

Initial: _____

Name _____

RUID _____

CS 198:336 Midterm Exam 2 - Spring 2019

Section 4, 5, 6 (Circle your section)

- Please put your initials on all pages
- Two queries are equivalent if they return the same answer (including duplicates) over all possible database states

Part 1	
Part 2	
Part 3	
Part 4	
Part 5	
Total	

Part 1: Functional Dependency (35 points)

Question 1.1 Consider the relational schema $R(A, B, C, D)$ and the following set of functional dependencies:

$$S = A \rightarrow B, BC \rightarrow A, D \rightarrow C$$

A functional dependency $X \rightarrow Y$ (e.g., $BD \rightarrow A$) is said to "logically follow" from S if when you compute the closure X^+ ($\{B, D\}^+$ in this case), it contains Y (A in this case).

If $X \rightarrow Y$ does not logically follow from S , then there must be an instance of the relation R which satisfies the dependencies in S , but does not satisfy $X \rightarrow Y$. (* Finding this may take a bit of thinking, and working backward.)

For each of the functional dependencies $X \rightarrow Y$ below show whether it logically follows from S or not. (So if the answer, is "yes", start by computing X^+ . If the answer is "no", show the appropriate (*smallest) instance.)

- (i) $A \rightarrow C$
- (ii) $BD \rightarrow A$
- (iii) $CD \rightarrow B$
- (iv) $BCD \rightarrow A$

Relational schema $R(A, B, C, D)$ where $S = A \rightarrow B, BC \rightarrow A, D \rightarrow C$

- (i) Does $A \rightarrow C$ logically follows from S ? If yes, explain your answer. **(5 points)**

- (ii) Does $BD \rightarrow A$ logically follows from S ? If yes, explain your answer. **(5 points)**

- (iii) Does $CD \rightarrow B$ logically follows from S ? If yes, explain your answer. **(5 points)**

- (iv) Does $BCD \rightarrow A$ logically follows from S ? If yes, explain your answer. **(5 points)**

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Question 1.2 Consider a relation $R(A, B, C, D, E)$ satisfying the following dependencies:

$$A \rightarrow E, BC \rightarrow D, ED \rightarrow A$$

(a) List all keys for R . (5 points)

LHS	Both	RHS

Columns	Plus Set	Superkey? (Yes/no)	Minimum Superkey? (Yes/no)

List Minimum Superkey(s): _____

(b) Is R in 3NF? Justify your answer. (4 points)

(c) R is not in BCNF. Explain why. (6 points)

Part 2: True/False (Totals 15 points)

- (1) _____ Assume that you have an E-R schema where relationship EnrolledIn relates entities Student, Course and Semester and represents the fact that a student is enrolled in a course for a certain semester (year-term). According to this schema, a student can't enroll for the same course more than once. (4 points)
- (2) _____ Consider relation Teaching(ProfId, CrsId, Sem), which keeps track of who taught what during a semester (such as '2008F') and assumes that a course is taught during any one term once by a single professor. For this relation, the expression
- ```
SELECT T.Sem, COUNT(ProfId) FROM Teaching T GROUP BY T.Sem;
```
- returns a relation showing how many courses were taught during each semester. (5 points)
- (3) \_\_\_\_\_ Given  $R(ABCDE)$  with functional dependencies  $F = \{AB \rightarrow C, A \rightarrow D, D \rightarrow E, AC \rightarrow B\}$ , then  $ABC$  is a key. (6 points)

**Part 3: Convert the following statements to SQL and Datalog (15 points)**

Consider a database with the following schema:

```
LIKES(drinker, beer); /* Key: All columns */
FREQUENTS(drinker, pub); /* Key: All columns */
SERVES(pub, beer, cost); /* Key: (pub, beer) */
```

1. Find pubs that serve some beer that Joe likes.

**SQL (5 points):**

**Datalog (5 points):**

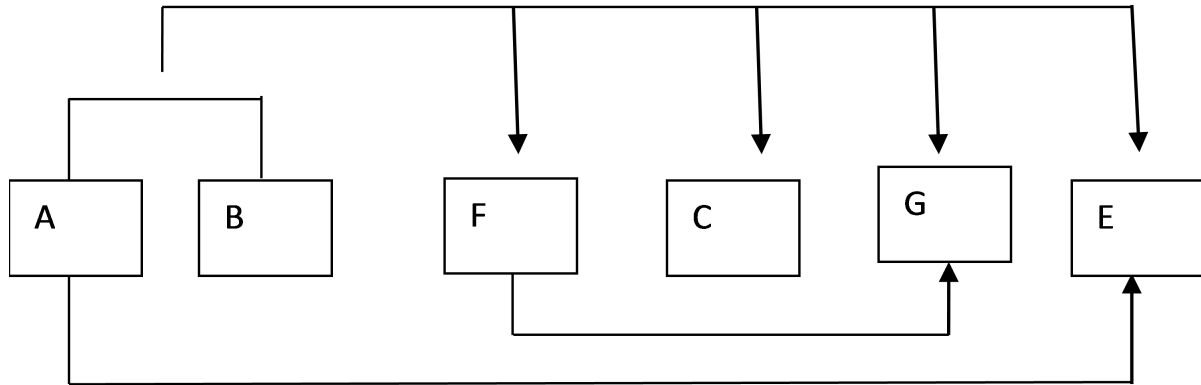
2. Find drinkers who frequent pubs where they can get a drink for less than \$3 (5 points)

**Datalog:**

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#### Part 4: Normalization (15 points)

Normalization: Label partial dependency and transitive dependency. Then solve the second normal form and third normal form with different tables and link them back with foreign key:



## PART 5. Integrity Constraints (CHECK, ASSERTION, TRIGGERS) (20 points)

Consider the following relational schema. An employee can work in more than one department; the `pct_time` field of the `Works` relation shows the percentage of time that a given employee works in a given department.

`Emp(eid: integer, ename: string, age: integer, salary: real)`

`Works(eid: integer, did: integer, pct_time: integer)`

`Dept(did: integer, budget: real, managerid: integer)`

Write SQL integrity constraints (domain, key, foreign key, CHECK constraints, assertions, SQL triggers) to ensure each of the following requirements, considered independently.

1. Employees must make a minimum salary of \$1000. (6 points)

`CREATE TABLE Emp (`

2. Every manager must also be an employee. (7 points) (Fill in underline)

`CREATE ASSERTION ManagerIsEmployee`

`CHECK ((SELECT _____ (*)`

`FROM _____ AS _____`

`WHERE _____.managerid _____ IN`

`(SELECT _____ FROM _____)) = 0)`

3. Use Triggers to monitor if the you try to modify the salary to employee table, and if old salary is less than new salary, put the information into the Warning table (7 points) (Fill in underline)

`CREATE TRIGGER dynamicSalaryCheck _____ -- (pick one: either BEFORE or AFTER)`

`_____ -- (pick one: INSERT, UPDATE, DELETE)`

`OF salary ON Employee REFERENCING`

`OLD ROW AS oldTuple`

`NEW ROW AS newTuple`

`FOR EACH ROW`

`WHEN (_____.salary > _____.salary)`

`INSERT INTO Warning (empID, oldSal, newSal)`

`VALUES (_____, _____, _____);`