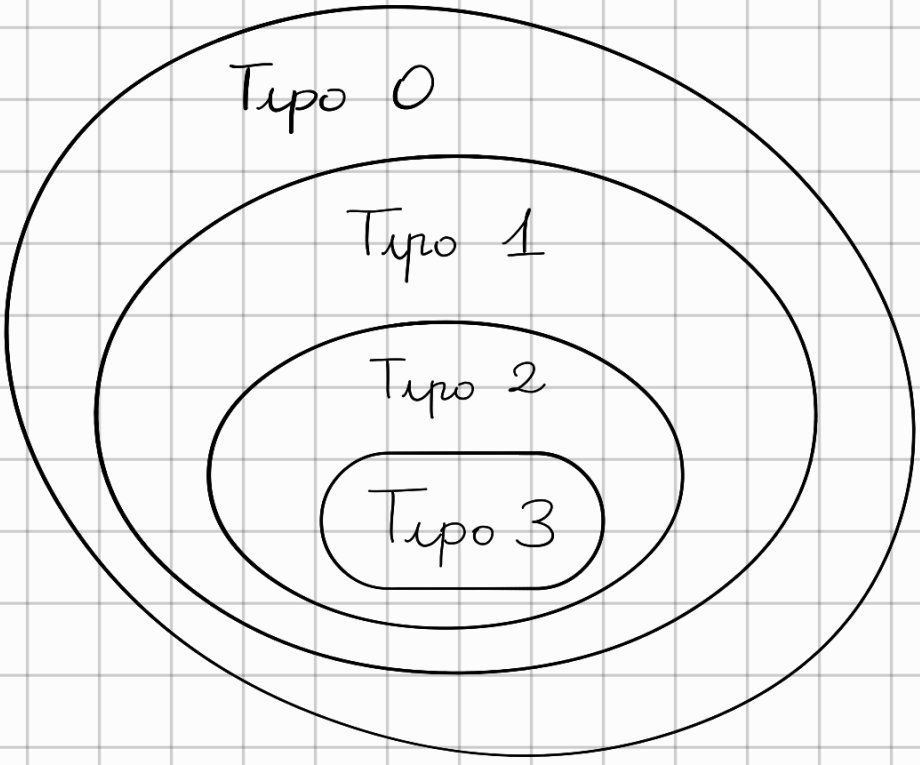
Tipo 0, tipo 1

tipo 2 C.F

tipo 3 regolari (o lineari destri)



$S \to aS$

Grammatica → Linguaggio

① $S \to aS \mid b$.

passo ricorsivo ↑ ↑ passo base

$S \to aS$.

$S \to b$.

$\lambda \overset{S \to b}{\Longrightarrow} b$

$\lambda \overset{S \to aS}{\Longrightarrow} aS \overset{S \to b}{\Longrightarrow} ab$

$\lambda \overset{S \to aS}{\Longrightarrow} aS \overset{S \to aS}{\Longrightarrow} aaS \overset{S \to b}{\Longrightarrow} aab$

$= \{ b, ab, aab, \dots \}$

- abbiamo n volte $\underline{a}$
- abbiamo una $\underline{b}$
- la $\underline{b}$ è sempre finale

$$L = \{ a^n b \mid n \geq 0 \}$$

$X^0 = \lambda$

$X^1 = X$

$X^2 = XX$

$\vdots$

$X^n = \underbrace{X \dots X}_{n \text{ volte}}$

n volte

$\Sigma = \{ a, b \}$ => TERMINALI

S => NONTERMINALE

$$L = \{ b^n a^n \mid n \geq 0 \} \neq \{ a^n b^n \mid n \geq 0 \}$$

② $S \to bSa \mid \lambda$

$\lambda \overset{S \Rightarrow aSb}{\Rightarrow} aSb \overset{S \to \lambda}{\Rightarrow} ab$

$\lambda \Rightarrow aSb \Rightarrow aaSbb \Rightarrow aaabbb$ ($S \to aSb$, $S \to aSb$, $S \to \lambda$)

$= \{ \lambda, ab, aabb, aaabbb, \ldots \}$

- n volte a
- n volte b
- λ

$$L = \{ a^n b^n \mid n \geq 0 \}$$

$X \to \alpha X \beta$

abb

③ → $S \to AB$ ←

- $A \to aAbb \mid abb$
- $B \to bBc \mid bc$

abb ? X

$S \to AB \Rightarrow AB \xrightarrow{A \to abb} abbB \xrightarrow{B \to bc} abbbc$

$S \to AB \Rightarrow AB \xrightarrow{A \to aAbb} aAbbB \xrightarrow{A \to abb} aabbB \xrightarrow{B \to bBc} aabbbBc \xrightarrow{B \to bc} aabbbbcc$

aabbbbcc, aabbbbbccc

$\{A \to aAbb \mid abb$

$= \{ abb, aabbbb, a^3b^6, \dots \}$

$$L_A = \{ a^n b^{2n} \mid n > 0 \}$$

$$B \to bBc \mid bc$$

$$= \{ bc, \; b^2c^2, \; b^3c^3, \ldots \}$$

$$L_B = \{ b^n c^n \mid n > 0 \}$$

- $L_A = \{ a^u b^{2u} \mid u > 0 \}$ ←
- $L_B = \{ b^m c^m \mid m > 0 \}$ ←

$S \to AB$

$\{ ab^2, a^2b^4, \ldots \}$ $\{ bc, b^2c^2, b^3c^3, \ldots \}$

$$a^n b^{2n} \cdot b^m c^m$$

$$= \{ a^n b^{2n+m} c^m \mid n > 0, \; m > 0 \}$$

$S \to AB$

$$L = \{ a^n b^{2n+m} c^m \mid n > 0, \; m > 0 \}$$

$a^3 b^5 c^1$ $\quad a^n b^{2n} \cdot b^m c^m$

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④ → $S \to \overset{(1)}{a}S\overset{}{c} \mid \overset{(2)}{a}B\overset{}{c}$

$B \to \overset{(3)}{b}B\overset{}{c} \mid \overset{(4)}{b}\underline{c}$

$$L = \{ a^n b^m \cdot e^{n+m} \mid n>0,\ m>0 \}$$

$$a^n b^m c^m c^n = a^n b^m c^{n+m}$$

Linguaggio → Grammatica

① $L = \{ a^n \mid n = 2\cdot h,\ h>0 \}$

$= \{ a^{2h} \mid h>0 \}$

$= \{ aa, a^4, a^6, \dots \}$

a è multiplo di 2

$\min \# a = 2$

$S \to aa \mid aaS$

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② $L = \{ a^n b^k c^m \mid n > 0 \leftarrow$
$m > 0 \leftarrow$
$k > n + m \}$

$n = 2$
$k = 4$
$m = 1$

$a^2 b^4 c^1$ $\quad aabbbbc \leftarrow$

$aabbbbbcc \leftarrow$

$aabbbbbbcc \leftarrow$

$b^x a^n b^n b^m c^m$

$\neq$

$= \{ a^n b^{n+m+x} c^m \mid n > 0, m > 0, x > 0 \}$

$L_1 \quad L_2 \quad L_3$

$L = a^n b^n \cdot b^x \cdot b^m c^m \leftarrow$

$A \to aAb \mid ab \qquad B \to bBc \mid bc$

$X \to b \mid bX$

Grammatica finale

$S \to AXB \leftarrow$
$L_1 \cdot L_2 \cdot L_3$

$A \to aAb \mid ab$

$X \to b \mid bX$

$B \to bBc \mid bc$

$$L = \left\{ a^i b^k c^j \mid i > 0, j > 0, 0 \le k \le i+j \right\}$$

ac, abc, abbc
aac, aabc, aabbc
aabbbc

$a^i b^{k_i}$ $0 \le k_i \le i$

$b^{k_j} c^j$ $0 \le k_j \le j$

$$L = \left\{ a^i b^{k_i} \cdot b^{k_j} c^j \mid \begin{array}{l} i > 0 \\ j > 0 \\ 0 \le k_i \le i \\ 0 \le k_j \le j \end{array} \right\}$$

$a^i b^{k_i + k_j} c^j$ $\quad 0 \le k_i + k_j \le i + j$

$L_1 = a^i b^{k_i}$ $i > 0$, $0 \le k_i \le i$ $\qquad L_2 = b^{k_j} c^j$ $0 \le k_j \le k$

$a^2 bc$

L_1 $A \to ab \mid a \mid aA \mid aAb$

L_2 $B \to bc \mid e \mid cB \mid bBc$

ae

$S \to AB$