Functional Dependencies

By Team 2

Functional Dependency

- A functional dependency is a constraint that specifies the relationship between two sets of attributes where one set can accurately determine the value of other sets.
- It is denoted as $X \rightarrow Y$
- Advantages:
  - Functional Dependency avoids data redundancy. Therefore same data do not repeat at multiple locations in that database
  - It helps you to maintain the quality of data in the database
  - It helps you to defined meanings and constraints of databases
  - It helps you to identify bad designs
  - It helps you to find the facts regarding the database design

Properties of Functional Dependency

1. **Reflexivity:** If Y is a subset of X, then X→Y holds by reflexivity rule
   For example, {roll_no, name} → name is valid.
2. **Augmentation:** If X → Y is a valid dependency, then XZ → YZ is also valid by the augmentation rule.
   For example, If {roll_no, name} → dept_building is valid, hence {roll_no, name, dept_name} → {dept_building, dept_name} is also valid.→
3. **Transitivity**: If X → Y and Y → Z are both valid dependencies, then X→Z is also valid by the Transitivity rule.
   For example, roll_no → dept_name & dept_name → dept_building, then roll_no → dept_building is also valid.

Trivial Functional Dependency

- The Trivial dependency is a set of attributes which are called a trivial if the set of attributes are included in that attribute.

- So, $X \rightarrow Y$ is a trivial functional dependency if Y is a subset of X.

Example of Trivial Functional Dependency

Emp_id	Emp_name
AS555	Harry
AS811	George
AS999	Kevin

Consider this table with two columns Emp_id and Emp_name.

{Emp_id, Emp_name} → Emp_id

This is a trivial functional dependency as Emp_id is a subset of {Emp_id,Emp_name}.

Non-Trivial Functional Dependency

- Functional dependency which also known as a nontrivial dependency occurs when $A \rightarrow B$ holds true where B is not a subset of A. In a relationship, if attribute B is not a subset of attribute A, then it is considered as a non-trivial dependency.

Example of Non-Trivial Functional Dependency

Company	CEO	Age
Microsoft	Satya Nadella	51
Google	Sundar Pichai	46
Apple	Tim Cook	57

{Company} → {CEO} (if we know the Company, we knows the CEO name) .

But CEO is not a subset of Company, and hence it's non-trivial functional dependency.

Multivalued Functional Dependency

- Multivalued dependency occurs when two attributes in a table are independent of each other but, both depend on a third attribute.
- A multivalued dependency consists of at least two attributes that are dependent on a third attribute that's why it always requires at least three attributes.
- A multivalued dependency is used to achieve 4NF.
- Any multivalued dependency would at least involve three attributes of any table.

Example on Multivalued Functional Dependency

BIKE_MODEL	MANUF_YEAR	COLOR
M2011	2008	White
M2001	2008	Black
M3001	2013	White
M3001	2013	Black

- Here columns COLOR and MANUF_YEAR are dependent on BIKE_MODEL and independent of each other.
- In this case, these two columns can be called as multivalued dependent on BIKE_MODEL.

Transitive Functional Dependency

- When an indirect relationship causes functional dependency it is called Transitive Dependency.
- If $P \rightarrow Q$ and $Q \rightarrow R$ is true, then $P \rightarrow R$ is a transitive dependency.
- Can only occur in the relationship of three or more attribute.
- To achieve 3NF, eliminate the Transitive Dependency.

Example of Transitive Functional Dependency

Book	Author	Author_Age
ABC	Nimal Bandara	48
XY	Sakunthala Weerasinghe	36
MNO	Nimal Bandara	48

If{ {Book} → {Author} & {Author} → {Author_age}}

Then, {Book} → {Author_age}

Thank You