How To 4

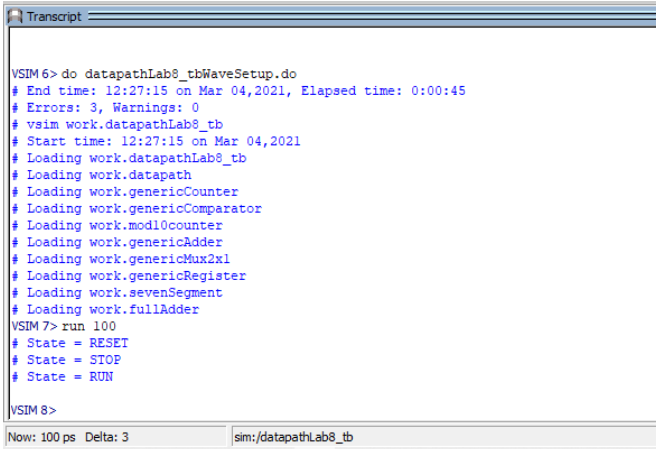
Using a Do file

I find setting up the testbench waves to be a pain, especially when you are making a lot of mistakes and need to rerun your simulation multiple times; each time setting up the waveforms. In order to simplify the process of setting up the waveforms, you can write a script files that performs the waveform setup and then call the script file inside ModelSim. The script file is called a "do" file. They are very easy to make and will save you time. If a do file is provided to you, you will most likely need to edit it because your signal names may be different.

In the discussion below I have used two placeholders: `<labName>` is the name of your testbench module. `<projectDirectory>` is the system path to your Verilog files corresponding to your project.

- If provided, download `<labName>_tbWaveSetup.do` into the: `<projectDirectory>\simulation\modelsim` directory If this folder does not exit, then you need to have to run "Start Analysis and Elaboration" at least once. You will know you are in `<projectDirectory>` when you see the project QPF file.
- If a do file is not created, you can use the template provided in Listing 4.1 as a starting point to make one for yourself. Make sure to put the do file in the: `<projectDirectory>\simulation\modelsim` directory
- Open `<labName>_tbWaveSetup.do` file using Notepad. The syntax is pretty straight forward and corresponds to the text displayed in the ModelSim console window when you add or modify waveforms.
- From Quartus, you need to:
  - Make sure that your testbench is the top-level. Do this in the Project Navigator, select File view and then right click on the file testbench and select "Set As Top Level Entity"
  - Launch the simulation. Do this by selecting Tools - Run Simulation Tool - RTL Simulation
  - This will launch Model Sim for your testbench
- From Model Sim, you need to:
  - Maximize the Model Sim window – this makes it easier to see all the subwindows.
  - In the library subwindow, open the **work** library
  - Right click on your testbench and select Simulate
  - In the console area of ModelSim (shown in the image below) type:

```
VSIM 3> do  <projectName>\_tbWaveSetup.do
```



```
VSIM 6> do datapathLab8_tbWaveSetup.do
# End time: 12:27:15 on Mar 04,2021, Elapsed time: 0:00:45
# Errors: 3, Warnings: 0
# vsim work.datapathLab8_tb
# Start time: 12:27:15 on Mar 04,2021
# Loading work.datapathLab8_tb
# Loading work.datapath
# Loading work.genericCounter
# Loading work.genericComparator
# Loading work.mod10counter
# Loading work.genericAdder
# Loading work.genericMux2x1
# Loading work.genericRegister
# Loading work.sevenSegment
# Loading work.fullAdder
VSIM 7> run 100
# State = RESET
# State = STOP
# State = RUN

VSIM 8>
```

Now: 100 ps Delta: 3 | sim:/datapathLab8_tb

- You can type “run <time>” in this area (as shown) to simulate some amount of time. I found this VERY handy when debugging my Verilog code.
- Also note that the console has tab completion. This allows you to type the first few characters of a command/filename and press Tab to fill in the rest of the command/filename. If there is more than one choice, the command/filename will be completed up to the ambiguity.

4.1 Example do file for hiLow Module

- Run the testbench for the hiLow module provided on Canvas. Produce a timing diagram with the following characteristics. Zoom to fill the available horizontal space with the waveform. Color inputs green and outputs red. Order the traces from top to bottom as

signal	radix	color trace
t_seedSwitch	unsigned	green
t_guessSwitch	unsigned	green
t_playSwitch	unsigned	green
t_randBut	default	green
t_hiLowBut	default	green
LFSR	unsigned	yellow
t_randNum	hex	red
t_randDisp	hex	red
t_hiLowSeg	hex	red
t_greenLEDs	default	red

- The do file for this testbench is shown in Listing 4.1. From top to bottom the sections are as follows.
  - Any line that starts with a “#” is a comment. The URL is a complete reference for do file syntax.
  - The restart command resets the simulation. I included this because I sometimes like to rerun the same simulation multiple times. This isn’t particularly useful for combinational logic circuits.
  - The delete wave command removes any waveforms that may have been added previously. Again, I included this because I sometimes like to rerun the same simulation multiple times

  - The add wave command puts a signal into the waveform viewing area. There are two parameters included which you will find helpful.
    - Radix changes what base the waveform value is displayed.
    - Color changes the color that the waveform is displayed.
- Once you have created the do file, you call it by running it from the console area using the do command discussed previously.
- You can advance the simulation time using the run command discussed previously.

Listing 4.1: do file for hiLow_tb.

```
########################################################################
#File:   hiLow_tbWaveSetup.do
########################################################################
restart -f
delete wave *

add wave -position end  -radix unsigned -color green sim:/hiLow_tb/t_seedSwitch
add wave -position end  -radix unsigned -color green sim:/hiLow_tb/t_guessSwitch
add wave -position end  -radix unsigned -color green  sim:/hiLow_tb/t_playSwitch
add wave -position end  -color green sim:/hiLow_tb/t_randBut
add wave -position end  -color green sim:/hiLow_tb/t_hiLowBut
add wave -position end  -radix unsigned -color yellow sim:/hiLow_tb/uut/randNum
add wave -position end  -radix hex -color red sim:/hiLow_tb/t_randDisp
add wave -position end  -radix hex -color red sim:/hiLow_tb/t_hiLowSeg
add wave -position end  -color red sim:/hiLow_tb/t_greenLEDs
```

4.2 Model Sim commands

ModelSim macros (also called DO files) are scripts that contain ModelSim and, optionally, Tcl commands.

You run the commands by typing tyhem in the console window at the bottom of the ModelSim window. What follows are the most popular commands that we use in the class. This is not an exhaustive list. You can find the complete list of command in the `ModelSim® Command Reference Manual` pdf. You will have to search the internet for this file as its location changes.

do `<file>` The do command executes commands contained in a macro `<file>`. If you provide no argument, the simulation runs for the default time (100 ns).

run ¡time¿ This command advances the simulation by the specified ¡time¿.

restart This command retarts the simuloation and resets the simulation time to zero. The -f option specifies that the simulation will be restarted without requiring confirmation in a popup window.

delete wave This command removes waveforms from the Wave window. The * option removes all the waves.

add wave This command can add signals, waves and busses to the Wave window:

- -position Specifies where the command adds the signals.
- -radix Specifies a user-defined radix.
- -color Specifies the color used to display a waveform.

radix define This command is used to create a user-defined radix used to map bit patterns to a set of enumeration labels. This command is used to map the binary codes for the states in a finite state machine (FSM) into symbolic names that are displayed on the timing diagram. This makes it much easier to understand what state your FSM is in. This bit patterns may contain “?” as a don’t care specifier.

vsim `<testbench>` This eliminates the need to open the word library and simulate the testbench. This is a legacy command that is no longer used in the class, until you see it.