Encoder

An encoder is a circuit that changes a set of signals into a code. Let's begin making a 2-to-1 line encoder truth table by reversing the 1-to-2 decoder truth table.

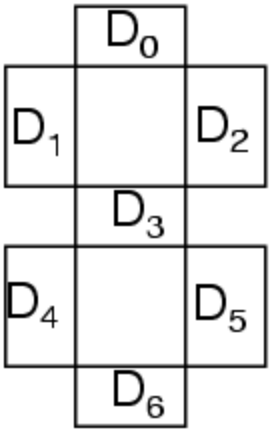
D_1	D_0	A
0	1	0
1	0	1

This truth table is a little short. A complete truth table would be

D_1	D_0	A
0	0	
0	1	0
1	0	1
1	1	

One question we need to answer is what to do with those other inputs? Do we ignore them? Do we have them generate an additional error output? In many circuits this problem is solved by adding sequential logic in order to know not just what input is active but also which order the inputs became active.

A more useful application of combinational encoder design is a binary to 7-segment encoder. The seven segments are given according



Our truth table is:

I_3	I_2	I_1	I_0	D_6	D_5	D_4	D_3	D_2	D_1	D_0
0	0	0	0	1	1	1	0	1	1	1
0	0	0	1	0	0	1	0	0	1	0
0	0	1	0	1	0	1	1	1	0	1
0	0	1	1	1	0	1	1	0	1	1
0	1	0	0	0	1	1	1	0	1	0
0	1	0	1	1	1	0	1	0	1	1
0	1	1	0	1	1	0	1	1	1	1
0	1	1	1	1	0	1	0	0	1	0
1	0	0	0	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1	0	1	1

Deciding what to do with the remaining six entries of the truth table is easier with this circuit. This circuit should not be expected to encode an undefined combination of inputs, so we can leave them as "don't care" when we design the circuit. The boolean equations are

$$D_0 = I_3 + I_1 + \bar{I}_3\bar{I}_2\bar{I}_1\bar{I}_0 + \bar{I}_3I_2\bar{I}_1I_0$$

$$D_1 = I_3 + \bar{I}_2\bar{I}_1 + I_2\bar{I}_1 + I_2\bar{I}_0$$

$$D_2 = I_2 + \bar{I}_3I_2\bar{I}_1\bar{I}_0 + \bar{I}_3I_2I_1I_0$$

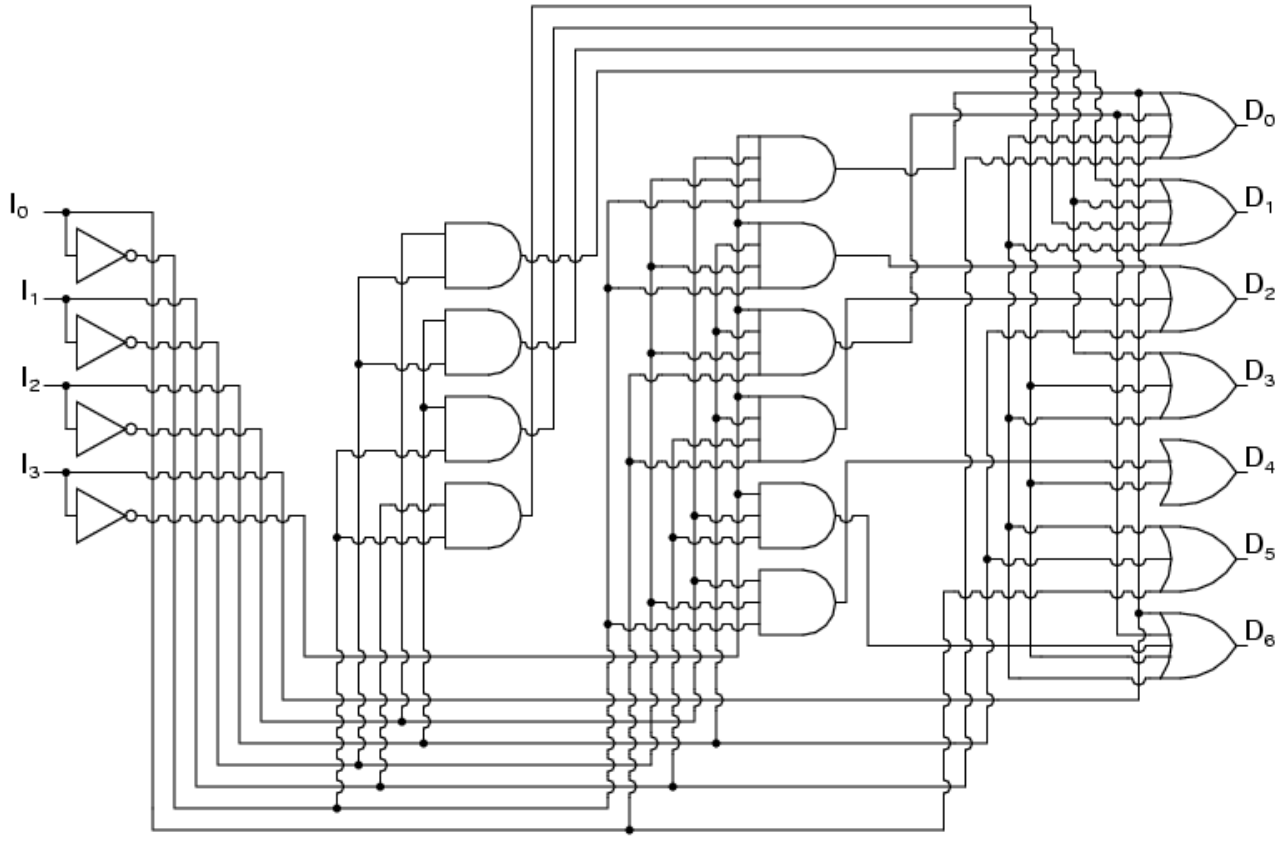
$$D_3 = I_3 + I_1\bar{I}_0 + I_2\bar{I}_1$$

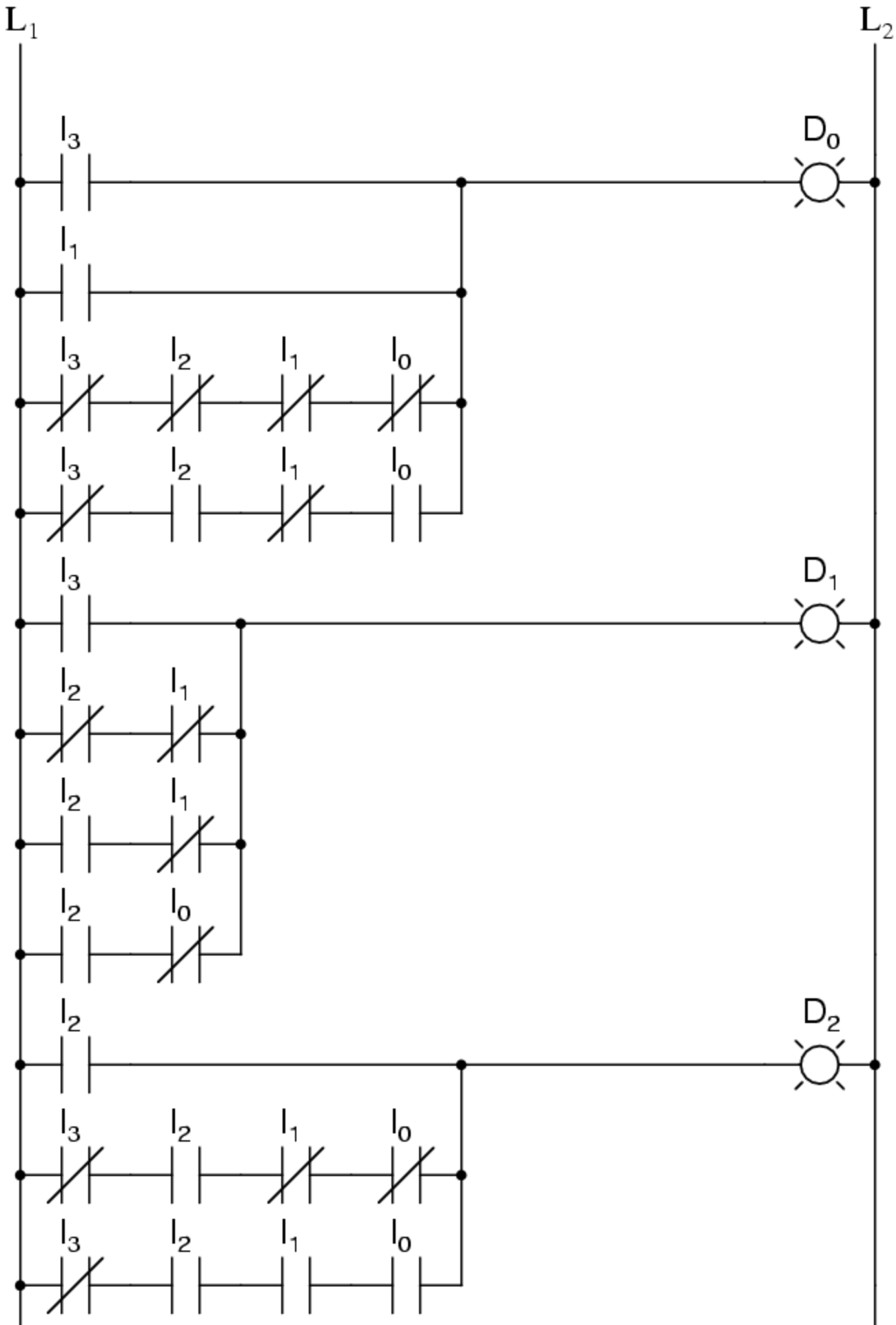
$$D_4 = I_1\bar{I}_0 + \bar{I}_2\bar{I}_1\bar{I}_0$$

$$D_5 = I_3 + I_2 + I_0$$

$$D_6 = I_3 + I_1\bar{I}_0 + \bar{I}_3\bar{I}_2I_1 + \bar{I}_3\bar{I}_2\bar{I}_1\bar{I}_0 + \bar{I}_3I_2\bar{I}_1I_0$$

and the circuit is




L1
L2
I3
D0
I1
I3 I2 I1 I0
I3 I2 I1 I0
I3
D1
I2 I1
I2 I1
I2 I0
I2
D2
I3 I2 I1 I0
I3 I2 I1 I0

Source: http://www.allaboutcircuits.com/vol_4/chpt_9/5.html