CS310 : Automata Theory 2019

IITB, India

Tutorial sheet 6 PDA=CFG, DPDA, and CNF

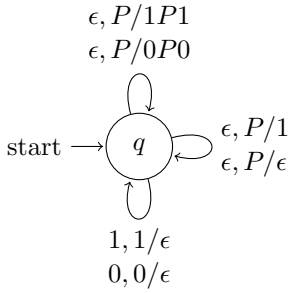
Ashutosh Gupta and S. Akshay

Compile date: 2019-02-21

1. Give a PDA to accept the following languages if possible
   (a) $\{a^i b^j c^k | i = j \text{ or } j = k\}$
   (b) $\{a^i b^j c^k | i \neq j \text{ or } j \neq k\}$
   (c) The set of all strings with twice as many 0's as 1's.
   (d) $\{0,1\}^* - \{ww | w \in \{0,1\}^*\}$
2. Give a construction that converts a PDA P to another PDA P' such that P' has a single state and $L^\epsilon(P) = L^\epsilon(P')$? Compare the sizes of P and P'.
3. Consider the construction from the lecture 17 to obtain an equivalent PDA A from a grammar G. Prove or disprove: if G be an unambiguous grammar, A is a DPDA.
4. Consider the following grammar
   (a) $P \to 0P0$
   (b) $P \to 1P1$
   (c) $P \to \epsilon$
   (d) $P \to 1$

   The following equivalent PDA recognizes the same language by empty stack.

$$A = (\{q\}, \{0,1\}, \{0,1,P\}, \delta, q, P, \{\})$$



   Consider word $w = 1001001$. Give a leftmost derivation for w from G and an accepting run of A. For each step of the derivation, give the segment of the run that simulates the step.

5. Prove or disprove: for any DPDA A, there is a DPDA A' such that $L(A) = L(A')$ and any ϵ-transition in A' is decreasing (i.e. $\delta(q, \epsilon, Z) = \{(q', \epsilon)\}$).

6. Convert the following grammars into Chomsky normal form(CNF)

   (a)

$$S \to ASB \mid \epsilon$$
$$A \to aAS \mid a$$
$$B \to SbS \mid A \mid bb$$

   (b)

$$S \to 0A0 \mid 1B1 \mid BB$$
$$A \to C$$
$$B \to S \mid A$$
$$C \to S \mid \epsilon$$