

count bits

5  
8

for i 0 → 31

$$\text{sum} += (x \& (1 \ll i)) \gg i$$

$$(x \gg i) \& 1$$

$$\begin{array}{r}
 (3, 5, 2, 1) \rightarrow 03050201 \\
 + (4, 9, 8, 7) \rightarrow 04090807 \\
 \hline
 \boxed{07} \boxed{14} \boxed{10} \boxed{08}
 \end{array}$$

↑

$$a = x \& 0b10101010 \dots 1010$$

$$b = x \& 0b0101 \dots 0101$$

$$(a \gg 1) + b \longrightarrow$$

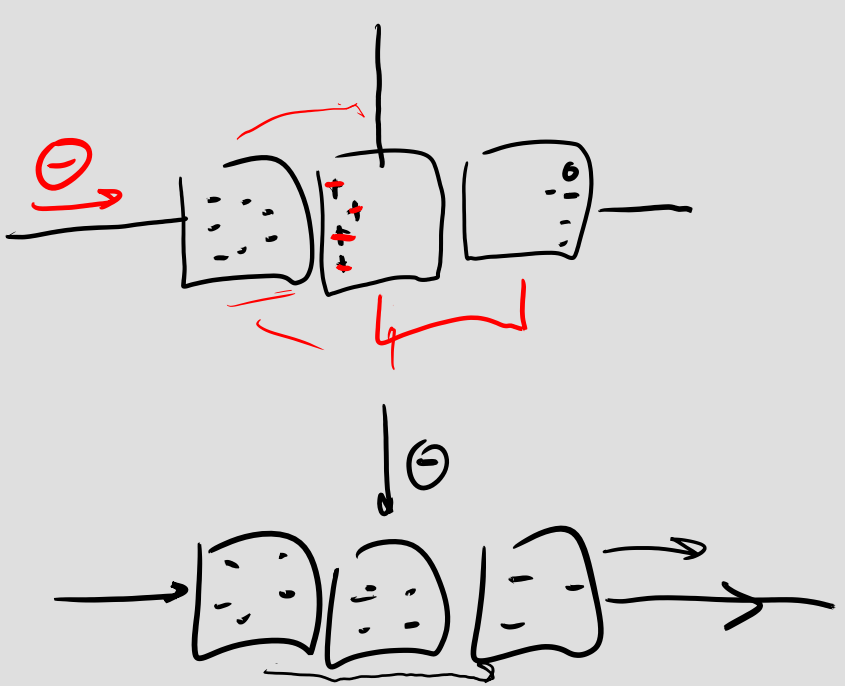
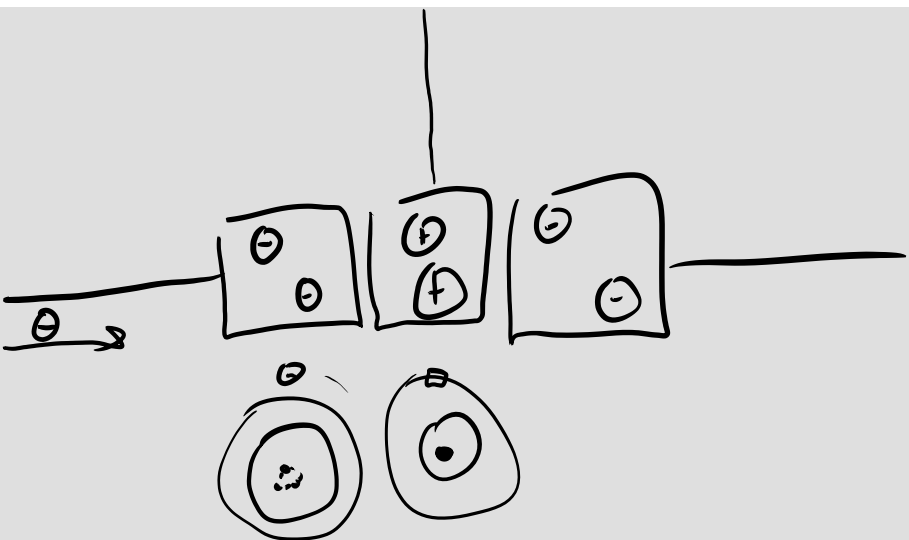


$(1101011100111)x$

\*

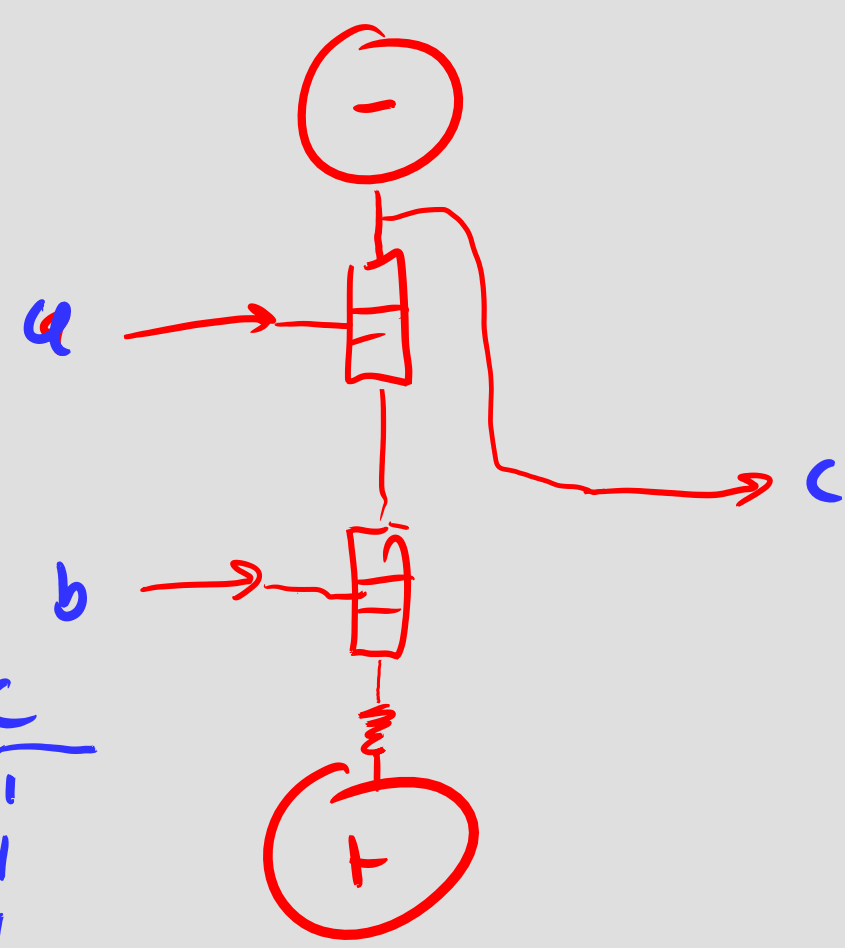
101  
↑ ↑

$$x + x \ll 2 \equiv S * x$$



a	b	c
0	0	1
1	0	1
0	1	1
1	1	0

$\text{nor}(a \oplus b)$



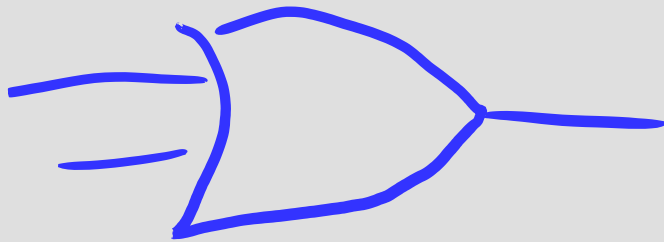
and



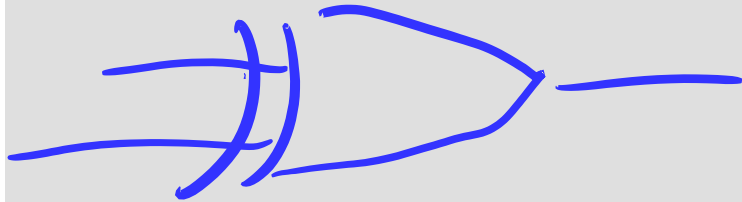
nand



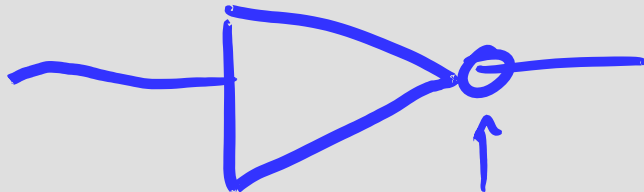
or

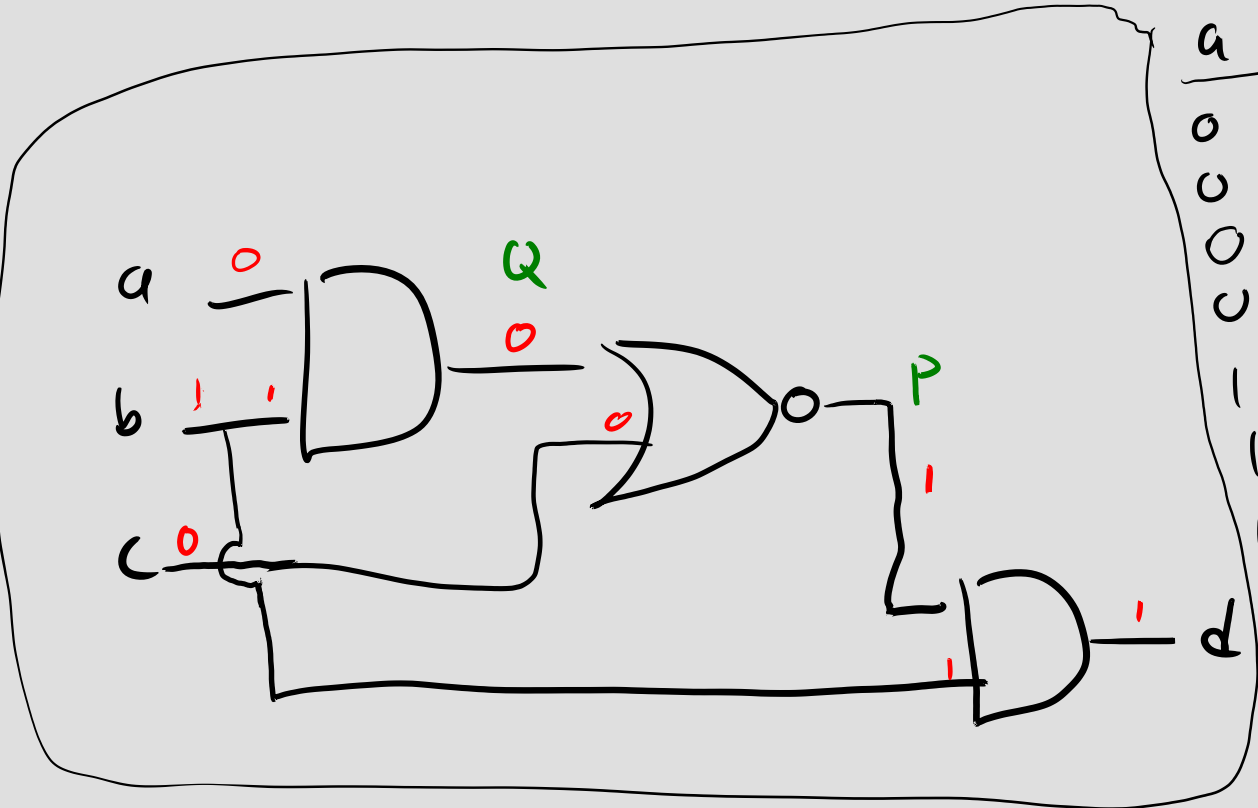


xor



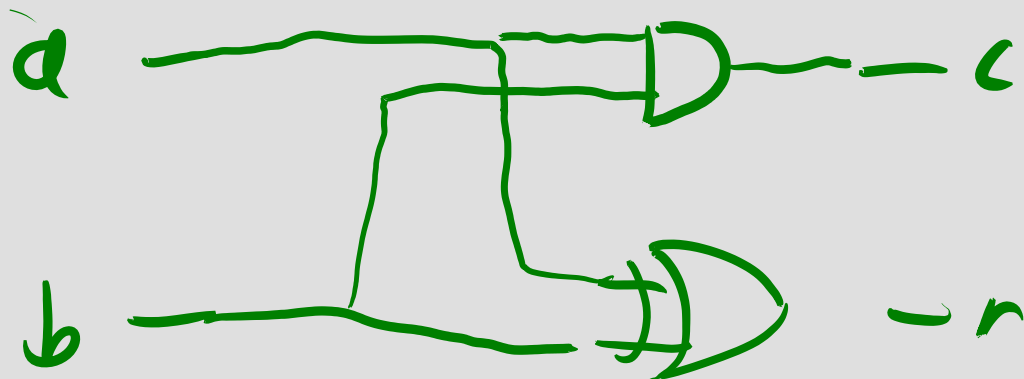
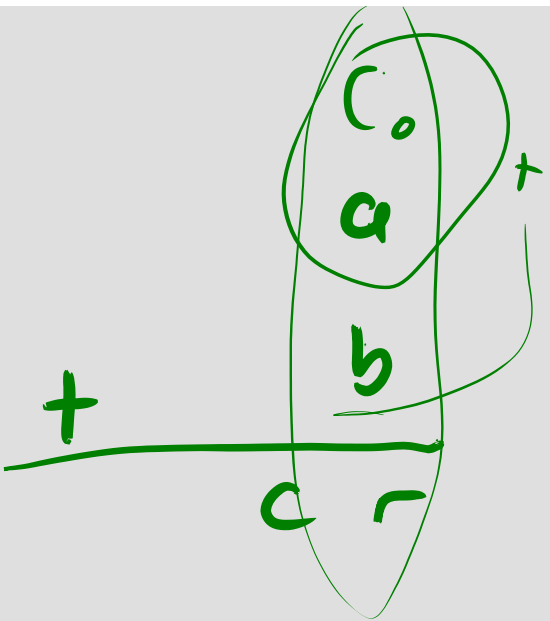
not





a	b	c	d	Q	P
0	0	0	0	0	1
0	0	1	0	0	0
0	1	0	1	0	1
0	1	1	0	0	0
1	0	0	0	0	1
1	0	1	0	0	0
1	1	0	1	1	0
1	1	1	1	1	0

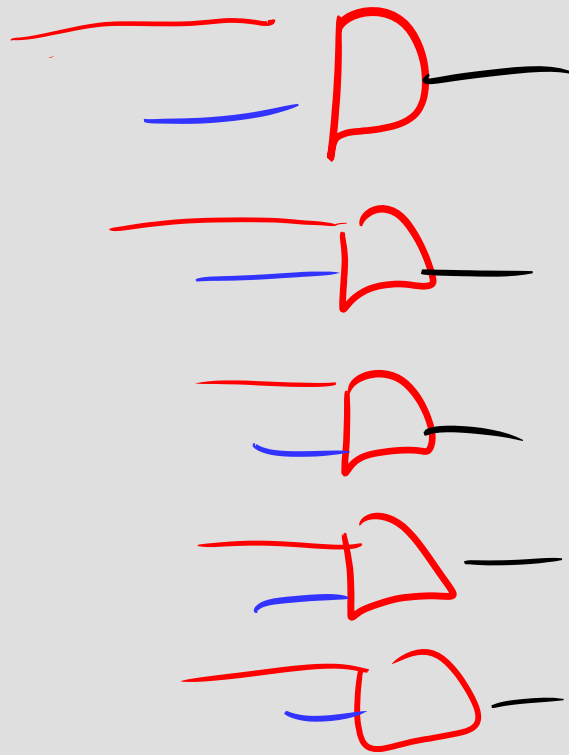
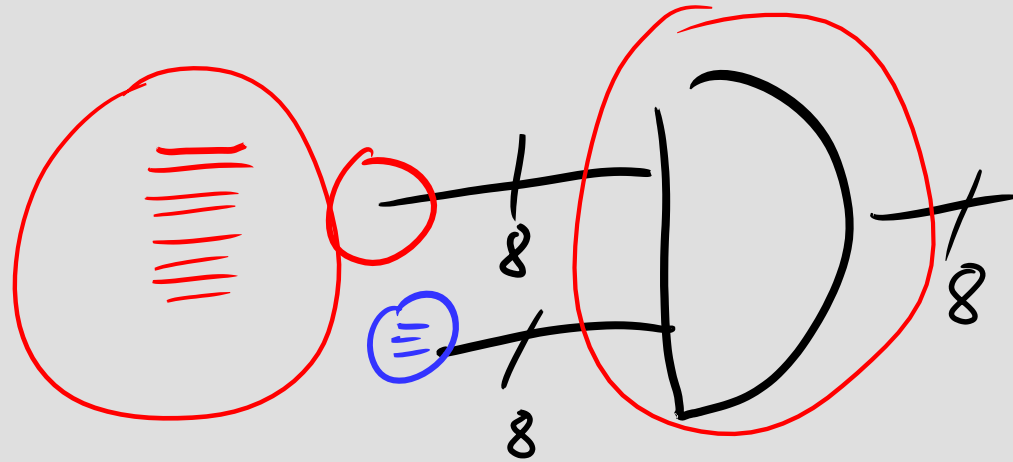
$\oplus$



1  
1  
0

1 0 1  
0 1 1  
1 1 1

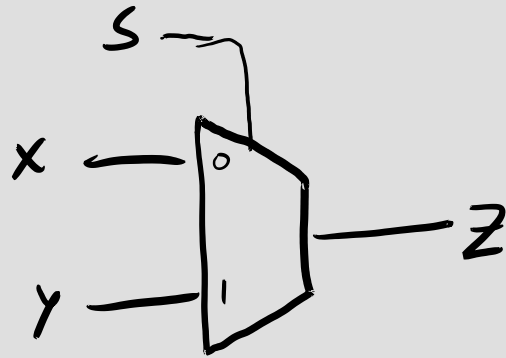
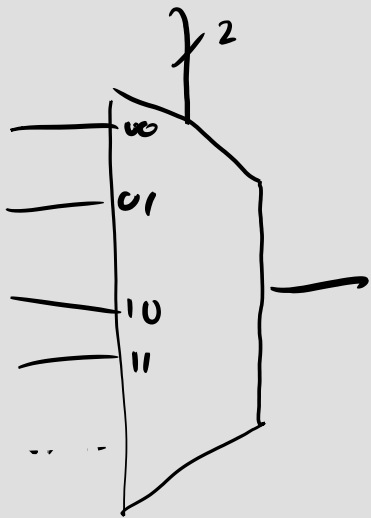
# Multi-bit wires



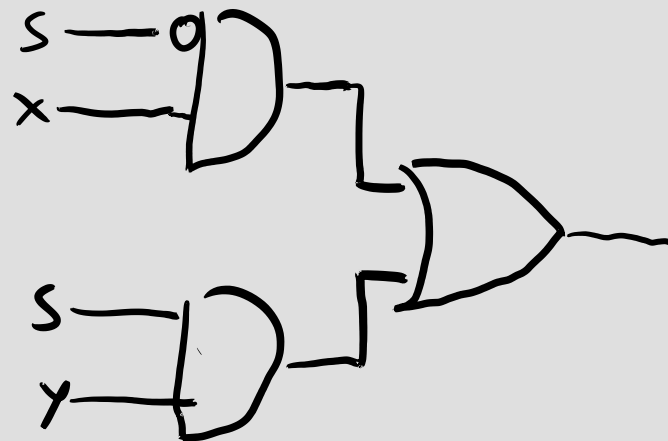


multiplexer

mux



if ( $s == 0$ )  $z = x$   
else  $z = y$



$z = s ? x : y$