In this lab, we'll write an LC-3 assembly language program to convert a letter in ASCII from upper case to lower case. The letter (in ASCII) to be converted is stored at memory address 0x4000, and is provided in the code window below (it's the letter 'S'). The result should be stored in register 6 (R6) and also saved into memory location 0x4001. *Hint*: Due to the limited length (5 bits) of the (sign-extended) immediate field, you need more than one operate instruction to perform the conversion.

Remember, the assembler automatically generates the code as you type (it refreshes every 3/4s of a second). The Check button will not respond. It should give errors (red 'X' next to the line number) when it runs into a problem. If new machine code on the right side does not appear, there's usually a problem with your input on the left side.

UPPER TO LOWER CASE CONVERSION

Use CTRL-A (Apple-A) and CTRL-C (Apple-C) to quickly capture the data in the machine code section.

LC-3 Assembler

```
1  .ORIG 0x3000
2  HALT
3  .DATA 0x4000
4  .STRINGZ S
5  .END
```

```
1  @0b11000000000000
2  0b1111000000100011
3  @0b1000000000000000
4  0b0000000001010011
5  0b0000000000000000
```

Check button now submits assembly to edX!

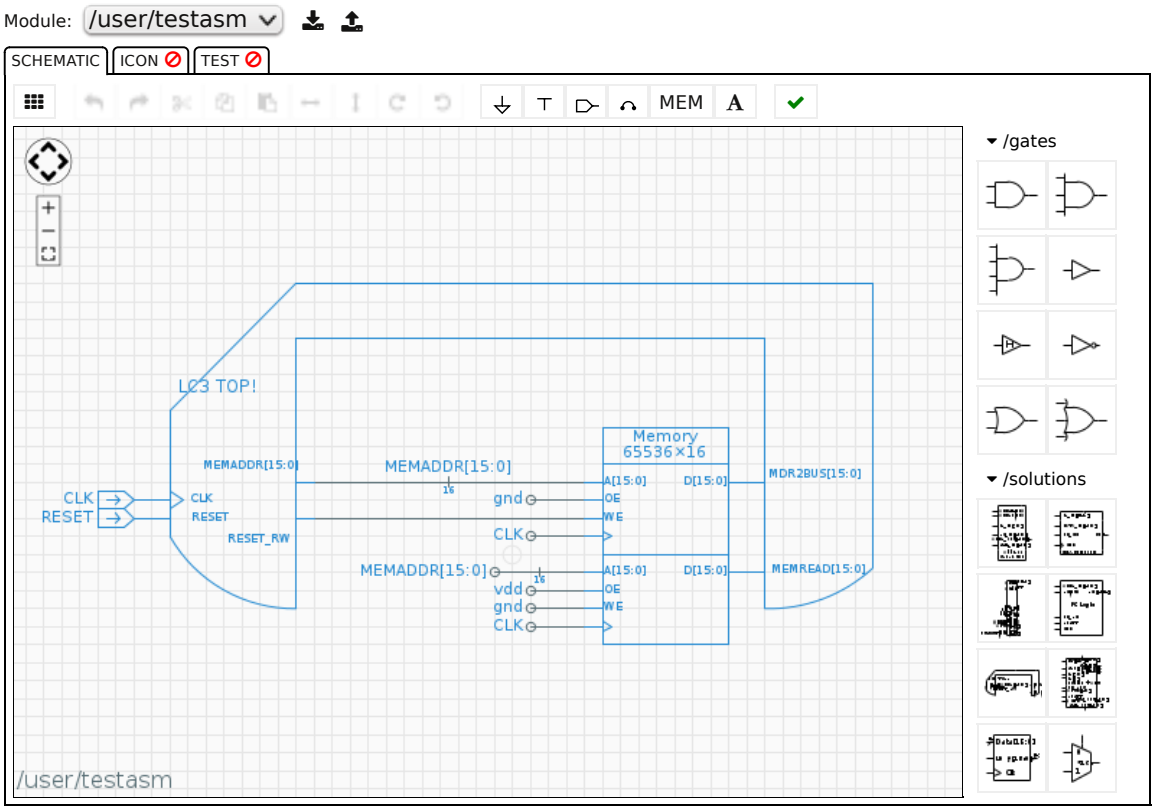
Check

Help

In the window below, the LC-3 Lite memory plug in solution **/solutions/lc3_plugin_memory/**, should already be created and hooked up to a memory. Double click on the memory and paste the entire contents of the right hand side window above into the Contents entry in the Edit Properties window. Because the memory is "enveloped" by the LC3 implementation, you may need to click towards the lower part of the memory to select it (instead of the LC3 itself).

Run the test. It checks to see that at the end of the program, you have successfully converted the value.

UPPER TO LOWER CASE CONVERSION (1 point possible)



Click component to select, click and drag on background for area select, shift-click and drag on background to pan

Jade 2.2.43 (2015 © MIT EECS)

Check

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If you would like to test your program on your own LC-3 Lite, use the ungraded Jade instance below.
Copy your machine code into the memory, and run the test.

You may need to name the lc3plugin_memory module "lc3".

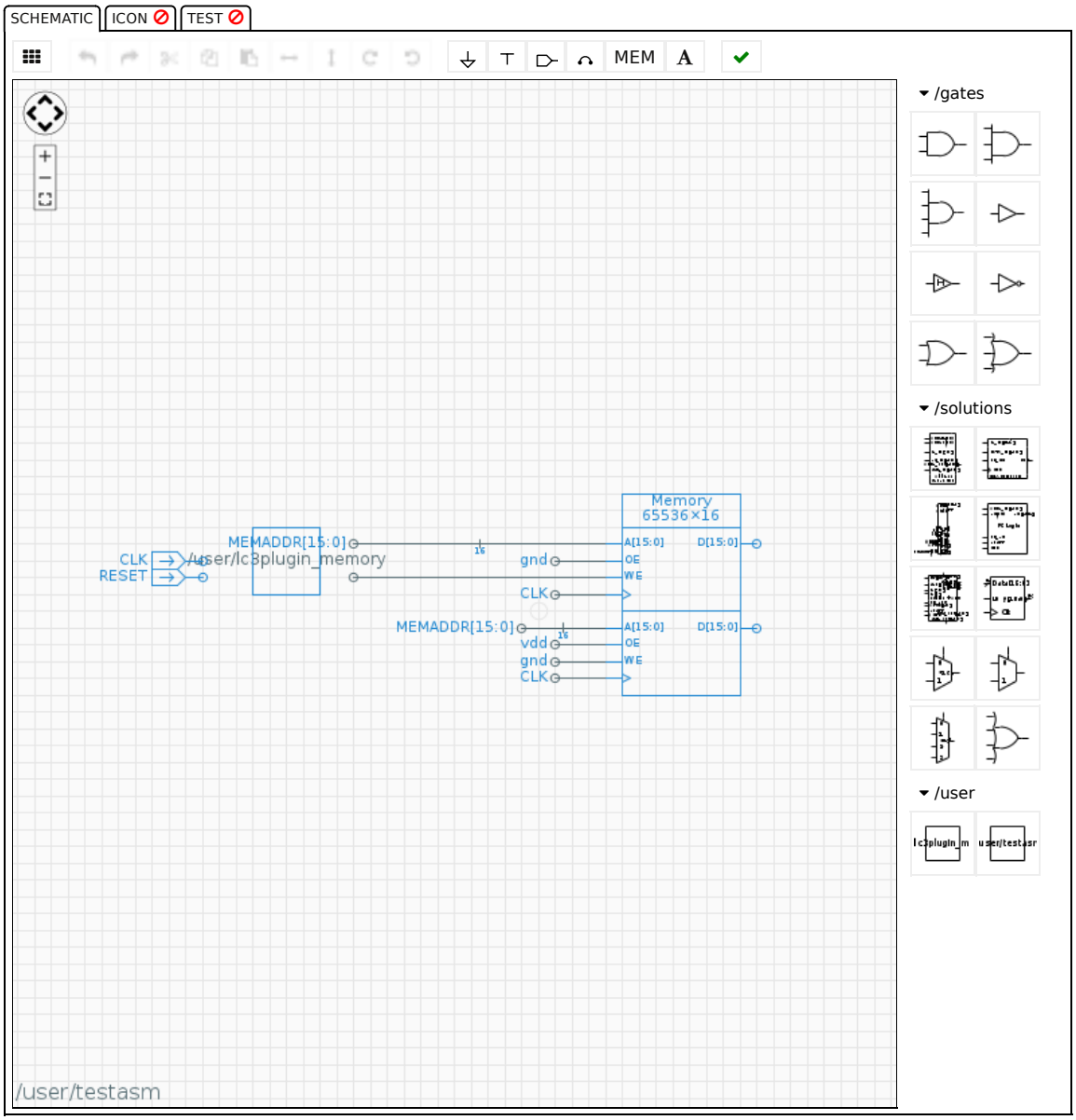
Help

It is configured to use the **/user/lc3plugin_memory** module. If you want to use your own test and code, we have moved that option to a new page here.

This is optional.

TESTING YOUR LC-3 LITE (UNGRADED)

Module: /user/testasm



Click component to select, click and drag on background for area select, shift-click and drag on background to pan

Jade 2.2.43 (2015 © MIT EECS)

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Check

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