

Assignment: Multiple Linear Regression for Robot Linear Velocity Prediction

Dataset: IMU-based Mobile Robot Motion Dataset (`imu_robot_motion.csv`)

A mobile robot is equipped with an IMU sensor that provides linear acceleration and angular velocity measurements along different axes. Using this sensor data, you are required to build a **Multiple Linear Regression model** to predict the **linear velocity of the robot**.

Tasks

1. **Problem Understanding**
 - a) Identify whether this problem is a classification or regression problem.
 - b) Justify your answer.
2. **Dataset Exploration**
 - a) Load the dataset and display the first five rows.
 - b) List all input features and the target variable.
 - c) State the total number of samples and features.
3. **Data Preprocessing**
 - a) Check for missing values in the dataset.
 - b) Handle missing values using an appropriate method and justify your choice.
 - c) Separate the dataset into feature matrix (X) and target vector (y).
4. **Exploratory Data Analysis (EDA)**
 - a) Plot histograms for at least three IMU features.
 - b) Analyze the distribution of the target variable.
 - c) Identify which features appear to have a strong relationship with linear velocity.
5. **Train-Test Split**
 - a) Split the dataset into training and testing sets using an 80:20 ratio.
 - b) Explain why train-test splitting is necessary.
6. **Model Development**
 - a) Write the general equation of Multiple Linear Regression.
 - b) Train a Multiple Linear Regression model using the training data.
7. **Model Evaluation**
 - a) Predict the linear velocity for the test data.
 - b) Compute the following evaluation metrics:
 - Mean Absolute Error (MAE)
 - Mean Squared Error (MSE)
 - Root Mean Squared Error (RMSE)
 - R-squared (R^2)
8. **Result Interpretation**
 - a) Explain the meaning of regression coefficients in the context of robot motion.
 - b) Discuss whether the model is suitable for predicting robot linear velocity.

Submission Instructions

- Submit a Python notebook or script file.
- Include necessary plots and explanations.
- Clearly comment each step of your code.