

1 Task 1: Mini Register File

1.1 Configuration

In this lab, we are going to use Logisim-Evolution to build a mini register file. The configuration is as follows:

- ▶ The register file contains **four** registers, one write port, and two read ports;
- ▶ Each register can store one **byte**;
- ▶ All registers are synchronized by a clock.

Based on Figure 3.14 from the textbook (pp.65), we need the following data signals:

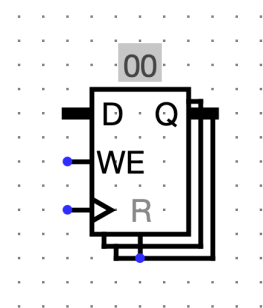
- ▶ Input:
 - **WriteReg** : the register ID for writing data;
 - **RegWrite** : the switch to control if we need to write to a register;
 - **RegDataW** : the data we want to write to the register;
 - **ReadReg1** : the register ID for reading (register 1);
 - **ReadReg2** : the register ID for reading (register 2);
- ▶ Output:
 - **RegData1** : data read from register 1;
 - **RegData2** : data read from register 2.

1.2 Write-Enabled Registers

In Logisim-Evolution, we can use write-enabled registers (left panel ▶ Memory ▶ Register), shown on the right.

The grey box with number shows the data stored in the register (hexadecimal); **D** is the input for data (write), and **Q** is the output for data (read). We can leave **R** unattached. The port with a small triangle is used to connect a clock. For this part you'd need to go to left panel ▶ Wiring ▶ Clock, choose the clock, and connect it with the register triangle.

The **WE** port means write-enabled, which is the **E** signal we used Figure 3.14 in the textbook, and should connect to an AND gate with input **RegWrite** and the output from a decoder. In this lab, you can certainly use the decoder provided by Logisim-Evolution: left panel ▶ Plexers ▶ Decoder.



1.3 Simulation and Timing Diagram

Before we start exploring timing diagram, make sure you have labeled all the input and output signals, as well as register numbers (such as **X1** , **X2** , etc).

Once you have built the timing diagram, we can start simulating our register file. To set up a comfortable environment for simulation, do the following:

- (1) Change the cursor to the finger (not arrow) to get ready for simulation;
- (2) Go to the top menu, choose Simulate, and make sure the item "Auto-Tick Enabled" is chosen;
- (3) Under same menu, choose "Auto-Tick Frequency", and choose 0.5Hz so it's not running too fast;
- (4) Under same menu, choose "Timing Diagram" to open a new window, and click on Timing Diagram tab;
- (5) Click the play button.

Then you'll see the clock starts ticking!

2 Task 2: Report

After task 1 has been completed, you will write a report to show that your register file works properly. The report includes two parts: reading and writing register file. Please follow the steps in the report template provided, and add screenshots (four in total) in each box.

3 Grading

The lab will be graded based on a total of 10 points, 5 for task 1 and 5 for task 2.

► Task 1:

- **-5:** if the circuits cannot be simulated at all;
- **-4:** if the configuration does not match the description in Section 1.1 Configuration;
- **-2:** if any of the components is not labeled correctly (see Section 1.1);
- **-1:** no pledge and/or name.

► Task 2:

- **-3:** if any of the screenshots misses timing diagram and/or the circuit;
- **-3:** if any of the screenshots show the register file is not working properly under certain condition;
- **-1:** no pledge and/or name.

Earlybird Extra Credit: 2% of extra credit will be given if the lab is finished by Wednesday 11:59PM EST (1 day before the lab deadline). For specific policy, see syllabus.

Attendance: check off at the end of the lab to get attendance credit.

Deliverable

One .circ file, and one PDF report, no need to zip.