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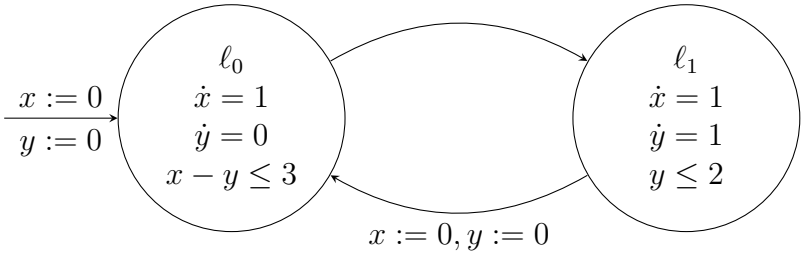
Tutorial for Cyber-Physical Systems - Hybrid Models
Exercise Sheet 10

Exercise 1: Backward reachability analysis of linear hybrid automata
Consider the following linear hybrid automaton (LHA) $\mathcal{H}$:



(a) Apply the backward analysis from $(\ell_0, x = 8 \wedge y = 10)$.

(b) How can you interpret your result?

Exercise 2: Convex hull approximation
We consider *convex hull reachability analysis*, i.e., forward analysis with convex hull approximation.

(a) Provide an LHA $\mathcal{H}_1$ where convex hull reachability analysis is exact.

(b) Provide an LHA $\mathcal{H}_2$ where convex hull reachability analysis is too approximative.

Hint: You need to add a specification which holds for $\mathcal{H}_2$ but which cannot be shown using the convex hull approximation.
For instance, introduce an error location ℓ_{err} such that (ℓ_{err}, ν) is unreachable for any ν. The (safety) specification is then the unreachability of (ℓ_{err}, ν).

(c) Provide an LHA $\mathcal{H}_3$ where standard forward reachability analysis does not terminate but convex hull reachability analysis does.

(d) Provide an LHA $\mathcal{H}_4$ where convex hull reachability analysis does not terminate.

Whenever you provide an example, give a short argument why it works.
Note: Not all of these exercises are simple.