Midterm Exam

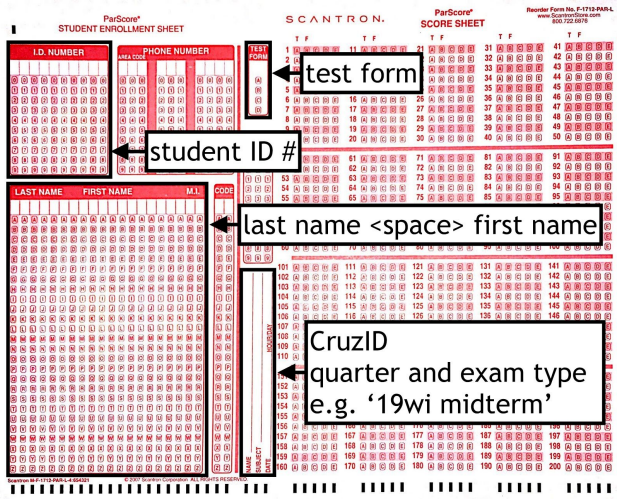
CMPE 012: Computer Systems and Assembly Language

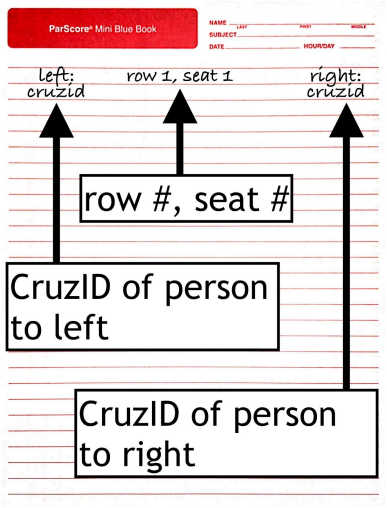
University of California, Santa Cruz

DO NOT BEGIN UNTIL YOU ARE TOLD TO DO SO.

This exam is closed book and closed notes. Only 4-function calculators are permitted. Answers must be marked on the Scantron form to be graded. All work must be written on the exam.

On the Scantron form, bubble in your name, student ID number, and test form (found in the footer of subsequent pages). In the center of the page write your CruzID, quarter, and exam type. On the back of the page, write the CruzIDs of students sitting to your left and right, and your row and seat number. See below.





On this page, write your last name, first name, CruzID, row and seat numbers, and the CruzIDs of the people to your immediate left and right. Once you are permitted to begin, write your CruzID on all subsequent pages of the exam.

You must sit in your assigned seat. Keep your student or government issued ID on your desk. Brimmed hats must be removed or turned around backwards. Only unmarked water bottles are permitted. Backpacks must be placed at the front of the room or along the walls. Your cell phone must be on a setting where it will not make noise or vibrate.

There are 22 questions on this exam; you only need to answer 20 for full points. The additional 2 questions (of your choosing) will be counted as extra credit. All questions are multiple choice, and some questions have more than one correct answer. **You must mark all correct answers to receive credit for a question.** Some true/false questions might list False as answer A and True as answer B. Follow the answers on the exam, **NOT** the T F notation on the Scantron Form. You will have 60 minutes to complete this exam.

_____	_____	_____
Row #	Seat #	CruzID
_____	_____	
Your Last Name	Your First Name	
_____	_____	
CruzID of person to left	CruzID of person to right	

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CMPE 12 Final - Version A

Summer 2019

Introduction

1. Which of the following scenarios are academic integrity violations? Select all that apply.
   - ◯ A. Alex and Shannon begin their lab assignment on their own. Alex is having trouble conceptualizing one aspect of the assignment, so Shannon shows Alex their code just to give Alex some idea of how to proceed. Alex does not copy any of the code down. Alex figures out how to move forward and completes the assignment independently. Both students document this interaction.
   - ◯ B. Alex and Shannon discuss the lab requirements and write detailed code on the board, meticulously taking notes. Afterwards, they go their separate ways and complete their lab assignments independently without discussing anything with each other. Neither student documents their collaboration.
   - ◯ C. Alex and Shannon discuss the lab requirements and outline the high level design of the program. They do not take notes on what is written on the board. They then proceed to work on the lab side-by-side, discussing the process at nearly every step. Neither student documents their collaboration.
   - ◯ D. Alex and Shannon begin their lab assignment on their own. Alex is having trouble conceptualizing one aspect of the assignment, so Shannon and Alex diagram on the whiteboard a high level approach to working through the problem. Alex figures out how to move forward and completes the assignment independently. Both students document this interaction.
   - ◯ E. Answer not listed
2. Who patented the first computer?
   - ◯ A. John Mauchley
   - ◯ B. Grace Hopper
   - ◯ C. Charles Babbage
   - ◯ D. Answer not listed
   - ◯ E. Alan Turing

Integer Numbering Systems

3. Assume a base 32 integer numbering system that includes all hexadecimal digits, and G = 16, H = 17, ... P = 25, ... V = 31. Convert the base 32 number $C3P0_{32}$ to base 4. Assume all answers are expressed in base 4 notation.
   - ◯ A. `1407440`
   - ◯ B. `397088`
   - ◯ C. `1200330200`
   - ◯ D. Answer not listed
   - ◯ E. `60F20`

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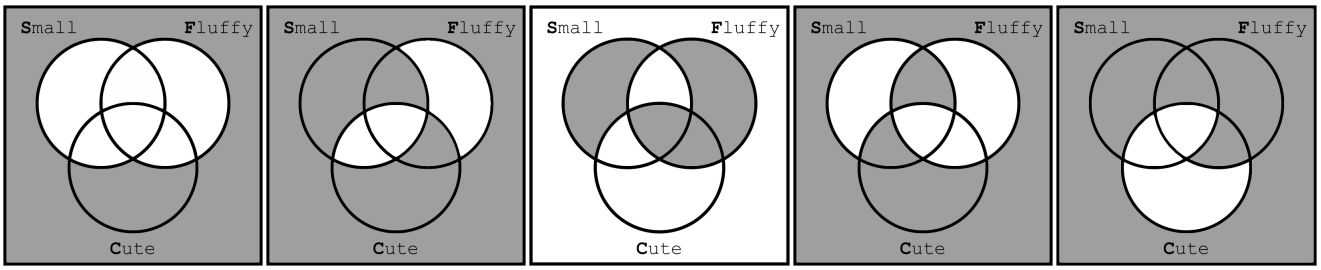
Boolean Algebra

4. The following Boolean expression matches the shaded area of which Venn diagram? Assume S = Small, F = Fluffy, and C = Cute.

$$SF\bar{C} + S\bar{F}C + \bar{S}\bar{F}$$



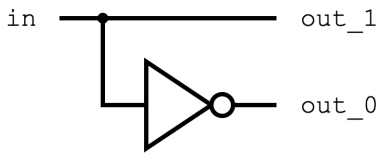
(a) (b) (c) (d) (e)

5. Select the **two** equivalent Boolean expressions:

- ◯ A. $\bar{A}\bar{B} + AB$
- ◯ B. $A \oplus B$
- ◯ C. $\overline{A + B}$
- ◯ D. $\bar{A}B + A\bar{B}$
- ◯ E. $\overline{A \oplus B}$

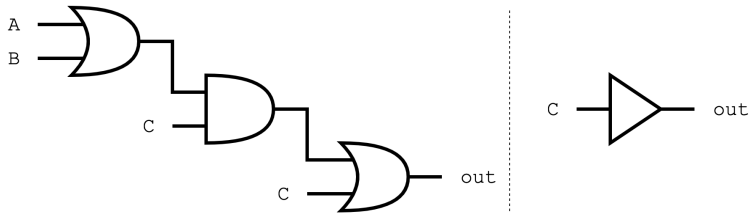
Combinational Logic

6. This circuit represents which logic element?



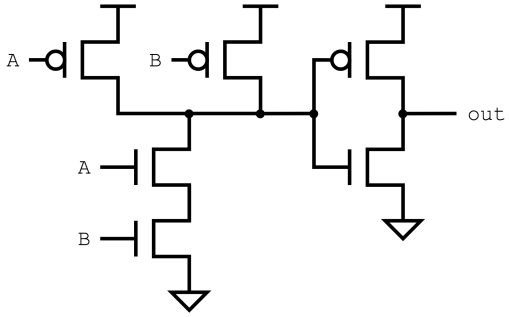
- ◯ A. Half adder
- ◯ B. Full adder
- ◯ C. 2-1 Multiplexor
- ◯ D. 1-2 Decoder
- ◯ E. Answer not listed

7. True or False: These two circuits are logically equivalent.



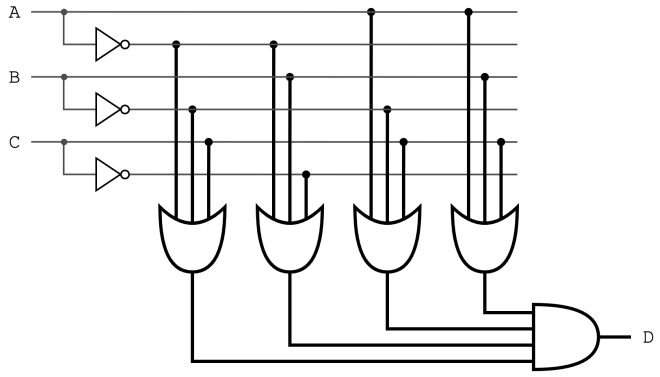
- ◯ A. False
- ◯ B. True

8. This circuit represents which logic element?



- ◯ A. Answer not listed
- ◯ B. OR gate
- ◯ C. XOR gate
- ◯ D. NOR gate
- ◯ E. XNOR gate

9. Select the sum of products Boolean expression that describes this circuit. Hint: complete the truth table first.



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

◯ A. $D = \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + A\bar{B}C + AB\bar{C}$

◯ B. $D = \overline{((A+B+\bar{C})(A+\bar{B}+C)(\bar{A}+B+\bar{C})(\bar{A}+\bar{B}+\bar{C}))}$

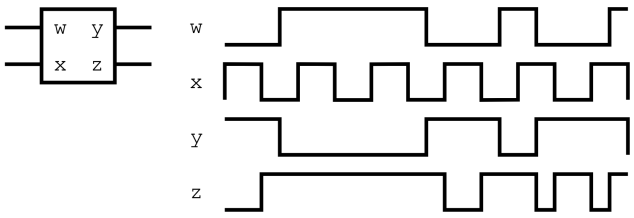
◯ C. $D = \bar{A}\bar{B}C + \bar{A}BC + A\bar{B}\bar{C} + ABC$

◯ D. $D = (\bar{A}+\bar{B}+C)(\bar{A}+B+\bar{C})(A+\bar{B}+C)(A+B+C)$

◯ E. $D = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}C + ABC$

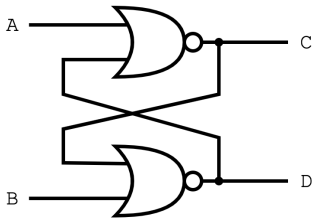
Sequential Logic

10. What device does this timing diagram represent?



◯ A. S-R Latch, active high
◯ B. D Flip-Flop, falling edge triggered
◯ C. Answer not listed
◯ D. D Flip-Flop, rising edge triggered
◯ E. S-R Latch, active low

11. Assume values A and B are 1 and 1, respectively. What are the values on wires C and D, respectively?



- ◯ A. 1, 0
- ◯ B. 0, 0
- ◯ C. There is not enough information to answer
- ◯ D. 0, 1
- ◯ E. 1, 1

Data Representation

12. What is the most positive number that can be represented in 6-bit two's complement? Answers are expressed in decimal.
    - ◯ A. `32`
    - ◯ B. `31`
    - ◯ C. `64`
    - ◯ D. `128`
    - ◯ E. `63`
13. Sign extend the 4-bit unsigned number `0b1100` to 8-bit two's complement representation:
    - ◯ A. `0xF4`
    - ◯ B. `0xFC`
    - ◯ C. `0x0C`
    - ◯ D. `0x04`
    - ◯ E. `0x8C`
14. Express 3_{10} in 8-bit bias 127 notation
    - ◯ A. `0x82`
    - ◯ B. `0x84`
    - ◯ C. Answer not listed
    - ◯ D. `0x8C`
    - ◯ E. `0x7C`
15. Decode the following ASCII string. Values are given in hex:

```
54 68 65 20 6f 64 64 73 20 6f 66 20 73 75 63 63 65 73 73 66 75 6c 6c 79
20 6e 61 76 69 67 61 74 69 6e 67 20 61 6e 20 61 73 74 65 72 6f 69 64 20
66 69 65 6c 64 20 61 72 65 20 33 37 32 30 20 74 6f 20 31 2e
```

    - ◯ A. Aren't you a little short to be a stormtrooper?
    - ◯ B. That's no moon. It's a space station.
    - ◯ C. The odds of successfully navigating an asteroid field are 3720 to 1.
    - ◯ D. Only imperial stormtroopers are so precise.
    - ◯ E. Never tell me the odds!

16. Convert -19.3 to IEEE 745 single precision floating point format. Answers are represented in hex.
    - ◯ A. `0xC19AAAAA`
    - ◯ B. `0x83AACCCC`
    - ◯ C. `0x41933333`
    - ◯ D. `0x40A01111`
    - ◯ E. `0xC19A6666`

Arithmetic and Logical Operations

17. Perform the following 5-bit unsigned addition.

```
  1 0 0 0 1
+ 0 1 1 0 1
_____________
```

    What is the answer in 8-bit two's complement?
    - ◯ A. `0xFE`
    - ◯ B. `0x02`
    - ◯ C. `0x8E`
    - ◯ D. `0xE2`
    - ◯ E. `0x1E`

18. Which of these 8-bit two's complement computations has overflow and carry out? Select all that apply.
    - ◯ A. `0xED + 0x8C = 0x79`
    - ◯ B. `0xCD + 0xCA = 0x97`
    - ◯ C. `0xC7 + 0x96 = 0x5D`
    - ◯ D. `0x55 + 0x64 = 0xB9`
    - ◯ E. `0xA5 + 0x5A = 0xFF`

19. What is the result of a shift right logical (SRL) by four and a shift right arithmetic (SRA) by four of the 8-bit number `0x17`? The operations are performed independently of each other.
    - ◯ A. SRL: `0xF1` SRA: `0x11`
    - ◯ B. SRL: `0x11` SRA: `0xF1`
    - ◯ C. SRL: `0x71` SRA: `0x71`
    - ◯ D. SRL: `0x01` SRA: `0x01`
    - ◯ E. SRL: `0x7F` SRA: `0x70`

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Command Line Interface

For the next 2 questions, consider the following file structure:

```
life
|
|--- fungi
|      |---- penicillium.pdf
|      |---- psilocybin.asm
|
|--- lagomorph
|      |---- hare.lgi
|      |---- pika.py
|      |---- rabbit.txt
|
|--- mollusk
       |---- nautilus.txt
       |---- octopus.png
       |---- scallop.asm
```

20. Given the stated directory structure, assume the command `ls` prints `fungi/ lagomorph/ mollusk/` to the screen. What is printed to the screen after the following commands are executed?

```
rm fungi/ *.*
rmdir fungi/
touch calculator.mml
mkdir tools
mv calculator.mml tools/pen.scratch
ls tools
```

◯ A. `lagomorph/ mollusk/ tools/ calculator.mml`
◯ B. `lagomorph/ mollusk/ tools/ pen.scratch`
◯ C. `pen.scratch`
◯ D. `fungi/ lagomorph/ mollusk/ tools/`
◯ E. `calculator.mml`

21. Given the stated directory structure, assume the command `ls` prints `hare.lgi pika.py rabbit.txt` to the screen. What is printed to the screen after the following commands are executed?

```
cd ../mollusk/
touch apple.yum
mkdir ../fruit
cp apple.yum ../fruit/
ls
```

- ◯ A. `nautilus.txt octopus.png scallop.asm`
- ◯ B. `apple.yum`
- ◯ C. `fungi/ lagomorph/ mollusk/ fruit/`
- ◯ D. `nautilus.txt octopus.png scallop.asm apple.yum`
- ◯ E. `fungi/ lagomorph/ mollusk/ tools/ apple.yum`

Git

22. The command `git status`
    - ◯ A. displays a list of git commits for the whole repository
    - ◯ B. displays the current state of the repository
    - ◯ C. displays a list of git commits for the present working directory
    - ◯ D. displays the current version of git
    - ◯ E. converts the present working directory to a repository

ASCII CODE					ASCII CODE					ASCII CODE					-	ASCII CODE				
BIN	OCT	DEC	HEX	CHARACTER	BIN	OCT	DEC	HEX	CHARACTER	BIN	OCT	DEC	HEX	CHARACTER		BIN	OCT	DEC	HEX	CHARACTER
010 0000	40	32	20	space	011 1000	70	56	38	8	101 0000	120	80	50	P		110 1000	150	104	68	h
010 0001	41	33	21	!	011 1001	71	57	39	9	101 0001	121	81	51	Q		110 1001	151	105	69	i
010 0010	42	34	22	"	011 1010	72	58	3A	:	101 0010	122	82	52	R		110 1010	152	106	6A	j
010 0011	43	35	23	#	011 1011	73	59	3B	;	101 0011	123	83	53	S		110 1011	153	107	6B	k
010 0100	44	36	24	$	011 1100	74	60	3C	<	101 0100	124	84	54	T		110 1100	154	108	6C	l
010 0101	45	37	25	%	011 1101	75	61	3D	=	101 0101	125	85	55	U		110 1101	155	109	6D	m
010 0110	46	38	26	&	011 1110	76	62	3E	>	101 0110	126	86	56	V		110 1110	156	110	6E	n
010 0111	47	39	27	'	011 1111	77	63	3F	?	101 0111	127	87	57	W		110 1111	157	111	6F	o
010 1000	50	40	28	(	100 0000	100	64	40	@	101 1000	130	88	58	X		111 0000	160	112	70	p
010 1001	51	41	29	)	100 0001	101	65	41	A	101 1001	131	89	59	Y		111 0001	161	113	71	q
010 1010	52	42	2A	*	100 0010	102	66	42	B	101 1010	132	90	5A	Z		111 0010	162	114	72	r
010 1011	53	43	2B	+	100 0011	103	67	43	C	101 1011	133	91	5B	[		111 0011	163	115	73	s
010 1100	54	44	2C	,	100 0100	104	68	44	D	101 1100	134	92	5C	\		111 0100	164	116	74	t
010 1101	55	45	2D	-	100 0101	105	69	45	E	101 1101	135	93	5D	]		111 0101	165	117	75	u
010 1110	56	46	2E	.	100 0110	106	70	46	F	101 1110	136	94	5E	^		111 0110	166	118	76	v
010 1111	57	47	2F	/	100 0111	107	71	47	G	101 1111	137	95	5F	_		111 0111	167	119	77	w
011 0000	60	48	30	0	100 1000	110	72	48	H	110 0000	140	96	60	`		111 1000	170	120	78	x
011 0001	61	49	31	1	100 1001	111	73	49	I	110 0001	141	97	61	a		111 1001	171	121	79	y
011 0010	62	50	32	2	100 1010	112	74	4A	J	110 0010	142	98	62	b		111 1010	172	122	7A	z
011 0011	63	51	33	3	100 1011	113	75	4B	K	110 0011	143	99	63	c		111 1011	173	123	7B	{
011 0100	64	52	34	4	100 1100	114	76	4C	L	110 0100	144	100	64	d		111 1100	174	124	7C	|
011 0101	65	53	35	5	100 1101	115	77	4D	M	110 0101	145	101	65	e		111 1101	175	125	7D	}
011 0110	66	54	36	6	100 1110	116	78	4E	N	110 0110	146	102	66	f		111 1110	178	126	7E	~
011 0111	67	55	37	7	100 1111	117	79	4F	O	110 0111	147	103	67	g		111 1111	177	127	7F	DEL

Note: ASCII codes 0x00 -> 0x1F are unprintable control characters used to control peripherals (e.g. printers)