Department of Computer Science and Engineering
Premier University

CSE 309: Theory of Computation

Title: CT 03

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Remarks

Q.1:
Design a Turing machine for the following language:-

$M_1 = \{ww^R \mid w \in \{0,1\}^*\}$

⇒ Here,

$M_1 = \{ww^R \mid w \in \{0,1\}^*\}$

(Set of even-length Palindromes)

Idea:

The Turing machine should check whether the input is a mirror image around the center.

Algorithm / Steps:

(1) Mark the first unmarked symbol on the left (change $0 \to x$, or $1 \to y$)

(2) Move right to the last unmarked symbol.

(3) If the last symbol matches the first (0 with 0 or 1 with 1), mark it ($0 \to x$, $1 \to Y$)

(4) Return to the leftmost unmarked symbol

(5) Repeat until all symbols are marked.

(6) If any dismatch occurs → Reject

(7) If all matches → Accept.

The TM pairs the first and last symbols recursively until the string is exhausted ensuring the input is of the form ww^R.

Q.2: Construct a Turing machine for the language, $L_3 = \{a^n b^n c^n \mid n \geq 1\}$.

=> Here,

$L_3 = \{a^n b^n c^n \mid n \geq 1\}$

Idea:

The TM should verify that the number of a, b and c are equal in order.

Algorithm/Steps:

(1) Scan from left to right:
- Find the first a, mark it as X
- Move right to find the first unmarked b, mark it as Y.
- Move right to find the first unmarked c, mark it as Z.

(2) Return to the leftmost X and repeat

(3) If all a, b, c are marked at the same rate → Accept.

(4) If any order violation or leftover symbols → Reject.

This Turing Machine matches a with one b and one c in each cycle. If, successful for all symbols, it ensures the input follows $a^n b^n c^n$.