METRO STATE UNIVERSITY

ICS 232 Computer Organization & Architecture
Homework 5 - Chapter 4 Part 2 - 10 points
Due Date: 6/14/2023

Name: Key

Note: Please post your homework to ICS232 D2L on or before the due date.

Chapter 4 – MARIE: An Introduction to a Simple Computer

Essential Terms and Concepts

31. How does a microprogram operation differ from a regular assembly language instruction?

A regular assembly language instruction are the instructions implemented by the CPU. In order to execute each assembly language instruction several execution steps are usually required. The microprogram instructions implement these steps by controlling the control signals needed to perform the operation.

39. Compare CISC machines to RISC machines.

In CISC machines instructions are of variable length allowing much more complex and compact instructions. In RISC machines all instructions are the same length. CISC instructions are more complex to decode. RISC instructions are easy to decode.

Exercises

34. Write the following code segment in MARIE assembly language. (Hint: Turn the for loop into a while loop):

```
      Sum = 0;
      for X = 1 to 10 do
        Sum = Sum + X;
```

```
       Load     One      /Load constant
       Store    X        /Initialize loop control variable X
       Clear
       Store    Sum
Loop,  Load     X        /Load X
```

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```
        Subt     Ten      /Compare X to 10
        SkipCond 800      /If AC> 0 (X less than 10)
        Jump     Go
        Jump     Endloop  /Terminate loop
Go,     Load     Sum
        Add      X        /Add X to Sum
        Store    Sum      /Store result in Sum
        Load     X
        Add      One      /Increment X
        Store    X
        Jump     Loop
Endloop, Load    Sum
        Output            /Print Sum
        Halt              /terminate program
Sum,    Dec 0
X,      Dec 0             /Storage for X
One,    Dec 1             /The constant value 1
Ten,    Dec 10            /The loop constant
        END
```

39. MARIE saves the return address for a subroutine in memory, at a location designated by the jump-and-store instruction. In some architectures, this address is stored in a register, and in many it is stored on a stack. Which of these methods would best handle recursion?
Explain your answer. (Hint: Recursion implies many subroutine calls.)

A stack would handle recursion more efficiently. The stack could grow as large as necessary to accommodate multiple calls to the subroutine. If there were only one register or one memory location, multiple calls to the subroutine from within the subroutine (i.e. recursion) would not be possible.

X1. Write a C program that has two functions named `findMax` and `countOdd`. Each function will take two arguments, an integer array and the number of elements in the array. `findMax` returns the largest element. `countOdd` returns the count of the number of odd elements in the array. The main function should call `findMax` and

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`countOdd` twice with different arrays and then print out the results of calling the functions. The two arrays used to test the program should be:

```
static int array1[] = {1, -1, 100, 32, 64, -97};
static int array2[] = {-100, 1, -10, 50, -40, 98, 110};
```

Submit the C code and the results of executing the program.

Prepare for next class by reading Chapter 5 – A Closer Look at Instruction Set Architectures.

Continue working on Project 1

Continue working on Your Group Project