**Step 1: Data Preprocessing**

1. Load the dataset (predictive\_maintenance.csv).
2. Handle missing values (if any).
3. Convert categorical variables (productID, Product Type) into numerical values.
4. Normalize numerical features (air temp, process temp, rotational speed, etc.).
5. Split dataset into features (X) and targets (y1: binary failure prediction, y2: failure type classification).
6. Perform train-test split.

**Step 2: Exploratory Data Analysis (EDA)**

1. Check dataset distributions (histograms, box plots).
2. Analyze correlation among features.
3. Identify class imbalances.

**Step 3: Model Selection & Training**

1. Choose a binary classification model for Machine Failure prediction (e.g., Logistic Regression, Random Forest, or Neural Network).
2. Choose a multi-class classification model for Failure Type prediction (e.g., Decision Trees, XGBoost, or Neural Network).
3. Train both models separately.
4. Use hyperparameter tuning (GridSearchCV/RandomizedSearchCV).

**Step 4: Model Evaluation**

1. Evaluate performance using accuracy, precision, recall, F1-score, and confusion matrix.
2. Address class imbalance using techniques like SMOTE (if needed).

**Step 5: Deployment**

1. Save the trained models.
2. Develop an API (Flask/FastAPI) to serve predictions.
3. Build a simple front-end dashboard (optional).