

Name: _____

ID: _____

ECS 17: Data, Logic, and Computing
Midterm 1
February 2, 2022

Notes:

- 1) The midterm is open book, open notes.
- 2) You have 50 minutes, no more: I will strictly enforce this.
- 3) The midterm is graded over 70 points
- 4) You can answer directly on these sheets (preferred), or on loose paper.
- 5) Please write your name at the top right of each page you turn in!
- 6) Please, check your work! **Also, do show your work**

Part I (6 questions, each 5 points; total 30 points)

(These questions are multiple choices; in each case, find the most **plausible** answer)

- 1) *How much space would you need to store a 5 min song that has been sampled at 44.1 kHz, with each data point stored on 24 bits, in mono (i.e. with a single microphone)? Assume no compression.*
 - a. About 40 Gbytes
 - b. About 40 Mbytes
 - c. About 53 Mbytes
 - d. About 400 Kbytes

- 2) *Let X be the number with the hexadecimal representation AA and Y the number whose hexadecimal representation is $9D$; which of these numbers T (in hexadecimal form) satisfies $X-T=Y$?*
 - a. A
 - b. B
 - c. C
 - d. D

- 3) *Which of these bytes represents the letter P (uppercase) based on the ASCII code?*
 - a. 01010000
 - b. 10100000
 - c. 01010010
 - d. 10100010

- 4) *The heart rate of a young athlete can go as high as 180 beats per minute. What is the most appropriate sampling rate to use if you want to monitor heart rate during exercise?*
 - a. 1 Hz,
 - b. 8 Hz,
 - c. 5 Hz,
 - d. 3 Hz.

Name: _____

ID: _____

5) *Multiplying two numbers on a computer requires 20 cycles of computing time. How long would it take to perform a calculation that involves 5 million multiplications on a 2GHz processor?*

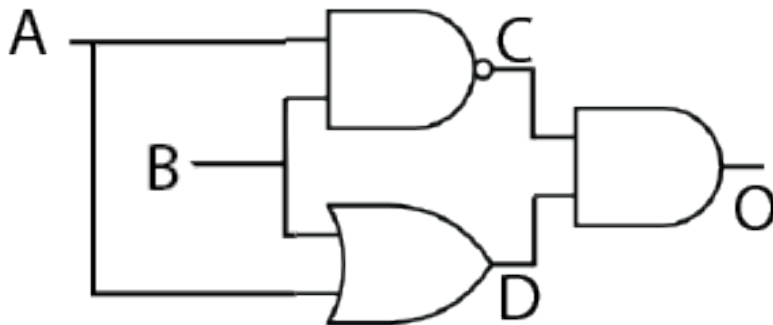
- a. 0.5 s
- b. 0.05 s
- c. 0.005 s
- d. 0.0005 s

6) *Which binary number comes right after the binary number 101111?*

- a. 101112
- b. 111111
- c. 101110
- d. 110000

Part II (two problems, each 10 points; total 20 points)

1) Complete the logic table corresponding to the logic gate shown below. Convert it into a Boolean expression (10 points)



A	B	C	D	O
1	1			
1	0			
0	1			
0	0			

Name: _____

ID: _____

2) You encounter a problem on an exam with only answer choices:

- a) Option 1
- b) Option 1 or Option 2
- c) Option 2 or Option 3

You do not know what those options are, as the question has been omitted, but you know that only one answer (a, b, or c) is possible. Can you find that answer? Which of the 3 options was in fact correct? Explain your reasoning. **(10 points)**

Part III (two problems, each 10 points; total 20 points)

1) Let p and q be two propositions. The compound proposition p NAND q is false when both p and q are true, and true otherwise. It is denoted $p \uparrow q$. Show that $p \uparrow q \Leftrightarrow \neg(p \wedge q)$ **(10 points)**

Name: _____

ID: _____

2) Find a compound proposition logically equivalent to $p \vee q$ using only the logical operator \uparrow .
Show your work (**10 points**)

Name: _____

ID: _____

Appendix A: ASCII table

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	00	Null	32	20	Space	64	40	@	96	60	`
1	01	Start of heading	33	21	!	65	41	A	97	61	a
2	02	Start of text	34	22	"	66	42	B	98	62	b
3	03	End of text	35	23	#	67	43	C	99	63	c
4	04	End of transmit	36	24	\$	68	44	D	100	64	d
5	05	Enquiry	37	25	%	69	45	E	101	65	e
6	06	Acknowledge	38	26	&	70	46	F	102	66	f
7	07	Audible bell	39	27	'	71	47	G	103	67	g
8	08	Backspace	40	28	(	72	48	H	104	68	h
9	09	Horizontal tab	41	29	)	73	49	I	105	69	i
10	0A	Line feed	42	2A	*	74	4A	J	106	6A	j
11	0B	Vertical tab	43	2B	+	75	4B	K	107	6B	k
12	0C	Form feed	44	2C	,	76	4C	L	108	6C	l
13	0D	Carriage return	45	2D	-	77	4D	M	109	6D	m
14	0E	Shift out	46	2E	.	78	4E	N	110	6E	n
15	0F	Shift in	47	2F	/	79	4F	O	111	6F	o
16	10	Data link escape	48	30	0	80	50	P	112	70	p
17	11	Device control 1	49	31	1	81	51	Q	113	71	q
18	12	Device control 2	50	32	2	82	52	R	114	72	r
19	13	Device control 3	51	33	3	83	53	S	115	73	s
20	14	Device control 4	52	34	4	84	54	T	116	74	t
21	15	Neg. acknowledge	53	35	5	85	55	U	117	75	u
22	16	Synchronous idle	54	36	6	86	56	V	118	76	v
23	17	End trans. block	55	37	7	87	57	W	119	77	w
24	18	Cancel	56	38	8	88	58	X	120	78	x
25	19	End of medium	57	39	9	89	59	Y	121	79	y
26	1A	Substitution	58	3A	:	90	5A	Z	122	7A	z
27	1B	Escape	59	3B	;	91	5B	[	123	7B	{
28	1C	File separator	60	3C	<	92	5C	\	124	7C	|
29	1D	Group separator	61	3D	=	93	5D	]	125	7D	}
30	1E	Record separator	62	3E	>	94	5E	^	126	7E	~
31	1F	Unit separator	63	3F	?	95	5F	_	127	7F	□

Name: _____

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Appendix B: Binary to Hexadecimal

Base 10	Base 2	Base 16
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F