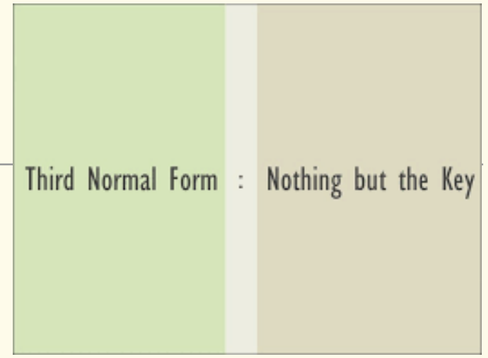
Third Normal Form



Third Normal Form (3NF)

- 3NF is 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 functionally 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 non-key functional dependencies exist remove them by placing them in a new relation along with a copy of their determinant.
- The following table (StaffBranch) is in 2NF but not in 3NF as there are non-key attributes functionally dependent on another non-key attribute.

StaffBranch(staffNo, name, position, salary, branchNo, branchAddress, telNo)

Primary key staffNo

2NF to 3NF

StaffBranch (Not 3NF)

staffNo	name	position	salary	branchNo	branchAddress	telNo
S1500	Tom Daniels	Manager	46000	B001	8 Jefferson Way, Portland, OR 97201	503-555-3618
S0003	Sally Adams	Assistant	30000	B001	8 Jefferson Way, Portland, OR 97201	503-555-3618
S0010	Mary Martinez	Manager	50000	B002	City Center Plaza, Seattle, WA 98122	206-555-6756
S3250	Robert Chin	Supervisor	32000	B002	City Center Plaza, Seattle, WA 98122	206-555-6756
S2250	Sally Stern	Manager	48000	B004	16 – 14th Avenue, Seattle, WA 98128	206-555-3131
S0415	Art Peters	Manager	41000	B003	14 – 8th Avenue, New York, NY 10012	212-371-3000

Primary key

Values in all non-primary-key columns can be worked out from the primary key, staffNo

Values in branchAddress and telNo columns can be worked out from branchNo, so table *not* in 3NF

Values in branchNo and telNo columns can be worked out from branchAddress, so table *not* in 3NF

Values in branchNo and branchAddress columns can be worked out from telNo, so table *not* in 3NF

2NF to 3NF

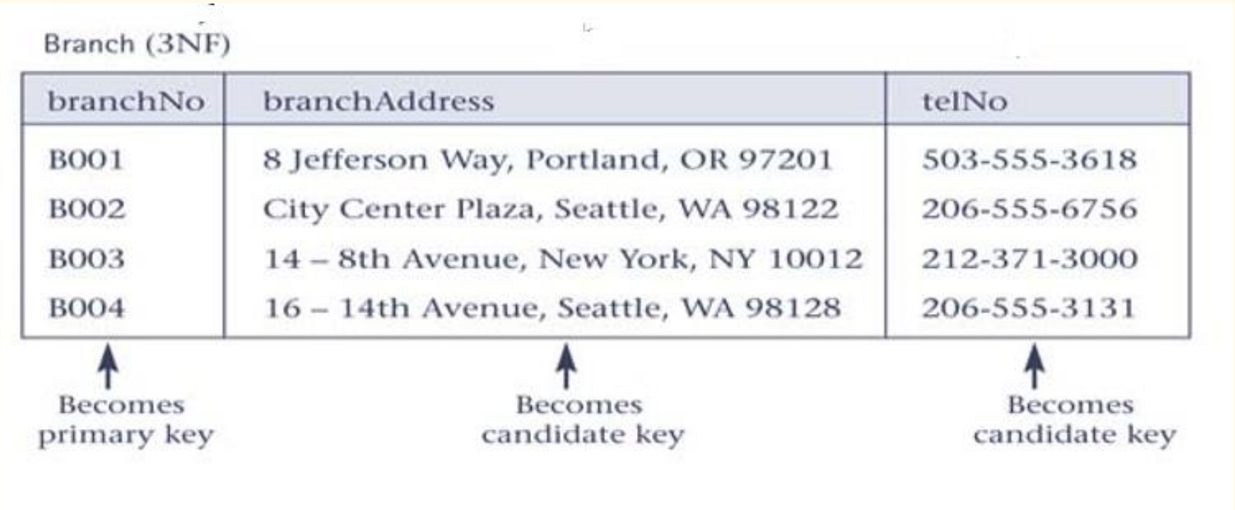
- The steps involved in transforming a table in second normal form into a set of third normal form tables are as follows:

    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 One

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



Example One

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

Staff (3NF)

staffNo	name	position	salary	branchNo
S1500	Tom Daniels	Manager	46000	B001
S0003	Sally Adams	Assistant	30000	B001
S0010	Mary Martinez	Manager	50000	B002
S3250	Robert Chin	Supervisor	32000	B002
S2250	Sally Stern	Manager	48000	B004
S0415	Art Peters	Manager	41000	B003

Primary key

Becomes foreign key

Example One – Full set of relations

Branch(branchNo, branchAddress, telNo)

Primary key branchNo

Staff(staffNo, name, position, salary, branchNo)

Primary key staffNo

Foreign key branchNo references Branch(branchNo)

Example Two

Vendor(vendorId, name, accountNumber, bankSortCode, bankAddress)

Primary key vendorId

Vendor

vendorId	name	accountNumber	bankSortCode	bankAddress
124	John Smith	987986543	93-41-19	AIB Lisduggan, Waterford
564	Melanie Ryan	456098124	93-34-30	AIB, New Ross, Wexford
789	Ken Brown	458997676	93-34-30	AIB, New Ross, Wexford
867	John Kehoe	983344863	93-41-19	AIB Lisduggan, Waterford

Example Two

- The relation (Vendor) is not in Third Normal Form) because there is a transitive dependency (i.e. a non key attribute (C) is functionally dependent on some other non key attribute (B) and is therefore functionally dependent on the primary key (A) through this attribute (B)).

  bankSortCode → bankAddress

Example Two

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

   BankDetails(bankSortCode, bankAddress)

   Primary key bankSortCode

Example Two

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

Vendor(vendorId, name, accountNumber, bankSortCode)
Primary key vendorId
Foreign key bankSortCode references BankDetails(bankSortCode)

Example Two – Full set of relations

BankDetails(bankSortCode, bankAddress)
Primary key bankSortCode

Vendor(vendorId, name, accountNumber, bankSortCode)
Primary key vendorId
Foreign key bankSortCode references BankDetails(bankSortCode)