

Comprehensive Exam Databases Spring 2003

1) (20 points) Define (in detail) each of the following components of a DBMS. Note that simply stating, for example, that the Query Processor is responsible for processing queries, is not sufficient.

(a) Query Processor

(b) Transaction Manager

(c) Buffer Manager

(d) Data Dictionary (or System Catalogue)

2) (20 points) Select the best answer for each of the following.

The purpose of normalization is:

- (a) eliminate redundancy
- (b) eliminate insertion, deletion and update anomalies
- (c) enhance system performance/efficiency
- (d) none of the above
- (e) both (a) and (b)

If every attribute in a relational scheme is “atomic” (or indivisible) then that scheme is in:

- (a) first normal form
- (b) second normal form
- (c) third normal form
- (d) all of the above
- (e) none of the above

Suppose that a relational scheme R1 is decomposed into R2 and R3, and that R2 and R3 are both in third normal form. Then it follows that:

- (a) R2 and R3 have a lossless join
- (b) R2 and R3 both preserve dependencies
- (c) none of the above
- (d) both (a) and (b)
- (e) depending on the specific decomposition, (a) or (b) or both may be true

Suppose that a relational scheme R1 is decomposed into R2 and R3, and that this decomposition preserves dependencies and has a lossless join. Then it follows that:

- (a) R2 and R3 are in third normal form
- (b) R2 and R3 are in BCNF
- (c) R2 and R3 are in third normal form, but not BCNF
- (d) R2 and R3 are in BCNF but not third normal form
- (e) depending on the specific decomposition, it might not even be in

Consider the following set F of functional dependencies for the relational scheme $R=(A,B,C,D,E,F)$.

$A \Rightarrow B$

$A \Rightarrow D$

$C \Rightarrow EA$

(a) (10 points) Now consider the decomposition of R into $R_1=(A,B,F)$ and $R_2=(A,C,D,E)$. Is this decomposition dependency preserving (yes or no)? If so, then explain why, and if not, then explain why not.

(b) (10 points) Now suppose that the set of functional dependencies, for the same relational scheme, is:

$A \Rightarrow B$

$A \Rightarrow D$

$C \Rightarrow EA$

$C \Rightarrow B$

Is the decomposition of R into $R_1=(A,B,F)$ and $R_2=(A,C,D,E)$ still dependency preserving (yes or no)? If so, then explain why, and if not, then explain why not.

3) (30 points) Consider the following collection of relation schemes.

employee(employee-name, street, city)

works(employee-name, company-name, salary)

company(company-name, city)

manages(employee-name, manager-name)

Give an SQL statement for each of the following.

(a) A list of manager names, and for each manager a count of the number of employees that they manage.

(b) As declared above, each employee works for exactly one company (This is indicated by the fact that *employeenname* is a candidate key for *works*). Give an SQL statement that lists all employee who do not work for First Bank Corporation.

(c) Now suppose that each employee can work for more than one company. Furthermore, suppose that in order to support this the schema for *works* is changed so that *employee-name* and *company-name* both collectively form the primary key. Does your answer to part (b) apply in this case as well (yes or no)? If not, then give an SQL query that does.

4) (20 points)

a) Define first normal form (1NF).

b) Define second normal form (2NF).

c) Define third normal form (3NF).

d) Define BCNF.