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Spring-20 HW3

Number of questions: 7
Positive points per question: 15.0
Negative points per question: 0.0

1. Let the relation A(MNOPQRST) satisfy the following functional dependencies: N → P, MO → Q, RS → T, Q → S, OP → M, PT → R. Which of the following FD's is also guaranteed to be satisfied by A? Recall that an FD of the form X → BC, where X is a set of attributes and where each of B and C is an attribute, is actually two FDs X → B and X → C. We say that an FD X → BC is guaranteed to be satisfied by a relation schema if and only if each of X → B and X → C is guaranteed to be satisfied by this relation schema.

- a) OST → PQ
- b) NQS → PT
- c) MNO → PS
- d) MRT → NO

2. Determine the keys and superkeys of the relation R(MNOPST) with FD's: NS → T, MNO → P, NO → T, MPST → N Then, demonstrate your knowledge by selecting the true statement from the list below. Each statement must include all the possible values.

- a) Superkeys: MOPS, MNPST
- b) Superkeys: MNOP, NST, MOPT
- c) Superkeys that are not keys: MNOPST, MNOPS, MNOST
- d) Keys: MNOPT, ST

3. Which of the following relations is in BoyceCodd Normal Form (BCNF)?

- a) R(LMNO) FD's: LMN → O; LNO → M; MNO → L; L → O
- b) R(LMNOP) FD's: M → NO; NO → L; L → MP
- c) R(LMNOP) FD's: LM → P; N → O; MP → N
- d) R(LMNO) FD's: MNO → L; LNO → M; M → L

4. Which of the following relations is correctly decomposed into the minimal number of relations that are collectively in BCNF (BoyceCodd Normal Form)?

- a) R(ABCDE) FD's: B → CD; A → E into R1(ABCDE), R2(AE)
- b) R(ABCD) FD's: C → B; C → D; B → A into R1(CD), R2(AB)
- c) R(ABCDE) FD's: BDE → A; A → C into R1(ABDE), R2(AC)
- d) R(ABCDE) FD's: A → B; B → D; D → E; C → A into R1(ABE), R2(CD)

5. A basis for a set of FD's F is any set G of FD's whose closure is the

same as the closure of F. That is, exactly the same FD's follow from F as from G. In addition, a basis must consist of a minimal set of nontrivial FD's. Suppose we have a relation R(W, M,X, Y, Z) with FD's W → M, M → X, X → Y, Y → Z, Z → W. Suppose we project R onto attributes WMXY. Describe all the bases for the set of FD's that hold in WMXY. Given a set of FD's, select statements that correctly explain if the set is a basis or not.

- a) W → M, M→ Y, Y → X, X → W: NOT a basis
- b) W → M, M→ X ,X → W, X → Y, Y → X: NOT a basis
- c) W → X, W → Y, X → Y, Y → X, M→ X, M→ Y: a basis
- d) W → M, M→ Y, X → Y, Y → W, Y → X: a basis

6. Suppose relation R(A,B,C,D) has the tuples:

A	B	C	D
a	1	4	e
b	2	10	e
c	7	6	f
a	3	19	e

And the relation S(F, G, H) has tuples:

F	G	H
b	15	21
b	4	5
c	7	2
b	5	4
a	20	11
d	6	3
b	17	12

Which of the following tuples is in the theta-join of R and S with the condition A = F AND C < G AND (D = 'e' OR D = 'f') AND (A = 'a' OR A = 'b') AND G > H?

- a) (b, 2, 10, e, b, 5, 4)
- b) (b, 2, 10, e, b, 4, 5)
- c) (c, 7, 6, f, b, 15, 21)
- d) (a, 1, 4, e, a, 20, 11)

7. Which of the following relations is in Third Normal Form (3NF)?

- a) R(VWXY) FD's: V → W; V → X; WX → Y
- b) R(VWXY) FD's: WXY → V; VW → X; Y → V; W → X
- c) R(VWXYZ) FD's: V → WX; Z → VY; W → Z
- d) R(VWXYZ) FD's: V → WZ; X → V; W → XY; Z → Y

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