CE/CZ4171: Internet of Things: Communications and Networking

Part I - Tutorial 1: A Case Study of Smart Parking

Before tutorial, please download and read the following paper:

Lin et al., A Survey of Smart Parking Solutions, IEEE Transactions on Intelligent Transportation Systems, Vol. 18, No. 12, pp. 3229-3253, December 2017.

https://ieeexplore.ieee.org/document/7895130

(or with NTU login) https://ieeexplore.ieee.org.remotexs.ntu.edu.sg/document/7895130

1. State the goal and benefits of smart parking applications.

2. Give an example scenario (a sequence of actions) of smart parking functionality.

3. List 6 sensors that can be used in smart parking solutions, explain each of the sensors briefly and its benefit.

4. Explain the data dissemination through communications and network infrastructure for Smart Parking applications.

5. Explain the concept of *crowdsensing* and its role(s) in smart parking, state its limitations and/or shortcomings.

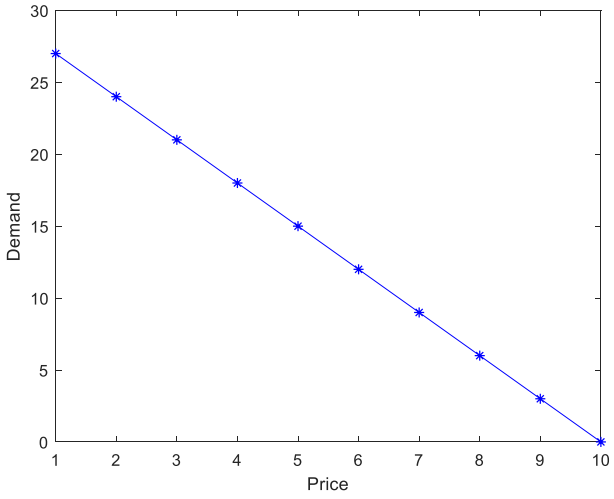
6. List and explain 5 attributes (information) that smart parking applications should predict.

7. Consider exponential smoothing prediction model which is described by the forecast equation and smoothing equation defined as follows: forecast equation is $y(t+h|t) = l(t)$, smoothing function is $l(t) = a*y(t) + (1-a)*l(t-1)$, where $l(t)$ is the smoothed value of the series at time t, and a is the smoothing parameter. Calculate the car park occupancy rate at time 12noon from the occupancy rates given in the table and $a = 0.5$.

Time	Car park occupancy rate
9:00am	80%
9:30am	82%
10:00am	85%
10:30am	83%
11:00am	90%
11:30am	92%

8. Explain competition in smart parking, analyze and discuss one solution to resolve the competition.

9. Optimal pricing: The demand of a car park in one hour is described by a function D(p) = 30-3p, where D(p) is the number of cars wanted to park at the car park if the price for each parked car is p. Basically, the demand decreases as the price increases. Determine the price that maximizes the profit of the car park provider if the car park's maximum capacity is 30 cars.



10. The demands of two car parks in one hour are described by functions D1(p1,p2) = 30-3*p1+p2 and D2(p2,p1) = 60-3*p2+p1, where D1(p1,p2) and D2(p2,p1) the number of cars wanted to park at the car parks 1 and 2, respectively, and p1 and p2 are the prices at the car parks. Basically, the demand of one car park decreases as its price increases and it increases if the price of another car park increases due to competition where users are sensitive to the price of the competitor. Car parks 1 and 2 have the maximum capacities of 30 and 60 cars, respectively. Determine the prices p1 and p2 that maximize individual profit of each of the car park providers if both the car parks belong to different providers 1 and 2.