DEPLOYING MACHINE LEARNING MODEL TO PREDICT MACHINE FAILURE

BY

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BRIEF OVERVIEW

- In today's rapidly evolving industrial landscape, minimizing downtime and optimizing maintenance strategies are critical for operational efficiency.

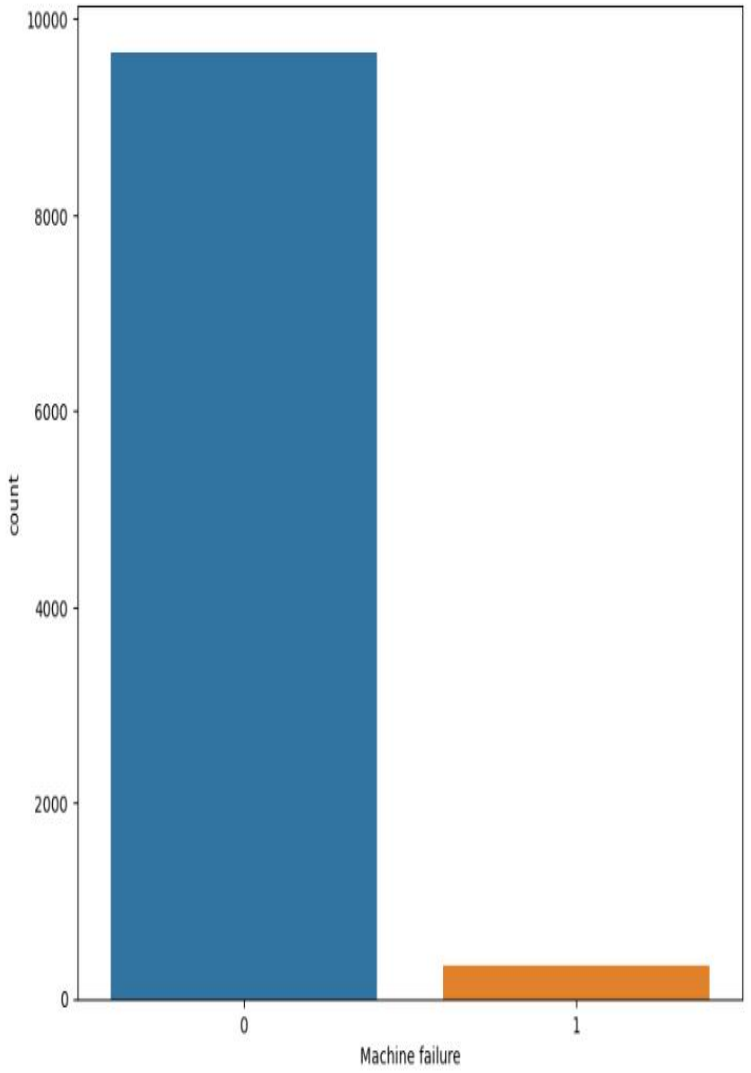
- This model for predicting machine failure addresses this challenge by leveraging advanced algorithms to forecast potential equipment issues before they occur.

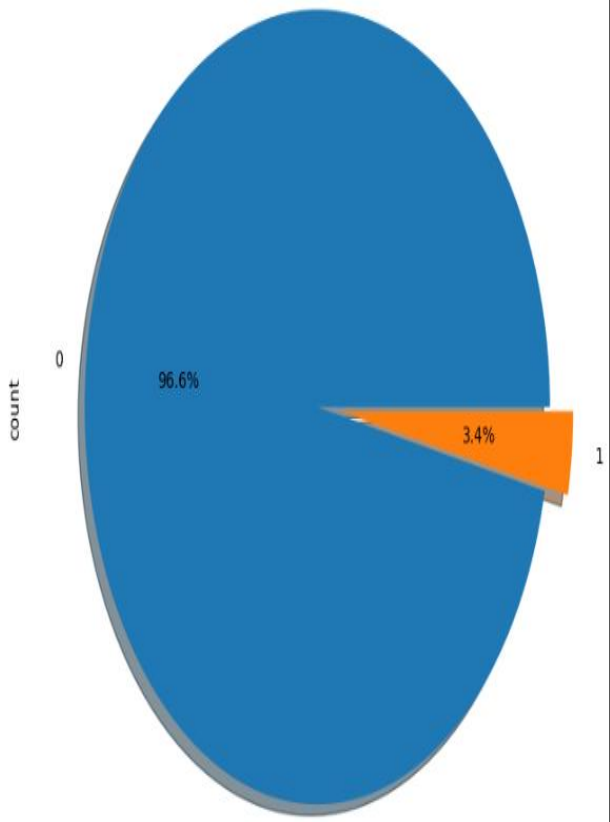
PROBLEM STATEMENT

- The model aims to address the costly and disruptive impact of unplanned machine failures by predicting potential issues in advance.

DATA COLLECTION

- Data was collected from KAGGLE
- 10,000 inputs from different machines with 14 features.
- 96.6% working machines.
- 3.4% failed machines.

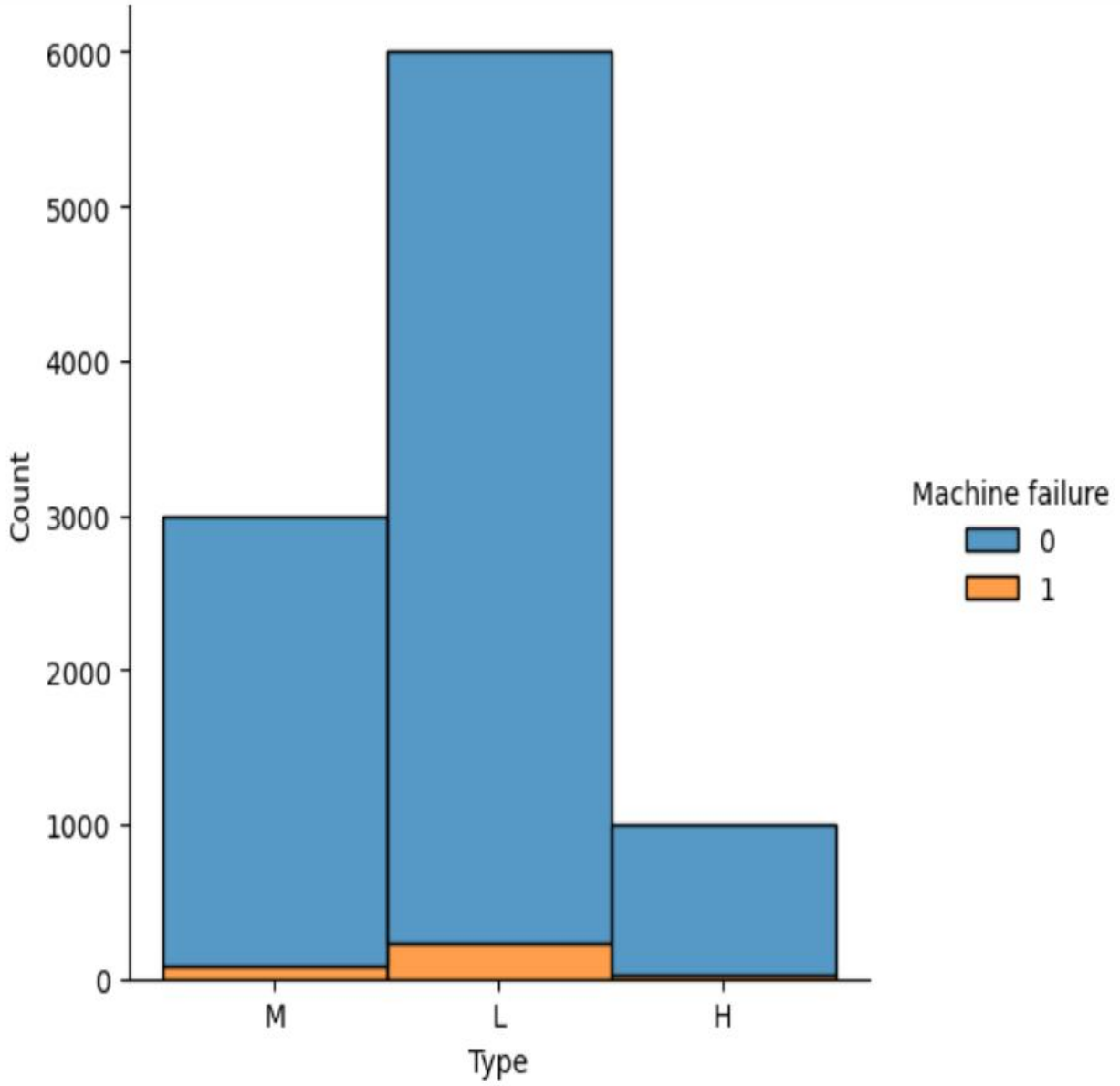




DATA FEATURES

- UID
- Type [L,M,H]
- Air temperature [K]
- Process temperature [K]
- Rotational speed [rpm]
- Torque [Nm]
- Tool wear [min]
- Machine failure
- Failure type: tool wear failure (TWF), heat dissipation failure (HDF), power failure (PWF), overstrain failure (OSF), random failures (RNF)

MACHINE FAILURE VS PRODUCT TYPE




```
In [18]: df['Type'].value_counts()

Out[18]: Type
         L    6000
         M    2997
         H    1003
         Name: count, dtype: int64
```

```
In [19]: pd.crosstab(df['Type'], df['Machine failure'])
```

Out[19]:

Machine failure	0	1
Type		
H	982	21
L	5765	235
M	2914	83

Statistically:

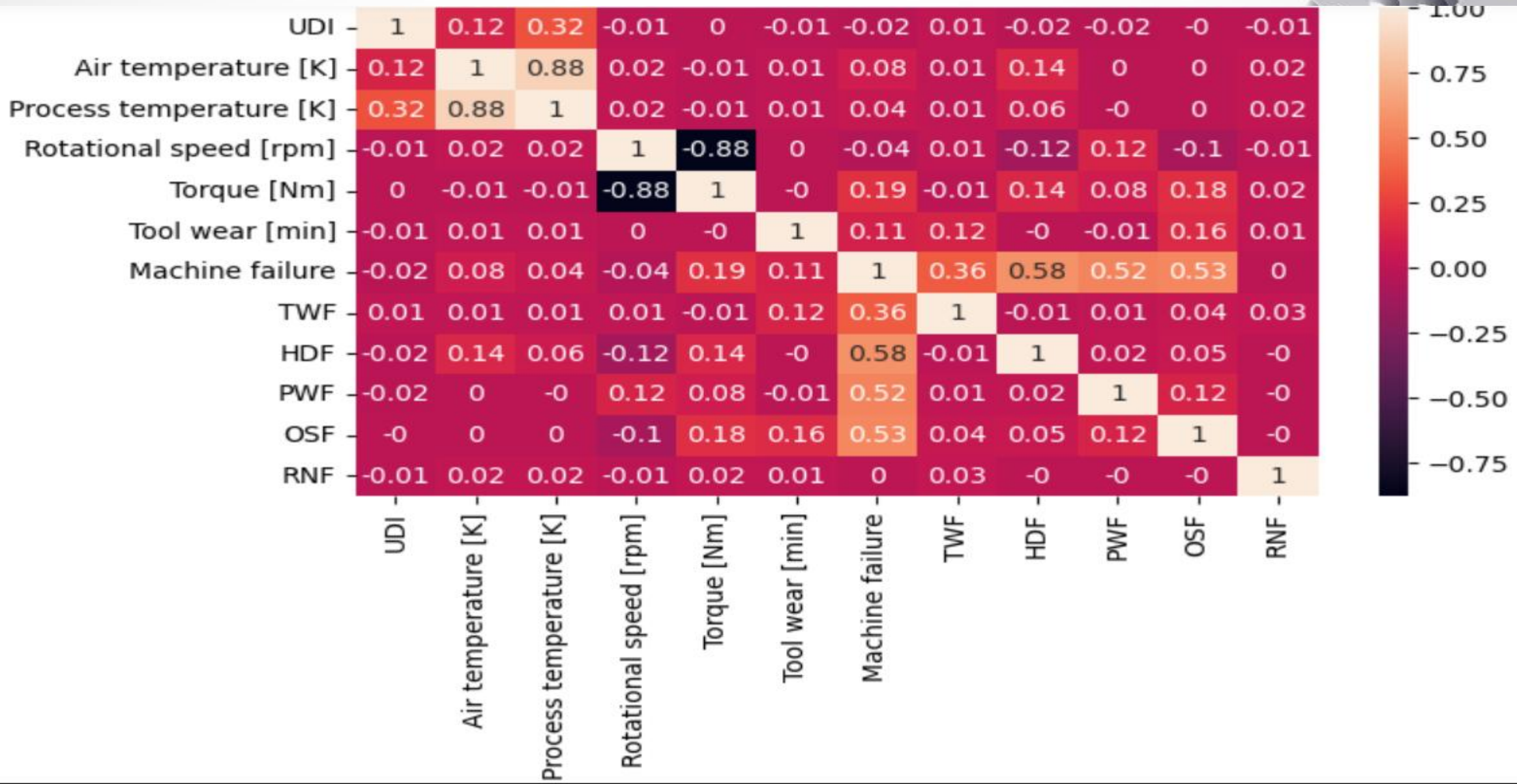
Chi-square test results:

- Chi-square statistic: 13.751716801149 31
- P-value: 0.001032411035945 4081

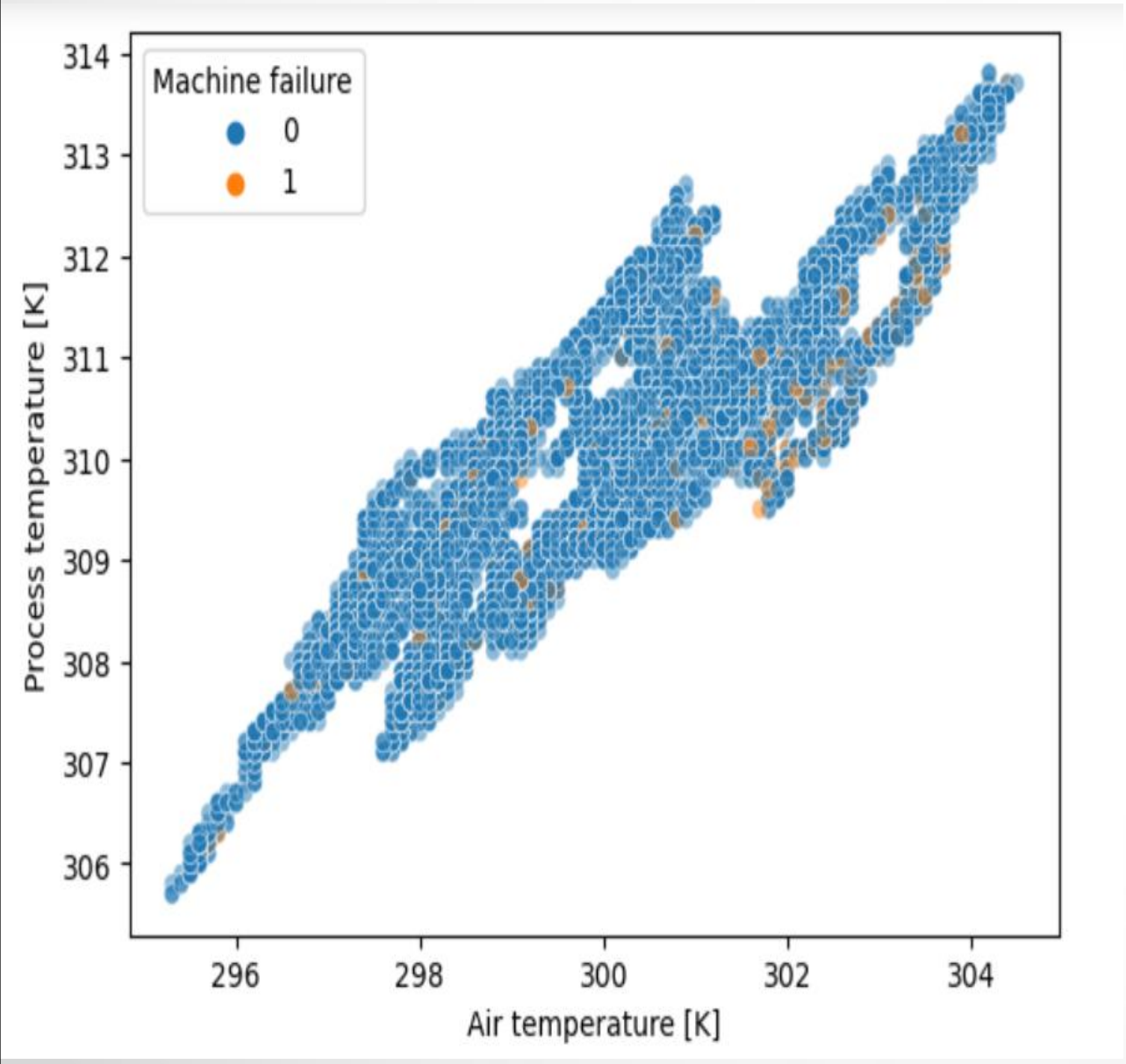
P-value < 0.05;

We reject the null hypothesis and conclude that there is a significant association between the type of machine and machine failure.

FEATURES CORRELATION MATRIX

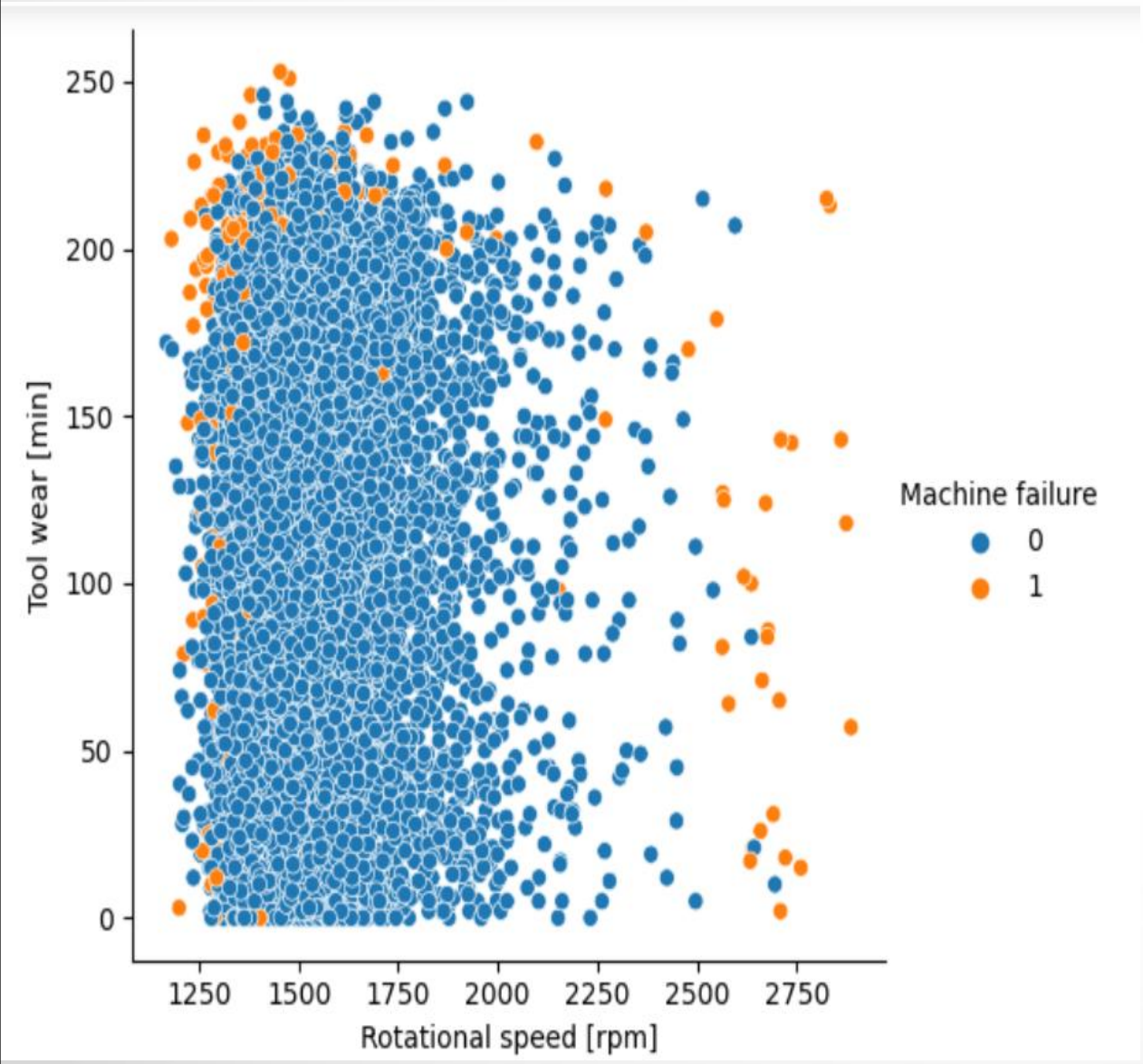


POCESS VS AIR TEMPERATURE



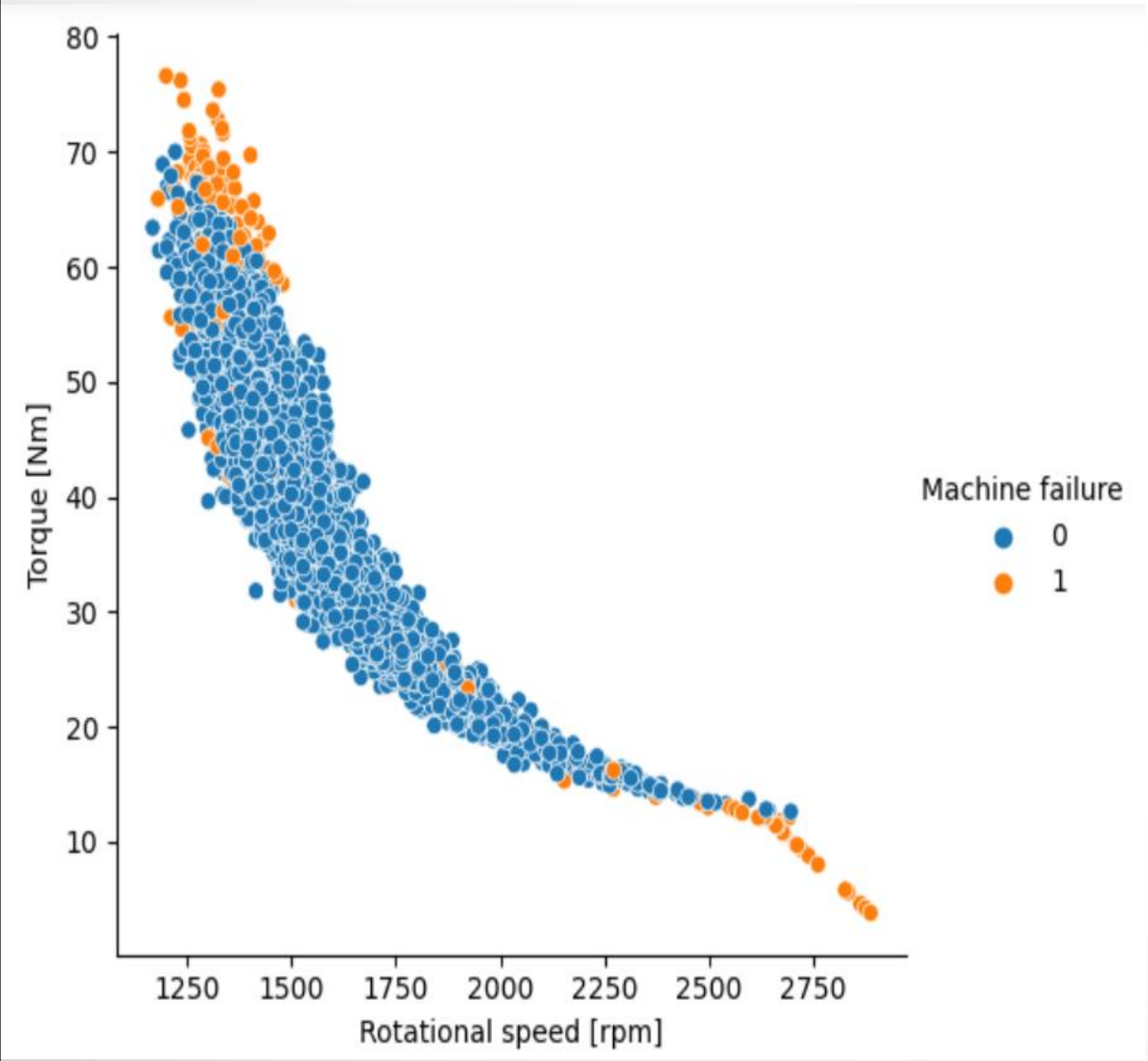
- Air temperature [K] and Process temperature [K] has linear relationship

TOOL WEAR VS ROTATIONAL SPEED



- There is no visual linear relationship between tool wear and rotational speed

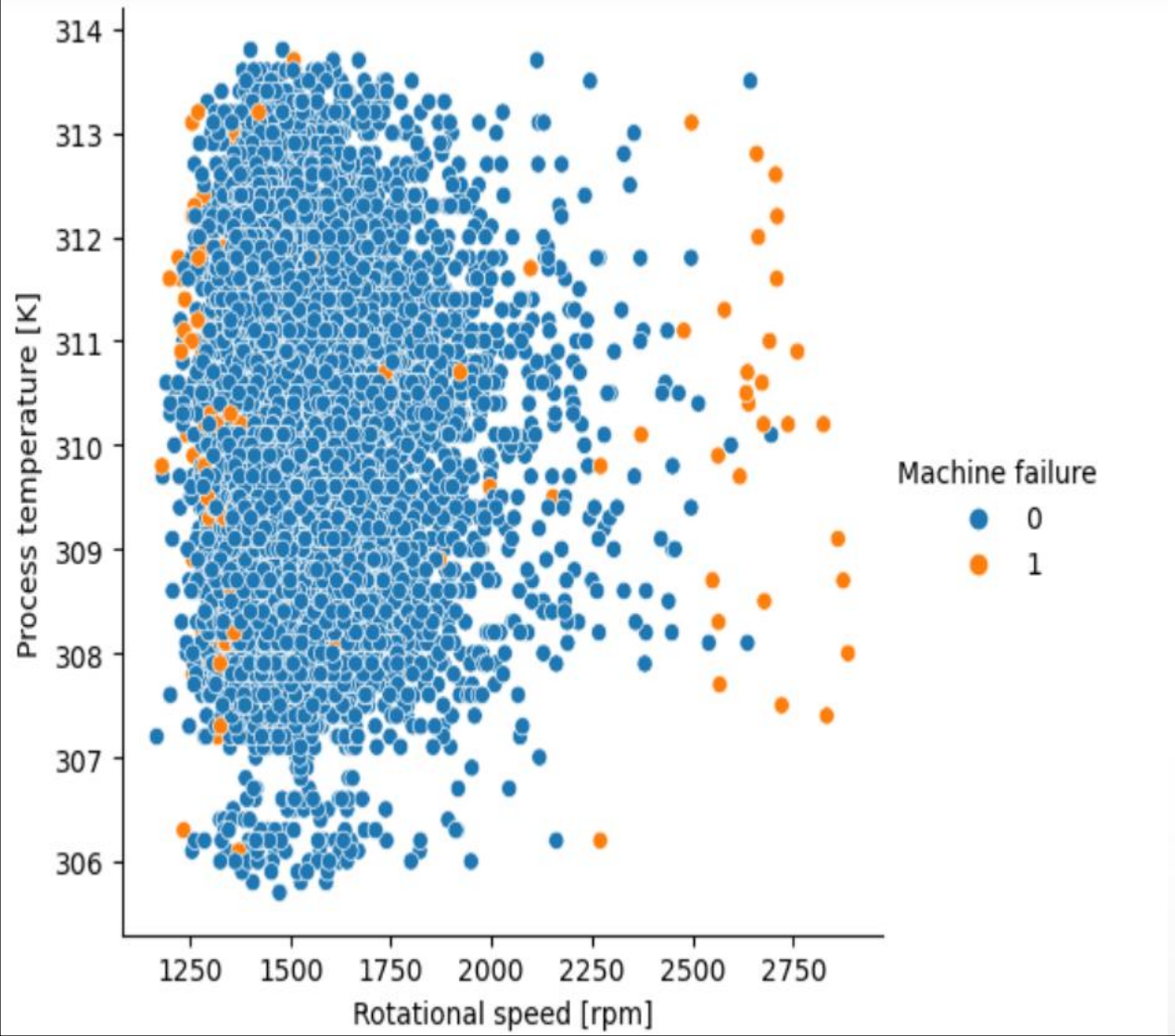
TORQUE VS ROTATIONAL SPEED



- Negative correlation between torque and rotational speed

- An increase in torque demand often leads to a decrease in rotational speed due to the additional load.

PROCESS TEMPERATURE VS ROTATIONAL SPEED



- There is no visual linear relationship between process temperature and rotational speed

MODELS AND ACCURACY

Split and Test

- Train shape: 70%
- Test shape: 30%

MODEL	ACCURACY
LOGISTIC REGRESSION	97.1%
DECISION TREE CLASSFIER	96.2%
SUPPORT VECTOR MACHINE	96.6%

LOGISTIC REGRESSION

- After extensive experimentation and evaluation, we found that a logistic regression model achieved the best performance in terms of predictive accuracy, robustness, and interpretability.

LOGISTIC REGRESSION

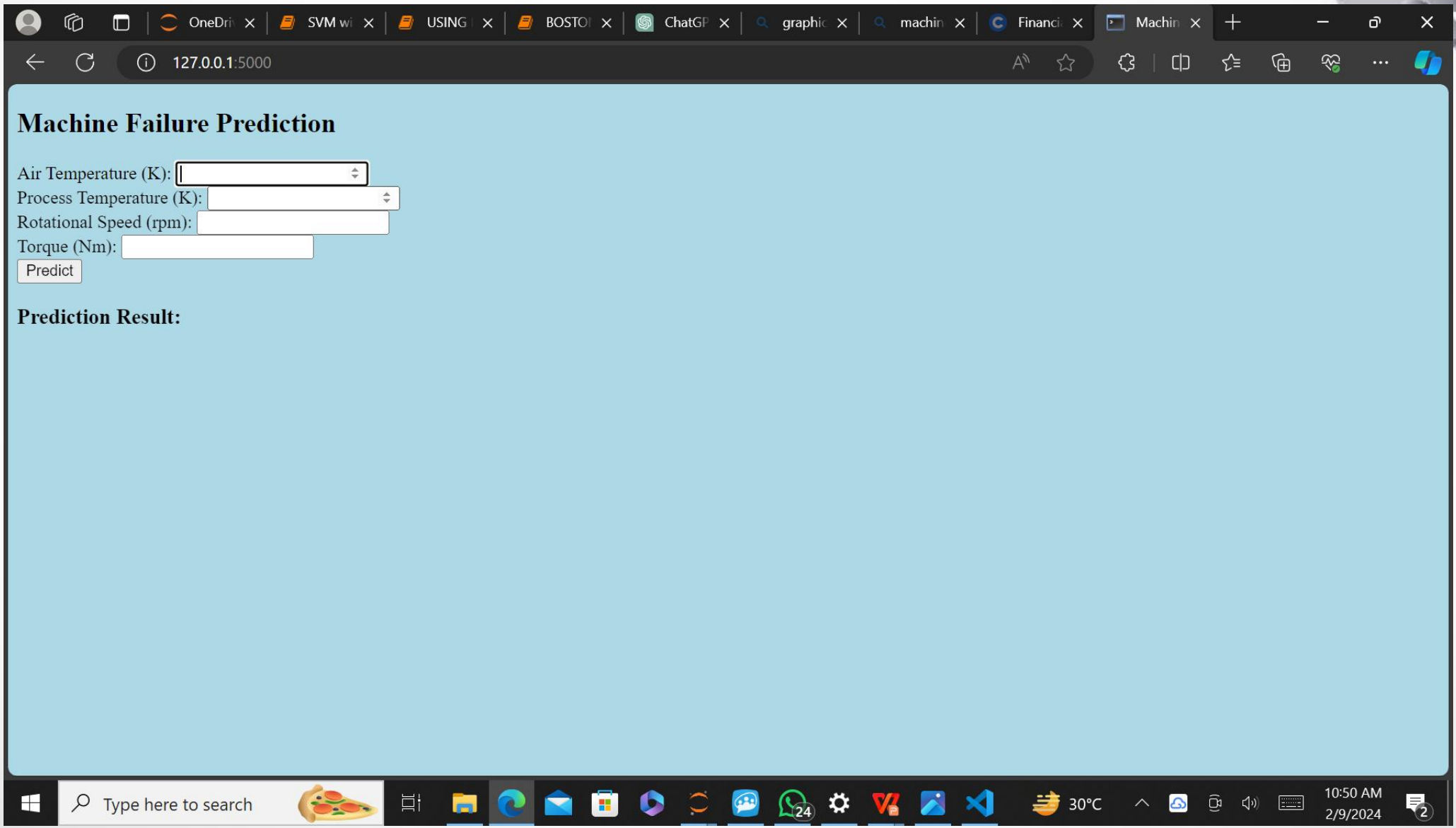
```
Accuracy for the model is: 0.9713333333333334
              precision    recall  f1-score   support

           0       1.00      0.97      0.99      2974
           1       0.21      0.81      0.33        26

    accuracy                           0.97      3000
   macro avg       0.60      0.89      0.66      3000
weighted avg       0.99      0.97      0.98      3000

[[2893    5]
 [  81   21]]
```

Web Application User Interface

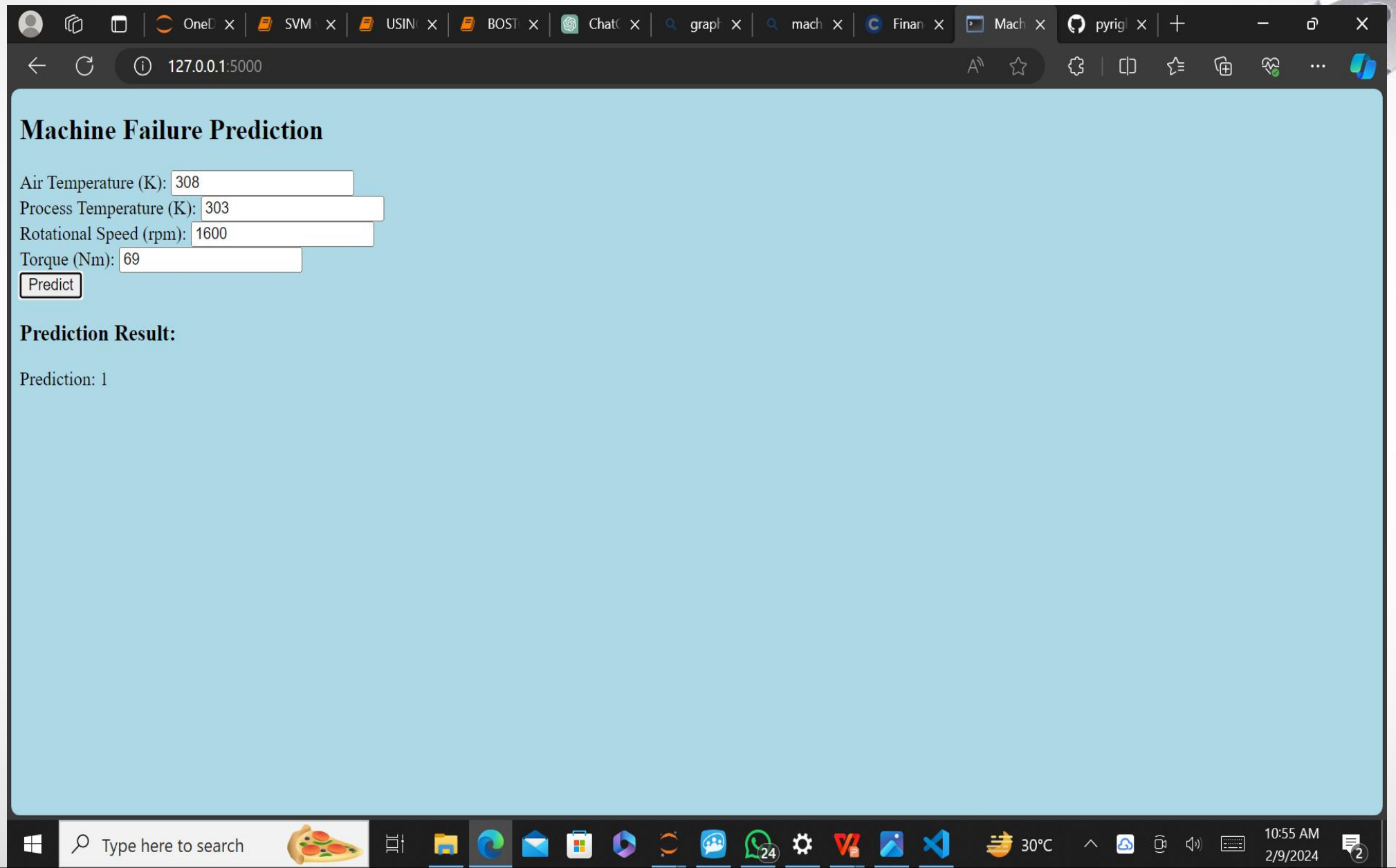
- The web application, developed using Flask, serves as the primary interface for users to access the integrated prediction system.

- The application seamlessly integrates various functionalities, including air temperature, process temperature, rotational speed and torque.

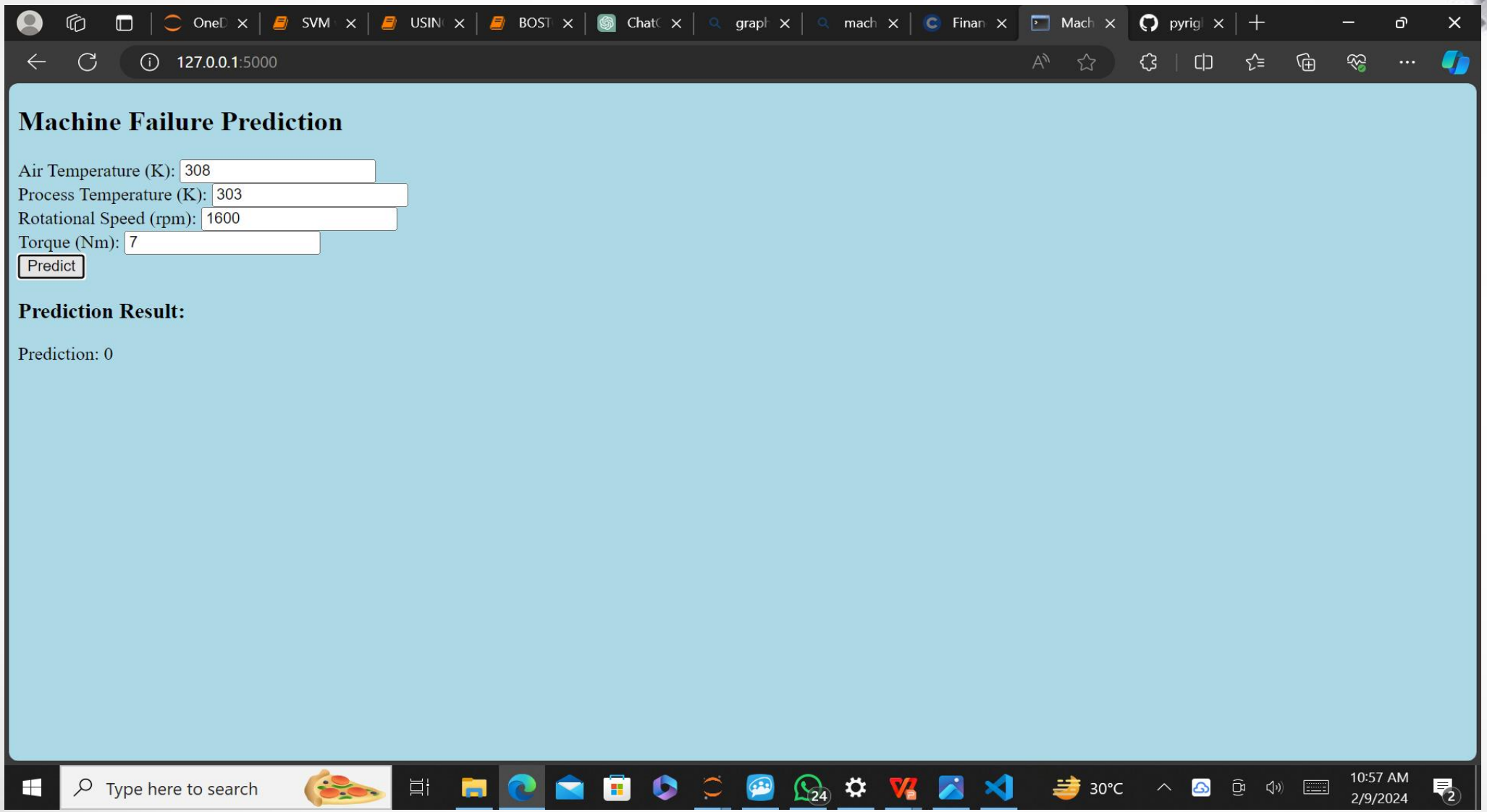
MODEL DEPLOYMENT



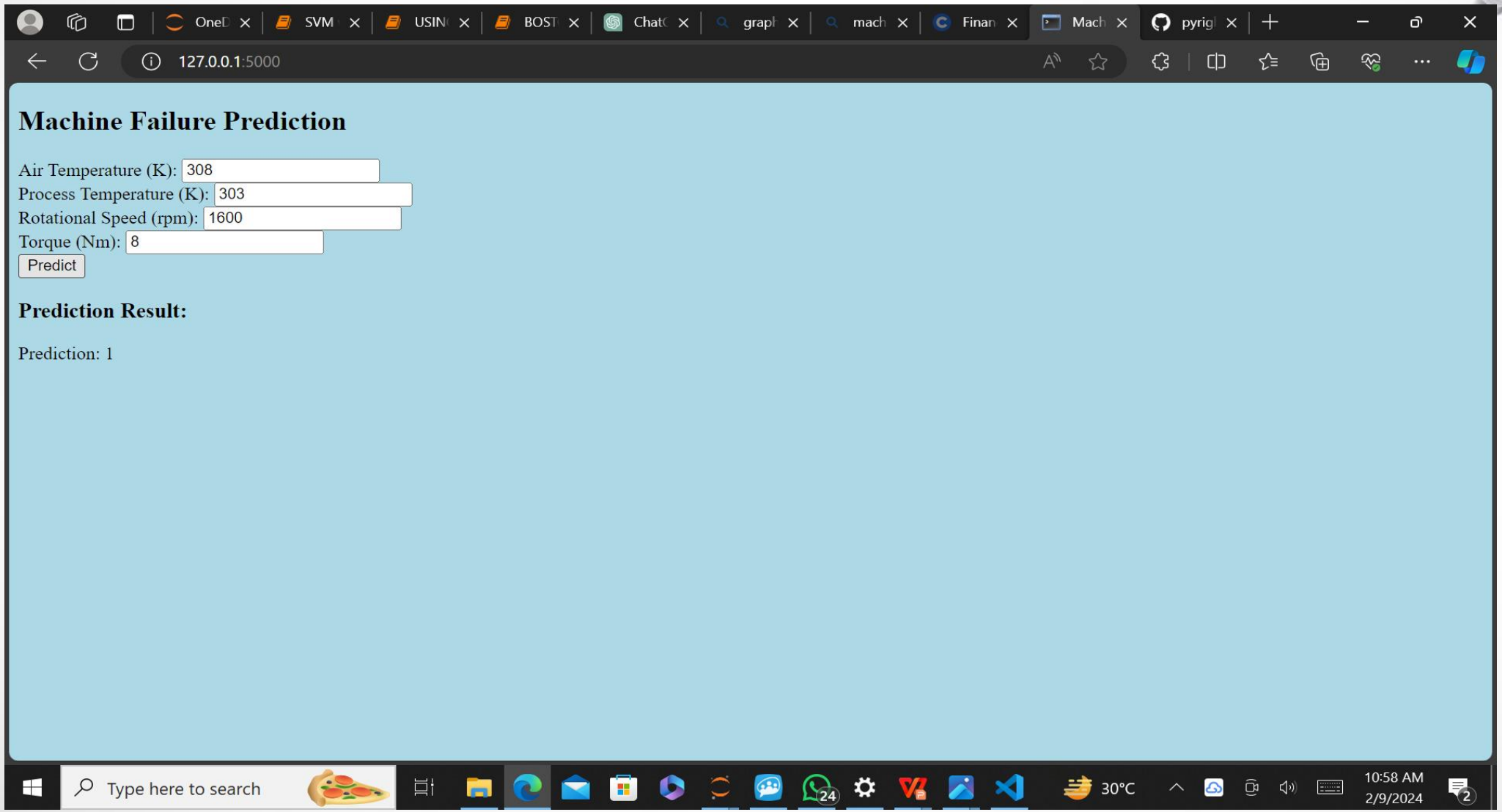
CASE 1


127.0.0.1:5000
Machine Failure Prediction
Air Temperature (K): 308
Process Temperature (K): 303
Rotational Speed (rpm): 1600
Torque (Nm): 69
Predict
Prediction Result:
Prediction: 1
Type here to search
30°C
10:55 AM
2/9/2024

CASE 2


127.0.0.1:5000
Machine Failure Prediction
Air Temperature (K): 308
Process Temperature (K): 303
Rotational Speed (rpm): 1600
Torque (Nm): 7
Predict
Prediction Result:
Prediction: 0
Type here to search
30°C
10:57 AM
2/9/2024

CASE 3


127.0.0.1:5000
Machine Failure Prediction
Air Temperature (K): 308
Process Temperature (K): 303
Rotational Speed (rpm): 1600
Torque (Nm): 8
Predict
Prediction Result:
Prediction: 1
Type here to search
30°C
10:58 AM
2/9/2024

CONCLUSION

- This machine learning model offers a reliable and actionable framework for predicting machine failure based on key operational parameters.

- By incorporating real-time data monitoring and continuous model refinement, our approach holds significant potential for enhancing operational efficiency, reducing maintenance costs, and maximizing productivity in industrial settings.

THANK YOU

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