ECE 331 – Fall 2024
Homework 1
Assigned Friday, September 6
Due Friday, September 13

1. Moore's Law is a prediction that the number of transistors in an integrated circuit will double every two years. Answer the following:

    a. Describe three aspects of performance that have improved as a result of this increasingly dense integration.

    b. Transistor feature sizes have steadily decreased while the overall integrated circuit (die) size has not changed significantly. Why?

2. In a few clear and concise sentences each, and in your own words, describe the function of each of the following combinational hardware elements. (i.e. what goes into each of these elements and what comes out?)

    a. Multiplexer (MUX)
    b. Magnitude comparator
    c. Line decoder
    d. Full adder
    e. Arithmetic logic unit

3. The following question refers to the ALU and data path depicted on Lecture 2, slides 13 and 14. Using this hardware:

    a. Compute `C+B-D-A` using a series of assembly pseudo instructions of the form depicted on Lecture 2, Slides 14 and 15.

    b. Show the contents of a control ROM, depicted on Lecture 2, Slide 15, that defines control signals and instructs the data path to perform the computation steps listed in (a)

4. Write ARM assembly code that implements the following line of C:
   `B = A[0] - A[1] + A[2] + A[3] - 10;`
   (Assume that the base address of `A` is stored in `x19` and the address of `B` is stored in `x20`)

5. There are five basic elements of every computer system. How does control relate to the other four elements and what is its function?

6. Answer the following, showing your work:

   a. What is the 2's complement of `0b10111101`?

   b. Represent `0xE37A` in binary format

   c. Represent `0b1110101011100101` in hexadecimal format

   d. Show `0d4923` (decimal) in hexadecimal, in both big- and little-endian formats, assuming a 16-bit unsigned integer datatype

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* special note: questions about the homework should use the Piazza forum (preferred):
https://piazza.com/umass/fall2024/ece331/home
Office hours for the TAs and instructors can be found on Piazza:
https://piazza.com/umass/fall2024/ece331/staff