PRIFYSGOL CYMRU; UNIVERSITY OF WALES

DEGREE EXAMINATIONS JANUARY 2002

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 through the invigilators

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CS_219 DATABASE SYSTEMS
(*Attempt 2 questions out of 3*)

Question 1

(a)   Describe, with the use of an example, functional dependence. What do we mean when we say something is fully functionally dependent?

[**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:

Patient#	Patient Name	Drug#	Drug Name	Dosage
1	Jones	4	Penicillin	3/day
1	Jones	6	Advil	2/day
2	Evans	4	Penicillin	2/day

which describes the dosage of a drug a particular patient takes and has the following functional dependencies:
Patient#->Patient Name
Drug#->Drug Name
(Patient#, Drug#)->Dosage

(ii)   Determine the primary key of this relation.
(iii)   Draw a functional dependency diagram for this relation.
(iv)   Identify an update, a modification 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:

Part#	Line#	Emp#	Employee Name
1	2	1	Daniel Cohen
2	2	1	Daniel Cohen
3	1	1	Daniel Cohen
4	3	2	Philip Morris

which describes the manufacturing line a part is made on and who is responsible for that manufacturing line, has the following and only the following functional dependencies:
Part#->Line#
Part#->Emp#
Part#->Employee Name
Line#->Emp#
Line#->Employee Name
Emp#->Employee Name
(Part# *is* the primary key as each part is made on one manufacturing line and each manufacturing line has only one employee responsible for it).

(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)   Describe the two phase commit protocol with respect to a database which has been duplicated across redundant servers. Explore some of the failures that can occur, and demonstrate how the two phase commit protocol ensures that consistency is achieved.

[**8 marks**]

Question 2

(a)   You have been asked to computerise the records of a publishing company. The following is the preliminary information you have been given.

A publishing company has records of all the books it publishes, and all of the authors of those books, including the date the book was published. It also has the names and addresses of potential customers, and records of the books they have bought in the past. This past history is in the form of dates, the book and the number they ordered. Each book is categorised into subject headings - fiction, science fiction, biographical, etc. For those books which entered the book selling charts, the position that book achieved on each week in the chart is recorded. The numbers of each book sold is stored, and the numbers sold of each book each month is also recorded. There are also numbers indicating how many books are left for a particular title, from which (along with recent demand) it is decided on whether to reprint the book.

Draw a complete ER diagram for the above problem. Include the cardinality of all relationships. The cardinality of some relationships cannot be deduced from the above passage. Assume sensible values, indicate them on your diagram by placing a star next to them, and write down the question you would have to ask to determine if you are correct.

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.
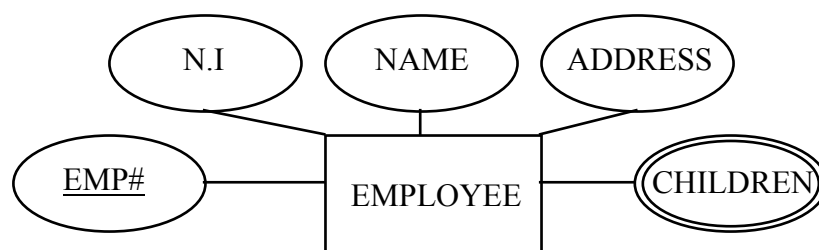
[**15 marks**]

(b)   Describe with the use of an example, the *inconsistent analysis* problem. Describe the types of locks a transaction can acquire, and show how these affect the inconsistent analysis problem. What new problem does locking introduce? Discuss *two distinct* ways of detecting and overcoming this new problem.

[**10 marks**]

Question 3

(a)   In the diagram below, employees have a multi-valued attribute called *children*. The resulting relational table for the employee entity is not even in first normal form. What do we introduce into the *ER diagram* to ensure the resulting relational table is in second normal form?

What is a weak entity? What primary key do we use for such entities, and which two benefits does this introduce?

[**5 marks**]

(b) The database of a CD retailer has been normalised to create the following relations:

Customer:

Customer Number	Customer Name	Customer Address
1	Tony Blur	10 Downing Street
2	John Lemon	1 Abbey Road
3	Chris Rear	1 Harley Street

This table keeps track of customers and their addresses. Note that only the current address is tracked in this database. Only the first few entries have been shown.

CD:

CD Number	Artist Name	CD Name	Current Price
1	Natalie Imbruglia	White Lilies Island	8.99
2	Madonna	Ray of Light	8.99
3	U2	All that you can't	8.99
4	Sting	…All this time	8.99
5	Robbie Williams	Sing When You're…	8.99
6	Jennifer Lopez	J.Lo	8.99

This table stores details about the CDs. Only the first few entries have been shown.

Sales:

CustNo	Date	CDno	Qty	Price
1	10/7/2001	1	1	8.99
2	15/3/2001	5	1	10.99
2	6/12/2001	6	1	8.99
2	6/12/2001	4	1	8.99
3	12/12/2001	5	2	8.99

This table stores the customer history. It records every transaction each customer has made. Only the first few entries have been shown.

Give the tuple relational calculus expression for the following queries:
(i)   Get the names of all of the CDs that have a current price less than £10.
(ii)   Get the customer numbers of all the customers that have bought CD number 5.
(iii)   Get the names and addresses of all the customers that have bought CD number 5.
(iv)   Get the names of all customers who bought a CD on 12/12/2001, and also the names of the CDs they bought.
(v)   Get the names of all customers who have bought **all** of the CDs in the CD table.

NB. You do not need to give the results of the queries – only the expression for the query.
[**11 marks**]

(c) 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 of part (b) and an update to customer 1 changing customer number from 1 to 1000 (assuming a customer 1000 is not already in the table and assuming CustNo in the Customer history table is a foreign key referencing Customer Number in the Customer table). What are the foreign key rules when deleting an attribute?

Suggest another foreign key constraint this database could contain. Suggest some validation constraints this database could contain.
[**9 marks**]