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IITD-AIA Foundation of Smart Manufacturing

Subject: **Weekly Progress Report**

**INTP23-ML-05:** Equipment Failure Prediction for Predictive Maintenance

What is happening this week:

- Deep diving into Deep Learning
- Going through some lectures
- Webinars online
- Research papers
- Reference materials
- Books

My understanding about Project:

When it comes to dealing with machines that require periodic maintenance, there are generally three possible outcomes:

1. maintaining machine too frequently, i.e., you are, maybe, wasting resources providing unnecessary maintenance
2. not maintaining machine frequently enough
3. maintaining a machine when it needs maintenance

Obviously, last one is the better alternative of the three.

Predictive Maintenance Systems will help us to monitor for future system failures and schedule maintenance in advance.

Predictive maintenance can tell us, based on data, when a machine requires maintenance. An effective predictive maintenance program will minimize under and over-maintaining the machine.

We can build a machine learning model to do predictive maintenance of machine. We have to train model to predict future failure by analyzing historical sensor data,

maintenance records, and operational parameters of industrial equipment, the model will identify patterns and indicator that precedes equipment failure. This project aims to enhance maintenance strategies, reduce downtime, and optimize the reliability and performance of critical machinery.

## Week 1

5<sup>th</sup> June:

Project Allotted: Equipment Failure Prediction for Predictive Maintenance

- Going through video lectures and online webinars
- Brushing up the basics of machine learning to implement it more effectively in real-life scenarios
- Understanding the project

6<sup>th</sup> June:

Deep Learning

- Introduction to deep learning
- Deep learning can be used for supervised, unsupervised as well as reinforcement machine learning. But learn how deep learning algorithm work differently than machine learning algorithm
- Which will be best to implement according to data scientist
- Deep Learning Architecture:
  - i) Feedforward neural networks
  - ii) Convolutional neural networks (CNNs)
  - iii) Recurrent neural networks (RNNs).

7<sup>th</sup> June:

Searching for resources across the internet.

- Gone through deep learning resources
- Learnt about Autoencoders
- Choosing a dataset to experiment till I got the real dataset to understand the project effectively: **NASA Turbofan Jet Engine Dataset**

8<sup>th</sup> June:

Learning Deep Learning and Neural Networks as these are must to understand to practically implement the model for Predictive Maintenance

- Revising Deep Learning
- Referring to research papers. It helped me to understand better about the project.
- Implement some Machine Learning Algorithm Logistic regression, Random Forest on the chosen dataset.
- Random Forest was not working so gone through its documentation to understand how it works and tried to resolve the error

9<sup>th</sup> June:

- Experimented again with dataset to visualize and understand more about data
- Implement Random Forest model on NASA Turbofan Jet Engine dataset.
- Gone through Pytorch LSTM Documentation
- Tried to understand implementation of Prediction of remaining useful life using Pytorch LSTM
- Learning Deep Learning from Provided resources.

10<sup>th</sup> June:

Learnt about deep learning techniques for Predictive Maintenance:

- Autoencoders
- Recurrent Neural Network
- LSTM network (Read again about LSTM to understand it)

Learnt about how to deal with imbalance dataset (Upsampling, SMOTE, ADASYN)

11<sup>th</sup> June:

Machine Learning Technique for Predictive Maintenance:

It Can be formulated in 2 ways:

- Classification Approach: predicts whether there is a possibility of failure in next n-steps.
- Regression Approach: predicts how much time is left before the next failure (Remaining Useful Life).

Read about them.

How to proceed with these approaches (on the chosen dataset)

Searched for more reference material

Revised Deep Learning and ML topics (Random Forest, RNN)

### **Reference:**

- 1) [machine\\_failure/Machine Learning for Equipment Maintenance - 2022.ipynb at master · shadgriffin/machine\\_failure · GitHub](#)
- 2) <https://www.infoq.com/articles/machine-learning-techniques-predictive-maintenance/>
- 3) [MIT 6.S191: Introduction to Deep Learning - YouTube](#)