

# Technical University of Denmark

31342 Introduction to Programmable Logic Controllers

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## Exercise 3

### PLC Startup

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*Student:*

Sefa Kayraklık (s186295)

*Instructor:*

Søren Hansen



Spring, February 20, 2019

## Task 1: My First Program: "Hello World!":

The red light is assigned to the 1<sup>st</sup> switch; as the switch becomes high, the light becomes on.



## Task 2: Basic Logic Functions:

Firstly, the logic gates AND, OR, and XOR are implemented. The output of AND gate is assigned to the red light, the output of OR gate is assigned to the yellow light, and the output of the XOR gate is assigned to the green light. The results are as expected.



Secondly, the logic gates NOR and NAND are implemented. The output of NOR gate is assigned to the red light, and the output of NAND gate is assigned to the yellow light. The results are as expected.



## Task 3: Logic Function:

The Karnaugh map method is considered to implement the truth table.

S2 S3	00	01	11	10
S1				
00	1		1	
01			1	

S2 S3	00	01	11	10
S1				
00		1	1	1
01	1	1	1	1

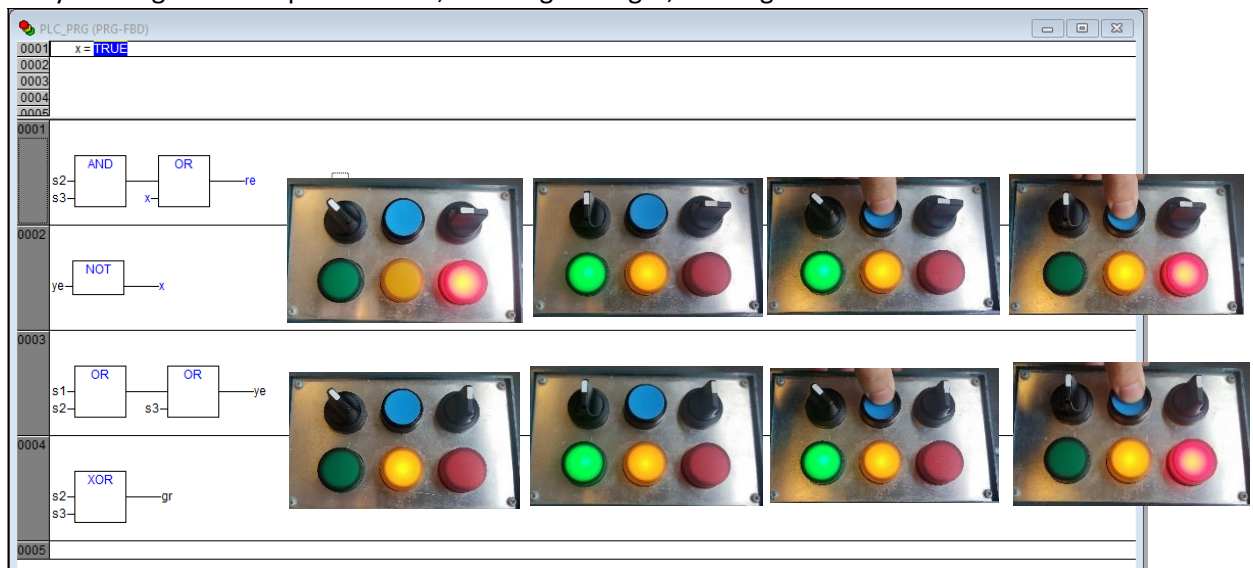
S2 S3	00	01	11	10
S1				
00		1		1
01		1		1

$$Re = S2S3 + S1'S2'S3'$$

$$Ye = S1 + S2 + S3$$

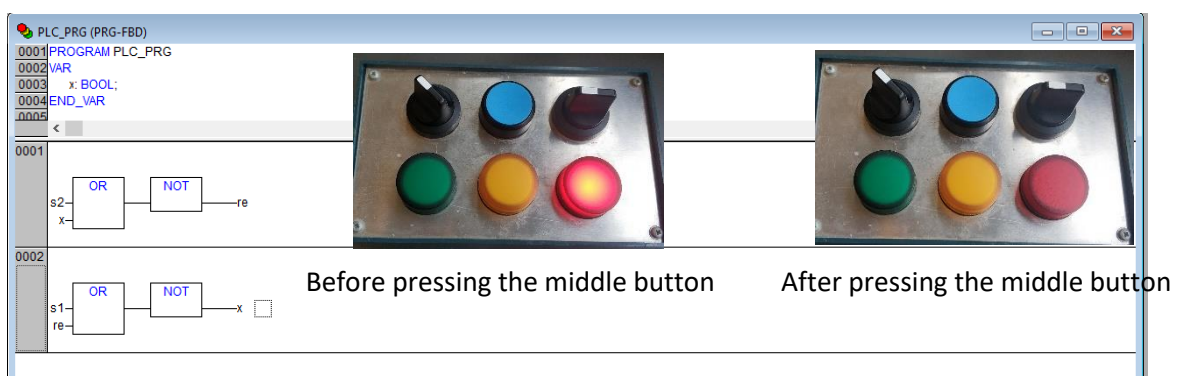
$$Ge = S2S3' + S2'S3 = S2 \oplus S3$$

For the yellow light, 2 OR gates are used; for the red light, 1 AND, 1 OR, and 1 NOT gate with the yellow light as an input are used; for the green light, 1 XOR gate is used.



## Task 4: Latch:

An SR latch is implemented with 2 NOR gates according to the Task 3 in the previous exercise.



In the SR latch, the middle button is assigned as the reset input. It can be seen that as the button is pressed, (meaning that a short pulse is given to the latch) the output (red light) is reset.

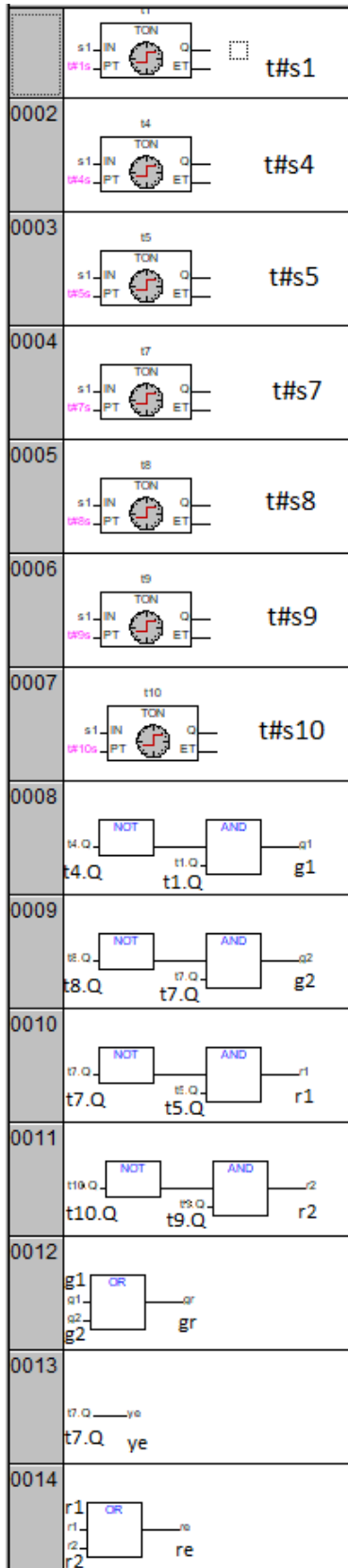
## Task 5: Timers:

The implementation of the time sequence is done by using switch 1 as an input. It is started to count the time when the input goes high.

The green light has two pulses and these pulses are implemented separately and combined with a OR gate.

The yellow light has only one pulse that goes always high.

The red light has two pulses and they are implemented as in the green light case.



```

PLC_PRG (PRG-FBD)
0001 PROGRAM PLC_PRG
0002 VAR
0003     t1: TON;
0004     t4: TON;
0005     t5: TON;
0006     t7: TON;
0007     t8: TON;
0008     t9: TON;
0009     t10: TON;
0010     r1: BOOL;
0011     r2: BOOL;
0012     g1: BOOL;
0013     g2: BOOL;
0014 END_VAR
0015

```

The video representation of the time sequence is attached through DTU-Inside