UCT Machine Learning Internship

# Project Report: Predicting Remaining Operational Cycles Before Failure – Turbofan Engine

🔹 Company: Uniconverge Technologies (UCT)  
🔹 Domain: Predictive Maintenance / Industrial IoT

## 1. Background

Aircraft turbofan engines operate under varying conditions, and failures can result in catastrophic outcomes. Monitoring engine health and predicting failure in advance is critical for safety and efficiency.

## 2. Problem Statement

To predict the Remaining Useful Life (RUL) of each turbofan engine using historical sensor data from NASA’s CMAPSS dataset (FD001 subset). This supports condition-based maintenance strategies.

## 3. Dataset Overview

- Source: NASA CMAPSS  
- Subset: FD001  
- Data:  
 - 100 training engines, 100 test engines  
 - 26 columns (unit, time, settings, sensors)  
 - RUL values provided for the test set

## 4. Design & Implementation

- Preprocessing:  
 - Remove empty columns  
 - Calculate RUL as difference from max cycle  
- Feature Selection:  
 - Dropped low-variance sensors  
- Model: Random Forest Regressor  
- Evaluation Metrics: RMSE, MAE, R²  
- Tools: Google Colab, Python, pandas, matplotlib, scikit-learn

## 5. Results

| Metric | Value |  
|--------|-------|  
| RMSE | 34.09 |  
| MAE | 24.73 |  
| R² | 00.33 |

## 6. Learnings & Takeaways

- Gained hands-on experience in time-series data preparation  
- Understood sensor relevance in condition monitoring  
- Applied regression models to real industrial problems  
- Improved confidence in predictive maintenance solutions

## 7. Conclusion

This project provided valuable insights into health monitoring of complex mechanical systems. The learned techniques are applicable across aerospace, automotive, and manufacturing domains.