

Functional Dependency

Exercise 1: Consider a relation $R(A, B, C, D, E)$ with the following dependencies:

$AB \rightarrow C$, $CD \rightarrow E$, $DE \rightarrow B$

Find all possible keys of the relation.

$(A,B)^+ = \{A,B,C\}$

$(ABD)^+ = \{A,B,C,D,E\}$

Exercise 2: Consider the universal relation $R = \{A, B, C, D, E, F, G, H, I, J\}$ and the set of functional dependencies:

$A, B \rightarrow C$

$A \rightarrow D, E$

$B \rightarrow F$

$F \rightarrow G, H$

$D \rightarrow I, J$

What is the key for R ? Decompose R into 2NF, then 3NF relations.

$(AB)^+ = \{A,B,C,D,E,F,G,H,I,J\}$

2NF:

$A \rightarrow D,E$ (violated the 2NF)

$B \rightarrow F$ (violated the 2NF)

$R_1(A,D,E)$

$R_2(B,F)$

$R_3(A,B,C,G,H,I,J)$

3NF:

$A \rightarrow D,E$ (valid)

$B \rightarrow F$ (valid)

$R_3(A,B,C,G,H,I,J)$ there is no transitive dependency

So the answer of 3NF is the same w 2NF

Exercise 3: Consider the universal relation $R = \{A, B, C, D, E, F, G, H, I, J\}$ and the set of functional dependencies:

$A, B \rightarrow C$

$B, D \rightarrow E, F$

$A, D \rightarrow G, H$

$A \rightarrow I$

$H \rightarrow J$

What is the key for R ? Decompose R into 2NF, then 3NF relations.

$$(A,B)^+ = \{A,B,C\}$$

$$(ABD)^+ = \{A,B,D,C,E,F,G,H,I,J\}$$

2NF:

$A \rightarrow I$ (violated the 2NF)

$A,B \rightarrow C$ (violated the 2NF)

$B,D \rightarrow E,F$ (violate the 2NF)

$A,D \rightarrow G,H$ (violate the 2NF)

$R_1(A,I)$

$R_2(A,B,C)$

$R_3(B,D,E,F)$

$R_4(A,D,G,H)$

$R_5(A,B,D,J)$

3NF:

The answer also the same as 2NF

Exercise 4: Consider the relation $R = \{ShipName, ShipType, VoyageID, Cargo, Port, Date\}$ and the set of functional dependencies:

$ShipName \rightarrow ShipType$

$VoyageID \rightarrow ShipName, Cargo$

$ShipName, Date \rightarrow VoyageID, Port$

What is the key for R ? Decompose R into 2NF, then 3NF relations.

$$(Date, ShipName)^+ = \{ShipType, ShipName, Cargo, VoyageID, Port\}$$

2NF:

$R_1(ShipName, ShipType)$

$R_2(ShipName, Date, Cargo, VoyageID, Port)$

3NF:

$R_1(ShipName, ShipType)$

$R_{2_1}(VoyageID, Cargo)$

$R_{2_2}(ShipName, Date, Port, VoyageID)$

