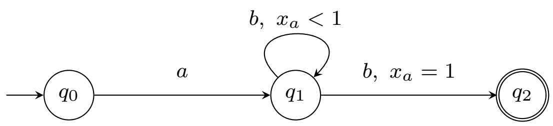
1. Complement the following event-clock automaton:



2. Let Σ and Γ be two finite alphabets. A *homomorphism* is a function $h : \Sigma \mapsto \Gamma$. This can be extended to timed words as follows:

$$h(\ (a_1 a_2 \dots a_k, t_1 t_2 \dots t_k)\ ) = (h(a_1)h(a_2)\dots h(a_k), t_1 t_2 \dots t_k)$$

Similarly, for a timed language L, we define $h(L) := \{\ h((w,t)) \mid (w,t) \in L\ \}$.

Call a timed language L to be an *event-clock language* if there is an ECA accepting L.

Given timed language L over Σ, and homomorphism $h : \Sigma \mapsto \Gamma$.

   (a) Are event-clock languages closed under homomorphisms? That is, if L is an event-clock language, is $h(L)$ also an event-clock language?

   (b) If $h(L)$ is an event-clock language, is L an event-clock language?

3. Let $w = (a_1 a_2 \dots a_n, t_1 t_2 \dots t_n)$ and $w' = (a_1 a_2 \dots a_n, t'_1 t'_2 \dots t'_n)$ be two timed words such that $t_i - t_j = t'_i - t'_j$ for all $i, j \in \{1, \dots, n\}$.

Show that for every ECA A, the word w is accepted by A iff w' is accepted by A.

4. Consider a reverse operation for an ECA A:

   - replace every transition (q, a, g, q') by (q', a, g', q) where g' is obtained by replacing every x_a by y_a, and every y_a by x_a (essentially, we reverse the transition and interchange recording and predicting clocks),
   - the final states of A are the initial states of A',
   - the initial states of A are the final states of A'.

What is the language of A', in terms of the language of A?