Introduction to Computing: Program 1

Fall 2025
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Due date: **Tuesday 10/21 at 11:59PM**

Objective

The purpose of this assignment is to write a program in LC-3 assembly language to Compute N^M, where N and M are non-negative inputs to your program.

Details

The input numbers are given to you in memory locations x3500 (N) and x3501 (M) and the result (N^M) has to be placed in x3502. Your program must start at x3000. If the computation of the value of N^M exceeds x7FFF (which is the largest positive number one can represent in 16 bits: $2^{15}-1 = 32767$) then you put the value -1 at x3502. Assume 0⁰ = 0.

First, develop an algorithm to capture your thoughts. Now translate the algorithm into code (assembly). Using a flowchart or pseudocode will help this process. You are required to turn the flowchart along with the assembly file for full credit on this assignment

Here are some questions/answers to guide your thought process in arriving at an algorithm :

1. What is N^0?
    Answer: 1
2. What is 0^M?
    Answer: 0
3. What is N^1?
    Answer: N
4. What is N^2?
    Answer: $N \times N$ that is, Multiply one time.
5. What is N^M when $M \geq 1$?
    Answer: $N \times N \times N \times \ldots (M-1) multiplications$
6. How does one do Multiplication $A \times B$ on a machine that only supports addition?
    Answer: Multiplication is successive addition
    $A + A + A \ldots (B-1) additions$: As shown in class

Test your solution to make sure it works for all possible inputs. Be judicious in choosing your test cases so you don't have to be exhaustive.

Examples: These are just examples and not exhaustive.
*   If the location x3500 has x0003 and x3501 has x0002, then after running your program x3502 should have x0009(3^2).
*   If the location x3500 has x000A and x3501 has x000A , then after running your program x3502 should have xFFFF(which is -1, as 10^{10} =10000000000 > 32767).
*   If the location x3500 has x0002 and x3501 has x000A , then after running your program x3502 should have x0400(2^{10} =1024).

- If the location x3500 has x00B2 and x3501 has x0002, then after running your program x3502 should have x7BC4(178^2 =31684).
- If the location x3500 has x7FFF and x3501 has x0001, then after running your program x3502 should have x7FFF ($x7FFF^1$ = x7FFF).

Specifics:
- The first line of your program should be the binary of the address where your program will load to. The LC-3 simulator will place your program starting at that address. For this assignment, you should place your program starting at x3000 as is already done for you in the starter program.
- You are allowed to use **labels** in your program. The inputs **N** and **M** and the result (**N2theM**) are already stored with labels at x3500, x3501 and, x3502

Submission Instructions
- You must do the programming assignment by yourself. You are permitted to get help from ONLY the TAs and the instructor.
- The file you submit should be a LC-3 assembly language file named **Program1.asm**. This is 1/2 files you need to submit. Programs named incorrectly or otherwise improperly submitted will receive point penalties.
- For full credit on this programming assignment you will also submit a second file (2/2): A Flowchart (as **Program1.pdf**) on the link provided in Canvas.