COMP 3350 PROJECT #1 Solutions

9 points 1. Convert the following unsigned base 2 numbers (binary) to base 16 numbers (hexadecimal):

A. 0110 0001 1111
B. 1000 1111 1100
C. 0001 0110 0100 0101

A.
0110 => 22+21=6
0001 => 20=1
1111 => 23+22+21+20=15=F
0110 0001 1111
6 1 F
Therefore, the result is **61F**

B.
1000 => 23=8
1111 => 23+22+21+20=15=F
1100 => 23+22=12=C
1000 1111 1100
8 F C
Therefore, the result is **8FC**

C.
0001 => 20=1
0110 => 22+21=6
0100 => 22=4
0101 => 22+20=5
0001 0110 0100 0101
1 6 4 5
Therefore, the result is **1645**

27 points 2. Convert the following signed base 2 numbers (binary) to base 10 numbers (decimal):

A. 1100 1010
B. 1111 0010
C. 1000 0111

Each using :

a) Signed_magnitude representation.
b) One's complement representation.
c) Two's complement representation.

a) sign_magnitude
A. 1100 1010: **-74D**
B. 1111 0010: **-114D**
C. 1000 0111: **-7D**

b) one's complement

A. 1011 0101: **-53D**

B. 1000 1101: **-13D**

C. 1111 1000: **-120D**

c) Two's Complement:

A.

Starting value 1100 1010.

Reverse the bits 0011 0101

Add 1 to the value + 1

Create the two's complement 0011 0110

Convert to decimal 54

Because the original integer was negative, its decimal value is **-54**

Signed magnitude -74

Ones complement 53
Original value is negative
so -53

B.

Starting value 1111 0010

Reverse the bits 0000 1101

Add1 to the value + 1

Create the two's complement 0000 1110

Convert to decimal 14

Because the original integer was negative, its decimal value is **-14**

C.

Starting value 1000 0111

Reverse the bits 0111 1000

Add 1 to the value + 1

Create the two's complement 0111 1001

Convert to decimal 121

Because the original integer was negative, its decimal value is **-121**

30 points (2.5 each) 3. Convert the following base 10 (decimal) values to two's complement (8-bits) :

A. -100d
B. -16d
C. -21d
D. -0d

Each using :

a) Signed_magnitude representation.
b) One's complement representation.
c) Two's complement representation.

A. (-100)

a) sign-magnitude representation: 1110 0100
b) one's complement representation: 1001 1011
c) two's complement representation: 1001 1100

B. (-16)

a) sign-magnitude representation: 1001 0000
b) one's complement representation: 1110 1111
c) two's complement representation: 1111 0000

C. (-21)

a) sign-magnitude representation: 1001 0101
b) one's complement representation: 1110 1010

c) two's complement representation: 1110 1011

D. (-0)

a) sign-magnitude representation: 1000 0000
b) one's complement representation: 1111 1111
c) two's complement representation: 0000 0000

4 points 4. What is the range of:

A. An unsigned 7-bit number ?
B. A signed 7-bit number ?

A.
The range of an unsigned 7-bit number is from 000 0000 to 111 1111
Therefore, the range is from 0 to 127
B.
Since a signed integer of n bits uses only n-1 bits to represent the number's magnitude, the range of a signed 7-bit number is from -26 to 26-1. That is from -64 to 63.

12 points 5. Provide the answer to the following problems ($\wedge$ = AND, $\vee$ = OR)

A. 1000 $\wedge$ 1110
B. 1000 $\vee$ 1110
C. (1000 $\wedge$ 1110) $\vee$ (1001 $\wedge$ 1110)

A.
1000
$\wedge$ 1110
= **1000**

B.
1000
$\vee$ 1110
= **1110**

C.
1000
$\wedge$ 1110
= 1000

1001
$\wedge$ 1110
= 1000

1000
$\vee$ 1000
= **1000**

Therefore, the result is 1000

9 points 6. Please demonstrate each step in the calculation of 25 - 65 (both 25 and 65 are signed decimal numbers)

(-65)D = (1 100 0001)sign_magnitude = (1011 1110)one's = (1011 1111)two's

```
  0001 1001 (+25)two's
 +1011 1111   (-65)two's
 = 1101 1000  (-40)two's
```

3 points

(-40)D = -(32 + 8) = (1010 1000) sign_magnitude
= (1101 0111) one's = (1101 1000) two's
same as mentioned in Q6