National University of Computer and Emerging Sciences

Lahore Campus

Database Systems (CS2005) Midterm2 Exam

Date: November 2nd 2024

Total Time (Hrs.): 1

Total Marks: 25

Total Questions: 4

Course Instructor(s)

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Roll No Section Student Signature

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Note: Please ensure that you attempt all questions and their respective parts in the given order.

CLO # 3: Develop a normalized relational design to remove anomalies in a set of relations.

Q. No 1: Consider a relation R (A, B, C, D, E),
with the set of FDs F= {AB→C, AB→D, D→A, BC→ D, BC→E}.
Find all possible keys (i.e. candidate keys) of this relation? Prove it. [5]

Ans: Keys are AB, BC, and BD.

CLO # 3: Develop a normalized relational design to remove anomalies in a set of relations.

Q. No 2: Consider the relation schema R (A, B, C, D, E, G, H),
with FDs F= {AD→BH, CD→EGC, BD→H, E→D, H→C, D→H}.
Find a minimal cover of *F* (i.e. F_c). [5]

Ans: F_c= {AD→BH, CD→EGC, BD→H, E→D, H→C, D→H }
i.e. F_c= {AD→B, D→EGH, E→D , H→C}.

CLO # 3: Develop a normalized relational design to remove anomalies in a set of relations.

Q. No 3: Consider the relation schema R (A, B, C, D, E), with FDs F= {CE → D, D → B, C → A, D → E}. Keys of this relation are CD and CE. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Justify your answer. If R is not in BCNF, decompose it into a set of BCNF relations and show your steps. Indicate which dependencies if any are not preserved by the BCNF decomposition. [5]

Ans: HNF=1NF as FD2/FD3 violate 2NF.
2NF Schema is R1(C, D, E) with FD1 & FD4 and Keys are CD & CE,
R2(B, D) with FD2,
R3(A, C) with FD3.
3NF Schema: The above schema is also in 3NF.
BCNF Schema: R1 is not in BCNF due to violation of FD4.

R11(C, D), R12(D, E), R2(B, D), R3(A, C)
FD1: CE→D is lost.

Consider the following database state for the next question.

Passenger

PID	PName	Gender	Pcity
1	Ali	M	Lhr
2	Fatima	F	Lhr
3	Zainab	F	Isb
4	Asad	M	Lhr

Agency

AID	AName	Acity
1	SkyTravels	Lhr
2	AirConnect	Isb
3	GlobeTravels	Lhr
4	WorldTour	Khi

Booking

PID	AID
1	1
2	2
3	2
2	3
1	3

CLO # 5: Author queries using relational algebra and SQL.

Q. No 4: Write the result of the following queries for database state given above. Also show the intermediate result sets. [10]

a. **R1**(AID, TotalBookings) ← AID $\Im_{count(*)}$ (booking)

Result ← $\sigma_{TotalBookings>1}$ (R1)

Ans:

R1:

AID	TotalBookings
1	1
2	2
3	2

Result:

AID	TotalBookings
2	2
3	2

b. **R1** ← passenger $\rtimes_{passenger.PID=booking.PID}$ (agency $\bowtie_{agency.AID=booking.AID}$ booking)

Result ← $\prod_{PID,PName,AID,AName,Acity}$ ($\sigma_{Pcity=Acity}$ (R1))

Ans:

R1: …

Result:

PID	Pname	AID	Aname	Acity
1	Ali	1	SkyTravels	Lhr
1	Ali	3	GlobeTravels	Lhr
2	Fatima	3	GlobeTravels	Lhr
3	Zainab	2	AirConnect	Isb