UNIVERSITY OF LONDON

BSc EXAMINATION 2022

For Internal Students of
Royal Holloway

DO NOT TURN OVER UNTIL TOLD TO BEGIN

CS2855: Databases
CS2855R: Databases – for FIRSTSIT/RESIT CANDIDATES

Time Allowed: **TWO hours**

Please answer **ALL** questions

1. (a) An airplane company needs a database. Its desired design is described below.

   - For every airplane owned by the company the system needs to store its registration number, which is unique for every airplane.
   - Each airplane is associated with exactly one type.
   - A type is identified by its name. In addition, for every type we store its size.
   - Every airplane is based at a specific airport which should be stored in the system.
   - For each airport we want to store its ID and its capacity. In addition we want to store the neighbouring airports to it (an airport can neighbour more than one airport).

   Draw an E-R diagram according to the above design. Remember to include all constraints. [15 marks]

   (b) Convert the following E-R diagram into a relational model. Present the relational model, including primary key and foreign key information. Minimize as far as possible. (D.O.B. stands for Date Of Birth.)

[15 marks]

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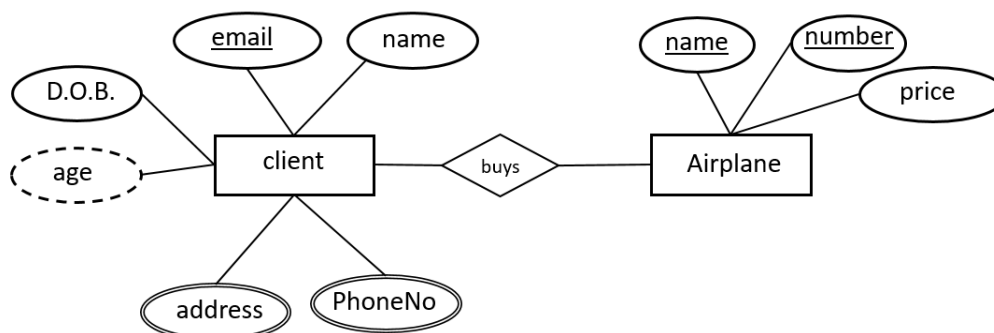
2. The following is a collection of relations that store information about an online bookstore. Every attribute which shares its name with the primary key of a different relation is a foreign key.

user		
user_id	name	rank
102	John	4
416	Kate	2
507	Alex	2
322	John	1

book			
book_id	title	year	price
4271	Animal Farm	1945	3.28
1836	Oliver Twist	1838	6.99
2418	How to Brew	2017	12.32
5944	Pulp	1994	8.40

user		
user_id	book_id	copies
102	4271	1
416	1836	2
507	1836	1
102	2418	3

(a) Evaluate and give the results of the following relational algebra expressions:

   i. $\pi_{\text{book\_id}}(\text{owns})$ [5 marks]

   ii. $\pi_{\text{title}}(\sigma_{\text{name} = \text{"John"}}(\text{user}) \bowtie (\text{owns} \bowtie \text{book}))$ [5 marks]

   iii. $\pi_{\text{book\_id, title}}(\sigma_{\text{year} > 1940}(\text{book}))$ [5 marks]

(b) The relation "owns" corresponds to a relationship between user and book. Is the relationship one-to-one, many-to-one, or many-to-many? Explain briefly your answer.   [5 marks]

(c) Write SQL statements for the following tasks, over the above relations. Your statements should be correct for general instances of the above schema and may not depend on the specific contents of the example tables above.

   i. Increase the price of every book by 5%.   [3 marks]

   ii. Decrease the price of every book written before 1920 by 10%.   [2 marks]

   iii. Delete all users that do not own any book.   [5 marks]

(d) Write SQL statements for the following tasks, over the above relations. Your statements should be correct for general instances of the above schema and may not depend on the specific contents of the example tables above.

   i. Output the title and the price of every book. The output should be ordered first by year and then by title.   [5 marks]

   ii. Output the name and the rank of every user that owns the book with id 4522.   [5 marks]

      iii. For every book, output its title and the number of copies owned by the users. So, for the tables above, the output for the book with id 1836 should be "Oliver Twist, 3". [5 marks]

      iv. Output the name of every user that has books that are published in at least three different years. [5 marks]

      v. The bookstore wants to allow its users to write reviews for books. Define a relation for the following table review(reviewid, user_id, book_id, text); reviewid consists of at most 10 letters and numbers. [5 marks]

3. (a) Consider the following schedule of transactions T1 and T2. Is the schedule serialisable? If yes, provide an equivalent serial schedule. If no, briefly explain why. [5 marks]

```
T1        | T2
----------------
Read(A) |
        | Read(B)
Write(A)|
        | Write(B)
Read(B) |
Write(B)|
```

(b) Briefly explain the "I" (isolation) part of the ACID properties of correctly performed transactions. [5 marks]

(c) Define BCNF (Boyce-Codd Normal Form). [5 marks]

END

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