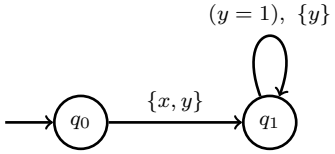
1. Let $X = \{x, y\}$ be a set of clocks. Consider a bounds function such that $M(x) = 4$ and $M(y) = 3$. What is Closure_M for the following zones?

   $$a)\ y - x \leq -2 \qquad b)\ x = y\ \wedge\ x > 3 \qquad c)\ y - x = 1\ \wedge\ x \geq 2$$

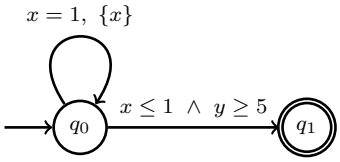
   Let M_1 be a function such that $M_1(x) = 4$ and $M_1(y) = 2$. What is Closure_{M_1} for the above zones?

2. Given two bound functions M_1 and M_2, we say that $M_1 \leq M_2$ if for all clocks x, $M_1(x) \leq M_2(x)$. Is it true that for any zone Z, $\text{Closure}_{M_2}(Z) \subseteq \text{Closure}_{M_1}(Z)$?

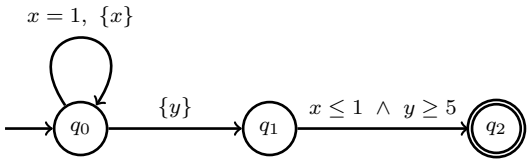
3. Consider the following familiar automaton and two bound functions M_1 and M_2. Set $M_1(y) = M_2(y) = 1$, $M_1(x) = 4$ and $M_2(x) = 2$. Execute the reachability algorithm (Algorithm 1.3 of notes) using Closure_{M_1} and Closure_{M_2}. Which of the bound functions gives a smaller zone graph?



4. Consider the following automaton. Suppose we set $M_1(x) = 1$ and $M_1(y) = 2$ and execute the reachability algorithm using Closure_{M_1} inclusion. What goes wrong?



5. The following automaton is a slight modification of the above automaton. Suppose we set $M_1(x) = 1$ and $M_1(y) = 2$ and execute the reachability algorithm using Closure_{M_1} inclusion for this automaton. Does something go wrong?



6. What are the bounds assigned to the following automaton by the static analysis algorithm?