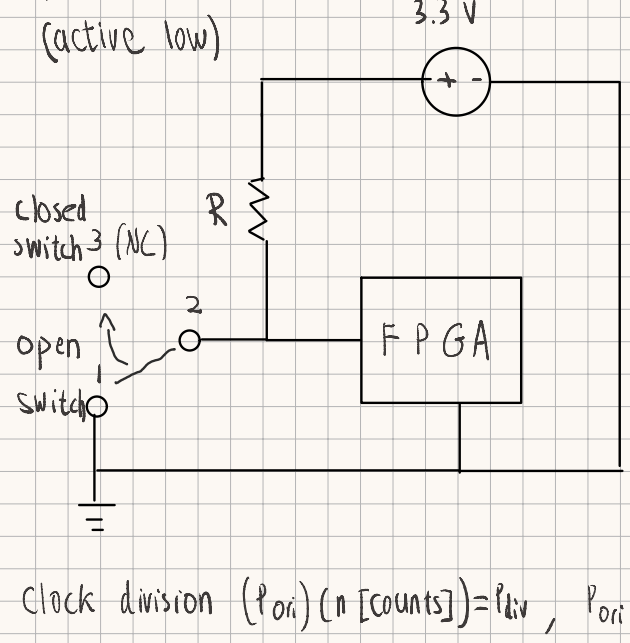
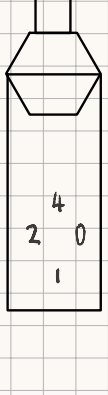
Pushbutton switch (active low)




LED #

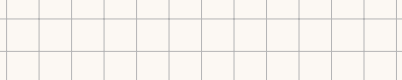



Clock division $(P_{ori})(n\ [counts]) = P_{div}$, $P_{ori} = \frac{1\ second}{12M\ cycles}$,

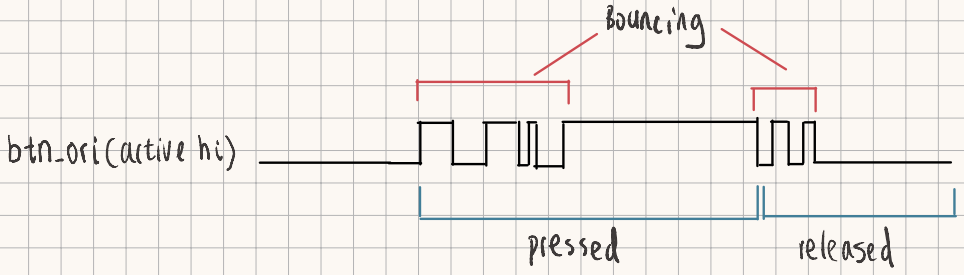
$P_{div} = \frac{1\ second}{1\ cycle}$, $n = \frac{P_{div}}{P_{ori}} = \left(\frac{1\ s/1\ c}{1\ s/12M\ c}\right)\left(\frac{12M\ c}{12M\ c}\right) = \frac{12M\ s}{1\ s}$

$= 12M$, How many bits to allocate? $2^m = 12M$, $m = \lg(12M)$

$= 23.5$, need $m+1 \rightarrow$ 24 bits, $(12M)_{10} = (1011\,0111\,0001\,1011\,0000\,0000)_2$

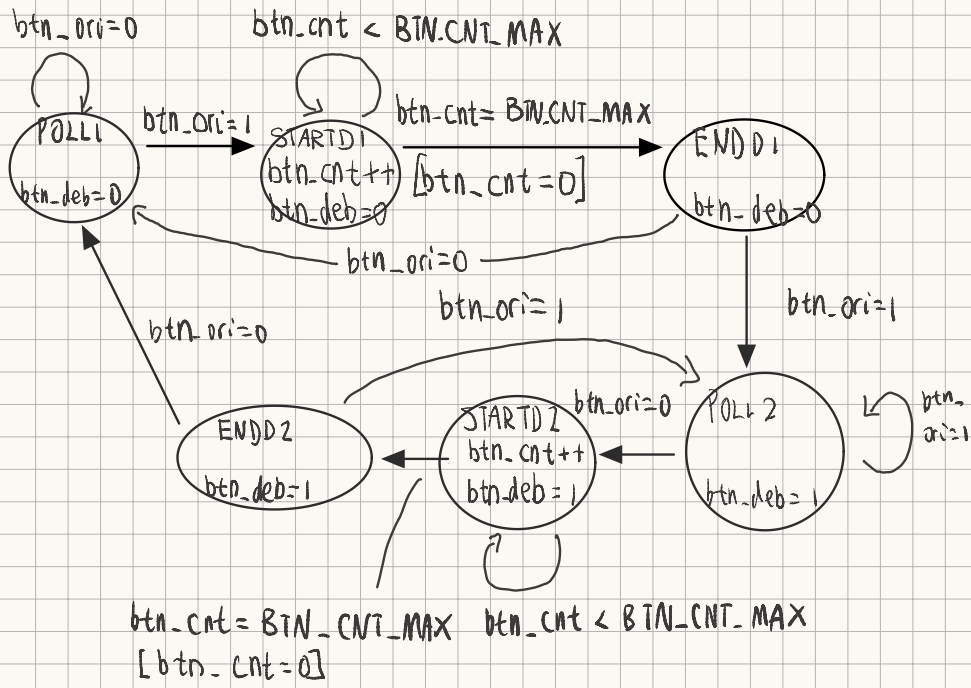


# Button debouncing (1)

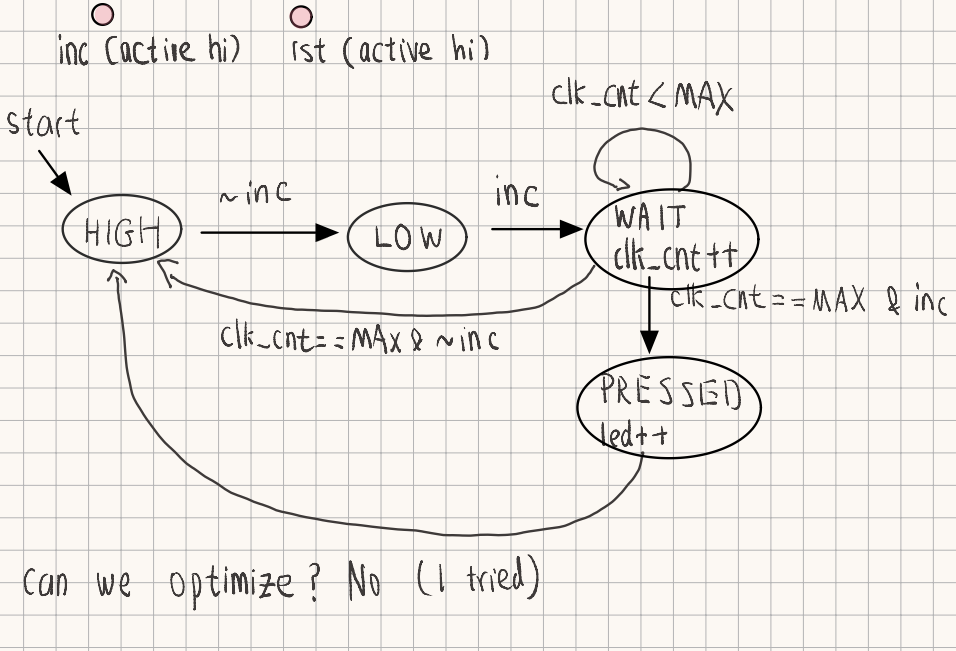



算法：if low to high, wait 40 ms, if still low: then btn is pressed, else 继续等待 for high to low

Moore machine



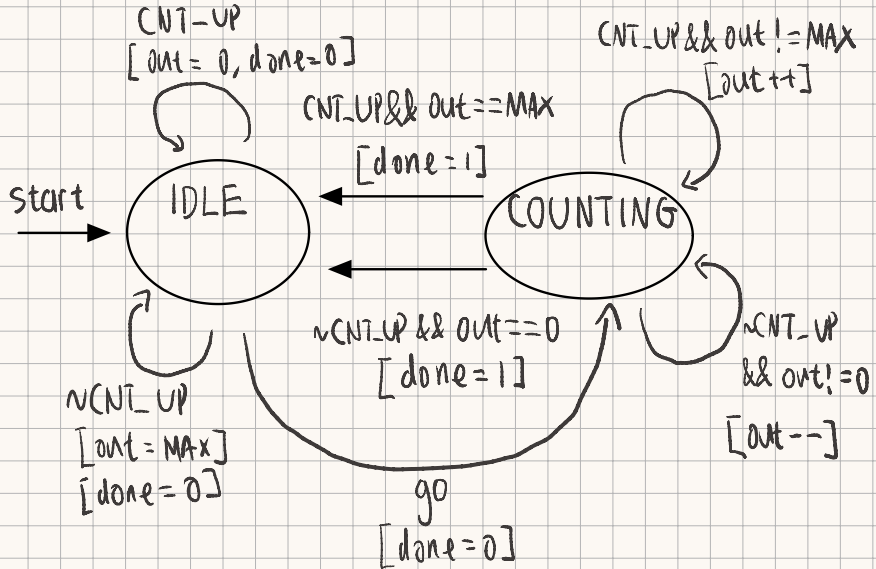
Button debouncing (2) 我的答案不管用 看下官方答案




can we optimize? No (I tried)

L6 challenge updown counter 从零数到三

Updown counter: single counter FSM (Mealy)




Let $n_1$ = # clock cycles for 40ms

$$(n_1)(P_{clk\_ori}) = 40\,ms, \quad n_1 = \frac{40\,ms}{P_{clk\_ori}} = \frac{(40)(10^{-3})\ seconds}{\left(\frac{1\ second}{(12)(10^6)\ cycles}\right)}$$

$= 480000$ cycles

Let $n_2$ = # clock cycles for 400 us

$$(n_2)(P_{clk\_ori}) = 400\,us, \quad n_2 = \frac{400\,us}{P_{clk\_ori}} = \frac{(400)(10^{-6})\ seconds}{\left(\frac{1\ second}{(12)(10^6)\ cycles}\right)}$$

$= 4800$ cycles

10ms = X ns?

$$(10\,ms)\left(\frac{10^{-3}\,s}{1\,ms}\right)\left(\frac{10^{9}\,ns}{1\,s}\right) = 10^{7}\,ns$$

1 us = X ns?

$$(1\,us)\left(\frac{10^{-6}\,s}{1\,us}\right)\left(\frac{10^{9}\,ns}{1\,s}\right) = 10^{3}\,ns$$

格雷码转二进制：$bin_{n-1} = gray_{n-1}$，$bin_i = gray_i \oplus bin_{i+1}$ $\Rightarrow$ $gray_i = bin_i \oplus bin_{i+1}$，所以，

二进制转格雷码：$gray_{n-1} = bin_{n-1}$，$gray_i = bin_i \oplus bin_{i+1}$

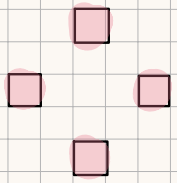
证正明：$(gray_i \oplus bin_{i+1}) \oplus bin_{i+1} = gray_i$

| $gray_i$ | $bin_{i+1}$ | $gray_i \oplus bin_{i+1}$ | $(gray_i \oplus bin_{i+1}) \oplus bin_{i+1}$ |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |

# 震动记录仪

PMOD[0] → RST

PMOD[1] → DO (5V)

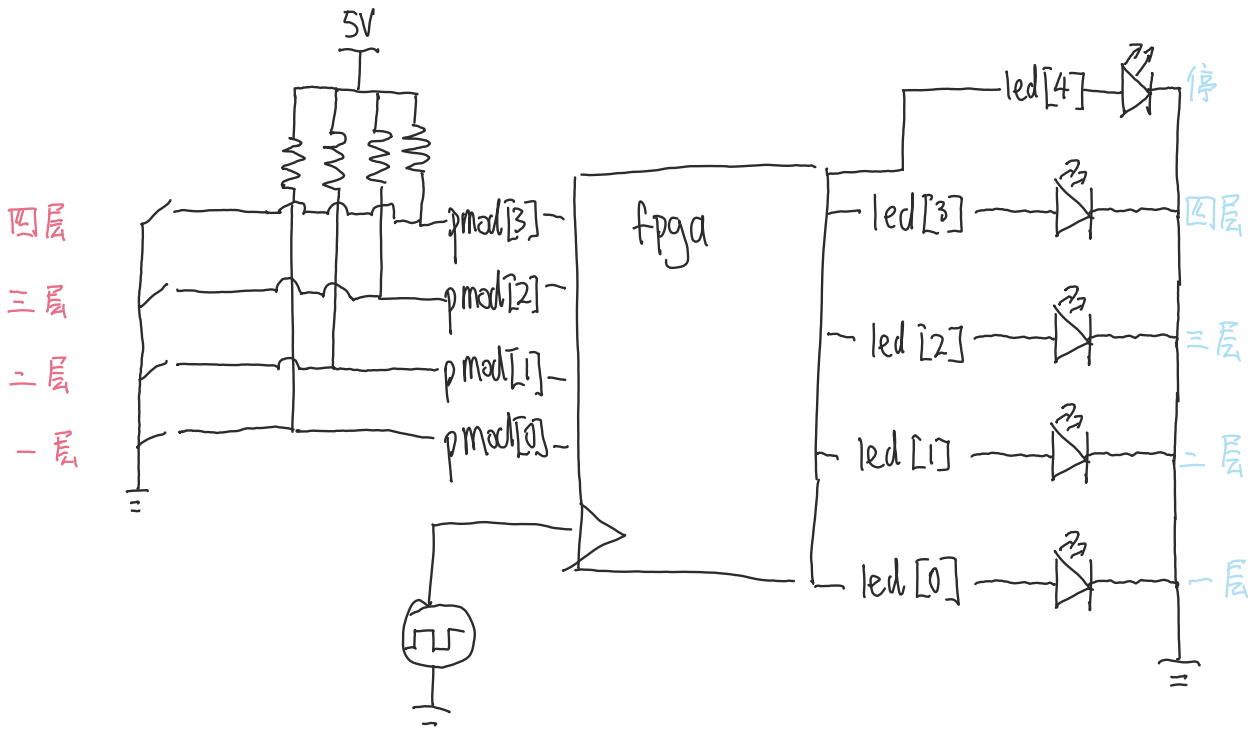


LED[3:0]=计数器

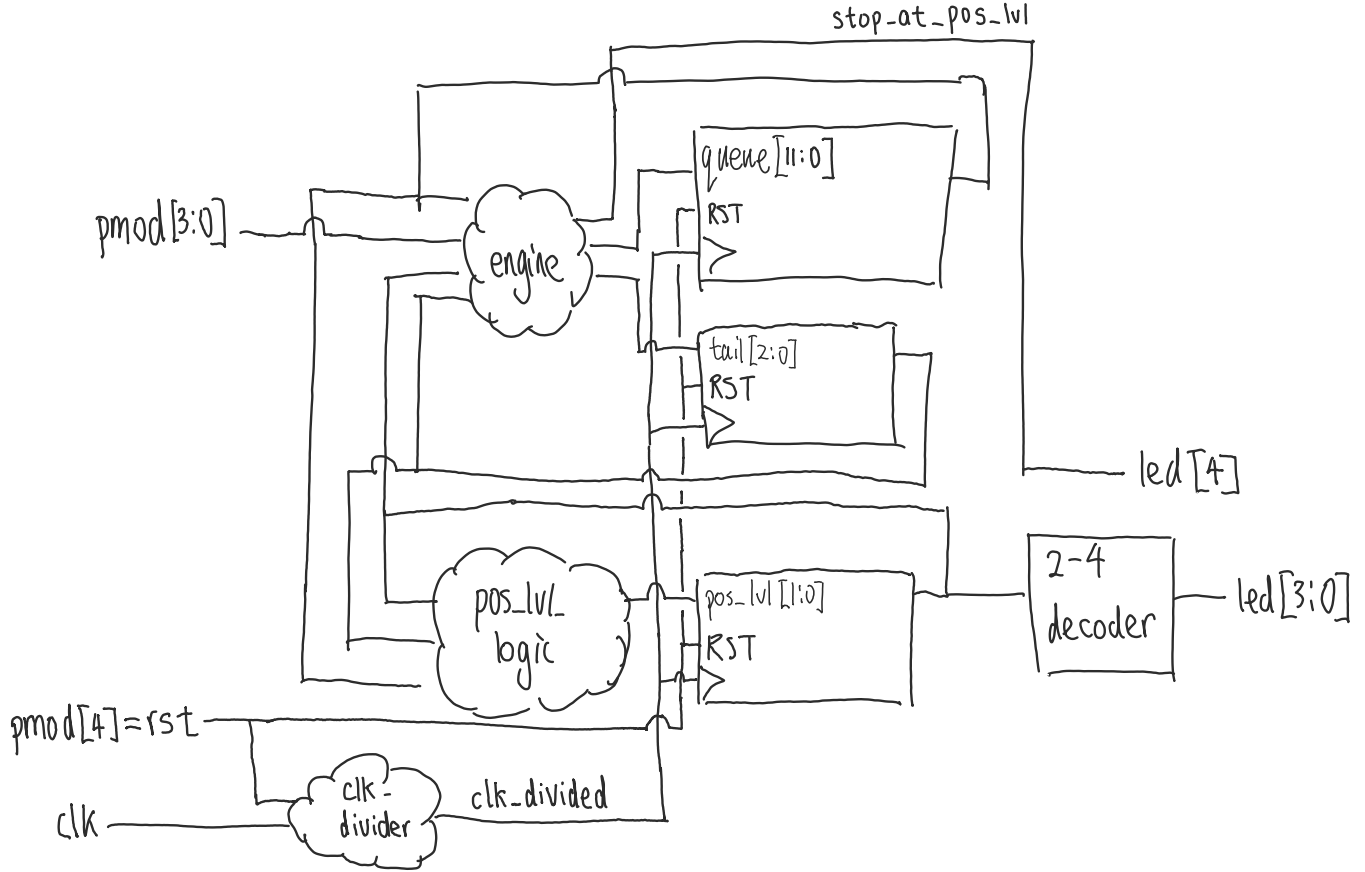
每次震动加一

由于震动传感器的输出电压（5伏）与FPGA的输入电压不搭配，该项目暂时不再进行。更新：但是传感气的电源必须来于FPGA！

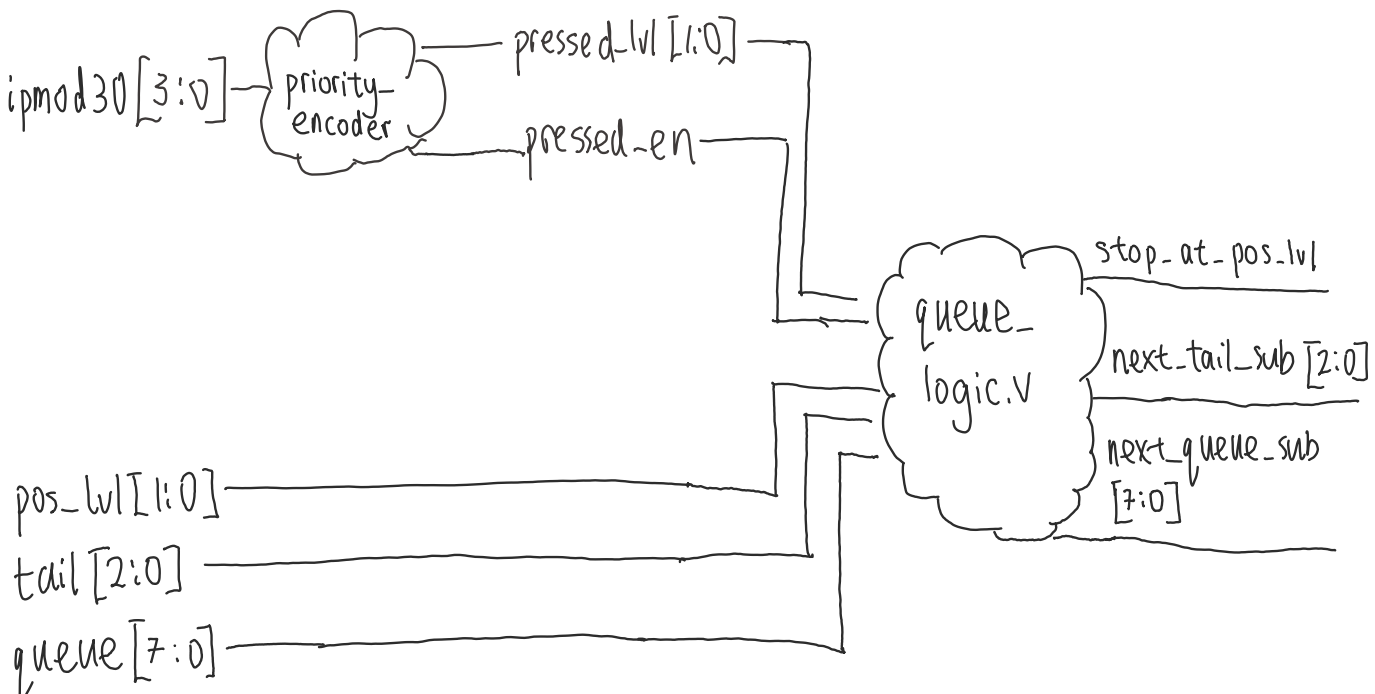
# 模拟人


5V
pmod[3]
pmod[2]
pmod[1]
pmod[0]
fpga
led[4]
led[3]
led[2]
led[1]
led[0]
停
四层
三层
二层
一层
四层
三层
二层
一层

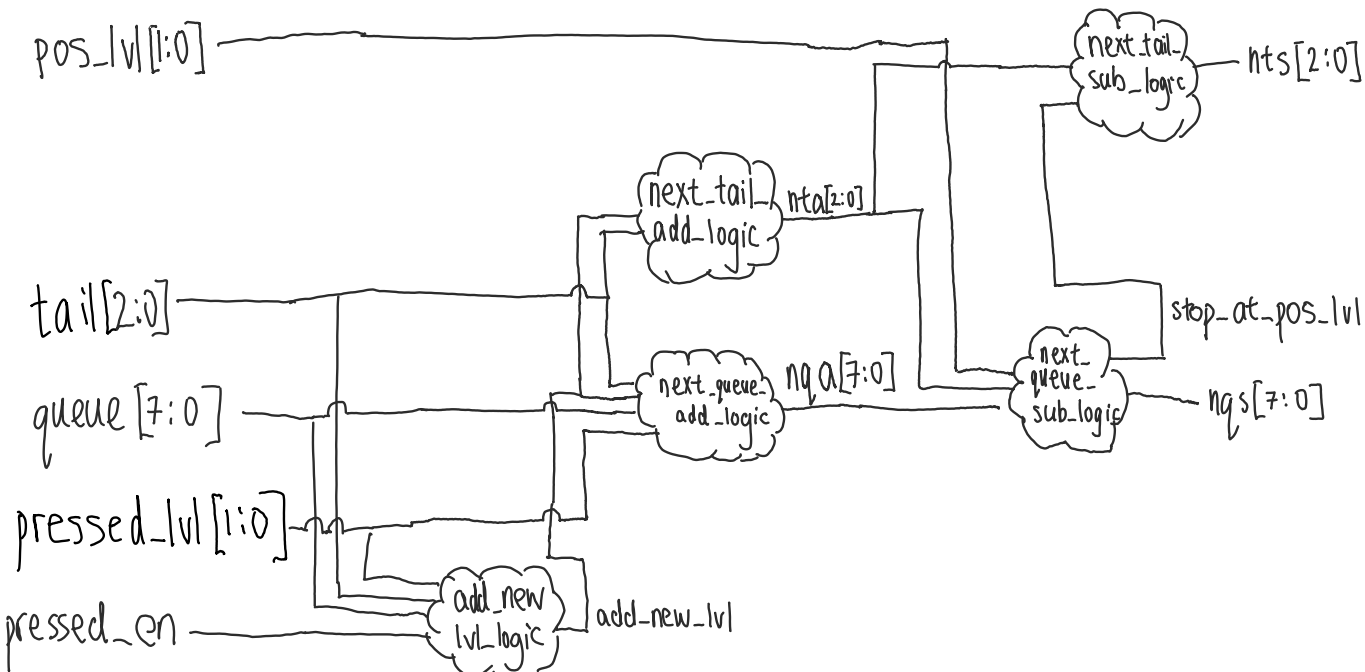
# elevator.v (top level)



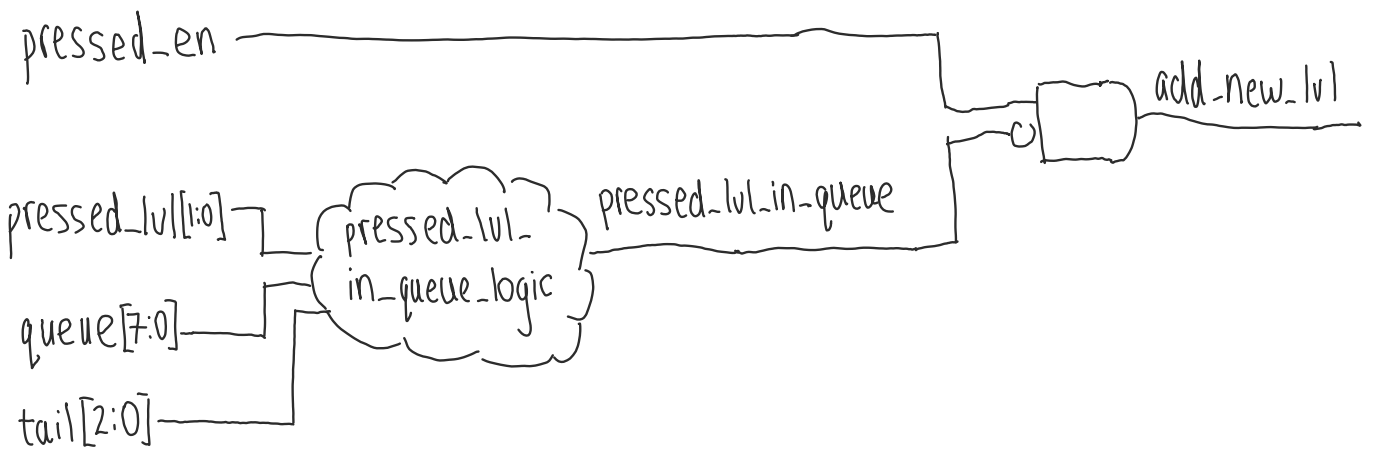
# engine.v


ipmod30[3:0]
priority_
encoder
pressed_lvl[1:0]
pressed_en
queue_
logic.v
stop_at_pos_lvl
next_tail_sub[2:0]
next_queue_sub
[7:0]
pos_lvl[1:0]
tail[2:0]
queue[7:0]

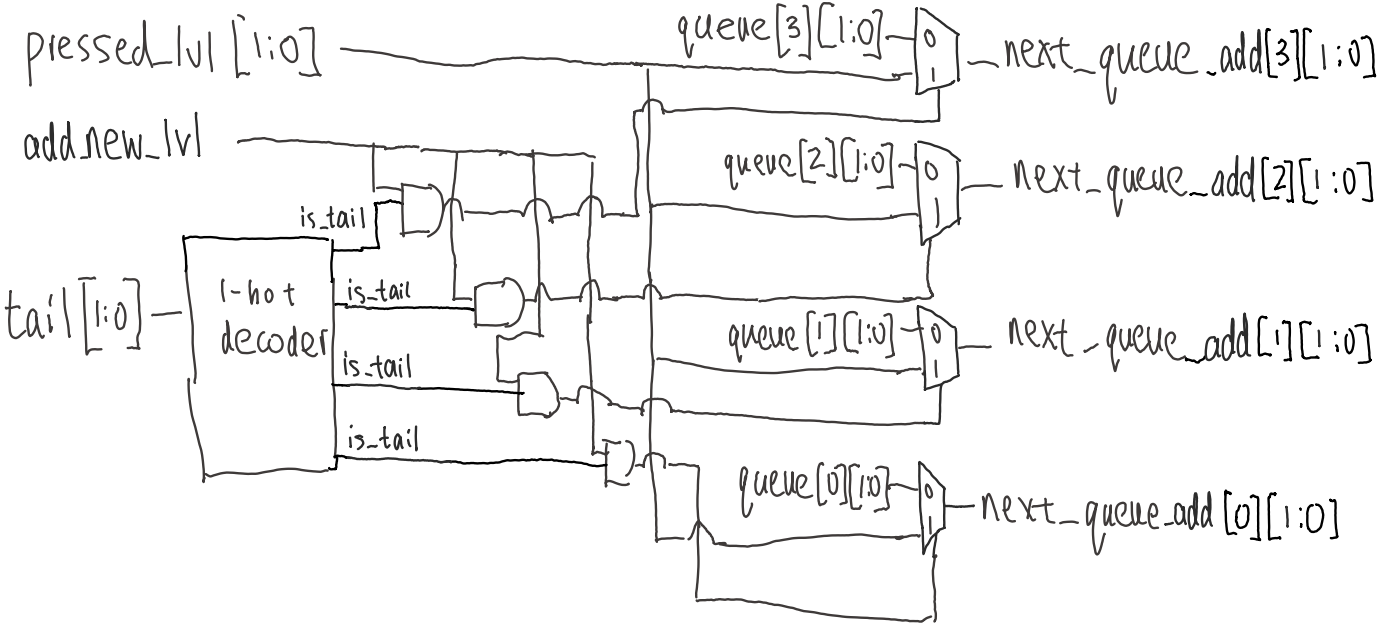
# queue_logic.v



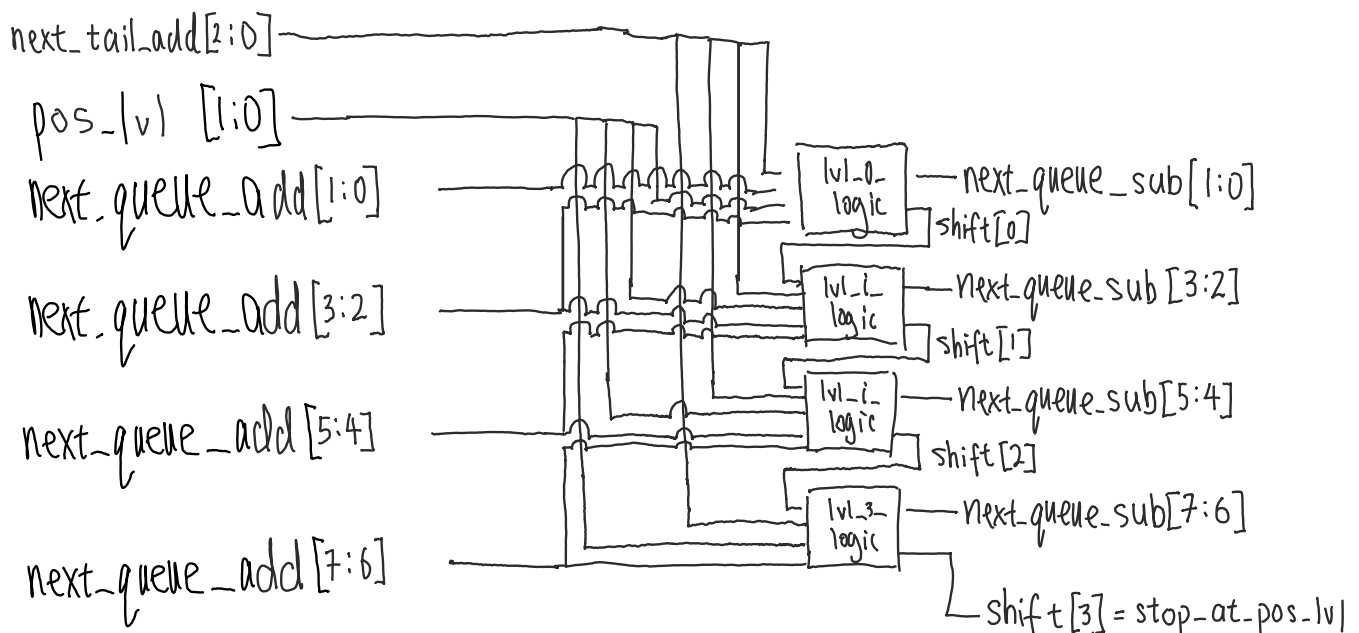
# add_new_lvl_logic.v



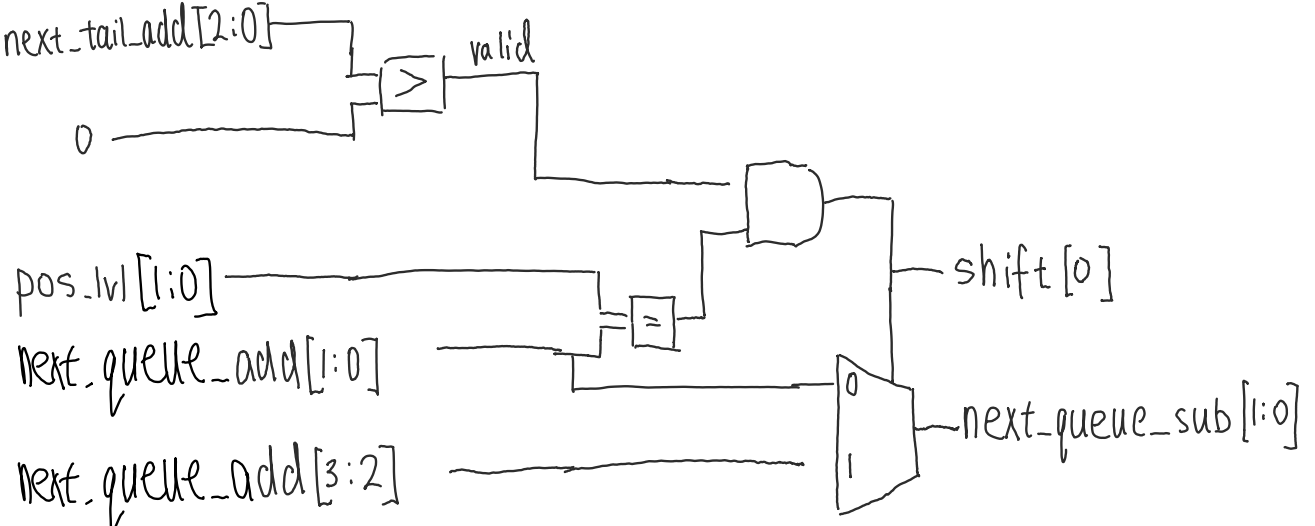
# next_queue_add_logic.v



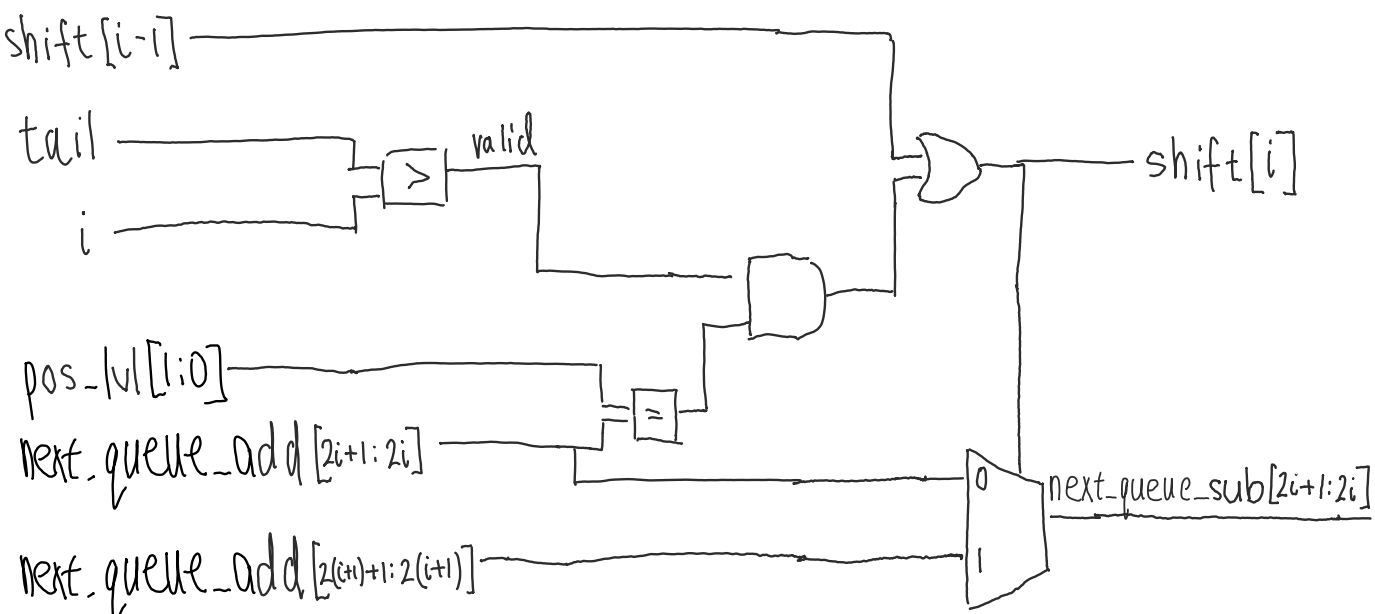
# next_queue_sub_logic.v



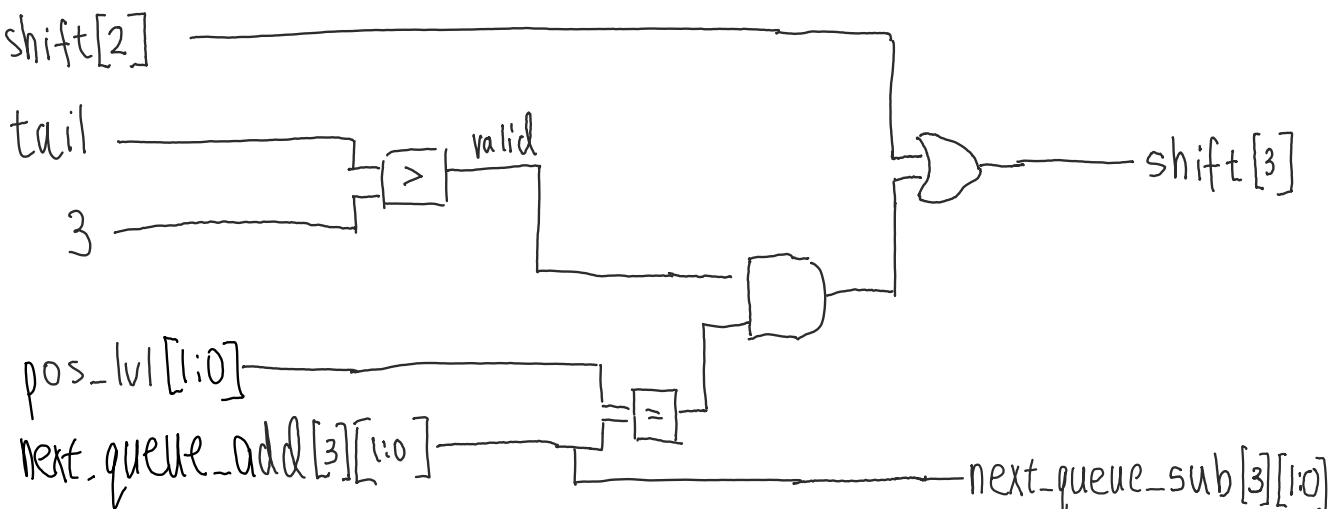
# level_0_logic.v



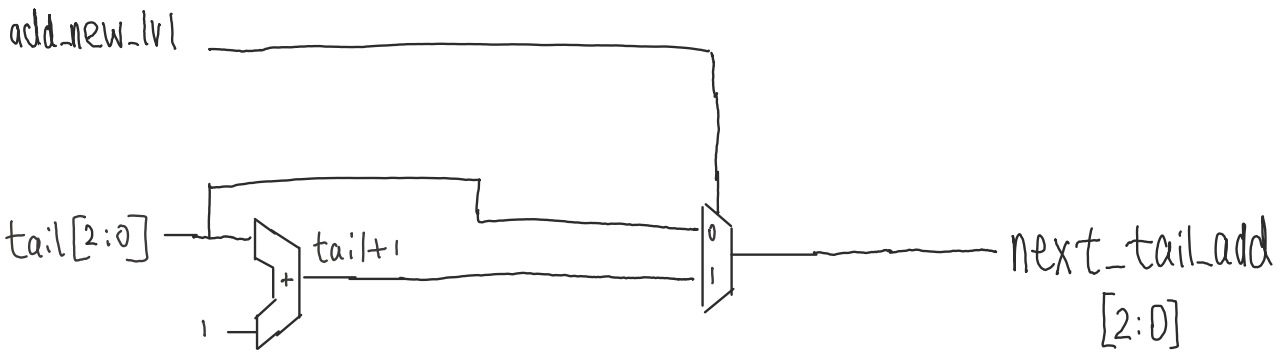
# level_i_logic.v



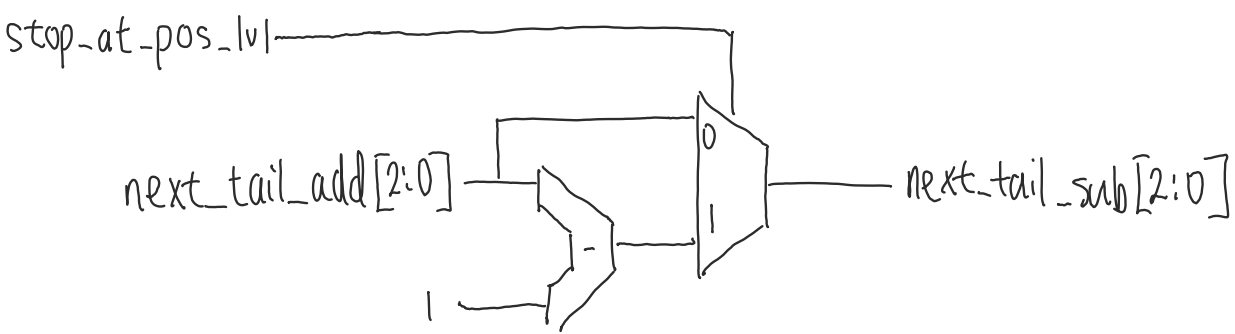
# level_3_logic.v



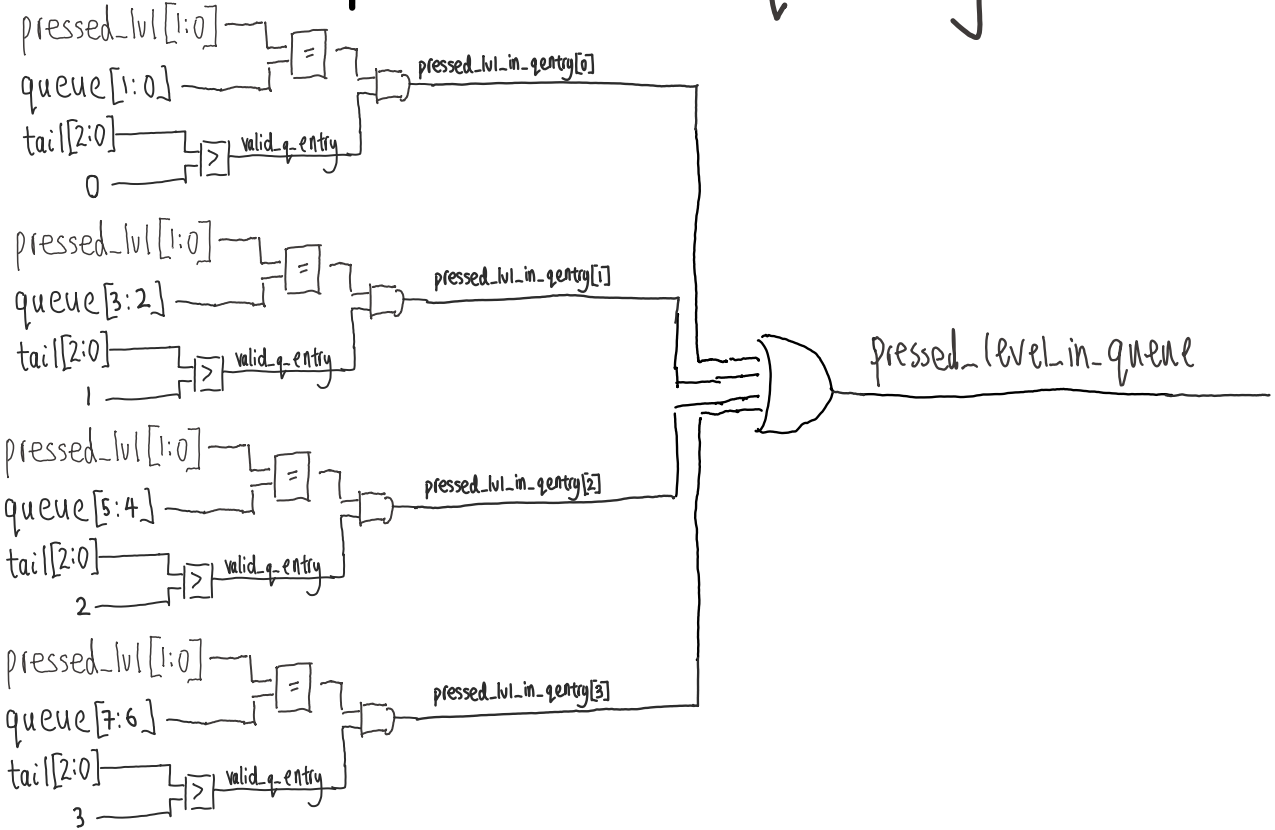
# next_tail_add_logic.v



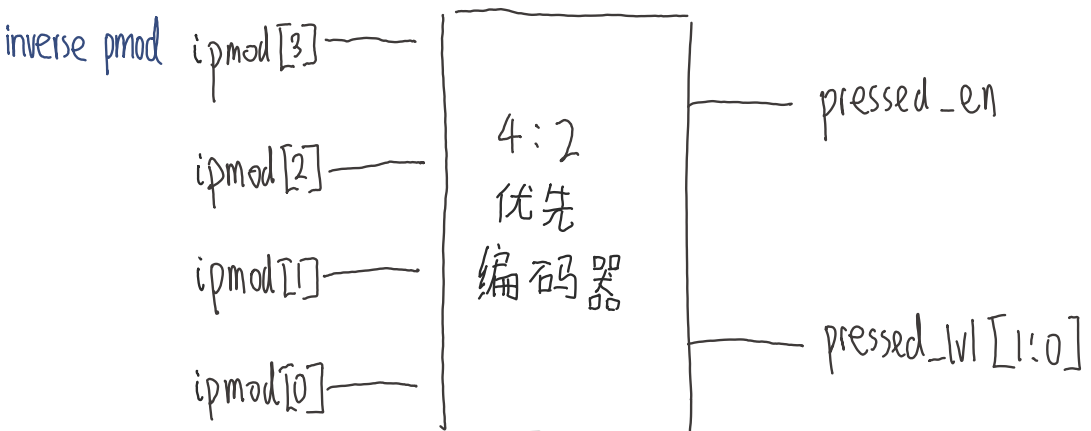
# next_tail_sub_logic.v

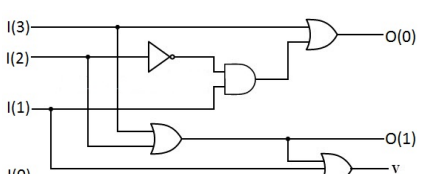


# pressed_lvl_in_queue_logic.v

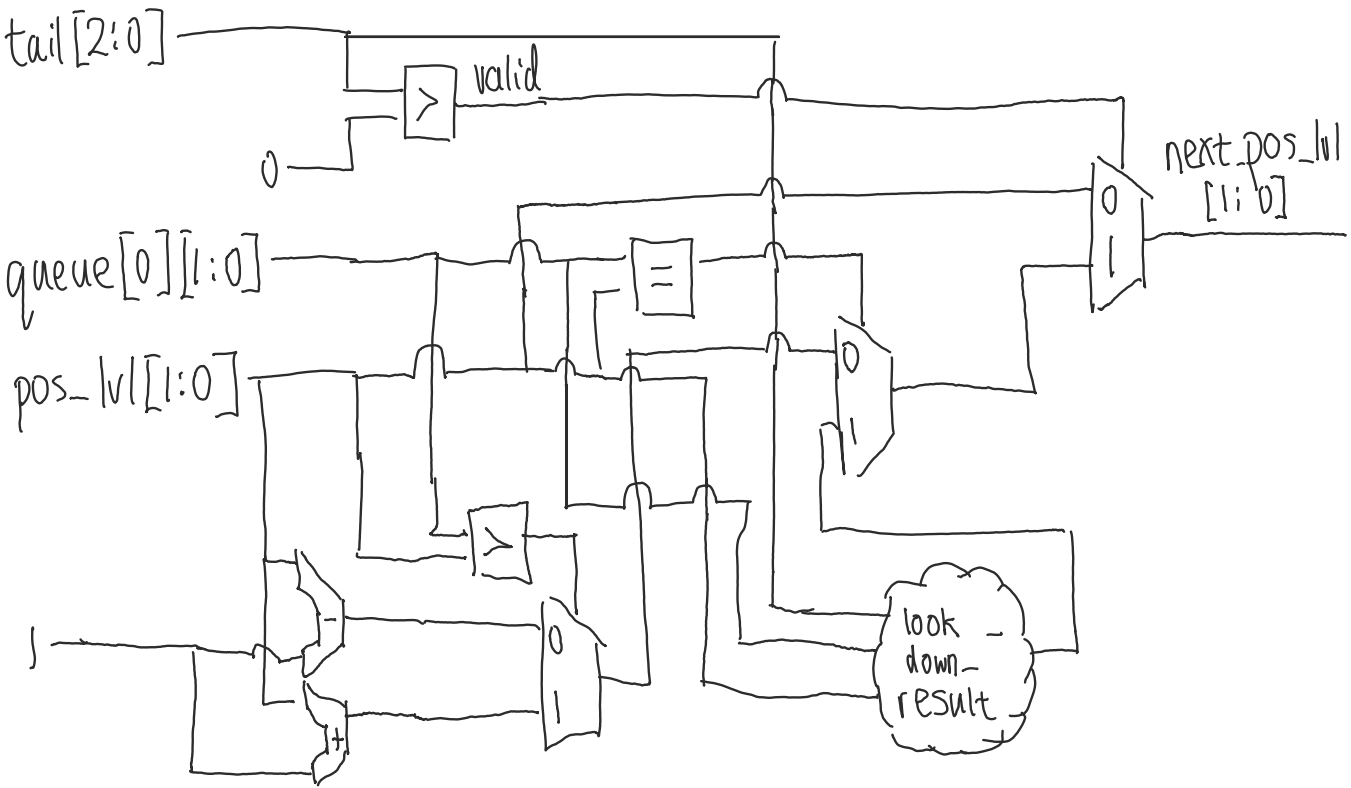


# priority_encoder.v



# next_pos_lvl_logic.v



# look_down_result.v