

Design of Combinatorial Circuits I

Please do the following exercises individually.

Chip Production

The chips produced in a factory have got a four-bit serial number. There was a malfunction on one of the assembly lines. Every chip whose third bit is set are defective. Your boss asks you to design a digital circuit which sorts these chips out.

In order to design the digital circuit, please form the state table. Minimize the normal function with the aid of a Karnaugh map. The switching function can then be transformed into a digital circuit.

A XOR Gate with three Input Lines

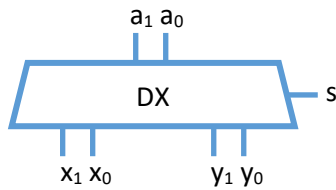
Your client needs a XOR gate with three input lines. Please create a state table for $a \oplus b \oplus c$ and then design the gate for your client.

Design of Combinatorial Circuits II

Please do the following exercises individually.

Demultiplexer

A demultiplexer is the counterpart of a multiplexer. Look at Wikipedia¹ to see the interplay of a multiplexer and a demultiplexer. Please design a two bit two way demultiplexer. Look at the following graphical symbol and formal description for details.



Formal description

$$DX: \{0,1\}^3 \mapsto \{0,1\}^4$$

$$(s, a_1, a_0) \rightarrow (x_1, x_0, y_1, y_0) := \begin{cases} (0, 0, a_1, a_0) & \text{if } s = 0 \\ (a_1, a_0, 0, 0) & \text{if } s = 1 \end{cases}$$

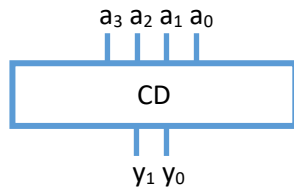
¹ http://en.wikipedia.org/wiki/Demultiplexer#Cost_savings

Design of Combinatorial Circuits III

Please do the following exercises individually.

Coder

A coder tells you which line is active. An interrupt controller may use a coder. If interrupt line three is active it requests the controller to execute interrupt no 3. Please design a four bit coder. Look at the following graphical symbol and formal description for details.



Formal description

$$\text{CD}: \{0,1\}^4 \mapsto \{0,1\}^2$$

$$(a_3, a_2, a_1, a_0) \rightarrow \begin{cases} i & \text{if only one } a_i = 1 \\ \text{undefined} & \text{otherwise} \end{cases}$$

Please remember that undefined values are don't-care terms which may help to find a better optimization.