COMPSCI 2GA3

Assignment/Homework 2, Oct. 5th 2021
Assignment due date: Oct. 17th, 23:59:59.
Note: Please work on this assignment individually. Students copying each other's answer will get a zero and will perform poor on midterm and final.

Written Exercises

Complete the following questions from *Computer Organization and Design: The Hardware Software Interface: Computer Organization and Design The Hardware/Software Interface: RISC-V Edition.*

Chapter 2: Instructions: Language of the Computer (20 Marks)

1. Exercise 2.14 (4 Marks) For the of instruction described by the following RISC-V fields:
   `opcode=0x33, funct3=0x0, funct7=0x20, rs2=5, rs1=7, rd=6`
   provide

   a. (1 mark) The instruction type

   b. (1 mark) Assembly language instruction

   c. (2 marks) Binary representation

2. Exercise 2.29 (6 Marks) Implement the following C code in RISC-V assembly.

```
int fib(int n){
    if (n==0)
        return 0;
    else
        if (n == 1)
            return 1;
        else
            return fib(n-1) + fib(n-2);
}
```

3. (4 Marks) Translate procedure `f` into RISC-V assembly language. The C code for `f` is:

```
long int f (long int g, long int h,
  long int i, long int j){
  return ((g+h)-i + ((g-h)+j));
}
```

   Assume arguments `g, h, i, j` are in registers `x10, x11, x12, x13`. Return value should be in `x10`. Please put comments in your code.

4. Exercise 2.40 (4 Marks) Assume that for a given program 70% of the executed instructions are arithmetic, 10% are load/store, and 20% are branch.

   a. (2 marks) Given this instruction mix and the assumption that an arithmetic instruction requires two cycles, a load/store instruction takes six cycles, and a branch instruction takes three cycles, find the average CPI.

   b. (1 mark) For a 25% improvement in performance, how many cycles, on average, may an arithmetic instruction take if load/store and branch instructions are not improved at all?

   c. (1 mark) For a 50% improvement in performance, how many cycles, on average, may an arithmetic instruction take if load/store and branch instructions are not improved at all?