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# **CAPSTONE PROJECT**

## **PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY**

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# OUTLINE

- Problem Statement
- Proposed System/Solution
- System Development Approach
- Algorithm & Deployment
- Result
- Conclusion
- Future Scope
- References

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# PROBLEM STATEMENT

- Industrial Machines Are Prone To Failures Such As Tool Wear, Heat Dissipation Issues, And Power Faults.
- These Failures Lead To Unplanned Downtime, Increased Maintenance Costs, And Reduced Operational Efficiency.
- Traditional Maintenance Strategies Are Reactive Or Scheduled, Often Missing Early Warning Signs.
- The Challenge Is To Build A System That Predicts Failures Before They Occur—enabling Proactive Maintenance And Minimizing Disruptions.

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# PROPOSED SOLUTION

Develop a machine learning-based classification model that:

- Analyzes real-time sensor data (e.g., torque, rotational speed, temperature)
- Predicts the **type of failure** before it happens
- Enables **automated alerts** for maintenance teams
- Reduces downtime and improves asset reliability

# SYSTEM APPROACH

## Platform & Tools:

- IBM Cloud Lite (AutoAI, Deployment Spaces)
- Python (Pandas, scikit-learn, imbalanced-learn)
- SMOTE for class balancing
- Snap ML Random Forest Classifier (P4 pipeline)

## Dataset Source:

**Kaggle – Predictive Maintenance Classification**

# ALGORITHM & DEPLOYMENT

- **Task:** Multi-class classification
- **Target Column:** Failure Type
- **Classes:** Tool Wear (TWF), Heat Dissipation (HDF), Power Failure (PWF), Overstrain (OSF), Random Failure (RNF), No Failure
- **Model Used:** Snap ML Random Forest Classifier
- **Optimized Metric:** F1 Weighted Score
- **Deployment:** IBM Cloud Lite Deployment Spaces (AutoAI export)

# RESULT

Metric	Holdout Score	Cross-Validation
Accuracy	0.997	0.995
F1 Weighted	0.996	0.994
Precision Macro	0.814	0.784
Recall Macro	0.818	0.768
Log Loss	0.025	0.094

## Insights:

- Model performs exceptionally well across all failure types
- SMOTE preprocessing helped balance rare classes
- Low log loss confirms high confidence in prediction

# RESULT

Deployment spaces / Fault\_Type\_Identification / P4 - Snap Random Forest Classifier: Fault\_type /



Fault\_Type\_prediction ✓ Deployed Online

API reference

Test

Enter input data

Text

JSON

Enter data manually or use a CSV file to populate the spreadsheet. Max file size is 50 MB.

[Download CSV template](#) ⬇

[Browse local files](#) ↗

[Search in space](#) ↗

[Clear all](#) ×

	UDI (double)	Product ID (other)	Type (other)	Air temperature [K] (double)	Process temperature [K] (double)	Rotational speed [rpm] (double)	Torque [Nm] (double)	Tool wear
1								
2								
3								
4								
5								

0 rows, 9 columns

Predict



# RESULT

Projects / Predictive\_maintenance / Fault\_type



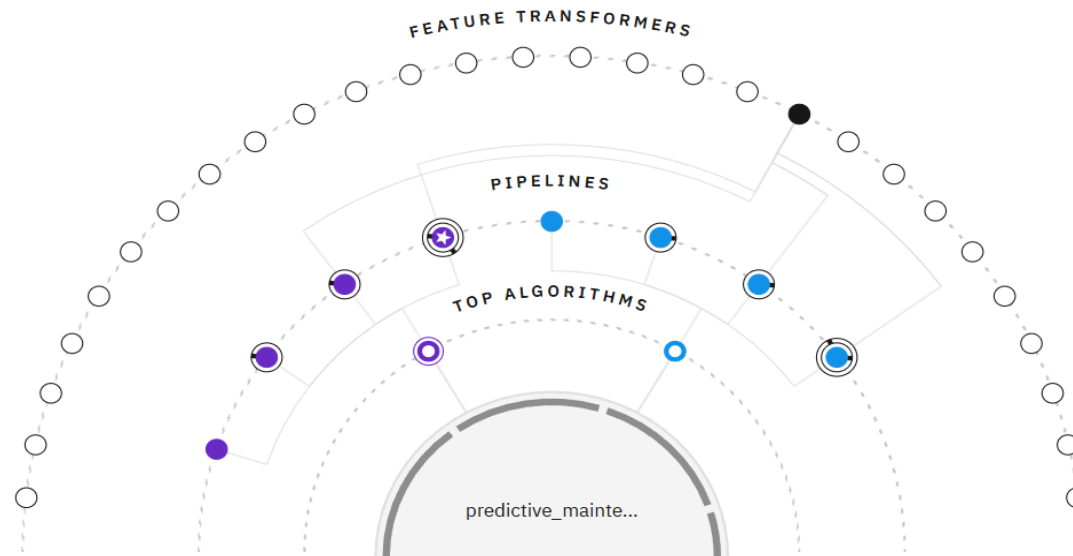
Experiment summary

Pipeline comparison

★ Rank by: F<sub>1</sub> weighted (Optimized) | Cross validation score

## Relationship map ⓘ

Prediction column: Failure Type



## Progress map

[Swap view↔](#)



Experiment completed ✓

8 PIPELINES GENERATED

8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.

Time elapsed: 2 minutes

[View log](#)

[Save code](#)

## Pipeline leaderboard ⌵

F<sub>1</sub> weighted (Optimized)

29°C  
Mostly sunny



Search



ENG  
IN

12:04  
31-07-2025

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# CONCLUSION

- The predictive maintenance model successfully anticipates machine failures with near-perfect accuracy.
- By leveraging IBM Cloud Lite and AutoAI, the system is scalable, interpretable, and ready for real-world deployment.
- It empowers industries to shift from reactive to proactive maintenance—saving time, cost, and resources.

# FUTURE SCOPE

- Integrate real-time IoT sensor streams
- Extend to regression for failure severity prediction
- Deploy on edge devices for low-latency alerts
- Add explainability using SHAP or LIME
- Expand to other domains (e.g., HVAC, robotics, power grids)

# REFERENCES

- Github Repository Link:

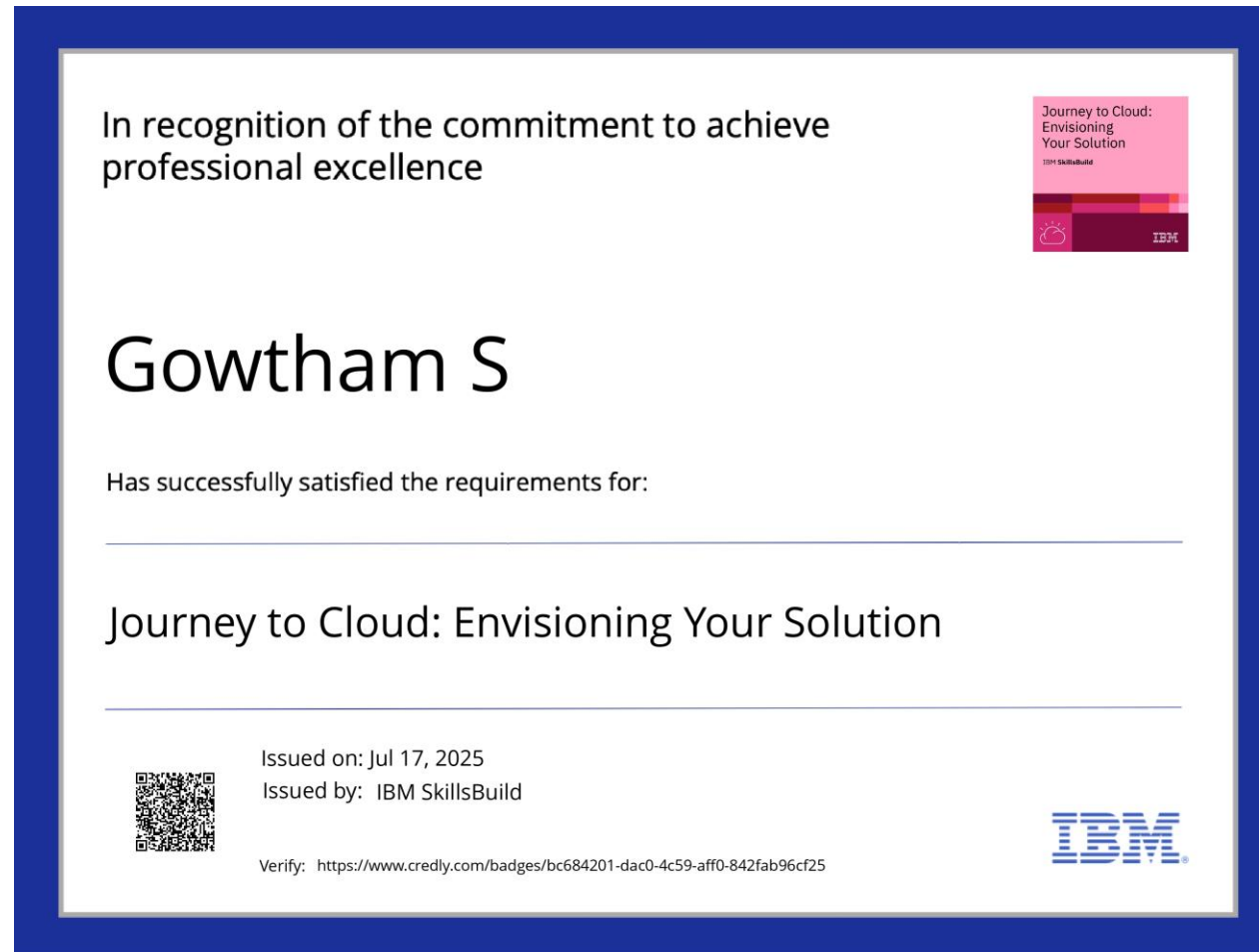
[https://github.com/Gowtham9503/Predictive\\_Maintenance\\_ML\\_Model.git](https://github.com/Gowtham9503/Predictive_Maintenance_ML_Model.git)

- IBM Snap ML Random Forest Classifier
- Scikit-learn documentation
- IBM Cloud Lite Deployment Spaces
- Kaggle Predictive Maintenance Dataset

# IBM CERTIFICATIONS



# IBM CERTIFICATIONS



# IBM CERTIFICATIONS

IBM SkillsBuild

Completion Certificate



This certificate is presented to  
**Gowtham S**

for the completion of

**Lab: Retrieval Augmented Generation with LangChain**

(ALM-COURSE\_3824998)

According to the Adobe Learning Manager system of record

**Completion date:** 23 Jul 2025 (GMT)

**Learning hours:** 20 mins



**THANK YOU**