

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 10 bits? Specify your answer as a base 10 number.

$$-2^9 = \mathbf{-512}$$

- 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.

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

Problem 2 (3 points)

Compute **(NOT 1101) OR (1010 AND 0101)**

$$1010 \text{ AND } 0101 = 0000$$

$$\text{NOT } 1101 = 0010$$

$$\text{Answer} = 0010 \text{ OR } 0000 = \mathbf{0010}$$

Problem 3 (3 points)

Consider the octal number system (base 8) where only the digits 0-7 are legal. Convert the decimal number **87** into an octal number.

$$87 = 1 \cdot 8^2 + 2 \cdot 8^1 + 7 \cdot 8^0$$

Answer = **127**

Problem 4 (4 points)

Consider the 8-bit binary bit pattern **11001100**. What is its decimal (base ten) value if the bit pattern is interpreted as:

(a) An unsigned integer?

$$4 + 8 + 64 + 128 = \mathbf{204}$$

(b) A two's complement integer?

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

Answer = **-52**

Problem 5 (4 points)

(a) Add the following 5-bit two's complement binary numbers: **01110 + 00110**. Express your answer in 5-bit two's complement. Please indicate if there was an overflow.

Sum = **10100**

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

(b) Add the following 5-bit two's complement binary numbers: **11101 + 11110**. Express your answer in 5-bit two's complement. Please indicate if there was an overflow.

Sum = 111011; Ignoring the overflowing bit, Answer = **11011**

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

Problem 6 (4 points)

(a) Convert the ASCII characters **p!Q** into binary. (See attached ASCII table.)

p = **0111 0000**

! = **0010 0001**

Q = **0101 0001**

(b) Convert the binary value **0100 0001 0110 0001** into an ASCII string.

Aa

Problem 7 (4 points)

(a) What is the base ten (decimal) value represented by binary **100.011** ?

4.375

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

Convert **1 1000010 10000000000000000000000** to decimal.

Sign = 1; Exponent = 130; Mantissa = 0.5

$$\text{Answer} = -1.5 \times 2^3 = \mathbf{-12}$$

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

(a) **What can binary 10100 represent? Answer (d)**

- a. Decimal 20
- b. Decimal -12
- c. The rectangular shape
- d. Any of the above

(b) **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)

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)