Portland State
UNIVERSITY

ECE 540 Getting Started Guide

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ECE 540 Tools Installation Guide

The instructions below are for a Windows OS. The instructions below show you how to install the software tools which are needed for this Course.
The following tools are:
A. Vivado
B. VSCode (Visual Studio Code) and PlatformIO

1. Installing Vivado

The steps below describe how to install Vivado 2019.2, which is freely available from Xilinx Inc. on a computer running the 64-bit Windows operating system. (Note that Vivado is also available for the Linux operating system but there is no native MacOS port). Given below are the steps for Installing Vivado on your own desktop. You can also access Vivado by remote login using RDP to one of the CAPSTONE or WCC lab's PC's.

Step 1. Download the installation file
Step 2. Open and execute the installation file

Step 1. Download the installation file

Browse to the Xilinx download website:

https://www.xilinx.com/support/download/index.html/content/xilinx/en/downloadNav/vivado-design-tools/2019-2.html You will see the webpage in Figure 1.

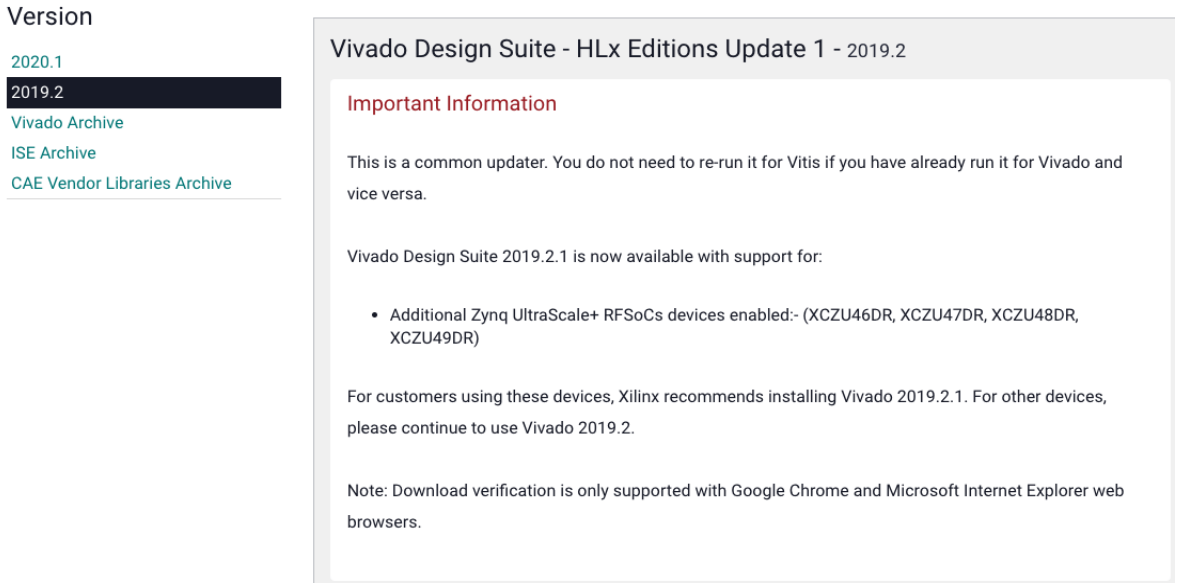

Figure 1. Xilinx download page

Find the Vivado 2019.2 Windows Self Extracting Web Installer, as shown in Figure 2.

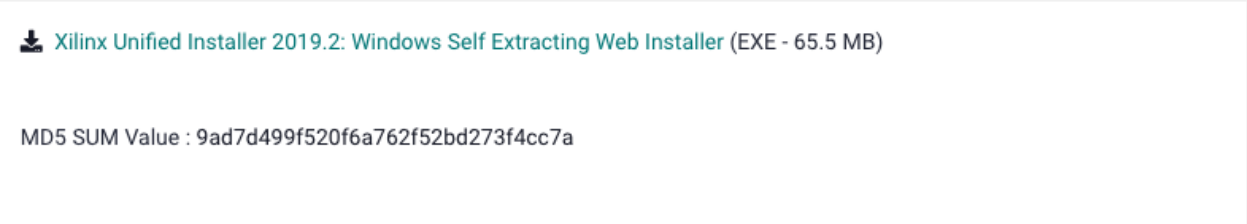

Figure 2. Download Vivado installation file

You will be taken to the Xilinx sign in page, as shown in Figure 3. If you don't already have a Xilinx account, click on **Create your account**. Creating an account is free.

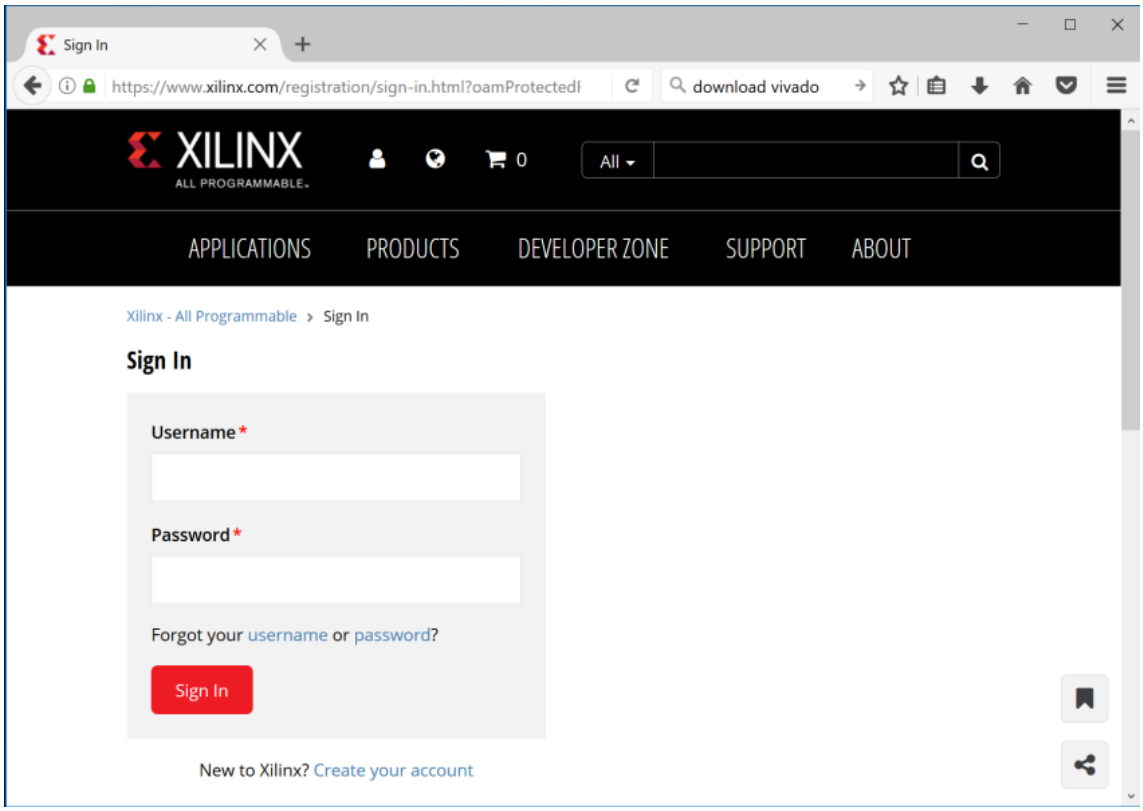

Figure 3. Xilinx sign in page

After you have signed in, the website will prompt you to enter your name, address, etc., as shown in Figure 4. After entering your information, click on **Next** at the bottom of the web page.

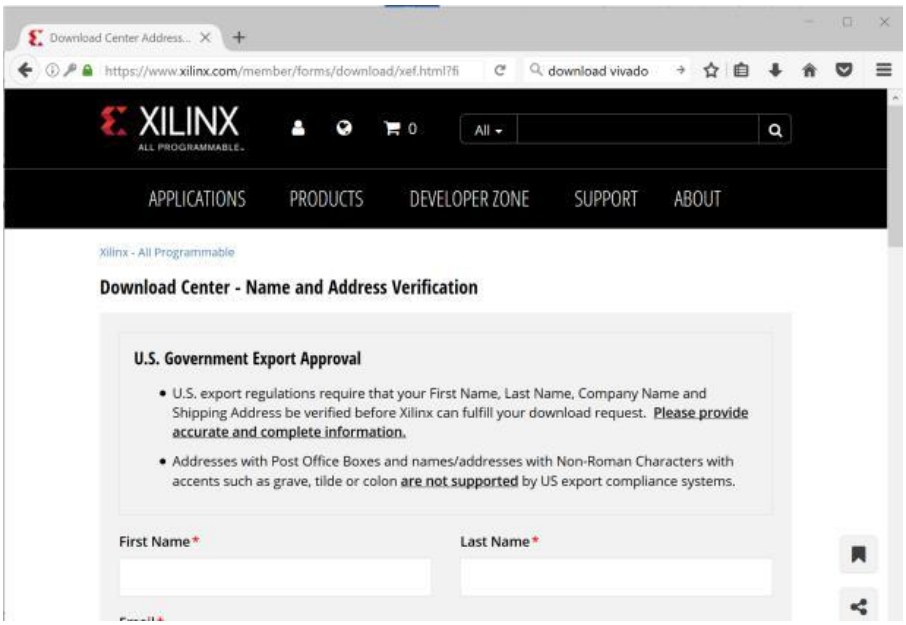

Figure 4. Download center name/address entry form

A pop-up window now gives you the option to save the installation executable. Save the file wherever is convenient (a temporary location is fine).

Step 2. Open the installation file

After the installation executable has downloaded, browse to where you saved it, and double-click on it to open it and start the installation. Now the Xilinx Installer will be extracted, as shown in Figure 5.

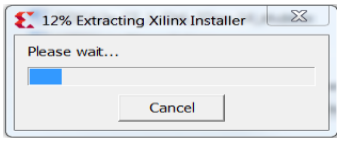

Figure 5. Xilinx installer extraction progress window

You may be asked if you want the Xilinx program to make changes to your computer. Click Yes.

The Vivado 2018.2 Installer window will now open, as shown in Figure 6. Click **Next**.

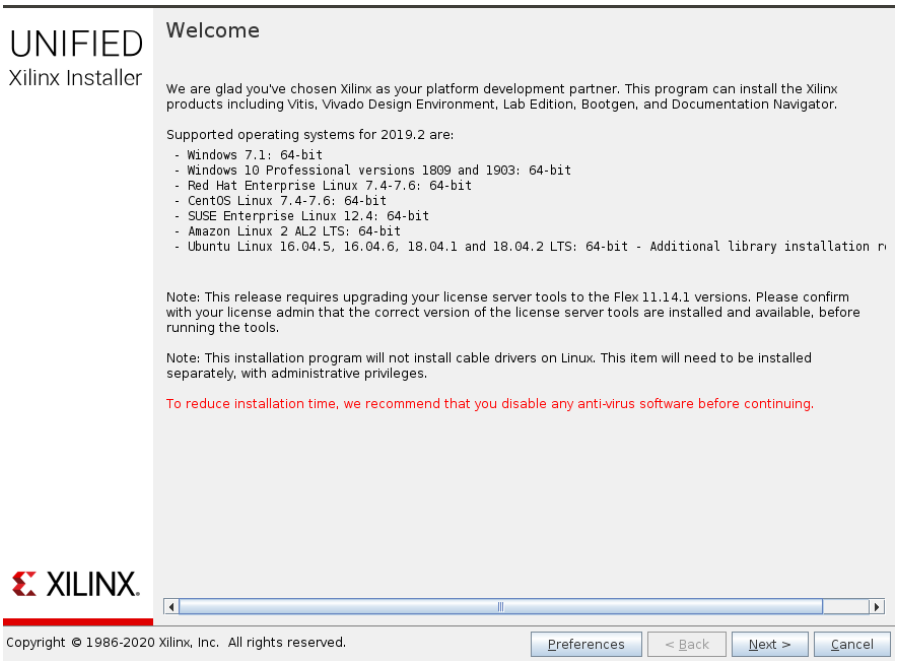

Figure 6. Xilinx Installer window

NOTE: You will get the similar window but not exactly like this as this is of Unified Xilinx Installer which is one of the other type of Installation file. But In place of that you will get Vivado HLX Edition which you are going to install.

You will be prompted for your Xilinx user id and password created in Step 1. Enter them and click **Next**. Now you will see the Xilinx license agreement. Click on all of the **I Agree** boxes and click **Next**.

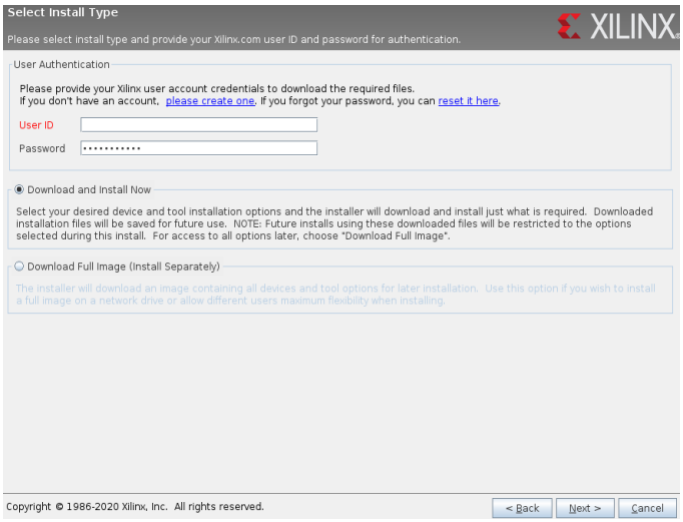

Figure 7. Xilinx Install Type and Password window

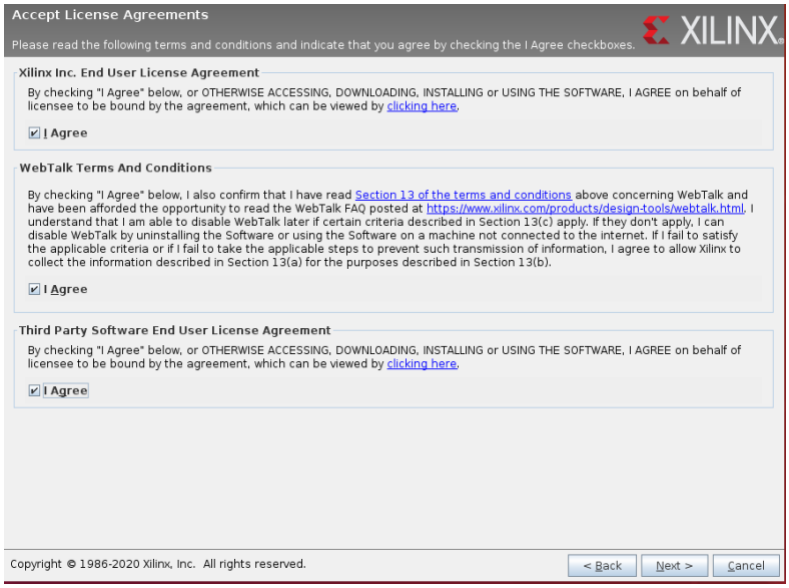

Figure 8. Xilinx Accept License Agreement

Select Vivado (not Vitis) as the Product to install.

Now select Vivado HL Webpack Edition, as shown in Figure 9, and click Next.

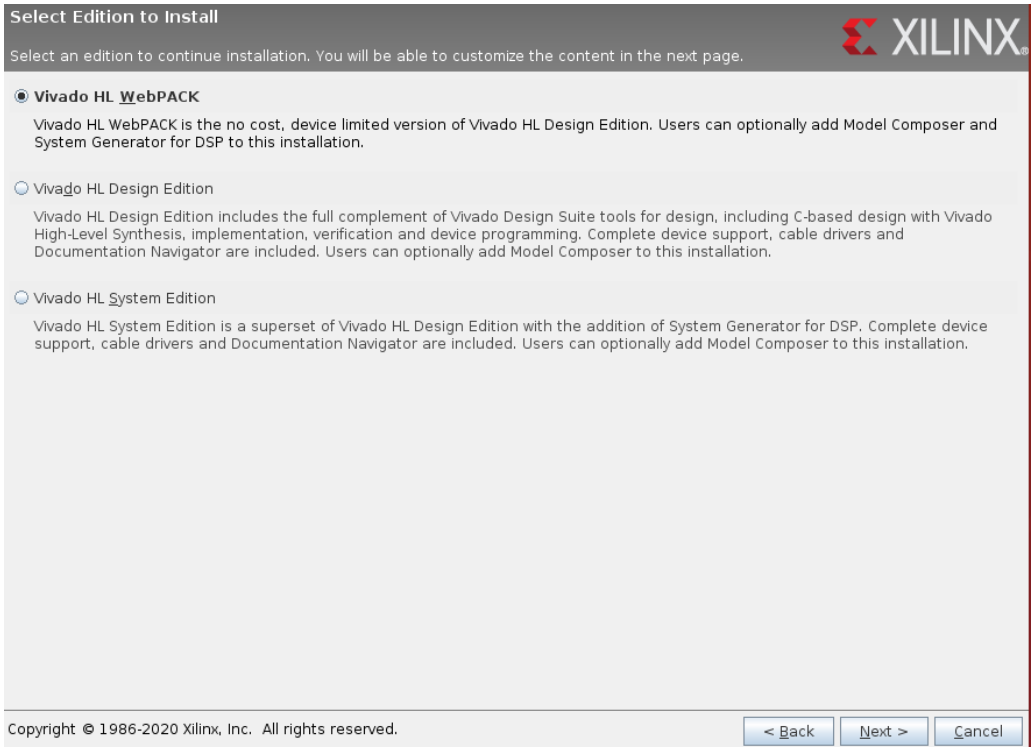

Figure 9. Choose Vivado Webpack Edition

Now choose which Design tools and Devices to support. Make sure the following are selected:

- Design Tools → Vivado Design Suite
- Devices → 7 Series → Artix-7
- Installation Options → Install Cable Drivers and Acquire or Manage a License Key

Artix-7 is the FPGA on the Nexys A7 board, so select at least that device. You should also install the Kintex library because many of the Vivado reference designs are implemented on a Kintex-based FPGA development platform. Feel free to add additional devices as desired.

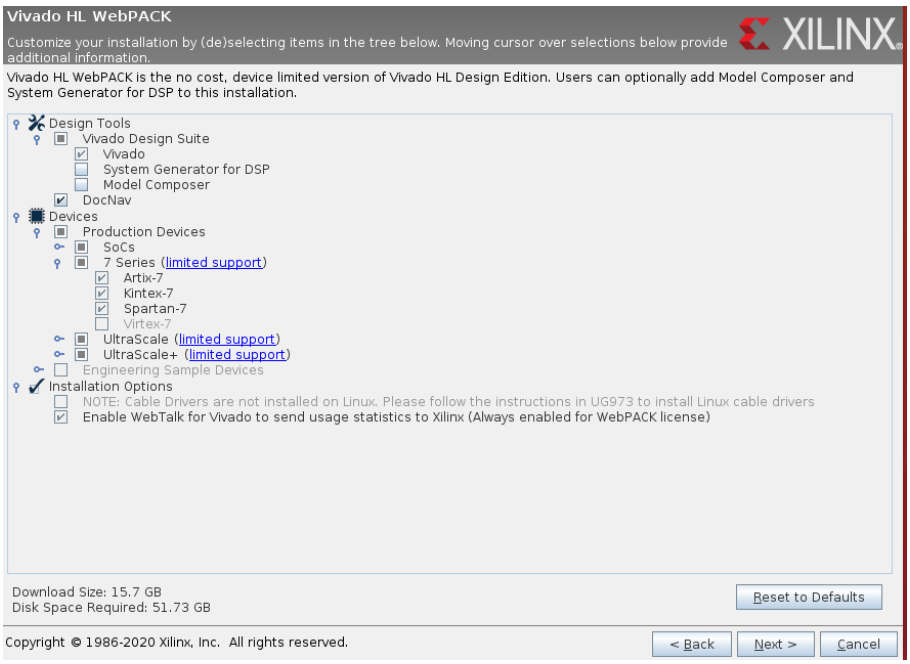

Figure 10. Choose Design Tools and Device Support

Click **Next**.

Now select a destination directory (or accept the default), as shown in Figure 11, and click **Next**. You may be prompted to approve the creation of the installation directory (i.e., C:\Xilinx). If you choose a directory other than C:\Xilinx make sure the directory name does not have any spaces or special characters in it. Vivado has had problems with this in the past.

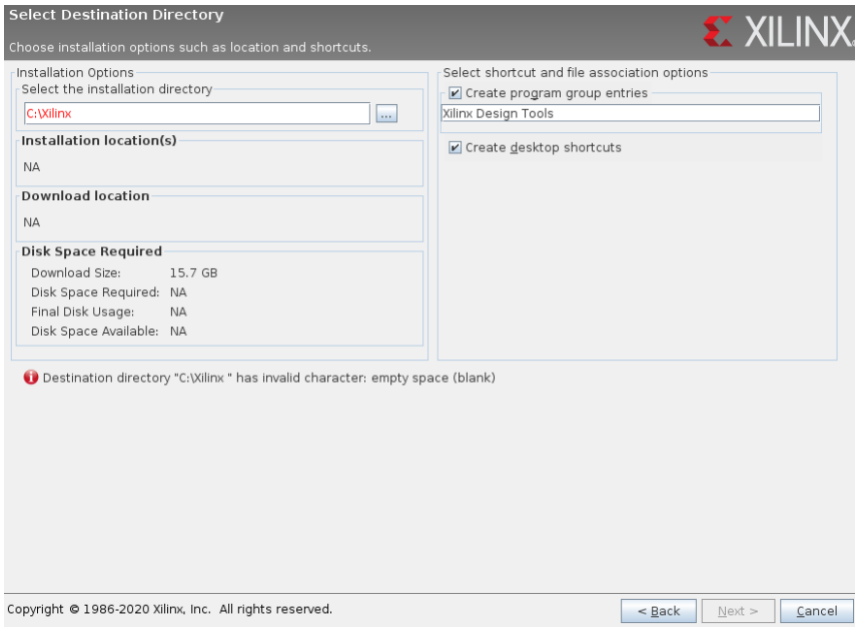

Figure 11. Xilinx Vivado destination directory

Now the Installation Summary window will appear, as shown in Figure 12. Click on Install.

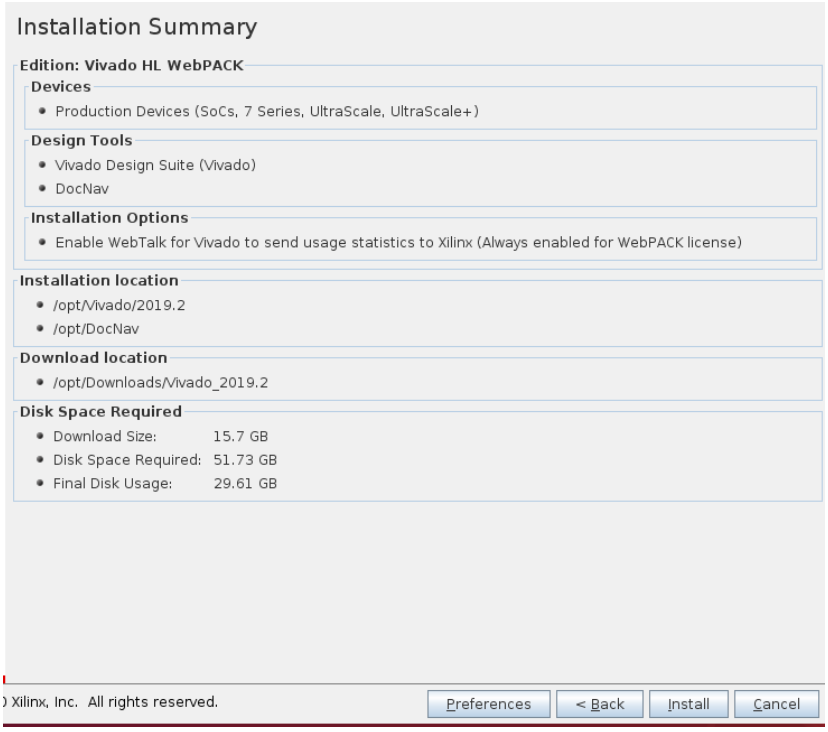

Figure 12. Installation Summary window

The installation Progress window will appear. Installation could take some time, depending on your internet and computer speed.

At the end of installation, the Vivado Installer will prompt you to unplug all Xilinx cables, as shown in Figure 13. Click **OK**.

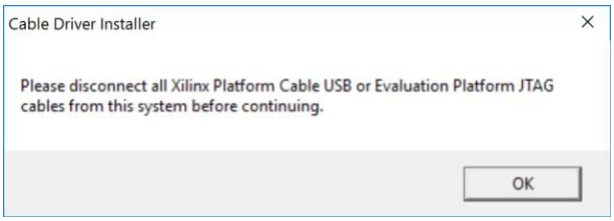

Figure 13. Cable Driver Installer window

If a window pops up asking if you want to install the device software, click **Install**.

After the cable drivers are installed, a window will pop up indicating that the installation was successful, as shown in Figure 14. Click **OK**.

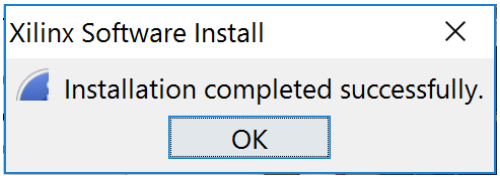

Figure 14. Installation successful window

You will also need to manually install the Digilent Board Files.

Digilent provides board files *for each FPGA development board. These files make it easy to select the correct part when creating a new project and allow for automated configuration of several complicated components used in many designs.*

- Download the archive of the vivado-boards from the Github repository and extract it.
- Open the folder extracted from the archive and navigate to its *new/board_files* directory. Select all folders within this directory and copy them.
- Open the folder that Vivado was installed into. Under this folder, navigate to its *2019.2/data/boards/board_files* directory, then paste the board files into this directory.

NOTE: You can also access Vivado remotely and Steps to access Vivado by remote login are properly defined on CAT website.

Here is the link to it CAT WEBSITE

If you have any queries regarding it, please contact TA for further details.

B. Install VSCode and PlatformIO

Now you will install VSCode and PlatformIO. PlatformIO is an integrated development environment (IDE) for embedded systems that is built on top of Microsoft's Visual Studio (VS) Code. It allows you to program the RISC-V processor (that is located on the FPGA) using C or assembly. PlatformIO is cross-platform and includes a built-in debugger.

Before moving forward with the steps just check whether GIT is installed in your PC. If not then you will need to install it. Detailed steps on how to Install GIT is provided on this link please have a look at it GIT Download Link

Follow these steps to install both VSCode and PlatformIO:

1. **Install VSCode:**

   a. Download the .exe file from the following link:
   https://code.visualstudio.com/Download

   b. Go to the location where you downloaded the .exe file and run it. This will only take a minute.

   c. By default, VS Code is installed under
   C:\users\{username}\AppData\Local\Programs\Microsoft VS Code.

2. **Install PlatformIO on top of VSCode:**

   a. Type "python" in the command prompt and press Enter. If it shows as the following screenshot, then you're good to go and skip to step 2.b.

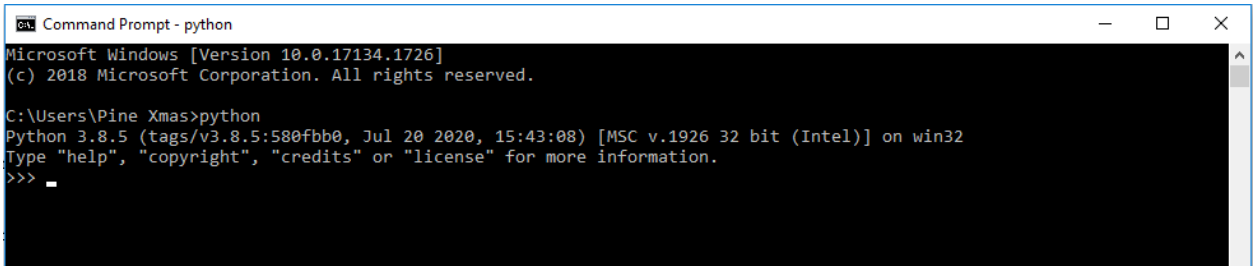

Figure 15. Python Installation Check

Otherwise, if it shows "**python is not recognized as an internal or external command, operable program or batch file**.", then you might not install Python yet, or you might not configure Python in your environment paths yet. If you are not sure if you have installed Python or not, we suggest you follow step 2. a.i. Otherwise, if you want to configure environment paths, please follow step 2.a.ii

i. **How to install Python**

- Go to "python.org/downloads" and click on "Download Python 3.x.x", like in the following screenshot on the next page.

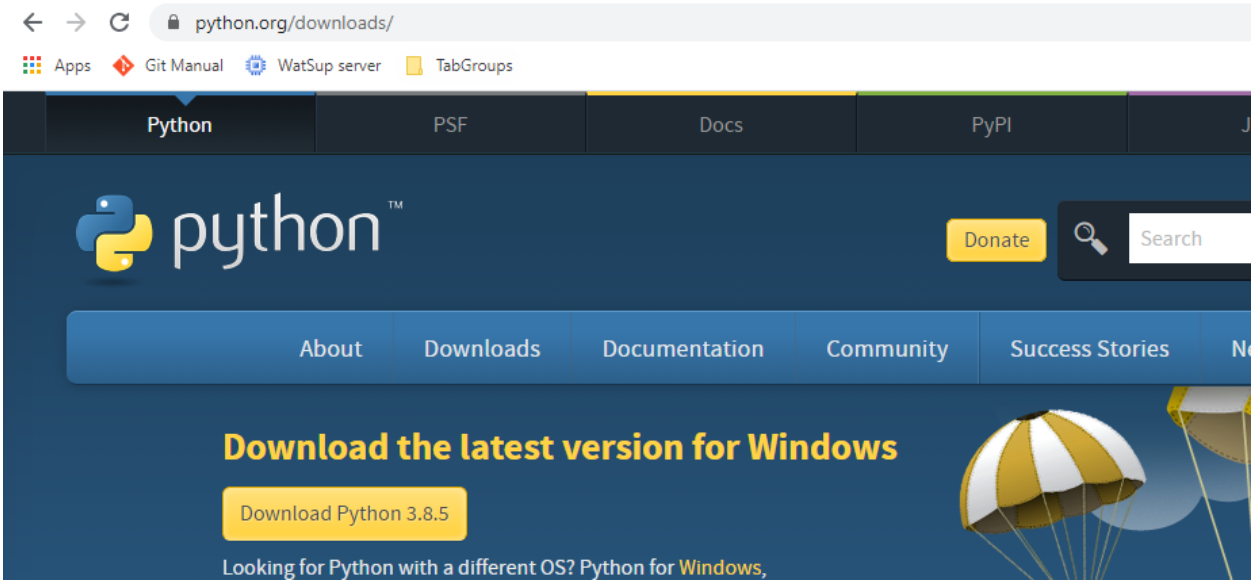

Figure 16. Python Web Page

- Double click on the downloaded exe file and install Python. Please keep all the settings default to avoid messing up with the paths.

- Then, open command prompt and type "python" command again to double check.

ii **How to configure Python path**

- Assume that you have installed Python on your computer and the exe file "python.exe" is located at some directory, for example: "D:\programs\python"

- Click "Start" (the Windows symbol on the bottom left corner), type "This PC", right click and select "Properties" as shown in figure below

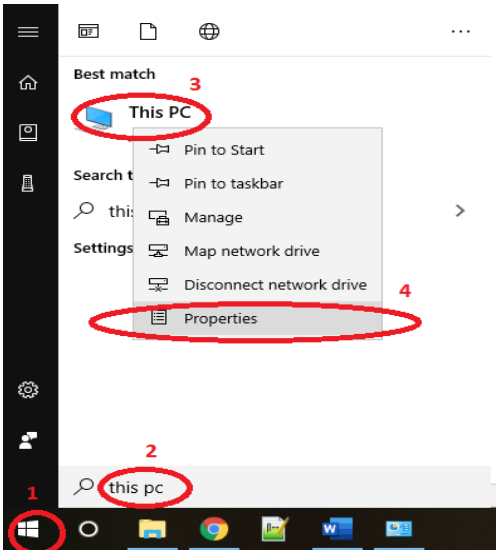

Figure 17.

- Then follow the following screenshot to add Python path to system path. For example, here, we add the directory “D:\programs\python”

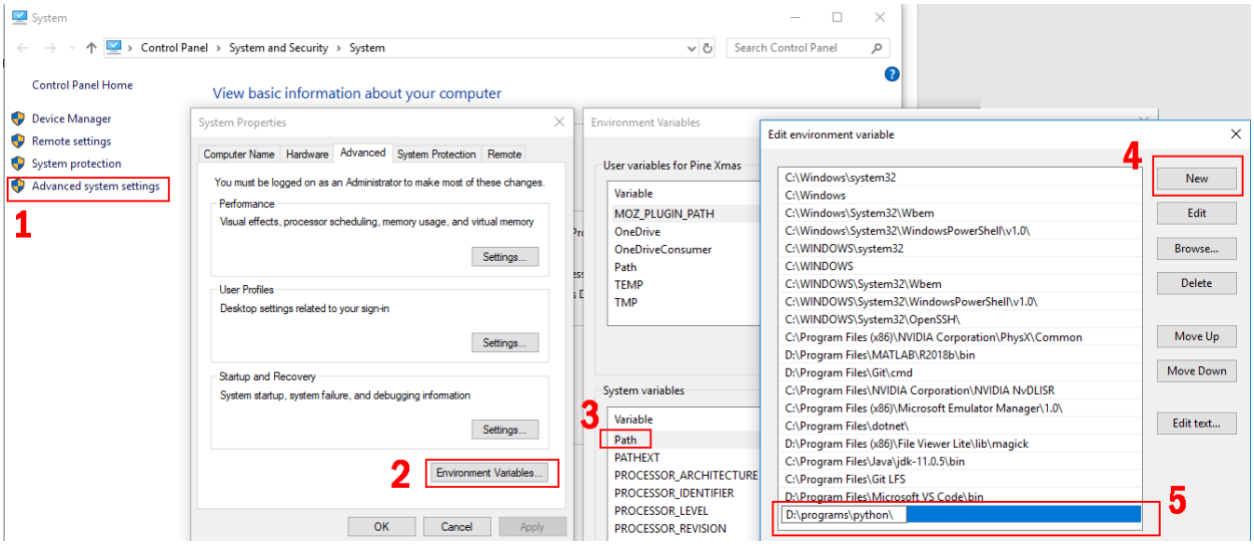

Figure 18.

- Click “OK” all the way to close all the opened windows. Then, open command prompt and type “python” command again to double check.

b. Start VSCode by selecting the Start button and typing “VSCode” in the search menu, then select VSCode.

c. In VSCode, click on the Extensions icon  located on the left side bar of VSCode (see Figure 15).

Figure 19. VSCode’s Extensions icon

d. Type *PlatformIO* in the search box and install the PlatformIO *IDE* by clicking on the install button next to it (see Figure 16).

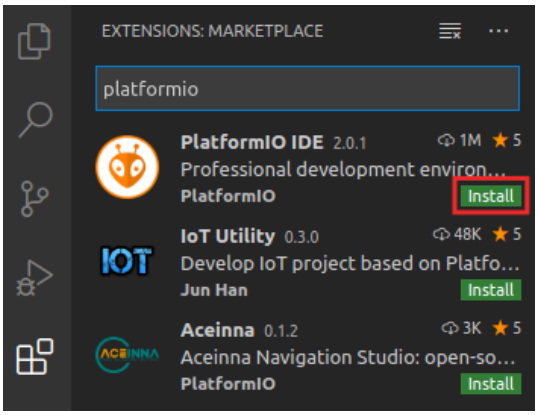

Figure 20. PlatformIO IDE Extension

e. The OUTPUT window on the bottom will inform you about the installation process. Once finished, you can "Reload Now" on the bottom right side window, and PlatformIO will be installed inside VSCode (see Figure 17).

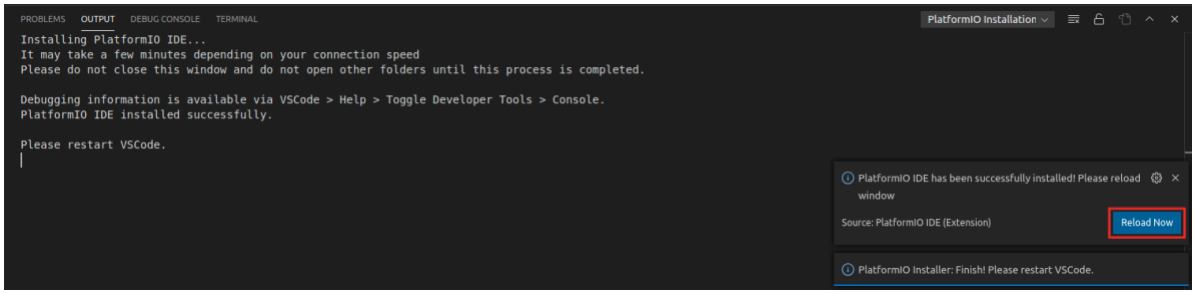

Figure 21. Reload Now after PlatformIO installs

3. Instructions to get Platform IO Working

Once you have Installed all the software you are almost there to get everything working. Just few steps away from it.

I. Now we need to add pio.exe to the system environment path. By default, the pio.exe file is located in the directory C:\Users\<user-name>\.platformio\penv\Scripts

Follow the same steps in 2.a.ii to add the directory to system path

- Click "Start" (the Windows symbol on the bottom left corner), type "This PC", right click and select "Properties"

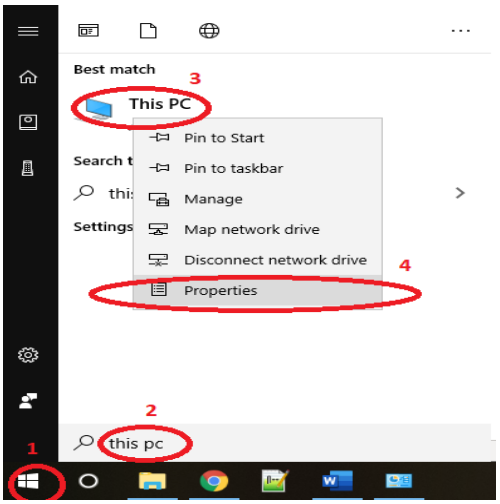

Figure 22.

- Then follow the following screenshot to add C:\Users\<user-name>\.platformio\penv\Scripts to the system path

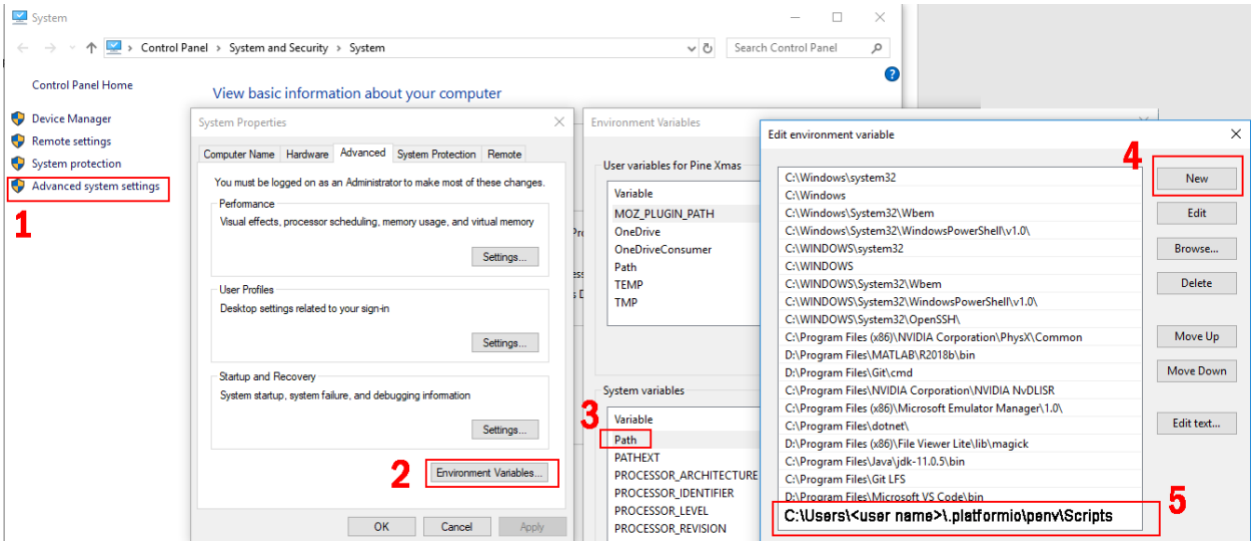

Figure 23.

- Click “OK” all the way to close all the opened windows.

I. Open PlatformIO in VSCode and click on the Terminal tab and Type the following two lines:

cd C:\Users\UserName\.platformio\penv\Scripts (where UserName is your account name)
./platformio.exe platform install [RvfpgaPath]\platform-chipsalliance --with-all-packages

II. Driver Switching

A/ Driver setup for PlatformIO

By default, Vivado can talk to the Nexys A7 without problem. However, when PlatformIO wants to talk to Nexys A7, the driver needs to be changed. Follow these steps to replace the driver:

Note: Make sure Vivado is totally closed, to prevent Vivado from holding and locking the driver from being changed

a) Download Zadig.exe (for example, from here: https://zadig.akeo.ie/)
b) Make sure your Nexys A7 board Is plugged into your PC and on
c) Run zadig.exe (for example zadig-2.5.exe).
d) Under Options, click List All Devices
e) Select Digilent USB Device (interface 0)
f) Click on Install Driver (or Reinstall Driver or…)

B/ Driver setup for Vivado

If the driver has been changed by Zadig, you must restore the driver back to Windows's default driver before Vivado can talk to the Nexys A7 again. Follow these steps to restore the driver:

- Click "Start" (the Windows symbol on the bottom left corner), type "Device Manager", left click

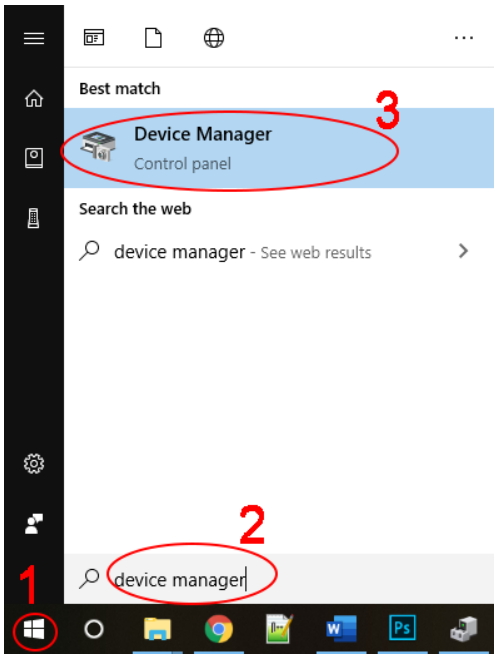

Figure 24.

- Scroll to the group “Universal Serial Bus Devices”, expand the group. There will be two items “Digilent USB device”. Right click on one of them and follow

- select “Update driver”
- select “Browse my computer for driver software”
- select “Let me pick from a list of available drivers on my computer”
- double click USB Serial Converter A (or B), then windows “Windows has successfully updated your drivers” will show, then select “Close”
- make sure that “USB Serial Converter A (or B)” shows in the group “Universal Serial Bus controllers”

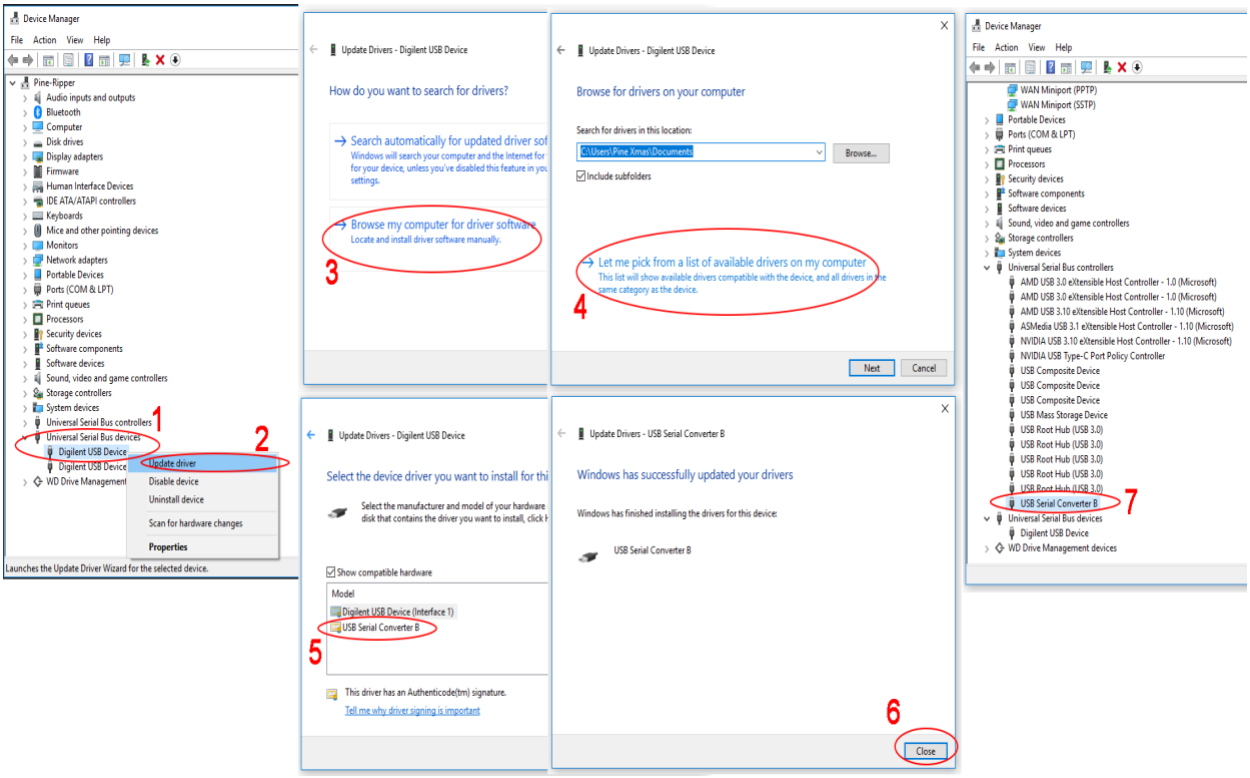

Figure 25.

- Repeat the same process with the other “Digilent USB device” item.
- Vivado now can recognize the Nexys A7 again.

Note: you will need to repeat these steps again whenever you switch the software to talk with the board: PlatformIO (follow II.A) or Vivado (follow II.B).