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**Functional Programming – WT 2023 / 2024**
**Reading Guide 8: Macros**

**Timeline:** This unit should be completed by 04.12.2023.

## 1 Material

- 28_macros.clj
- Clojure for the Brave and True, chapter 8
- Clojure Reference: Reader (Macro Characters) `https://clojure.org/reference/reader#macrochars`
- Learning Video: Reader Macros: `https://mediathek.hhu.de/watch/ca5672bf-bfde-41c7-904a-cae901e9`

## 2 Learning Outcomes

After completing this unit you should be able to

- name the values that are generated by the reader.
- read and use reader-macros correctly.
- write macros by yourself using the templating syntax.
- identify unhygienic macros and rewrite them to be hygienic.

## 3 Highlights

- Reader syntax: `` ` `` (Syntax-Quote), `'` (Quote), `~` (Unquote), `~@` (Unquote-Splicing), # (Gensym)

## 4 Exercises

*Note:* the exercises are the same as last week. Here, use the templating syntax.

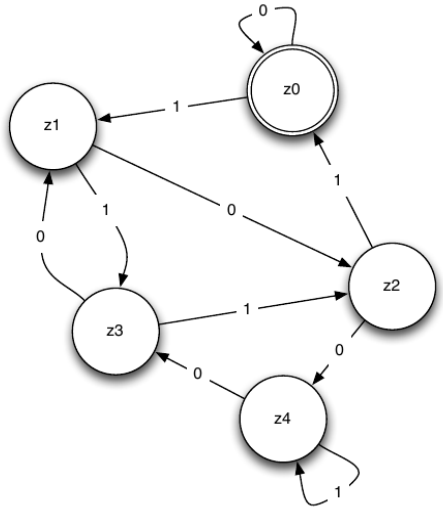
**Exercise 8.1 (Macro)**

a) Write a macro that implements a simple calculator with infix notation. The first argument should be a vector with bindings of symbols to values. Parentheses and operator precedences need not be considered. The macro should work as follows:

```
user=> (calc [a 3] 3 + 5 * a)
24
user=> (calc [b 5 a 3] a * b + 3)
18
```

b) Why can you not write this calculator as a function?

**Exercise 8.2 (DFA)**
Your task is to develop a simple DSL for DFAs. The automaton that recognizes binary numbers divisible by five will serve as example. The states in the automaton are labeled according to the residue class modulo 5, so z0 represents all numbers divisible by 5, z3 all numbers whose remainder is 3, etc.




The DSL should look as follows:

```
(declare z0 z1 z2 z3 z4)
(def z0 (dfa-state :accept {\0 z0 \1 z1}))
(def z1 (dfa-state :reject {\0 z2 \1 z3}))
(def z2 (dfa-state :reject {\0 z4 \1 z0}))
(def z3 (dfa-state :reject {\0 z1 \1 z2}))
(def z4 (dfa-state :reject {\0 z3 \1 z4}))
```

`(dfa-state ... )` should return a function, which receives a string, consisting of 0s and 1s, as parameter and returns :accept, if the string starting from this node results in an accepting state. Otherwise :reject should be returned.

`(dfa-match init text)` should serve as entry point, which, starting from init, processes the input text.

```
user=> (dfa-match z0 "")
:accept
user=> (dfa-match z0 "010100010")
:reject
user=> (dfa-match z0 "0101000101")
:accept
```

Test your implementation with larger inputs (i.e. longer strings).

Note: It is likely that your first implementation will not work. Do not let yourself be discouraged by this and try to locate the problem, in order to fix it afterwards.

## Questions

If you have any questions, please contact Philipp Körner (`p.koerner@hhu.de`) or post it to the Rocket.Chat group.