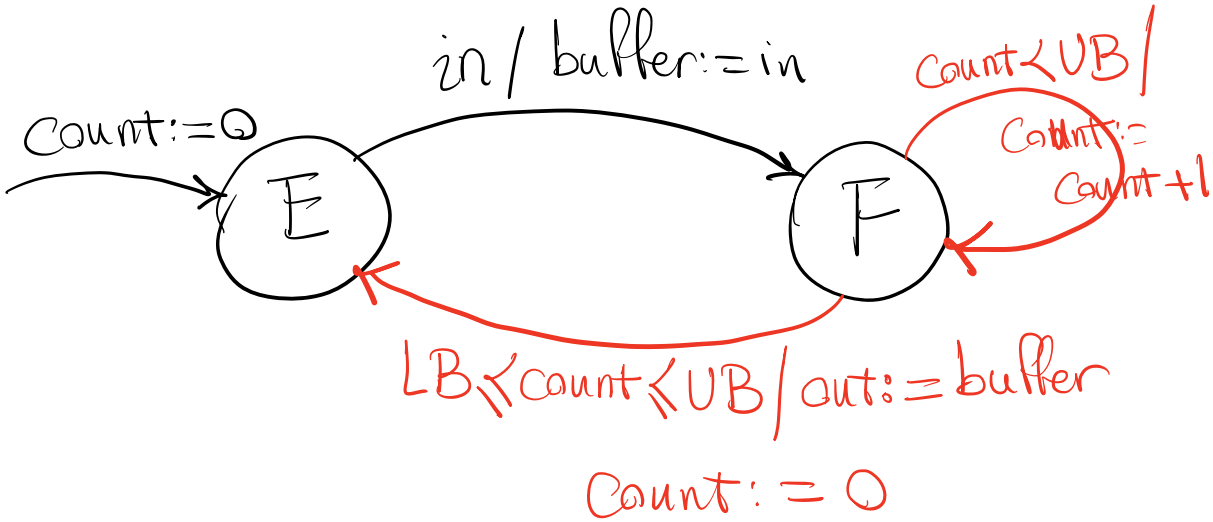
Question 3 [part a]

input: $in \in \{0, \ldots, 127\}$

output: $out \in \{0, \ldots, 127\}$

variable: $count \in \mathbb{N}$

$buffer \in \{0, \ldots, 127\}$



the red arrows indicate non-determinisim

[part b]

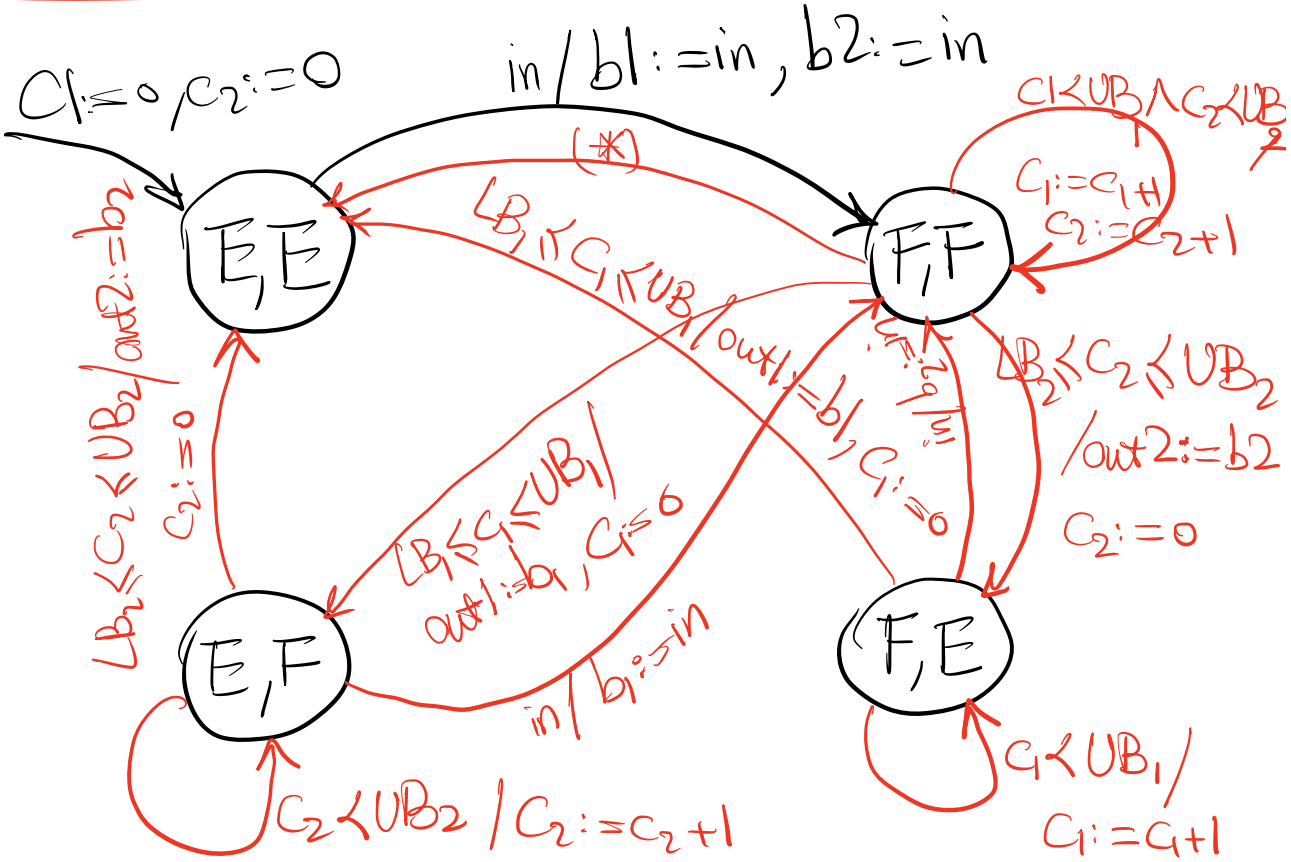
input: $in \in \{0, \dots, 127\}$

outputs: $out1, out2 \in \{0, \dots, 127\}$

variables: $c1, c_2 \in \mathbb{N}$

$b1, b2 \in \{0, \dots, 127\}$

$(*)(LB_1 \leq c_1 \leq UB_1) \wedge (LB_2 \leq c_2 \leq UB_2)$ / $out1 := b_1, out2 := b_2, c_1 = c_2 := 0$



[part c]

True (if considering the first time any block outputs)

Start at (E, E).

When in is present the system moves to (F, F). Since both timers start at zero,

they increase together.

The first block must output first. Imagine it does not output first, therefore, second black should output first. Then it must be that

$$LB_2 \leq C_2 \leq UB_2$$

Because $C_1 = C_2$,

we get

$$LB_2 \lesssim C_1 \lesssim UB_2$$

However this is in

contradiction with that

$$LB_1 \lesssim C_1 \lesssim UB_1 < LB_2$$

Therefore, we have proved

that first block outputs first

by a contrapositive argument