Intro to Computer Science Theory: Homework 9

Alvin Lin and Joshua Cotton

August 2017 - December 2017

Problem 1

Give CFGs for the following languages.

(a) $\{a^i b^j c^k \mid i = j \text{ or } j = k\}$. $G = (V, \Sigma, R, S)$

- $V = \{S, S_1, S_2, T_1, T_2, U_1, U_2\}$
- $\Sigma = \{a, b, c\}$
- $R = \{$
  - $S \to S_1 \mid S_2$
  - $S_1 \to T_1 U_1$
  - $T_1 \to aT_1 b \mid \epsilon$
  - $U_1 \to cU_1 \mid \epsilon$
  - $S_2 \to T_2 U_2$
  - $T_2 \to uT_2 \mid \epsilon$
  - $U_2 \to bU_2 c \mid \epsilon$

  $\}$

(b) $\{a^i b^{i+j} c^j \mid i \geq 0 \text{ and } j \geq 0\}$. $G = (V, \Sigma, R, S)$

- $V = \{S, T, U\}$
- $\Sigma = \{a, b, c\}$
- $R = \{S \to TU, T \to \epsilon, T \to aTb, U \to \epsilon, U \to bUc\}$

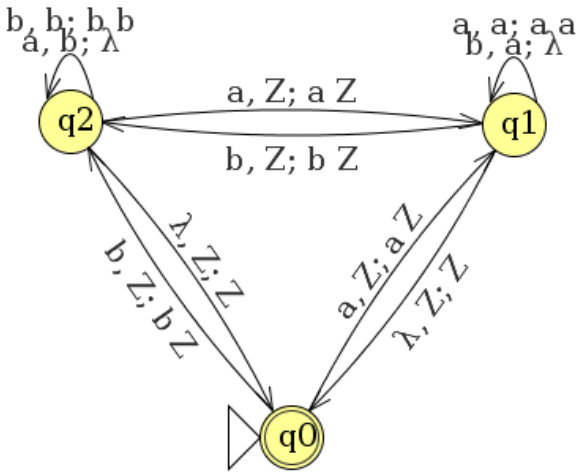
(c) $\{a^{i+j} b^i c^j \mid i \geq 0 \text{ and } j \geq 0\}$. $G = (V, \Sigma, R, S)$

- $V = \{S, T\}$
- $\Sigma = \{a, b, c\}$
- $R = \{S \to aSc, S \to T, T \to aTb, T \to \epsilon\}$

Problem 2

Give state transition diagrams for PDAs for the following languages.

(a) $\{x \in \{a, b\}^* \mid n_a(x) = n_b(x)\}$

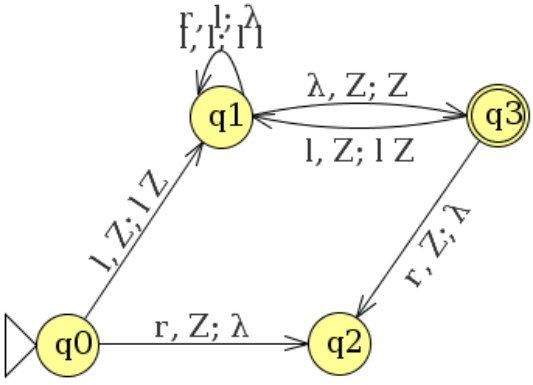


where Z denotes the empty stack character.

(b) $\{x \in \{a, b\}^* \mid n_b(x) \leq n_a(x) \leq 2n_b(x)\}$

?

(c) The set of all balanced parentheses.



where Z denotes the empty stack character.

If you have any questions, comments, or concerns, please contact me at alvin@omgimanerd.tech