

Name: \_\_\_\_\_

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**Intro. to Computer Architecture**  
**CSE 240 Autumn 2006**

**Homework 1**  
**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.

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(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.

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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)  $A \text{ OR } B$

(c)  $A \text{ AND } B$

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(d)  $B - A$

(e)  $A - B$

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

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

(a)

$A$	$\bar{A}$	$A \text{ OR } \bar{A}$	$A \text{ AND } \bar{A}$
0	1		
1	0		

(b)

$A$	$B$	$C$	$(A \text{ OR } B) \text{ AND } C$	$(A \text{ AND } C) \text{ OR } (B \text{ AND } C)$
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)

$A$	$B$	$(\bar{A} \text{ AND } \bar{B})$	$\overline{(A \text{ OR } B)}$
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?

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(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?