CAPSTONE PROJECT

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

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OUTLINE

- **Problem Statement** (Should not include solution)
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

PROBLEM STATEMENT

- Industrial machinery often experiences unplanned breakdowns, leading to high downtime and maintenance costs. The challenge is to predict such failures in advance using sensor data collected from these machines. This predictive maintenance task involves identifying early patterns in real-time operational data that can signal the likelihood and type of upcoming failure (e.g., tool wear, power failure, heat dissipation failure).

PROPOSED SOLUTION

- This system aims to proactively detect machinery failures using classification models trained on historical sensor data. By applying machine learning algorithms to predict failure types, maintenance teams can take corrective actions in advance. IBM Cloud Watson Studio was used for AutoAI model training and deployment.

- Steps:
- - Data collection and preprocessing from Kaggle dataset
- - Feature selection and engineering
- - Classification using Snap Random Forest
- - Deployment and prediction in IBM Cloud Lite

SYSTEM APPROACH

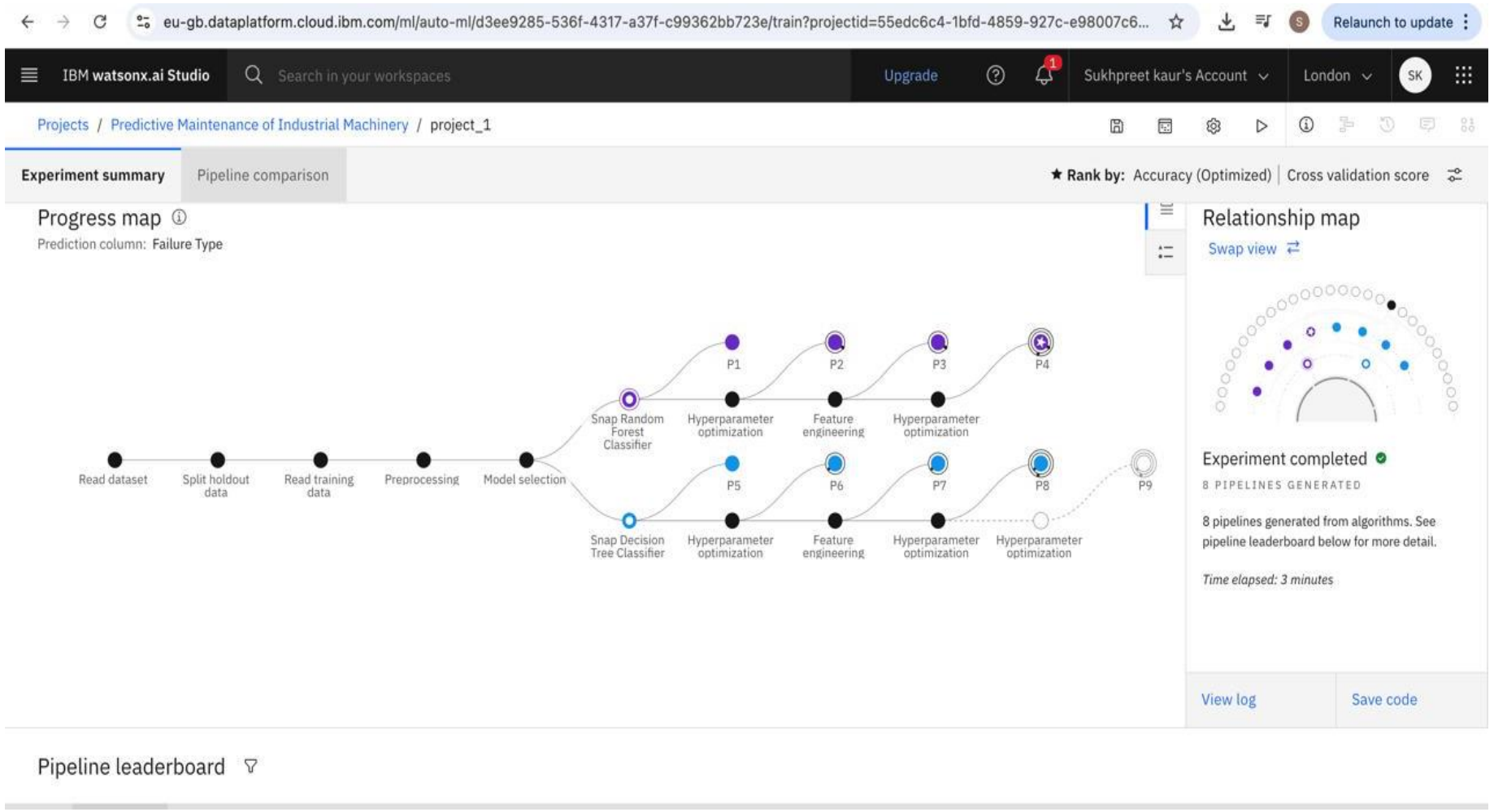
- System Requirements:
- - IBM Cloud Lite Account
- - IBM Watson Studio
- - Kaggle Dataset on Predictive Maintenance

- Libraries/Tools:
- - pandas, scikit-learn (backend)
- - IBM AutoAI for model selection and tuning
- - IBM Watson Deployment UI for testing

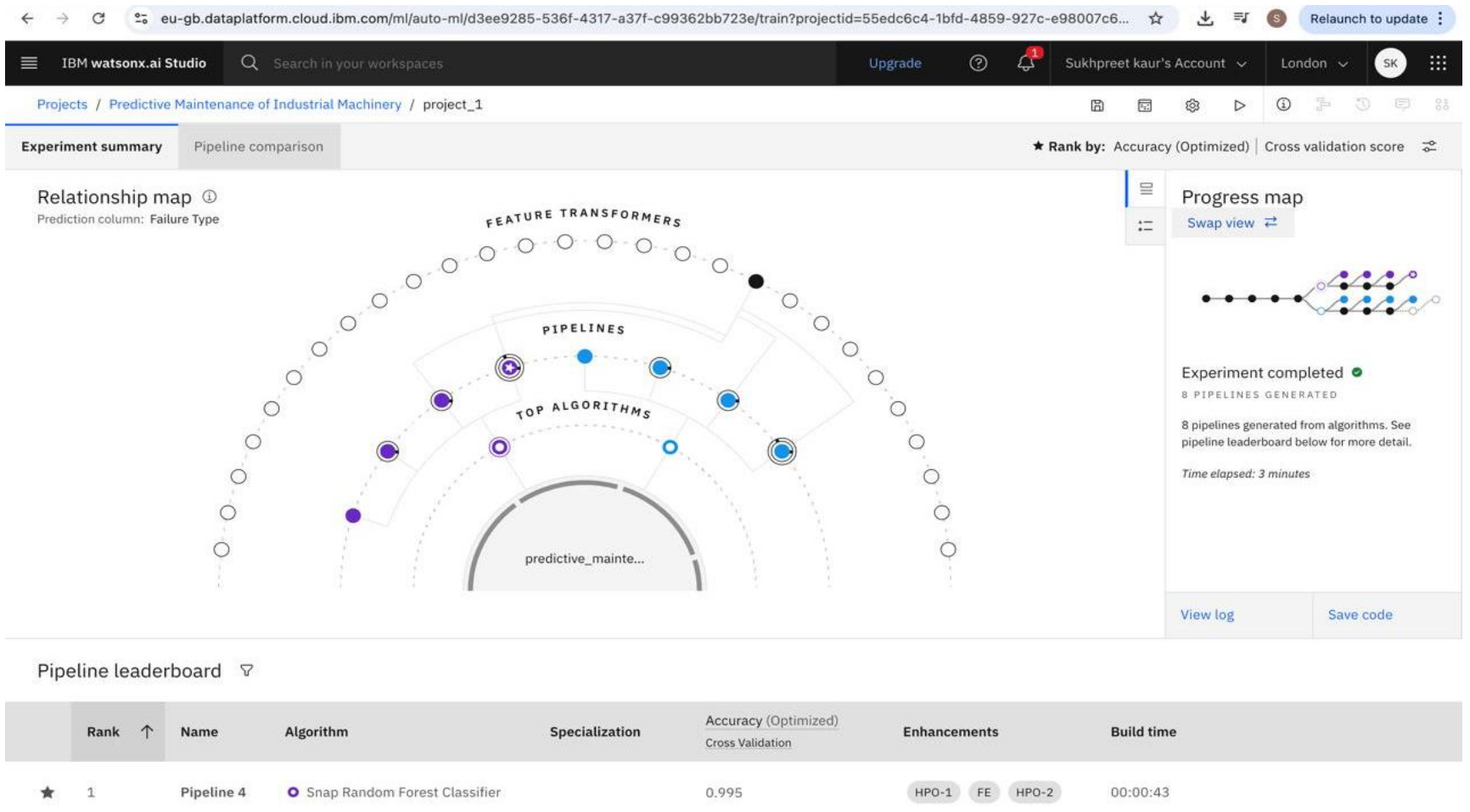
ALGORITHM & DEPLOYMENT

- Algorithm: Snap Random Forest Classifier
- Why RF?
- - Handles multi-class classification well
- - Robust to overfitting on large datasets
- Input Features:
- - Air temperature, process temperature, torque, tool wear, rotational speed
- Deployment:
- - Model deployed in IBM Watson ML service
- - Real-time predictions with JSON/table inputs

RESULT



RESULT



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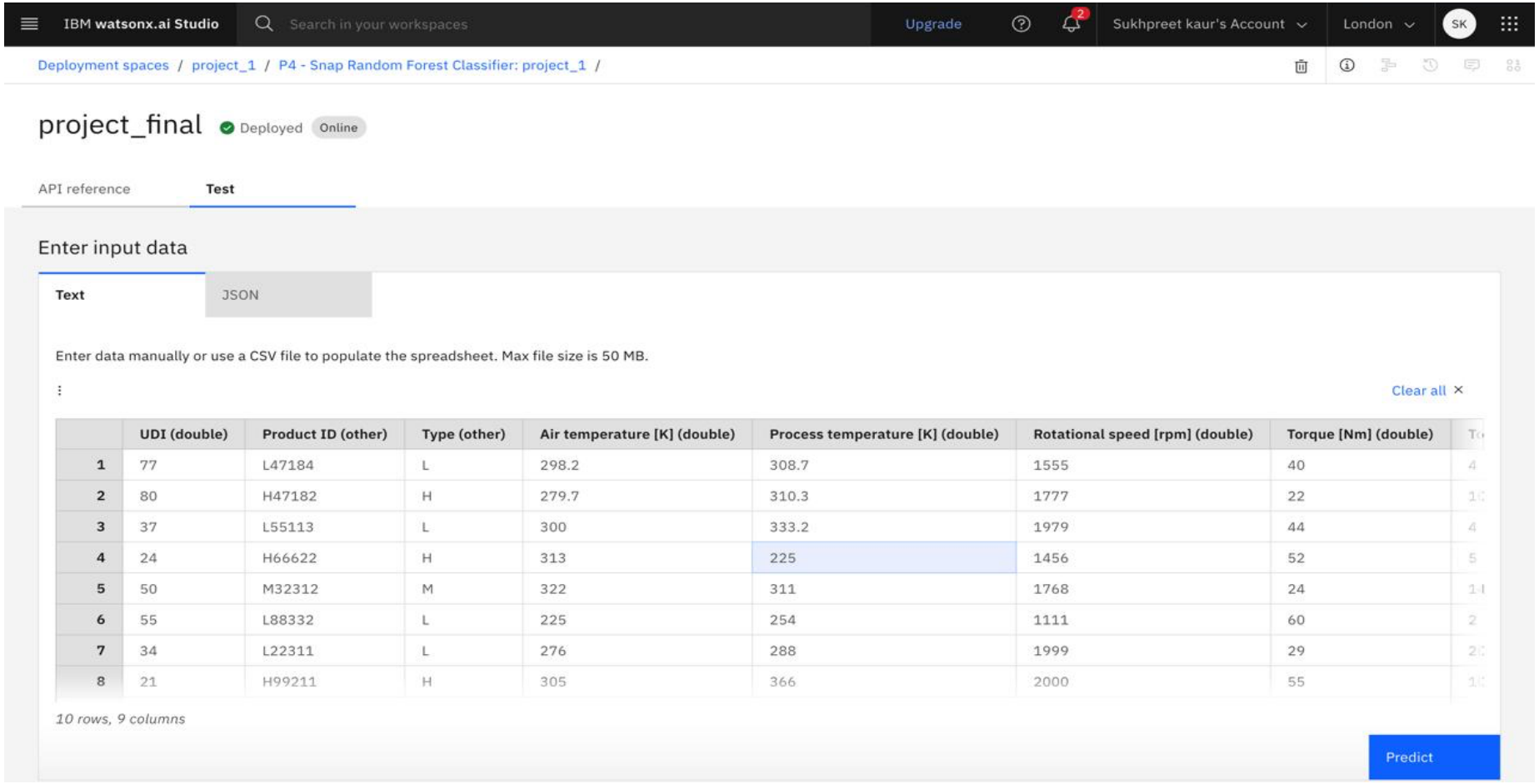
RESULT



	UDI (double)	Product ID (other)	Type (other)	Air temperature [K] (double)	Process temperature [K] (double)	Rotational speed [rpm] (double)	Torque [Nm] (double)
1	77	L47184	L	298.2	308.7	1555	40
2	80	H47182	H	279.7	310.3	1777	22
3	37	L55113	L	300	333.2	1979	44
4	24	H66622	H	313	225	1456	52
5	50	M32312	M	322	311	1768	24
6	55	L88332	L	225	254	1111	60
7	34	L22311	L	276	288	1999	29
8	21	H99211	H	305	366	2000	55

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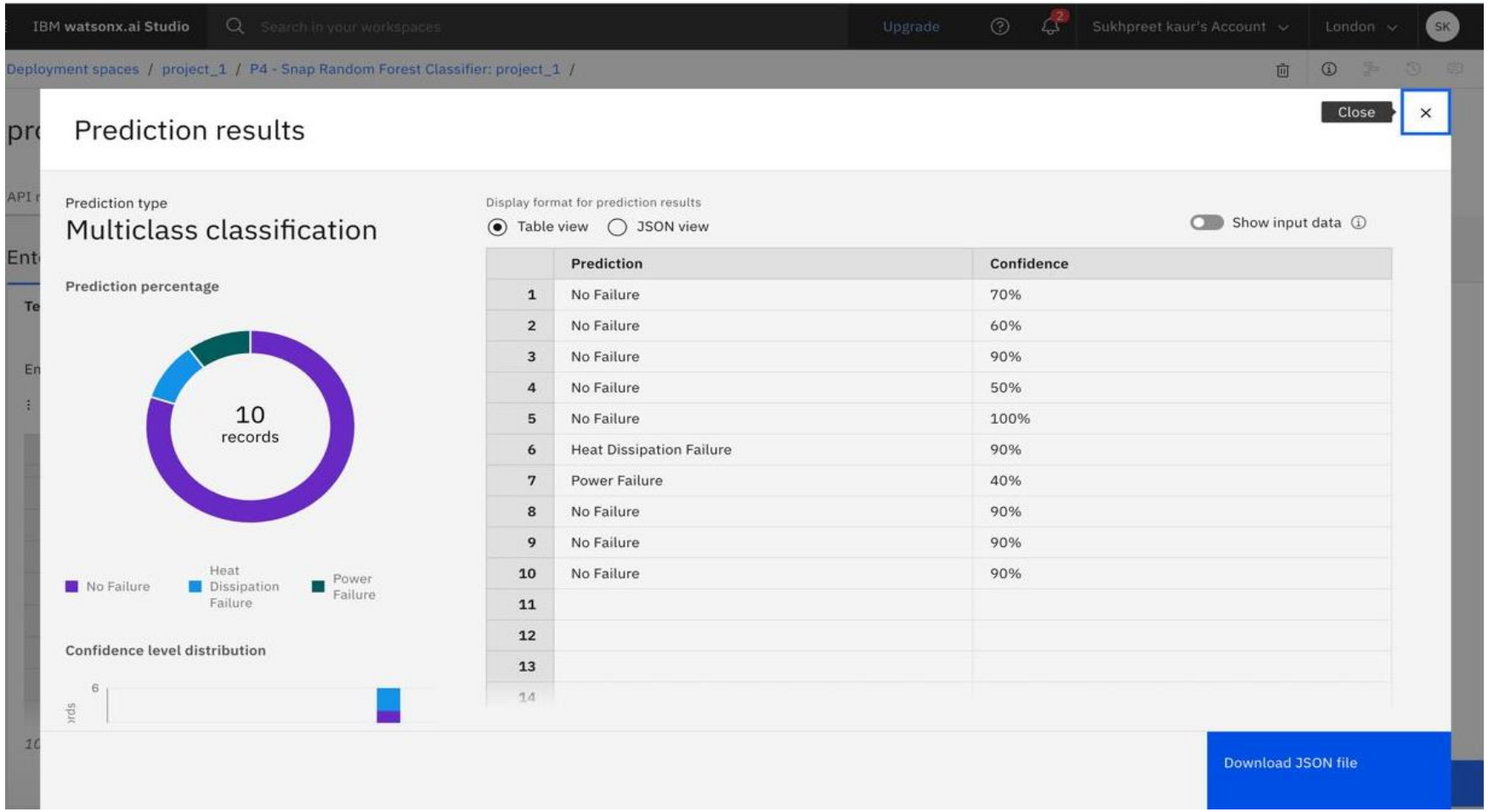
RESULT



CONCLUSION

- The predictive maintenance system developed using machine learning successfully anticipates machinery failures such as tool wear, power failure, and heat dissipation. By leveraging IBM Watson AutoAI and deploying the model on IBM Cloud Lite, the system achieves high accuracy (up to 99.5%) in classifying different types of failures. This enables proactive maintenance scheduling, reduces unplanned downtime, and lowers operational costs. The use of real-time sensor data ensures continuous monitoring and faster decision-making.

FUTURE SCOPE

- Integrate the model with IoT sensors on real machines for live predictions
- Expand the dataset with more operational parameters (vibration, pressure)
- Improve accuracy using ensemble or deep learning models
- Build a dashboard for maintenance teams with real-time alerts
- Use Edge AI for on-site deployment in remote industrial areas

REFERENCES

- Shivam Bansal, "Predictive Maintenance Dataset," Kaggle
  https://www.kaggle.com/datasets/shivamb/machinepredictive-maintenance-classification
- IBM Cloud Watson Studio
  https://www.ibm.com/cloud/watson-studio
- IBM AutoAI Documentation
  https://dataplatform.cloud.ibm.com/docs/content/wsj/autoai
- scikit-learn documentation
  https://scikit-learn.org

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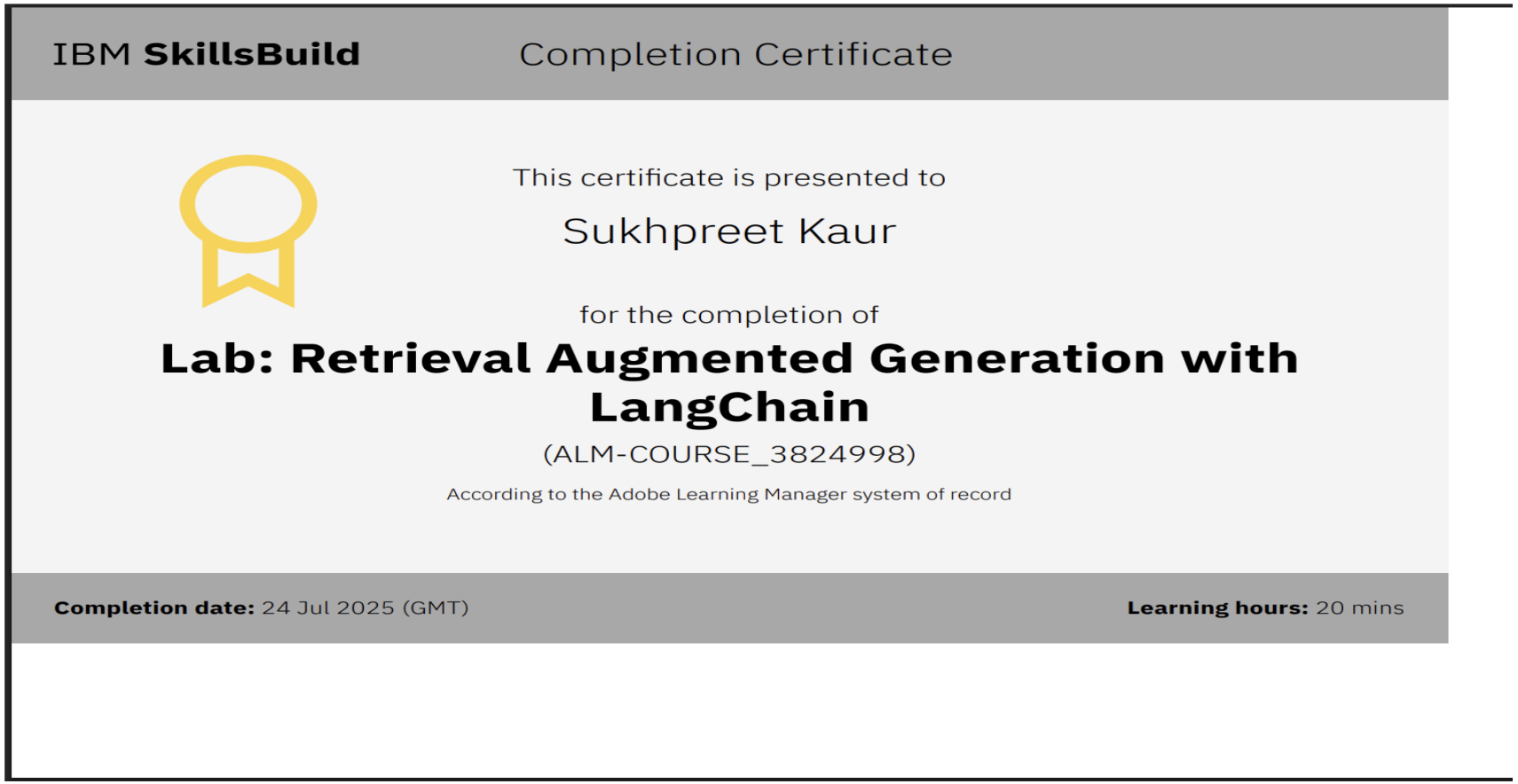

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