Tik-79.148 **Spring 2001**
Introduction to Theoretical Computer Science
Tutorial 6
Exercises

Ordinary exercises:

1. Let $G = (V, \Sigma, R, S)$ be a context-free grammar where

$$V = \{0, 1, 2, S, A, R\}$$
$$\Sigma = \{0, 1, 2\}$$
$$R = \{S \to AR, A \to 0, A \to 0A, R \to 1R2, R \to e\}$$

   Give a derivation for the string 001122. Give an informal description on what words belong to the language defined by the grammar. Is the language regular?

2. Construct context-free grammars for the following languages:

   a) $\{w \in \{a, b, c\}^* \mid w = w^R\}$

   b) $\{w \in \{a, b\}^* \mid$ there are twice as many as than bs in $w\}$

3. Let $G = (V, \Sigma, R, S)$ be a regular grammar

$$V = \{a, b, A, B, S\}$$
$$\Sigma = \{a, b\}$$
$$R = \{S \to abA, S \to B, S \to baB,$$
$$S \to e, A \to bS, B \to aS, A \to b\}$$

   Construct a non-deterministic finite state automaton M such that $L(M) = L(G)$. Compare how Vertaile tapaa, jolla automaatit käsittelevät sanaa *abbaabb*.

Demonstration exercises

4. Let $\Sigma = \{a, b, (,), \cup, ^*, \emptyset\}$. Construct a context-free grammar that generates all valid regular expressions that can be formed with symbols in Σ^*.

5. Construct context-free grammars for the following languages:

   a) $\{a^m b^n \mid m \geq n\}$

   b) $\{uawb \mid u, w \in \{a, b\}^*, |u| = |w|\}$

6. (*practical*)

   Design and implement a simple parsers that reads consequtive additions and subtractions of natural numbers (for example, 2 + 3 - 8 + 2) and prints out the sum after the user presses enter.