

Exercise 3

Question 1

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

$AB \rightarrow C$

$CD \rightarrow E$

$DE \rightarrow B$

Is AB a candidate key of this relation? If not, is ABD ? Explain your answer.

Question 2

Consider the relation R , which has attributes that hold schedules of courses and sections at a university; $R = \{ \text{Course_no}, \text{Sec_no}, \text{Offering_dept}, \text{Credit_hours}, \text{Course_level}, \text{Instructor_ssn}, \text{Semester}, \text{Year}, \text{Days_hours}, \text{Room_no}, \text{No_of_students} \}$. Suppose that the following functional dependencies hold on R :

$\{ \text{Course_no} \} \rightarrow \{ \text{Offering_dept}, \text{Credit_hours}, \text{Course_level} \}$

$\{ \text{Course_no}, \text{Sec_no}, \text{Semester}, \text{Year} \} \rightarrow \{ \text{Days_hours}, \text{Room_no}, \text{No_of_students}, \text{Instructor_ssn} \}$

$\{ \text{Room_no}, \text{Days_hours}, \text{Semester}, \text{Year} \} \rightarrow \{ \text{Instructor_ssn}, \text{Course_no}, \text{Sec_no} \}$

Try to determine which sets of attributes form keys of R .

Question 3

Consider the following relation for published books:

$\text{BOOK}(\text{Book_title}, \text{Author_name}, \text{Book_type}, \text{Listprice}, \text{Author_affil}, \text{Publisher})$

Author_affil refers to the affiliation of the author. Suppose the following dependencies exist:

$\text{Book_title} \rightarrow \text{Publisher}, \text{Book_type}$

$\text{Book_type} \rightarrow \text{Listprice}$

$\text{Author_name} \rightarrow \text{Author_affil}$

(a) What normal form is the relation in? Explain your answer.

(b) Decompose the relation into a set of 3NF relations if it is not in 3NF.

Question 4

Consider the relation $\text{REFRIG}(\text{MODEL\#}, \text{YEAR}, \text{PRICE}, \text{MANUF_PLANT}, \text{COLOR})$, which is abbreviated as $\text{REFRIG}(M, Y, P, MP, C)$, and the following set of F of functional dependencies:

$F = \{ M \rightarrow MP, \{M, Y\} \rightarrow P, MP \rightarrow C \}$

(a) Evaluate each of the following as a candidate key for REFRIG , giving reasons why it can or cannot be a key: $\{M\}$, $\{M, Y\}$, $\{M, C\}$

(b) Based on the above key determination, state whether the relation REFRIG is in 3NF and in BCNF, giving proper reasons.

(c) Consider the decomposition of REFRIG into $D=\{R1(M,Y,P), R2(M,MP,C)\}$. Is this decomposition lossless? Show why.

Question 5

Consider a relation $R(A, B, C, D, E, G, H)$ and its FD set $F = \{AB \rightarrow CD, E \rightarrow D, ABC \rightarrow DE, E \rightarrow AB, D \rightarrow AG, ACD \rightarrow BE\}$. Answer the following questions and justify your answers.

- 1) List all the candidate keys for R .
- 2) Determine the highest normal form of R with respect to F .
- 3) Is the decomposition $\{ABCD, DEGH\}$ (with the same FD set F) of R lossless-join?
- 4) Find a minimal cover F_m for F .
- 5) Decompose into a set of 3NF relations if it is not in 3NF. Make sure your decomposition is dependency-preserving and lossless-join.
- 6) Decompose it into a collection of BCNF relations if it is not in BCNF. Make sure your decomposition is lossless-join.

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