

# Tutorial 1

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## Question 1 – Designing a Hybrid Input Output Automata (HIOA)

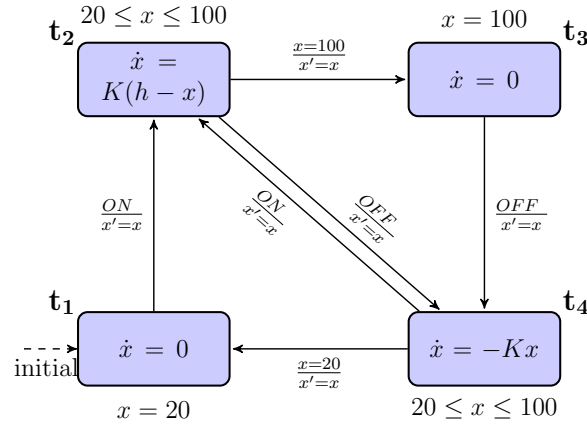


Figure 1: HIOA describing the water-tank heating and cooling dynamics

You are given a HIOA, in Figure 1, describing the water-tank heating and cooling dynamics. We want to design an embedded controller, which has the following specification:

1. Initially, the controller switches *on* the water-tank, by emitting signal *ON*, the water in the tank starts heating up.
2. The controller continuously monitors the temperature of the water via variable  $x$ .
3. When the temperature of the water crosses  $93^\circ$ , the controller switches off the water-tank heating system by emitting signal *OFF*.
4. Once the controller switches the water-tank heating system back on as soon as the temperature of the water falls  $93^\circ$ .
5. The above two steps continue ad infinitum.

Specify the controller as a HIOA.

## Question 2 – Translating HIOA into a corresponding Synchronous Witness Input Output Automata (SWIOA)

Convert the water-tank HIOA and the controller HIOA into corresponding SWIOAs.

## Question 3 – Composition of a network of SWIOAs

Give a single SWIOA by synchronously composing the water-tank and controller SWIOAs.

### Bonus question

Compare the execution trace of the single SWIOA from Question 3 above against individual **cyclic** and **alternating** execution of the water-tank and controller SWIOAs.