3NF and BCNF from CANONICAL COVER and CLOSURE

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3NF Using Canonical Cover

Ex.3.5: R (A, B, C, D, E)

FDs= {A→ B, AB→ D, B→BDE, C→D, D→D}

CANONICAL COVER:

Step1 ALL LHS	Step 2 Copy FDs	Step 3 Remove Reflexivity	Step 4 Remove Extraneous att	Step 5 Canonical Cover
A	**A→ B**	**A→ B**	**A→ B**	**A→ B**
B	**B→ BDE**	**B→ BDE**	**B→ DE**	**B→ DE**
AB	**AB→ D**	**AB→ D**	**AB→ D**	**C→ D**
C	**C→ D**	**C→ D**	**C→ D**	
D	**D→ D**	**D→ D**		

AB→D== A→B & B→D

B→ DE== B→D & B→E

Step6: Check or find Superkey ABC+ ={A,B,C,D,E}Which ensure that ABC is a super key.

Result is: R1 (A,B), R2(B,D,E), R3 (CD) are in 3NF.

Ex.3.6: R (A, B, C)

FDs= {A→BC, B→C, A→B, AB→C}

Step1 ALL LHS	Step 2 Copy FDs	Step 3 Remove Reflexivity	Step 4 Remove Extraneous att	Step 5 Canonical Cover
A	**A→ BC**	**A→ BC**	**A→ BC**	**A→ B**
B	**B→ C**	**B→ C**	**B→ C**	**B→ C**
AB	**AB→ C**	**AB→ C**	**AB→ C**	

AB→ C== A→C & B→C

A→ BC == A→B & A→C if you consider A→B & B→ C == A→C

Step6: Super key: AB+=(A,B,C)

R1(A,B) and R2(B,C) are in 3NF.

BCNF Using Canonical Cover/ F+

1. For all dependencies $A \rightarrow B$ in F+, check if A is a superkey
   - By using attribute closure
2. If not, then
   - Choose a dependency in F+ that breaks the BCNF rules, say $A \rightarrow B$
   - Create R1 = A B
   - Create R2 = A (R – (B – A))
   - Note that: $R1 \cap R2 = A$ and $A \rightarrow AB$ (= R1), so this is lossless decomposition
3. Repeat for R1, and R2
   - By defining F1+ to be all dependencies in F that contain only attributes in R1
   - Similarly F2+

- $R = (A, B, C)$
  $FD = \{A \rightarrow B$
  $B \rightarrow C\}$
- Key = $\{A\}$
- R is not in BCNF ($B \rightarrow C$ but B is not super key)
- Decomposition

$R_1 = (B, C)$

$R_2 = (A,B)$

Ex.4.5: R (A, B, C, D, E)

FDs= {A→ B, AB→ D, B→BDE, C→D, D→D}

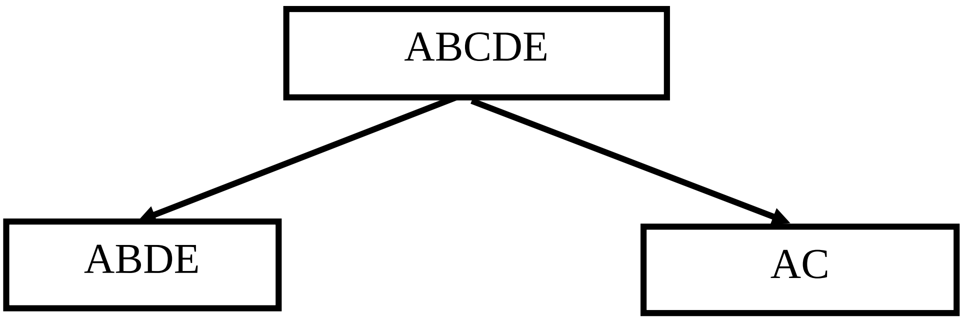
Find F+

Step1 Attr & LHS	Step 2 FDs	Step 3 Reflexivity	Step 4 Transivity	Step 5 F+
A	**A→ B**	**A→ AB**	**A→ ABDE**	**A→ ABDE (SK?)**
B	**B→ B DE**	**B→ B DE**	**B→ B DE**	**B→ B DE (SK?)**
AB	**AB→ D**	**AB→ AB D**	**AB→ ABDE**	**AB→ ABDE**
C	**C→ D**	**C→ C D**	**C→ C D**	**C→ C D (SK?)**
D	**D→ D**	**D→ D**	**D→ D**	**D→D (TR)**
E	**E**	**E→E**	**E→E**	**E→E (TR)**

If you calculate A+→ A is not super key (SK) → Violets the BCNF and hence break here

A+ = {ABCDE}- ({ABDE}-{A}) [all- (RHS – alpha)]

= **{AC}→ TR**

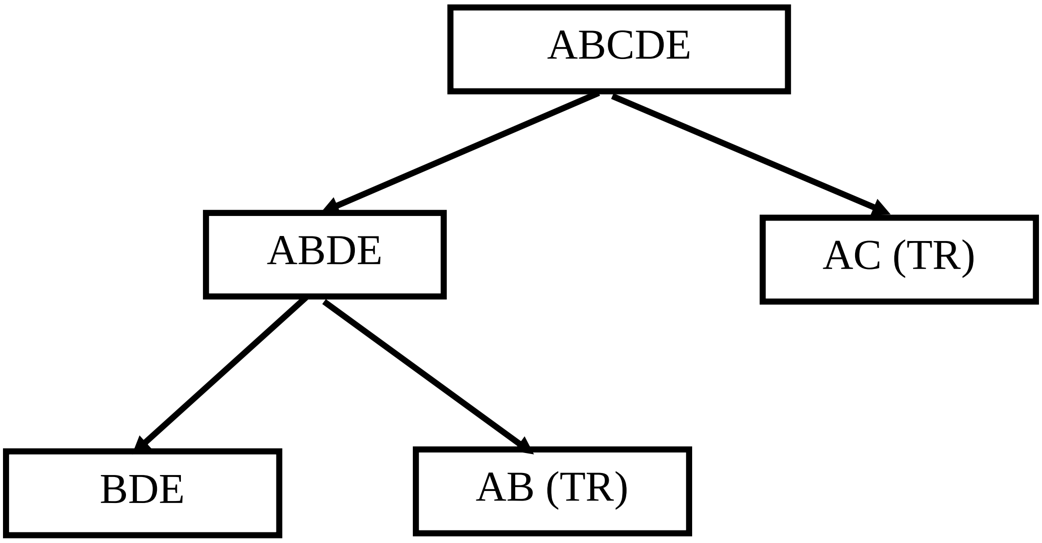


You can not say about A is SK or not?

We are considering **B→ BDE (SK?)**

B+ = {ABDE}- ({BDE}-{B}) [Original- (RHS – alpha)]

= **{AB}➔ TR**



R1 (B, D, E)[🡐 B→BDE], R2 (A, B), R3 (A, C) are in BCNF.

Case study: $R = (A, B, C)$
$FD = \{A \rightarrow B, B \rightarrow C\}$

Supposed R is decomposed in two different ways:

Case-1: R1 (A, B), R2 (B, C)

- Does this satisfy lossless-join decomposition?

✓ Yes: R1 ∩ R2 = {B} and B → BC (B is super key of R2)

- Does this satisfy dependency preserving?

✓ Yes: dependencies can be checked without joining tables

Case-2. R1(A, B), R2(A, C)

- Does this satisfy lossless-join decomposition?

✓ Yes: R1 ∩ R2 = {A} and A → AB (A is super key of R1)

- Does this satisfy dependency preserving?

✓ No: cannot check B → C without joining R1 and R2

Exercise1: Find the canonical cover of the following relation R as

$R = (A, B, C)$
$F = \{A \rightarrow BC, B \rightarrow C, A \rightarrow B, AB \rightarrow C\}$

Exercise2: Find the 3NF and BCNF of the following relation R as

$R = (A, B, C)$
$F = \{A \rightarrow C, C \rightarrow DE, D \rightarrow B, A \rightarrow D\}$