

5. Exercises Formal Grammars, Languages and Machines, Week 5, May 31, 2012

- 5.1. (i) Show and explain that the language $\{w \in \{a, b\}^* \mid abba \text{ is a subword of } w\}$ satisfies the pumping lemma for regular languages.
(ii) Show and explain that the language $\{w \in \{a, b\}^* \mid abba \text{ is a not subword of } w\}$ satisfies the pumping lemma for regular languages.
- 5.2. Show that the language $\{w \in \{a, b\}^* \mid W \text{ is a palindrome of even length}\}$ does not satisfy the pumping lemma for regular languages.
- 5.3. Show that the language $\{a^n b^{2m} c^{2n+1} \mid n \geq 0\}$ is context-free.
- 5.4. Given is the following grammar G . The alphabet consists of finitely many words over the latin alphabet with upper-case and lower-case letters, occurring below in red. The auxiliary symbols consist of linguistic names in cornered brackets!

S	$=$	$\langle sentence \rangle$	\rightarrow	$\langle noun - phrase \rangle \langle verb - phrase \rangle$.
		$\langle sentence \rangle$	\rightarrow	$\langle noun - phrase \rangle \langle verb - phrase \rangle \langle object - phrase \rangle$.
		$\langle noun - phrase \rangle$	\rightarrow	$\langle name \rangle \mid \langle article \rangle \langle noun \rangle$
		$\langle name \rangle$	\rightarrow	$John \mid Jill$
		$\langle noun \rangle$	\rightarrow	$bicycle \mid mango$
		$\langle article \rangle$	\rightarrow	$a \mid the$
		$\langle verb - phrase \rangle$	\rightarrow	$\langle verb \rangle \mid \langle adverb \rangle \langle verb \rangle$
		$\langle verb \rangle$	\rightarrow	$eats \mid rides$
		$\langle adverb \rangle$	\rightarrow	$slowly \mid frequently$
		$\langle adjective - list \rangle$	\rightarrow	$\langle adjective \rangle \langle adjective - list \rangle \mid \lambda$
		$\langle adjective \rangle$	\rightarrow	$big \mid juicy \mid yellow$
		$\langle object - phrase \rangle$	\rightarrow	$\langle adjective - list \rangle \langle name \rangle$
		$\langle object - phrase \rangle$	\rightarrow	$\langle article \rangle \langle adjective - list \rangle \langle noun \rangle$

- (i) Show that ‘Jill frequently eats a juicy yellow mango’ belongs to $L(G)$
(ii) Show that other English sentences belong to $L(G)$.
(iii) Give an example of an English sentences made from the red words that does not belong to $L(G)$.
(iv) Give an example of an element of $L(G)$ that is not correct English.
- 5.5. Do the exercise on slide 7.
- 5.6. Do the blue exercise on slide 8.