Christian Boni
COE 0147 T/H
Lab #6

Written Part

1. Add the following unsigned binary numbers (show the carry and overflow bits)

```
 11111  1000  0010  ←Carry Bits
  0010  0110  1001
+ 1111  1100  0101
 ----------------------
1 0010  0010  1110
```

^ Overflow Bit

2. Subtract the following unsigned binary numbers (show the borrow and underflow bits). Do not convert to two's-complement.

```
 0011 0111 0101      ← 885 in decimal
- 1110 1000 1110     ← 2841 in decimal
 --------------
```

→ Answer is negative thus cannot be computed with unsigned numbers

3. Convert the following decimal numbers to binary numbers (represent each as a 16-bit number):

1639:	Remainder	
1639/2 = 819	1	~LSB
819/2 = 409	1	
409/2 = 204	1	
204/2 = 102	0	
102/2 = 51	0	
51/2 = 25	1	
25/2 = 12	1	
12/2 = 6	0	
6/2 = 3	0	
3/2 = 1	1	
1/2 = 0	1	~ MSB

1639 → 0000011001100111

Christian Boni
COE 0147 T/H
Lab #6

48265:	Remainder	
48265/2 = 24132	1	~LSB
24132/2 = 12066	0	
12066/2 =6033	0	
6033/2 = 3016	1	
3016/2 = 1508	0	
1508/2 = 754	0	
754/2 = 377	0	
377/2 = 188	1	
188/2 = 94	0	
94/2 = 47	0	
47/2 = 23	1	
23/2 = 11	1	
11/2 = 5	1	
5/2 = 2	1	
2/2 = 1	0	
1/2 = 0	1	~ MSB

48265 → 1011110010001001

1010:	Remainder	
1010/2 = 505	0	~LSB
505/2 = 252	1	
252/2 = 126	0	
126/2 = 63	0	
63/2 = 31	0	
31/2 = 15	1	
15/2 = 7	1	
7/2 = 3	1	
3/2 = 1	1	
1/2 = 0	1	~ MSB

1010 → 0000001111110010

Christian Boni
COE 0147 T/H
Lab #6

4. Convert the following unsigned binary numbers to decimal numbers:

Number 1: 10000001 01011110

→ 2^15 + 2^8 + 2^6 + 2^4 + 2^3 + 2^2 + 2^1 = 33118

Number 2: 00000110 01010011

→ 2^10 + 2^9 + 2^6 + 2^4 + 2^1 + 2^0 = 1619

5. Convert the following decimal numbers into 9-bit binary numbers (with sign-magnitude):

48:	Remainder	
48/2 = 24	0	~LSB
24/2 = 12	0	
12/2 = 6	0	
6/2 = 3	0	
3/2 = 1	1	
1/2 = 0	1	~ MSB

48 → 000110000

-126:	Remainder	
126/2 = 63	0	~LSB
63/2 = 31	1	
31/2 = 15	1	
15/2 = 7	1	
7/2 = 3	1	
3/2 = 1	1	
1/2 = 0	1	~ MSB

-126 → 101111110

Christian Boni
COE 0147 T/H
Lab #6

-34:	Remainder	
34/2 = 17	0	~LSB
17/2 = 8	1	
8/2 = 4	0	
4/2 = 2	0	
2/2 = 1	0	
1/2 = 0	1	~ MSB

-34 → 100100010

6. Convert the following 9-bit binary numbers (with sign-magnitude) to decimal numbers:

010011110:

→ 2^7 + 2^4 + 2^3 + 2^2 + 2^1 = 158

100110111:

→ 2^5 + 2^4 + 2^2 + 2^1 + 2^0 = -55

110101010:

→ 2^7 + 2^5 + 2^3 + 2^1 = -170

7. Convert the following decimal numbers into 9-bit binary numbers in 1's complement form:

56:	Remainder	
56/2 = 28	0	~LSB
28/2 = 14	0	
14/2 = 7	0	
7/2 = 3	1	
3/2 = 1	1	
1/2 = 0	1	~ MSB

56 → 000111000

Christian Boni
COE 0147 T/H
Lab #6

-145:	Remainder	
145/2 = 72	1	~LSB
72/2 = 36	0	
36/2 = 18	0	
18/2 = 9	0	
9/2 = 4	1	
4/2 = 2	0	
2/2 = 1	0	
1/2 = 0	1	~ MSB

145 = 010010001
-145 → 101101110

52:	Remainder	
52/2 = 26	0	~LSB
28/2 = 13	0	
14/2 = 6	1	
7/2 = 3	0	
3/2 = 1	1	
1/2 = 0	1	~ MSB

52 = 000110100
-52 → 111001011

8. Convert the following 8-bit binary numbers in 1's complement to decimal numbers:

01010011:
→ 2^6 + 2^4 + 2^1 + 2^0 = 83

11010010: = -(00101101)
→ -1 * (2^5 + 2^3 + 2^2 + 2^0) = -45

11110111: = -(00001000)
→ -1 * 2^3 = -8

Christian Boni
COE 0147 T/H
Lab #6

9. Convert the following decimal numbers into 9-bit binary numbers in 2's complement form:

196:	Remainder	
196/2 = 98	0	~LSB
98/2 = 49	0	
49/2 = 24	1	
24/2 = 12	0	
12/2 = 6	0	
6/2 = 3	0	
3/2 = 1	1	
1/2 = 0	1	~ MSB

196 → 011000100

-17:	Remainder	
17/2 = 8	1	~LSB
8/2 = 4	0	
4/2 = 2	0	
2/2 = 1	0	
1/2 = 0	1	~ MSB

17 = 000010001
-17 → 111101111

-95:	Remainder	
95/2 = 47	1	~LSB
47/2 = 23	1	
23/2 = 11	1	
11/2 = 5	1	
5/2 = 2	1	
2/2 = 1	0	
1/2 = 0	1	~ MSB

95 = 001011111
-95 → 110100001

Christian Boni
COE 0147 T/H
Lab #6

10. Convert the following 8-bit binary numbers in 2's complement to decimal numbers:

01010101:

→ 2^6 + 2^4 + 2^2 + 2^0 = 85

10111101: = -((01000010) + 1) = -(01000011)

→ -1 * (2^6 + 2^1 + 2^0) = -67

11010000: = -((00101111) + 1) = -(00110000)

→ -1 * (2^5 + 2^4) = -48