CS 202: Automata Theory and Formal Languages

Assignment 2

February 20, 2015

1. Design a context free grammar for L where L={w: w contains equal number of a's and b's} and also show a derivation tree for the string abab (assume $\Sigma = \{a, b\}$)

2. Determine whether the following language is regular or non regular. If it is regular construct a DFA for it and if it is non regular use pumping lemma to prove it. L = { $w \in \Sigma \mid n_a(w) \bmod 3 = 1$ }, with $\Sigma = \{$a, b$\}$ and $n_a(w)$ is the number of a's in string w.

3. Can the pumping length (value of i in $xy^i z$) be 1 to show that the language is not regular ? why or why not

4. What languages does the following set of productions generate
   a)$S-> aSbS|bSaS|\lambda$
   b) $S-> aS|Sb|a|b$

5. Show that following language is not regular using pumping lemma L=$\{a^n b^m c^t$ where $n \neq m$ or $m \neq t\}$

6. Design a DFA for all strings over the alphabet $\Sigma = \{0, 1\}$ where leftmost and rightmost symbols of strings are different.

7. Design a non-deterministic pushdown automata (npda) for the language L=$\{a^n b^m \mid n \leq m \leq 3n\}$

8. Consider the derivation tree shown in Figure 1. construct the context free grammar corresponding to this (assume all possible productions appear in this derivation tree) and derive 4 more sentences in the language and give a verbal description of the language it represents.

9. Design a context free grammar to generate parentheses which are balanced. For example ((())) and (())()((())) are balanced and ((()), (((()() are imbalanced. Also design an npda for the same language.

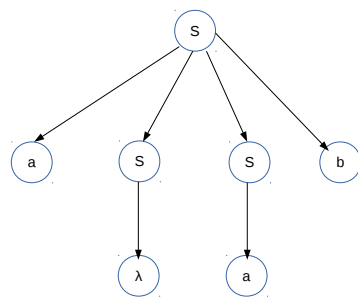10. Let $\Sigma = \{0, 1, +, =\}$ and define a language ADD = {x=y+z | x,y,z are binary strings over $\Sigma = \{0, 1\}$ }. Show that this language is not regular using pumping lemma.

Figure 1: Derivation Tree