1 Exercise 2

Having the function in maxterms

$$f_1(A,B,C,D) = \prod(M_0, M_1, M_5, M_7, M_8, M_{10}, M_{14}, M_{15})$$

equivalent to

$$f_2(A,B,C,D) = \sum(m_2, m_3, m_4, m_6, m_9, m_{11}, m_{12}, m_{13})$$

using minterms, can be simplify by different ways and represented using logic gates.

1.1 Boolean Algebra

Using the Boolean algebra propertie

$$(A+B).(A+\overline{B}) = A \ (1)$$

or

$$(AB) + (A\overline{B}) = A \ (2)$$

the function could be simplify using (1):

$$\begin{aligned}
f_1(A,B,C,D) = {} & (A+B+C+D).(A+B+C+\overline{D}).(A+\overline{B}+C+\overline{D}).(A+\overline{B}+\overline{C}+\overline{D}). \\
& (\overline{A}+B+C+D).(\overline{A}+B+\overline{C}+D).(\overline{A}+\overline{B}+\overline{C}+D).(\overline{A}+\overline{B}+\overline{C}+\overline{D}) \\
= {} & (A+B+C).(A+\overline{B}+\overline{D}).(\overline{A}+B+D).(\overline{A}+\overline{B}+\overline{C})
\end{aligned}$$

Which in minterms would be, using (2):

$$\begin{aligned}
f_2(A,B,C,D) = {} & (\overline{AB}C\overline{D}) + (\overline{AB}CD) + (\overline{A}B\overline{CD}) + (\overline{A}BC\overline{D}) + \\
& (A\overline{BC}D) + (A\overline{B}CD) + (AB\overline{CD}) + (AB\overline{C}D) \\
= {} & (A\overline{B}D) + (\overline{A}B\overline{D}) + (\overline{AB}C) + (AB\overline{C})
\end{aligned}$$

1.2 Karnaugh Map

Karnaugh map is a easier way to simplify logic experesion when the functions are too complex or too large to handle, cause Karnaugh map gives a more representative view for a faster analisis for it to simplify.

If the simplification is done with minterms, the groups should be of 1, adding each group in case there is more than 1, and in each group the independent variables would be multiplied.

CD \ AB	00	01	11	10
00	0	1	1	0
01	0	0	1	1
11	1	0	0	1
10	1	1	0	0

Now grouping the colour groups we get that the function in minterms would be:

$$\begin{aligned} f_2(A,B,C,D) = {} & (A\overline{B}D)\ (Red) \\ & +(\overline{A}B\overline{D})\ (Blue) \\ & +(\overline{A}\overline{B}C)\ (Orange) \\ & +(AB\overline{C})\ (Green) \end{aligned}$$

The same method could be done with maxterms, grouping O, multipling groups in case there is more than 1, and in each group the independent variables would be added.