6. Exercises Formal Grammars, Languages and Machines, Week 6, June 7, 2012

Let $\Sigma = \{a, b, c\}$. By 'pumping lemma' we intend that statement for *regular languages*.

6.1.   (i)   Consider $L_1 = \{abc\}$ and $L_2 = L(M)$ with M a PFA given by

δ	a	b	c
0	1		
1		2	
2			0

Let

$$
\begin{aligned}
L_3 &= \{a^n b^{n+1} \mid n > 0\} \\
L_4 &= \{a^n b^{n+1} c^{n+2} \mid n \geq 0\}
\end{aligned}
$$

Describe these languages (by giving examples and non-examples of words in them and possibly a formula description).

(ii)   Give regular grammars for L_1, L_2.

(iii) Give a context-free grammar for L_3.

(iv) What does it mean for these languages to satisfy the pumping lemma?

(v)   Determine which of these languages satisfy the pumping lemma.

6.2.   Consider the context-free grammars

$$
G_1 \quad
\begin{array}{lcl}
S & \to & \texttt{aABb} \\
A & \to & \texttt{aA} \mid \texttt{a} \\
B & \to & \texttt{bB} \mid \texttt{b}
\end{array}
\qquad
G_2 \quad
\begin{array}{lcl}
S & \to & \texttt{AABB} \\
A & \to & \texttt{AA} \mid \texttt{a} \\
B & \to & \texttt{BB} \mid \texttt{b}
\end{array}
$$

(i)   Describe $L_1 = L(G_1)$ and $L_2 = L(G_2)$.

(ii)   Show $L_1 = L_2$.