Database Management System 18

Advanced Normal Forms

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MVD(Multi-Valued Dependency)

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A table involves a multi-valued dependency if it may contain multiple values for an entity

A multi-valued dependency A $\rightarrow\rightarrow$ B exists iff for every occurrence of A; there exists multiple occurrences of B

If A $\rightarrow\rightarrow$ B and A $\rightarrow\rightarrow$ C, then we have a single attribute A which multi-determines two other attributes, B and C

Multi-valued dependencies are also referred to as tuple generating dependencies

MVD(Multi-Valued Dependency)...

Employee

Name	Project	Hobby
Asis	Microsoft	Reading
Asis	Oracle	Music
Asis	Microsoft	Music
Asis	Oracle	Reading
Bikash	Intel	Movies
Bikash	Sybase	Riding
Bikash	Intel	Riding
Bikash	Sybase	Movies

MVDs are: Name $\rightarrow\rightarrow$ Project and Name $\rightarrow\rightarrow$ Hobby

MVD

An MVD X $\rightarrow\rightarrow$ Y in relation R is called a trivial MVD if:

- Y is a subset of X, or
- X $\cup$ Y = R

An MVD that satisfies neither the first nor the second condition is called a nontrivial MVD

Normally, MVDs exist in pair

4NF(Fourth Normal Form)

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A relation is in 4NF iff the following two conditions are satisfied simultaneously:

- It is in 3NF
- It contains no multiple MVDs

In other words, a relation is in 4NF iff:

- There are no nontrivial MVDs in the relation, or
- The determinant of any nontrivial MVD in the relation is a key

The previous relation is not in 4NF

Employee_Project

Name	Project
Asis	Microsoft
Asis	Oracle
Bikash	Intel
Bikash	Sybase

Name $\rightarrow\rightarrow$ Project

Employee_Hobby

Name	Hobby
Asis	Reading
Asis	Music
Bikash	Riding
Bikash	Movies

Name $\rightarrow\rightarrow$ Hobby

These relations are present in 4NF because the MVDs are

JD(Join Dependency)

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A relation R satisfies join dependency (R_1, R_2 ... R_n) iff:

- R is equal to the join of R_1, R_2 ... R_n on the common attributes, where R_i is a subset of the relation R

That means R satisfies join dependency iff R= $R_1 \bowtie R_2 \bowtie ... \bowtie R_n$

In other words, a join dependency is said to hold over a relation R if R_1, R_2 ... R_n is a lossless-join decomposition of R

5NF(Fifth Normal Form)

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A relation is in 5NF iff the following two conditions are satisfied simultaneously:

- It is in 4NF
- Every join dependency is implied by the candidate keys

In other words, a relation is in 5NF if it is in 4NF and the decomposition is lossless type

Dealer

Dealer	Parts	Customer
D_1	P_1	C_1
D_1	P_1	C_2
D_1	P_2	C_1
D_2	P_1	C_1

Dealer $\rightarrow\!\!\rightarrow$ Parts, Dealer $\rightarrow\!\!\rightarrow$ Customer

Dealer_Parts

Dealer	Parts
D_1	P_1
D_1	P_2
D_2	P_1

Dealer $\rightarrow\!\!\rightarrow$ Parts

Dealer_Customer

Dealer	Customer
D_1	C_1
D_1	C_2
D_2	C_1

Dealer $\rightarrow\!\!\rightarrow$ Customer

This decomposition is not in 5NF

5NF(Fifth Normal Form)...

Dealer_Parts

Dealer	Parts
D_1	P_1
D_1	P_2
D_2	P_1

Dealer $\rightarrow\rightarrow$ Parts

Dealer_Customer

Dealer	Customer
D_1	C_1
D_1	C_2
D_2	C_1

Dealer $\rightarrow\rightarrow$ Customer

Parts_Customer

Parts	Customer
P_1	C_1
P_1	C_2
P_2	C_1

Parts $\rightarrow\rightarrow$ Customer

Dealer_Parts $\bowtie$ Parts_Customer $\bowtie$ Dealer_Customer = Dealer

Thus, decomposition of Dealer to Dealer_Parts, Parts_Customer and Dealer_Customer is in 4NF as well as in 5NF

Denormalization

Denormalization

- **Advantages of normalization**:
  - It removes data redundancy
  - It solves Insertion, Updation, and Deletion anomalies
  - This makes it easier to maintain in the database in a consistent state
- **Disadvantages of normalization**:
  - It leads to more tables in the database
  - For retrieving the records or information, these tables need to be joined back together, which is an expensive task
- Thus, sometimes it is worth denormalizing

Denormalization...

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Once a normalized database design has been achieved, adjustments can be made with the potential consequences (anomalies) in mind

Possible denormalization steps include the following:

- Recombining relations that were split to satisfy normalization rules
- Storing redundant data in tables
- Storing summarized data in tables

Denormalization is the opposite of Normalization

It is the process of increasing redundancy in the database either for convenience or to improve performance