

CDS130 Mid-term exam: Sample

- Be sure your exam booklet has 6 pages.
- Write your name at the top of the front page.
- This is a closed book exam.
- You may not use a calculator.
- You may not use MATLAB during exam except the last two problems.
- Absolutely no interaction between students is allowed.
- Each problem is worth 5 points unless indicated otherwise. Partial credit may be awarded **ONLY** if work is shown.
- Duration for this exam: 75 minutes.

Q1. $(?)_{10} = (01110011)_2$ (using the excess-127 method).

Answer:

$01110011 = (115)_{10}$ unsigned

in excess-127

$(-12)_{10} = (01110011)_2$

Q2. Convert decimal -62 to 8-bit binary using the Sign-and-magnitude method.

Answer:

$1011\ 111\ 0$

Q3. Convert decimal 31.875 into binary.

Answer:

1111.111

Q4. $(2D3)_{16} = (1011010011)_2$

Answer:

Q5. What is the minimum number of bits needed for multiplying a 5-bit integer and a 8-bit integer without overflow? State your reasoning.

Answer:

13 bits.

The largest decimal number of 8 bits is $(2^8 - 1)$, and the largest number of 5 bits is $(2^5 - 1)$

$$2^{12} - 1 < (2^8 - 1) \times (2^5 - 1) < 2^{13} - 1$$

Q6. In two's complement method, what is the largest decimal number that 8-bit bit pattern can represent?

127

0111 1111 is the largest positive number in the two's complement method.

This is equal to 127 in decimal.

Q7. How many bits are required to represent the sum of : $(2^{13} + 2^{13} + 2^{12} + 2^{12})_{10}$?

$$2^{13} + 2^{13} + 2^{12} + 2^{12} = 2^{14} + 2^{13}$$

15 bits are needed to write this.

Q8. A forensic computer scientist is able to examine a file at the low-level of bytes for analyzing malware. A snippet of the document with the binary format reads:

```
0111 0000 0111 0101 0111 0011 0110 1000 0010 0000 0100 0001
0110 1101 0110 1111 0111 0110 0110 0101 0010 0000 0110 0010
```

Suppose the text is encoded with the ASCII code (see the encoding table attached to this exam).

(1) what is the content of the document displayed above?

(2) How many bytes are used for the text shown above?

push a

move b

(2) 12 bytes

Q9. What is the 8-bit result of dividing the following two binary numbers?

$$10111001 \div 00010101$$

1000R10001

Q10. Using the two's complement method, adding the following two 8-bit numbers. Convert the result to its decimal equivalent

$$\begin{array}{r} 10001010 \\ + 00001011 \\ \hline \end{array}$$

the sum is 10010101

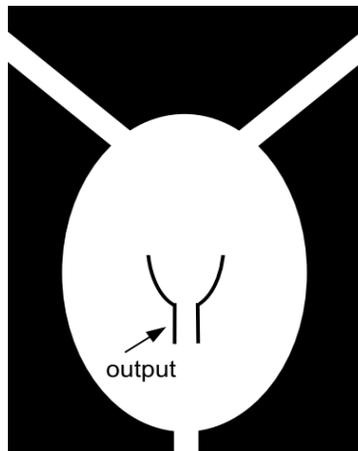
using the two's complement method,

(1) flip all bits: 01101010

(1) add 1: 01101011

The corresponding decimal number is: -107

Q11. Water flows into one, both, or none of the two white tubes at the top. What logic gate does it produce from the output indicated?



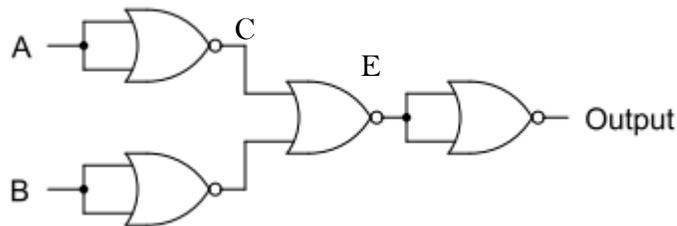
- A) AND
 - B) OR
 - C) NAND
 - D) NOR
 - E) XOR
- Answer:

the truth table:

A	B	out
0	0	0
1	0	0
0	1	0
1	1	1

This is an AND gate.

Q12. What one logic gate is equivalent to the logic circuit shown below? Draw the logic gate.



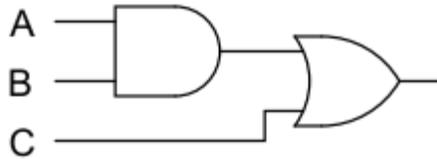
Answer:

The boolean algebra this is circuit is:

$$\overline{\overline{A+B}} = \overline{A+B} = \overline{A \times B}$$

this is an NAND gate

Q13. (10 points) Using only NAND gates, draw a circuit equivalent to the given circuit.



Answer:

Replace the AND gate and OR gate with the universal NAND gates.

Q14. (10 points) Without running matlab, provide answer to the following matlab build in functions

- (1) floor(pi)
- (2) ceil (-3.02)
- (3) sqrt(round(3.5))
- (4) 2.0\4.0/2.0^2.0
- (5) mod (7, 4)

Answer:

- (1) 3
- (2) -3
- (3) 2
- (4) 0.5
- (5) 3

Q15. (10 points) An anonymous function defined in matlab is a function that is not stored in a program file, but associated with a variable.

$$f(x, y) = \sin^2(x^2) + \cos^2(y^2) + e^{x-y}$$

Now, define an anonymous function for $f(x,y)$, and calculate the values of

$$f(f(1,2), f(2,1)) \text{ using the defined anonymous function in Matlab.}$$

- (1) How to write the anonymous function in Matlab?
- (2) What is the value of $f(f(1,2), f(2,1))$?

Answer:

(1) the anonymous function:

$$f = @(x,y) \sin(x^2)^2 + \cos(y^2)^2 + \exp(x-y)$$

$$(2) f(f(1,2), f(2,1)) = 1.6492$$

Q16. (10 points) Write a script that asks the user to

- (a) write a user-defined function (not an anonymous function) $\text{power}(x,y,z)$ to evaluate the value of $x^y - x^z$
- (b) use the user-provided values to test the results of $\text{power}(3,4,5)$.

Answer the following questions:

- (1) What is the file name you saved for this user-defined function?
- (2) Write the script in the following blank
- (3) what is your value for $\text{power}(3,4,5)$?

Answer:

(1) my_power.m

(2)

```
function f=my_power(x,y,z)
f = x^y - x^z
end
```

(3) my_power(3,4,5) = -162

Encoding Table

Dec	Hex	Name	Char	Ctrl-char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	0	Null	NUL	CTRL-@	32	20	Space	64	40	@	96	60	`
1	1	Start of heading	SOH	CTRL-A	33	21	!	65	41	A	97	61	a
2	2	Start of text	STX	CTRL-B	34	22	"	66	42	B	98	62	b
3	3	End of text	ETX	CTRL-C	35	23	#	67	43	C	99	63	c
4	4	End of xmit	EOT	CTRL-D	36	24	\$	68	44	D	100	64	d
5	5	Enquiry	ENQ	CTRL-E	37	25	%	69	45	E	101	65	e
6	6	Acknowledge	ACK	CTRL-F	38	26	&	70	46	F	102	66	f
7	7	Bell	BEL	CTRL-G	39	27	'	71	47	G	103	67	g
8	8	Backspace	BS	CTRL-H	40	28	(	72	48	H	104	68	h
9	9	Horizontal tab	HT	CTRL-I	41	29	)	73	49	I	105	69	i
10	0A	Line feed	LF	CTRL-J	42	2A	*	74	4A	J	106	6A	j
11	0B	Vertical tab	VT	CTRL-K	43	2B	+	75	4B	K	107	6B	k
12	0C	Form feed	FF	CTRL-L	44	2C	,	76	4C	L	108	6C	l
13	0D	Carriage feed	CR	CTRL-M	45	2D	-	77	4D	M	109	6D	m
14	0E	Shift out	SO	CTRL-N	46	2E	.	78	4E	N	110	6E	n
15	0F	Shift in	SI	CTRL-O	47	2F	/	79	4F	O	111	6F	o
16	10	Data line escape	DLE	CTRL-P	48	30	0	80	50	P	112	70	p
17	11	Device control 1	DC1	CTRL-Q	49	31	1	81	51	Q	113	71	q
18	12	Device control 2	DC2	CTRL-R	50	32	2	82	52	R	114	72	r
19	13	Device control 3	DC3	CTRL-S	51	33	3	83	53	S	115	73	s
20	14	Device control 4	DC4	CTRL-T	52	34	4	84	54	T	116	74	t
21	15	Neg acknowledge	NAK	CTRL-U	53	35	5	85	55	U	117	75	u
22	16	Synchronous idle	SYN	CTRL-V	54	36	6	86	56	V	118	76	v
23	17	End of xmit block	ETB	CTRL-W	55	37	7	87	57	W	119	77	w
24	18	Cancel	CAN	CTRL-X	56	38	8	88	58	X	120	78	x
25	19	End of medium	EM	CTRL-Y	57	39	9	89	59	Y	121	79	y
26	1A	Substitute	SUB	CTRL-Z	58	3A	:	90	5A	Z	122	7A	z
27	1B	Escape	ESC	CTRL-[	59	3B	;	91	5B	[	123	7B	{
28	1C	File separator	FS	CTRL-\	60	3C	<	92	5C	\	124	7C	|
29	1D	Group separator	GS	CTRL-]	61	3D	=	93	5D	]	125	7D	}
30	1E	Record separator	RS	CTRL-^	62	3E	>	94	5E	^	126	7E	~
31	1F	Unit separator	US	CTRL-`	63	3F	?	95	5F	`	127	7F	DEL