LC3 Assembly Programming Week 7 Lab Exercise

Today

- Write assembly program
  - Loop through memory locations
    - Get familiar with Load and Store instructions
  - Implement XOR operation

- The lab exercises, and assembly programming homework, will help you prepare for Project 4
  - Please save the code you write – you can reuse it for the project

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Exercise

- Write LC3 assembly program that iterates through an array MyArray of N numbers and replaces with MyArray[i] XOR temp
  - MyArray is stored starting at x4000
  - temp is a variable in your program – assume it is #55
    - o Recall: a variable is a memory location with a label
    - o Can be initialized using the .FILL assembler directive
  - N is a variable (length of array) in your program – assume it is 10

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Using LC3 Assembler/Simulator (LC3 Tools)

- Important Note on using LC3 simulator
  - Open file (or start new one), type your assembly code
  - Assemble
  - Open Simulator.... **Set breakpoint at last instruction/HALT of your program– this will stop the simulation after the instruction**
  - **Set it by click on small dot (exclamation) next to where you want to set breakpoint…it goes red to indicate breakpoint set.**
- To execute one instruction at a time, use step over
  - Track the register and memory contents after each step
- or run entire program, and check contents at end of the program
- "Step into" option shows you execution within each instruction (will get clearer once we cover datapath details)

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Creating and Loading a "data" file

- LC3Tools permits loading multiple object files
  - Loaded at the address specified in that object file (i.e., .ORIG command)
- Can use this to create and load a file containing the data to be processed by your code.
- Ex: MyData.asm is a list of numbers starting at address x4000
- Assemble the code – creates object code MyData.obj
- Load this object file into simulator
  - Important: make sure you reset program counter is set to start of your main program.

MyData.asm

```
.ORIG x4000
.FILL #10
.FILL #20
.FILL #30
.FILL #40
.END
```

Put values 10,20,30,40 at addresses x4000, 4001, 4002, 4003 Respectively.
Loading MyData.obj will result in these Values in those memory addresses of the simulator

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- How do you implement R1 XOR R2 in LC3 (bitwise XOR)?
  - You have AND and NOT
- How do you implement: for (i=0; i < N; i++)
  Equivalently: while i<N

- To iterate through MyArray:
  - load starting address of MyArray (x4000) into a register R4
  - Fetch element and XOR with #55 (value loaded from temp – store into R2)
  - Loop N times (in this case N =10)
  - Each time increment register R4 by 1 so it points to next array element

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