Homework 2

Due Date: March 6

There is nothing to hand in for this homework assignment. There will be a quiz at the **beginning of class** on the indicated date. Points on the quiz will be scaled relative to the "time" value given in the book (the number in square brackets next to the problem), unless indicated differently below. The solution sheet will be posted on the course web page.

Do the following problems from the text; note that if the question asks for an answer using C, the answer will be the same in C++. Note, also, that in any problem that references MIPS, you must use **true** MIPS assembly instructions, which means **no pseudo-instructions.** In the text, SPIM refers to the assembly language that includes pseudo-instructions and MIPS refers to the true language.

2.3, 2.4[1], 2.5, 2.10.1–2.10.4, 2.19, 2.20

In addition (be sure to look up each instruction's format first, where applicable), do the following problems. In those that show MIPS code, do not assume that variables are contained in certain registers; rather, you have to move data into or out of memory.

1. [10] Show the single MIPS instruction or minimal sequence of instructions for the following C++ statement. Assume that `x` is a 32-bit integer, `A`, and `B` are arrays of 32-bit integers, and all variables have already been defined/allocated in memory.

   ```
   x = A[B[x]];
   ```

2. [10] Show the single MIPS instruction or minimal sequence of instructions (no pseudoinstructions) for the following C++ statement:

   ```
   A[4] = A[5] + x;
   ```

   Assume that `x` corresponds to register `$t3` and the array `A` has a base address of $18,875,010_{10}$.[2]

3. [5] Show the single MIPS instruction or minimal sequence of instructions for this C++ statement, where `a` and `b` are integer variables:

   ```
   b = 45 | a;
   ```

4. [10] Give the binary instruction equivalent of the MIPS instruction: `sw $s1, number($t2)`, where the base address of `number` is 132. Show all of the fields (i.e., don't just write the 32-bit binary value, but show the result as a "box" as done in class).

5. [10] Write the binary instruction equivalent of the MIPS instruction: `sllv $t1, $s4, $t7`.

6. [10] Find a reduced sum-of-products version of the following expression:

   $AB + BC + A\overline{B}\ \overline{C} + \overline{A}BC + \overline{A}\ \overline{B}C$.

   The use of a Karnaugh map is suggested but not required.

7. [5] Draw the gates required for the expression found in the previous problem.

8. [5] DeMorgan's Laws indicate that $\overline{BC} = \overline{B} + \overline{C}$. Prove that the expression $\overline{B}\ \overline{C} = \overline{B} + \overline{C}$ is **not** true.

[1] They *really* mean **one** C++ instruction.

[2] Hint: This is not as straightforward as you might think. The size of the addressing portion of the instruction format is important! Also remember that `li` is a pseudoinstruction, and therefore not available in MIPS.