Tutorial B Installing Quartus II

Section I: Overview

In the first two lab sessions, we built circuits by hand using breadboard and discrete logic gates. Building circuits in this way for more complex circuits becomes an annoyingly tedious exercise – one with little educational benefit. Instead, Computer-Aided Design (CAD) software can greatly improve designer productivity when building complex circuits. Starting from Lab 3, we will use a CAD tool developed by Altera, called Quartus II, to design circuits on the computer. This enables us to work on more advanced exercises without the tedious tasks of building circuits by hand.

This tutorial explains how to install Quartus II on your personal computer. **Windows and Linux users can install Quartus natively on their computer. Mac users will have to either dual boot or use a pre-built virtual machine (VM) that we provide.** By nature, the virtual machine will be slower and less convenient than a native installation. Section II and III briefly cover Windows and Linux installation while Section IV explains how to run the VM.

However, we will not provide technical support for native installation problems, since there is abundant support on the internet. While installing Quartus II on Windows should be fairly straightforward, the installation could be rather involved for Linux.

Section II: Downloading and Installing Quartus in Windows

You should download Quartus II Web Edition, **version 15.0** to your personal computer. Note that Quartus II version 15 only works for a 64-bit OS. If you have a 32-bit OS, we suggest you to use the pre-built VM (this requires a 64-bit processor with hardware virtualization support). If you cannot run a 64-bit OS or a 64-bit VM, you can install Version 13.0. However, this version may not fully support the DE0-CV board that we use. Before installing, make sure you have the following:

- A reliable Internet connection,
- Approximately 10 GB of free space on your hard drive, and
- About an hour or so for the actual download process (the download size is ~3 GB).

Go to the following URL to download Quartus II from Altera. Quartus II is available for Windows and Linux. This section provides instructions for Windows.

http://dl.altera.com/15.0/?edition=web

Click on the *Individual Files* tab, and then download the following files:

- Quartus II Software
- Modelsim-Altera Edition
- Cyclone V device support

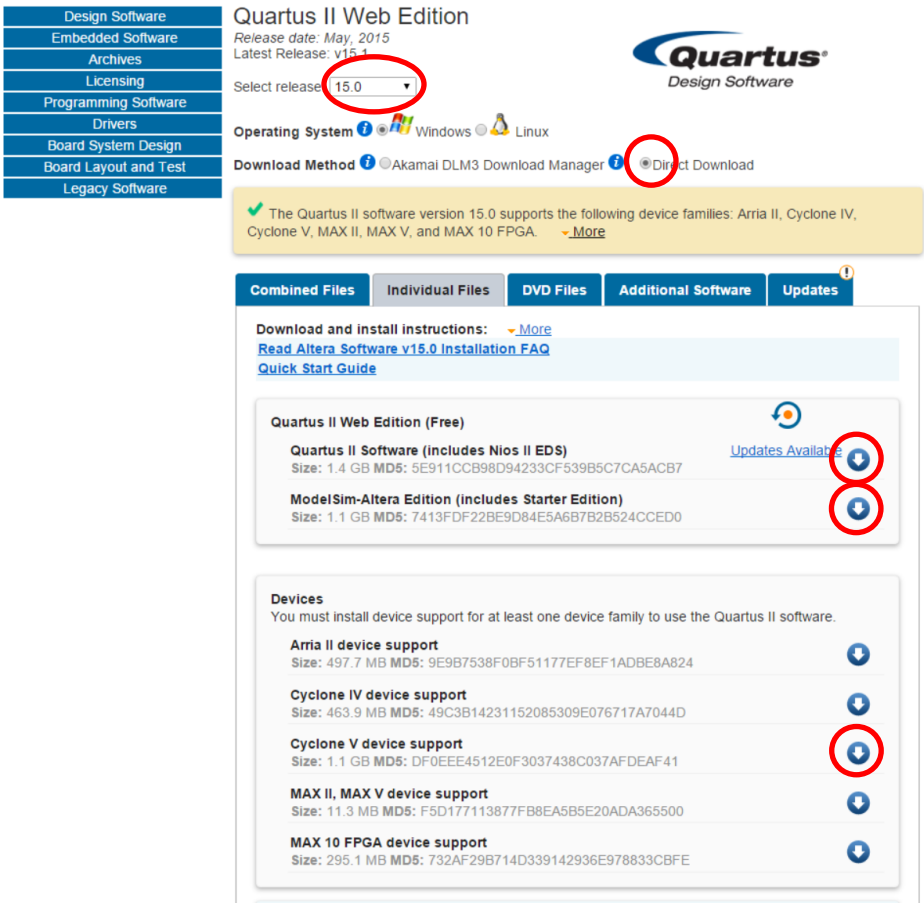

Figure 4. Quartus II download site, download link highlighted in red.

You will be taken to a sign-in page. Here, go to the bottom, select *Create Your myAltera Account*, and enter your email address. When prompted during the account creation process, put Cornell University as your company. Also, unless you really want spam mails, uncheck the newsletter boxes towards the bottom of the page. After creating the account, you might be directed to the page that lists Subscription version of Quartus (Quartus Prime Pro Edition) instead of the page that lists the Web Edition version. **DO NOT install the Pro Edition!** If you don't see Web Edition written on the page, please click on the link http://dl.altera.com/15.0/?edition=web again to get directed to the right version and download the above softwares.

All downloads should be saved to the same folder on your computer. Once done, start the installer for Quartus II Software. The installer should automatically detect the other downloaded files. After agreeing to the terms, make sure the following components are selected:

- *Quartus II Web Edition (Free)*

- *Modelsim-Altera Starter Edition (Free)*.
- *Devices -> Cyclone V*

Click *Next* and wait for the installer to finish. The software will take up about 10 GB.

Remember – due to the size of the download, the installation process could take a long time. Please plan accordingly.

Section III: Installing Quartus on Linux

GNU/Linux users can download the Linux packages from the same link and select the Linux operationg system. You will download the same set of files as the Windows users.

http://dl.altera.com/15.0/?edition=web

Make the .run script executable and execute it to get a graphical installation wizard. From there installation should proceed the same way as in Windows. Note that even if Quartus itself runs after installation, there is a good chance you may not be able to (1) program the FPGA board, or (2) run RTL simulation using ModelSim. You will want to test these features after installation.

For issues programming the board, the two most frequent causes include:

- **Missing libudev.so.0 in modern Linux distros.** This issue can be resolved by making a soft link from libudev.so.1 to libudev.so.0 as below:

```
$> sudo ln -sf /lib/$(arch)-linux-gnu/libudev.so.1 /lib/$(arch)-linux-gnu/libudev.so.0
```

- **USB device permissions.** Follow the link below to debug and resolve the issues. If you don't want a quick fix follow the instructions in the "Work-around" section and add a call to the Altera **jtagd** executable to /etc/rc.local.

http://www.fpga-dev.com/altera-usb-blaster-with-ubuntu/

For issues with ModelSim, you may need to install some libraries. Follow the link below:

http://mattaw.blogspot.com/2014/05/making-modelsim-altera-starter-edition.html

For additional support for Linux, you may look at the Arch User Repository (AUR) pkgbuild script for dependencies and other installation commands:

https://aur.archlinux.org/packages/quartus-free

Section IV: Installing the Pre-Built Virtual Machine (VM)

An easy way to get Quartus running on your machine, regardless of OS, is to download our pre-built virtual machine (VM), which comes with Quartus II already installed. If you run Mac OS X, this is the only supported way to run Quartus II for this course.

Before you begin, make sure you have enough disk space (~25GB). The installation process involves downloading a large file, which may take a few hours to finish. If you don't have a fast Internet connection, you can use the lab computers in Phillips 318 to download the file, and transfer it to your personal computer using a flash drive.

Installing the Pre-Built Virtual Machine (VM) Using VirtualBox

Oracle VM VirtualBox is a free program that runs a virtual machine (software that allows you to run another OS, such as Linux, from inside your host OS). To download VirtualBox, go to

https://www.virtualbox.org/wiki/Downloads

and select the appropriate version for your OS. You will also need to download the *VirtualBox Extension Pack* for the VM to work with USB devices. Download the files, and run the intaller to install VirtualBox (Figure 1). After successfully installing VirtualBox, double-click the VirtualBox Extension Pack file to install it.

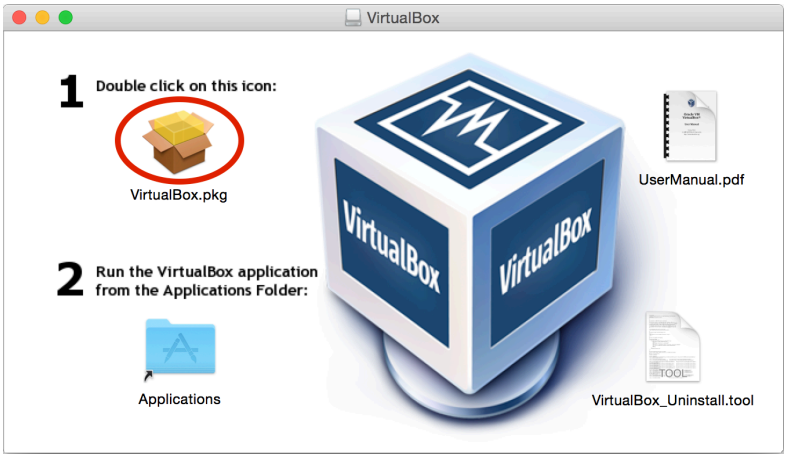

Figure 1. VirtualBox installation launcher (using OS X).

Next, download the pre-built VM from the following URL. The file is around 13 GB.

https://cornell.box.com/s/7lr2b969afeoedkl8ig3rxzupwwskfcy

Then, open the VirtualBox application, and import the downloaded VM into VirtualBox by selecting **File -> Import Appliance**. In the dialog, choose the file that you downloaded (Figure 2). Make sure you have enough disk space (~20GB). The import process could take few minutes.

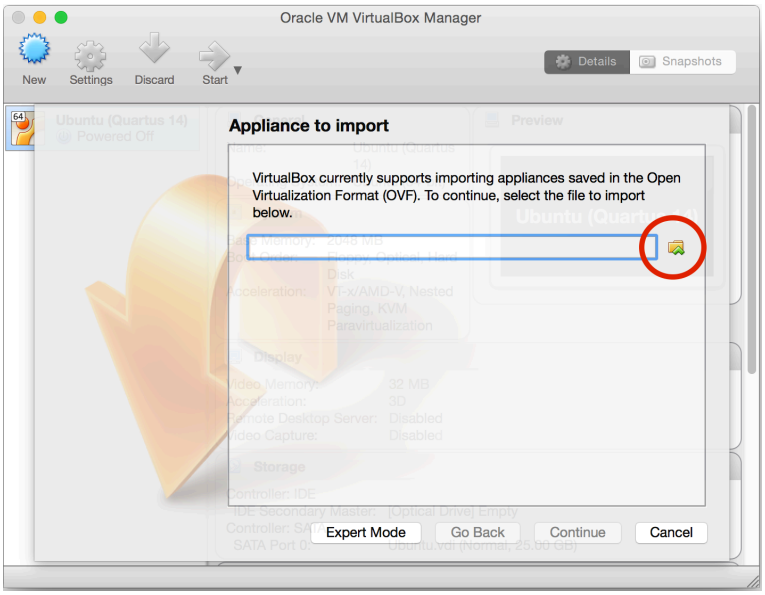

Figure 2. Import the VM into VirtualBox.

After the import process finishes, you should be able to see the virtual machine in VirtualBox (name may differ). Quartus II is already installed in this virtual machine. Select the virtual machine, hit "Start", and the virtual machine should boot up (Figure 3).

Note: The password for Ubuntu in VM is ***flipflop***.

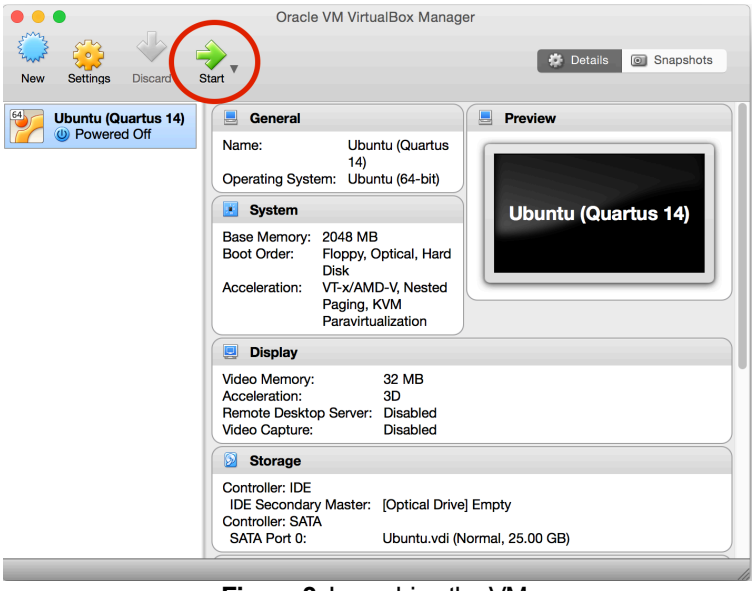

Figure 3. Launching the VM.

Section V: Verifying Installation

Launch Quartus. When you do this for the first time, a window will pop up prompting you about licensing. Select the second option, *Run the Quartus II software*. If Quartus starts up without any errors, the installation was successful. On Linux systems it is highly recommended you also try **RTL Simulation** and **programming the FPGA board**.

Follow the following steps to verify the quartus installation:

1) Download **test_quartus.zip** from the Lab 2 assignment. Unzip this onto your computer, into a folder called **test_quartus**.
2) In Quartus, Click on *File* → *Open Project…* Go to the **test_quartus** folder that you created, and then click on the **not_gate** file. Click the *Open* button.
3) On the left, you should see a box called *Project Navigator*, with three tabs. If the project opened correctly, you will see **not_gate** listed under the *Hierarchy* tab.
4) Click on *Processing* → *Start Compilation*.
5) Wait until the messages box at the bottom of the Quartus window says *Quartus II Full compilation was successful* and then click on *OK*.
6) Close the *Compilation Report* tab.
7) Click on *Tools* → *Run Simulation Tool* → *RTL Simulation*.
8) Wait for the simulation window to appear (Figure 4). You will see green lines on the right hand side when it is finished. This is the *waveform*, which plots the input and output values of the circuit over time. If the waves do not show up, make sure you have the Wave window shown (check *View* → *Wave*), and that there are no errors in the Transcript window (at bottom).
9) In the Transcript window at the bottom of ModelSim screen, you should see [PASSED] message for two test cases.

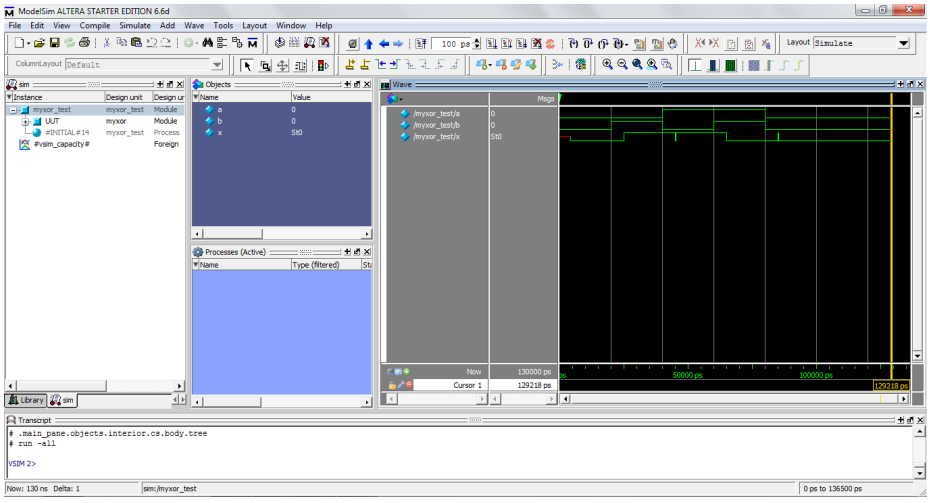

Figure 4. ModelSim-Altera window once simulation has completed.