

FUNCTION DEPENDENCY AND TYPES & EXAMPLE

DEFINATION

- Functional dependency is a relationship that exists when one attribute uniquely determines another attribute. If R is a relation with attributes X and Y, a functional dependency between the attributes is represented as $X \rightarrow Y$, which specifies Y is functionally dependent on X.
 - The attributes of a table is said to be dependent on each other when an attribute of a table uniquely identifies another attribute of the same table.
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- For example:
 - Suppose we have a student table with attributes: **Stu_Id**, **Stu_Name**, **Stu_Age**.
 - Here **Stu_Id** attribute uniquely identifies the **Stu_Name** attribute of student table because if we know the student id we can tell the student name associated with it.
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Functional dependency and can be written as :

Stu_Id- $\geq$ Stu_Name_

we can say **Stu_Name** is functionally dependent on **Stu_Id**.

Formally:

If column A of a table uniquely identifies the column B of same table then it can be represented as $A \rightarrow B$ (Attribute B is functionally dependent on attribute A)

Types of Functional Dependencies

- Trivial functional dependency
 - Non-trivial functional dependency
 - Multivalued dependency
 - Transitive dependency
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Trivial functional dependency

- The dependency of an attribute on a set of attributes is known as trivial functional dependency if the set of attributes includes that attribute.

Symbolically:

- $A \rightarrow B$ is trivial functional dependency if B is a subset of A .
 - The following dependencies are also trivial: $A \rightarrow A$ & $B \rightarrow B$
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- For example:

Consider a table with two columns **Student_id** and **Student_Name**.

$\{\text{Student_Id}, \text{Student_Name}\} \rightarrow \text{Student_Id}$ is a trivial functional dependency as **Student_Id** is a subset of $\{\text{Student_Id}, \text{Student_Name}\}$.

- Also, $\text{Student_Id} \rightarrow \text{Student_Id}$ & $\text{Student_Name} \rightarrow \text{Student_Name}$ are trivial dependencies too.
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Non-trivial functional dependency

- If a functional dependency $X \rightarrow Y$ holds true where Y is not a subset of X then this dependency is called non trivial Functional dependency.
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Example :

An employee table with three attributes: **emp_id**, **emp_name**, **emp_address**.

The following functional dependencies are non-trivial:

emp_id -> **emp_name** (**emp_name** is not a subset of **emp_id**)

emp_id -> **emp_address** (**emp_address** is not a subset of **emp_id**)

- On the other hand, the following dependencies are trivial:

$\{\text{emp_id}, \text{emp_name}\} \rightarrow \text{emp_name}$ [emp_name is a subset of $\{\text{emp_id}, \text{emp_name}\}$]

Completely non trivial FD:

If a Functional dependency $X \rightarrow Y$ holds true where $X \cap Y$ is **Null** then this dependency is said to be completely **non trivial function dependency**.

Multivalued dependency

- Multivalued dependency occurs when there are more than one independent multivalued attributes in a table.
 - a **multivalued dependency** is a full constraint between two sets of attributes in a relation. In contrast to the functional **dependency**, the **multivalued dependency** requires that certain tuples be present in a relation.
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- Consider a bike manufacture company, which produces two colors (Black and white) in each model every year.

bike_model	manuf_year	color
M1001	2007	Black
M1001	2007	Red
M2012	2008	Black
M2012	2008	Red
M2222	2009	Black
M2222	2009	Red

- Here columns **manuf_year** and **color** are **independent** of each other and **dependent** on **bike_model**. In this case these two columns are said to be **multivalued dependent** on **bike_model**.

These dependencies can be represented like this:

- $\text{bike_model} \twoheadrightarrow \text{manuf_year}$
 - $\text{bike_model} \twoheadrightarrow \text{color}$
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Transitive dependency

A functional dependency is said to be transitive if it is indirectly formed by two functional dependencies.

$X \rightarrow Z$ is a transitive dependency if the following three functional dependencies hold true:

$X \rightarrow Y$

Y does not $\rightarrow X$

$Y \rightarrow Z$

A transitive dependency can only occur in a relation of three or more attributes. This dependency helps us normalizing the database in 3NF (3rd Normal Form).

- Example :-

Book	Author	Author_age
Game of Thrones	George R. R. Martin	66
Harry Potter	J. K. Rowling	49
Dying of the Light	George R. R. Martin	66

- $\{\text{Book}\} \rightarrow \{\text{Author}\}$ (if we know the book, we know the author name)
 - $\{\text{Author}\}$ does not $\rightarrow \{\text{Book}\}$
 - $\{\text{Author}\} \rightarrow \{\text{Author_age}\}$
 - Therefore as per the rule of **transitive dependency**:
 - $\{\text{Book}\} \rightarrow \{\text{Author_age}\}$ should hold, that makes sense because if we know the book name we can know the author's age.
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THANK YOU

