Master of Engineering(CSE)
Ist Semester 2012-13

Theory of Formal Languages
Assignment # 2

1. Construct a Turing machine to recognize the language $L = \{a^n b^n c^n | n \geq 0\}$.

2. Let M be the Turing machine defined by following table:

δ	B	a	b	c
q_0	q_1, B, R			
q_1	q_2, B, L	q_1, a, R	q_1, c, R	q_1, c, R
q_2		q_2, c, L		q_2, B, L

   (a) Trace the computation for input *aabca*

   (b) Trace the computation for the input *abcacbab*

   (c) Draw the state diagram of M.

   (d) Comment on the language of M.

3. Let L be the set of Palindromes over $\{a, b\}$.

   (a) Build a standard Turing Machine that accepts L.

   (b) Build a two-tape machine that accepts L in which the computation with input w should take no more than $3|w| + 4$ transitions.

4. What is Universal Turing Machine? Describe the construction of Universal Turing Machine, which can be simulated by a 3-tape Turing machine.

5. Explain the simulation of non-deterministic TM using a 3-tape Turing Machine.

6. Construct a TM to concatenate two strings. Initial configuration: Bq_0uBvB, final configuration: Bq_fuvB, where $u, v \in \{a, b\}^*$, and B stands for blank-space character.

7. Construct Turing machines that compute the following number-theoretic functions and relations. Do not use the macros in the design of these machines.

   (a) $f(n) = 2n + 3$

   (b) $half(n) = \lfloor n/2 \rfloor$, where $\lfloor x \rfloor$ is the greatest integer less or equal to x.

   (c) $eq(n, m) = \begin{cases} 1 & \text{if } n \text{ is even} \\ 0 & \text{otherwise} \end{cases}$

8. Construct the Turing machines that perform the actions specified by the following macros. The computation should not leave the segment of the tape specified in the input configuration.

(a) ZR: input $\underline{B}BB$, output $\underline{B}\overline{0}B$

(b) INT : input $\underline{B}\bar{n}B\bar{m}B$, output $\underline{B}\bar{m}B\bar{n}B$

9. Use the macros and machines to design the machines that compute the following functions:

   (a) $f(n) = 2n+3$

   (b) $f(n_1, n_2, n_3) = n_2 + 2n_3$

10. What do you understand by decidability in computing? Explain.

11. Show that $A_{DFA}, A_{REX}, A_{EQDFA}$, i.e., acceptability of a string w by a DFA, acceptability of a string w for a regular expression, and equality of two DFAs are decidable languages.

12. Explain Undecidability and Halting problem of Turing machine.

Submission Deadline: Jan. 07, 2013
Format: Loose sheets of A4 size stapled together.