Introduction

This assignment is a *group* assignment. If I, in the room, do not **hear** you interacting with the other students, you are doing it *wrong*!

Assignment Goals

Learning Outcomes After completing this group assignment, each student is expected to be able to

- Convert between *binary*, *decimal*, and *hexadecimal* representations of unsigned integers.
- Convert between *binary* and *decimal* representations of **signed** integers.

Procedure

Get out paper. The group will turn in *one* document. Make sure all participating members' names are on the page.
Copy each question before the answer. Since the point is to make your answer sheet a stand-alone study guide, the copy need not be verbatim but must give your answer enough context to evaluate.
Assign Roles. Students should take roles they have not held recently (or, perhaps, ever):

Manager Move discussion forward.
Recorder Writes the report that will be turned in.
Reflector Monitor that everyone gets heard and is caught up. (This is a **group** obligation, really.)
Speaker (Combine w/ **Reflector** if necessary.) Asks facilitator questions; communicates what the team has done.

Answer these questions.

1. **Add** the following binary numbers; indicate whether or not there was overflow. The addends are presented in the expected bit width of the sums.

(a)
```
  1110 1111
+ 0110 0001
-----------
1 0101 0000
```

(b)
```
  0001 0010
+ 0110 0110
-----------
0 0111 1000
```

(c)
```
  1111 1111
+ 0001 0000
-----------
1 0000 1111
```

2. **Interpret** each problem in question 1 by translating the *binary* numbers to corresponding *decimal* numbers, assuming they are encoding *unsigned integers*. Are the answers the same in both representations?

Solution:

```
239
 97
 80  336

 18
102
120  120

255
 16
 15  271
```

3. **Interpret** each problem in question 1 by translating the *binary* numbers to corresponding *decimal* numbers, assuming they are encoding *sign-magnitude integers*. Are the answers the same in both representations?

Solution:

```
-111
  97
  80  -14

  18
 102
 120  120

 -127
   16
   15  -113
```

4. **Interpret** each problem in question 1 by translating the *binary* numbers to corresponding *decimal* numbers, assuming they are encoding *2's-compliment integers*. Are the answers the same in both representations?

Solution:

```
 -17
  97
  80  80

  18
 102
 120  120

  -1
  16
  15  15
```

5. If you were to interpret the integers in question 1 as *excess-n* integers, what would *n* be?

Solution:

$128 = 2^{8-1}$

6. **Convert** each of the following *decimal* numbers into their corresponding *6-bit, unsigned, binary number*.

(a) `32` `10 0000`

(b) `27` `01 1011`

(c) `1` `00 0001`

(d) `15` `00 1111`

7. **Convert** each value in question 6 into a *6-bit, signed, 2's-compliment, binary number* or explain why that cannot be done.

(a) `32` Cannot be done: range is -32 – 31

(b) `27` `10 0101`

(c) `1` `11 1111`

(d) `15` `11 0001`

8. Negate each value in question 6 and **convert** the result into a *6-bit, signed, 2's-compliment, binary number* or explain why that cannot be done.
9. Negate each value in question 6 and **convert** the result into a *6-bit, signed, sign-magnitude, binary number* or explain why that cannot be done.
10. Negate each value in question 6 and **convert** the result into a *6-bit, signed, excess-n, binary number* or explain why that cannot be done.
11. **Interpret** (into *decimal*) each of the following 6-bit patterns as 6-bit numbers according to each of the integer encodings we know.

	Unsigned	Sign/Magnitude	Excess-*n*	2's-Compliment
`10 0000`				
`00 0001`				
`10 0001`				
`11 1111`				
`00 0000`				
`01 1111`				
`11 0000`				

12. Which of the above answers represent the *largest* or *smallest* value that can be encoded into a 6-bit representation using the given encoding system?