

Formal Models for Parallel and Distributed Systems

Exercise 1 (November 6)

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The exercise is to be submitted by **November 6** (hard deadline)

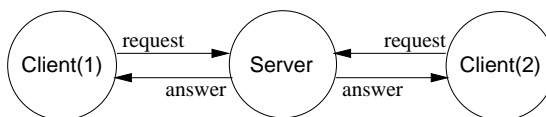
1. as a single PDF file sent to me per email, or
2. as a paper report (cover page with full name and Matrikelnummer, pages stapled) handed out to me in class.

1 A Client/Server System

Write the TLA+ specification of a distributed system of a server and two clients where the server maintains a shared resource which it grants to at most one of the clients at a time as depicted by the following pseudo-code:

```
Server:
  local given, waiting, sender
begin
  given := 0; waiting := 0
  loop
    sender := receiveRequest()
    if sender = given then
      if waiting = 0 then
        given := 0
      else
        given := waiting;
        waiting := 0
        sendAnswer(given)
      endif
    elsif given = 0 then
      given := sender
      sendAnswer(given)
    else
      waiting := sender
    endif
  endloop
end Server

Client(ident):
  param ident
begin
  loop
    ...
    1: sendRequest()
    2: receiveAnswer()
    ... // critical region
    3: sendRequest()
  endloop
end Client
```



The system operates on the variables *given*, *waiting*, *sender* (describing the internal state of the server component), the variables *pc1* and *pc2* (“program counter”, describing the state of the client component) and four channels *request1*, *request2*, *answer1*, and *answer2* holding the requests sent from each client to the server respectively the answers returned from the server.

The system can be modeled by four server actions (corresponding to the combined effect of each conditional branch in above pseudo-code) and, for each client, three client actions (corresponding to the transition from one labeled command to the next ($1 \rightarrow 2$, $2 \rightarrow 3$, $3 \rightarrow 1$)). The “send/receive” calls in above pseudo-code mark the writing to/reading from the respective channels.

You may use the TLA+ specification “Channel” presented in class as a building block for your own specification.

The TLA+ specification can be written informally in “presentation style”.

Optional Bonus (50%, no deadline) Write the specification in the formal TLA+ ASCII syntax and check it with the “SANY Syntax Analyzer” available from the “TLA+ tools” page. This program is written in pure Java, thus all you need is a local installation of the Java runtime environment. Within the RISC environment, the TLA+ tools are installed at `/zvol/formal/tla`.