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# CSE 232 SPRING 2020
## HOMEWORK 2.

1-) Assuming Moore's law (doubling each 18 months)

$\frac{12.10}{18} = 6,667$ doublings.

$2^{6,667} = 101,617143$ billion transistors.

2-) F = (a And b) OR c OR d

a) F = (1 And 1) OR 1 OR 0 => F = 1

b) F = (0 And 1) OR 1 OR 0 => F = 1

c) F = (1 AND 1) OR 0 OR 0 => F = 1

d) F = (1 AND 0) OR 1 OR 1 => F = 1

3-)

a) The variables are a, b, c, d.

b) The literals are a, a', b, c, c', d.

c) The product terms are a, a'b, acd and c'.

4-) $F = a'b'c + a'bc' + a'bc + ab'c + abc' + abc$

5-) $F = (a,b,c) = a'b'c + a'bc' + a'bc + ab'c + abc' + abc$

$= a'b'c + ab'c + a'bc' + a'bc + abc' + abc$

$= (a'+a)b'c + a'b(c'+c) + ab(c'+c)$

$= (1)b'c + a'b(1) + ab(1)$ (since $x+x'=1$)

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

$= b'c + (a'+a)b$

$= b'c + (1)b = b'c + b$

$= (b'+b)(c+b)$

$= (1)(c+b)$

$= b+c$

$F(a,b,c) = (b+c)$ //

6) $f = (a+b)'a$

a)
$$F = (a+b)'a$$
$$= (a'b')a$$
$$= (aa')b'$$
$$= (0)b'$$
$$F = 0 \quad (1) \qquad G = a+b' \quad (2)$$

Compare equation (1) and (2) different.

Hence, the two Boolean equations are not equivalent.

b) Table (1)

| a | b | a+b | (a+b)' | F = (a+b)'a |
|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 |

Table (2)

| a | b | b' | G = a+b' |
|---|---|---|---|
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |

=) Table (1) and Table (2)'s output values are different.

Hence, the two Boolean equations are not equivalent

=

7) input output

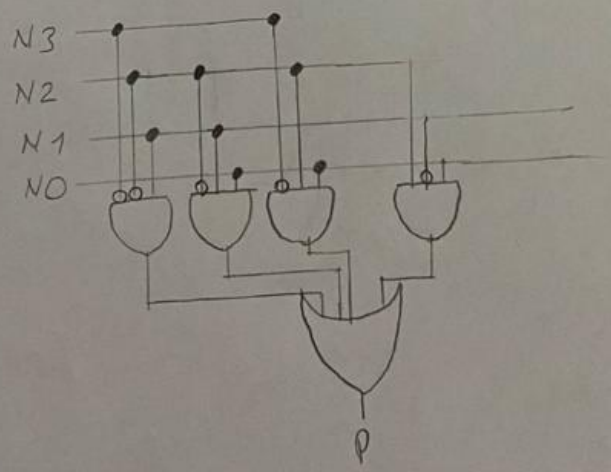
| N3 | N2 | N1 | N0 | P |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | |

The output Boolean equation

$$P = \begin{cases} N3'N2'N1N0' + N3'N2'N1N0 + N3'N2N1'N0 \\ + N3'N2N1N0 + N3N2'N1N0 + N3N2N1'N0 \end{cases}$$

$$P = N3'N2'N1 + N2'N1N0 + N3'N2N0 + N2N1'N0$$

The gate level circuit for the simplified Boolean equation



8-)

| Input | | | | Outputs |
|---|---|---|---|---|
| m3 | m2 | m1 | m0 | C |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |

$C' = m3'm2'm1'm0' + m3'm2'm1'm0 + m3'm2'm1m0' + m3'm2m1'm0' + m3m2'm1m0'$

- The gate level circuit.