CMP 334 Practice Exam 1 (Spring 2019)

1 a) 0x9D7A → 0b 1001 1101 0111 1010

b) 0b 1101 0011 0110 1110 0111 → 0xD36E7

c) 725_{10} = $0b\ 1011010101_2$

$725 \cdot 2^0$	=	$362 \cdot 2^1$	+	$1 \cdot 2^0$
$362 \cdot 2^1$	=	$181 \cdot 2^2$	+	$0 \cdot 2^1$
$181 \cdot 2^2$	=	$90 \cdot 2^3$	+	$1 \cdot 2^2$
$90 \cdot 2^3$	=	$45 \cdot 2^4$	+	$0 \cdot 2^3$
$45 \cdot 2^4$	=	$22 \cdot 2^5$	+	$1 \cdot 2^4$
$22 \cdot 2^5$	=	$11 \cdot 2^6$	+	$0 \cdot 2^5$
$11 \cdot 2^6$	=	$5 \cdot 2^7$	+	$1 \cdot 2^6$
$5 \cdot 2^7$	=	$2 \cdot 2^8$	+	$1 \cdot 2^7$
$2 \cdot 2^8$	=	$1 \cdot 2^9$	+	$0 \cdot 2^8$
$1 \cdot 2^9$	=	$0 \cdot 2^{10}$	+	$1 \cdot 2^9$

d) $0b1000111001 = 2^9 + 2^5 + 2^4 + 2^3 + 2^0 = 512 + 32 + 16 + 8 + 1 = 569_{10}$

e) 1789_{10} = 0x6FD

$1789 \cdot 16^0$	=	$111 \cdot 16^1$	+	$13 \cdot 16^0$
$111 \cdot 16^1$	=	$6 \cdot 16^2$	+	$15 \cdot 16^1$
$6 \cdot 16^2$	=	$0 \cdot 16^3$	+	$6 \cdot 16^2$

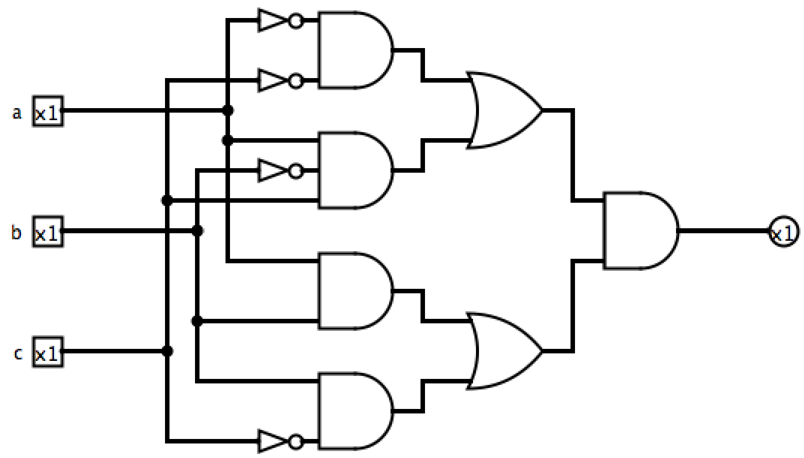
f) 0x25AE

$$\begin{aligned} \text{0x25AE} &= 2 \cdot 16^3 + 5 \cdot 16^2 + 10 \cdot 16^1 + 14 \cdot 16^0 \\ &= 2 \cdot 4096 + 5 \cdot 256 + 10 \cdot 16 + 14 \\ &= 8192 + 1280 + 160 + 14 \\ &= 9646_{10} \end{aligned}$$

2 a) Give the truth table (with columns for each sub-formula) for: $(\overline{ac} + a\overline{b}c) \cdot (ab + b\overline{c})$.

a	b	c	$\overline{a}$	$\overline{b}$	$\overline{c}$	$\overline{ac}$	$a\overline{b}c$	$\overline{ac}+a\overline{b}c$	$(\overline{ac} + a\overline{b}c)\cdot(ab + b\overline{c})$	$ab+b\overline{c}$	ab	$b\overline{c}$
0	0	0	1	1	1	1	0	1	0	0	0	0
0	0	1	1	1	0	0	0	0	0	0	0	0
0	1	0	1	0	1	1	0	1	1	1	0	1
0	1	1	1	0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	0	0	0	0	0	0	0
1	0	1	0	1	0	0	1	1	0	0	0	0
1	1	0	0	0	1	0	0	0	0	1	1	1
1	1	1	0	0	0	0	0	0	0	1	1	0

b) Draw a circuit for: $(\overline{ac} + a\overline{b}c) \cdot (ab + b\overline{c})$.



3) Given: X = 0xD7 and Y = 0x4B,

a) Convert X and Y to 8-bit binary numbers. X = 0b11010111 Y = 0b01001011

b) Compute the 8-bit sum **X+Y** of X and Y.

```
  11010111
  01001011
 11011111
 100100010
```

c) Compute **Y** the 8-bit 2's complement of Y.

```
 01001011
 10110100
 00000001
 10110101
```

d) Compute the 8-bit difference **X–Y** of X and Y.

```
  11010111
  10110101
 11110111
 110001100
```

e) Convert **X+Y**, **Y**, and, **X–Y** to hexadecimal. 0x22, 0xB5, 0x8C

f) What are the values of the condition flags upon computing **X+Y**? $\overline{Z}NC\overline{V}$

g) What are the values of the condition flags upon computing **X–Y**? $\overline{Z}NC\overline{V}$

h) T or **F** The unsigned 8-bit sum **X+Y** is honest.

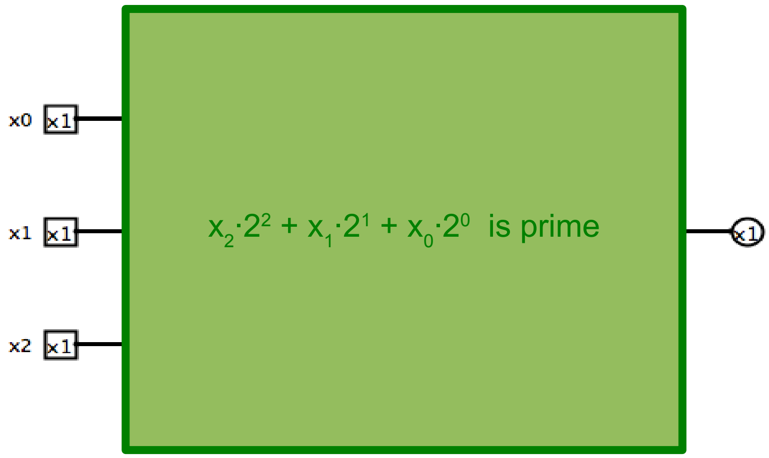
i) **T** or F The signed 8-bit sum **X+Y** is honest.

j) **T** or F The unsigned 8-bit difference **X–Y** is honest.

k) **T** or F The signed 8-bit difference **X–Y** is honest.

4) Use the recipe for designing combinational circuits to design a circuit that determines if a 3 bit unsigned integer is prime. (Remember: an integer X is prime if, and only if, exactly 2 distinct positive numbers, 1 and X itself, divide X with a remainder of 0.)

a) Draw a black box for the circuit that specifies its inputs and output.



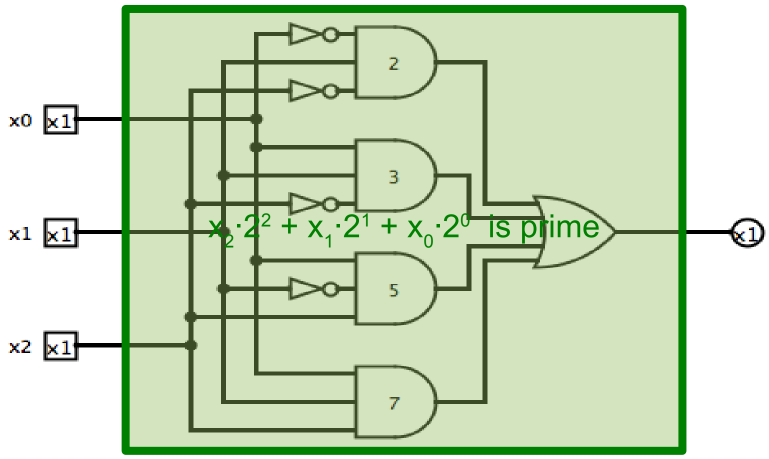
b) Formalize the informal semantics of this circuit with a truth table.

x_2	x_1	x_0	**x**	is **prime**
0	0	0	0	0
0	0	1	1	0
0	1	0	2	1
0	1	1	3	1
1	0	0	4	0
1	0	1	5	1
1	1	0	6	0
1	1	1	7	1

c) Construct the boolean formula corresponding to the truth table.

$$\overline{x}_2 x_1 \overline{x}_0 + \overline{x}_2 x_1 x_0 + x_2 \overline{x}_1 x_0 + x_2 x_1 x_0$$

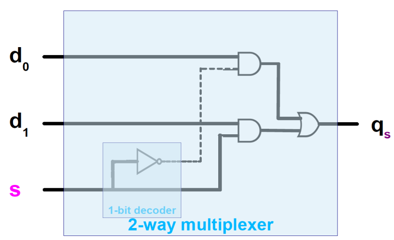
d) Draw the circuit corresponding to the boolean formula.



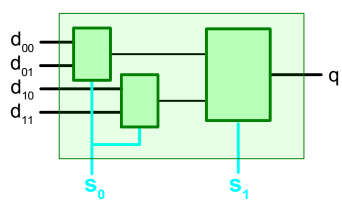
5 a) What does a multiplexer do?

N selector inputs bits pick one of 2^N data inputs bits to output.

b) Draw the circuit for a **2-way** multiplexer.



c) Build (draw) a **4-way** multiplexer using 1-bit multiplexers.



6) For each row in the following table, determine whether the assertion would hold if the indicated operation produced the indicated condition flag values.

operation		flags	assertion	**T / F**
$A \overset{\cdots}{+} B$	unsigned	$\overline{Z}N\overline{C}\overline{V}$	result is honest	**T**
$A \overset{\cdots}{-} B$	signed	$\overline{Z}\overline{N}CV$	result is honest	**F**
$A \overset{\cdots}{-} B$	unsigned	$\overline{Z}N\overline{C}V$	result is honest	**F**
$A \overset{\cdots}{+} B$	signed	$Z\overline{N}\overline{C}V$	result is honest	**F**
$A \overset{\cdots}{-} B$	unsigned	$\overline{Z}NCV$	$A > B$	**T**
$A \overset{\cdots}{-} B$	signed	$\overline{Z}N\overline{C}\overline{V}$	$A < B$	**T**
$A \overset{\cdots}{-} B$	unsigned	$\overline{Z}\overline{N}CV$	$A = B$	**F**
$A \overset{\cdots}{-} B$	signed	$\overline{Z}\overline{N}C\overline{V}$	$A > B$	**T**
$A \overset{\cdots}{-} B$	unsigned	$\overline{Z}NC\overline{V}$	$A < B$	**F**
$A \overset{\cdots}{-} B$	signed	$\overline{Z}\overline{N}CV$	$A \geq B$	**F**
$A \overset{\cdots}{-} B$	unsigned	$\overline{Z}\overline{N}\overline{C}V$	$A \leq B$	**T**
$A \overset{\cdots}{-} B$	signed	$\overline{Z}\overline{N}CV$	$A = B$	**F**
$A \overset{\cdots}{-} B$	unsigned	$\overline{Z}NC\overline{V}$	$A \geq B$	**T**
$A \overset{\cdots}{-} B$	signed	$\overline{Z}\overline{N}CV$	$A \leq B$	**T**