

# 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:

$\text{BOOK}(\text{Book\_title}, \text{Authorname}, \text{Book\_type}, \text{Listprice}, \text{Author\_affil}, \text{Publisher})$

$\text{Author\_affil}$  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  $\text{REFRIG}$ , 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  $\text{REFRIG}$  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.