CS/ECE 252: INTRODUCTION TO COMPUTER ENGINEERING

UNIVERSITY OF WISCONSIN—MADISON

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Midterm Examination 1
In Class (50 minutes)
Friday, Feb 11
Weight: 15%

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

This exam has 8 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 6.

LAST NAME: ______________________________

FIRST NAME: ______________________________

SECTION: ______________________________

ID# ______________________________

Question	**Maximum Point**	**Points**
1	6	
2	8	
3	4	
4	8	
5	4	
6	10	
Total	40	

Q1. (6 points)

The value -19,739 can be represented as a 2’s complement integer with 16 bits as shown below:

a. Represent -19, 741 as a 2’s complement integer with 16 bits in the box provided. (2 points)

b. Represent -19, 739 as a 2’s complement integer with 32 bits in the box provided. (4 points)

Q2. (8 points)

The value “-4 3/8” can be represented by the strings of 0s and 1s according to the following data types. Please show them below.

ASCII (Only represent the characters between the quotation marks and assume it is a null terminated string, show your result in hexadecimal)	
32 Bit IEEE Floating Point	

The bits for an IEEE floating point number are allocated as follows:

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

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

Q3. (4 points)

Give an example of an *integer* that can be represented in floating point format (32-bit IEEE format), but cannot be represented as a 32-bit two's complement integer. Show its hexadecimal representation.

Q4. (8 points)

Fill in the following boxes with appropriate values. If there are more than one values possible, write all the possible values. Mark in "NA" if something is not possible.

Number	**8-bit Unsigned binary**	**8-bit Sign-magnitude**	**8-bit 1's-complement**	**8-bit 2's-complement**
128				
-128				
127				
-100				

Q5. (4 points)

Add the following 8-bit numbers in 2's-complement notation. For each set, provide the sum (in 8-bit 2's-complement) and indicate whether or not an overflow has occurred.

a. 0101 1011 + 0010 0000

b. 1110 0010 + 0001 1011

Q6. (2 points each)

I.When referring to an algorithm, definiteness means:

a. Each step must be precisely defined
b. The algorithm's variables must not overflow a fixed number of bits
c. The number of unknowns and equations is the same
d. All of the above

II. Two computers, A and B, are identical except for the fact that A has a divide instruction and B does not. Both have subtract instructions. Which of the following is true?

a.B can compute all the same problems as A, in the same amount of time.
b. B can compute all the same problems as A, in the same amount of time, given enough memory.
d. B can compute all the same problems as A, but might take longer.
e. A can compute more types of problems than B.

III. A Turing machine is an abstract idea that helps us to define:

a. How to do binary arithmetic
b. What it means to compute
c. How to make an infinite tape
d. The shortcomings of digital computers compared to analog

IV. A collection of n bits can have how many states?

a. n
b. 2n
c. 2^n
d. 2^{n-127}

V. Put the following in order of their levels of abstraction. "1" represents the lowest level, and "4" represents the highest level.

a. Instruction Set Architecture
b. Algorithm
c. Transistors and other such devices
d. Circuits

1	2	3	4

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	'	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	,	2C	L	4C	l	6C
cr	0D	-	2D	M	4D	m	6D
so	0E	.	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	_	5F	del	7F