Digital Logic Circuits

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January 25, 2023

- Canonical POS Forms

    - Product of Sums / Conjunctive Normal Form / Maxterm Expansion

A	B	C	Maxterms
0	0	0	$\mathbf{A} + \mathbf{B} + \mathbf{C} = M0$
0	0	1	$\mathbf{A} + \mathbf{B} + \bar{\mathbf{C}} = M1$
0	1	0	$\mathbf{A} + \bar{\mathbf{B}} + \mathbf{C} = M2$
0	1	1	$\mathbf{A} + \bar{\mathbf{B}} + \bar{\mathbf{C}} = M3$
1	0	0	$\bar{\mathbf{A}} + \mathbf{B} + \mathbf{C} = M4$
1	0	1	$\bar{\mathbf{A}} + \mathbf{B} + \mathbf{C} = M5$
1	1	0	$\bar{\mathbf{A}} + \bar{\mathbf{B}} + \mathbf{C} = M6$
1	1	1	$\bar{\mathbf{A}} + \bar{\mathbf{B}} + \bar{\mathbf{C}} = M7$

    - This can be rewritten as:

$$\mathbf{F} = (\mathbf{A} + \mathbf{B} + \mathbf{C})(\mathbf{A} + \mathbf{B} + \bar{\mathbf{C}})(\mathbf{A} + \bar{\mathbf{B}} + \mathbf{C}) = \prod M(0, 1, 2)$$

    - The terms numbered $M < \# >$ is known as the maxterm shorthand
    - It is best to choose whichever form (product or sum) gives the least terms

- Sample Design (or Quiz) Problem

    - A sound alarm is connected to three environmental sensors. The alarm is triggered only when any two out of three, or all three inputs from the sensors are high

        1. Set up a truth table for the output of the alarm system

a	b	c	f(a,b,c)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

        2. Find the boolean expression for the output
            * As a sum of products

$$\bar{a}bc + a\bar{b}c + ab\bar{c} + abc$$

        3. Draw the combinational logic circuit diagram for output
           The number of "and" gates for any sum of products would be proportional to the amount of terms. For the above from (2), there will be 4 "and" gates leading to an "or" gate

- The first step would be to create a "black box" and define and name inputs and outputs
  * Try to give meaningful names
  * Not just something like i, j, k, etc.