For

Paper: E401 (INTRODUCTION TO DATABASE MANAGEMENT SYSTEM)

Topics: Functional dependency, Types of functional dependency

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Functional Dependencies

A *functional dependency* (FD) is a relationship between two attributes, typically between the primary key and other non-key attributes within a table. A functional dependency denoted by

X → Y , is an association between two sets of attribute X and Y. Here, **X** is called the *determinant*, and Y is called the *dependent*.

For example,
SIN ————-> Name, Address, Birthdate

Here, SIN determines Name, Address and Birthdate.So, SIN is the determinant and Name, Address and Birthdate are the dependents.

Rules of Functional Dependencies

1. Reflexive rule : If Y is a subset of X, then X determines Y .

   $$\text{If } Y \subseteq X, \text{ then } X \rightarrow Y$$

2. Augmentation rule: It is also known as a partial dependency, says if X determines Y, then XZ determines YZ for any Z

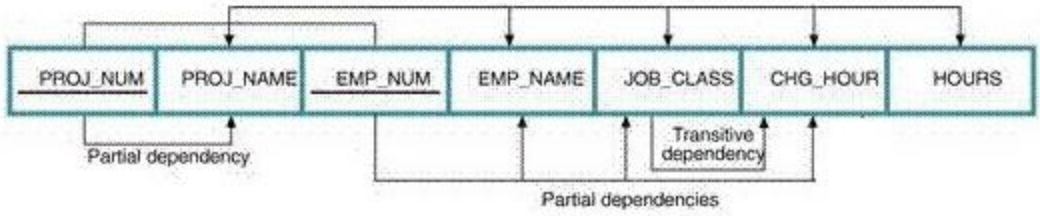
   $$\text{If } X \rightarrow Y, \text{ then } XZ \rightarrow YZ \text{ for any } Z$$

3. Transitivity rule: Transitivity says if X determines Y, and Y determines Z, then X must also determine Z

   $$\text{If } X \rightarrow Y \text{ and } Y \rightarrow Z, \text{ then } X \rightarrow Z$$

Dependency Diagram

A dependency diagram, shown in the following figure illustrates the various dependencies that might exist in a *non-normalized table*. A non-normalized table is one that has data redundancy in it.



In this dependency diagram, the primary key is { PROJ_NUM,EMP_NUM}

Full functional dependency:

{ PROJ_NUM,EMP_NUM} → HOURS

Partial functional dependency:

PROJ_NUM → PROJ_NAME

EMP_NUM → EMP_NAME

EMP_NUM → JOB_CLASS

EMP_NUM → CHG_HOUR

Transitive dependency:

EMP_NUM → JOB_CLASS (comes from EMP_NUM → JOB_CLASS and JOB_CLASS → CHG_HOUR)

Types of functional dependency

The following are types functional dependency in DBMS:

1. Fully-Functional Dependency
2. Partial Dependency
3. Transitive Dependency
4. Trivial Dependency
5. Multivalued Dependency

Full functional Dependency

A functional dependency X→Y is said to be a full functional dependency, if removal of any attribute A from X, the dependency does not hold any more. i.e. Y is **fully functional** dependent on X, if it is **Functionally** Dependent on X and not on any of the proper subset of X.
For example,

{Emp_num,Proj_num} → Hour
Is a full functional dependency. Here, *Hour* is the working time by an employee in a project.

Partial functional Dependency

A functional dependency X→Y is said to be a partial functional dependency, if after removal of any attribute A from X, the dependency does not holds. i.e. Y is dependent on a proper subset of X. So X is partially dependent on X.

For example,

If {Emp_num,Proj_num} → Emp_name but also Emp_num → Emp_name then Emp_name is partially functionally dependent on {Empl_num,Proj_num}.

Transitive dependency

A functional dependency is X → Z is said to be a transitive functional dependency if there exists the functional dependencies X → Y and Y → Z. i.e. it is an indirect relationship.

For example,

EMP_NUM → JOB_CLASS

is a transitive dependency which comes from EMP_NUM → JOB_CLASS and JOB_CLASS → CHG_HOUR

Trivial functional dependency

A functional dependency X → Y is said to be a trivial functional dependency if Y is a subset of X.

For example,

{Emp_num,Emp_name} → Emp_num

is a trivial functional dependency since Emp_num is a subset of {Emp_num,Emp_name}.

Multivalued dependency

Multivalued dependency occurs in the situation where there are multiple independent multivalued attributes in a single table. A multivalued dependency is a complete constraint between two sets of attributes in a relation. It requires that certain tuples be present in a relation.

Example: Consider the following table

Car_model	Manufr_year	Color
H001	2017	Metallic
H001	2017	Green
H005	2018	Metallic
H005	2018	Blue
H010	2015	Metallic
H033	2012	Gray

The functional dependencies

car_model -> manufr_year

car_model-> colour

are multivalued dependency since manufr_year and color both are multivalued attribute