EEC 18

Oct. 7

Word problems

1) Figure out inputs and outputs

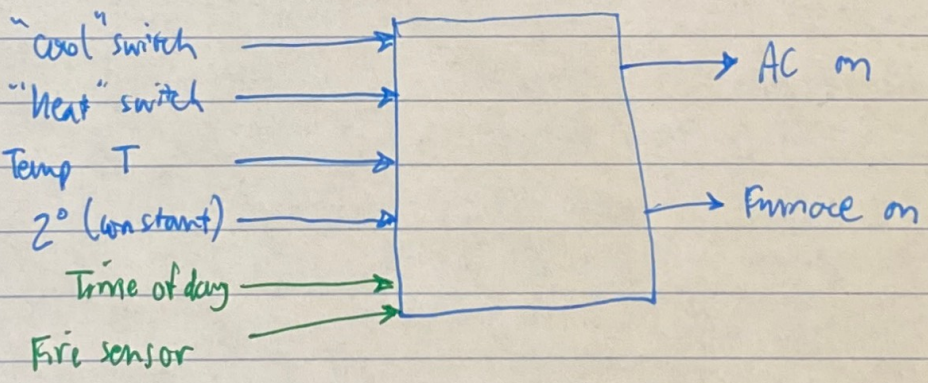
2) Understand relationship between inputs + outputs

3) Write an expression for each output

- Each output is an independent problem

Ex: Thermostat for HVAC

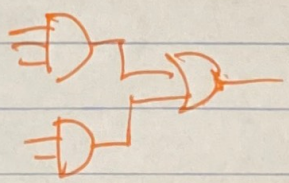
1) AC on if "cool" on and Temp $\geq 2°$ + setting
2) Furnace on if "heat" on " " $\leq$ setting $-2°$



Methods to describe Boolean expressions:

1) Simple English (if A=1 and B=0, then out=1)

2) Circuit schematic



3) Truth Table

enumerate all input combinations

inputs	output(s)

4) Expression

A + B · C , SOP , POS

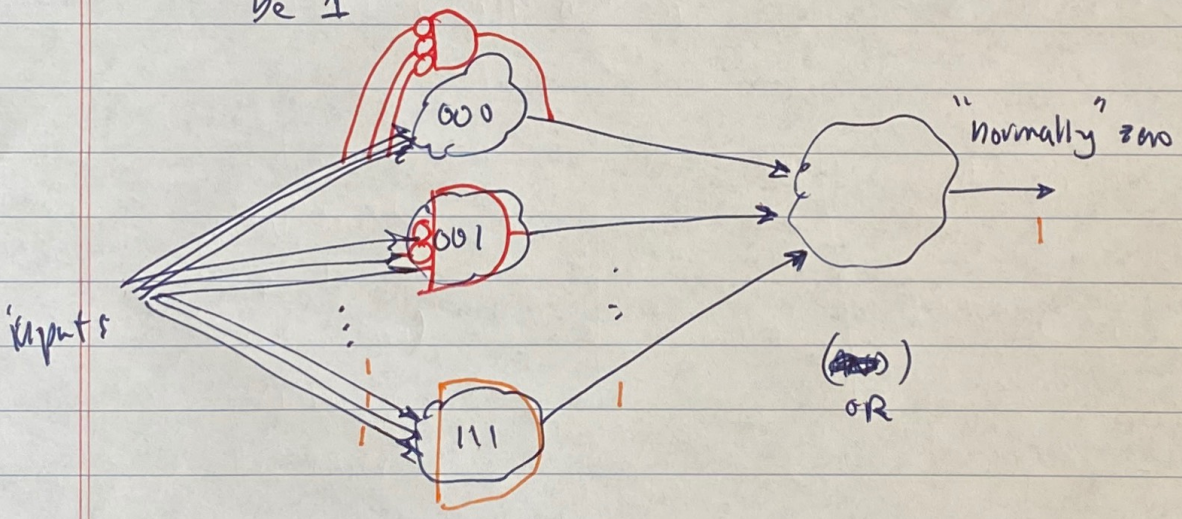
5) Min term

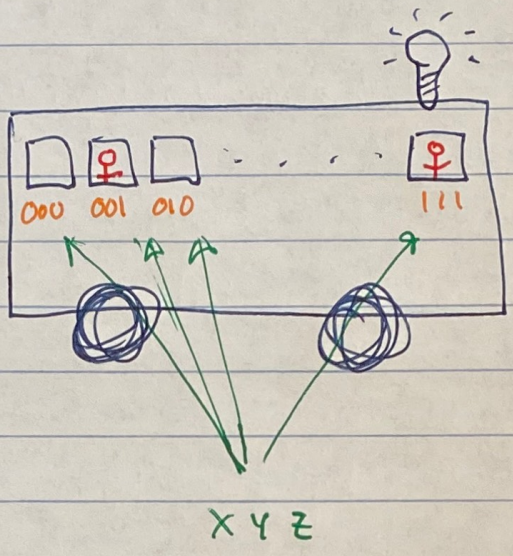
6) Max term

Min terms

SOP expression

Enumerate combinations of inputs which force the output to be 1





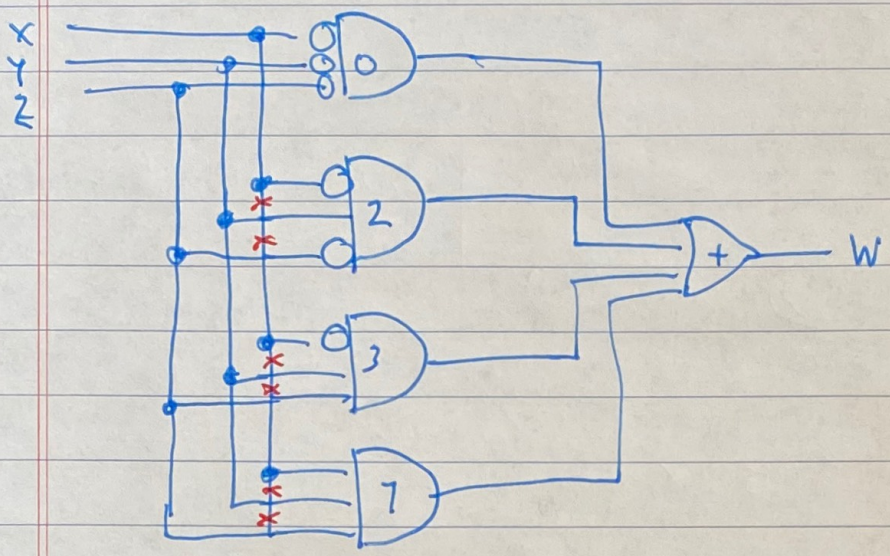
Truth table

X	Y	Z	XYZ	W
0	0	0	000 = binary "0" = 0_{10}	1 ←
0	0	1	"1" = 1_{10}	0
0	1	0	2	1 ←
0	1	1		1 ←
1	0	0		0
1	0	1		0
1	1	0		0
1	1	1	$= 7_{10}$	1 ←

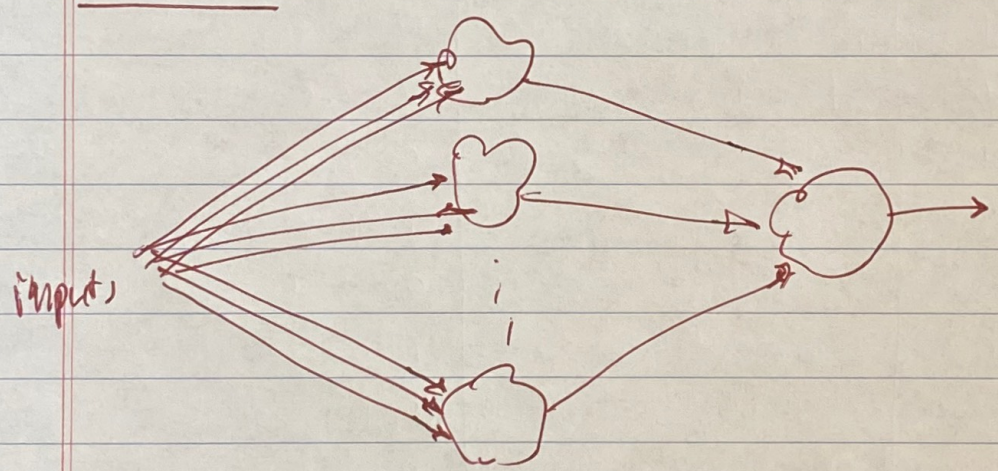
$$W = m_0 + m_2 + m_3 + m_7$$

$$W = X' \cdot Y' \cdot Z' + X' \cdot Y \cdot Z' + X' \cdot Y \cdot Z + X \cdot Y \cdot Z \quad \text{SOP}$$

$$W = \sum m(0,2,3,7)$$



Maxterms



P.O.S. expression where each entry in a T.T. is a potential Maxterm

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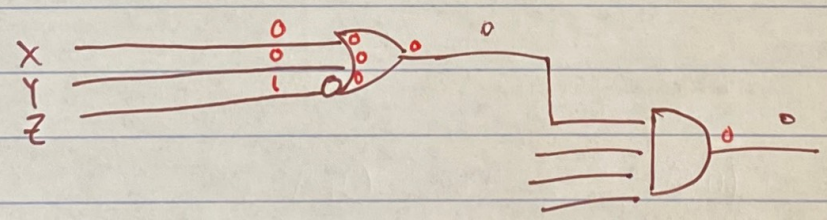
ppt

X	Y	Z		W
0	0	0	$X+Y+Z = M_0$	1
0	0	1	$X+Y+Z' = M_1$	0 ←
0	1	0	$X+Y'+Z = M_2$	1
0	1	1		1
1	0	0		0 ←
1	0	1		0 ←
1	1	0		0 ←
1	1	1	$X'+Y'+Z' = M_7$	1

$W = \underline{M_1} \cdot M_4 \cdot M_5 \cdot M_6$

$= \Pi M(1,4,5,6)$

$= (\overset{M_1}{\underline{X+Y+Z'}}) \cdot (X'+Y+Z) \cdot (X'+Y+Z') \cdot (X'+Y'+Z)$



- No common terms between minterm & maxterm expansions of the same function
- All 2^n (n = # of inputs) terms in minterm or maxterm expansion

X	Y	Z	Z'
0	0	1	0
0	1	1	0
1	0	1	0
1	1	0	1

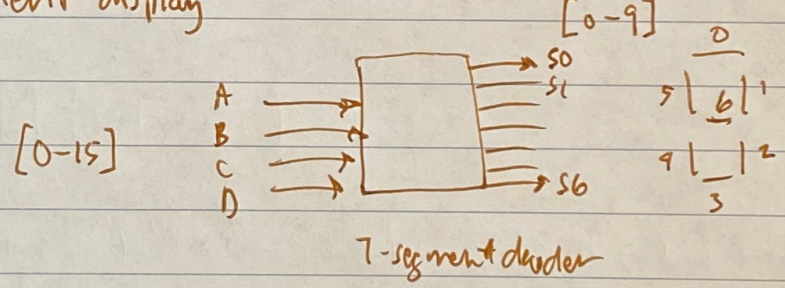
$Z = \sum m(0,1,2) = \prod M(3)$

$Z' = \sum m(3) = \prod M(0,1,2)$

Incompletely-Specified Functions

"Don't Care" = X ~ third value for variables

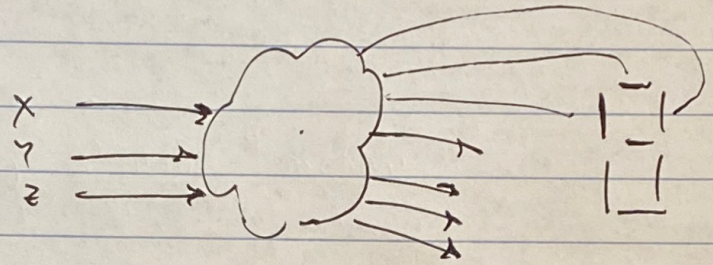
Ex: 7-segment display



A	B	C	D	S0	S1	S2	S3	S4	S5	S6
0	0	0	0	1	1	1	1	1	1	0
0	0	0	1	0	1	1	0	0	0	0
⋮										
1	0	1	0	X	X	X	X	X	X	X
⋮				X	X	X	X	X	X	X
1	1	1	1	X	X	X	X	X	X	X

$S_0 = \sum m(0, 2, 3, \ldots) + \sum d(10, 11, 12, 13, 14, 15)$

$S_0 = \pi M(1, 4, \ldots) \cdot \pi D(10, 11, 12, 13, 14, 15)$



x y z	–	–	–	–	–	–	–
~~0 0 0~~	0	0	0	0			
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