

Database Systems (CS2005)

Final Exam

Date: Wednesday, Dec 18th 2024

Course Instructor(s): Dr. Zulfiqar Ali Memon,

Dr. Anam Qureshi, Ms. Javeria Farooq, Mr.

Basit Ali, Ms. Atiya Jokhiyo, Ms. Abeer Gauher,

Ms. Fizza Aqeel, Mr. Omer Qureshi, Ms. Zain

Noreen, and Ms. Alina Arshad

Total Time (Hrs): 3

Total Marks: 50

Total Questions: 8

Do not write below this line

Attempt all the questions.

CLO #2: Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms, such as a data dictionary.

Q1: [Marks: 5] [Estimated Time: 15 minutes]

A database system uses the steal/no-steal policy for managing buffer pages. During transaction T1, the following events occur:

- Transaction T1 updates several pages in the buffer.
- Before Transaction T1 commits, one of the updated pages is removed from the buffer and written to disk.
- Shortly after, the system crashes, and Transaction T1's log records are incomplete.

Answer the following questions:

- a) Based on the described behavior, identify whether the database system follows a steal or no-steal policy? Justify your answer.
- b) How would this crash impact the recovery process for Transaction T1, and what steps would need to be taken to ensure database consistency after recovery?
- c) What is the advantage of a steal policy?

CLO #2: Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms, such as a data dictionary.

Q2: [Mark: 5] [Estimated Time: 15 minutes]

Consider the following transactions:

- Transaction T1: Transfers \$300 from Account A to Account B.
- Transaction T2: Transfers \$200 from Account B to Account A.

Using concurrency control, explain how deadlock can occur and describe a solution to prevent or resolve the deadlock.

CLO #1: Explain fundamental database concepts.

Q3: [Marks: 5] [Estimated Time: 15 minutes]

Imagine an online shopping platform where users can place orders, update their shopping cart, and make payments simultaneously. During a sale event, multiple transactions are executed concurrently:

- a) User A adds an item to their cart but the system crashes before the transaction is completed.
- b) User B places an order, which updates the inventory, but another user, User C, views the inventory before the update is committed.
- c) User D makes a payment, but due to a system failure, their payment status is not saved even though the payment is processed by the bank.

Explain how the ACID properties (Atomicity, Consistency, Isolation, Durability) are applied to handle the above scenarios and ensure reliable transaction processing.

National University of Computer and Emerging Sciences
Karachi Campus

CLO #2: Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms, such as a data dictionary.

Q4: [Marks: 5] [Estimated Time: 15 minutes]

✓ Discuss the timestamp ordering protocol for concurrency control. What challenges can arise in basic timestamp ordering? How does strict timestamp ordering address these challenges? Illustrate with suitable example.

CLO #2: Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms, such as a data dictionary.

Q5: [marks: 10] [Estimated Time: 30 minutes]

Consider the following schedules of two transactions. For each schedule, show the proper working and classify if it is: recoverable, non recoverable, cascading rollback, cascadeless, strict, or conflict serializable. A schedule may have more than one property. ere, R1 defines read of transaction 1, W1 defines write of transaction 1, A1 defines abort of transaction 1, and C1 defines commit of transaction 1. Same goes for transaction 2.

- a) R1(X);R2(Y);W1(Y);C1;A2
- ✓ b) R1(X);W1(X);R2(X);W2(X);C2;C1
- ✓ c) R1(X);W1(X);R2(X);W2(X);A1;A2
- ✓ d) W1(X);R2(X);A1;W2(X);C2
- ✓ e) R1(X);W1(X);R2(X);C1;W2(X);C2
- ✓ f) W1(X);R2(X);W2(X);A2;C1
- ✓ g) W1(X);W2(Y);R2(X);R1(Y);W1(Y);C1;C2
- ✓ h) R1(X);W1(X);R2(X);A1;W2(X);C2
- ✓ i) W1(X);W2(Y);W1(Y);C1;R2(X);C2
- ✓ j) W1(X);W2(Y);R1(Y);R2(X);A1;A2

CLO #3: Demonstrate an understanding of normalization theory to normalize the database and formulate, using SQL & relational algebra, solutions to a broad range of query & data problems in a team work..

Q6: [Marks: 10] [Estimated Time: 30 minutes]

The following schema is part of a university database. The primary keys are underlined and the foreign keys you have to identify yourself.

Student (StudentId, StudentName)
Faculty (FacultyId, ProfName)
Course (CourseId, CourseName)
Qualified (FacultyId, CourseId, DateQualified)
Section (SectionNo, Semester, CourseId)
Registration(SectionID, Student No, Semester)

Using the above schema, write down the relational algebraic expressions for the following statements. Also convert the relational algebraic expressions to SQL queries

- ✓ a) Display all courses for which Professor Miley has been qualified.
- ✓ b) Which instructors are qualified to teach CT220?
- ✓ c) Is any instructor qualified to teach CT220 and not qualified to teach CS208?
- ✓ d) How many students are enrolled in section 1345 during semester I-2012?
- ✓ e) How many students are enrolled in CT220 during semester I-2012?

CLO # 2: Demonstrate an understanding of normalization theory to normalize the database and formulate, using SQL & relational algebra, solutions to a broad range of query & data problems in a team work.

Q7: [Marks: 5] [Estimated Time: 15 minutes]

✓ The Hospital Management System aims to maintain a record of all appointments with respect to the doctors available as shown in Table 01. Each appointment has a unique ApptNo. The system stores all details related to a particular appointment, including the patient's name and ID, the doctor's name and ID, the appointment type, time, and any other necessary information related to the appointment.

National University of Computer and Emerging Sciences
Karachi Campus

Table 01: Appointments Record

Appt No	Appt Date	Appt Time	Appt Type	Patient ID	Fname	Lname	Doctor ID	Contact#	Dname
1	4/11/2024	8:00am	Flu	111	Mr.	Ali	XXXU	332-7960	Dr. Laughs
2	4/11/2024	9:00am	Cough	112	Mrs.	Ali	UXXU	332-7968	Dr. Care
3	5/11/2024	10:00am	Skin	113	Mr.	Ahmed	XUX	334-9999	Dr. Michel
4	5/11/2024	11:00 am	Flu	111	Mr.	Ali	X1UUX2	332-7960	Dr. English
5	6/11/2024	10:00am	Cough	115	Mrs.	Ahmed	UXXU	331-3331	Dr. Care
6	6/11/2024	8:00am	Skin	112	Mrs.	Ali	X2UUX1	332-7968	Dr. Johnson

- Convert the table into 1NF by addressing any unorganized data (if applicable).
- With the primary key given for the relation and remove partial dependencies, (if any) to achieve 2NF and show Functional Dependencies (FD's).
- Identify transitive dependencies (if any) and show FD's and convert the table to 3NF.
- After converting the table into 3NF, present the final schema.

CLO # 2: Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms, such as a data dictionary.

Q8: [Marks: 5][Estimated Time: 15 minutes]

An e-commerce platform efficiently manages a network of products, customers, orders, payments, and inventory. Customers create unique accounts with personal details, save multiple shipping addresses, and link payment methods for seamless transactions. They place orders containing various products, each identified by attributes like ID, name, price, and category. Vendors, identified by unique IDs, manage their products, inventory, and shipping. Orders capture details such as order ID, date, customer, total price, status, and shipping information, often including items from different vendors. Payments are processed with transaction details like method, amount, and status, while real-time inventory updates ensure accurate availability. Shipping is tracked with IDs, carriers, costs, and statuses. The platform ensures smooth operations across purchase, inventory management, and delivery, handling the intricate relationships between customers, vendors, and products. Your task is to create an Entity Relationship Diagram to show the complete flow of the platform. Also mention the structural constraints if required.

Good Luck!