

# A2 Synchronization — Part 1

RVR and FBS

September 21, 2019

## 1 Mutual Exclusion for Three

Consider the following mutual exclusion protocol for three processes  $P_0$ ,  $P_1$ , and  $P_2$ :

- There is a single integer variable  $turn$  initialized to one of  $\{0, 1, 2\}$ .
- The entry protocol for process  $P_i$  is:

**await**  $turn = i \quad \{A_i\}$   
*execute critical section*

- The exit protocol is:

$turn := turn + 1 \bmod 3$

Answer the following questions:

1. What must be proved about  $A_0$ ,  $A_1$ , and  $A_2$  to demonstrate that mutual exclusion is satisfied?
2. Give a candidate for  $A_i$  that suffices for proving 1.
3. Would these entry/exit protocols be suitable for a solution to the critical section or are there properties not satisfied that ought to be (and what are those properties)?

## 2 The Swap Instruction

Execution of the swap instruction **swap**(L, S) interchanges the values in variable L and variable S, and it executes as a single indivisible action.

1. Give an entry protocol and exit protocol for solving the mutual exclusion problem by using the swap instruction. Your protocols should not use additional interlock instructions or other synchronization mechanisms.
2. Give an invariant for your protocols and show that your invariant suffices to demonstrate mutual exclusion of critical sections.