IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2019

BEng Honours Degree in Computing Part I
MEng Honours Degrees in Computing Part I
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the Associateship of the City and Guilds of London Institute

PAPER C130

DATABASES

Friday 10th May 2019, 14:00
Duration: 80 minutes

Answer ALL TWO questions

Paper contains 2 questions
Calculators not required

1 a The following relations model a movie rental example:

MOVIE(MovieID, Title, ProducerName)
PRODUCER(Name, Address, Phone)
DVDs(MovieID, StoreID, nof_DVDs)

MovieID references MOVIE.MovieID
StoreID references DVD_STORE.StoreID

DVD_RENTAL(MovieID, StoreID, MemberNo, DateOut, DateDue)

MovieID references MOVIE.MovieID
StoreID references DVD_STORE.StoreID
MemberNo references RENTER.MemberNo

DVD_STORE(StoreID, StoreName, Address)
RENTER(MemberNo, Name, Address, Phone)

A movie is produced by a producer and is copied on DVDs. DVDs can be rented by members in a DVD store.

Given these relations, for each question below, write the corresponding SQL query. The query should return the attribute specified in the brackets.

You have to use LEXIS to answer and save the queries (question 1a only!). This comes with the benefit of being able to test the queries using the same application as in the coursework. Log-in to your workstation and open a terminal (stay in your home directory). Launch the application using *java -jar /data/ExamDatabase2019.jar* in the terminal window. Choose a query you want to answer, and use ”Execute” to test it and ”Save Query” to save it (writes a file into your home directory). Your answers are saved in files and are automatically backed up by CSG. Do this for all queries.

i) Retrieve the titles (Title) of all movies who have been rented at least once. Use a subquery. Sort ascending by Title.

ii) Retrieve the title of all movies (Title) along with the number of DVDs (as a column called number) for that movie available at all stores without using a group by. Sort ascending by Title.

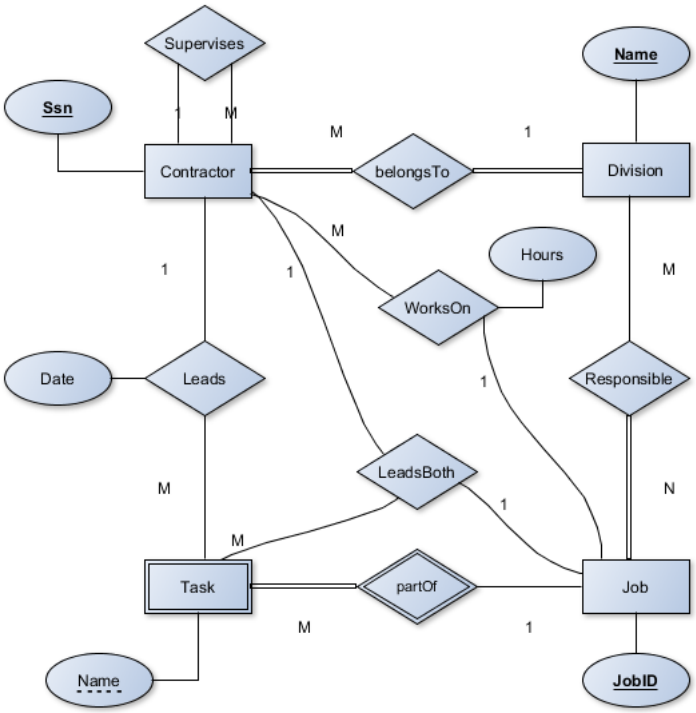
iii) Return the set of addresses (Address) containing all addresses of renters and the addresses of stores they rent from. Sort by address in ascending order.

iv) Retrieve the names of the producers (return as a column named Name) of which the movies have been rented by renters whose name starts with K and who have rented at least two movies from that producer. Use a subquery. Sort ascending by ProducerName.

v) Retrieve the ID of all members (MemberNo) who have rented more than one DVD that is overdue. Sort ascending by MemberNo.

All questions carry equal weight.

b Given the following E-R Model:



Write the equivalent relational model including table names, column names, primary keys (underlined), foreign keys as well as triggers, e.g.:

table(column1, column2)

column2 **references** othertable.column3 **on delete cascade**

The two parts carry equal marks.

2a Given the relation $R(A, B, C, D, E)$, compute a canonical cover based on the following functional dependencies:

$$ABC \rightarrow DE$$
$$BC \rightarrow A$$
$$DE \rightarrow B$$
$$CE \rightarrow AB$$

b Given the relation $R(A, B, C, D, E, F, G)$, compute a canonical cover based on the following functional dependencies:

$$AB \rightarrow C$$
$$C \rightarrow A$$
$$BC \rightarrow D$$
$$ACD \rightarrow B$$
$$D \rightarrow EG$$
$$BE \rightarrow C$$
$$CG \rightarrow BD$$
$$CE \rightarrow AG$$

c Given the relation $R(A, B, C, D, E, F, G)$, decompose it into the third normal form (3NF) based on the following functional dependencies:

$$AB \rightarrow C$$
$$C \rightarrow A$$
$$BC \rightarrow D$$
$$ACD \rightarrow B$$
$$D \rightarrow EG$$
$$BE \rightarrow C$$
$$CG \rightarrow BD$$
$$CE \rightarrow AG$$

d Given the relation $R(A, B, C, D, E, F, G)$, decompose it - if necessary - so it satisfies Boyce-Codd Normal Form (BCNF) based on the following functional dependencies:

$$AB \rightarrow C$$
$$C \rightarrow A$$
$$BC \rightarrow D$$
$$ACD \rightarrow B$$
$$D \rightarrow EG$$
$$BE \rightarrow C$$
$$CG \rightarrow BD$$
$$CE \rightarrow AG$$

e Given the relation $R(A, B, C, D, E, F, G, H, I, J)$, decompose it - if necessary - so it satisfies Boyce-Codd Normal Form (BCNF) based on the following functional dependencies:

$$AB \rightarrow C$$
$$A \rightarrow DE$$
$$B \rightarrow F$$
$$F \rightarrow GH$$
$$D \rightarrow IJ$$

The five parts carry equal marks.