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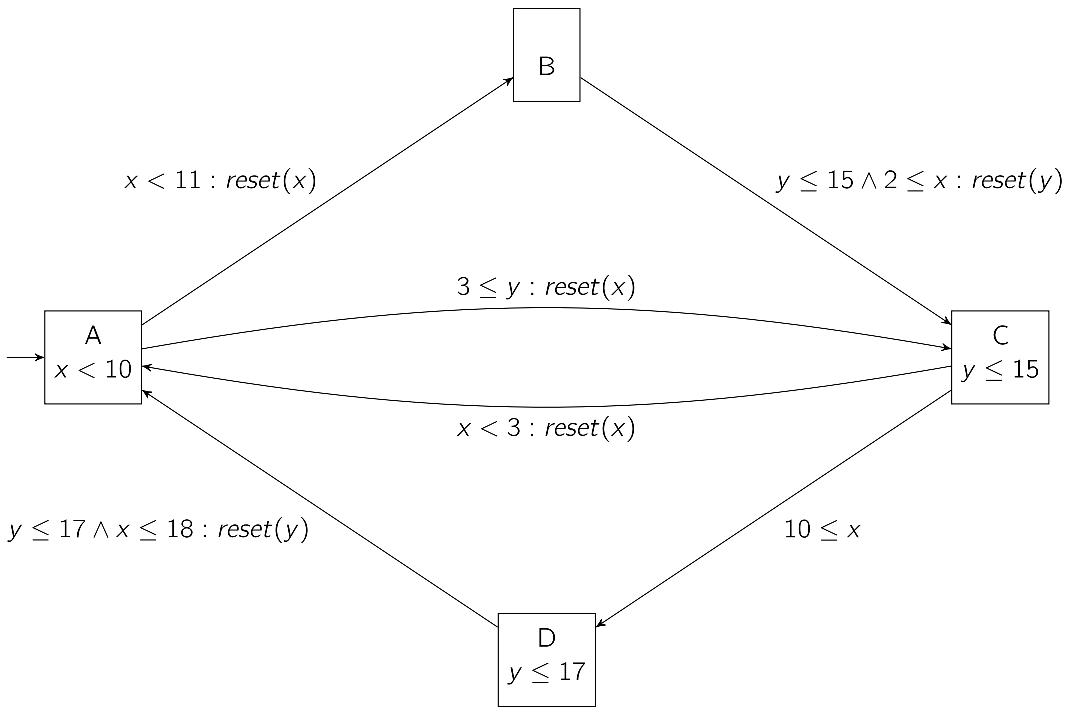
Exercise 1 (Timelocks, zenoness): (1+1 points)

Consider the following TA and answer the following questions. Justify your answers.

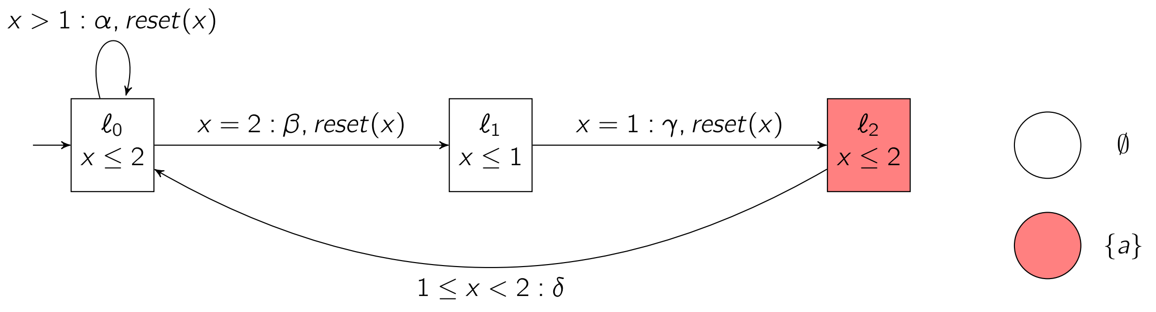


(a) Is the TA non-zeno?

(b) Is the TA timelock-free?

Exercise 2 (Analysis of timed automata): (1+2+1 points)

Consider the following TA.



(a) TA

(b) Legend

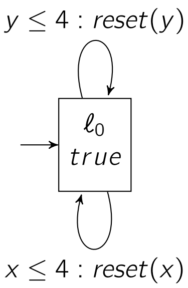
(a) Determine the set of states $Sat(\exists\Diamond^{\leq 4} a)$.

(b) Determine the region transition system $RTS(TA, true)$.

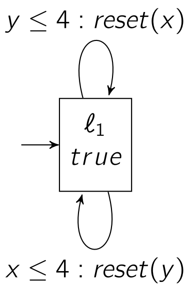
(c) Is the TA timelock-free? Justify your answer.

Exercise 3 (Reachable states): **(2 points)**

Consider the following two timed automata TA_1 and TA_2.



(c) TA_1



(d) TA_2

As these automata only have a single location, their states can be thought of as a point in the real plane. A point $(d, e) \in \mathbb{R}^2_{\geq 0}$ then represents that clock x has value d and clock y has value e. Determine the reachable state space of both timed automata. Justify your answer.

Exercise 4 (TCTL): **(1+1 points)**

(a) Find a counterexample showing that

$$\forall\Diamond^{=d}\Phi \wedge \forall\Diamond^{=d}\Psi \not\equiv \forall\Diamond^{=d}(\Phi \wedge \Psi)$$

where $\Diamond^{=d} = \Diamond^{[d,d]}$ for $d \in \mathbb{R}_{\geq 0}$.

(b) Does this also hold for $J = [0, \infty)$? Justify your answer.