Homework 1

1. **(Optional)** If you want to run the code presented in the lectures, install the Scala programming language available (for free) from

   <http://www.scala-lang.org>

   If you want to follow the code I present during the lectures, read the handout about Scala.

2. **(Optional)** Have a look at the crawler programs. Can you find a usage for them in your daily programming life? Can you improve them? (For example in cases there are links that appear on different recursion levels, the crawlers visit such web-pages several times. Can this be avoided?)

3. Read the handout of the first lecture and the handout about notation. Make sure you understand the concepts of strings and languages.

4. In the context of the AFL-course, what is meant by the term *language*?

5. Give the definition for regular expressions. What is the meaning of a regular expression?

6. Assume the concatenation operation of two strings is written as $s_1@s_2$. Define the operation of *concatenating*, written $\_ @ \_$ two sets of strings.

7. Assume a set A contains 4 strings and a set B 7 strings, how many strings are in $A@B$?

8. How is the power of a language defined? (Hint: There are two rules, one for $\_^0$ and one for $\_^{n+1}$.)

9. How many regular expressions are there to match the string abc? How many if they cannot include ϵ and $\varnothing$? How many if they are also not allowed to contain stars? How many if they are also not allowed to contain $\_ + \_$?

10. When are two regular expressions equivalent? Can you think of instances where two regular expressions match the same strings, but it is not so obvious that they do? For example $a + b$ and $b + a$ do not count…they obviously match the same strings, namely $[a]$ and $[b]$.