

COMSM1302 Lab Sheet 3

The treachery of Logisim

1. Nope! You should observe that the output is now updating to D on both rising and falling edges of E, not just rising edges.
2. What's going on is that by adding four more NOT gates, we've increased the propagation delay of the falling edge of E by so much that the en input of the leader latch goes high and the D input propagates through to the follower latch before the en input of the follower latch goes low, causing the output to change.
3. You should see that the lights representing the outputs of the NAND gates are on at a reduced brightness compared to a normal 1 output. What's going on here is again a matter of propagation delay - the circuit is oscillating between one state in which the five lines are 1, 0, 1, 0, and 1, and another state in which the five lines are 0, 1, 0, 1, and 0. This oscillation is happening too fast to see, but on average the LEDs are receiving half as much voltage as normal, so they appear dimmer.

This circuit is called a *ring oscillator*. In principle you could use it to output a clock signal, but the frequency is very inconsistent and depends on e.g. the temperature of the circuit boards — in fact, the variations in frequency are sometimes used as a source of hardware-based randomness.