Q9

Question 9. Consider the relation R with schema R(A,B,C,D), and functional dependencies $\{AB \to C, C \to D, D \to A\}$.

(a) Is the relation in BCNF? Is it in 3NF? Explain why or why not.

(b) Is the decomposition of R into AB, BC and CD lossless? Why or why not?

(c) Is the decomposition of R into AB, BC and CD dependency preserving? Why or why not?

a) The keys are AB, BC, BD (by augmentation of FDs). Hence, the latter two dependencies violate BCNF but not 3NF (since all attributes are prime). R is in 3NF not BCNF.

b) No, since B is not a key for AB nor BC.

c) No, AB→C is lost.

1

Q10

Prove the following inference rule for functional dependencies using only Armstrong's axioms: If $P \to QR$ and $R \to S$, then $P \to QS$.

Show the steps of your proof, and indicate which of Armstrong's axioms is applied in each step.

$P \to QR$	Given
$R \to S$	Given
$P \to Q$	decomposition
$P \to R$	decomposition
$P \to S$	transitivity w/ $R \to S$
$P \to QS$	union

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Q11

- For each schedule indicate which properties hold.

a) $R_1(A), W_2(A), R_1(B), Commit_1, W_3(B), R_3(B), W_3(A), Commit_3, R_2(C), Commit_2.$

Conflict serializable	Yes
ACA	Yes
Recoverable	Yes
2PL	No
Strict 2PL	No

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Q11

- For each schedule indicate which properties hold.

b) $R_1(A), W_2(B), R_1(B), Commit_1, Commit_2$

Conflict serializable	Yes
ACA	No
Recoverable	No
2PL	Yes
Strict 2PL	No

c) $R_1(A), W_2(B), R_1(B), Commit_2, Commit_1$

Same as above except this schedule is recoverable.

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Q12 (see practice final for full details)

- Give the sequence of lock requests using Wound-Wait policy.

(a) $R_1(X), W_2(Y), W_2(X), W_3(Y), W_1(Y)$

- T1 acquires shared lock on X; T2 acquires an exclusive lock on Y.
- T2 requests an exclusive lock on X. Since T2 is lower priority, it will wait.
- T3 requests an exclusive lock on Y; it also waits.
- T1 now requests an exclusive lock on Y; since it has the higher priority than T2, it will abort T2.

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Q12

- Given the following actions, under strict 2PL with deadlock detection, is there a deadlock? If so, show the WFG.

$R_1(X), W_2(Y), W_2(X), W_3(Y), W_1(Y), Commit_1, Commit_2, Commit_3$

- Yes, deadlock exists.

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FINAL REVIEW

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Final Exam

8

- December 21, 2021 at 9:00am (2.5 hours)

8

Relational Model

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- Logical model, physical model
- Data Independence
- Schemas
- Integrity Constraints (tuple, domain)
- Keys (superkey, PK, FK)
- Referential integrity (what is it, enforcement)

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E-R Model

10

- Read and interpret an ER diagram
- How to translate English requirements to an ER diagram
- Avoid redundancy
- Different types of relationships (one-many, many-many, one-one)
- Total vs. partial participation
- Weak entities
- ISA hierarchies
- Covering and overlap constraints

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SQL

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- DDL, DML
- Create table, update, delete statements
- Relational predicates, clauses, operators
- Joins (outer, full, equijoin, self), aggregation, grouping, sub-queries, etc.
- Keys: PKs, FKs, referential integrity (ways of enforcement)
- Bag semantics vs. set semantics
- Given a schema:
  - Evaluate the results (output) of an SQL query
  - Translate English statement to write an SQL query

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Views and Indexes

12

- View definition
- Distinction between virtual vs. materialized views
  - Benefits, disadvantages of each
- Insertions and updates on views
- Clustered vs. unclustered index
- B+ tree index, hash index, composite index
- When are indexes best used
- How to select the best index for a workload

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Relational Algebra

13

- RA operators and operands (selection, projection, joins, renaming, set operations, and others…)
- Set vs. bag semantics
- Extended operators
- Given a schema, know how to:
  - Write an RA expression from English statement
  - Evaluate an RA expression for its output

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Database Design

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- Redundancy, and how this causes anomalies
- Functional Dependencies (FDs)
- Keys, superkeys
- Armstrong's Axioms
- Dependency inference
- Closure
- Minimum Cover

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Database Design (cont'd)

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- Projection of FDs
- Given R, and set of FDs F, find the keys
- Schema decomposition (properties, goals)

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Normalization

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- Lossless join decomposition
  - What does this mean
  - Test to determine if a decomposition is lossless
- Dependency preserving
  - What does this mean
  - How to check if a decomposition is dependency preserving
- BCNF, 3NF
  - Distinction between the two
  - Properties of each
  - Is a decomposition BCNF or 3NF?
  - Find a BCNF, 3NF decomposition: decomposition algorithms

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Transactions

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- Transaction properties (ACID)
- Schedules
  - properties such as: serial, equivalent, serializable, conflict serializable, avoid cascading aborts, recoverable, 2PL, strict 2PL
  - How to check for these properties
- Conflict operations
- Precedence graph
- Given a schedule, determine its properties

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Locking

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- Types of locks
- Strict 2PL, 2PL
- Phantom problem
- Performance/overhead of locks
- Isolation levels

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Locking

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- Deadlocks
  - Detection: Waits-for-graph
  - Prevention: Wait-die, Wound-wait
- Multiple Granularity Locking
  - Intention locks, lock conversions (upgrades/downgrades)

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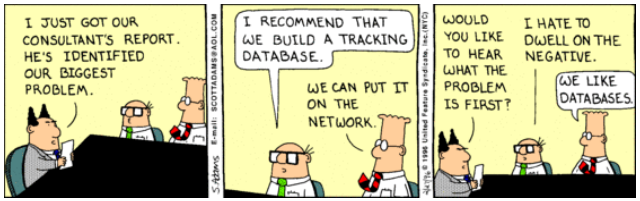

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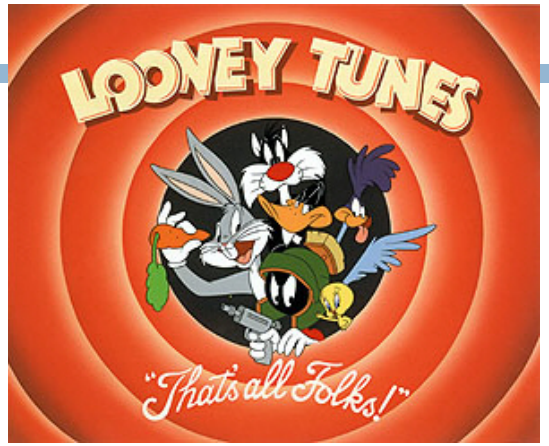

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Course Evaluations

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Final reminder if you can please complete by end of today – thank you!

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