Homework 7

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

Qn:	**…a difficult question from me…**
A:	**…an answer from you …**
Q$n+1$	**…another difficult question…**
A:	**…another brilliant answer from you…**

Solutions will only be accepted until 30th December!

1. Suppose the context-sensitive grammar

$$\begin{array}{lcl} S & \to & bSAA \mid \epsilon \\ A & \to & a \\ bA & \to & Ab \end{array}$$

   where S is the starting symbol of the grammar. Give a derivation of the string *"aaabaaabb"*. What can you say about the number of as and bs in the strings recognised by this grammar.

2. Consider the following grammar

$$\begin{array}{l} S \to N \cdot P \\ P \to V \cdot N \\ N \to N \cdot N \\ N \to A \cdot N \\ N \to \texttt{student} \mid \texttt{trainer} \mid \texttt{team} \mid \texttt{trains} \\ V \to \texttt{trains} \mid \texttt{team} \\ A \to \texttt{The} \mid \texttt{the} \end{array}$$

   where S is the start symbol and S, P, N, V and A are non-terminals. Using the CYK-algorithm, check whether or not the following string can be parsed by the grammar:

```
The trainer trains the student team
```

3. Transform the grammar

$$\begin{array}{lcl} A & \to & 0A1 \mid BB \\ B & \to & \epsilon \mid 2B \end{array}$$

   into Chomsky normal form.

4. Consider the following grammar G

$$
\begin{aligned}
S &\to \texttt{if0} \cdot E \cdot \texttt{then} \cdot S \\
S &\to \texttt{print} \cdot S \\
S &\to \texttt{begin} \cdot B \cdot \texttt{end} \\
B &\to S \cdot \texttt{;} \\
B &\to S \cdot \texttt{;} \cdot B \\
E &\to num
\end{aligned}
$$

where S is the start symbol and S, E and B are non-terminals.

Check each rule below and decide whether, when added to G, the combined grammar is ambiguous. If yes, give a string that has more than one parse tree.

(i) $S \to \texttt{if0} \cdot E \cdot \texttt{then} \cdot S \cdot \texttt{else} \cdot S$

(ii) $B \to B \cdot B$

(iii) $E \to (\cdot E \cdot)$

(iv) $E \to E \cdot + \cdot E$