Design a PDA which accepts the language which is the set of all strings of 0s and 1s such that no prefix has more 1s than 0s.

$P = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$ $\quad F = \{f\}$ $\quad = \{\}$

$\Sigma = \{0,1\}$, $Q = \{q_0, q, f\}$, $\Gamma = \{Z_0, 0\}$

$\underbrace{L(P)}_{\text{acceptance by final state}}$, $\underbrace{N(P)}_{\text{acceptance by empty stack}}$

δ:

$(q_0, 1, Z_0) \to (q, Z_0)$

$(q, e, Z_0) \to (q, Z_0)$

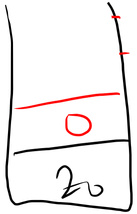
$(q_0, 0, Z_0) \to (q_0, 0Z_0)$

$(q_0, 1, 0) \to (q_0, \varepsilon)$

$(q_0, e, Z_0) \to (q_0, \varepsilon)$ / $(q_0, e, Z_0) \to (f, Z_0)$

$(q_0, e, 0) \to (q_0, \varepsilon)$ $\quad (q_0, e, 0) \to (f, Z_0)$

$\cancel{0}\cancel{0}\cancel{0}\cancel{0}\cancel{1}\cancel{1}\cancel{1}$



Non-deterministic

Design a PDA that accepts the language which is the set of all strings of 0s and 1s with twice as many 0s as 1s.

δ:

$(q_0, 0, Z_0) \to (q_0, 0Z_0)$

$(q_0, 1, Z_0) \to (q_0, 1Z_0)$

$(q_0, 0, 0) \to (q_0, 00)$

$(q_0, 1, 1) \to (q_0, 11)$

$(q_0, 0, 1) \to (q_1, 1)$

$(q_1, 0, 1) \to (q_0, \varepsilon)$

$(q_1, 1, 1) \to (q_1, 11)$

$(q_0, 1, 0) \to (q_2, \varepsilon)$

$(q_2, e, 0) \to (q_0, \varepsilon)$

$(q_2, 0, Z_0) \to (q_0, Z_0)$

$(q_2, 1, Z_0) \to (q_2, 1Z_0)$

$(q_2, 1, 1) \to (q_2, 11)$

$(q_2, 0, 1) \to (q_0, 1)$

$(q_0, e, Z_0) \to (f, Z_0)$

Non-deterministic

Design a PDA that will accept the following languages by empty stack:

a) $L = \{w \in \{0, 1\}^* \mid w = 0^n1^m;\ n \leq m \leq 2n\}$.

b) $L = \{w \in \{a, b, c\}^* \mid w = a^nb^mc^{2(m+n)};\ n \geq 0,\ m \geq 0\}$

a) CFG: $S \to 0S1 \mid 0S11 \mid e$

$w = 00111$

PDA P:

δ: $(q_0, e, Z_0) \to (q, SZ_0)$

$(q, e, S) \to (q, 0S1)$

$(q, e, S) \to (q, 0S11)$

$(q, e, S) \to (q, \varepsilon)$

$(q, 0, 0) \to (q, \varepsilon)$

$(q, 1, 1) \to (q, \varepsilon)$

$(q, e, Z_0) \to (q, \varepsilon)$

$(q_0, 00111, Z_0) \vdash (q_0, 00111, SZ_0) \vdash (q_0, 00111, 0S11Z_0) \vdash (q_0, 0111, S11Z_0)$

$\vdash (q_0, 0111, 0S111Z_0)$

$\vdash (q_0, 111, S111Z_0)$

$\vdash (q_0, 111, 111Z_0)$

$\vdash^3 (q_0, e, Z_0)$

$\vdash (q_0, e, e)$

Non-deterministic

b) CFG G: $S \to aScc \mid X$ $L = \{w \in \{a, b, c\}^* \mid w = a^n b^m c^{2(m+n)};\ n \geq 0,\ m \geq 0\}$

$X \to bXcc \mid e$

PDA P:

δ: $(q_0, e, Z_0) \to (q, SZ_0)$

$(q, e, S) \to (q, aScc)$

$(q, e, S) \to (q, X)$

$(q, e, X) \to (q, bXcc)$

$(q, e, X) \to (q, \varepsilon)$

$(q, a, a) \to (q, \varepsilon)$

$(q, b, b) \to (q, \varepsilon)$

$(q, c, c) \to (q, \varepsilon)$

$(q, e, Z_0) \to (q, \varepsilon)$

Non-deterministic

For each of the PDAs in the previous problems, determine whether they are deterministic or not.

Answers are in each question's page.

Pairs marked are contradicting with the rules.