Computer Architecture – bi-directional counter assignment

1. Using built-in Logisim “D”-type flip-flops, configure 4 (four) of them to “toggle” by connecting Q’ back to the flip-flop’s D input. With each flip-flop connected in this way, a clock pulse will cause it to reverse its state.
2. Between each flip flop, place a two-to-one line multiplexer, with ‘facing’ = East, ‘include enable’ = no, ‘data bits’ = 1 and finally ‘select bits’ = 1
3. Working from the left-most flip-flop, connect the Q output to the topmost input of the multiplexer between the first and second flip-flops. Connect the Q’ output to the bottom input of the multiplexer.
4. Drive the clock input of the next flip-flop in sequence from the output of the multiplexer.
5. Drive the leftmost (first) flip-flop’s clock from a push button.
6. When you have connected three multiplexers and four flip-flops, create an UP/DOWN line, driven by a single (1) pin, by connecting together all of the “SELECT” lines on all multiplexers (lower left input) to this pin.
7. Use the Q outputs and a splitter to drive a hex display. You should find that when the pin is at “0”, the counter becomes a down counter, but when the pin is a 1, and you are supplying the next clock with Q’, the circuit becomes an up counter.