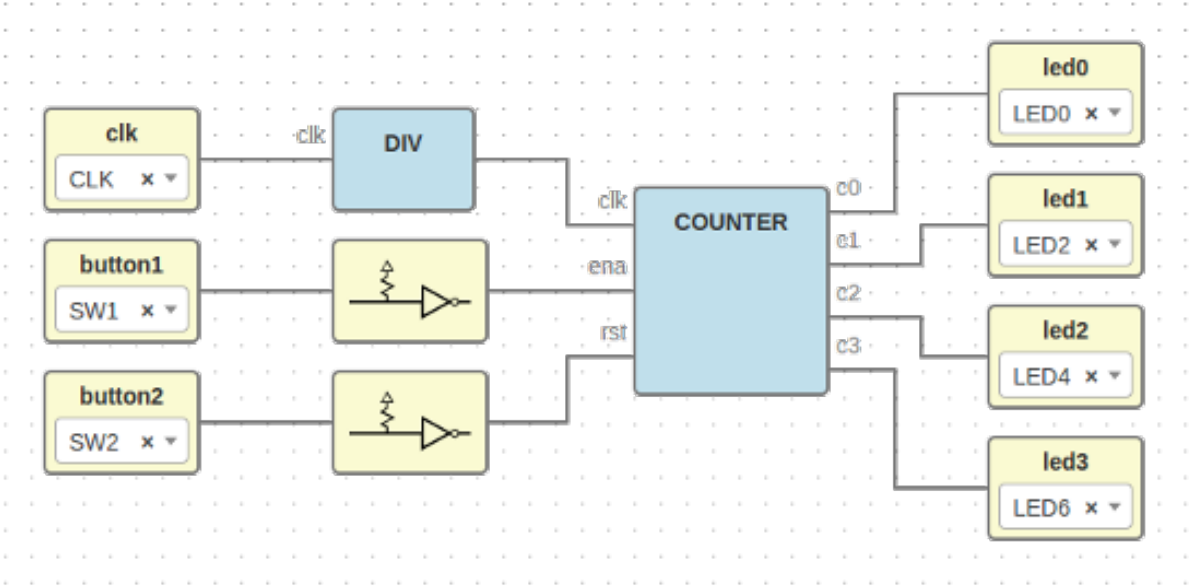
# Workshop - Open FPGA tools



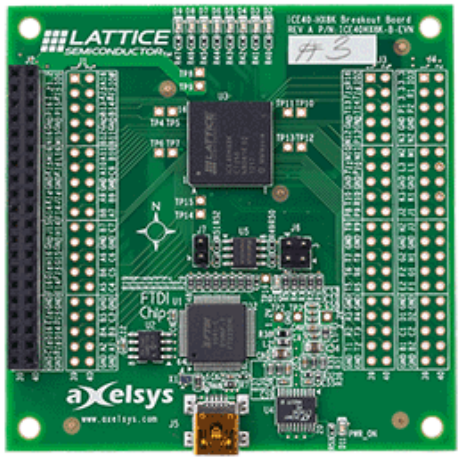


Jesús Arroyo Torrens

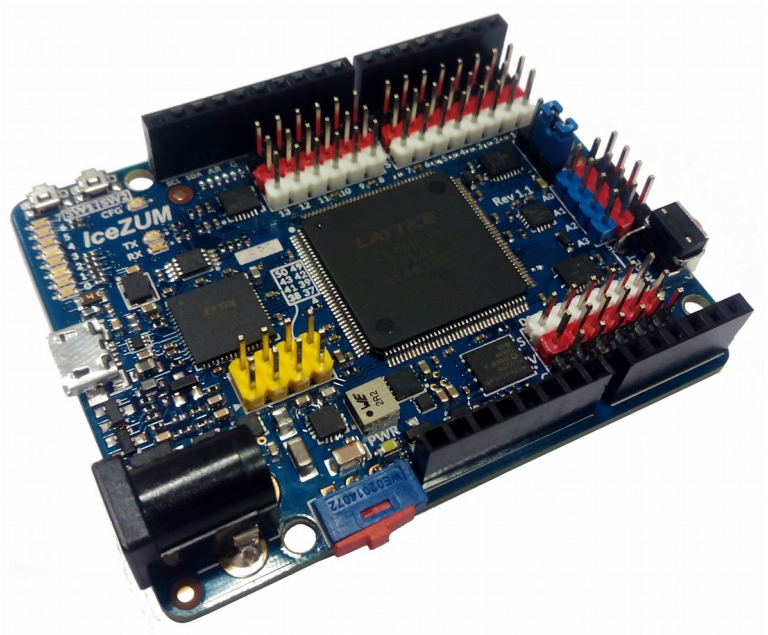
https://github.com/Jesus89

# Open FPGA boards

Icestick




iCE40-HX8K Breakout Board




IceZUM Alhambra

# Open FPGA toolchains

Icestorm

Iverilog

GTKWave

# Open FPGA toolchains

API ide

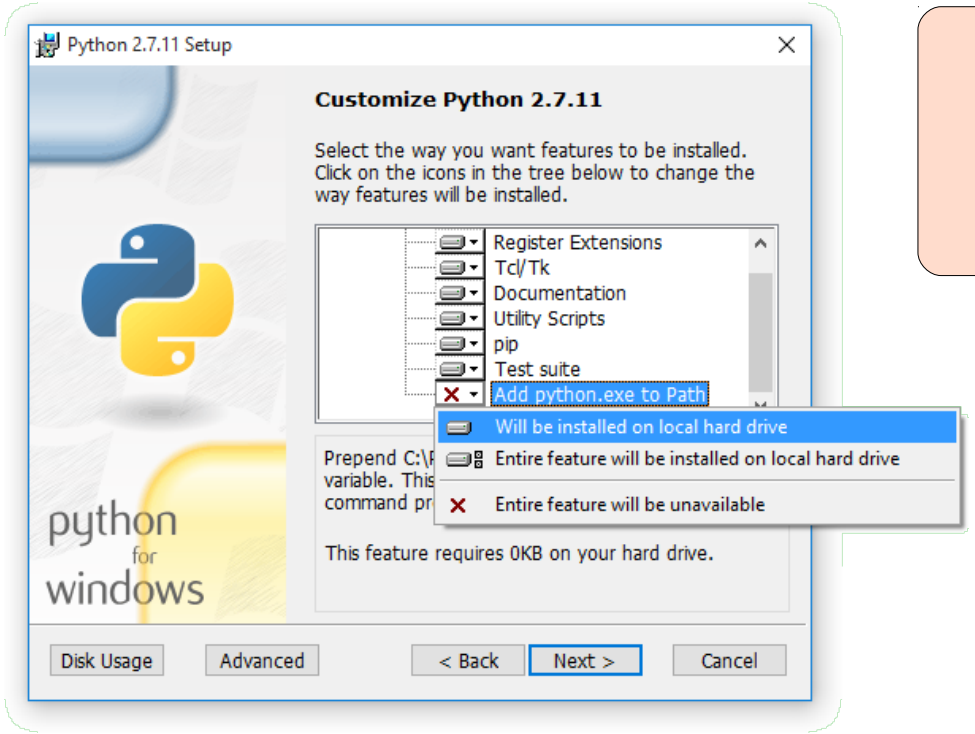
APIO

| | | |
|---|---|---|
| Icestorm | Iverilog | GTKWave |

# Open FPGA stack tools

# Requirements

1. **Python 2.7** https://www.python.org

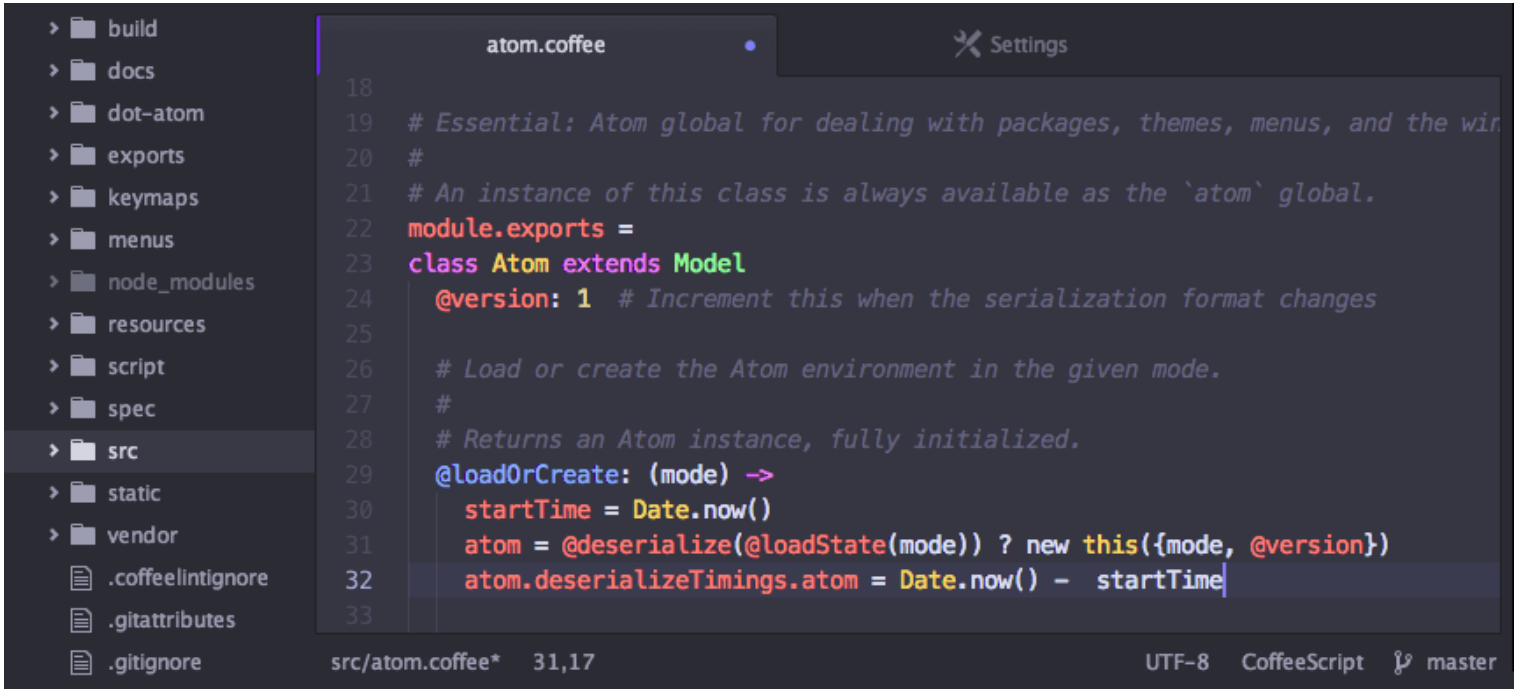



*Windows Users*: DON'T FORGET to select `Add python.exe to Path` feature on the "Customize" stage.

Check installation: open a console and type **`python`**

# Requirements

2. **Atom Editor** https://atom.io



# Requirements

3. **Apio packages*** https://github.com/FPGAwars/workshops/releases

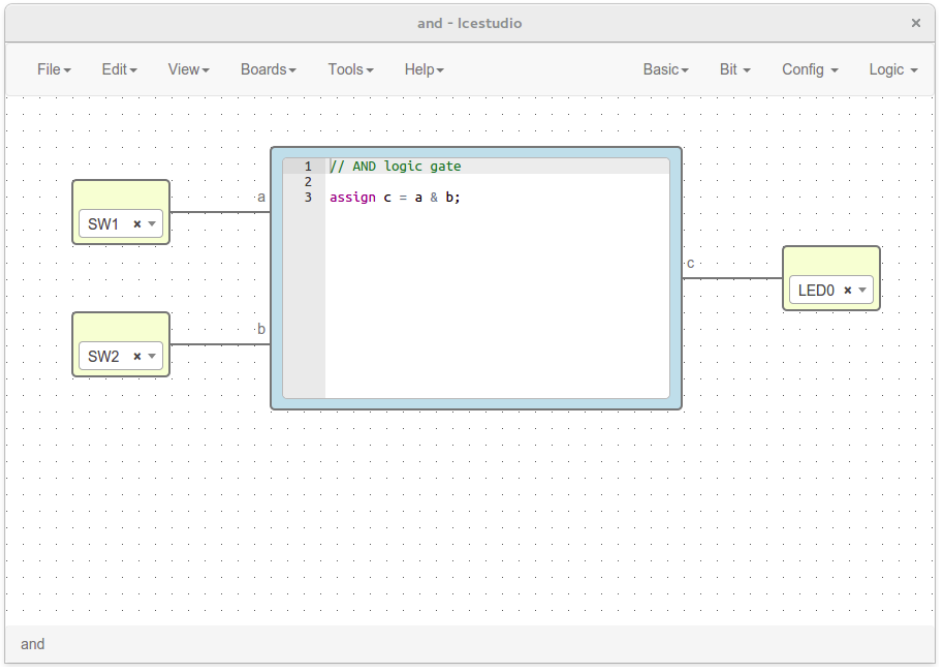
- Copy *apio-dir.zip*
- Copy *install.py*
- Open console and execute

```
$ python install.py
Insert the zip filename: apio-dir-linux64.zip
Success: .apio dir updated!
```

* (optional) equivalent to *Icestudio Install toolchain* or `apio install –all`.
It is used to save time downloading the packages

# Icestudio

https://github.com/FPGAwars/icestudio

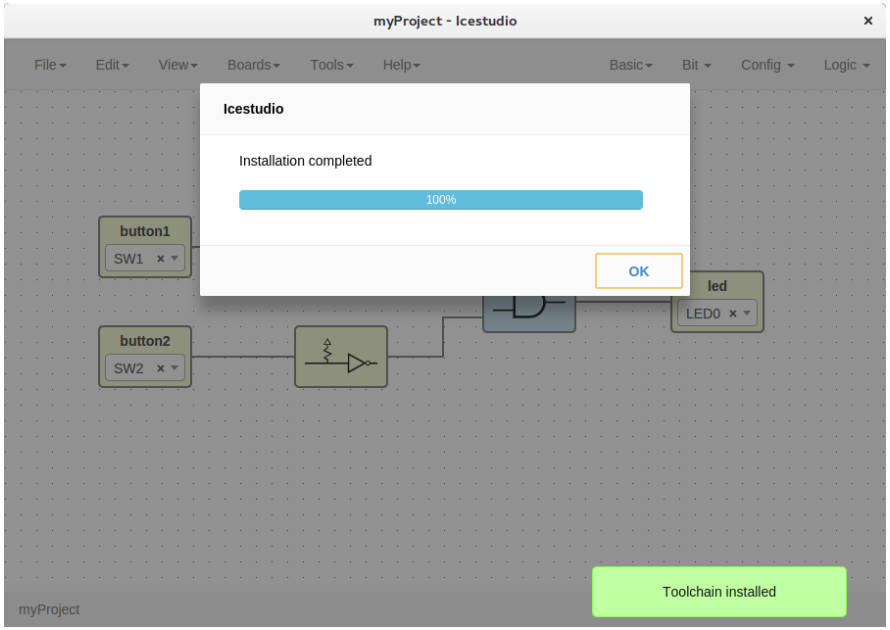




Experimental graphic editor for open FPGAs. Created with HTML and JS

# Icestudio

## 1. **Install**

- Copy *icestudio-0.2.2-rc.zip*
- Unzip the file
- Execute *icestudio*




## 2. **Setup**

- Install toolchain

  *Tools > Install/Upgrade toolchain*

- Install drivers

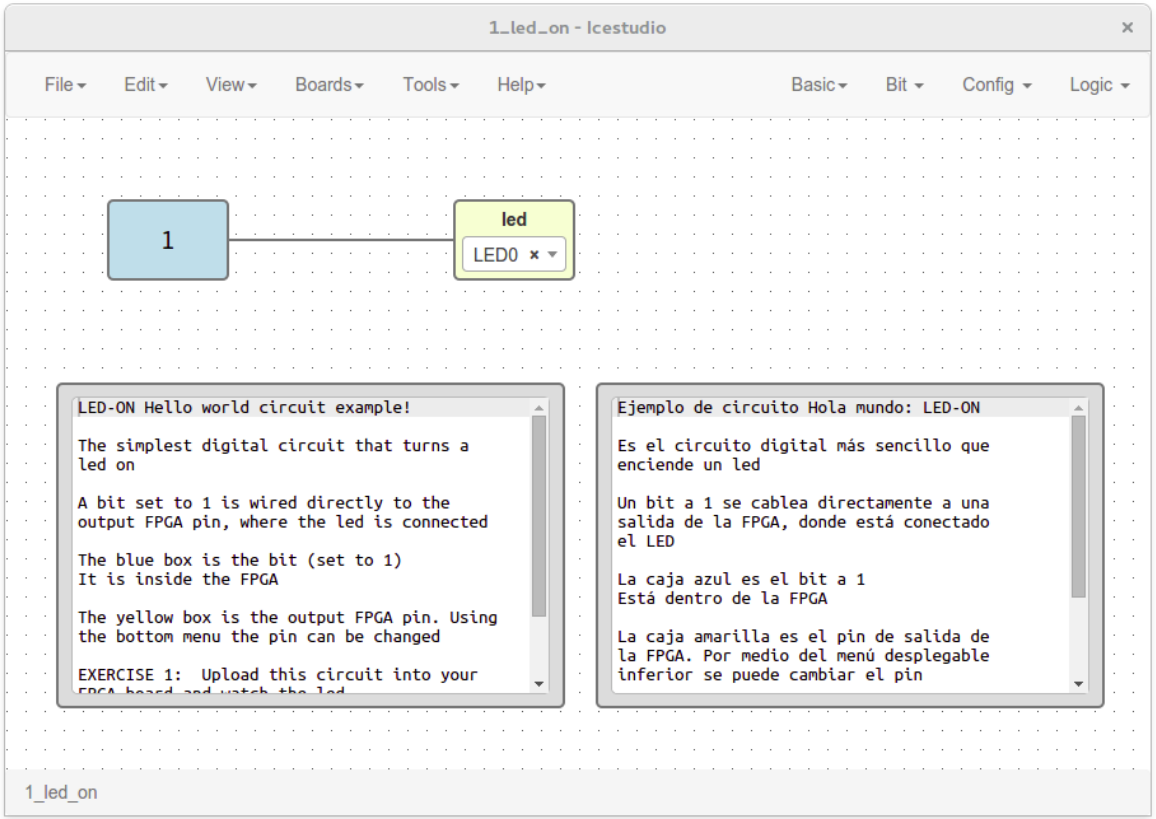
  *Tools > Enable drivers*

*Drivers configuration* requires administrator permissions
Follow the instructions in each OS

# Icestudio

## 3. **Hello, world!**

- Load example
  *File > Examples*
- Select board
  *Board > IceZUM*
- Select I/O pin
  *Edit the combo*
- Upload bit stream
  *Tools > Upload*

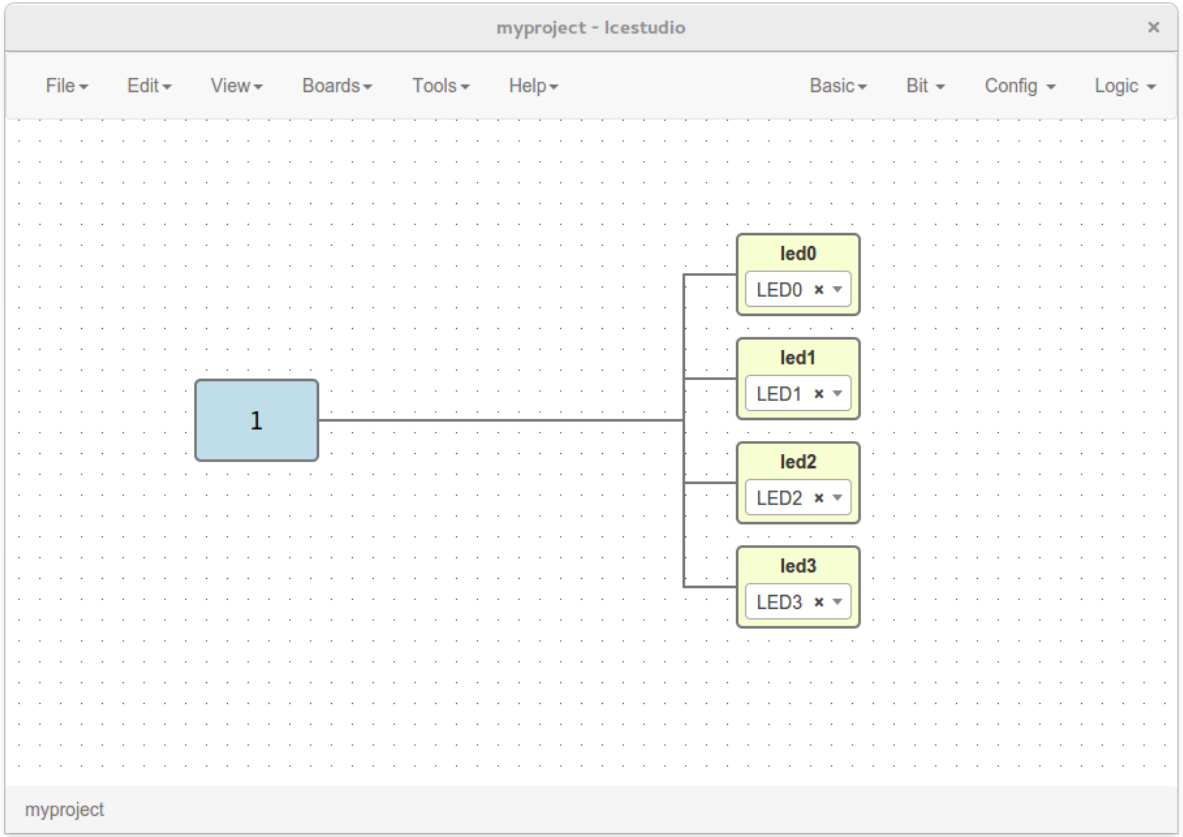



Inspect a block and edit a I/O label using *double-click*

# Icestudio

## 4. **More leds on**

- Create a project
  *File > New project*
- Add blocks
  *Bit > 1*
  *Basic > Output*
- Connect wires
- Upload bit stream
  *Tools > Upload*

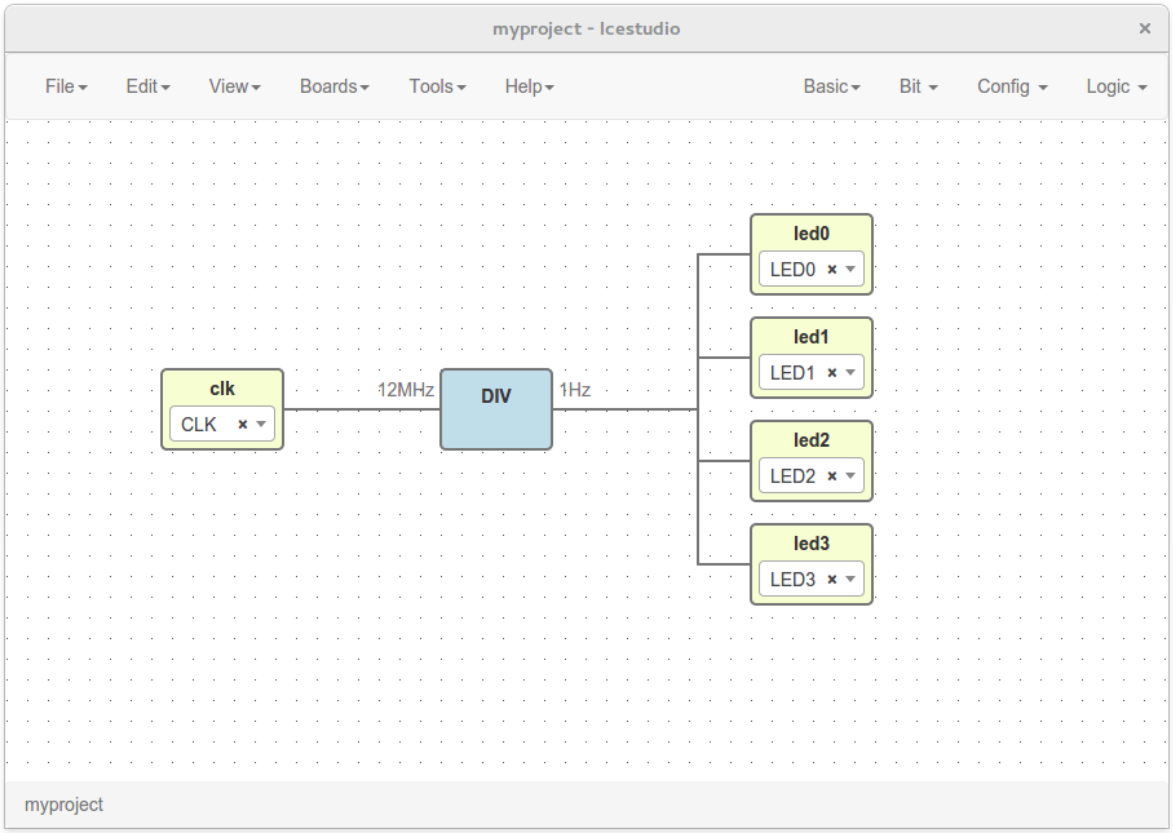



Multiple I/O blocks can be created e.g. "*led0␣led1␣led2*"

# Icestudio

5. **Blink**

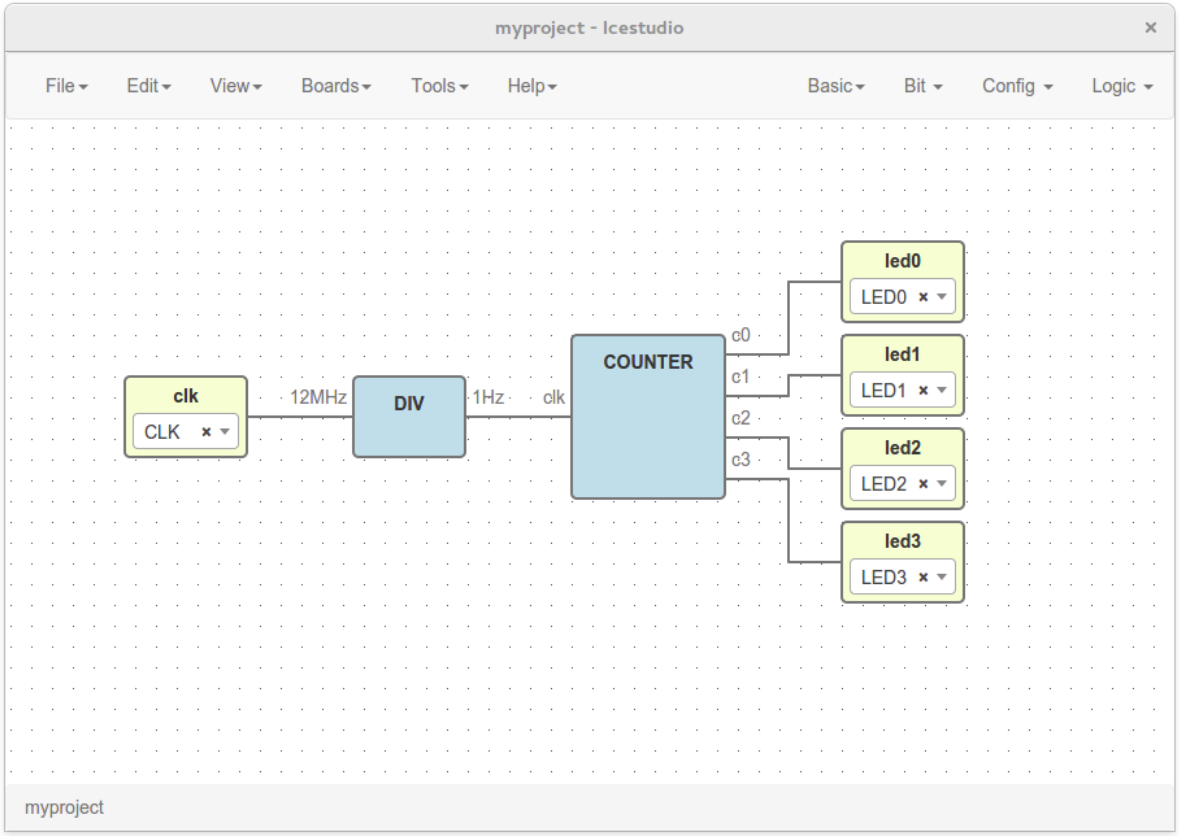
- Import DIV block
  *File > Import block*
- Add clock input
  *Basic > Input*
- Connect wires
- Upload bit stream
  *Tools > Upload*



# Icestudio

## 5. **Counter**

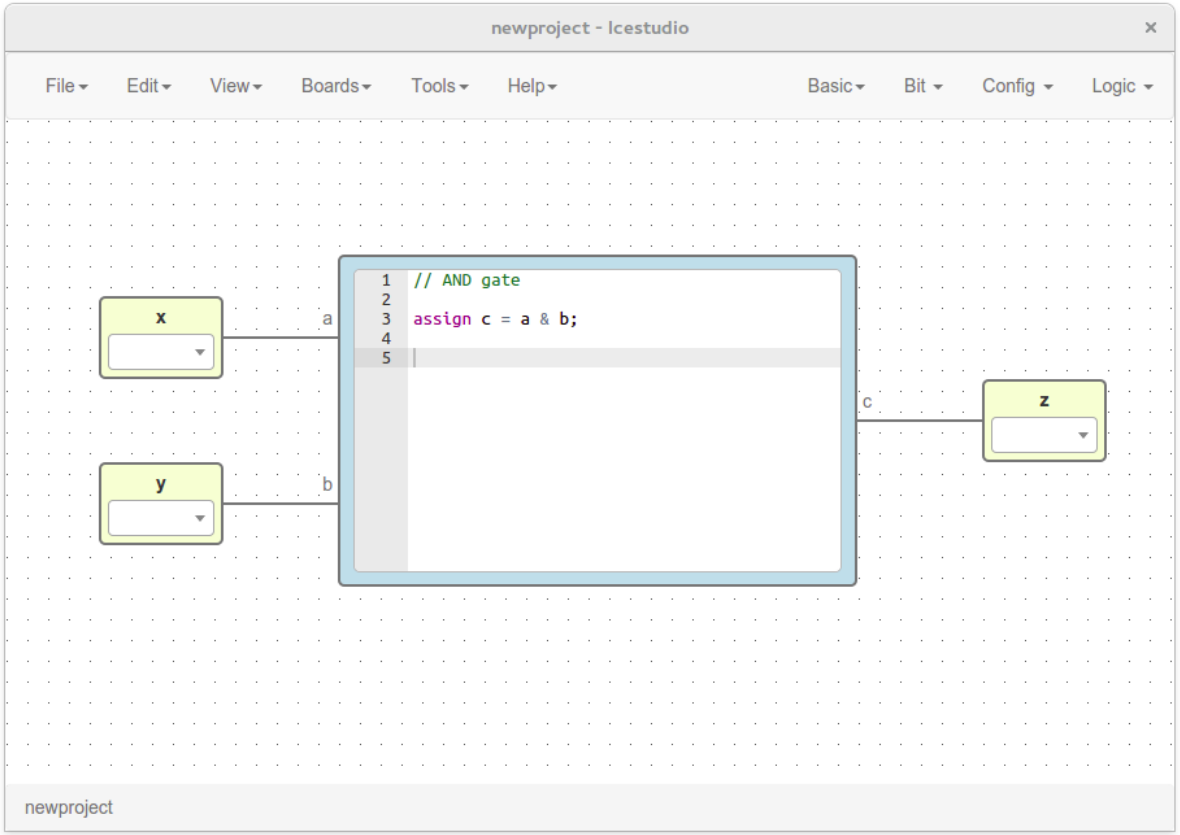
- Import counter
  *File > Import block*
- Reconnect wires
- Upload Bit stream
  *Tools > Upload*



# Icestudio

## 6. **Let's code**

- Create a project
  *File > New project*
- Add blocks
  *Basic > Code*
  *Basic > Input*
  *Basic > Output*
- Connect wires
- Verify the design
  *Tools > Verify*




Code block ports can be created "in␣*out*" e.g. "a,b␣*c*"

# Icestudio

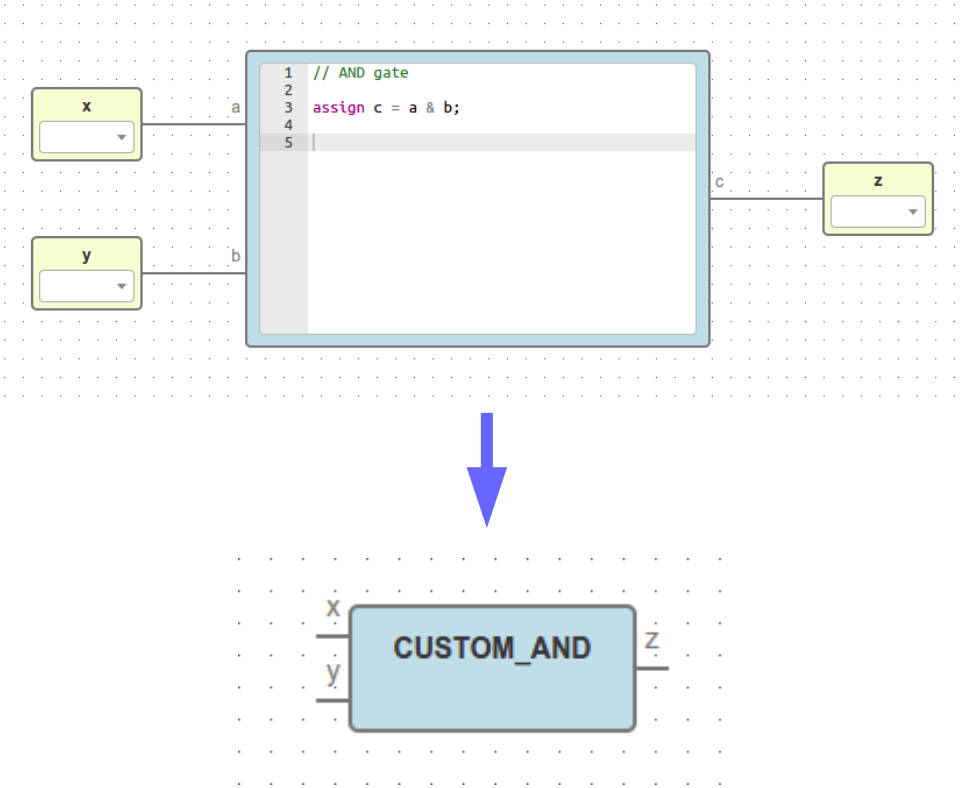
## 7. **Custom block**

- Load a project

  *File > Open project*

- Save project as block

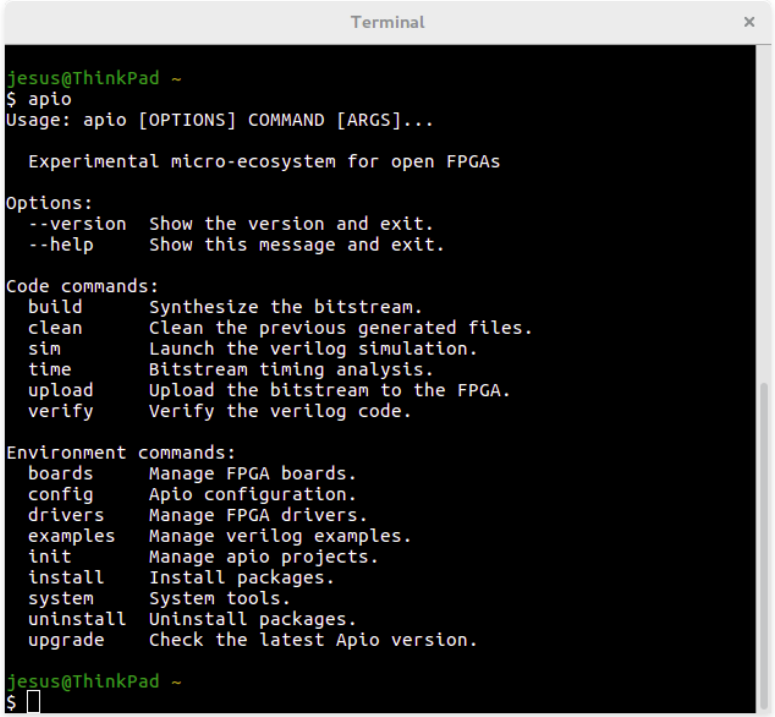
  *File > Export as block*




Input / Output pins will become in/out block ports

# Apio

https://github.com/FPGAwars/apio


Experimental open source ecosystem for open FPGAs. Created with Python

# Apio

## 1. **Install**

- Open the console and execute

```
$ pip install -U apio
```

- Check apio

```
$ apio
```

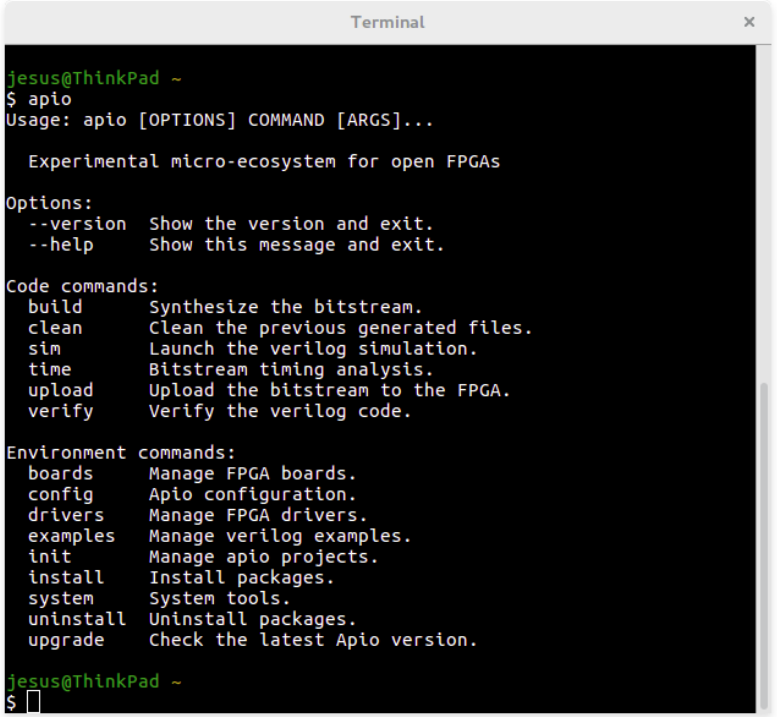
## 2. **Setup**

- Install toolchain

```
$ apio install --all
```

- Install drivers

```
$ apio drivers --enable
```




*Drivers configuration* requires administrator permissions
Follow the instructions in each OS

# Apio

## 3. **Hello, world!**

- Load example

  ```
  $ apio examples -d icezum/leds
  ```

- Move to example

  ```
  $ cd icezum/leds
  ```

- Verify and simulate

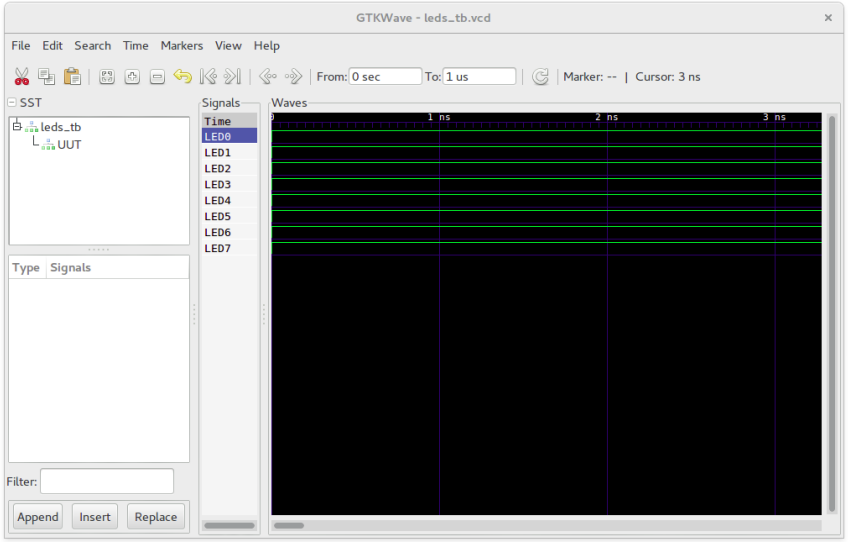
  ```
  $ apio verify $ apio sim
  ```

- Build and upload

  ```
  $ apio build $ apio upload
  ```

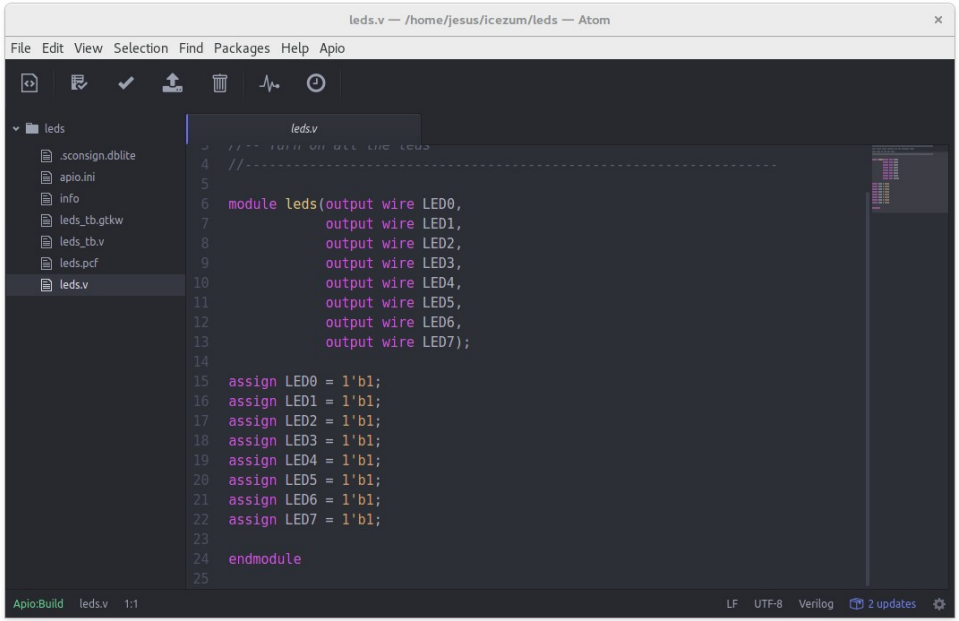
- Time analysis and clean

  ```
  $ apio time $ apio clean
  ```



# Apio IDE

https://github.com/FPGAwars/apio-ide

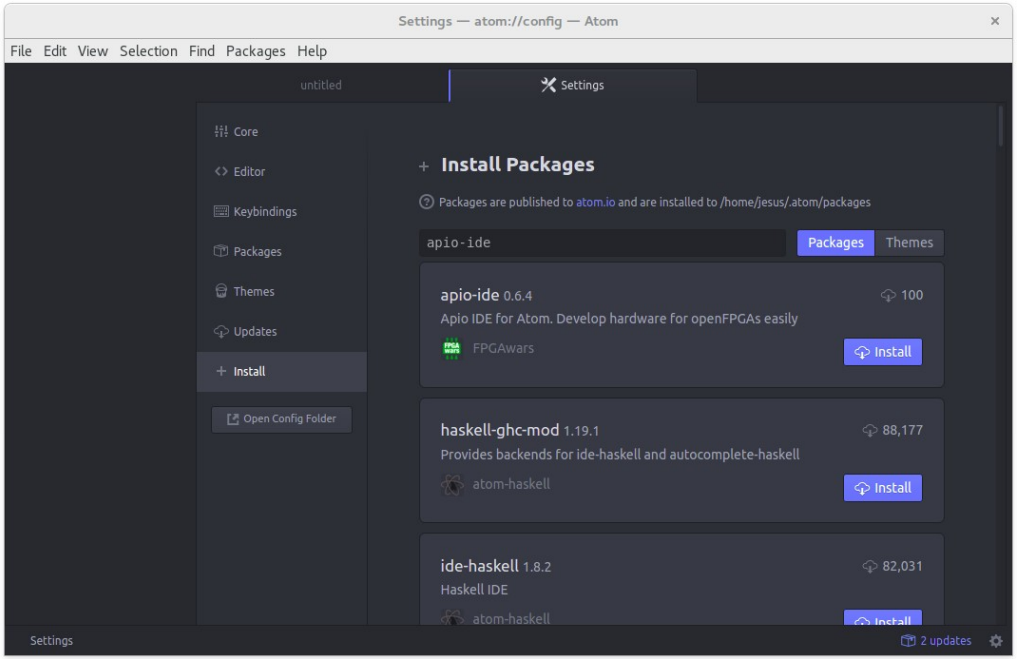




Experimental open source ecosystem for open FPGAs. Created with Python

# Apio IDE

## 1. **Install**

- Open Atom
- Edit > Preferences
- + Install: apio-ide
- Retart Atom

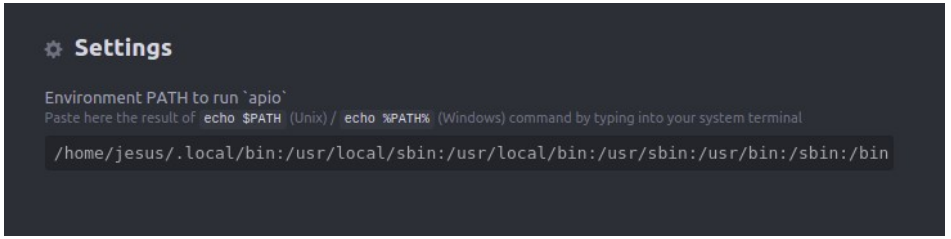



## 2. **Setup**

- Sometimes is required to add

  *apio-ide > Settings > Env PATH*

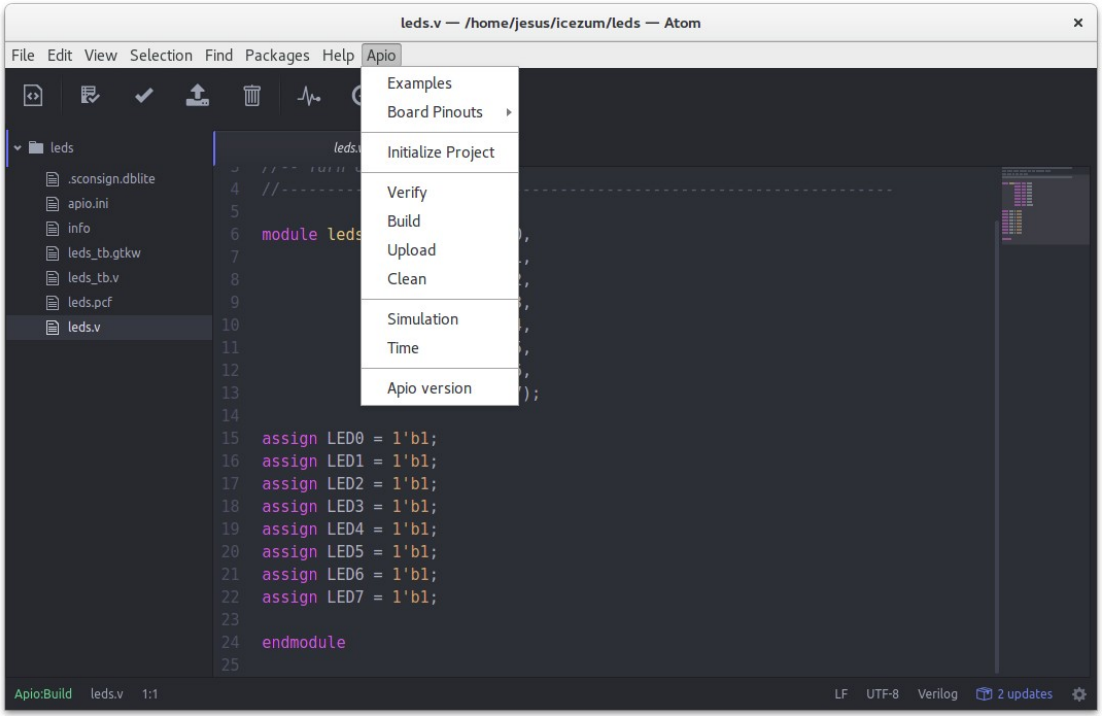
  to let Atom find apio



# Apio IDE

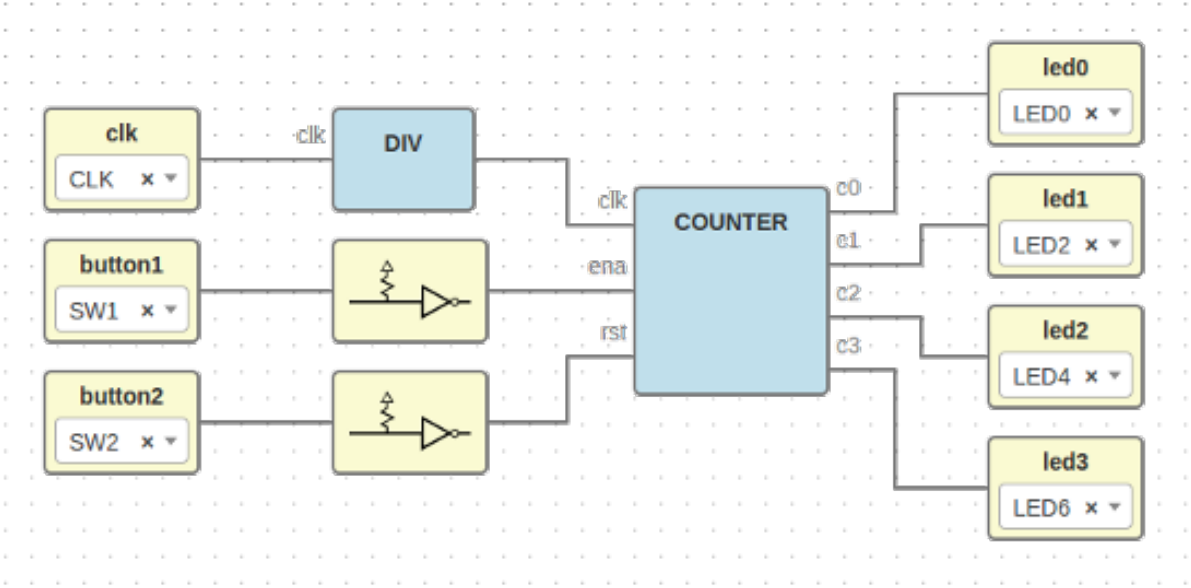
3. **Hello, world!**

- Open a new window
  *File > New Window*
- Load icezum/leds
  *File > Open Folder...*
- Load and edit leds.v
- Upload bit stream
  *Toolbar > Upload*
  *Apio menu > Upload*




All **apio code commands** are implemented in the GUI

# Workshop: open FPGAs tools





Jesús Arroyo Torrens

https://github.com/Jesus89