

Project Title: IoT Predictive Maintenance Engine (Time-Series Classification)

Dataset: NASA Turbofan Engine Degradation Dataset (C-MAPSS)

The NASA Turbofan Engine Degradation Simulation Dataset (also known as C-MAPSS) is a synthetic, run-to-failure time-series dataset developed by NASA for predictive maintenance and remaining useful life (RUL) modeling.

Dataset Entity	Manufacturing Analogy
Turbofan engine	Robotic arm / Machine
Engine cycle	Operating hour
Sensor readings	Vibration, temperature, pressure
Failure point	Machine breakdown
RUL	Time left before failure

>>Files in the Downloaded Folder

1.Training Files:

- Contain full run-to-failure data
- Each engine runs until failure
- Used to train models

2.Test Files:

- Engines do NOT reach failure
- Used for model evaluation
- Corresponding RUL provided separately

3.RUL Files

- Each value = Remaining cycles after last test cycle
- Used to calculate true RUL for test engines

In this Project we will use Dataset Variant-FD001 (single condition, single fault)

Data Structure: Each row represents: One engine at one operating cycle

Total Columns: 26

Column Type	Count
Engine ID	1
Cycle number	1
Operational settings	3
Sensor measurements	21

Column Description

- Identification Columns

Column	Description
engine_id	Unique engine identifier
cycle	Time step / operating hour

- Operational Settings

Column	Meaning
op_setting_1	Environmental / operating condition
op_setting_2	Environmental / operating condition
op_setting_3	Environmental / operating condition

- Sensor Measurements

Sensor Type	Example Meaning
sensor_1	Fan inlet temperature
sensor_2	Pressure
sensor_3	Rotational speed
sensor_4	Fuel flow
sensor_7	Vibration-related
sensor_11	Temperature
sensor_15	Mechanical efficiency

Not all sensors degrade — some are constant or noisy.

Time-Series Nature

- Each engine has different lifespan
- Sensor readings show:
 - Stable behavior initially
 - Gradual degradation
 - Rapid failure close to end

Label Availability

- The dataset does NOT contain: Failure flag or Binary classification label
- What Is Provided:
 - Run-to-failure cycles (training)
 - Remaining Useful Life (RUL) for test set

Why this is ideal?

- Designed exactly for predictive maintenance

- Contains time-series sensor readings
- Includes failure labels

What it contains?

- Multiple engines (similar to robotic arms)
- Sensor readings over time
- Engine gradually degrades until failure
- Can be converted to: Failure in next 24 hours → Yes/No