UNIVERSITY OF DUBLIN
TRINITY COLLEGE

Faculty of Engineering, Mathematics and Science

School of Computer Science & Statistics

Integrated Computer Science   **Trinity Term 2013**

BA (Mod) Business & Computing

Information Management II

Prof. Séamus Lawless

Thursday 2nd May 2013   **Luce Upper(405)**   **09:30 – 11:30**

Instructions to Candidates:

Answer three questions in total
This must include **either** question **1 or 4.**
Questions 2 and 3 are mandatory.
All questions carry equal marks.
Answer each question in a separate answer book.

Materials permitted for this examination:

None

1. The Tour de France cycle race organisers have to maintain a database for the event. The race is made up of a number of "stages" which are individual races that take place in different locations throughout France over the course of a month. A number of teams compete in the race. Each team is made up of a number of cyclists. All cyclists take part in every stage of the race. The position that each cyclist finished and their time must be recorded for each stage. In addition a record must be kept of the overall leader of the race, who wears the "yellow jersey".

   a. Using the notation described in class, draw an Entity Relationship Diagram for the above "real world" event. Map this Entity Relationship Diagram to a Relational Schema. Ensure you indicate the Primary Keys of your tables and any Foreign Keys. In addition, draw a Functional Dependency Diagram for this schema and ensure that the schema is in Boyce Codd normal form. State any assumptions that you make in your modelling of the database.

   [10 Marks]

   b. Write SQL Commands to do the following:

      i. Create the Stage table with at least one appropriate semantic constraint.

      [5 Marks]

      ii. Retrieve the names of all stage winners in the Tour.

      [2 Marks]

      iii. Remove a cyclist from the Database who has had to retire from the Tour due to injury.

      [3 Marks]

      iv. Write a trigger which ensures that, before a cyclist is inserted or updated, the team they are allocated to does not have more than the maximum 9 cyclists.

      [5 Marks]

2.

   a. What are the four desirable properties of a transaction? Explain each of these properties.

[4 Marks]

   b. Concurrently executing transactions can potentially cause a number of problems if they are not correctly scheduled. Discuss these problems, making reference to "Lost Update", "Temporary Update (Dirty Read)" and "Incorrect Summary".

[5 Marks]

   c. Serializable schedules are those which are said to be equivalent to a serial schedule. How is equivalence measured?
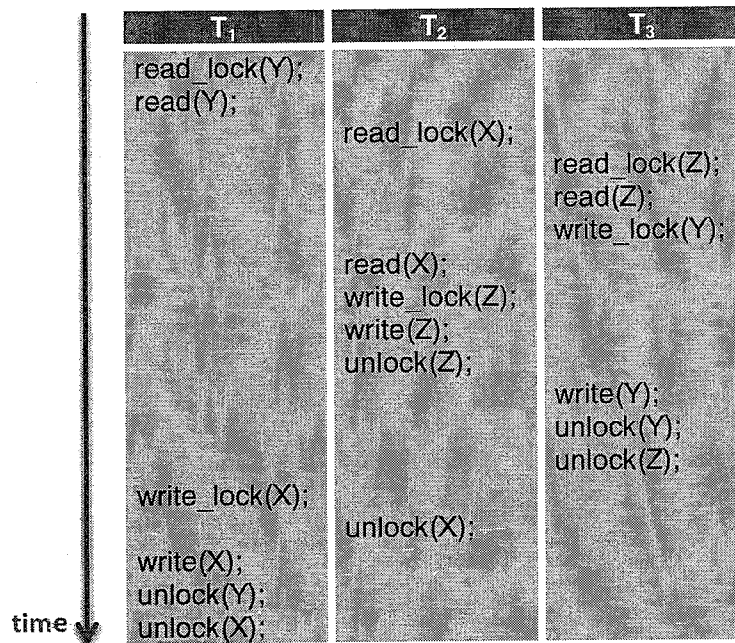
[4 Marks]

   d. Explain how concurrency control algorithms which are based upon locking techniques ensure that concurrently executing transactions do not interfere with each other's execution. How are the problems of deadlock and starvation avoided? Make specific reference to the operation of the "Wait-Die" and "Wound-Wait" algorithms.

[8 Marks]

(Question 2 continued from previous page).....

e. Indicate how the "Wound-Wait" algorithm would execute the following schedule:

T₁	T₂	T₃
read_lock(Y); read(Y);		
	read_lock(X);	
		read_lock(Z); read(Z); write_lock(Y);
	read(X); write_lock(Z); write(Z); unlock(Z);	
		write(Y); unlock(Y); unlock(Z);
write_lock(X);		
	unlock(X);	
write(X); unlock(Y); unlock(X);		

[4 Marks]

3.

   a. Distinguish between Security and Integrity in a relational database. Define three basic types of integrity constraint that all relational databases must support.

[5 Marks]

   b. What operations on a database can violate referential integrity? What clauses can be specified in order to avoid violating referential integrity? Use a create table statement for one of the tables in question 1 or 4 to help illustrate your answer.

[5 Marks]

   c. Access Control is often used to secure a relational database. Discuss the various means by which a DBMS can manage access control including privileges and propagation.

[5 Marks]

   d. What SQL command(s) would be used to allow a user called "admin" to populate, read and update the information contained within each of the tables in either question 1 or 4? How would you modify the command to allow admin to pass on these abilities to other users?

[5 Marks]

   e. Compare and contrast Discretionary Access Control and Mandatory Access Control in relational databases.

[5 Marks]

4. The owner of a chain of gyms has commissioned the design of a database to store all the information that is required for the day to day operation of the business. She needs to store information related to the branches of the chain that are in operation, the staff that work in various roles in those branches, the equipment used, the gym members and the classes that are offered by each branch.

   a. Using the notation described in class, draw an Entity Relationship Diagram for the above "real world" business. Map this Entity Relationship Diagram to a Relational Schema. Ensure you indicate the Primary Keys of your tables and any Foreign Keys. In addition, draw a Functional Dependency Diagram for this schema and ensure that the schema is in Boyce Codd normal form. State any assumptions that you make in the modelling of your database.

   [10 Marks]

   b. In order to keep track of the bookings that are made for each class in a particular branch, the database must store a list of booked and (as yet) available places in each class. This allows the receptionist in each branch to check availability in classes and make bookings. Using the appropriate SQL command, update your class table to include an attendee capacity and create a bookings table that tracks bookings at each class for members. When inserting a new booking, how could the database ensure that there is a place available in the class?

   [7 Marks]

   c. Write SQL Commands to do the following:

      i. One of the branches has moved into new premises; update the address of the branch to reflect this.

      [3 Marks]

(Question 4 continued from previous page).....

    ii. Retrieve the names of all members who have attended spinning classes in 2013.

<div align="right">[2 Marks]</div>

    iii. Write a retrieval command which checks if there is any availability for an upcoming class of your choice.

<div align="right">[3 Marks]</div>