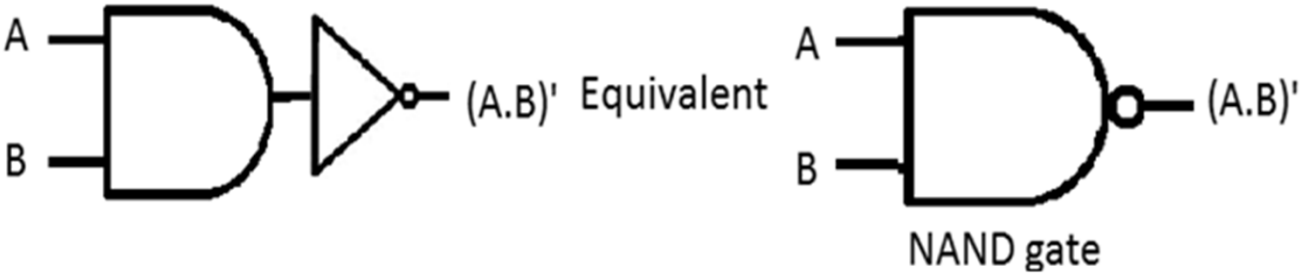
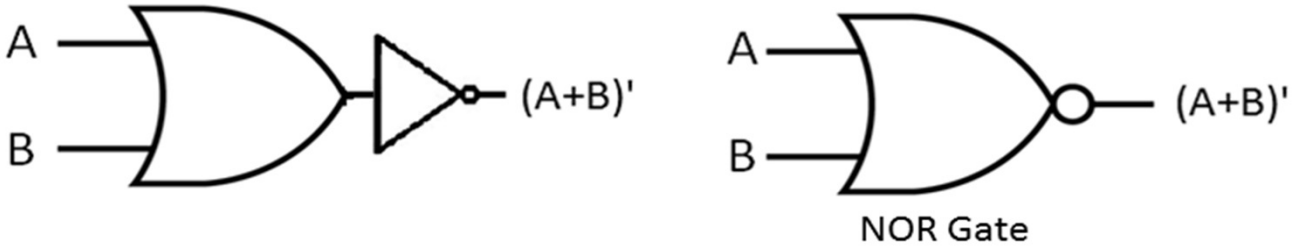


A	B	(A.B)’
0	0	1
0	1	1
1	0	1
1	1	0

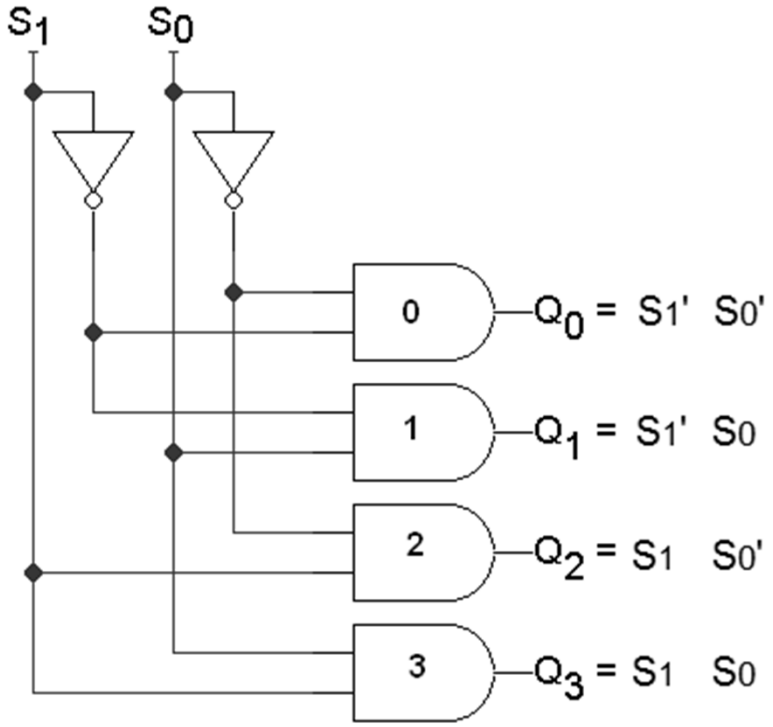


A	B	(A+B)’
0	0	1
0	1	0
1	0	0
1	1	0

Decoders

2 inputs and 2^2 *outputs*

S1	S0	Q0	Q1	Q2	Q3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1



2-to-4 decoder

Observe that the output *Q* which becomes active has the subscript equal to decimal value of the input $(S1,S0)_{10}$

Octal (Base 8)

- Shorter & easier to read than binary
- 8 digits: 0, 1, 2, 3, 4, 5, 6, 7
- **Octal numbers to Decimal**

$$136_8 = 1*8^2 + 3*8^1 + 6*8^0$$
$$= 1*64 + 3*8 + 6*1$$
$$= 64 + 24 + 6$$
$$= 94_{10}$$

Hexadecimal (base 16)

- Shorter & easier to read than binary
- 16 digits:

  0, 1, 2, 3, 4, 5, 6, 7, 8, 9, **A, B, C, D, E, F**
- "0x" often precedes hexadecimal numbers

$$0x123 = 1*16^2 + 2*16^1 + 3*16^0$$
$$= 1*256 + 2*16 + 3*1$$
$$= 256 + 32 + 3$$
$$= 291$$

Fractional Number

- Point:

  Decimal Point, Binary Point, Hexadecimal point

- Decimal

  $247.75 = 2x10^{2} + 4x10^{1} + 7x10^{0} + 7x10^{-1} + 5x10^{-2}$

- Binary

  $10.101 = 1x2^{1} + 0x2^{0} + 1x2^{-1} + 0x2^{-2} + 1x2^{-3}$

- Hexadecimal

  $6A.7D = 6x16^{1} + 10x16^{0} + 7x16^{-1} + Dx16^{-2}$

Decimal ↔ Binary

a) Divide the decimal number by **2**; the remainder is the LSB of the **binary** number.

b) If the **quotient** is zero, the conversion is complete. Otherwise repeat step (a) using the **quotient** as the decimal number. The new remainder is the next most significant bit of the **binary** number.

a) Multiply each bit of the **binary** number by its corresponding bit-weighting factor (i.e., Bit-0→$\mathbf{2}^0$=1; Bit-1→$\mathbf{2}^1$=2; Bit-2→$\mathbf{2}^2$=4; etc).

b) Sum up all of the products in step (a) to get the decimal number.

Decimal to Binary : Division Method

- Divide decimal number by 2 and insert remainder into new binary number.
  - Continue dividing quotient by 2 until the quotient is 0.
- Example: Convert decimal number 12 to binary

12 div 2 = (Quo=6 , Rem=0) LSB
6 div 2 = (Quo=3, Rem=0)
3 div 2 = (Quo=1,Rem=1)
1 div 2 = (Quo=0, Rem=1) MSB

$12_{10} = 1\ 1\ 00_{2}$

Decimal to Octal Conversion

The Process: Successive Division

- Divide number by **8**; R is the LSB of the **octal** number
- While Q is **not zero**
  - Using the Q as the decimal number. Divide
  - New remainder is MSB of the **octal** number.

$$8 \overline{)\,94} \quad r = 6 \leftarrow \text{LSB}$$

$$8 \overline{)\,11} \quad r = 3$$

$$8 \overline{)\,1} \quad r = 1 \leftarrow \text{MSB}$$

$$94_{10} = 136_{8}$$

Decimal to Hexadecimal Conversion

The Process: Successive Division

- Divide number by **16**; R is the LSB of the **hex** number
- While Q is NOT zero
  - Use the Q as the decimal number. Divide by 16
  - New remainder is MSB of the **hex** number.

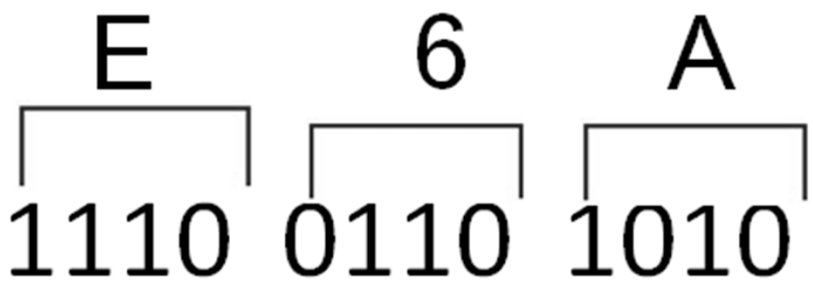
$$16\overline{)\,94}\quad r = E \leftarrow \text{LSB}$$

$$16\overline{)\,5}\quad r = 5 \leftarrow \text{MSB}$$

$$94_{10} = 5E_{16}$$

Substitution Code

Convert $1110\ 0110\ 1010_2$ to hex using the 4-bit substitution code :



$E6A_{16}$