

Homework 4

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

Qⁿ: ...a difficult question from me...
A: ...an answer from you ...
Qⁿ⁺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. If a regular expression r does not contain any occurrence of \emptyset , is it possible for $L(r)$ to be empty?
2. Define the tokens and regular expressions for a language consisting of numbers, left-parenthesis (, right-parenthesis), identifiers and the operations +, - and *. Can the following strings in this language be lexed?
 - $(a + 3) * b$
 - $)() + + - 33$
 - $(a/3) * 3$

In case they can, can you give the corresponding token sequences.

3. Assume that s^{-1} stands for the operation of reversing a string s . Given the following *reversing* function on regular expressions

$$\begin{aligned} rev(\mathbf{0}) &\stackrel{\text{def}}{=} \mathbf{0} \\ rev(\mathbf{1}) &\stackrel{\text{def}}{=} \mathbf{1} \\ rev(c) &\stackrel{\text{def}}{=} c \\ rev(r_1 + r_2) &\stackrel{\text{def}}{=} rev(r_1) + rev(r_2) \\ rev(r_1 \cdot r_2) &\stackrel{\text{def}}{=} rev(r_2) \cdot rev(r_1) \\ rev(r^*) &\stackrel{\text{def}}{=} rev(r)^* \end{aligned}$$

and the set

$$Rev A \stackrel{\text{def}}{=} \{s^{-1} \mid s \in A\}$$

prove whether

$$L(rev(r)) = Rev(L(r))$$

holds.

4. Assume the delimiters for comments are `/*` and `*/`. Give a regular expression that can recognise comments of the form

$$/* \dots */$$

where the three dots stand for arbitrary characters, but not comment delimiters. (Hint: You can assume you are already given a regular expression written `ALL`, that can recognise any character, and a regular expression `NOT` that recognises the complement of a regular expression.)

5. Simplify the regular expression

$$(\mathbf{0} \cdot (b \cdot c)) + ((\mathbf{0} \cdot c) + \mathbf{1})$$

Does simplification always preserve the meaning of a regular expression?

6. The Sulzmann & Lu algorithm contains the function `mkeys` which answers how a regular expression can match the empty string. What is the answer of `mkeys` for the regular expressions:

$$\begin{aligned} &(\mathbf{0} \cdot (b \cdot c)) + ((\mathbf{0} \cdot c) + \mathbf{1}) \\ &(a + \mathbf{1}) \cdot (\mathbf{1} + \mathbf{1}) \end{aligned}$$

7. What is the purpose of the record regular expression in the Sulzmann & Lu algorithm?