Machine Predictive Maintenance

Failure Classification

December, 2022

Project objective:

Deliver a product to Northrup Grumman to predict types of machine failure

Data

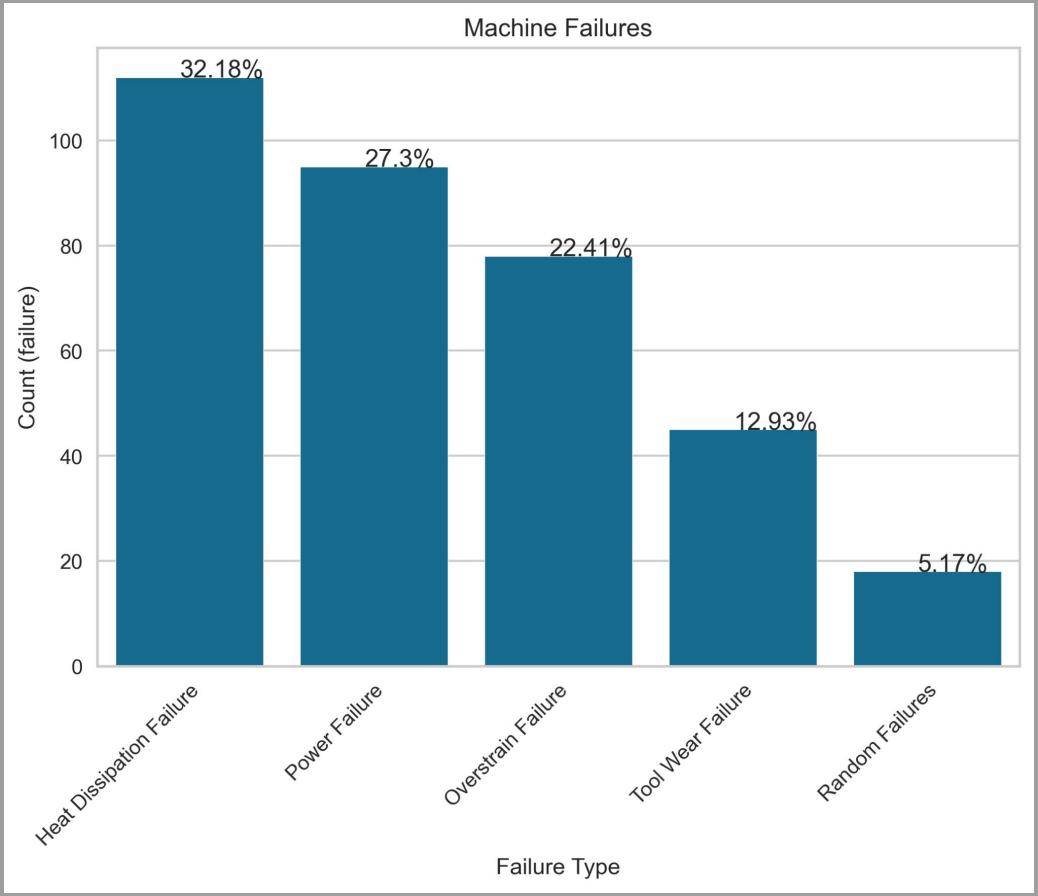
Northrup Grumman Machine Failure

Data

Northrup Grumman Machine Failure

- Contains a data point for each product run through the machine
- 10000 points in dataset accounting for about 76 days of machine time
- Includes information on air temp, process temp, rotational speed, torque, tool wear, failure, and type of failure

Range



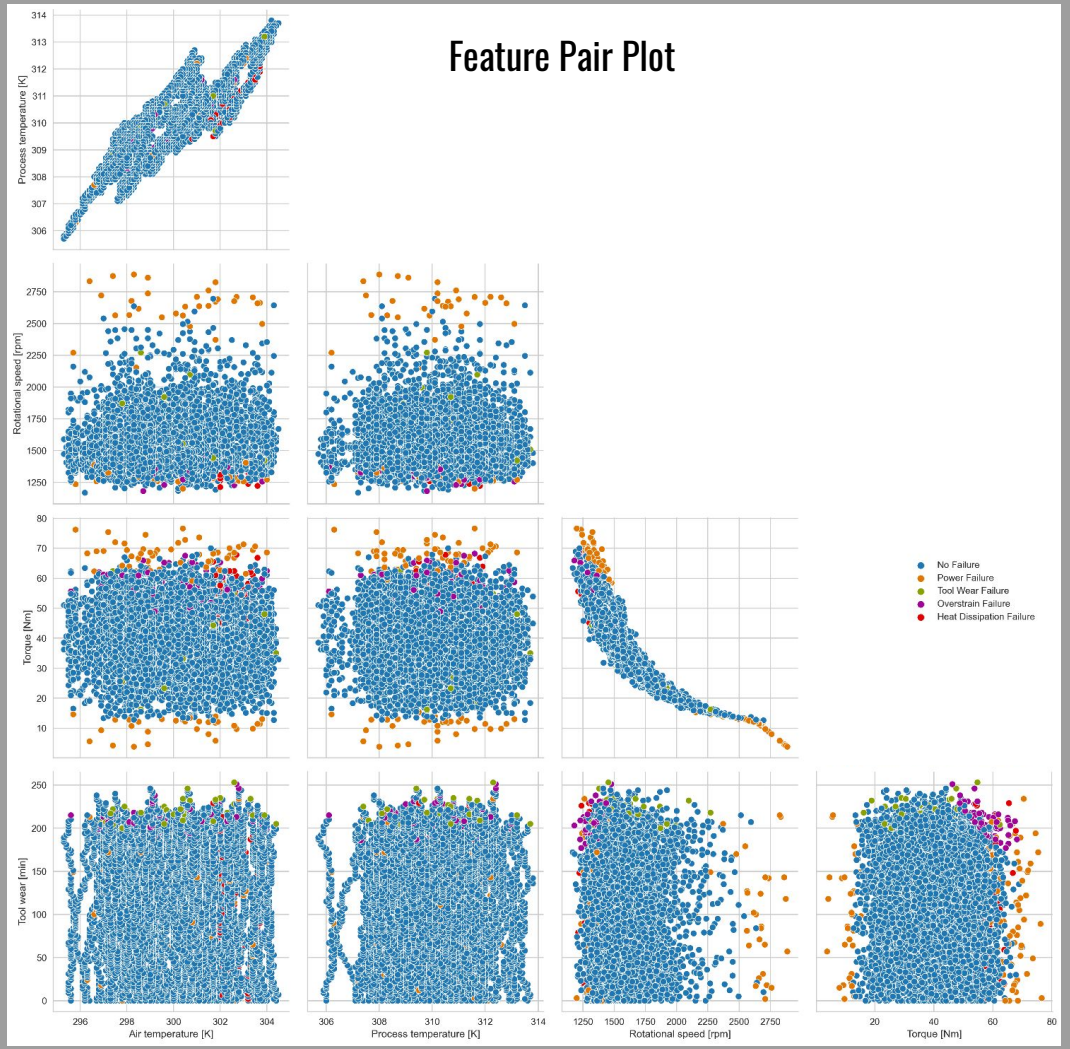
These machine failures are what was provided to us in the dataset

9661 No failure data points
339 Failure data points (3.39%)

Heat Dissipation, Power Failure, and Overstrain Failure are most common failures

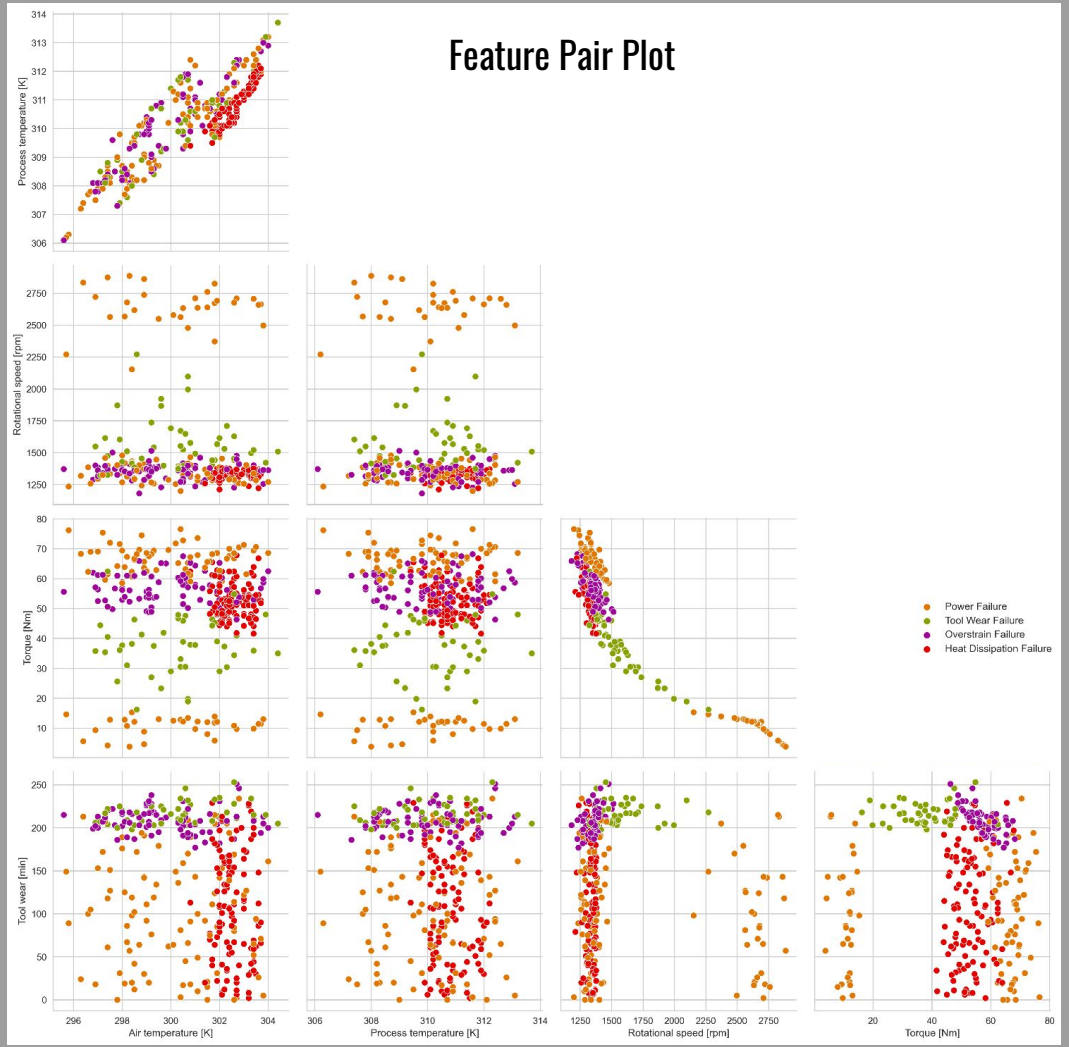
Relationships

Grouping between features show correlation between type of recorded data and type of failure

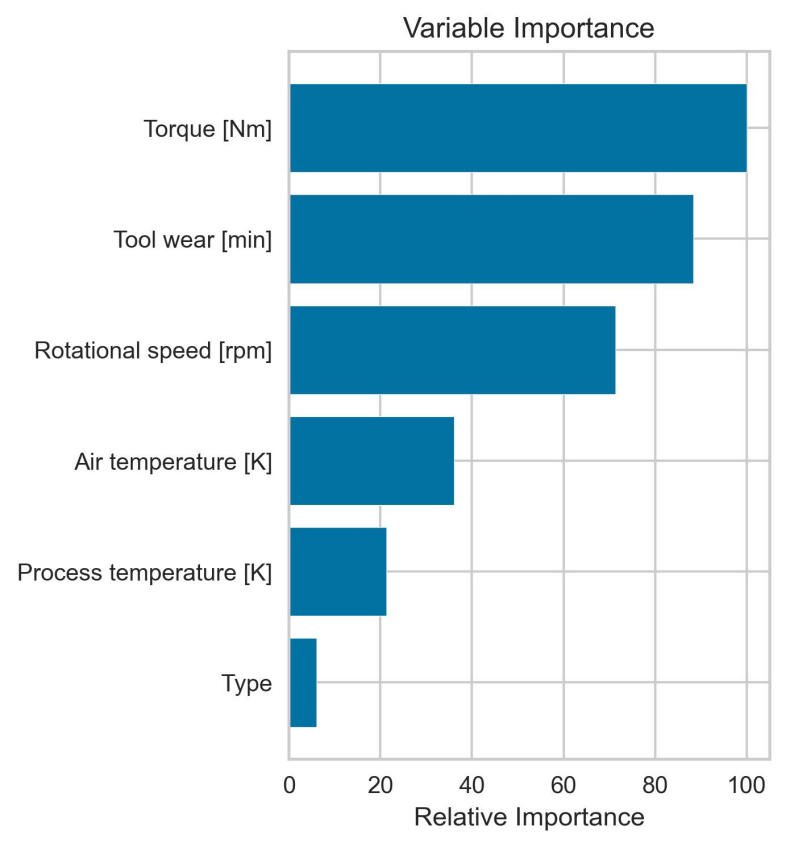


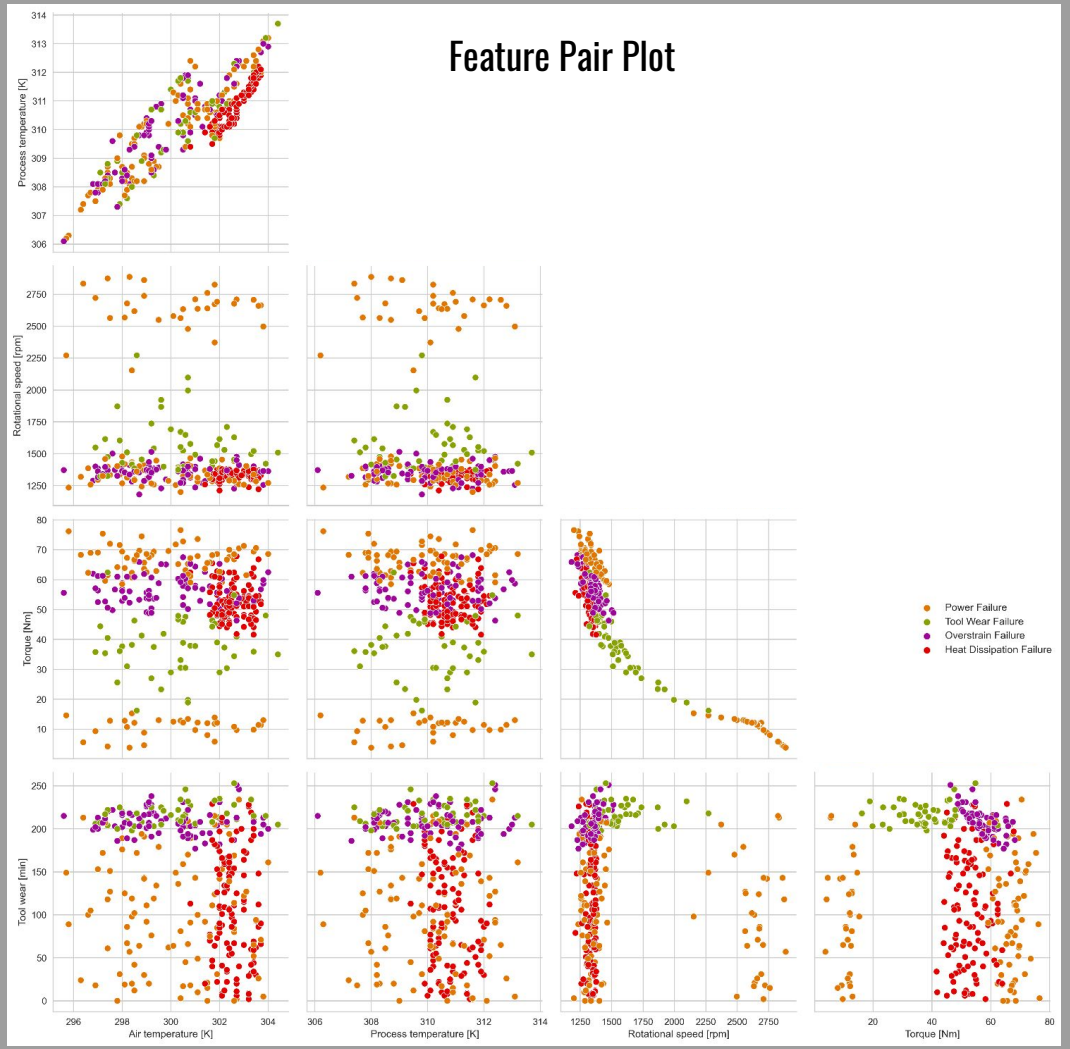
Relationships

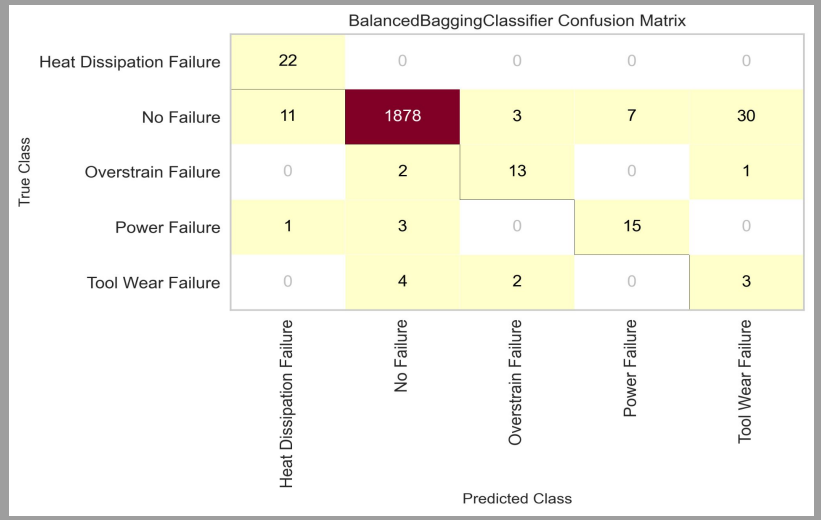
Grouping between features show correlation between type of recorded data and type of failure



Relationships

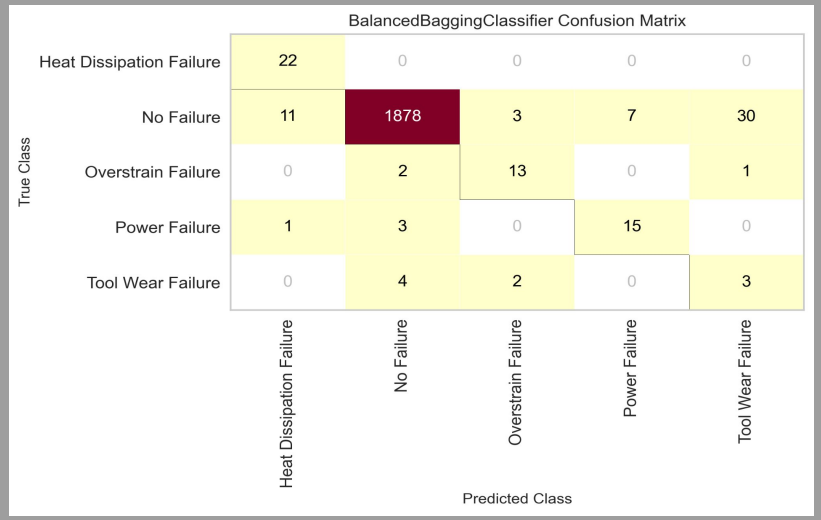


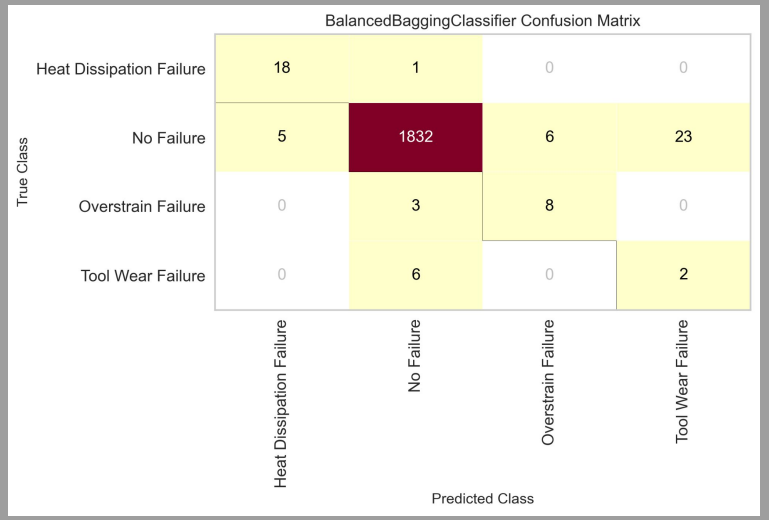




Final Model has the most incorrect predictions in no failure at 9 out of 1995

RESULTS

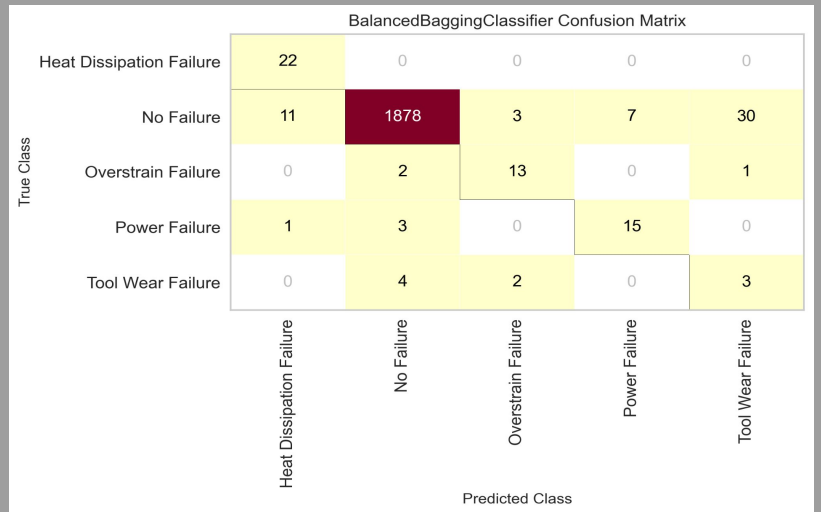


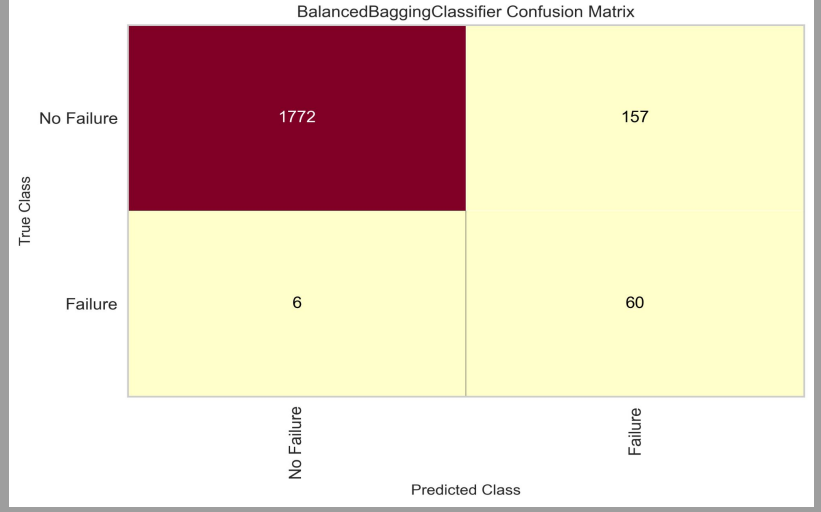


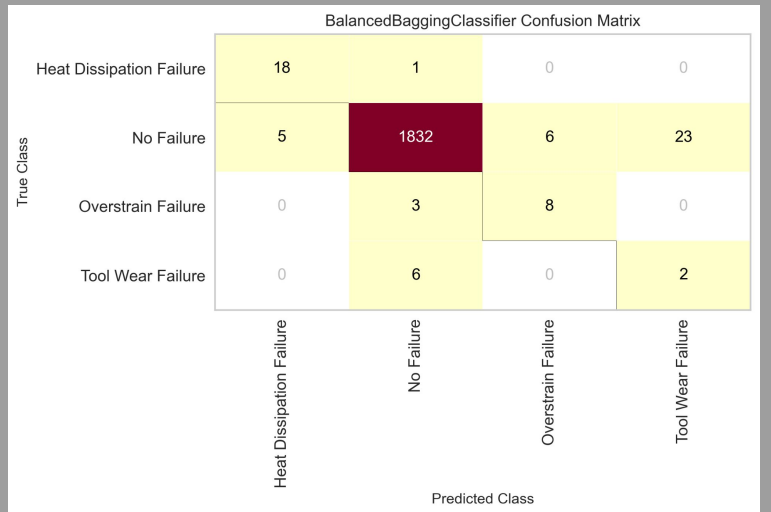
Final Model has the most incorrect predictions in no failure at 9 out of 1995

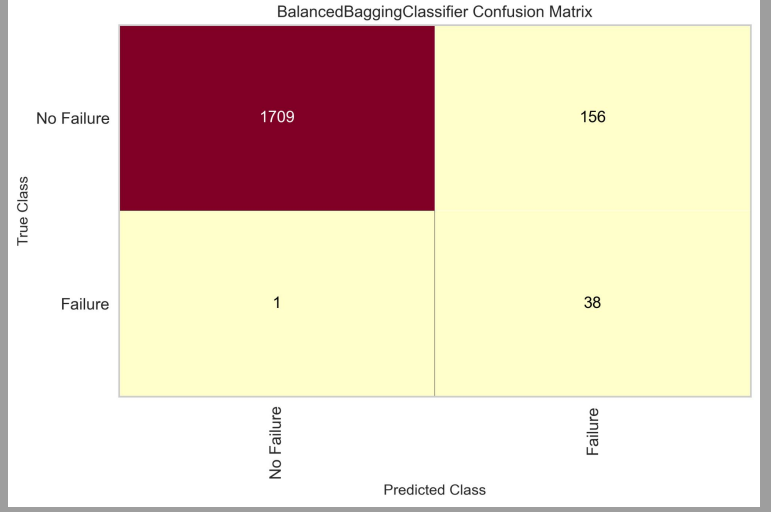
Final Model after removing 2.25% of data at the upper and lower bounds of torque (data above

RESULTS


BalancedBaggingClassifier Confusion Matrix
Heat Dissipation Failure
No Failure
Overstrain Failure
Power Failure
Tool Wear Failure
True Class
22 0 0 0 0
11 1878 3 7 30
0 2 13 0 1
1 3 0 15 0
0 4 2 0 3
Heat Dissipation Failure
No Failure
Overstrain Failure
Power Failure
Tool Wear Failure
Predicted Class


BalancedBaggingClassifier Confusion Matrix
No Failure
Failure
True Class
1772 157
6 60
No Failure
Failure
Predicted Class


BalancedBaggingClassifier Confusion Matrix
Heat Dissipation Failure
No Failure
Overstrain Failure
Tool Wear Failure
True Class
18 1 0 0
5 1832 6 23
0 3 8 0
0 6 0 2
Heat Dissipation Failure
No Failure
Overstrain Failure
Tool Wear Failure
Predicted Class


BalancedBaggingClassifier Confusion Matrix
No Failure
Failure
True Class
1709 156
1 38
No Failure
Failure
Predicted Class

CONCLUSIONS

- All types of failure have varying relationships with multiple features in the data
- Highest counts of failure in order are: Heat dissipation, Power failure, Overstrain failure, and Tool Wear.

- By removing outliers in torque feature, final model was able to predict only one incorrect false negative out of 1904 data points.

FUTURE WORK

1. Expand Dataset to confirm results

2. Predict Maintenance for other machines in the facility

THANK YOU