Formal Design Considerations

1) Start with a relation that has all the attributes.
2) Specify the functional dependencies (fds) and the multivalued dependencies (mvds)
3) decompose the table with all the attributes into relations (i.e., tables) that are in normal form. (NF)

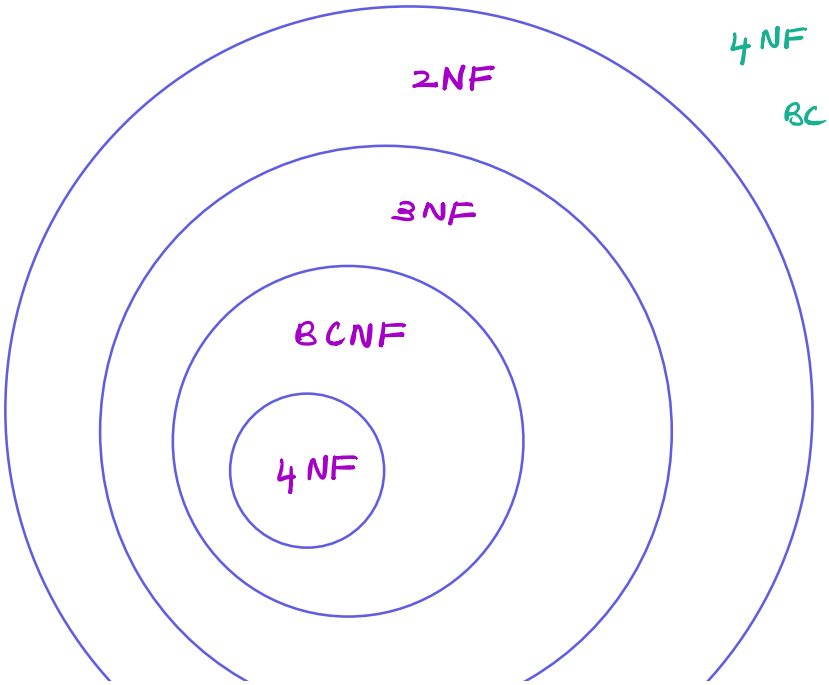
* a set of tables in NF does not suffer from insert, delete, update, join anomalies.

if R1 & R2 are in NF, then $R = R1 \bowtie R2$

1NF, 2NF, 3NF, BCNF, 4NF

↓

Boyce Codd Normal Form

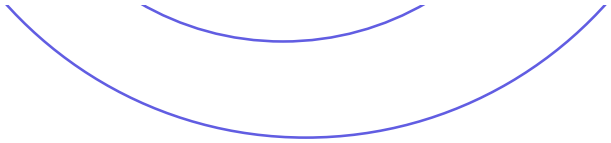


4NF ⇒ BCNF

BCNF ⇏ 4NF

BCNF ⇒ 3NF

3NF ⇏ BCNF



* BCNF is the set of relations that satisfy FDs.
* 4NF satisfy both FDs & MVDs.

Functional Dependencies (FDs)

$a \longrightarrow b \qquad \neg b \longrightarrow \neg a$

dno $\longrightarrow$ mgr

a) Can 2 emp in the same dept have different managers?
No

b) Can 2 emp in different depts have the same manager?
Yes

c) Can same person manage 2 department? Yes

dno	mgr
1	Smith
2	John
3	Smith
4	Smith

$\forall$ tuples $t_1, t_2 \in Emp,$

$t_1[dno] = t_2[dno] \Rightarrow t_1[mgr] = t_2[mgr]$

Example

A	B	C
a1	b1	c1
a1	b1	c2
a2	b1	c3
a3	b1	c4

① $A \xrightarrow{?} B$ ✓

$a1 \to b1$

$a2 \to b1$

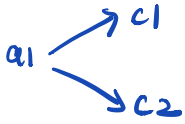
$a3 \to b1$

$A \to B$ ✗

$a1 \to b1$

$a1 \to b2$

②



③ $C \xrightarrow{?} A$ ✓

$C \xrightarrow{?} B$ ✓

C is a key for R(A, B, C)

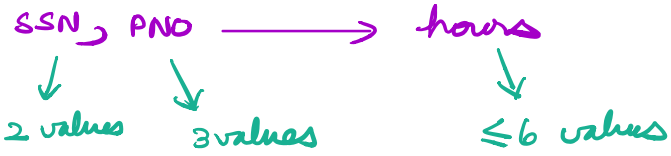
④ $B \xrightarrow{?} A$ ✗

$B \xrightarrow{?} C$ ✗

Does $A \to B$?

* if there are 3 unique values for A $\Rightarrow$ ≤ 3 values for B

* if there are 3 unique values for B $\Rightarrow$ ≥ 3 values for A



Emp - Proj Example

SSN → Ename

Pno → Pname, Plocation

SSN, Pno → Hrs

R1': (SSN, Ename)

R2': (Pno, Pname, Plocation)

R3': (SSN, Pno, Hrs)

$R = R1' \bowtie R2' \bowtie R3'$

Example:

A	B	C
a1	b1	c1
a1	b2	c2
a1	b3	c3
a2	b1	c4
a2	b2	c5
a2	b3	c5

Find the FDs & the key

$A \xrightarrow{?} B$ ✗

$B \xrightarrow{?} A$ ✗

$C \xrightarrow{?} A$ ✓

$C \xrightarrow{?} B$ ✗