Tutorial 2

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Question 1 – Specifying Linear Temporal Logic (LTL) properties

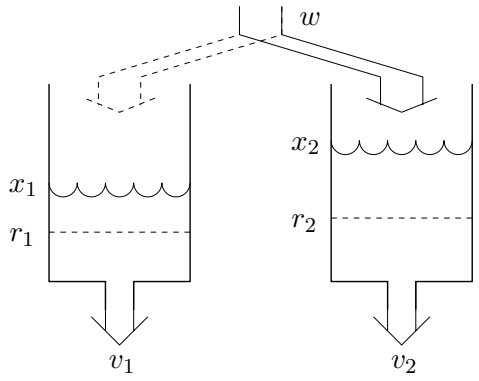
Given the following atomic propositions:

- $coffee\_chosen$
- tea_chosen
- $money\_inserted$
- $coffee\_delivered$
- $tea\_delivered$

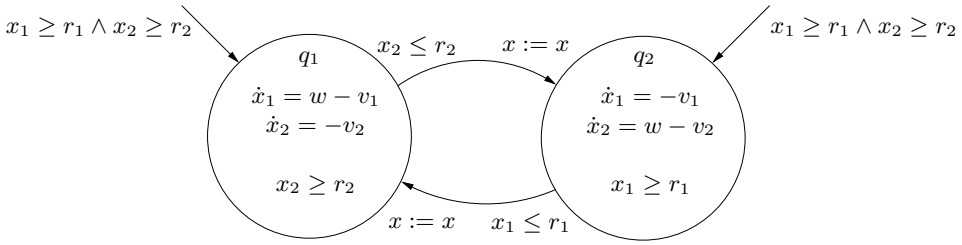
Write the *formal* LTL specification of the following English language specification of the properties used to check correct functioning of a vending machine:

1. Once in a while someone chooses tea or coffee
2. If coffee is chosen and next money is inserted, coffee will be delivered.
3. When coffee is chosen tea will not be delivered until tea is chosen.

Question 2 – Analyzing Hybrid Input Output Automata (HIOA) models



(a) Switch tank system



(b) HIOA capturing the switch tank system dynamics

Figure 1: Switch tank system and its HIOA model

Figure 1 shows a switch-tank system and its model captured as a HIOA. Answer the following questions, based on Figure 1:

1. Does the HIOA capture the physical process accurately?
2. What happens when $v_1 > w$ *and* $v_2 < w$?
3. What happens when $v_1 > w$ *and* $v_2 > w$?
4. What properties would you want to verify on this HIOA?

Question 3 – Trace equivalence of HIOA and Synchronous Witness Input Output Automata (SWIOA)

- Draw the SWIOA corresponding to the HIOA in Figure 1.

    1. Are the traces of the SWIOA and the HIOA equivalent?
    2. Does the SWIOA suffer from the same problems as the HIOA when $v_1 > w$ and $v_2 > w$?

Bonus question

Do **Zeno** effects happen in reality or is this an artifact of the HIOA model and its semantics?