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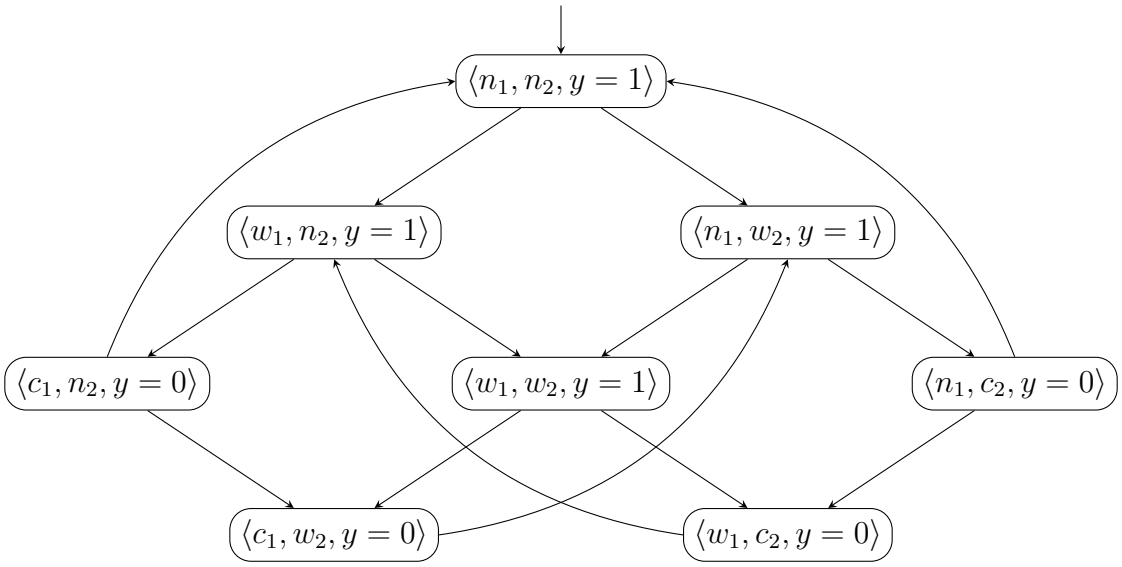
Hand in until February 2nd, 2017
11:59 via the post boxes
Discussion: February 5th, 2017

Tutorial for Cyber-Physical Systems - Discrete Models
Exercise Sheet 13

The goal of this sheet is to see how to use Büchi automata to check whether a transition system satisfies a given ω-regular property, in a way similar to checking regular properties using finite automata. This exercise concludes the model-checking part of this course.

Exercise 1: Checking ω-regular properties
Consider the transition system TS_{Sem} for mutual exclusion with a semaphore below.



Let P_{live} be the following ω-regular property over $AP = \{w_1, c_1\}$:

> "Whenever process 1 is in its waiting location (w_1), it will eventually enter its critical section (c_1)."

Note that the labeling function is given implicitly by the state names, e.g., w_1 holds in all states whose name contains this string.

(a) Depict an NBA $\mathcal{A}$ for P_{live} and an NBA $\overline{\mathcal{A}}$ for the complement property $\overline{P}_{live} = \left(2^{AP}\right)^{\omega} \setminus P_{live}$.

(b) Check if $TS_{Sem} \not\models P_{live}$ holds by performing the following steps described in Section 4.4 in the book.

(i) Construct the reachable fragment of the product $TS_{Sem} \otimes \overline{\mathcal{A}}$.

(ii) Check if this product transition system satisfies the persistence property "eventually forever $\neg F$". (Remember that F is the set of accepting states of $\overline{\mathcal{A}}$.)

In case the product satisfies the property, argue why this is the case. Otherwise, give a path in the product that shows the violation of the persistence property and give the corresponding path in TS_{Sem} that shows the violation of P_{live}.