

## 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  $\delta$  is defined as:

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

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  $\delta$  is defined as:

$$\delta(q_0, a, Z_0) = \{(q_0, aZ_0)\} \quad \delta(q_1, b, a) = \{(q_1, \wedge)\}$$

$$\delta(q_0, a, a) = \{(q_0, aa)\} \quad \delta(q_1, \wedge, Z_0) = \{(q_1, \wedge)\}$$

$$\delta(q_0, b, a) = \{(q_1, \wedge)\}$$

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
$\rightarrow q_1$	$bRq_2$			$bRq_1$
$q_2$	$1Rq_2$	$bRq_3$		$bRq_2$
$q_3$		$2Rq_3$		$bRq_3$
$q_4$			$bRq_4$	$bLq_7$
$q_5$	$1Lq_6$		$3Lq_5$	$bLq_5$
$q_6$	$1Lq_6$			$bRq_1$
$q_7$				

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.