

# Lab 1: Introduction to Git and VHDL

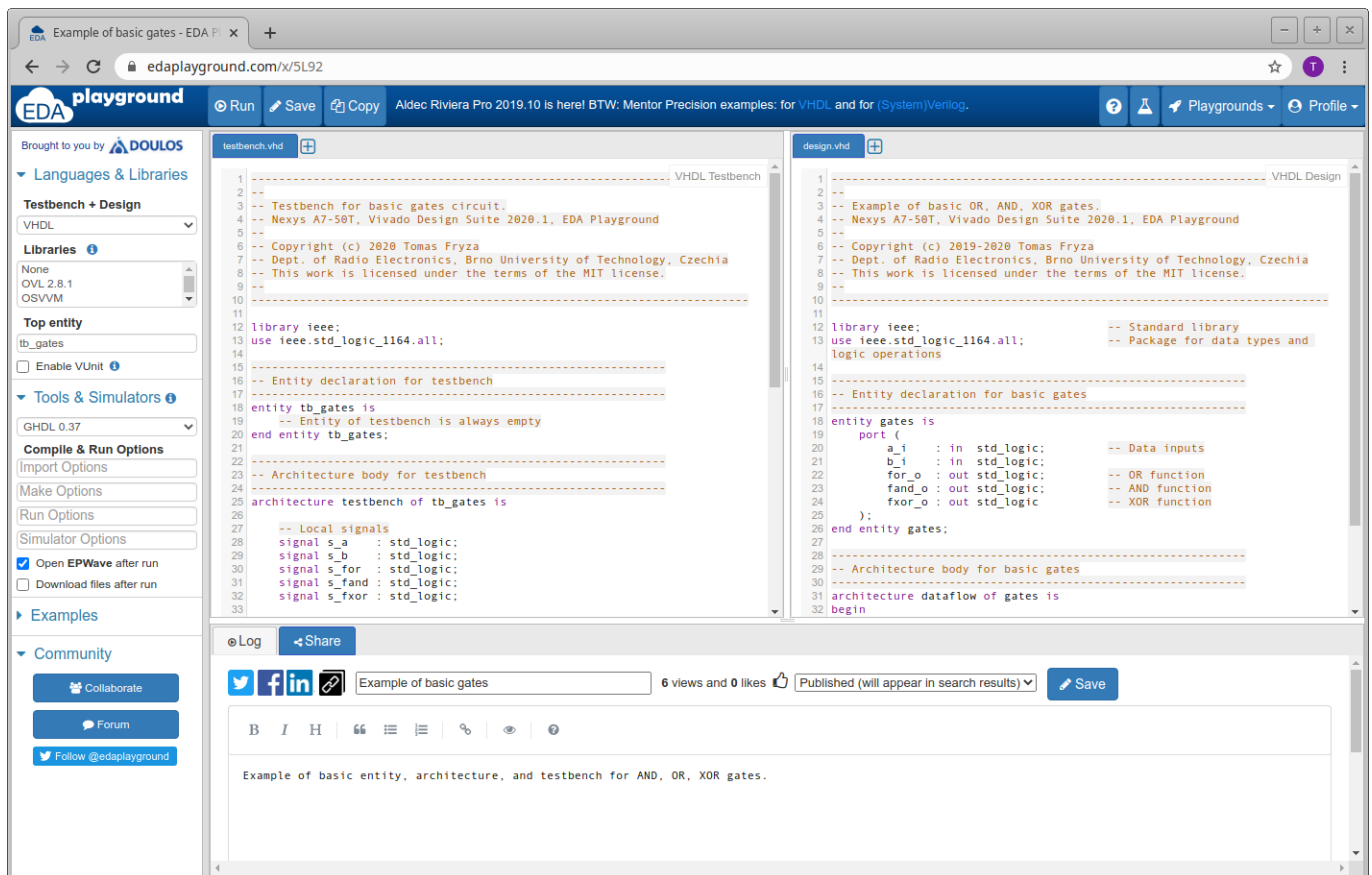


EUROPEAN UNION  
European Structural and Investment Funds  
Operational Programme Research,  
Development and Education



## Learning objectives

The purpose of this laboratory exercise is to learn how to use the git versioning system, write the markdown readme file, use the Linux console terminal to work in the lab, and how to compose a basic VHDL code using the online development tool.



## Preparation tasks (done before the lab at home)

Create an account on [GitHub](#).

If you don't have Google or Facebook account, register your account on [EDA Playground](#).

Download and install [git](#).

## Part 1: GitHub

GitHub is a code hosting platform for collaboration and version control. GitHub lets you (and others) work together on projects.

In GitHub, create a new public repository titled **Digital-electronics-1**. Initialize a README and [MIT license](#).

Use one of the available git manuals, such as [1](#), [2](#), or [3](#), and add the following sections to your README file.

- Headers
- Emphasis (italics, bold)
- Lists (ordered, unordered)
- Links
- Table
- Listing of VHDL source code

## Part 2: Local repository

Run Git Bash (Windows) or Terminal (Linux) and create your own home folder inside **Documents**.

```
## Windows Git Bash:
$ cd d:/Documents/
$ mkdir your-name
$ cd your-name/

## Linux:
$ cd
$ cd Documents/
$ mkdir your-name
$ cd your-name/
```

With help of **git** command, clone a local copy of your public repository.

```
## Windows Git Bash or Linux:
$ git clone https://github.com/your-github-account/Digital-electronics-1
$ cd Digital-electronics-1/
$ ls
LICENSE  README.md
```

Download **Docs** folder from [this repository](#) and copy it to your **Digital-electronics-1** local repository.

```
## Windows Git Bash or Linux:
$ ls
Docs  Examples  LICENSE  README.md
```

Create a new working folder **Labs/01-gates** for this exercise.

```
## Windows Git Bash or Linux:
$ mkdir Labs
$ cd Labs/
$ mkdir 01-tools
```

### Part 3: EDA Playground

Open the [Example of basic gates](#). Take a look at the basic parts of the VHDL source code, such as [entity](#), [architecture](#), and testbench. Use button **Run** to run the simulation and log in to your account using **Log In (save edits)**.

Most common VHDL operators are shown in the table.

Operator	Description
<code>&lt;=</code>	Value assignment
<code>and</code>	Logical AND
<code>nand</code>	Logical AND with negated output
<code>or</code>	Logical OR
<code>nor</code>	Logical OR with negated output
<code>not</code>	Nagation
<code>xor</code>	Exclusive OR
<code>xnor</code>	Exclusive OR with negated output
<code>-- comment</code>	Comments

Use De Morgan's laws and modify the following logic function to the form with NAND and NOR gates only. Verify all three functions in EDA Playground tool.

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

Note that, equations were generated by [Online LaTeX Equation Editor](#) using the following code.

```
\begin{align*}
f(c,b,a) &= \sim \overline{b} \wedge a + \overline{c} \wedge \overline{b} \\
f(c,b,a)_{\{\text{NAND}\}} &= \\
f(c,b,a)_{\{\text{NOR}\}} &= \\
\end{align*}
```

Run any text editor, such as *Visual Studio Code* or *Atom*, open your [Digital-electronics-1/Labs/01-gates/README.md](#) local file (not on GitHub), create/complete tables with logical values, add link to your

Playground and a screenshot with time waveforms from the simulator.

c	b	a	f(c,b,a)
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

## Synchronize git

When you finish working, always synchronize the contents of your working folder with the local and remote versions of your repository. This way you are sure that you will not lose any of your changes.

Use [git commands](#) to add, commit, and push all local changes to your remote repository. Note that, a detailed description of all git commands can be found [here](#). Check the repository at GitHub web page for changes.

```
## Windows Git Bash or Linux:
$ git status
$ git add <your-modified-files>
$ git status
$ git commit -m "[LAB] Creating 01-gates lab"
$ git status
$ git push
$ git status
```

## Experiments on your own

1. In EDA Playground, verify basic Boolean postulates:

$$x \cdot \overline{x} = 0$$

$$x + \overline{x} = 1$$

$$x + x + x = x$$

$$x \cdot x \cdot x = x$$

and Distributive laws:

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

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

2. Try several online graphics simulators, such as [CircuitVerse](#), [Logicly](#), [CircuitLab](#), [simulatorIO](#), [LogicEmu](#), and compare their options.

## Lab assignment

1. Submit the GitHub link to your [Digital-electronics-1](#) repository.
2. Verification of basic Boolean postulates. Submit:
  - VHDL code ([design.vhd](#)),
  - Screenshot with simulated time waveforms,
  - Link to your public EDA Playground example.
3. Verification of Distributive laws. Submit:
  - VHDL code ([design.vhd](#)),
  - Screenshot with simulated time waveforms,
  - Link to your public EDA Playground example.

The deadline for submitting the task is the day before the next laboratory exercise. Use [BUT e-learning](#) web page and submit a single PDF file.