CAPSTONE PROJECT

PROJECT TITLE

Presented By:
Snehal Samal- M.S. Ramaiah University of Applied Sciences- CSE Dept.

edunet foundation

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

- Develop 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. The goal is to create a classification model that can predict the type of failure (e.g., tool wear, heat dissipation, power failure) based on real-time operational data. This will enable proactive maintenance, reducing downtime and operational costs.

PROPOSED SOLUTION

- The goal is to build a predictive maintenance system using machine learning to anticipate industrial machine failures and reduce unplanned downtime. The solution involves:

Data Collection:

- Use historical sensor data from machines, including air temperature, process temperature, rotational speed, torque, and tool wear.
- Label data with failure types such as tool wear failure, heat dissipation failure, power failure, overstrain, and random failure.

Data Preprocessing:

- Clean the dataset, handle any outliers, and normalize sensor values.
- Encode failure types and prepare features for training.

Machine Learning Model:

- Train a classification model (e.g., Random Forest, XGBoost) to predict specific failure types.
- Evaluate model performance using metrics like accuracy, precision, recall, and F1-score.

Deployment:

- Deploy the trained model using IBM Cloud services such as Watson Studio.
- Future integration can allow real-time monitoring and predictive alerts for timely maintenance actions.

Outcome:

- Reduce unexpected breakdowns, optimize maintenance schedules, and improve overall equipment efficiency.

SYSTEM APPROACH

- The "System Approach" section outlines the overall strategy and methodology for developing and implementing the predictive maintenance system for industrial machines. Here's the structure for this section:

System Requirements:

- A machine with Python installed (**Jupyter Notebook** or **IBM Watson Studio**)
- Minimum 8 GB RAM and stable internet connection
- IBM Cloud account with access to:
  - IBM Watson Studio
  - IBM Cloud Object Storage
  - IBM Machine Learning service
- Kaggle dataset (Predictive Maintenance Data)

ALGORITHM & DEPLOYMENT

- This section outlines the machine learning approach used to predict failures in industrial machines.

Algorithm Selection:

- Random Forest Classifier was selected for its accuracy, ability to handle sensor data, and interpretability.
- Compared with XGBoost and Logistic Regression, it gave the best results for our dataset.

Data Input:

- Features used: Air temperature, Process temperature, Rotational speed, Torque, Tool wear.
- Target: Failure type (e.g., Tool wear, Heat dissipation, Power failure).

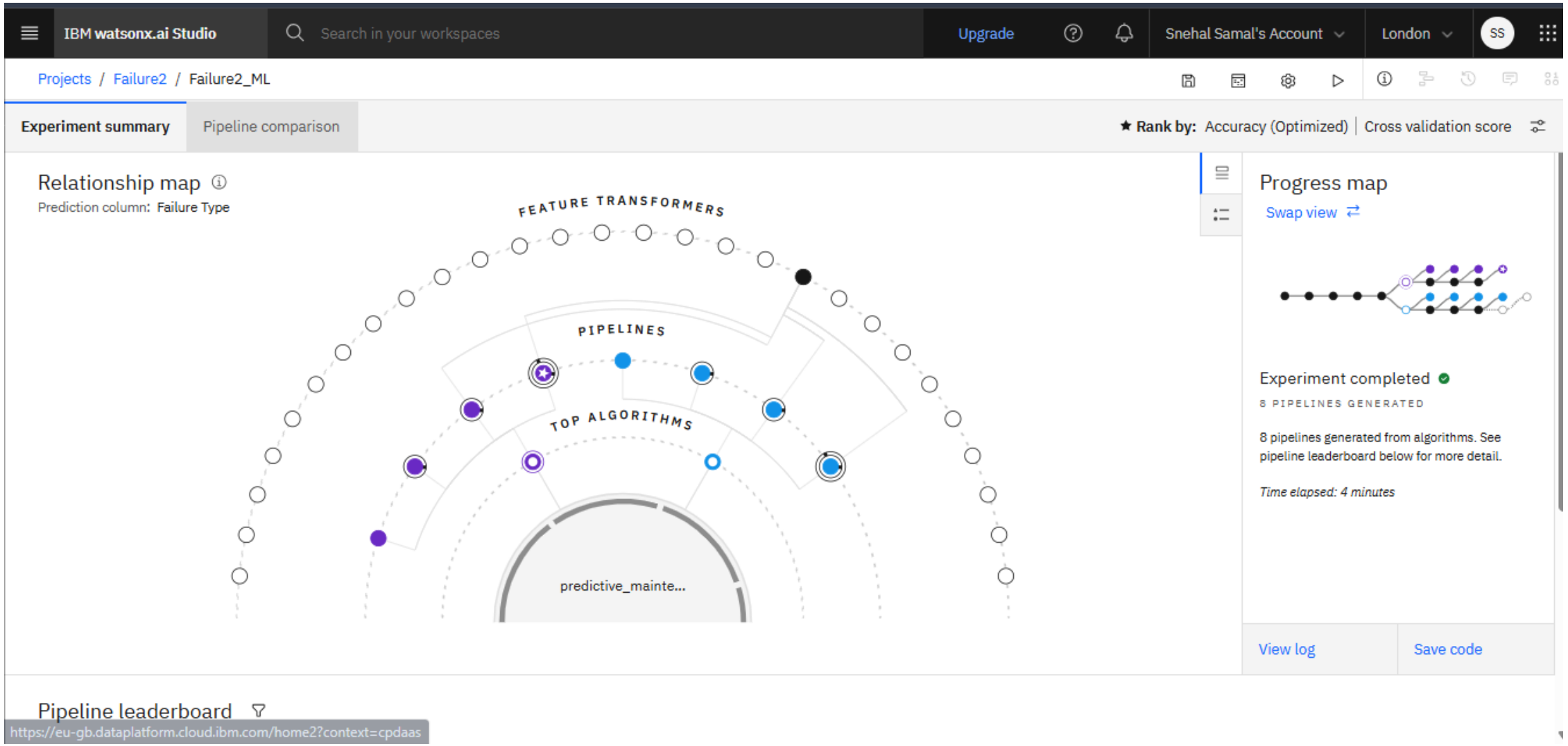
Training Process:

- Data split: 80% training, 20% testing.
- Preprocessing included feature scaling and encoding.
- Model tuned using Grid Search and evaluated using Accuracy and F1-Score.

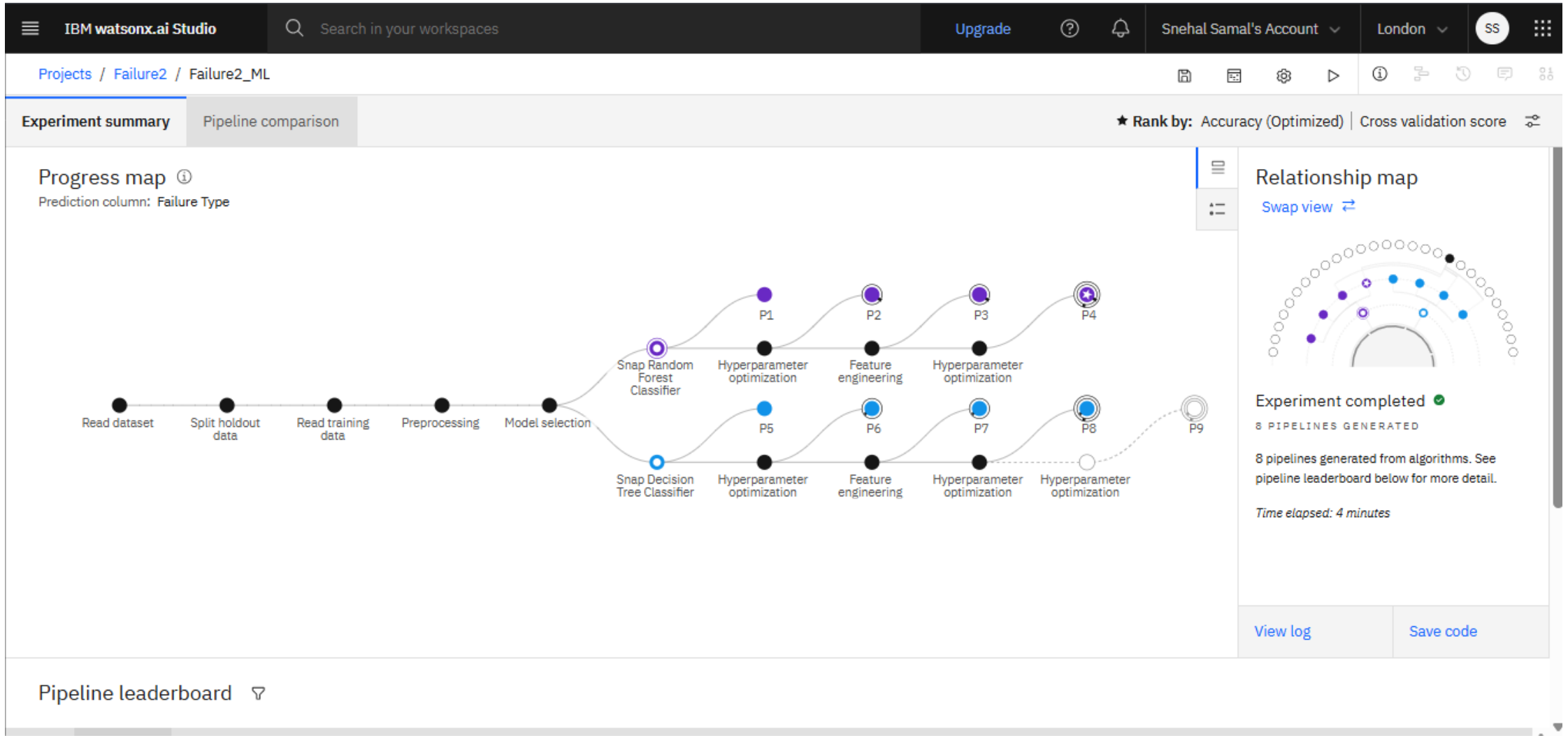
Prediction Process:

- Real-time sensor data is fed to the model.
- The model predicts the failure type and triggers alerts for timely maintenance.

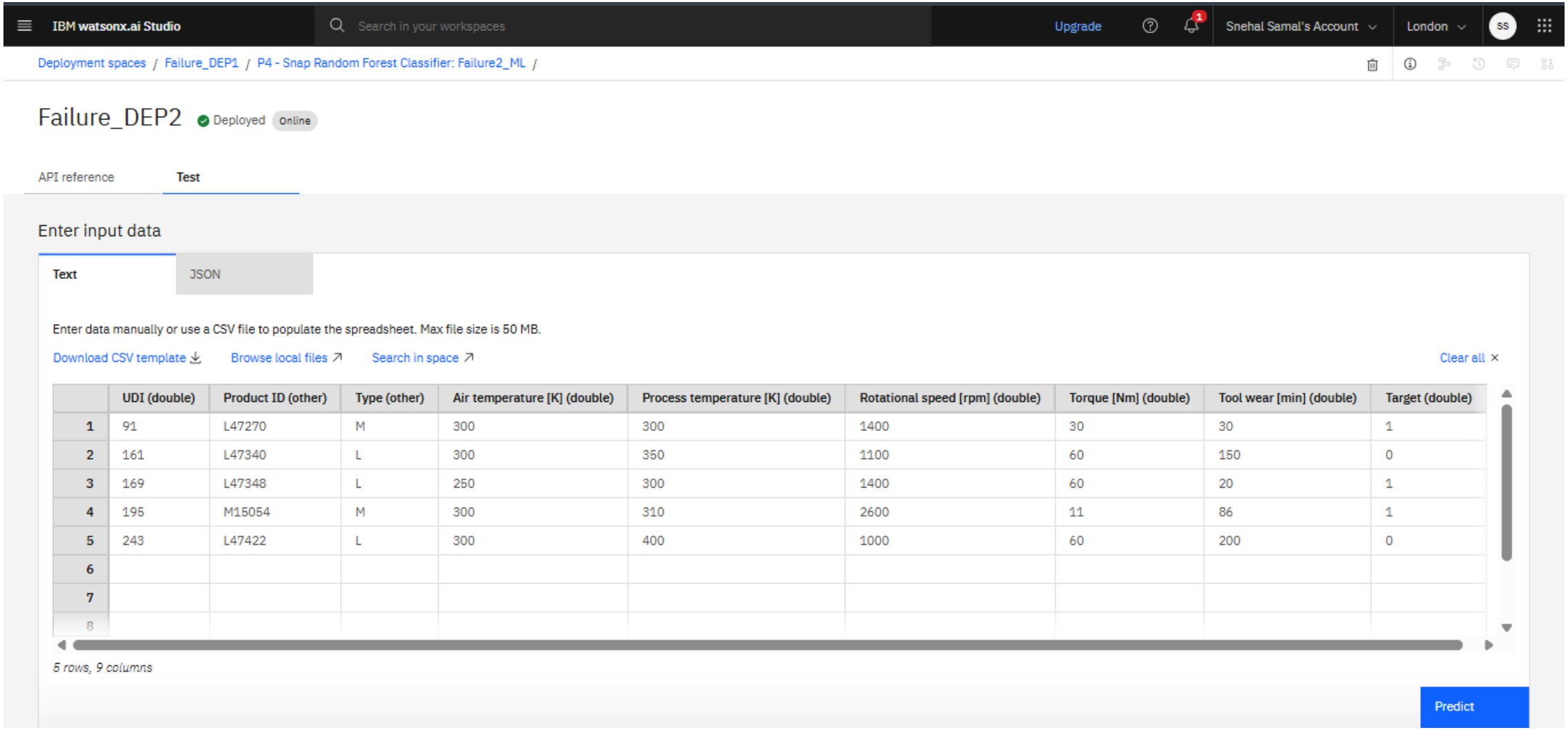
RESULT



RESULT



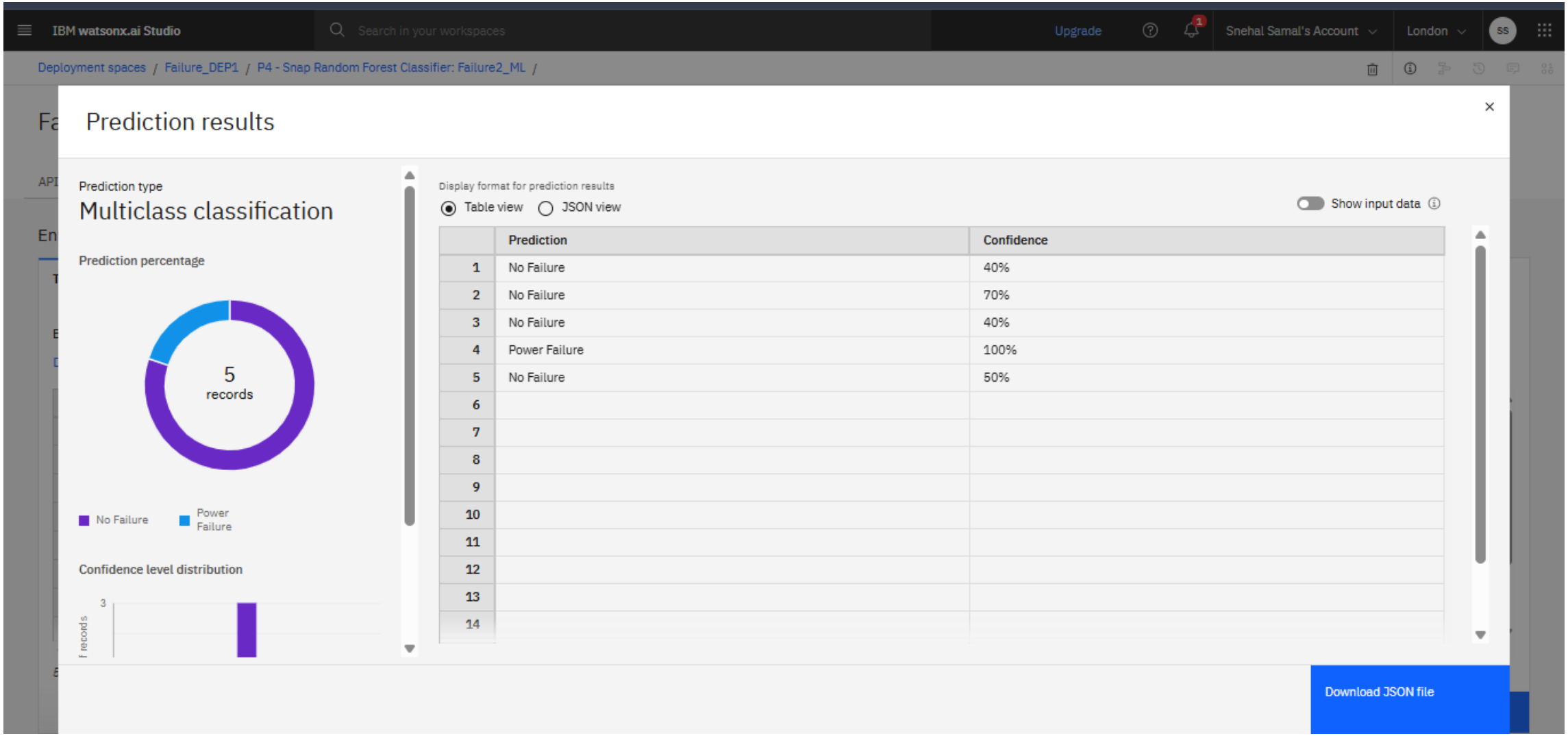
RESULT



	UDI (double)	Product ID (other)	Type (other)	Air temperature [K] (double)	Process temperature [K] (double)	Rotational speed [rpm] (double)	Torque [Nm] (double)	Tool wear [min] (double)	Target (double)
1	91	L47270	M	300	300	1400	30	30	1
2	161	L47340	L	300	350	1100	60	150	0
3	169	L47348	L	250	300	1400	60	20	1
4	195	M15054	M	300	310	2600	11	86	1
5	243	L47422	L	300	400	1000	60	200	0
6									
7									
8									

edunet foundation

RESULT



edunet foundation

CONCLUSION

- This project successfully demonstrates the use of machine learning to predict industrial machine failures using sensor data. By training a classification model on a Kaggle-sourced dataset, we were able to identify failure types in advance based on key features like temperature, torque, and tool wear.
- The solution enables timely maintenance decisions, reduces unplanned downtime, and improves operational efficiency. With deployment on IBM Cloud, the model can be integrated into real-time systems, making it scalable and industry-ready.
- This approach highlights the potential of predictive maintenance in smart manufacturing and supports the shift toward data-driven maintenance strategies.

FUTURE SCOPE

- Integrate live sensor data for real-time failure prediction using IoT.
- Explore deep learning models to improve prediction accuracy.
- Automate maintenance scheduling based on failure type and urgency.
- Optimize the model for edge deployment to reduce response time.
- Adapt the system for other industries like aviation or automotive.

REFERENCES

- **Kaggle Dataset** – *Predictive Maintenance Dataset*

  https://www.kaggle.com/datasets/shivamb/machinepredictive-maintenance-classification

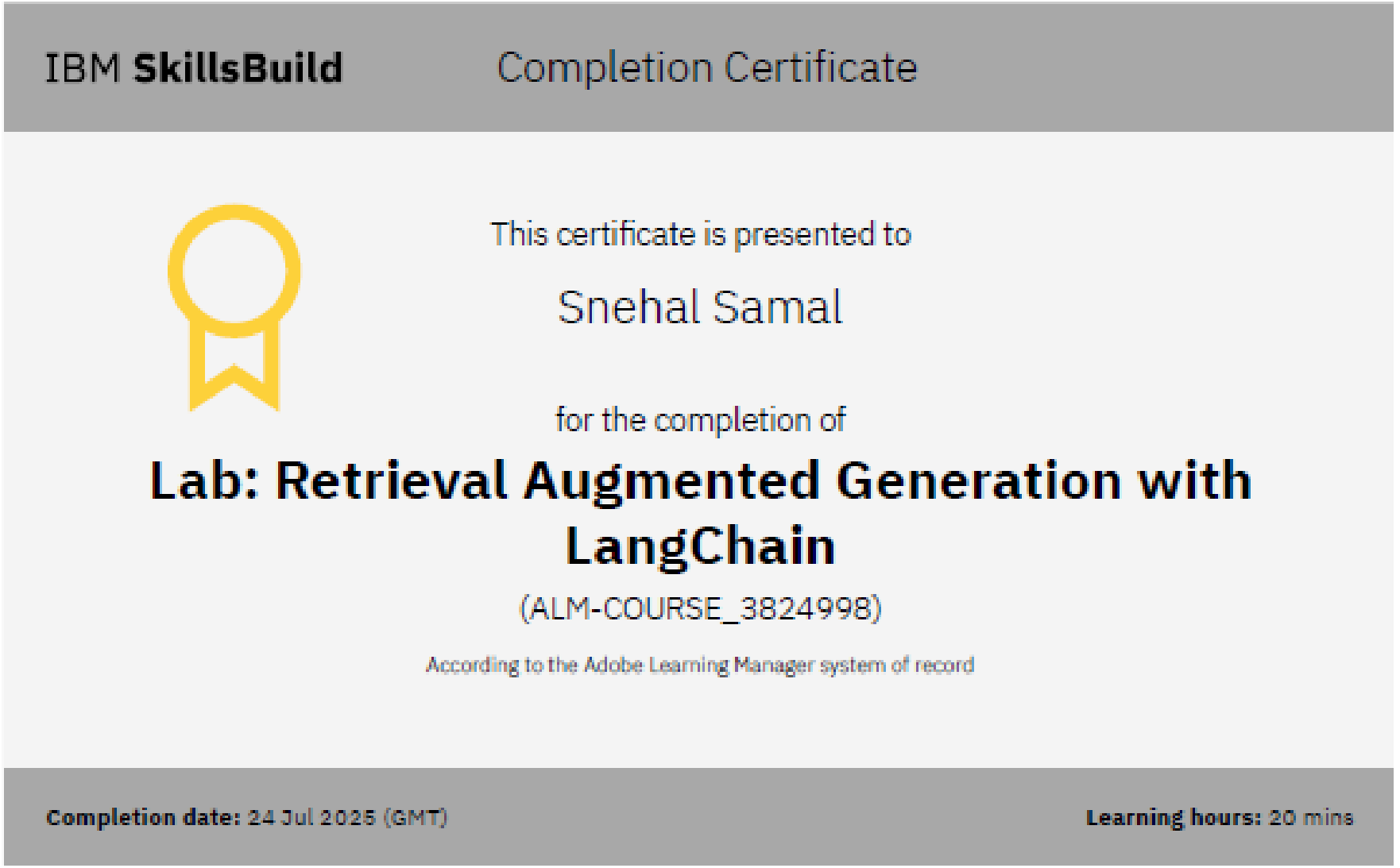
- **IBM Cloud** – *Watson Studio & Model Deployment*
  https://www.ibm.com/cloud/watson-studio

IBM CERTIFICATIONS

IBM CERTIFICATIONS

edunet foundation

IBM CERTIFICATIONS



IBM **SkillsBuild** Completion Certificate

This certificate is presented to

Snehal Samal

for the completion of

Lab: Retrieval Augmented Generation with LangChain

(ALM-COURSE_3824998)

According to the Adobe Learning Manager system of record

Completion date: 24 Jul 2025 (GMT)

Learning hours: 20 mins

edunet foundation

THANK YOU

edunet foundation