

1. Instructions to Run Code

Step	Notebook	Description
1: Data Prep	Assignment_Preprocessing.ipynb	Load Data: Reads the raw telemetry data. Clean & Engineer: Performs time synchronization, handles non-finite values, calculates Haversine distance, and converts quaternions to Euler angles. Scale & Split: Scales the data and saves the final Train, Validation, and Test sets.
2: SVC Model	Final_SVC.ipynb	Train: Trains the SVC model. Evaluate: Generates classification reports and confusion matrices. Explain: Runs LIME and SHAP analysis to determine local and global feature importance.
3: LSTM Model	Final_LSTM.ipynb	Train: Trains the LSTM with Attention model, testing hyperparameter configurations Evaluate: Tracks validation performance over epochs. Explain: Runs SHAP and Partial Dependence Plots (PDPs) to interpret sequence model decisions.

4: VAE Model	Final_VAE.ipynb	Train: Trains the Variational Autoencoder exclusively on Normal data. Test: Calculates reconstruction error on all classes to identify anomalies. Explain: Uses SHAP/PDP to explain the features driving the anomaly score.
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2. List of Required Libraries and Versions

Library	Version (Example)	Purpose
Python	3.10+	Core programming environment.
pandas	2.1.0	Data manipulation and analysis.
numpy	1.25.2	Numerical operations.
scikit-learn	1.3.0	StandardScaler , SVC model, and general evaluation metrics.
torch	2.0.1	Core framework for LSTM with Attention and VAE models.
torchvision	0.15.2	Utility for PyTorch (often installed with torch).
matplotlib	3.7.2	Data visualization and plotting.
seaborn	0.13.0	High-level statistical visualizations (for EDA).
shap	0.43.0	Explainable AI (SHapley Additive exPlanations).
lime	0.2.0	Explainable AI (Local Interpretable Model-agnostic Explanations).
joblib	1.3.2	Saving and loading trained models (SVC).

3. Expected Runtime for Training

Model / Task	Recommended Platform	Approximate Time (Total)	Notes
Data Preprocessing	CPU	30 minutes	Time dominated by feature engineering.
SVC Training	CPU	40 minutes	The SVC kernel calculation can be intensive on a large dataset.
LSTM Training	GPU (NVIDIA T4)	60 minutes	Based on $\text{EPOCHS}=100$ and $\text{PATIENCE}=10$.
VAE Training	GPU (NVIDIA T4)	60 minutes	Requires GPU for efficient backpropagation.