

CS 51 Homework 6

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1.

Testing

- Each component (CND, RegWriter, RegReader, and ALU) was independently tested in previous homework assignments.
- Walking through the circuit with instructions that touch at least one/multiple of these components can be used to verify that they have been properly integrated and work together as expected. Examples include `addl %ecx, %eax` (encoded as `0x6010`) and `cmovl %ecx, %edx` (encoded as `0x2212`). Tests included in Q4 should account for this.

2.

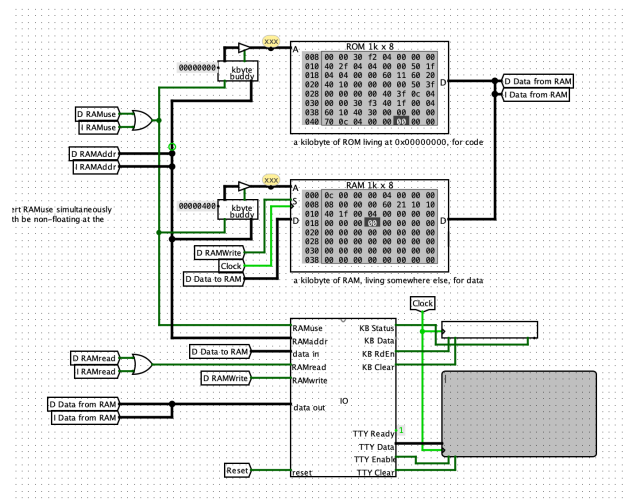


Figure 1: ROM, RAM, and I/O

Testing

Ideas for testing “normal” functionality:

- Read instructions from I-ROM
- Read/write data to D-RAM

and for Von Neumann:

- Read data from I-ROM
- Read/execute instructions in D-RAM
- Read data from KBDR/KBSR/DSR, write data to DDR
- Read/execute instructions in KBDR

Some of these are tested in `q2_test.hex`, particularly reading data from I-ROM and executing instructions in D-RAM to demonstrate the Von Neumann memory architecture. `q2_echo.hex`, a copy of `echo.y8` from class in hex form but with the stack initialized at a valid address in D-RAM, tests reading from the keyboard and writing to the display.

3.

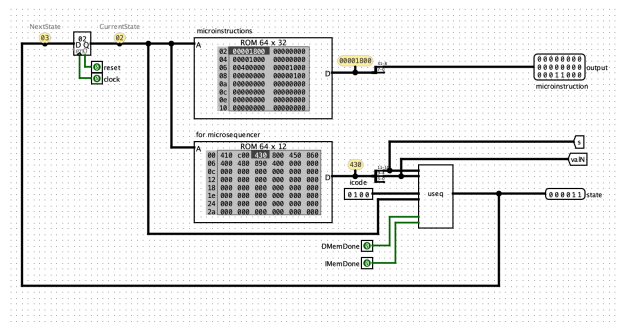


Figure 2: FSM

Testing

I tested my FSM by first setting the microinstructions for the `RMMOVL` path:

TOP

- IWAIT (while `IMemDone = 0`)
- RMMOVL
- MEMWRITE

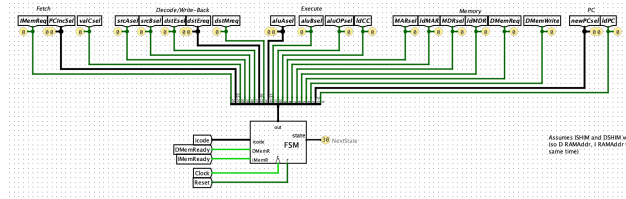


Figure 3: FSM in datapath

→ DWAIT0 (while DMemDone = 0)

→ TOP

Then,

- I reset `PC` to 0 and `CurrentState` to 0 by asserting `Reset`
- put `0xfeedcafe` into `%eax`
- put the hex encoding of `rmmovl %eax, 0x400` = `0x400f00040000` at address `0x000` in the I-ROM
- manually clocked through each state, ensuring that my FSM was correctly computing the next state for a given set of inputs
- and verified that address `0x400` contained `0xfeedcafe` when the program halted.

This path is useful for testing because it covers all four `select` options:

<i>select</i>	<i>NextState</i>
00	CurrentState
01	valN
10	CurrentState (if DMemReady == 0) valN (if DMemReady == 1)
11	CurrentState (if IMemReady == 0) <div style="border: 1px solid black; padding: 2px; display: inline-block;">1 1</div> icode (if IMemReady == 1)

The FSM is further tested in the test program for Q4.

4.

Testing

See `q4_test.py` and `q4_test.hex` for code that tests all instructions.

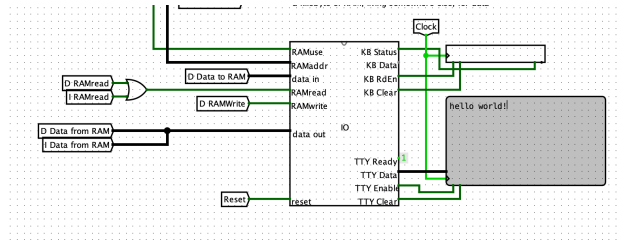


Figure 4: “hello world!” output from `hello.hex`

5.

See `hello.ys` and `hello.hex`.