Intro. to Computer Architecture	Homework 1
CSE 240 Autumn 2004	Due: Fri. 17 September 2004

Write your answers on these pages. Additional pages may be attached (with staple) if necessary. Please ensure that your answers are legible. Please show your work. Write your name at the top of each page. Due at the ***beginning of class***. Total points: 66.

1. [12 Points] **Conversion**.

   (a) Convert the binary number 00100101 to decimal.

   (b) Convert the decimal number 21 to an 8-bit unsigned binary representation.

   (c) Convert the 8-bit 2's complement binary number 11011010 to decimal.

(d) Convert the decimal number -111 to an 8-bit 2's complement binary representation.

(e) Convert the 8-bit unsigned binary number 11010010 to hexadecimal.

(f) Convert the unsigned hexadecimal number 29 to unsigned 8-bit binary.

2. [12 Points] **Binary Arithmetic and Logical Operations**. Let $A = 00100101$ and $B = 11111011$ be 2's complement integers. Compute the following. Assume a fixed width of 8 bits (*i.e.*, your answers must be 8 bits). Please 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. [6 Points] **Logical Operations.** Complete the following truth tables.

(a)

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

(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. [6 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] **Bits Are 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).

   (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 bit represent green, and the low-order 5 bits represent blue.

7. [No Points] **Last and Most Important Question!** This question is compulsory. 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?