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A Tutorial on WiFi-based Indoor Localization

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The task of localization:

- Aims to determine a user's (or an object's) position in space.
- Essential for a variety of applications (i.e emergency response, health care and public safety).
- The **outdoor** localization problem was solved by the **global navigation satellite systems** (GPS, GLONASS and GALILEO).
- The **indoor** localization still remains an **open problem**.

A WiFi-based approach for indoor localization

1. Record WiFi **received signal strength** (RSS) values at predefined **reference points** (RPs) to construct a radio map of an indoor area.
2. Using the radio map, train a location prediction model to map RSS values to RPs.
3. Determine a user's position in real-time using the pretrained model and the current WiFi signal values

Datasets

Most of the current WiFi datasets are **grid-based**:

- The indoor area is split into grids
- RPs are positioned in the center of these cells and then randomly assigned to training and testing sets
- Not suitable for sequential localization as temporal information is not present.

Datasets

In this tutorial we will use the simplified version of the **WiFine** dataset:

- RPs are scattered at random locations
- Recorded at finer granularity, across multiple floors, as a user moved in the building
- Contains continuously recorded streams of RSS values

The dataset structure

- Each recorded trajectory of a user is stored in a separate CSV file.
- # of rows = # of recorded samples (checkpoints)
- The samples are listed in the **temporal** order:

  - The top row is the start of the trajectory

  - The bottom row is the end of trajectory

The dataset structure

- # columns = 223
- 0-219: features (WiFi RSS values).
  - Each sample contains RSS values coming from 220 APs.
  - The 1st column (idx 0) represents the received data from the 1st AP.
- 220-222: target values, or the true X, Y, Z coordinates a reference point.

Next: practice with Jupyter Notebooks

1. Load the WiFine dataset
2. Train and test a Regression Tree to map RSS values to RPs.
3. Train and test a Multi Layer Perceptron to map RSS values to RPs.

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Follow up with Jupyter Notebooks

Accessed at
https://github.com/IS2AI/ISSAI-AUA-Summer-School