: 0.0071 - val_precision: 0.8615 - val_recall: 0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 278/300
78/78 ──────────────────── **2s** 22ms/step - fn: 3.2405 - fp: 3.0633 - loss: 1.8371e-04 - precision: 0.9774 - recall: 0.9821 - tn: 81736.1875 - tp: 145.1772 - val_fn: 16.0000 - val_fp: 9.0000 - val_loss: 0.0070 - val_precision: 0.8548 - val_recall: 0.7681 - val_tn: 39795.0000 - val_tp: 53.0000
Epoch 279/300
78/78 ──────────────────── **2s** 22ms/step - fn: 4.4430 - fp: 1.7468 - loss: 3.1755e-04 - precision: 0.9853 - recall: 0.9698 - tn: 81741.7578 - tp: 139.7215 - val_fn: 13.0000 - val_fp: 9.0000 - val_loss: 0.0067 - val_precision: 0.8615 - val_recall: 0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 280/300
78/78 ──────────────────── **2s** 22ms/step - fn: 3.1392 - fp: 1.7848 - loss: 1.9225e-04 - precision: 0.9914 - recall: 0.9830 - tn: 81731.4453 - tp: 151.3038 - val_fn: 12.0000 - val_fp: 8.0000 - val_loss: 0.0067 - val_precision: 0.8769 - val_recall: 0.8261 - val_tn: 39796.0000 - val_tp: 57.0000
Epoch 281/300
78/78 ──────────────────── **2s** 22ms/step - fn: 2.1519 - fp: 1.3165 - loss: 1.8002e-04 - precision: 0.9932 - recall: 0.9832 - tn: 81733.4453 - tp: 150.7595 - val_fn: 12.0000 - val_fp: 7.0000 - val_loss: 0.0069 - val_precision: 0.8906 - val_recall: 0.8261 - val_tn: 39797.0000 - val_tp: 57.0000
Epoch 282/300
78/78 ──────────────────── **2s** 22ms/step - fn: 4.2025 - fp: 1.5316 - loss: 1.2729e-04 - precision: 0.9924 - recall: 0.9780 - tn: 81731.6484 - tp: 150.2911 - val_fn:

12.0000 - val_fp: 11.0000 - val_loss: 0.0073 - val_precision: 0.8382 - val_recall:
0.8261 - val_tn: 39793.0000 - val_tp: 57.0000
Epoch 283/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 22ms/step - fn: 5.3291 - fp: 3.4937 - loss: 2.9713e-
04 - precision: 0.9600 - recall: 0.9691 - tn: 81738.2266 - tp: 140.6203 - val_fn:
12.0000 - val_fp: 11.0000 - val_loss: 0.0068 - val_precision: 0.8382 - val_recall:
0.8261 - val_tn: 39793.0000 - val_tp: 57.0000
Epoch 284/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 23ms/step - fn: 3.2405 - fp: 1.8228 - loss: 1.4031e-
04 - precision: 0.9837 - recall: 0.9820 - tn: 81743.1172 - tp: 139.4937 - val_fn:
14.0000 - val_fp: 10.0000 - val_loss: 0.0066 - val_precision: 0.8462 - val_recall:
0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 285/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 25ms/step - fn: 2.7215 - fp: 1.7215 - loss: 2.0289e-
04 - precision: 0.9888 - recall: 0.9854 - tn: 81740.3047 - tp: 142.9241 - val_fn:
14.0000 - val_fp: 8.0000 - val_loss: 0.0068 - val_precision: 0.8730 - val_recall:
0.7971 - val_tn: 39796.0000 - val_tp: 55.0000
Epoch 286/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 25ms/step - fn: 4.6076 - fp: 3.3291 - loss: 1.8082e-
04 - precision: 0.9821 - recall: 0.9700 - tn: 81741.8828 - tp: 137.8481 - val_fn:
12.0000 - val_fp: 13.0000 - val_loss: 0.0068 - val_precision: 0.8143 - val_recall:
0.8261 - val_tn: 39791.0000 - val_tp: 57.0000
Epoch 287/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 27ms/step - fn: 3.2405 - fp: 1.0759 - loss: 1.6931e-
04 - precision: 0.9902 - recall: 0.9759 - tn: 81741.6562 - tp: 141.6962 - val_fn:
13.0000 - val_fp: 12.0000 - val_loss: 0.0072 - val_precision: 0.8235 - val_recall:
0.8116 - val_tn: 39792.0000 - val_tp: 56.0000
Epoch 288/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 29ms/step - fn: 3.0886 - fp: 3.6709 - loss: 2.1195e-
04 - precision: 0.9758 - recall: 0.9829 - tn: 81732.9375 - tp: 147.9747 - val_fn:
14.0000 - val_fp: 10.0000 - val_loss: 0.0069 - val_precision: 0.8462 - val_recall:
0.7971 - val_tn: 39794.0000 - val_tp: 55.0000
Epoch 289/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 28ms/step - fn: 5.1646 - fp: 4.1772 - loss: 2.5191e-
04 - precision: 0.9703 - recall: 0.9610 - tn: 81735.0469 - tp: 143.2785 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0072 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 290/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 28ms/step - fn: 3.5063 - fp: 0.8354 - loss: 1.4405e-
04 - precision: 0.9967 - recall: 0.9815 - tn: 81737.2188 - tp: 146.1139 - val_fn:
15.0000 - val_fp: 8.0000 - val_loss: 0.0070 - val_precision: 0.8710 - val_recall:
0.7826 - val_tn: 39796.0000 - val_tp: 54.0000
Epoch 291/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 28ms/step - fn: 3.1646 - fp: 3.3418 - loss: 1.6677e-
04 - precision: 0.9822 - recall: 0.9829 - tn: 81735.0391 - tp: 146.1266 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0069 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 292/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 27ms/step - fn: 3.2278 - fp: 2.6962 - loss: 1.4683e-
04 - precision: 0.9840 - recall: 0.9821 - tn: 81743.1172 - tp: 138.6329 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0069 - val_precision: 0.8750 - val_recall:
0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
Epoch 293/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 29ms/step - fn: 2.5316 - fp: 1.3291 - loss: 1.3347e-
04 - precision: 0.9927 - recall: 0.9861 - tn: 81733.8203 - tp: 149.9873 - val_fn:
13.0000 - val_fp: 9.0000 - val_loss: 0.0069 - val_precision: 0.8615 - val_recall:
0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 294/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 27ms/step - fn: 3.3165 - fp: 0.7468 - loss: 1.3012e-
04 - precision: 0.9972 - recall: 0.9779 - tn: 81736.5547 - tp: 147.0506 - val_fn:
14.0000 - val_fp: 7.0000 - val_loss: 0.0069 - val_precision: 0.8871 - val_recall:
0.7971 - val_tn: 39797.0000 - val_tp: 55.0000
Epoch 295/300
78/78 ━━━━━━━━━━━━━━━━━━━━ **2s** 27ms/step - fn: 1.6076 - fp: 1.1266 - loss: 1.3182e-

```
04 - precision: 0.9945 - recall: 0.9916 - tn: 81737.5547 - tp: 147.3797 - val_fn:
12.0000 - val_fp: 11.0000 - val_loss: 0.0071 - val_precision: 0.8382 - val_recall:
0.8261 - val_tn: 39793.0000 - val_tp: 57.0000
Epoch 296/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 24ms/step - fn: 1.0127 - fp: 1.7468 - loss: 1.2423e-
04 - precision: 0.9894 - recall: 0.9960 - tn: 81730.4531 - tp: 154.4557 - val_fn:
13.0000 - val_fp: 10.0000 - val_loss: 0.0071 - val_precision: 0.8485 - val_recall:
0.8116 - val_tn: 39794.0000 - val_tp: 56.0000
Epoch 297/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 24ms/step - fn: 3.5823 - fp: 1.2785 - loss: 1.7409e-
04 - precision: 0.9933 - recall: 0.9729 - tn: 81733.4844 - tp: 149.3291 - val_fn:
13.0000 - val_fp: 9.0000 - val_loss: 0.0070 - val_precision: 0.8615 - val_recall:
0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 298/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 24ms/step - fn: 2.7595 - fp: 1.3924 - loss: 1.9493e-
04 - precision: 0.9926 - recall: 0.9860 - tn: 81734.8828 - tp: 148.6329 - val_fn:
13.0000 - val_fp: 9.0000 - val_loss: 0.0071 - val_precision: 0.8615 - val_recall:
0.8116 - val_tn: 39795.0000 - val_tp: 56.0000
Epoch 299/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 26ms/step - fn: 4.8228 - fp: 3.1139 - loss: 2.3366e-
04 - precision: 0.9774 - recall: 0.9696 - tn: 81736.9375 - tp: 142.7975 - val_fn:
15.0000 - val_fp: 5.0000 - val_loss: 0.0067 - val_precision: 0.9153 - val_recall:
0.7826 - val_tn: 39799.0000 - val_tp: 54.0000
Epoch 300/300
78/78 ━━━━━━━━━━━━━━━━━━━━ 2s 23ms/step - fn: 2.8608 - fp: 1.7468 - loss: 2.3344e-
04 - precision: 0.9911 - recall: 0.9815 - tn: 81738.0781 - tp: 144.9873 - val_fn:
13.0000 - val_fp: 8.0000 - val_loss: 0.0070 - val_precision: 0.8750 - val_recall:
0.8116 - val_tn: 39796.0000 - val_tp: 56.0000
```

In [24]:
```python
score = model.evaluate(X_test, y_test)
print(score)
```

```
2671/2671 ━━━━━━━━━━━━━━━━━━━━ 3s 1ms/step - fn: 16.0348 - fp: 8.5958 - loss: 0.00
69 - precision: 0.8658 - recall: 0.7602 - tn: 42688.9648 - tp: 54.3694
[0.004801953677088022, 25.0, 18.0, 85289.0, 111.0, 0.8604651093482971, 0.816176474
0943909]
```

In [25]:
```python
plt.figure(figsize=(12, 16))

plt.subplot(4, 2, 1)
plt.plot(r.history['loss'], label='Loss')
plt.plot(r.history['val_loss'], label='val_Loss')
plt.title('Loss Function evolution during training')
plt.legend()

plt.subplot(4, 2, 2)
plt.plot(r.history['fn'], label='fn')
plt.plot(r.history['val_fn'], label='val_fn')
plt.title('Accuracy evolution during training')
plt.legend()

plt.subplot(4, 2, 3)
plt.plot(r.history['precision'], label='precision')
plt.plot(r.history['val_precision'], label='val_precision')
plt.title('Precision evolution during training')
plt.legend()

plt.subplot(4, 2, 4)
plt.plot(r.history['recall'], label='recall')
plt.plot(r.history['val_recall'], label='val_recall')
plt.title('Recall evolution during training')
plt.legend()
```

Out[25]:
```
<matplotlib.legend.Legend at 0x298b18d8430>
```
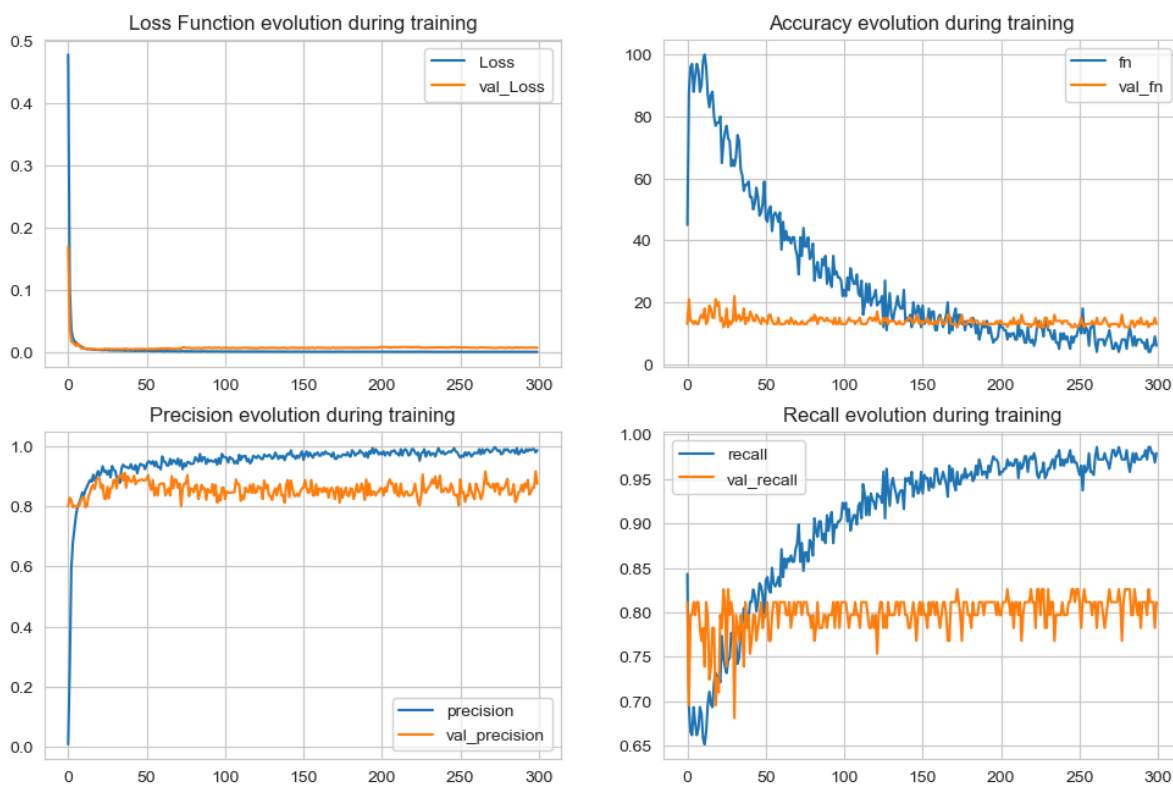
```
In [26]:  y_train_pred = model.predict(X_train)
          y_test_pred = model.predict(X_test)

          print_score(y_train, y_train_pred.round(), train=True)
          print_score(y_test, y_test_pred.round(), train=False)

          scores_dict = {
              'ANNs': {
                  'Train': f1_score(y_train, y_train_pred.round()),
                  'Test': f1_score(y_test, y_test_pred.round()),
              },
          }
```

```
4985/4985 ——————————————— 4s 859us/step
2671/2671 ——————————————— 2s 802us/step
Train Result:
================================================
Accuracy Score: 100.00%
_____

Classification Report:
                  0        1   accuracy   macro avg   weighted avg
precision      1.00     1.00       1.00        1.00           1.00
recall         1.00     0.99       1.00        1.00           1.00
f1-score       1.00     0.99       1.00        1.00           1.00
support    159204.00   287.00       1.00   159491.00      159491.00
_____

Confusion Matrix:
 [[159203       1]
 [     2     285]]

Test Result:
================================================
Accuracy Score: 99.95%
_____

Classification Report:
                 0        1   accuracy   macro avg   weighted avg
precision     1.00     0.86       1.00        0.93           1.00
recall        1.00     0.82       1.00        0.91           1.00
f1-score      1.00     0.84       1.00        0.92           1.00
support   85307.00   136.00       1.00    85443.00       85443.00
_____

Confusion Matrix:
 [[85289     18]
 [   25    111]]
```

4. 2. XGBoost

In [27]:
```
pip install --upgrade xgboost
```

```
Requirement already satisfied: xgboost in c:\users\khush\anaconda3\lib\site-packag
es (2.1.3)
Requirement already satisfied: scipy in c:\users\khush\anaconda3\lib\site-packages
(from xgboost) (1.10.0)
Requirement already satisfied: numpy in c:\users\khush\anaconda3\lib\site-packages
(from xgboost) (1.23.5)
Note: you may need to restart the kernel to use updated packages.
```

In [28]:
```python
from xgboost import XGBClassifier
from sklearn.metrics import f1_score

# Create the model
xgb_clf = XGBClassifier()

# Fit the model without evals
xgb_clf.fit(X_train, y_train)

# Make predictions
y_train_pred = xgb_clf.predict(X_train)
y_test_pred = xgb_clf.predict(X_test)

# Assuming print_score is a function you've defined to print the scores
print_score(y_train, y_train_pred, train=True)
print_score(y_test, y_test_pred, train=False)
```

```python
# Store the F1 scores in the scores_dict
scores_dict['XGBoost'] = {
    'Train': f1_score(y_train, y_train_pred),
    'Test': f1_score(y_test, y_test_pred),
}
```

```
Train Result:
================================================
Accuracy Score: 100.00%
_____
Classification Report:
                    0        1  accuracy  macro avg  weighted avg
precision        1.00     1.00      1.00       1.00          1.00
recall           1.00     1.00      1.00       1.00          1.00
f1-score         1.00     1.00      1.00       1.00          1.00
support    159204.00   287.00      1.00  159491.00     159491.00
_____
Confusion Matrix:
 [[159204      0]
 [     0    287]]

Test Result:
================================================
Accuracy Score: 99.96%
_____
Classification Report:
                   0        1  accuracy  macro avg  weighted avg
precision       1.00     0.95      1.00       0.97          1.00
recall          1.00     0.82      1.00       0.91          1.00
f1-score        1.00     0.88      1.00       0.94          1.00
support    85307.00   136.00      1.00  85443.00      85443.00
_____
Confusion Matrix:
 [[85301      6]
 [   25    111]]
```

4. 3. Random Forest

```python
In [30]:  from sklearn.ensemble import RandomForestClassifier

          rf_clf = RandomForestClassifier(n_estimators=100, oob_score=False)
          rf_clf.fit(X_train, y_train)

          y_train_pred = rf_clf.predict(X_train)
          y_test_pred = rf_clf.predict(X_test)

          print_score(y_train, y_train_pred, train=True)
          print_score(y_test, y_test_pred, train=False)

          scores_dict['Random Forest'] = {
                  'Train': f1_score(y_train,y_train_pred),
                  'Test': f1_score(y_test, y_test_pred),
          }
```

```
Train Result:
================================================
Accuracy Score: 100.00%
_____
Classification Report:
                 0       1   accuracy   macro avg   weighted avg
precision     1.00    1.00       1.00        1.00           1.00
recall        1.00    1.00       1.00        1.00           1.00
f1-score      1.00    1.00       1.00        1.00           1.00
support   159204.00 287.00       1.00   159491.00      159491.00
_____
Confusion Matrix:
 [[159204      0]
  [     0    287]]

Test Result:
================================================
Accuracy Score: 99.96%
_____
Classification Report:
                 0      1   accuracy   macro avg   weighted avg
precision     1.00   0.92       1.00        0.96           1.00
recall        1.00   0.81       1.00        0.90           1.00
f1-score      1.00   0.86       1.00        0.93           1.00
support   85307.00 136.00       1.00    85443.00       85443.00
_____
Confusion Matrix:
 [[85298      9]
  [   26    110]]
```

4. 4. CatBoost

In [31]:
```python
from catboost import CatBoostClassifier

cb_clf = CatBoostClassifier()
cb_clf.fit(X_train, y_train)
```

```
        Learning rate set to 0.089847
0:      learn: 0.3914637       total: 201ms      remaining: 3m 20s
1:      learn: 0.2368418       total: 232ms      remaining: 1m 55s
2:      learn: 0.1341780       total: 261ms      remaining: 1m 26s
3:      learn: 0.0788514       total: 287ms      remaining: 1m 11s
4:      learn: 0.0482949       total: 314ms      remaining: 1m 2s
5:      learn: 0.0315326       total: 346ms      remaining: 57.2s
6:      learn: 0.0213628       total: 390ms      remaining: 55.4s
7:      learn: 0.0153604       total: 425ms      remaining: 52.6s
8:      learn: 0.0115137       total: 454ms      remaining: 50s
9:      learn: 0.0090128       total: 482ms      remaining: 47.8s
10:     learn: 0.0071550       total: 511ms      remaining: 45.9s
11:     learn: 0.0060638       total: 543ms      remaining: 44.7s
12:     learn: 0.0052453       total: 584ms      remaining: 44.3s
13:     learn: 0.0046542       total: 617ms      remaining: 43.4s
14:     learn: 0.0042229       total: 649ms      remaining: 42.6s
15:     learn: 0.0038780       total: 677ms      remaining: 41.6s
16:     learn: 0.0036112       total: 707ms      remaining: 40.9s
17:     learn: 0.0034152       total: 735ms      remaining: 40.1s
18:     learn: 0.0032511       total: 779ms      remaining: 40.2s
19:     learn: 0.0031177       total: 816ms      remaining: 40s
20:     learn: 0.0030015       total: 846ms      remaining: 39.5s
21:     learn: 0.0029212       total: 875ms      remaining: 38.9s
22:     learn: 0.0028291       total: 908ms      remaining: 38.6s
23:     learn: 0.0027727       total: 934ms      remaining: 38s
24:     learn: 0.0027228       total: 964ms      remaining: 37.6s
25:     learn: 0.0026800       total: 996ms      remaining: 37.3s
26:     learn: 0.0026503       total: 1.05s      remaining: 37.7s
27:     learn: 0.0026258       total: 1.11s      remaining: 38.7s
28:     learn: 0.0025642       total: 1.15s      remaining: 38.5s
29:     learn: 0.0025473       total: 1.19s      remaining: 38.6s
30:     learn: 0.0025169       total: 1.23s      remaining: 38.5s
31:     learn: 0.0024811       total: 1.27s      remaining: 38.6s
32:     learn: 0.0024655       total: 1.31s      remaining: 38.3s
33:     learn: 0.0024468       total: 1.34s      remaining: 38.2s
34:     learn: 0.0023958       total: 1.37s      remaining: 37.8s
35:     learn: 0.0023774       total: 1.4s       remaining: 37.5s
36:     learn: 0.0023270       total: 1.43s      remaining: 37.3s
37:     learn: 0.0022984       total: 1.47s      remaining: 37.3s
38:     learn: 0.0022654       total: 1.51s      remaining: 37.4s
39:     learn: 0.0022550       total: 1.55s      remaining: 37.3s
40:     learn: 0.0022288       total: 1.6s       remaining: 37.4s
41:     learn: 0.0021987       total: 1.65s      remaining: 37.7s
42:     learn: 0.0021688       total: 1.69s      remaining: 37.6s
43:     learn: 0.0021542       total: 1.72s      remaining: 37.3s
44:     learn: 0.0021357       total: 1.75s      remaining: 37.2s
45:     learn: 0.0021207       total: 1.78s      remaining: 36.9s
46:     learn: 0.0021062       total: 1.8s       remaining: 36.5s
47:     learn: 0.0020970       total: 1.83s      remaining: 36.3s
48:     learn: 0.0020833       total: 1.85s      remaining: 36s
49:     learn: 0.0020661       total: 1.88s      remaining: 35.8s
50:     learn: 0.0020467       total: 1.93s      remaining: 35.9s
51:     learn: 0.0020346       total: 1.98s      remaining: 36.2s
52:     learn: 0.0020196       total: 2.03s      remaining: 36.2s
53:     learn: 0.0020130       total: 2.08s      remaining: 36.4s
54:     learn: 0.0020056       total: 2.12s      remaining: 36.4s
55:     learn: 0.0019957       total: 2.15s      remaining: 36.3s
56:     learn: 0.0019889       total: 2.2s       remaining: 36.4s
57:     learn: 0.0019825       total: 2.23s      remaining: 36.2s
58:     learn: 0.0019600       total: 2.28s      remaining: 36.3s
59:     learn: 0.0019374       total: 2.32s      remaining: 36.4s
60:     learn: 0.0019227       total: 2.36s      remaining: 36.3s
61:     learn: 0.0019063       total: 2.41s      remaining: 36.4s
62:     learn: 0.0019015       total: 2.46s      remaining: 36.6s
```

```
63:      learn: 0.0018947        total: 2.52s       remaining: 36.8s
64:      learn: 0.0018835        total: 2.56s       remaining: 36.8s
65:      learn: 0.0018731        total: 2.6s        remaining: 36.8s
66:      learn: 0.0018636        total: 2.63s       remaining: 36.7s
67:      learn: 0.0018589        total: 2.67s       remaining: 36.7s
68:      learn: 0.0018532        total: 2.72s       remaining: 36.7s
69:      learn: 0.0018334        total: 2.77s       remaining: 36.8s
70:      learn: 0.0018286        total: 2.81s       remaining: 36.8s
71:      learn: 0.0018218        total: 2.85s       remaining: 36.7s
72:      learn: 0.0018016        total: 2.89s       remaining: 36.8s
73:      learn: 0.0017934        total: 2.94s       remaining: 36.8s
74:      learn: 0.0017731        total: 2.98s       remaining: 36.8s
75:      learn: 0.0017715        total: 3.02s       remaining: 36.7s
76:      learn: 0.0017646        total: 3.05s       remaining: 36.6s
77:      learn: 0.0017565        total: 3.1s        remaining: 36.6s
78:      learn: 0.0017442        total: 3.15s       remaining: 36.7s
79:      learn: 0.0017397        total: 3.19s       remaining: 36.7s
80:      learn: 0.0017360        total: 3.23s       remaining: 36.6s
81:      learn: 0.0017335        total: 3.27s       remaining: 36.6s
82:      learn: 0.0017236        total: 3.31s       remaining: 36.5s
83:      learn: 0.0017176        total: 3.35s       remaining: 36.5s
84:      learn: 0.0017112        total: 3.39s       remaining: 36.5s
85:      learn: 0.0017029        total: 3.45s       remaining: 36.7s
86:      learn: 0.0016948        total: 3.48s       remaining: 36.6s
87:      learn: 0.0016877        total: 3.52s       remaining: 36.5s
88:      learn: 0.0016813        total: 3.57s       remaining: 36.6s
89:      learn: 0.0016670        total: 3.62s       remaining: 36.6s
90:      learn: 0.0016498        total: 3.65s       remaining: 36.5s
91:      learn: 0.0016409        total: 3.68s       remaining: 36.4s
92:      learn: 0.0016255        total: 3.72s       remaining: 36.3s
93:      learn: 0.0016125        total: 3.77s       remaining: 36.3s
94:      learn: 0.0016085        total: 3.8s        remaining: 36.2s
95:      learn: 0.0015968        total: 3.85s       remaining: 36.2s
96:      learn: 0.0015894        total: 3.89s       remaining: 36.2s
97:      learn: 0.0015826        total: 3.93s       remaining: 36.2s
98:      learn: 0.0015800        total: 3.96s       remaining: 36.1s
99:      learn: 0.0015741        total: 4.01s       remaining: 36.1s
100:     learn: 0.0015707        total: 4.06s       remaining: 36.2s
101:     learn: 0.0015667        total: 4.11s       remaining: 36.2s
102:     learn: 0.0015599        total: 4.15s       remaining: 36.1s
103:     learn: 0.0015560        total: 4.19s       remaining: 36.1s
104:     learn: 0.0015535        total: 4.25s       remaining: 36.3s
105:     learn: 0.0015488        total: 4.3s        remaining: 36.3s
106:     learn: 0.0015417        total: 4.35s       remaining: 36.3s
107:     learn: 0.0015379        total: 4.4s        remaining: 36.3s
108:     learn: 0.0015357        total: 4.43s       remaining: 36.2s
109:     learn: 0.0015185        total: 4.49s       remaining: 36.3s
110:     learn: 0.0015033        total: 4.54s       remaining: 36.4s
111:     learn: 0.0014958        total: 4.59s       remaining: 36.4s
112:     learn: 0.0014934        total: 4.63s       remaining: 36.4s
113:     learn: 0.0014873        total: 4.67s       remaining: 36.3s
114:     learn: 0.0014833        total: 4.72s       remaining: 36.3s
115:     learn: 0.0014806        total: 4.76s       remaining: 36.3s
116:     learn: 0.0014782        total: 4.8s        remaining: 36.2s
117:     learn: 0.0014766        total: 4.83s       remaining: 36.1s
118:     learn: 0.0014726        total: 4.87s       remaining: 36.1s
119:     learn: 0.0014654        total: 4.91s       remaining: 36s
120:     learn: 0.0014566        total: 4.94s       remaining: 35.9s
121:     learn: 0.0014465        total: 4.97s       remaining: 35.8s
122:     learn: 0.0014403        total: 5s          remaining: 35.6s
123:     learn: 0.0014362        total: 5.02s       remaining: 35.5s
124:     learn: 0.0014255        total: 5.05s       remaining: 35.4s
125:     learn: 0.0014217        total: 5.07s       remaining: 35.2s
126:     learn: 0.0014024        total: 5.1s        remaining: 35s
```

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127:    learn: 0.0013988      total: 5.12s      remaining: 34.9s
128:    learn: 0.0013925      total: 5.15s      remaining: 34.8s
129:    learn: 0.0013891      total: 5.17s      remaining: 34.6s
130:    learn: 0.0013764      total: 5.2s       remaining: 34.5s
131:    learn: 0.0013685      total: 5.22s      remaining: 34.3s
132:    learn: 0.0013625      total: 5.25s      remaining: 34.2s
133:    learn: 0.0013590      total: 5.27s      remaining: 34.1s
134:    learn: 0.0013531      total: 5.3s       remaining: 34s
135:    learn: 0.0013479      total: 5.34s      remaining: 33.9s
136:    learn: 0.0013452      total: 5.39s      remaining: 33.9s
137:    learn: 0.0013341      total: 5.44s      remaining: 34s
138:    learn: 0.0013268      total: 5.49s      remaining: 34s
139:    learn: 0.0013215      total: 5.53s      remaining: 34s
140:    learn: 0.0013154      total: 5.57s      remaining: 34s
141:    learn: 0.0013119      total: 5.62s      remaining: 34s
142:    learn: 0.0013083      total: 5.65s      remaining: 33.9s
143:    learn: 0.0013014      total: 5.69s      remaining: 33.8s
144:    learn: 0.0012945      total: 5.72s      remaining: 33.7s
145:    learn: 0.0012891      total: 5.76s      remaining: 33.7s
146:    learn: 0.0012706      total: 5.8s       remaining: 33.6s
147:    learn: 0.0012671      total: 5.84s      remaining: 33.6s
148:    learn: 0.0012633      total: 5.89s      remaining: 33.6s
149:    learn: 0.0012593      total: 5.92s      remaining: 33.5s
150:    learn: 0.0012566      total: 5.96s      remaining: 33.5s
151:    learn: 0.0012517      total: 6s         remaining: 33.5s
152:    learn: 0.0012480      total: 6.04s      remaining: 33.4s
153:    learn: 0.0012453      total: 6.07s      remaining: 33.3s
154:    learn: 0.0012434      total: 6.09s      remaining: 33.2s
155:    learn: 0.0012415      total: 6.13s      remaining: 33.2s
156:    learn: 0.0012391      total: 6.16s      remaining: 33.1s
157:    learn: 0.0012376      total: 6.22s      remaining: 33.1s
158:    learn: 0.0012358      total: 6.25s      remaining: 33.1s
159:    learn: 0.0012341      total: 6.3s       remaining: 33.1s
160:    learn: 0.0012326      total: 6.34s      remaining: 33s
161:    learn: 0.0012291      total: 6.36s      remaining: 32.9s
162:    learn: 0.0012280      total: 6.39s      remaining: 32.8s
163:    learn: 0.0012266      total: 6.42s      remaining: 32.7s
164:    learn: 0.0012199      total: 6.46s      remaining: 32.7s
165:    learn: 0.0012135      total: 6.51s      remaining: 32.7s
166:    learn: 0.0012109      total: 6.54s      remaining: 32.6s
167:    learn: 0.0012013      total: 6.57s      remaining: 32.5s
168:    learn: 0.0011997      total: 6.6s       remaining: 32.4s
169:    learn: 0.0011975      total: 6.63s      remaining: 32.4s
170:    learn: 0.0011950      total: 6.66s      remaining: 32.3s
171:    learn: 0.0011937      total: 6.68s      remaining: 32.2s
172:    learn: 0.0011858      total: 6.71s      remaining: 32.1s
173:    learn: 0.0011818      total: 6.74s      remaining: 32s
174:    learn: 0.0011801      total: 6.77s      remaining: 31.9s
175:    learn: 0.0011772      total: 6.8s       remaining: 31.8s
176:    learn: 0.0011728      total: 6.83s      remaining: 31.8s
177:    learn: 0.0011700      total: 6.86s      remaining: 31.7s
178:    learn: 0.0011608      total: 6.9s       remaining: 31.7s
179:    learn: 0.0011524      total: 6.94s      remaining: 31.6s
180:    learn: 0.0011503      total: 6.97s      remaining: 31.5s
181:    learn: 0.0011484      total: 7s         remaining: 31.4s
182:    learn: 0.0011466      total: 7.03s      remaining: 31.4s
183:    learn: 0.0011449      total: 7.08s      remaining: 31.4s
184:    learn: 0.0011423      total: 7.16s      remaining: 31.6s
185:    learn: 0.0011402      total: 7.19s      remaining: 31.5s
186:    learn: 0.0011347      total: 7.22s      remaining: 31.4s
187:    learn: 0.0011312      total: 7.25s      remaining: 31.3s
188:    learn: 0.0011304      total: 7.29s      remaining: 31.3s
189:    learn: 0.0011248      total: 7.32s      remaining: 31.2s
190:    learn: 0.0011186      total: 7.35s      remaining: 31.1s
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191:    learn: 0.0011162    total: 7.4s     remaining: 31.1s
192:    learn: 0.0011083    total: 7.44s    remaining: 31.1s
193:    learn: 0.0011065    total: 7.47s    remaining: 31s
194:    learn: 0.0011045    total: 7.49s    remaining: 30.9s
195:    learn: 0.0011030    total: 7.52s    remaining: 30.8s
196:    learn: 0.0011008    total: 7.54s    remaining: 30.7s
197:    learn: 0.0010973    total: 7.58s    remaining: 30.7s
198:    learn: 0.0010897    total: 7.61s    remaining: 30.6s
199:    learn: 0.0010875    total: 7.66s    remaining: 30.7s
200:    learn: 0.0010811    total: 7.7s     remaining: 30.6s
201:    learn: 0.0010792    total: 7.73s    remaining: 30.5s
202:    learn: 0.0010761    total: 7.76s    remaining: 30.5s
203:    learn: 0.0010742    total: 7.78s    remaining: 30.4s
204:    learn: 0.0010695    total: 7.82s    remaining: 30.3s
205:    learn: 0.0010676    total: 7.84s    remaining: 30.2s
206:    learn: 0.0010658    total: 7.86s    remaining: 30.1s
207:    learn: 0.0010638    total: 7.88s    remaining: 30s
208:    learn: 0.0010621    total: 7.89s    remaining: 29.9s
209:    learn: 0.0010556    total: 7.92s    remaining: 29.8s
210:    learn: 0.0010543    total: 7.93s    remaining: 29.7s
211:    learn: 0.0010517    total: 7.96s    remaining: 29.6s
212:    learn: 0.0010493    total: 7.98s    remaining: 29.5s
213:    learn: 0.0010436    total: 8.01s    remaining: 29.4s
214:    learn: 0.0010383    total: 8.03s    remaining: 29.3s
215:    learn: 0.0010367    total: 8.05s    remaining: 29.2s
216:    learn: 0.0010339    total: 8.07s    remaining: 29.1s
217:    learn: 0.0010314    total: 8.1s     remaining: 29.1s
218:    learn: 0.0010291    total: 8.14s    remaining: 29s
219:    learn: 0.0010177    total: 8.17s    remaining: 29s
220:    learn: 0.0010113    total: 8.2s     remaining: 28.9s
221:    learn: 0.0010009    total: 8.24s    remaining: 28.9s
222:    learn: 0.0009987    total: 8.28s    remaining: 28.8s
223:    learn: 0.0009879    total: 8.32s    remaining: 28.8s
224:    learn: 0.0009855    total: 8.35s    remaining: 28.8s
225:    learn: 0.0009814    total: 8.38s    remaining: 28.7s
226:    learn: 0.0009793    total: 8.41s    remaining: 28.6s
227:    learn: 0.0009778    total: 8.44s    remaining: 28.6s
228:    learn: 0.0009763    total: 8.46s    remaining: 28.5s
229:    learn: 0.0009757    total: 8.48s    remaining: 28.4s
230:    learn: 0.0009741    total: 8.5s     remaining: 28.3s
231:    learn: 0.0009727    total: 8.52s    remaining: 28.2s
232:    learn: 0.0009713    total: 8.55s    remaining: 28.1s
233:    learn: 0.0009680    total: 8.59s    remaining: 28.1s
234:    learn: 0.0009668    total: 8.62s    remaining: 28.1s
235:    learn: 0.0009646    total: 8.64s    remaining: 28s
236:    learn: 0.0009619    total: 8.68s    remaining: 27.9s
237:    learn: 0.0009607    total: 8.71s    remaining: 27.9s
238:    learn: 0.0009587    total: 8.75s    remaining: 27.9s
239:    learn: 0.0009539    total: 8.78s    remaining: 27.8s
240:    learn: 0.0009521    total: 8.82s    remaining: 27.8s
241:    learn: 0.0009510    total: 8.86s    remaining: 27.7s
242:    learn: 0.0009496    total: 8.89s    remaining: 27.7s
243:    learn: 0.0009483    total: 8.92s    remaining: 27.6s
244:    learn: 0.0009464    total: 8.96s    remaining: 27.6s
245:    learn: 0.0009442    total: 9s       remaining: 27.6s
246:    learn: 0.0009426    total: 9.04s    remaining: 27.6s
247:    learn: 0.0009409    total: 9.08s    remaining: 27.5s
248:    learn: 0.0009405    total: 9.11s    remaining: 27.5s
249:    learn: 0.0009348    total: 9.15s    remaining: 27.4s
250:    learn: 0.0009319    total: 9.18s    remaining: 27.4s
251:    learn: 0.0009208    total: 9.22s    remaining: 27.4s
252:    learn: 0.0009179    total: 9.24s    remaining: 27.3s
253:    learn: 0.0009134    total: 9.26s    remaining: 27.2s
254:    learn: 0.0009123    total: 9.29s    remaining: 27.1s
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255:    learn: 0.0009100     total: 9.32s    remaining: 27.1s
256:    learn: 0.0009081     total: 9.35s    remaining: 27s
257:    learn: 0.0009036     total: 9.38s    remaining: 27s
258:    learn: 0.0009018     total: 9.4s     remaining: 26.9s
259:    learn: 0.0009002     total: 9.43s    remaining: 26.8s
260:    learn: 0.0008923     total: 9.46s    remaining: 26.8s
261:    learn: 0.0008916     total: 9.48s    remaining: 26.7s
262:    learn: 0.0008906     total: 9.5s     remaining: 26.6s
263:    learn: 0.0008895     total: 9.52s    remaining: 26.5s
264:    learn: 0.0008883     total: 9.55s    remaining: 26.5s
265:    learn: 0.0008842     total: 9.57s    remaining: 26.4s
266:    learn: 0.0008827     total: 9.6s     remaining: 26.4s
267:    learn: 0.0008813     total: 9.64s    remaining: 26.3s
268:    learn: 0.0008800     total: 9.68s    remaining: 26.3s
269:    learn: 0.0008785     total: 9.71s    remaining: 26.3s
270:    learn: 0.0008774     total: 9.75s    remaining: 26.2s
271:    learn: 0.0008761     total: 9.77s    remaining: 26.2s
272:    learn: 0.0008666     total: 9.81s    remaining: 26.1s
273:    learn: 0.0008636     total: 9.85s    remaining: 26.1s
274:    learn: 0.0008559     total: 9.88s    remaining: 26s
275:    learn: 0.0008528     total: 9.92s    remaining: 26s
276:    learn: 0.0008511     total: 9.95s    remaining: 26s
277:    learn: 0.0008488     total: 9.98s    remaining: 25.9s
278:    learn: 0.0008480     total: 10s      remaining: 25.9s
279:    learn: 0.0008465     total: 10s      remaining: 25.8s
280:    learn: 0.0008430     total: 10.1s    remaining: 25.8s
281:    learn: 0.0008411     total: 10.1s    remaining: 25.7s
282:    learn: 0.0008376     total: 10.1s    remaining: 25.7s
283:    learn: 0.0008340     total: 10.2s    remaining: 25.6s
284:    learn: 0.0008324     total: 10.2s    remaining: 25.5s
285:    learn: 0.0008306     total: 10.2s    remaining: 25.4s
286:    learn: 0.0008293     total: 10.2s    remaining: 25.4s
287:    learn: 0.0008287     total: 10.2s    remaining: 25.3s
288:    learn: 0.0008262     total: 10.2s    remaining: 25.2s
289:    learn: 0.0008245     total: 10.3s    remaining: 25.1s
290:    learn: 0.0008243     total: 10.3s    remaining: 25.1s
291:    learn: 0.0008233     total: 10.3s    remaining: 25s
292:    learn: 0.0008227     total: 10.3s    remaining: 24.9s
293:    learn: 0.0008212     total: 10.4s    remaining: 24.9s
294:    learn: 0.0008201     total: 10.4s    remaining: 24.8s
295:    learn: 0.0008177     total: 10.4s    remaining: 24.8s
296:    learn: 0.0008131     total: 10.5s    remaining: 24.8s
297:    learn: 0.0008124     total: 10.5s    remaining: 24.7s
298:    learn: 0.0008076     total: 10.5s    remaining: 24.6s
299:    learn: 0.0008048     total: 10.5s    remaining: 24.6s
300:    learn: 0.0008015     total: 10.6s    remaining: 24.5s
301:    learn: 0.0007977     total: 10.6s    remaining: 24.4s
302:    learn: 0.0007972     total: 10.6s    remaining: 24.4s
303:    learn: 0.0007946     total: 10.6s    remaining: 24.3s
304:    learn: 0.0007904     total: 10.6s    remaining: 24.2s
305:    learn: 0.0007895     total: 10.7s    remaining: 24.2s
306:    learn: 0.0007892     total: 10.7s    remaining: 24.1s
307:    learn: 0.0007883     total: 10.7s    remaining: 24s
308:    learn: 0.0007838     total: 10.7s    remaining: 24s
309:    learn: 0.0007825     total: 10.8s    remaining: 24s
310:    learn: 0.0007801     total: 10.8s    remaining: 23.9s
311:    learn: 0.0007777     total: 10.8s    remaining: 23.9s
312:    learn: 0.0007757     total: 10.9s    remaining: 23.8s
313:    learn: 0.0007736     total: 10.9s    remaining: 23.8s
314:    learn: 0.0007732     total: 10.9s    remaining: 23.7s
315:    learn: 0.0007729     total: 10.9s    remaining: 23.7s
316:    learn: 0.0007709     total: 11s      remaining: 23.6s
317:    learn: 0.0007676     total: 11s      remaining: 23.6s
318:    learn: 0.0007661     total: 11s      remaining: 23.5s
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319:    learn: 0.0007636    total: 11s      remaining: 23.5s
320:    learn: 0.0007630    total: 11.1s    remaining: 23.4s
321:    learn: 0.0007616    total: 11.1s    remaining: 23.4s
322:    learn: 0.0007583    total: 11.1s    remaining: 23.3s
323:    learn: 0.0007535    total: 11.2s    remaining: 23.3s
324:    learn: 0.0007525    total: 11.2s    remaining: 23.2s
325:    learn: 0.0007492    total: 11.2s    remaining: 23.2s
326:    learn: 0.0007479    total: 11.2s    remaining: 23.1s
327:    learn: 0.0007457    total: 11.3s    remaining: 23.1s
328:    learn: 0.0007442    total: 11.3s    remaining: 23.1s
329:    learn: 0.0007434    total: 11.3s    remaining: 23s
330:    learn: 0.0007414    total: 11.4s    remaining: 23s
331:    learn: 0.0007400    total: 11.4s    remaining: 22.9s
332:    learn: 0.0007381    total: 11.4s    remaining: 22.9s
333:    learn: 0.0007363    total: 11.4s    remaining: 22.8s
334:    learn: 0.0007345    total: 11.5s    remaining: 22.8s
335:    learn: 0.0007334    total: 11.5s    remaining: 22.7s
336:    learn: 0.0007317    total: 11.5s    remaining: 22.7s
337:    learn: 0.0007300    total: 11.5s    remaining: 22.6s
338:    learn: 0.0007283    total: 11.6s    remaining: 22.6s
339:    learn: 0.0007252    total: 11.6s    remaining: 22.5s
340:    learn: 0.0007233    total: 11.6s    remaining: 22.5s
341:    learn: 0.0007216    total: 11.7s    remaining: 22.4s
342:    learn: 0.0007201    total: 11.7s    remaining: 22.4s
343:    learn: 0.0007194    total: 11.7s    remaining: 22.3s
344:    learn: 0.0007166    total: 11.7s    remaining: 22.3s
345:    learn: 0.0007151    total: 11.8s    remaining: 22.2s
346:    learn: 0.0007129    total: 11.8s    remaining: 22.2s
347:    learn: 0.0007116    total: 11.8s    remaining: 22.1s
348:    learn: 0.0007102    total: 11.8s    remaining: 22.1s
349:    learn: 0.0007063    total: 11.9s    remaining: 22s
350:    learn: 0.0007008    total: 11.9s    remaining: 22s
351:    learn: 0.0006997    total: 11.9s    remaining: 22s
352:    learn: 0.0006982    total: 12s      remaining: 21.9s
353:    learn: 0.0006977    total: 12s      remaining: 21.9s
354:    learn: 0.0006942    total: 12s      remaining: 21.8s
355:    learn: 0.0006935    total: 12s      remaining: 21.8s
356:    learn: 0.0006918    total: 12.1s    remaining: 21.7s
357:    learn: 0.0006893    total: 12.1s    remaining: 21.7s
358:    learn: 0.0006884    total: 12.1s    remaining: 21.6s
359:    learn: 0.0006874    total: 12.1s    remaining: 21.6s
360:    learn: 0.0006859    total: 12.2s    remaining: 21.5s
361:    learn: 0.0006849    total: 12.2s    remaining: 21.5s
362:    learn: 0.0006817    total: 12.2s    remaining: 21.5s
363:    learn: 0.0006790    total: 12.2s    remaining: 21.4s
364:    learn: 0.0006784    total: 12.3s    remaining: 21.3s
365:    learn: 0.0006769    total: 12.3s    remaining: 21.3s
366:    learn: 0.0006757    total: 12.3s    remaining: 21.3s
367:    learn: 0.0006730    total: 12.4s    remaining: 21.2s
368:    learn: 0.0006705    total: 12.4s    remaining: 21.2s
369:    learn: 0.0006671    total: 12.4s    remaining: 21.1s
370:    learn: 0.0006657    total: 12.4s    remaining: 21.1s
371:    learn: 0.0006611    total: 12.5s    remaining: 21s
372:    learn: 0.0006603    total: 12.5s    remaining: 21s
373:    learn: 0.0006583    total: 12.5s    remaining: 20.9s
374:    learn: 0.0006534    total: 12.5s    remaining: 20.9s
375:    learn: 0.0006532    total: 12.6s    remaining: 20.9s
376:    learn: 0.0006528    total: 12.6s    remaining: 20.8s
377:    learn: 0.0006517    total: 12.6s    remaining: 20.8s
378:    learn: 0.0006510    total: 12.6s    remaining: 20.7s
379:    learn: 0.0006508    total: 12.7s    remaining: 20.7s
380:    learn: 0.0006499    total: 12.7s    remaining: 20.6s
381:    learn: 0.0006487    total: 12.7s    remaining: 20.6s
382:    learn: 0.0006474    total: 12.8s    remaining: 20.5s
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383:    learn: 0.0006449    total: 12.8s    remaining: 20.5s
384:    learn: 0.0006445    total: 12.8s    remaining: 20.4s
385:    learn: 0.0006421    total: 12.8s    remaining: 20.4s
386:    learn: 0.0006405    total: 12.9s    remaining: 20.4s
387:    learn: 0.0006381    total: 12.9s    remaining: 20.3s
388:    learn: 0.0006346    total: 12.9s    remaining: 20.3s
389:    learn: 0.0006341    total: 12.9s    remaining: 20.2s
390:    learn: 0.0006311    total: 13s      remaining: 20.2s
391:    learn: 0.0006299    total: 13s      remaining: 20.2s
392:    learn: 0.0006259    total: 13s      remaining: 20.1s
393:    learn: 0.0006193    total: 13.1s    remaining: 20.1s
394:    learn: 0.0006132    total: 13.1s    remaining: 20s
395:    learn: 0.0006125    total: 13.1s    remaining: 20s
396:    learn: 0.0006099    total: 13.1s    remaining: 20s
397:    learn: 0.0006063    total: 13.2s    remaining: 19.9s
398:    learn: 0.0006049    total: 13.2s    remaining: 19.9s
399:    learn: 0.0006047    total: 13.2s    remaining: 19.8s
400:    learn: 0.0006040    total: 13.2s    remaining: 19.8s
401:    learn: 0.0006033    total: 13.3s    remaining: 19.7s
402:    learn: 0.0006026    total: 13.3s    remaining: 19.7s
403:    learn: 0.0005992    total: 13.3s    remaining: 19.7s
404:    learn: 0.0005945    total: 13.4s    remaining: 19.6s
405:    learn: 0.0005913    total: 13.4s    remaining: 19.6s
406:    learn: 0.0005884    total: 13.4s    remaining: 19.6s
407:    learn: 0.0005862    total: 13.5s    remaining: 19.5s
408:    learn: 0.0005837    total: 13.5s    remaining: 19.5s
409:    learn: 0.0005830    total: 13.5s    remaining: 19.4s
410:    learn: 0.0005802    total: 13.5s    remaining: 19.4s
411:    learn: 0.0005736    total: 13.6s    remaining: 19.4s
412:    learn: 0.0005677    total: 13.6s    remaining: 19.3s
413:    learn: 0.0005652    total: 13.6s    remaining: 19.3s
414:    learn: 0.0005633    total: 13.6s    remaining: 19.2s
415:    learn: 0.0005627    total: 13.6s    remaining: 19.2s
416:    learn: 0.0005575    total: 13.7s    remaining: 19.1s
417:    learn: 0.0005541    total: 13.7s    remaining: 19.1s
418:    learn: 0.0005521    total: 13.7s    remaining: 19s
419:    learn: 0.0005481    total: 13.7s    remaining: 19s
420:    learn: 0.0005476    total: 13.8s    remaining: 18.9s
421:    learn: 0.0005473    total: 13.8s    remaining: 18.9s
422:    learn: 0.0005402    total: 13.8s    remaining: 18.8s
423:    learn: 0.0005391    total: 13.8s    remaining: 18.8s
424:    learn: 0.0005370    total: 13.8s    remaining: 18.7s
425:    learn: 0.0005341    total: 13.9s    remaining: 18.7s
426:    learn: 0.0005335    total: 13.9s    remaining: 18.6s
427:    learn: 0.0005316    total: 13.9s    remaining: 18.6s
428:    learn: 0.0005292    total: 13.9s    remaining: 18.5s
429:    learn: 0.0005275    total: 14s      remaining: 18.5s
430:    learn: 0.0005270    total: 14s      remaining: 18.5s
431:    learn: 0.0005254    total: 14s      remaining: 18.4s
432:    learn: 0.0005245    total: 14s      remaining: 18.4s
433:    learn: 0.0005241    total: 14.1s    remaining: 18.3s
434:    learn: 0.0005235    total: 14.1s    remaining: 18.3s
435:    learn: 0.0005224    total: 14.1s    remaining: 18.2s
436:    learn: 0.0005220    total: 14.1s    remaining: 18.2s
437:    learn: 0.0005215    total: 14.1s    remaining: 18.1s
438:    learn: 0.0005201    total: 14.2s    remaining: 18.1s
439:    learn: 0.0005184    total: 14.2s    remaining: 18.1s
440:    learn: 0.0005172    total: 14.2s    remaining: 18s
441:    learn: 0.0005139    total: 14.2s    remaining: 18s
442:    learn: 0.0005111    total: 14.3s    remaining: 17.9s
443:    learn: 0.0005106    total: 14.3s    remaining: 17.9s
444:    learn: 0.0005099    total: 14.3s    remaining: 17.8s
445:    learn: 0.0005093    total: 14.3s    remaining: 17.8s
446:    learn: 0.0005054    total: 14.3s    remaining: 17.7s
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447:    learn: 0.0005008    total: 14.4s    remaining: 17.7s
448:    learn: 0.0005004    total: 14.4s    remaining: 17.6s
449:    learn: 0.0004995    total: 14.4s    remaining: 17.6s
450:    learn: 0.0004975    total: 14.4s    remaining: 17.5s
451:    learn: 0.0004938    total: 14.4s    remaining: 17.5s
452:    learn: 0.0004934    total: 14.5s    remaining: 17.4s
453:    learn: 0.0004929    total: 14.5s    remaining: 17.4s
454:    learn: 0.0004914    total: 14.5s    remaining: 17.4s
455:    learn: 0.0004853    total: 14.5s    remaining: 17.3s
456:    learn: 0.0004844    total: 14.5s    remaining: 17.3s
457:    learn: 0.0004815    total: 14.6s    remaining: 17.2s
458:    learn: 0.0004803    total: 14.6s    remaining: 17.2s
459:    learn: 0.0004787    total: 14.6s    remaining: 17.1s
460:    learn: 0.0004754    total: 14.6s    remaining: 17.1s
461:    learn: 0.0004752    total: 14.6s    remaining: 17s
462:    learn: 0.0004731    total: 14.7s    remaining: 17s
463:    learn: 0.0004702    total: 14.7s    remaining: 17s
464:    learn: 0.0004678    total: 14.7s    remaining: 16.9s
465:    learn: 0.0004675    total: 14.7s    remaining: 16.9s
466:    learn: 0.0004667    total: 14.7s    remaining: 16.8s
467:    learn: 0.0004663    total: 14.7s    remaining: 16.8s
468:    learn: 0.0004660    total: 14.8s    remaining: 16.7s
469:    learn: 0.0004643    total: 14.8s    remaining: 16.7s
470:    learn: 0.0004619    total: 14.8s    remaining: 16.6s
471:    learn: 0.0004598    total: 14.8s    remaining: 16.6s
472:    learn: 0.0004591    total: 14.8s    remaining: 16.5s
473:    learn: 0.0004570    total: 14.9s    remaining: 16.5s
474:    learn: 0.0004566    total: 14.9s    remaining: 16.5s
475:    learn: 0.0004558    total: 14.9s    remaining: 16.4s
476:    learn: 0.0004554    total: 14.9s    remaining: 16.4s
477:    learn: 0.0004552    total: 14.9s    remaining: 16.3s
478:    learn: 0.0004549    total: 15s      remaining: 16.3s
479:    learn: 0.0004512    total: 15s      remaining: 16.2s
480:    learn: 0.0004504    total: 15s      remaining: 16.2s
481:    learn: 0.0004488    total: 15s      remaining: 16.1s
482:    learn: 0.0004466    total: 15.1s    remaining: 16.1s
483:    learn: 0.0004459    total: 15.1s    remaining: 16.1s
484:    learn: 0.0004454    total: 15.1s    remaining: 16.1s
485:    learn: 0.0004421    total: 15.2s    remaining: 16s
486:    learn: 0.0004407    total: 15.2s    remaining: 16s
487:    learn: 0.0004385    total: 15.2s    remaining: 16s
488:    learn: 0.0004378    total: 15.3s    remaining: 15.9s
489:    learn: 0.0004375    total: 15.3s    remaining: 15.9s
490:    learn: 0.0004369    total: 15.3s    remaining: 15.9s
491:    learn: 0.0004359    total: 15.3s    remaining: 15.8s
492:    learn: 0.0004352    total: 15.4s    remaining: 15.8s
493:    learn: 0.0004333    total: 15.4s    remaining: 15.8s
494:    learn: 0.0004322    total: 15.5s    remaining: 15.8s
495:    learn: 0.0004305    total: 15.5s    remaining: 15.7s
496:    learn: 0.0004299    total: 15.5s    remaining: 15.7s
497:    learn: 0.0004268    total: 15.6s    remaining: 15.7s
498:    learn: 0.0004259    total: 15.6s    remaining: 15.7s
499:    learn: 0.0004204    total: 15.6s    remaining: 15.6s
500:    learn: 0.0004202    total: 15.7s    remaining: 15.6s
501:    learn: 0.0004199    total: 15.7s    remaining: 15.6s
502:    learn: 0.0004191    total: 15.7s    remaining: 15.5s
503:    learn: 0.0004168    total: 15.7s    remaining: 15.5s
504:    learn: 0.0004146    total: 15.8s    remaining: 15.4s
505:    learn: 0.0004143    total: 15.8s    remaining: 15.4s
506:    learn: 0.0004141    total: 15.8s    remaining: 15.4s
507:    learn: 0.0004126    total: 15.8s    remaining: 15.3s
508:    learn: 0.0004103    total: 15.8s    remaining: 15.3s
509:    learn: 0.0004100    total: 15.9s    remaining: 15.2s
510:    learn: 0.0004087    total: 15.9s    remaining: 15.2s
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511:      learn: 0.0004074      total: 15.9s      remaining: 15.1s
512:      learn: 0.0004063      total: 15.9s      remaining: 15.1s
513:      learn: 0.0004038      total: 15.9s      remaining: 15.1s
514:      learn: 0.0004027      total: 16s        remaining: 15s
515:      learn: 0.0004015      total: 16s        remaining: 15s
516:      learn: 0.0004006      total: 16s        remaining: 14.9s
517:      learn: 0.0003989      total: 16s        remaining: 14.9s
518:      learn: 0.0003928      total: 16s        remaining: 14.9s
519:      learn: 0.0003911      total: 16.1s      remaining: 14.8s
520:      learn: 0.0003896      total: 16.1s      remaining: 14.8s
521:      learn: 0.0003891      total: 16.1s      remaining: 14.8s
522:      learn: 0.0003876      total: 16.1s      remaining: 14.7s
523:      learn: 0.0003867      total: 16.2s      remaining: 14.7s
524:      learn: 0.0003852      total: 16.2s      remaining: 14.6s
525:      learn: 0.0003850      total: 16.2s      remaining: 14.6s
526:      learn: 0.0003844      total: 16.2s      remaining: 14.6s
527:      learn: 0.0003830      total: 16.3s      remaining: 14.5s
528:      learn: 0.0003818      total: 16.3s      remaining: 14.5s
529:      learn: 0.0003798      total: 16.3s      remaining: 14.5s
530:      learn: 0.0003796      total: 16.3s      remaining: 14.4s
531:      learn: 0.0003776      total: 16.3s      remaining: 14.4s
532:      learn: 0.0003759      total: 16.4s      remaining: 14.3s
533:      learn: 0.0003746      total: 16.4s      remaining: 14.3s
534:      learn: 0.0003745      total: 16.4s      remaining: 14.3s
535:      learn: 0.0003740      total: 16.4s      remaining: 14.2s
536:      learn: 0.0003734      total: 16.5s      remaining: 14.2s
537:      learn: 0.0003732      total: 16.5s      remaining: 14.2s
538:      learn: 0.0003715      total: 16.5s      remaining: 14.1s
539:      learn: 0.0003713      total: 16.5s      remaining: 14.1s
540:      learn: 0.0003695      total: 16.6s      remaining: 14s
541:      learn: 0.0003677      total: 16.6s      remaining: 14s
542:      learn: 0.0003675      total: 16.6s      remaining: 14s
543:      learn: 0.0003656      total: 16.6s      remaining: 13.9s
544:      learn: 0.0003614      total: 16.6s      remaining: 13.9s
545:      learn: 0.0003599      total: 16.7s      remaining: 13.8s
546:      learn: 0.0003581      total: 16.7s      remaining: 13.8s
547:      learn: 0.0003569      total: 16.7s      remaining: 13.8s
548:      learn: 0.0003563      total: 16.7s      remaining: 13.7s
549:      learn: 0.0003550      total: 16.7s      remaining: 13.7s
550:      learn: 0.0003545      total: 16.8s      remaining: 13.6s
551:      learn: 0.0003529      total: 16.8s      remaining: 13.6s
552:      learn: 0.0003514      total: 16.8s      remaining: 13.6s
553:      learn: 0.0003501      total: 16.8s      remaining: 13.5s
554:      learn: 0.0003485      total: 16.8s      remaining: 13.5s
555:      learn: 0.0003469      total: 16.9s      remaining: 13.5s
556:      learn: 0.0003464      total: 16.9s      remaining: 13.4s
557:      learn: 0.0003448      total: 16.9s      remaining: 13.4s
558:      learn: 0.0003424      total: 16.9s      remaining: 13.4s
559:      learn: 0.0003423      total: 17s        remaining: 13.3s
560:      learn: 0.0003414      total: 17s        remaining: 13.3s
561:      learn: 0.0003412      total: 17s        remaining: 13.2s
562:      learn: 0.0003401      total: 17s        remaining: 13.2s
563:      learn: 0.0003395      total: 17s        remaining: 13.2s
564:      learn: 0.0003380      total: 17.1s      remaining: 13.1s
565:      learn: 0.0003360      total: 17.1s      remaining: 13.1s
566:      learn: 0.0003359      total: 17.1s      remaining: 13.1s
567:      learn: 0.0003344      total: 17.2s      remaining: 13.1s
568:      learn: 0.0003334      total: 17.2s      remaining: 13s
569:      learn: 0.0003330      total: 17.2s      remaining: 13s
570:      learn: 0.0003329      total: 17.2s      remaining: 12.9s
571:      learn: 0.0003328      total: 17.3s      remaining: 12.9s
572:      learn: 0.0003326      total: 17.3s      remaining: 12.9s
573:      learn: 0.0003321      total: 17.3s      remaining: 12.8s
574:      learn: 0.0003319      total: 17.3s      remaining: 12.8s
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575:    learn: 0.0003306    total: 17.3s    remaining: 12.8s
576:    learn: 0.0003294    total: 17.4s    remaining: 12.7s
577:    learn: 0.0003288    total: 17.4s    remaining: 12.7s
578:    learn: 0.0003286    total: 17.4s    remaining: 12.7s
579:    learn: 0.0003273    total: 17.4s    remaining: 12.6s
580:    learn: 0.0003270    total: 17.4s    remaining: 12.6s
581:    learn: 0.0003264    total: 17.5s    remaining: 12.5s
582:    learn: 0.0003254    total: 17.5s    remaining: 12.5s
583:    learn: 0.0003249    total: 17.5s    remaining: 12.5s
584:    learn: 0.0003246    total: 17.5s    remaining: 12.4s
585:    learn: 0.0003233    total: 17.6s    remaining: 12.4s
586:    learn: 0.0003229    total: 17.6s    remaining: 12.4s
587:    learn: 0.0003221    total: 17.6s    remaining: 12.3s
588:    learn: 0.0003217    total: 17.6s    remaining: 12.3s
589:    learn: 0.0003214    total: 17.6s    remaining: 12.3s
590:    learn: 0.0003200    total: 17.6s    remaining: 12.2s
591:    learn: 0.0003183    total: 17.7s    remaining: 12.2s
592:    learn: 0.0003171    total: 17.7s    remaining: 12.1s
593:    learn: 0.0003152    total: 17.7s    remaining: 12.1s
594:    learn: 0.0003141    total: 17.7s    remaining: 12.1s
595:    learn: 0.0003121    total: 17.8s    remaining: 12s
596:    learn: 0.0003115    total: 17.8s    remaining: 12s
597:    learn: 0.0003106    total: 17.8s    remaining: 12s
598:    learn: 0.0003102    total: 17.8s    remaining: 11.9s
599:    learn: 0.0003093    total: 17.8s    remaining: 11.9s
600:    learn: 0.0003082    total: 17.9s    remaining: 11.9s
601:    learn: 0.0003080    total: 17.9s    remaining: 11.8s
602:    learn: 0.0003078    total: 17.9s    remaining: 11.8s
603:    learn: 0.0003074    total: 17.9s    remaining: 11.7s
604:    learn: 0.0003054    total: 17.9s    remaining: 11.7s
605:    learn: 0.0003045    total: 17.9s    remaining: 11.7s
606:    learn: 0.0003036    total: 18s      remaining: 11.6s
607:    learn: 0.0003007    total: 18s      remaining: 11.6s
608:    learn: 0.0003005    total: 18s      remaining: 11.6s
609:    learn: 0.0002997    total: 18s      remaining: 11.5s
610:    learn: 0.0002979    total: 18.1s    remaining: 11.5s
611:    learn: 0.0002978    total: 18.1s    remaining: 11.5s
612:    learn: 0.0002968    total: 18.1s    remaining: 11.4s
613:    learn: 0.0002958    total: 18.1s    remaining: 11.4s
614:    learn: 0.0002952    total: 18.1s    remaining: 11.4s
615:    learn: 0.0002941    total: 18.2s    remaining: 11.3s
616:    learn: 0.0002940    total: 18.2s    remaining: 11.3s
617:    learn: 0.0002929    total: 18.2s    remaining: 11.3s
618:    learn: 0.0002927    total: 18.3s    remaining: 11.2s
619:    learn: 0.0002925    total: 18.3s    remaining: 11.2s
620:    learn: 0.0002918    total: 18.3s    remaining: 11.2s
621:    learn: 0.0002910    total: 18.3s    remaining: 11.1s
622:    learn: 0.0002896    total: 18.3s    remaining: 11.1s
623:    learn: 0.0002893    total: 18.4s    remaining: 11.1s
624:    learn: 0.0002888    total: 18.4s    remaining: 11s
625:    learn: 0.0002881    total: 18.4s    remaining: 11s
626:    learn: 0.0002878    total: 18.4s    remaining: 11s
627:    learn: 0.0002877    total: 18.5s    remaining: 10.9s
628:    learn: 0.0002871    total: 18.5s    remaining: 10.9s
629:    learn: 0.0002859    total: 18.5s    remaining: 10.9s
630:    learn: 0.0002853    total: 18.5s    remaining: 10.8s
631:    learn: 0.0002849    total: 18.6s    remaining: 10.8s
632:    learn: 0.0002844    total: 18.6s    remaining: 10.8s
633:    learn: 0.0002835    total: 18.6s    remaining: 10.7s
634:    learn: 0.0002834    total: 18.6s    remaining: 10.7s
635:    learn: 0.0002818    total: 18.6s    remaining: 10.7s
636:    learn: 0.0002809    total: 18.7s    remaining: 10.6s
637:    learn: 0.0002806    total: 18.7s    remaining: 10.6s
638:    learn: 0.0002803    total: 18.7s    remaining: 10.6s
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639:    learn: 0.0002799    total: 18.7s    remaining: 10.5s
640:    learn: 0.0002780    total: 18.8s    remaining: 10.5s
641:    learn: 0.0002776    total: 18.8s    remaining: 10.5s
642:    learn: 0.0002745    total: 18.8s    remaining: 10.4s
643:    learn: 0.0002744    total: 18.8s    remaining: 10.4s
644:    learn: 0.0002731    total: 18.9s    remaining: 10.4s
645:    learn: 0.0002730    total: 18.9s    remaining: 10.3s
646:    learn: 0.0002720    total: 18.9s    remaining: 10.3s
647:    learn: 0.0002718    total: 18.9s    remaining: 10.3s
648:    learn: 0.0002705    total: 18.9s    remaining: 10.2s
649:    learn: 0.0002695    total: 19s      remaining: 10.2s
650:    learn: 0.0002694    total: 19s      remaining: 10.2s
651:    learn: 0.0002688    total: 19s      remaining: 10.2s
652:    learn: 0.0002658    total: 19.1s    remaining: 10.1s
653:    learn: 0.0002655    total: 19.1s    remaining: 10.1s
654:    learn: 0.0002652    total: 19.1s    remaining: 10.1s
655:    learn: 0.0002649    total: 19.2s    remaining: 10.1s
656:    learn: 0.0002645    total: 19.2s    remaining: 10s
657:    learn: 0.0002644    total: 19.3s    remaining: 10s
658:    learn: 0.0002642    total: 19.3s    remaining: 9.98s
659:    learn: 0.0002634    total: 19.3s    remaining: 9.96s
660:    learn: 0.0002630    total: 19.4s    remaining: 9.93s
661:    learn: 0.0002627    total: 19.4s    remaining: 9.89s
662:    learn: 0.0002624    total: 19.4s    remaining: 9.86s
663:    learn: 0.0002623    total: 19.4s    remaining: 9.83s
664:    learn: 0.0002606    total: 19.4s    remaining: 9.8s
665:    learn: 0.0002599    total: 19.5s    remaining: 9.77s
666:    learn: 0.0002596    total: 19.5s    remaining: 9.73s
667:    learn: 0.0002594    total: 19.5s    remaining: 9.7s
668:    learn: 0.0002588    total: 19.5s    remaining: 9.67s
669:    learn: 0.0002586    total: 19.6s    remaining: 9.63s
670:    learn: 0.0002585    total: 19.6s    remaining: 9.6s
671:    learn: 0.0002582    total: 19.6s    remaining: 9.57s
672:    learn: 0.0002580    total: 19.6s    remaining: 9.53s
673:    learn: 0.0002577    total: 19.7s    remaining: 9.51s
674:    learn: 0.0002555    total: 19.7s    remaining: 9.48s
675:    learn: 0.0002547    total: 19.7s    remaining: 9.45s
676:    learn: 0.0002538    total: 19.7s    remaining: 9.42s
677:    learn: 0.0002534    total: 19.8s    remaining: 9.39s
678:    learn: 0.0002530    total: 19.8s    remaining: 9.36s
679:    learn: 0.0002526    total: 19.8s    remaining: 9.33s
680:    learn: 0.0002522    total: 19.8s    remaining: 9.3s
681:    learn: 0.0002511    total: 19.9s    remaining: 9.27s
682:    learn: 0.0002500    total: 19.9s    remaining: 9.23s
683:    learn: 0.0002492    total: 19.9s    remaining: 9.2s
684:    learn: 0.0002489    total: 19.9s    remaining: 9.17s
685:    learn: 0.0002485    total: 20s      remaining: 9.14s
686:    learn: 0.0002479    total: 20s      remaining: 9.11s
687:    learn: 0.0002473    total: 20s      remaining: 9.08s
688:    learn: 0.0002471    total: 20s      remaining: 9.05s
689:    learn: 0.0002463    total: 20.1s    remaining: 9.02s
690:    learn: 0.0002455    total: 20.1s    remaining: 8.99s
691:    learn: 0.0002444    total: 20.1s    remaining: 8.96s
692:    learn: 0.0002438    total: 20.1s    remaining: 8.92s
693:    learn: 0.0002438    total: 20.2s    remaining: 8.89s
694:    learn: 0.0002419    total: 20.2s    remaining: 8.86s
695:    learn: 0.0002417    total: 20.2s    remaining: 8.83s
696:    learn: 0.0002412    total: 20.2s    remaining: 8.79s
697:    learn: 0.0002402    total: 20.3s    remaining: 8.76s
698:    learn: 0.0002393    total: 20.3s    remaining: 8.73s
699:    learn: 0.0002392    total: 20.3s    remaining: 8.7s
700:    learn: 0.0002387    total: 20.3s    remaining: 8.67s
701:    learn: 0.0002369    total: 20.4s    remaining: 8.64s
702:    learn: 0.0002353    total: 20.4s    remaining: 8.61s
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703:    learn: 0.0002336    total: 20.4s    remaining: 8.58s
704:    learn: 0.0002334    total: 20.4s    remaining: 8.55s
705:    learn: 0.0002330    total: 20.5s    remaining: 8.52s
706:    learn: 0.0002324    total: 20.5s    remaining: 8.49s
707:    learn: 0.0002321    total: 20.5s    remaining: 8.46s
708:    learn: 0.0002316    total: 20.6s    remaining: 8.44s
709:    learn: 0.0002299    total: 20.6s    remaining: 8.41s
710:    learn: 0.0002293    total: 20.6s    remaining: 8.38s
711:    learn: 0.0002292    total: 20.6s    remaining: 8.35s
712:    learn: 0.0002275    total: 20.7s    remaining: 8.32s
713:    learn: 0.0002265    total: 20.7s    remaining: 8.29s
714:    learn: 0.0002248    total: 20.7s    remaining: 8.26s
715:    learn: 0.0002246    total: 20.7s    remaining: 8.23s
716:    learn: 0.0002244    total: 20.8s    remaining: 8.2s
717:    learn: 0.0002226    total: 20.8s    remaining: 8.17s
718:    learn: 0.0002225    total: 20.8s    remaining: 8.13s
719:    learn: 0.0002214    total: 20.8s    remaining: 8.1s
720:    learn: 0.0002212    total: 20.9s    remaining: 8.07s
721:    learn: 0.0002203    total: 20.9s    remaining: 8.04s
722:    learn: 0.0002201    total: 20.9s    remaining: 8.01s
723:    learn: 0.0002195    total: 20.9s    remaining: 7.97s
724:    learn: 0.0002193    total: 20.9s    remaining: 7.95s
725:    learn: 0.0002188    total: 21s      remaining: 7.92s
726:    learn: 0.0002172    total: 21s      remaining: 7.88s
727:    learn: 0.0002154    total: 21s      remaining: 7.86s
728:    learn: 0.0002148    total: 21.1s    remaining: 7.83s
729:    learn: 0.0002137    total: 21.1s    remaining: 7.8s
730:    learn: 0.0002123    total: 21.1s    remaining: 7.77s
731:    learn: 0.0002115    total: 21.1s    remaining: 7.74s
732:    learn: 0.0002112    total: 21.2s    remaining: 7.71s
733:    learn: 0.0002103    total: 21.2s    remaining: 7.68s
734:    learn: 0.0002096    total: 21.2s    remaining: 7.65s
735:    learn: 0.0002092    total: 21.2s    remaining: 7.62s
736:    learn: 0.0002086    total: 21.3s    remaining: 7.58s
737:    learn: 0.0002081    total: 21.3s    remaining: 7.55s
738:    learn: 0.0002072    total: 21.3s    remaining: 7.52s
739:    learn: 0.0002070    total: 21.3s    remaining: 7.49s
740:    learn: 0.0002068    total: 21.3s    remaining: 7.46s
741:    learn: 0.0002062    total: 21.4s    remaining: 7.43s
742:    learn: 0.0002060    total: 21.4s    remaining: 7.39s
743:    learn: 0.0002059    total: 21.4s    remaining: 7.36s
744:    learn: 0.0002057    total: 21.4s    remaining: 7.33s
745:    learn: 0.0002055    total: 21.5s    remaining: 7.3s
746:    learn: 0.0002052    total: 21.5s    remaining: 7.27s
747:    learn: 0.0002040    total: 21.5s    remaining: 7.24s
748:    learn: 0.0002036    total: 21.5s    remaining: 7.21s
749:    learn: 0.0002034    total: 21.6s    remaining: 7.18s
750:    learn: 0.0002033    total: 21.6s    remaining: 7.15s
751:    learn: 0.0002027    total: 21.6s    remaining: 7.12s
752:    learn: 0.0002026    total: 21.6s    remaining: 7.09s
753:    learn: 0.0002023    total: 21.6s    remaining: 7.06s
754:    learn: 0.0002016    total: 21.7s    remaining: 7.03s
755:    learn: 0.0002010    total: 21.7s    remaining: 7s
756:    learn: 0.0001991    total: 21.7s    remaining: 6.97s
757:    learn: 0.0001989    total: 21.7s    remaining: 6.94s
758:    learn: 0.0001986    total: 21.8s    remaining: 6.91s
759:    learn: 0.0001984    total: 21.8s    remaining: 6.88s
760:    learn: 0.0001979    total: 21.8s    remaining: 6.85s
761:    learn: 0.0001973    total: 21.8s    remaining: 6.82s
762:    learn: 0.0001972    total: 21.9s    remaining: 6.79s
763:    learn: 0.0001969    total: 21.9s    remaining: 6.76s
764:    learn: 0.0001967    total: 21.9s    remaining: 6.73s
765:    learn: 0.0001950    total: 21.9s    remaining: 6.7s
766:    learn: 0.0001948    total: 22s      remaining: 6.67s
```

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767:     learn: 0.0001943      total: 22s       remaining: 6.64s
768:     learn: 0.0001940      total: 22s       remaining: 6.61s
769:     learn: 0.0001937      total: 22s       remaining: 6.58s
770:     learn: 0.0001936      total: 22.1s     remaining: 6.55s
771:     learn: 0.0001925      total: 22.1s     remaining: 6.52s
772:     learn: 0.0001922      total: 22.1s     remaining: 6.49s
773:     learn: 0.0001918      total: 22.1s     remaining: 6.46s
774:     learn: 0.0001914      total: 22.2s     remaining: 6.43s
775:     learn: 0.0001912      total: 22.2s     remaining: 6.4s
776:     learn: 0.0001908      total: 22.2s     remaining: 6.38s
777:     learn: 0.0001900      total: 22.2s     remaining: 6.35s
778:     learn: 0.0001886      total: 22.3s     remaining: 6.32s
779:     learn: 0.0001883      total: 22.3s     remaining: 6.29s
780:     learn: 0.0001869      total: 22.3s     remaining: 6.26s
781:     learn: 0.0001865      total: 22.3s     remaining: 6.23s
782:     learn: 0.0001856      total: 22.4s     remaining: 6.2s
783:     learn: 0.0001847      total: 22.4s     remaining: 6.17s
784:     learn: 0.0001847      total: 22.4s     remaining: 6.14s
785:     learn: 0.0001845      total: 22.4s     remaining: 6.11s
786:     learn: 0.0001837      total: 22.4s     remaining: 6.08s
787:     learn: 0.0001834      total: 22.5s     remaining: 6.04s
788:     learn: 0.0001831      total: 22.5s     remaining: 6.01s
789:     learn: 0.0001828      total: 22.5s     remaining: 5.98s
790:     learn: 0.0001825      total: 22.5s     remaining: 5.95s
791:     learn: 0.0001822      total: 22.6s     remaining: 5.92s
792:     learn: 0.0001819      total: 22.6s     remaining: 5.89s
793:     learn: 0.0001806      total: 22.6s     remaining: 5.87s
794:     learn: 0.0001805      total: 22.6s     remaining: 5.84s
795:     learn: 0.0001802      total: 22.7s     remaining: 5.81s
796:     learn: 0.0001800      total: 22.7s     remaining: 5.78s
797:     learn: 0.0001798      total: 22.7s     remaining: 5.75s
798:     learn: 0.0001790      total: 22.7s     remaining: 5.72s
799:     learn: 0.0001767      total: 22.8s     remaining: 5.69s
800:     learn: 0.0001764      total: 22.8s     remaining: 5.66s
801:     learn: 0.0001759      total: 22.8s     remaining: 5.63s
802:     learn: 0.0001758      total: 22.8s     remaining: 5.6s
803:     learn: 0.0001755      total: 22.9s     remaining: 5.57s
804:     learn: 0.0001754      total: 22.9s     remaining: 5.54s
805:     learn: 0.0001751      total: 22.9s     remaining: 5.51s
806:     learn: 0.0001746      total: 22.9s     remaining: 5.48s
807:     learn: 0.0001745      total: 22.9s     remaining: 5.45s
808:     learn: 0.0001744      total: 23s       remaining: 5.42s
809:     learn: 0.0001744      total: 23s       remaining: 5.39s
810:     learn: 0.0001743      total: 23s       remaining: 5.36s
811:     learn: 0.0001742      total: 23s       remaining: 5.33s
812:     learn: 0.0001736      total: 23s       remaining: 5.3s
813:     learn: 0.0001731      total: 23.1s     remaining: 5.27s
814:     learn: 0.0001726      total: 23.1s     remaining: 5.24s
815:     learn: 0.0001724      total: 23.1s     remaining: 5.21s
816:     learn: 0.0001722      total: 23.1s     remaining: 5.18s
817:     learn: 0.0001721      total: 23.2s     remaining: 5.15s
818:     learn: 0.0001714      total: 23.2s     remaining: 5.12s
819:     learn: 0.0001714      total: 23.2s     remaining: 5.09s
820:     learn: 0.0001710      total: 23.2s     remaining: 5.06s
821:     learn: 0.0001708      total: 23.3s     remaining: 5.04s
822:     learn: 0.0001707      total: 23.3s     remaining: 5.01s
823:     learn: 0.0001705      total: 23.3s     remaining: 4.98s
824:     learn: 0.0001703      total: 23.3s     remaining: 4.95s
825:     learn: 0.0001697      total: 23.3s     remaining: 4.92s
826:     learn: 0.0001696      total: 23.4s     remaining: 4.89s
827:     learn: 0.0001688      total: 23.4s     remaining: 4.86s
828:     learn: 0.0001687      total: 23.4s     remaining: 4.83s
829:     learn: 0.0001686      total: 23.4s     remaining: 4.8s
830:     learn: 0.0001685      total: 23.4s     remaining: 4.77s
```

```
831:      learn: 0.0001684      total: 23.5s      remaining: 4.74s
832:      learn: 0.0001680      total: 23.5s      remaining: 4.71s
833:      learn: 0.0001668      total: 23.5s      remaining: 4.68s
834:      learn: 0.0001667      total: 23.5s      remaining: 4.65s
835:      learn: 0.0001663      total: 23.5s      remaining: 4.62s
836:      learn: 0.0001663      total: 23.6s      remaining: 4.59s
837:      learn: 0.0001659      total: 23.6s      remaining: 4.56s
838:      learn: 0.0001657      total: 23.6s      remaining: 4.53s
839:      learn: 0.0001655      total: 23.6s      remaining: 4.5s
840:      learn: 0.0001646      total: 23.7s      remaining: 4.47s
841:      learn: 0.0001641      total: 23.7s      remaining: 4.44s
842:      learn: 0.0001638      total: 23.7s      remaining: 4.41s
843:      learn: 0.0001637      total: 23.7s      remaining: 4.38s
844:      learn: 0.0001634      total: 23.7s      remaining: 4.36s
845:      learn: 0.0001627      total: 23.8s      remaining: 4.33s
846:      learn: 0.0001626      total: 23.8s      remaining: 4.3s
847:      learn: 0.0001623      total: 23.8s      remaining: 4.27s
848:      learn: 0.0001615      total: 23.8s      remaining: 4.24s
849:      learn: 0.0001612      total: 23.9s      remaining: 4.21s
850:      learn: 0.0001610      total: 23.9s      remaining: 4.18s
851:      learn: 0.0001609      total: 23.9s      remaining: 4.15s
852:      learn: 0.0001607      total: 23.9s      remaining: 4.12s
853:      learn: 0.0001606      total: 23.9s      remaining: 4.09s
854:      learn: 0.0001604      total: 24s        remaining: 4.06s
855:      learn: 0.0001603      total: 24s        remaining: 4.03s
856:      learn: 0.0001602      total: 24s        remaining: 4s
857:      learn: 0.0001598      total: 24s        remaining: 3.98s
858:      learn: 0.0001596      total: 24s        remaining: 3.95s
859:      learn: 0.0001595      total: 24.1s      remaining: 3.92s
860:      learn: 0.0001593      total: 24.1s      remaining: 3.89s
861:      learn: 0.0001592      total: 24.1s      remaining: 3.86s
862:      learn: 0.0001590      total: 24.1s      remaining: 3.83s
863:      learn: 0.0001588      total: 24.2s      remaining: 3.8s
864:      learn: 0.0001571      total: 24.2s      remaining: 3.77s
865:      learn: 0.0001567      total: 24.2s      remaining: 3.75s
866:      learn: 0.0001564      total: 24.2s      remaining: 3.72s
867:      learn: 0.0001560      total: 24.2s      remaining: 3.69s
868:      learn: 0.0001559      total: 24.3s      remaining: 3.66s
869:      learn: 0.0001558      total: 24.3s      remaining: 3.63s
870:      learn: 0.0001555      total: 24.3s      remaining: 3.6s
871:      learn: 0.0001555      total: 24.3s      remaining: 3.57s
872:      learn: 0.0001554      total: 24.3s      remaining: 3.54s
873:      learn: 0.0001547      total: 24.4s      remaining: 3.51s
874:      learn: 0.0001537      total: 24.4s      remaining: 3.48s
875:      learn: 0.0001535      total: 24.4s      remaining: 3.45s
876:      learn: 0.0001533      total: 24.4s      remaining: 3.42s
877:      learn: 0.0001532      total: 24.4s      remaining: 3.4s
878:      learn: 0.0001528      total: 24.5s      remaining: 3.37s
879:      learn: 0.0001527      total: 24.5s      remaining: 3.34s
880:      learn: 0.0001525      total: 24.5s      remaining: 3.31s
881:      learn: 0.0001519      total: 24.5s      remaining: 3.28s
882:      learn: 0.0001518      total: 24.5s      remaining: 3.25s
883:      learn: 0.0001517      total: 24.6s      remaining: 3.22s
884:      learn: 0.0001514      total: 24.6s      remaining: 3.19s
885:      learn: 0.0001500      total: 24.6s      remaining: 3.17s
886:      learn: 0.0001497      total: 24.6s      remaining: 3.14s
887:      learn: 0.0001496      total: 24.6s      remaining: 3.11s
888:      learn: 0.0001494      total: 24.7s      remaining: 3.08s
889:      learn: 0.0001490      total: 24.7s      remaining: 3.05s
890:      learn: 0.0001489      total: 24.7s      remaining: 3.02s
891:      learn: 0.0001488      total: 24.7s      remaining: 2.99s
892:      learn: 0.0001484      total: 24.7s      remaining: 2.96s
893:      learn: 0.0001478      total: 24.8s      remaining: 2.94s
894:      learn: 0.0001476      total: 24.8s      remaining: 2.91s
```

```
895:    learn: 0.0001471        total: 24.8s    remaining: 2.88s
896:    learn: 0.0001470        total: 24.8s    remaining: 2.85s
897:    learn: 0.0001469        total: 24.8s    remaining: 2.82s
898:    learn: 0.0001468        total: 24.9s    remaining: 2.79s
899:    learn: 0.0001465        total: 24.9s    remaining: 2.76s
900:    learn: 0.0001463        total: 24.9s    remaining: 2.74s
901:    learn: 0.0001461        total: 24.9s    remaining: 2.71s
902:    learn: 0.0001460        total: 24.9s    remaining: 2.68s
903:    learn: 0.0001459        total: 25s      remaining: 2.65s
904:    learn: 0.0001456        total: 25s      remaining: 2.62s
905:    learn: 0.0001452        total: 25s      remaining: 2.6s
906:    learn: 0.0001452        total: 25s      remaining: 2.57s
907:    learn: 0.0001450        total: 25.1s    remaining: 2.54s
908:    learn: 0.0001444        total: 25.1s    remaining: 2.51s
909:    learn: 0.0001443        total: 25.1s    remaining: 2.48s
910:    learn: 0.0001441        total: 25.1s    remaining: 2.46s
911:    learn: 0.0001435        total: 25.2s    remaining: 2.43s
912:    learn: 0.0001431        total: 25.2s    remaining: 2.4s
913:    learn: 0.0001430        total: 25.2s    remaining: 2.37s
914:    learn: 0.0001429        total: 25.2s    remaining: 2.35s
915:    learn: 0.0001428        total: 25.3s    remaining: 2.32s
916:    learn: 0.0001427        total: 25.3s    remaining: 2.29s
917:    learn: 0.0001427        total: 25.3s    remaining: 2.26s
918:    learn: 0.0001425        total: 25.3s    remaining: 2.23s
919:    learn: 0.0001424        total: 25.4s    remaining: 2.21s
920:    learn: 0.0001419        total: 25.4s    remaining: 2.18s
921:    learn: 0.0001416        total: 25.4s    remaining: 2.15s
922:    learn: 0.0001414        total: 25.4s    remaining: 2.12s
923:    learn: 0.0001413        total: 25.4s    remaining: 2.09s
924:    learn: 0.0001412        total: 25.5s    remaining: 2.06s
925:    learn: 0.0001411        total: 25.5s    remaining: 2.04s
926:    learn: 0.0001409        total: 25.5s    remaining: 2.01s
927:    learn: 0.0001406        total: 25.5s    remaining: 1.98s
928:    learn: 0.0001396        total: 25.5s    remaining: 1.95s
929:    learn: 0.0001393        total: 25.6s    remaining: 1.92s
930:    learn: 0.0001388        total: 25.6s    remaining: 1.9s
931:    learn: 0.0001387        total: 25.6s    remaining: 1.87s
932:    learn: 0.0001386        total: 25.6s    remaining: 1.84s
933:    learn: 0.0001385        total: 25.6s    remaining: 1.81s
934:    learn: 0.0001384        total: 25.7s    remaining: 1.78s
935:    learn: 0.0001380        total: 25.7s    remaining: 1.76s
936:    learn: 0.0001379        total: 25.7s    remaining: 1.73s
937:    learn: 0.0001375        total: 25.7s    remaining: 1.7s
938:    learn: 0.0001368        total: 25.8s    remaining: 1.67s
939:    learn: 0.0001367        total: 25.8s    remaining: 1.65s
940:    learn: 0.0001365        total: 25.8s    remaining: 1.62s
941:    learn: 0.0001363        total: 25.8s    remaining: 1.59s
942:    learn: 0.0001361        total: 25.9s    remaining: 1.56s
943:    learn: 0.0001360        total: 25.9s    remaining: 1.54s
944:    learn: 0.0001358        total: 25.9s    remaining: 1.51s
945:    learn: 0.0001358        total: 25.9s    remaining: 1.48s
946:    learn: 0.0001357        total: 26s      remaining: 1.45s
947:    learn: 0.0001355        total: 26s      remaining: 1.43s
948:    learn: 0.0001355        total: 26s      remaining: 1.4s
949:    learn: 0.0001353        total: 26s      remaining: 1.37s
950:    learn: 0.0001347        total: 26.1s    remaining: 1.34s
951:    learn: 0.0001345        total: 26.1s    remaining: 1.31s
952:    learn: 0.0001344        total: 26.1s    remaining: 1.29s
953:    learn: 0.0001340        total: 26.1s    remaining: 1.26s
954:    learn: 0.0001338        total: 26.2s    remaining: 1.23s
955:    learn: 0.0001335        total: 26.2s    remaining: 1.2s
956:    learn: 0.0001332        total: 26.2s    remaining: 1.18s
957:    learn: 0.0001330        total: 26.2s    remaining: 1.15s
958:    learn: 0.0001324        total: 26.2s    remaining: 1.12s
```

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959:    learn: 0.0001323    total: 26.3s    remaining: 1.09s
960:    learn: 0.0001321    total: 26.3s    remaining: 1.07s
961:    learn: 0.0001321    total: 26.3s    remaining: 1.04s
962:    learn: 0.0001319    total: 26.3s    remaining: 1.01s
963:    learn: 0.0001315    total: 26.3s    remaining: 984ms
964:    learn: 0.0001314    total: 26.4s    remaining: 956ms
965:    learn: 0.0001313    total: 26.4s    remaining: 929ms
966:    learn: 0.0001312    total: 26.4s    remaining: 901ms
967:    learn: 0.0001310    total: 26.4s    remaining: 873ms
968:    learn: 0.0001310    total: 26.4s    remaining: 846ms
969:    learn: 0.0001306    total: 26.5s    remaining: 818ms
970:    learn: 0.0001297    total: 26.5s    remaining: 791ms
971:    learn: 0.0001296    total: 26.5s    remaining: 764ms
972:    learn: 0.0001295    total: 26.5s    remaining: 736ms
973:    learn: 0.0001295    total: 26.6s    remaining: 709ms
974:    learn: 0.0001293    total: 26.6s    remaining: 681ms
975:    learn: 0.0001290    total: 26.6s    remaining: 654ms
976:    learn: 0.0001284    total: 26.6s    remaining: 627ms
977:    learn: 0.0001283    total: 26.6s    remaining: 599ms
978:    learn: 0.0001282    total: 26.7s    remaining: 572ms
979:    learn: 0.0001278    total: 26.7s    remaining: 544ms
980:    learn: 0.0001276    total: 26.7s    remaining: 517ms
981:    learn: 0.0001273    total: 26.7s    remaining: 490ms
982:    learn: 0.0001271    total: 26.7s    remaining: 462ms
983:    learn: 0.0001270    total: 26.8s    remaining: 435ms
984:    learn: 0.0001269    total: 26.8s    remaining: 408ms
985:    learn: 0.0001265    total: 26.8s    remaining: 380ms
986:    learn: 0.0001264    total: 26.8s    remaining: 353ms
987:    learn: 0.0001256    total: 26.8s    remaining: 326ms
988:    learn: 0.0001256    total: 26.9s    remaining: 299ms
989:    learn: 0.0001255    total: 26.9s    remaining: 271ms
990:    learn: 0.0001247    total: 26.9s    remaining: 244ms
991:    learn: 0.0001247    total: 26.9s    remaining: 217ms
992:    learn: 0.0001242    total: 26.9s    remaining: 190ms
993:    learn: 0.0001242    total: 27s      remaining: 163ms
994:    learn: 0.0001237    total: 27s      remaining: 136ms
995:    learn: 0.0001234    total: 27s      remaining: 109ms
996:    learn: 0.0001228    total: 27.1s    remaining: 81.4ms
997:    learn: 0.0001219    total: 27.1s    remaining: 54.3ms
998:    learn: 0.0001216    total: 27.1s    remaining: 27.1ms
999:    learn: 0.0001216    total: 27.1s    remaining: 0us
```

Out[31]: <catboost.core.CatBoostClassifier at 0x298b0ddeb60>

In [32]:
```python
y_train_pred = cb_clf.predict(X_train)
y_test_pred = cb_clf.predict(X_test)

print_score(y_train, y_train_pred, train=True)
print_score(y_test, y_test_pred, train=False)

scores_dict['CatBoost'] = {
        'Train': f1_score(y_train,y_train_pred),
        'Test': f1_score(y_test, y_test_pred),
}
```

```
Train Result:
================================================
Accuracy Score: 100.00%
_____
Classification Report:
                  0       1  accuracy  macro avg  weighted avg
precision      1.00    1.00      1.00       1.00          1.00
recall         1.00    1.00      1.00       1.00          1.00
f1-score       1.00    1.00      1.00       1.00          1.00
support    159204.00  287.00      1.00  159491.00     159491.00
_____
Confusion Matrix:
 [[159204      0]
 [     1    286]]

Test Result:
================================================
Accuracy Score: 99.96%
_____
Classification Report:
                  0       1  accuracy  macro avg  weighted avg
precision      1.00    0.93      1.00       0.97          1.00
recall         1.00    0.82      1.00       0.91          1.00
f1-score       1.00    0.87      1.00       0.94          1.00
support     85307.00  136.00      1.00   85443.00      85443.00
_____
Confusion Matrix:
 [[85299      8]
 [   25    111]]
```

4. 5. LigthGBM

In [33]:
```python
pip install lightgbm
```

```
Requirement already satisfied: lightgbm in c:\users\khush\anaconda3\lib\site-packa
ges (4.5.0)
Requirement already satisfied: scipy in c:\users\khush\anaconda3\lib\site-packages
(from lightgbm) (1.10.0)
Requirement already satisfied: numpy>=1.17.0 in c:\users\khush\anaconda3\lib\site-
packages (from lightgbm) (1.23.5)
Note: you may need to restart the kernel to use updated packages.
```

In [34]:
```python
from lightgbm import LGBMClassifier

lgbm_clf = LGBMClassifier()
lgbm_clf.fit(X_train, y_train)

y_train_pred = lgbm_clf.predict(X_train)
y_test_pred = lgbm_clf.predict(X_test)

print_score(y_train, y_train_pred, train=True)
print_score(y_test, y_test_pred, train=False)

scores_dict['LigthGBM'] = {
        'Train': f1_score(y_train,y_train_pred),
        'Test': f1_score(y_test, y_test_pred),
}
```

```
[LightGBM] [Info] Number of positive: 287, number of negative: 159204
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of testing
was 0.018004 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 7650
[LightGBM] [Info] Number of data points in the train set: 159491, number of used f
eatures: 30
[LightGBM] [Info] [binary:BoostFromScore]: pavg=0.001799 -> initscore=-6.318459
[LightGBM] [Info] Start training from score -6.318459
Train Result:
================================================
Accuracy Score: 99.58%

_____
Classification Report:
                 0         1   accuracy   macro avg   weighted avg
precision     1.00      0.23       1.00        0.62           1.00
recall        1.00      0.59       1.00        0.79           1.00
f1-score      1.00      0.33       1.00        0.67           1.00
support   159204.00   287.00       1.00   159491.00      159491.00

_____
Confusion Matrix:
 [[158652     552]
 [   119     168]]

Test Result:
================================================
Accuracy Score: 99.50%

_____
Classification Report:
                 0        1   accuracy   macro avg   weighted avg
precision     1.00     0.16       0.99        0.58           1.00
recall        1.00     0.53       0.99        0.76           0.99
f1-score      1.00     0.25       0.99        0.62           1.00
support   85307.00   136.00       0.99   85443.00       85443.00

_____
Confusion Matrix:
 [[84942     365]
 [   64      72]]
```
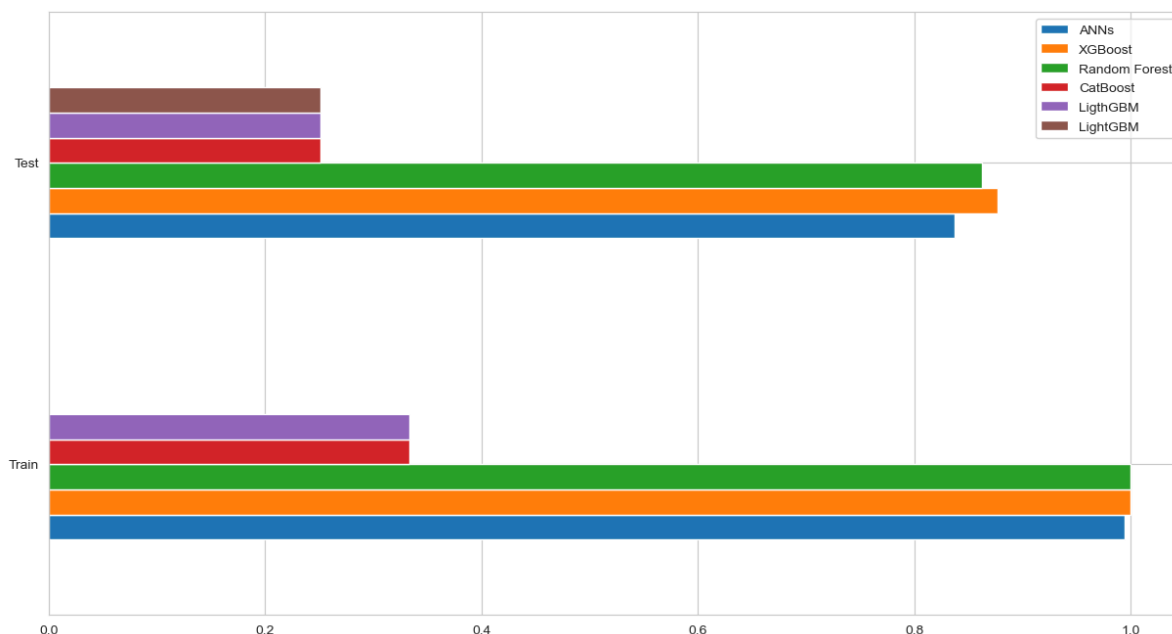
5. Model Comparaison

```
In [42]:   scores_df = pd.DataFrame(scores_dict)

           scores_df.plot(kind='barh', figsize=(15, 8))
```

```
Out[42]:   <Axes: >
```
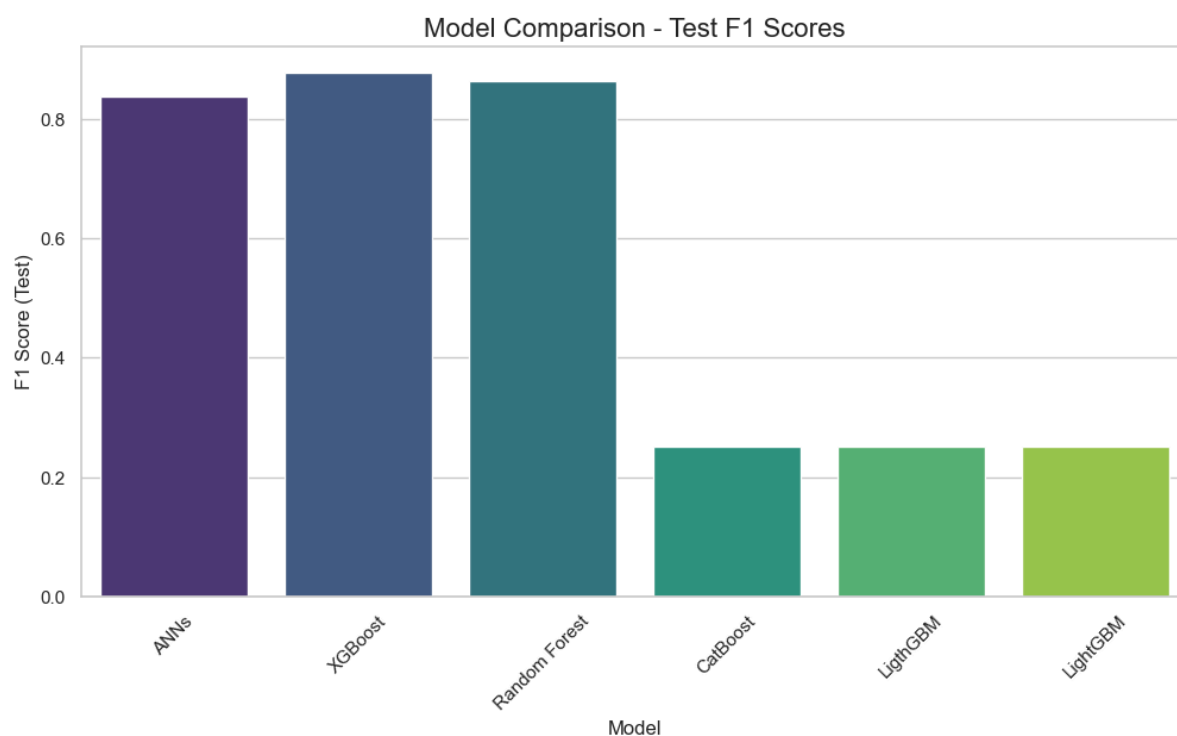
```python
In [43]:  import matplotlib.pyplot as plt
          import seaborn as sns

          # Convert scores_dict to a DataFrame
          scores_df = pd.DataFrame(scores_dict).T

          # Set a Seaborn style for better visuals
          sns.set(style="whitegrid")

          # Plot the F1 scores for test data comparison
          plt.figure(figsize=(12, 6))
          sns.barplot(x=scores_df.index, y=scores_df['Test'], palette="viridis")
          plt.title("Model Comparison - Test F1 Scores", fontsize=16)
          plt.xlabel("Model", fontsize=12)
          plt.ylabel("F1 Score (Test)", fontsize=12)
          plt.xticks(rotation=45)
          plt.show()
```

In [ ]: