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Ex. 1:

$$\overline{ABC} + \overline{AB}C + \bar{A}B\bar{C} + A\bar{B}C + A\overline{BC}$$

$\equiv \overline{AB}(\bar{C}+C) + \bar{A}B\bar{C} + A\bar{B}(C+\bar{C})$ factor $\overline{AB}$, $A\bar{B}$.

$\equiv \overline{AB}(1) + \bar{A}B\bar{C} + A\bar{B}C(1)$ complement of C

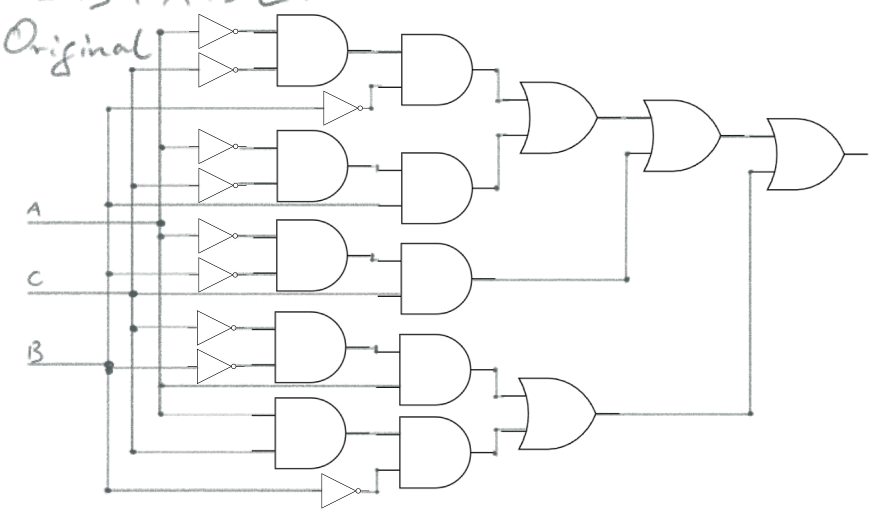
$\equiv \overline{AB} + \bar{A}B\bar{C} + A\bar{B}$ identity with $\overline{AB}$ and $A\bar{B}$.

$\equiv \bar{B}(\bar{A}+A) + \bar{A}B\bar{C}$ factor $\bar{B}$.

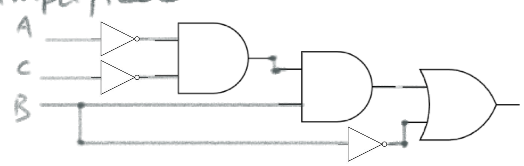
$\equiv \bar{B}(1) + \bar{A}B\bar{C}$ complement of A

$\equiv \bar{B} + \bar{A}B\bar{C}$. identity with $\bar{B}$.

Original




Simplified:

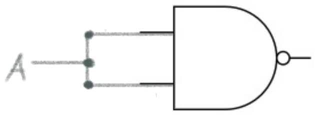



Ex. 2:

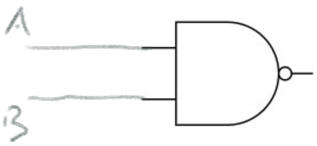
NAND and NOR are called functionally complete gates since every operation or function could be described as an algebra using only one of these two gates.

using NAND gates only:

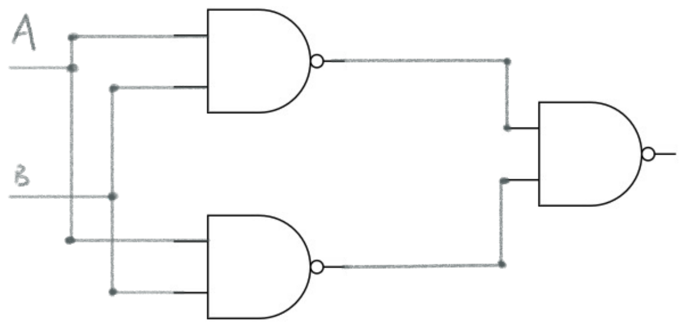
NOT A = A NAND A



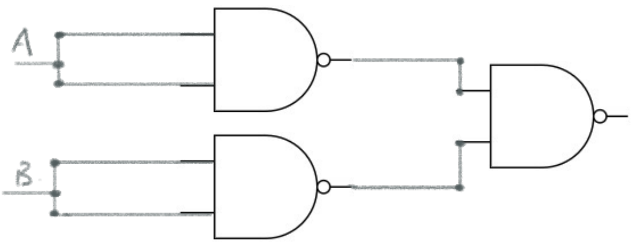

A NAND B = A NAND B



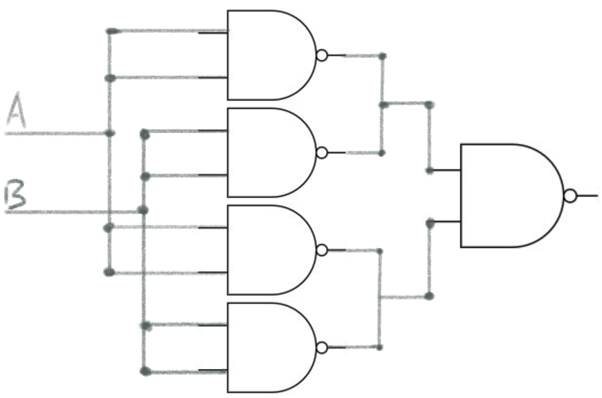

A AND B = (A NAND B) NAND (B NAND A)




A OR B = (A NAND A) NAND (B NAND B)

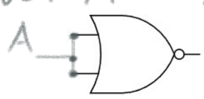



A NOR B = [(A NAND A) NAND (B NAND B)] NAND [(A NAND A) NAND (B NAND B)]

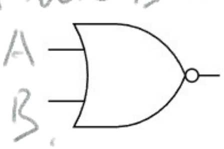



using NOR Gates only:

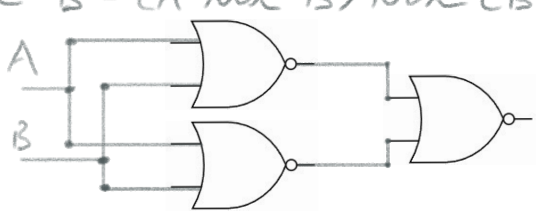
NOT A = A NOR A



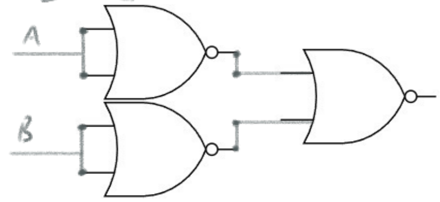

A NOR B = A NOR B



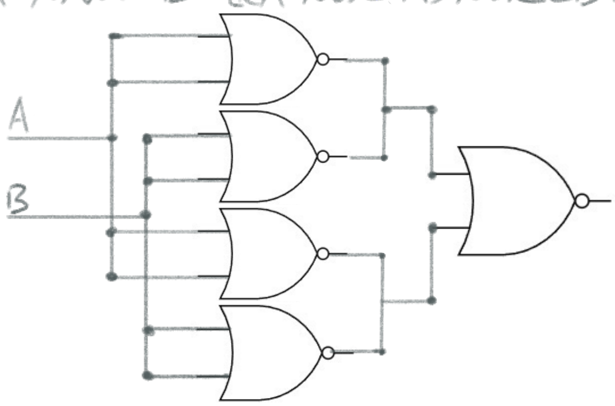

A OR B = (A NOR B) NOR (B NOR A)

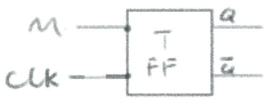



A AND B = (A NOR A) NOR (B NOR B)



A NAND B = [(A NOR A) NOR (B NOR B)] NOR [(A NOR A) NOR (B NOR B)]




Ex. 3:

$S \equiv S_0 S_1$

$Q_{n+1} \equiv MUX(a, b, c, d, S)$

$Q_{n+1} \equiv \overline{S_0 S_1}\, a + \bar{S}_0 S_1 b + \bar{S}_1 S_0 c + S_0 S_1 d$

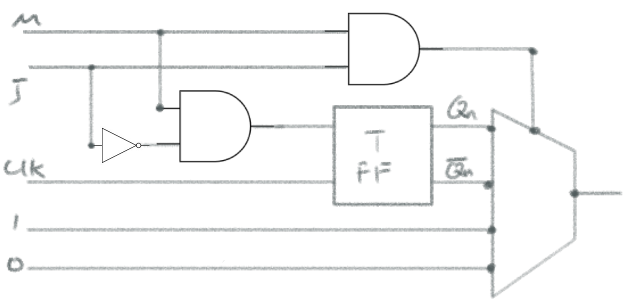
Assuming that $a = 1$, $b = 0$, $c = \bar{Q}_n$, $d = Q_n$, we could get:

$Q_{n+1} \equiv \overline{S_0 S_1} \cdot 1 + \bar{S}_0 S_1 \cdot 0 + \bar{S}_1 S_0 \cdot \bar{Q}_n + S_0 S_1 \cdot Q_n$

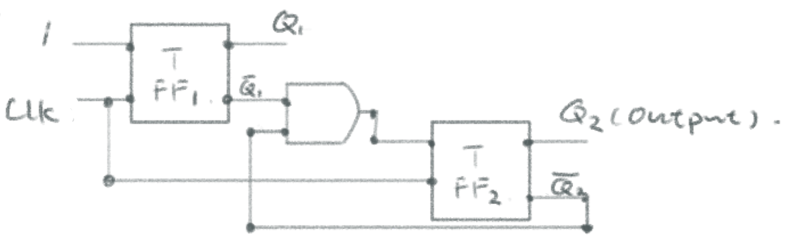
$\equiv \overline{S_0 S_1} + \bar{S}_1 S_0 \bar{Q}_n + S_0 S_1 Q_n$

Giving that MJ flipflop is controlled by M and J, we could get

$Q_{n+1} \equiv \overline{MJ} + \bar{M} J \bar{Q}_n + MJ Q_n$

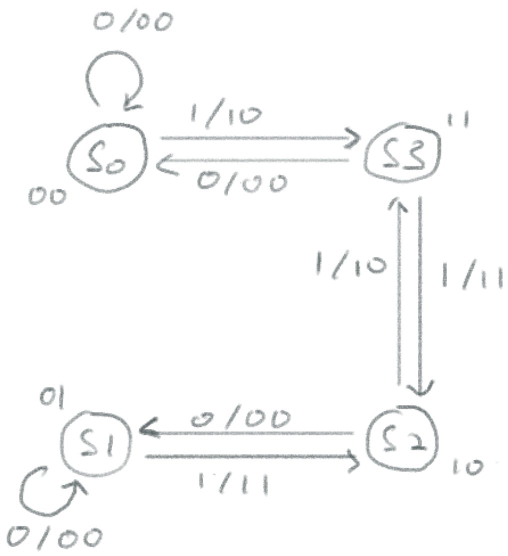



Ex. 4



Ex. 5.

(a)




(b)

| PS | In | NS | G | F |
|---|---|---|---|---|
| 00 | 0 | 00 | 0 | 0 |
| 00 | 1 | 11 | 1 | 0 |
| 01 | 0 | 01 | 0 | 0 |
| 01 | 1 | 10 | 1 | 1 |
| 10 | 0 | 01 | 0 | 0 |
| 10 | 1 | 11 | 1 | 0 |
| 11 | 0 | 00 | 0 | 0 |
| 11 | 1 | 10 | 1 | 1 |

* Out is breaked into G and F

(c).

DNF for G:

$$G \equiv \overline{PS0} \cdot \overline{PS1} \cdot In + \overline{PS0} \cdot PS1 \cdot In + \overline{PS1} \cdot PS0 \cdot In + PS0 \cdot PS1 \cdot In$$

$$\equiv In \cdot (\overline{PS0} \cdot \overline{PS1} + \overline{PS0} \cdot PS1 + \overline{PS1} \cdot PS0 + PS1 \cdot PS0)$$

$$\equiv I$$

DNF for F:

$$F \equiv PSO \cdot \overline{PS1} \cdot In + PS1 \cdot PSO \cdot In$$

$$\equiv PSO \cdot In \cdot (\overline{PS1} + PS1)$$

$$\equiv PSO \cdot In$$

DNF for NSO:

$$NSO \equiv \overline{PSO} \cdot \overline{PS1} \cdot In + PSO \cdot \overline{PS1} \cdot \overline{In} + PS1 \cdot \overline{PSO} \cdot \overline{In} + PS1 \cdot \overline{PSO} \cdot In$$

$$\equiv \overline{PSO} \cdot \overline{PS1} \cdot In + PSO \cdot \overline{PS1} \cdot \overline{In} + PS1 \cdot \overline{PSO}$$

DNF for NS1:

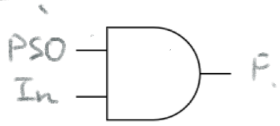
$$NS1 \equiv \overline{PSO} \cdot \overline{PS1} \cdot In \cdot PSO \cdot \overline{PS1} \cdot In + \overline{PSO} \cdot PS1 \cdot In + PSO \cdot PS1 \cdot In$$

$$\equiv In$$

(d)

G:


F:




NSO:

NS1: