University of Konstanz
Chair for Software and Systems Engineering
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System Specification Using TLA$^+$
Winter Term 2023/24
Issued: 18.11.2023

Assignment 3

Deadline: Friday **24.11.2023** 23:55

Notes:

- Solve the assignment **on your own** — no groups allowed.
- Hand-written solutions will not be accepted, except for graphs and diagrams.
- If you hand in non-pdf files or multiple files, name your submission as `stla23_03_SURNAME.zip`, replacing `SURNAME` with your surname. Otherwise `stla23_03_SURNAME.pdf`. Also include your full name in the submitted PDF.
- Submit your solution via **Ilias**.

Exercise 3.1 Functions — 12 Points

a) Define an operator *AF* such that, if *r* is a record, then: if *r* has a *"count"* field, then *AF(r)* is *r* with the count field incremented by 1, otherwise *AF(r)* is obtained from *r* by adding a "count" field with value 0. **(3 points)**

b) Define an operator *Reverse*, so if *s* is any sequence, then *Reverse(s)* is sequence *s* in reverse order. (Hint: you don't have to use recursion.) Test it with TLC. (Don't forget to check that it works on the empty sequence, $\langle\rangle$.) **(6 points)**

c) Define a function *Sum* whose domain is *Seq(Nat)* such that *Sum(s)* is the sum of the elements of *s*. (Let $Sum(\langle\rangle)$ equal 0.) **(3 points)**

Exercise 3.2 Debugging — 4 Points

Introduce an error into the write-through cache algorithm by replacing *vmem* by *wmem* in the definition of *MemQRd*, and use TLC to find a trace that demonstrates why it's an error. (Hint: how large does QLen have to be to reveal the error?)

Exercise 3.3 Double FIFO write-through cache — 4 Points

Specify a version of the write-through cache algorithm in which there is a FIFO queue *rdQ* on the data path from the memory to the bus through which values read from memory pass before entering the cache. Use TLC to check your specification.

Total: 20 Points