Nirma University

2CS601 Theory of Computation (CSE)

Tutorial No 10

Turing Machines

Q-1 Solve the following:

1. Design a TM over $\Sigma = \{1\}$ to accept the language $L = \{ 1^m \mid m \text{ is odd}\}$
2. Design a TM over $\Sigma = \{0\}$ to accept the language $L = \{ 0^m \mid m \text{ is even}\}$
3. Design a TM over $\Sigma = \{0\}$ to accept the language $L = \{ 0^m \mid m \text{ is multiple of } 3\}$
4. Design a TM over $\Sigma = \{1\}$ to accept the language $L = \{ 1^m \mid m \text{ is odd}\}$
5. Design a TM to accept the language $\{a,b\}^* \{aba\}\{a,b\}^*$
6. Design a TM to accept the language $L = \{a^n b^n \mid n \geq 1\}$
7. Design a TM to accept the language $L = \{a^n b^n c^n \mid n \geq 1\}$

Q:2 Design a Turing Machine to accept the language of odd length and even length palindrome. Trace the strings: ababa, abbb, abbbba

Q:3 Design a Turing Machine to accept the language of $\{ SS \mid S \in \{a,b\}^*\}$. Trace the string aaabbaaabb

Q:4 Design a Turing Machine for reversing a string.

Q:5 Design a Turing Machine for copying a string.

Q:6 Design a Turing Machine for deleting a symbol.

Q-7 Multiple Choice Questions:

(1) A Turing Machine is more powerful than the PDA because
   a. The head can move in both directions
   b. The current input symbol can be changed
   c. The tape is infinite
   d. All of the above

(2) A PDA can behave like Turing Machine when
   a. It has no stack
   b. It has two or more stacks
   c. It has a stack of infinite size
   d. All of the above

(3) The difference between an LBA and a Turning machine is that
   a. The LBA has limited number of states
   b. The LBA has an additional stack
   c. The length of the tape in the LBA is limited

d. All of the above

(4) A Post Machine has
   a. An auxiliary queue
   b. An auxiliary queue and a stack
   c. Two auxiliary stacks
   d. Two auxiliary queues

(5) A Turing Machine can be simulated by a semi-infinite tape
   a. With two tracks
   b. With one track
   c. With three tracks
   d. Cannot be simulated by a semi-infinite tape

Q-8 (Extra Problems for Practice)

1: Design a Turing Machine M to compute $\sum_{k=1}^{n} \mathrm{k}$ for a given positive integer n.

2: Design a Turing Machine M over {0,1} such that L(M)={$0^{2n}1^{n}$|n>=1}

3: Design a Turing Machine M over {0,1,2,3} such that L(M)={$0^{2n}1^{n}2^{n}3^{2n}$|n>=1}

4: Design a Two track Turing Machine M to compute $\sum_{k=1}^{n} \mathrm{k}$ for a given positive integer n.

5: Design a Turing Machine M to find the successor of a positive integer.