Technische Hochschule Rosenheim

Exercise 07: Relational database design and normalisation

Task 1: Normalisation

Given the following relations R and S in the first normal form with functional dependencies $F = F_C$:

$$\begin{aligned} R &= (A,B,C,D,E,F)\ with \\ A,B &\rightarrow C,D,E \\ D &\rightarrow F\ and \\ &\{A,B\} \text{ is Key.} \end{aligned}$$

$$\begin{aligned} S &= (V,W,X,Y,Z)\ with \\ V &\rightarrow W,Z \\ W,Z &\rightarrow V,X,Y \\ Y &\rightarrow Z\ and \\ &\{V\},\{W,Z\},\{W,Y\} \text{ are keys..} \end{aligned}$$

1. Show as briefly as possible that R does not correspond with the third normal form (3NF).
2. Through decomposition, split R into relations that correspond with the third normal form (3NF). Are the resulting relations dependency preserving and lossless join decomposition?
3. Split R using the synthesis process. Are the resulting relations dependency preserving and lossless join decomposition?
4. Show as briefly as possible that S does not correspond with the Boyce-Codd normal form (BCNF).
5. Through decomposition, split S into relations that correspond with the Boyce-Codd normal form (BCNF). Are the resulting relations dependency preserving and lossless join decomposition? Is the decomposition useful?
6. Split S using the synthesis process. Are the resulting relations dependency preserving and lossless join decomposition?

Task 2: Simplified synthesis process

Given the following relation R and functional dependencies F:

$$\begin{aligned} R &= (A,B,C,D,E,F) \\ A &\rightarrow B,C \\ D &\rightarrow E,F \end{aligned}$$

1. Obviously R does not correspond with the second normal form. The only key is $\{A,D\}$ and all prime attributes only depend on a real subset of the key. At which point in the synthesis process will a difficulty arise with the runtime?
2. If you used the simplified synthesis procedure with the additional rule $A,B,C,D,E,F \rightarrow \delta$, what is the improvement and what result is to be expected?
3. Carry out the simplified synthesis process for R.

Additional task: Comparison of synthesis and decomposition

Given the following relations S_1 and S_2 in the first normal form with functional dependencies:

$$
\begin{array}{rcl}
S_1 & = & (A,P,H,R,O,D,I,T,E)\ with \\
R & \rightarrow & O,D \\
O & \rightarrow & A,H,P,R\ and \\
 & & \{I,T,E,R\},\ \{I,T,E,O\} \text{ are keys.}
\end{array}
\qquad
\begin{array}{rcl}
S_2 & = & (A,P,H,R,O,D,I,T,E)\ with \\
R & \rightarrow & O \\
O & \rightarrow & A,P,H,R,D\ and \\
 & & \{I,T,E,R\},\ \{I,T,E,O\} \text{ are keys.}
\end{array}
$$

- Through decomposition, split S_1 and S_2 into relations in the Boyce-Codd normal form (BCNF). Can this be done?
- Decompose the relational schema using the synthesis process.

- Carry out the simplified synthesis process.
- So now, which process is better: decomposition, synthesis or the simplified synthesis process?