International Institute of Information Technology, Bangalore

Theory of Computation

Sample Questions: Turing Machines

1. Give a Turing machine to check if number is a power of 2. That is, give a Turing machine to accept the language $\{a^{2^n} \mid n \geq 0\}$.

2. Give a Turing machine to accept the language $\{0^n 1^n 0^n \mid n \geq 1\}$.

3. Give a Turing machine to accept the language $\{ww \mid w \in \{a, b\}^*\}$.

4. Show that the class of recursively enumerable languages is closed under the operations of union and intersection.

5. Describe the function from $\{a, b\}^*$ to $\{a, b\}^*$ defined by the Turing machine M below. M has as its set of states $\{s, p, q, u, t\}$, input alphabet $\{a, b\}$, left-end marker $\vdash$, and blank symbol $\flat$. s is the start state and t is the accept state. The transition relation is given as follows:

$$
\begin{aligned}
(s, \vdash) &\rightarrow (s, \vdash, R) \\
(s, b) &\rightarrow (s, b, R) \\
(s, \flat) &\rightarrow (u, a, L) \\
(u, b) &\rightarrow (u, a, L) \\
(u, \vdash) &\rightarrow (t, \vdash, R) \\
(s, a) &\rightarrow (p, a, R) \\
(p, a) &\rightarrow (p, a, R) \\
(p, b) &\rightarrow (p, b, R) \\
(p, \flat) &\rightarrow (q, \flat, L) \\
(q, b) &\rightarrow (q, a, L)
\end{aligned}
$$