Lab #2 (Boolean Arithmetic)

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Date: 2-14-23

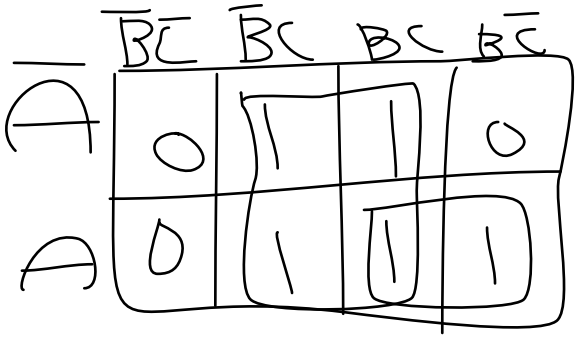
1. Given the following Truth Table

A	B	C	F
0	0	0	0
0	0	1	1
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) Write the function in its canonical form

$f = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + AB\bar{C} + ABC$

b) Draw the K-Map of the function



c) Write the function in its simplified form

$f = C + AB$

d) What is the difference in the number of gates used between canonical and simplified forms?

4

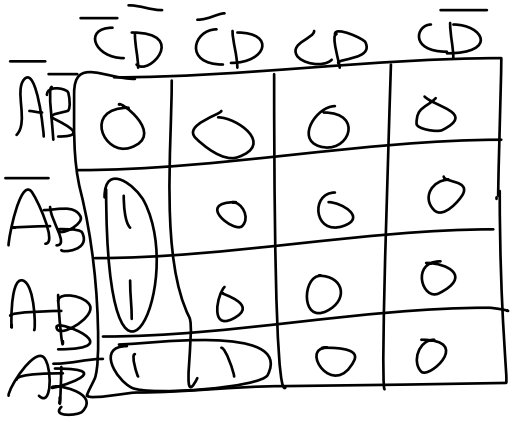
2. Given the following Truth Table

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

a) Write the function in its canonical form

$Y = \bar{A}B\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D + AB\bar{C}\bar{D}$

b) Draw the K-Map of the function



c) Write the function in its simplified form

$Y = B\bar{C}\bar{D} + A\bar{B}\bar{C}$

d) What is the difference in the number of gates used between canonical and simplified forms?

7

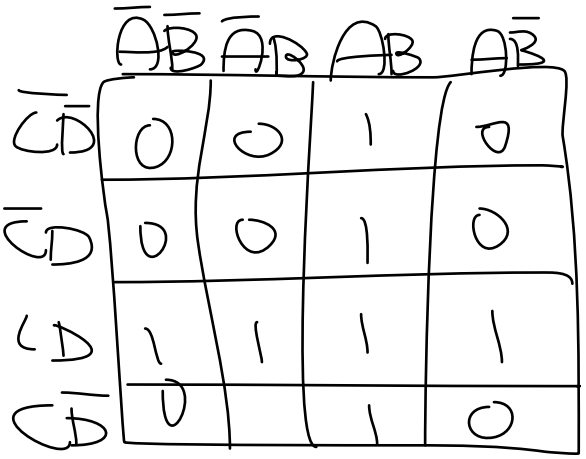
3. Given the following Truth Table

a	b	c	d	z
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

a) Write the function in its canonical form

$Z = \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + A\bar{B}\bar{C}D + A\bar{B}CD + AB\bar{C}D + ABCD$

b) Draw the K-Map of the function



c) Write the function in its simplified form

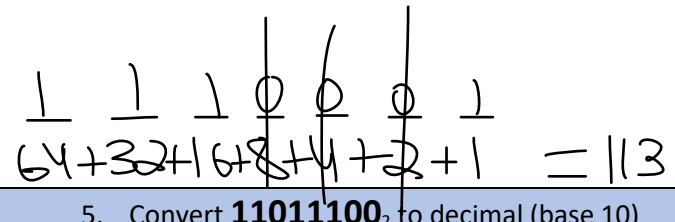
$Z = AB + CD$

d) What is the difference in the number of gates used between canonical and simplified forms?

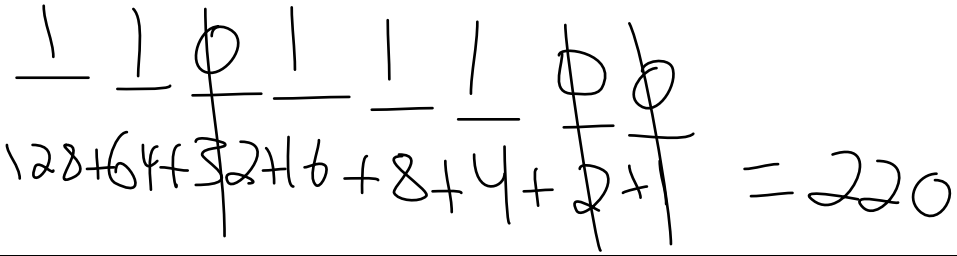
7

Converting between Binary and Decimal Numbers

4. Convert **1110001**$_2$ to decimal (base 10)
   Use sum of expansion of products (don't skip steps!)

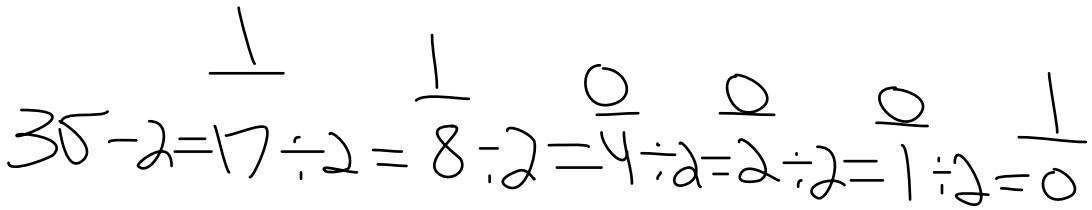


5. Convert **11011100**$_2$ to decimal (base 10)
   Use sum of expansion of products (don't skip steps!)



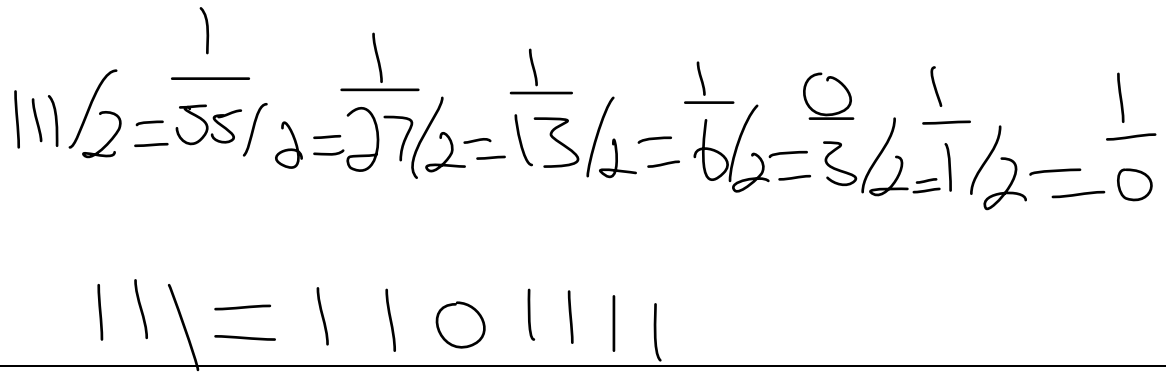
Converting between Decimal and Binary Numbers

6. Convert **35**$_{10}$ to binary (base 2)
   Use the Double-Dabble method of successive division (don't skip steps!)



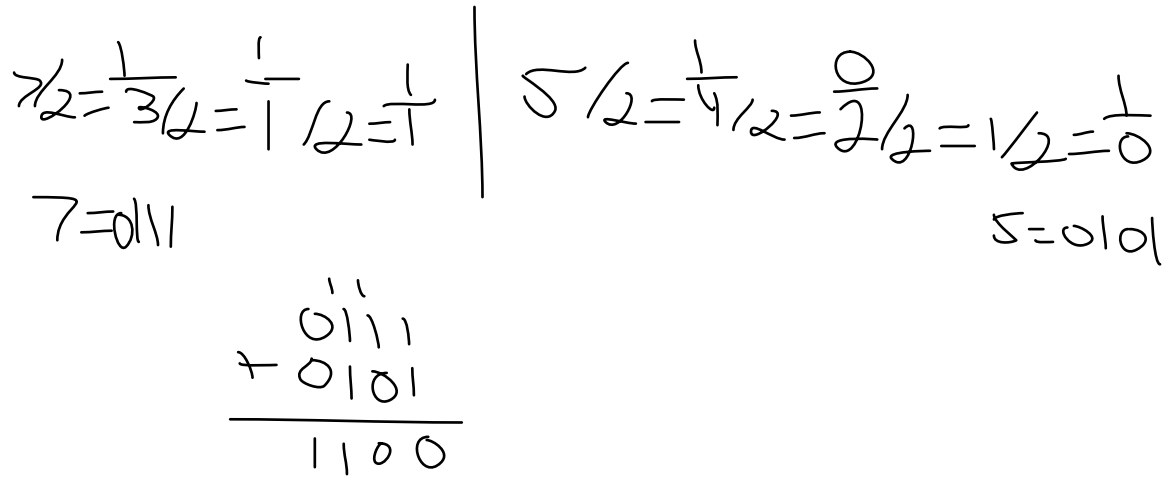
35=100011

7. Convert **111_{10}** to binary (base 2)
   Use the Double-Dabble method of successive divsion (don't skip steps!)



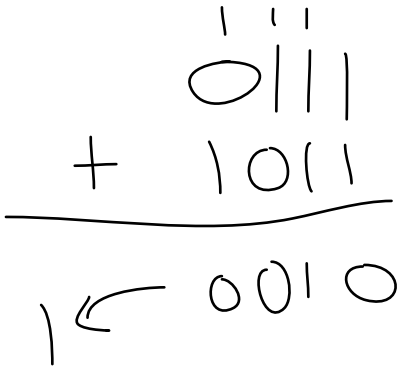
Adding Unsigned Binary Numbers

8. Add 7 + 5 in binary.
   First convert to binary, then compute the sum.



Adding Signed Binary Numbers (with Negatives)

9. Add 7 + (-5) in binary. Same as subtraction.
   First convert to binary, then compute the sum.



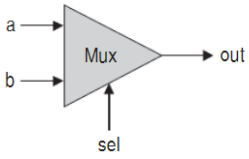
Multiplexor (Mux) Design

10. Write the Boolean function for the output (out). Use K-maps if needed.
    Then write the HDL code.

out(a,b,sel) =

a	b	sel	out
0	0	0	0
0	1	0	0
1	0	0	1
1	1	0	1
0	0	1	0
0	1	1	1
1	0	1	0
1	1	1	1

sel	out
0	a
1	b

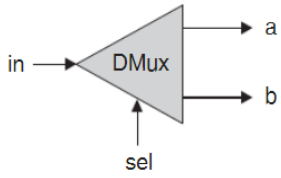



```
CHIP Mux {
   IN a, b, sel;
   OUT out;

   PARTS:




}
```

Demultiplexor (DMux) Design

11. Write the Boolean function for the output (out). Use K-maps if needed. Then write the HDL code.

sel	a	b
0	in	0
1	0	in



a(in, sel) =

b(in, sel) =

```
CHIP DMux {
   IN in, sel;
   OUT a, b;

   PARTS:

}
```