# CNF example

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Create a $G_{CNF}$ where $L(G_{CNF}) = L(G_{CF})$

$G_{CF} = (\{S, A, B, C, D\}, \{a, b, c, d\}, S, P)$

P:
$S \to ABaC$
$A \to BC$
$B \to b \mid \lambda$
$C \to D \mid \lambda$
$D \to d$

$\boxed{B \to b \mid \lambda \quad C \to D \mid \lambda} \equiv \{B \to b,\ B \to \lambda,\ C \to D,\ C \to \lambda\}$

int x, y, z;
≡
int x;
int y;
int z;

1. remove lambda productions.

[ $\cancel{S \to AaC}$ partially ok ]

$S \to ABaC \to \bar{B}\bar{\bar{C}}\ ba\ D$

$\to b\bar{\bar{D}}\ bad \to bdbad$ ]

[A→] [B→] [C→]
$S \to ABaC \mid BaC \mid AaC \mid ABa$

[AB→] [BC→] [AC→] [ABC→]
$\mid aC \mid Aa \mid Ba \mid a$

[ $A \to BC \to b\bar{C} \to b\bar{D} \to b\bar{d}$ ]

[B→] [C→]
$A \to BC \mid C \mid B$

$B \to b$
$C \to D$
$D \to d$

$G' = (\{S, A, B, C, D\}, \{a, b, c, d\}, S, P')$

P':
$S \to ABaC \mid BaC \mid ABa \mid aC \mid Aa \mid Ba \mid a \mid AaC$
$A \to BC \mid B \mid C$
$B \to b$
$C \to D$
$D \to d$

$L(G') = L(G)$

2. Remove unit productions

$S \to ABaC \mid BaC \mid AaC \mid ABa \mid aC \mid Aa \mid Ba \mid a$
$A \to BC \mid b \mid D$
$B \to b$
$C \to d$
$D \to d$

$G'' = (\{S, A, B, C, D\}, \{a, b, c, d\}, S, P'')$

P'':
$S \to ABaC \mid BaC \mid AaC \mid ABa \mid aC \mid Aa \mid Ba \mid a$
$A \to BC \mid b \mid d$
$B \to b$
$C \to d$
$D \to d$

$L(G') = L(G'')$

3. Remove useless productions

$G''' = (\{S, A, B, C\}, \{a, b, c, d\}, S, P''')$

P''':
$S \to ABaC \mid BaC \mid AaC \mid ABa \mid aC \mid Aa \mid Ba \mid a$
$A \to BC \mid b \mid d$
$B \to b$
$C \to d$

$L(G''') = L(G'')$

I. $S \to ABX_aC \mid BX_aC \mid AX_aC \mid ABX_a \mid X_aC \mid AX_a \mid BX_a \mid a$
$A \to BC \mid b \mid d$
$B \to b$
$C \to d$
$X_a \to a$

$L(G_I) = L(G''')$

II.
$S \to X_{AB}X_{aC} \mid BX_{aC} \mid AX_{aC} \mid X_{AB}X_a \mid X_aC \mid AX_a \mid BX_a \mid a$
$A \to BC \mid b \mid d$
$B \to b$
$C \to d$
$X_a \to a$
$X_{AB} \to AB$
$X_{aC} \to X_aC$

CNF

$L(G_{II}) = L(G_I)$
$\Downarrow$
$L(G_{CNF}) = L(G_{CF})$