Fault Detection of Industrial Gas Turbine Engines

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Introduction

- This notebook analyzes sensor data from industrial gas turbine engines to detect faults and support predictive maintenance.
- The main goal is to develop machine learning models that can accurately classify failures in gas compressors. This is critical for midstream pipeline operations where turbines drive compression systems.

Literature Review

- SVM and Random Forests effective for rotating machinery.
- Feature engineering: pressure ratios, temperature/vibration analysis.
- Outlier detection: Isolation Forest, DBSCAN.

Dataset Overview and Sources

- Source: Kaggle Gas Turbine Engine Fault Detection Dataset
- 1,386 samples: sensor readings (temperature, pressure, RPM).
- Supervised: Includes labeled operational/faulty states.
- Dataset: https://www.kaggle.com/datasets/ziya07/gas-turbine-engine-fault-detection-dataset

Data Preprocessing Techniques

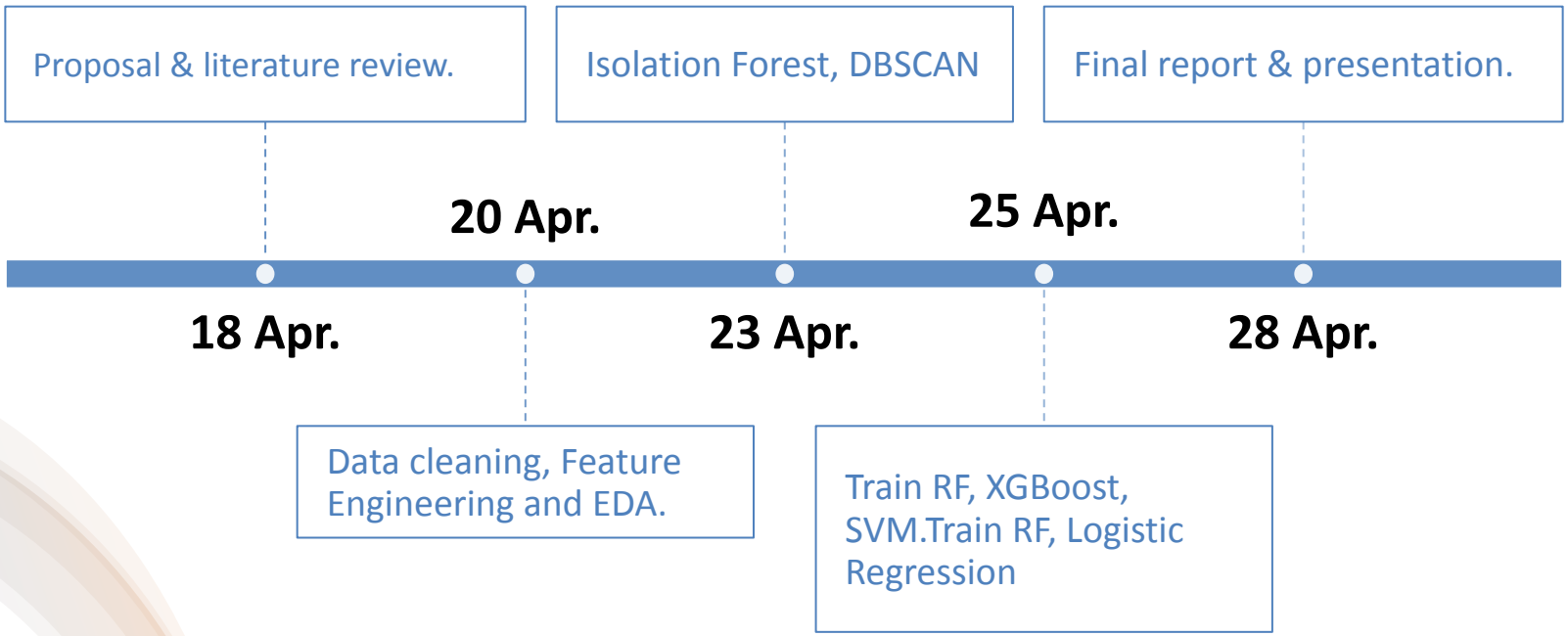
- Feature Scaling using StandardScaler.
- PCA for dimensionality reduction.
- Feature Engineering: ratios, delta metrics.

Modeling Strategies

- **Models Used:** Logistic Regression, Random Forest, XGBoost, SVM.
- **Outlier Detection:** Isolation Forest, DBSCAN.
- Hyperparameter tuning with GridSearchCV.

Evaluation Metrics and Validation

Project Timeline and Milestones



Expected Impact and Applications

- Reduced downtime, optimized maintenance, cost savings.
- Enhanced safety in gas turbine operations.
- Applications: Pipelines, power plants, manufacturing.

Conclusion and Next Steps

- Multiple ML classifiers evaluated.
- PCA reduced dimensionality while preserving variance.
- Outlier detection flagged potential anomalies for review.