

# Task Report:

## User Localization using Machine Learning

### 1. Introduction:

We explore the application of Machine Learning (ML) techniques for predicting user location based on Received Signal Strength (RSS) signals obtained from Wi-Fi access points. The dataset encompasses 103,584 Wi-Fi fingerprints collected over twenty-five months within the library building of Universitat Jaume I, Spain.

### 2. Methodology:

#### 2.1 Data Loading and Preprocessing:

- The training data is initially loaded and preprocessed to ensure its suitability for training ML models.
- Missing values within the dataset are filled using the mean of the respective column to maintain data integrity.
- Duplicate entries, if any, are removed to prevent bias during model training.
- This preprocessing pipeline is replicated for each test dataset to maintain consistency.

#### 2.2 Data Splitting:

- The dataset is partitioned into features and targets. Features comprise RSS signals from Wi-Fi access points along with the floor number, while the target represents the user's location coordinates (x, y).

#### 2.3 Model Training:

- A K-Nearest Neighbors (KNN) regressor model is employed for training using the preprocessed training data.
- KNN is chosen due to its simplicity and effectiveness in handling regression tasks, particularly in cases where spatial relationships are significant.

#### 2.4 Prediction:

- The trained KNN model is utilized to predict the user's location for each instance within the test datasets.

## 2.5 Error Calculation:

- Prediction errors are calculated as the Euclidean distance between the predicted and actual location coordinates.
- The Average Localization Error (ALE) is then computed as the mean of these errors, providing an overall assessment of the model's performance.

## 2.6 Result Saving:

- The ALEs obtained for all months are consolidated and saved in an Excel file titled 'ALE\_25\_months.xlsx'.

## 3. Conclusion:

Through the implementation of a KNN regressor model on Wi-Fi fingerprint data, this project demonstrates the feasibility of ML-based user localization.

This project underscores the significance of ML in addressing challenges related to user localization, paving the way for innovative solutions with widespread applicability.