Normal forms
3NF (Third Normal Form)

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- Conditions for 3NF

It is in 2NF and there is no transitive dependency.

(Transitive dependency???) A → B & B → C then A → C

- A relation R is in third normal form (3NF) Iff:
  1. It is in **2NF** and
  2. **Any non-prime attribute is NOT transitively dependent upon any key**

OR

- A relation R is in third normal form (3NF) iff:
  1. If and only if it is in **2NF** and
  2. **Every non-prime attribute is non-transitively dependent on the key**

Note: Non-Prime Attribute → Non-Prime Attributes is not allowed.

- A relation R is in third normal form (3NF) iff:

  X → Y

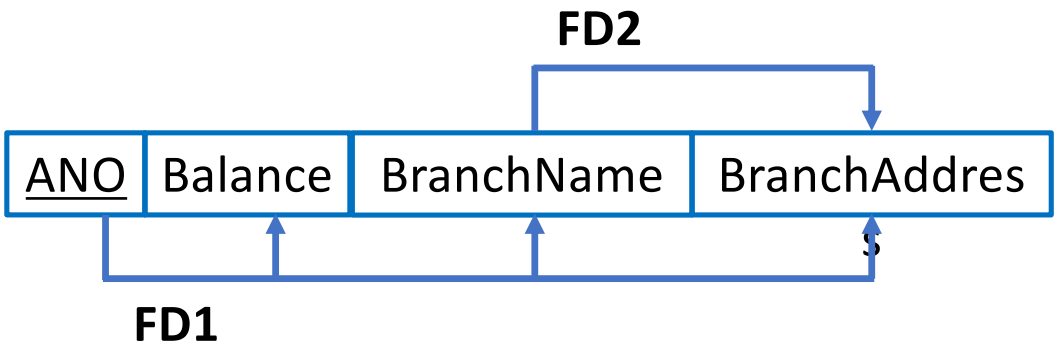
  Either X : is super key

  Or Y : is prime attribute

3NF (Third Normal Form) [Example]

Customer

ANO	Balance	BranchName	BranchAddress
A01	50000	Rajkot	Kalawad road
A02	40000	Rajkot	Kalawad Road
A03	35000	Surat	C.G Road
A04	25000	Surat	C.G Road

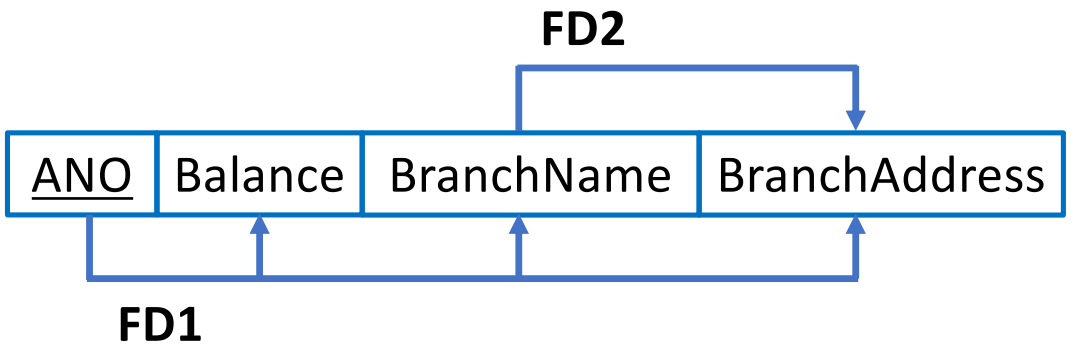


- **FD1**: ANO → {Balance, BranchName, BranchAddress}
- **FD2**: BranchName → BranchAddress
- So ANO → BranchAddress (Using Transitivity rule)
- **BranchAddress transitivily depends on primary key (ANO)**. So customer relation is not in 3NF.

3NF (Third Normal Form) [Example]

Customer

ANO	Balance	BranchName	BranchAddress
A01	50000	Rajkot	Kalawad road
A02	40000	Rajkot	Kalawad Road
A03	35000	Surat	C.G Road
A04	25000	Surat	C.G Road



- **Problem:** In this relation, **branch address will be stored repeatedly** for each account of the same branch which **occupies more space**.

3NF (Third Normal Form) [Example]

Customer

ANO	Balance	BranchName	BranchAddress
A01	50000	Rajkot	Kalawad road
A02	40000	Rajkot	Kalawad Road
A03	35000	Surat	C.G Road
A04	25000	Surat	C.G Road

Table-1

BranchName	BranchAddress
Rajkot	Kalawad road
Surat	C.G Road

Table-2

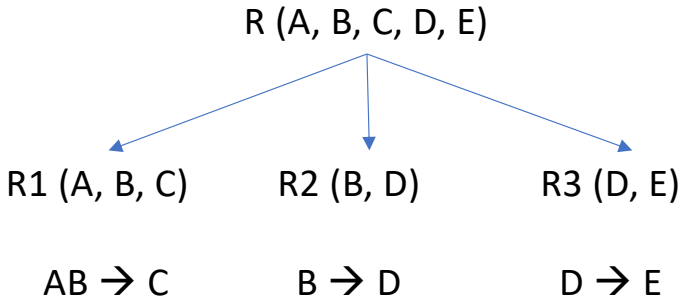
ANO	Balance	BranchName
A01	50000	Rajkot
A02	40000	Rajkot
A03	35000	Surat
A04	25000	Surat

- **Solution:** **Decompose relation in** such a way that **resultant relations do not have any transitive FD.**
  - **Remove transitive dependent attributes** from the relation that violets 3NF.
  - **Place them in a new relation along** with the **non-prime attributes due to which transitive dependency occurred**.
  - The **key of the new relation** will be **non-prime attributes due to which transitive dependency occurred**.
  - **Keep other attributes same as in the table** with **same primary key** and **add prime attributes of other relation into it as a foreign key**.

Q. Given that R(A, B, C, D, E) & FD {AB → C, B → D, D → E}. Check whether it is in 3NF or not, if not, then convert it into 3NF.

Key = {AB}.
B → D
D → E are not in 3NF.

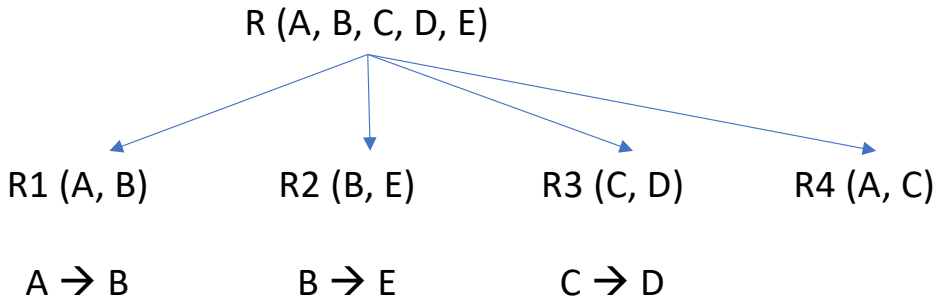
Transitive dependency from AB → E;
B to D and then D to E, AB can reach to E



Q. Given that R(A, B, C, D, E) & FD {A → B, B → E, C → D}. Check whether it is in 3NF or not, if not, then convert it into 3NF.

Key = {AC}.

Not in 3NF.

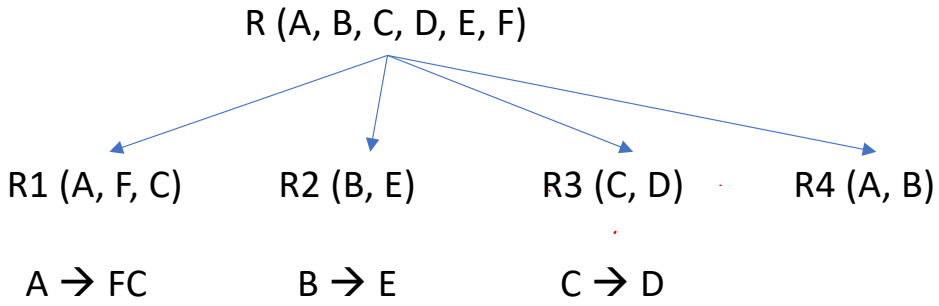


3NF (Third Normal Form) [Exercise]

Q. Given that R(A, B, C, D, E, F) & FDs {A → FC, B → E, C → D}. Check whether it is in 3NF or not, if not, then convert it into 3NF.

Key = {AB}.

Not in 3NF.

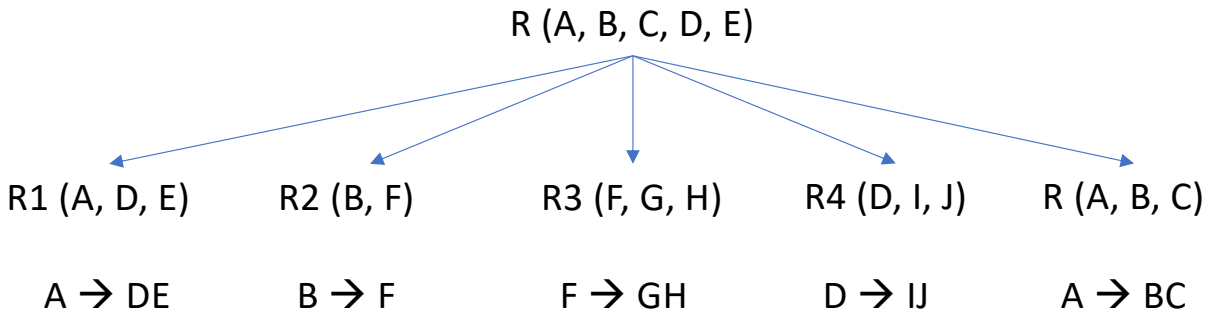


Q. Given that R(A, B, C, D, E, F, G, H, I, J) & FD {AB → C, A → DE, B → F, F → GH, D → IJ}. Check whether it is in 3NF or not, if not, then convert it into 3NF.

Key = {AB}.

A → DE
B → F
F → GH
D → IJ

Not in 3NF.



Q. Given that R(A, B, C, D, E, F, G, H, I, J) & FD {AB → C, AD → GH, BD → EF, A → I, H → J}. Check whether it is in 3NF or not, if not, then convert it into 3NF.

Key = {ABD}.

Not in 3NF.