CS439 – Wireless Networks and Mobile Computing
Spring 2015
Project on Positioning
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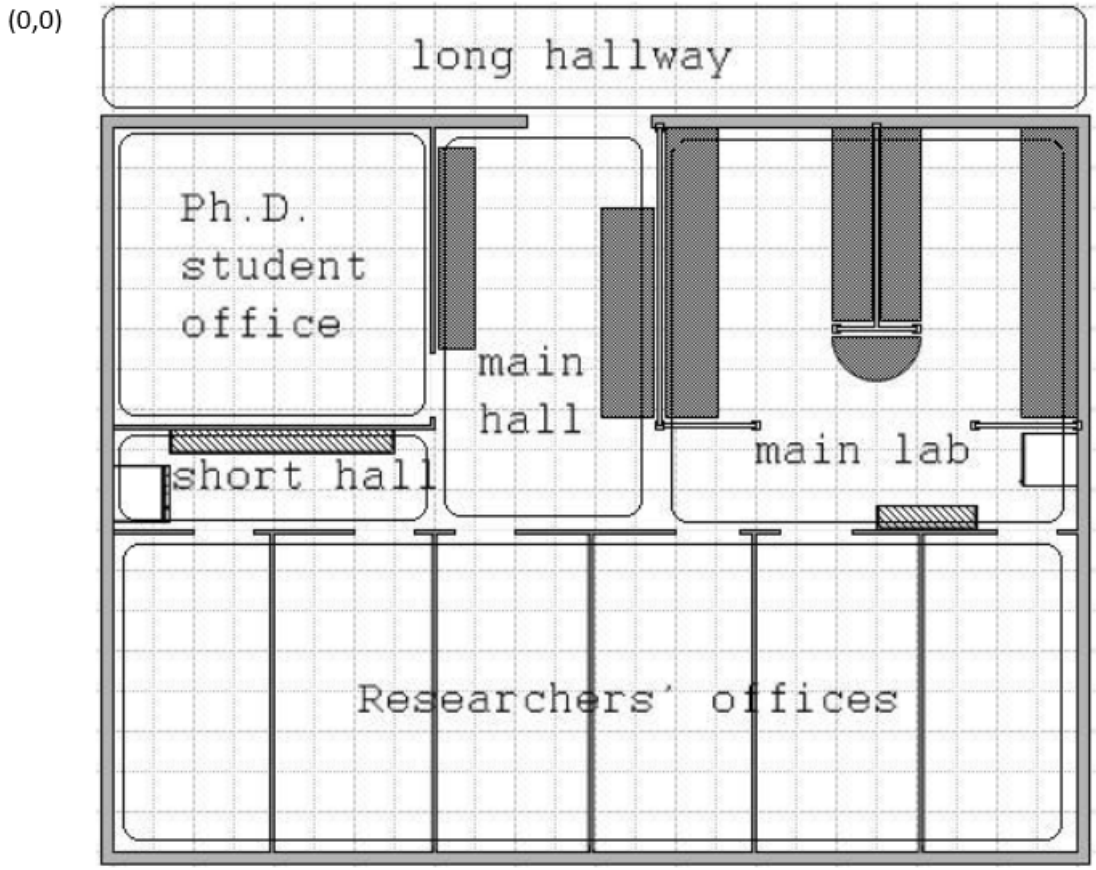
In this project you will develop an algorithm for a fingerprinting location-sensing system in order to infer position.

The figure below shows the floorplan of the Telecommunications and Networks Laboratory (TNL) at FORTH. The area is divided into cells of equal size. The cells are represented with the gray squares at the figure.



A fingerprinting positioning system works as follows:

Step 1 (Training): During training, signal strength measurements are collected from all the active APs at each cell. You have been provided with a training dataset containing the collected signal strength measurements at each cell. Each file in the dataset contains 3 fields which are the timestamp, AP MAC address and signal strength value.

Step 2 (Runtime): During runtime, signal strength measurements are collected from the location of the user. These values are compared with the training dataset and the cell with the most "similar" RSSI values is reported as the estimated position.

In this project you will develop an algorithm that compares the runtime and training measurements in order to infer users' location based on percentiles (http://cnx.org/content/m10805/latest/)

Your algorithm will take as input the training data of all the cells (the signal strength map of the area) and measurements from a runtime cell and output the estimated location.

A simple implementation can be the following:

1. Read RSSI values from training and runtime cells.
2. Compute 10 percentiles (10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100% percentile) per AP for each cell.
3. Compute the weight of each cell c using the following formula:

$$w(c) = \sum_{i=1}^{N} \sqrt{\sum_{j=1}^{p} \left(R_j^i - T_j^i(c)\right)^2}$$

   where N is the number of APs, p is the number of percentiles, R_j^i is the j-th percentile of runtime measurements from the i–th AP, and $T_j^i(c)$ is the j-th percentile of the training measurements from the i-th AP at cell c.

4. Report the cell with the minimum weight as the estimated position.

(A further reference on location-sensing algorithms including percentiles can be found at http://www.ics.forth.gr/mobile/publications/mswim2010.pdf)

NOTE: The file ap_map_10 contains the MAC addresses of the 10 APs used both in training and runtime. You will notice that not all APs are present in all the cells. When an AP does not have measurements in a given file you can assign very small signal strength values (-100) for all its percentiles.

Error analysis

Run your algorithm for all the provided runtime cells. Compute the location error as the Euclidean distance between the real cell and the estimated cell. (The size of each cell is 0.55 m x 0.55 m). Report the CDF and the median error.

Submit your code and a report where you explain your algorithm in detail and provide the error analysis. Provide also details on how to compile and run your code.