5) (ABCDEF) $\{AB \to C,\ C \to D,\ CD \to AE,\ DE \to F,\ EF \to B\}$

$\{AB,\ C,\ AEF,\ ADE\}$ Prime $\{A, B, C, D, E, F\}$

	$AB \to C$	$C \to D$	$CD \to AE$	$DE \to F$	$EF \to B$
			✓	✗	✗
BCNF	✓	✓		✓	✓
3NF	✓	✓	✓		

This table is in 3NF ✓

SK

'C' 'CD'

when all the attributes are prime attributes, then the table is in 3NF.

It may & may not be in BCNF.

6) (ABCDE) CK = { AE, DE, CE, BE } { A, B, C, D, E }

{ $A \to B$ $B \to C$ $C \to D$ $D \to A$ }

	$A \to B$	$B \to C$	$C \to D$	$D \to A$	
BCNF	✗	✗	✗	✗	— ✗ BCNF
3NF	✓	✓	✓	✓	— ~~Bn~~ 3NF ✓.

Highest NF of table = 3NF.

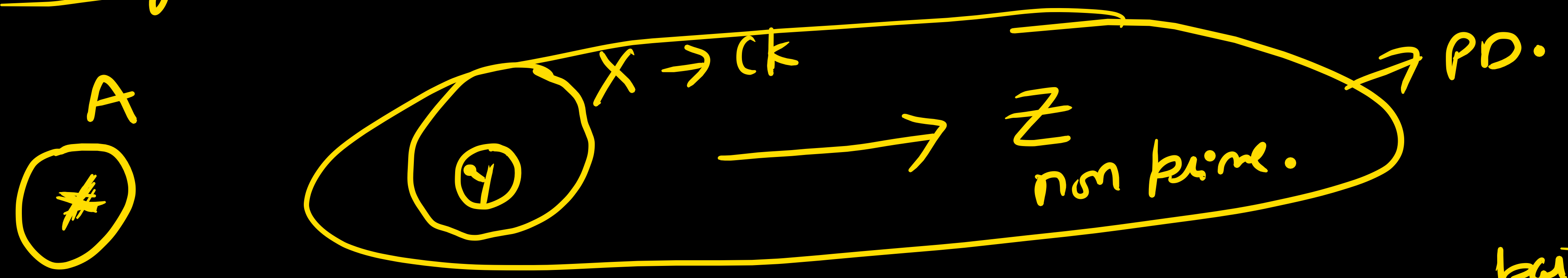
7) R(ABCD) CK{A, B}

{A → B, B → AC, C → D}

	A → B	B → AC	C → D
BCNF →	✓	✓	✗
3NF →	✓	✓	✗

Checking 2NF: 2NF there should be no partial dependencies.

Table is in II NF. ✓



A ⊃ X no partial dependency ✓

CK: {A, B}

no chance of getting Partial key ✓

*** when all the CKS are simple Keys, then the table is definitely in II NF. It may & may not be in III NF & BCNF.

Q Relational schema 'R' with ~~non-tri~~ no non trivial FD is alway in

$\boxed{\text{BCNF.}}$ ✓ CK = {ABC} ✓

Ex: R(ABC) no non trivial FD.

{No ~~non~~ non trivial FD's in R} ⇒ {no Redundancy over FDS} → Redendancy comes only when LHS is not SK.

How is redundancy formed. No fd's → 0% redn

↓

BCNF

X → Y ✗

↓

not SK.

Q) Relation schema 'R' with only two attributes is always in ______

R(A B) ✓

all possible case :

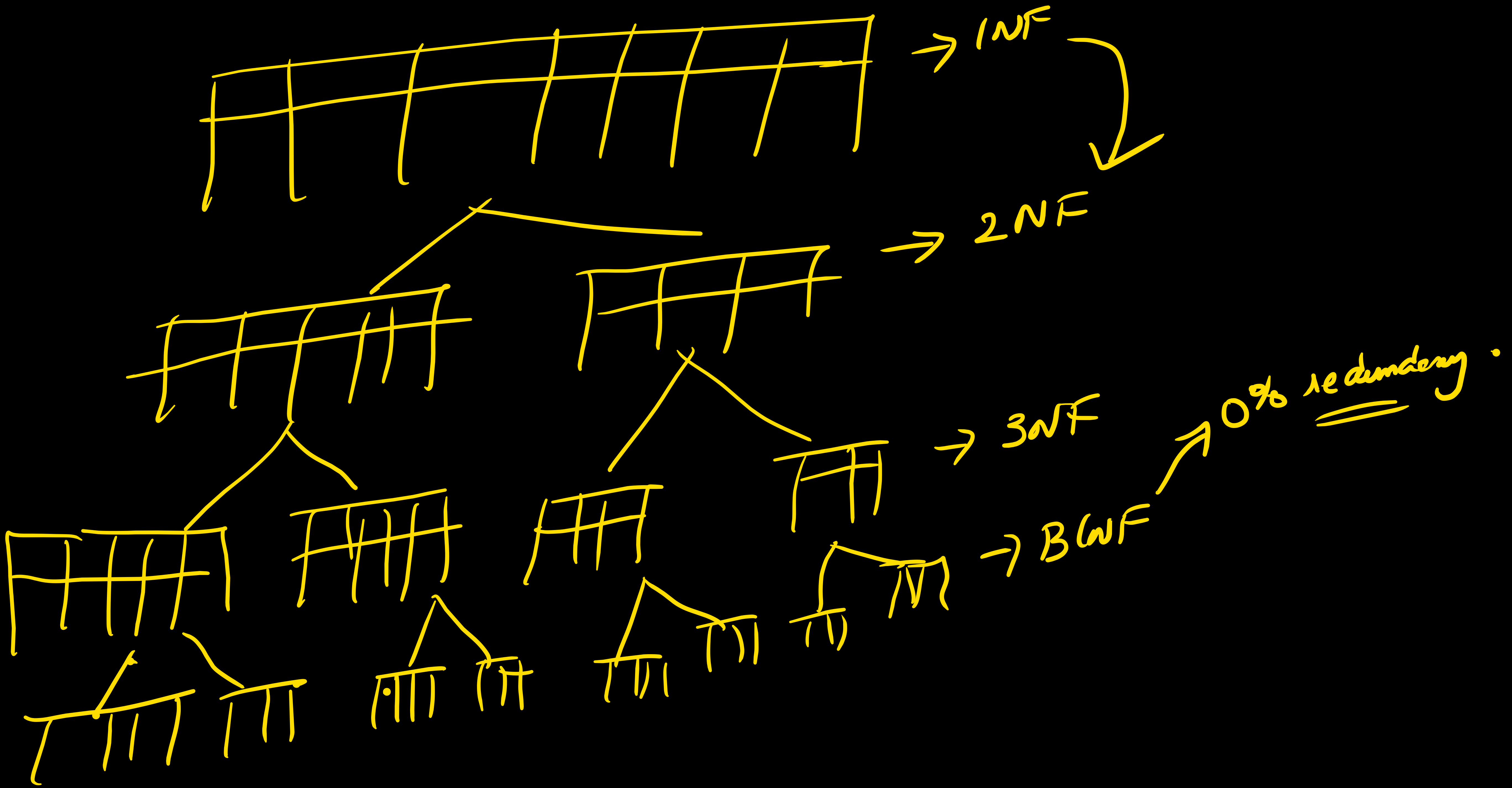
a) $\{A \rightarrow B\}$ $CK = A \rightarrow$ BCNF

b) $\{B \rightarrow A\}$ $CK = B \rightarrow$ BCNF

c) $\{A \rightarrow B, B \rightarrow A\}$ $CK : \{A, B\} \Rightarrow$ BCNF

d) No nontrivial FD $\rightarrow$ BCNF

Decomposition of Relation into higher NF:



2NF decomposition:

$R(AB \ldots\ldots X\,Y\,Z)$

$\{ \ldots\ldots\ldots\ Y \rightarrow Z \}$

Partial dependency.

$Y^{+} = \{ X\,Y\,Z \ldots \}$

$(\ldots\ldots Y)$ $(Y\,X\,Z)$

$Y \rightarrow Z$

$(\ldots\ldots Y)$ $(X\,Y\,Z \ldots)$

$Y \rightarrow Z$

CK → not PK

$R(\underline{Sid}, Sname, DOB, Cid)$

$\{Sid\} \to \underline{Sname}\ \cancel{Dob}\ \underline{DOB}\}$

$CK = \{Sid\ Cid\}$

Partial. dependency.

$\therefore$ not in 2NF.

$CK = \{Sid, Cid\} \supset \underline{Sid}.$

when we break a table, there should be something in common. that part should be SK of one of the tables

Decompose into 2NF:

$(Sid)^+ = \{Sid, Sname, DoB\}$

new table.

Sid	Cid

NO FDS BCNF

Sid	Sname	DoB

$Sid \to Sname\ DOB$

BNF

arrow will go into PK

$R(Sid\ Sname\ DOB\ Cid)$

$Sid \rightarrow Sname\ DOB$

Redundancy

Sid	Sname	DOB	Cid
S_1	A	1990	C_1
S_1	A	1990	C_2
S_1	A	1990	C_3

Sid	Sname	DOB
S_1	A	1990

no redundancy

Sid	Cid
S_1	C_1
S_1	C_2
S_1	C_3

$R(ABCDEF)$ $\{AB \to C,\ C \to D,\ B \to E,\ E \to F\}$ $CK = \{AB\}$

Break into 2NF:

Partial dependency.

$B^+ = BEF$

In this example.
we go LLJ decomp.
DP decomposition.
BCNF.

$ACDB$

$AB \to C$

$C \to D$

× 3FN

BEF

$B \to E$

$E \to F$

2NF
LLJ
No PD
2NF

× 3NF

ABC — $AB \to C$

$C^+ = CD$ — $C \to D$

BE — $B \to E$

$E^+ = EF$ — $E \to F$

Every LHS is a CK. So table is in BCNF.

Process: Take a fd which is problematic and split the table.

5 min break.

$R(ABCDEFG)$ CK: (AB).

$\{AB \to C, C \to D, A \to E, B \to F, F \to G\}$

Partial Dependencies

$R_1(ABCD)$

$AB \to C$

$C \to D$ X

3NF.

$A^+ = (AE)\ R_2$

$A \to E$

BCNF

$B^+ = (BFG)\ R_3$

$B \to F$

$F \to G$ X

3NF.

$R_5\ \boxed{ABC}$

$AB \to C$.

$C^+ = \boxed{CD}\ R_6$

$C \to D$.

$\boxed{BF}$

$B \to F$

$F^+ = \boxed{FG}\ R_7$.

$F \to G$.

$\therefore$ BCNF

$\therefore$ all LHS are superkeys

In this ~~ex~~ example, Lossless join, & + DP. + BCNF = 0% redundancy.

But it may not always be the case.

R(ABCDE) CK: {ABDE, BCDE, ACDE} Prime attr = {A BCDE}

when all the attributes are prime, then 3NF.

{AB → C, BC → A, AC → B}

3NF ✓ ✓ ✓

BCNF ✗ ✗ ✗

A B C DE

$(AB)^+ = ABC$

CK = {AB, BC, AC}

R_1: ABC ✓

AB → C ✓

BC → A ✓

AC → B

BCNF ✓

DEAB CK: DEAB.

~~A → A~~

~~B → B~~

~~A → A~~

~~BC → B~~

No non trivial FD's ✓

BCNF.

R(ABC) {AB → C, C → A} CK {AB, BC} P.A = {A, B, C}

(In this example, we cannot get both DP and BCNF)

lost ← AB → C   C → A

	AB → C	C → A
3NF	✓	✓
BCNF	✓	✗

$C^+ = CA$

AB~~C~~.

BC	→	CA

~~AB → C~~ then

No non trivial FDS

BCNF.

C → A

BCNF.

LLJ ✓

BC ∩ CA = C → CA

DP ✗

BCNF ✓

$R(ABCD)$ $\{ABC \to D,\ D \to B\}$ CK: $\{ABC, ACD\}$ Prime $= \{ABCD\}$

all attributes are prime, ∴ 3NF.

$ABC \to D$ ✓ BCNF ⇒

$D \to B$ ✗

D^+

DB

$D \to B$.

BCNF.

ACD

No non trivial dependency.

So CK ACD

BCNF

In this example

It is Lossless dep join decomp,

✗ Dep preserve

✓ BCNF.

Conclusion:

DB design goal based on normalization	1NF	2NF	3NF	BCNF	4NF
1) lossless join decomp	✓	✓	✓	✓	may not be possible
2) dependency preserving	✓	✓	✓	may or may not	may or may not
3) 0% Redundancy	NO	NO	NO	{ Yes over FD's } { NO over MVD }	Yes. ✓

→ ~~most~~ accurate NF among all NFS is 3FN

Lossless   DP

→ Lossless join, dependency preserving decomposition are possible to every relation till 3NF.