CS/ECE 252: INTRODUCTION TO COMPUTER ENGINEERING

UNIVERSITY OF WISCONSIN—MADISON

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Examination 1
In Class (50 minutes)
Friday, Feb 10, 2012
Weight: 17.5%

NO: BOOK(S), NOTE(S), CALCULATORS OF ANY SORT.

This exam has 9 pages, including a blank page at the end. Plan your time carefully, since some problems are longer than others. You must turn in pages 1 to 7.

LAST NAME: _____

FIRST NAME:_____

SECTION: _____

ID# _____

Question	Maximum Points	Points
1	8	
2	4	
3	4	
4	2	
5	2	
6	3	
7	3	
8	4	
Total	30	

Q1 (8 points)

a. Convert the ASCII string "**-6.19**" to its hexadecimal representation. Only represent the characters between the quotation marks and assume it is a null terminated string.

-	6	.	1	9
2D	36	2E	31	39

b. Convert the following binary code into an ASCII string:
0010 0011 0110 0010 0011 0001 0100 1110 0000 0000

x23	x62	x31	x4E	x00
#	b	1	N	null

"#b1N"

c. Convert the decimal number **194** into its 4-digit hexadecimal representation.

194 = 0x00C2

d. Find the unsigned fixed point binary representation of the decimal number **512.5.**

1000000000.1

Q2. (4 points)

Consider the 8-bit binary bit pattern **11001100.** What is its decimal (base ten) value if the bit pattern is interpreted as:

a. A **one's complement** integer?

$(11001100)_1 = -(00110011) = -(48+3) = -51$

b. A **two's complement** integer?

$(11001100) = -(00110100) = -(48 + 4) = -52$

Q3 (4 points)

Consider the Octal number system (base 8) where only the digits 0-7 are legal.

a. What is the maximum unsigned decimal value that one can represent with **5** octal digits?

$(77777)_8 = 32767$

b. What is the maximum unsigned decimal value that one can represent with **n** octal digits?

$(77...7)_8 = 8^n - 1$

Q4 (2 points)

Given the two 16-bit numbers expressed in hexadecimal representation: **xABCD** and **xCAFE**, evaluate the following expression. Give your answer in **hexadecimal** (base 16).

xABCD OR (NOT(xCAFE))

xBFCD

Q5. (2 points)

Add the following 6-bit two's complement binary numbers:

101110 + 110110

Express your answer in 6-bit two's complement. Explain why the output is correct or incorrect

```
101110  (-18)
110110  (-10)
------------
100100 (-28)
```

There is no overflow, we have added two negative numbers and the result is a negative number.

Q6 (3 points)

Number the following in order of their levels of abstraction, where "1" represents the **lowest level** and "6" is the **highest**.

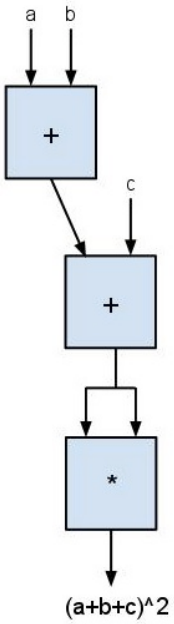
2	Microprocessor
4	Java Code
3	Instruction Set Architecture
5	Algorithm
1	Logic gates
6	Problem

Q7 (3 points)

Given the black boxes of Figure 1, show how to connect them together to calculate the following equation: $\mathbf{a^2 + b^2 + c^2 + 2ab + 2ac + 2bc}$. Assume that the output of a box may be connected to multiple inputs. Give an answer using **three** boxes. **Hint: Try factoring.**

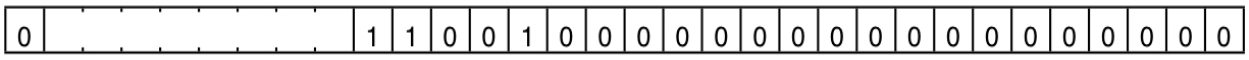
$a^2 + 2ab + b^2 + 2ac + 2bc + c^2 =$

$(a+b)^2 + 2(a+b)c + c^2 = (a + b + c)^2$



Q8 (4 points)

Shown below is the floating point representation of a value. Note that the exponent bits have been left out.



a. Fill in the exponent bits so that the value being represented is an integer. If you feel there is more than one possible answer, then the correct answer is the integer having the smallest absolute value. Recall that the bits for an IEEE floating point number are allocated as follows:

Sign (1 bit)	Exponent (8 bits)	Fraction (23 bits)

where $N = (-1)^S \times 1.\text{fraction} \times 2^{\text{exponent}-127}$

fraction = 2^-1 + 2^-2+ 2^-5 = 1/2+1/4+1/32 = 25/32
N = (1+fraction)*2^(e-127)
N = (57/32)*2^(e-127)

We choose e so that 2^(e-127) is a multiple of 32 to cancel out the denominator
2^5 =32 so e-127 = 5
e = 132 = 0x84 = 1000 0100

Any answer greater than or equal to 132 will make this an integer, so we choose the smallest value.

b. What is the decimal value of the integer represented in part a?

N = 57/32 *2^(132-127) = 57