CAPSTONE PROJECT

PREDICTIVE MAINTENANCE OF INDUSTRIAL MACHINERY USING MACHINE LEARNING

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OUTLINE

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

PROBLEM STATEMENT

No.39 – Predictive Maintenance of Industrial Machinery

- **The Challenge:** 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

- Developed a machine learning project to address the type of failure in the machines based on the real-time operational data. This will enable proactive maintenance, reducing downtime and operational costs.
- **Key Components:**

- **Data Collection:** Use the Kaggle dataset on Predictive Maintenance of Industrial Machinery.
- **Preprocessing:** The raw sensor data is cleaned ,normalized, and formatted for analysis.
- **Model Development:** Machine learning models such as Random forest classifier ,Decision tree classifier etc.. are trained to identify patterns leading to failure. They are trained using historical failure logs and real-time sensor data.
- **Real-Time Prediction:** The deployed model continuously monitors incoming data and predicts potential failures.
- **Evaluation:** validate the model using precision & Recall, f1 score and Confusion Matrix.

SYSTEM APPROACH

The system follows a modular, end-to-end pipeline that integrates data acquisition, ML model development and cloud based deployment to enable predictive maintenance.

- System requirements:

- IBM Cloud access.
- IBM Watson Studio for developing and training the model.
- IBM Watson Machine Learning for deploying the model.
- IBM cloud object storage for storing training datasets.

ALGORITHM & DEPLOYMENT

- **Algorithm Selection:**

  Random forest classifier.

- **Data Input:**

  Air temperature, Process temperature, Rotational speed ,Torque.

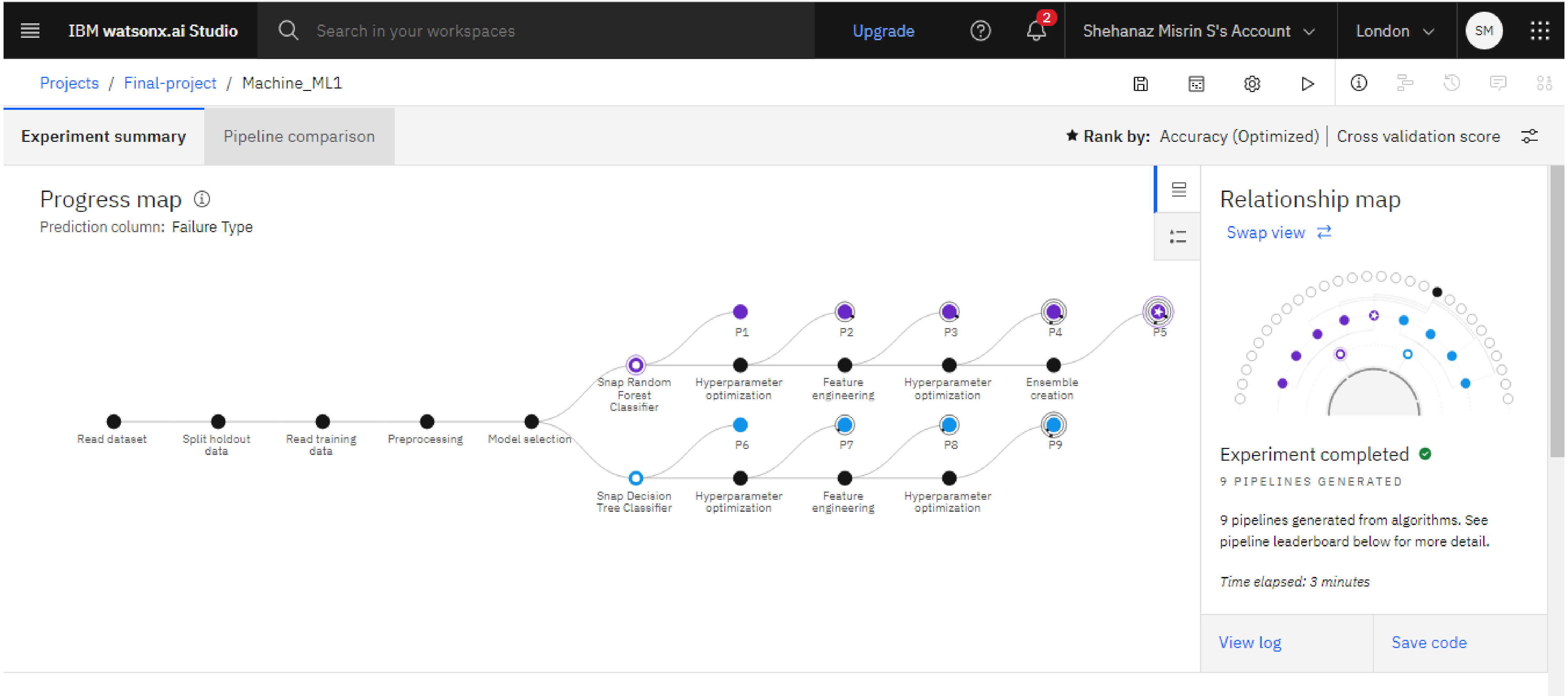
- **Training Process:**

  Clean the dataset, Feature selection, Data splitting, Model Training and Model Evaluation.

- **Prediction Process:**

  Model deployed on IBM Watson Studio with API endpoint for real-time predictions.

RESULT



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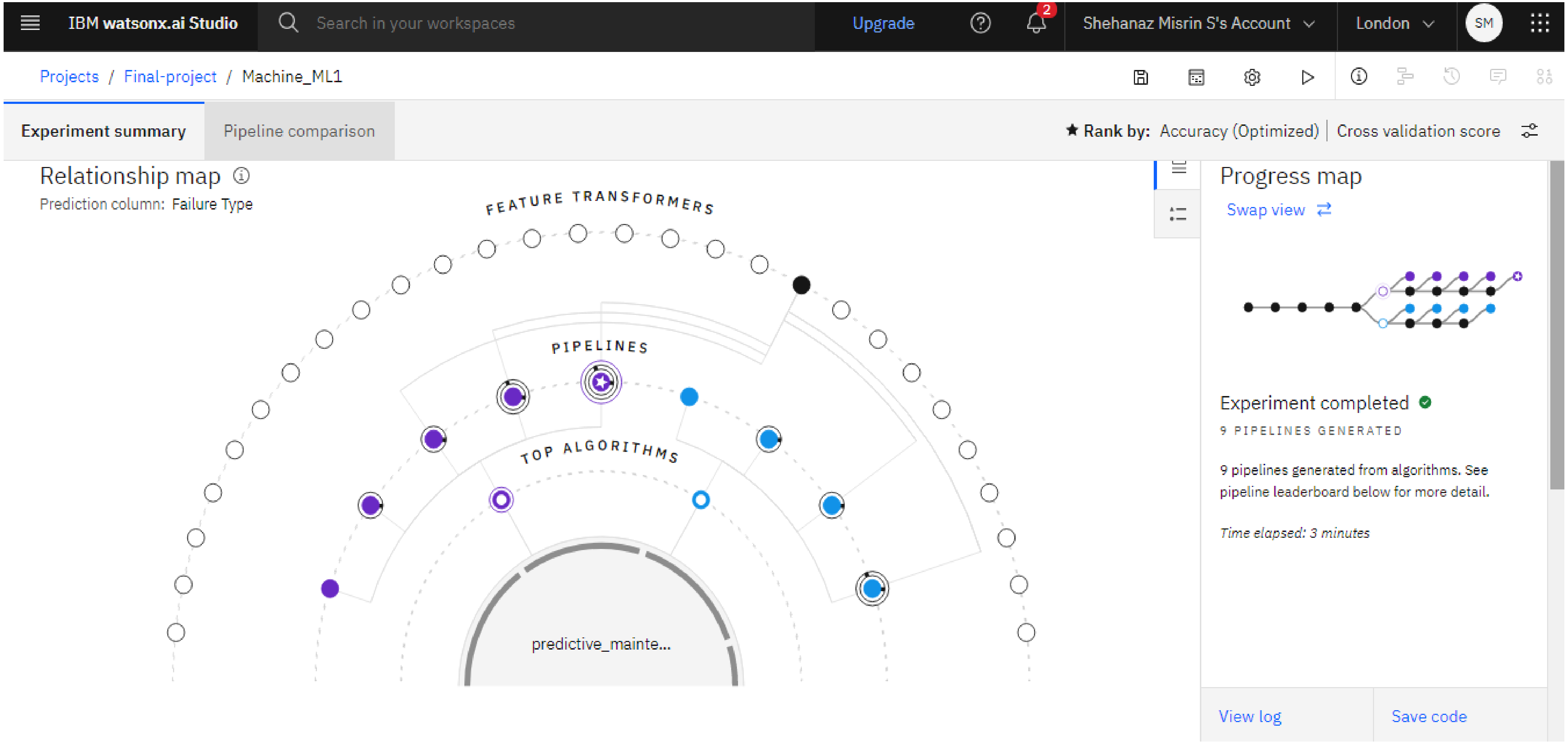
RESULT



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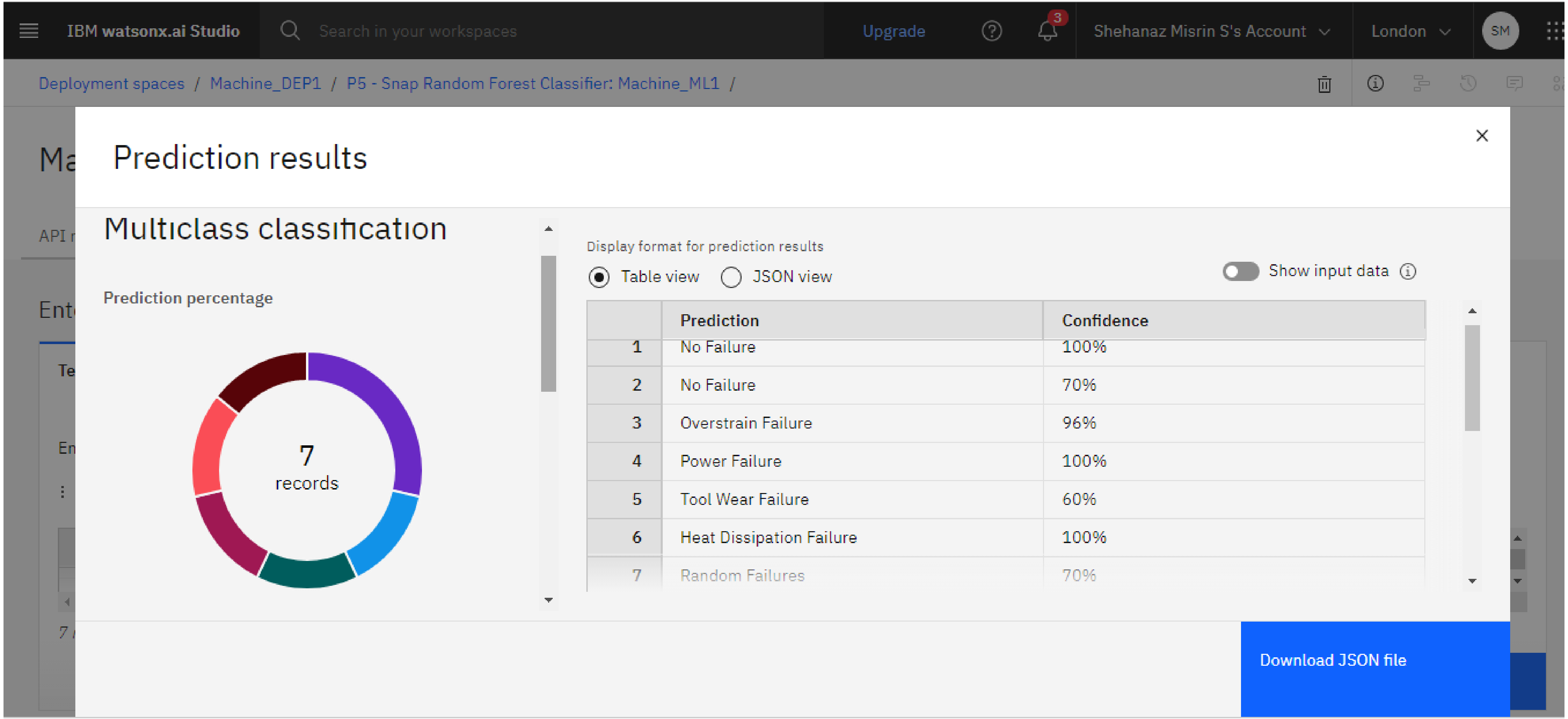
RESULT


IBM watsonx.ai Studio
Search in your workspaces
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London
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Deployment spaces / Machine_DEP1 / P5 - Snap Random Forest Classifier: Machine_ML1 /
Prediction results
Multiclass classification
Prediction percentage
7
records
Display format for prediction results
Table view
JSON view
Show input data
Prediction
Confidence
1 No Failure 100%
2 No Failure 70%
3 Overstrain Failure 96%
4 Power Failure 100%
5 Tool Wear Failure 60%
6 Heat Dissipation Failure 100%
7 Random Failures 70%
Download JSON file

CONCLUSION

- The implementation of a machine learning-based predictive maintenance system significantly enhances the reliability, efficiency, and cost-effectiveness of industrial operations. By leveraging historical and real-time sensor data, the system successfully predicts potential machine failures before they occur, allowing for timely and proactive maintenance decisions.
- This project highlights the practical value of integrating machine learning with cloud technologies in industrial environments. The results confirm that predictive maintenance is not just a theoretical concept but a deployable, impactful solution for smart manufacturing.

FUTURE SCOPE

- Integration with IoT and Edge Computing.
- Support for Multiple Machine Types.
- Advanced Algorithm and Deep Learning .
- Automated Maintenance Scheduling.
- Explainable AI.

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Learning hours: 20 mins

THANK YOU

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