# Lesson 1

Compiler Design I (Kompilatorteknik I) 2016

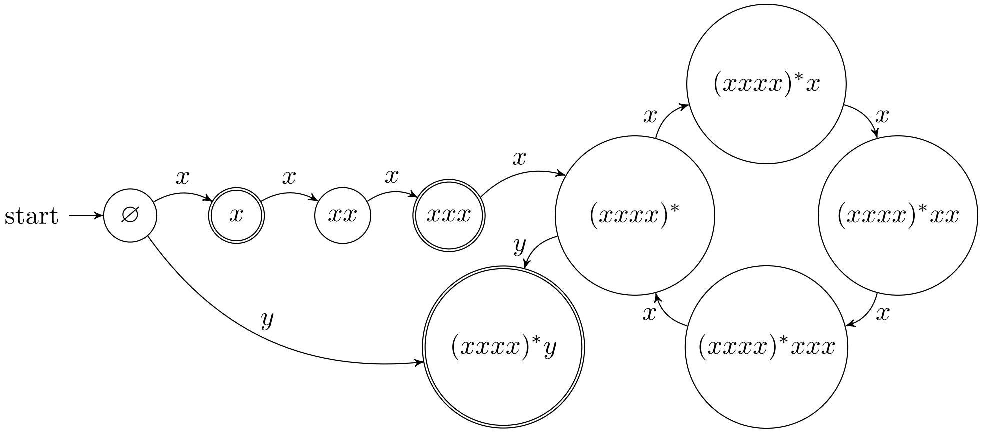
## 1 Lexical Analysis

Let $L$ be a language of strings on $\Sigma = \{x, y\}$ defined by $L = \{x, xxx, (xxxx)*y\}$, that is $\{x, xxx\} \bigcup \{x^{4n}y|n \geq 0\}$.

1. Construct a DFA that accepts L. *(Hint: Begin with an NFA and then convert it)*

   **Answer:**

   The states have been labeled either with the token that would be emitted (accepting) or with a symbolic name corresponding to the input that has been read so far (non-accepting). The error state has been omitted.

2. Describe how the lexical analyzer will tokenize the following inputs:

   - xx

     **Answer:**

     Reading two '$x$'s, the lexical analyzer reaches state "$xx$". The input ends in a non-accepting state, so the analyzer backtracks to the most recent accepting state ("$x$") and outputs the corresponding token, consuming just one of the two '$x$'s. Starting from scratch and reading the remaining '$x$' again, the analyzer reaches the "$x$" state again, and the input ends there so it emits a second "$x$" token.

   - xxxxxxxxy

     **Answer:**

     With the given input, the DFA reaches the "$(xxxx)^*y$" state. The input ends there, so the analyzer emits just one token of type "$(xxxx)^*y$".

- `xxxxxxxxxxxxxy` *(13 x characters)*

  **Answer:**

  The given input drives the DFA to the "$(xxxx)^*x$" state before the '$y$' is read, leading to the null state. The analyzer backtracks, therefore, and emits the most recent acceptable token: "$xxx$", leaving the rest 10 '$x$'s to be scanned again. Starting from scratch, the state "$(xxxx)^*xx$" is reached before '$y$' is read, so the analyzer backtracks again, emitting a second "$xxx$" token and leaving 7 '$x$'s to be re-scanned. A third pass will reach state "$(xxxx)^*xxx$" before '$y$' again leads to an error, so a third "$xxx$" token is emitted after backtracking, with 4 '$x$'s remaining. Finally the rest input leads to the accepting state "$(xxxx)^*y$", which is the last token that the analyzer will emit.