

Please read 15 – 15.4 of the textbook and then answer the following, trying not to look at your notes or at the textbook. Quiz #5, on Wednesday 1st November, will consist of questions **inspired from** the Part I of this homework.

Part I — Short Questions

Question 1

What is insertion anomaly? Give an example.

Question 2

Why should we avoid attributes whose value will often be NULL? Can the usage of NULL be completely avoided?

Question 3

Consider the following relation:

STUDENT(SSN, Name, ..., Bike_brand)

Why is it a poor design to have a “Bike_brand” attribute in such a relation? How should we store this information?

Question 4

Consider the following relational database schema:

STUDENT(login, Name, ..., Major, Major_Head)

DEPARTMENT(Code, Name)

Assuming that “Major” is a foreign key referencing “DEPARTMENT.Code”, what is the problem with that schema? How could you address it?

Question 5

Consider the relation $R(A, B, C, D, E, F)$ and the following sets of functional dependencies:

1. $\{F \rightarrow \{D, C\}, D \rightarrow \{B, E\}, \{B, E\} \rightarrow A\}$
2. $\{\{A, B\} \rightarrow \{C, D\}, \{B, E\} \rightarrow F\}$
3. $\{A \rightarrow \{C, D\}, E \rightarrow F, D \rightarrow B\}$

For each set of functional dependency, give a key for R . We want a key, so it has to be minimal.

Question 6

Consider the relation $R(A, B, C, D, E, F)$ and the following functional dependencies: $A \rightarrow \{D, E\}, D \rightarrow \{B, F\}, \{B, E\} \rightarrow A, \{A, C\} \rightarrow \{B, D, F\}, A \rightarrow F$. Answer the following:

1. How many candidate keys is there? List them.
2. How many transitive dependencies can you find? Give them and justify them.

Question 7

Consider the relation $R(A, B, C, D)$ and answer the following:

1. If $\{A, B\}$ is the only key, is $\{A, B\} \rightarrow \{C, D\}, \{B, C\} \rightarrow D$ a 2NF? List the nonprime attributes and justify.
2. If $\{A, B, C\}$ is the only key, is $A \rightarrow \{B, D\}, \{A, B, C\} \rightarrow D$ a 2NF? List the nonprime attributes and justify.

Question 8

Consider the relation $R(A, B, C, D, E, F)$ with candidate keys $\{A, B\}$ and C . Answer the following:

1. What are the prime attributes in R ?
2. Is $\{C, D\} \rightarrow E$ a fully functional dependency?
3. Write a set of functional dependencies containing at least one transitive dependency, and justify your answer.

Question 9

Consider the relation $R(A, B, C, D)$ and answer the following:

1. If A is the only key, is $A \rightarrow \{B, C, D\}, \{A, B\} \rightarrow C, \{B, C\} \rightarrow D$ a 3NF? List the nonprime attributes and justify.
2. If B is the only key, is $B \rightarrow \{A, C, D\}, A \rightarrow \{C, D\}, \{A, C\} \rightarrow D$ a 3NF? List the nonprime attributes and justify.



Part II — Problem

This part will help you in assessing your level of understanding of this lecture, and give you an idea of the kind of problem you will be asked to solve during the exams. I'll assume that you will have successfully completed those two problems by the time Homework #6 is released (Wednesday 1st November), so don't wait and let me know if you had difficulties solving them.

Problem 1

Consider the relations R and T below, and their functional dependencies:

$R(\underline{\text{EventId}}, \underline{\text{Email}}, \text{Time}, \text{Date}, \text{Location}, \text{Status})$

$T(\underline{\text{Invno}}, \text{Subtotal}, \text{Tax}, \text{Total}, \text{Email}, \text{Lname}, \text{Fname}, \text{Phone})$

$\{\text{EventId}, \text{Email}\} \rightarrow \text{Status}$

$\text{EventId} \rightarrow \{\text{Time}, \text{Date}, \text{Location}\}$

$\text{Invno} \rightarrow \{\text{Subtotal}, \text{Tax}, \text{Total}, \text{Email}\}$

$\text{Email} \rightarrow \{\text{Fname}, \text{Lname}, \text{Phone}\}$

Normalize the relations to 2NF and 3NF. Show all relations at each stage (2NF and 3NF) of the normalization process.

Problem 2

Consider the following relation, and its functional dependencies:

$\text{CAR_SALE}(\underline{\text{Car_no}}, \underline{\text{Date_sold}}, \underline{\text{Salesman_no}}, \text{Commission}, \text{Discount_amt})$

$\{\text{Car_no}, \text{Salesman_no}\} \rightarrow \{\text{Date_sold}, \text{Commission}, \text{Discount_amt}\}$

$\text{Date_sold} \rightarrow \text{Discount_amt}$

$\text{Salesman_no} \rightarrow \text{Commission}$

Based on the given primary key, is this relation in 1NF, 2NF, or 3NF? Why or why not? Normalize it completely. Then draw an ER diagram for the resulting schema.

