Homework#2 for ECE 152
Instruction Sets (Chapter 2)
Due in class on Monday, February 2

All homework must be done in a group of 2 students. Each group should turn in one hard-copy in class. If your handwriting is unreadable, please type your homework.

1) [5 points] Patterson & Hennessy 2.10.1
2) [5 points] P&H 2.10.4
3) [10 points] For an accumulator-based ISA, write (on paper) an assembly program that computes \( X = (A+B)*(C+(D*E+F)) \). Assume that you have the following instructions: clear, add, multiply, where acc = “accumulator” and:

\[
\begin{align*}
clear & \rightarrow acc = 0 \\
add A & \rightarrow acc = acc + A \\
mult A & \rightarrow acc = acc * A
\end{align*}
\]

4) [30] Write a MIPS assembly program that reads a string of integers and computes the whether this number (i.e., the number represented by the entire string) is evenly divisible by 13. Assume the string of integers has no more than 5 digits.

Use the spim simulator (available on the textbook’s CD - please refer to page B-42 of the textbook for more information) to run and test your assembly program. Spim (and xspim) is a program that simulates the behavior of MIPS32 computers and can run MIPS32 assembly language programs. Documentation for spim is available in Appendix B of your textbook and at: [http://www.cs.wisc.edu/~larus/spim.html](http://www.cs.wisc.edu/~larus/spim.html). This spim website also contains a link for downloading a PC version of spim, if you’d rather run it on your PC than on a dsil workstation. A helpful reference is a simple program that I’ve provided for you at: [http://www.ee.duke.edu/~sorin/ece152/resources/simple.s](http://www.ee.duke.edu/~sorin/ece152/resources/simple.s). This simple program sums the entries in a list of 9 integers.

To submit your code for this question and the next question, create a directory in your ECE account. You can name this directory whatever you want, but for this explanation I’ll assume it’s named ~yourlogin/homework2. Put your program files in this directory and name them question4.s and question5.s. Create a .tar.gz file called homework2.tar.gz that includes question4.s and question5.s, and then use the electronic submission website to upload homework2.tar.gz.

You may re-submit as often as you like, but a re-submission will overwrite whatever you’ve previously submitted for this assignment. I will grade whatever has been submitted before 10:00AM on Monday, February 2.

5) [30] Write a MIPS assembly program that sorts, in descending order, all of the characters that are provided as inputs (sorting is done by ASCII code). Assume you won’t get more than 100 characters. Some inputs may repeat. The pseudo-code for your program is below. Once again, use spim to run and test your code. Your program will be tested by the grader with several different arrays of characters, to make sure that your program does indeed work correctly. You absolutely, positively MUST use procedures for insertAnd-
Sort() and printArray(). I want to see you use procedures and stack frames. If you don’t use procedures, you will not receive much credit for your work, even if the end result is functionally correct.

```c
main:   read one char;
    if (char == carriage return){
        exit program;
    } else {
        call insertAndSort(char);
    }
    call printArray();
    goto main;
// insertAndSort() must keep the array sorted in descending order.
// You MUST have procedures for insertAndSort() and printArray().
// I want to see you use procedures and stack frames.
```