



DBG
M

F1LLM

Automotive LLM Model

F1LLM



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OBJECTIVES

An AI solution for precise **POST-SESSION ANALYSIS** to support telemetrists and race engineers

A Large Language Model (LLM) that efficiently processes telemetry data for **RAPID INSIGHTS**

TIME-SAVING support for telemetrists with **EFFICIENT** data analysis





VALUE PROPOSITION

*Help race engineers **SAVING TIME** through telemetry data analysis by **DETECTING** anomalies and **CLASSIFYING** failures*



9 INDUSTRY, INNOVATION
AND INFRASTRUCTURE



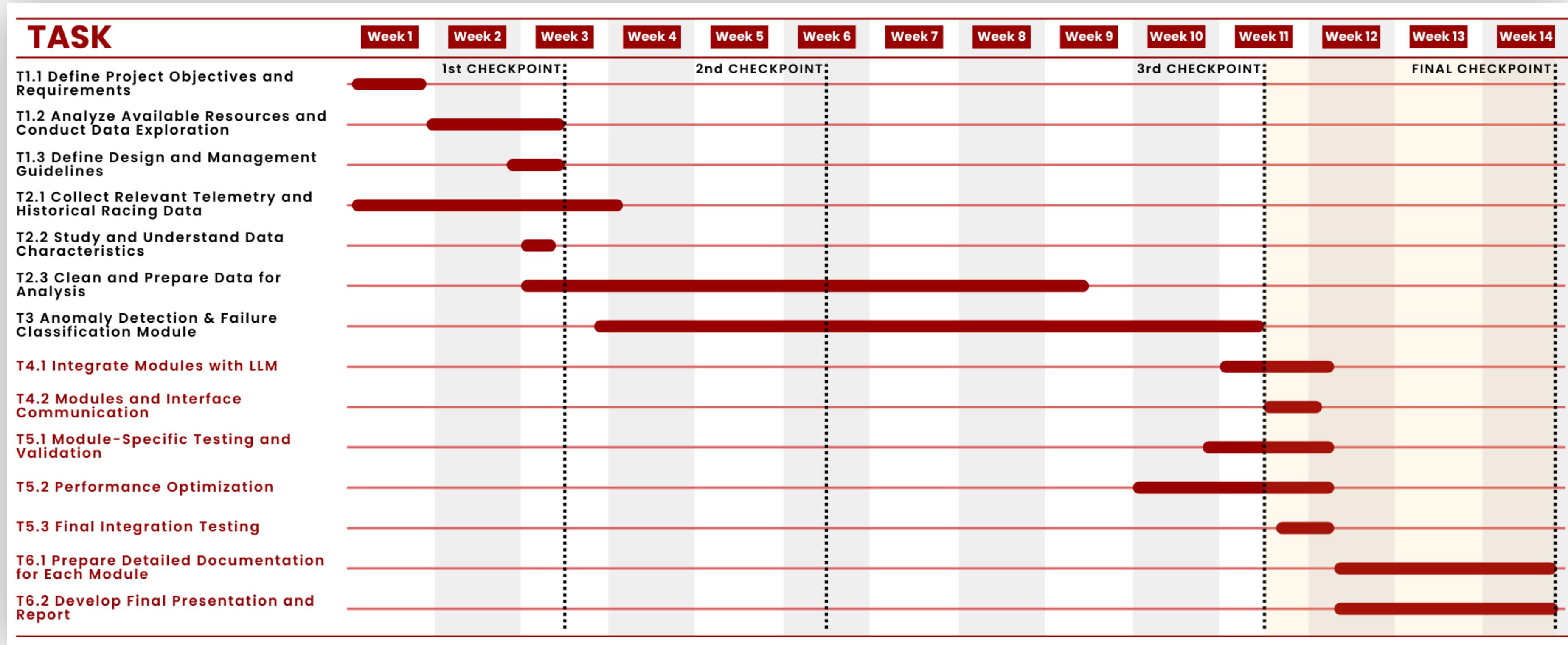
Our project aligns with **SDG 9** by leveraging advanced AI to drive innovation, improve efficiency, and support **SUSTAINABLE** practices in modernizing motorsport performance and infrastructure.





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GANNT





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TARGET AUDIENCE



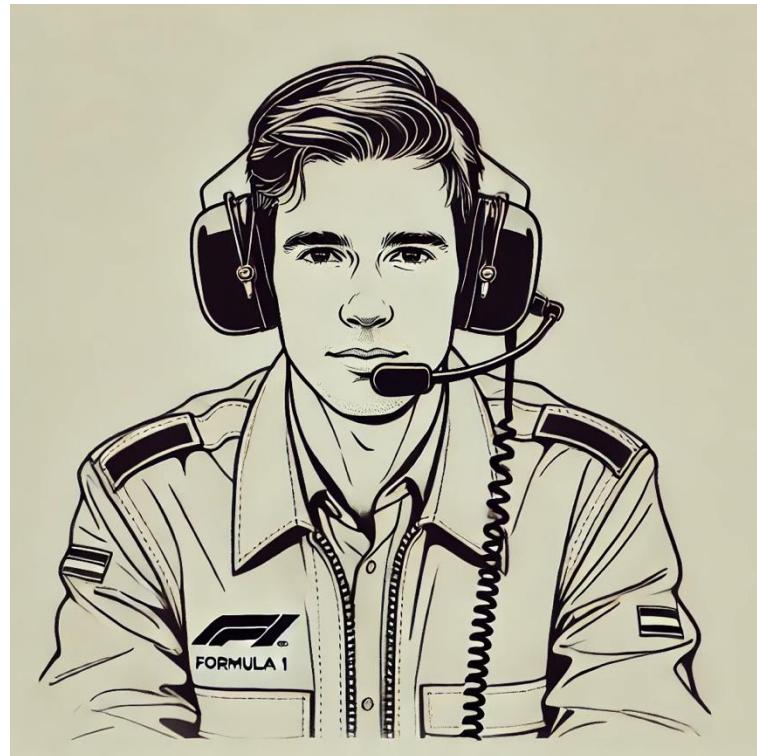
Alex
TELEMETRIST

*Overwhelmed by data volume,
making issues detection
difficult*



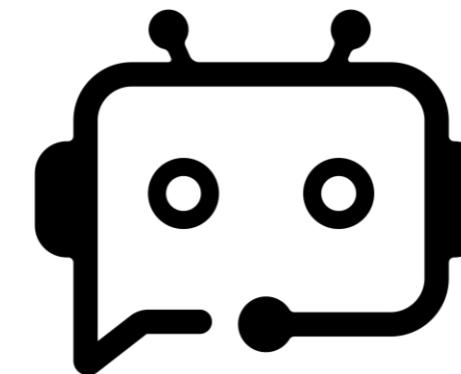
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SOLUTION



Alex
TELEMETRIST

*Overwhelmed by data volume,
making issues detection
difficult*



LLM

SIMPLE to use
USER FRIENDLY
RAPID results



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DATASET





FASTF1

KEY FEATURES



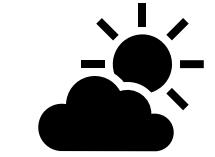
SESSION
DATA



TELEMETRY
AND CAR DATA



VISUALIZATION



TRACK & WEATHER
CONDITIONS



TABULAR DATA



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ANOMALY DETECTION & FAILURE CLASSIFICATION





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ANOMALY DETECTION DATA PREPROCESSING

TRAIN

TEST

SOURCE

DIFFERENT GRANULARITY → merge (telemetry, weather, laps)

SEASON

From 2019 to 2023

2024

FAILURE FILTER

Data WITHOUT FAILURES

Data WITH FAILURES

DATA CLEANING

Removal of NaN VALUES and DUPLICATE handling

PIT STOP LAPS

Data WITHOUT PIT STOP laps

Complete data WITH PIT STOP laps

NORMALIZATION

DATA TYPE handling to normalize (Min Max Scaler) only NUMERICAL and TEMPORAL values.
MAPPING of CATEGORICAL data

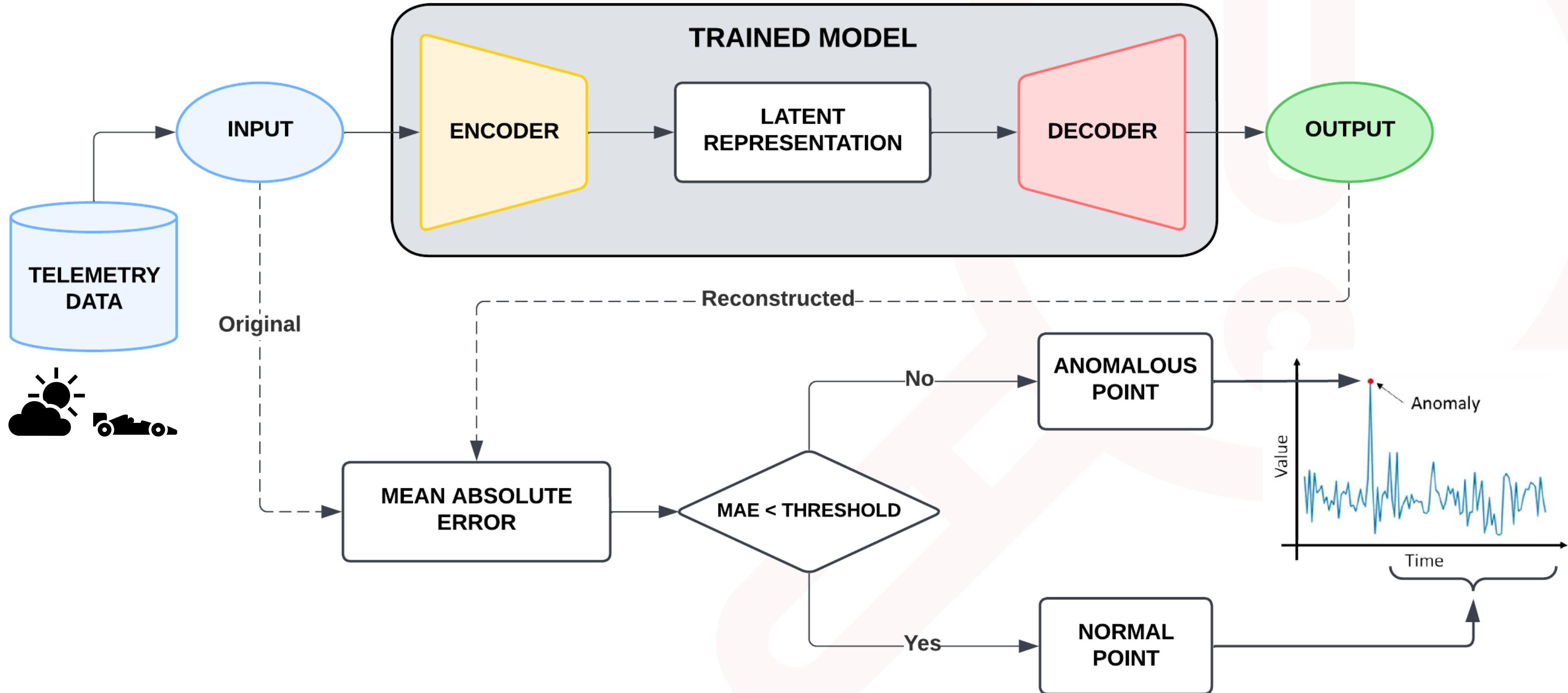
STORAGE

Data are stored in NPZ instead of CSV files in order to reduce the amount of STORAGE ON DISK and OPTIMIZE the data loading and management



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ANOMALY DETECTION AUTOENCODER





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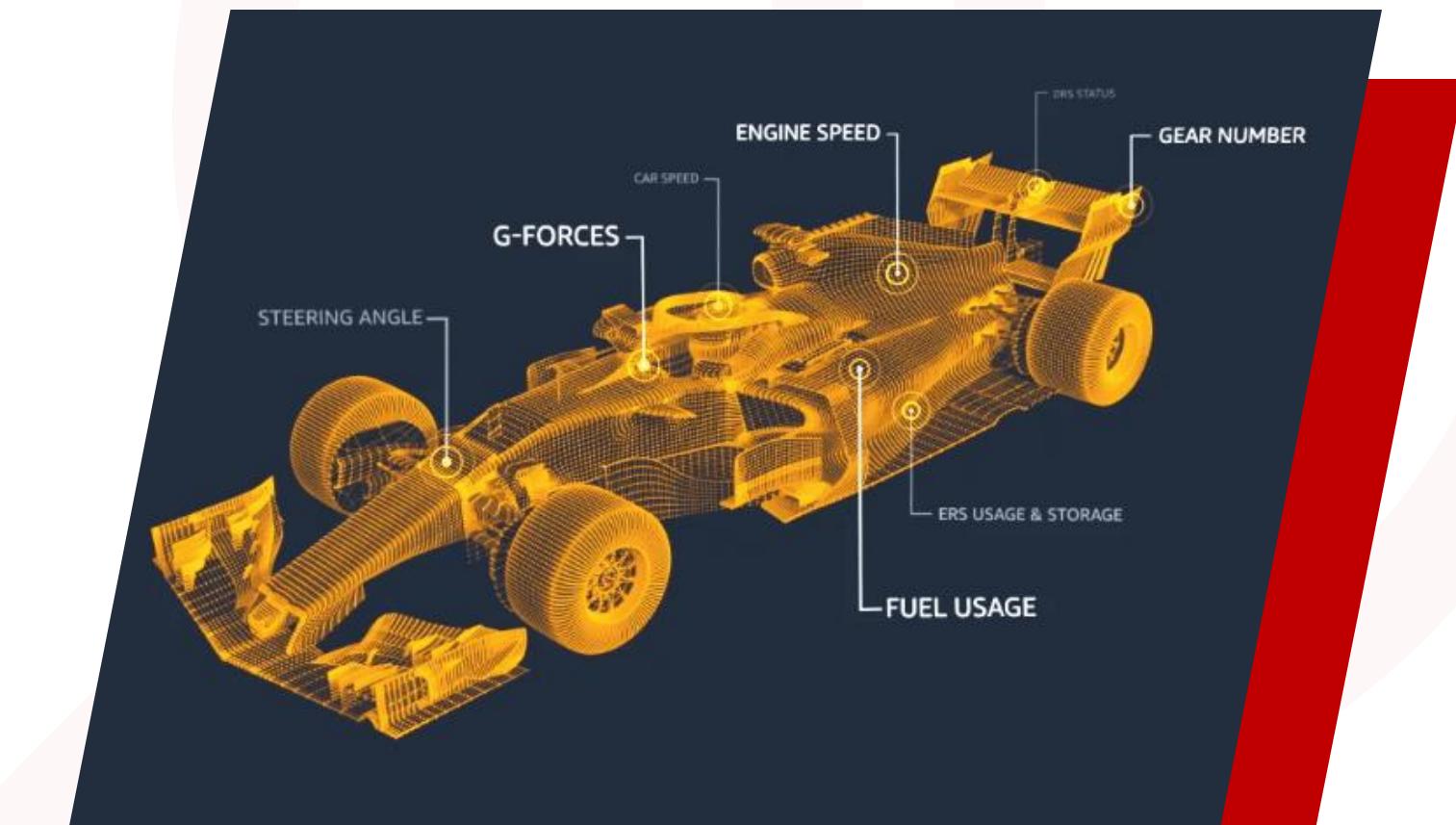
ANOMALY DETECTION TRAINING

SLIDING WINDOWS and different **BATCH SIZES** to reduce the load on RAM.

K-FOLD CROSS VALIDATION to generalize the model and reduce the overfitting.

Different **LEARNING RATES** and **OPTIMIZERS** to improve the model.

LOW final **LOSS** value reached

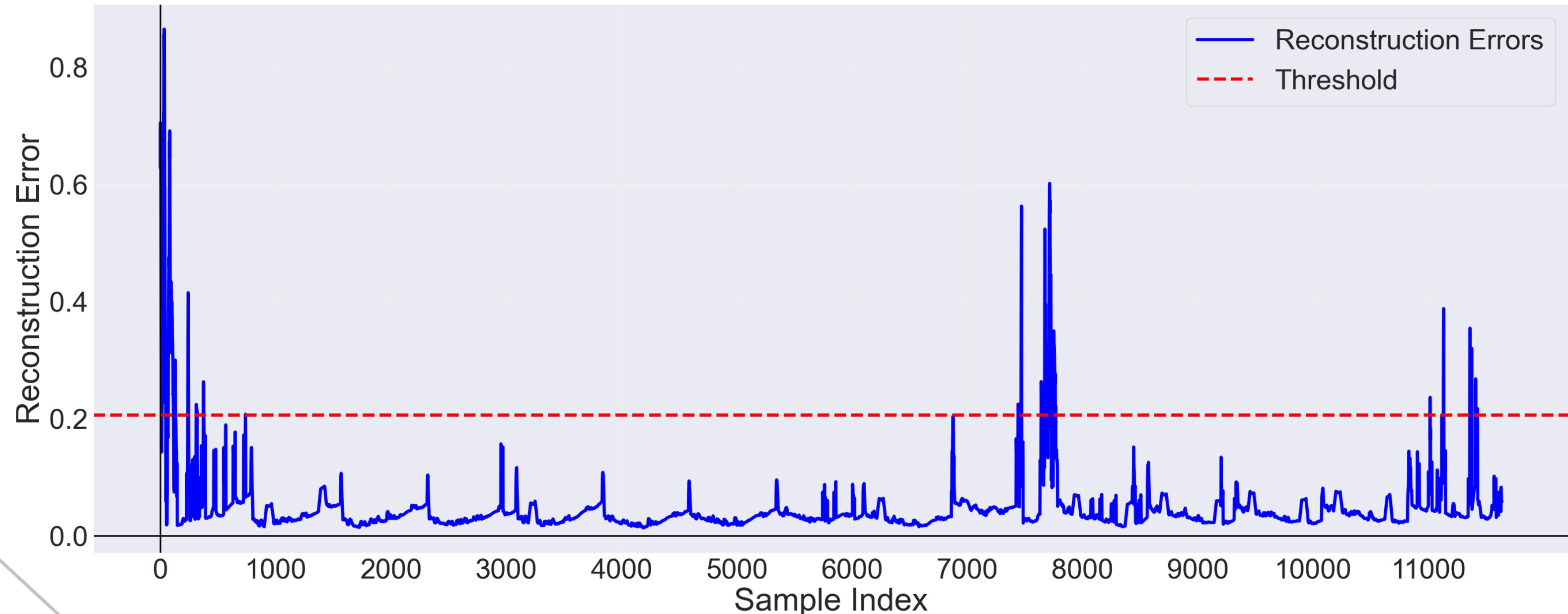




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ANOMALY DETECTION RESULTS

The model find **TELEMETRY IRREGULARITIES** on new unknown data complete of failures



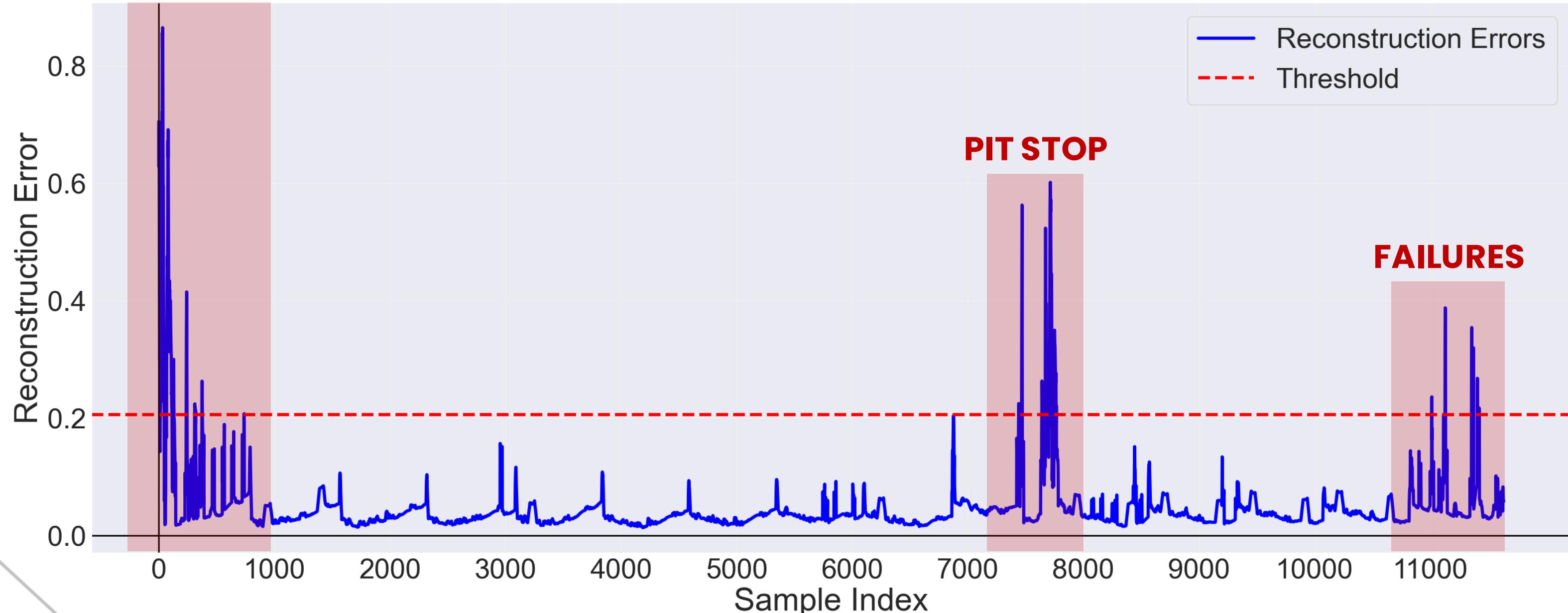


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ANOMALY DETECTION RESULTS

The model find **TELEMETRY IRREGULARITIES** on new unknown data complete of failures

STARTING LAPS



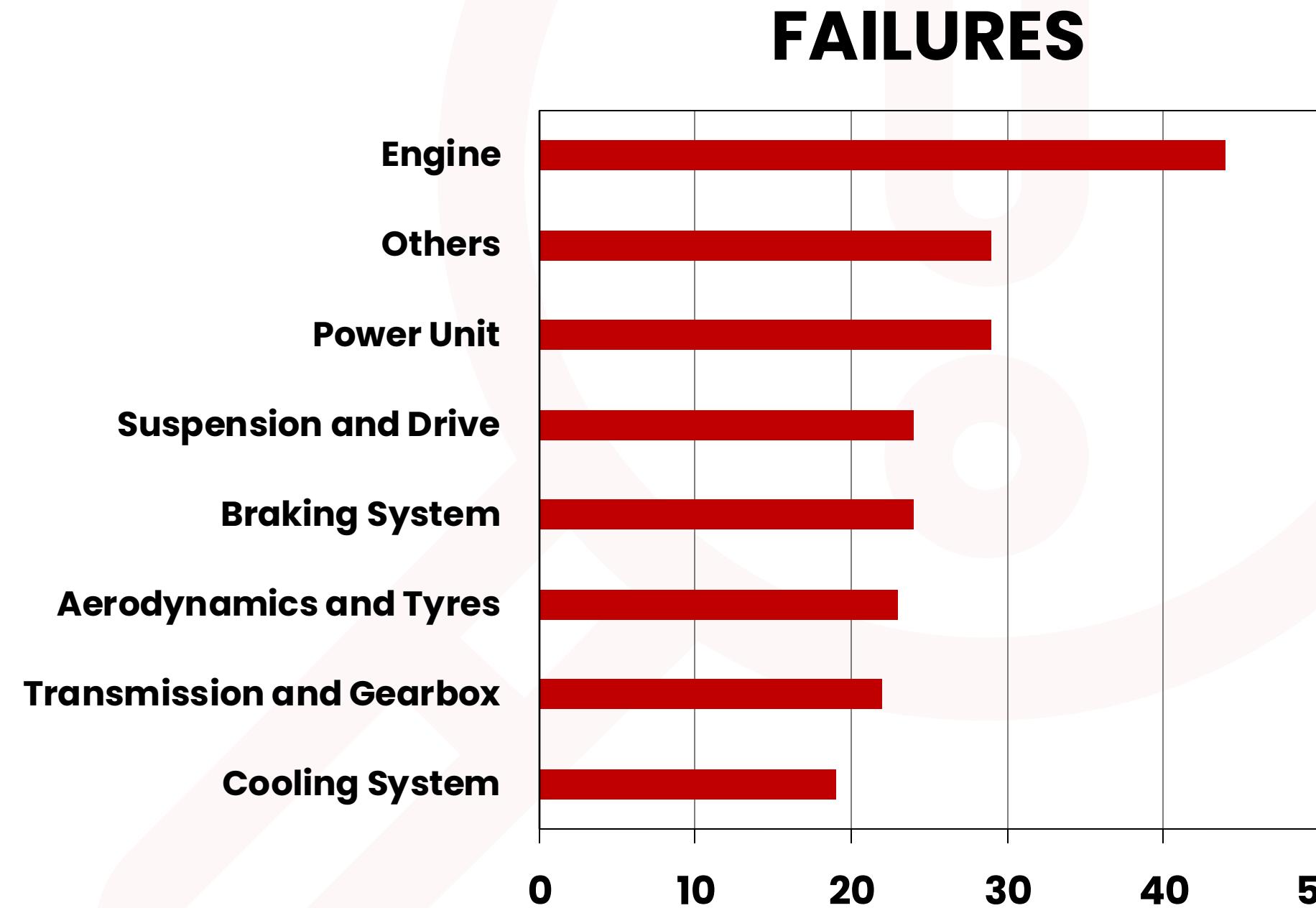


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FAILURE CLASSIFICATION DATA PREPROCESSING

Propose a **FAILURE CATEGORY**
that can be identified and
CLASSIFIED based on the
anomalies detected in the data

45 different anomalies → **8** failure groups

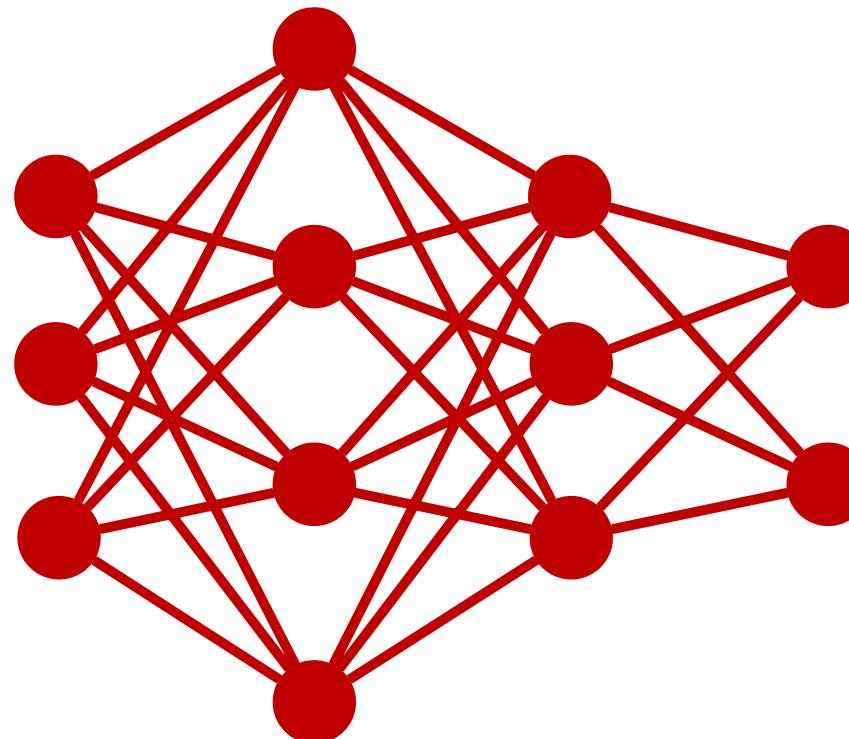




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FAILURE CLASSIFICATION TRAINING

NEURAL NETWORK



PROS:

- Powerful for **COMPLEX PATTERNS**
- Adaptable to **HIGH-DIMENSIONAL** data
- Considers feature **INTERACTIONS**

CONS:

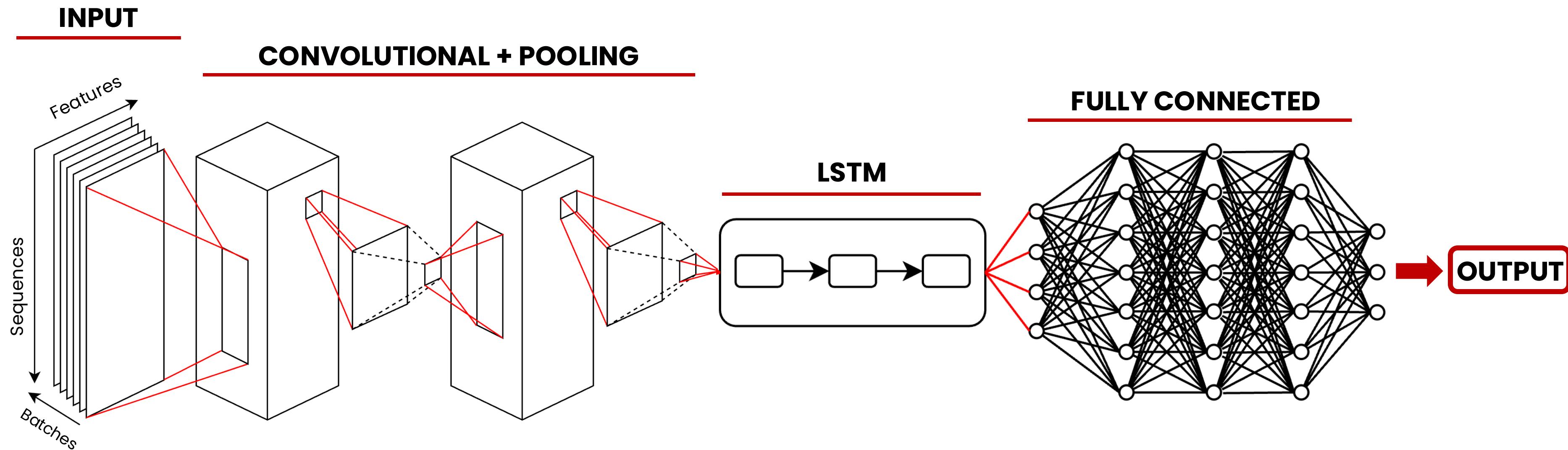
- Computationally **EXPENSIVE**
- **LESS INTERPRETABLE**
- **DIFFICULT** to tune



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FAILURE CLASSIFICATION

CNN + LSTM + FC

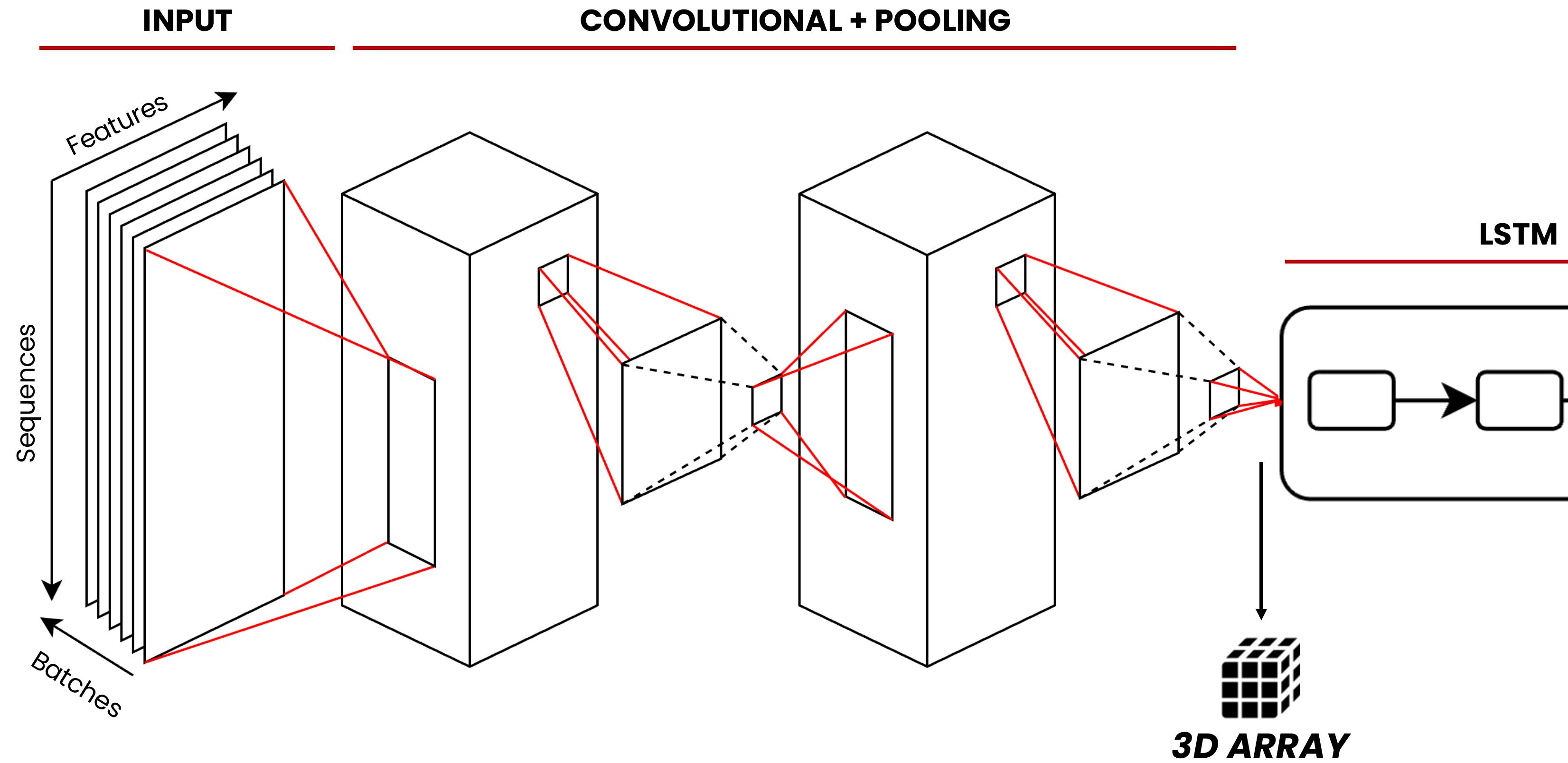




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FAILURE CLASSIFICATION

CNN + LSTM + FC

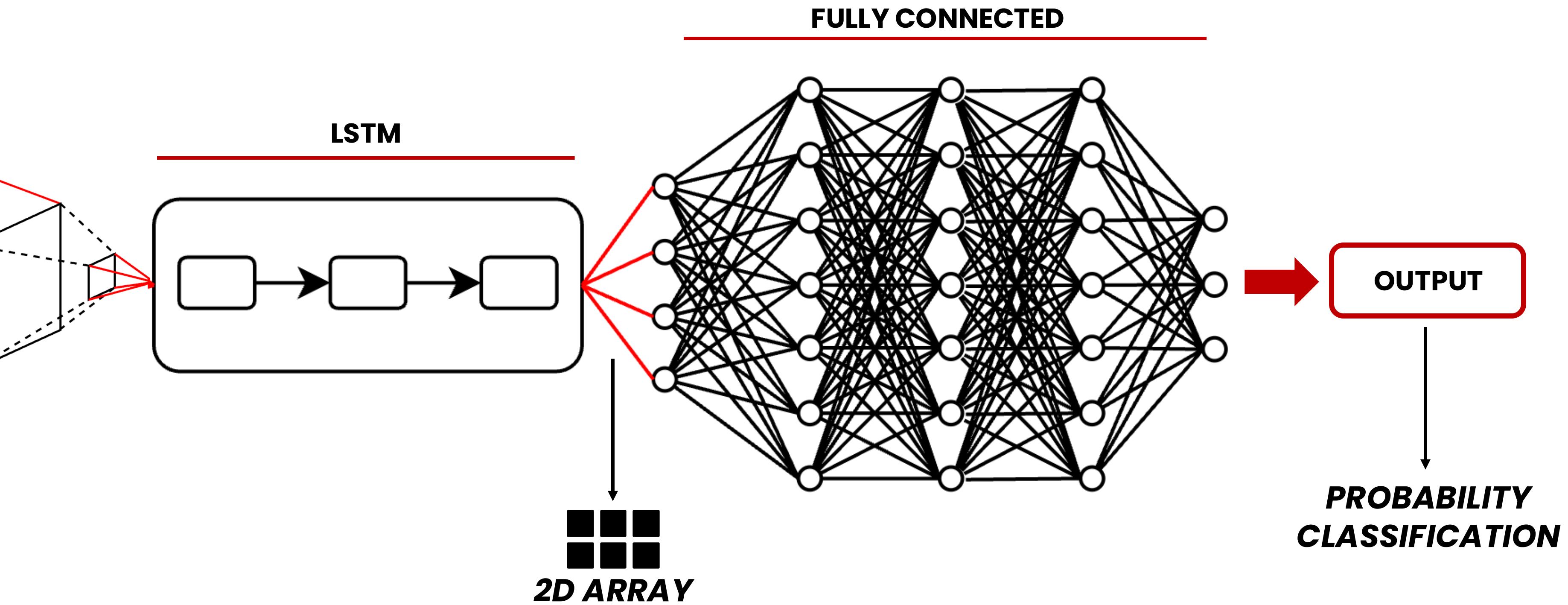




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FAILURE CLASSIFICATION

CNN + LSTM + FC





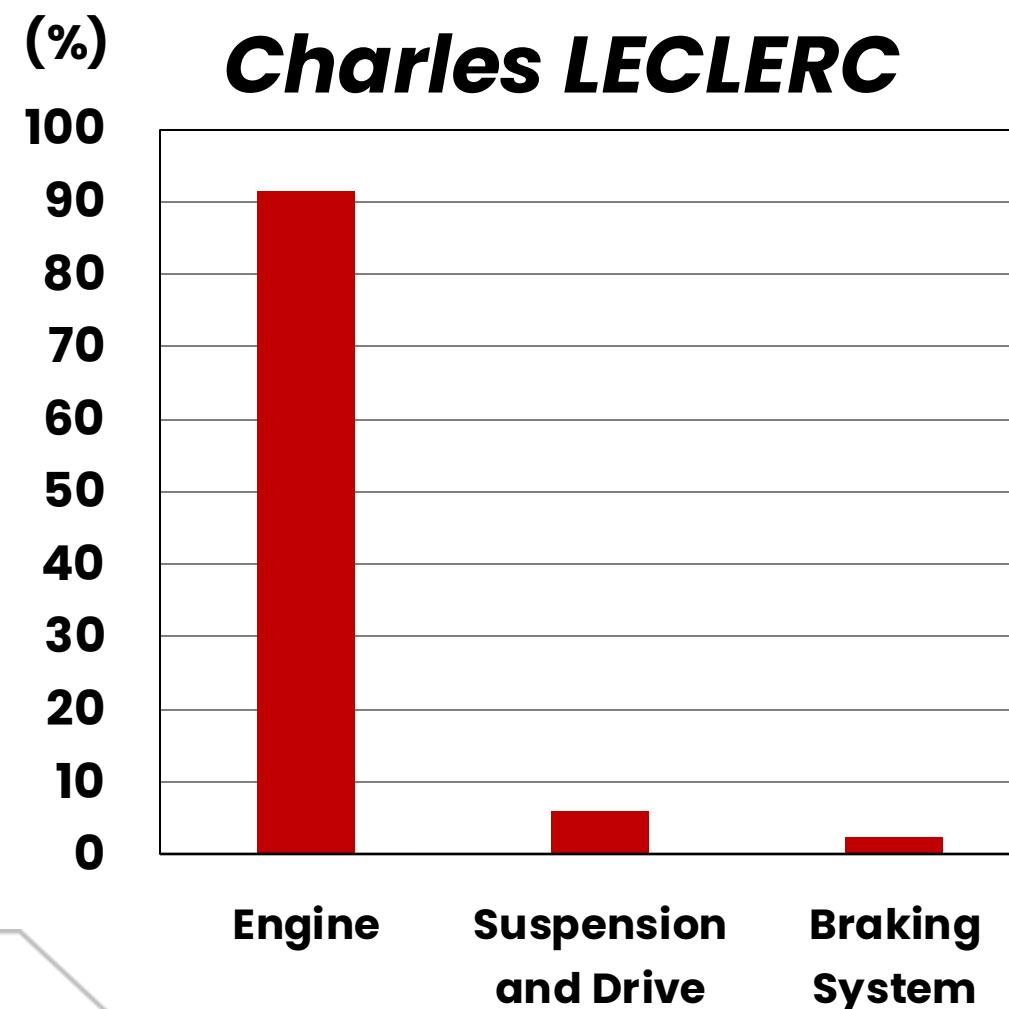
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FAILURE CLASSIFICATION RESULTS

CANADIAN GRAND PRIX

Actual Anomaly
Engine

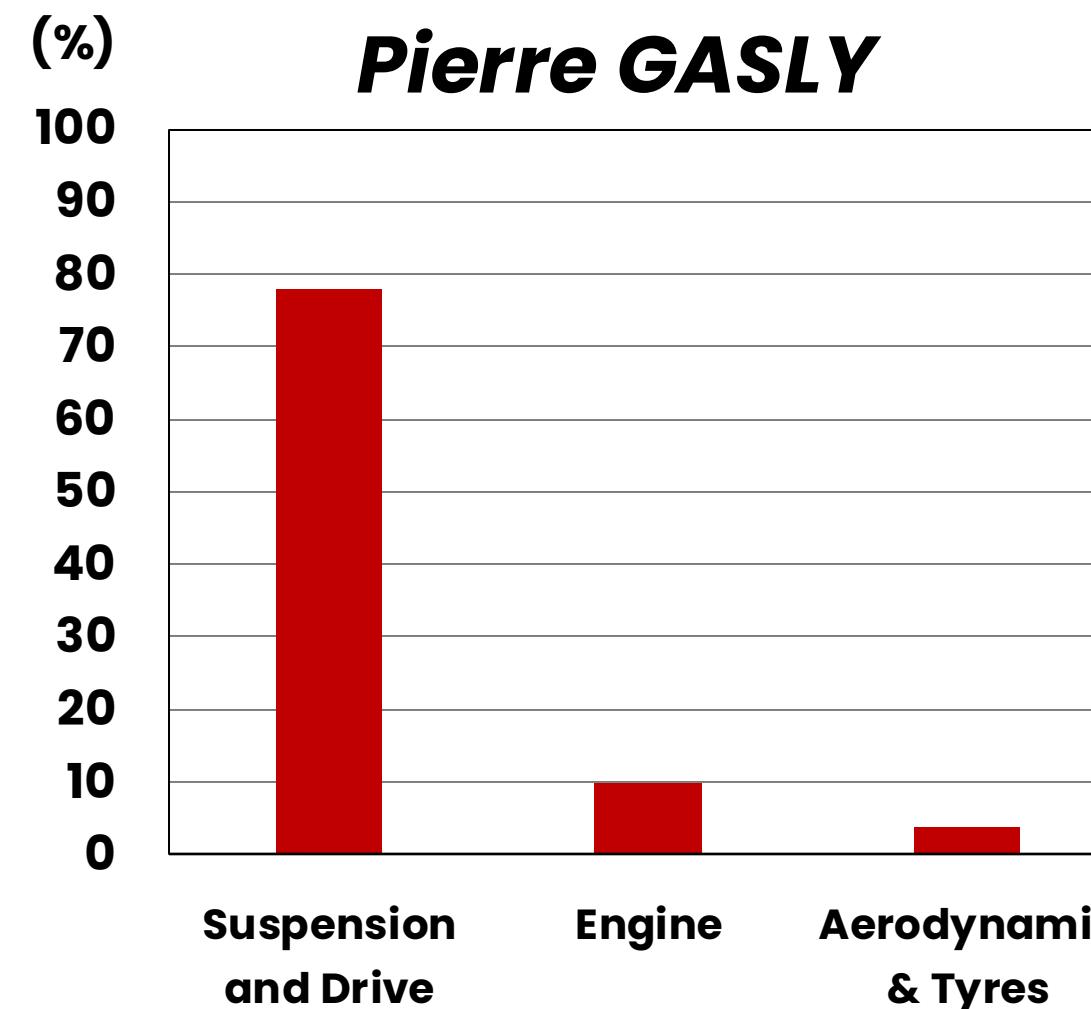
Predicted Anomaly
Engine



HUNGARIAN GRAND PRIX

Actual Anomaly
Suspension and Drive

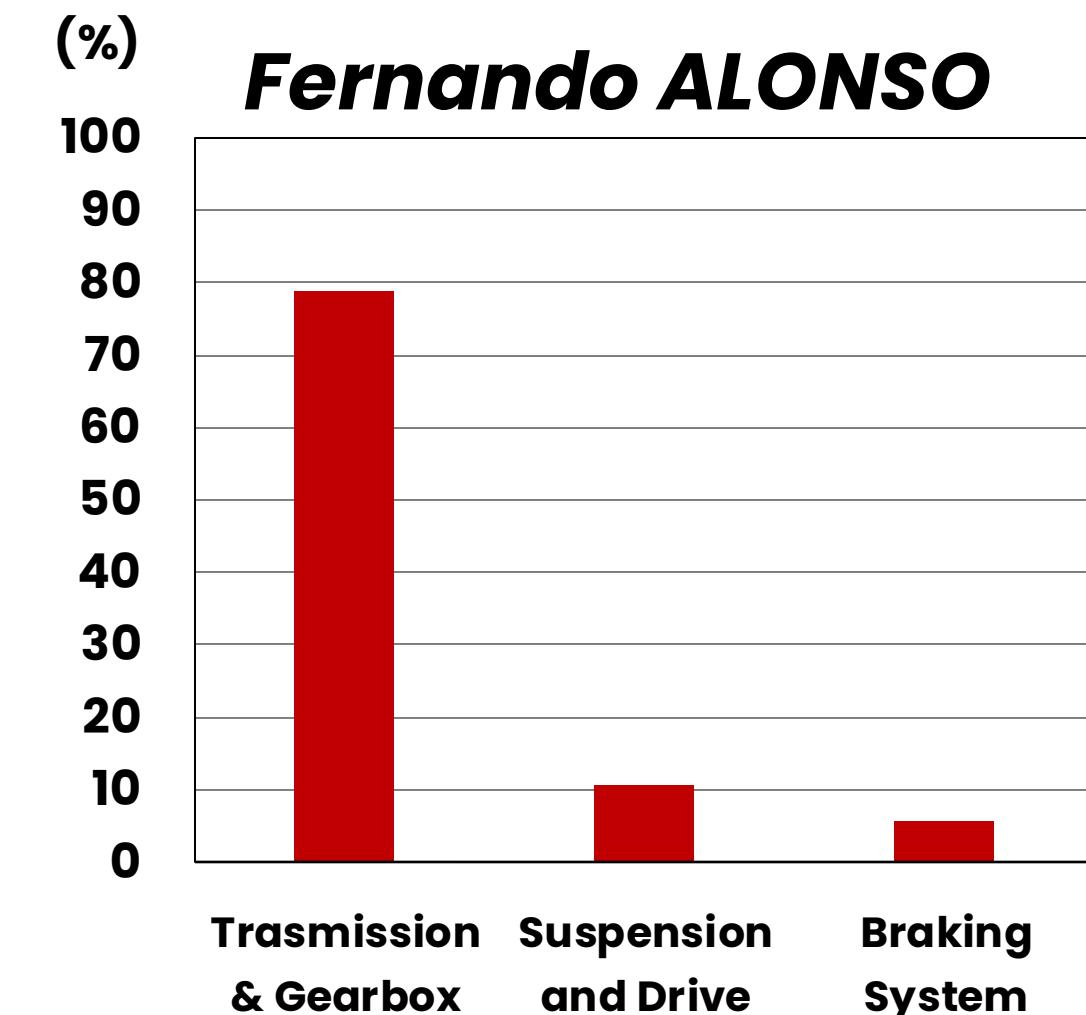
Predicted Anomaly
Suspension and Drive



MEXICOCITY GRAND PRIX

Actual Anomaly
Braking System

Predicted Anomaly
Transmission and Gearbox





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LLM AGENT





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LLM Agent

F1LLM - Your F1 Personal Assistant

Provide a message to interact with the LLM or upload a `.npz` file containing telemetry data for anomaly detection and classification. This tool leverages advanced AI to assist in analyzing race data.

Enter your message

output

Upload a .npz file

Drop File Here
- or -
Click to Upload

↑



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LLM Agent

F1LLM - Your F1 Personal Assistant

Provide a message to interact with the LLM or upload a **.npz** file containing telemetry data for anomaly detection and classification. This tool leverages advanced AI to assist in analyzing race data.

Enter your message

Can you provide anomaly detection?

X

2024_LasVegasGrandPrix_MinMaxScaler_GAS_normalized_complete_....npz 215.9 KB ↓

output

CONTEXT

ROLE: F1-AI assistant.
TASK: analyze the input data received, interpret the results, explain their meaning in a clear and concise manner

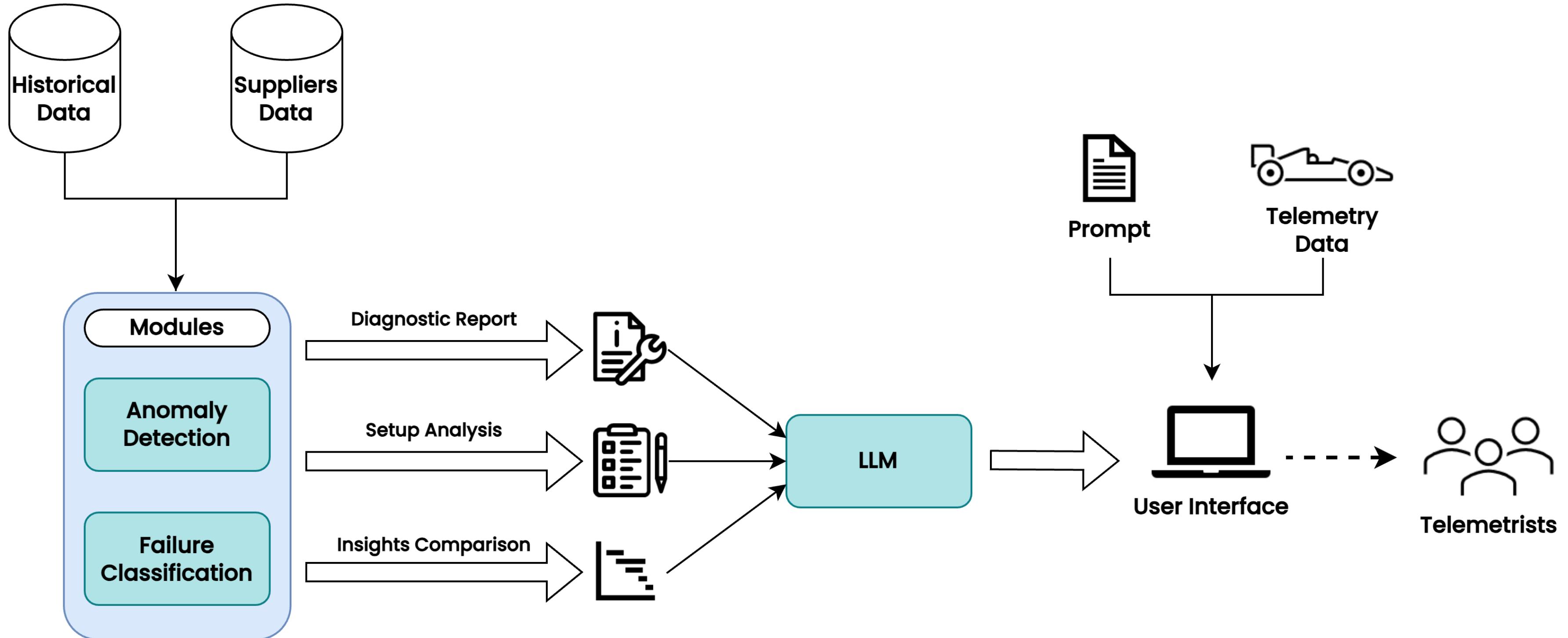
Based on the telemetry data, anomalies were detected. Anomalies in Formula 1 refer to unexpected or abnormal events during a race or test session. The following are the most common anomalies in Formula 1:

- Mechanical issues: These include engine, gearbox, suspension, and aerodynamic problems.
- Driver errors: This includes braking issues, oversteer, understeer, and spins.
- Weather conditions: This includes rain, wind, and temperature.
- Mechanical issues: This includes engine, gearbox, suspension, and aerodynamic problems.
- Driver errors: This includes braking issues, oversteer, understeer



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FUNCTIONAL DIAGRAM





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FUTURE WORKS

1 NEW
MODULES

1.1 LAP SIMULATION

1.2 TELEMETRY COMPARISON

2 DATASET
IMPROVEMENTS



THANK YOU

FOR YOUR ATTENTION



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