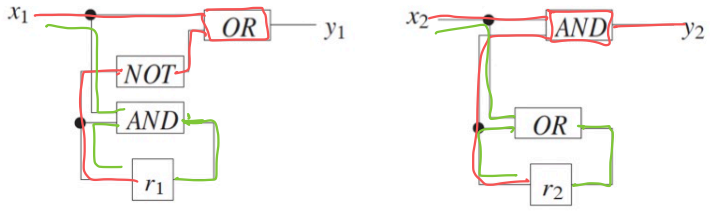
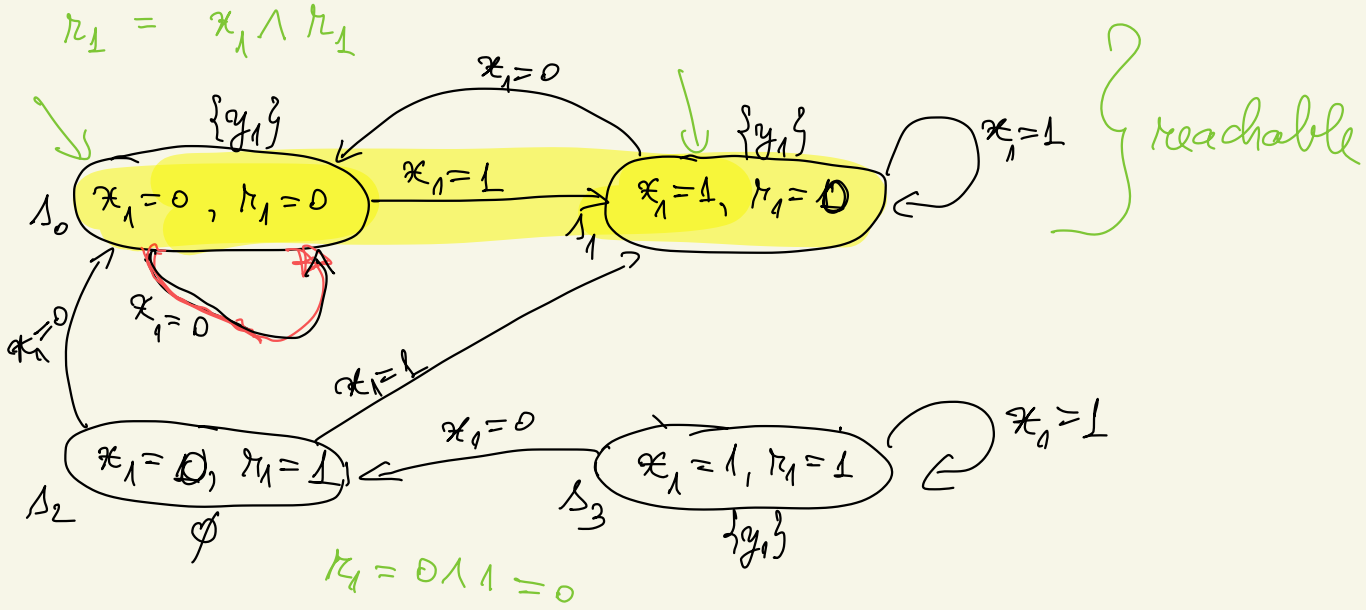
1. Consider the following two sequential hardware circuits:



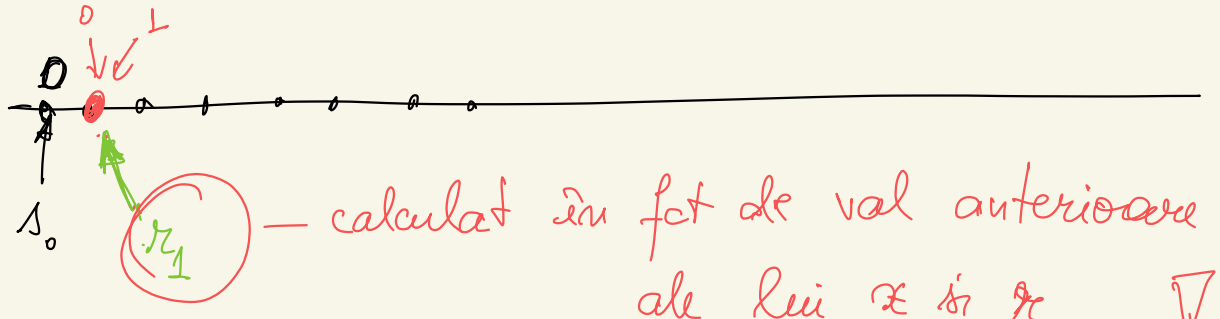
- Give the transition systems of both hardware circuits.
- Determine the reachable part of the transition system of the synchronous product of thesetransition systems. Assume that the initial values of the registers are $r_1 = 0$ and $r_2 = 1$.

$y_1 = x_1 \vee \neg r_1$

$r_1 = x_1 \wedge r_1$



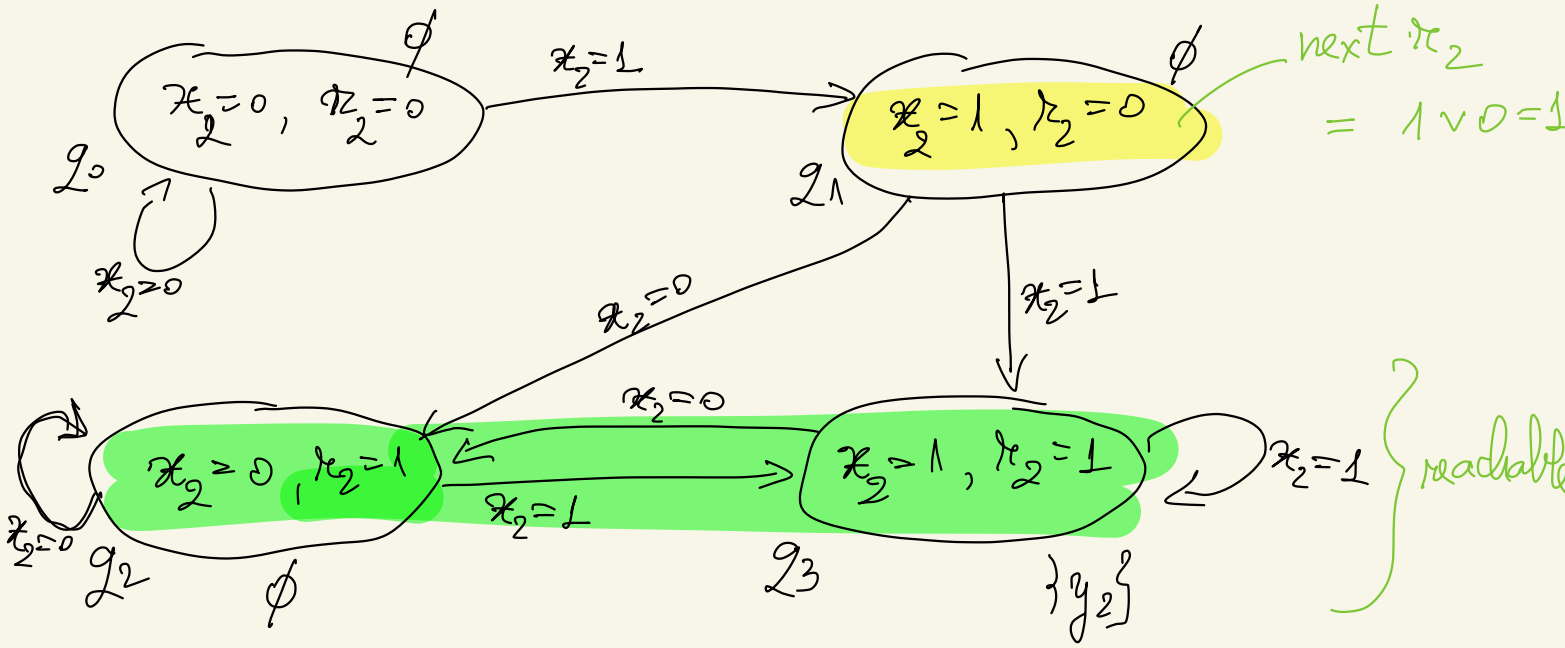
$r_1 = 0 \wedge 1 = 0$



— calculat în fct de val anterioare ale lui x și r ▽

$y_2 = x_2 \wedge r_2$

$r_2 = x_2 \vee r_2$



Produsul sincron

Let $T_1 = (S_1, Act_1, S_0^1, \rightarrow_1, L_1)$ $\quad Act_1 \cap Act_2 = \emptyset$

$T_2 = (S_2, Act_2, S_0^2, \rightarrow_2, L_2)$

The synchronous product $T = (S, Act, S_0, \rightarrow, L)$ is

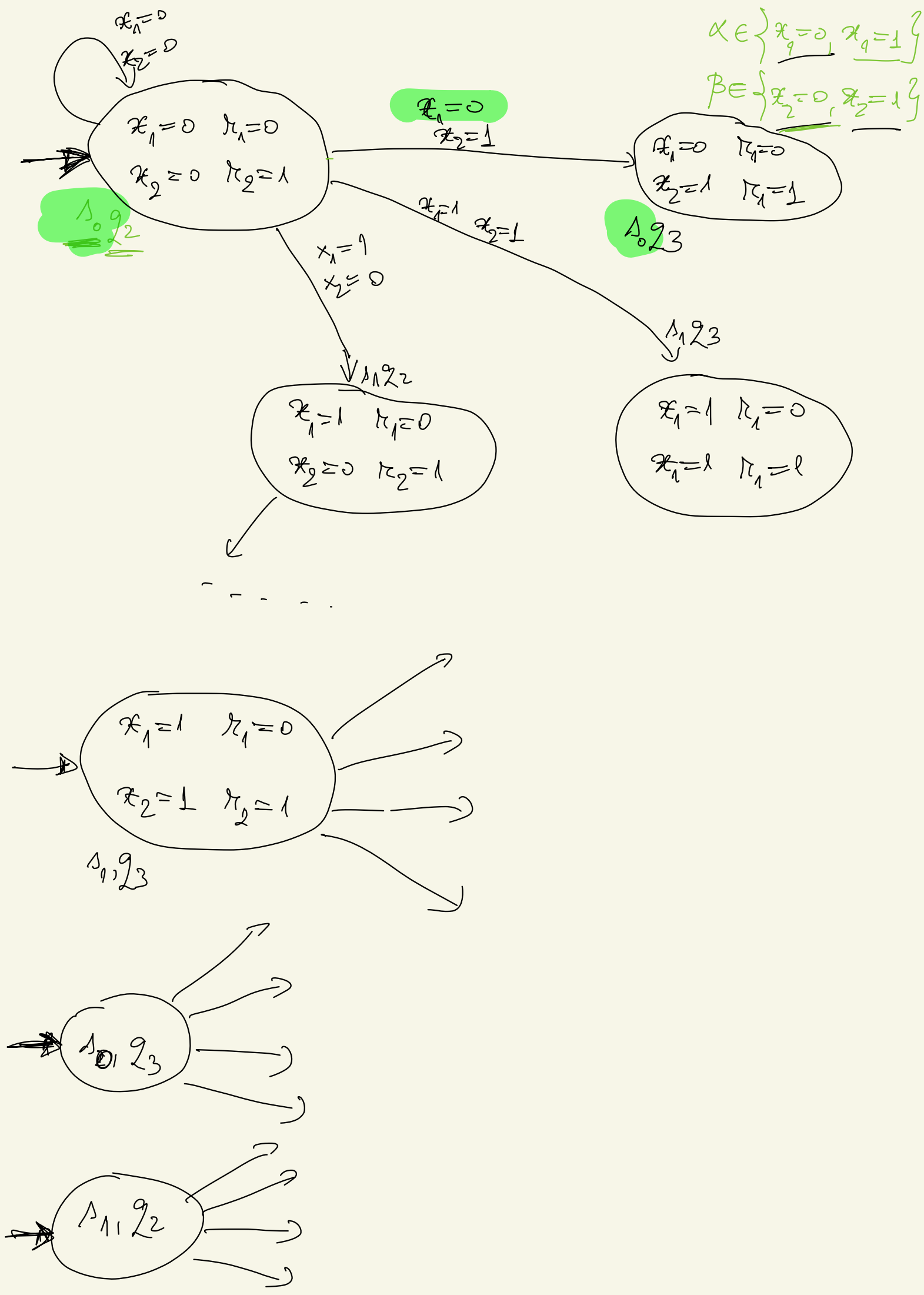
$S = S_1 \times S_2$

$Act = Act_1 \times Act_2$

$S_0 = S_1^0 \times S_2^0$

$$\frac{s_1 \xrightarrow[1]{\alpha} s_1' \qquad q_1 \xrightarrow[2]{\beta} q_1'}{(s_1, q_1) \xrightarrow{(\alpha,\beta)} (s_1', q_1')}$$

$L(s,q) = L_1(s) \cup L_2(s)$


$\alpha \in \{x_1=0,\ x_1=1\}$
$\beta \in \{x_2=0,\ x_2=1\}$
$x_1=0$ $x_2=0$
$x_1=0$ $r_1=0$
$x_2=0$ $r_2=1$
$s_0 q_2$
$x_1=0$
$x_2=1$
$x_1=0$ $r_1=0$
$x_2=1$ $r_1=1$
$s_0 q_3$
$x_1=1$ $x_2=1$
$x_1=1$
$x_2=0$
$s_1 q_3$
$s_1 q_2$
$x_1=1$ $r_1=0$
$x_2=0$ $r_2=1$
$x_1=1$ $r_1=0$
$x_2=1$ $r_2=1$
s_1, q_3
s_0, q_3
s_1, q_2

2. Handshaking : Railroad Crossing

For a railroad crossing a control system needs to be developed that on receipt of a signal indicating that a train is approaching closes the gates, and only opens these gates after the train has sent a signal indicating that it crossed the road. The complete system consists of the three components Train, Gate, and Controller.

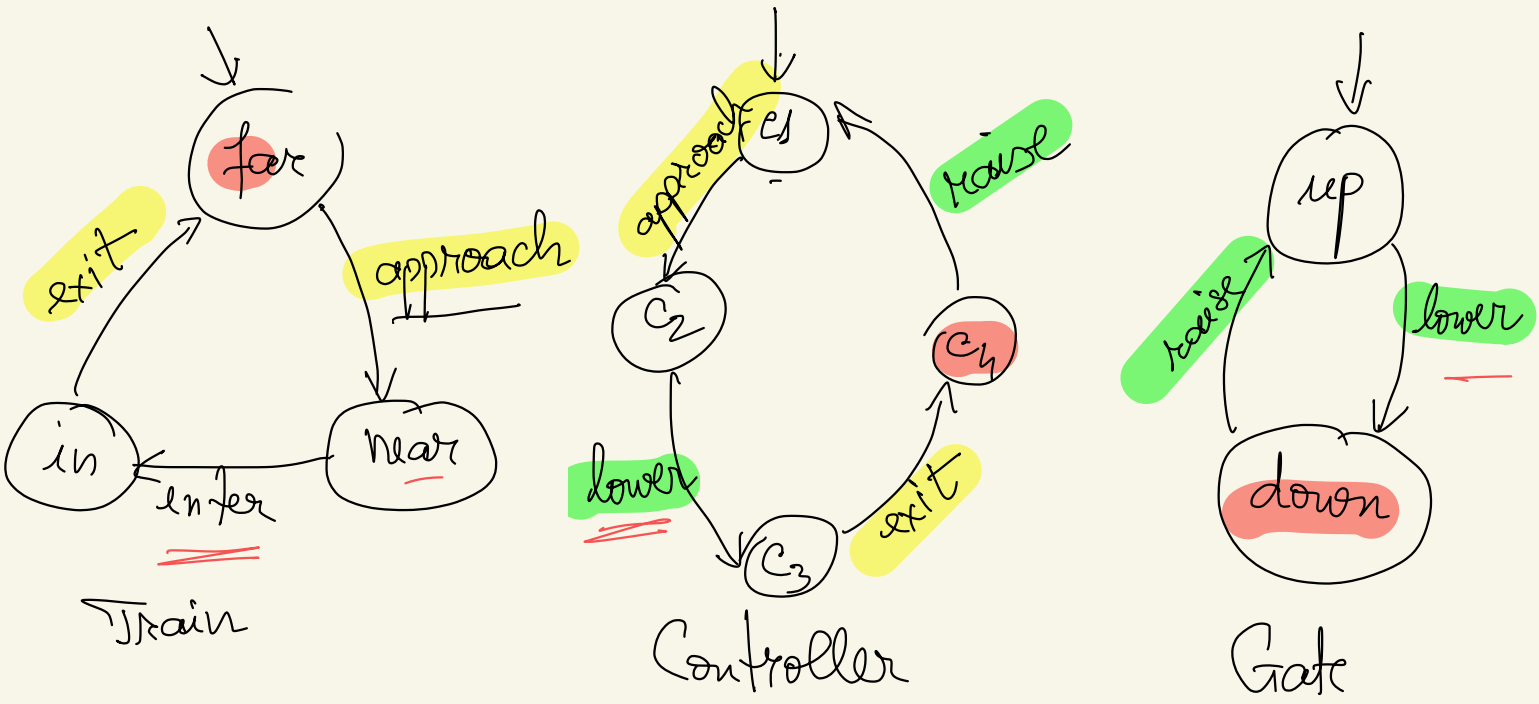
Controller handshakes with the trains (via the actions approach and exit) and the Gate (via the actions lower and raise via which the Controller causes the gate to close or to open, respectively).

Model the three components and then compute the transition system modelling the handshaking between the three components.

The Train: Has three states modelling the position where it is with respect to the gate (far, near, in). It approaches the gate, enter the gate and then exits.

The Controller: When the train approaches, the Controller receives the signal and then he lowers the gate. Then, after the train passes, the controller raises the gate.

The Gate: has two states (up and down) and it is controlled by the Controller.

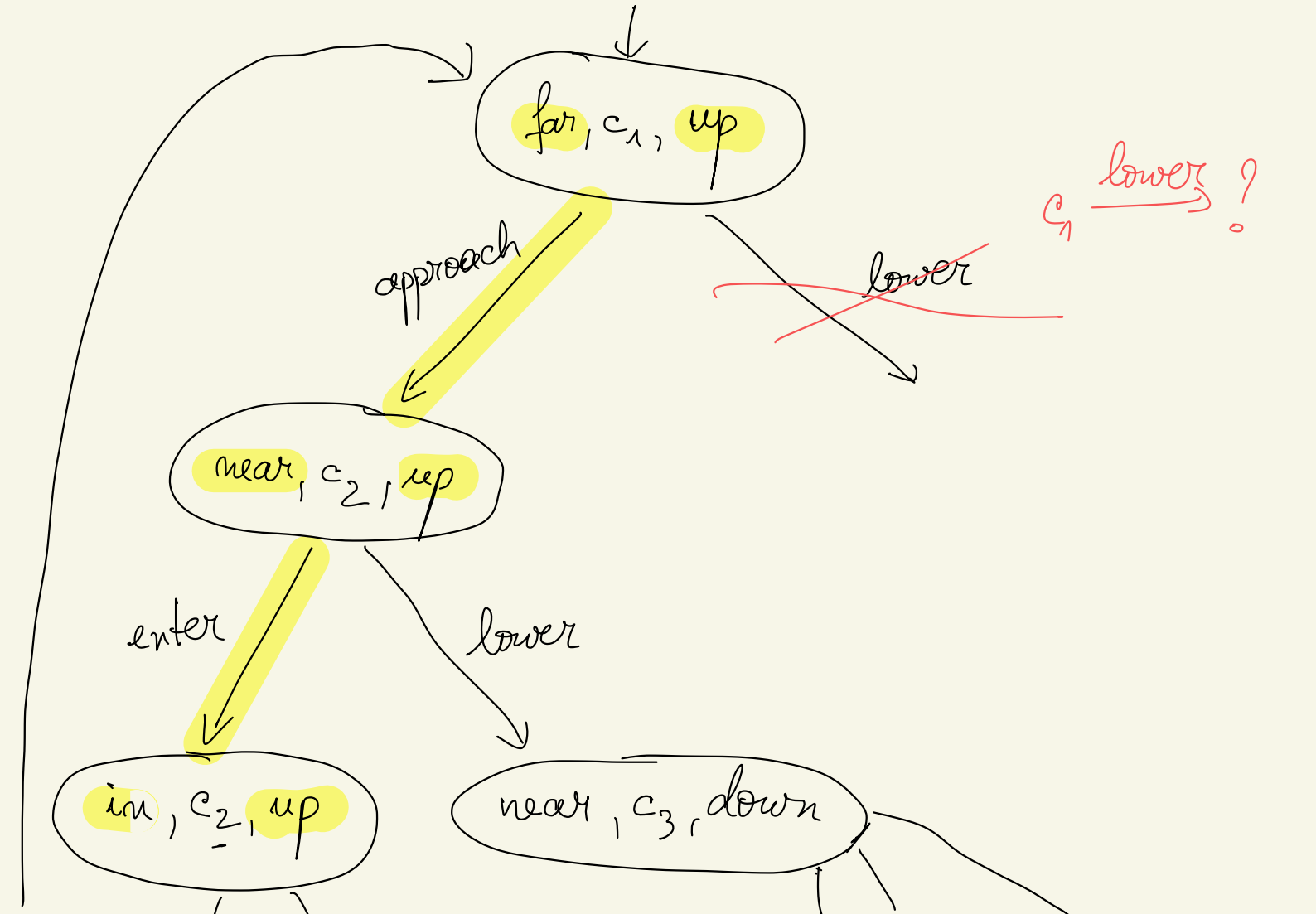


$$(\text{Train} \underset{H_1}{\|} \text{Controller}) \underset{H_2}{\|} \text{Gate}$$

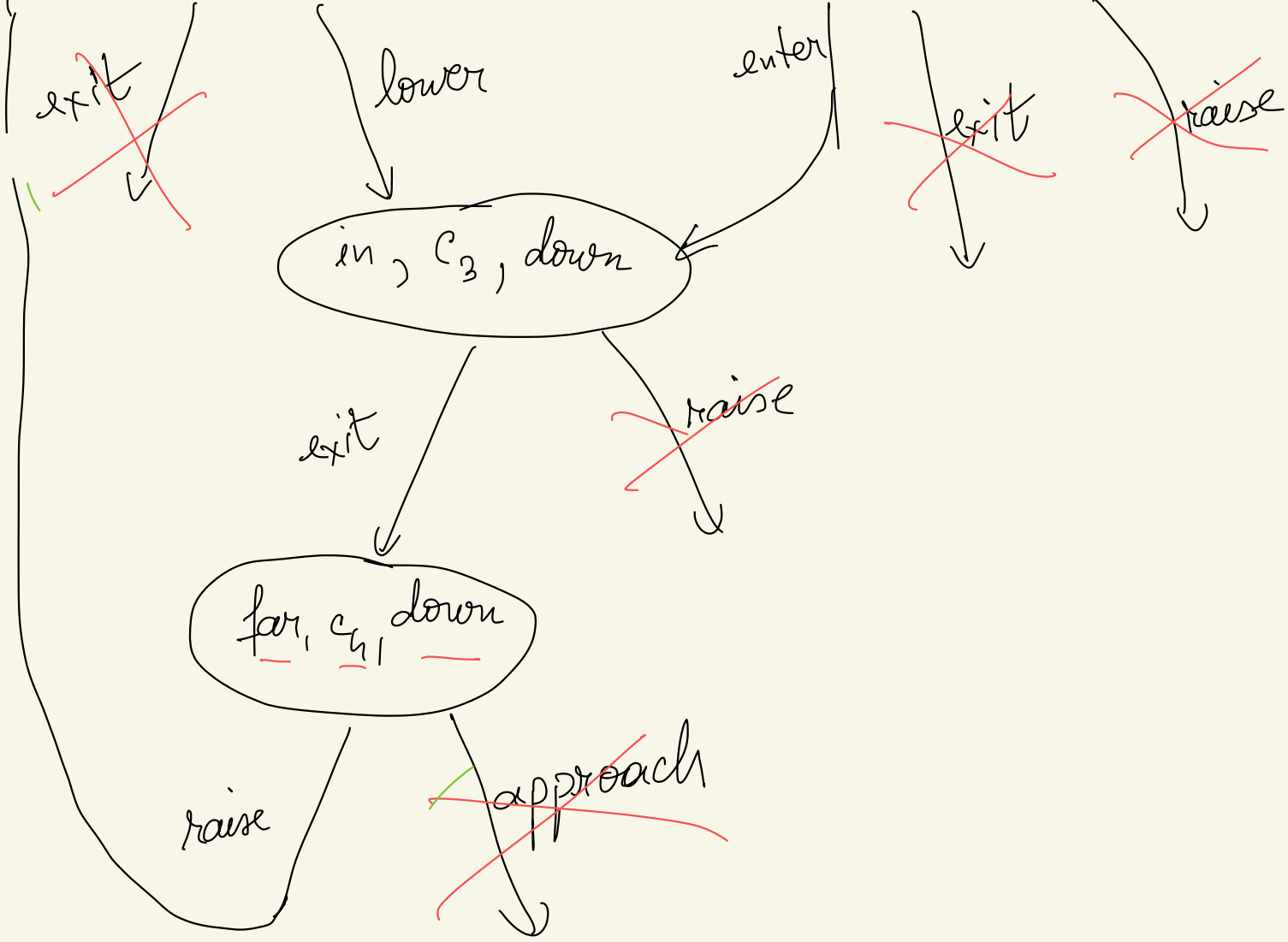
- $H_1 = H_2 = Act_t \cap Act_c \cap Act_g$

sau

- $H_1 \subseteq Act_t \cap Act_c$ și $H_1 \cap Act_g = \emptyset$
  $H_1 = \{approach, exit\}$
  $H_2 \subseteq Act_c \cap Act_g$ și $H_2 \cap Act_t = \emptyset$
  $H_2 = \{raise, lower\}$



c_1 lower ?


exit
lower
enter
exit
raise
in, c_3, down
exit
raise
far, c_4, down
raise
approach