

26th December 2022, 08:30 am – 11:30 am

Course Code: CS2005	Course Name: Database Systems
Instructor Name: Dr. Zulfiqar Ali Memon, Ms. Anam Qureshi, Mr. Muhammad Danish Khan, Ms. Eman Shahid, Ms. Hajra Ahmed, Ms. Zumar Noor	
Student Roll No:	Section:

Instructions:

- Return the question paper. Don't write anything on question paper, except your Roll # & Section #.
- Read each question completely before answering it. There are 7 questions and 3 pages.
- In case of any ambiguity, you may make assumptions. But your assumptions should not contradict any statement in the question paper.
- All the answers must be solved according to the sequence given in the question paper.
- This paper is subjective. Write the answers only on answer sheet.

Time: 180 minutes.

Max Marks: 50

Question 01: [CLO #2]

[8 marks]

Consider the following two transactions:

- A.** Add lock and unlock instructions to transactions T31 and T32, so that they observe the two-phase locking protocol. Can the execution of these transactions result in a deadlock?
- B.** Most implementations of database systems use strict two-phase locking. Suggest three reasons for the popularity of this protocol.

T_{31} : read(A);
read(B);
if $A = 0$ then $B := B + 1$;
write(B).

T_{32} : read(B);
read(A);
if $B = 0$ then $A := A + 1$;
write(A).

Question 02: [CLO # 2]

[8 marks]

Consider the following schedule where, for clarity, we have included all the operations that will appear in the system log, plus additional helpful detail.

System Log
T1 STARTS
T1 reads item B
T1 writes item B with old value 11, new value 12
T2 STARTS
T2 reads item B
T2 writes item B with old value 12, new value 13
T3 STARTS
T3 reads item A
T3 writes item A with old value 29, new value 30
T2 reads item A
T2 writes item A with old value 30, new value 31
T2 COMMITS
T1 reads item D
T1 writes item D with old value 44, new value 45 ***
T3 COMMITS

Suppose that a crash occurs right after the log record with asterisks next to it is written to disk, and the recovery procedure is then run.

- Which transactions get rolled back?
- Does cascading rollback take place? Why or why not?
- Which operations in the log get undone?
- At the time of the crash, which of the five data write operations are guaranteed to have taken place on disk?
- At the time of the crash, which of the five data write operations are guaranteed to not have taken place on disk?

Questions 03: [CLO # 1]

[8 marks]

In the table given below there are three transactions T11, T12, and T13 running some read and write operations in an interleaved manner. Consider Database is updated every time after a transaction commits. Moreover, before T11, T12, and T13 the values of $X=100$, $Y=50$, $Z=25$, $Sum = 0$; in the database.

a) After each operation, what will be the values of X, Y, and Z in the system log and in the database?

Time	T11	T12	T13	System Log	Database
t ₁		begin_transaction			
t ₂	begin_transaction	Sum = 0			
t ₃	read(X)	Read(X)			
t ₄	$X = X - 10$	Sum = Sum + X			
t ₅	Write (X)	Read(Y)			
t ₆	Read(Z)	Sum = Sum + Y			
t ₇	$Z = Z + 10$				
t ₈	Write(Z)		Begin_transaction		
t ₉	Commit	Read(Z)	Read(X)		
t ₁₀		Sum = Sum + Z	$X = X + 10$		
t ₁₁			Write (X)		
t ₁₂		Read(X)			
t ₁₃		$X = X - 10$			
t ₁₄		Write(X)	Rollback		
t ₁₅		Commit			

b) What concurrency problem(s) did you observe in the given schedule of transactions? Briefly explain.

Question 04: [CLO # 2]

[7 marks]

Consider the following Rental Company scenario and draw the complete ER Diagram.

Our company arranges rentals of properties owned by both private and business owners. We record every property owner by unique owner number, its address, owner's name, email, and phone numbers. For a business owner, we record the type (description) of its business. Each property is identified by a unique property number, we record its address and its type. Each property may be placed in several advertisements. Each such advertisement may be displayed in many newspapers on several dates. The newspapers are identified by unique names. The term renter refers to a private person or a business who signed a rental agreement for a property. We record the date of the signing of the rental agreement, the starting and ending date of the rental agreement. A renter can rent many properties. For each renter, we record its address, its name, its email address and phone numbers. Each renter has a unique renter number in our database. In our database, we identify the staff by a unique staff number. For each staff member we record address, name, email address, phone numbers, gender, position, and salary. Each property is overseen by a unique staff member.

Question 05: [CLO # 3]**[6 marks]**

Consider the following relations:

Passenger (pid:int, pname:string, pgender:char, pcity:string)

Agency(aid:int, aname:string, acity:string)

Flight(fid:int, fdate:string, time:string, src: string, dest: string)

Booking(pid:int, aid:int, fid:int, fdate:string)

The meaning of the relations given above are straightforward; for example, a passenger can book a flight through an agency and get the booking details. Write the Relational Algebra Expression for the following statements.

- Find the agency names for agencies that are located in the same city as passenger with passenger id 123.
- Get the details of flights that are scheduled on both dates 01/12/2022 and 02/12/2022 at 16:00 hours.
- Find the agency names for agencies who do not have any bookings for passengers with id 123.
- Find the details of all male passengers who are associated with Jet agency.
- Find all the names of the passengers who are using the same flight and agency as passenger id 123.

Question 06: [CLO # 3]**[7 marks]**

Describe and illustrate the process of normalization for following table. Convert the table up to 3NF by identifying the functional dependencies represented by the attributes. State any assumptions you make about the data shown in the table:

Student No	Student Name	Major	Course No	Instructor No	Instructor Name	CourseName	Grade	Instructor Location
1	Ali	CS	1001,1002,1003	1,2,3	Anila, Huzaiifa, Yousuf,	Programming Fundamentals, Calculus, Basic Electrical Engineering	A,A+, B	Karachi, Fast, Karachi, Fast, Karachi, Fast
2	Abdullah	CS	1002,1004,1003	2,4,3	Huzaiifa, Azam, Yousuf	Calculus, English, Basic Electrical Engineering	A+,A+,A+	Karachi, Fast, Karachi, Fast, Karachi, Fast
3	Babar	SE	1003,1005,1006,	3,5,1	Yousuf, Khalid, Anila	Basic Electrical Engineering, Applied Physics, Introduction to IT	A,B+, A+	Karachi, Fast, Karachi, Fast, Karachi, Fast

Question 7: [CLO # 1]**[6 marks]**

- How databases ensure controlled redundancy whereas, filesystems do not.
- Mention the difference between triggers & stored procedures.
- Mention the difference between logical and physical data independence. Which one is easier to achieve? Support your reason with a valid example.

Good Luck!