

Functional Dependency

In a relational database management, functional dependency is a concept that specifies the relationship between two sets of attributes where one attribute determines the value of another attribute. It is denoted as $X \rightarrow Y$, where the attribute set on the left side of the arrow, X is called Determinant, and Y is called the Dependent.

For example:

Assume we have an employee table with attributes: Emp_Id, Emp_Name, Emp_Address.

Here Emp_Id attribute can uniquely identify the Emp_Name attribute of employee table because if we know the Emp_Id, we can tell that employee name associated with it.

Functional dependency can be written as:

$\text{Emp_Id} \rightarrow \text{Emp_Name}$

We can say that Emp_Name is functionally dependent on Emp_Id.

Types of Functional Dependencies in DBMS

1. Trivial functional dependency
2. Non-Trivial functional dependency
3. Multivalued functional dependency
4. Transitive functional dependency

1. Trivial Functional Dependency

In Trivial Functional Dependency, a dependent is always a subset of the determinant. i.e. If $X \rightarrow Y$ and Y is the subset of X , then it is called trivial functional dependency

Example:

roll_no	name	age
42	abc	17
43	pqr	18
44	xyz	18

Here, $\{\text{roll_no}, \text{name}\} \rightarrow \text{name}$ is a trivial functional dependency, since the dependent `name` is a subset of determinant set $\{\text{roll_no}, \text{name}\}$. Similarly, $\text{roll_no} \rightarrow \text{roll_no}$ is also an example of trivial functional dependency.

2. Non-trivial Functional Dependency

In Non-trivial functional dependency, the dependent is strictly not a subset of the determinant. i.e. If $X \rightarrow Y$ and Y is not a subset of X , then it is called Non-trivial functional dependency.

Example:

roll_no	name	age
42	abc	17
43	pqr	18
44	xyz	18

Here, $\text{roll_no} \rightarrow \text{name}$ is a non-trivial functional dependency, since the dependent `name` is not a subset of determinant `roll_no`. Similarly, $\{\text{roll_no}, \text{name}\} \rightarrow \text{age}$ is also a non-trivial functional dependency, since `age` is not a subset of $\{\text{roll_no}, \text{name}\}$.

3. Multivalued Functional Dependency

In Multivalued functional dependency, entities of the dependent set are not dependent on each other. i.e. If $a \rightarrow \{b, c\}$ and there

exists no functional dependency between b and c , then it is called a multivalued functional dependency.

For example,

roll_no	name	age
42	abc	17
43	pqr	18
44	xyz	18
45	abc	19

Here, $\text{roll_no} \rightarrow \{\text{name}, \text{age}\}$ is a multivalued functional dependency, since the dependents name & age are not dependent on each other(i.e. $\text{name} \rightarrow \text{age}$ or $\text{age} \rightarrow \text{name}$ doesn't exist !)

4. Transitive Functional Dependency

In transitive functional dependency, dependent is indirectly dependent on determinant. i.e. If $a \rightarrow b$ & $b \rightarrow c$, then according to axiom of transitivity, $a \rightarrow c$. This is a transitive functional dependency.

For example,

enrol_no	name	dept	building_no
42	abc	CO	4
43	pqr	EC	2
44	xyz	IT	1
45	abc	EC	2

Here, $\text{enrol_no} \rightarrow \text{dept}$ and $\text{dept} \rightarrow \text{building_no}$. Hence, according to the axiom of transitivity, $\text{enrol_no} \rightarrow \text{building_no}$ is a valid functional dependency. This is an indirect functional dependency, hence called Transitive functional dependency.

5. Fully Functional Dependency

In full functional dependency an attribute or a set of attributes uniquely determines another attribute or set of attributes. If a relation R has attributes X, Y, Z with the dependencies $X \rightarrow Y$ and $X \rightarrow Z$ which states that those dependencies are fully functional.

6. Partial Functional Dependency

In partial functional dependency a non key attribute depends on a part of the composite key, rather than the whole key. If a relation R has attributes X, Y, Z where X and Y are the composite key and Z is non key attribute. Then $X \rightarrow Z$ is a partial functional dependency in RDBMS.