Your name Ambika Murali

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CS 350 Midterm Exam, Mon Mar 7, 2011

(75 minutes, 100 points total)

Instructions

This exam is closed book, one 8.5"×11" page of notes (both sides). No sharing notes and no equipment (calculators, phones, music players, etc). The usual penalty for copying or sharing answers on a quiz or exam is a final grade of E for the course. If you have any questions, please ask during the quiz, not after.

Short Answer Questions [points as marked]

1. [8 pts] For each of the three schemes for representing negative numbers, (a) What decimal value does 1000 0000 represent? (b) Is 1000 0000 the most negative number in this scheme?

a.) signed: -0 / -64
1's: -127
2's: 10000000 → 01111111 + 1 = 10000000 (-64)
-128
-2

b.) 10000000 is the most negative in the 1's complement.

2. [8 pts] Let octal 111 represent a 7-bit 2's complement number. (a) What is the decimal value of this number? (b) Translate this number into 8-bit 2's complement hexadecimal. What is the result?

111
01001001
-1

a.) 1001001 → 0110110 + 1 = 0110111
6 5 4 3 2 1 0
$(1\times2^0)+(1\times2^1)+(1\times2^2)+(0\times2^3)+(1\times2^4)+(1\times2^5)+(0\times2^6)$
$= 1+2+4+16+32$
$= 55$
-55 not -455

sign extend
1001001_2
to $11001001_2 = C9_{16}$

b.) 55 = 110111
55 / 2 = 27 r 1
27 / 2 = 13 r 1
13 / 2 = 6 r 1
6 / 2 = 3 r 0
3 / 2 = 1 r 1
2 / 2 = 1 r 0
1 / 2 = 0 r 1

b.) 11011111 → 00100000 + 1 = 00100001
2 9
hex: 29

3. [4 pts] Let hexadecimal B9 represent an 8-bit 2's complement number. What is the decimal value of the number?

B9 B - 1011

9 - 1001

1011 1001

↳ 0100 0110

+ 1

0 1 0 0 0 1 1 1

7 6 5 4 3 2 1 0

minus!

$(1\times2^0)+(1\times2^1)+(1\times2^2)+(0\times2^3)+(0\times2^4)+(0\times2^5)+(1\times2^6)+(0\times2^7)$

$= 1+2+4+64 = 71$

4. [8 pts] Translate 25.375_{10} into binary. Give both the plain and the scientific notation representations. ("Plain" means "times 2^0.")

$1/2 = 0.5$ $1/4 = 0.25$ $1/8 = 0.125$

not correct

2|25 1

2|12 0

2|6 0

2|3 1

2|2 0

2|1 1

25. 0 1 1

1/2 1/4 1/8

11001.011

inconsistent

you're reading downward should be upward

11001 not 10011

11001. $(0\times2^{-1})(1\times2^{-2})(1\times2^{-3})$

1.1010011×2^{4} ×4

consistent

-1

5. [12 pts] What is the IEEE 32-bit representation of $-1.101_2 \times 2^{10}$? (Feel free to add extra spaces for readability.)

110.001

1.10001×2^2

bit 1

exponent: 10 + 127

= 137 10001001

bin: 10001001

2|137 1

2|68 0

2|34 0

2|17 1

2|8 0

2|4 0

2|2 0

2|1 1

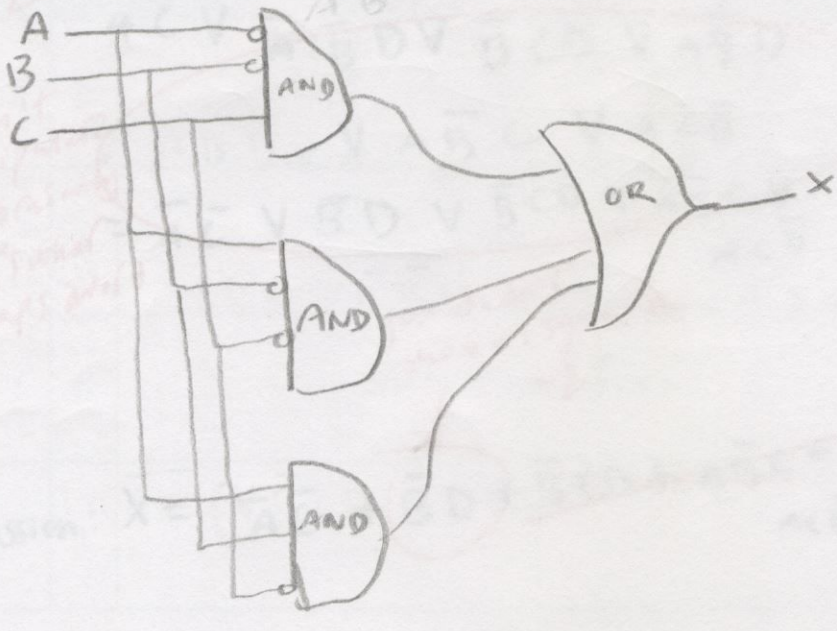
fraction: 10100000000000000000000

1 10001001 10100000000000000000000

-1

6. [6 pts] Draw a PLA-based logic gate implementation for output X from inputs A, B, and C as specified by the table to the right.

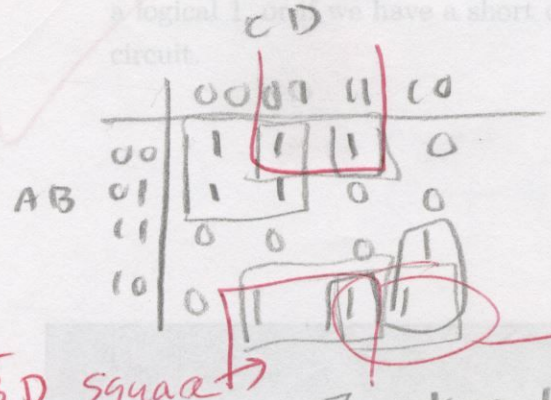
A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0



-3

7. [14 pts] Take the truth table to the right, draw a Karnaugh map for output X from inputs A, B, C, and D, select implicants, and translate your implicants to a simplest boolean expression for X.

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



redundant -1

$\bar{B}D$ square -2

Implicants

$\bar{A}\bar{C} \vee \bar{A}\bar{B}D \vee \bar{B}CD \vee A\bar{B}\bar{D} \vee A\bar{B}C \vee AC\bar{D}$

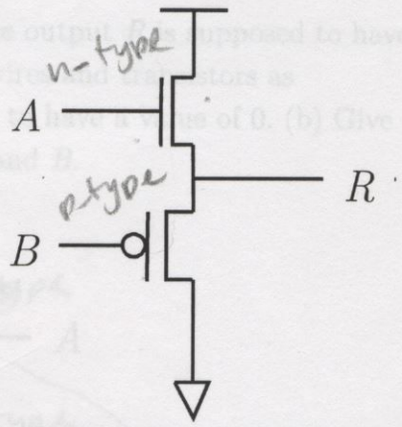
Don't manipulate algebraically. That's what K-maps avoid

$= \bar{A}\bar{C} \vee \bar{B}D \vee \bar{B}CD \vee A\bar{B}C \vee AC\bar{D}$

you didn't show as square -2

Expression: $X = (\bar{A}\bar{C} + \bar{B}D + \bar{B}CD + A\bar{B}C + AC\bar{D})$

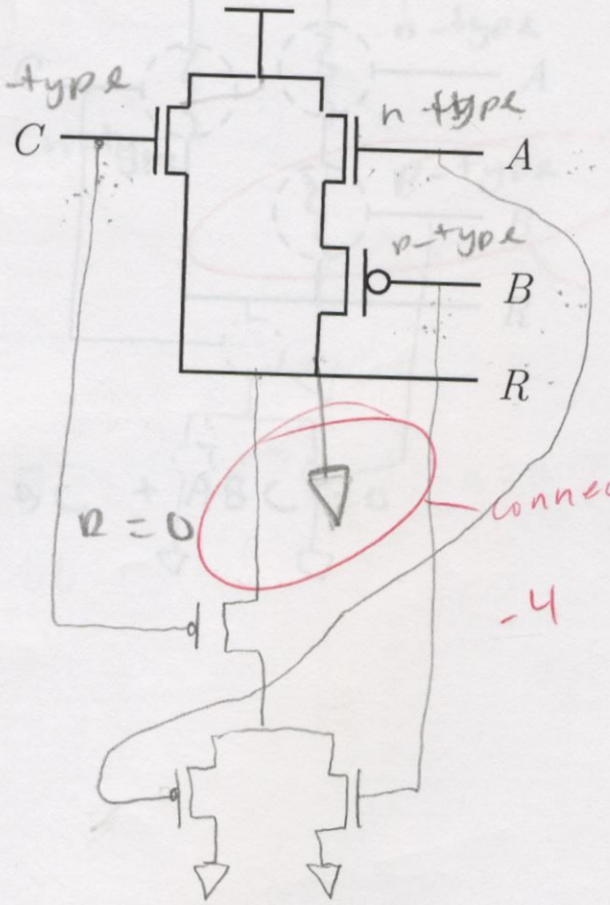
8. [8 pts] Inspect the transistor diagram to the right. Fill in the table below: For each combination of A and B, specify whether the result R is a logical 0, a logical 1, or if we have a short circuit or an open circuit.



A	*B*	*R*
0	0	0
0	1	open circuit
1	0	short circuit
1	1	1

9. [9 pts] The transistor diagram below specifies when the output R is supposed to have a value of 1, but the diagram is incomplete: (a) Add wires and transistors as necessary to connect R to ground when R is supposed to have a value of 0. (b) Give a boolean expression description of R using inputs A and B.

a.)



connect if $\bar{C}(A+B)$

-4 ie $\neg(A\bar{B}+C)$

A B C	R
0 0 0	1
0 0 1	—
0 1 0	—
0 1 1	1
1 0 0	0
1 0 1	—
1 1 0	—
1 1 1	0

b.) $R = A\bar{B}\bar{C} + ABC$

$R = A\bar{B} + C$

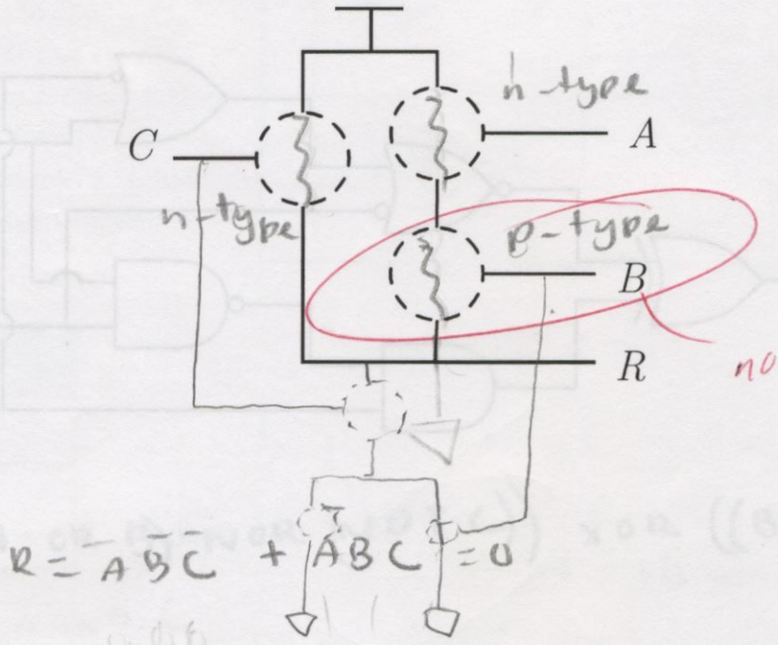
-2

R conn. to power iff $C + A\bar{B}$

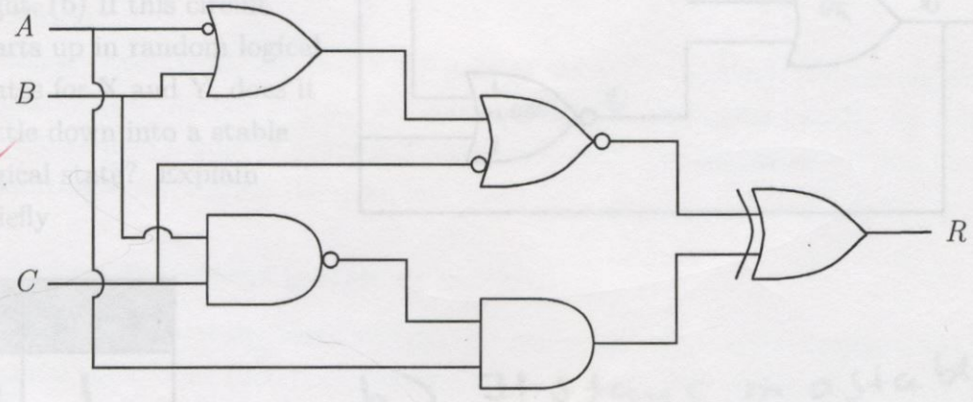
R conn. to gnd iff $\neg(C + A\bar{B})$

iff $\bar{C}(\bar{A}+B)$

10. [8 pts] Complete the wire diagram below so that it describes your circuit from the previous problem when $A = B = C = 1$.



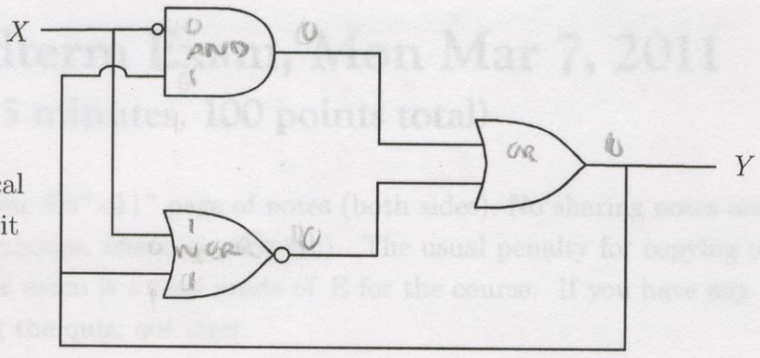
11. [6 pts] Translate the logic gate circuit below to a boolean expression for the output R using the inputs A, B, and C.



R= ((NOT A OR B) NOR (NOT C)) XOR ((B NAND C) AND A)

B NAND C

12. [7 pts] (a) Fill in the truth table below for the circuit to the right. (b) If this circuit starts up in random logical states for X and Y, does it settle down into a stable logical state? Explain briefly



a.)

X	Y	new Y
0	0	1
0	1	1
1	0	0
1	1	0

b.) It stays in a stable logical state if x & y are both 0, if x=0 and y=1, x=1 and y=0, and both x & y are 1.