Example 1:

On a particular piece of operator-controlled production equipment, the production process may only be performed by the operator activating two safety switches, located at some distance from each other. This is to prevent the equipment from accidentally starting whilst the operator is loading or unloading the machine. The switches have to be depressed together by the operator using both hands.

(a) What is the truth table for this operation?

(b) What is the Boolean logic expression for this operation?

(c) What is the logic network diagram for the operation?

a) The truth table

A	B	output = Y
0	0	0
0	1	0
1	0	0
1	1	1

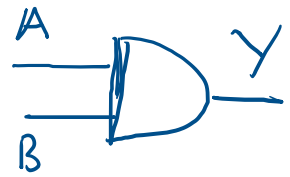
N input = 2

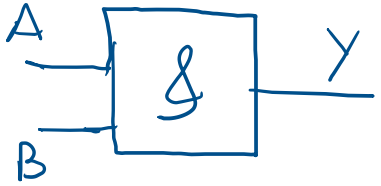
A and B

$2^2 = 4$

b) $Y = A * B$

c) Logical diagram





$A = \begin{cases} 0 \\ 1 \end{cases}$; $B \begin{cases} 0 \\ 1 \end{cases}$

PLC ladder diagram

Example 2:

Write the Boolean logic expression for the pushbutton switch system below using the following symbols:

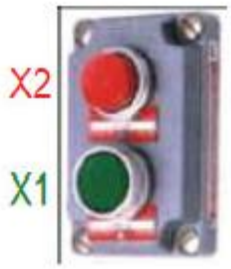
Create ladder logic diagram for Push Button switch.

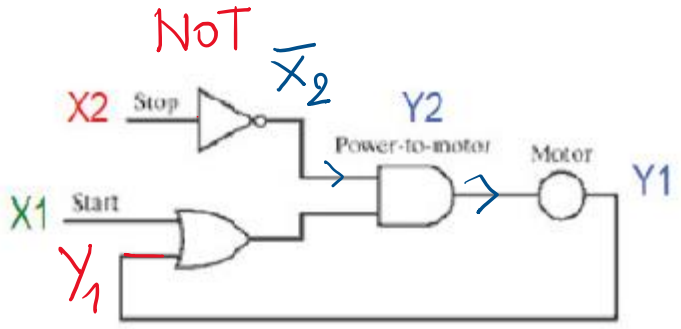
X1 = START,

X2 = STOP,

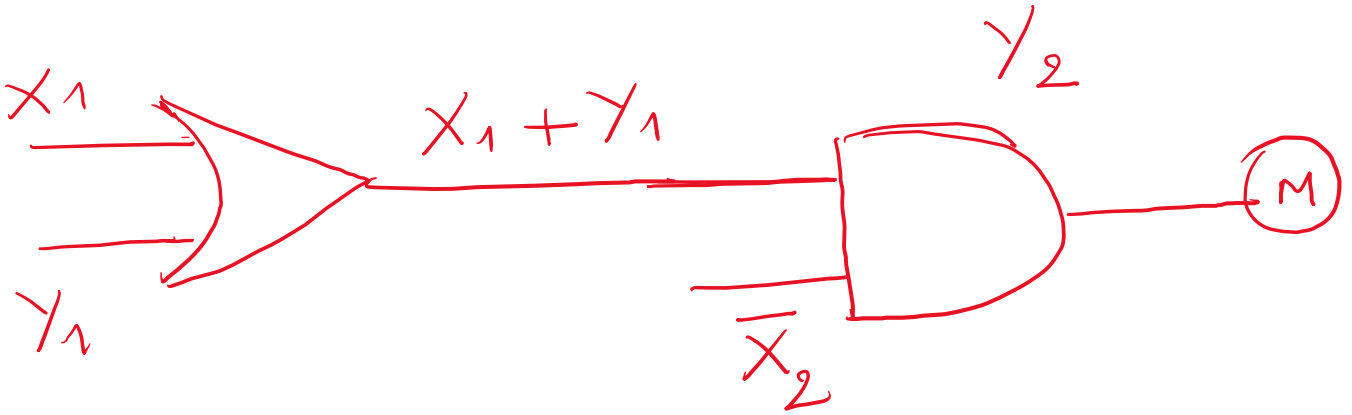
Y1 = MOTOR, and

Y2 = POWER-TO-MOTOR.





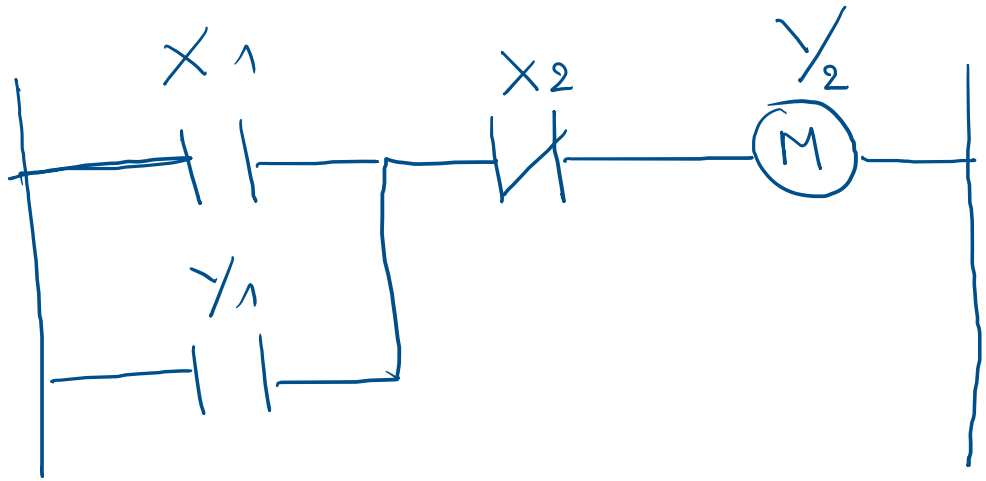
logic network diagram



$$Y_2 = (X_1 + Y_1) * \overline{X_2}$$

Truth table

x_1	$\overline{x_2}$	y_1	$y_2 = \overline{x_2} * (x_1 + y_1)$
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1


X1
X2
Y2
M
Y1

PLC ladder diagram

Example 3:

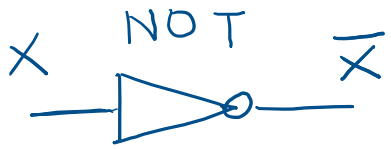
1) Construct the ladder logic diagrams for the NOT gate.

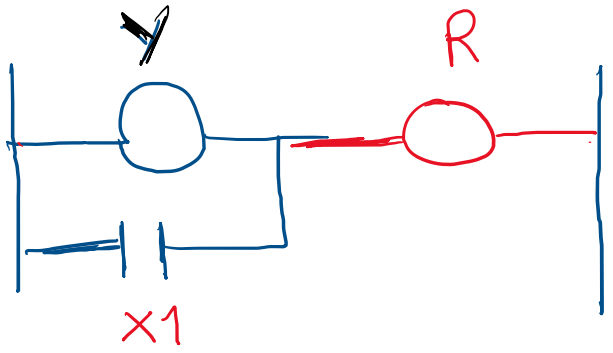
2) Construct the ladder logic diagrams for the NAND gate.

3) Construct the ladder logic diagrams for the NOR gate.

Solution Example 3:

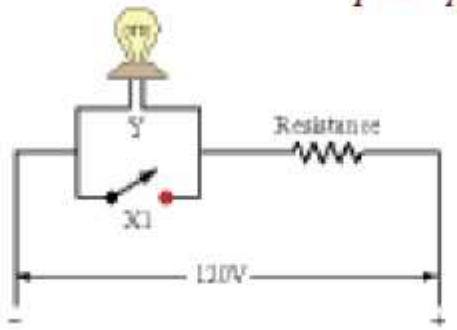
1) Gate NOT



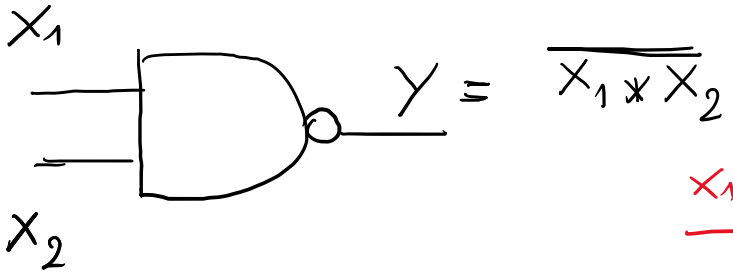


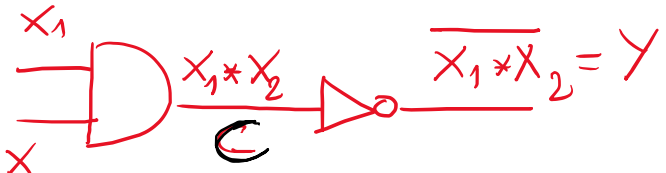
NOT function is expressed as

$$Y = \bar{A}$$



2) Gate NAND = NOT AND

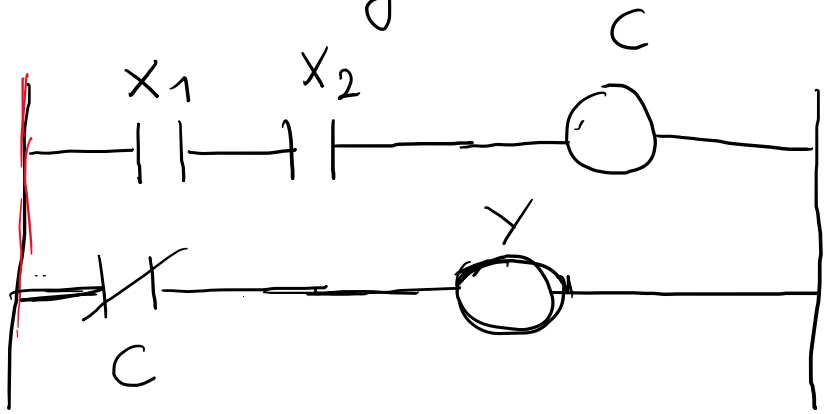




AND NOT

* —

Ladder diagram



$Y = \overline{C}$

$C = X_1 * X_2$

X_1	X_2	$Y = \overline{X_1 * X_2}$
0	0	1
0	1	1
1	0	1
1	1	0

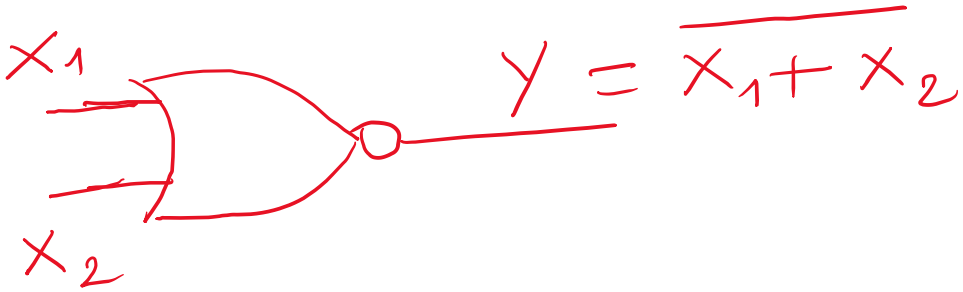
- If X_1 OR X_2 open C is closed

  So Y is ON

- If X_1 and X_2 closed C is open

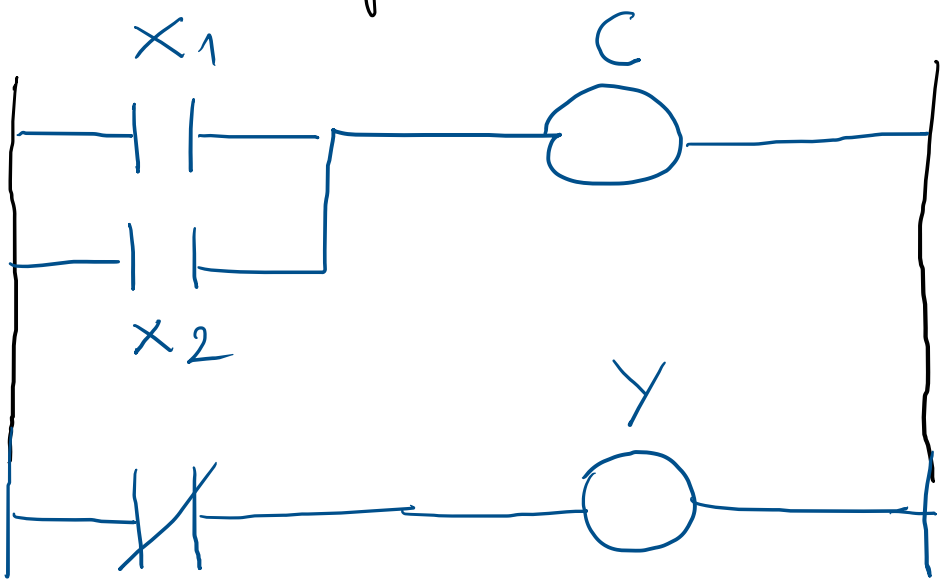
  So Y is OFF

3) Gate NOR



x_1	x_2	$y = \overline{x_1 + x_2}$
0	0	1
0	1	0
1	0	0
1	1	0

Ladder diagram



- IF X_1 and X_2 open C is closed
  so Y is ON
- iF X_1 or X_2 is closed C is open
  so Y is OFF

Example 4:

A motor controlled by stop and start push button switches.
One signal light must be illuminated when the power is applied to the motor and another when it is not applied.