Master of Science in Computer Science - University of Camerino
Reactive Systems Verification A. Y. 2017/2018
Written Test of 11th July 2018 (Appello IV)
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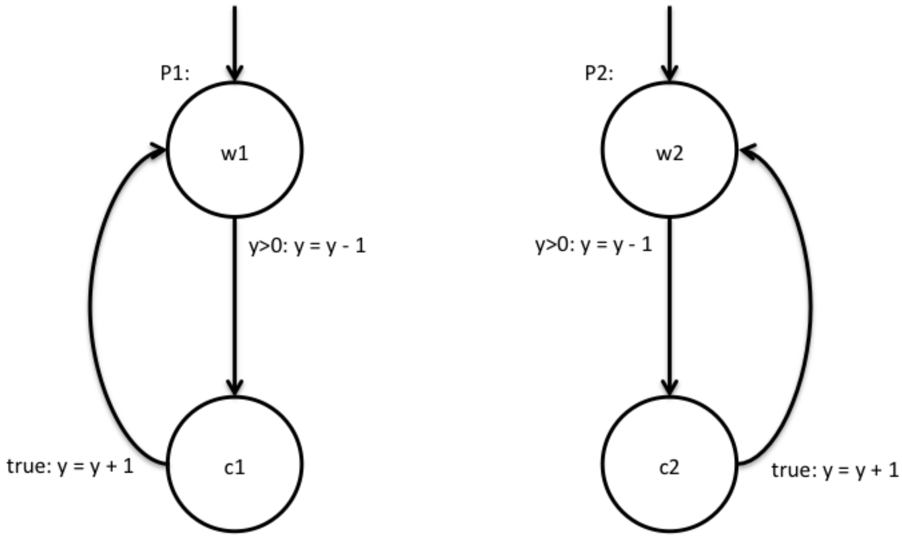
EXERCISE 1 (8 points)

Consider the following program graphs:



1. Draw the transition system corresponding to $P_1|||P_2$ when the shared variable y is initialised to 1.
2. Draw and discuss the transition systems corresponding to $P_1|||P_2$ when the shared variable y is initialised to $n > 1$.
3. Consider $AP = \{w_1, c_1, w_2, c_2\}$ and discuss the reachability of a state satisfying $c_1 \wedge c_2$ in all the cases above.

EXERCISE 2 (10 points)

Consider the alphabet $AP = \{A, B, C\}$ and the following linear time properties:

(a) The sequence "A immediately followed by B, immediately followed by C" occurs at least once and whenever A holds then B holds immediately after.

(b) If A holds at least once then B holds infinitely many times.

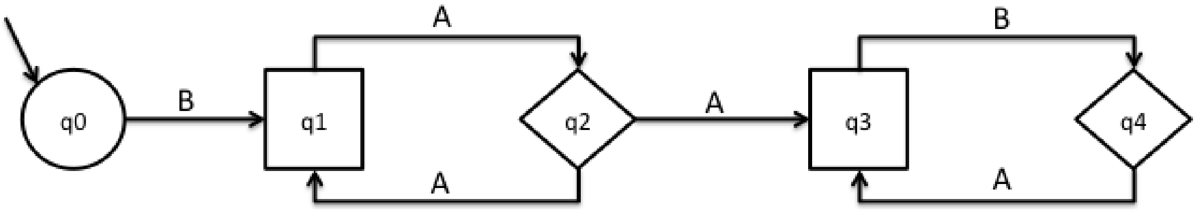
(c) Whenever A holds then C also holds or B holds immediately after.

For each property:

1. formalise it as a set of infinite words using set operators and first order logic;
2. formalise it in LTL; allowed operators are: next, until, box and diamond, all boolean connectives;
3. tell if it is a safety, liveness or mixed property. In case it is a pure safety property provide an NFA for the language of the **minimal** bad prefixes. In case it is a pure liveness property provide an NBA for the language of **bad behaviours**.

EXERCISE 3 (8 points)

Consider the following Generalised Nondeterministic Büchi Automaton on the alphabet $\Sigma = \{A, B\}$ and whose family of accepting states is $\mathcal{F} = \{\{q_1, q_3\}, \{q_2, q_4\}\}$:



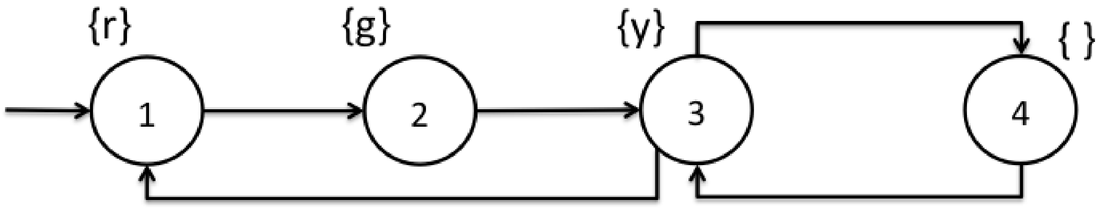
1. Describe the language accepted by the GNBA using an ω-regular expression.

2. Transform the given GNBA into an equivalent NBA.

In both cases, justify your answers.

EXERCISE 4 (8 points)

Consider the following transition system



1. Calculate $\mathrm{Sat}(\forall(g\,\mathcal{U}\,\forall(y\,\mathcal{U}\,r)))$. Justify your answers by showing the steps of the algorithm used for calculating the satisfaction of CTL formulas.