Bits, Bytes and Integers **4190.308 Computer Architecture**

Due Date: Thursday, September 10, 2015, 23:59 **Solution**

Submission: in paper form.
There will be a drop off box in class and in front of the CSAP Lab in building 301, room 419.
Please update your e-mail address and mobile phone number in eTL

Question 1

Hexadecimal and Binary notations

Perform the following number conversions and calculations.

example) `0x39A7F8` in binary notation

0b001110011010011111111000

a) 0b1100100100111011 in hexadecimal notation

b) `0xD5F4C` in binary notation

c) 0b101101111001111010101 in hexadecimal notation

d) 190 in binary notation

e) `0x503C` + `0x88` in hexadecimal notation

f) `0x503C` – `0x44` in hexadecimal notation

g) `0x503C` + 88 in decimal notation

Question 2

Logical Operations in C

Suppose that x, y and z have the byte values `0xA8F1`, `0x17DF` and `0xCDB8`, respectively. Fill in the following table indicating the byte values of the different C expressions(in hexadecimal notation).

Expression	Value	Expression	Value
x & y	`0x00D1`	x && y	
x | y		x || y	
x | (y & z)		x || (y && y)	
~x | ~y		!x || !y	
x & !y		x && ~y	
x & (!y | ~z)		(~(x & z) | x) & y	

Question 3

Signed vs. Unsigned

Assume the following expressions are executed on a machine with a 32-bit word size. Fill in the following tables with the types and the result of the evaluations of the following expressions.

Expression	Type	Evaluation
-2147483647-1 == 2147483648U	unsigned	1
-2147483647-1U < 2147483647		
-2147483647-1U < -2147483647		
2147483647U > -2147483647-1		
2147483647 > (int) 2147483648U		
-1 < 0U		

Question 4

Signed vs. Unsigned

Consider the following C functions.

```
int fun1(unsigned word) {
     return (int) ((word << 26) >> 26);
}

int fun2(unsigned word) {
     return ((int) word  << 26) >> 26;
}
```

Assume the functions above are executed on a machine with a 32-bit word size that uses two's-complement arithmetic. Assume also that right shifts of signed values are performed arithmetically, while right shifts of unsigned values are performed logically.

Fill in the following table showing the effect of these functions for several example arguments.

w	fun1(w)	fun2(w)
0xDEADBEEF	0x0000002F	0xFFFFFFEF
0xBADDCAFE		
0x0D15EA5E		
0xFEE1DEAD		

Question 5

Two's-Complement Multiplication

Fill in the following table showing the results of multiplying different 3-bit numbers, in the style of Figure 2.26 in the text book:

Mode	x		y		x*y		Truncated x*y	
Unsigned	3	011	4	100	12	001100	4	100
Two's comp.	3	011	-4	100	-12	110100	-4	100
Unsigned		101		111				
Two's comp.		101		111				
Unsigned		111		111				
Two's comp.		111		111				