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) **= 61F** (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) = **8FC** (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) = **1645** (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) = **-74** (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) = **-53** (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) = **-54** (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) = **-114** (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) = **-13** (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) = **-14** (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) = **-7** (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) = **-120** (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) = **-121** (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. -100d

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:

**11100100** (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:

**10011011** (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:

**10011100** (base 2 for 2’s complement)

B. -16d

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:

**10010000** (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:

**11101111** (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:

**11110000** (base 2 for 2’s complement)

C. -21d

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:

**10010101** (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:

**11101010** (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:

**11101011** (base 2 for 2’s complement)

D. -0d

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?

The range for this will be from 0 to 255

B. A signed 7-bit number?

The range for this will be from -128 to 127

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

1. 1000 ∧ 1110

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

* + 1 ∧ 1 = 1
  + 0 ∧ 1 = 0
  + 0 ∧ 1 = 0
  + 0 ∧ 0 = 0

1000 ∧ 1110 = **1000**

1. 1000 ∨ 1110

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

* + 1 ∨ 1 = 1
  + 0 ∨ 1 = 1
  + 0 ∨ 1 = 1
  + 0 ∨ 0 = 0

1000 ∨ 1110 = **1110**

1. (1000 ∧ 1110) ∨ (1001 ∧ 1110)

Let’s evaluate the first set in parenthesis: (1000 ∧ 1110) = 1000

Now the other set in parenthesis: (1001 ∧ 1110) = 1000

This leaves us with: 1000 ∨ 1000 = **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: **-40** (base 10)

7. (3 points) Mathematically the answer in Q6 is -40d. 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: 0011001

+ 0111111

1011000

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, **-40** (base 10)