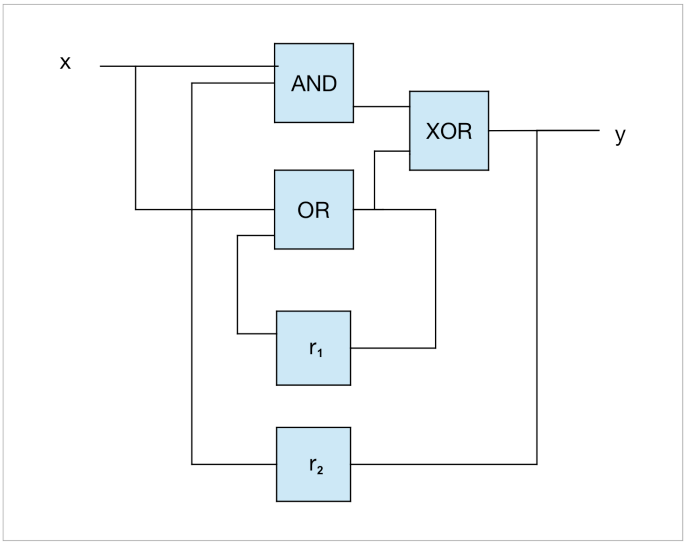
Master of Science in Computer Science - University of Camerino
Reactive Systems Verification A. Y. 2016/2017
Written Test of 24th July 2017 (Appello III)
Teacher: Luca Tesei

EXERCISE 1 (8 points)

Consider the following scheme of a circuit.



1. Model the behaviour of the circuit as a transition system assuming that the initial state of the registers is 0.

EXERCISE 2 (8 points)

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

(a) Whenever A holds then B holds after two steps

(b) B and C hold together infinitely many times

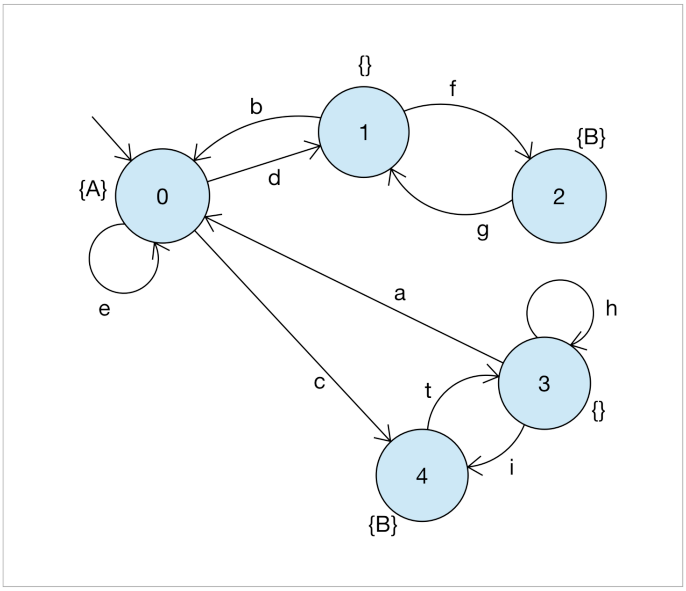
(c) C holds once and D never holds

For each property:

1. formalise it using set expressions and first order logic;
2. formalise it in LTL (you can use the operators next, until, box and diamond, together with all boolean connectives);
3. tell if it is a safety, liveness or mixed property; in case it is a safety property provide an NFA for the language of the **minimal** bad prefixes.

EXERCISE 3 (8 points)

Consider the following transition system TS on $AP = \{A, B\}$.



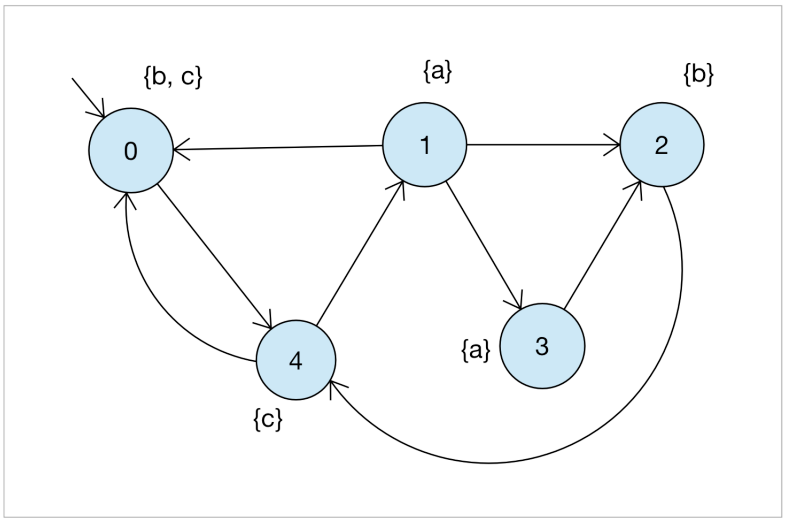
Consider the following LTL formulas:

$$\varphi_1 = \Box(A \Rightarrow \Diamond B)$$
$$\varphi_2 = \Box(B \Rightarrow \Diamond A)$$

1. Determine, for each formula above, the *weakest* fairness assumption ψ_i ($i \in \{1, 2\}$) needed for $TS \models_{\psi_i} \varphi_i$ to hold. Justify your answer by showing that a weaker fairness assumption would cause the properties not to hold.

EXERCISE 4 (8 points)

Consider the following transition system



1. Calculate $\mathrm{Sat}(b \wedge (c \leftrightarrow a))$, $\mathrm{Sat}(\exists(a \vee c)\mathcal{U}b)$ and $\mathrm{Sat}(\exists\Box(c \vee a))$. Justify your answers by showing the steps of the algorithm used for the CTL formulas.