Computer Systems Week 2 Lab

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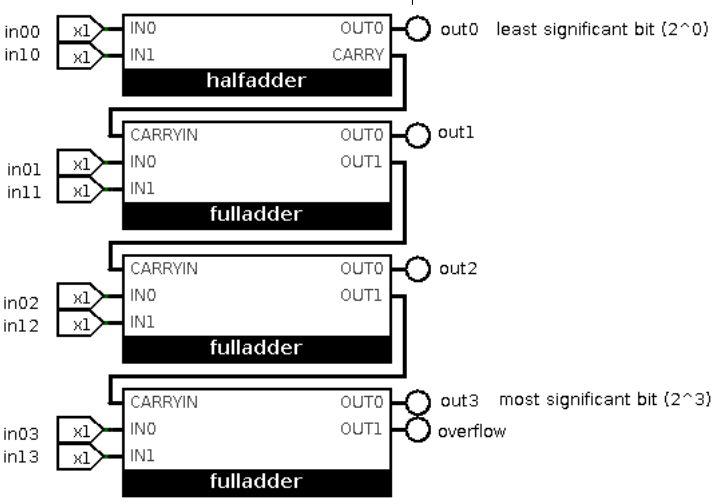
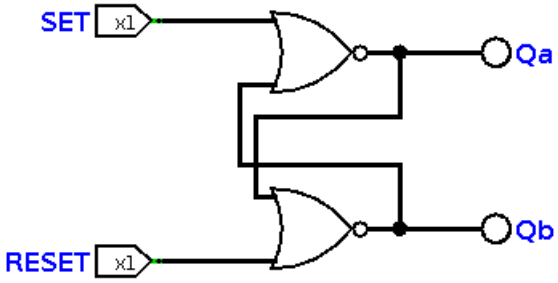
4-Bit Binary Adder

input0	input1	output
0101	0000	00101
0101	0001	00110
0101	0010	00111
0101	0011	01000
0101	0100	01001
0101	0101	01010
0101	0110	01011
0101	0111	01100
0101	1000	01101
0101	1001	01110
0101	1010	01111
0101	1011	10000
0101	1100	10001
0101	1101	10010
0101	1110	10011
0101	1111	10100



RS Flip Flop

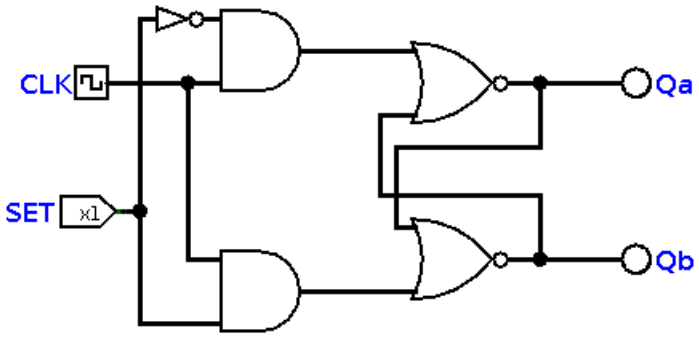
set	reset	Qa	Qb
1	0	0	1
1	1	0	0
0	1	1	0
1	1	0	0



When both inputs are on then both outputs turn off, which in a flip flop is an invalid state since Qb should always be the inverse of Qa. The reason why this is an issue is because if we go from a state where both inputs are on to one where both are off, in the physical realm we cannot predict what it's output would be since it would ultimately depend on which one is off first.

D Flip Flop

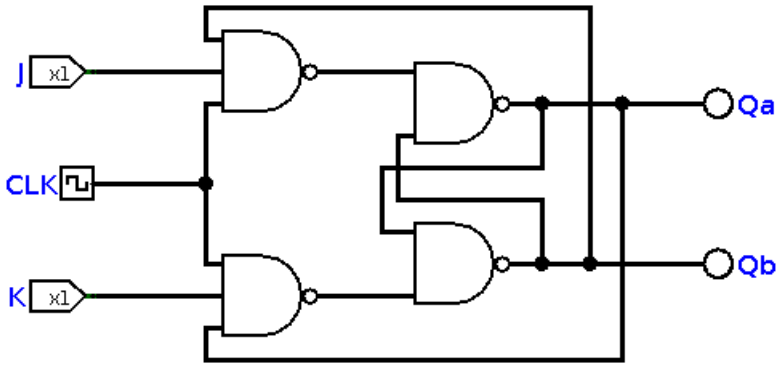
clk	set	Qa	Qb
0	0	0	1
0	1	0	1
1	1	1	0
1	0	0	1



The D Flip Flop works by matching the set input when the clock input is on. This allows us to synchronize it to a circuit's clock which is useful in circuit design for time sensitive tasks where you need to be sure that certain actions are synchroized with each other. This is used over the RS Flip Flop because it is both synchronized to a clock as well as completely safe to indeterminite states, or in other words the output is always predictable.

JK Flip Flop

J	K	Qa	Qb
0	0	0	1
1	0	1	0
0	1	0	1
1	1	1	0



The reason why the JK Flip Flop is considered a more programmable and general purpose flip flop is because of how you can adapt it's use to a D or T Flip Flop. To make it work like a D Flip Flop you simply control it with the J and K inputs to make Qa on or off respectively on a clock cycle. To make it work like a T Flip Flop then all you need to do is turn both J and K inputs on, which will in turn toggle Qa on and off with each clock cycle.