Midterm Exam

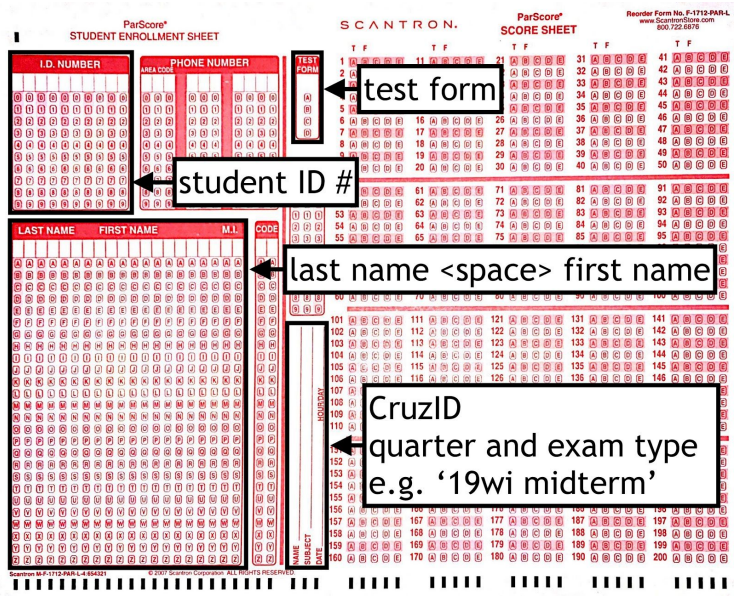
CMPE 012: Computer Systems and Assembly Language

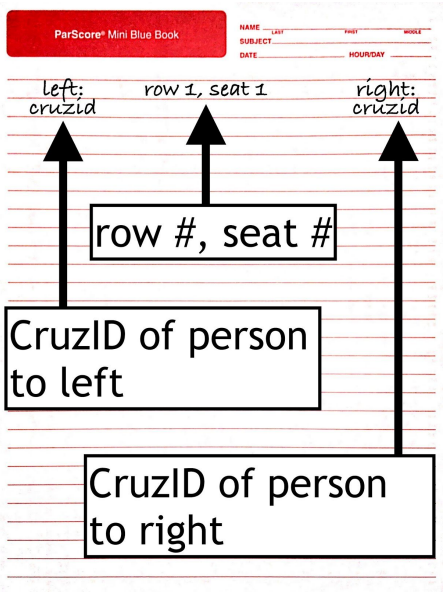
University of California, Santa Cruz

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 27 questions on this exam; you only need to answer 25 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 Midterm - VERSION A

Spring 2019

Introduction

1. Who is considered to be the first programmer?
   - ◯ A. Charles Babbage
   - ◯ B. Grace Hopper
   - ◯ C. Alan Turing
   - ◯ D. Ada Augusta
   - ◯ E. Blaise Pascal
2. True or False: There is exactly one microarchitecture implementation for each ISA.
   - ◯ A. True
   - ◯ B. False
3. The problem "Find a target in a sorted array" is representative of which level of abstraction?
   - ◯ A. program
   - ◯ B. natural language
   - ◯ C. logic circuits
   - ◯ D. algorithm
   - ◯ E. machine architecture

Integer Numbering Systems

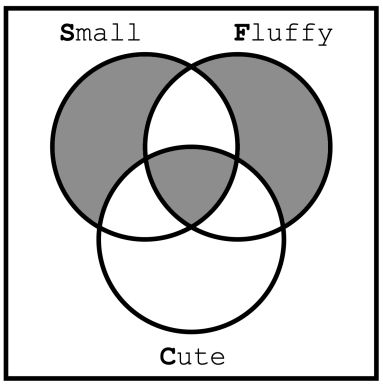
4. Convert the base 4 number 1213_4 to hexadecimal:
   - ◯ A. `0xBC`
   - ◯ B. `0x67`
   - ◯ C. `0x103`
   - ◯ D. Answer not listed
   - ◯ E. `0x4BD`
5. The movie Prometheus had an alien character called Enigma with 6 fingers on each hand who could count by 12's as easily as we count by 10's. If Enigma counted to 110 in base 12, what would that be in base 10?
   - ◯ A. 156_{10}
   - ◯ B. 10_{10}
   - ◯ C. 105_{10}
   - ◯ D. 210_{10}
   - ◯ E. 12_{10}

Boolean Algebra

6. Select the **three** equivalent Boolean expressions:

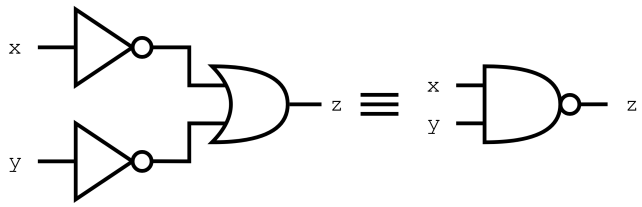
- ◯ A. $\overline{(A+\bar{B})(\bar{A}+B)(\bar{A}+A)}$
- ◯ B. $(A\bar{B})+(A\bar{B})+(A)$
- ◯ C. $(AB)+(\bar{A}\bar{B})$
- ◯ D. $A \oplus B$
- ◯ E. $(\bar{A}B)+(A\bar{B})$

7. Which Boolean expression does this Venn diagram represent? Assume S = Small, F = Fluffy, and C = Cute.



- ◯ A. $(AB)+(\bar{A}\bar{B}C)$
- ◯ B. $S\bar{C}\bar{F}+SCF+\bar{S}\bar{C}F$
- ◯ C. $(A\bar{B}C)+(\bar{A}BC)+(A\bar{B}\bar{C})(\bar{A}B\bar{C})$
- ◯ D. $C\bar{S}F+F\bar{C}\bar{S}$
- ◯ E. $CS\bar{F}+F\bar{C}\bar{S}+CSF$
- ◯ F. $(AB\bar{C})+(ABC)+(\bar{A}\bar{B}C)$

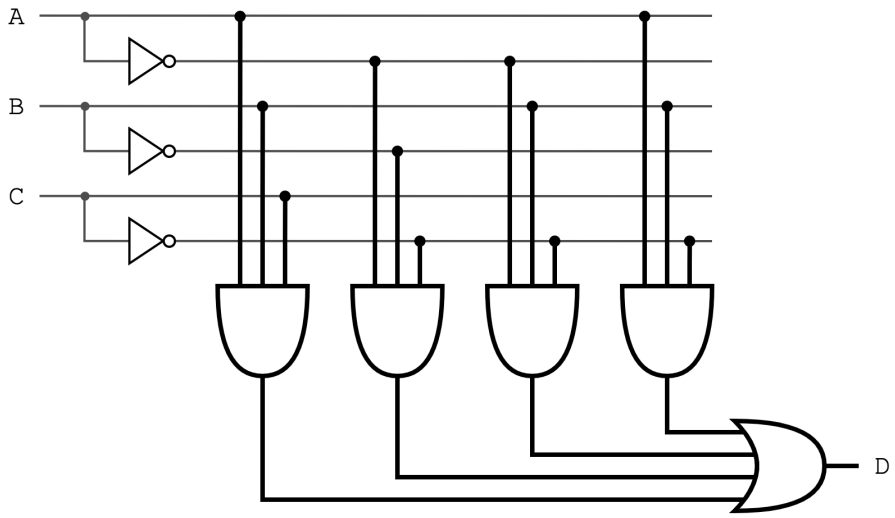
8. The given circuit transformation demonstrates which property of Boolean Algebra?



- ◯ A. Absorbtion
- ◯ B. De Morgan's Law
- ◯ C. Combining
- ◯ D. Double Negation
- ◯ E. Distribution

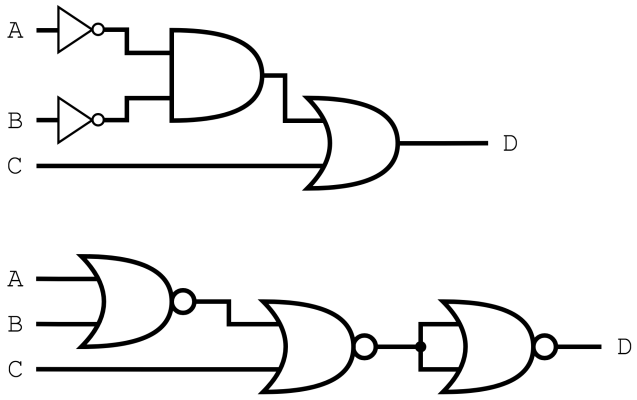
Combinational Logic

9. Which Boolean expression does this **PLA** represent?



- ◯ A. $(A+B+C)(\bar{A}+\bar{B}+\bar{C})(\bar{A}+B+\bar{C})(A+B+\bar{C})$
- ◯ B. $\overline{(A+B+C)(\bar{A}+\bar{B}+\bar{C})(\bar{A}+B+\bar{C})(A+B+\bar{C})}$
- ◯ C. $\overline{(\bar{A}+\bar{B}+\bar{C})(A+B+C)(A+\bar{B}+C)(\bar{A}+\bar{B}+C)}$
- ◯ D. $(\bar{A}+B+\bar{C})(\bar{A}+B+C)(A+B+C)(\bar{A}+\bar{C}+\bar{B})$
- ◯ E. Answer not listed

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



- ◯ A. True
- ◯ B. False

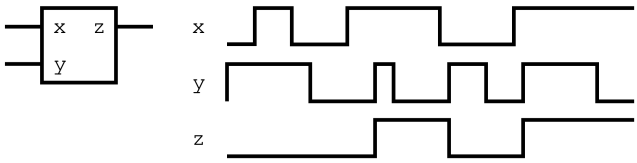
11. What is the **product of sums** solution to this truth table?

A	B	C	Out
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

◯ A. $(A+B+C)(A+\bar{B}+C)(\bar{A}+B+\bar{C})(\bar{A}+\bar{B}+C)$
◯ B. $(\bar{A}\bar{B}C)+(\bar{A}BC)+(A\bar{B}\bar{C})+(ABC)$
◯ C. $(\bar{A}\bar{B}\bar{C})+(\bar{A}B\bar{C})+(A\bar{B}C)+(AB\bar{C})$
◯ D. $(A\bar{B}\bar{C})+(\bar{A}BC)+(ABC)+(\bar{A}\bar{B}C)$
◯ E. $(A+B+\bar{C})(A+\bar{B}+\bar{C})(\bar{A}+B+C)(\bar{A}+\bar{B}+\bar{C})$

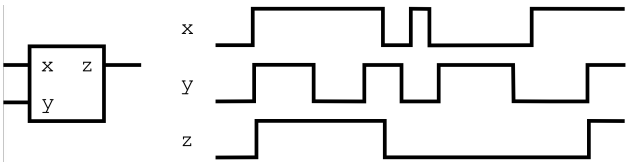
Sequential Logic

12. What device does this timing diagram represent?



◯ A. S-R Latch, active high
◯ B. D Flip-Flop, falling edge triggered
◯ C. D Latch, level triggered
◯ D. S-R Latch, active low
◯ E. D Flip-Flop, rising edge triggered

13. What device does this timing diagram represent?



◯ A. S-R Latch, active low
◯ B. S-R Latch, active high
◯ C. D Flip-Flop, falling edge triggered
◯ D. D Latch, level triggered
◯ E. D Flip-Flop, rising edge triggered

Data Representation

14. Sign extend the 4-bit two's complement number `0b0100` to 8-bit two's complement representation:
    - ◯ A. `0xF2`
    - ◯ B. `0x44`
    - ◯ C. `0xFB`
    - ◯ D. `0x04`
    - ◯ E. `0xF4`

15. What is the 5-bit two's complement representation of the number 7_{10} ?
    - ◯ A. 11001_2
    - ◯ B. 01011_2
    - ◯ C. 00101_2
    - ◯ D. 10111_2
    - ◯ E. 00111_2

16. What is the most negative number that can be represented in 8-bit two's complement?
    - ◯ A. -8
    - ◯ B. -1024
    - ◯ C. -7
    - ◯ D. -256
    - ◯ E. -128

17. What is -1 (base 10) in 4-bit sign magnitude representation?
    - ◯ A. `0001`
    - ◯ B. `1000`
    - ◯ C. `0110`
    - ◯ D. `1001`
    - ◯ E. `1111`

18. Computer ADP-110 represents its memory values on core dumps using base-8 (octal) representation. How would it represent the value 1321201_4 in its memory?
    - ◯ A. 17141_8
    - ◯ B. Answer not listed
    - ◯ C. 36301_8
    - ◯ D. 36302_8
    - ◯ E. 17442_8

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Arithmetic and Logical Operations

19. Which of these 8-bit two's complement computations has carry out but no overflow? **Select two answers:**

◯ A.
```
  0 1 1 0 0 1 1 0
+ 0 1 1 1 1 1 1 0
```

◯ B.
```
  1 0 0 0 0 0 0 0
+ 1 1 1 1 1 1 1 1
```

◯ C.
```
  1 1 1 0 1 0 1 1
+ 0 1 0 0 1 1 0 1
```

◯ D.
```
  0 1 1 0 1 0 1 1
+ 0 1 0 1 1 1 0 1
```

◯ E.
```
  1 1 1 0 1 1 1 0
+ 1 1 1 1 1 0 0 0
```

20. Using 4-bit two's complement arithmetic, which of the following additions will result in overflow?

```
1) 1100      2) 0011      3) 1111
  +1100        +0111        +0111
```

◯ A. 1 and 3
◯ B. 3 only
◯ C. 1 only
◯ D. 1 and 2
◯ E. 2 only

21. Perform the following 5-bit two's complement addition.

```
  1 0 0 1 1
+ 0 0 1 1 1
-----------
```

What is the answer in 5-bit sign magnitude?

◯ A. 10110
◯ B. 01010
◯ C. 11011
◯ D. 00110
◯ E. 11010

22. In a bitwise operation, the operation is performed on each bit of the operands. For example, the bitwise operation of `0b1010 AND 0b0101` would be equal to `0b0000`:

```
    0b1010
AND 0b0101
-----------
    0b0000
```

The result of bitwise OR between 0x0E0F and 0x9876 is:

- ◯ A. `0x0806`
- ◯ B. None of the other answers
- ◯ C. `0x9E7F`
- ◯ D. `0x0000`
- ◯ E. `0x9876`

23. Which of these 8-bit twos complement computations has overflow and no carry out?

- ◯ A. `0xA5 + 0x5A = 0xFF`
- ◯ B. `0xCD + 0xCA = 0x97`
- ◯ C. `0xED + 0x8C = 0x79`
- ◯ D. `0x55 + 0x64 = 0xB9`
- ◯ E. Answer not listed

Command Line Interface

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

```
top
|--- lab0
|      |---- Readme.txt
|
|--- lab1
|      |---- lab1.lgi
|      |---- Readme.txt
|
|--- lab4
      |---- lab4.asm
      |---- FlowChart.pdf
```

24. Given the stated directory structure, assume the command `ls` prints `Readme.txt` to the screen. What is printed to the screen after the following commands are executed?

```
touch a.txt
rm Readme.txt
cd ..
ls lab4
```

- ◯ A. `lab4/`
- ◯ B. `a.txt`
- ◯ C. `lab0/ lab1/ lab4/`
- ◯ D. `lab4.asm FlowChart.pdf`
- ◯ E. `a.txt Readme.txt`

25. Given the stated directory structure, assume the command `ls` prints `Readme.txt` and `lab1.lgi` to the screen. The following commands are executed. What is printed to the screen after the last command?

```
touch a.txt
mv Readme.txt b.txt
cp b.txt c.txt
mkdir dir
ls
```

- ◯ A. Answer not listed
- ◯ B. `a.txt b.txt c.txt dir/`
- ◯ C. `a.txt b.txt c.txt Readme.txt dir/`
- ◯ D. `a.txt c.txt lab1.lgi`
- ◯ E. `/lab0 lab1/ lab4/`

Git

26. When you finish working on a file on your computer, you enter the command git add. What does that command do to the file? **Select all that apply:**
    - ◯ A. Adds the file to Git to be tracked
    - ◯ B. Commits the file to the Git server
    - ◯ C. Stages the file for commit
    - ◯ D. Adds the file to the Git server
    - ◯ E. Answer not listed
27. To get updated files on the server use the following git command:
    - ◯ A. git commit
    - ◯ B. git pull
    - ◯ C. git push
    - ◯ D. git touch
    - ◯ E. git commit pull