

# Verification of Cyber-Physical System

## Fall 2017

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### Exercice Sheet 6

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### Exercice 1

**Corrections :** We consider only one particular execution. An execution is strongly fair or weakly fair with respect to some task, if in that execution the task satisfies :

- $\Diamond\Box en \rightarrow \Box\Diamond ex$  weakly fair
- $\Box\Diamond en \rightarrow \Box\Diamond ex$  strongly fair
- Always enabled  $\rightarrow$  task has to be executed  $\infty$  often
- Enabled finitely many times or never  $\rightarrow$  is weakly fair or strongly fair w.r.t. the task
- Enabled alternatively  $\rightarrow$ 
  - weakly fair *true*
  - strongly fair *true* only if the task is executed  $\infty$  many times

Model w.f./s.f. w.r.t. some task  $\leftrightarrow \forall$  execution w.f./s.f. is *true*.

(1)

The task  $A_x$  is always executable, but if  $x$  is even, it may be possible that  $A_x$  would never change again and only  $A_y$  is going to be executed. So  $A_x$  is not strongly fair.

That is an extreme case, if we assume that the extreme case would not appear,  $A_x$  is strongly fair, because it would always be executable and would always be executed in the future.

(2)

The task  $A_y$  would always be executable, but it may be possible that only  $A_x$  is going to be executed so  $A_y$  would never be executed again.

That is an extreme case, if we assume that the extreme case would not appear,  $A_y$  would always be executable and would always be executed in the future.

(3)

The execution is weakly fair with respect to the task  $A_x$ , because  $A_x$  would always be executable, and (by assuming the extreme case won't appear) going to be executed.

(4)

The execution is weakly fair with respect to the task  $A_y$ , because  $A_y$  would always be executable, and (by assuming the extreme case won't appear) going to be executed.

## Exercise 2

(1)

There is no guarantee that the value of  $x$  would eventually exceeds 5 (the system could always execute the task  $Process_2$  and never  $Process_1$ ). In order to guarantee that, we need to add a strong fairness for the task  $Process_1$ . We don't have to add any kind of fairness to the task  $Process_2$  (if we have to, we could add a weak fairness for task  $Process_2$ ).

(2)

There is no guarantee that the value of  $x$  would eventually exceeds 5 (the system could always execute the task  $Process_1$  and never  $Process_2$ ). In order to guarantee that, we need to add a strong fairness for the task  $Process_2$  and a weak fairness to the task  $Process_1$ . So  $Process_1$  would be executed at least one time and then  $y$  would increase in order to exceeds 5.

(3)

There is no guarantee that the values  $x$  and  $y$  would become equal in the execution. In order to guarantee that, we have to add a strong fairness assumption for both task  $Process_1$  and  $Process_2$ . So it would exist an infinite amount of execution in which  $x == y$  would holds at a certain time.