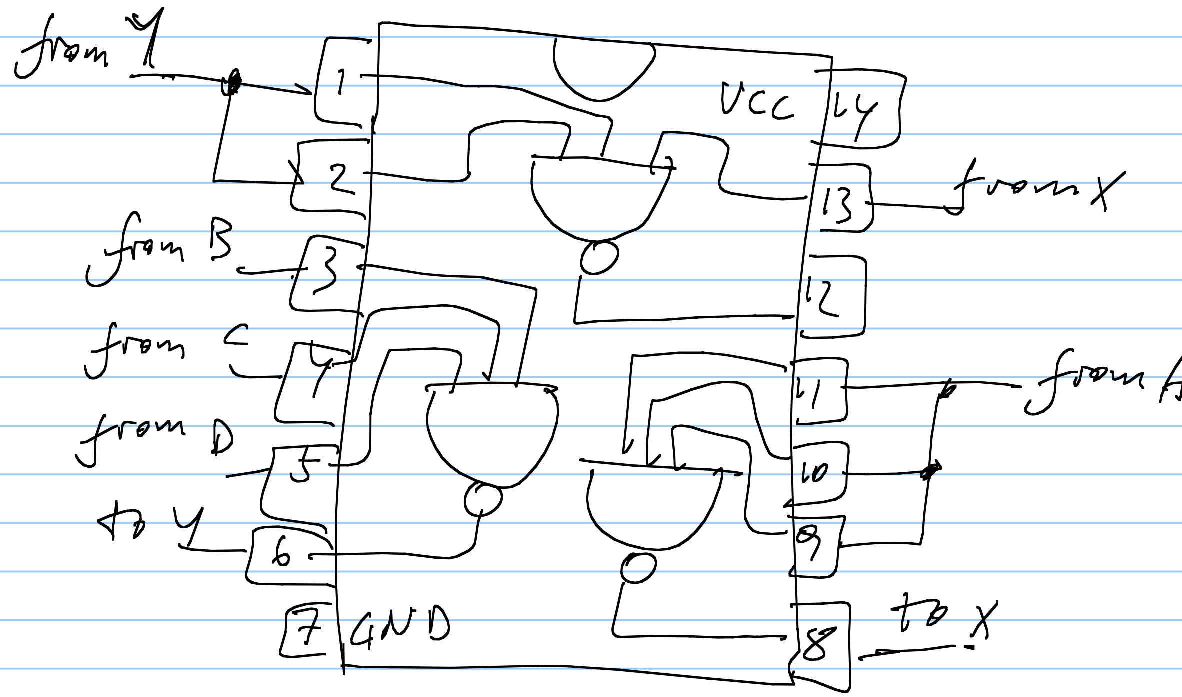
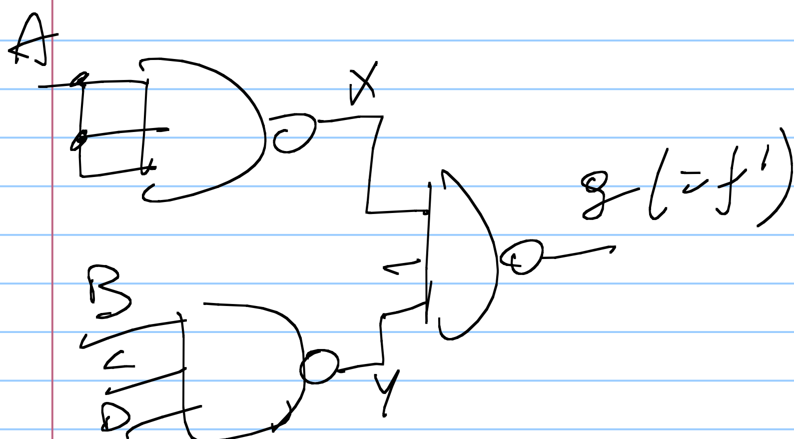
Note Title 3/30/2009

7410

Circuit 2

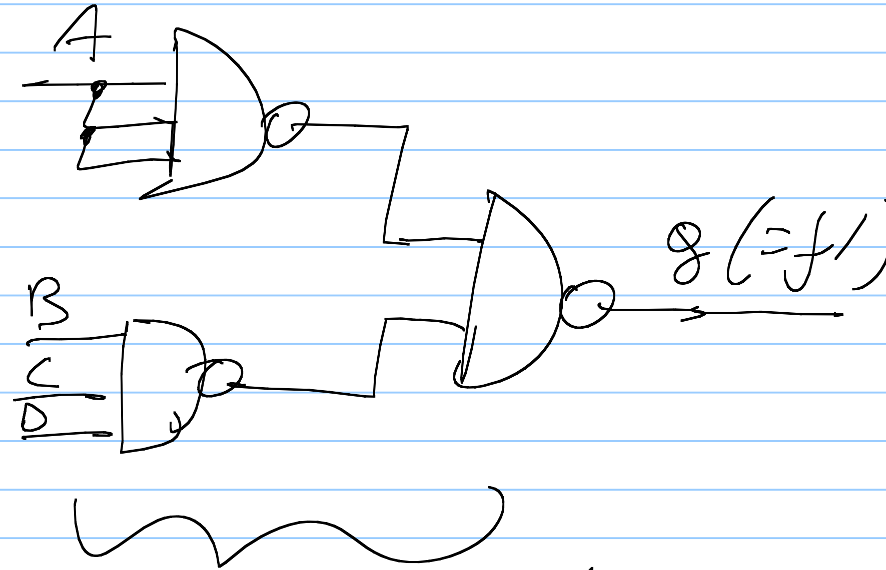




Mr. Warren

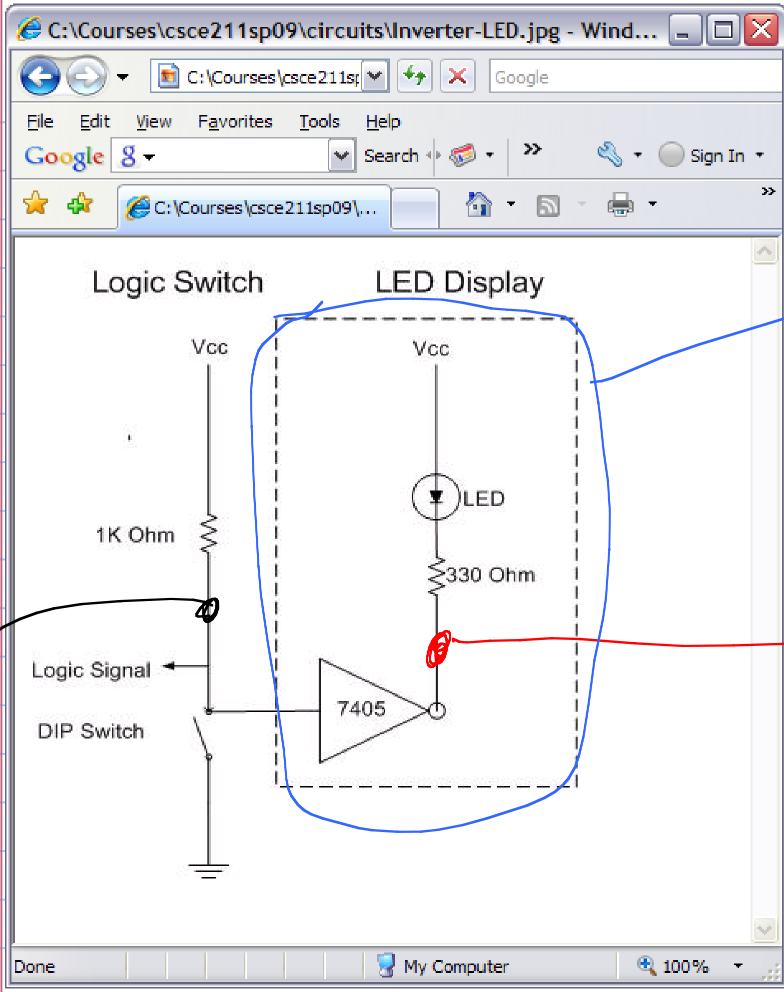
Mr. Evans

	A	B	C	D	f	g = f'
m_0	0	0	0	0	1	0
m_1	0	0	0	1	1	0
m_2	0	0	1	0	1	0
m_3	0	0	1	1	1	0
m_4	0	1	0	0	1	0
m_5	0	1	0	1	1	0
m_6	0	1	1	0	1	0
m_7	0	1	1	1	0	1
m_8	1	0	0	0	0	1
m_9	1	0	0	1	0	1
m_{10}	1	0	1	0	0	1
m_{11}	1	0	1	1	0	1
m_{12}	1	1	0	0	0	1
m_{13}	1	1	0	1	0	1
m_{14}	1	1	1	0	0	1
m_{15}	1	1	1	1	0	1



Three NAND gates from the 7410 chip. which has three NAND gates

Either solution is acceptable.
Some pros & cons are described below.



This is a buffer driven circuit

Sorry - see below!

Take inputs for circuit 2 here

No - do not fool with the output of an open collector.

Do not take them here - several of you did this.

Please redo & bring your circuit on Friday, April 3!

Each input is 1 • when the corresponding DIP switch is OFF
• when the corresponding LED is lit

Q8 $(AB) = (A' + B')' = (A')' \cdot (B')' = AB$

De Morgan's Law: $(X+Y)' = X'Y'$

Quine-McCluskey Algorithm
Ch. 7 text

$f(a, b, c, d) = \sum m(0, 1, 2, 5, 6, 7, 8, 9, 10, 14)$

group 0	0	0000
group 1	1	0001
	2	0010
	8	1000
group 2	5	0101
	6	0110
	9	1001
	10	1010
group 3	7	0111
	14	1110

Equation (6-2)

Group minterms by how many 1s they have

Table 6-1. Determination of Prime Implicants

Column I				Column II			Column III	
group 0	0	0000	✓	0, 1	000–	✓	0, 1, 8, 9	–00–
group 1	1	0001	✓	0, 2	00–0	✓	0, 2, 8, 10	–0–0
	2	0010	✓	0, 8	–000	✓	~~0, 8, 1, 9~~	~~–00–~~
	8	1000	✓	1, 5	0–01		~~0, 8, 2, 10~~	~~–0–0~~
group 2	5	0101	✓	1, 9	–001	✓	2, 6, 10, 14	––10
	6	0110	✓	2, 6	0–10	✓	~~2, 10, 6, 14~~	~~––10~~
	9	1001	✓	2, 10	–010	✓		
	10	1010	✓	8, 9	100–	✓		
group 3	7	0111	✓	8, 10	10–0	✓		
	14	1110	✓	5, 7	01–1			
				6, 7	011–			
				6, 14	–110	✓		
				10, 14	1–10	✓		

Table 6-2. Prime Implicant Chart

		0	1	2	5	6	7	8	9	10	14
(0, 1, 8, 9)	$b'c'$	X	X					X	X		
(0, 2, 8, 10)	$b'd'$	X		X				X		X	
(2, 6, 10, 14)	cd'			X		X				X	X
(1, 5)	$a'c'd$		X		X						
(5, 7)	$a'bd$				X		X				
(6, 7)	$a'bc$					X	X				

$b'c' + cd' + a'bd$

Table 6-5.

			0	1	2	5	6	7
P_1	(0, 1)	$a'b'$	X	X				
P_2	(0, 2)	$a'c'$	X		X			
P_3	(1, 5)	$b'c$		X		X		
P_4	(2, 6)	bc'			X		X	
P_5	(5, 7)	ac				X		X
P_6	(6, 7)	ab					X	X

no essential prime implicant
Every column has at least two crosses; every minterm can be covered by at least two prime implicants.

<u>Patrick's method</u> Note: a similar technique has applications outside of digital logic design.

Label the prime implicants by P_i, $1 \le i \le n$ (n is the number of prime implicants, as in the example of Table 6-5). Since all minterms must be covered, the following expression is true:

$$P = (P_1 + P_2)(P_1 + P_3)(P_2 + P_4)(P_3 + P_5)(P_4 + P_6)(P_5 + P_6)$$

Use $x + yz = (x+y)(x+z)$ (p.161 book)

$P = (P_1 + P_2 P_3)(P_4 + P_2 P_6)(P_5 + P_3 P_6) =$

$= (P_1 P_4 + P_1 P_2 P_6 + \dots$

$= P_1 P_4 P_5 + P_1 P_2 P_5 P_6 + P_2 P_3 P_4 P_5 + P_1 P_3 P_4 P_6 + P_2 P_3 P_6$

$a'b' + bc' + ac$

$a'c' + b'c + ab$