# Computer Systems Week 3 Lab

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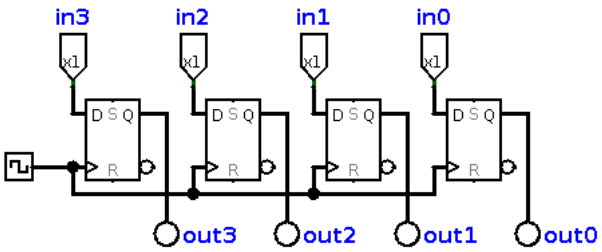
Big Endian 4 Bit Register

| Qx | input | output |
|---|---|---|
| 0 | 0000 | 0000 |
| 1 | 0001 | 0001 |
| 2 | 0010 | 0010 |
| 3 | 0011 | 0011 |
| 4 | 0100 | 0100 |
| 5 | 0101 | 0101 |
| 6 | 0110 | 0110 |
| 7 | 0111 | 0111 |
| 8 | 1000 | 1000 |
| 9 | 1001 | 1001 |
| A | 1010 | 1010 |
| B | 1011 | 1011 |
| C | 1100 | 1100 |
| D | 1101 | 1101 |
| E | 1110 | 1110 |
| F | 1111 | 1111 |




Hardware counters are useful for things like progress displays, especially on simpler pieces of hardware that might not have or need software implementations to operate.

A ripple counter works similar to how the name implies. Every JK flip flop in the counter has both the J and K inputs on so that it works as a T flip flop. The thing that makes this work then is that clock input, since each JK flip flop has it's clock input

connected to the previous one's Q output. Because of this each subsequent flip flop will only be able to toggle it's input once the previous flip flop's Q output is on, "rippling" the counting down the chain of flip flops.

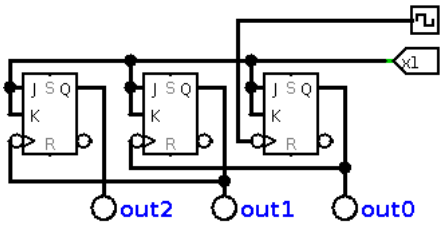



Figure 1: Big endian 3 bit ripple counter

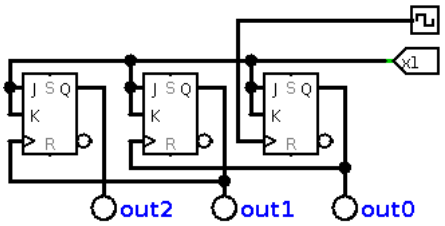



Figure 2: Big endian 3 bit reverse ripple counter

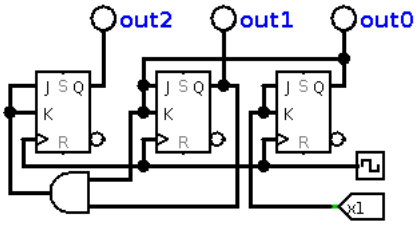



Figure 3: Big endian 3 bit common clock counter

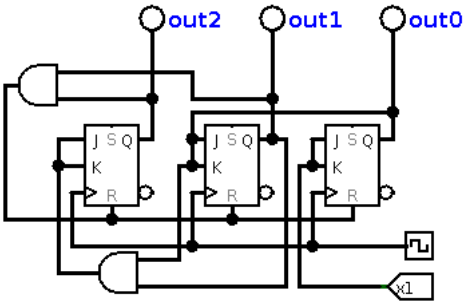



Figure 4: Big endian 3 bit common clock counter MOD 6

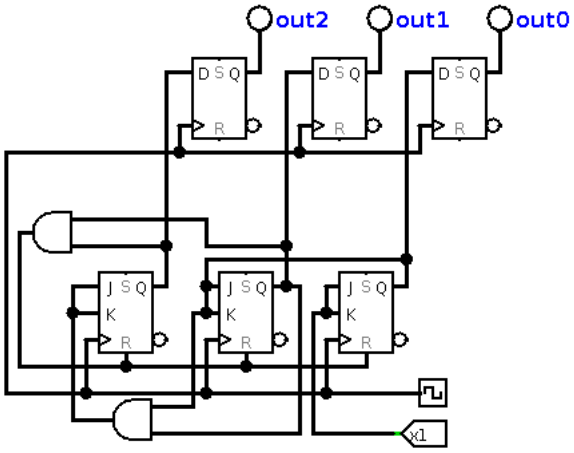



Figure 5: Big endian 3 bit common clock counter MOD 6 with register

Using a register to handle illegal states is very important because while we are just simulating things within a program where timing between things is very consistent and easy to predict, if an illegal state slips by in an actual physical circuit then you may run into issues with that state in a later part of the circuit that it feeds into, causing unpredictable behaviour.

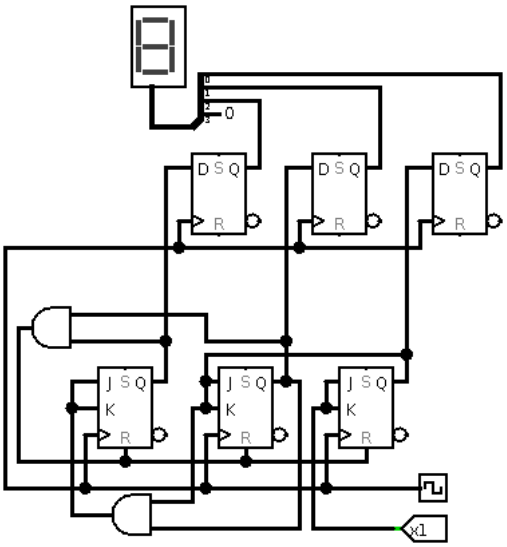



Figure 6: Big endian 3 bit common clock counter MOD 6 with register and hex display