CSCI-UA.0201-003

Computer Systems Organization

Midterm Exam Fall 2015 (time: 60 minutes)

Last name: First name:

Notes:

- **If you perceive any ambiguity in any of the questions, state your assumptions clearly.**
- **Questions vary in difficulty; it is strongly recommended that you do not spend too much time on any one question.**

1. [2 points] What would have happened if we didn't have linkers? State 2 consequences.

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2. [5 points] Fill in the blanks in the following table, assume the instructions are executed sequentially (i.e. instruction 1 executed, then instruction 2, then instruction 3. Assume rax and rbx are holding signed numbers.

instruction#	**instruction**	**rax**	**rbx**	**CF**	**ZF**	**SF**	**OF**
Initially		0xFFFFFFFF	0x00000001	0	0	0	0
1	addq %rbx, %rax						
2	testq %rbx, %rax						
3	cmpq %rbx, %rax						

3. [5 points] For the following assembly code and its corresponding C code, fill-in the blanks in the C code assuming x will go into %rbx and y will go into %rax;

```
        cmpq %rax, %rbx          _____ x, y;  /* declaration of x and y;
        ja  L1                   if ( _____ )
        subq, %rbx, %rax          {
        jmp L2                        _____
L1:     addq $10, %rax            }
L2:     addq %rbx, %rax          else
                                 {
                                      _____
                                 }
                                 _____
```

4. [2 points] Can the carry flag (CF) and the overflow flag (OF) be both 1 at the same time? If yes, give an example of an operation that does this (no need for assembly code, just describe the operation). If not, explain why not.

5. [2 points] State two reasons for why do we need an assembler and not making the compiler generate the binary presentation right away.

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6. Suppose x is an integer (i.e. 4 bytes). We want to test whether the most significant bit of x is 1 or not (i.e. the left most bit), so we wrote the expression:

if((x & mask) != 0)

a. [1 point] What is the value of mask, both in binary and hexadecimal?

b. [2 points] Which of the following expressions generate correct mask? Circle ALL correct answers. There may be more than one correct answer, or there may be none!

- 0x1FFFFFFF << 3
- 0x1FFFFFFF << 2
- two's complement of 0xFFFFFFFC
- two's complement of (-2)

c. [1 point] Please give the expression that sets the most significant bit of x to 1 and leave all the other bits unchanged.