Theory of Computing
Turing Machine - 2

TD 10 with PCs

2ND YEAR - ENSIA

PRE-TUTORIAL EXERCISES

An input string on a memory tape needs to be shifted one cell to the left.

- Write the algorithm
- Create the turing machine using JFLAP

EXERCISES

Exercise C1 (Creating TM)

Construct a Turing machine that doubles each character in its input string. For example, if the input is 0100, then the machine should change its tape so it contains 00110000. Show all the states and transitions.

Exercise C2 (Creating TM):

Write the algorithm and design the draw machine using JFLAP for the following problems.

1. Increment a binary number by 1
2. Decrement a binary number by 1

Simulate your turing machines on the following input:

1. 001
2. 101
3. 1
4. 0
5. Empty String

Exercise C3 (Creating TM):

Write the algorithm and design the draw machine using JFLAP for the following problem.

- Count the number of symbols in an input string and write the result as a binary number at the tape. After execution, the tape should contain only the result.

Example

01000 →
101

Exercise P1 (Optional)

Construct the turing machine which decrements binary numbers by 1 provided that we consider negative numbers . Negative binary numbers are denoted by the minus sign. (Ex. -1 , -10 ..)

Exercise P2 (Optional)

Draw a TM that takes as input a string of 0's and 1's, interprets it as the binary representation of a nonnegative integer, and leaves as output the unary representation of that integer (i.e., a string of that many 1's).. Assume 0 → 1, 1 → 11, 2→ 111, 3→1111…

Exercise P3 (Optional)

Give the state diagram of a TM M that does the following on input #w where w ∈ {0, 1} . Let |w|=n, If n is even, then M converts #w to #0 (# means the number of) . If n is odd, then M converts #w to #1. Assume that the empty string is an even length string.

Exercise P4 (Optional)

Construct the turing machine which deletes the first three zeros while shifting to the left:
Example : 10100100011 → 11100011

Exercise P5 (Optional)

For the language where the number of 0 is a multiple of the number of 1, Construct the turing machine which accepts this language.

Exercise P6 (Optional)

Construct the machine which multiplies two binary numbers given in the form:
11x1101

Write the the results either after the input string preceded by = or just erase the tape and write the result

Exercise P7 (Optional)

For each case below, draw a TM that computes the indicated function. In the first five parts, the function is from N to N . In each of these parts, assume that the TM uses the binary notation.

1. f (x) = x + 2
2. f (x) = 2x
3. f (x) = x^2

Exercise P8 (Optional)

Construct the machine which computes the modulus of two binary numbers given in the format for instance:
1101%10

Exercise P9 (Optional)

Construct the two machines for the following :

1. Convert a binary number to decimal
2. Convert a decimal number to binary number

Exercise P10 (Challenge)

Write a Turing machine using JFLAP to sort two binary numbers of different length. The input string is given as a#b. If both a<b the input string would be kept intact, if a>b, the turing machine would change the input string to b#a

You need to submit the JFLAP file for a solution that has been tested. Please don’t submit non-working solutions.

Examples:

111#1 →
1#111

101#1111 →
101#1111

Exercise P11 (Optional, difficult)

For solving the problem of detecting a connected or disconnected graph, write the algorithm and design the full turing machine for this problem.