Virginia Tech - ECE 5484 - Summer 2020

Homework 4

Before starting this homework assignment, please be sure that you have completed all of the following activities.

- View the relevant online lectures and read associated sections in the textbook before or while you work on this homework assignment.
- Review the course syllabus. Note the grading policies, including policies for submitting assignments.
- Review the course schedule. Note the due dates for course assignments, including this one.
- Review the Graduate Honor System at https://graduateschool.vt.edu/academics/expectations/graduate-honor-system.html. Review the Graduate Honor System Constitution, especially Articles I (Sections 1, 2, and 3), V, VI, VII, VIII, and IX.

Please note the following.

- Solutions must be clear and presented in the order assigned. Solutions must show work needed, as appropriate, to derive your answers. Written answers should be concise, but sufficiently complete to answer the question. Neat hand drawings, where needed, are acceptable. Your final solution for each problem must be easily identified.
- At the top of the first page, include: your name (as recorded by the university); your email address; and the assignment name ("ECE 5484, Homework 4"). Do *not* include your Virginia Tech ID number or your social security number.
- Homework must be submitted as a PDF (.pdf) file with the file name *lastname_firstname*_HW4.pdf, where *lastname* is your last or family name and *firstname* is your first or given name. Submit a single file.
- Submit your assignment using the Assignments area of the class website. You must submit your assignment by 11:55 p.m. on the due date.

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1. Consider the MARIE program below.

   a) List the hexadecimal code for *each line* of the program (including the symbols).
   b) Draw the symbol table.
   c) What is the value stored in the AC when the program terminates?

```
        ORG 100
Begin,  LOAD Base
        ADD Offs
Loop,   SUBT Two
        STORE Addr
        SKIPCOND 800
        JUMP Done
        CLEAR
        LOAD Offs
Done,   HALT
Base,   HEX 200
Offs,   DEC 11
Two,    HEX 0002
Addr,   HEX 007
```

2. Write the assembly language equivalent of the following MARIE machine language instructions:

   a) 0100 0001 1000 0101
   b) 1000 0100 0000 0000
   c) 0111 0000 0000 0000

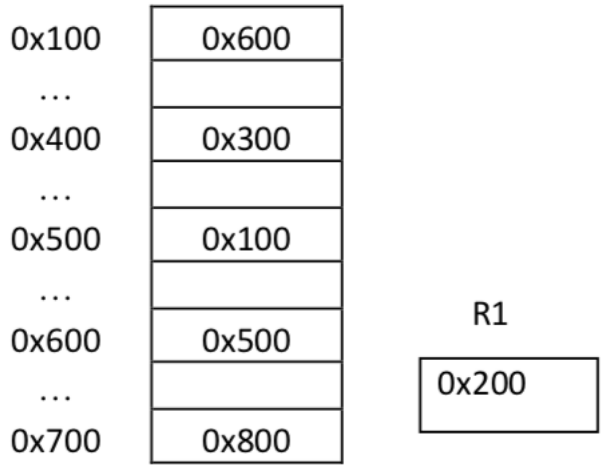
3. Write the following code segment in MARIE's assembly language:

```
if X < 1 then
    Y = X - 2;
    X = 0;
endif;
Y = Y + 7;
```

4. Fill in the following table to show how the given integers are represented, assuming 16-bits are used to store values and the machine uses 2's complement notation.

Integer	Binary	Hex	2 Byte Big Endian (hex value as seen in memory)	2 Byte Little Endian (hex value as seen in memory)
7				
1329				
-7				
-27109				
31307				

5. Suppose we have the instruction Load 600. Given memory and register R1 contain the values below and assuming R1 is implied in the indexed addressing mode, determine the actual value loaded into the accumulator and fill in the table below:



Mode	Value loaded into AC
Immediate	
Direct	
Indirect	
Indexed	

6. Suppose an instruction takes four cycles to execute in a nonpipelined CPU: one cycle to fetch the instruction, one cycle to decode the instruction, one cycle to perform the ALU operation, and one cycle to store the result. In a CPU with a 4-stage pipeline, that instruction still takes four cycles to execute, so how can we say the pipeline speeds up the execution of the program?

7. **Scavenger Hunt:** John Cocke and David Patterson made significant contributions to Reduced

Instruction Set Computer (RISC) architectures. *Answer the following questions separately for each of these two individuals.* Cite the sources you used to find your answers. Your entire answer should be one page or less.

a. In your own words, what was his contribution to RISC architectures? Try to be specific.