Welcome to Home

🛠️ Predictive Maintenance Dashboard

Anticipating Failures Before They Happen

This project explores machine learning approaches for **predicting industrial machine failures** using a synthetic dataset.
The goal is to:

- **Predict if a machine will fail** (binary classification)
- **Identify the cause of failure** (multiclass classification)

This can help reduce downtime, improve safety, and optimize maintenance schedules.

📦 Dataset Overview

Click to view dataset structure and features

The dataset simulates real-world manufacturing conditions with **10,000 data points** and **14 features**.
It includes sensor readings, operational settings, and failure indicators.

🔧 Features

Feature	Description
UID	Unique identifier (1 to 10,000).
Product ID	Product quality variant (L: low, 50%; M: medium, 30%; H: high, 20%) with serial number.
Air Temperature [K]	Random walk around 300 K (σ = 2 K).
Process Temperature [K]	Air temp + 10 K + small variation (σ = 1 K).
Rotational Speed [rpm]	Generated from power with noise.
Torque [Nm]	Normally distributed around 40 Nm (σ = 10), clipped to non-negative.
Tool Wear [min]	Indicates usage time; varies by quality level.
Machine Failure	Target label: 1 if any failure occurred, else 0.

⚠️ Failure Modes

Click to view failure conditions

A machine failure (label `1`) occurs if **any** of the following independent conditions are met:

Failure Mode	Condition	Occurrences
Tool Wear Failure (TWF)	Tool wear exceeds 200–240 mins.	120
Heat Dissipation Failure (HDF)	Air-process temp difference < 8.6 K and speed < 1380 rpm.	115
Power Failure (PWF)	Power (Torque × Speed in rad/s) < 3500 W or > 9000 W.	95
Overstrain Failure (OSF)	Wear × Torque > threshold (varies by quality level).	98
Random Failure (RNF)	Random 0.1% probability.	5

> **Note:** While the `Machine Failure` label is binary, the exact failure mode is also available as a multiclass label for root cause classification.

🔍 Use the sidebar to explore data, train models, and view metrics.