Exercise Sensor Networks - (till July 4, 2005)

Lecture 10: Applications for synchronization in sensor networks

Exercise 10.1: Signal propagation times

Three sensors detect an acoustic signal at times t1, t2 and t3. The positions of the nodes are denoted with P1, P2 and P3. Nodes 1 and 2 hear the signal at the same time but node 3 detects it d time units earlier (or later for $d < 0$). Where is the event producing the noise located for varying values of d?

Exercise 10.2: Special cases of distance measurements

Only two nodes at the boundary of a sensor network hear the same event. Based on the different arrival times of the signal or in other words based on shorter or longer signal propagation times from the event to the nodes the direction of the event can be guess.

This direction or angle is not always precise as we have seen in the lecture (at least not when based on two nodes).

a) When can the direction of the incoming sound theoretically be determined precisely and why can the angle not always be determined without an error?

b) Two nodes detect an event, but one node detects is z time units later than its fellow. On what curve could the even be located for a given z?

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Exercise 10.3: Requests to the Tiny Aggregation Service (TAG)

Sensor nodes are scattered over a large area of a mountain landscape. Every node can measure the following quantities:

light
temperature
altitude

The mean temperature should now be determined at the same level of altitude, whereas the altitude in only defined in intervals of 100 meters (in other words: it is quantized to buckets of 100 meters).

Example: 51 up to 149 meters are assigned to be 100 meter. The function round() is available which returns arithmetically rounded integer values.

Only the temperature in the shadow is of interest, so only those node should take part in the determination which measure less than 100 Lux.

The temperature sensors used for the nodes are cheap so many of them are defective. Fortunately, defective sensors exhibit a temperature of less than -200° Celsius. A group containing a defective sensor should be canceled entirely.

Finally, the sensor network should provide the requested data once an hour.

Find the SQL-like query according to the TAG-model.

Hint: Do not bother aggregating in the HAVING-clause. This is ok in SQL :)