Chris Hunt HW2 ENGR 271

1) What is the largest unsigned binary number possible for a 16-bit processor?

$$\boxed{1111\ 1111\ 1111\ 1111_2 = 65,535_{10} = 2^{16} - 1}$$

2) What is the largest and smallest sign/magnitude binary number possible for a 16-bit processor?

Largest = $0111\ 1111\ 1111\ 1111_2 = 32767_{10}$ $\quad \frac{2^{16}}{2} - 1$

Smallest = $1111\ 1111\ 1111\ 1111_2 = -32767_{10}$ $\quad -\left(\frac{2^{16}}{2} - 1\right)$

3) What is the largest and smallest two's compliment binary number possible for a 16-bit processor

Largest = $0111\ 1111\ 1111\ 1111_2 = 32767_{10}$ $\quad \frac{2^{16}}{2} - 1$

Smallest = $1000\ 0000\ 0000\ 0000_2 = -32768_{10}$ $\quad -\frac{2^{16}}{2}$

4) Add the two's complement 8-bit binary values

```
 1111 111
 0101 0111
+0110 1011
----------
 1100 0010
```

invert → 0011 1101 add one

```
  0011 1101
+         1
-----------
  0011 1110 : 62
```

-62

a) $1100\ 0010_2$

b) -62

c) There is overflow. The answer should have been 194 but 8 bit - 2's compliment can only be precise within -128 - 127. This is why we got a negative result.

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5) Subtract the two's compliment 8 bit binary values
Convert 0111 0010 to it's neg value then add the values.

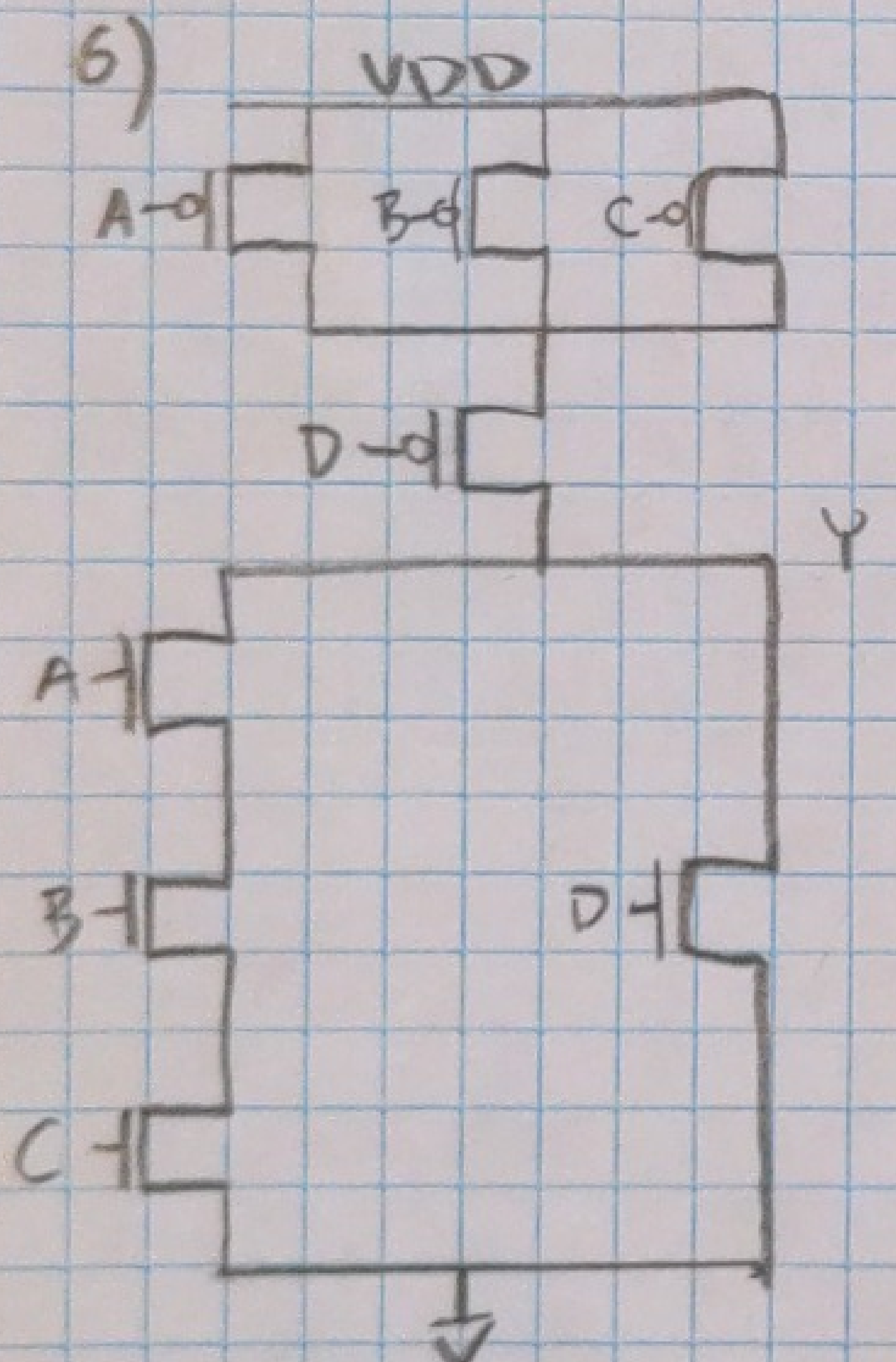
```
 1000 1101
+        1
----------
 1000 1110
```

```
 0110 1011
+1000 1110
----------
 1111 1001 -> 0000 0110
             +        1
             ----------
              0000 0101 -> -7
```

```
  107
- 114
-----
   -7
```

a) $1111\,1001_2$ b) -7_{10} C) No overflow

6)

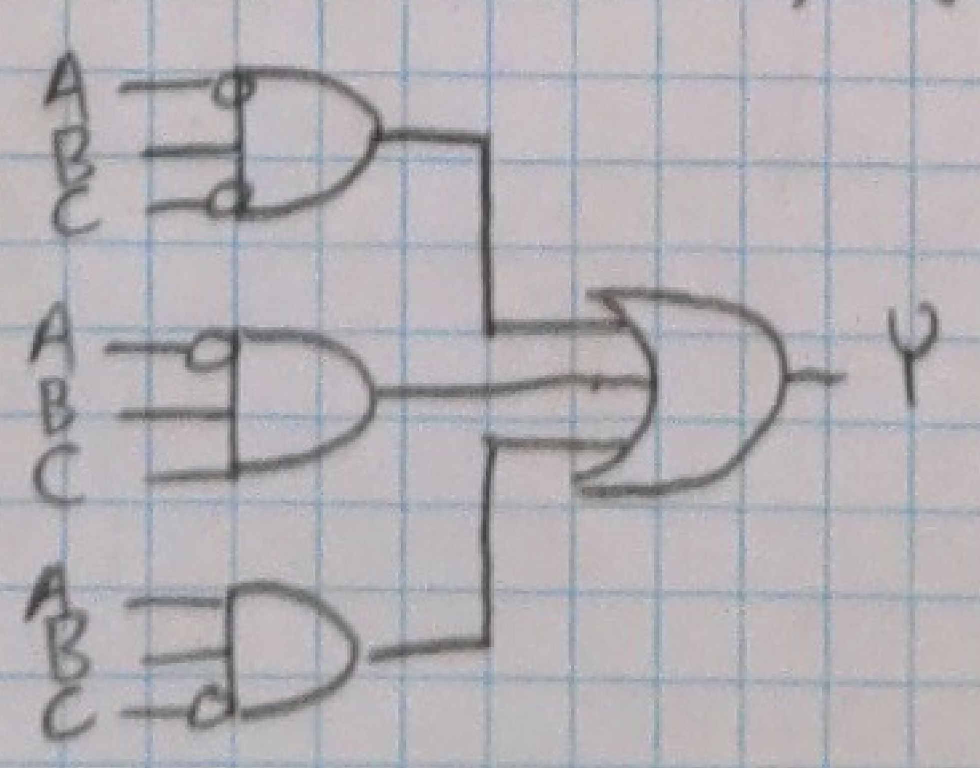


A	B	C	D	Y
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

7) Write a Boolean equation for the following truth table using Sum-of Products

A	B	C	Y	minterm
0	0	0	0	
0	0	1	0	
0	1	0	1	$\bar{A}B\bar{C}$
0	1	1	1	$\bar{A}BC$
1	0	0	0	
1	0	1	0	
1	1	0	1	$AB\bar{C}$
1	1	1	0	

$$Y = (\bar{A}B\bar{C}) + (\bar{A}BC) + (AB\bar{C})$$



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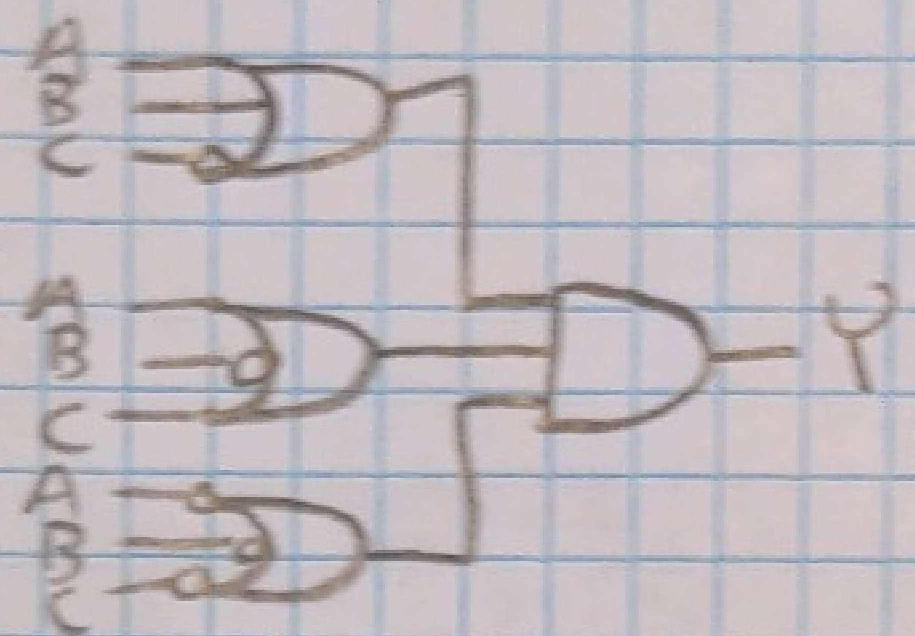
8) Write a Boolean equation for the truth table below using Product-of-Sums method

A	B	C	Y	maxterm
0	0	0	1	
0	0	1	0	$A+B+\bar{C}$
0	1	0	0	$A+\bar{B}+C$
0	1	1	1	
1	0	0	1	
1	0	1	1	
1	1	0	1	
1	1	1	0	$\bar{A}+\bar{B}+\bar{C}$

$Y=(A+B+\bar{C})(A+\bar{B}+C)(\bar{A}+\bar{B}+\bar{C})$



9) Simplify:

a) $Y=\bar{A}BC+\bar{A}B\bar{C} \rightarrow Y=((\bar{A}B)C)+((\bar{A}B)\bar{C})$

$Y=((\bar{A}B)C)+((\bar{A}B)\bar{C}) \rightarrow Y=(\bar{A}B)(C+\bar{C})$ By T8

$Y=(\bar{A}B)(C+\bar{C}) \rightarrow \boxed{Y=\bar{A}B}$ By T5'

b) $Y=\overline{ABC}+A\bar{B} \rightarrow Y=\bar{A}+\bar{B}+\bar{C}+A\bar{B}$ By T12

$Y=\bar{A}+\bar{B}+\bar{C}+A\bar{B} \rightarrow \boxed{Y=\bar{A}+\bar{B}+\bar{C}=\overline{ABC}}$ By T11

10) Simplify:

a) $Y=\bar{A}BC+\overline{B\bar{C}}+BC \rightarrow Y=\bar{A}BC+\bar{B}+C+BC$ By T12

$Y=\bar{A}BC+\bar{B}+C+BC \rightarrow \boxed{Y=\bar{B}+C}$ By T11

b) $Y=\bar{A}BC+\overline{(\bar{A}+\bar{B}+C)}+AC \rightarrow Y=\bar{A}BC+AB\bar{C}+AC$ By T12'

$Y=\bar{A}BC+AB\bar{C}+AC$

$Y=\bar{A}BC+A(B\bar{C}+C)$

$Y=\bar{A}BC+A(B+C)$

$Y=\bar{A}BC+AB+AC$

$Y=B(\bar{A}C+A)+AC \rightarrow Y=B(C+A)+AC$

$\boxed{Y=BC+BA+AC}$