# Spring 2014

# BSM 206 Computer Organization

# Final Example

Questions:

**1)** [10 points] [Fill in the blanks questions] There will be some fill in the blanks question in the exam. These questions will be about what affects the performance of a computer and floating point representation.

**2)** [20 points] [Language of Computers] Consider the following sequence of code:
x = x * y - z + q;
Assume that x, y, z, q are stored in registers $s1, $s2, $s3, $s4.

a) Write the code into MIPS assembler.

b) Complete the machine code and memory addresses given below for these instructions (check Appendix).

| Memory | op | rs | rt | rd | shamt | funct |
|---|---|---|---|---|---|---|
| 40016 | | | | | | |
| | | | | | | |
| | | | | | | |

**3)** [30 points] [Language of Computers] Consider the following C function:

```
int fact (int n)
{
  if (n < 1) return 1;
  else return n * fact(n - 1);
}
```

a) For this function, MIPS code is given below. The argument n is stored in $a0. Complete the missing instructions and some parts of instructions. For each instruction please insert a comment with your own words. For the first three instructions comments are inserted for you.

```
fact:
    addi $sp, $sp, -8      # adjust stack for 2 items
    sw   $ra, 4($sp)       # save return address
    sw   $a0, 0($sp)       # save argument
    slti $t0, $a0, 1       #
    _______________, L1    #
    addi $v0, $zero, 1     #
    addi $sp, $sp, 8       #
    ________________       #
L1: addi $a0, _______      #
    jal  fact              #
    lw   $a0, 0($sp)       #
    ________________       #
    addi $sp, $sp, 8       #
    mul  $v0, _______      #
    jr   $ra               #
```

b) For this MIPS code, the machine code is provided below. Complete the missing parts.

| Memory | op | rs | rt | rd | shamt | funct |
|---|---|---|---|---|---|---|
| | | | | constant or address | | |
| 80000 | 8 | 29 | 29 | -8 | | |
| 80004 | 43 | 29 | 31 | 4 | | |
| 80008 | 43 | 29 | 4 | 0 | | |
| 80016 | 10 | 4 | 8 | 1 | | |
| 80020 | | | | | | |
| 80024 | 8 | 2 | 0 | 1 | | |
| 80028 | 8 | 29 | 29 | 8 | | |
| 80032 | | | | | | |
| 80036 | 8 | | | | | |
| 80040 | 3 | | | | | |
| 80044 | 35 | 29 | 4 | 0 | | |
| 80048 | | | | | | |
| 80052 | 8 | 29 | 29 | 8 | | |
| 80056 | 0 | | | 0 | 0 | 24 |
| 80060 | | | | | | |

**4)** [40 points] [Processors] Consider the datapath and control units of a processor shown below.

a) For the third instruction you found in question 2, please state the inputs and the outputs of the main control unit ALU control unit. Which datapath elements will be functional?

b) Repeat (a) for the instruction stored in instruction memory 80008 in question 3.

c) Repeat (a) for the instruction stored in instruction memory 80020 in question 3.

d) Repeat (a) for the instruction stored in instruction memory 80040 in question 3.