CAPSTONE PROJECT

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

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OUTLINE

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PROBLEM STATEMENT

Industrial machinery failure causes significant downtime and cost.

The challenge is to predict failures before they happen using sensor data.

This includes anticipating tool wear, heat dissipation, and power failure.

PROPOSED SOLUTION

- a predictive maintenance model for a fleet of industrial machines to anticipate failures before they occur. This project will involve analyzing sensor data from machinery to identify patterns that precede a failure.
- **Data Collection:** Used sensor data from industrial machines (e.g., tool wear, torque, rotational speed)
- **Data Preprocessing:** Handled missing values and applied feature engineering (e.g., PCA, rounding)
- **Machine Learning Algorithm:** AutoAI selected Snap Random Forest for failure classification
- **Deployment:** Deployed model as REST API using IBM Watson Studio for real-time predictions
- **Evaluation:** Evaluated models using accuracy and pipeline comparisons within AutoAI
- **Result:** Achieved high accuracy in predicting failure types, enabling proactive maintenance

SYSTEM APPROACH

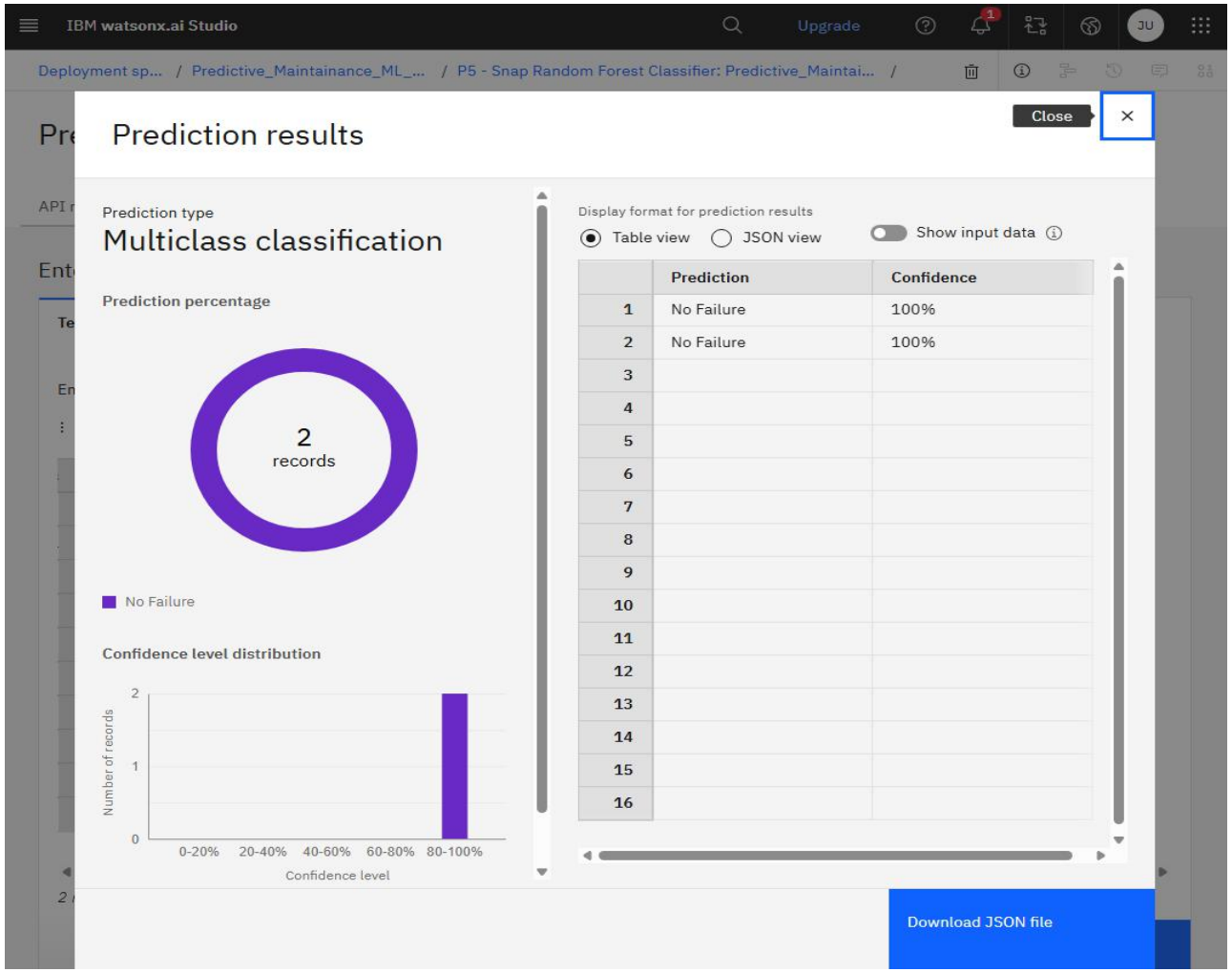
- Requirements: IBM Cloud Lite, Watson Studio, Kaggle dataset
- Libraries: AutoAI (built-in), pandas, numpy (for EDA)
- Methodology:

1. Upload data to IBM Watson Studio
2. Use AutoAI for automated preprocessing and model building
3. Select best-performing pipeline
4. Deploy model via REST API

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:** Snap Random Forest Classifier was selected by IBM AutoAI for its high accuracy in classifying failure types from sensor data. It outperformed other models during the evaluation phase.
- **Data Input**: Key features included tool wear, rotational speed, torque, and principal components (PCA_0, PCA_2, PCA_6), with rounding applied for better stability.
- **Training Process:** AutoAI used 10% of the dataset for initial model selection and performed automated feature engineering and pipeline optimization. The final model was trained with cross-validation to ensure generalization.
- **Prediction Process:** The trained model predicts failure types like tool wear or power failure using real-time machine sensor data. It can be deployed as a REST API for integration with live monitoring systems.

RESULT



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CONCLUSION

- The project built an effective predictive maintenance model using IBM AutoAI, accurately classifying machinery failures. It helps reduce downtime and costs through proactive maintenance. Key challenges like high-dimensional data were addressed using AutoAI's automated feature selection. The solution is efficient and can be improved further with real-time deployment and better explainability.

FUTURE SCOPE

- Extend to other machinery and industries
- Add prescriptive maintenance for recommendations
- Connect with CMMS tools for automation
- Use explainable AI to improve trust
- Detect anomalies using unsupervised learning

REFERENCES

- Kaggle Dataset: “Predictive Maintenance Classification” https://www.kaggle.com/datasets/shivamb/machine-predictive-maintenance-classification
- IBM Documentation: Watson Studio AutoAI Overview https://www.ibm.com/docs/en/cloud-paks/cp-data/4.0?topic=tools-autoai
- IBM Cloud: Getting Started with IBM Cloud Lite Account: https://cloud.ibm.com/docs/account?topic=account-liteaccount

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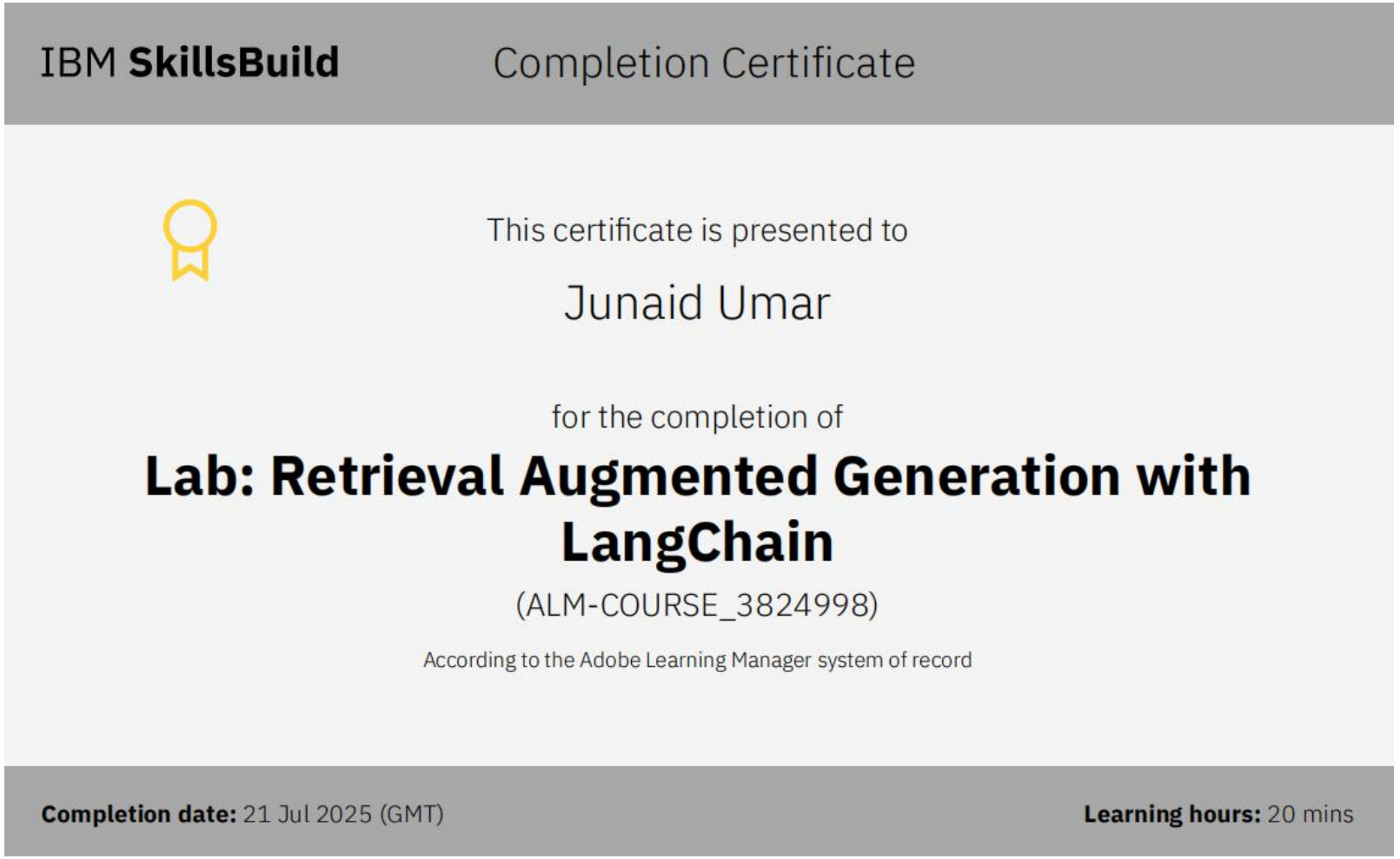

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