



The Abdus Salam  
**International Centre  
for Theoretical Physics**



**IAEA**

Joint ICTP-IAEA School on  
Systems-on-Chip based on  
FPGA for Scientific Instrumentation  
and Reconfigurable Computing



**Joint ICTP-IAEA School on  
Systems-on-Chip based on  
FPGA for Scientific  
Instrumentation and  
Reconfigurable Computing |  
(smr 3891)**

*Before Starting (LAB 0)*

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ICTP



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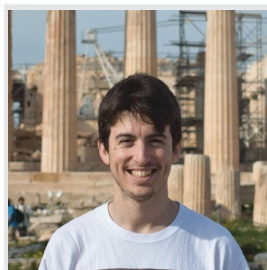


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**Agustin Silva**

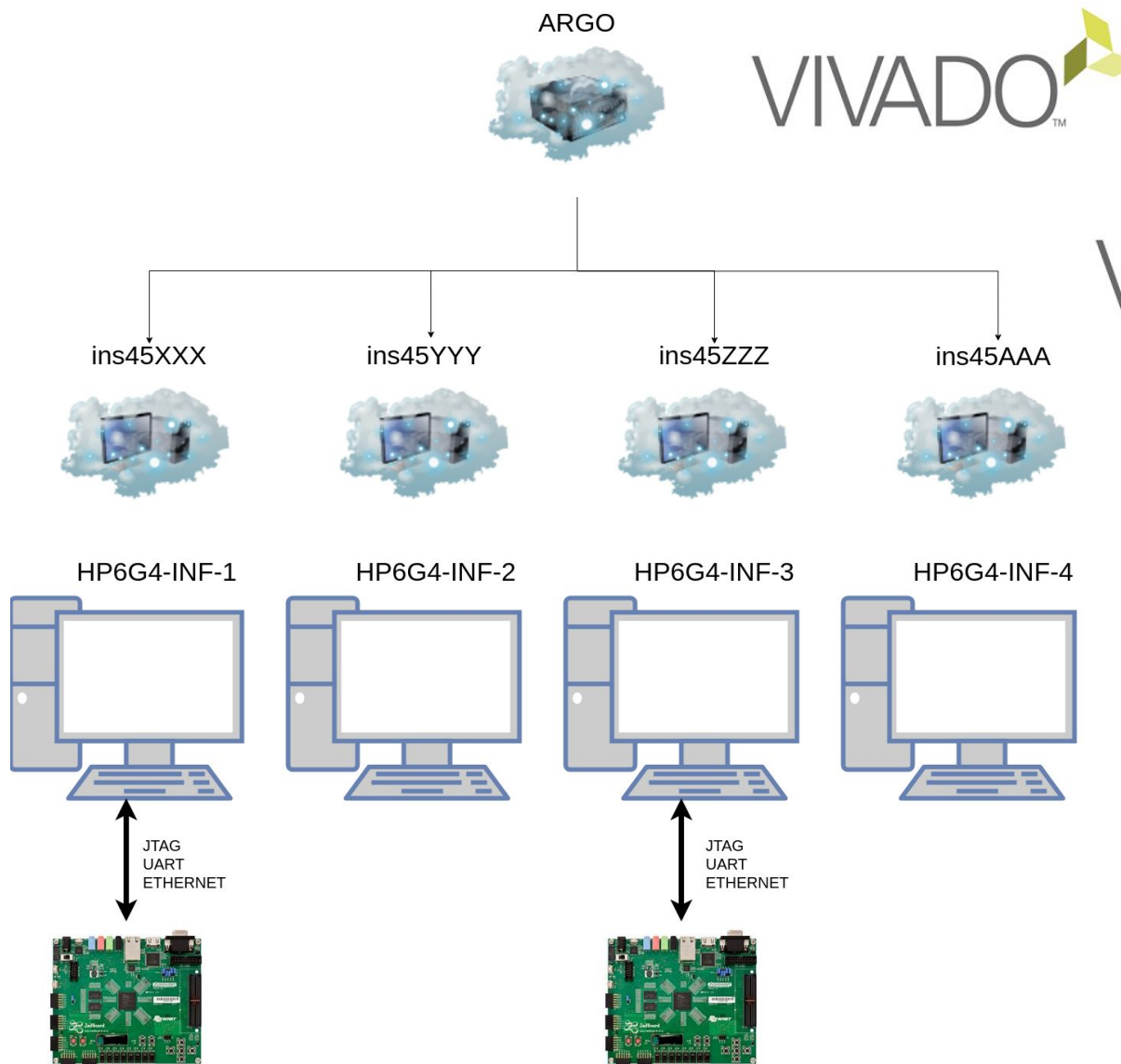
PHD Student

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MLAB-102

Virtual Machines

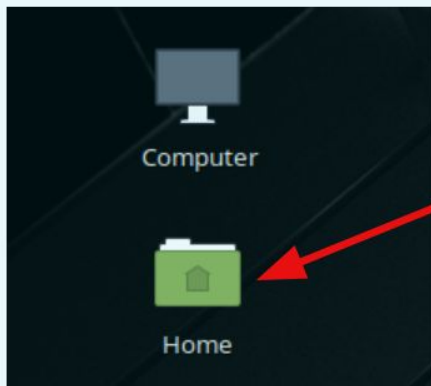
Local Machines



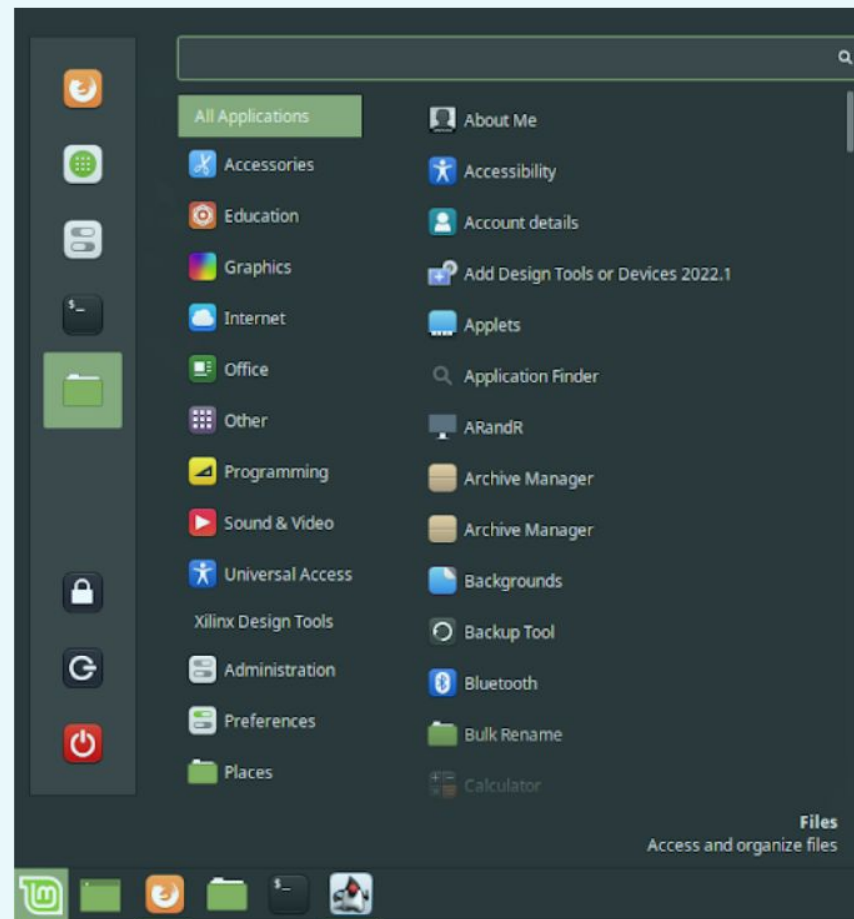
ETHERNET

shutterstock.com · 2112293564

## Knowing your Desktop (Cinnamon Environment)



Home folder

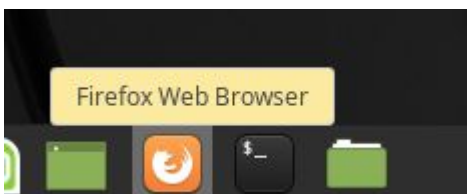


## Gitlab Wiki

<https://gitlab.com/ictp-mlab/smr-3891/-/wikis/home>

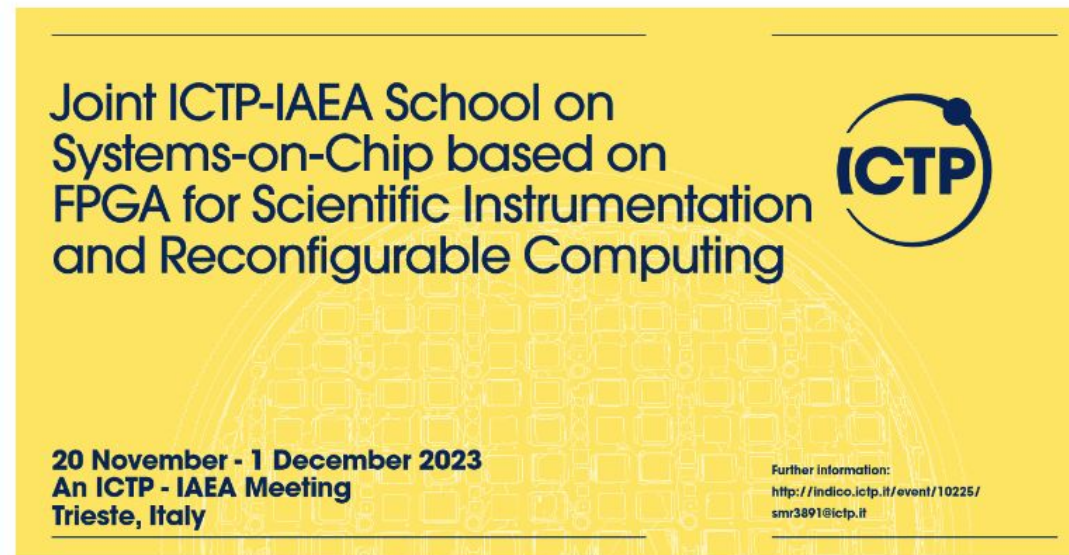
## Gitlab Repository

<https://gitlab.com/ictp-mlab/smr-3891>



### Home

Welcome to the Joint ICTP-IAEA School on Systems-on-Chip based on FPGA for Scientific Instrumentation and Reconfigurable Computing | (smr 3891)



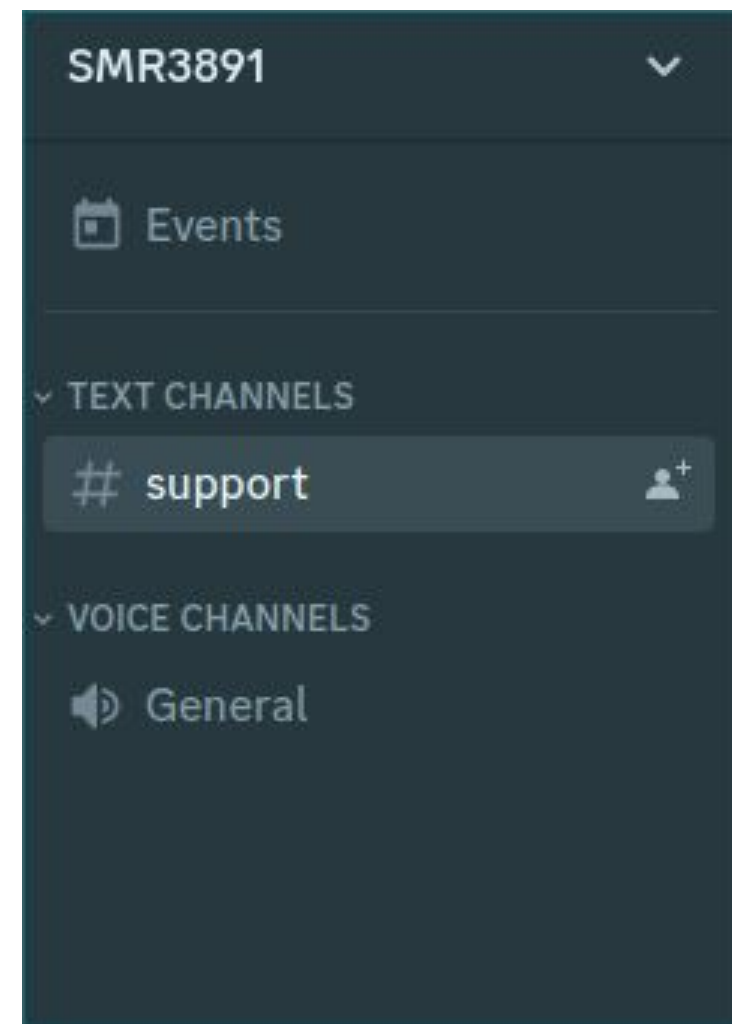
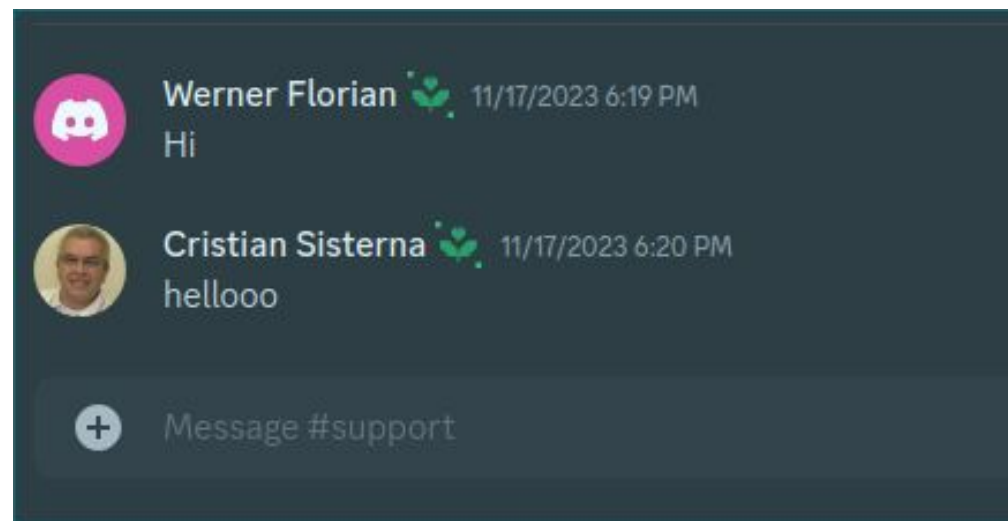
Joint ICTP-IAEA School on  
Systems-on-Chip based on  
FPGA for Scientific Instrumentation  
and Reconfigurable Computing

**20 November - 1 December 2023**  
An ICTP - IAEA Meeting  
Trieste, Italy

Further information:  
<http://indico.ictp.it/event/10225/smr3891@ictp.it>

### Speakers Slides

Indico	Google Drive	Gitlab
		
<a href="#">Click here.</a>	<a href="#">Click here.</a>	<a href="#">Click here</a>



<https://discord.gg/3uXV7tTVE>

The screenshot shows a GitLab Wiki page titled "Before Starting" for the project "smr3891". The page features a large yellow banner with the text "Joint ICTP-IAEA School on Systems-on-Chip based on FPGA for Scientific Instrumentation and Reconfigurable Computing" and the ICTP logo. Below the banner, there is a "Before Starting" section with a welcome message and a paragraph about the workshop environment. A diagram titled "ARGO" shows a central node connected to four sub-nodes: "ins45XXX", "ins45YYY", "ins45ZZZ", and "ins45AAA". The right sidebar contains a "Home" section with a list of laboratory guides for revision.

Before Starting

Joint ICTP-IAEA School on Systems-on-Chip based on FPGA for Scientific Instrumentation and Reconfigurable Computing

### Before Starting

Welcome to the Joint International Centre for Theoretical Physics (ICTP) and International Atomic Energy Agency (IAEA) School on Systems-on-Chip based on FPGA for Scientific Instrumentation and Reconfigurable Computing. We are thrilled to have you with us for these upcoming weeks!

The System-on-Chip/FPGA workflow often involves various tools written in different programming languages, requiring a specific work environment. To streamline this process, we've created a virtual machine that includes all the necessary tools and configurations for this workshop. The overall structure is shown in the figure below.

```
graph TD; ARGO --- ins45XXX; ARGO --- ins45YYY; ARGO --- ins45ZZZ; ARGO --- ins45AAA;
```

### Home

#### Laboratory guides (revisar)

- Before Starting
- Lab 1: Hello World and GPIO IP Cores
- Lab 2: Communication Block (ComBlock) and RTL instantiation
- Lab 3: SoC-FPGA Development Framework: UDMA & Jupyter Notebook
- Lab 4: SoC-FPGA DAQ system and TCL
- Project Lab 1: Digital Pulse Processing for Isotope Identification
  - Stage 1.1: Pulse acquisition and detector characterization
  - Stage 1.2: Digital pulse processing and isotope identification
  - Stage 1.3: Baseline restorer and pile-up rejection
- Project Lab 2: Digital Pulse Processing for X-ray Photon Detection and Energy Measurement
  - Digital Pulse Processor (DPP)

## Virtual environment

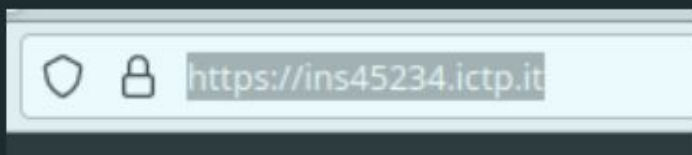
Additionally to your ICTP credentials you have been given a *username* and *password* for your virtual machine. The typical format is the following:

```
user: insXXXXX  
password: xxxxxx
```

To enter into the virtual machine you should type in the explorer bar the following url:

```
https://insXXXXX.ictp.it
```

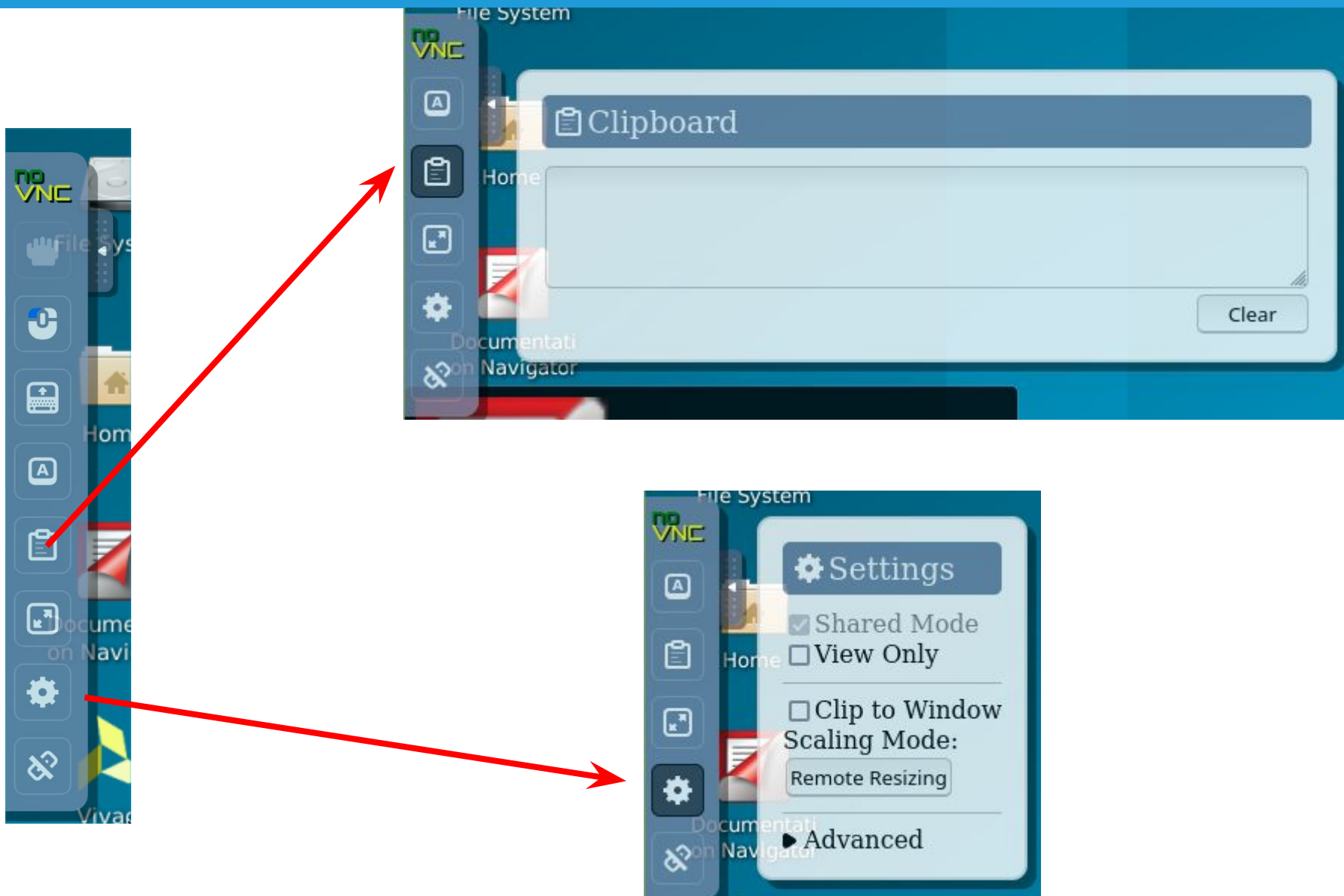
In this **example** the user is `ins45234`, and the input in the explorer bar should look like this:







The screenshot shows a Mozilla Firefox browser window titled "noVNC - Mozilla Firefox". The address bar displays "https://ins45150.ictp.it". The main content area features the ICTP logo and text: "The Abdus Salam International Centre for Theoretical Physics" and "SMR 3891" in large yellow font. Below this is a blue "Connect" button with a link icon. A noVNC control panel is visible on the left side of the window.




## The Git repository and the Virtual Machine.

Once we got access into the VM, let's proceed to create an environment suited for the school.

As mentioned [before](#) all the material for the laboratories will be handle in a **git** repository. Let's start by **cloning** the repository into our VMs.

1. Let's create and enter into a new directory called `smr3891` in our **Home** folder. There are two ways of doing this:
  - **Option 1:** By opening a `Terminal` in `Applications -> Terminal Emulator` and running the following command:

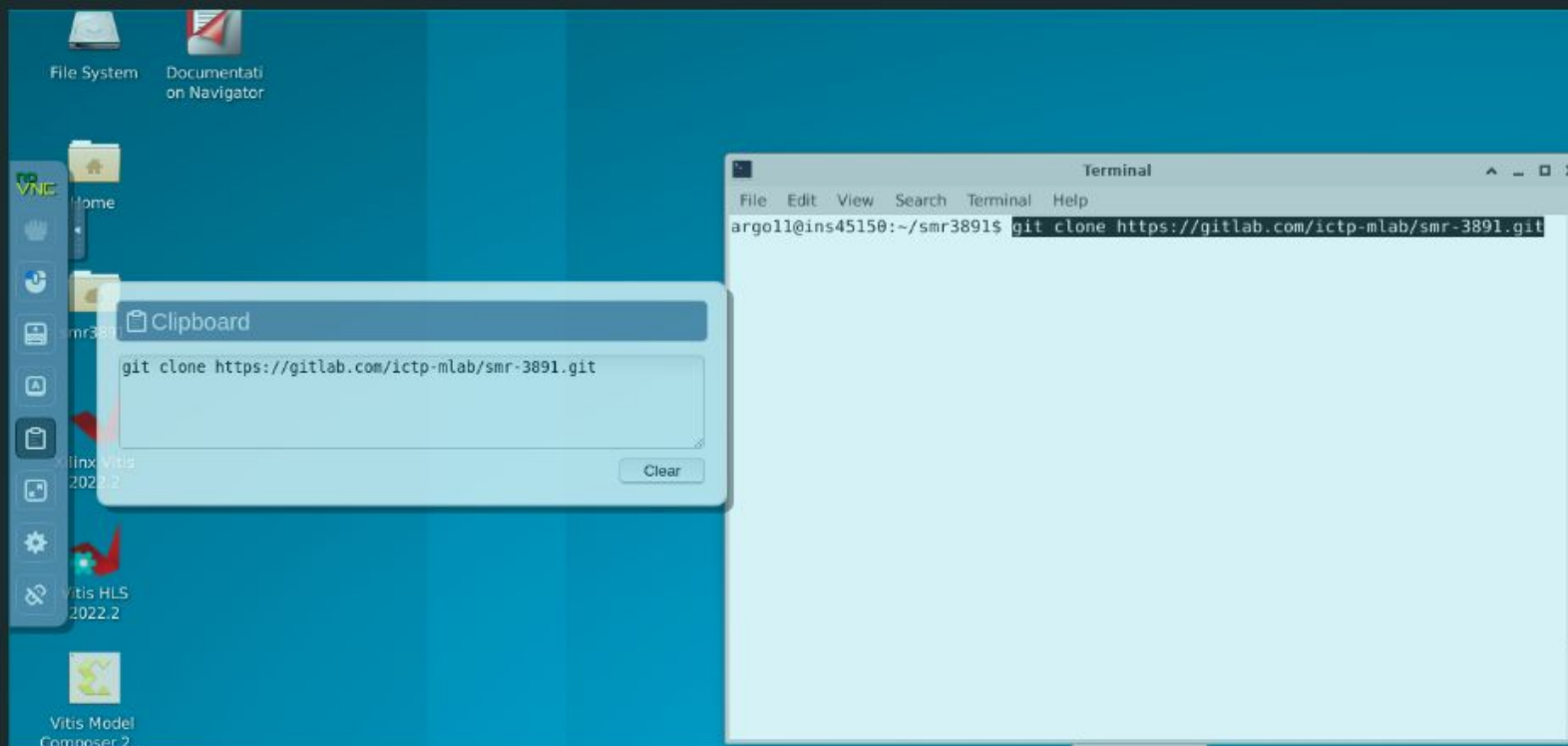
```
mkdir ~/smr3891  
cd ~/smr3891
```

- **Option 2:** By using the graphic interface, open the **Home** directory in your desktop, right click, and selecting the option . Then, name it as `smr3891`.

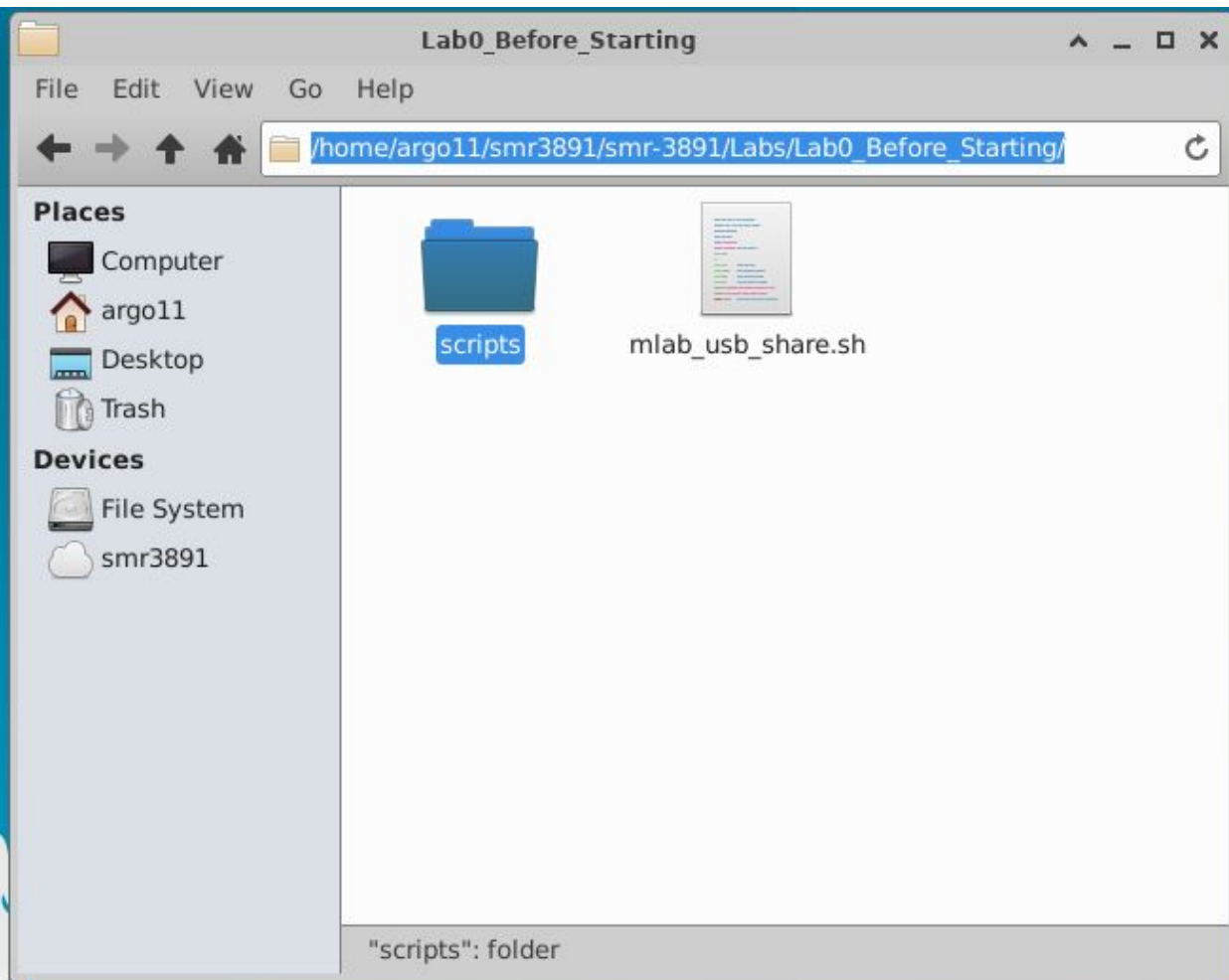
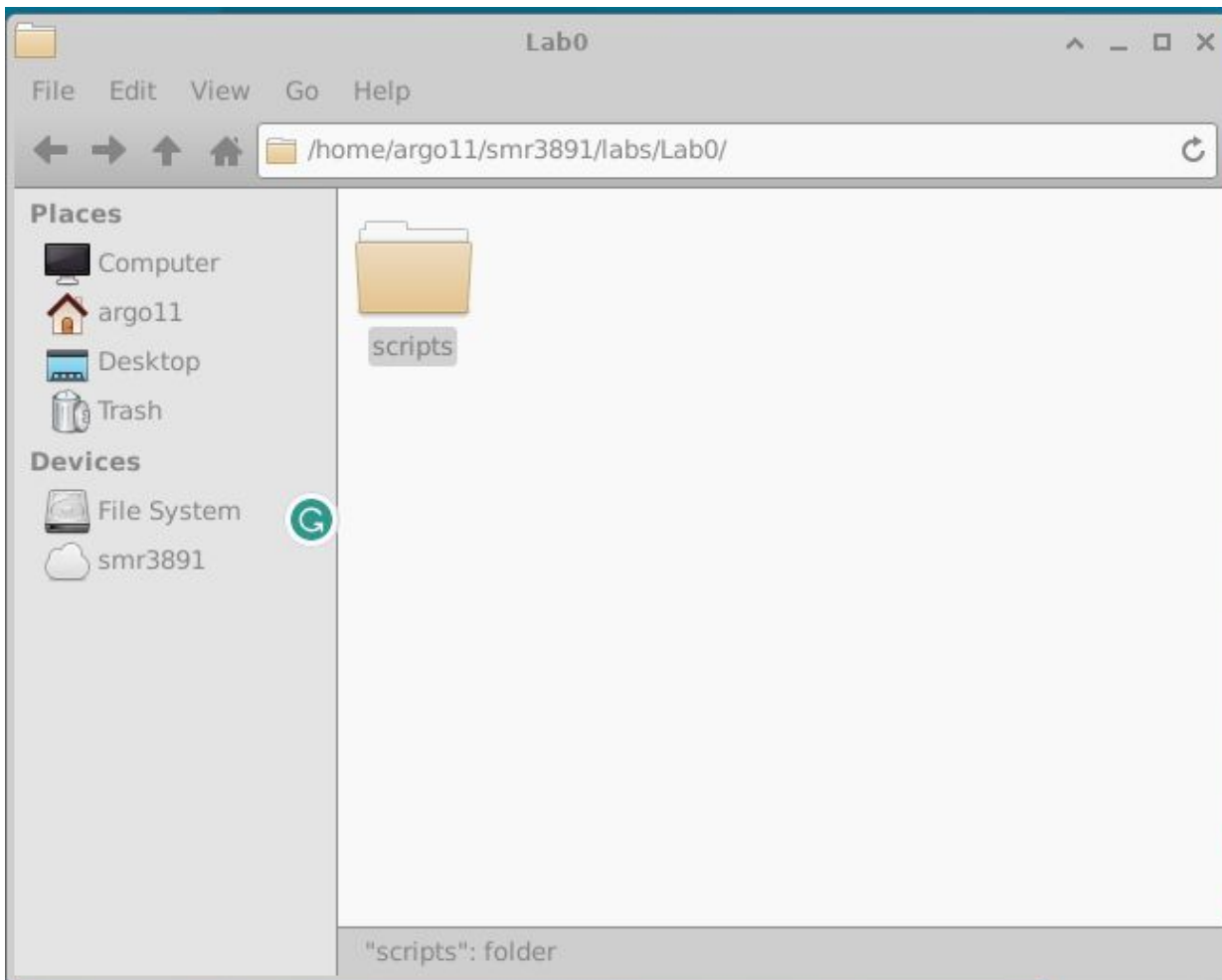
3. Copy the following code into the VM clipboard:

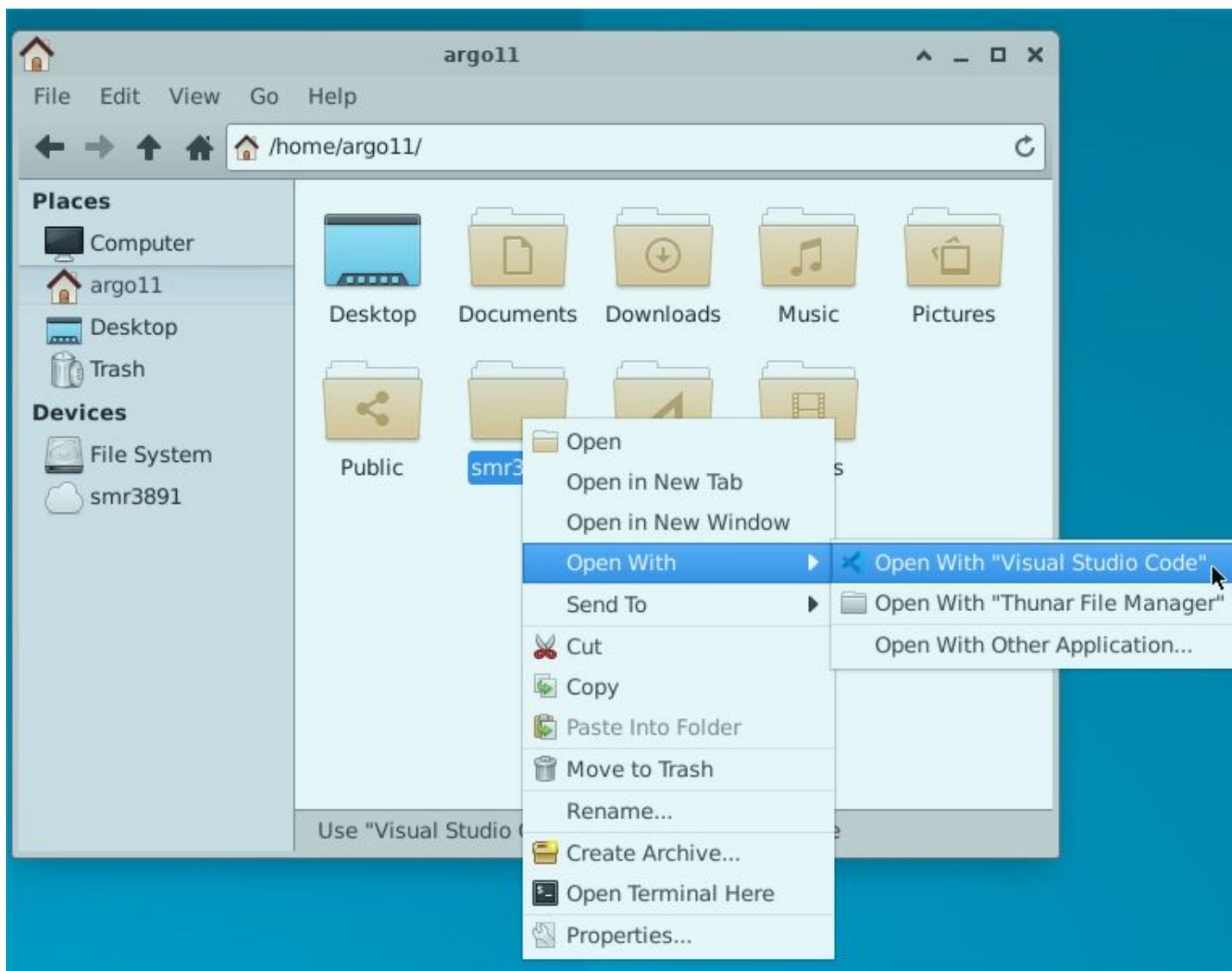
```
git clone https://gitlab.com/ictp-mlab/smr-3891.git
```

and paste it into the open terminal. **\*\*PRO-TIP:** paste into the terminal using `Ctrl+Shift+v`.

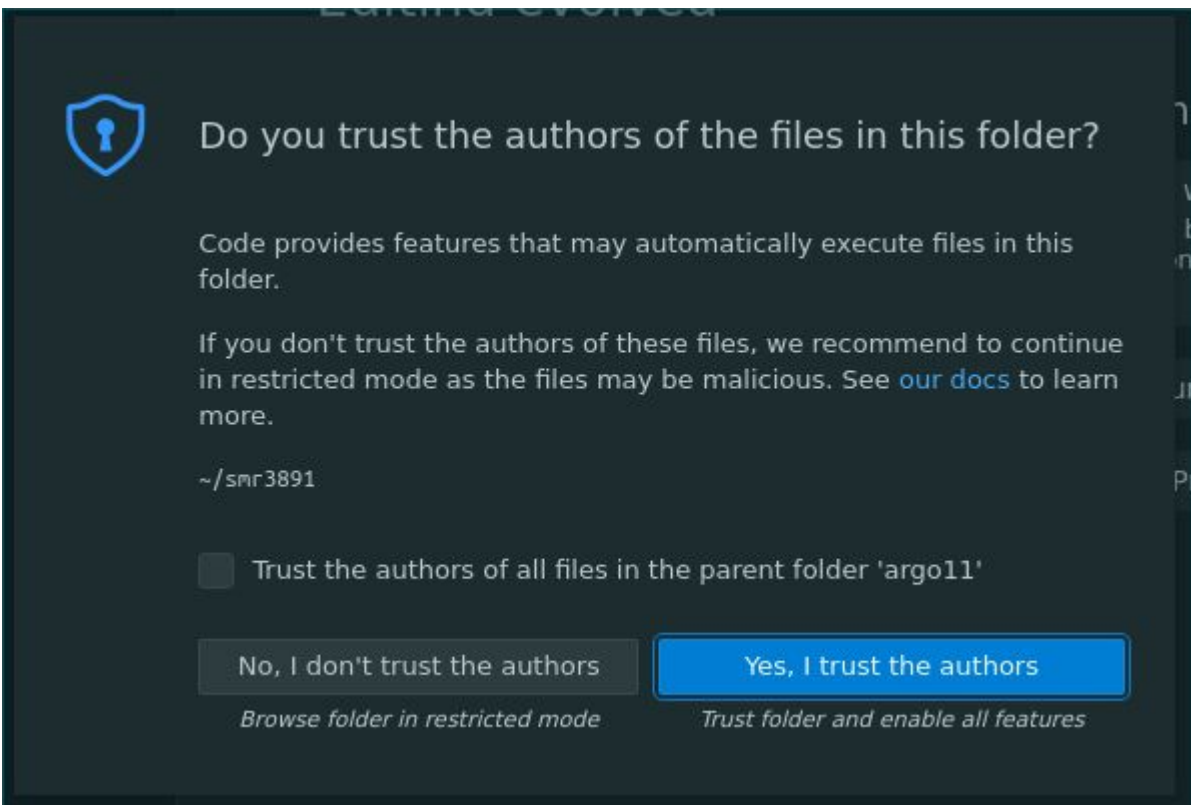


```
/home/<argo_user>/
└─ smr3891/
    └─ labs/
        └─ Lab0/
            └─ scripts/
                └─ Lab0_Before_Starting.ipynb
        └─ Lab1/
            └─ <Vivado_prj_name>
            └─ ...
            └─ ...
        └─ Lab2/
            └─ ...
    └─ smr-3891 / #Git Repository
        └─ Labs
        └─ Readme.md
        └─ ...
    └─ <git_repo_1>
    └─ <git_repo_2>
    └─ ...
```

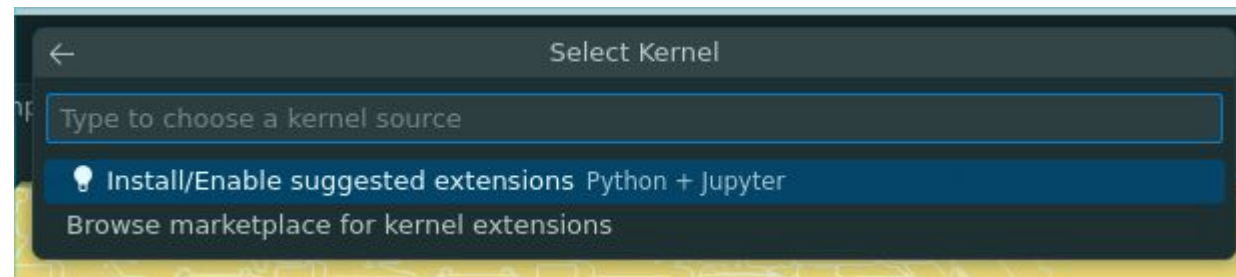
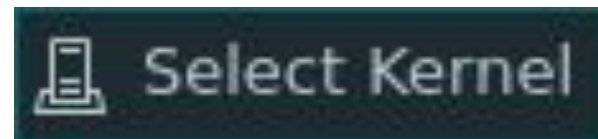




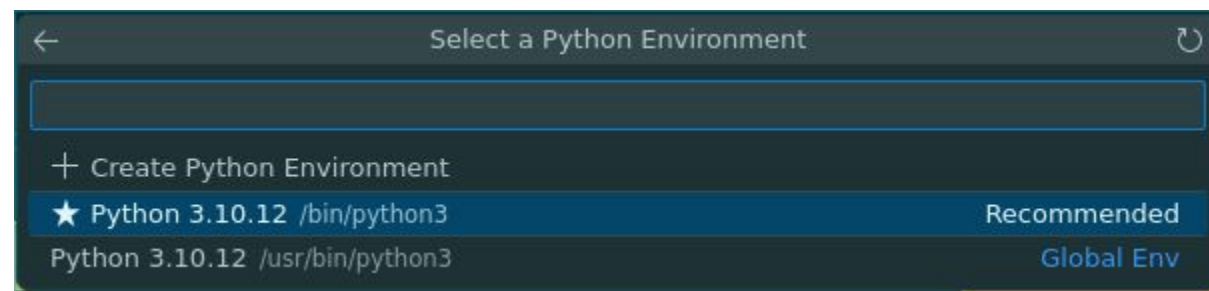
## 1. Trust the Sources



## 2. Install Extensions and Restart VSCode



## 3. Select Python Kernel







Lab0\_Before\_Starting.ipynb - smr3891 - Visual Studio Code

File Edit Selection View Go Run Terminal Help

EXPLORER

- SMR3891
  - labs / Lab0 / scripts
    - .img
    - .gitignore
    - Lab0\_Before\_Starting.ipynb
  - smr-3891

labs > Lab0 > scripts > Lab0\_Before\_Starting.ipynb

+ Code + Markdown ...

Select Kernel

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### Test Code

Hello again, during this workshop we will be using **Python**, running on a **Jupyter-notebook** environment. Many of you may be already familiar with this programming language, however we will test if we have all the required dependencies installed.

This is an example using the libraries we will be using in this workshop. A brief explanation of all of them will be found below if you wish to learn a little bit more of them later. However for this activity we will just **Run All** functions to

Cell 1 of 12

Run All

The Zedboard JTAG programmer and UART port are the following devices:

```
Bus 003 Device 010: ID 0403:6014 Future Technology Devices  
International, Ltd FT232H Single HS USB-UART/FIFO IC
```

```
Bus 003 Device 008: ID 04b4:0008 Cypress Semiconductor Corp.
```

For network connectivity, we will be using an ethernet dongle that can be **ONE** of these two devices shown below:

```
Bus 004 Device 003: ID 0b95:1790 ASIX Electronics Corp. AX88179 Gigabit  
Ethernet
```

```
Bus 002 Device 011: ID 0bda:8153 Realtek Semiconductor Corp. RTL8153  
Gigabit Ethernet Adapter
```

The Zedboard JTAG programmer and UART port are the following devices:

Bus 003 Device 010: ID 0403:6014 Future Technology Devices International, Ltd FT232H Single HS USB-UART/FIFO IC

Bus 003 Device 008: ID 04b4:0008 Cypress Semiconductor Corp.

For network connectivity, we will be using an ethernet dongle that can be **ONE** of these two devices shown below:

Bus 004 Device 003: ID 0b95:1790 ASIX Electronics Corp. AX88179 Gigabit Ethernet

Bus 002 Device 011: ID 0bda:8153 Realtek Semiconductor Corp. RTL8153 Gigabit Ethernet Adapter

```
ictp_share_usb_device share <device_id_0>  
<device_id_1> ...
```

```
Bus 002 Device 002: ID 8087:8000 Intel Corp.  
Bus 002 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub  
Bus 001 Device 002: ID 8087:8008 Intel Corp.  
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub  
Bus 004 Device 003: ID 0b95:1790 ASIX Electronics Corp. AX88179 Gigabit Ethernet  
Bus 004 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub  
Bus 003 Device 004: ID 0403:6014 Future Technology Devices International, Ltd FT  
232H Single HS USB-UART/FIFO IC  
Bus 003 Device 003: ID 04b4:0008 Cypress Semiconductor Corp.  
Bus 003 Device 002: ID 0c45:6340 Microdia Camera  
Bus 003 Device 008: ID 046d:c05b Logitech, Inc. M-U0004 810-001317 [B110 Optical  
USB Mouse]  
Bus 003 Device 007: ID 03f0:354a Hewlett-Packard  
Bus 003 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
```

```
ictp_share_usb_device share 0403:6014 04b4:0008  
0b95:1790
```

Did you get an error?

```
$ sudo apt update  
$ ictp_share_usb_device share 0403:6014 04b4:0008  
0b95:1790
```

Too complicated? Let's go to the Wiki:

1. Open a terminal and run the following lines:

```
wget https://dbox.ictp.it/index.php/s/usb_share/download/mlab_usb_share.sh  
chmod +x mlab_usb_share.sh
```

2. Now you can mount the zedboard ports and the USB Ethernet dongle using the following command:

```
./mlab_usb_share.sh
```



Don't worry, this configuration has to be done only once, unless you shut down the Zedboard or restart the PC.

So please **Do not Shut Down the Zedboards, or Disconnect them from their PCs**



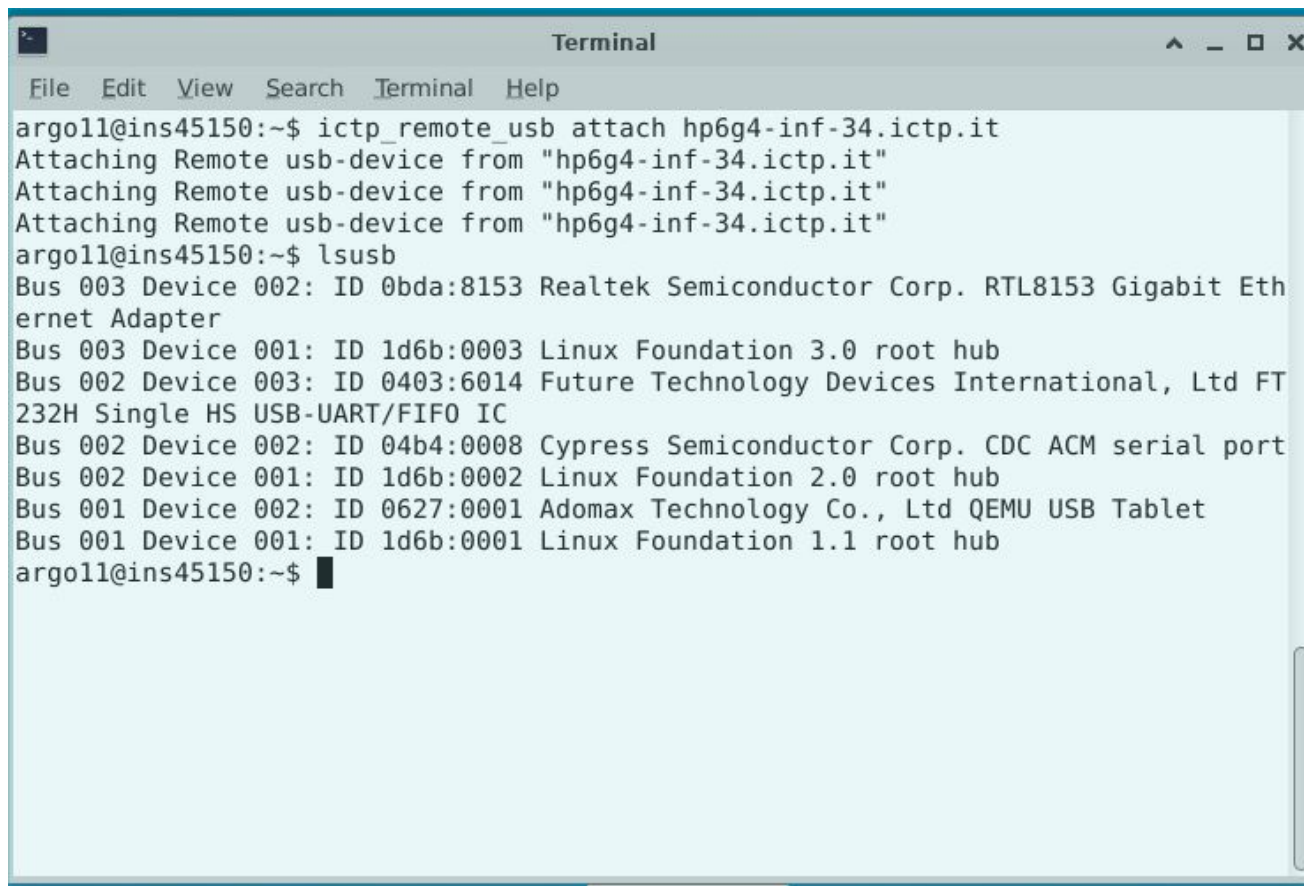
## On the Virtual Machine

```
ictp_remote_usb attach <local_machine_name>.ictp.it
```



On the Virtual Machine e.g.

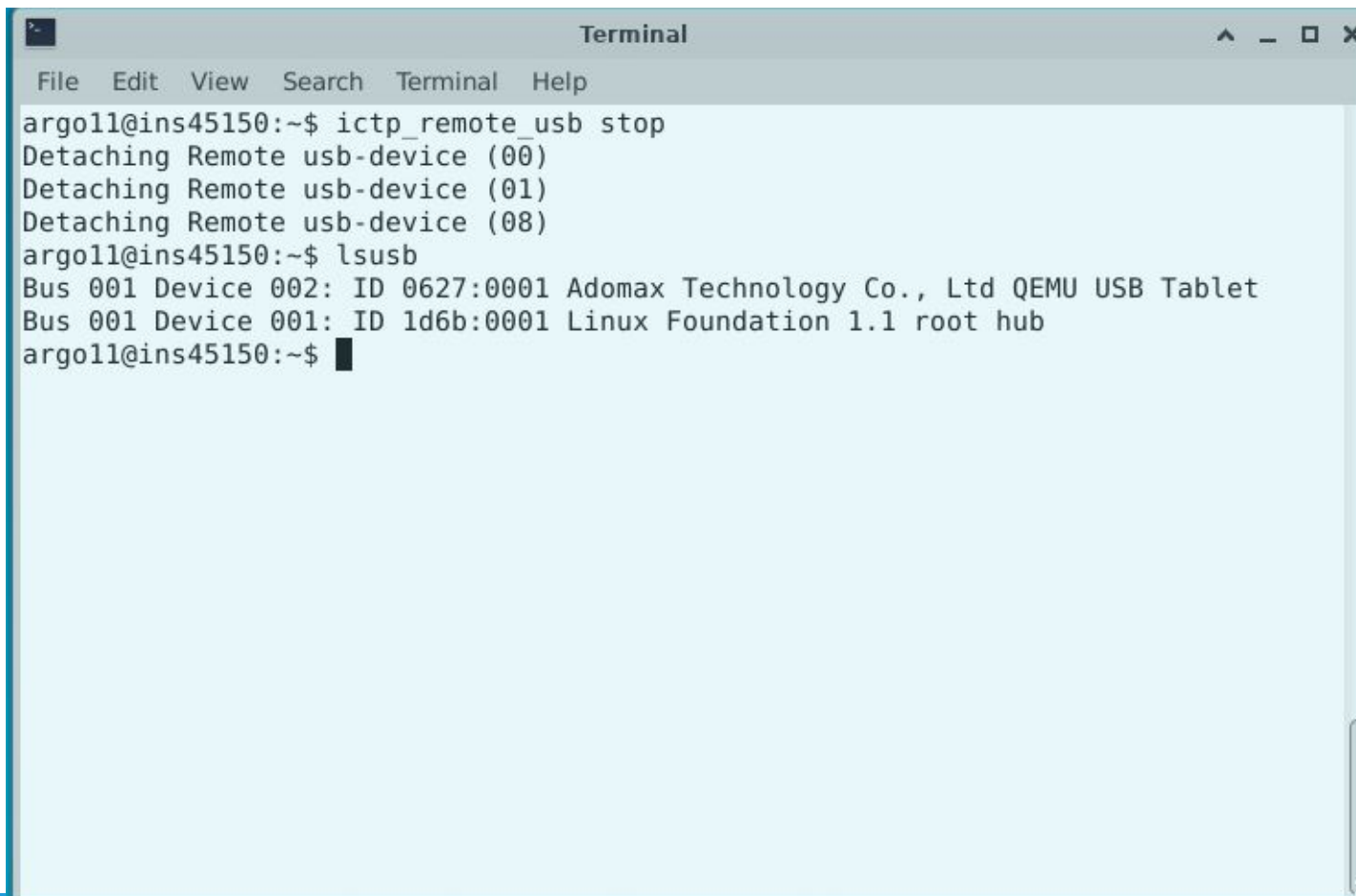
**ictp\_remote\_usb attach hp6g4-inf-XX.ictp.it**



```
Terminal
File Edit View Search Terminal Help
argoll@ins45150:~$ ictp_remote_usb attach hp6g4-inf-34.ictp.it
Attaching Remote usb-device from "hp6g4-inf-34.ictp.it"
Attaching Remote usb-device from "hp6g4-inf-34.ictp.it"
Attaching Remote usb-device from "hp6g4-inf-34.ictp.it"
argoll@ins45150:~$ lsusb
Bus 003 Device 002: ID 0bda:8153 Realtek Semiconductor Corp. RTL8153 Gigabit Ethernet Adapter
Bus 003 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 002 Device 003: ID 0403:6014 Future Technology Devices International, Ltd FT232H Single HS USB-UART/FIFO IC
Bus 002 Device 002: ID 04b4:0008 Cypress Semiconductor Corp. CDC ACM serial port
Bus 002 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 001 Device 002: ID 0627:0001 Adomax Technology Co., Ltd QEMU USB Tablet
Bus 001 Device 001: ID 1d6b:0001 Linux Foundation 1.1 root hub
argoll@ins45150:~$
```

On the Virtual Machine e.g.

**ictp\_remote\_usb stop**



```
Terminal
File Edit View Search Terminal Help
argoll@ins45150:~$ ictp_remote_usb stop
Detaching Remote usb-device (00)
Detaching Remote usb-device (01)
Detaching Remote usb-device (08)
argoll@ins45150:~$ lsusb
Bus 001 Device 002: ID 0627:0001 Adomax Technology Co., Ltd QEMU USB Tablet
Bus 001 Device 001: ID 1d6b:0001 Linux Foundation 1.1 root hub
argoll@ins45150:~$
```

## Let your neighbor connect to the Zedboard

```
ictp_remote_usb attach <local_machine_name>.ictp.it
```

```
ictp_remote_usb stop
```

## Tasks

Manage IP >

Open Hardware Manager >

Vivado Store >

Welcome to Vivado Store. You can browse and search the available applications and install to your local drive.

Tcl Apps | Boards | Example Designs [Go to Git](#)

Q-

Name	Revision	Status	Action
UltraFast Design Methodology	Revision 1.9	Not Installed	Install
Debug Utilities	Revision 1.1	Not Installed	Install
Design Utilities	Revision 1.56	Installed	
Project Utilities	Revision 3.533	Installed	
Incremental Compile	Revision 1.2	Not Installed	Install
Vivado Simulator	Revision 2.447	Installed	
ModelSim® Simulator	Revision 2.323	Installed	
Questa® Advanced Simulator	Revision 2.275	Installed	
Incisive® Enterprise Simulator IES	Revision 4.79	Not Installed	Install
Xcelium™ Parallel Simulator	Revision 11.127	Installed	
Verilog Compiler Simulator VCS®	Revision 10.7	Installed	

**Details**

Name: **UltraFast Design Methodology**

Application Name: ultrafast

Description: This app is a collection of scripts that are used by the UltraFast Design Methodology. Refer to the user guide UG949 'UltraFast Design Methodology Guide for the Vivado Design Suite' for further information.

Revision: 1.9 [Revision History](#)

Required: Vivado 2014.1

Company: Xilinx, Inc.

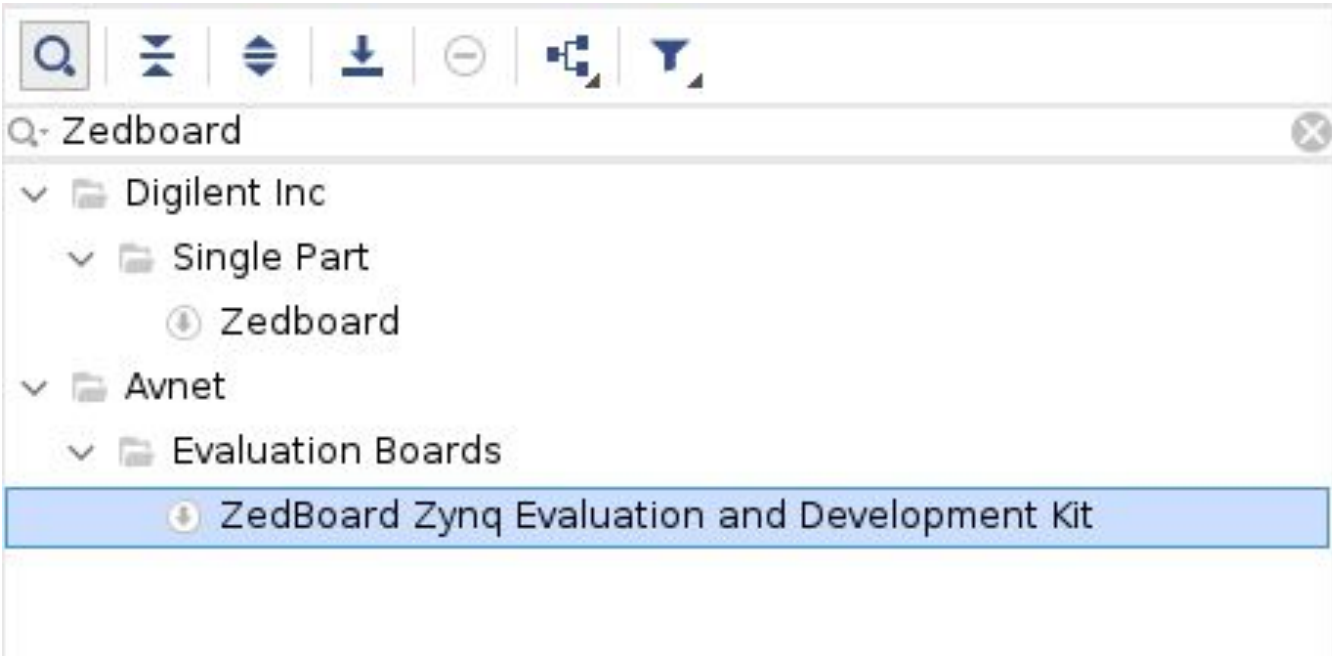
URL: <https://github.com/Xilinx/XilinxTclStore/tree/2022.2-dev/tclapp/xilinx-ultrafast>

**Tcl Procs (4)**

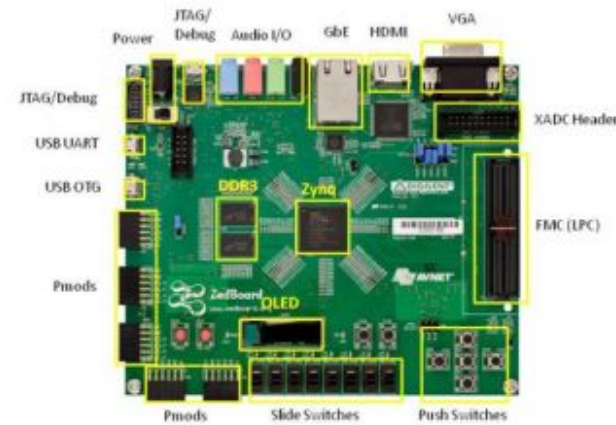
xilinx::ultrafast::check_bd_axi_interface	Report AXI Interconnect Internal Block Every AXI Master and AXI Slave in an Interconnect instance
xilinx::ultrafast::check_pll_connectivity	Report MMCM/PLL information
xilinx::ultrafast::report_io_reg	Report I/O ports information
xilinx::ultrafast::report_reset_signals	Generate Report for Control Signals (Reset/Set/Clear/Preset)

Catalog was last updated on 10/13/2022 11:10:29 PM

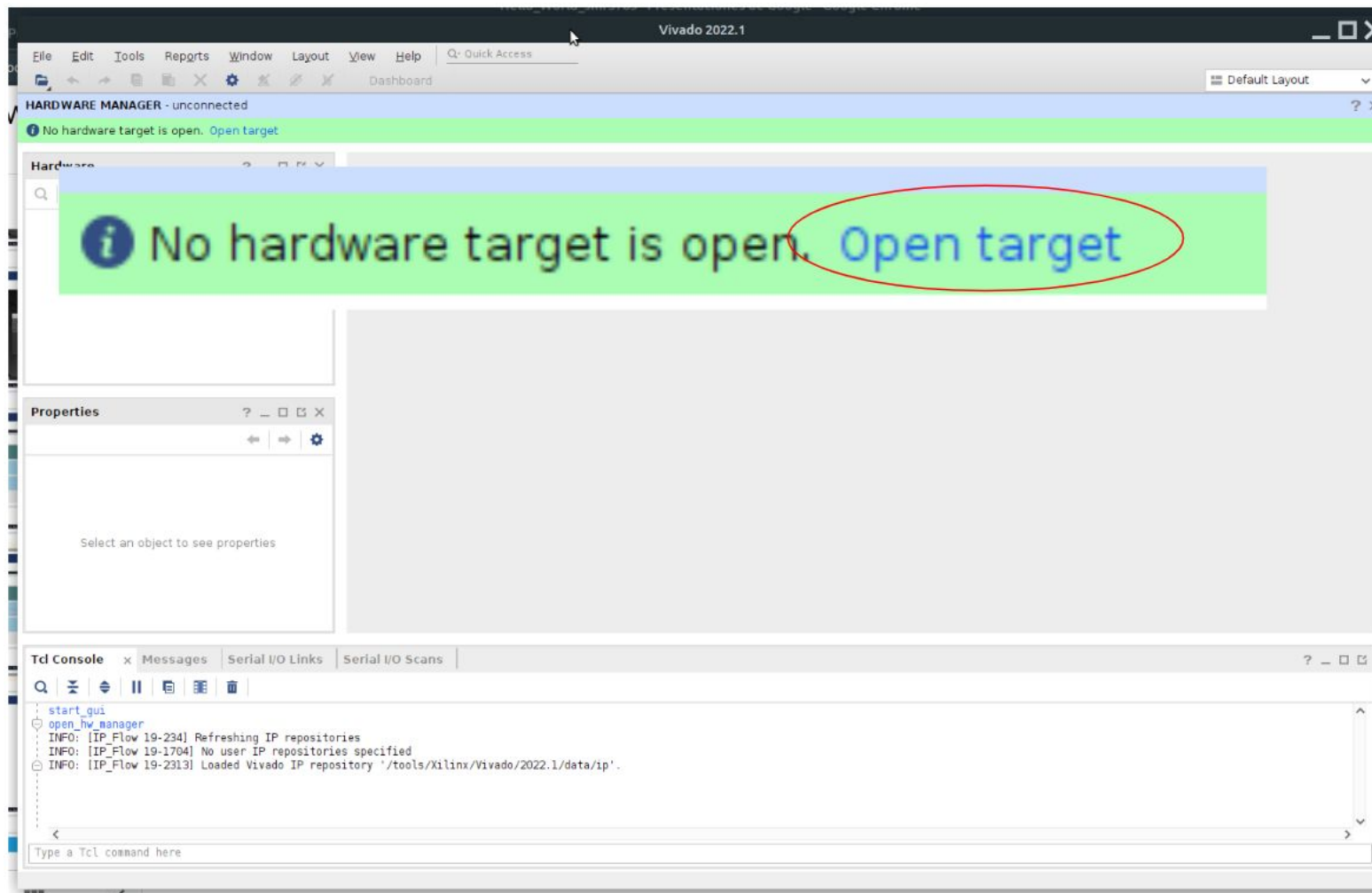
Icl Apps | **Boards** | Example Designs



Name: **ZedBoard Zynq Evaluation and Development Kit**  
 Description: ZedBoard Zynq Evaluation and Development Kit  
 Revision: **1.4**  
[Revision History](#)  
 URL: <https://github.com/Xilinx/XilinxBoardStore/tree/2022.2/boards/Avnet/zedk>  
 Company: Avnet



\* SD card cage and QSPI Flash reside on backside of board



The screenshot shows the Vivado 2022.1 Hardware Manager window. The window title is "Hardware" and it contains a table with the following data:

Name	Status
localhost (1)	Connected
xilinx_tcf/Digilent/210248780176	Open
arm_dap_0 (0)	N/A
xc7z020_1 (1)	Not programmed
XADC (System Monitor)	

Below the table, there is a console window showing the following output:

```
cal = 7537 ; free virtual = 20148  
cal = 5607 ; free virtual = 18225  
refresh_hw_device -update_hw_probes false [index [get_hw_devices xc7z020_1] 0]  
INFO: [Labtools 27-1435] Device xc7z020 (JTAG device index = 1) is not programmed (DONE status = 0).
```

