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**Functional Programming – WT 2023 / 2024**
**Reading Guide 5: Recursion, Destructuring & More**

**Timeline:** This unit should be completed by 13.11.2023.

## 1 Material

- 05_recursion.clj
- 04_destructuring.clj
- 07_java_interop.clj
- 08_namespaces.clj
- 09_evaluation_order.clj
- Learning Video: Destructuring: `https://mediathek.hhu.de/watch/b65ae856-dcd4-4eb7-82d7-62d0d727a`
- Learning Video: Recursion: `https://mediathek.hhu.de/watch/fe5c892a-b6e0-4811-aead-2821d5fa714e`

**Note:** This unit groups several REPL sessions. The focus lies on understanding explicit recursion and destructuring. While the code volume is larger than usual, the REPL sessions do not introduce complex concepts and require less cognitive load. In particular, we do not expect you to be able to write programs interacting heavily with Java or to name all internal mappings of a namespace. Nonetheless, you should be aware of the basic mechanisms and might be required to work with them later on.

Please check the intended learning outcomes carefully before you take a deep dive into weird rabbit holes, but — of course! — feel free to ask questions.

## 2 Learning Outcomes

After completing this unit you should be able to

- write recursive programs yourself.
- read destructurings of data structures and specify the binding of symbols.
- be able to read Host interop forms.
- roughly sketch how namespaces work.
- know in which order symbols are evaluted.

## 3 Highlights

- Destructuring
- Special Forms: `loop`, `recur`
- Functions: `trampoline`

## 4 Exercises

**Exercise 5.1 (4clojure Exercise Unlocks)**
After completing this unit, you gained the knowledge to solve all exercises. Enjoy!

Expect exam questions to be about "medium" level. It is worthwhile to tackle a couple hard problems in order to prepare for the exam.

**Exercise 5.2 (Newton's method)**
Newton's method is an algorithm to approximate a solution $c$ for $f(c) = 0$ for a given function $f$. The algorithm uses the series

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

It terminates if $|x_{n+1} - x_n| < \epsilon$ holds for a given $\epsilon > 0$.

a) Write a function `(defn newton [f f'] ...)` that receives the function and its derivative as a parameter. The call to `newton` should then return a function which in turn receives a starting value $x$ and a precision $eps$ and approximates the solution for $f(x) = 0 \pm eps$ using Newton's method.

b) The square root of a number $K$ is a solution for the equation $c^2 - K = 0$. So we can apply Newton's Method to the function $f(x) = x^2 - K$. Write a function `(defn sqrt [n] ...)` which approximates the square root of $n$ using Newton's method. You can use $10^{-5}$ as both initial value and precision.

*Spoiler alert*: we will return to this exercise in unit 13. That reading guide will contain a solution.

## Questions

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