CS/ECE 252: INTRODUCTION TO COMPUTER ENGINEERING

UNIVERSITY OF WISCONSIN—MADISON

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Midterm Examination 1

In Class (50 minutes)

Friday, February 7, 2014

Weight: 17.5%

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

The exam has **ten** pages. **Circle your final answers**. Plan your time carefully since some problems are longer than others. You **must turn in the pages 1-8**.

LAST NAME: ____________________

FIRST NAME: ____________________

ID# ____________________

Problem 1 **(1 Point)**

Explain why natural languages cannot be used as programming languages?

They are ambiguous, imprecise

Problem 2 **(2 Points)**

Label the following items/terms according to their level of abstraction relative to one another. Label the most abstract term as 1 and least abstract as 6.

3	Code in High level language (C/C++/Java)
4	Instruction Set Architecture (ISA)
1	Problem Statement
5	Micro Architecture
2	Algorithm to solve problem
6	Transistors (CMOS or NMOS)

Problem 3 **(2 points)**

Assume that we had a "black box," which takes two numbers as input and outputs their sum, as shown in Figure 1(a). Also assume that we had another box capable of multiplying two numbers together, as shown in Figure 1(b). We can connect these boxes together to compute p × (m + n), as shown in Figure 1(c).

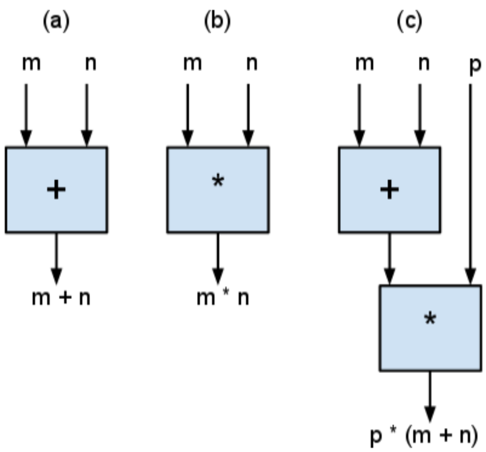
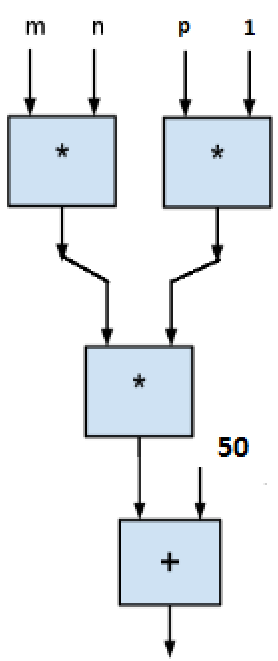


Fig 1. "Black boxes" capable of (a) Addition, (b) Multiplication and (c)A combination of both

Now, assume we have unlimited number of these boxes (ie, the ones shown in Fig 1(a) and 1(b)). Show how to connect them together to compute m * n * p + 50



Problem 4 **(2 Points)**

In 1900, assume that we needed just 5 bits to uniquely represent everyone living in Madison. Also assume that the population of Madison at present is 10 times the population in 1900. What is the minimum number of bits required to uniquely represent everyone presently living in Madison?

Total population in 1990 = 2^5 = 32

Total population now = 32*10 = 320

=> No of bits required = $\log_2(320)$ = 9

Problem 5 **(3 Points)**

Using **8 bits** to represent each number, write the representations of 19, -19 in signed magnitude, 1's complement and 2's complement notations.

Number	Signed Magnitude	1’s complement	2’s complement
19	00010011	00010011	00010011
-19	10010011	11101100	11101101

Problem 6 **(6 points)**

Fill in the table below with the largest and smallest decimal numbers that can be represented with:

a) 5-bit unsigned number
b) 5-bit signed magnitude number
c) 5-bit 2's complement number

(Note: -2 is smaller than -1)

Representation	Largest Decimal Number that can be represented using this representation	Smallest Decimal Number that can be represented using this representation
5-bit unsigned number	2^5 - 1 = 31	0
5-bit signed magnitude number	-(2^(5-1) - 1) = -15	2^(5-1) - 1 = 15
5-bit 2's complement number	-2^(5-1) = -16	2^(5-1) - 1 = 15

Problem 7 **(2 points)**

Perform binary arithmetic for the following pairs of 8-bit 2's complement numbers

```
         10101001
a)     + 00111100
        ----------
         11100101
```

```
         00010001
b)     - 11100111
        ----------
         00101010
```

Problem 8 **(4 points)**

Perform the specified logical operations on the following 16-bit numbers expressed in hexadecimal representation. Express your result in **hexadecimal** (base 16).

a) NOT(xBCDE)

= NOT(1011110011011110)
= (0100 0011 0010 0001)
= 0x4321

b) xBCDE

=1011 1100 1101 1110 OR 1111 0001 0010 0011
=1111 1101 1111 1111 =
= 0xFDFF

Problem 9 **(2 points)**

Represent the decimal 3.5 in fixed point notation

3 = 011
.5 = 1/2 = 2^-1 = 0.1
=> Ans: 11.1

Problem 10 **(4 points)**

Convert the decimal value -14.125 into its single-precision floating point representation. Write your answer in hexadecimal

14 = 1110
.125 = 1/8 = 2^-3 = 0.001
= 1110.001 = 1.110001 x 2^-3
Exponent - 127 = 3 => Exponent = 130 = 10000010
Mantissa/Fraction = 110001
Sign = 0

=> Ans: 1 10000010 11000100000000000000000 = 0xC1620000

Problem 11 **(2 points)**

Convert the ASCII string "Se7en!" to its hexadecimal representation. Only represent the characters within the quotation marks and assume it is null terminated. **Hint: See ASCII to hexadecimal table on the last page of the exam.**

Ans : 0x 53 65 37 65 6e 21 00

Extra page for handwritten work, if needed. This page is not required and will NOT affect your grade. You don’t even need to hand this page in.