CAPSTONE PROJECT

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY

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OUTLINE

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

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PROBLEM STATEMENT

In industrial settings, unexpected machinery failures can lead to significant downtime, safety issues, and financial loss. Predictive maintenance aims to forecast such failures in advance by analyzing sensor data. The goal is to develop a classification model that can predict specific failure types—such as tool wear, heat dissipation failure, or power system failure—based on real-time operational sensor data, enabling proactive maintenance and reduced costs.

PROPOSED SOLUTION

The solution uses a machine learning model to classify types of industrial machinery faults based on sensor data like tool wear, torque, and temperature. It enables early detection of failures such as tool wear or power issues, allowing for timely and proactive maintenance to minimize downtime.

The approach includes:

Data Collection : Uses sensor data from Kaggle's predictive maintenance dataset.

Preprocessing : Cleaned null values, normalized data, handled class imbalance.

Model Training : Trained and selected the best model based on accuracy.

Prediction : Predict type of failures (tool wear, power failure, etc.) before it occurs.

Deployment : Model deployed and evaluated on IBM Watsonx.ai Studio.

SYSTEM APPROACH

The "System Approach" section outlines the overall strategy and methodology for developing and implementing the Predictive Maintenance of Industrial Machinery . Here's a suggested structure for this section:

- System requirements

  IBM Cloud

  IBM Watsonx.ai Studio for model developing and deployment

  IBM Cloud Storage for dataset handling

ALGORITHM & DEPLOYMENT

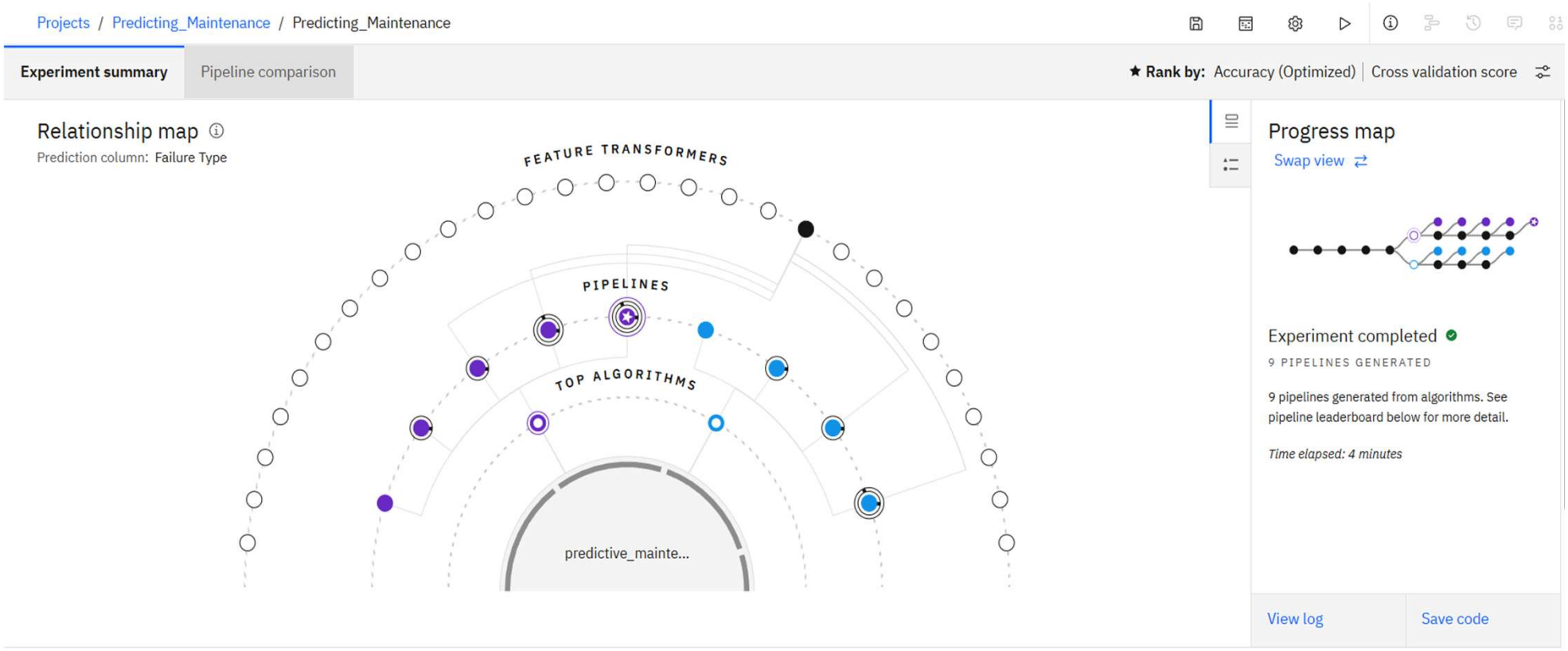
- **Algorithm Selection:**
  Used a classification algorithm suitable for predicting multiple failure types.

- **Data Input:**
  Sensor features like torque, temperature, and tool wear were used.

- **Training Process:**
  Trained on historical data with automatic tuning and model selection.

- **Prediction process:**
  Predicts the type of machine fault based on new sensor data.

RESULT



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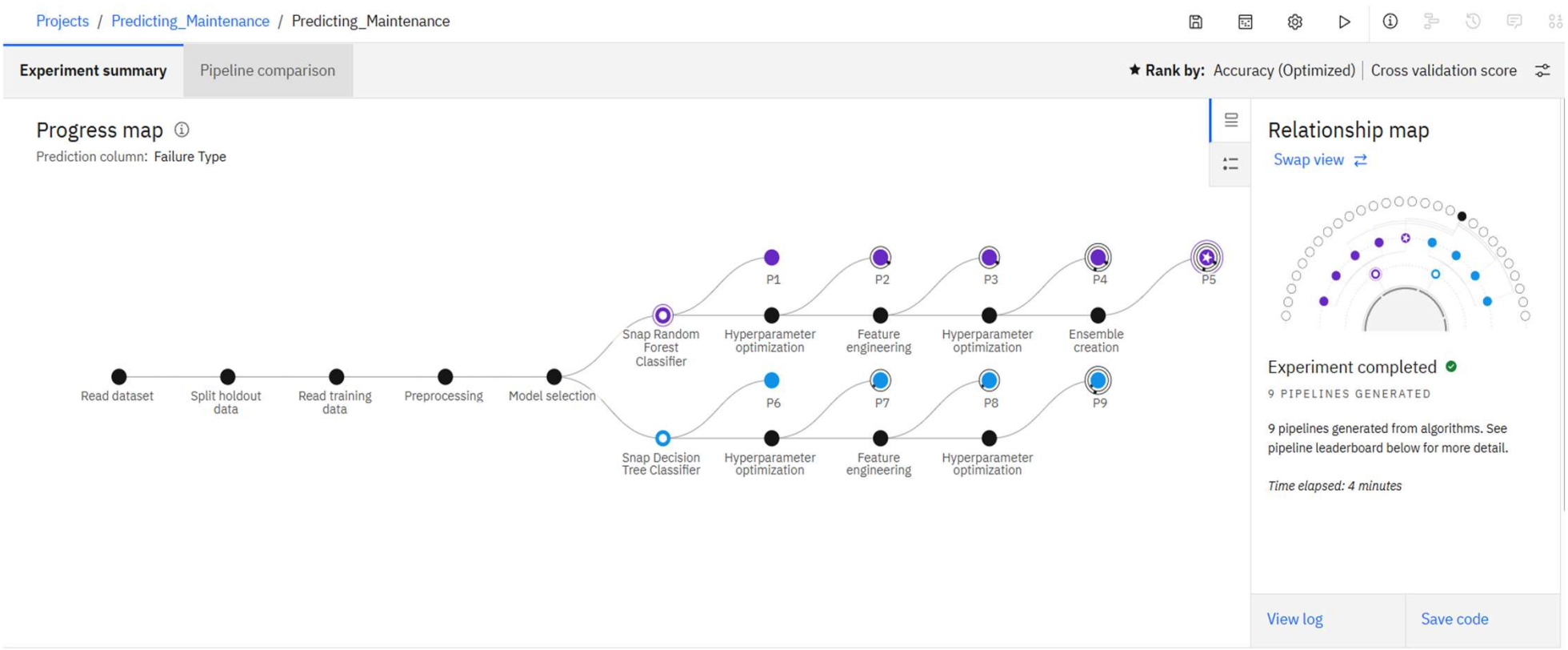
RESULT



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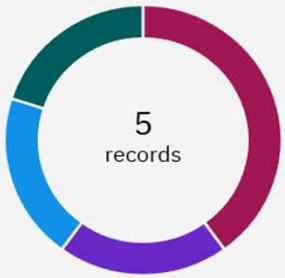
RESULT

Prediction results

Prediction type

Multiclass classification

Prediction percentage



Tool Wear Failure
Overstrain Failure
Power Failure
No Failure

Display format for prediction results

(•) Table view ( ) JSON view

Show input data

	Prediction	Confidence
1	Tool Wear Failure	100%
2	Overstrain Failure	96%
3	Power Failure	100%
4	No Failure	100%
5	No Failure	100%
6		
7		
8		
9		
10		

Download JSON file

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CONCLUSION

- The project successfully developed a machine learning model to predict different types of industrial machinery failures using sensor data. By using IBM Watsonx.ai's automated tools, the entire process—from data preprocessing to model deployment—was completed without coding. The solution enables early failure detection, helping reduce downtime, improve safety, and optimize maintenance operations.

FUTURE SCOPE

- In the future, this predictive maintenance system can be enhanced by integrating real-time sensor data streams, enabling live failure prediction and instant alerts. The model can also be deployed on edge devices for on-site analysis, reducing response time in critical environments. Visualization dashboards using tools like IBM Cognos Analytics can help maintenance teams monitor machine health more effectively. Additionally, incorporating more sensor features such as vibration or pressure data can further improve model accuracy. The solution can also be adapted for broader industrial applications, including manufacturing, automotive, and energy sectors.

REFERENCES

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   Machine Predictive Maintenance Classification Dataset
   https://www.kaggle.com/datasets/shivamb/machine-predictive-maintenance-classification

2. IBM Watsonx.ai Documentation
   https://www.ibm.com/docs/en/watsonx

3. IBM Cloud Lite
   https://www.ibm.com/cloud/free

4. AutoAI Overview – IBM Developer
   https://developer.ibm.com/articles/automated-machine-learning-autoai/

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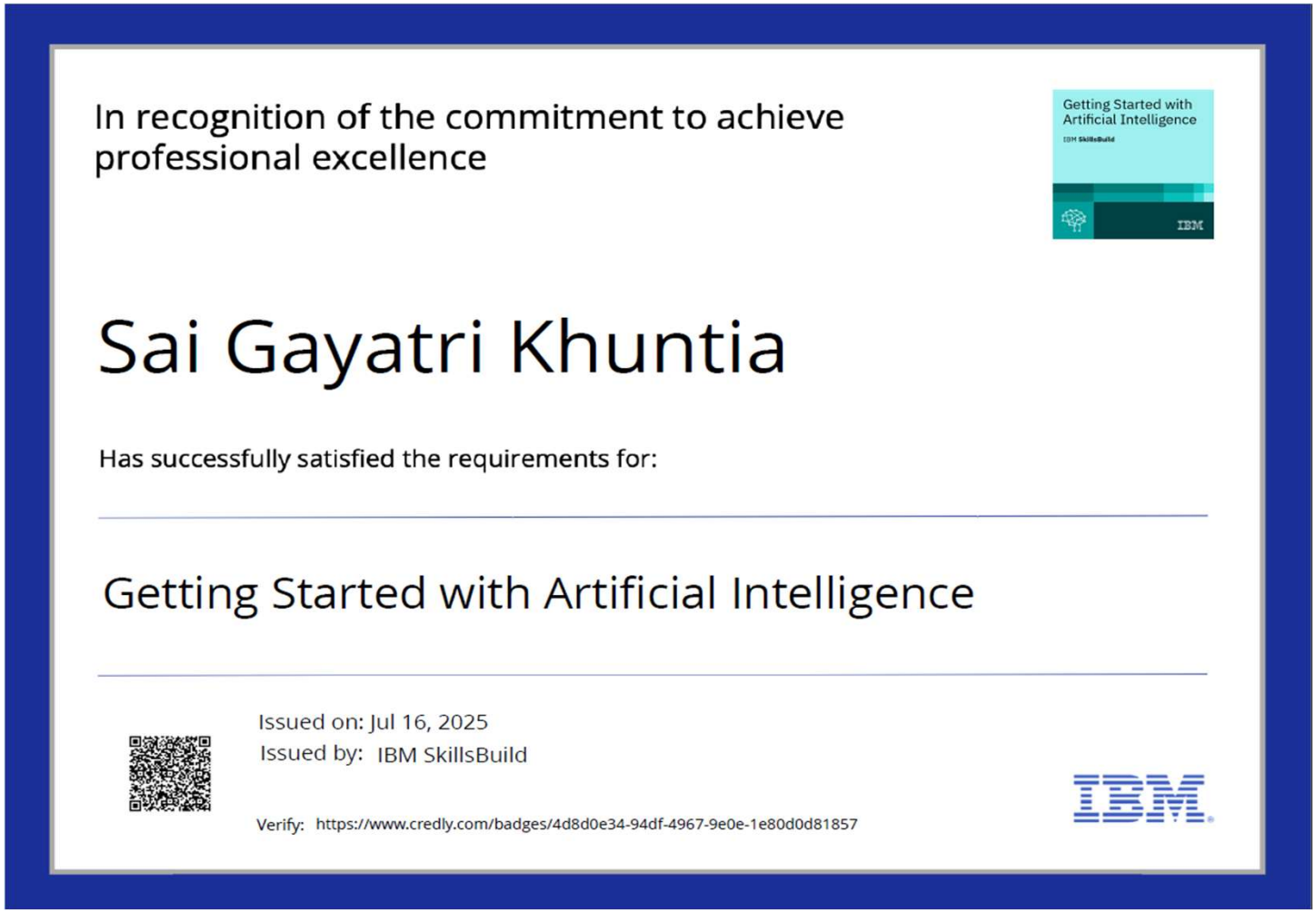

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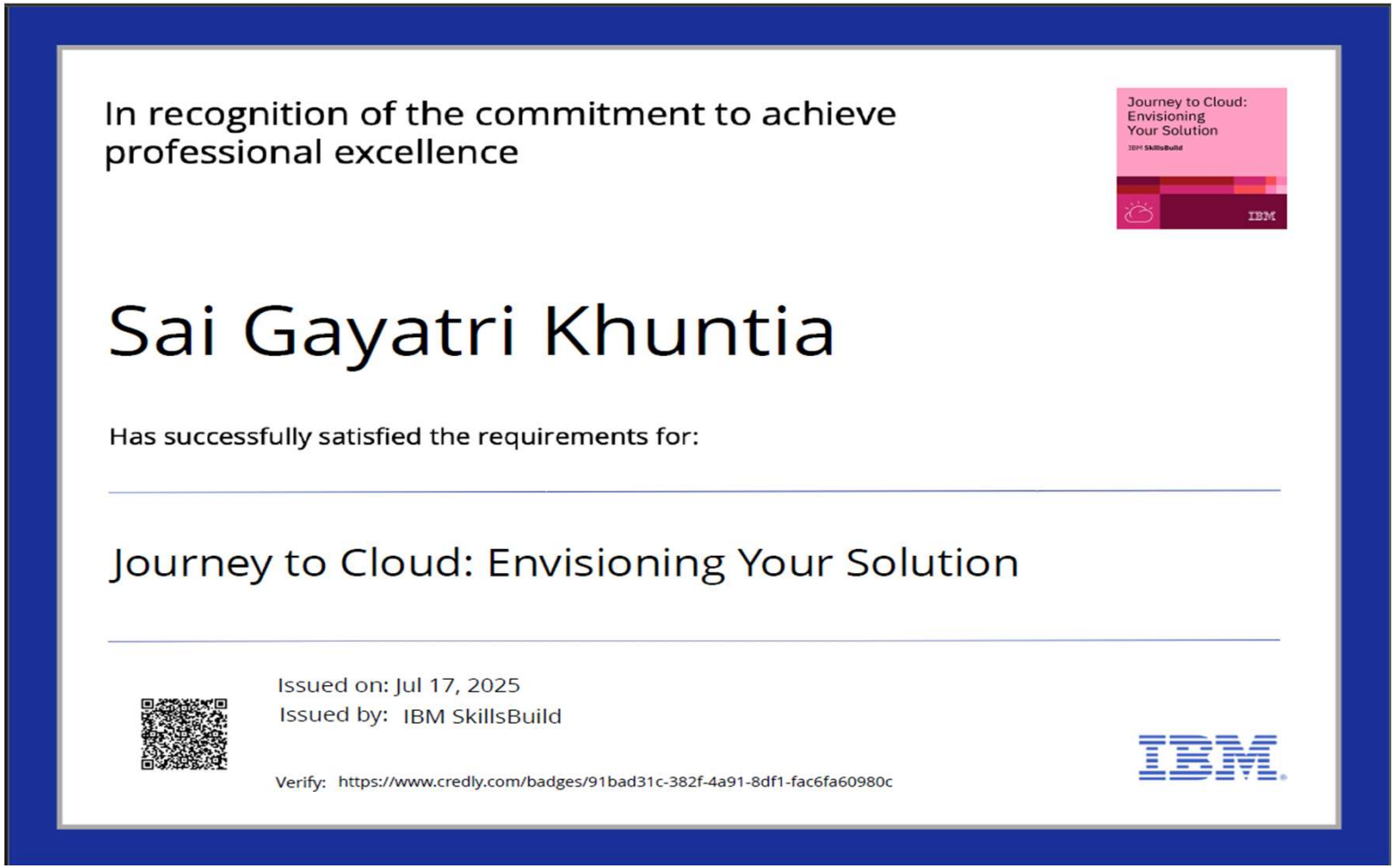

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