Finite Automata Theory and Formal Languages
TMV027/DIT321 – LP4 2014

Turing Machines

Week 8

1. Given the alphabet $\Sigma = \{I\}$, the Natural number n can be represented in a tape as n consecutive occurrences of I.

   Give both a high-level description and a transition diagram of a Turing machine computing the following operations on Natural numbers:

   (a) Successor and predecessor;

   (b) Addition and subtraction;

   (c) Multiplication.

   Consider the input numbers on the tape separated by a blank symbol ($\square$).

2. For each of the below languages L_i, give both a high-level description and a transition diagram of a Turing machine for L_i.

   In each case, state whether your Turing machine is also a Turing decider or not.

   (a) $L_1 = \{\sharp w_1 \sharp w_2 \mid w_1, w_2 \in \{0,1\}^* \text{ and } w_1 \neq w_2\}$;

   (b) $L_2 = \{\sharp w_1 \sharp w_2 \mid w_1, w_2 \in \{0,1\}^* \text{ and } \text{length}(w_1) < \text{length}(w_2)\}$;

   (c) $L_3 = \{\sharp w_1 \sharp w_2 \mid w_1, w_2 \in \{0,1\}^* \text{ and } \text{length}(w_1) = \text{length}(w_2)\}$;

   (d) $L_4 = \{0^n 1^n 2^n \mid n \geqslant 0\}$;

   (e) $L_5 = \{0^i 1^j 2^k \mid k = i * j\}$;

   (f) $L_6 = \{0^i 1^j \mid j = i^2\}$.