Comp 3350 – Project 1

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(all answers are boxed in)

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

A. 0110 0001 1111

Convert each set of 4 numbers to hex: 0110 = **6**, 0001 = **1**, 1111 = **F**

0110 0001 1111 (base 2) = $\boxed{\textbf{61F}\text{ (base 16)}}$

B. 1000 1111 1100

Convert each set of 4 numbers to hex: 1000 = **8**, 1111 = **F**, 1100 = **C**

1000 1111 1100 (base 2) = $\boxed{\textbf{8FC}\text{ (base 16)}}$

C. 0001 0110 0100 0101

Convert each set of 4 numbers to hex: 0001 = **1**, 0110 = **6**, 0100 = **4**, 0101 = 5

0001 0110 0100 0101 (base 2) = $\boxed{\textbf{1645}\text{ (base 16)}}$

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

A. 1100 1010

a.)

First number represents the sign: 1 = negative

Convert the rest to decimal: 100 1010 = 74

1100 1010 (base 2) = $\boxed{\textbf{-74}\text{ (base 10 for signed magnitude)}}$

b.)

First number represents the sign: 1 = negative

Convert the rest to 1's complement: 011 0101 = 53

1100 1010 (base 2) = $\boxed{\textbf{-53}\text{ (base 10 for 1's complement)}}$

c.)

First number represents the sign: 1 = negative

Convert the rest to 2's complement: 011 0110 = 54

1100 1010 (base 2) = $\boxed{\textbf{-54}\text{ (base 10 for 2's complement)}}$

B. 1111 0010

a.)

First number represents the sign: 1 = negative

Convert the rest to decimal: 111 0010 = 114

1111 0010 (base 2) = $\boxed{\textbf{-114}\text{ (base 10 for signed magnitude)}}$

b.)

First number represents the sign: 1 = negative

Convert the rest to 1's complement: 000 1101 = 13

1111 0010 (base 2) = $\boxed{\textbf{-13}\text{ (base 10 for 1's complement)}}$

c.)

First number represents the sign: 1 = negative

Convert the rest to 2's complement: 000 1110 = 14

1111 0010 (base 2) = $\boxed{\textbf{-14}\text{ (base 10 for 2's complement)}}$

C. 1000 0111

a.)

First number represents the sign: 1 = negative

Convert the rest to decimal: 000 0111 = 7

1000 0111 (base 2) = $\boxed{\textbf{-7} \text{ (base 10 for signed magnitude)}}$

b.)

First number represents the sign: 1 = negative

Convert the rest to 1's complement: 111 1000 = 120

1000 0111 (base 2) = $\boxed{\textbf{-120} \text{ (base 10 for 1's complement)}}$

c.)

First number represents the sign: 1 = negative

Convert the rest to 2's complement: 111 1001 = 121

1000 0111 (base 2) = $\boxed{\textbf{-121} \text{ (base 10 for 2's complement)}}$

Each using:

a) Signed_magnitude representation.

b) One's complement representation.

c) Two's complement representation.

3. (36 points) Convert the following base 10 (decimal) values to two's complement (8-bits):

A. -100_d

a.)

First, we convert to binary: 100 (base 10) = 1100100 (base 2)

Now since we have a negative value, we put a 1 at the front of our value:

$\boxed{\textbf{11100100} \text{ (base 2 for signed magnitude)}}$

b.)

First, we convert to binary: 100 (base 10) = 1100100 (base 2)

Now we convert this to 1's complement by swapping each number:

1100100 = 0011011

Lastly, we must put a 1 in front to make this a negative value:

$\boxed{\textbf{10011011} \text{ (base 2 for 1's complement)}}$

c.)

First, we convert to binary: 100 (base 10) = 1100100 (base 2)

Now we convert this to 2's complement by swapping each value and adding 1:

1100100 = 0011100

Lastly, we must put a 1 in front to make this a negative value:

$\boxed{\textbf{10011100} \text{ (base 2 for 2's complement)}}$

B. -16_d

a.)

First, we convert to binary: 16 (base 10) = 0010000 (base 2)

Now since we have a negative value, we put a 1 at the front of our value:

$\boxed{\textbf{10010000} \text{ (base 2 for signed magnitude)}}$

b.)

First, we convert to binary: 16 (base 10) = 0010000 (base 2)

Now we convert this to 1's complement by swapping each number:

0010000 = 1101111

Lastly, we must put a 1 in front to make this a negative value:

$\boxed{\textbf{11101111} \text{ (base 2 for 1's complement)}}$

c.)

First, we convert to binary: 16 (base 10) = 0010000 (base 2)

Now we convert this to 2's complement by swapping each value and adding 1:

0010000 = 1110000

Lastly, we must put a 1 in front to make this a negative value:

$\boxed{\textbf{11110000} \text{ (base 2 for 2's complement)}}$

C. -21$_d$

a.)

First, we convert to binary: 21 (base 10) = 0010101 (base 2)

Now since we have a negative value, we put a 1 at the front of our value:

$\boxed{\textbf{10010101} \text{ (base 2 for signed magnitude)}}$

b.)

First, we convert to binary: 21 (base 10) = 0010101 (base 2)

Now we convert this to 1's complement by swapping each number:

0010101 = 1101010

Lastly, we must put a 1 in front to make this a negative value:

$\boxed{\textbf{11101010} \text{ (base 2 for 1's complement)}}$

c.)

First, we convert to binary: 21 (base 10) = 0010101 (base 2)

Now we convert this to 2's complement by swapping each value and adding 1:

0010101 = 1101011

Lastly, we must put a 1 in front to make this a negative value:

$\boxed{\textbf{11101011} \text{ (base 2 for 2's complement)}}$

D. -0_d

a.)

First, we convert to binary: 0 (base 10) = 0000000 (base 2)

Now since we have a negative value, we put a 1 at the front of our value:

10000000 (base 2 for signed magnitude)

b.)

First, we convert to binary: 0 (base 10) = 0000000 (base 2)

Now we convert this to 1's complement by swapping each number:

0000000 = 1111111

Lastly, we must put a 1 in front to make this a negative value:

11111111 (base 2 for 1's complement)

c.)

First, we convert to binary: 0 (base 10) = 0000000 (base 2)

Now we convert this to 2's complement by swapping each value and adding 1:

0000000 = 1111111+1 = 0000000

Lastly, we must put a 1 in front to make this a negative value:

10000000 (base 2 for 2's complement)

Each using:

a) Signed magnitude representation.

b) One's complement representation.

c) Two's complement representation.

4. (4 points) What is the range of:

A. An unsigned 7-bit number?

$\boxed{\text{The range for this will be from 0 to 255}}$

B. A signed 7-bit number?

$\boxed{\text{The range for this will be from -128 to 127}}$

5. (12 points) Provide the answer to the following problems (∧ = AND, ∨ = OR)

1. $1000 \land 1110$

   Let's check each of the values in the same position:

   - $1 \land 1 = 1$
   - $0 \land 1 = 0$
   - $0 \land 1 = 0$
   - $0 \land 0 = 0$

   $1000 \land 1110 = \boxed{\mathbf{1000}}$

2. $1000 \lor 1110$

   Let's check each of the values in the same position:

   - $1 \lor 1 = 1$
   - $0 \lor 1 = 1$
   - $0 \lor 1 = 1$
   - $0 \lor 0 = 0$

   $1000 \lor 1110 = \boxed{\mathbf{1110}}$

3. $(1000 \land 1110) \lor (1001 \land 1110)$

   Let's evaluate the first set in parenthesis: $(1000 \land 1110) = 1000$

   Now the other set in parenthesis: $(1001 \land 1110) = 1000$

   This leaves us with: $1000 \lor 1000 = \boxed{\mathbf{1000}}$

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

We start with the 1's place 5 – 5 = 0.

Next we move to the 10's place 20 – 60 but since 60 > 20 we must borrow from the next place.

This makes it 100 – 60 = 40.

Since we had to borrow from numbers we don't have, our number is negative, making our answer: $\boxed{\text{-40 (base 10)}}$

7. (3 points) Mathematically the answer in Q6 is -40_d. Please verify your answer in Q6 using a conversion of 2's and decimal numbers.

25 (base 10) = 11001 (base 2)

65 (base 10) = 1000001 (base 2)

Now instead of 25 – 65, we do 25 + (-65)

To get this we take the 2's complement of 65: 0111111

Now we do:

$$\begin{array}{r} 0011001 \\ \underline{+\ 0111111} \\ 1011000 \end{array}$$

We keep the sign bit (1) and get the 2's complement again to get the actual answer:

101000 = 40, with the sign 1 = negative

This gives us our answer, $\boxed{\text{-40 (base 10)}}$