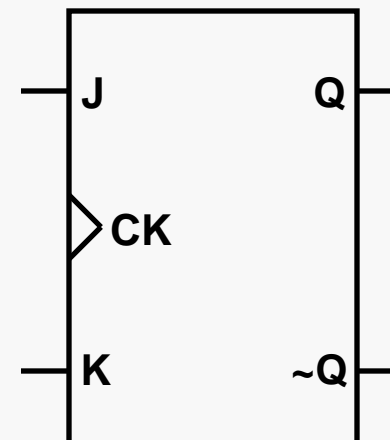


The JK flip-flop takes two data inputs and updates its state Q , on a clock tick, according to the table:

J	K	Q	$\sim Q$

0	0	no change	
0	1	0	1
1	0	1	0
1	1	opposite	

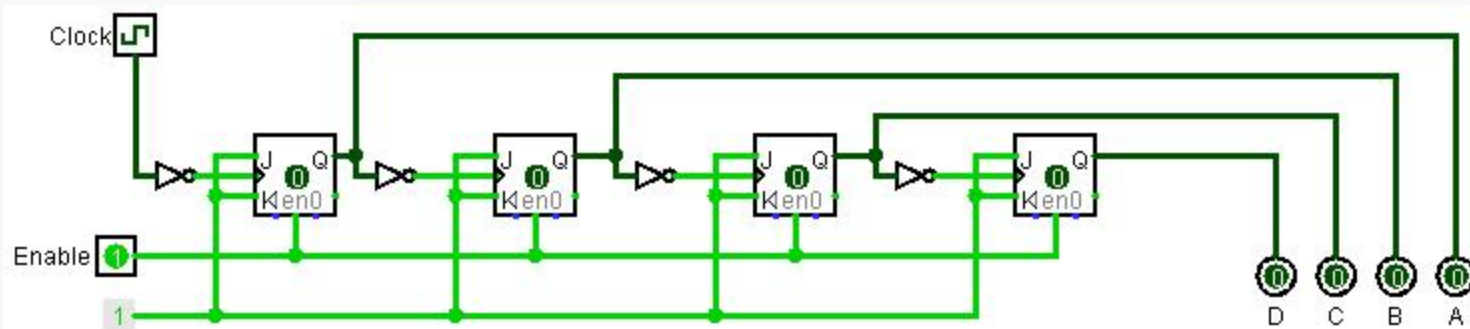


In Logisim, the JK flip-flops updates state on the rising edge (when the clock goes from low to high).

A mod-16 Counter

Counters 2

We can use JK flip-flops to implement a 4-bit counter:



Note that the J and K inputs are all set to the fixed value 1, so the flip-flops "toggle".

As the clock signal runs, the circuit will cycle its outputs through the values

0000, 0001, 0010, . . . , 1111

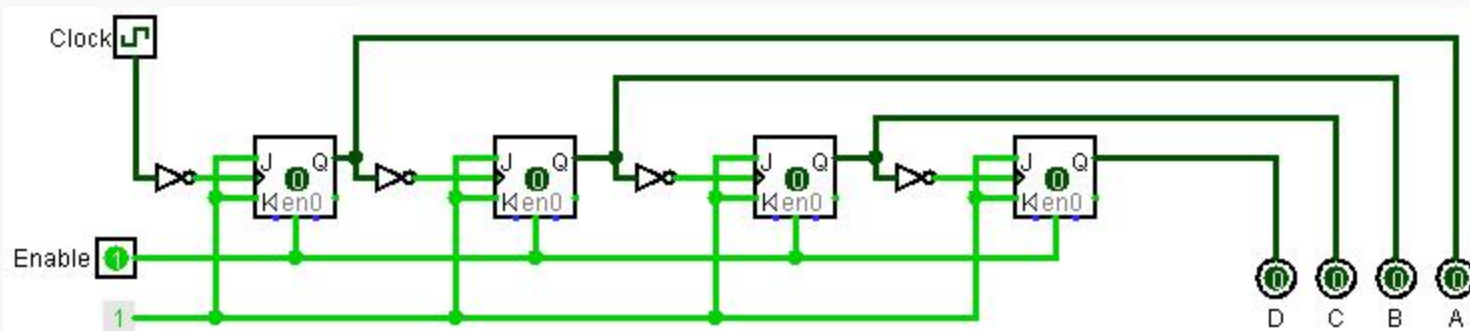
and then repeat the pattern.

So, it counts clock ticks, modulo 16.

mod-16 Counter: first tick

Counters 3

Suppose the counter is in the initial state shown below (output is 0000).

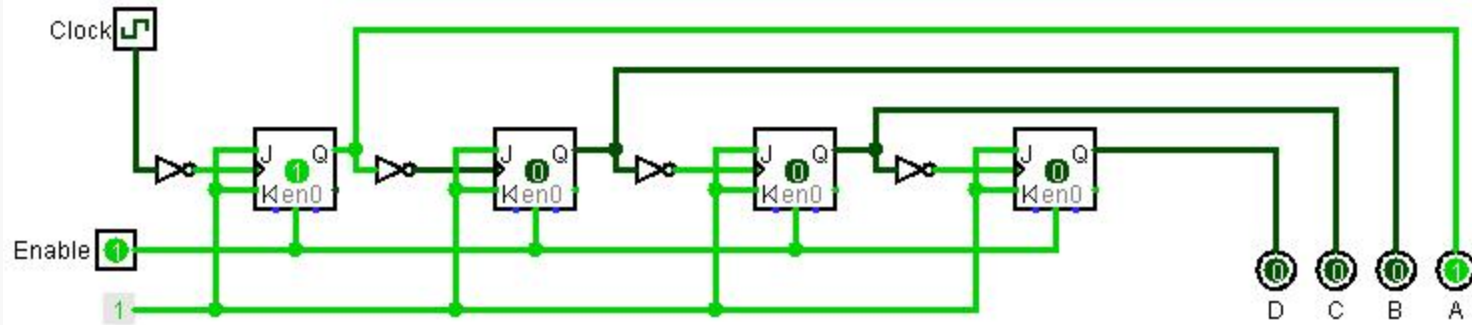


When the clock cycles from high to low:

- the left-most sees its (inverted) clock signal go from low to high, and so it toggles its state to 1
- the next flip-flop sees its clock signal go from high to low, and so it doesn't toggle
- and so, neither do the other flip-flops...

So, the output is 0001.

Suppose the counter is now in the state shown below (output is 0001).

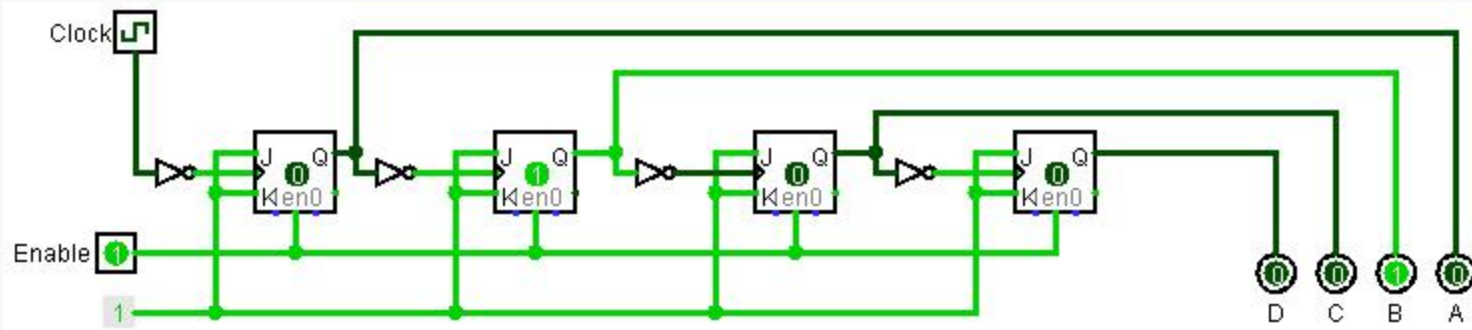


When the clock cycles from high to low (2nd cycle):

- the left-most sees its (inverted) clock signal go from low to high, and so it toggles its state to 0
- the next flip-flop sees its clock signal go from low to high, and so it toggles its state to 1
- the next flip-flop sees its clock signal go from high to low, so it doesn't toggle

So the output is 0010.

Suppose the counter is now in the state shown below (output is 0010).



When the clock cycles from high to low (3rd cycle):

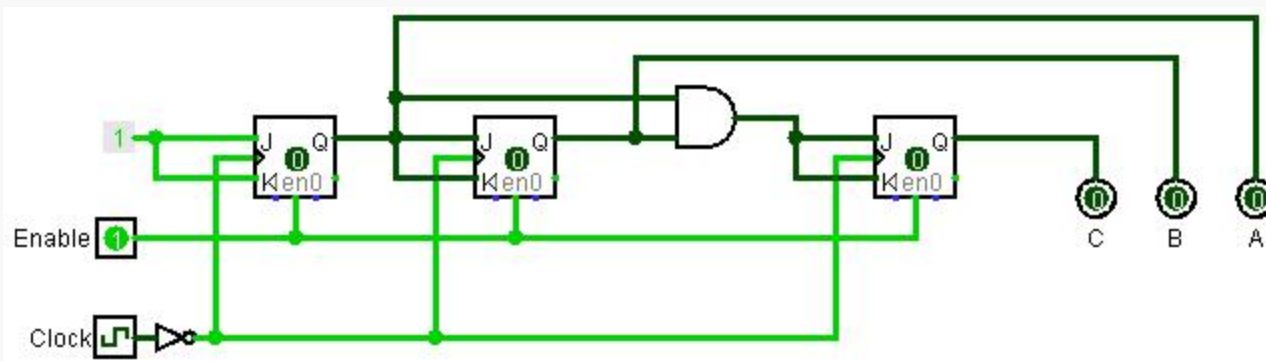
- the left-most sees its (inverted) clock signal go from low to high, and so it toggles its state to 0
- the next flip-flop sees its clock signal go from high to low, and so it doesn't toggle

So the output is 0011.

A mod-8 Parallel Counter

Counters 6

We can use JK flip-flops to implement a 3-bit parallel counter:



As the clock signal runs, the circuit will cycle its outputs through the values
000, 001, 010, . . . , 111
and then repeat the pattern.

So, it counts clock ticks, modulo 8.