

Tutorial 4

Normalisation

Classroom Exercise

1. A medical clinic database schema contains the following:

APPOINTMENT (patient-id, patient-name, doctor-id, doctor-name, appointment-date, appointment-time, clinic-room-no)

Identify the functional dependencies in the schema, stating any assumptions made. Using these functional dependencies, normalise the schema to Third Normal Form.

2. Consider the relation Courses(C, T, H, R, S, G) whose attributes may be thought informally as course, teacher, hour, room, student, and grade. Let the set of FD's of Courses be:

$C \rightarrow T, HR \rightarrow C, HT \rightarrow R, HS \rightarrow R, \text{ and } CS \rightarrow G.$

(a) What are all the keys for Courses?

(b) Verify that the given FDs are their own minimal basis.

(c) Use the 3NF decomposition algorithm to find a lossless-join, dependency-preserving decomposition.

3. Consider a relation R(W, X, Y, Z) which satisfies the following set of FDs $G = \{Z \rightarrow W, Y \rightarrow X, Y \rightarrow Z, XW \rightarrow Y\}$, where G is a minimal basis.

(a) Decompose R into a set of relations in 3NF.

(b) Is the decomposition also in BCNF? Explain your answer.

4. Consider a relation R(A,B,C,D,E) and FD's $A \rightarrow BC, CD \rightarrow E, E \rightarrow A, \text{ and } B \rightarrow D.$

(a) Is the decomposition $R_1(A,B,C)$ and $R_2(A,D,E)$ of R lossless or lossy? Justify your answer. Is this decomposition dependency preserving? If your answer is NO, then what is not preserved?

(b) Is the decomposition $R_3(A,B,C,D)$ and $R_4(C,D,E)$ of R lossless or lossy? Justify your answer. Is this decomposition dependency preserving? If your answer is NO, then what is not preserved?

Critical Thinking Exercise

5. We perform decomposition to normalize an original schema to be of certain normal forms. For such a decomposition to be “equivalent” to the original schema, it is desirable to be lossless. To study this concept, let’s consider an original schema $R(A, B, C)$. Suppose we decompose R into $R_1(A, B)$ and $R_2(A, C)$.
- (a) Is this decomposition always lossless? Answer *yes* or *no* and briefly explain why.
 - (b) Give an example instance of R (*i.e.*, an example table with several tuples) and demonstrate its decomposition, to support your answer in (a).