Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Advanced Databases Systems

Date: Wednesday 25th May 2011
Time: 09:45 - 11:45

Please answer any THREE questions from the FIVE questions provided

For full marks your answers should be concise as well as accurate.
Marks will be awarded for reasoning and method as well as being correct.

This is a CLOSED book examination

The use of electronic calculators is NOT permitted
1. The following PL/SQL stored procedure, given the name and address of a customer, makes a booking for a given number of flight seats and hotel rooms on a given package on a given departure week number. Relation WeeklyPackage is the setting for the questions that follow.

WeeklyPackage (packagecode, depweek, seatsavail, roomsavail);

procedure make_booking (name char, address char, package number, departureweek number, seats number, rooms number) is

seats_available binary_integer;
rooms_available binary_integer;

not_enough_seats exception;
not_enough_rooms exception;

begin
select seatsavail, roomsavail
into seats_available, rooms_available
from WeeklyPackage
where packagecode = package and depweek = departureweek;

if (seats_available < seats) then
  raise not_enough_seats;
end if;

if (rooms_available < rooms) then
  raise not_enough_rooms;
end if;

insert into Booking values
  (name, address, package, departureweek, seats, rooms);

exception
  when not_enough_seats then
    raise_application_error(-20226, 'Not enough seats');
  when not_enough_rooms then
    raise_application_error(-20226, 'Not enough rooms');
end make_booking

a) Provide an implementation of the same functionality using JDBC. You do not need to show how the connection to the database is established or provide details of how Java exceptions are caught. State any assumptions you make.

(10 marks)
b) State 4 reasons why PL/SQL may be preferred in a project to JDBC.

(4 marks)

c) You have been told the following: “The PL/SQL will be quicker in this case”. Do you agree with this statement? Discuss your opinion, using as arguments the issues that are relevant to this claim.

(6 marks)
2. This question assumes the following tables:

\[ \text{Student(} \text{stdId, name, overallMark) } \]
\[ \text{Grade(} \text{stdId, Module, Mark) } \]

The Student table stores the identifier, the name and the total mark obtained by a student on all of his/her modules. The overall mark is the sum of the module marks. The Grade table indicates that mark was obtained by each student on each module.

a) Write row triggers that propagate all relevant changes made to the Grade table (i.e. inserts, deletes or updates) to the Student table, stating any assumptions you make. (10 marks)

b) Triggers and stored procedures provide ways of implementing application functionality within the database. State five advantages or disadvantages of moving functionality from application programs into the database, indicating why you think each is a good or bad thing. (10 marks)
3. a) Assuming that a persistent class Part is present in a JDO database, and it has attributes id (unique), name and price, write a JDO program that deletes all parts with a price higher than 200 from the database. You do NOT need to write the statements related to database connection, and you can assume that you have access to an initialised PersistenceManager object. You DO need to include transactions and exception handling. (5 marks)

b) The following code fragment creates two Java objects.

```java
Team t = new Team("Manchester United");
Player p = new Player (9, "Wayne", t);
```

i) Provide additional code that would enable the objects to be stored on disk, assuming that each Player has a reference to its Team. You do NOT need to write the statements related to database connection, and you can assume that you have access to an initialised PersistenceManager object. You DO need to include transactions and exception handling. (6 marks)

ii) In the above example, state whether you need to make both objects persistent explicitly and explain why. (2 marks)

c) In JDO, any request that can be expressed as a query can also be written as a program that navigates from an extent. Discuss the pros and cons of the two approaches. (7 marks)
4. The following XML Schema is relevant to this question:

```xml
<schema xmlns="http://www.w3.org/2001/XMLSchema"
    xmlns:r="http://recipes.org"
    targetNamespace="http://recipes.org"
    elementFormDefault="qualified">
  <element name="collection">
    <complexType>
      <sequence>
        <element name="description" type="string"/>
        <element ref="r:recipe" minOccurs="0" maxOccurs="unbounded"/>
      </sequence>
    </complexType>
  </element>
  <element name="recipe">
    <complexType>
      <sequence>
        <element name="title" type="string"/>
        <element ref="r:ingredient" minOccurs="0" maxOccurs="unbounded"/>
        <element ref="r:preparation"/>
        <element name="comment" minOccurs="0" type="string"/>
        <element name="nutrition">
          <complexType>
            <attribute name="protein" type="r:nonNegativeDecimal" use="required"/>
            <attribute name="carbohydrates" type="r:nonNegativeDecimal" use="required"/>
            <attribute name="fat" type="r:nonNegativeDecimal" use="required"/>
            <attribute name="calories" type="r:nonNegativeDecimal" use="required"/>
            <attribute name="alcohol" type="r:nonNegativeDecimal" use="optional"/>
          </complexType>
        </element>
      </sequence>
    </complexType>
  </element>
  <element name="preparation">
    <complexType>
      <sequence>
        <element name="step" type="string" minOccurs="0" maxOccurs="unbounded"/>
      </sequence>
    </complexType>
  </element>
  <element name="ingredient">
    <complexType>
      <attribute name="unit" type="string" use="optional"/>
    </complexType>
  </element>
</schema>
```
a) Give an example of an XML document that validates against the above schema, and represents a recipe of your own choosing. (7 marks)

b) Construct a relational schema that contains the same information as the above XML Schema. The schema should state keys and constraints where relevant, and types for all attributes. State any assumptions you make. (7 marks)

c) Illustrating your answer with the XML example above, state four benefits or weaknesses of the XML data representation compared with the relational model. (6 marks)
5. The following database schemas store information on electrical goods:

**Database1:**

Cost(partId:String, description:String, cost:Real)
  // Cost is sale cost – includes VAT
Maker(partId:String, manufacturer:String)
Television(partId:String, screenSize:Integer)
PersonalStereo(partId:String, type:String)
  // Type = CD | Cassette
Hifi(partId:String, power:Integer, CD:Bool, cassette:Bool, record:Bool)

**Database2:**

Product(id:String, desc:String, maker:String, cost:Real)
  // Cost excludes VAT
AudioProduct(id:String, CD:Bool, turner:Bool, cassette:Bool, portable:Bool)
TV(id:String, video:Bool, digital:Bool)

a) Describe 4 examples of schema conflicts between the above schemas. Each of the conflicts should be of a different kind (e.g. you should not describe more than one Table-Attribute conflict), and in each case you should state the kind of conflict involved. (8 marks)

b) It is common practice to use views to hide from users the schematic differences between independently developed schemas. Provide SQL views that:

   i) Derive a table Cost with the schema given in Database1 using only the tables in Database2. (3 marks)
   ii) Derive a table Product with the schema given in Database2 using only the tables in Database1. (4 marks)
   iii) Derive a table AudioProduct with the schema given in Database2 using only the tables in Database1. (5 marks)