**Predictive Maintenance System for Industrial Machines**

**Project Overview:** Developed and deployed a predictive maintenance system using the AI4I 2020 Predictive Maintenance Dataset. The project involved building an end-to-end machine learning pipeline to predict machine failures, ensuring timely maintenance and reducing downtime.

**Key Responsibilities:**

* **Data Preprocessing and Feature Engineering:**
  + Conducted exploratory data analysis to understand the dataset and identify key features.
  + Handled missing values and performed data cleaning to prepare the dataset for modeling.
  + Converted categorical variables to numerical values using one-hot encoding.
  + Scaled continuous features using StandardScaler to normalize the data.
  + Addressed class imbalance using Synthetic Minority Over-sampling Technique (SMOTE) to improve model performance.
* **Model Training and Evaluation:**
  + Split the dataset into training and test sets to evaluate model performance.
  + Trained a Random Forest Classifier to predict machine failures, leveraging its robustness and interpretability.
  + Evaluated the model using metrics such as accuracy, precision, recall, and F1-score to ensure reliable predictions.
* **Model Deployment:**
  + Implemented a Flask web application to serve the trained model as a web service.
  + Designed a user-friendly HTML interface for inputting machine data and receiving predictions.
  + Deployed the Flask application, enabling real-time predictions for machine maintenance.
* **Tools and Technologies:**
  + **Programming Languages:** Python
  + **Libraries and Frameworks:** scikit-learn, pandas, streamlit, imbalanced-learn, joblib
  + **Development Tools:** Jupyter Notebook, Git, Virtualenv
  + **Data Processing:** One-hot encoding, StandardScaler, SMOTE
  + **Modeling Techniques:** Random Forest Classifier, Train-Test Split, Model Evaluation Metrics

**Project Impact:**

* Successfully reduced the downtime of industrial machines by predicting potential failures in advance.
* Improved maintenance scheduling and resource allocation, leading to cost savings and enhanced operational efficiency.