A27227

No calculator permitted in this examination

UNIVERSITY OF BIRMINGHAM

School of Computer Science

Degree of MSc

Computer Science

06 21923

Fundamentals: Databases

Summer Examinations 2011

Time allowed: 1 ½ hours

[Answer THREE out of Four Questions]

1. Suppose that in a conceptual ERM an entity type called Employees has amongst its attributes an EmployeeId attribute (the primary key), first-name and last-name attributes and a multivalued attribute called Languages. The Languages attribute is intended to record which foreign (i.e., non-English) languages an employee speaks.

   (a) Show how the Languages attribute would appear in a Chen-style ERD. [2%]

   (b) Explain what practical problems could arise from attempting to implement the Languages attribute entirely within a table for Employees. [8%]

   (c) Explain a better method of implementing the attribute. [8%]

   (d) Using ***either*** the implementation you explained for part (c) ***or*** one that you discussed for part (b), provide an SQL query that would list without repetition the identity numbers of all employees who speak French. Make sure to specify what implementation you are using, and explain what your table names and attribute names mean. [6%]

   (e) Using ***either*** the implementation you explained for part (c) ***or*** one that you discussed for part (b), provide an SQL query that would list all employees, by identity number and name, who speak at least two foreign languages. Make sure to specify what implementation you are using, and explain what your table names and attribute names mean, if not already explained in part (d). [10%]

2. (a) Explain what a superkey is and what a candidate key is. Do not merely provide an example. [6%]

(b) Provide as realistic an example as you can of an entity type that has two candidate keys containing different numbers of attributes. (The candidate keys may overlap if you wish.) [4%]

(c) Explain what a transitive dependency is. Do not merely provide an example. [6%]

(d) Explain carefully the method used for converting an entity type that is in 2NF but not 3NF into a set of entity types that are in 3NF. Please provide ***both*** a general description ***and*** an example consisting of suitable diagrams. [6%]

(e) To what extent is it possible to use SQL queries to determine whether a specified attribute Y in an entity type has a functional dependency on another specified attribute X? (You are not being asked to provide any SQL query.) [6%]

(f) Suppose a table T contains integer-valued attributes X and Y. Provide an SQL query that lists the pairs of X and Y values that occur together in rows of the table, but always putting the smaller value first on each line (or in either order if they are equal). [6%]

3. (a) Use relational algebra to express the calculation done by the following SQL query:

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SELECT DISTINCT   office, year FROM staff, lecturing
        WHERE     staff.sid = lecturing.sid
        AND       year > 2002;
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You may assume that 'sid' is the only attribute name in common between 'staff' and 'lecturing'.

[6%]

(b) In what ways does the relational algebra notation that you learned about in the module fail to reflect operations that one sometimes needs to do in database querying? [6%]

(c) In what ways is a database table like a mathematical relation and in what ways is it different? [6%]

(d) Using the language of mathematical relations, explain what a functional dependency is. [6%]

(e) Discuss what referential integrity (in a database) is and any features of SQL that help to manage it. [10%]

4. Draw an ERD (or a set of related ERDs) for a database that might be used to represent a set of superheroes (such as Superwoman, Spiderman and Reformed Zombie---use any you like or invent some!)*. In your design consider matters ***such as*** the superheroes' abilities, whether the superheroes form teams, the disguises they have (e.g., Superman as Clark Kent), the world-saving activities they are engaged in, and the supervillains (i.e., very bad people/creatures) they need to deal with.

   Given the limited time available, only five or so entity types are expected, with five or so suitable relationships between them. Make clear what each of your entity types represents by using clear names for the types and/or providing brief additional notes in English. Similarly, make clear what each relationship represents. State (in the ERD itself or in additional notes) what the main attributes are in each entity type. Also make the primary keys clear.

   It is important to specify the connectivities of the relationships and the extent of relationship participation.

   You may use any ERD style, and you may make creative modifications to styles. State briefly what standard style(s) you are using. Explain, briefly but precisely, any modifications to or mixing of standard styles, and any entirely new diagram conventions. [**Up to 8 extra points** will be given for modifications or new features. However, you can get full marks on the Question by using a specified standard style well and concentrating on other parts of the question.]

   There is ***no need*** to specify data types for attributes or to provide SQL CREATE statements. [However, **up to 8 extra points** can be obtained for providing one or more good CREATE statements.]

   [Total for Question capped at 34%]

* In case you don't know, a superhero is a mythical entity with special powers such as superhuman strength, X-ray vision, ability to fly or be invisible etc. They usually fight evil criminals, evil creatures from other worlds, etc. In doing this they sometimes team up with each other.