INF2270, equivalence of Boolean expressions and making a decoder from a demultiplexer

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April 20, 2010

Abstract

Equivalence of two boolean expressions

In the last lecture an example Karnaugh map has been discussed and a simple functional expression has been derived, once using regions of 1's in the K-map and once regions of 0's. The result were two different Boolean expressions, which necessarily define the same function, since they have been derived from the same truth table. The two expressions were:

$$F = a \wedge \bar{c} \vee a \wedge \bar{d} \vee \bar{b} \wedge \bar{c} \wedge \bar{d} \quad (1)$$
$$F = (a \vee \bar{d}) \wedge (a \vee \bar{c}) \wedge (a \vee \bar{b}) \wedge (\bar{c} \vee \bar{d}) \quad (2)$$

Can you show, that those two expressions define the same function by stepwise applying rules for equivalency of Boolean expression (see lecture from January 18th, page 10) to expression (1) until you get (2)?

Building a decoder from a demultiplexer

In the lecture from January 25th and in the repetition of April 19th we discussed one implementation variant of a decoder and a demultiplexer. The 3-bit decoder implementation that was shown was composed of 3 inverters and 8 three-port AND gates (figure 1). The demultiplexer implemenatation then made use of the decoder, with additional 8 AND gates (figure 2). Note, that these are by no means the only ways to implement these two circuits. Thus, it is also possible to implement a 3-bit decoder quite compactly by assuming that one has a functional 3-bit demultiplexer as a building block, i.e. the other way round than presented in the lecture. Can you show how?

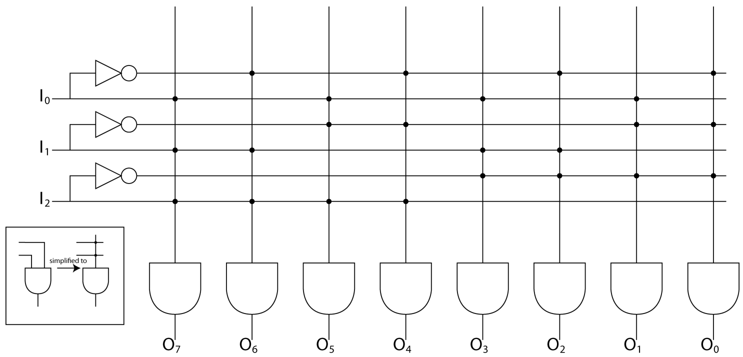

Figure 1: 3-bit decoder, possible implementation

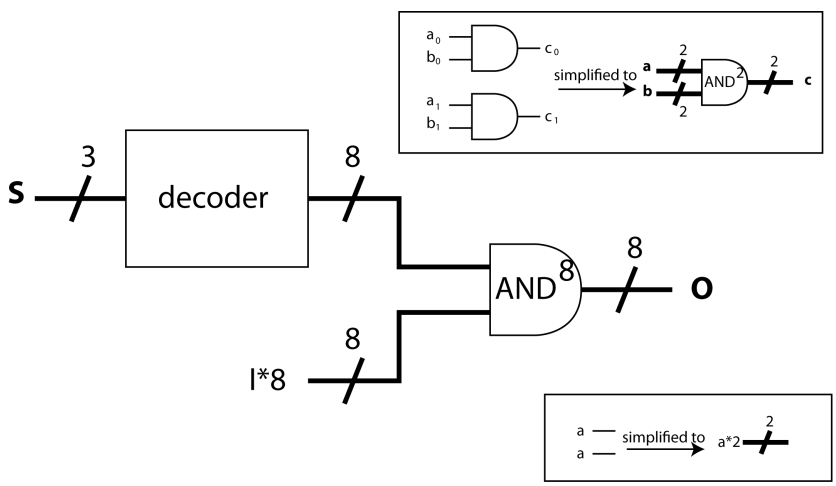

Figure 2: 3-bit demultiplexer, possible implementation