Practice Problems for Topic 4

CIS*2030: Structure and Application of Microcomputers

The practice problems below are important, but will *not* be marked. Their purpose is to ensure that you understand the major concepts covered in Topic 4. Doing these problems by yourself is imperative, as a portion of the marks on the midterm and final exam will be based on questions related to Topic 4. Solutions will be covered during the following (Monday) lecture.

1. What is an *address mode* and why do some ISAs, like the Motorola 68000 and Intel x86, have a relatively large number of address modes?

2. Column 1 of Table 2-1 on page 59 of your textbook lists the names of all 68000 address modes. Use this table to identify (the full) name of the address modes for the source and destination operands in the following instructions:

    a) `ADD.L      D3,$7000`

    b) `SUB.B      #-1,-(A1)`

    c) `MOVE.W     (A1)+,$9000`

    d) `MOVE.B     (A1,D2.W),-3(A3)`

3. Name the addressing mode for each of the following addressing situations:

    a) The operand (i.e., actual data value) is included (encoded) in the instruction.

    b) The instruction specifies a pointer to the actual data value.

4. Show two different 68000 instructions for placing the memory address associated with the label LIST into address register A0.

5. If address register A3 contains $00FF80D4 and data register D5 contains $000FFFFF, determine the (32-bit) hexadecimal address of the destination operand for the following instructions:

    a) `CLR.B`   `$FFFE(A3)`

    b) `SUB.B`   `#-1,(A3)+`

    c) `MOVE.L`   `$1234,-(A1)`

    d) `MOVE.B`   `(A1,D2.W),-2(A3,D5.W)`

6. Write a single 68000 instruction to copy the longword pointed to by A0 to location in memory pointed to by A2.

7. What does the instruction MOVE.L 4(A4),(A4) accomplish?

8. Below, you will find a *memory map*. For the sake of simplicity, both the addresses and the contents of memory are shown in *decimal*.

address	Contents
0	12
1	17
2	7
3	4
4	8
5	4
6	4
7	6
8	0
9	5
10	12
11	7
12	6
13	3
14	2

Use the memory map to explain the action of each of the following instructions by determining the contents of the destination operand (i.e., register). These instructions correspond to 68000 instructions, but for the sake of simplicity, you should assume that all addresses are *bytes*, expressed in decimal, and that registers

D7=0 A0 = 4, A1=2, and PC=10. In other words, you do not have to supply a full 32-bit hexadecimal value.

a) `LEA (A0),A4`

b) `LEA -2(A0),A4`

c) `MOVE.B 4(PC),D3`

d) `MOVE.B -1(A0,A1),D4`

9. The instruction `ADD.L LABEL(PC),D1` appears in two different locations in a given program (e.g., first at the beginning of the program then later towards the end of the program). Is the machine language code for the two ADD instructions the same? Explain. Would the code be the same if PC was replaced with and address register?

10. Based on your knowledge of the instruction cycle, instruction encodings in binary, and the number of times memory is accessed using different 68000 address modes, order the following instructions from slowest to fastest; that is, the slowest will have a rank of 1, the next slowest a rank of 2, and the fastest a rank of 3. You may assume that the largest value that can be read from or written to memory is a word. [1 point]

    `MOVE.B $9FFF,D1`   _____

    `MOVE.B A4,D3`   _____

    `MOVE.B $1234,D1`   _____

11. Convert the following MOVE machine instructions into assembly instructions:

a) 23F839C200009000

b) 171C