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Assignment 9

*6.2.2b

PDA to accept all strings with twice as many 0's as 1's:

$P = (Q, \Sigma, T, \delta, q_0, z_0, f)$

$Q = \{q_0, q_f\}$

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

$T = \{0, H, 1, z_0\}$ where H means "half"

$\delta =$

$\delta(q_0, \varepsilon, z_0) = \{(q_0, \varepsilon)\}$

$\delta(q_0, 1, z_0) = \{(q_0, 00z_0)\}$

$\delta(q_0, 0, z_0) = \{(q_0, Hz_0)\}$

$\delta(q_0, 0, H) = \{(q_0, 0)\}$

$\delta(q_0, 0, 1) = \{(q_0, H1)\}$

$\delta(q_0, 0, 0) = \{(q_0, \varepsilon)\}$

$\delta(q_0, 1, 1) = \{(q_0, \varepsilon)\}$

$\delta(q_0, 1, c) = \{(q_1, \varepsilon)\}$

$\delta(q_1, \varepsilon, 0) = \{(q_0, c)\}$

$q_0 = q_0$

$z_0 = z_0$

$f = \emptyset$ (acceptence by empty stack)

*6.2.5

b. Execution trace:

(q_0, abb, Z_0)

↓

(q_1, bb, AAZ_0)

↓

(q_1, b, AZ_0)

↓

(q_1, ε, Z_0)

↓

(q_0, ε, Z_0)

↓

(f, ε) acceptance by final state ✓

c. (q_0, b^7a^4, Z_0)

↓

(q_2, b^6a^4, BZ_0)

each reading of b with top stack B : 1 more B on stack

...

↓

(q_2, a^4, B^7Z_0)

↓

(q_3, a^3, B^6Z_0)

↓

(q_2, a^3, B^5Z_0)

↓

(q_3, a^2, B^4Z_0)

↓

(q_2, a^2, B^3Z_0)

(q_3, a, B^2Z_0)

↓

(q_2, a, BZ_0)

↓

(q_3, ε, Z_0)

After reading b^7a^4 from input, the stack only contains the start symbol, Z_0. If the next epsilon transition is followed, the state of the stack would be AZ_0.

*6.3.5

a. PDA: $(\{q_0, q_1, q_2\}, \{a, b, c\}, \{X, Z_0\}, \delta, q_0, Z_0, \phi)$

accept by empty stack

$\delta(q_0, a, S) = \{(q_0, XXS)\}$ where $S \in \Gamma$

$\delta(q_0, \varepsilon, S) = \{(q_1, S)\}$ where $S \in \Gamma$

$\delta(q_1, b, S) = \{(q_1, XXS)\}$ where $S \in \Gamma$

$\delta(q_1, \varepsilon, S) = \{(q_2, S)\}$ where $S \in \Gamma$

$\delta(q_2, c, X) = \{(q_2, \varepsilon)\}$

$\delta(q_2, \varepsilon, Z_0) = \{(q_3, \varepsilon)\}$

b. CFG productions:

$S \rightarrow PC \mid AQ$

$P \rightarrow aaPb \mid \varepsilon$

$C \rightarrow cC \mid \varepsilon$

$A \rightarrow aA \mid \varepsilon$

$Q \rightarrow bbQc \mid \varepsilon$

PDA: $(\{q\}, \{a, b, c\}, \{a, b, c, A, C, P, Q, S\}, \delta, q, S, \phi)$

accept by empty stack

$\delta(q, \varepsilon, S) = \{(q, PC), (q, AQ)\}$

$\delta(q, \varepsilon, P) = \{(q, aaPb), (q, \varepsilon)\}$

$\delta(q, \varepsilon, C) = \{(q, cC), (q, \varepsilon)\}$

$\delta(q, \varepsilon, A) = \{(q, aA), (q, \varepsilon)\}$

$\delta(q, a, a) = \{(q, \varepsilon)\}$

$\delta(q, b, b) = \{(q, \varepsilon)\}$

$\delta(q, c, c) = \{(q, \varepsilon)\}$