1) $L=\{0^i1^j2^k \mid i=j$ ou $j=k$, com $i,j,k>0\}$

Sol:

$G=(\{S,A,B,C,D\},\{0,1,2\},P,S)$

onde:

$$P=\left\{\begin{array}{l} S\to A2 \mid 0B \\ A\to A2 \mid C \\ B\to 0B \mid D \\ C\to 0C1 \mid 01 \\ D\to 1D2 \mid 12 \end{array}\right\}$$

Nota: A gramática é ambígua. (Dica: Testar "012")

2) $G=\{N,\Sigma,P,S\}$

$N=\{S,A,B,C,D\}$ $\Sigma=\{0,1\}$

$$P=\left\{\begin{array}{l} S\to 0S1 \mid 0A \mid D \\ A\to ASC \mid 1C \mid 1 \\ B\to 0B1 \mid 01 \\ C\to 0D1 \\ D\to 01C \end{array}\right.$$

Sol

Símbolos Geradores $=\{0,1,A,B,S\}$

$$P_{SG}=\left\{\begin{array}{l} S\to 0S1 \mid 0A \\ A\to 1 \\ B\to 0B1 \mid 01 \end{array}\right.$$

Símbolos Alcançáveis $=\{S,A\}$

$$P_{SA}=\left\{\begin{array}{l} S\to 0S1 \mid 0A \\ A\to 1 \end{array}\right\}$$

3) $G = (N, \Sigma, P, E)$

$N = \{E\}$ $\Sigma = \{+, *, id, (, )\}$

$P = \{E \to E+E \mid E*E \mid (E) \mid id\}$

Sol

a) Ambigüidade:

- $E \underset{lm}{\Rightarrow} E+E \underset{lm}{\Rightarrow} id \cancel{+E} \underset{lm}{\Rightarrow} id+E*E$
- $E \underset{lm}{\Rightarrow} E*E \underset{lm}{\Rightarrow} E+E*E \underset{lm}{\Rightarrow} id+E*E$

b) Dica: Estabelecer prioridade.

$$
P = \{ E \to T \mid E+T \mid \\
T \to F \mid T*F \\
F \to (E) \mid id
$$

4) $G = (N, \Sigma, P, S)$

$N = \{S, A, B\}$ $\Sigma = \{a, b\}$

$$
P = \{ S \to AB \mid aBB \mid aSBa \\
A \to a \mid aB \mid aSb \\
B \to \varepsilon \mid bB \mid aSB \}
$$

(Dica: Primeiro simplificar produções vazias)

Sol:

$$
P = \{ S \to A \mid AB \mid aB \mid aBB \mid \underline{aSa} \mid \underline{aSBa} \\
A \to a \mid aB \mid \underline{aSb} \\
B \to b \mid bB \mid \underline{aS} \mid \underline{aSB} \}
$$

(Dica: Reemplazar aS com variável X)

$$
P = \{ S \to A \mid AB \mid aB \mid aBB \mid Xa \mid XBa \\
A \to a \mid aB \mid Xb \\
B \to b \mid bB \mid X \mid XB \\
X \to aS \}
$$

(Dica: Reemplazar S por Y que se comporta como S)

$$
P = \{ S \to A \mid AB \mid aB \mid aBB \mid Xa \mid XBa \\
A \to a \mid aB \mid Xb \\
B \to b \mid bB \mid X \mid XB \\
X \to aY \\
Y \to A \mid AB \mid aB \mid aBB \mid Xa \mid XBa \}
$$

5) $G = (N, \Sigma, P, \langle cad \rangle)$

$N = \{\langle cad \rangle, \langle meio \rangle\}$ $\quad \Sigma = \{a, b\}$

$P = \{ \langle cad \rangle \rightarrow ab \mid a \langle meio \rangle b$

$\langle meio \rangle \rightarrow a \langle meio \rangle \mid \langle meio \rangle b \mid a \mid b \}$

Sol:

$L = \{ab, aab, abb, aabb, aaab, abbb, \ldots\}$

então:

$L = \{ awb \mid w \in \{a, b\}^* \}$

Para demonstrar ambiguidade testar a cadeia "aabb"

$\langle cad \rangle \Rightarrow_{lm} a \langle meio \rangle b \Rightarrow_{lm} a a \langle meio \rangle b \Rightarrow_{lm} aabb$

$\langle cad \rangle \Rightarrow_{lm} a \langle meio \rangle b \Rightarrow_{lm} a \langle meio \rangle b b \Rightarrow_{lm} aabb$

6) $G = \{N, \Sigma, P, S\}$

$N = \{S, A, B, C\}$ $\quad \Sigma = \{a, b\}$

$P = \{ S \rightarrow \cancel{AB} \mid CA$

$A \rightarrow a$

~~$B \rightarrow BC \mid AB$~~

$C \rightarrow \cancel{aB} \mid b$

$\}$

Sol: (Dica: Não tem produções vazias, nem unárias)

Simbolos Geradores $= \{a, b, A, C, S\}$

Simbolos Alcançaveis $= \{S, C, A, a, b\}$ (Nota: [illegible])

$P = \{ S \rightarrow CA$

$A \rightarrow a$

$C \rightarrow b \}$

7) $S \to XY$ $\quad X \to B$
$Y \to \varepsilon$ $\quad B \to YA$
$A \to AA \mid C \mid D$ $\quad C \to 0$
$D \to 1$ $\quad E \to X$

Sol:

a) Vazias:

$S \to X$ ~~XY | X~~ $\quad X \to B$
$A \to AA \mid C \mid D$ $\quad B \to A$
$D \to 1$ $\quad C \to 0$
$E \to X$

b) Unitarias:

~~(S, S) Ø~~
~~(A, A) A → AA~~
~~(B, B) Ø~~
~~(C, C) C → 0~~
~~(D, D) D → 1~~
~~(X, X) Ø~~
(E, E) Ø

~~(S, X) Ø~~
~~(S, B) Ø~~
~~(S, A) S → AA~~
~~(S, C) S → 0~~
~~(S, D) S → 1~~
~~(X, B) Ø~~
~~(X, A) X → AA~~

~~(A, C) A → 0~~
~~(A, D) A → 1~~
~~(B, A) B → AA~~
~~(B, C) B → 0~~
~~(B, D) B → 1~~
~~(X, C) X → 0~~
~~(X, D) X → 1~~

(E, X) Ø
(E, B) Ø
(E, A) E → AA
(E, C) E → 0
(E, D) E → 1

$S \to AA \mid 0 \mid 1$
$A \to AA \mid 0 \mid 1$
~~B → AA | 0 | 1~~
~~C → 0~~
~~D → 1~~
~~X → AA | 0 | 1~~ $\quad E \to AA \mid 0 \mid 1$

c) Não geradores:
Simbolos geradores: {0, 1, S, A, B, C, D, X, E}
Todos.

d) Não alcanzaveis:
Simbolos alcanzaveis: {S, A, 0, 1}

$S \to AA \mid 0 \mid 1$
$A \to AA \mid 0 \mid 1$

8) $G = (N, \Sigma, P, S)$

$N = \{S, T, L\}$ $\quad \Sigma = \{a, b, +, -, *, /, [, ]\}$

$P = \{ S \to T+S \mid T-S \mid T$

$\quad T \to L*T \mid L/T \mid L$

$\quad L \to a \mid b \mid [S] \quad \}$

Sol:

$L = \{ a, b, a+b, a-b, [a], [b], [a+b], [a-b], a*a+b \ldots \}$

L = { é a linguagem que define o formato de operações aritméticas +, -, *, /; de ~~os~~ identificadores a e b onde * e / têm a mesma prioridade entre eles e têm maior prioridade que + e -. Embora [ ] tem a maior prioridade de resolução }

FNC:

a) Vazias: Não tem.

b) unitárias:

$S \to T+S \mid T-S \mid L*T \mid L/T \mid a \mid b \mid [S]$

$T \to L*T \mid L/T \mid a \mid b \mid [S]$

$L \to a \mid b \mid [S]$

c) Não Geradores:

Simbolos geradores: $\{a, b, L, T, S\}$

d) Não alcançáveis:

Simbolos alcançaveis: $\{S, T, L, a, b\}$

e) FNC:

$S \to TC_1 \mid TC_3 \mid LC_5 \mid LC_7 \mid a \mid b \mid C_9C_{10}$

$C_1 \to C_0S \qquad C_5 \to C_4T \qquad C_9 \to C_8S$

$C_0 \to + \qquad C_4 \to * \qquad C_8 \to [$

$C_3 \to C_2S \qquad C_7 \to C_6T \qquad C_{10} \to ]$

$C_2 \to - \qquad C_6 \to /$

$T \to LC_5 \mid LC_7 \mid a \mid b \mid C_9C_{10}$

$L \to a \mid b \mid C_9C_{10}$

7) $G = (N, \Sigma, P, S)$

$N = \{S\}$ $\Sigma = \{p, \sim, \Rightarrow, [, ]\}$

$P = \{S \rightarrow p \mid \sim S \mid [S \Rightarrow S]\}$

Sol:

$L = \{p, \sim p, [p \Rightarrow p], [p \Rightarrow [p \Rightarrow p]], \dots\}$

L = { é a linguagem das cadeias w ou ~w onde w pode ser p ou a estrutura [w ⇒ w] }

FNG:

a) vazios: Não tem

b) Unitários: Não tem

c) Não geradores: Não tem

d) Não alcançáveis: Não tem.

2) FNG:

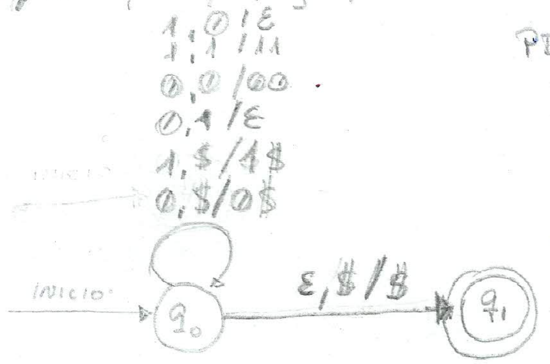
$S \rightarrow p \mid \sim S \mid [SXSY$

$X \rightarrow \Rightarrow$

$Y \rightarrow ]$

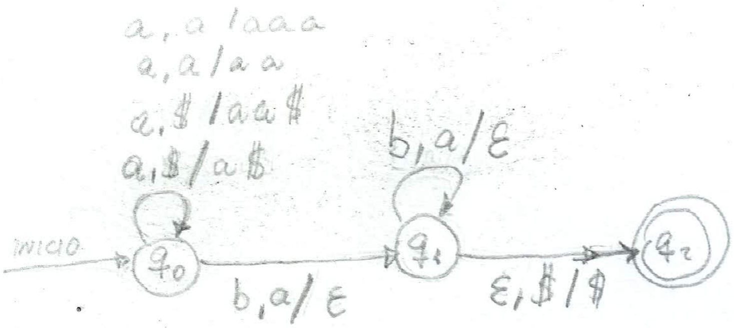
10.a) $L1 = \{w \in \{0,1\}^* \mid w$ contém o mesmo número de 0's e 1's

$PDA_F = (\{q_0, q_1\}, \{0,1\}, \{\$, 0, 1\}, \delta_F, q_0, \$, q_1)$




10.b) $L2 = \{a^n b^m \mid n \leq m \leq 2^*n$ e $n, m > 0\}$

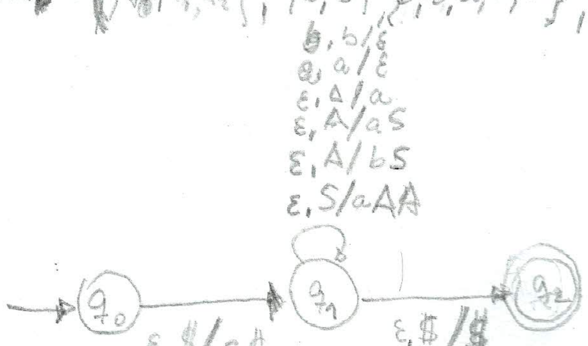
$PDA_F = (\{q_0, q_1, q_2\}, \{a, b\}, \{\$, a\}, \delta_F, q_0, \$, q_2)$



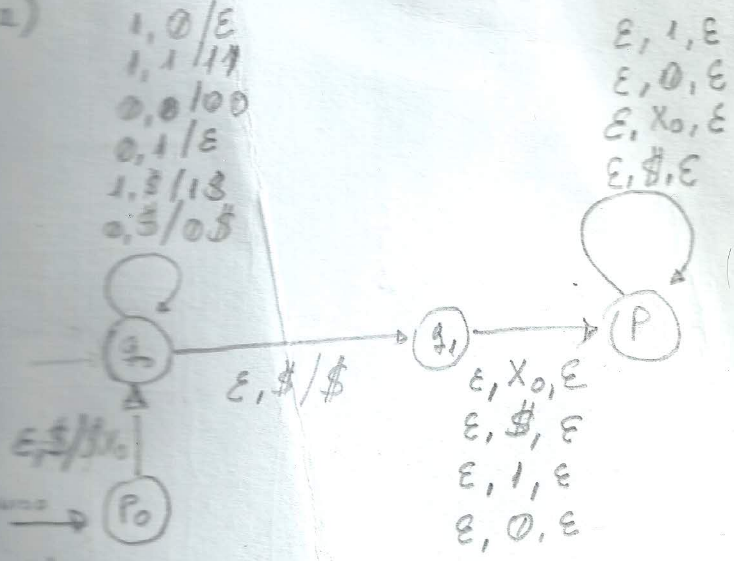

10.c) $L3 = L(G) \Rightarrow G = (\{S, A\}, \{a, b\}, P, S)$

onde: $P = \{S \rightarrow aAA,\ A \rightarrow bS \mid aS \mid a\}$

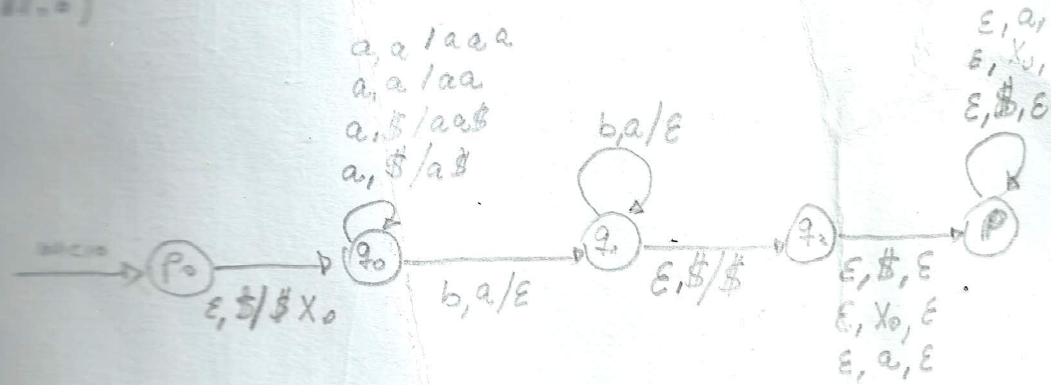
$PDA_F = (\{q_0, q_1, q_2\}, \{a, b\}, \{\$, S, a, b, A\}, \delta_F, q_0, \$, q_2)$



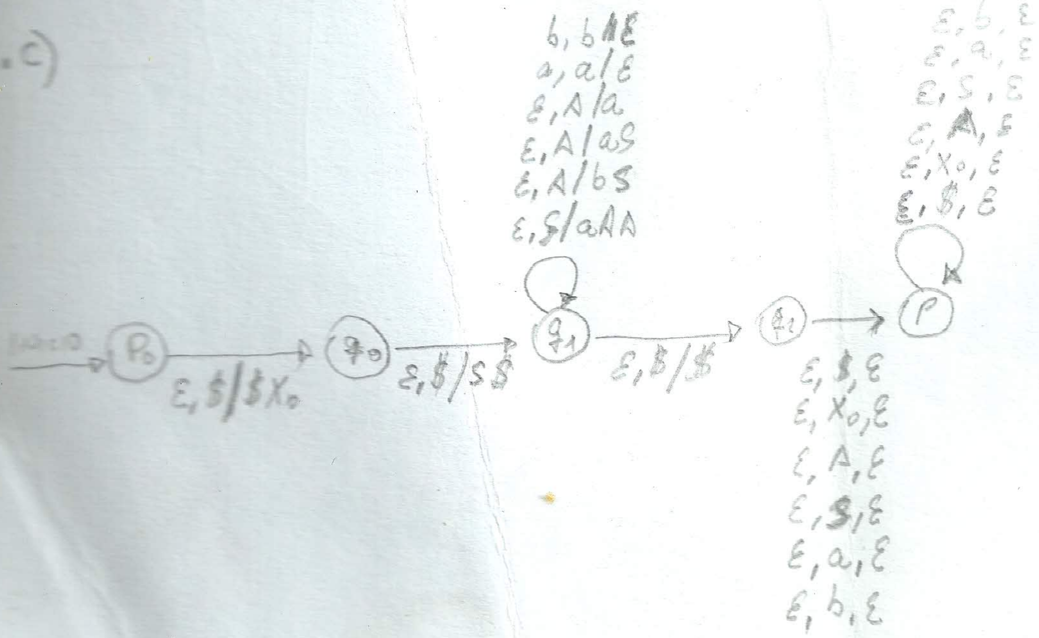
11.a)


1, 0 / ε
1, 1 / 11
0, 0 / 00
0, 1 / ε
1, $ / 1$
0, $ / 0$
ε, $ / $X₀
ε, $ / $
ε, X₀, ε
ε, $, ε
ε, 1, ε
ε, 0, ε
ε, 1, ε
ε, 0, ε
ε, X₀, ε
ε, $, ε
p₀
q₀
q₁
P

11.b)


a, a / aaa
a, a / aa
a, $ / aa$
a, $ / a$
ε, $ / $X₀
b, a / ε
b, a / ε
ε, $ / $
ε, $, ε
ε, X₀, ε
ε, a, ε
ε, a, ε
ε, X₀, ε
ε, $, ε
p₀
q₀
q₁
q₂
P

11.c)


b, b / ε
a, a / ε
ε, A / a
ε, A / aS
ε, A / bS
ε, S / aAA
ε, $ / $X₀
ε, $ / S$
ε, $ / $
ε, b, ε
ε, a, ε
ε, S, ε
ε, A, ε
ε, X₀, ε
ε, $, ε
ε, $, ε
ε, X₀, ε
ε, A, ε
ε, S, ε
ε, a, ε
ε, b, ε
p₀
q₀
q₁
q₂
P

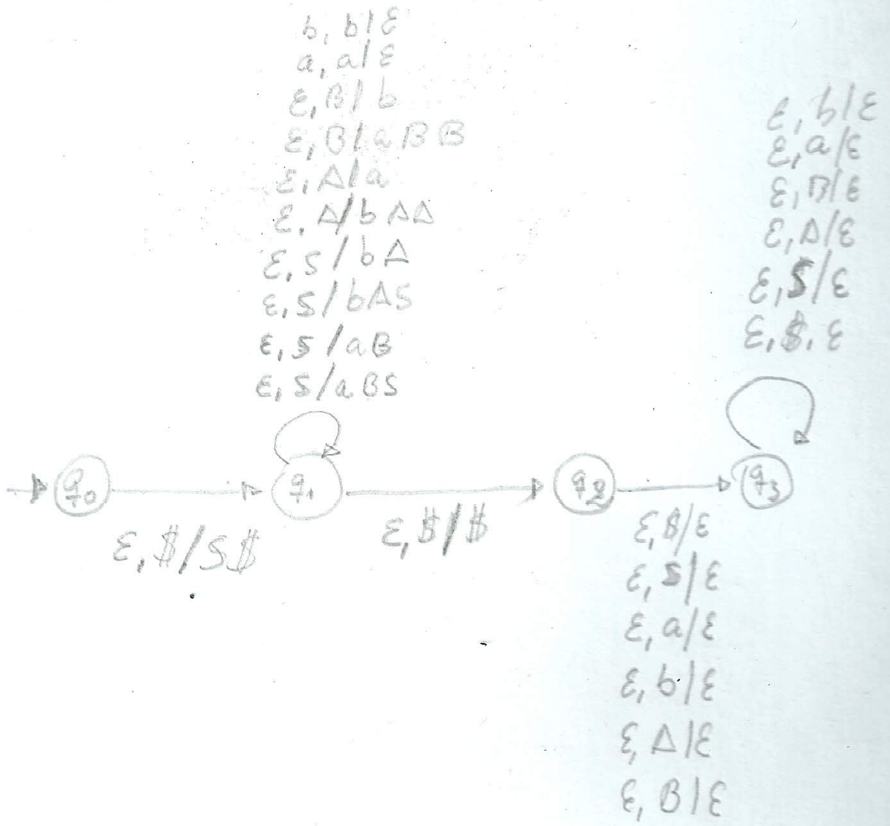
12) $G = (N, \Sigma, P, S)$

$N = \{S, A, B\}$ $\quad \Sigma = \{a, b\}$

$P = \{ S \rightarrow aBS \mid aB \mid bAS \mid bA$

$A \rightarrow bAA \mid a$

$B \rightarrow aBB \mid b \}$




13) Regras para $N(M) = (\{q_0, q_1\}, \{0, 1\}, \{Z_0, X\}, \delta, q_0, Z_0, F)$

- Inicio:

  $S \rightarrow [q_0, Z_0, q_0] \mid [q_0, Z_0, q_1]$

- Pop da Pilha: $\delta(q_i, \{\varepsilon, 0, 1\}, \{Z_0, X\}) \vdash \{(q_j, \varepsilon)\}$

  $[q_i, \{Z_0, X\}, q_j] \rightarrow \{\varepsilon, 0, 1\}$

- Push da Pilha: $\delta(q_i, \{\varepsilon, 0, 1\}, \overbrace{\{Z_0, X\}}^{A}) \vdash \{(q_j, \overbrace{\{Z_0 X_0\}^{*}}^{BCD\ldots})\}$

  $[q_i, A, \_\_] \rightarrow \{\varepsilon, 0, 1\} [q_j, B, \_\_][\_, C, \_\_][\_, D, \_] \ldots$

Toda combina estados

$M = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$ $\quad Q = \{q_0, q_1\}$ $\quad \Sigma = \{0,1\}$ $\quad \Gamma = \{Z_0, X\}$

$\delta =$ ① $\delta(q_0, 1, Z_0) = \{(q_0, XZ_0)\}$ ② $\delta(q_0, 1, X) = \{(q_0, XX)\}$

③ $\delta(q_0, \varepsilon, Z_0) = \{(q_0, \varepsilon)\}$ ④ $\delta(q_0, 0, X) = \{(q_1, X)\}$

⑤ $\delta(q_1, 0, Z_0) = \{(q_0, Z_0)\}$ ⑥ $\delta(q_1, 1, X) = \{(q_1, \varepsilon)\}$

$G(M) = (N, \Sigma, P, S)$

$N = \{S, [q_0,Z_0,q_0], [q_0,Z_0,q_1], [q_0,X,q_0], [q_0,X,q_1],$
$[q_1,Z_0,q_1], [q_1,X,q_0], [q_1,X,q_1] [q_1,Z_0,q_0]\}$

$\Sigma = \{0,1\}$

$\Sigma = \{0,1\}$

$P = \{ S \to [q_0,Z_0,q_0] \mid [q_0,Z_0,q_1]$ → ⓪

$[q_0,Z_0,q_0] \to 1 [q_0,X,q_0][q_0,Z_0,q_0]$
$[q_0,Z_0,q_0] \to 1 [q_0,X,q_1][q_1,Z_0,q_0]$
$[q_0,Z_0,q_1] \to 1 [q_0,X,q_0][q_0,Z_0,q_1]$
$[q_0,Z_0,q_1] \to 1 [q_0,X,q_1][q_1,Z_0,q_1]$ ①
$[q_0,X,q_0] \to 1 [q_0,X,q_0][q_0,X,q_0]$
$[q_0,X,q_0] \to 1 [q_0,X,q_1][q_1,X,q_0]$ ②
$[q_0,X,q_1] \to 1 [q_0,X,q_0][q_0,X,q_1]$
$[q_0,X,q_1] \to 1 [q_0,X,q_1][q_1,X,q_1]$
$[q_0,Z_0,q_0] \to \varepsilon$ → ③
$[q_0,X,q_0] \to 0 [q_1,X,q_0]$ ④
$[q_0,X,q_1] \to 0 [q_1,X,q_1]$
$[q_1,Z_0,q_0] \to 0 [q_0,Z_0,q_0]$ ⑤
$[q_1,Z_0,q_1] \to 0 [q_0,Z_0,q_1]$
$[q_1,X,q_1] \to 1$ → ⑥