CS/ECE 252: INTRODUCTION TO COMPUTER ENGINEERING

UNIVERSITY OF WISCONSIN—MADISON

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Midterm Examination 1

In Class (50 minutes)

Wednesday, October 2, 2013

Weight: 17.5%

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

The exam has 8 pages. **Circle your final answers**. Plan your time carefully since some problems are longer than others. You **must turn in the pages 1-7**. Use the blank sides of the exam for scratch work.

LAST NAME: _____

FIRST NAME: _____

ID# _____

Problem	Maximum Points	Points Earned
1	6	
2	2	
3	4	
4	2	
5	6	
6	3	
7	2	
8	3	
9	2	
Total	30	

Problem 1 **(6 Points)**

For the following problems, circle the **best** answer. **Choose only one answer per question.**

i How many unique bit patterns can be represented using n bits?
- a n
- b 2n
- c 2n
- d 2(n-1)

ii How many Instruction Set Architectures (ISAs) are usually implemented by a given microarchitecture?
- a None
- b 1
- c 2
- d There is no limit

iii What is the binary representation of the hexadecimal value **0x6D**
- a 0110 1100
- b 0110 1101
- c 0011 1100
- d 0011 1101

iv In how many ways can **0** be represented in Signed Magnitude form?
- a 1
- b 2
- c None
- d Cannot be determined

v Which of the following are specified by an Instruction Set Architecture (ISA)?
- a Addressing modes
- b Instructions
- c Data types
- d All of the above

vi Digital designs are preferred over analog designs because it is hard to increase the accuracy of analog designs.
- a True
- b False

Problem 2 **(2 Points)**

Perform binary arithmetic for the following pairs of 6-bit 2's complement numbers.

a
```
  011001
+ 101101
----------
```

b
```
  010111
- 111110
----------
```

Problem 3 **(4 Points)**

Perform the specified logical operations on the following binary numbers. Express your result in **hexadecimal**.

a `10111110 AND (NOT(10010001))` (2 Points)

b `(NOT(0011)) OR (1101 AND 0101)` (2 Points)

Problem 4 **(2 Points)**

Convert the ASCII string "Fall_13" 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.**

Problem 5 **(6 Points)**

What are the smallest and largest numbers that can be represented using 5-bits in the following formats?

Format	**Smallest number**	**Largest number**
Unsigned integer		
Signed Magnitude		
2's complement		

Problem 6 **(3 Points)**

Answer the following questions briefly. **(1 or 2 sentences)**

a Why cannot natural language be used as programming languages? (1 Point)

b What is the advantage of using fixed point representation of fractions? What is the advantage of using the IEEE floating point representation? (2 Points)

Problem 7 **(2 Points)**

Arrange the following in order, from highest to lowest level of abstraction. The first element in the sequence has been filled for you.

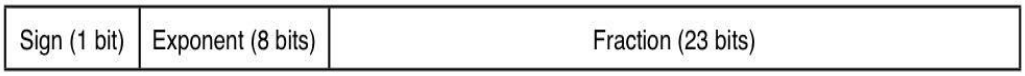
i. Binary/Machine code
ii. Transistors/Devices
iii. Programming language
iv. Microarchitecture
v. Problem Statement

1	**v. Problem Statement**
2	
3	
4	
5	

Problem 8 **(3 Points)**

Convert the decimal value **2.5** into its single-precision floating point representation. Write your answer in **hexadecimal**.

Recall that the bits for the IEEE floating point number are as follows:



where $N = (-1)^{sign} * 2^{exponent-127} * 1.fraction$

Problem 9 **(2 Points)**

Does the following binary arithmetic operation result in an overflow for the following 4-bit 2's complement numbers?

```
1100 + 1001
```

Illustrate your answer by converting the operands and result to decimal. Assume the result is also represented using 4-bits.

ASCII Table

Character	Hex	Character	Hex	Character	Hex	Character	Hex
nul	00	sp	20	@	40	`	60
soh	01	!	21	A	41	a	61
stx	02	“	22	B	42	b	62
etx	03	#	23	C	43	c	63
eot	04	$	24	D	44	d	64
enq	05	%	25	E	45	e	65
ack	06	&	26	F	46	f	66
bel	07	‘ *(Apostr.)*	27	G	47	g	67
bs	08	(	28	H	48	h	68
ht	09	)	29	I	49	i	69
lf	0A	*	2A	J	4A	j	6A
vt	0B	+	2B	K	4B	k	6B
ff	0C	, *(Comma)*	2C	L	4C	l	6C
cr	0D	-	2D	M	4D	m	6D
so	0E	. *(Period)*	2E	N	4E	n	6E
si	0F	/	2F	O	4F	o	6F
dle	10	0	30	P	50	p	70
dc1	11	1	31	Q	51	q	71
dc2	12	2	32	R	52	r	72
dc3	13	3	33	S	53	s	73
dc4	14	4	34	T	54	t	74
nak	15	5	35	U	55	u	75
syn	16	6	36	V	56	v	76
etb	17	7	37	W	57	w	77
can	18	8	38	X	58	x	78
em	19	9	39	Y	59	y	79
sub	1A	:	3A	Z	5A	z	7A
esc	1B	;	3B	[	5B	{	7B
fs	1C	<	3C	\	5C	|	7C
gs	1D	=	3D	]	5D	}	7D
rs	1E	>	3E	^	5E	~	7E
us	1F	?	3F	_ *(Undrscre)*	5F	del	7F