LO53: Indoor Positioning Systems - Final test

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Reminder: personal notes authorized.
Test delay: 2 hours.

1 Indoor Positioning Systems

1.1 Knowledge Questions (2 pts)

1. We consider an IPS whose architecture is a distributed system. How & why does this architecture impact on the system scalability?

2. What is the primary advantage of Wi-Fi based indoor positioning systems against dedicated IPS?

3. In one element of the signal strength space, what do represent the N signal strength values?

4. Check the proper cells in following table (checking a cell meaning that the property is met by the system):

	RADAR	Interlink Networks	FBCM	Simple FRBHM	Continuous FRBHM
Accurate					
Quick setup					
Dynamical					
Propagation-based					
RSSI map based					

1.2 Exercise 1 (4 pts)

1.2.1 FBCM calibration

Given the following 2D-data:

```
Access point AP1                Reference point RP3
----------------                ------------------
Coordinates: (0.0, 0.0)         Coordinates: (55.0, 2.7)
ESSID: IPS                      Measurement1: 00:15:77:40:ef:01, -32 dBm
BSSID: 00:15:77:3b:de:06        Measurement2: 00:15:77:3b:de:06, -79 dBm
Output power: 20 100 mW         Measurement3: 00:15:77:3b:a5:23, -54 dBm
Antenna: 2.1 dBi                Calibration client antenna: 2.1 dBi
Channel: 13
Output freq.: 2472 MHz
```

Compute the Friis index for AP1 and RP3.

1.2.2 Apply FBCM

We consider now the following measurement:

```
Measurement M1
--------------
Measurement1: 00:15:77:3b:de:06, -52 dBm
Measurement2: 00:15:77:40:ef:01, -37 dBm
Measurement3: 00:15:77:3b:a5:23, -74 dBm
Client antenna: 2.1 dBi
```

What is the distance between AP1 and current device location?

1.2.3 RSSI space distance

Give the RSSI space distance between RP3 and M1?

1.2.4 Viterbi-like algorithm

What is the complexity of a straight implementation of Viterbi-like algorithm?
What is the complexity with optimized version? (Viterbi-like improved)

1.2.5 IPS architecture

Where do you choose to locate the measurements:

- in a system where you own the mobile devices fleet?

- in a system where you own the infrastructure?

- in a system where you own neither the infrastructure or the mobile devices?

1.3 Exercise 2 (4 pts)

Write two functions:

- a function to setup discrete FRBHM (a.k.a. Viterbi+topology),

- a function to locate a mobile terminal with discrete FRBHM.

You can use any function developped in exercises sessions and lab sessions (only functions presented in the questions, no personal ones).

2 LBS and Applications

2.1 Exercise 1 (3 pts)

Answer the following questions:
a. Provide the definition of LBS applications
b. List five LBS applications
c. Identify the components and participants of LBS applications and describe the interaction between these components
d. Explain what context means and provide the different types of context.
e. Try to identify elements of the LBS keywords for the following application: a car driver want to go to the next gas station using the car navigation system

2.2 Exercise 2 (3 pts)

A GPRMC sentence latitude of a point A in degree is 58.65375°. Provide the following conversions:
a. From decimal-degrees (d) to Degrees decimal-minutes (D m)
b. From decimal-degrees (d) to Degrees Minutes decimal-seconds (D M s)
c. From Degrees decimal-minutes (D m) to decimal-degrees (d)
d. From Degrees decimal-minutes (D m) to Degrees Minutes decimal-seconds (D M s)
e. From Degrees Minutes decimal-seconds (D M s) to decimal-degrees (d)
f. From Degrees Minutes decimal-seconds (D M s) to Degrees decimal-minutes (D m)

2.3 Exercise 3 (4 pts)

Specify the best suitable communication technologies for the following applications: Safe distance, Curve speed warning, Emergency vehicle warning, Free flow tolling, Vehicle tracking and tracing, Parking booking, Distributed games. Write your suggestions by giving strong arguments, i.e. specify why you choose one technology, and why you didn't choose another one?