Queen Mary
University of London

***e.g.* BSc Examination by course unit/ BA by Special Regulations/ MSc Examination**

Friday 8th May 2013 14:30 - 17:00

ECS740 Databases Duration: 2 hours 30 minutes

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Answer FOUR questions

If you answer more questions than specified, only the first answers (up to the specified number) will be marked. Cross out any answers that you do not wish to be marked

Calculators are/are not permitted in this examination. Please state on your answer book the name and type of machine used.

Complete all rough workings in the answer book and cross through any work that is not to be assessed.

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Question 1 (Database History & Design)

a) Describe the three main concepts of the ERM. Give an example for each concept, refer to the notion of “type” and “set”, and relate the concepts to object-oriented modelling.

[5 marks]

b) Describe the principal mapping of the ERM into the relational model. Thereby, explain how the cardinality of relationships affects the mapping.

[5 marks]

c) What were the main milestones in DB history?

[5 marks]

d) Provide a basic ERM diagram for the university scenario with “students”, “courses”, and “modules”. Students register for courses, and students sit exams of modules. There are first sits and resits. The exam marks have to be recorded, and the database system shall keep track of who entered and updated the exam marks.

Specify the relational model, and underline the attributes that form the primary keys, and list the foreign keys.

[5 marks]

e) List five of the main database applications. Describe the nature of each application briefly.

[5 marks]

Question 2 (SQL & Relational Model)

Given the following relational DB schema.

Plane(PLID, Name, DateOfReg)

Airport(AID, Name, Country, City)

Passenger(PID, FName, LName, Nationality, DOB, PassportNumber)

Flight(FlightNumber, PlaneID, Date, DepAirport, DestAirport, DepTime, Delay, Status)

Status: is one of "scheduled", "delayed", "cancelled", "arrived", "baggage in hall".

WeatherForecast(Date, City, Source, Text)

Source: is one of "BBC", "Met Office", "MeteoGroup".

a) Identify and specify the referential integrity constraints inherent in the above schema. Specify the create table statement for "flight".

[5 marks]

b) SQL Query: Find all flights going from Stansted to Dortmund that are delayed.

[5 marks]

c) SQL Query: Find all airports with at least one flight to a destination (city) in France. Use a nested SQL query.

[5 marks]

d) Schema refinement and normalisation.

i) One requirement is to list airports where a weather warning is active, which means flights are likely to be delayed or diverted. Which extension of the schema do you propose to satisfy this requirement?

ii) Note that the schema of Airport contains the attributes City and Country. What do you propose regarding the normalisation of the schema?

[5 marks]

e) Explain the translation of the SQL query “SELECT … FROM … WHERE” into an expression of the relational algebra.

[5 marks]

Question 3 (Enhanced ERM)

a) Describe the main mechanisms that the Extended Entity Relationship (EER) model provides which are not available in the Entity Relationship (ER) model.

[5 marks]

b) Design a movie database in the basic ERM (do not use concepts of the enhanced ERM). The movie database comprises movies, directors, casts, actors, plots (movie descriptions), and reception (how the movie was received). For each director and actor, the DB maintains a pointer to a web site describing the actor. Particular to this movie DB is that we store also the main reviews (e.g. reviews from rotten tomatoes or empire magazine). A review has a rating: 1-5 stars. The database shall support analytical queries such as "show the average rating of Woody Allen movies".

(i) Give a textual specification of the ERM.

(ii) Show an ERM diagram that illustrates some of the main components of the ERM.

(ii) Show a more refined diagram that includes cardinalities and the key attributes for strong entities.

[10 marks]

c) Improve the basic ERM by applying concepts of the enhanced ERM.

(i) There are several entities in the movie database that are specialisations of "person". Show the E-ERM. Also, generalise entities such as "plot", "review" and "reception" by introducing the entity "document".

(ii) Map the E-ERM to the relational schema. List the three options to map the E-ERM concepts to relations in the relational model; explain each option briefly.

[10 marks]

Question 4 (Transaction Management)

a) List the three problems that may occur for concurrent transactions. Explain each problem briefly.

[5 marks]

b) Draw the precedence graph for the following schedule. Let T1, T2 and T3 be three transactions.

Time	T1	T2	T3
t_1	read(A)		
t_2	read(B)		
t_3		read(A)	
t_4		read(C)	read(A)
t_5	read(C)		write(A)
t_6	write(C)		
t_7			read(B)
t_8	write(A)		write(B)

[5 marks]

c) Transaction Properties: Explain the notion of ACID.

(i) What does ACID stand for? Explain each concept.

(ii) Is ACID important for banking systems? Why or why not?

(iii) Is ACID important for web-based services (e.g. bbc news pages) where users browse data? Why or why not?

[5 marks]

d) Serialisable Schedules:

(i) When is a non-serial schedule called serialisable?

(ii) When are two schedules in conflict?

[5 marks]

e) Two-phase locking.

(i) Explain the overall idea of 2-phase locking.

(ii) What are the two main phases referred to?

(iii) Explain what does 2-phase locking ensures.

(iv) What are the disadvantages of 2-phase locking?

[5 marks]

End of Paper