Formal Language and Automata Theory (CS21004)

Tutorial - IX

Class: CSE 2^{nd} Year *Date*: 22^{nd} March, 2010

Exercise 1. Consider the following CFG in CNF and show using the CYK table construction that the string '$aaaaa$' is in the language of the grammar $L(G)$.

$$S \rightarrow AB \mid BC$$
$$A \rightarrow BA \mid a$$
$$B \rightarrow DD \mid b$$
$$D \rightarrow AB \mid a$$

where S is the start symbol, $\{S, A, B, D\}$ are the non terminals and $\{a, b\}$ are the terminals.

Exercise 2. A language L is *prefix-closed* if for every $x \in L$, every prefix of x is also is in L. Let L be an *infinite, prefix-closed, context-free language.* Show that L has an *infinite regular subset*.

Exercise 3. Design a DTM that accepts the language $L_1 = \{a^i b^j c^k : i, j, k \geqslant 1, i + j = k\}$.

Exercise 4. Design a DTM that converts a string a^n to the binary representation of n. In fact it transforms an input $\overbrace{aaa\ldots aa}^{n}$ to binary representation of n.

Exercise 5. What will be the running time complexity of a singly-infinite tape DTM that recognises the language $L = \{x \in \{a, b\}^\star : x = x^R\}$? Can you think of a Turing machine model where it can be better?

Exercise 6. Convert the machine of *exercise 3* so that either it will accept a string or it will loop-forever. The language is $L_1 = \{a^i b^j c^k : i, j, k \geqslant 1, i + j = k\}$.