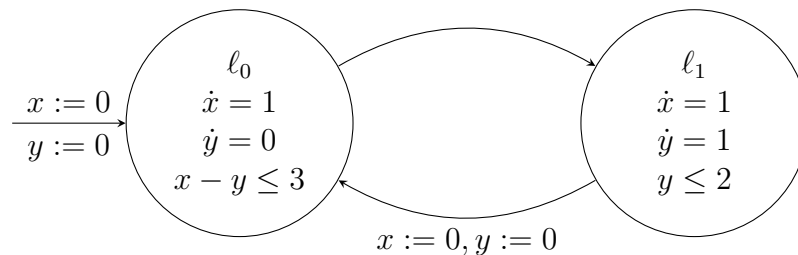# Tutorial for Cyber-Physical Systems - Hybrid Models
Exercise Sheet 10

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 $(\ell_{\mathrm{err}}, \nu)$ is unreachable for any ν. The (safety) specification is then the unreachability of $(\ell_{\mathrm{err}}, \nu)$.

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

(d) Provide an LHA $\mathcal{H}_4$ for which 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.