CS/ECE 252: INTRODUCTION TO COMPUTER ENGINEERING

Spring 2015, Section 2

UNIVERSITY OF WISCONSIN—MADISON

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Midterm Examination 1

In Class (50 minutes)

Friday, February 13, 2015

Weight: 17.5%

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

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

Note: ASCII table is provided on Page 9

LAST NAME: _____

FIRST NAME: _____

ID#: _____

Problem	Maximum Points	Points Earned
1	2	
2	1	
3	3	
4	1	
5	1	
6	2	
7	3	
8	2	
9	4	
10	4	
11	2	
12	4	
13	1	
Total	30	

Problem 1 **(2 Points)**

Shown below are a few concepts covered in Chapter 1:

- Definiteness
- Finiteness
- Effective Computability
- Abstraction
- Language/Code

In the table below, fill in the name of the concept that best matches the corresponding description:

Concept	**Description**
	Determines whether or not a problem is solvable
	Will not run on forever, will stop at some point
	Underlying mechanisms are hidden or unknown
	Can be used to write an algorithm that a computer can understand
	Each step of a process must be clearly laid out

Problem 2 **(1 Point)**

Explain briefly why natural languages cannot be used as programming languages.

Problem 3 **(3 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.

	Code in high-level language (C/C++/Java)
	Instruction set architecture (ISA)
	Problem statement/application
	Microarchitecture
	Algorithm to solve the problem
	Transistors (CMOS/NMOS/PMOS)

Problem 4 **(1 Point)**

Mention one difference between high-level languages and assembly languages.

Problem 5 **(1 Point)**

How does a microarchitecture differ from an instruction set architecture (ISA)?

Problem 6 **(2 Points)**

When CS252 was offered in Spring 1999, assume that only 6 bits were required to uniquely represent every student enrolled in this course. However, assume that the number of students who will be enrolling this course in Spring 2016 will be 5 times the number of students enrolled in Spring 1999. What is the minimum number of bits required to uniquely represent every student who will be enrolled in Spring 2016?

Problem 7 **(3 Points)**

Using 8 bits to represent each number, write the representations of -2, 99 and -99 in signed magnitude, 1's complement, and 2's complement notations.

Number	Signed Magnitude	2's complement
-2		
99		
-99		

Problem 8 **(2 Points)**

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

a) 12-bit unsigned number
b) 12-bit 2's complement number
(Note: -2 is smaller than -1)

Representation	**Largest decimal number that can be represented**	**Smallest decimal number that can be represented**
12-bit unsigned number		
12-bit 2's complement number		

Problem 9 **(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. xA005 OR xBF09

b. NOT(xA005) AND xFFF4

Problem 10 **(4 Points)**

Perform binary arithmetic for the following pairs of 2's complement numbers. Write your result in binary. Also indicate if there is any overflow.

a. 1100 1000
+ 1111 0111

Is there any overflow?

b. 1011 0000
- 0001 0001

Is there any overflow?

Problem 11 **(2 Points)**

Assume that we have an 8-bit fixed point binary notation, with 5 bits for the integer part, i.e., 5 bits to the left of the binary point, and 3 bits for the fractional part, i.e., 3 bits to the right of the binary point. Represent the decimal 15.5 in this fixed point notation.

Problem 12 **(4 Points)**

Convert the decimal value -20.125 into its IEEE single-precision floating point representation.

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

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

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

Problem 13 **(1 Point)**

Convert the ASCII string “Spr_15” 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.)

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