Mestrado em Engenharia Electrotécnica
e de Computadores

Sistemas de Informação e Bases de Dados

Part II

Project Assignment

Group 1

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Contents

1 Database creation

1.1 Database Schema

The database is created according to the provided schema. The file that sets up the database is called `databaseCreate.sql`. This file can be seen in Listing 1.

For textual columns we used the `varchar` type as it is a variable length type and therefore can result in smaller storage. `varchar` was also used to store devices' serial numbers so that they can be alphanumeric instead of being strictly numeric. The maximum length of each column was defined to values that we deemed reasonable.

Mobile numbers, municipality codes and patient IDs are created as `unsigned integer`s. On the other hand, values for readings and writings we used the `decimal` type.

To store dates the `datetime` type was used. This type allows us to store both the date and time on a single field.

All the primary and foreign keys were created as defined in the provided schema. The constraints introduced by these keys result in that the order of creation of the tables is not aribitrary. For example, the table `Actuator` has a foreign key to the `Device` table. Therefore, `Actuator` can only be created after the creation of `Device`. Creating the tables in an order that results in no errors is possible. But it is not desirable that the tables need to be created in a specific order. Therefore we used the `foreign_key_checks` MySQL option to disable the foreign key checking while doing the `drop`s and `create`s that set up the database. This way we could order both the `drop`s and `create`s alphabetically, which results in improved readability of the script. The use of `foreign_key_checks` can be seen in Listing 1.

At the end of the script the triggers and procedures are `source`d, so that the database is completely ready to be used when the script ends.

Listing 1: `databaseCreate.sql`

```
-- Disable foreign key checking while dropping the tables and
   creating new
-- ones. Otherwise tables must be dropped and created in a specific
   order such
-- that foreign keys' constraints are not infringed.
set foreign_key_checks=0;
drop table if exists Actuator;
drop table if exists Connects;
drop table if exists Device;
drop table if exists Lives;
drop table if exists Municipality;
drop table if exists PAN;
drop table if exists Patient;
drop table if exists Period;
drop table if exists Reading;
drop table if exists Sensor;
drop table if exists Setting;
```

```
drop table if exists Wears;


create table Actuator(
    snum            varchar(30),
    manuf           varchar(30),
    units           varchar(50),
    primary key(snum, manuf),
    foreign key(snum, manuf) references Device(serialnum,
       manufacturer)
);

create table Connects(
    start           datetime,
    end             datetime,
    snum            varchar(30),
    manuf           varchar(30),
    pan             varchar(21),
    primary key(start, end, snum, manuf),
    foreign key(start, end) references Period(start, end),
    foreign key(snum, manuf) references Device(serialnum,
       manufacturer),
    foreign key(pan) references PAN(domain)
);

create table Device(
    serialnum       varchar(30),
    manufacturer    varchar(30),
    description     varchar(255),
    primary key(serialnum, manufacturer)
);

create table Lives(
    start           datetime,
    end             datetime,
    patient         integer(9) unsigned,
    muni            integer(5) unsigned,
    primary key(start, end, patient),
    foreign key(start, end) references Period(start, end),
    foreign key(patient) references Patient(number),
    foreign key(muni) references Municipality(nut4code)
);
```

```
create table Municipality(
    nut4code        integer(5) unsigned,
    name            varchar(255),
    primary key(nut4code)
);

create table PAN(
    domain          varchar(255),
    phone           integer(9) unsigned,
    primary key(domain)
);

create table Patient(
    number      integer(9) unsigned,
    name        varchar(255),
    address     varchar(255),
    primary key(number)
);

create table Period(
    start           datetime,
    end             datetime,
    primary key(start, end)
);

create table Reading(
    snum            varchar(30),
    manuf           varchar(30),
    datetime        datetime,
    value           decimal(5,1),
    primary key(snum, manuf, datetime),
    foreign key(snum, manuf) references Sensor(snum, manuf)
);

create table Sensor(
    snum            varchar(30),
    manuf           varchar(30),
    units           varchar(50),
    primary key(snum, manuf),
    foreign key(snum, manuf) references Device(serialnum,
       manufacturer)
);
```

```
create table Setting (
    snum            varchar(30),
    manuf           varchar(30),
    datetime        datetime,
    value           decimal(5,1),
    primary key(snum, manuf, datetime),
    foreign key(snum, manuf) references Actuator(snum, manuf)
);

create table Wears(
    start           datetime,
    end             datetime,
    patient         integer(9) unsigned,
    pan             varchar(255),
    primary key(start, end, patient),
    foreign key(start, end) references Period(start, end),
    foreign key(patient) references Patient(number),
    foreign key(pan) references PAN(domain)
);

-- Re-enable foreign key checking
set foreign_key_checks=1;

-- Set up triggers
-- Trigger creation will raise warnings since we previously dropped
   the
--   tables the triggers were associated with. Dropping the tables
   also drops
--   the triggers.

source triggerDeviceTimeOverlap.sql;
source triggerUpdateDeviceTimeOverlap.sql;
source triggerPatientTimeOverlap.sql;
source triggerUpdatePatientTimeOverlap.sql;

-- Set up procedures
source display_all_readings.sql;
source display_all_settings.sql;
source display_devices.sql;

source queryManufacturer.sql;
source queryMunicipality.sql;
source queryReadings.sql;
```

1.2 Triggers

The database is expected to fire an error whenever trying to connect a device or patient to a PAN for a period of time overlapping an existing period for that device or patient. To enforce this behaviour we create four triggers: two triggers `before insert` and other two `before update`. These triggers check if a period incompatible with the one we are trying to create exists. If it does, then an inexistent procedure `overlapping_data()` is called. When this procedure is called an error will be generated (since the procedure does not exist) and this will rollback any changes that were made.

One thing we thought about is that triggering an error by calling a non-existing procedure is not a clean way to go about it. If in the future a procedure was added to the database with the same name as the procedure that is called to generate the error then not only would an error not be generated but also the `insert`/`update` could work when it should not. As of MySQL 5.5 a new keyword `signal` exists that allows to "'return' an error". This keyword also allows to set an error message.

Listings 2 and 4 show the triggers for inserting and updating a new device. The triggers for associating patients to a PAN are very alike the ones to associate devices (see Listings 3 and 5).

Listing 2: `triggerDeviceTimeOverlap.sql`

```
-- This trigger throws an error when inserting
-- (serial number, manufacturer, PAN) tuple whose time period
-- overlaps an already existing record.

drop trigger if exists overlapping_device_time;
delimiter $$

create trigger overlapping_device_time
before insert
on Connects for each row

begin
    if exists (select * from Connects
        where new.pan = Connects.pan
        and new.snum = Connects.snum
        and new.manuf = Connects.manuf
        and new.start <= end    -- trying to insert after a perior
            that exists
        and new.end >= start) then    -- trying to insert before a
            perior that exists

        -- call a non-existing method to raise an error
        -- TODO: solve this in a safer way
        call overlapping_data();
end if;
```

```
end$$

delimiter ;
```

Listing 3: triggerPatientTimeOverlap.sql

```
-- This trigger throws an error when inserting (PAN, patient) pair
-- whose time period overlaps an already existing record.

drop trigger if exists overlapping_patient_time;
delimiter $$

create trigger overlapping_patient_time
before insert
on Wears for each row

begin
    if exists (select * from Wears
        where new.pan = Wears.pan
        and new.patient = Wears.patient
        and new.start <= end    -- trying to insert after a perior
            that exists
        and new.end >= start) then    -- trying to insert before a
            perior that exists

        -- call a non-existing method to raise an error
        -- TODO: solve this in a safer way
        call overlapping_data();
end if;

end$$

delimiter ;
```

Listing 4: triggerUpdateDeviceTimeOverlap.sql

```
-- This trigger throws an error when updating
-- (serial number, manufacturer, PAN) tuple whose time period
-- overlaps an already existing record.

drop trigger if exists update_overlapping_device_time;
delimiter $$
```

```
create trigger update_overlapping_device_time
before update
on Connects for each row

begin
    if exists (select * from Connects
        where new.pan = Connects.pan
        and new.snum = Connects.snum
        and new.manuf = Connects.manuf
        and new.start <= end     -- trying to insert after a perior
            that exists
        and new.end >= start     -- trying to insert before a perior
            that exists
        and start not in(        -- removing the old row from the
            matching
            select start from Connects
            where old.start = start)
        and end not in(          -- removing the old row from the
            matching
            select end from Connects
            where old.end = end)) then
        -- call a non-existing method to raise an error
        -- TODO: solve this in a safer way
        call overlapping_data();
end if;

end$$

delimiter ;
```

Listing 5: triggerUpdatePatientTimeOverlap.sql

```
-- This trigger throws an error when updating (PAN, patient) pair
-- whose time period overlaps an already existing record.

drop trigger if exists update_overlapping_patient_time;
delimiter $$

create trigger update_overlapping_patient_time
before update
on Wears for each row

begin
    if exists (select * from Wears
```

```
        where new.pan = Wears.pan
        and new.patient = Wears.patient
        and new.start <= end     -- trying to insert after a perior
            that exists
        and new.end >= start     -- trying to insert before a perior
            that exists
        and start not in(        -- removing the old row from the
            matching
             select start from Wears
             where old.start = start)
        and end not in(          -- removing the old row from the
            matching
             select end from Wears
             where old.end = end)) then
        -- call a non-existing method to raise an error
        -- TODO: solve this in a safer way
         call overlapping_data();
end if;

end$$

delimiter ;
```

2 Queries

In this section the queries written for Question 2 of the assignment are presented.

2.1 Readings in the last 6 months concerning 'blood pressure'

Listing 6: queryReadings.sql

```
-- What are all the readings of a patient (identified by his/her
   number)
-- in the last 6 months from devices with the words "blood pressure"
-- in the description field?

drop procedure if exists queryReadings;

delimiter $$

create procedure queryReadings()
begin
    select distinct Wears.patient as 'Patient ID', Reading.snum,
       Reading.manuf, datetime, Sensor.units,Reading.value, Device.
       description
    from Reading, Wears, Connects, Device, Sensor
    where Wears.pan = Connects.pan
    and Connects.snum = Reading.snum
    and Connects.manuf = Reading.manuf
    and Connects.snum = Device.serialnum
    and Connects.manuf = Device.manufacturer
    and Connects.snum = Sensor.snum
    and Reading.datetime between DATE_SUB(NOW(), interval 6 month)
       and NOW()
    and Reading.datetime between Connects.start and Connects.end
    and Reading.datetime between Wears.start and Wears.end
    and lower(Device.description) like 'blood pressure'
    order by Wears.patient;
end$$

delimiter ;
```

2.2 Municipality with the highest number of devices from Philips

Listing 7: queryMunicipality.sql

```
-- Which municipality has currently (now) the highest number of
-- installed devices from manufacturer "Philips?"

drop procedure if exists queryMunicipality;

delimiter $$

create procedure queryMunicipality()
begin
    select name as 'Municipality', muni as 'Code', count(manuf) as '
       Installed Devices'
    from Lives, Connects, Wears, Municipality
    where lower(Connects.manuf) = 'philips'
    and Connects.pan = Wears.pan
    and Wears.patient = Lives.patient
    and Municipality.nut4code = muni
    and NOW() between Connects.start and Connects.end
    and NOW() between Wears.start and Wears.end
    and NOW() between Lives.start and Lives.end
    group by muni
    having count(manuf) >= all(select count(manuf)
        from Lives, Connects, Wears
        where lower(Connects.manuf) = 'philips'
        and Connects.pan = Wears.pan
        and Wears.patient = Lives.patient
        and NOW() between Connects.start and Connects.end
        and NOW() between Wears.start and Wears.end
        and NOW() between Lives.start and Lives.end
        group by muni);

end$$

delimiter ;
```

2.3 Manufacturers that during the last year had a 'scale' being worn in all municipalities

Listing 8: `queryManufacturer.sql`

```
-- Which manufacturers had devices described as "scale" being
-- worn last year in all municipalities covered by the
-- medical centre?

drop procedure if exists queryManufacturer;

delimiter $$

create procedure queryManufacturer()
begin
select distinct manufacturer
from Device as d
where not exists(
    select nut4code
    from Municipality
    where nut4code not in(
        select muni
        from Connects, Device as d2, Wears, Lives
        where description like 'scale'
        and d2.serialnum = Connects.snum
        and Connects.pan = Wears.pan
        and Wears.patient = Lives.patient
        and d2.manufacturer = d.manufacturer
        and Wears.end > DATE_SUB(NOW(), interval 1 year)
        and Lives.end > DATE_SUB(NOW(), interval 1 year)
        and Connects.end > DATE_SUB(NOW(), interval 1 year)));

end$$

delimiter ;
```

3 The web application

In this section the pages and the website frontend and backend are presented. The main application page can be seen in Figure 1.

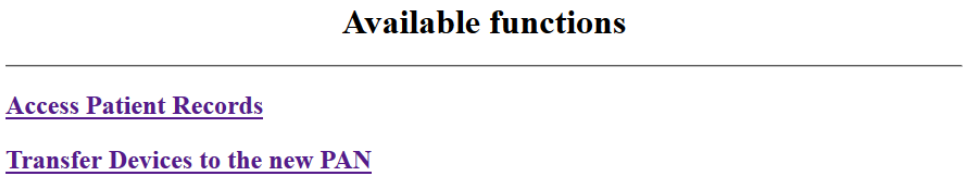

Figure 1: `index.php`

3.1 Search patients and show readings and settings

Listing 9: `patient_records.php`

```
<html>
    <head>
        <title>Find patient's readings and settings</title>
    </head>
    <body>

        <?php
            include_once("credentials.php");
            // what the file should include:
            // $user = "istXXXXX";
            // $dbhost = "db.ist.utl.pt";
            // $dbpass ="XXXXXX";
            // $dbname = "istXXXXX";
            $dsn = "mysql:host=$dbhost;dbname=$dbname";
        ?>

        <form method="post" action="patient_records.php">
            <p>Enter the patient's name:</p>
            <input type="text" name="name" />
            <input type="submit" name="submit" value="submit" />
        </form>
```

Enter the patient's name:

Marty McFly submit

Readings

Patient Number	*Read Date*	*Serial Number*	*Manufacturer*	*Units*	*Value*
111111111	2015-11-19 00:00:00	C4444	Philips	Kg	30.0
111111111	2015-11-12 00:00:00	C4444	Philips	Kg	30.0
111111111	2014-06-10 00:00:00	A3333	Ola	mmHg	40.0
111111111	2014-02-23 00:00:00	B2222	Aki	mmHg	9.0

Settings

Patient Number	*Setting Date*	*Serial Number*	*Manufacturer*	*Units*	*Value*
111111111	2014-06-10 00:00:00	A3333	Ola	mg/dl	31.0
555555555	2015-12-01 00:00:00	B5555	Aki	mg/dl	3.0
555555555	2015-11-01 00:00:00	A5555	Ola	mg/dl	28.9
555555555	2015-03-11 00:00:00	A5555	Ola	mg/dl	30.9

Figure 2: `patient_records.php`

```
<table border="1">
    <caption>Readings</caption>
    <tr>
        <td>Patient Number</td>
        <td>Read Date</td>
        <td>Serial Number</td>
        <td>Manufacturer</td>
        <td>Units</td>
        <td>Value</td>
    </tr>

    <?php
        // display readings for this patient
        if(isset($_POST['submit'])) {
            try{
                $connection = new PDO($dsn, $user, $dbpass);
            }
```

```
                catch(PDOException $exception){
                    echo("<p>Error: ");
                    echo($exception->getMessage());
                    echo("</p>");
                    exit();
                }
                $name = $_POST['name'];
                $sql = "call display_all_readings('$name');";
                $result = $connection->query($sql);
                if ($result == FALSE){
                    $info = $connection->errorInfo();
                    echo("<p>Error: {$info[2]}</p>");
                    exit();
                }

                $connection = null;

                foreach($result as $row){
                    echo("\n<tr>");
                    for($j = 0; $j < 6; $j++){
                        echo("<td>{$row[$j]}</td>");
                    }
                    echo("</tr>");
                }
            }
        ?>

    </table>
    <br><br>
    <table border="1">
        <caption>Settings</caption>
        <tr>
            <td><em>Patient Number</em></td>
            <td><em>Setting Date</em></td>
            <td><em>Serial Number</em></td>
            <td><em>Manufacturer</em></td>
            <td><em>Units</em></td>
            <td><em>Value</em></td>
        </tr>

        <?php
            // display settings for this patient
            if(isset($_POST['submit'])) {
```

```
                    try{
                        $connection = new PDO($dsn, $user, $dbpass);
                    }
                    catch(PDOException $exception){
                        echo("<p>Error: ");
                        echo($exception->getMessage());
                        echo("</p>");
                        exit();
                    }
                    $sql = "call display_all_settings('$name');";
                    $result = $connection->query($sql);
                    if ($result == FALSE){
                        $info = $connection->errorInfo();
                        echo("<p>Error: {$info[2]}</p>");
                        exit();
                    }
                    foreach($result as $row){
                        echo("<tr>");
                        for($j = 0; $j < 6; $j++){
                            echo("<td>{$row[$j]}</td>");
                        }
                        echo("</tr>\n");
                    }
                    $connection = null;
                }
            ?>

        </table>
    </body>
</html>
```

Listing 10: `display_all_readings.sql`

```
drop procedure if exists display_all_readings;

delimiter $$

create procedure display_all_readings(in p_name varchar(255))
begin
    select distinct Patient.number, Reading.datetime, Reading.snum,
       Reading.manuf, Sensor.units, Reading.value
    from Patient, Wears, Connects, Reading, Sensor
    where Patient.name = p_name
    and Patient.number = Wears.patient
```

```
    and Wears.pan = Connects.pan
    and Connects.snum = Reading.snum
    and Reading.snum = Sensor.snum
    and Reading.datetime between Wears.start and Wears.end
    and Reading.datetime between Connects.start and Connects.end
    order by Patient.number, Reading.datetime desc;
end$$

delimiter ;
```

Listing 11: display_all_settings.sql

```
drop procedure if exists display_all_settings;

delimiter $$

create procedure display_all_settings(in p_name varchar(255))
begin
    select distinct Patient.number, Setting.datetime, Setting.snum,
       Setting.manuf, Actuator.units, Setting.value
    from Patient, Wears, Connects, Setting, Actuator
    where Patient.name = p_name
    and Patient.number = Wears.patient
    and Wears.pan = Connects.pan
    and Connects.snum = Setting.snum
    and Setting.snum = Actuator.snum
    and Setting.datetime between Wears.start and Wears.end
    and Setting.datetime between Connects.start and Connects.end
    order by Patient.number, Setting.datetime desc;
end$$

delimiter ;
```

3.2 Transfering devices from a patients' old PAN to his new one

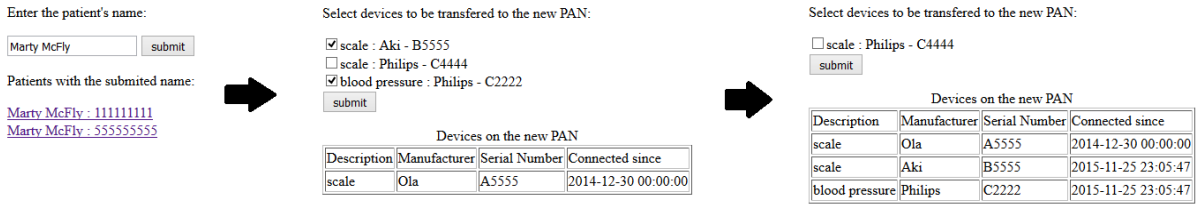

Figure 3: `transfer_devices.php`

Listing 12: `transfer_devices.php`

```
<html>
    <head>
        <title>Transfer devices to the new PAN</title>
    </head>
    <body>

        <?php
            include_once("credentials.php");
            // what the file should include:
            // $user = "istXXXXX";
            // $dbhost = "db.ist.utl.pt";
            // $dbpass ="XXXXXX";
            // $dbname = "ist173373";
            $dsn = "mysql:host=$dbhost;dbname=$dbname";
        ?>

        <form method="post" action="transfer_devices.php">
            <p>Enter the patient's name:</p>
            <input type="text" name="name" />
            <input type="submit" name="submit" value="submit" />
        </form>


        <?php
            // find the patients 2 most recent PAN's
            if(isset($_POST['submit'])) {
                echo "<p>Patients with the submited name:</p>";
                try{
                    $connection = new PDO($dsn, $user, $dbpass);
                }
```

```
                catch(PDOException $exception){
                    echo("<p>Error: ");
                    echo($exception->getMessage());
                    echo("</p>");
                    exit();
                }
                $name = $_POST['name'];

                $get_patients = "select number from Patient where
                   name = '$name'";

                $result = $connection->query($get_patients);


                foreach($result as $row){
                      echo("<a href='transfer_devices2.php?ID=$row
                         [0]'>$name : $row[0]</a></br>");
                }

                $connection = null;
            }
        ?>
    </body>
</html>
```

Listing 13: `transfer_devices2.php`

```
<?php session_start(); ?>
<html>
    <head>
        <title>Transfer devices to the new PAN</title>
    </head>
    <body>

<?php
    include_once("credentials.php");
    // what the file should include:
    // $user = "istXXXXX";
    // $dbhost = "db.ist.utl.pt";
    // $dbpass ="XXXXXX";
    // $dbname = "ist173373";
    $dsn = "mysql:host=$dbhost;dbname=$dbname";

    try{
```

```
        $connection = new PDO($dsn, $user, $dbpass);
    }
    catch(PDOException $exception){
        echo("<p>Error: ");
        echo($exception->getMessage());
        echo("</p>");
        exit();
    }

    if(isset($_REQUEST['ID'])){

        $ID = $_REQUEST['ID'];

        $get_pans = "select end, pan from Wears, Patient
                where Patient.number = Wears.patient
                and number = $ID
                order by end desc limit 2";

        $result = $connection->query($get_pans);


        $current_pan = $result->fetch()['pan'];

        $previous_pan = $result->fetch();

        $previous_end = $previous_pan['end'];
        $previous_pan = $previous_pan['pan'];

        if(isset($_POST['submit'])){
            $selected_devices = $_POST['selected_devices'];
            $now = date('Y-m-d H:i:s');
            $connection->query("insert into Period values ('$now',
               '2099-01-01 00:00:00')");

            foreach($selected_devices as $i){
                $manuf = $_SESSION['devices'][$i]['manuf'];
                $snum = $_SESSION['devices'][$i]['snum'];

                $update = "update Connects set start='$now', pan='
                   $current_pan' where manuf='$manuf' and snum='
                   $snum' and end='2099-01-01 00:00:00'";
                $result = $connection->query($update);
                if($result == False){
```

```
                echo("<p>Error: {$connection->errorInfo()[2]}/<p
                    >");
            }
        }
    }

    $get_devices = "select start, end, snum, manuf, description
                from Connects, Device
                where snum = serialnum
                and manuf = manufacturer
                and pan = '$previous_pan'
                and '$previous_end' < '2099-01-01 00:00:00'
                and end = '2099-01-01 00:00:00'";
                //pan nao activa e device ainda ligado a pan


    $result = $connection->query($get_devices);
    if($result == False){
        echo("<p>Error: {$connection->errorInfo()[2]}/<p>");
    }

    echo("<form method='post' action=''>");
    echo("<p>Select devices to be transfered to the new PAN:</p>
        ");

    $i = 0;
    foreach($result as $row){
        $devices[$i]['manuf'] = $row['manuf'];
        $devices[$i]['snum'] = $row['snum'];
        echo("<input type='checkbox' name='selected_devices[]'
            value=$i />$row[description] : $row[manuf] - $row[
            snum]</br>");
        $i++;
    }
    $_SESSION['devices'] = $devices;

    echo("<input type='submit' name='submit' value='submit' />")
        ;
    echo("</form>");

    $get_devices = "select start, end, snum, manuf, description
                    from Connects, Device
                    where snum = serialnum
```

```
                        and manuf = manufacturer
                        and pan = '$current_pan'
                        and end = '2099-01-01 00:00:00'";
                        //pan nao activa e device ainda ligado a pan


        $result = $connection->query($get_devices);
        if($result == False){
            echo("<p>Error: {$connection->errorInfo()[2]}/<p>");
        }
        echo "<table border='1'>
                <caption>Devices on the new PAN</caption>
                <tr>
                    <td>Description</td>
                    <td>Manufacturer</td>
                    <td>Serial Number</td>
                    <td>Connected since</td>
                </tr>";

        foreach($result as $row){
            echo("<tr><td> $row[description] </td><td> $row[manuf]
               </td><td> $row[snum] </td><td> $row[start] </td></tr>
               ");
        }
        echo "</table>";
    }

    $connection = null;
?>
    </body>
</html>
```

A Sample data for the database

The file in Listing 14 was used to populate the database and do subsequent testing of the project's functionalities.

Listing 14: `testingdata/databaseInsert.sql`

```
insert into Patient values (111111111, 'Ana', 'Porto');
insert into Patient values (222222222,'Beatriz','Lisboa');
insert into Patient values (333333333, 'Xavier', 'Faro');
insert into Patient values (444444444, 'Pedro', 'Porto');
insert into Patient values (555555555, 'Ana', 'Lisboa');
insert into Patient values (666666666, 'Maria', 'Faro');

insert into PAN values ('www.ist1111.com',911111111);
insert into PAN values ('www.ist2222.com',922222222);
insert into PAN values ('www.ist3333.com',933333333);
insert into PAN values ('www.ist4444.com',944444444);
insert into PAN values ('www.ist5555.com',955555555);
insert into PAN values ('www.ist6666.com',966666666);
insert into PAN values ('www.ist7777.com',977777777);

insert into Device values ('A1111', 'Ola','blood pressure');
insert into Device values ('A2222', 'Ola','scale');
insert into Device values ('A3333', 'Ola','blood pressure');
insert into Device values ('A4444', 'Ola','scale');
insert into Device values ('A5555', 'Ola','scale');
insert into Device values ('B1111', 'Aki','scale');
insert into Device values ('B2222', 'Aki','blood pressure');
insert into Device values ('B3333', 'Aki','scale');
insert into Device values ('B4444', 'Aki','blood pressure');
insert into Device values ('B5555', 'Aki','scale');
insert into Device values ('C1111', 'Philips','scale');
insert into Device values ('C2222', 'Philips','blood pressure');
insert into Device values ('C3333', 'Philips','blood pressure');
insert into Device values ('C4444', 'Philips','scale');
insert into Device values ('C5555', 'Philips','scale');

insert into Sensor values ('A1111', 'Ola','mmHg');
insert into Sensor values ('A2222', 'Ola','Kg');
insert into Sensor values ('A3333', 'Ola','mmHg');
insert into Sensor values ('A4444', 'Ola','Kg');
insert into Sensor values ('B1111', 'Aki','Kg');
insert into Sensor values ('B2222', 'Aki','mmHg');
```

```
insert into Sensor values ('B3333', 'Aki','Kg');
insert into Sensor values ('B4444', 'Aki','mmHg');
insert into Sensor values ('C1111', 'Philips','Kg');
insert into Sensor values ('C2222', 'Philips','mmHg');
insert into Sensor values ('C4444', 'Philips','Kg');

insert into Actuator values ('A1111', 'Ola','mg/dl');
insert into Actuator values ('A3333', 'Ola','mg/dl');
insert into Actuator values ('A5555', 'Ola','mg/dl');
insert into Actuator values ('B2222', 'Aki','mg/dl');
insert into Actuator values ('B5555', 'Aki','mg/dl');
insert into Actuator values ('C2222', 'Philips','mg/dl');
insert into Actuator values ('C3333', 'Philips','mg/dl');
insert into Actuator values ('C5555', 'Philips','mg/dl');

insert into Municipality values (11111, 'Porto');
insert into Municipality values (22222, 'Lisboa');
insert into Municipality values (33333, 'Faro');

insert into Period values ('2014-01-20 00:00:00','2014-06-10
   00:00:00');
insert into Period values ('2014-06-20 00:00:00','2099-01-01
   00:00:00');
insert into Period values ('2015-10-30 00:00:00','2099-01-01
   00:00:00');
insert into Period values ('2015-01-10 00:00:00','2015-02-22
   00:00:00');
insert into Period values ('2014-12-30 00:00:00','2099-01-01
   00:00:00');
insert into Period values ('2014-12-01 00:00:00','2099-01-01
   00:00:00');
insert into Period values ('2015-02-11 00:00:00','2015-03-11
   00:00:00');
insert into Period values ('2014-01-01 00:00:00','2014-03-02
   00:00:00');
insert into Period values ('2014-08-09 00:00:00','2099-01-01
   00:00:00');
insert into Period values ('2014-02-23 00:00:00','2014-06-10
   00:00:00');
insert into Period values ('2014-02-20 00:00:00','2014-06-10
   00:00:00');
insert into Period values ('2014-02-28 00:00:00','2014-06-10
   00:00:00');
```

```
insert into Period values ('2014-06-20 00:00:00','2015-01-10
    00:00:00');
insert into Period values ('2014-06-10 00:00:00','2015-01-10
    00:00:00');
insert into Period values ('2014-06-10 00:00:00','2099-01-01
    00:00:00');
insert into Period values ('2015-01-10 00:00:00','2099-01-01
    00:00:00');
insert into Period values ('2015-03-11 00:00:00','2099-01-01
    00:00:00');
insert into Period values ('2014-01-30 00:00:00','2014-06-10
    00:00:00');
insert into Period values ('2015-02-02 00:00:00','2099-01-01
    00:00:00');
insert into Period values ('2015-11-01 00:00:00','2099-01-01
    00:00:00');
insert into Period values ('2015-11-08 00:00:00','2099-01-01
    00:00:00');
insert into Period values ('2015-11-10 00:00:00','2099-01-01
    00:00:00');
insert into Period values ('2015-11-12 00:00:00','2099-01-01
    00:00:00');
insert into Period values ('2015-11-17 00:00:00','2099-01-01
    00:00:00');
insert into Period values ('2015-11-19 00:00:00','2099-01-01
    00:00:00');
insert into Period values ('2014-01-01 00:00:00','2099-01-01
    00:00:00');

insert into Reading values ('A1111' ,'Ola'  ,'2014-01-20 00:00:00'
    ,10.1);
insert into Reading values ('A1111' ,'Ola'  ,'2015-11-01 00:00:00'
    ,20.8);
insert into Reading values ('A1111' ,'Ola'  ,'2015-01-10 00:00:00'
    ,1.2);
insert into Reading values ('A1111' ,'Ola'  ,'2015-02-11 00:00:00'
    ,2.1);
insert into Reading values ('A1111' ,'Ola'  ,'2015-11-08 00:00:00'
    ,4.9);
insert into Reading values ('A2222' ,'Ola'  ,'2014-01-01  00:00:00'
    ,22);
insert into Reading values ('A2222' ,'Ola'  ,'2015-11-01 00:00:00'
    ,33);
```

```
insert into Reading values ('A2222','Ola' ,'2015-11-12 00:00:00'
    ,44);
insert into Reading values ('A3333','Ola' ,'2014-06-10 00:00:00'
    ,40);
insert into Reading values ('A3333','Ola' ,'2014-06-20 00:00:00'
    ,63);
insert into Reading values ('A3333','Ola' ,'2015-02-22 00:00:00'
    ,41);
insert into Reading values ('A3333','Ola' ,'2015-11-10 00:00:00'
    ,45);
insert into Reading values ('A4444','Ola' ,'2014-01-01 00:00:00'
    ,61);
insert into Reading values ('A4444','Ola' ,'2014-06-20 00:00:00'
    ,37);
insert into Reading values ('A4444','Ola' ,'2015-11-17 00:00:00'
    ,54);
insert into Reading values ('B1111','Aki' ,'2014-03-02 00:00:00'
    ,22);
insert into Reading values ('B1111','Aki' ,'2014-06-10 00:00:00'
    ,33);
insert into Reading values ('B1111','Aki' ,'2015-11-01 00:00:00'
    ,11);
insert into Reading values ('B2222','Aki' ,'2014-01-20 00:00:00'
    ,10);
insert into Reading values ('B2222','Aki' ,'2014-02-23 00:00:00'
    ,9);
insert into Reading values ('B2222','Aki' ,'2014-06-20 00:00:00'
    ,8);
insert into Reading values ('B2222','Aki' ,'2014-12-01 00:00:00'
    ,12);
insert into Reading values ('B2222','Aki' ,'2015-11-01 00:00:00'
    ,11);
insert into Reading values ('B3333','Aki' ,'2014-08-09 00:00:00'
    ,1.2);
insert into Reading values ('B3333','Aki' ,'2015-11-17 00:00:00'
    ,11);
insert into Reading values ('B3333','Aki' ,'2015-11-19 00:00:00'
    ,22);
insert into Reading values ('B4444','Aki' ,'2014-08-09 00:00:00'
    ,23);
insert into Reading values ('B4444','Aki' ,'2015-01-10 00:00:00'
    ,28);
```

```
insert into Reading values ('B4444','Aki','2015-03-11 00:00:00'
    ,29);
insert into Reading values ('C1111','Philips','2014-08-09 00:00:00
    ',10);
insert into Reading values ('C1111','Philips','2015-01-10 00:00:00
    ',5);
insert into Reading values ('C1111','Philips','2015-11-17 00:00:00
    ',9);
insert into Reading values ('C2222','Philips','2015-11-17 00:00:00
    ',22);
insert into Reading values ('C2222','Philips','2015-11-12 00:00:00
    ',33);
insert into Reading values ('C4444','Philips','2015-11-12 00:00:00
    ',30);
insert into Reading values ('C4444','Philips','2015-11-19 00:00:00
    ',30);

insert into Setting values ('A1111','Ola','2014-01-20 00:00:00'
    ,5.1);
insert into Setting values ('A1111','Ola','2014-12-01 00:00:00'
    ,20.1);
insert into Setting values ('A1111','Ola','2015-10-30 00:00:00'
    ,30.1);
insert into Setting values ('A3333','Ola','2014-06-10 00:00:00'
    ,31);
insert into Setting values ('A3333','Ola','2015-11-19 00:00:00'
    ,27);
insert into Setting values ('A5555','Ola','2015-03-11 00:00:00'
    ,30.9);
insert into Setting values ('A5555','Ola','2015-11-01 00:00:00'
    ,28.9);
insert into Setting values ('B2222','Aki','2014-01-20 00:00:00'
    ,12);
insert into Setting values ('B2222','Aki','2015-11-19 00:00:00'
    ,3);
insert into Setting values ('B2222','Aki','2015-11-12 00:00:00'
    ,4);
insert into Setting values ('B5555','Aki','2015-12-01 00:00:00'
    ,3);
insert into Setting values ('B5555','Aki','2015-11-19 00:00:00'
    ,11);
insert into Setting values ('C2222','Philips','2014-03-02 00:00:00
    ',43);
```

```
insert into Setting values ('C2222','Philips','2015-11-17 00:00:00
    ',65);
insert into Setting values ('C3333','Philips','2015-11-12 00:00:00
    ',90);
insert into Setting values ('C3333','Philips','2015-11-19 00:00:00
    ',66);
insert into Setting values ('C5555','Philips','2014-01-20 00:00:00
    ',43);
insert into Setting values ('C5555','Philips','2014-06-10 00:00:00
    ',38);
insert into Setting values ('C5555','Philips','2015-11-08 00:00:00
    ',39);

insert into Wears values ('2014-01-20 00:00:00','2014-06-10
   00:00:00',111111111,'www.ist1111.com');
insert into Wears values ('2014-06-20 00:00:00','2099-01-01
   00:00:00',111111111,'www.ist4444.com');
insert into Wears values ('2015-01-10 00:00:00','2015-02-22
   00:00:00',222222222,'www.ist2222.com');
insert into Wears values ('2015-10-30 00:00:00','2099-01-01
   00:00:00',222222222,'www.ist5555.com');
insert into Wears values ('2014-01-01 00:00:00','2014-03-02
   00:00:00',333333333,'www.ist3333.com');
insert into Wears values ('2014-12-30 00:00:00','2099-01-01
   00:00:00',333333333,'www.ist6666.com');
insert into Wears values ('2014-01-30 00:00:00','2014-06-10
   00:00:00',444444444,'www.ist5555.com');
insert into Wears values ('2015-02-11 00:00:00','2015-03-11
   00:00:00',444444444,'www.ist1111.com');
insert into Wears values ('2015-10-30 00:00:00','2099-01-01
   00:00:00',444444444,'www.ist7777.com');
insert into Wears values ('2014-01-01 00:00:00','2014-03-02
   00:00:00',555555555,'www.ist4444.com');
insert into Wears values ('2014-12-30 00:00:00','2099-01-01
   00:00:00',555555555,'www.ist3333.com');

insert into Lives values ('2014-02-23 00:00:00','2014-06-10
   00:00:00',111111111,33333);
insert into Lives values ('2014-06-10 00:00:00','2099-01-01
   00:00:00',111111111,11111);
insert into Lives values ('2014-02-28 00:00:00','2014-06-10
   00:00:00',222222222,11111);
```

```
insert into Lives values ('2014-06-10 00:00:00' ,'2015-01-10
    00:00:00' ,222222222 ,33333);
insert into Lives values ('2015-01-10 00:00:00' ,'2099-01-01
    00:00:00' ,222222222 ,22222);
insert into Lives values ('2015-01-10 00:00:00' ,'2099-01-01
    00:00:00' ,333333333 ,33333);
insert into Lives values ('2015-02-11 00:00:00' ,'2015-03-11
    00:00:00' ,444444444 ,33333);
insert into Lives values ('2015-03-11 00:00:00' ,'2099-01-01
    00:00:00' ,444444444 ,11111);
insert into Lives values ('2015-02-11 00:00:00' ,'2015-03-11
    00:00:00' ,555555555 ,11111);
insert into Lives values ('2015-03-11 00:00:00' ,'2099-01-01
    00:00:00' ,555555555 ,22222);
insert into Lives values ('2014-06-20 00:00:00' ,'2099-01-01
    00:00:00' ,666666666 ,33333);

insert into Connects values('2014-01-20 00:00:00' ,'2014-06-10
    00:00:00' ,'C1111' ,'Philips' ,'www.ist1111.com');
insert into Connects values('2014-02-20 00:00:00' ,'2014-06-10
    00:00:00' ,'A3333' ,'Ola'   ,'www.ist1111.com');
insert into Connects values('2014-02-23 00:00:00' ,'2014-06-10
    00:00:00' ,'B2222' ,'Aki'   ,'www.ist1111.com');
insert into Connects values('2014-02-28 00:00:00' ,'2014-06-10
    00:00:00' ,'B3333' ,'Aki'   ,'www.ist1111.com');
insert into Connects values('2014-06-20 00:00:00' ,'2099-01-01
    00:00:00' ,'C2222' ,'Philips' ,'www.ist4444.com');
insert into Connects values('2015-01-10 00:00:00' ,'2015-02-22
    00:00:00' ,'C3333' ,'Philips' ,'www.ist2222.com');
insert into Connects values('2015-10-30 00:00:00' ,'2099-01-01
    00:00:00' ,'A1111' ,'Ola'   ,'www.ist5555.com');
insert into Connects values('2014-01-01 00:00:00' ,'2014-03-02
    00:00:00' ,'A1111' ,'Ola'   ,'www.ist3333.com');
insert into Connects values('2014-01-01 00:00:00' ,'2014-03-02
    00:00:00' ,'B1111' ,'Aki'   ,'www.ist3333.com');
insert into Connects values('2014-12-30 00:00:00' ,'2099-01-01
    00:00:00' ,'A2222' ,'Ola'   ,'www.ist6666.com');
insert into Connects values('2015-10-30 00:00:00' ,'2099-01-01
    00:00:00' ,'C5555' ,'Philips' ,'www.ist6666.com');
insert into Connects values('2014-01-01 00:00:00' ,'2099-01-01
    00:00:00' ,'B4444' ,'Aki'   ,'www.ist5555.com');
insert into Connects values('2015-02-11 00:00:00' ,'2015-03-11
    00:00:00' ,'C1111' ,'Philips' ,'www.ist1111.com');
```

```
insert into Connects values('2015-10-30 00:00:00','2099-01-01
    00:00:00','A4444','Ola','www.ist7777.com');
insert into Connects values('2014-01-01 00:00:00','2099-01-01
    00:00:00','C4444','Philips','www.ist4444.com');
insert into Connects values('2014-01-01 00:00:00','2099-01-01
    00:00:00','B5555','Aki','www.ist4444.com');
insert into Connects values('2014-12-30 00:00:00','2099-01-01
    00:00:00','A5555','Ola','www.ist3333.com');
```