

## Weekly Progress Report

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Domain: Predictive Maintenance / Industrial Manufacturing

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### I. Overview:

In Week 3, the focus was on optimizing model performance and enhancing reliability. Significant improvements were made through hyperparameter tuning and extended dataset usage. The mining process model was further strengthened with better feature engineering and interpretability analysis.

### II. Achievements:

#### 1. Turbofan Engine RUL Prediction

- Tuned LSTM model using RandomizedSearchCV and KerasTuner.
- Added attention layer to improve long-range dependency learning.
- Trained and validated the model on FD002 and FD003 datasets.
- Achieved improved RMSE and plotted performance comparison across FD subsets.
- Developed scripts for generating predictive maintenance alerts.

#### 2. Mining Process Quality Prediction

- Introduced lag and rolling window features for capturing temporal behavior.
- Handled multicollinearity through VIF and feature selection techniques.
- Re-trained XGBoost with tuned hyperparameters using Optuna.
- Integrated SHAP summary plots and dependence plots for business explainability.

### III. Challenges:

#### 1. Computational Resources:

- Training on multiple FD sets increased GPU usage and training time.
- Needed optimization in batch size and model saving checkpoints.

#### 2. Time-Dependent Feature Drift:

- In the mining dataset, temporal shifts led to drops in performance requiring retraining with updated samples.

#### IV. Lessons Learned:

- Effective application of KerasTuner and Optuna for deep learning and tree-based models.
- Practical skills in using attention mechanisms in LSTM models.
- Advanced feature engineering for time series with lag and trend variables.
- Importance of continual evaluation to address drift and maintain performance.

#### V. Next Week's Goals:

##### 1. Turbofan Engine Project

- Finalize best performing model and prepare it for deployment.
- Build dashboards or logging interface for maintenance predictions.

##### 2. Mining Process Project

- Deploy model for batch inference simulation using stream-like input.
- Prepare final documentation and create summary insights report.

#### VI. Additional Comments:

Week 3 was focused on strengthening model performance and setting up for deployment. The work has transitioned from prototyping to near-final implementation, paving the way for final integration and insights generation in Week 4.