

HOMWORK 1

All submissions must be PDF and should be typed. Exception can only be made for drawing parse trees, which can be handwritten and scanned in the submitted document.

Note. Some of these problems are taken from the Dragon book.

Problem 1. Consider the following regular expressions (we omit the dot operator)

$$\begin{aligned}R_0 &= 1|2|3|4|5|6|7|8|9 \\R_1 &= 0|1|2|3|4|5|6|7|8|9 \\R_2 &= (0|1)^* R_0 (0|1) \\R_3 &= 00 R_0^* (0|1)^* \\R_4 &= R_3^* R_2^* 000\end{aligned}$$

Assume that the longest prefix-matching rule is used. Assume that ties are broken in favor of the regular expression listed first in the list.

1. Give an example of input for which getToken() returns R_0
2. Give an example of input for which getToken() returns R_1
3. Give an example of input for which getToken() returns R_2
4. Give an example of input for which getToken() returns R_3
5. Give an example of input for which getToken() returns R_4
6. If getToken() is called repeatedly on the following input, what is the sequence of tokens returned?

99001101678100010101030123457000010

Explain your answers.

Problem 2. Consider the grammar

$$S \rightarrow AB$$

$$A \rightarrow BaA \mid bB$$

$$B \rightarrow aSB \mid AS \mid \epsilon$$

1. Show that this grammar is ambiguous by constructing two different leftmost derivations for the sentence abab
2. Show that this grammar is ambiguous by constructing two different parse trees for the string abab

Problem 3. Compute FIRST sets for the following grammar.

$$S \rightarrow aAB \mid CD$$

$$A \rightarrow CD \mid SE \mid \epsilon$$

$$B \rightarrow aSB \mid AS$$

$$C \rightarrow cC \mid \epsilon$$

$$D \rightarrow CDd \mid \epsilon$$

$$E \rightarrow eFg$$

$$F \rightarrow Fg \mid \epsilon$$

Show your work. An answer by itself does not count.