

MC301 Theory of Computation

Assignment-III

1. Construct pda's that accept the following languages on $\Sigma = \{a, b, c\}$.

(a) $\{w : n_a(w) = 2n_b(w)\}$, n_a, n_b means the number of a's and b's in string w respectively.

(b) $\{wcw^R : w \in \{a, b\}^*\}$, w^R means the reverse of string w.

(c) $\{a^n b^{n+m} c^m : n \geq 0, m \geq 1\}$

2. Write the instantaneous description of a PDA after reading the string abb for the PDA that accepts the language $L = \{a^n b^n \mid n \geq 0\}$.

3. Differentiate between **acceptance by final state** and **acceptance by empty stack**. Prove that both acceptance modes are equivalent.

4. If the initial ID of the pda A is $(q_0, aacaa, Z_0)$. What is the ID after processing of $aacaa$? If the input string is (i) $abcba$, (ii) $abcb$, (iii) $acba$, (iv) $abac$, (v) $abab$, will A process the entire string? If, so what will be the final ID?

$$A = (\{q_0, q_1, q_f\}, \{a, b, c\}, \{a, b, Z_0\}, \delta, q_0, Z_0, F)$$

where δ is defined as:

$$\begin{aligned} \delta(q_0, a, Z_0) &= \{(q_0, aZ_0)\} & \delta(q_0, b, Z_0) &= \{(q_0, bZ_0)\} \\ \delta(q_0, a, a) &= \{(q_0, aa)\} & \delta(q_0, b, b) &= \{(q_0, bb)\} \\ \delta(q_0, a, b) &= \{(q_0, ab)\} & \delta(q_0, b, a) &= \{(q_0, ba)\} \\ \delta(q_0, c, a) &= \{(q_1, a)\} & \delta(q_0, c, b) &= \{(q_1, b)\} \\ \delta(q_0, c, Z_0) &= \{(q_1, Z_0)\} & \delta(q_1, \wedge, Z_0) &= \{(q_f, Z_0)\} \\ \delta(q_1, a, a) &= \delta(q_1, b, b) & &= \{(q_1, \wedge)\} \end{aligned}$$

5. Draw the transition diagram for Turing machine given below, q_5 is the final state:

Present State	Tape Symbol		
	b	0	1
$\rightarrow q_1$	$1Lq_2$	$0Rq_1$	
q_2	bRq_3	$0Lq_2$	$1Lq_2$
q_3		bRq_4	bRq_5
q_4	$0Rq_5$	$0Rq_4$	$1Rq_4$
q_5	$0Lq_2$		

6. Construct a Context-free grammar G accepting $N(M)$ for the pda M given below:

$$A = (\{q_0, q_1, q_f\}, \{a, b\}, \{a, Z_0\}, \delta, q_0, Z_0, q_f)$$

where δ is defined as:

$$\begin{aligned}\delta(q_0, a, Z_0) &= \{(q_0, aZ_0)\} & \delta(q_1, b, a) &= \{(q_1, \wedge)\} \\ \delta(q_0, a, a) &= \{(q_0, aa)\} & \delta(q_1, \wedge, Z_0) &= \{(q_1, \wedge)\} \\ \delta(q_0, b, a) &= \{(q_1, \wedge)\}\end{aligned}$$

7. Construct the computation sequence for strings 1213, 2133, 312 for the Turing machine given below(q_7 is final state):

Present State	Input Tape Symbol			
	1	2	3	b
$\rightarrow q_1$	bRq_2			bRq_1
q_2	$1Rq_2$	bRq_3		bRq_2
q_3		$2Rq_3$	bRq_4	bRq_3
q_4			$3Lq_5$	bLq_7
q_5	$1Lq_6$	$2Lq_5$		bLq_5
q_6	$1Lq_6$			bRq_1
q_7				

8. What is the difference between a halting state and a rejecting state in a Turing Machine?
9. Explain how the stack helps in recognizing languages like $a^n b^n$.
10. Explain the difference between input head movement in PDA and TM.