Assignment 3 | FPGA Lab

Deeshant Sharma [EE21MTECH14002]

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1 Question

We have to perform the problem presented in Assignment-1 on arduino and verify the output using assembly language. **Also, Draw the truth table for the inputs and outputs for the given expression**

$$(A.B)' + (A' => B)$$

2 Operators Description

2.1 Binary Operator: AND

The AND operator (symbolically: "**.**") also known as logical conjunction requires both A and B to be True(1) for the result to be True(1). All other cases result in False(0).

2.2 Binary Operator: OR

The OR operator (symbolically: "**+**") requires only one premise to be True(1) for the result to be True(1)

2.3 Binary Operator: NOT

The NOT operator is commonly represented by a [**'**]. It negates, or switches truth value.

2.4 Conditional Operator: if-then

Logical implication (symbolically: $\mathbf{A \rightarrow B}$ or "$=>$"), also known as "if-then", results True(1) in all cases except the case T $\rightarrow$ F.This is logically equivalent to $\mathbf{A'+B}$

3 Solution

3.1 Tautology

Truth Values are True(1) for any combination of truth value of variables.

3.2 Contradiction

Truth Values are False(0) for any combination of truth value of variables.

3.3 Contingency

Some Truth Values are True(1) for some combination of truth value of variables and some truth value are False(0) for truth value combination of other variables.

3.4 Truth Table

A	B	$A.B$	$(A.B)'$	A'	$(A' => B)$	$(A.B)' + (A' => B)$
1	**1**	1	0	0	1	**1**
1	**0**	0	1	0	1	**1**
0	**1**	0	1	1	1	**1**
0	**0**	0	1	1	0	**1**

4 Assembly Code

```
.include "/home/ramesh720/m328Pdef.inc"

Start:
ldi r17, 0b11000011 ; identifying input pins 10,11,12,13
out DDRB,r17 ; declaring pins as input
ldi r17, 0b11111111 ;
out PORTB,r17 ; activating internal pullup for pins 10,11,12,13
in r17,PINB

ldi r20,0b00000010
rcall loopr

ldi r21,0b00000001
and r21,r17 ;w
lsr r17
ldi r22,0b00000001
and r22,r17 ;z
lsr r17
ldi r23,0b00000001
and r23,r17 ;b
lsr r17
```

```
ldi r24,0b00000001
and r24,r17 ;a

ldi r25,0b00000001

mov r14,r23
and r23,r24   ;r23 = a.b
com r23       ;r23 = (a.b)'
or r24,r14    ;r24 = a+b
or r24,r23    ;r24 = (a+b) + (a.b)'



ldi r20,0b00000010
rcall loopl

ldi r16, 0b00111100    ;identifying output pins 2,3,4,5
out DDRD,r16 ;declaring pins as output
out PORTD,r24 ;writing output to pins 2,3,4,5


rjmp Start

loopr: lsr r17
dec r20
brne loopr
ret

loopl: lsl r24
dec r20
brne loopl
ret
```

5 Result

Since for all combination of A and B given proposition gives output as **True(1)** hence, given proposition is a **Tautology**.

`The assignment has been completed and truth table isverified.`

Implemented the above truth table in Arduino. The inputs A,B equivalent are displayed on seven segment display and its corresponding output is displayed with LED.
Steps:
1. Login into ubuntu and go to avra-1.3.0 folder
2. In avra-1.3.0 folder open src folder and write program in assign3.asm

3. One program was written to display LHS truth table and other to display RHS truth table.

4. Compile the program to generate the hex file.

5. After generating the hex file save it on laptop and load it in Arduino usng XLoader.