CAPSTONE PROJECT

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

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OUTLINE

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PROBLEM STATEMENT

- Industrial Machines Are Prone To Failures Such As Tool Wear, Eat 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.

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)

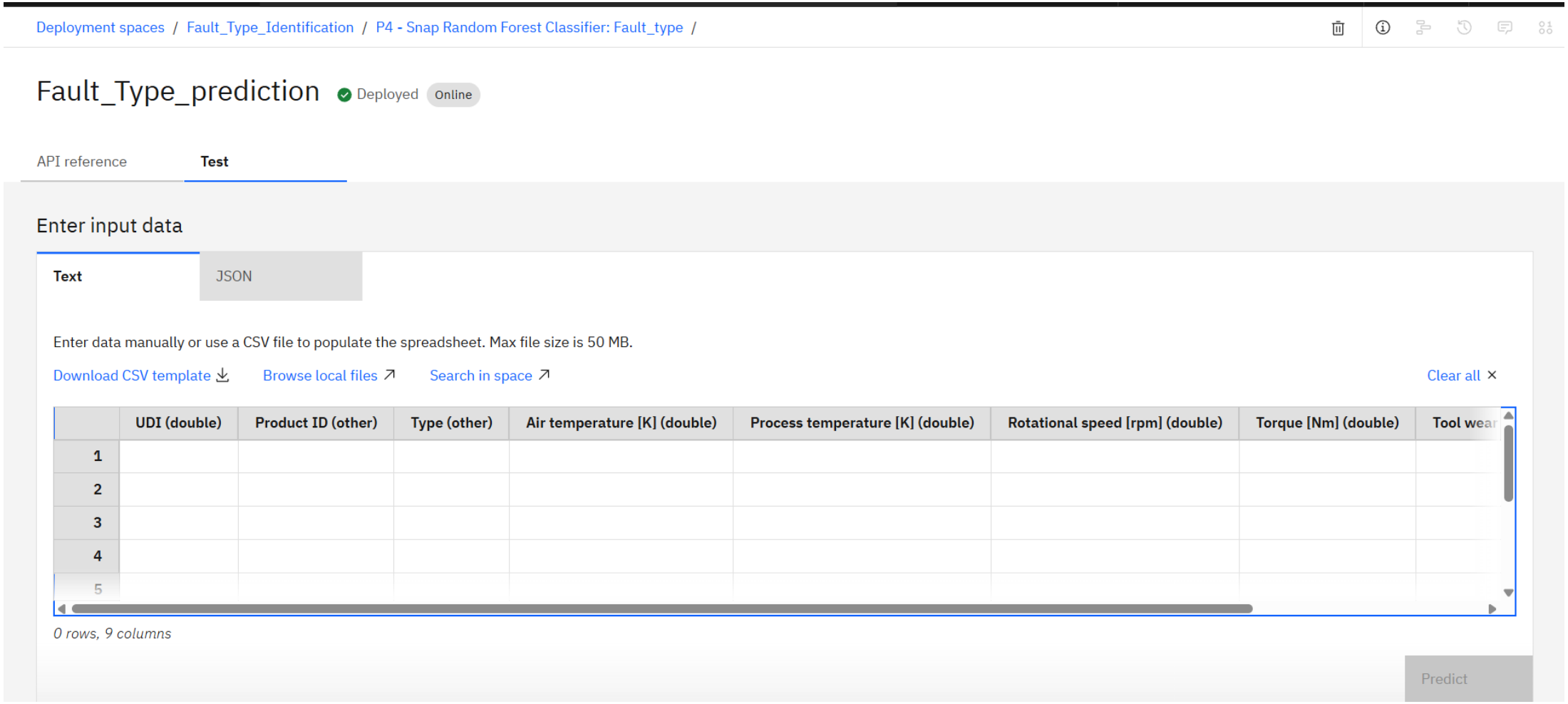
RESULT

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



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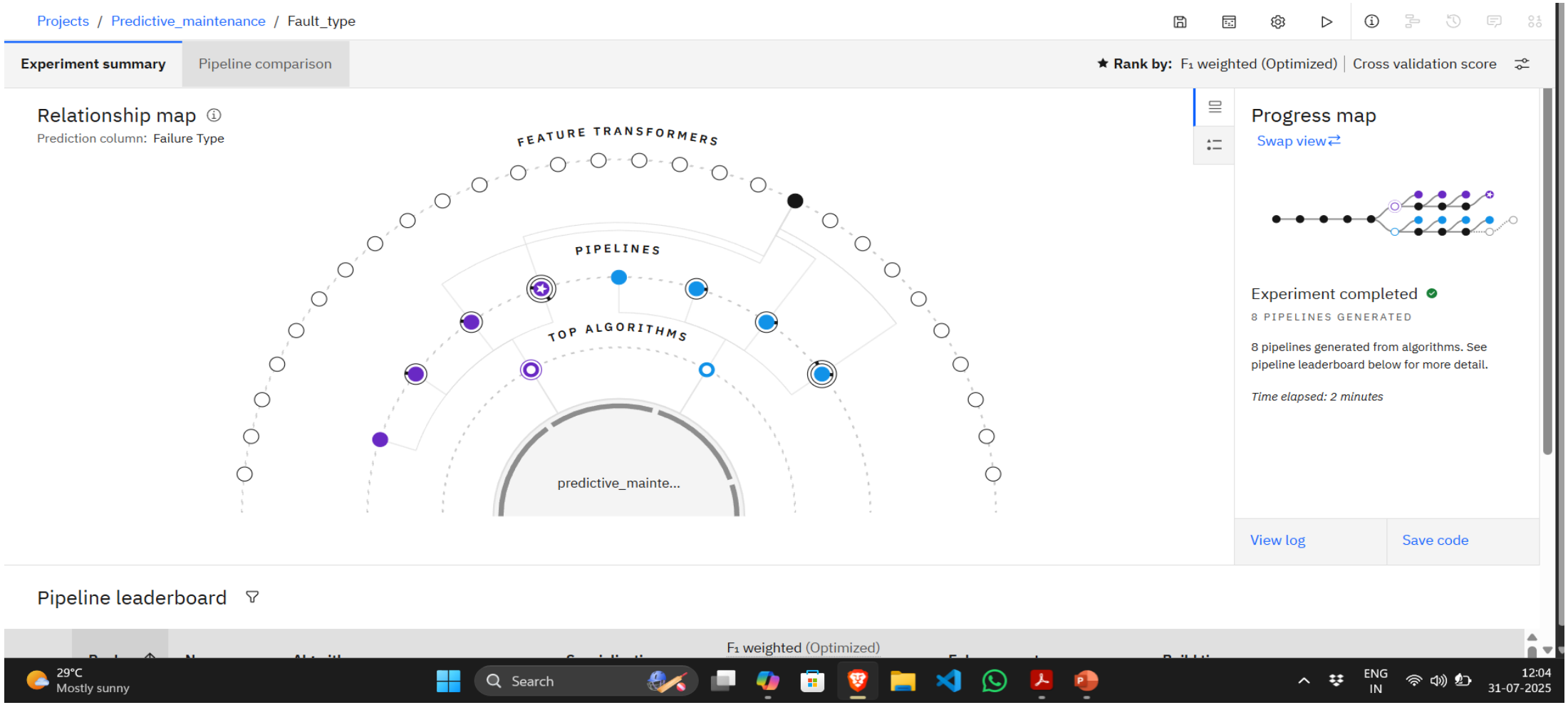
RESULT



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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

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

IBM CERTIFICATIONS

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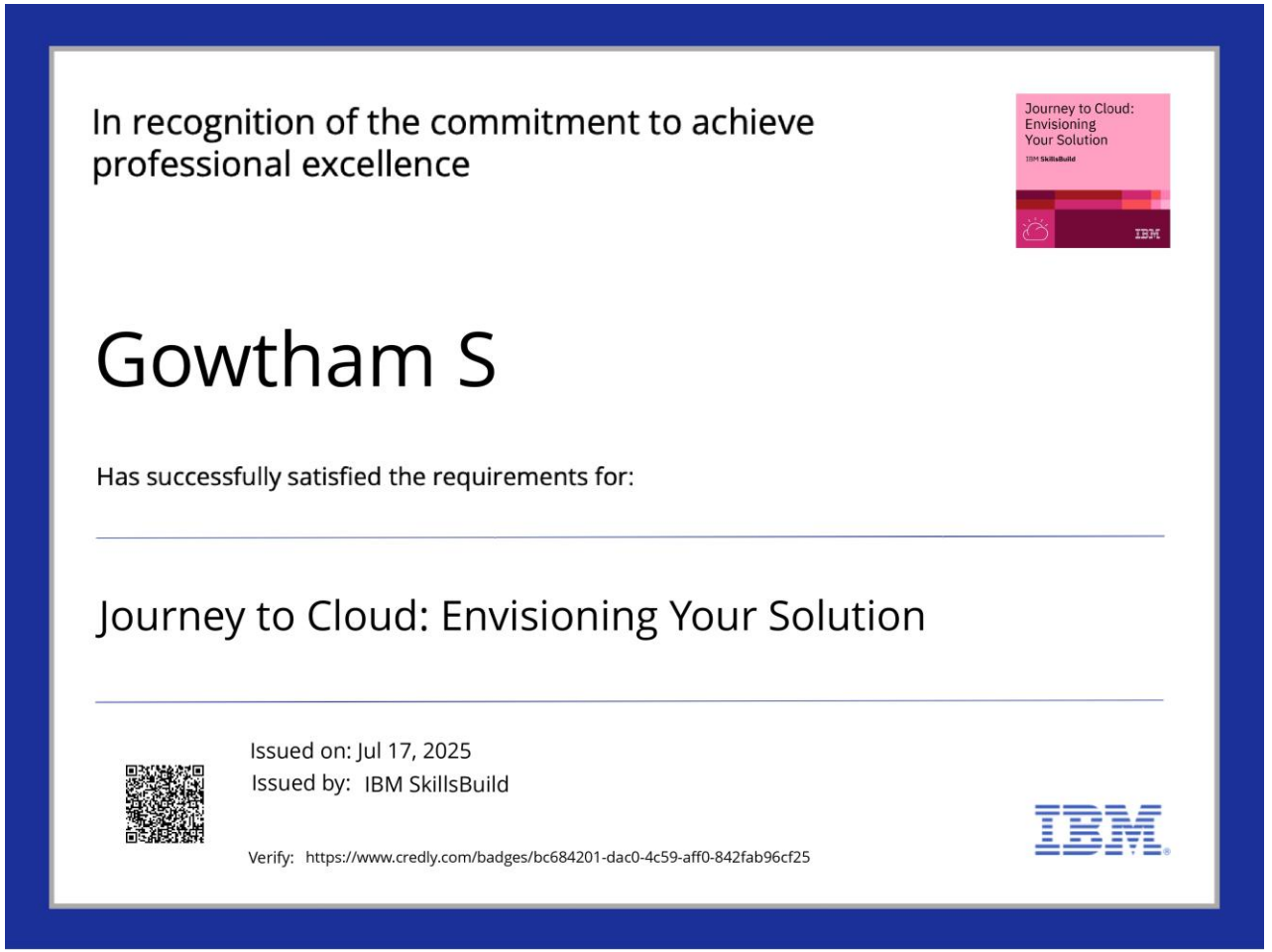

IBM CERTIFICATIONS

IBM **SkillsBuild** Completion Certificate

This certificate is presented to

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According to the Adobe Learning Manager system of record

Completion date: 23 Jul 2025 (GMT) **Learning hours:** 20 mins

THANK YOU

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