Project Assignment (Part I)

A health care centre is planning to manage its population of chronic disease patients using wearable electronic medical devices to monitor health parameters. The devices worn by a patient form a Personal Area Network[1] (PAN), communicating through Continua[2] protocols with a smart phone, which acts as a gateway to the medical centre. Most of the patients will only wear reading devices (*sensors*), to monitor health parameters, such as the heartbeat and glucose level, but some of the patients will also wear output devices (*actuators*), to control an insulin pump[3] or set the speed on a VAD[4]. Your task is to design the database of the medical centre to manage the collected readings and settings of monitored patient devices. A more detailed description follows:

A medical device can be an input sensor (glucose meter), an actuator (insulin pump) or both. Every device has a serial number from its manufacturer and a description (e.g., "blood pressure meter" or "insulin pump+glucose meter"). Devices handle readings and writings of values of physical measures, such as glucose level (5.9 mmol/L), temperature (37.8 ºC), rotating speed (2000 RPM) or voltage (35 mV). These values and the times of observation/setting are to be recorded in the database. Actuators receive "settings" of values at specific times (e.g., setting the rotating speed of a pump to 2000 RPM). Sensors can collect "readings", sets of values at specific times. For instance, a device for measuring the heart rate could send the last 60 values sampled in the past hour to be stored on the database associated to the time of collecting that data from the sensor; in that case, an example reading would store the signal as 60 name-value pairs ("minute 00" : 75, "minute 01" : 78, … "minute 59" : 125) associated to "Wed Sep 30 23:58:29 WEST 2015". Another case is a blood pressure meter which collects in each reading two name-value pairs (e.g., "min" : 7.2 and "max" : 13.8).

The wearable devices of a patient are connected to a patient's PAN. A given device is connected to one (and only one) PAN during a time period, but may be disconnected after some time (for instance, to be replaced or connected to the PAN of another patient), or even reconnected again (for instance, after a repair).

Patients who carry wearable devices have a PAN (in practice a smart phone, and no more than one PAN per patient!). The PAN is used to transfer data (readings and settings)

[1] https://en.wikipedia.org/wiki/Personal_area_network
[2] http://www.continuaalliance.org
[3] https://en.wikipedia.org/wiki/Insulin_pump
[4] https://en.wikipedia.org/wiki/Ventricular_assist_device

between the wireless medical devices and the database in the medical centre. PANs, each identified by a unique internet domain name ("panXXX.healthunit.org"), have a mobile phone number. PANs are worn by patients over some periods (when prescribed), but a patient may replace a PAN for another PAN after some time (for instance, a given PAN that was used by a recovered patient may be assigned later to a new patient).

In the medical centre, we also keep track of the municipalities where each patient is living over different periods of time ("Joe lived in Cascais from 1-dec-2011 to 31-mar-2013 and in Lisbon since then"). We also keep track of the periods in which two patients have cohabitated ("Joe lived with Mary from 1-dec-2011 to 31-mar-2013 and has been living with Nicole since 30-apr-2014"). The database has the name, address and the (unique) National Health Service number of each patient: a municipality has a name and a unique 5 digit code (assigned by the National Bureau of Statistics).

> **Note:** To encode periods that have not ended in the database, i.e., periods spanning from sometime ago to the present you could set the final date of the period to a special date, e.g. Dec 31st, 2999. For instance, to encode that a blood pressure device is connected to PAN pan99.healthunit.org since September 28th, 2015 until now, or a patient who moved to the municipality of Lisbon the same date, we would set the start and end dates of the relevant periods to "Mon Sep 28 00:00:00 WEST 2015" and "Tue Dec 31 00:00:00 WEST 2999", respectively.

Expected Results

Your group's report must include two main results:

1. An E-R model describing your proposed database design. Every design decision that can be captured in the E-R model should be represented in the diagram. The E-R notation should be the same as in the slides for this course. You may use a diagram editor, such as *Dia*, to draw the final E-R model[5].

2. The relational model that is obtained by converting the E-R diagram into a set of tables. Please follow the conversion rules as explained in the slides for this course. To represent the relational model, use the following notation:

[5] *Dia* is available for Linux, Mac, and Wndows. See: http://dia-installer.de/

$$table_1(\underline{column_1}, column_2, column_3, column_4, \ldots)$$
$$column_2 : FK(table_2)$$
$$column_3, column_4 : FK(table_3)$$
$$\ldots$$

where *column₁* is underlined because it is the primary key, and *column₂* is a foreign key to *table₂*.

Submission Notes

The project report should be submitted to Fénix as a single PDF file[6]. Please check that the file is readable with a standard program such as Adobe Reader.

The document cover page should mention the names, student numbers, and group number of its authors.

If possible, the E-R diagram should be presented on a single page, and the relational model also on a single separate page.

The deadline for submission is Wednesday, October 21 2015 23:59 (Fénix time). According to Murphy's law, Fénix may have a downtime, and there might be peaks of activity that render the system unusable when the deadline approaches. Do not leave the submission to the last minute; ensure that the project is delivered properly and in a timely fashion.

[6] In most word processors, there is a menu option such as: File | Save as... PDF (*.pdf). In *Dia*, you can export a diagram as an image (File | Export...) and then insert the image into a document.