

6. Exercises Formal Grammars, Languages and Machines, Week 6, June 7, 2013

Exercise 6.2 can be made and handed in.

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

δ	a	b	c
q_0	q_0, q_1		
q_1		q_1, q_2	
q_2			q_0, q_2

in M we have $F = \{q_0\}$.

Let

$$L_3 = \{a^n b^{n+2} \mid n \geq 0\}$$

$$L_4 = \{a^n b^n a^m b^m \mid n > 0, m > 0\}$$

- (i) Describe the language L_2 using a regular expression.
- (ii) Give regular grammars for L_1, L_2 .
- (iii) Give a context-free grammar for L_3 .
- (iv) Give a context-free grammar for L_4 .

6.2. Consider the regular grammars

$$G_1 \quad \begin{array}{l} S \rightarrow abA \mid baB \\ A \rightarrow aaA \mid aS \\ B \rightarrow bbB \mid bS \mid \lambda \end{array}$$

$$G_2 \quad \begin{array}{l} S \rightarrow aA \mid bS \mid \lambda \\ A \rightarrow bA \mid aB \\ B \rightarrow bB \mid aS \end{array}$$

- (i) Give a NFA_λ that accepts $L_1 = L(G_1)$.
 - (ii) Generate 4 different words using G_2 .
 - (iii) Give a regular expression e such that $L(e) = L(G_2)$.
- 6.3. (This is a challenge!) Give a context-sensitive grammar that generates

$$\{a^n b^n c^n \mid n \geq 1\}$$

This language is not context free.