



Tutorial for Cyber-Physical Systems - Discrete Models

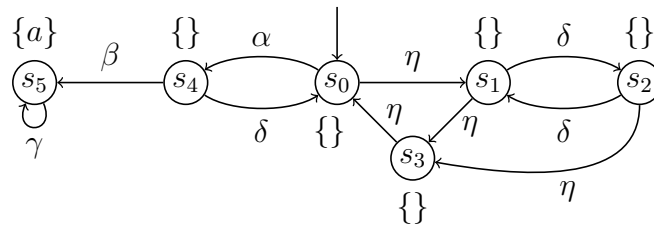
Exercise Sheet 11

Exercise 1: Satisfaction under Fairness Assumptions

12 Points

The goal of this task is to train your ability to identify fair and unfair traces of a given transition system, in order to reason about properties of a system under given fairness assumptions.

Consider the following transition system:



For the fairness assumptions given in (a)–(h), perform the following tasks.

- (i) For each of the fairness assumptions below, give an execution that fulfills the fairness assumption (a fair execution) and an execution that violates the fairness assumption (an unfair execution).
- (ii) A system satisfies a property P under a given fairness assumption, if all fair traces (i.e., traces corresponding to fair executions) satisfy property P . Under which of the following fairness assumptions does the system satisfy the property “eventually a ”? Justify your answer.
 - (a) unconditional fairness for $A = \{\gamma\}$
 - (b) unconditional fairness for $A_1 = \{\alpha\}$ and for $A_2 = \{\gamma\}$
 - (c) unconditional fairness for $A = \{\alpha, \gamma\}$
 - (d) strong fairness for $A = \{\beta\}$
 - (e) strong fairness for $A_1 = \{\alpha\}$ and for $A_2 = \{\beta\}$
 - (f) strong fairness for $A_1 = \{\alpha\}$ and for $A_2 = \{\beta\}$ and for $A_3 = \{\eta\}$
 - (g) weak fairness for $A = \{\eta\}$
 - (h) weak fairness for $A_1 = \{\alpha\}$ and for $A_2 = \{\beta\}$ and for $A_3 = \{\eta\}$

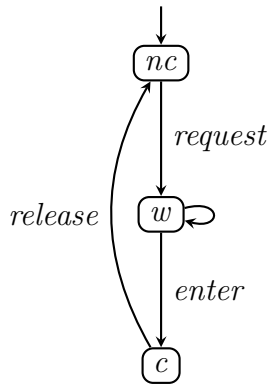
Exercise 2: Fairness Assumptions

6 Points

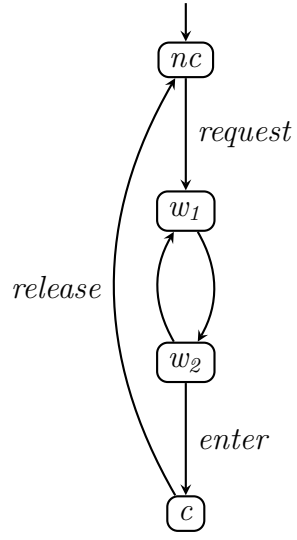
For each of the following three systems (each consisting of one single process) give the weakest fairness assumption on action *enter* to ensure non-starvation.

Give an informal explanation for your answers.

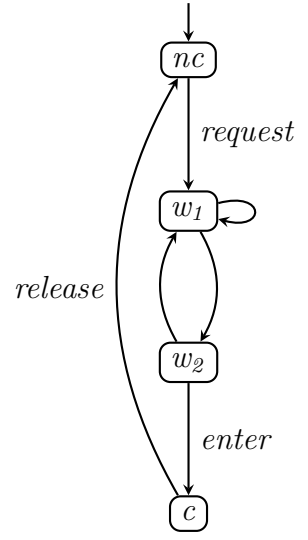
Non-starvation means that a process that is has requested will eventually enter its critical section.



(a)



(b)



(c)