Question Paper

Exam Date & Time: 29-May-2023 (02:30 PM - 05:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

FOURTH SEMESTER B.TECH (COMPUTER AND COMMUNICATION ENGINEERING) END SEMESTER EXAMINATIONS, MAY 2023

DATABASE SYSTEMS [ICT 2271]

Α

Marks: 50

Duration: 180 mins.

(5)

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

- 1) Consider the following information about a university database:
 - Professors have an SSN, a name, an age, a rank, and a research specialty. Projects have a project A) number, a sponsor name (e.g., NSF), a starting date, an ending date, and a budget. Graduate students have an SSN, a name, an age, and a degree program (e.g., M.S. or Ph.D.). Each project is managed by one professor (known as the project's principal investigator). Each project is worked on by one or more professors (known as the project's co- investigators). Professors can manage and/or work on multiple projects. Each project is worked on by one or more graduate students (known as the project's research assistants). When graduate students work on a project, a professor must supervise their work on the project. Graduate students can work on multiple projects, in which case they will have a (potentially different) supervisor for each one. Departments have a department number, a department name, and a main office. Departments have a professor (known as the chairman) who runs the department. Professors work in one or more departments, and for each department that they work in, a time percentage is associated with their job. Graduate students have one major department in which they are working on their degree. Each graduate student has another, more senior graduate student (known as a student advisor) who advises him or her on what courses to take.

Design and draw an ER diagram that captures the information about the university. Further reduce the diagram into a database schema.

B) Displays the names of the suppliers whose all product has a unit price of less than 20\$. (3)

Consider the below database schema.

Product(ProductID, ProductName, SupplierID, Unit_Price)

Supplier(SupplierID, SupplierName)

- C) Two transactions concurrently attempt to update the same data item. How does a validation based (2) concurrency control protocol ensure data consistency in this scenario?
- 2) i) Suppose that relation R(A,B,C,D,E) is decomposed into R1(A,B,C) and R2(A,D,E). Find whether (5) this decomposition is lossless or lossy decomposition if the following set of functional dependencies
 A) hold, F(A->BC; CD->E; B->D; E->A)
 - ii) Write the algorithm to find the canonical cover. Consider a relation R = (A, B, C, D) and set of functional dependencies $F = \{AB >C, C >D, A >B, BD >A\}$, Find the minimal cover.
 - B) With proper justification based on CAP theory, suggest a proper category for the following systems : (3)
 - i. During network partition, MongoDB may not be able to service read/write requests until

partition is resolved and consistency is restored.

- ii. Cassandra's architecture may return stale or conflicting data to clients in the event of network partition or failures
- C) Consider the database schema given in Q.No. 1B and enforce the constraint that Supplier can (2) supply maximum of 10 products using suitable database concept. (Note: without using trigger concept).
- 3) Suppose there are three transactions T1,T2, T3 with timestamp 10,20,30 respectively. T2 is holding (5) a data item which T1 and T3 are requesting to acquire. Analyze wait-wound and wait-die deadlock
 A) prevention schemes with respect to this scenario.
 - B) Write a procedure that retrieves employee's salary whose salary is more than \$2000 from the (3) employees table. The procedure then calculates the employee's bonus amount and updates their bonus_amount field in the employees table. Finally, it prints out the employee's original salary and their new bonus amount. To compute the employee's bonus amount, procedure retrives employees' department's bonus percentage from the department table.

Employee (Emp_id, Emp_name, Salry, Emp_Dept_id)

Department (Dept_id, Dept_name, Dept_bonus_Percentage).

- C) A transfer of Rs.50 has to be done from account A to account B. Evaluate this transaction with (2) respect to the desirable properties a transaction should have.
- 4) Consider the relation R, which has attributes that hold schedules of courses and sections at a university; R = {Course_No, Sec_No, Offering_Dept, Credit_Hours, Course_Level, Instructor_ssn, Semester, Year, Days_hours, Room_No, No_of_Students}. Suppose that the following functional dependencies hold on R: {CourseNo} -> {OfferingDept, CreditHours, CourseLevel}, {CourseNo, SecNo, Semester, Year} -> {Days_Hours, RoomNo, NoOfStudents, InstructorSSN}, {RoomNo, Days_Hours, Semester, Year} -> {InstructorSSN, CourseNo, SecNo}

Determine the keys of R. How would you normalize this relation to its highest decomposition level .

- B) Prove or disprove that the following schedule be converted to a conflict serializable or view (3) serializable or both?
 - W1(X),W2(X),W2(Y), W1(Y), W3(Y).
- C) A database system has three transactions T1, T2, and T3. T1 updates data item A at timestamp (2) T1=5, T2 updates data item A at timestamp T2=6, and T3 attempts to read data item A at timestamp T3=7. According to the timestamp concurrency control protocol, what will happen to T3? Justify your answer.
- 5) Consider the following schedule

A)

(5)

- R1(X) W1(X),R2(X), W2(X), COMMIT, R1(Y). Suppose T1 fails immediately after R1(Y). Justify and answer the following:
 - i. Is the schedule recoverable?
 - ii. Would aborting T2 and then restarting T1 and T2 ensure correct results?
 - iii. Would aborting and re starting T2 ensure correct results?
- B)Consider the following Emloyee table: Employee(Emp-id, Emp_name, Salary, Emp_dept,
Manager_ld). Write the SQL queries to perform the following.(3)

i) List out the top four highest paid employees in each department:

ii) List the manager's name who are supervising at least five employees.

C) Illustrate the usage of Abstract entity set with a suitable example.

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