

Weekly Progress Report

Name: Abhishek Kumar Gupta
Domain: Predictive Maintenance using ML
Date of submission: 20/08/25

Week Ending: 03

I. Overview

Week 3 focused on **completing model building, running evaluations, and identifying the best-fit models** across the three predictive maintenance projects. Work emphasized refining architectures, improving generalization, and preparing for explainability and deployment.

II. Achievements

◆ Project 6 – Turbofan Engine RUL Prediction

- Finalized baseline LSTM and GRU implementations.
- Implemented a hybrid CNN-LSTM model for better feature extraction.
- Added regularization methods (dropout, early stopping) to address overfitting.
- Built visualizations for predicted vs actual RUL trends.

◆ Project 7 – Bearing Lifetime Prediction

- Completed baseline machine learning models (Random Forest, Gradient Boosting).
- Implemented advanced boosting models (XGBoost, LightGBM) for improved results.
- Applied cross-validation to validate consistency.
- Visualized bearing degradation and health state transitions.

◆ Project 8 – Gearbox Fault Diagnosis

- Completed CNN-based classification pipeline using FFT and STFT features.
- Explored transfer learning with deep CNNs for enhanced performance.
- Built confusion matrix and ROC curve visualizations for evaluation.

◆ Python & ML Learning Enhancement

- Practiced ensemble modeling techniques.
- Learned SHAP explainability for ML/DL models.
- Enhanced skills in PyTorch for deep learning workflows.

III. Challenges

- Managing computational requirements for deep learning experiments.
- Avoiding overfitting during training.
- Balancing interpretability with performance when selecting models.

IV. Lessons Learned

- Hybrid architectures can outperform single models in time-series prediction.
- Boosting frameworks are strong for structured sensor data.
- Transfer learning accelerates training for vibration-based classification.
- Visualization and explainability make models more practical for industry.

V. Next Week's Goals (Week 4)

- Conduct explainability analysis using SHAP.
- Explore ensemble stacking for RUL prediction.
- Start dashboard integration with Plotly/Dash/Streamlit.
- Prepare initial draft of consolidated project report.

VI. Additional Comments

This week marked the **completion of core model building and evaluations**. Promising models have been identified for each project, and the focus will now shift to **explainability, ensemble methods, and interactive result presentation**.