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Indian Institute of Engineering Science and Technology, Shibpur
B.E.(CST) 6th Semester Examination, 2014
Database Management Systems (CS 601)
Answer any five questions

F.M. 70

Time: 3 hrs

1. Consider the following set of requirements for a COMPANY database that is used to keep track of company's employees, departments and projects.

- (a) The company is organized into departments. Each department has unique name, a unique number and a particular employee who manages the department. A department may have several locations.
- (b) A department controls a number of projects, each of which has name, unique number and a single location.
- (c) An employee is assigned to one department but may work on several projects, which are not necessarily controlled by the same department. The company tracks the number of hours per week that an employee works on each project. The company also keeps track of the direct supervisor of each employee.
- (d) The company wants to keep track of the dependents of each employee for insurance purpose.

Design an ER schema for this application and draw an ER diagram for that schema. Specify key attributes of each entity type and constraints on each relationship type. Note any unspecified requirement and make appropriate assumptions to get the specification complete. [14]

2. (a) Define *row trigger* and *statement trigger*.

(b) What are the main differences between operational databases and data warehouses?

(c) Consider the schema DEPT(DNAME, LOCATION). Write a PL/SQL programme to process each row of the DEPT table, moving SALES department to location Delhi, and other departments to New York. It also keeps a count of departments placed in each location. [3 + 4 + 7]

3. (a) What are the differences between primary and secondary indexes? How many clustering indexes and secondary indexes can have on a file?

(b) Consider a disk with block size $B = 512$ bytes. A block pointer P is 6 bytes long, and a record pointer P_R is 7 bytes long. A file has $r = 30,000$ EMPLOYEE records of fixed length. Each record has the following fields: NAME (30 bytes), ENO (9 bytes), DNO (9 bytes), ADDRESS (40 bytes), PHONE (9 bytes), DOB (8 bytes), SEX (1 byte), JOBCODE (4 bytes) and SALARY (4 bytes). Suppose the file is not ordered by the key ENO and we want to construct a B^+ -tree access structure on ENO. Calculate (i) the orders p and p of leaf of the B^+ -tree; (ii) The number of leaf-level blocks needed if blocks are approximately 69 % full (rounded up for convenience); (iii) the number of levels needed of blocks if internal nodes are also 69 % full (rounded up for convenience). [(4 + 1) + 9]

4. (a) What is dependency preservation property for a decomposition? Why is it important?

(b) Consider the relation $R(A, B, C, D, E)$ having decomposition consisting of $R_1(A, C)$, $R_2(A, B, C)$ and $R_3(D, E)$ with FDs $A \rightarrow C$, $AB \rightarrow D$, and $D \rightarrow E$. Is the decomposition loss-less? Justify your answer.

(c) Consider the following schema and the FDs:

LOTS(PropertyID, CountyName, Lot, Area, Price, TaxRate)

PropertyID \rightarrow (CountyName, Lot, Area, Price)

Lot \rightarrow (PropertyID, Area, Price, TaxRate)

CountyName \rightarrow TaxRate Area \rightarrow Price

In what normal form is the LOTS relation schema with respect to the restrictive interpretation of normal form that take only the primary key into account? Would it be the same normal form if the general definitions of the normal form were used? [4 + 5 + 5]

5. (a) Discuss the ACID properties of a database transaction.

(b) Let T_1 , T_2 , and T_3 be the transactions that operate on the same data items X, Y, and Z. Let $r_1(X)$ means that T_1 reads X, $w_1(X)$ means that T_1 writes X and so on for T_2 and T_3 . The schedules S1 and S2 are given below.

S1: $r_1(X); r_2(Z); r_1(Z); r_3(X); r_3(Y); w_1(X); w_3(Y); r_2(Y); w_2(Z); w_2(Y)$

S2: $r_1(X); r_2(Z); r_3(X); r_1(Z); r_2(Y); r_3(Y); w_1(X); w_2(Z); w_3(Y); w_2(Y)$

Draw a precedence graph for S1 and S2, and state whether each schedule is serializable or not. If a schedule is serializable, write down an equivalent serial schedule. [5 + 9]

6. (a) Discuss the problem of deadlock with respect to DBMS and the different approaches to deal with this problem.

(b) What are differences between deferred update protocol and immediate update protocol?

(c) Explain the purpose of checkpoint mechanism. [5 + 5 + 4]

7. Consider the following database schema and find the schedules and rooms of all courses taken by any Math major. Student (stuId, Name, major, credits)

Class (classNo, facId, schedule, room)

Faculty (facId, Name, department, rank)

Enroll (stuId, classNo, grade)

Write an SQL query for the aforesaid requirement. Transform the query into a query tree and optimize it using heuristics. [14]

8. Write short notes on the following: [8 + 6]

(i) Time stamping protocol.

(ii) Estimation cost of join operation using index.