



**Nemexpetr** Update README.md

🕒 **History**

👤 1 contributor

Raw

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97 lines (67 sloc) | 3.11 KB

## 🔗 **01 - Logic gates**

### 🔗 **Lab assignment**

- ✓ 1. Submit the GitHub link to your Digital-electronics-1 repository.
- ✓ 2. Verification of De Morgan's laws of function  $f(c,b,a)$ . Submit:
  - Listing of VHDL code design.vhd,
  - Screenshot with simulated time waveforms,
  - Link to your public EDA Playground example.
- ✓ 3. Verification of Distributive laws. Submit:
  - Listing of VHDL code design.vhd,
  - Screenshot with simulated time waveforms,
  - Link to your public EDA Playground example.
- ☐ Prepare all tasks in your README file Digital-electronics-1/Labs/01-gates/README.md, export/print it to PDF, use BUT e-learning web page

and submit a single PDF file. The deadline for submitting the task is the day before the next laboratory exercise.

## 1 Submitting GitHub repository

My GitHub [repository](#).

## 2 Verification of De Morgan's laws of function $f(c,b,a)$

Parts:

- Listing of VHDL code `design.vhd`,
- Screenshot with simulated time waveforms,
- Link to your public EDA Playground example.

Function is defined as follows. We also derived the only NAND and NOR form of function via De Morgan's laws.

$$f(c,b,a) = \bar{b}a + \bar{c}\bar{b}$$

$$f(c,b,a)_{\text{NAND}} = \overline{\bar{b}a\bar{c}\bar{b}}$$

$$f(c,b,a)_{\text{NOR}} = \overline{\bar{b} + \bar{a} + \bar{c} + \bar{b}} = \overline{\bar{b} + \bar{a}} + \overline{\bar{c} + \bar{b}}$$

Equations were generated by [Online LaTeX Equation Editor](#).

Code from [EDU Playground](#):

Excerpt from `design.vhd`:

```
architecture dataflow of gates is
begin
    f_o <= (not b_i and a_i) or (not b_i and not c_i);
    fnand_o <= not(not((not b_i) and a_i) and not(not c_i and not b_i));
    fnor_o <= not(b_i or not a_i) or not(c_i or b_i);

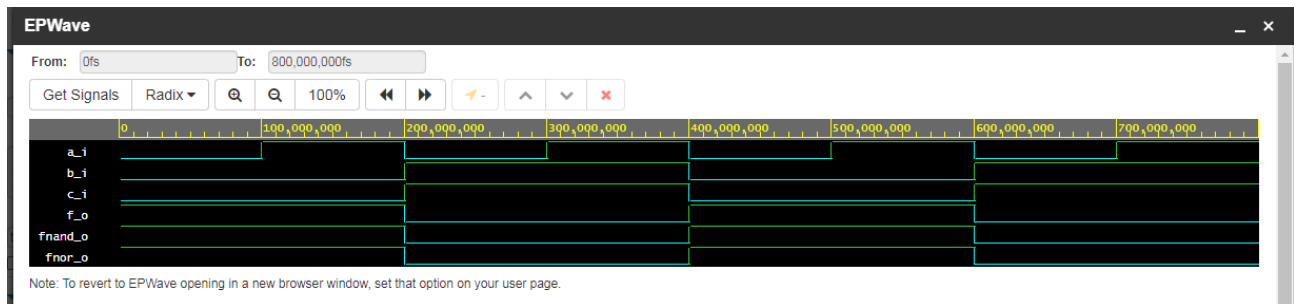
end architecture dataflow;
```

Here are the simulation results in table:

c	b	a	$f(c,b,a)$	$f(c,b,a)_{\text{nand}}$	$f(c,b,a)_{\text{nor}}$
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c	b	a	f(c,b,a)	f(c,b,a)nand	f(c,b,a)nor
0	0	0	1	1	1
0	0	1	1	1	1
0	1	0	0	0	0
0	1	1	0	0	0
1	0	0	1	1	1
1	0	1	1	1	1
1	1	0	0	0	0
1	1	1	0	0	0

And a photo of simulation results in EDA Playground:



We successfully verified De Morgan's laws with function f(c,b,a).

## 3 Verification of Distributive laws

Parts:

- Listing of VHDL code `design.vhd`,
- Screenshot with simulated time waveforms,
- Link to your public EDA Playground example.

### Distributive laws

$$x \cdot y + x \cdot z = x \cdot (y + z)$$

$$(x + y) \cdot (x + z) = x + (y \cdot z)$$

Code from [EDU Playground](#)

Excerpt from `design.vhd`:

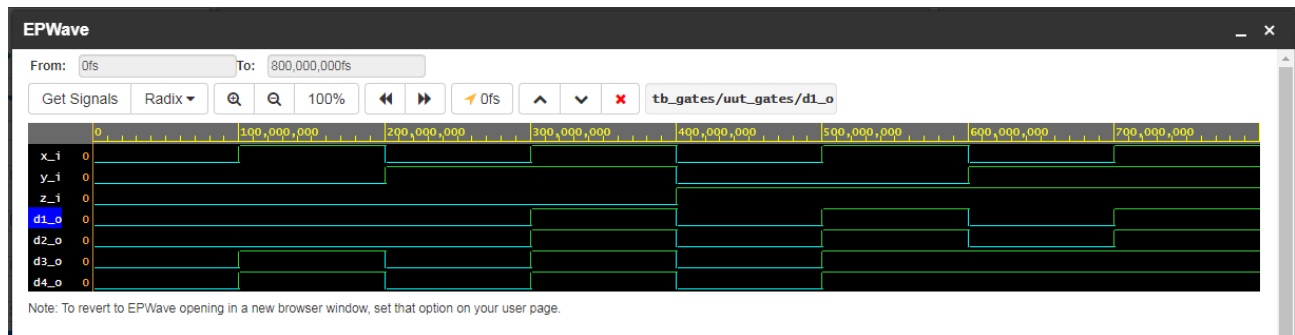
```

architecture dataflow of gates is
begin
    d1_o <= (x_i and y_i) or (x_i and z_i);
    d2_o <= x_i and (y_i or z_i);
    d3_o <= (x_i or y_i) and (x_i or z_i);
    d4_o <= x_i or (y_i and z_i);

end architecture dataflow;

```

Photo of the simulation results in EDA Playground:



From the simulation it is apparent that  $d1$  and  $d2$  are equal as well as  $d3$  and  $d4$  which **verifies distributive laws**.