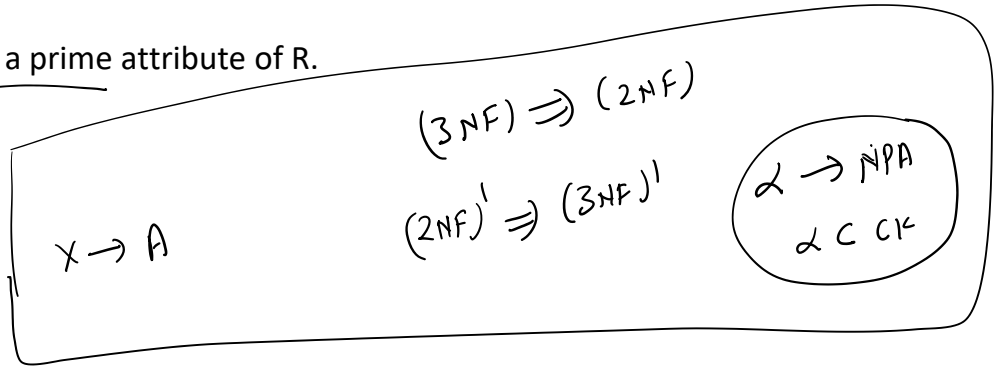
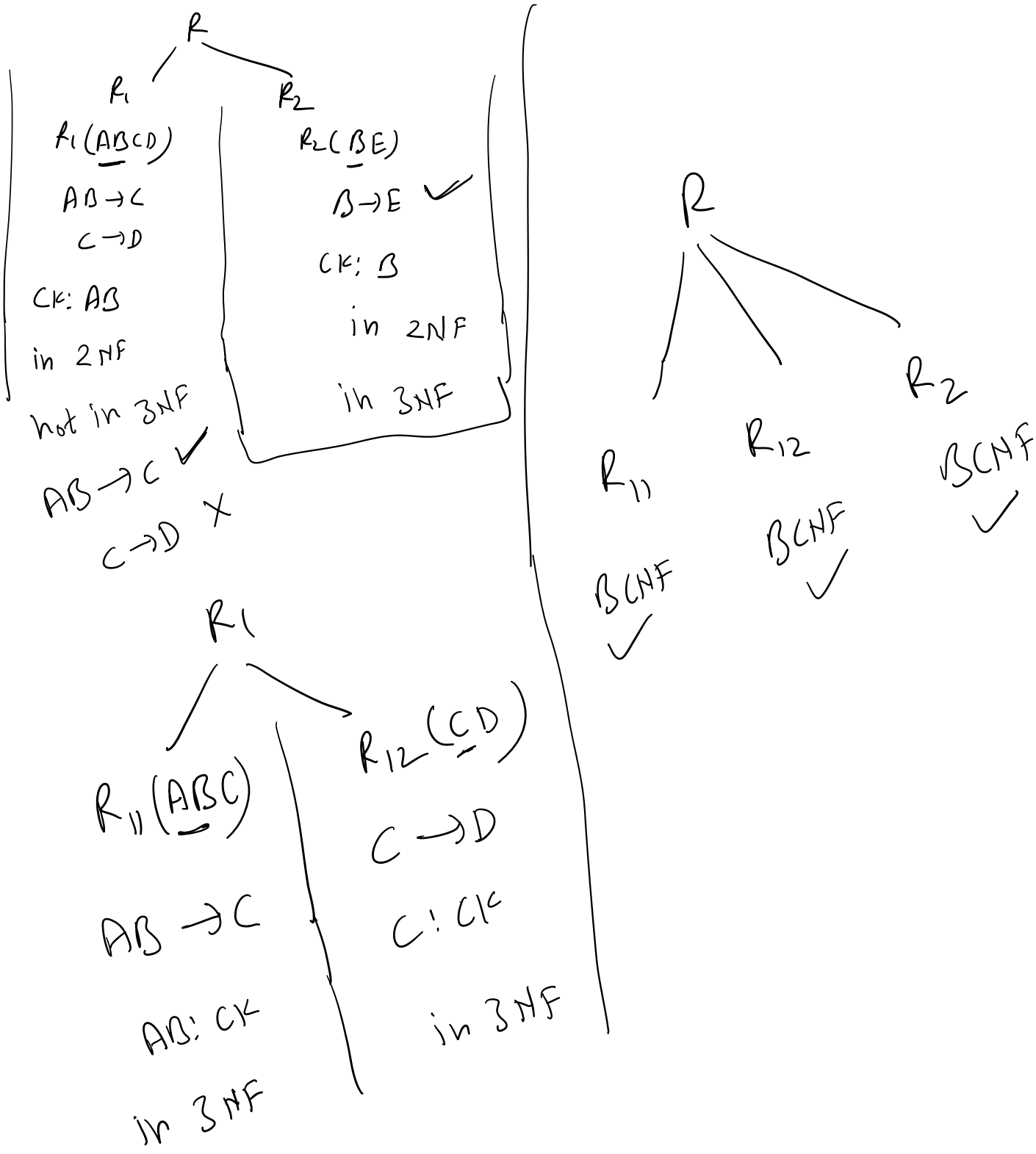
Third Normal Form

Definition: A relation schema R is in third normal form (3NF) if, whenever a nontrivial functional dependency X → A holds in R, either
(a) X is a superkey of R,
or
(b) {A-X} is a prime attribute of R.




R
R1
R2
R1(ABCD)
AB → C
C → D
CK: AB
in 2NF
not in 3NF
AB → C ✓
C → D X
R2(BE)
B → E ✓
CK: B
in 2NF
in 3NF
R
R11
R12
R2
BCNF
BCNF ✓
BCNF ✓
R1
R11(ABC)
AB → C
AB: CK
in 3NF
R12(CD)
C → D
C: CK
in 3NF

Boyce-Codd Normal Form

Definition: A relation schema R is in BCNF if whenever a nontrivial functional dependency $X \rightarrow A$ holds in R, then X is a superkey of R.

Every relation in BCNF is also in 3NF; however, a relation in 3NF is not necessarily in BCNF.

(BCNF) ⇒ (3NF)

(3NF)' ⇒ (BCNF)'

R(ABCD) { AB → CD , D → A }

CK : { AB, BD }

AB → CD ✓

D → A ✓

BCNF ✗

3NF ✓

R(ABCDEF)

A → BCDEF , BC → ADEF, B → F, D → E

1NF ✓

CK : {A, BC}

PA : { A, B, C } NPA : { D , E , F }

2NF ✗

A → BCDEF ✓ , BC → ADEF ✓ , B → F ✗ , D → E ✓

R_1

ABCDE

$A \rightarrow BCDE$ ✓

$BC \rightarrow ADE$ ✓

$D \rightarrow E$ ✓

CK: {A, BC}

2NF

R_2

BF

$B \rightarrow F$

CK: B

2NF

3NF

BCNF

R_1

R_{11}

ABCD

$A \rightarrow BCD$

$BC \rightarrow AD$

CK: {A, BC}

3NF

BCNF

R_{12} (DE)

$D \rightarrow E$ ✓

CK: {D}

3NF

BCNF

R(ABCDE)

{$AB \rightarrow C$, $B \rightarrow D$, $B \rightarrow E$}

CK: AB

R1	R2
ABC	BDE
AB → C	B → D
CK: AB	B → E
BCHF ✓	CK: B
	BCHF ✓

R(ABCDE}

{ AB → C, B → D, A → E }

× ×

R1 R2 R3

ABC BD AE

R(ABCDE)

$\{ A \rightarrow BC,\ AD \rightarrow E,\ B \rightarrow C \}$