

**PRIFYSGOL CYMRU; UNIVERSITY OF WALES**

**DEGREE EXAMINATIONS MAY/JUNE 2003**

**SWANSEA**

**Computer Science**

**CS 219 Database Systems**

**Attempt 2 questions out of 3**

**Time allowed: 2 hours**

**Students are permitted to use the dictionaries provided by the University**

**Students are NOT permitted to use calculators**

## CS\_219 DATABASE SYSTEMS

(Answer 2 questions out of 3)

### Question 1

- (a) Give the definitions for functional dependence and full functional dependence. Describe both with the use of an example.

[5 marks]

(b)

- (i) Given a first normal form relation  $R(A,B,C,D)$  with a composite primary key of  $(A,B)$ , give a situation where  $R$  is not in second normal form. What do you have to do to place relation  $R$  in second normal form?

Given the relation:

EmployeeNo	Employee Name	ProjectNo	Project Name	Hours Worked
1	Jones	4	A465 Upgrade	40
1	Jones	6	Zebra Crossing	17
2	Evans	4	A465 Upgrade	12

which describes the hours an employee works on a particular project and has the following non-trivial functional dependencies:

EmployeeNo  $\rightarrow$  Employee Name

ProjectNo  $\rightarrow$  Project Name

(EmployeeNo, ProjectNo)  $\rightarrow$  Hours Worked

- (ii) Determine the primary key of this relation.  
(iii) Draw a functional dependency diagram for this relation.  
(iv) Identify an update, an insert and a deletion problem for this relation.  
(v) Does the relation conform to second normal form? If not, place the relation into second normal form.

[7 marks]

(c)

- (i) Given a second normal form relation  $R(A,B,C)$  with a primary key of  $A$ , give a situation where  $R$  is not in third normal form. What do you have to do to place relation  $R$  in third normal form?

This relation:

<u>StudentNo</u>	TutorNo	Tutor Name
1	1	Jack Daniels
2	1	Jack Daniels
3	2	Philip Morris
4	3	Harley Davidson

which describes the tutor for each student has the following non-trivial functional dependencies:

StudentNo  $\rightarrow$  TutorNo

StudentNo  $\rightarrow$  Tutor Name

TutorNo  $\rightarrow$  Tutor Name

- (ii) Draw the functional dependency diagram for this relation.  
(iii) Give the relations that result when this relation is placed into third normal form.

[5 marks]

- (d) What is the referential integrity rule? What is the entity integrity rule?

What three foreign key rules apply when a foreign key attribute is updated? Use, as an example in your answer, the relations below and an update to supplier S1 changing supplier number from S1 to S9 (assuming SNo in the SP table is a foreign key referencing the Supplier table). Also, what are the foreign key rules when deleting an attribute and what effect would be observed using each rule when S2 is deleted from the Supplier table?

Supplier	<u>SNo</u>	<u>SNAME</u>	<u>STATUS</u>	<u>CITY</u>	SP	<u>SNo</u>	<u>PNo</u>	<u>QTY</u>	
	S1	Smith	20	London		S1	P1	300	
	S2	Jones	10	Paris		S1	P2	200	
	S3	Blake	30	Paris		S1	P3	400	
	S4	Clark	20	London		S1	P4	200	
	S5	Adams	30	Athens		S1	P5	100	
						S1	P6	100	
Part	<u>PNo</u>	<u>PNAME</u>	<u>COLOUR</u>	<u>WEIGHT</u>	<u>CITY</u>		S2	P1	300
	P1	Nut	Red	12	London		S2	P2	400
	P2	Bolt	Green	17	Paris		S3	P2	200
	P3	Screw	Blue	17	Rome		S4	P2	200
	P4	Screw	Red	14	London		S4	P4	300
	P5	Cam	Blue	12	Paris		S4	P5	400
	P6	Cog	Red	19	London				

Suggest another foreign key constraint this database could contain. Suggest some validation constraints this database could contain.

[8 marks]

## Question 2

- (a) You have been asked to create an E-R diagram for a hospital. The following paragraph is all the information you have been given:

*Each patient with a symptom may visit a doctor in the hospital on a particular date (it is assumed for simplicity that no patient will visit the hospital more than once a day). The doctor will make a diagnosis based upon the symptom and then decide whether to treat the patient as an out-patient, or an in-patient. The out-patient will be given a date upon which they must return, and details about the consultant they will see upon that date. The in-patient will be placed in a ward, and will have a bed within that ward. The in-patient may have to take a number of drugs, each, in a certain dosage particular to that in-patient. Facts must also be stored about drugs that react with other drugs, and drugs that require another drug to be taken at the same time. Each in-patient will also be allocated to a consultant. The consultant will visit a number of wards on his round, and each ward will be visited by several consultants.*

Draw a complete E-R diagram for the above problem situation. You should choose sensible attributes for the consultant and patient entities. You should also list any assumptions you have had to make about cardinalities and / or other unknown information.

Select one relationship from your diagram that would use the conversion rule “relation to relationship relation with two foreign keys”, and show how it would be represented by a table in the database. You should indicate any primary key and foreign key constraints.

[15 marks]

- (b) The database of a chain of book stores has been normalised to create the following tables:

Author:

	A
	1 P
	1 C
	1 G
	1 S

This keeps track of each author's name and address. (Many entries have been omitted).

Book:

Title
Let Sleeping Vets Lie
The Wasp Factory
It Shouldn't Happen to a Vet
Persuasion
200 Challenging Walks in Bri

This shows the details of the book, and AuthorNo refers to the author table.

Supply:

This shows the current numbers of each book held at each branch.

Give the **tuple relational calculus** expression for the following queries:

- (i) Get the Titles of all of the books that are written by authorNo=1.
- (ii) Get the BookNo and BranchNo where the quantity of that book at that branch is less than 10 in the supply table.
- (iii) Get the Title of each book and the BranchNo where the quantity at that branch is less than 10 (i.e. a modification of ii).
- (iv) Get the Author Name, the Title of the book, and the Quantity that the book is stocked in each branch.
- (v) Get the BranchNo of each branch that currently stocks all the books in the book table.

NB. You do not need to give the results of the queries – only the expression for the query. If you **do not know** the tuple relational calculus, marks will be given for demonstrating which tables need to be joined to give the result or for SQL query statements.

**[10 marks]**

### Question 3

- (a) Describe with the use of an example, the inconsistent analysis problem. Describe the types of locks a transaction can acquire on a table and what happens when another transaction attempts to acquire a lock (of both kinds) on the same table. Indicate the impact on performance that locking has. Show how locking affects the inconsistent analysis problem. What new problem does locking introduce? Discuss two distinct ways of detecting and overcoming this new problem.

**[10 marks]**

- (b) What is a multi-valued dependency?

Give an example of a relational table that is in Boyce-Codd normal form, but is not in fourth normal form. Show an insertion, an update and a deletion problem on this table. Why does the table suffer from these problems?

From what problem do tables not in fifth normal form (but in fourth normal form) suffer?

**[6 marks]**

- (c) What are the benefits of using a relational database when compared to the situation where a number of separate applications are used? You should give reasons for each benefit. What extra software technologies allow a database to run over the internet?

**[9 marks]**