Synchronous counter (`DGTL_counter_1.sqproj`)

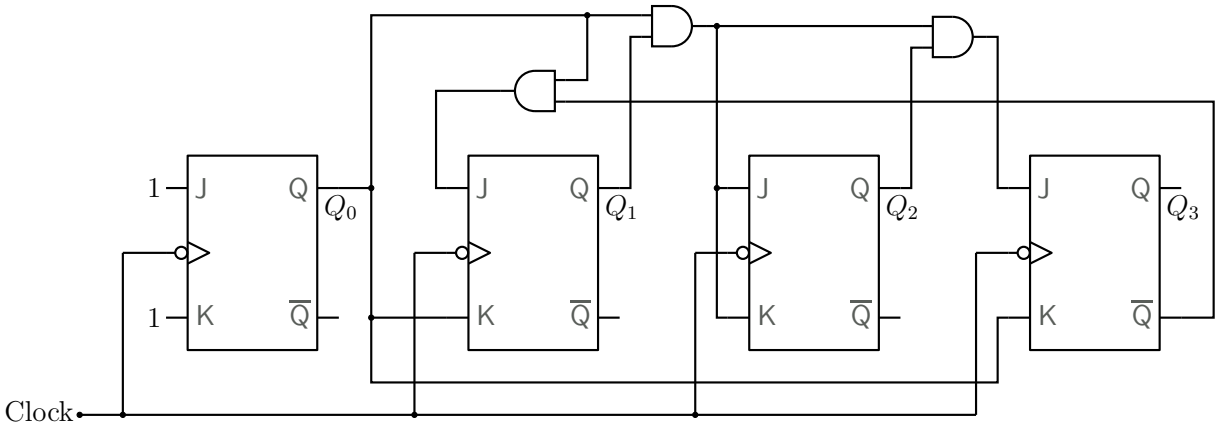

Figure 1: Synchronous counter example.

Question: In the synchronous counter shown in Fig. 1, the initial state is $Q_3Q_2Q_1Q_0 = \texttt{0000}$. Construct the state table for the counter.

Solution:

Since the flip-flops are negative edge-triggered, we look at the inputs for each flip-flop *just before* the negative clock edge, starting with t_1 in Fig. 2. Then, for each flip-flop, using the JK flip-flop transition table, we find its next state which remains constant until the next active clock edge. Repeating this procedure, we obtain the state table and plots shown in Fig. 2.

k	t_k^-												t_k^+			
	Q_3	Q_2	Q_1	Q_0	J_3	K_3	J_2	K_2	J_1	K_1	J_0	K_0	Q_3	Q_2	Q_1	Q_0
1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1
2	0	0	0	1	0	1	0	0	1	1	1	1	0	0	1	0
3	0	0	1	0	0	0	0	0	0	0	1	1	0	0	1	1
4	0	0	1	1	0	1	1	1	1	1	1	1	0	1	0	0
5	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1
6	0	1	0	1	0	1	0	0	1	1	1	1	0	1	1	0
7	0	1	1	0	0	0	0	0	0	0	1	1	0	1	1	1
8	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
9	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1
10	1	0	0	1	0	1	0	0	0	1	1	1	0	0	0	0

Clock	J	K	Q_{n+1}
$\downarrow$	0	0	Q_n
$\downarrow$	0	1	0
$\downarrow$	1	0	1
$\downarrow$	1	1	$\overline{Q}_n$

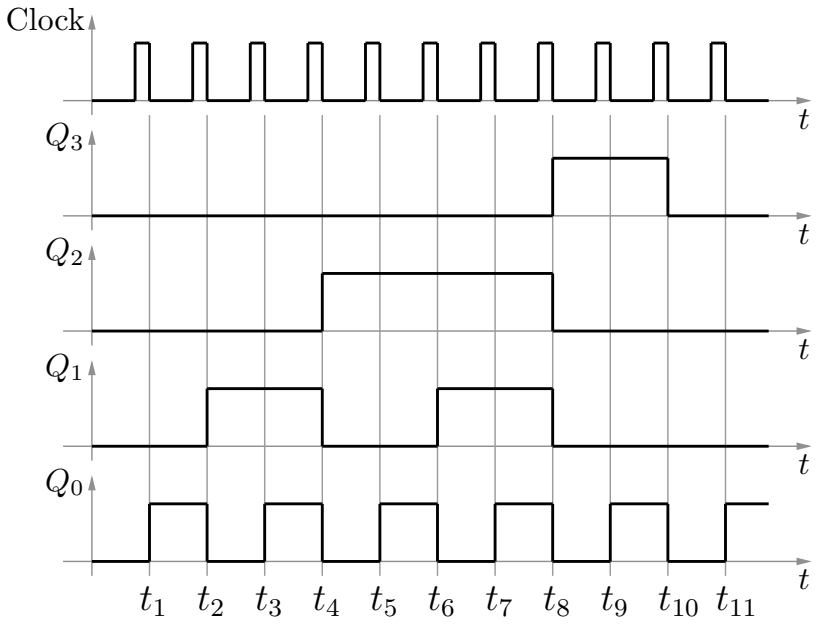

Figure 2: Construction of state table for the counter of Fig. 1.

SequelApp Exercises: In the synchronous counter shown in Fig. 3, the initial state is $Q_2Q_1Q_0 = \texttt{000}$. Construct the state table for the counter.

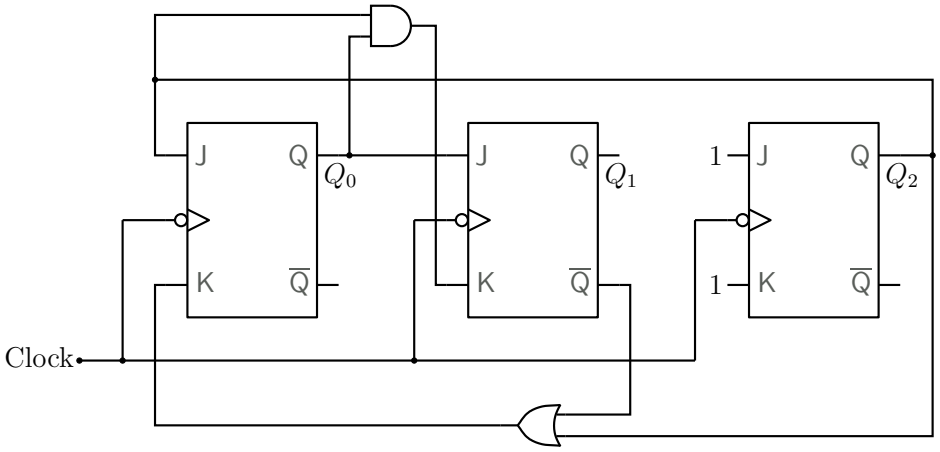

Figure 3: Synchronous counter example.

Verify your answers using SequelApp.