Name: _____

Intro. to Computer Architecture	**Homework 1**
CSE 240 Autumn 2006	**Due: Fri. 15 September 2006**

Write your answers on these pages. Additional pages may be attached (with staple) if necessary. Please ensure that your answers are legible and *show your work.* Write your name at the top of each page. Due at the ***beginning of class***. Total points: 58.

1. [12 Points] **Basic Conversions**.

   (a) Convert the binary number 01110000 to decimal.

   (b) Convert the decimal number 42 to an 8-bit unsigned binary representation.

   (c) Convert the 8-bit 2's complement binary number 10110110 to decimal.

(d) Convert the decimal number -117 to an 8-bit 2's complement binary representation.

(e) Convert the 8-bit unsigned binary number 10110010 to hexadecimal.

(f) Convert the unsigned hexadecimal number BEAD to unsigned 16-bit binary.

2. [12 Points] **Binary Arithmetic and Logical Operations**. Let $A = 00100110$ and $B = 11010011$ be 2's complement integers. Compute the following, giving your answers in *both* 8-bit 2's complement and decimal. Use a fixed width of 8 bits (*i.e.*, your answers must be 8 bits). As always, show your work.

   (a) $A + B$

   (b) $A \; OR \; B$

   (c) $A \; AND \; B$

(d) $B - A$

(e) $A - B$

(f) $A + \overline{B} + 1$

3. [7 Points] **Logical Operations.** Complete the following truth tables.

(a)

A	$\overline{A}$	$A\ OR\ \overline{A}$	$A\ AND\ \overline{A}$
0	1		
1	0		

(b)

A	B	C	$(A\ OR\ B)\ AND\ C$	$(A\ AND\ C)\ OR\ (B\ AND\ C)$
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

(c)

A	B	$(\overline{A}\ AND\ \overline{B})$	$\overline{(A\ OR\ B)}$
0	0		
0	1		
1	0		
1	1		

4. [8 Points] **Floating Point.**

(a) Give an example of a number that has a 32-bit floating point representation (as in Figure 2.2 in the textbook) and cannot be represented as a 32-bit 2's complement integer. Explain why this number cannot be represented as an integer.

(b) Give an example of a number that can be represented as a 32-bit 2's complement integer but cannot be represented exactly as a 32-bit floating point. Explain why this number cannot be represented as a floating point.

5. [8 Points] **Limitations of Fixed-Width Arithmetic.** Consider the following 8-bit 2's complement numbers: $A = 01111111$, $B = 00000101$, and $C = 10001011$. Assume that only 8 bits are available to represent values. Show your work.

   (a) Evaluate $A + B$. Give your answer as an 8-bit 2's complement number. Convert this number to decimal. Why doesn't this represent the sum of A and B?

   (b) Evaluate $C - A$. Give your answer as an 8-bit 2's complement number. Convert this number to decimal. Why doesn't this represent the difference of C and A?

6. [10 Points] **Multiple Interpretations of Bits.** Consider the following sequence of 16 bits: 1100 0110 0011 0001. These bits can be interpreted in many different ways.

   (a) If we interpret these bits as a 16-bit unsigned binary integer, what is the decimal value represented by the bit sequence?

   (b) If we interpret these bits as a 16-bit 2's complement integer, what is the decimal value represented by the bit sequence?

(c) If we interpret the low-order 8 bits as an ASCII character (see Appendix E in your textbook), what is this character?

(d) If we interpret these bits as a floating point number, what is the decimal value represented by the bit sequence. Assume that the floating point representation devotes 1 bit to the sign, 5 bits to the exponent, and 10 bits to the fraction (similar Figure 2.2 in your textbook). Give the answer in the following form: $A \times 2^B$, where A and B are *decimal* numbers.

(e) If we interpret these bits as an Red-Green-Blue (RGB) color, what is the color represented by the bit sequence? Assume the high-order bit is always 1, the next 5 bits represent red, the next 5 bits represent green, and the low-order 5 bits represent blue.

7. [1 Point] **Last and Most Important Question!** Give us your feedback.

(a) How many hours did you spend on this assignment?

(b) On a scale of 1-5, how difficult did you find this assignment? (1-easiest, 5-most difficult)

(c) Do you have any other comments on your experience completing this assignment? What are they?