Third Normal Form

Third Normal Form (3NF)

- Based on the concept of transitive dependency.
- Transitive Dependency is a condition where
- A, B and C are attributes of a relation such that if $A \rightarrow B$ and $B \rightarrow C$,
- then C is transitively dependent on A through B. (Provided that A is not functionally dependent on B or C).

Third Normal Form (3NF)

- **A table is in third normal form (3NF) if and only if it is in 2NF and every non-key attribute is dependent only on the primary key (i.e. No transitive dependency exists).**

2NF to 3NF

- Identify the primary key in the 2NF relation.
- Identify functional dependencies in the relation.
- If transitive dependencies exist on the primary key remove them by placing them in a new relation along with a copy of their determinant.

2NF to 3NF

- The steps involved in transforming a table in second normal form into a set of third normal form tables are as follows:

    1. We must break out the determinant and the dependent attribute(s) into a table of their own. The determinant is the primary key of this new table.

    2. The determinant remains as an attribute in the original table.

Example

- Consider the EmployeeDepartment relation:

  EmployeeDepartment(PPS, Name, DeptNumber, DeptName, DeptMgr)

  Primary key PPS

PPS	Name	DeptNumber	DeptName	DeptMgr
123456789	Smith, John	D1	Sales	Jones, Philip
333456781	English, Joyce	D2	Production	Roche, Collette
345123876	Ryan, Melanie	D1	Sales	Jones, Philip

EmployeeDepartment

Example

- PPS → Name, DeptNumber, DeptName, and DeptMgr.
- However, DeptNumber → DeptName, and DeptMgr also.
- Therefore, PPS→ DeptName, and DeptMgr is transitive via DeptNumber.

Example

1. We must break out the determinant (DeptNumber) and the dependent attribute(s) (DeptName, DeptMgr) into a table of their own. The determinant is the primary key of this new table.

Department(DeptNumber, DeptName, DeptMgr)
Primary key DeptNumber

Example

2. The determinant remains as an attribute in the original table.

EmployeeDepartment(PPS, Name, DeptNumber)
Primary key PPS
Foreign key DeptNumber references Department(DeptNumber)

Exercise

StaffDistributionCenter(staffNo, name, position, salary, dCenterNo, dAddress, dTelno)
Primary key staffNo

StaffDistributionCenter

staffNo	name	position	salary	dCenterNo	dAddress	dTelNo
S1500	Tom Daniels	Manager	48000	D001	8 Jefferson Way, Portland, OR 97201	503-555-3618
S0003	Sally Adams	Assistant	30000	D001	8 Jefferson Way, Portland, OR 97201	503-555-3618
S0010	Mary Martinez	Manager	51000	D002	City Center Plaza, Seattle, WA 98122	206-555-6756
S3250	Robert Chin	Assistant	33000	D002	City Center Plaza, Seattle, WA 98122	206-555-6756
S2250	Sally Stern	Manager	48000	D004	2 W. El Camino, San Francisco, CA 94087	822-555-3131
S0415	Art Peters	Manager	42000	D003	14 – 8th Avenue, New York, NY 10012	212-371-3000

Exercise

- The relation (StaffDistributionCenter) is not in Third Normal Form)

  i. Why?

  ii. Explain the steps involved in transforming the relation into Third Normal Form (3NF).

  iii. Transform the relation into a set of Third Normal Form (3NF) relations.

Exercise