CSC 370 - Database Systems

Midterm 02 Version 01
The Relational Data Model

45 MINUTES

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Notes

This examination consists of ten equally-weighted multiple choice questions. You should record your solutions in the provided bubble sheet. Each question has a single best solution; if you record more than one solution for the same question, you will receive a score of zero on that question. If you answer x questions correctly, then your grade on the exam will be x/10, i.e., you must answer at least five questions correctly to pass. This exam is closed-book: you are welcome to bring with you empty pages and a single-sided A4/US letter note sheet, but you cannot bring other notes nor electronic devices to your desk. Please confirm immediately after the exam starts that you have all five pages and ten questions. You may take this booklet with you when you leave, but you must turn in your note sheet.

1. (1 point) Which of the following statements is *not* accurate in the relational data model?

    A. Two tuples in the same relation can have different data types for the same attribute

    B. The order of tuples in a relation instance is unimportant

    C. A projection on a relation instance with ten tuples can produce an instance with fewer than ten tuples

    D. Relation schemata R(A, B, C) and R(C, B, A) are the same

    E. A selection on a relation instance with ten tuples can produce an instance with fewer than ten tuples

2. (1 point) Which of the functional dependencies below is appropriate for a relation, ClassTextbooks(title, author, instructor, course_id, semester, course_subject). Assume that some instructors of a course may, but do not necessarily, use the same textbook.

    A. instructor $\rightarrow$ semester

    B. semester $\rightarrow$ instructor

    C. title author $\rightarrow$ instructor

    D. course_subject $\rightarrow$ title author

    E. None of the above

3. (1 point) You have a relation R(A, B, C, D, E, F) and the functional dependencies given below. Which of the following options is a key for R?
   CD $\rightarrow$ AB
   AC $\rightarrow$ B
   AF $\rightarrow$ CE
   E $\rightarrow$ CE

    A. $\{$A, C, D, F$\}$

    B. $\{$A, F$\}$

    C. $\{$D, E, F$\}$

    D. $\{$E$\}$

    E. None of the above

4. (1 point) You have a relation R(A, B, C, D, E, F) and the functional dependencies given below. Which of the following options is a BCNF decomposition that would arise from the recursive algorithm presented in class and in the Garcia-Molina et al. text?
   $C \rightarrow BE$
   $B \rightarrow D$
   $D \rightarrow AB$

   A. S(A, B, D), T(C, D, E, F)

   B. S(A, B, D), T(C, F), U(C, D, E)

   C. S(B, C, E), T(B, D), U(D, A, B, C), V(C, F)

   D. S(A, B, C, D, E), T(C, F)

   E. S(B, D), T(A, B), U(C, D, E, F)

5. (1 point) You have a relation R(A, B, C, D, E) and the functional dependencies given below. Which of the following options is a 3NF decomposition that would arise from the recursive algorithm presented in class and in the Garcia-Molina et al. text?
   $A \rightarrow BC$
   $C \rightarrow AB$

   A. S(A, B, C), T(A, D)

   B. S(A ,B, C, D)

   C. S(A, B, C), T(C, A, B), U(A, D)

   D. S(A, B), T(A, C), U(C, A), V(C, B), W(C, D)

   E. S(A, B), T(A, C), U(C, D)

6. (1 point) Assume that attribute id is enforced as a key for relation Student(id, name). Which of the following statements best describes the relational algebra expression in Figure 1 below?

$$\rho_A(\text{Student}) \bowtie_{\text{A.id = B.id}} \rho_B(\text{Student}) = \emptyset$$

   A. Every student should have an id

   B. Every student id should be unique

   C. Every id in Student table A should appear in Student table B

   D. All students should have the same id

   E. The Student relation must be empty

7. (1 point) You have a relation R(A, B, C, D, E) and the functional dependencies given below. Which of the following statements best describes the attribute set, {A, B}?
   A → D
   BC → D
   D → ADE
   C → AB

   A. {A, B} is a key

   B. {A, B} is a superkey

   C. {A, B} is both a key and a superkey

   D. {A, B} is neither a key nor a superkey

   E. There is insufficient information to answer this question

8. (1 point) Assume that there exists a constraint enforcing that if two tuples have the same values for attributes A and B, they must have the same values for attribute C. Which of the following statements expresses that constraint formally?

   A. C → A B

   B. A → C and B → C

   C. C → A and C → B

   D. A B → C

   E. None of the above

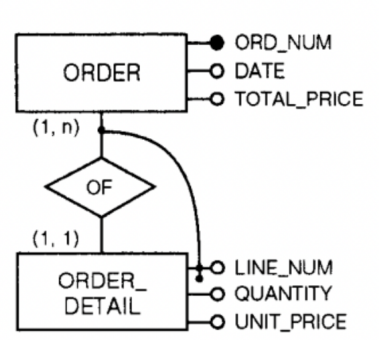

Figure 1: Figure 6.14(a) (Batini et al.), unmodified.

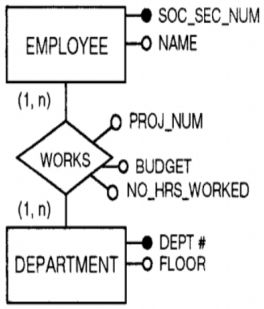

Figure 2: Figure 6.9(b) (Batini et al.), unmodified

9. (1 point) Consider the Entity-Relationship Diagram (ERD) in Figure 6.14(a) above. Which of the following relations would arise from converting it into a BCNF-normalised relational schema?

   A. OrderDetail(lineNum, quantity, unitPrice)

   B. Of(lineNum, ordNum)

   C. Order(ordNum, date, totalPrice)

   D. Order(ordNum, lineNum, date, totalPrice)

   E. None of the above

10. (1 point) Consider the Entity-Relationship Diagram (ERD) in Figure 6.14(b) above. Which of the following functional dependencies are implied by the conceptual schema?

    A. socSecNum deptNum → budget

    B. socSecNum → deptNum

    C. projNum → budget

    D. name → socSecNum

    E. No functional dependencies can be inferred from this ERD

Answer Key

Question 1

Two tuples in the same relation can have different data types for the same attribute

Question 2

None of the above

instructor → semester // instructors can teach in more than one semester
semester → instructor // multiple instructors can teach each semester
title author → instructor // multiple instructors can use the same text
course_subject → title author // multiple instructors can use different texts for same subject

Question 3

{D, E, F}

{A, C, D, F} // 0.25 marks: superkey, not key
{A, F} // misses C
{E} // totally wrong.

Question 4

S(A, B, D), T(C, F), U(C, D, E)

S(A, B, D), T(C, D, E, F) // 0.5: missed projection
S(B, C, E), T(B, D), U(D, A, B, C), V(C, F) // 3NF algorithm
S(A, B, C, D, E), T(C, F) // did not recurse on S
S(B, D), T(A, B), U(C, D, E, F) // decomp'd non-violation

Question 5

S(A, B), T(A, C), U(C, D)

S(A, B, C), T(A, D) // 0.5 marks: no minimal basis
S(A ,B, C, D) // not in 3NF
S(A, B, C), T(C, A, B), U(A, D) // duplicate relations
S(A, B), T(A, C), U(C, A), V(C, B), W(C, D) // duplicates & no minimal basis

Question 6

The Student relation must be empty

Every student id should be unique // 0.5 marks: this is the correct pattern, but the self-join is incorrect

Question 7

{A, B} is neither a key nor a superkey

Question 8

A B → C

Question 9

Order(ordNum, date, totalPrice)

OrderDetail(lineNum, quantity, unitPrice) // missing supporting identifer attribute
Of(lineNum, ordNum) // Many-one is not materialised as a table
Order(ordNum, lineNum, date, totalPrice) // 0.5 marks: weak entity set backwards

Question 10

socSecNum deptNum → budget