Tate Finley
ECE 3140
HW 3 Problem 4.2

Obtain the simplified Boolean expressions for output F and G in terms of the input variables in the circuit of Fig. P4.2

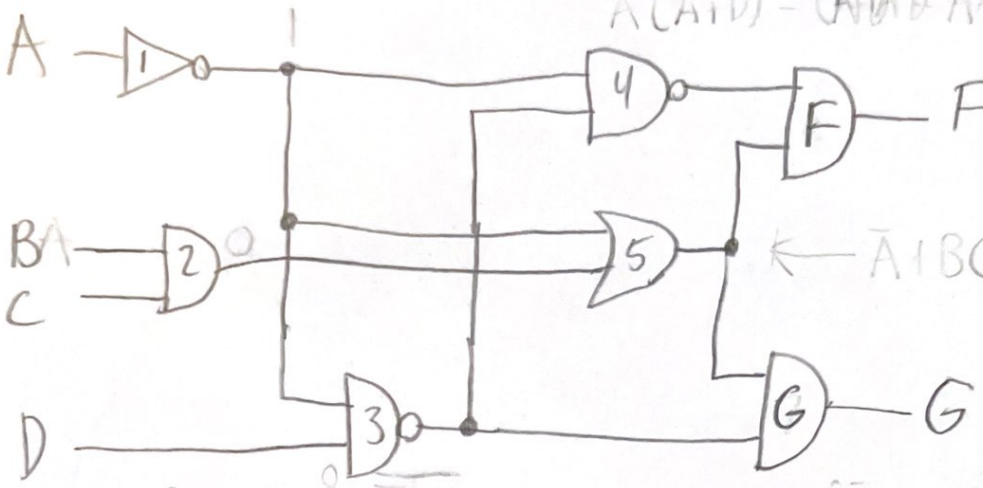

Fig. P4.2

A B C D	F	G
0 0 0 0	0	1
0 0 0 1	1	0
0 0 1 0	0	1
0 0 1 1	1	0
0 1 0 0	0	1
0 1 0 1	1	0
0 1 1 0	0	1
0 1 1 1	1	0
1 0 0 0	0	0
1 0 0 1	0	0
1 0 1 0	0	0
1 0 1 1	0	0
1 1 0 0	0	0
1 1 0 1	0	0
1 1 1 0	1	1
1 1 1 1	1	1

Gate 1: $\bar{A}$

Gate 2: BC

Gate 3: $\overline{\bar{A}D} = (A+\bar{D})$

Gate 4: $\overline{\bar{A}(A+\bar{D})}$

$\overline{0+\bar{A}\bar{D}}$

$\overline{\bar{A}\bar{D}} = A+D$

Gate 5: $\bar{A}+BC$

Gate F → output F: $(A+D)(\bar{A}+BC)$

$0+ABC+\bar{A}D+BCD$

$ABC+\bar{A}D+ABCD+\bar{A}BCD$

$F = ABC+\bar{A}D$

Gate G → output G: $(A+\bar{D})(\bar{A}+BC)$

$0+ABC+\bar{A}\bar{D}+BC\bar{D}$

$ABC+\bar{A}\bar{D}+ABC\bar{D}+\bar{A}BC\bar{D}$

$G = ABC+\bar{A}\bar{D}$

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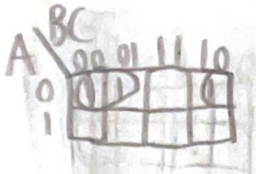
HW 3 Problem 4.4

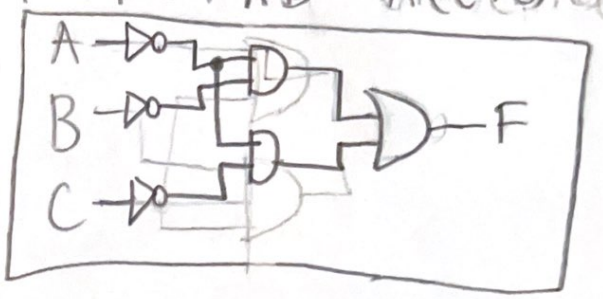
Design a combinational circuit with three inputs and one output.

a) The output is 1 when the binary value of the inputs is less than 3. the output is 0 otherwise

A B C	F
0 0 0	1
0 0 1	1
0 1 0	1
0 1 1	0
1 0 0	0
1 0 1	0
1 1 0	0
1 1 1	0

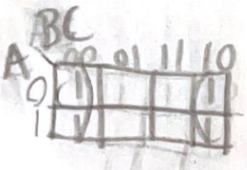


$F = \bar{A}\bar{C} + \bar{A}\bar{B} = \overline{A(\bar{C}+B)} = \overline{A+BC}$

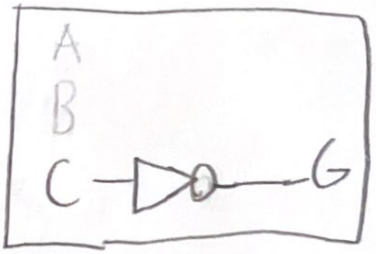


b) The output is 1 when the binary value of the inputs is an even number

A B C	G
0 0 0	1
0 0 1	0
0 1 0	1
0 1 1	0
1 0 0	1
1 0 1	0
1 1 0	1
1 1 1	0



$G = \bar{C}$



Tate Finley
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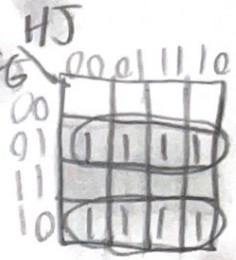
HW 3 Problem 4.7

Design a combinational circuit that converts a four bit Gray code to a four-bit binary number using exclusive OR gates.

Gray code input FGHJ	Binary output ABCD
0000	0000
0001	0001
0011	0010
0010	0011
0110	0100
0111	0101
0101	0110
0100	0111
1100	1000
1101	1001
1111	1010
1110	1011
1010	1100
1011	1101
1001	1110
1000	1111

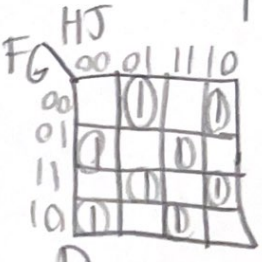
A $A = F$



B $B = \bar{F}G + F\bar{G}$

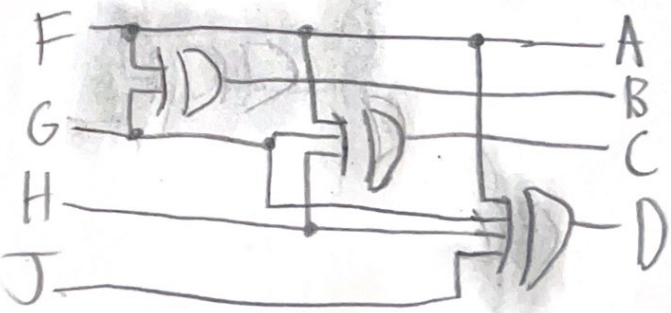
$F \oplus G$

C $C = \bar{F}\bar{G}H + FGH + \bar{F}G\bar{H} + F\bar{G}\bar{H}$



D $D = F \oplus G \oplus H \oplus J$

$(F \oplus G \oplus H)$



Tate Finley
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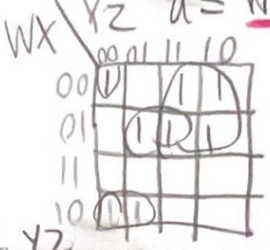
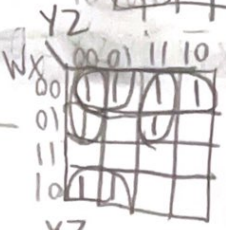
HW 3 Problem 4.9

Using a truth table and karnough maps, design the BCD-to-seven-segment decoder using a minimum number of gates. The six invalid combinations should result in a blank display.

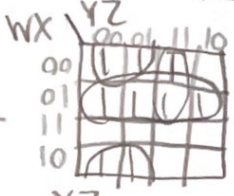
WXYZ	a b c d e f g
0 0 0 0	1 1 1 1 1 1 0
0 0 0 1	0 1 1 0 0 0 0
0 0 1 0	1 1 0 1 1 0 1
0 0 1 1	1 1 1 1 0 0 1
0 1 0 0	0 1 1 0 0 1 1
0 1 0 1	1 0 1 1 0 1 1
0 1 1 0	1 0 1 1 1 1 1
0 1 1 1	1 1 1 0 0 0 0
1 0 0 0	1 1 1 1 1 1 1
1 0 0 1	1 1 1 1 0 1 1
1 0 1 0	0 0 0 0 0 0 0
1 0 1 1	0 0 0 0 0 0 0
1 1 0 0	0 0 0 0 0 0 0
1 1 0 1	0 0 0 0 0 0 0
1 1 1 0	0 0 0 0 0 0 0
1 1 1 1	0 0 0 0 0 0 0



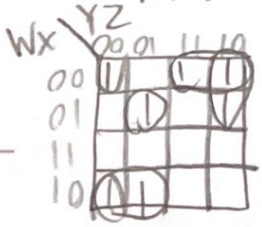
$a = \bar{W}Y + \bar{W}XZ + W\bar{X}\bar{Y} + X\bar{Y}\bar{Z}$



$b = \bar{X}\bar{Y} + \bar{W}\bar{X} + \bar{W}\bar{Y}\bar{Z} + \bar{W}YZ$

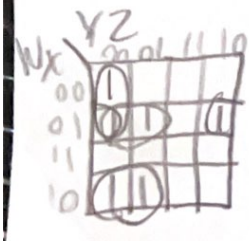


$c = \bar{X}\bar{Y} + \bar{W}X + \bar{W}YZ$

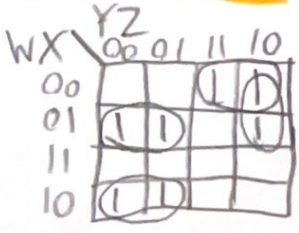


$d = W\bar{X}\bar{Y} + X\bar{Y}\bar{Z} + \bar{W}\bar{X}Y \ldots$
$\bar{W}Y\bar{Z} + \bar{W}X\bar{Y}Z$

$e = \bar{X}\bar{Y}\bar{Z} + \bar{W}Y\bar{Z}$

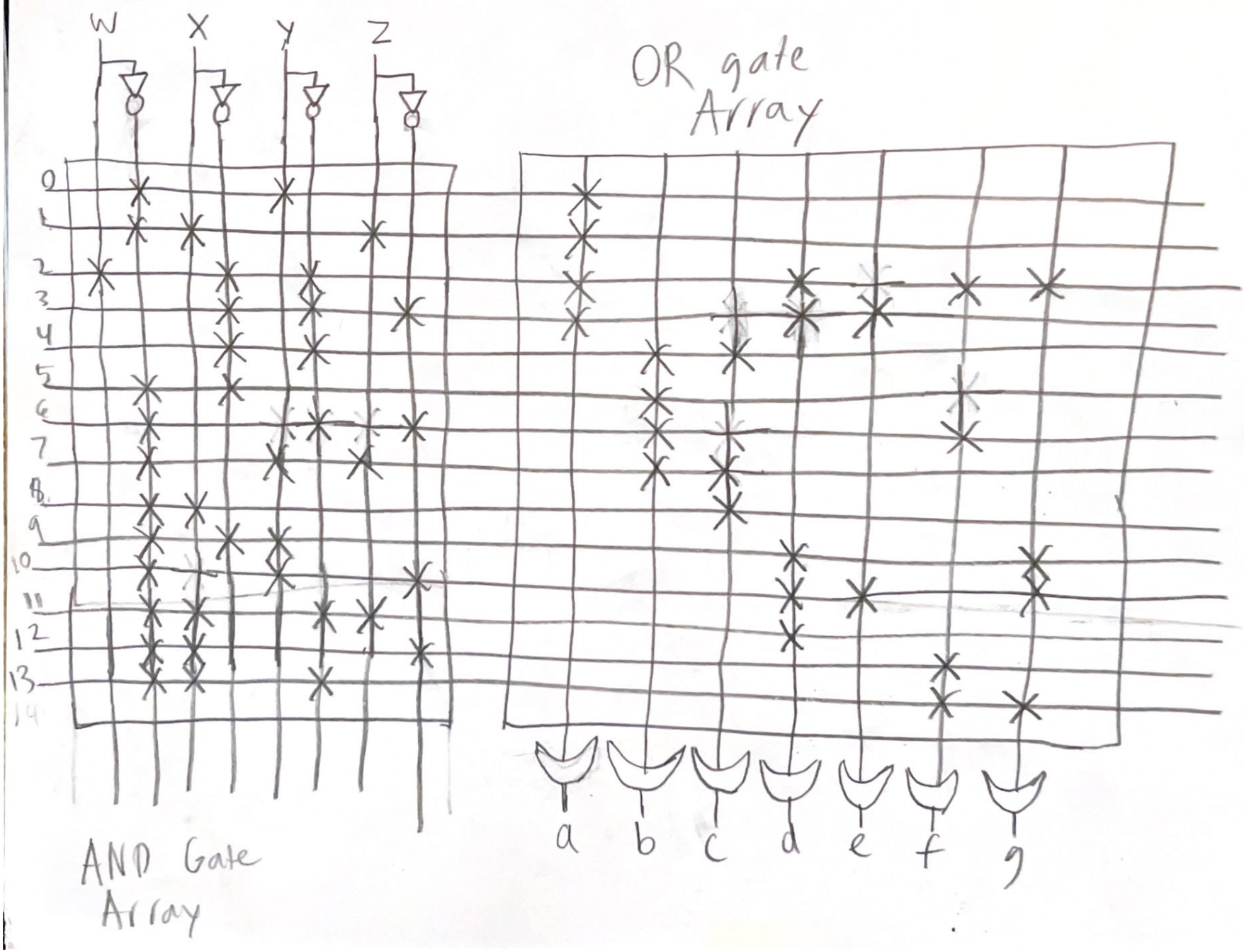


$f = W\bar{X}\bar{Y} + \bar{W}X\bar{Z} + \bar{W}X\bar{Y} + \bar{W}\bar{Y}\bar{Z}$



$g = W\bar{X}\bar{Y} + \bar{W}X\bar{Y} + \bar{W}\bar{X}Y + \bar{W}Y\bar{Z}$

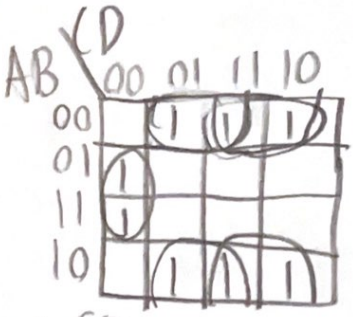
Problem 4.9 cont...



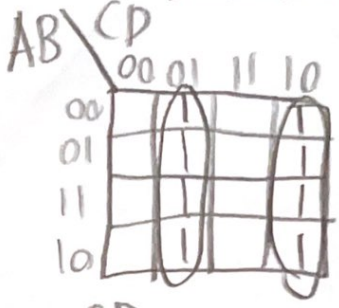
Design a four-bit combinational circuit 2's complementer. Construct the circuit with exclusive or gates.

Input ABCD	output WXYZ
0000	0000
0001	1111
0010	1110
0011	1101
0100	1100
0101	1011
0110	1010
0111	1001
1000	1000
1001	0111
1010	0110
1011	0101
1100	0100
1101	0011
1110	0010
1111	0001

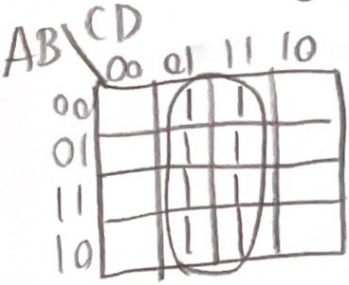
$$W = \bar{A}B + \bar{A}C + \bar{A}D + A\bar{B}\bar{C}\bar{D}$$
$$\bar{A}(B+C+D) + A\overline{(B+C+D)}$$
$$A \oplus (B+C+D)$$



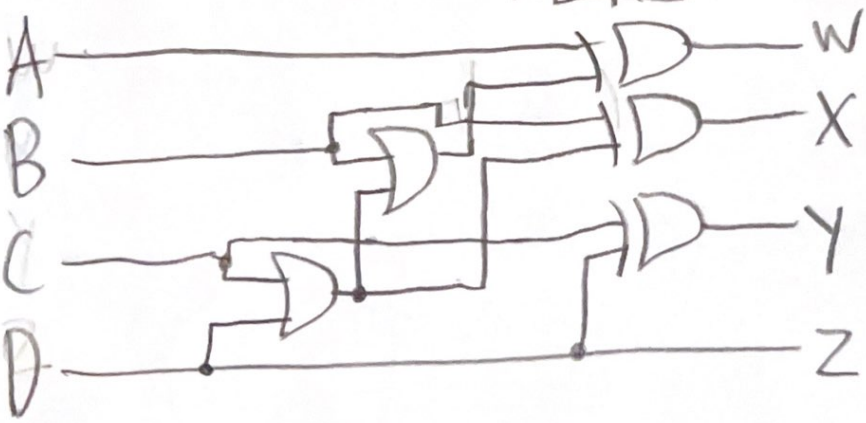
$$X = \bar{B}D + \bar{B}C + B\bar{C}\bar{D}$$
$$\bar{B}(C+D) + B\overline{(C+D)}$$
$$B \oplus (C+D)$$



$$Y = \bar{C}D + C\bar{D} = C \oplus D$$



$$Z = D$$



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HW3 Problem 4.10

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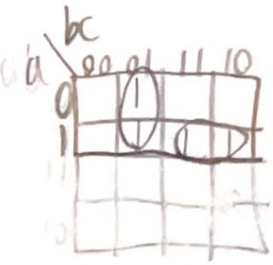
HW 3 : Problem 8

Design the minimal SOP circuit to implement the function

$F(a,b,c) = SUM\ m(1,5,6,7)$



$F = \bar{b}c + ab$