$A\alpha_1$

$S \to Sa$

$S \to aS' \mid a$

$S' \to aS' \mid a$

$A \to A\alpha_1 \mid \dots \mid A\alpha_m \mid \beta_1 \mid \dots \mid \beta_n$

$\Downarrow$

$A \to \beta_1 A' \mid \dots \mid \beta_n A' \mid \beta_1 \mid \dots \mid \beta_n$

$A' \to \alpha_1 A' \mid \alpha_m A' \mid \alpha_1 \mid \dots \mid \alpha_m$

$\alpha_1 \quad \alpha_2 \quad \beta_1 \quad \beta_2$

$S \to SA \mid Sa \mid Bb \mid b$

$\Downarrow$

$S \to BbS' \mid bS' \mid Bb \mid b$

$S' \to AS' \mid aS' \mid A \mid a$

$L = \{ a^p b^{p+2q} a^q \mid p, q > 0 \}$

$a^p b^p b^q b^q a^q$

$S \to XY$

$X \to aXb \mid ab$

$Y \to bbYa \mid bba$

$\Downarrow$

1 $S \to XY$

2 $X \to Z_0 B \mid AB$

3 $Y \to Z_1 Z_2 \mid Z_1 A$

4 $Z_0 \to AX$

5 $Z_1 \to BB$

6 $Z_2 \to YA \Rightarrow Z_2 \to Z_1 Z_2 A \mid Z_1 AA$

7 $A \to a \quad \Rightarrow Z_2 \to BBZ_2 A \mid BBAA$

8 $B \to b$

$\Rightarrow$

$S \to aXBY \mid aBY$

$X \to aXB \mid aB$

$Y \to bBZ_2 \mid bBA$

$Z_0 \to aX$

$Z_1 \to bB$

$Z_2 \to bBZ_2 A \mid bBAA$

$A \to a$

$B \to b$

$L: a^n b^n$

$S \to aSb \mid ab \Rightarrow$

1 $S \to Z_0 B \mid AB$

2 $Z_0 \to AS$ (CNF)

3 $A \to a$ $\Rightarrow$

4 $B \to b$

$S \to aSB \mid aB$

$Z_0 \to aS$ (GNF)

$A \to a$

$B \to b$

$L = \{ a^r b^s c^t a^n c^h \mid s = r+t, r,n,t \geq 0 \}$

$\overbrace{a^r b^r b^t}^{x} \overbrace{c^t a^n c^h}^{y}$

aabb|bbcc

$S \to ABY$

$A \to aAb \mid \varepsilon$

$B \to bBc \mid \varepsilon$

$Y \to a^n c \mid \varepsilon$

ε-transizioni $\Rightarrow$

$S \to ABY \mid AB \mid BY \mid A \mid B \mid Y$

$A \to aAb \mid ab$

$B \to bBc \mid bc$

$Y \to aYc \mid ac$

Unitarie $\Rightarrow$

ridotta

$S \to ABY \mid AB \mid BY \mid aAb \mid bBc \mid aYc \mid ab \mid bc \mid ac \mid \varepsilon$

$A \to aAb \mid ab$

$B \to bBc \mid bc$

$Y \to aYc \mid ac$

1 $S \to Z_0 Y \mid AB \mid BY \mid Z_1 X_b \mid Z_2 C \mid Z_3 C \mid X_a X_b \mid X_b C \mid X_a C \mid \varepsilon$

2 $A \to Z_1 X_b \mid X_a X_b$

3 $B \to Z_2 C \mid X_b C$

4 $Y \to Z_3 C \mid X_a X_c$

6 $Z_0 \to AB \Rightarrow Z_0 \to Z_1 X_b B \mid X_a X_b B$

6 $Z_1 \to X_a A$

7 $Z_2 \to X_b B$

8 $Z_3 \to X_a Y$

9 $X_a \to a$

10 $X_b \to b$

11 $C \to c$

$S \to aAX_bBY \mid aX_bBY \mid aAX_bB \mid aX_bB \mid bBCY \mid bBCY \mid aAX_b$
$bBC \mid aYC \mid aX_b \mid bC \mid aC \mid \varepsilon$

$A \to aAX_b \mid aX_b$

$B \to bBC \mid bBC$

$Y \to aYC \mid aX_c$

$Z_0 \to aAX_bB \mid aX_bB$

$Z_1 \to aA$

$Z_2 \to bB$

$Z_3 \to aY$

$X_a \to a$

$X_b \to b$

$C \to c$