

CS/ECE 252: INTRODUCTION TO COMPUTER ENGINEERING

UNIVERSITY OF WISCONSIN—MADISON

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Midterm Examination 1

In Class (50 minutes)

Friday, September 25, 2009

Weight: 15%

CLOSED BOOK, NOTE, CALCULATOR, PHONE, & COMPUTER.

The exam has **four** two-sided pages. **Circle your final answers.**

Plan your time carefully, since some problems are longer than others.

NAME: _____

SECTION: _____

ID# _____

Problem Number	Maximum Points	Actual Points
1	4	
2	3	
3	3	
4	4	
5	4	
6	4	
7	4	
8	4	
Total	30	

Problem 1 (4 points)

- a) What is the greatest magnitude negative number that can be represented in *two's complement* using 9 bits? Specify your answer as a base 10 number.

$$-2^8 = -256$$

- b) What is the largest positive number that can be represented as an *unsigned* integer using 10 bits? Specify your answer as a base 10 number.

$$2^{10} - 1 = 1023$$

Problem 2 (3 points)

Compute **(NOT 1100) OR (1110 AND 0101)**

$$1110 \text{ AND } 0101 = 0100$$

$$\text{NOT } 1100 = 0011$$

$$\text{Answer} = 0011 \text{ OR } 0100 = \mathbf{0111}$$

Problem 3 (3 points)

Consider the octal number system (base 8) where only the digits 0-7 are legal. Convert the decimal number **83** into an octal number.

$$83 = 1*8^2 + 2*8^1 + 3*8^0$$

Answer = **123**

Problem 4 (4 points)

Consider the 8-bit binary bit pattern **11101100**. What is its decimal (base ten) value if the bit pattern is interpreted as:

(a) An unsigned integer?

$$4 + 8 + 32 + 64 + 128 = \mathbf{236}$$

(b) A two's complement integer?

$$\text{Two's complement of the given number} = 0001\ 0011 + 1 = 0001\ 0100$$

Answer = **-20**

Problem 5 (4 points)

(a) Add the following 5-bit two's complement binary numbers: **11101 + 11011**. Express your answer in 5-bit two's complement. Please indicate if there was an overflow.

Sum = 111000; Ignoring the overflowing bit, Answer = **11000**

No overflow (since carry into MSB is equal to carry out of MSB)

(b) Add the following 5-bit two's complement binary numbers: **00110 + 01100**. Express your answer in 5-bit two's complement. Please indicate if there was an overflow.

Sum = **10010**

Overflow (since carry into MSB is not equal to carry out of MSB)

Problem 6 (4 points)

(a) Convert the ASCII characters **x!Y** into binary. (See attached ASCII table.)

x = 0111 1000

! = 0010 0001

Y = 0101 1001

(b) Convert the binary value **0100 1101 0110 1101** into an ASCII string.

Mm

Problem 7 (4 points)

(a) What is the base ten (decimal) value represented by binary **011.101** ?

3.625

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

sign (1 bit)	exponent (8 bits)	fraction (23 bits)
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where $N = (-1)^S \times 1.\text{fraction} \times 2^{\text{exponent}-127}$

Convert **1 10000011 1000000000000000000000** to decimal.

Sign = 1; Exponent = 131; Mantissa = 0.5

Answer = $-1.5 \times 2^4 = -24$

Problem 8 – Circle the correct answer (2 points each)

(a) **Which of the following statements is/are true? Answer (b)**

- a. It is impossible to add two negative numbers that are represented in signed magnitude form.
- b. Signed magnitude form has two zeroes.
- c. Two's complement is preferred to signed magnitude because arithmetic is more accurate in two's complement than signed magnitude.
- d. Both (b) and (c)

(b) **What can binary 10001 represent? Answer (d)**

- a. Decimal 17
- b. Decimal -15
- c. The rectangular shape
- d. Any of the above

ASCII Table

<i>Character</i>	<i>Hex</i>	<i>Character</i>	<i>Hex</i>	<i>Character</i>	<i>Hex</i>	<i>Character</i>	<i>Hex</i>
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

Scratch Sheet (in case you need additional space for some of your answers)