PREVENTIVE MAINTANENCE

DEEP LEARNING

APRIL 2024

Overview

- Importance of predictive maintenance in industry
- Objective: Develop a deep learning model to predict failures
- Benefit: Prevent costly downtime, optimize maintenance

Business Understanding

Objective

OBJECTIVE: DEVELOP A DEEP LEARNING MODEL TO PREDICT FAILURES

BENEFIT: PREVENT COSTLY DOWNTIME, OPTIMIZE MAINTENANCE

Goal

GOAL: ACCURATE PREDICTIONS TO ENABLE PROACTIVE MAINTENANCE

IMPACT: REDUCE BREAKDOWNS, EXTEND EQUIPMENT LIFE, OPTIMIZE SCHEDULES

Data Set

- Utilized historical sensor data from machinery
- Identified operational status indicators from machine sensors
- Various operational parameter with different scales

Data Insight

ATTRIBUTES

- Total Entries: 220.320
- Total Columns: 55
- Unnamed: 0Column:ID/Index
- Sensor 15 column: Removing

DISTRIBUTION

- Normal: 205,836
- Recovering: 14,477
- Broken: 7

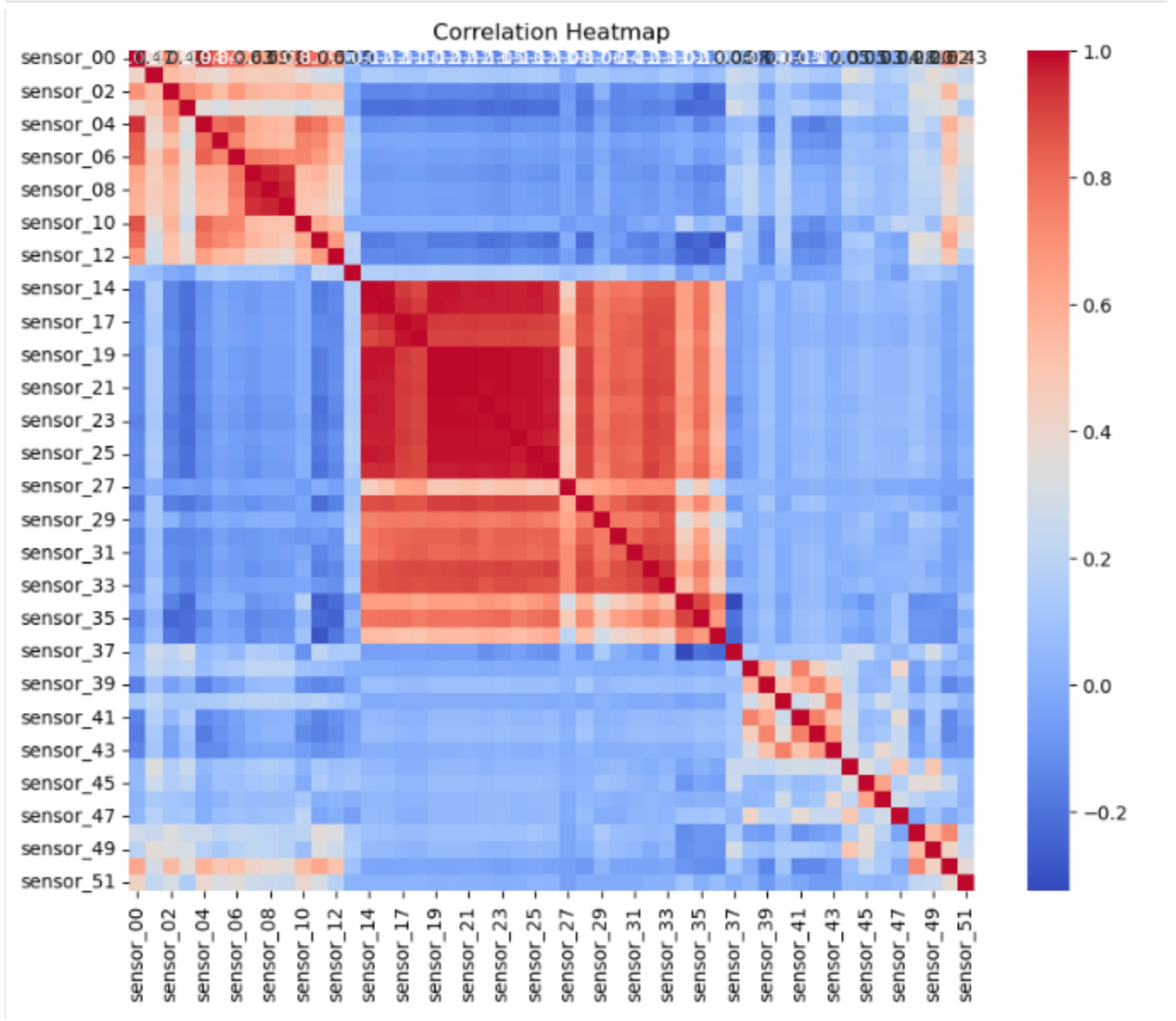
MISSING VALUES

- 77.017 and 220,320 missing
- Checked for duplicates

Data Prep

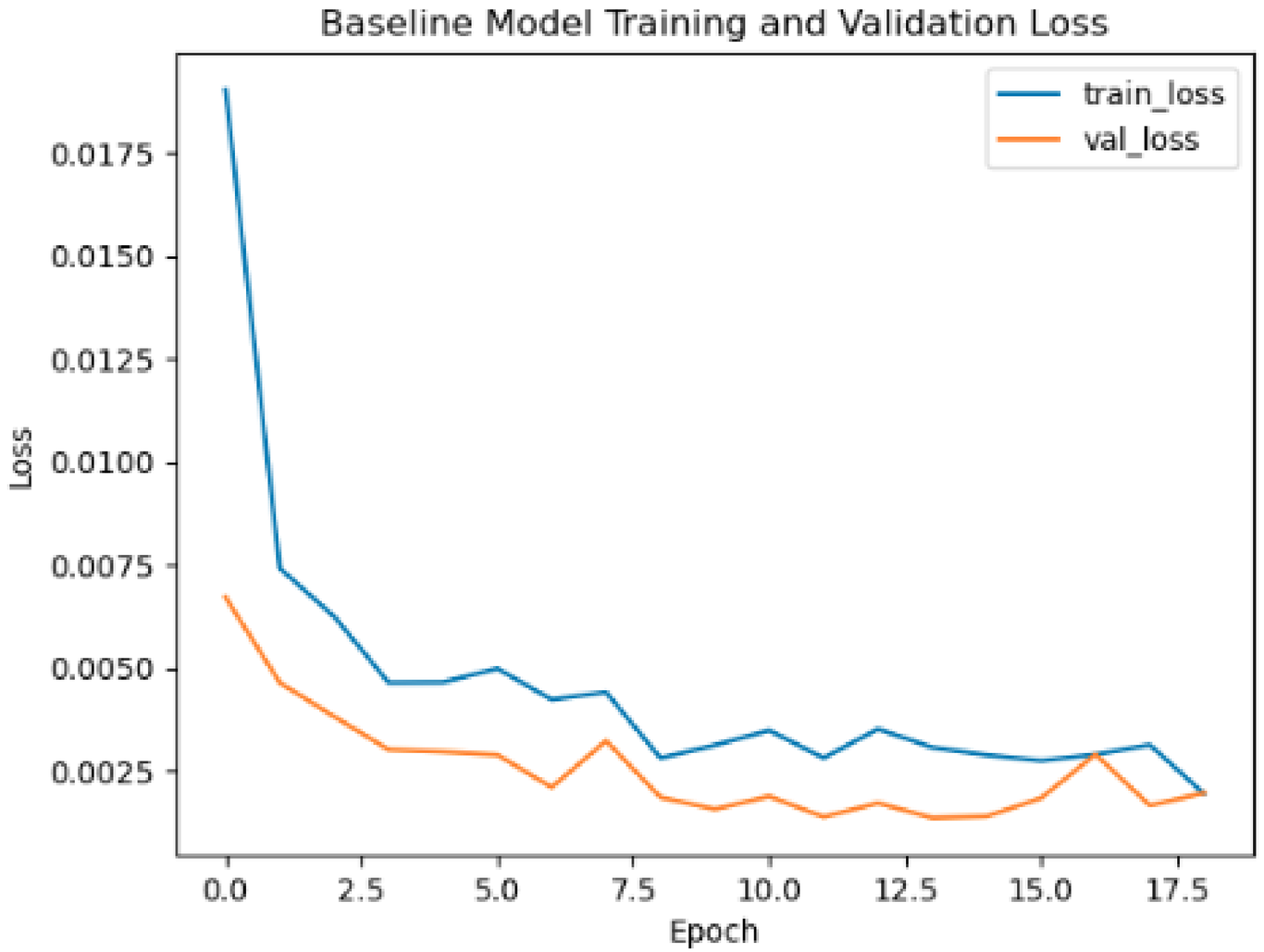
- Scaled features for uniformity
- Encoded target variables for model ingestion
- Employed stratified split for balanced class representation
- Conducted EDA to understand feature relationships

Data

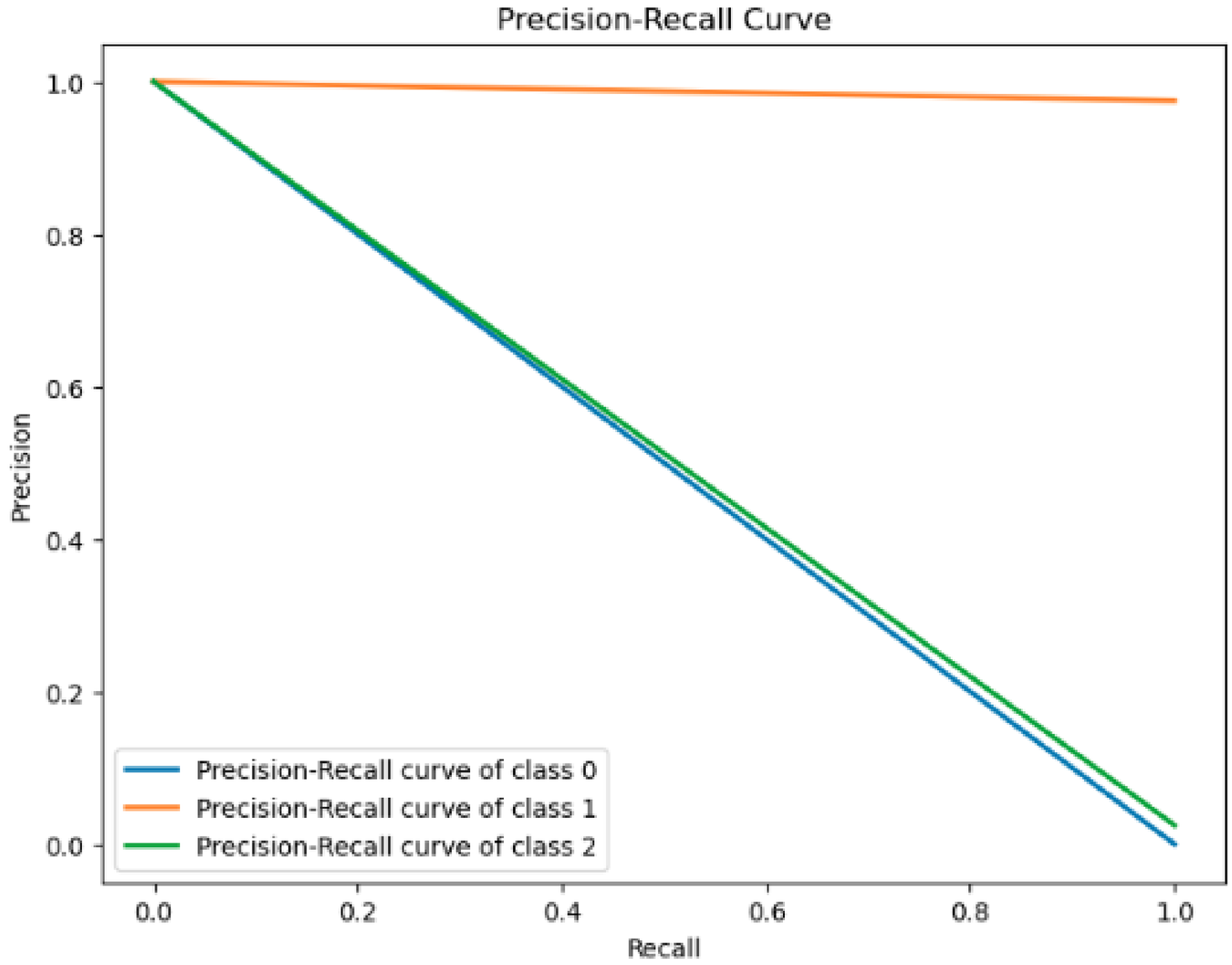

Correlation Heatmap
sensor_00
sensor_02
sensor_04
sensor_06
sensor_08
sensor_10
sensor_12
sensor_14
sensor_17
sensor_19
sensor_21
sensor_23
sensor_25
sensor_27
sensor_29
sensor_31
sensor_33
sensor_35
sensor_37
sensor_39
sensor_41
sensor_43
sensor_45
sensor_47
sensor_49
sensor_51
1.0
0.8
0.6
0.4
0.2
0.0
−0.2

Data

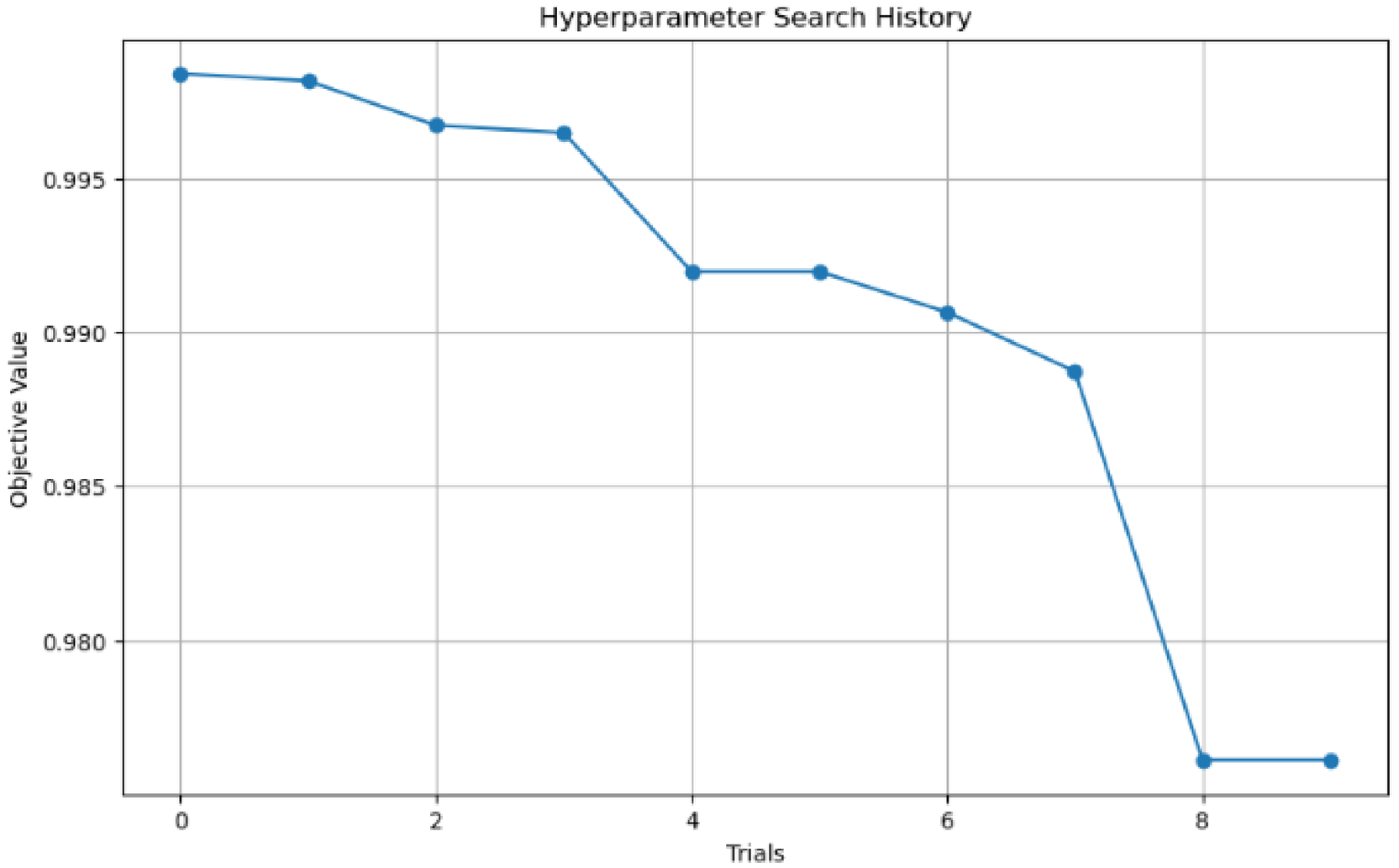
```
Test accuracy: 0.999636173248291
```



Data

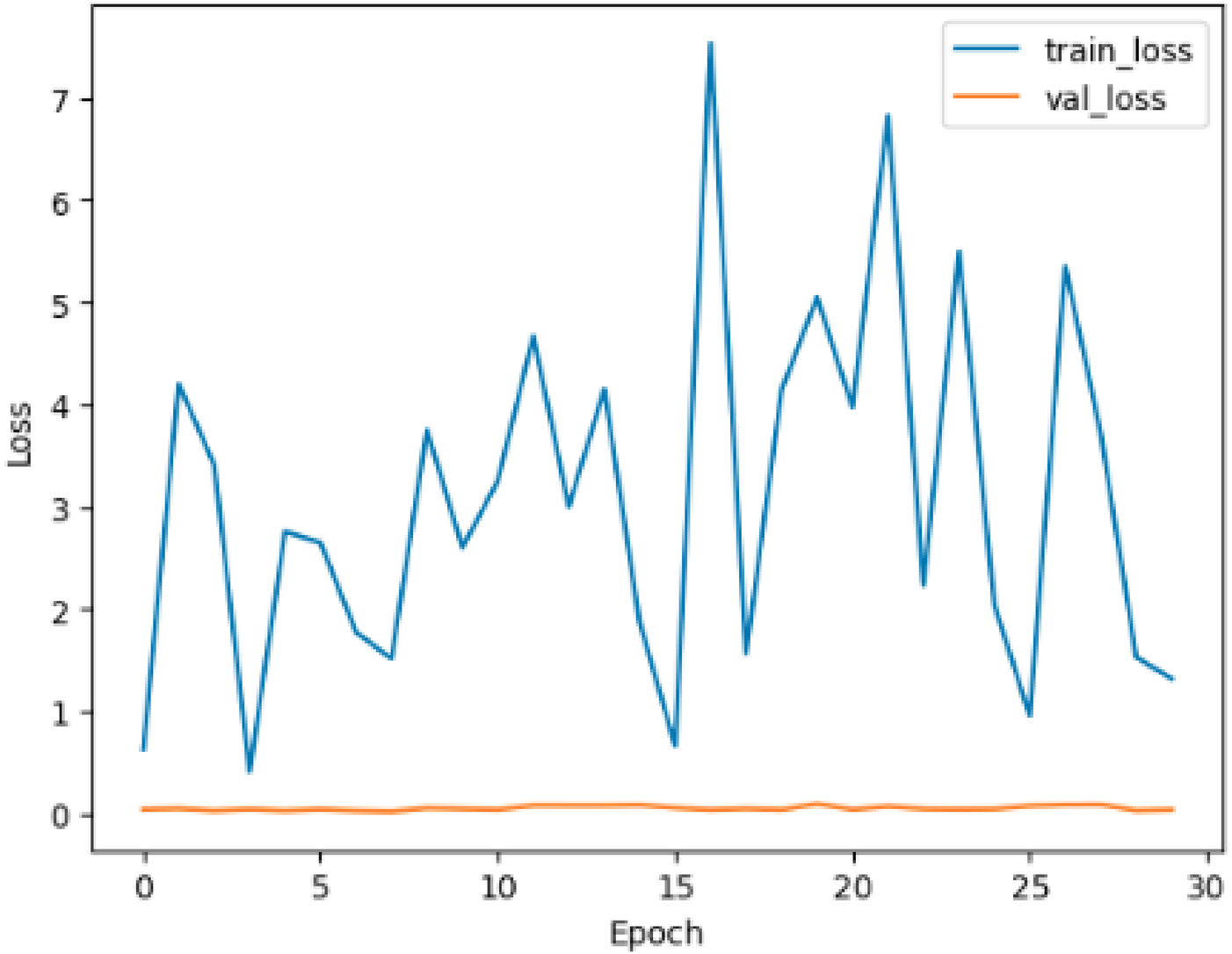

Precision-Recall Curve
Precision
Recall
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Precision-Recall curve of class 0
Precision-Recall curve of class 1
Precision-Recall curve of class 2

Data


Hyperparameter Search History
Objective Value
0.995
0.990
0.985
0.980
0
2
4
6
8
Trials

Data

```
Test loss: 0.04529045149683952
Test accuracy: 0.9972600936889648
```



Model Process

01

Feedforward Neural Network(FNN)

- Developed a baseline neural network with dropout layers to prevent overfitting.

02

Gradient Boosting

- Trained a Gradient Boosting Classifier to capture non-linear patterns.

03

Tuning

- Optimized model with hyperparameter adjustments
- Performed hyperparameter tuning via GridSearchCV

Results

- Both models achieved near-perfect accuracy rates.
- Ensured no data leakage and that models generalize well beyond training data.

Next Steps

01

Refine models

- Further refine models with regularization and ensemble methods

02

Hyperparameters

- Implement early stopping and learning rate adjustments

03

More data insight

- Explore additional metrics for deeper insights
- Interpret models to identify key predictive sensors.

04

Further experiment

- Pilot the model in a controlled environment before full deployment

CONTACT

www.github.com/yaterjo

jly35630@yahoo.com

555-867-5309

Atlanta, Georgia

Our Team

Johnathan Yater

Data Science

THANK YOU