Midterm Exam

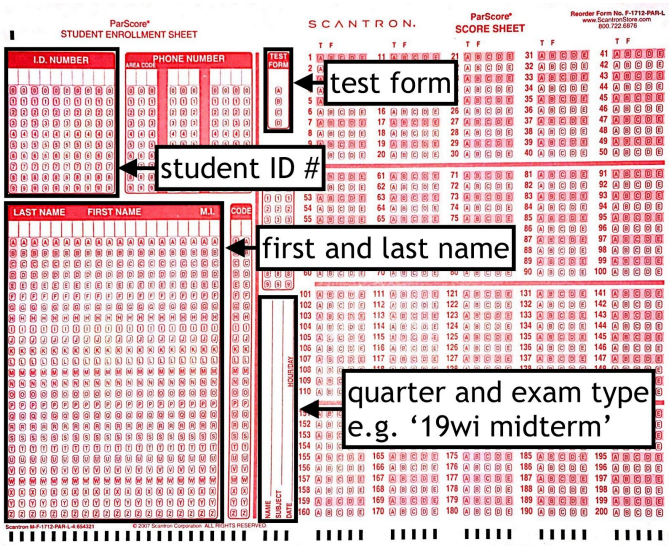
CMPE 012: Computer Systems and Assembly Language

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). Write in the quarter and exam type in the center of the page as shown 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. 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 two 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. You will have 60 minutes to complete this exam.

Row # _____ Seat # _____ CruzID _____

Last Name _____ First Name _____

CruzID of person to left _____ CruzID of person to right _____

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CMPE 12 Midterm Exam - Version A

Winter 2019

Intro

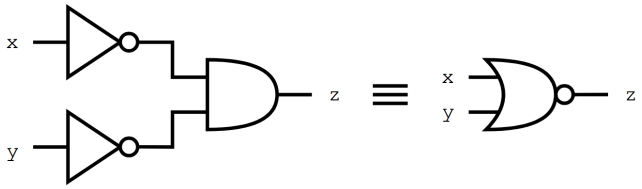
1. What is Charles Babbage known for inventing?
   - ◯ A. ENIAC
   - ◯ B. Punch Cards
   - ◯ C. Slide Rule
   - ◯ D. Abacus
   - ◯ E. Difference Engine

Binary Arithmetic

2. The result of the bit-wise OR operation between 0xCE12 and 0x2019 is:
   - ◯ A. $1110\ 1110\ 0001\ 1011_2$
   - ◯ B. $1111\ 1010\ 1111\ 0010_2$
   - ◯ C. $1111\ 1110\ 1110\ 1101_2$
   - ◯ D. $1110\ 0000\ 0001\ 1011_2$
   - ◯ E. $1011\ 1110\ 1110\ 1111_2$
3. Which of these 4-bit two's complement computations have overflow but no carry out? Select two answers.
   - ◯ A. 0100 + 0101
   - ◯ B. 0010 + 1111
   - ◯ C. 1010 + 0001
   - ◯ D. 0100 + 0010
   - ◯ E. 0010 + 0111
4. Let x be an 8-bit number whose value is 1001 1001 = 0x99. What is the result of a right logical shift by three ($x >> 3$) and a left arithmetic shift by three ($x << 3$)? Note: these operations are performed independent of one another.
   - ◯ A. 0xF3 and 0xCF
   - ◯ B. 0x93 and 0xC8
   - ◯ C. 0x13 and 0xC8
   - ◯ D. 0xF3 and 0xC8
   - ◯ E. 0x13 and 0xCF

Boolean Algebra

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

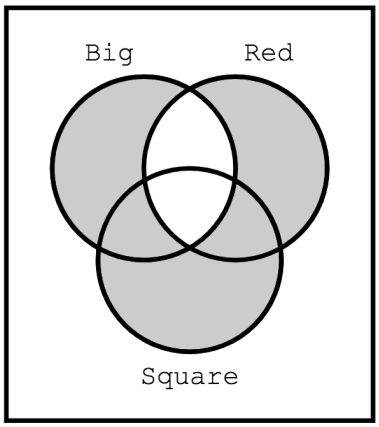


- ◯ A. De Morgan's Law
- ◯ B. Distribution
- ◯ C. Absorbtion
- ◯ D. Double Negation
- ◯ E. Combining

6. Select three equivalent Boolean equations:
   - ◯ A. $A \oplus B$
   - ◯ B. $A \cdot \bar{B} + B$
   - ◯ C. $\bar{A} \cdot B + A \cdot \bar{B}$
   - ◯ D. $\overline{((\bar{A}+B) \cdot (A+\bar{B}) \cdot (\bar{B}+B))}$
   - ◯ E. $\bar{A} \cdot \bar{B} + A \cdot B$

7. Select the Boolean expressions that are equivalent to $\overline{A \cdot B}$
   - ◯ A. $\overline{\bar{A} \cdot \bar{B}}$
   - ◯ B. $\bar{A} \cdot \bar{B}$
   - ◯ C. $A + B$
   - ◯ D. $\overline{A \cdot A} + \overline{B \cdot B}$
   - ◯ E. none of the other answers

8. Select the Boolean expression matching the filled areas of this Venn diagram:



- ◯ A. $\overline{(\texttt{Big} + \texttt{Red})} \cdot (\texttt{Big} \cdot \texttt{Red} \cdot \texttt{Square})$
- ◯ B. $\overline{\texttt{Big} \cdot \texttt{Red}}$
- ◯ C. none of the other answers
- ◯ D. $(\texttt{Big} \cdot \texttt{Red}) \cdot \overline{(\texttt{Big} + \texttt{Red} + \texttt{Square})}$
- ◯ E. $\overline{(\texttt{Big} \cdot \texttt{Red})} \cdot (\texttt{Big} + \texttt{Red} + \texttt{Square})$

Data Representation

9. Which floating point number has the largest positive exponent?
   - ◯ A. `0x3f82a089`
   - ◯ B. `0x4fcaa889`
   - ◯ C. `0x504ccccd`
   - ◯ D. `0x80955245`
   - ◯ E. `0x9f808314`

10. Which 8-bit 2SC computations result in carryout but no overflow? Select two answers.
   - ◯ A. `0x99 + 0xBB = 0x54`
   - ◯ B. `0xD9 + 0x5C = 0x35`
   - ◯ C. `0xAA + 0x55 = 0xFF`
   - ◯ D. `0xED + 0xF9 = 0xE6`
   - ◯ E. `0x66 + 0x7C = 0xE2`

11. Convert the following decimal value 42.8_{10} to unsigned fractional binary
   - ◯ A. 101010.1100
   - ◯ B. 101010.0001
   - ◯ C. $101010.\overline{1100}$
   - ◯ D. 101010.1000
   - ◯ E. $101010.\overline{0001}$

12. Which number is the largest? Assume answers are in IEEE 754 single precision floating point representation.
   - ◯ A. `0x4347D000`
   - ◯ B. `0x430FA000`
   - ◯ C. `0x43C7D000`
   - ◯ D. `0x457A0000`
   - ◯ E. `0x44FD0000`

13. Select the 8-bit sign extended representation of this 4-bit unsigned binary number: 1010
   - ◯ A. 00001010
   - ◯ B. 11111010
   - ◯ C. 11110011
   - ◯ D. 11101010

14. Select the base 7 representation of the following base 4 number: 203_4
   - ◯ A. 1211_7
   - ◯ B. 35_7
   - ◯ C. 50_7
   - ◯ D. 23_7
   - ◯ E. 100011_7

15. Perform the following 5-bit two's complement addition. What is the answer in 5-bit sign magnitude?

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

   - ◯ A. -0x01101
   - ◯ B. 0b10011
   - ◯ C. none of the other answers
   - ◯ D. -0x00011
   - ◯ E. 0b11101

16. Convert 1312_4 to base 16.
    - ◯ A. 0xBE
    - ◯ B. 0x2131
    - ◯ C. 0x67
    - ◯ D. 0x76

17. Convert -34_{10} to an 8-bit two's complement number.
    - ◯ A. 0x9E
    - ◯ B. 0x1E
    - ◯ C. 0xDD
    - ◯ D. 0xDE

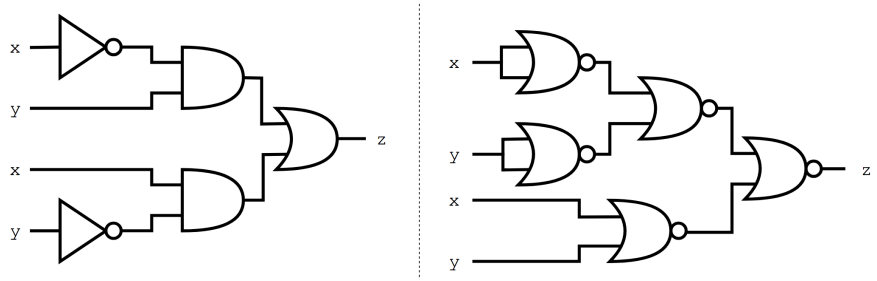
Logic Design

18. What is the unsimplified Product of Sums Boolean expression that represents the following truth table?

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

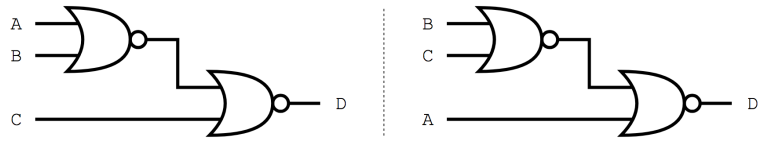
    - ◯ A. $\bar{A}\cdot\bar{B}\cdot\bar{C}+\bar{A}\cdot B\cdot C+A\cdot\bar{B}\cdot C+A\cdot B\cdot\bar{C}+A\cdot B\cdot C$
    - ◯ B. $\bar{A}\cdot\bar{B}\cdot C+\bar{A}\cdot B\cdot\bar{C}+A\cdot\bar{B}\cdot\bar{C}$
    - ◯ C. $(A+B+C)\cdot(A+\bar{B}+\bar{C})\cdot(\bar{A}+B+\bar{C})\cdot(\bar{A}+\bar{B}+C)\cdot(\bar{A}+\bar{B}+\bar{C})$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

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



    - ◯ A. True
    - ◯ B. False

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

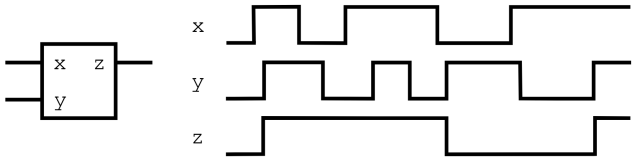


- ◯ A. False
- ◯ B. True

Sequential Logic

21. How many flip flops are required to create a 5-bit register?
    - ◯ A. 64
    - ◯ B. 4
    - ◯ C. 5
    - ◯ D. 32
    - ◯ E. 8

22. What device does this timing diagram represent?



- ◯ A. D Latch
- ◯ B. SR Latch active high
- ◯ C. D Flip Flop
- ◯ D. SR Latch active low
- ◯ E. none of the other answers

Memory

23. Assume you have a memory space of 128 MB that is 32-byte addressable. How many memory locations are required?
    - ◯ A. 32
    - ◯ B. 2^{12}
    - ◯ C. 2^{32}
    - ◯ D. 22
    - ◯ E. 2^{22}

MIPS

24. What is the value in $t0 after executing the following MIPS instruction?

```
xor $t1, $t1, $t0
```

- ◯ A. 0x00000000
- ◯ B. we don't have enough information to answer this question
- ◯ C. 0x000000FF
- ◯ D. 0xFFFFFFFF
- ◯ E. none of the other answers

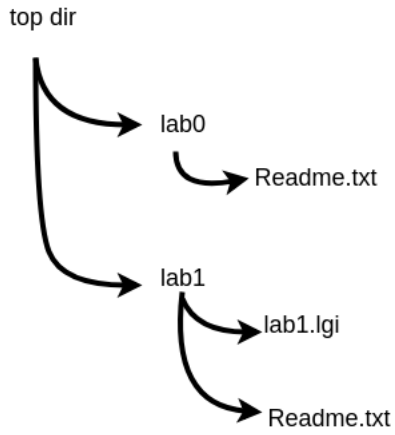
25. What is the value in $t1 after executing the following MIPS instructions?

```
xor  $t0, $t7, $t7
addi $t1, $t0, 5
```

- ◯ A. 5
- ◯ B. we don't have enough information to answer this question
- ◯ C. none of the other answers
- ◯ D. 6
- ◯ E. 0

Command Line

Refer to this file structure for the next two questions:



26. The command `pwd` prints `/top_dir/lab1`. What will the command `ls` print?

- ◯ A. none of the other answers
- ◯ B. lab1.lgi
- ◯ C. lab0 lab1
- ◯ D. Readme.txt
- ◯ E. lab1.lgi Readme.txt

27. The command `pwd` prints `/top_dir/lab1`. What will the command `ls` print after following commands are executed?

```
$ cd ..
$ mkdir  lab2
$ cp  lab1/Readme.txt  lab2
$ touch  lab2/hello.asm
```

- ◯ A. hello.asm
- ◯ B. lab0 lab1
- ◯ C. none of the other answers
- ◯ D. hello.asm Readme.txt
- ◯ E. Readme.txt