

## Homework 6

Please submit your solutions via email. Please submit only ASCII text or PDFs. Every solution should be preceded by the corresponding question, like:

**Q<sub>n</sub>:**     ...a difficult question from me...  
**A:**        ...an answer from you ...  
**Q<sub>n</sub> + 1**   ...another difficult question...  
**A:**        ...another brilliant answer from you...

**Solutions will only be accepted until 30th December! Please send only one homework per email.**

1. (i) Give the regular expressions for lexing a language consisting of whitespaces, identifiers (some letters followed by digits), numbers, operations =, < and >, and the keywords if, then and else. (ii) Decide whether the following strings can be lexed in this language?

- (a) "if y4 = 3 then 1 else 3"  
(b) "if33 ifif then then23 else else 32"  
(c) "if x4x < 33 then 1 else 3"

In case they can, give the corresponding token sequences. (Hint: Observe the maximal munch rule and priorities of your regular expressions that make the process of lexing unambiguous.)

2. Suppose the grammar

$$\begin{aligned} E &\rightarrow F \mid F \cdot * \cdot F \mid F \cdot \setminus \cdot F \\ F &\rightarrow T \mid T \cdot + \cdot T \mid T \cdot - \cdot T \\ T &\rightarrow \text{num} \mid ( \cdot E \cdot ) \end{aligned}$$

where  $E$ ,  $F$  and  $T$  are non-terminals,  $E$  is the starting symbol of the grammar, and  $\text{num}$  stands for a number token. Give a parse tree for the string  $(3+3)+(2*3)$ .

3. Define what it means for a grammar to be ambiguous. Give an example of an ambiguous grammar.
4. Suppose boolean expressions are built up from

- 1.) tokens for true and false,
- 2.) the infix operations  $\wedge$  and  $\vee$ ,
- 3.) the prefix operation  $\neg$ , and
- 4.) can be enclosed in parentheses.

(i) Give a grammar that can recognise such boolean expressions and (ii) give a sample string involving all rules given in 1.-4. that can be parsed by this grammar.