Full Name _____

CSCI 2400, Fall 2014
First Midterm Exam

Instructions:

- Check that your exam has all 4 pages, and write your full name clearly on the front.

- Write your answers in the space provided for each problem. Feel free to use the back of each page to help you determine the answer, but make sure your answer is entered in the space provided on the front of the page.

- This exam is CLOSED BOOK and no electronics are allowed. You can use one page of personal notes and the printed midterm packet of tables. Good luck!

Problem	Page	Possible	Score
1	1	8	
2	2	16	
3	2	18	
4	3	28	
5	4	30	
Total		100	

1. **[8 Points]** In the following, state whether the statement is true or false. An incorrect answer will cancel a correct answer. The lowest possible score is zero on this question.

   (a) _____ In big endian systems, the most significant byte of a word has the lowest memory address.

   (b) omitted

   (c) omitted

   (d) omitted

2. **[16 Points]** In the following questions assume the variable `x` is a signed integer and that the machine uses two's complement representation. Also assume that `TMax` is the maximum integer, `TMin` is the minimum integer, and `W` is one less than the word length (e.g., `W = 31` for 32-bit integers). The `>>` operator behaves as an arithmetic shift.

Match each of the descriptions on the left with a line of code on the right (write in the letter in the blank). You will be given 4 points for each correct match.

```
                              a)  ~TMin + 1

1)  -x      _____
                              b)  ! (x ^ 0)

2)  TMax    _____
                              c)  ~x - (TMin - (~TMax+1))

3)  x!=0    _____
                              d)  ! ! (x ^ ( ~( (1 << W) >> W ) ))

4)  0       _____
                              e)  ~(TMin + TMax)

                              f)  ~ (1 << W)
```

3. **[18 Points]** Assume we are running code on a 6-bit machine using two's complement arithmetic for signed integers. Also assume that `TMax` is the maximum integer, `TMin` is the minimum integer. Fill in the empty boxes in the table below. The following definitions are used in the table:

```
int y = -29;
int x = 30;
```

Note: For the empty boxes in the first column (Expression) you MUST USE either x or y along with any other constants, e.g. x+17. In the column labeled "Overflow", you should indicate Yes or No whether overflow occurred.

Expression	Decimal Representation	Hex Representation	Overflow?
y	-29	0x23	No
	TMax		No
	-32	0x20	Yes
x+y	1	0x01	
x + TMax		0x3d	Yes
TMin+y			

4. **[28 Points]** omitted

5. **[30 Points]**

Look at the C code below and pick the correct option to fill out the blanks in the corresponding assembly code. Options for blanks: `%eax`, `%ecx`, `%edx`, `%esi`, `%edi`, `%esp`, `%ebp`, `add`, `sub`, `imull`, `jmp`, `cmpl`, `movsbw`, `movzbw`, and `movzwl`. Options may be used more than once. Each blank is worth 3 points.

C Code:

```c
myFunction(char a, int x) {

signed int b[7];
unsigned short i;
signed int y = 15;


for (i = x; i > 0 ; i--) {

        if (y < 0) {
                b[i-1] = a + i;
        }
        else {
                b[i] = a;
        }
        y = y + b[i];
}
return y;
}
```

```asm
myFunction:
push       %ebp
mov        _____,%ebp
sub        $0x34,%esp
mov        0x8(%ebp),%eax
mov        %al,-0x34(%ebp)
movl       $0xf,-0x20(%ebp)
mov        0xc(_____),%eax
mov        %ax,-0x22(%ebp)
_____       L1

.L4
_____       $0x0,-0x20(%ebp)
jns        L2
movzwl     -0x22(%ebp),%eax
sub        $0x1,%eax
movsbl     -0x34(%ebp),_____
movzwl     -0x22(%ebp),%edx
_____       %ecx,%edx
mov        %edx,-0x1c(%ebp,_____,4)
jmp        L3

.L2
_____       -0x22(%ebp),%eax
movsbl     -0x34(%ebp),%edx
mov        _____,-0x1c(%ebp,%eax,4)

.L3
movzwl     -0x22(%ebp),%eax
mov        -0x1c(%ebp,%eax,4),%eax
add        %eax,-0x20(%ebp)
movzwl     -0x22(%ebp),%eax
_____       $0x1,%eax
mov        %ax,-0x22(%ebp)

.L1
cmpw       $0x0,-0x22(%ebp)
jne        .L4
mov        -0x20(%ebp),%eax
mov        %esp,%ebp
pop        %ebp
ret
```