Automata Theory and Formal Languages
Class 9

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Linear Bounded Automaton

A linear bounded automaton in basic model is a Turing machine with the stop property and limited memory (tape

$$M = (Q, \Sigma, \Gamma, \delta, q_0, B, \sharp, \&, F, R)$$

$\sharp, \&$ are left and right guards$\sharp, \& \in \Gamma \wedge \sharp, \& \notin \Sigma$

$\sharp a_1 a_2 \ldots a_n \&$ is the initial tape state

Linear Bounded Automaton

Design Linear Bounded Automaton that accepts language $L = \{a^i b^j c^k : i = j = k\}$ over alphabet $\Sigma = \{a, b, c\}$

Idea

1. #*aaabbbccc*&
2. #*X*aabbbccc&
3. #*X*aa*X*bbccc&
4. #*X*aa*X*bb*X*cc&
5. #*XX*a*X*bb*X*cc&
6. #*XXXXXXXXX*&

Transition function

δ	a	b	c	$\#$	$\&$	X
q_0	(q_1, X, R)	q_R	q_R	$-$	q_A	(q_0, X, R)
q_1	(q_1, a, R)	(q_2, X, R)	q_R	$-$	q_R	(q_1, X, R)
q_2	q_R	(q_2, b, R)	(q_3, X, R)	$-$	q_R	(q_2, X, R)
q_3	q_R	q_R	(q_3, c, R)	$-$	$(q_4, \&, L)$	(q_3, X, R)
q_4	(q_4, a, L)	(q_4, b, L)	(q_4, c, L)	$(q_0, \#, R)$	$-$	(q_4, X, L)

The final model

$$
\begin{aligned}
M = (Q = & \{q_0, \ldots, q_4, q_A, q_R\}, \\
\Sigma = & \{a, b, c\}, \\
\Gamma = & \{a, b, c, X, \#, \&\}, \\
& \delta, \\
& q_0, \\
& B, \\
& \#, \\
& \&, \\
F = & \{q_A\} \\
R = & \{q_R\})
\end{aligned}
$$

Assignments I

1. Design a linear bounded automata to recognise the following languages
   - 1.1 The language L over alphabet $\Sigma = \{0, 1\}$ of words with an equal number of 0's and 1's
   - 1.2 $L = \{a^i b^j c^k : k = \max(i, j)\}$ over alphabet $\Sigma = \{a, b, c\}$
   - 1.3 The language L over alphabet $\Sigma = \{1\}$ of strings with length that is not a prime number