

# CSC 370 - Database Systems

## Midterm 02 Version 02 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 accurate in the relational data model?
- A. The order of tuples in a relation instance is important
  - B. Two tuples in the same relation must have the same data types for the same attribute
  - C. A projection on a relation instance with ten tuples always produces an instance with ten tuples
  - D. A selection on a relation instance with ten tuples always produces an instance with ten tuples
  - E. Relation schemata  $R(A, B, C)$  and  $R(C, B, A)$  are different
2. (1 point) Which of the functional dependencies below is appropriate for a relation,  $BookReviews(isbn, reviewer\_name, rating, review\_text, subject, reviewer\_agency)$ . Assume that the ISBN identifies a book, name identifies a reviewer, and multiple reviewers can work for the same agency.
- A.  $reviewer\_agency \rightarrow reviewer\_name$
  - B.  $reviewer\_name \rightarrow rating$
  - C.  $rating\ review\_text \rightarrow isbn\ subject$
  - D.  $subject \rightarrow isbn\ reviewer\_agency$
  - 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  $R$ ?
- $CF \rightarrow AD$
  - $CD \rightarrow A$
  - $BD \rightarrow CE$
  - $E \rightarrow CE$
- A.  $\{B, E, F\}$
  - B.  $\{B, C, D, F\}$
  - C.  $\{B, D\}$
  - 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?

E → CF

F → D

D → AF

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

5. (1 point) You have a relation R(A, B, C, D) 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?

D → AB

B → AD

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

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?

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

- A. Every student should have an id
- B. Every student id should be unique // 0.5 marks: this is the correct pattern, but the self-join is incorrect
- 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,  $\{A, B\}$ ?

$A \rightarrow D$

$BC \rightarrow D$

$D \rightarrow CDE$

$C \rightarrow AB$

- 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 attributes  $a$  and  $b$  make a key for relation  $R$ . Which of the following statements does not follow immediately from that?

- A. All other attributes of  $R$  can be functionally determined from  $\{a, b\}$
- B. There exists at least one other attribute in  $R$
- C. The projection of  $R$  onto  $\{a, b\}$  has exactly as many tuples as does  $R$
- D. All tuples have a unique value for the combination of  $a$  and  $b$
- E. None of the above

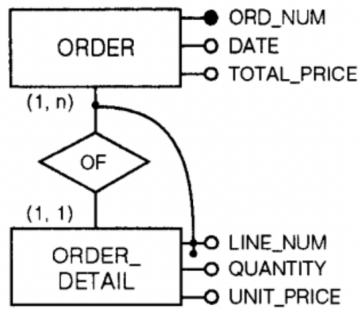


Figure 1: Figure 6.14(a)  
(Batini et al.), unmodified.

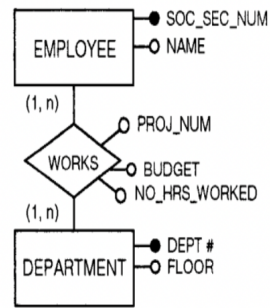


Figure 2: Figure 6.9(b)  
(Batini et al.), unmodified

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  $\rightarrow$  budget
- B. socSecNum  $\rightarrow$  deptNum
- C. projNum  $\rightarrow$  budget
- D. name  $\rightarrow$  socSecNum
- E. No functional dependencies can be inferred from this ERD

## Answer Key

### Question 1

Two tuples in the same relation must have the same data types for the same attribute

### Question 2

None of the above

### Question 3

{B, E, F}

{B, C, D, F} // 0.25 marks: superkey, not key

{B, D} // misses C

{E} // totally wrong.

### Question 4

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

S(D, F), T(A, F), U(B, C, D, E) // decomp'd non-violation

S(C, E, F), T(D, F), U(A, D, E, F), V(B, E) // 3NF algorithm

S(A, C, D, E, F), T(B, E) // did not recurse on S

S(A, D, F), T(B, C, D, E) // 0.5: missed projection

### Question 5

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

S(A,D), T(B,D), U(D,B), V(A,B), W(B,C) // duplicates & no minimal basis

S(A,B,D), T(C,D) // 0.5 marks: no minimal basis

S(A,B,D), T(D,A,B), U(C,D) // duplicate relations

S(A,B,C,D) // not in 3NF

## 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 a superkey

## Question 8

There exists at least one other attribute in R

## Question 9

Order(ordNum, date, totalPrice)

OrderDetail(lineNum, quantity, unitPrice) // missing supporting identifier 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