Birkbeck

(University of London)

BSc/FD EXAMINATION

Department of Computer Science and Information Systems

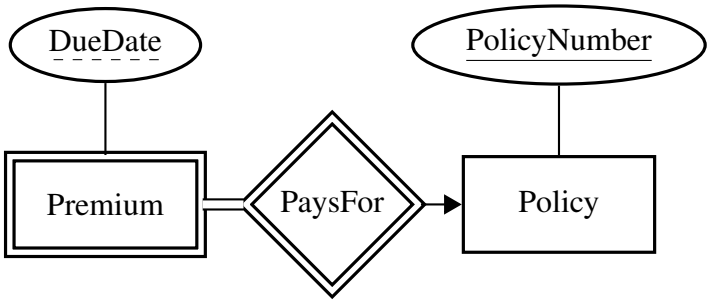
Database Management (COIY028H6)

CREDIT VALUE: 15 credits

Date of examination: 22 May 2017
Duration of paper: (14:30–16:30)

There are **five** questions on this paper.
Answer only **four** of the five questions.
If you answer more than four questions, only the best four answers will count.
Each question carries **25** marks in total.
The paper is not prior-disclosed.
The use of electronic calculators is not permitted.

1. (a) Consider the following fragment of an *Entity-Relationship Diagram* representing premium payments for insurance policies:



i. What is the *cardinality* (or *multiplicity*) of the PaysFor relationship type?

(**1** mark)

ii. What kind of entity type is the Premium entity type and what does this mean?

(**3** marks)

iii. How would the Premium entity type be represented in the relational model (i.e., give the relation schema and any necessary constraints)? You can assume that the Policy entity type is represented by a relation schema of the same name.

(**5** marks)

(b) Consider a relation schema Music, with schema(Music) = {Track, TrackTitle, Album, AlbumTitle, Artist}, which represents information about music files. Assume we have established that the following functional dependencies (FDs) hold:

Track $\rightarrow$ TrackTitle
Album $\rightarrow$ AlbumTitle
Track $\rightarrow$ Album

i. Identify a *key* for the Music schema, showing why it is a key (i.e., do not just give the definition for a key).

(**4** marks)

ii. Decompose the Music schema into *Boyce-Codd Normal Form* (BCNF), explaining each step of the decomposition.

(**7** marks)

(c) By means of an example, explain what the GROUP BY clause does and how it is used in SQL.

(**5** marks)

2. (a) Assume that we have a database schema containing the following relation schemas:

```
Visits(person,store)
Sells(store,item)
Likes(person,item)
```

representing the stores people visit, the items sold by stores, and the items liked by people, respectively.

i. Provide a description of the answer returned by the SQL query:

```
select person, item
from Visits natural join Sells
```

(**3** marks)

ii. Provide a description of the answer returned by the SQL query:

```
select person, item
from Visits natural join Sells natural join Likes
```

(**3** marks)

iii. Would the following SQL query always return the same answer as the SQL query in (2(a)ii) above?

```
select person, item
from Visits V join Sells S on V.store=S.store
              join Likes L on S.item=L.item
```

Explain your answer.

(**4** marks)

(b) Explain what *null* values are used for in the relational model. Describe three situations in which the use of null values either complicates the syntax of SQL or makes query processing more involved.

(**5** marks)

(c) When defining a foreign key constraint in SQL, we can specify three possible actions the database system can take (the default and two others) when a value referenced by the foreign key value is to be deleted or updated. Explain what the three possible actions do.

(**5** marks)

(d) Compare Boyce-Codd Normal Form and Third Normal Form in terms of their relative advantages and disadvantages.

(**5** marks)

3. (a) Let U be a relation schema with $schema(U) = ABCDEG$. Let F be the following set of functional dependencies (FDs) over U:

$$A \rightarrow B$$
$$BC \rightarrow D$$
$$D \rightarrow A$$
$$DE \rightarrow G$$

i. Compute the *closure* of the set of attributes CD, explaining each step of the computation.

(**2** marks)

ii. Find a *key* for U, showing *in detail* why it is a key.

(**4** marks)

(b) Explain what is meant by embedded SQL and how the embedded instructions are identified and executed. Use an example to show how *shared* variables are declared and used.

(**7** marks)

(c) Consider the following three functional dependencies (FDs):

Employee $\rightarrow$ Department
Employee $\rightarrow$ Manager
Department $\rightarrow$ Manager

i. One of the three FDs above is a *transitive* FD. Which is the transitive FD and what is meant by the term "transitive"?

(**2** marks)

ii. Why does Third Normal Form disallow relation schemas which have transitive FDs?

(**2** marks)

iii. Given the above three FDs over the set of attributes {Employee, Department, Manager}, produce a Third Normal Form design.

(**2** marks)

(d) Name six features provided by object-relational database systems which are not available in (pure) relational database systems.

(**6** marks)

4. (a) Relational database systems support the notion of a *view*

i. Give two reasons why SQL views are considered useful.

(**2** marks)

ii. The view (or external) layer is one of the three levels of abstraction in a database management system. What are the other two?

(**2** marks)

iii. Views are sometimes described as *virtual*. Describe what is meant by this.

(**2** marks)

(b) In the context of transaction management, explain what is meant by a *dirty read* operation. What is the potential problem with allowing such an operation? Which of the SQL transaction isolation levels will disallow dirty read operations?

(**7** marks)

(c) Consider the following relation representing information about films, the people who directed them, and the year in which the films were made:

Film	Director	Year
Mr and Mrs Smith	Hitchcock	1941
Suspicion	Hitchcock	1941
Mr and Mrs Smith	Liman	2005

i. Give three functional dependencies *violated* by the relation.

(**3** marks)

ii. Give two functional dependencies *satisfied* by the relation.

(**2** marks)

iii. Which (if either) of the functional dependencies satisfied by the relation would you expect to *hold* on the relation schema? Explain your answer.

(**4** marks)

(d) Given two tables A and B, what do the the SQL expressions (i) A UNION B, (ii) A INTERSECT B and (iii) A EXCEPT B return?

(**3** marks)

5. (a) Database systems provide a number of advantages for users and programmers. Describe four of these advantages.

(**8** marks)

(b) Consider a relation schema `Sells(Pub, Beer, Price)`, where each row represents the price paid for a pint of a particular beer at some pub. Assume that the primary key of `Sells` is `(Pub, Beer)`. Consider (independently) each of the following SQL INSERT statements which generates an error when executed. In each case, give the (possible) cause(s) of the error.

i.
```
INSERT INTO Sells (pub, beer)
       values ('White Horse', 'Bad Habit')
```
(**3** marks)

ii.
```
INSERT INTO Sells
       values ('Horse and Hound', 'Bad Habit', 0.0)
```
(**3** marks)

iii.
```
INSERT INTO Sells (pub) values ('March Hare')
```
(**1** mark)

(c) Give a short explanation of what is meant by each of the following terms (2 marks each):

i. left outer join

ii. ISA relationship type

iii. dependency preserving decomposition

iv. atomic transaction

v. noSQL database

(**10** marks)

