CSCI 2500 — Computer Organization ♩
Fall 2018 Quiz 7 (December 11, 2018)

Please silence and put away all laptops, notes, books, phones, electronic devices, etc. This quiz is designed to take 25 minutes; therefore, for 50% extra time, the expected time is 38 minutes and 100% extra time is 50 minutes. Questions will not be answered except when there is a glaring mistake or ambiguity in a question. Please do your best to interpret and answer each question.

1. **(24 POINTS)** Convert each of the 16-bit binary values shown below into its equivalent hexadecimal and decimal values (i.e., convert base 2 to base 16 and base 10). Assume these are two's complement signed integers.

   (a) $0001\ 0000\ 0001\ 1011_{two}$ ==> 0x_____$_{hex}$ ==> _____$_{ten}$

   (b) $0010\ 0000\ 0010\ 1010_{two}$ ==> 0x_____$_{hex}$ ==> _____$_{ten}$

   (c) $1111\ 0111\ 1111\ 1110_{two}$ ==> 0x_____$_{hex}$ ==> _____$_{ten}$

   (d) $1111\ 1111\ 1111\ 1111_{two}$ ==> 0x_____$_{hex}$ ==> _____$_{ten}$

2. **(10 POINTS)** After the MIPS code shown below is executed, what is the exact contents of register $f16? Clearly circle the **best** answer.

   ```
   li.s  $f16,2.0
   li.s  $f18,73.0
   div.s $f16,$f18,$f16
   div.s $f16,$f18,$f16
   ```

   (a) 0.00037530_{ten} (c) 2.00000000_{ten} (e) 36.50000000_{ten}

   (b) 1.00000000_{ten} (d) 18.25000000_{ten} (f) 73.00000000_{ten}

3. **(10 POINTS)** In C, for function `snapchat()`, we want to pass first parameter `x` (an `int`) by value and second parameter `y` (an `int`) by reference. To do so, we should use the following function prototype. Clearly circle the **best** answer.

   (a) `int snapchat( int & x, int y );`   (d) `int snapchat( int x, int & y );`

   (b) `int snapchat( int * x, int y );`   (e) `int snapchat( int & x, int & y );`

   (c) `int snapchat( int x, int * y );`   (f) `int snapchat( int * x, int * y );`

4. **(24 POINTS)** A *functionally complete set* is a minimal set of operators that can be used to represent any possible Boolean expression. We know from class that AND, OR, and NOT form a functionally complete set.

   (a) Do the two operators NOR and NAND form a functionally complete set (yes or no)?

   (b) If "yes," describe how. If "no," describe why not (i.e., describe what's missing).

5. **(32 POINTS)** For this last question, you are given a three-way set associative cache with two-word blocks and a total size of 24 words.

   How many bits are required for the index bits? _____

   How many bits are required for the block offset bits? _____

   Next, using the sequence of references given below, show the **final** cache contents if an LRU replacement algorithm is used. Assume the cache is initially empty and that values within each set are ordered from least-recently used to most-recently used.

   And for each reference, identify the tag bits, index bits, block offset bits, and if it is a *hit* or a *miss*. Write each numeric value as a decimal (i.e., base 10) value.

   3, 180, 43, 2, 191, 88, 190, 14, 181, 44, 186, 253

Tag	Index	Block Offset	Hit or Miss

!!! H A V E   A   N I C E   H O L I D A Y !!!