

# Third Normal Form

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# Third Normal Form (3NF)

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- 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)

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- **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

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- 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 dominant.

## 2NF to 3NF

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- 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

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- Consider the EmployeeDepartment relation:

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

**Primary key PPS**

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

**EmployeeDepartment**

# Example

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- $PPS \rightarrow \text{Name, DeptNumber, DeptName, and DeptMgr.}$
- However,  $\text{DeptNumber} \rightarrow \text{DeptName, and DeptMgr}$  also.
- Therefore,  $PPS \rightarrow \text{DeptName, and DeptMgr}$  is transitive via DeptNumber.

# Example

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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

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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

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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

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- 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.