ECE 5727

Lab 0: Hardware Check

Due Wednesday, January 29
Lab Point Value: 5

Objectives

In this lab you will:

1. Get introduced to the usage of Xilinx Vivado and learn the design flow from design entry to physical implementation into an FPGA.
2. Get introduced to the usage of Xilinx Vivado SDK and learn the design flow for programming the ARM microprocessor.
3. Confirm that cable drivers have been installed properly and you can program the Zybo-Z7 dev board.

Lab Overview

We will be working with the Xilinx Zynq-7000 series system on chip. It is a combination FPGA and ARM dual-core microprocessor on one die. This allows for far faster and easier transfer of data between the FPGA programmable logic and the software running on the microprocessor, than if they were two individual chips connected together on a PCB.

To work with this chip, we will need to install Xilinx's Vivado Design suite. Instructions can be found on Canvas.

The board we will be working with is Digilent's Zybo-Z7. This is a re-spin of their older ZYBO board, with slightly upgraded/changed peripherals.

In order to work with the board, we need to know how things are connected to the Zynq chip. Luckily, Digilent has made this easy for us by providing board configuration files so that we don't have to put it all together ourselves from their schematics.

Once we have the design tools and board files installed, it is time to check that they are installed and working, and that we can use them to program the Zybo. To do this, we will be following the first exercise from the Zynq Book Tutorials.

Instructions

Install Vivado

You will find instructions for installing Vivado on Canvas: Xilinx -> Vivado Installation Instructions.pdf. It will walk you through installation of the Vivado Design Suite, as well as setting up a Virtual Machine with Linux if you are a Mac user, and installation of the Xilinx Cable Drivers so that the computer will be able to communicate with the board.

Install Board Files

When you have gotten Vivado fully installed, we need to install the Digilent Zybo board file. Instructions for this are also included in the Zynq Book Tutorial, as well as through Digilent. I'm also putting them here for clarity. Do ***NOT*** use the Zybo board file from their source files. It is for the older model board, not the Zybo-Z7 we are using. Get the files from Digilent.

1. Go to Digilent's Github (github.com/Digilent) and download their Vivado-Boards repository.
2. Under new/board_files, there will be a bunch of directories named for Digilent's various boards. You are welcome to just copy all these directories if it is easier. However, we only need the one labeled **Zybo-Z7-10**, *not* Zybo-Z7-20 or Zybo.
3. Go to your Vivado installation directory, then into data/boards/board_files/
4. Copy the Zybo-Z7-10 directory (or all the directories) into this location

Zynq Book Exercise 1

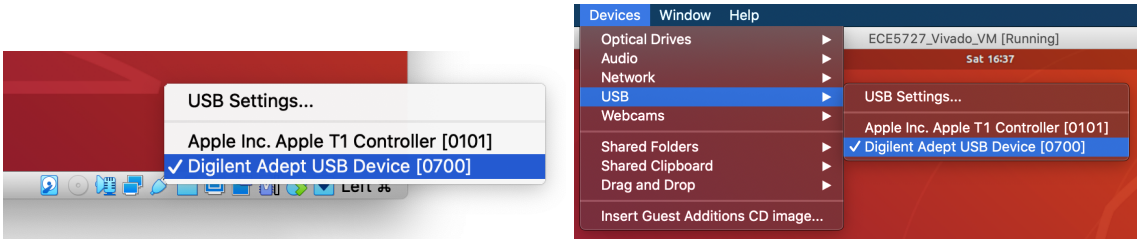
With everything set up for development, it is time to make your first project and run it on the board! If you have not already, download the Zynq Book Tutorial and source code from zynqbook.com. Alternatively, the pdf is on Canvas in the Zynq Book folder, and the source code is in Zynq Book -> Source Files.

Work your way through Exercise 1A-C: First Designs on Zynq. A couple things to note in general:

- The tutorials were last updated in 2015. Thus, everything refers to Vivado 2015.1. While some things may be slightly different, the UI has not changed that much, so you should be able to follow along just fine. And everything will work in 2018.3 as well as it did in 2015.1.
- If you installed the Digilent board file(s) above, then you have already done the one time set-up referred to at the start of 1A. If you have not, do so now. However, do ***NOT*** use the Zybo board file from their source files. It is for the older model board, not the Zybo-Z7 we are using. Get the files from Digilent.
- Like with the Vivado version, the board is also newer, having changed from the Zybo to the Zybo-Z7. But again, everything should still work and match up relatively well with the tutorial's instructions.
- The tutorials assume you are on Windows. If you are Linux, in place of C:/ use whatever you want (I recommend ~/). But for either Windows or Linux, it doesn't really matter where you create your workspace directory. Just use that path wherever the refer to C:/...

Exercise Notes:

- 1A(e) You can select Verilog in place of VHDL if you prefer. Especially for this tutorial though, it really doesn't matter what you choose.
- 1A(i) Select Zybo ***Z7-10*** rev **B.2**, not Zybo rev B.3 (this is the old board - things will not work if you select the wrong board).
- 1B(j-k) When you go to save, it will automatically validate your design. From 2017.1 onwards (or thereabouts), Xilinx changed their recommendations for routing/timing between the chip and a DDR chip. So you will end up getting 4 Critical Warnings about negative values. You can ignore these. As long as you don't have any other warnings, you passed validation.
- 1C(i) Move the jumpers before you plug it in & turn it on :)
- 1C(j) Before clicking program, make sure the board is plugged into the computer and turned on. And if you are on VM, make sure you have passed the USB connection through to it.



Make sure there is a check mark next to the device name to indicate the VM can see it

Post Lab

Please complete the quiz on Canvas.